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July 22, 2008
File No.: 04.02.06.02
Project No. 357891

DOCKET
07-AFC-5
DATE JUL 2 2 2008
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Mr. Che McFarlin, Project Manager
California Energy Commission
Systems Assessment and Facilities Siting Division
1516 9th Street, MS 15
Sacramento, CA 95814-5504

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

Dear Mr. McFarlin:

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 2B, which provides a supplemental response to Staff's Data Request 23, dated May 8, 2008.

Please call me if you have any questions.

Sincerely,

CH2M HILL

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 2B

(Responses to Data Requests: Alternatives, Biological Resources, Closure & Restoration, Cultural Resources, Project Description, Soil & Water, and Visual Resources)

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

July 22, 2008

With Assistance from

CH2MHILL

2485 Natomas Park Drive
Suite 600
Sacramento, CA 95833

Contents

Section Page

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 U.S. Bureau of Land Management (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.

Alternatives (121-123)

BACKGROUND

Alternatives

In Section 6.0 Alternatives, page 6-8, Section 6.2.2, Alternatives Carried Forward for Further Analysis of the Application for Certification (AFC) four alternative sites are considered as well as the proposed Ivanpah SEGS site. Each alternative site is described very generally and all are shown on a single large scale map (Figure 6.1-1 General Locations of Alternative Sites).

In late March of 2008, PG&E issued a press release stating that it has entered into a contract with BrightSource Energy to purchase power from the ISEGS Project and a future project at Broadwell Lake east of Barstow in San Bernardino County. BrightSource is apparently pursuing permitting of the Broadwell Lake site with the Bureau of Land Management, so is likely acquiring environmental baseline information for that site.

DATA REQUEST

121. Please provide a detailed map (at least 1:24,000) showing the most likely project boundaries for the Siberia and Broadwell Lake Alternative sites described in AFC Section 6.2.2.

Response: As stated in Applicant's May 29, 2008 letter, the Applicant objects to this data request as requesting confidential information. Without waiving this objection, Applicant is providing Figures DR121-1a and 1b, and DR121-2a through 2d under a request for confidentiality.

122. Please provide a detailed map (at least 1:24,000) showing the linear components and access roads that would be associated with the Siberia and Broadwell Lake Alternative sites described in AFC Section 6.2.2.

Response: As stated in Applicant's May 29, 2008 letter, the Applicant objects to this data request as requesting confidential information. Without waiving this objection, Applicant is providing Figures DR121-1 and DR121-2 under a request for confidentiality.

123. Please provide copies of all baseline environmental information you have acquired for the Siberia and Broadwell Lake Alternative sites described in AFC Section 6.2.2, particularly in the following subject areas:

a) Biological Resources: AFC Section 6.2.3.2 states that the Broadwell Lake and Siberia Alternative sites are expected to contain similar habitat conditions as the Proposed Project site. It also states that a California Natural Diversity Database (CNDDB) search was performed at a 10-mile radius from these alternative sites and revealed several special-status species. Please provide the results of the CNDDB search for the Broadwell Lake and Siberia Alternative sites and evaluate the potential for occurrence of each species as well as any other biological background materials you have available.

Response: As stated in Applicant's May 29, 2008 letter, the Applicant objects to this data request as requesting confidential information. Without waiving this objection, the Applicant is providing, under a request for confidentiality, Confidential Figures DR123a-1 and DR123a-2 showing the CNDDB data for a 10-mile radius around these sites. In addition, Attachment DR123a-1 provides the CNDDB printout for Siberia, while Attachment DR123a-2 provides the CNDDB printout for Broadwell Lake, both of which are also being filed under a request for confidentiality.

b) Cultural Resources: AFC Section 6.2.3.3 states that the proposed site and four alternative sites carried forth for further analysis would have similar potential for cultural impacts. Table 6.2-3 further states that a cultural resource database search was not conducted for the Siberia and Broadwell Lake Alternative sites. Please provide a Clearinghouse search (Class I) for recorded sites identified within the potential Siberia and Broadwell Lake sites, as well as any cultural resource research materials available.

Response: As stated in Applicant's May 29, 2008 letter, the Applicant objects to this data request as requesting confidential information. Without waiving this objection, the Applicant is forwarding information provided by the California Historical Resources Information System (CHRIS) of cultural records near Broadwell Lake and Siberia. These reports are provided as Attachment DR123b-1, which is being filed under a request for confidentiality.

c) Water Resources: AFC Sections 6.2.2.4 and 6.2.2.5 say that little is known about water resources in either the Siberia or Broadwell Lake site areas. Please provide any information about water resources at these two sites that has been acquired since the submittal of the AFC.

Response: As stated in Applicant's May 29, 2008 letter, the Applicant objects to this data request as requesting confidential information. Without waiving this objection, Applicant states that it has no additional information about water for these sites.

Biological Resources (124)

BACKGROUND:

Data request 17 stated: Provide status and progress updates on the anticipated schedule (including estimated dates) for submitting the Biological Assessment (BA) and consulting with the California Department of Fish and Game (CDFG) regarding rare plant and desert tortoise impacts. The data request response stated: A draft BA was prepared by CH2M HILL and submitted to the BLM on October 30, 2007. The BA will be submitted to the United States Fish and Wildlife Service (USFWS) by the BLM upon the completion of their review of the document. Meetings with CDFG will be scheduled within 60 days of submittal.

BLM has reviewed the draft BA submitted on October 30, 2007. In general, BLM has determined that more effects analysis is needed, and specifically, protective measures for the desert tortoise on the gas pipeline and water pipeline portions of the project are lacking incomplete, inaccurate, or confusing. Also, the desert tortoise protective measures need to be organized to reflect whether or not they apply to construction, or to operations and maintenance. Applicant will need to incorporate the protective measures into the proposed action. BLM is concerned other agencies such as the US Army Corps of Engineers and the State Water Resources Control Board (SWRCB) may require additional mitigation measures or changes to the project that will affect the project footprint therefore changing the proposed action. Changes to the project proposed action must all be made prior to submission of the BA to the USFWS.

DATA REQUEST:

124. The following requests are based on BLM review of the Draft Biological Assessment for the Ivanpah Solar Electric Generating System Project (October 2007); hereinafter referred to as the ISEGS draft BA:

- Change use of the word “will” in this document to “would.
- This consultation is on the *desert tortoise*. Refer to this species as such throughout the document. Please replace “covered species” with “desert tortoise” throughout the document.
- Update the BA as outlined in attachment #1, Biological Assessment Comments. Please coordinate with Charles Sullivan (BLM Needles Field Office) concerning questions on these sections of the BA that require modification.

Response: The Applicant is working to incorporate BLM’s comments into the revised BA. However, the BA will also include a Raven Control Plan (see Data Request 29) and a Tortoise Relocation Plan. It is our intention to provide these plans for review and comment before they are incorporated into the BA. The Raven Control Plan should be available for agency review and comment by the end of July, 2008. A meeting has been set up at the end of July among the resource agencies to discuss tortoise relocation. Therefore, a Draft Tortoise Relocation Plan will not be available until August, 2008.

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 Technical Basis Document (TBD) has been prepared and is provided as Attachment DR125-1A. This document provides a technical basis as a starting point for the revegetation plan. An outline for the revegetation and rehabilitation plan is currently under preparation and is anticipated to be submitted by the end of July, 2008 with the complete plan in August, 2008.

Attachment DR125-1A

Technical Basis Document

For Revegetation and Reclamation Planning
Ivanpah Solar Electric Generating System
Eastern Mojave Desert
San Bernardino County, California

Ivanpah Solar Electric Generating System

Ivanpah, California

(07-AFC-5)

Submitted to the

California Energy Commission

Submitted by

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

With Technical Assistance by

CH2MHILL

Sacramento, California

July 2008

Contents

Tables (tables can be found at the end of the document)

Acronyms and Abbreviations

°Celsius	degrees Celsius
AFB	Air Force Base
BLM	U.S. Bureau of Land Management
CMM	Castle Mountain Mine
H_2O	water
H_2SO_4	sulfuric acid
Ivanpah SEGS	Ivanpah Solar Electric Generating System
lbs/ac	pounds per acre
LMNRA	Lake Mead National Recreation Area
n/s	not specified
USGS	U.S. Geological Survey
VAM	vesicular-arbuscular micorrhizae

1.0 Introduction to the Technical Basis Document

This technical basis document is intended to provide an overview of salient findings from studies of desert revegetation processes. The topics can be divided into two overarching categories: studies of natural vegetation recovery following disturbance (Section 2.0), and artificial revegetation methods to propagate plant species on disturbed habitat so that recovery occurs more rapidly than it would naturally (Section 3.0). This is intended to be a stand-alone document that provides an overview of the concepts and methods to be employed in the Revegetation and Rehabilitation plans for both temporarily disturbed areas, as well as the Ivanpah Solar Electric Generating System (Ivanpah SEGS) facility after decommissioning.

This technical basis document shows that there is a sufficient level of knowledge regarding processes and means of revegetation to identify reclamation and revegetation techniques that would be adequate and appropriate for the Ivanpah SEGS. Specifically, this technical basis document demonstrates the following:

- The identity of pioneer, successional, and mature-community (climax) plant species that would be optimal for use at the Ivanpah SEGS can be readily established.
- The natural successional processes (processural baseline) that would be enhanced by revegetation efforts can be specified.
- Realistic criteria for measuring progress can be identified according to what is currently known of vegetation response to disturbance.

Based on an understanding of the research and investigations already conducted, this document shows that adequate revegetation and reclamation measures for the Ivanpah SEGS site can be formulated with the scientific knowledge at hand. Neither study plots nor a research program *per se* are necessary to identify goals and methods of revegetation, the native species to employ at the Ivanpah SEGS site, or the criteria for measuring success. As discussed in the sections below, the data suitable to these goals are already available, and the techniques, while not widely published, have been applied in a number of relevant circumstances.

The main body of this Technical Basis document is found in Sections 2 and 3. Section 2 provides the ecological context for revegetation and rehabilitation by discussing examples of natural vegetation succession following disturbance in Mojave Desert scrub similar to that at Ivanpah SEGS. Section 3 summarizes the revegetation methods and materials that have been used in a number of different projects, chiefly in the eastern Mojave Desert, and the lessons learned that are applicable to this project moving forward. Section 4 provides a summary of these findings and some basic recommendations for the next steps in the development of a comprehensive revegetation and rehabilitation plan.

2.0 Natural Revegetation Processes and Criteria for Assessing Progress

In this case, "criteria for assessing progress" refers to the baseline or comparative criteria that will be used to judge the efficacy of revegetation efforts. As the studies discussed below show, in many cases it takes decades, if not centuries, for a disturbed area to attain the physical and biotic attributes of surrounding undisturbed areas. From an ecological point of view this is neither extraordinary nor unusual. The same would apply if the project were to be built in prairie or forest. However, once this is appreciated it is important to understand the processes of recovery that occur in Mojave Desert scrub in order to be able to accelerate that recovery where possible. The applicant understands this and in this document provides the information that can be used to move forward with planning to accelerate this recovery.

2.1 Natural Revegetation in the Mojave Desert Part I—Studies in the Funeral Range

Both human and natural agencies are responsible for disturbing the desert surface. Natural agencies, such as erosional events, have been impacting plant communities since the development of desert ecosystems and, as a consequence, there are desert plant species well-adapted to disturbed habitat. Historic disturbances have been used as opportunities to study natural revegetation in the Mojave Desert. The most comprehensive studies include two conducted by the U.S. Geological Survey (USGS) (Webb et al., 1988; Steiger and Webb, 2000) of abandoned early 20th Century mining towns and mid-20th Century military targets. Other studies include those of disturbed utility corridors (Vasek et al., 1975a and b) and off-road vehicle impacts (Webb and Wilshire, 1983).

The natural revegetation of these disturbed areas has been modeled in terms of "plant succession." This has been a controversial concept because of its association with Clements' (1916) assertion that the plant community represents essentially a "superorganism" with predictable stages of maturation (Ricklefs, 1982). Plant communities are better conceptualized as open systems, and the details of the directional progression of succession, from barren ground through vegetation dominated by pioneer and early successional plant species, to mature plant communities are never entirely predictable. Therefore, the composition of mature plant communities or climax communities is never entirely predictable. Ecologists usually conceptualize a single community as representing one point on a multi-dimensional continuum (Ricklefs, 1982).

In their study of plant succession on different-age alluvial terraces in the Black Mountains of the Funeral Range, about 60 miles northwest of the Ivanpah SEGS site, Webb et al. (1988) found initial colonization by short-lived, reproduction-oriented species such as cheese-bush (*Hymenoclea salsola*). They identified a sequence of as many as six vegetational stages that constitute a successional sequence occurring over more than 10,000-years[1]. Webb et al. (1988) note that each stage is entirely gradational with the previous and following stages They note that an initial pioneer stage with annuals such as storksbill (*Erodium cicutarium*) and chess or red brome (*Bromus rubens*) followed within several years by disturbance-adapted perennials and biennials such as saltbush (*Atriplex* spp.), rabbitbrush (*Chrysothamnus* sp.), and species of desert buckwheat (*Eriogonum* spp.). The next successional stages (3 through 5) describe a continuum of, initially, increasing diversity and cover with immigration of such shrubs as hopsage (*Grayia spinosa*), boxthorn (*Lycium* spp.), and Nevada ephedra (*Ephedra nevadensis*). The final succession of Stages 5 and 6 is characterized by decreasing diversity and increasing abundance of blackbrush (*Coleogyne ramosissima*), which is the dominant perennial of the end-stage or climax community at elevations between ca. 5,200 and 6,000 feet. No duration is attached to Stage 6, which represents the conceptual endpoint of vegetation succession, and geomorphic evidence evaluated by Webb et al. (1988) indicates that Stage 5 takes up to 5,000 years.

At the lower elevation site of Gold Valley in the Funeral Range, within creosote bush desert scrub in the same area, Webb et al. (1988) found that succession can be easily described in stages but is not less gradational. Desert trumpet (*Eriogonum inflatum*) and cheesebush are pioneer and early successional species, and are slowly replaced by perennial shrubs including ephedra, perennial buckwheat (*Eriogonum fasciculatum*), and burrobush (*Ambrosia dumosa*). Depending on site elevation and substrate, this leads to vegetation dominated by creosote bush and burrobush, or blackbrush at higher elevations. In the case of Gold Valley, Webb et al. (1988) note that geomorphic factors including the heterogenous distribution of soils and erosional scours contribute to the instability of the oldest stages of primary succession in this area, with eroded areas in a matrix of creosote bush or blackbrush desert scrub dominated by early successional species (e.g., cheesebush, desert trumpet).

The Webb et al. (1988) study of the Greenwater town site in creosote bush desert scrub provides further insight into vegetation succession in Mojave Desert scrub. By comparing plots that were abandoned 73 years ago with control plots that had not been disturbed by historic mining activity, Webb et al. (1988) found that total cover was similar between both types of sites. However, the disturbed sites could be readily distinguished by differences in species composition, biomass, and the apparent slow reestablishment of creosote bush. As with other sites, cheesebush is the first colonizer on disturbed sites, along with ephedra and desert rue (*Thamnosma montana*) as additional pioneer species.

Webb et al. (1988) noted several factors that affected the rate and nature of vegetational succession and, therefore, the composition of successional plant communities. These include compaction of the soils column, the presence or absence of a strongly developed carbonate soil (calcrete or caliche) at depth, whether or not the pedon[2] had been completely removed or not, and changes in local climate over the last millennium.

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[1] As benchmarks: (a) the regional vegetation change accompanying the end of the last Ice Age occurred between 13,000 and 8,000 years ago (BP) (Spaulding, 1990) when steppe and woodland gave way to xerophytic desert scrub; (b) in its slow postglacial migration northward, creosote bush (*Larrea tridentata*) did not reach the latitude of the Ivanpah Valley until after 8,000 BP (Hunter et al., 2001).

[2] In common usage, the word soil refers to any packet of loose sediment covering the ground surface, while in technical use, it applies to that suite of chemical and physical changes with depth that is developed over time as a result of weathering as well as biotic interactions. In such cases where synonymy might be confusing, the term, “pedon,” is used for the latter.

2.2 Natural Revegetation in the Mojave Desert Part II—Studies of World War II Targets

Twenty-two target sites were cleared in 1942 by the First Army under the command of General George C. Patton in the eastern Mojave Desert, about 20 miles east of the Colorado River and west of the Hualapai Mountains in creosote bush-burrobush desert scrub. Steiger and Webb (2000) selected 10 of these sites for detailed study in this area, which is about 100 miles to the southeast of the Ivanpah SEGS site, and at elevations ranging from 3,280 to about 3,610 feet. Other species that are common in the local vegetation and shared at the Ivanpah SEGS site include Virgin River brittlebush (*Encelia virginensis*), ratany (*Krameria* sp.), goldenhead (*Acamptopappus sphaerocephalus*), catclaw acacia (*Acacia greggii*), and the disturbance adapted perennials cheesebush and bladder-sage (*Salazaria mexicana*). Plant species with southern affinities that do not occur as far north as the Ivanpah SEGS site include ocotillo (*Fouquieria splendens*) and the little-leaf paloverde (*Cercidium microphyllum*), the latter chiefly as a desert riparian (*sensu* Bradley and Deacon, 1967) species in washes with catclaw acacia.

The objective of Steiger and Webb's (2000) study was not to describe the stages of successional processes in Mojave Desert vegetation but to follow-up on studies by Wilshire and Reneau (1992) relating the degree of recovery of plant communities[3] at individual sites to differences in the age and composition of the site surfaces. Differences in the age and geomorphology of different surfaces are strongly correlated with differences in attributes of the individual plant associations, including rates of recovery. Their findings also include the following (Steiger and Webb, 2000):

- There is a higher variability in the degree of recovery from disturbance among sites on older geomorphic surfaces than among sites on younger surfaces.
- There appears to be a tendency for an inverse relationship between the degree of recovery and relative geomorphic age, with recovery retarded on older surfaces.
- The results are affected by the tendency of older geomorphic surfaces to support more heterogeneous (higher site to site differences) vegetation than younger surfaces.
- The type of disturbance (in this case, blading with a bulldozer, frequently limited to one pass) strongly affects the pace as well as nature of recovery.

As Steiger and Webb (2000) succinctly note:

> The effects of disturbance on revegetation vary according to the functional edaphic characteristics of each (different geomorphic) unit, and how those characteristics are modified by the disturbance

Although they could not conclusively demonstrate it, Steiger and Webb (2000) note that their results suggest that successional convergence (the tendency for different vegetation in different plots to converge on the same vegetation type, or regional climax through time) does occur. Life-history strategies of the perennial plant involved significantly affected

[3] "Recovery" with respect to a plant community is normally thought of as its similarity in cover, composition, and structure with a predetermined climax plant community that has not been disturbed for (presumably) millennia.

subsequent succession, especially given the typically shallow disturbance at the target areas. Root-crown survival among creosote bush and paloverde as a consequence of shallow blading led to the dominance of these perennials in successional vegetation. The authors suggest that the subsequent preemption of habitat by creosote bush inhibited the reestablishment of burrobush.

2.3 Other Revegetation Studies in the Mojave Desert

The research described above is particularly valuable not only because of the similarity of the vegetation at the Funeral Range and target sites with that of Ivanpah SEGS, but also because these were studies of large polygonal disturbance areas rather than of linear corridors, although a review of these suggests that areal extent or geometry of a disturbed area do not have a readily noticeable effects on the patterns of vegetation succession. According to studies of vegetational succession in linear rights-of-way in the Mojave Desert, Vasek (1983; as summarized by Webb et al., 1988) characterized succession in desert scrub as comprising the following processural stages:

1. Initial phase of colonization by pioneer species of low stature and short lifespan.
2. Immigration of perennial species, largely successional but also elements of the climax community, increases the height, structural complexity, stratification, and biomass of the community.
3. Productivity, species diversity, and niche partitioning continue to increase as the plant community exerts increasing influence on microclimate and soil development.
4. The replacement of late-successional species by longer-lived climax species often results in a decrease in productivity and species diversity.
5. Extreme stability prevails as selection for competitive ability among shrubs results in the dominance of a few, long-lived species, and a reduction in population size.

These processes are more pronounced at higher elevations in more diverse desert scrub ecosystems. Beatley (1976) noted that successional processes are more complex at higher altitudes as a function of increased precipitation, decreased evaporation, and interrelated increases in diversity, soil-forming processes and organic matter, and biomass. In low-elevation, xeric desert scrub where temperature and evaporative limits are exceeded for many plant species, diversity and niche partitioning is much simpler, and some of the stages described above are consequently not discernable.

2.4 Conclusions and Recommendations Based on Natural Revegetation Studies

After vegetation disturbance, the site cannot be immediately returned to its predisturbance condition, or climax vegetation, because the physical conditions are no longer appropriate for that plant association. This is the case for any vegetation type, be it Mojave Desert scrub or temperate deciduous forest, and it is why vegetation succession occurs. 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 nevertheless occur quickly. Even in the absence of human intervention, recolonization by pioneer plant species occurs within a year, and the first successional perennials are usually present within 2 to 3 years. The fact that a plant community cannot be immediately returned to its predisturbance composition means that the criteria for revegetation success need to be established on the basis of *successional* plant associations rather than mature climax vegetation.

Successional stages can be identified to the extent that the initial stage of colonization, intermediate successional stage(s), and final stage or climax vegetation are generally predictable. Revegetation can be significantly affected by the nature of the substrate and by the type of disturbance. The studies reviewed above also found that the pace of succession can be affected by soil conditions to the extent that succession of scrub vegetation on compacted surfaces appeared to take significantly longer than on surfaces that had not been compacted. Successional processes are more complex and occur at faster rates in higher elevation desert scrub habitats, similar to the Ivanpah SEGS site.

These data inform both revegetation strategies as well as the selection of baseline or comparative criteria by which to evaluate revegetation undertaken at the Ivanpah SEGS. A practically attainable approach to revegetation would accelerate the natural successional process. This means that instead of planning for climax vegetation that physically cannot become established for decades, successional plant communities composed of species native to the area could readily occupy previously disturbed areas. Accelerating their initial establishment and growth in terms of diversity, density, and stature can be achieved through an ecologically realistic revegetation program.

3.0 Accelerating Revegetation—An Evaluation of Methods

Site revegetation techniques used in deserts are different from many methods used in subhumid to humid parts of the world. The extreme aridity, unpredictable rainfall, poorly developed soils, and different types of vegetation that adapted to this demanding environment need to be considered. The Mojave Desert is one of the driest places in North America, and the extremely low and variable rainfall make it one of the most difficult places to accomplish revegetation (Anderson and Ostler, 2002). As a result, many revegetation efforts in the Mojave Desert have failed to achieve plant community development goals in a timely manner. Vegetation clearing and land disturbance often result in visible scars with limited regrowth and ongoing erosion problems that can persist for decades. Even when revegetation is successful, plant communities established are typically composed of pioneer and successional species adapted to disturbed substrate.

Appropriate revegetation methodology requires a site-specific understanding of limiting factors, as well as the flora and substrate, and consistency with the current practices for desert revegetation. This section summarizes previous research on Mojave Desert revegetation as a basis for developing recommendations for Ivanpah SEGS that incorporate current understanding of successful revegetation techniques. Based on the review presented below, Ivanpah SEGS can develop and execute an effective revegetation program.

3.1 Castle Mountain Mine

3.1.1 Context and Objectives

Castle Mountain Mine (CMM) was an operating gold mine between 1991 and 2001, and is located in the Mojave Desert just west of the Colorado River trough in eastern San Bernardino County, California. During this time, the owner, Viceroy Gold, sponsored and pursued reclamation and revegetation procedures as required by resource agencies, and also supported a research program to identify and test for successful desert revegetation and reclamation. Research topics included seed treatment and germination, plant propagation, pest management, plant salvage, soil stockpile management, plant hormone use, use of vesicular-arbuscular micorrhizae (VAM), plant water relationships, plant spacing patterns and density, diversity, herbivory, and irrigation design. As a part of the project, Viceroy Gold established an extensive native nursery including greenhouses to support research of site-specific revegetation efforts, including plant propagation for revegetation.

3.1.2 Approaches and Results

As part of the stipulations in its Record of Decision (BLM, 1990) Viceroy Gold's CMM established extensive greenhouse operation for nursery-grown native plants that were transplanted onto rehabilitation areas. Over 2,000 plants were transplanted in 1996, and 8,203 plants in 2001. Transplant species were composed of succulents. Plants persisting

4 years after being transplanted are listed in Table 3-1[4]. In addition, broad areas of the reclaimed mine were aerially or hand-broadcast seeded, most occurring in November 2001. Truck irrigation was applied to portions of the Ivanpah SEGS site (predominantly reported on transplant locations). Seeded areas were apparently not irrigated. Heavy rainfall events favored site revegetation (particularly in the 2004 to 2005 winter), and as of the 2005 annual report (fourth monitoring year), all transects but one had exceeded the 10-year success criterion of 855 perennial plants per acre. In addition, the transect species count ranged from 12 and 24, significantly exceeding the 5-year requirements on diversity (five species). Although not a success criterion, total vegetative cover across the transects ranged from 10 to 57 percent, the latter value being high for desert scrub. The average cover of desirable species in the surveyed areas was 23 percent. Russian thistle, a pioneer species, is decreasing site-wide, varying from 0 to 5 percent cover and averaged about 2 percent. The surface of the reclamation area continued to remain stable with no deep erosional gullies or rills during 2005. Water catchment basins and ridges continue to perform as designed.

The transplanting program at CMM has had poor results. Many transplanted shrubs have not survived to the fourth year since reclamation and transplanting. Many large Joshua trees (*Yucca brevifolia*) are still alive but do not appear to be healthy. Specific data on survivorship of transplants was not provided in a recent report on the effort (Bamberg Ecological, 2005) because survivorship of transplants does not appear to be a success criterion. However, the success of seeding, and the poor performance of the native plant transplant program are consistent with other studies and have important implications for Ivanpah SEGS revegetation planning.

3.2 Las Vegas Valley Landfill Revegetation Review

In response to a request by a Las Vegas Valley client to develop a revegetation program for a landfill closed during the mid-20th Century, CH2M HILL developed a plan that provided a balance of aesthetics appropriate for both the site and advancing residential development, with effective water use and reasonable costs. To preliminarily identify revegetation methods, CH2M HILL was contracted to provide a review and evaluation of other desert revegetation efforts, and to make recommendations regarding post-closure revegetation for the landfill. The scope of work was subsequently amended to include the preparation of contract specification sheets for the entire landscaping and revegetation project to be implemented before 2010.

As a part of this effort, a summary of "lessons learned" was developed from revegetation projects for the following projects or entities:

- City of Henderson Equestrian Detention Basin
- Edwards Air Force Base (AFB) Landfill Closure
- U.S. Department of Energy/Department of Defense Revegetation Research
- Bechtel Nevada (BN)
- Lake Mead National Recreation Area (LMNRA)
- U.S. Bureau of Land Management (BLM)

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[4] Tables can be found at the end of this document.

In accordance with these findings, a series of recommendations for this landfill revegetation project were prepared according to knowledge of specific site conditions and the results of other projects summarized in the sections below.

3.2.1 Henderson Equestrian Detention Basin

Details on revegetation implementation of this detention basin are only generally known from administrative records, but it is understood that container stock of mostly native plants was planted and temporary irrigation was to be applied for the first two seasons. The instructive part of this revegetation project was the difference in vegetative recovery among the different habitats created by excavating this basin. In addition, this detention basin was constructed on the upper reaches of a bajada surface extending from the River Mountains, and the alluvial soils are not dissimilar to those of the Ivanpah SEGS site.

Slopes with an aspect (orientation towards the sun) that minimizes evapotranspirational stress, and surfaces that receive little disturbance, show rapid development of scrub vegetation. Others with greater exposure to intense afternoon sunlight, as well as those receiving greater disturbance, remain largely barren after more than 5 years. The silt-rich floor of the bottom of the detention basin supports many more species (n = 13) than the slopes (n = 5), but the shrubs are of smaller stature and the visual effect is rather bleak compared with slopes with optimum aspect that support dense scrub. Perennial desert shrubs that are the most aggressive recolonizers of the Ivanpah SEGS site are those known to have adapted to disturbance, and that occur near the site. At this site, at least burrobush is a robust successional species and, therefore, useful in revegetation.

3.2.2 Edwards Air Force Base Landfill Closure

Shallow rooted plants were selected for growth over soil on a landfill liner. Plants were seeded in winter using an imprint seeder that drives seed into a 3- to 5-inch-deep imprint. The site was watered once a week for 3 months after planting with a water truck, averaging 0.29 inches per month. After 4 years, native cover was well established, although visual contrast with surrounding relatively undisturbed Joshua tree scrub is expected to persist. The success of the seeding effort could have been a result of a sequence of relatively wet seasons, although the evidence is anecdotal.

3.2.3 U.S. Department of Energy/Department of Defense Revegetation Research

BN has conducted a number of revegetation research projects in the northern Mojave Desert. The typical revegetation approach implemented is to seed in the fall using a rangeland drill with no disk openers or press wheels (essentially dropping the seed on the ground as broadcast seeding), and following with a drag to incorporate the seed. Irrigation is implemented for the first year with a portable system, with application during the fall and winter following seeding. Germination results seeding climax species burrobush and creosote bush were poor until the seed was pretreated and mixed with mulch and water at the time of seeding.

3.2.4 Lake Mead National Recreation Area

LMNRA uses container-grown plants and cuttings (for *Opuntia*) rather than seeding, and uses temporary irrigation to achieve revegetation in a relatively short timeframe and with reasonably high survival rate. Special attention is paid to the local flora, and the selection of containerized stock is partly determined by comparison against a predetermined list of species most appropriate to the habitat. Soil stockpiling and respreading, and the use of a diverse mixture of annual plant species is also considered important to revegetation success.

3.2.5 U.S. Bureau of Land Management

In a guidance document for revegetation of energy project sites, the BLM Las Vegas Field Office (2001) identified varying levels of rehabilitation depending on land management status (e.g., conservation areas versus multiple-use areas) and level of disturbance. Requirements may include seed collection for onsite propagation; plant propagation in a nursery facility for subsequent planting; cactus and yucca salvage, relocation, and replanting; windrowing vegetation, topsoil, and subsoil; replacing soils in sequence; decompacting soils; reseeding by broadcast seeding; and monitoring. Use of containerized planting in revegetation is more resource and labor intensive than seeding, and transplants require irrigation through at least the first summer. Use of mulch from the former vegetation as well as soil stockpiling and respreading is considered important to revegetation success.

3.3 Summary of Findings

Findings of these revegetation programs are summarized by topic and describe methods that can be used to develop effective revegetation strategies for different phases of the Ivanpah SEGS.

3.3.1 Site Selection and Overall Propagation Strategy

Some of the studies discussed in Section 2.0 of this technical basis document focus on the role of the physical attributes of a site in affecting the nature and timing of revegetation. In addition, these specific revegetation efforts show the following:

- West and south facing slopes are vulnerable to intense afternoon heat and desiccation, which impede seedling establishment and stress transplanted stock. East-facing slopes are warmed early in the morning and appear less susceptible to frost inhibition.
- Revegetation of older surfaces underlain by well-developed caliche soils will be affected by poor permeability.
- Ongoing disturbance can significantly curtail revegetation success; fencing, earthen berms, natural bollards, or other exclusion methods should be implemented where appropriate.
- For larger areas, seeding with some sort of impresser or drill, rather than containerized planting, is the more economical approach.
- Failure of containerized stock and transplants as a result of desiccation and/or inappropriate soil conditions is common.
- Success of seeding efforts could be considered more common that expected given because of the rigor of the desert environment.

3.3.2 Soil Salvage and Preparation

- Soils need to be evaluated for texture, infiltration potential, salt content, and other parameters that can affect the plant palette design. This approach can be deferred if there is sufficient native vegetation nearby or if the vegetation of the site is adequately censused prior to disturbance.
- Topsoil stockpiling and redistribution is important to relatively rapid revegetation. Windrowing vegetation, topsoil, and subsoil in separate rows is favored.
- Replacing vegetation mulch and/or litter as the final application will increase moisture retention and reduce erosion.
- At CMM, a hydro-axe brush cutter was used to mulch vegetation biomass to 8 inches, and to mine the topsoil for salvage. However, it was not explained how this was achieved, only that it performed superior to a "continuous miner" unit ,which is designed to scrape off surficial deposits of coal or other minerals.
- To remediate compaction at CMM, roads slated for rehabilitation were deep ripped (48-inch tines) and shallow ripped (8-inch tines) prior to being planted. Ripping with bull dozers to 2 to 3 feet deep reduced compaction and created a rough surface for seed catchment and soil conservation. Scarification (ripping to a shallower depth or up to 18 inches) provides similar enhancements.
- Rough grading and fine-grading at CMM were implemented to create topographic diversity with more natural, undulating landforms, and to create microcatchment basins to facilitate seed germination and plant growth, while reducing erosion. Basins were less than 3 feet deep, 1 to 15 feet wide, and a few to 50 feet in length.

3.3.3 Plant Selection

- Understanding potential natural vegetation and successional stages of that vegetation is key. Pioneer and early successional plants are most likely to be quickly established and maintain high rates of growth and survivorship.
- Selection of climax plant species for revegetation of areas with deeply disturbed soils increases probability of widespread planting failure.
- Diverse seed and plant mixes ensure greater probability of some germinants and plants established, and annual species can contribute to erosion control and soil development.
- Introduced annuals, although not native, are aggressive colonizers of disturbed soils, reducing erosion and accelerating soil development. Their ubiquity and usually inevitable presence in the seed bank are considered realistic approaches to the revegetation plant pallet.
- Plant/seed availability and economic factors can be effectively integrated in planning large-scale revegetation work.
- Local ecotypes of selected plant species should be incorporated for maximum replanting success. To achieve this, it is often necessary to collect local seed and grow and/or establish a native nursery to grow local stock on large rehabilitation sites.

3.3.4 Seed Collection

- At CMM, seed was collected within 25 miles of the site to ensure that it was from local ecotypes, that is, plants adapted to climate, soil, and other site conditions similar to those where the seed would be sown. Seed of grasses was also grown and harvested in nursery facilities.
- Bulk seed at CMM was collected by direct harvest from plants, underneath shrubs, and from windblown debris caught in depressions and washes. Areas near roadsides or invasive plants were avoided.
- Bulk seed has advantages in the following ways: seeds may be naturally inoculated with beneficial microorganisms; a larger diversity of seed, including annuals, will be collected; large quantities can be collected; seed maturing at different times will be included in collections; seeds can be sown immediately without concern for dormancy.

3.3.5 Plant Propagation

3.3.5.1 Seed Preparation

Seed preparation is important for some species, and may be essential for germination. Creosote bush and burrobush seed benefit from rinsing. Other methods may be required to increase germination rates to acceptable levels, such as stratification (i.e., subjecting seed to temperature cycles), scarification (altering seed coat through physical or chemical means), or breaking dormancy through other methods (e.g., photoperiod alteration, seasonal limits on germination). Table 3-2 summarizes results from germination methods from CMM.

3.3.5.2 Cuttings

- Many succulents can readily be transplanted or propagated from cuttings.
- Extensive propagation of plants from cuttings was implemented at CMM. Cuttings were rooted in various soil mixes in a greenhouse or nursery setting. Table 3-3 provides data from CMM on success of plant propagation from cuttings.
- Growth hormones and transpiration inhibitors appeared to have no long-term benefits on salvaged plants or cuttings.

3.3.5.3 Growth Media

- Initially, growth medium for greenhouse plants at CMM was 100 percent calcined clay (oil-absorbent kitty litter), because it was thought to encourage root establishment. However, plants grown in it had low vigor.
- Subsequent growth media used at CMM included three parts calcined clay: two parts medium-grade vermiculite: one part standard organic potting mix (3:2:1 mix).
- Later, an over-the-counter mix was used (Scotts Metro-Mix 200® growing medium), a commercial organic soil mix that contained vermiculite, peat moss, perlite, and sand. Because plants did not show transplant shock when transferred to a calcined clay mix, this medium was used more regularly.

3.3.5.4 Nursery Pests

- Desert rodent and rabbit populations were a constant problem in nurseries at CMM, primarily chewing through drip line and also foraging on plants. Packrats (*Neotoma* sp.) established dens in hard-to-reach areas and attracted parasites. Dogs were stationed in the nursery and provided some relief.
- Aphids and mealy bugs were problematic in nurseries and greenhouses at CMM. White flies, spider mites, and scale were also reported. Biological control (i.e., ladybugs) was ineffectual and plants were sprayed with insecticides.
- Weeds, particularly Russian thistle (*Salsola tragus*), were problematic where irrigation overspray occurred in nurseries at CMM. Weeds were removed by hand; a labor intensive undertaking that reinforces the idea that large--scale irrigation is not advisable for desert scrub revegetation.

3.3.5.5 Vesicular-arbuscular Micorrhizae

- VAM inoculation in plant roots is important for nutrient acquisition, and vascular plants rely on these symbiotic relationships. At CMM, specific VAM associations were isolated, cultured, identified, and purified. Propagation of VAM cultures was undertaken at CMM for later use in revegetation.
- It was reported at CMM that VAM spore numbers and inoculum in soil stockpiles were fewer in undisturbed soils, but still “significant,” and that inoculum was reduced with age of stockpile. However, reports were inconsistent on these data.
- Experiments at CMM showed that plants grown with native undisturbed soil as the VAM inoculum grew better than plants inoculated with commercially available VAM inoculants or mine overburden.

3.3.6 Planting Methods and Plant Salvage

3.3.6.1 Seeding

- Fall seeding is recommended, although seeding has been conducted throughout the winter.
- Imprint seeding appears to be a successful approach for controlling erosion and establishing seedlings on finer soils, but is not likely to work on sandy soils.
- Broadcast seeding can be effective, but should be followed with a drag device to provide some soil disturbance and to bury the seed. Predation rates can be higher for broadcast seed than drilled seed.
- Rangeland drill seeding can effectively place seed in soil slots and cover them, reducing predation, but equipment might not be able to operate in rocky areas, and germinants can become established in unnatural appearing rows.
- Hydroseeding is not recommended, unless irrigation is applied after seeding, because without follow-on irrigation, pre-soaked seed will fail.

- Seeds are especially vulnerable to predation by rodents, ants, birds, or other organisms; predation rates routinely exceed 90 percent, and methods (e.g., drill seeding) to protect seed can be beneficial. Placing an alternative grain out with broadcast seeding, such as cracked wheat, can reduce predation on seeds.
- At CMM, aerial and manual seeding was implemented. Aerial seeding was conducted with a crop duster. Seed was dispersed with a Transland spreader with a variable controlled rate of release. Release rates were predetermined and verified post-flight. Flight patterns were controlled with a geographical positioning system and Satloc guidance system. Application rate was 10 to 15 pounds/acre (lbs/ac).
- Manual seed dispersal was performed by hand seeding from a 5-gallon bucket at predesignated release rates (20 lbs/ac).

3.3.6.2 Plant Salvage/Transplanting

- Salvaging plants provides significant source of soil microflora and fauna, which are essential to healthy soil-plant interactions. In addition, salvage plants provide immediate habitat structure that can protect adjacent plants or seeds, and could be less expensive than other revegetation efforts.
- Plants too small or too large are not easily transplanted; plants too small might not survive transplanting, and plants too large are not easily handled.
- Transplant orientation per the cardinal direction should be the same as original orientation.
- Results from CMM indicate that growth hormones and transpiration inhibitors have no long-term benefits on salvaged plants.
- Tree spades that excavated large, mature trees and shrubs with the root system intact, resulted in 95 percent survival rate, but cost between $125 to $400 per individual transplant at CMM.
- Bare root methods involved removal with a bladed pick-axe to expose bare root, and replanting either in postholes or trenches. High mortality rates were reported for many species from this method at CMM (above 40 percent for all species after several years).
- Plants were watered before and after transplanting at CMM. Transplanting occurred in most species within 8 hours of removal. No fertilizer was used.
- Mortality by species was not well reported, but at CMM, Mojave yucca (*Yucca schidigera*) and Joshua tree (*Yucca brevifolia*) had low survival rates (less than 50 percent) when transplanted by bare root methods over the time period reported.
- Generally, most species showed less than 50 percent survival from transplanting at CMM, unless the tree spade method was used. Cacti were the exception, which did well when transplanted.
- Cuttings/transplanting can be used for most species of *Opuntia*. Barrel cacti (*Echinocactus; Ferocactus*) can be readily transplanted.

3.3.6.3 Container Stock

- Container stock can achieve cover and visual criteria more quickly than seed, but is more expensive to procure and install.
- Appropriate ecotypes should be used, that is, local stock is likely to be better adapted to specific site conditions. However, there can be considerable delay between when seeds are needed for revegetation purposes, and when they are available for collecting. .
- Planting should occur in the late fall to early spring.

3.3.6.4 Mulching and Other Additives

- Mulching appears to contribute to seeding success; cleared vegetation from the site can be mulched or straw mulch used.
- Water-absorbing polyacrylamide gel could improve initial seedling survival, but might not provide a long-term benefit.

3.3.7 Soil Moisture and Irrigation Application

The larger the application area, the less likely it is that irrigation will be practicable. Nevertheless, thought and experimentation have been applied to questions of enhancing the survivability of particularly transplants using temporary irrigation methods.

- Where seeding is implemented, a favorable rainfall year or sequence of seasons following seeding will result in much greater success. In the eastern Mojave Desert, moisture is more typically bimodal, with half or more of annual precipitation falling between October/November and April as winter storms, and the remainder falling between July and September/October as monsoonal rains. May and June typically have very low precipitation.
- Typical revegetation seeding occurs in the fall and is intended to precede the winter rainy season.
- Irrigation through the first growing season is important for transplants, and can be sufficient for establishment, if climatic factors are favorable in subsequent years. Cessation of irrigation for containerized stock and transplants prior to the first summer is not recommended.
- Quantity of irrigation should reflect a favorable moisture year (5 to 10 inches a year at the Ivanpah SEGS site), without overwatering, which can result in mortality and disease (e.g., fungal and rot problems) for the dry-adapted desert vegetation.
- Evaporative demand, driven by climate, can be summarized using potential evapotranspiration or reference crop evapotranspiration. Some data on plant-specific water demands for some desert scrub species (e.g., creosote, burrobush) are available, and there are challenges with using standard crop coefficients for desert shrub irrigation because of the sensitivity to overwatering.
- At Edwards AFB, watering after seeding in February 2002 was conducted once per week for 3 months. Approximately 2,000 gallons per acre were applied at each application (or

about 0.29 inch per month). Rainfall was relatively normal through the summer, but 7.1 inches of rain in September 2002 are thought to have contributed significantly to the success of the revegetation.

- Irrigation can be achieved by truck application on smaller sites. Truck access should be limited to defined access routes because it will result in ongoing disturbance to the site and soil compression in the tracks. In steep or rough terrain, truck access is limited.
- Temporary pipe irrigation is more expensive to install but might be more realistic on larger sites or inaccessible sites. Some components of temporary irrigation (e.g., polyethylene drip tubes) are susceptible to damage by rodents, coyotes, or other animals, although burying the piping will help.
- Portable sprinkler systems (e.g., Superstand) have been used on sites up to 9 acres effectively, but might not be effective on larger sites.

3.3.8 Color Treatments

- Color treatment may be a component of mulching to reduce visual impacts.

3.3.9 Weed Management

- A noxious weed control program will be necessary for the first few years after revegetation.
- Reducing overhead irrigation will reduce weed problems.

3.3.10 Herbivory

- Cattle grazing affected some revegetation efforts at CMM, specifically species more prone to grazing (e.g., apricot mallow [*Sphaeralcea ambigua*]), while not affecting others.
- Ungulates will require management because they are more likely to be attracted to emerging vegetation, and can also damage irrigation installations.
- Although seed predators (rodents, ants) have been a concern, there is no immediately accessible data on their effect on revegetation efforts.
- Tubex™ tree shelters improved survivorship of planted catclaw acacia and other species at CMM.

4.0 Recommendations and Conclusions

The summary provided in Section 3.0 points to the substantial amount of information presently available on appropriate revegetation methods for desert scrub habitat such as that at Ivanpah SEGS. Along with the Section 2.0 guidance on ecologically based revegetation processes, resources currently available also include the draft Biological Assessment, and attendant biotic and geomorphic inventories of the Ivanpah SEGS site. The specific information, as well as the background in theory and methods, are sufficient to formulate effective revegetation strategies for the Ivanpah SEGS site, for both temporary disturbance areas, as well as to incorporate in long-term reclamation plans.

A research program would be unnecessary to identify methods and plant taxa to include in realistically achievable revegetation plans for the Ivanpah SEGS because these methods have been developed by the CMM and other programs. Natural vegetation succession can be accelerated by taking advantage of the means and methods of vegetation propagation developed for the Mojave Desert. Study plots in undisturbed desert scrub would be necessary neither to identify revegetation goals nor to monitor revegetation progress; those goals and that progress can be stated in terms of the rates and components of successional processes. Finally, the plant species most appropriate to revegetation efforts can be identified with the available information on the flora of Ivanpah SEGS. The last two 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.

Therefore, Ivanpah SEGS and its consultants look forward to working with the BLM, CDFG, and other concerned agencies to finalize a list of plant species to be used, and to identify the revegetation methods to be employed at different facilities and at different phases over the life of the Ivanpah SEGS.

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Tables

TABLE 3-1
Transplanted plants still documented on the CMM site transects four years from transplanting.

Banana yucca
Barrel cactus
Clustered barrel cactus
Golden cholla
Joshua tree
Mojave prickly pear
Pancake prickly pear

TABLE 3-2
Methodologies used for seed germination and resulting germination rates.

Species	Date	Methodologies	Percent germination
Antelope bush (*Purshia glandulosa*)	1998	60-d stratification at 40°C. Sown directly in Metro-Mix 200®.	15
Banana yucca	Sep 1997	200 seeds placed in wicking tray. Mouse consumed a large portion.	n/s
	1998	No pretreatment. Seeds placed on moist paper towels in covered Pyrex dish. Germinated seeds sown in Metro-Mix 200®.	79
Barrel cactus	Jan 1997	1000 seeds sown in mixture of commercial potting soil and #30 silica sand (proportions unspecified) in shallow plastic pot. Pot watered, covered with clear plastic bag, and placed beneath grow light in headhouse.	68
Beehive cactus	Jan 1997	500 seeds treated as barrel cactus (above).	41
Blackbrush	1996	Not scarified; soaked in a mild chlorine solution to sterilize the seed coat	8
Boxthorn (*Lycium andersonii*)	Jul 1997	196 seeds sown directly into 3:2:1[a] mix.	2
Boxthorn (*L. cooperi*)	Jul 1997	196 seeds sown directly into 3:2:1 mix.	0
Brickellbush	1998	No pretreatment. Sown directly into Metro-Mix 200®.	86
California buckwheat	Aug 1996	Batch 1: seed coat removed. Batch 2: wings removed but seed coat left on. All seeds sown directly into 3:2:1 mix.	11, 1
	1998	Outer seed coat removed. Sown directly in Metro-Mix 200®.	23
Cheesebush	Jun, Sep 1996	Seed coat ground and wings knocked off. Jun: seeds sown in peat-based mix in multi-celled germinating trays. Sep: seeds sown in 3:2:1 mix.	26, 87
Cotton thorn	May 1996	Batch 1: Pappus removed. Batch 2: pappus intact. All placed on wicking trays.	91, 78
	Jan 1997	Pappus removed from 196 seeds, which were directly sown into 3:2:1 mix.	92
	1998	24-hour leaching	12
Coyote melon	Sep 1996	Seeds placed on wicking tray.	22
Creosote bush	May, Aug 1996	Leached in a nylon stocking by pumping water through stocking into 3.5-gallon bucket. Rinse water reused. Water changed several times in the first few days as seed leachate builtup. All seedlings planted in calcined material. *If creosote bush seedlings are watered from above, they lose volatile oils and die.* Alternatives are to water seedlings from the side (methods n/s), or wick-watering, such as dipping seedling container racks in water up to 1 inch from top of seedling container. Wick-watering method is effective even with the use of a	48, 52

TABLE 3-2
Methodologies used for seed germination and resulting germination rates.

Species	Date	Methodologies	Percent germination
		calcined growing medium.	
	Jan 1997	2 batches of 300 seeds each treated as in 1996	50, 47
	1998	Leached with H_2O for up to 5 days; germinated seeds removed daily. Sown directly in Metro-Mix 200®.	45, 32
Desert almond	1998	Outer seed coat removed, 50-day stratification at 5°C. Sown directly in Metro-Mix 200®.	66, 77
Desert needlegrass	Jun 1997	No pretreatment. Seeds sown directly into 3:2:1 mix.	70
Fourwing saltbush	1996	Seeds ground, wings knocked off, surface-sterilized with chlorine bleach. Placed in a single wicking tray in headhouse. Two wetting/drying cycles.	3
	1998	Continuous dark at 15°C	18
Galleta grass	Jan, Jun 1997	196 seeds sown directly into 3:2:1 mix.	56, 78
Goldenbush (*E. cooperi*)	1998	No pretreatment. Sown directly in Metro-Mix 200®.	1
Goldenbush (*E. cuneata*)	1998	No pretreatment. Sown directly in Metro-Mix 200®.	54
Goldenhead	1998	Outer seed coat removed. Sown directly in Metro-Mix 200®.	78
Hedgehog cactus	Jan 1997	500 seeds treated as barrel cactus (above).	52
Hop-sage	May 1996	Seeds removed from papery fruit sac, placed on wicking tray.	72
Indian ricegrass	1997	No pretreatment. Seeds sown in 3:2:1 mix.	<1
Interior goldenbush	1998	No pretreatment. Sown directly in Metro-Mix 200®.	88, 11
Joshua tree	1997	8000 seeds pregerminated in wicking trays and then planted in organic potting mix.	n/s
Mojave aster	Feb 1996	Seeds soaked in bleach, placed on wicking tray.	88
Mojave sage	Dec 1997	196 seeds sown directly into Metro-Mix 200®.	13
Mormon tea	Feb, Aug, Sep 1996	Feb and Aug: seeds surface-sterilized in bleach and placed in wicking tray in headhouse. Sept: no pretreatment; seeds sown in 3:2:1 mix, placed in greenhouse.	33, 21, 52
	May 1997	588 seeds sown directly into 3:2:1 mix.	18
Pima rhatany	1998	Leached w/ H_2O for 24 hours. Sown directly in Metro-Mix 200®.	71
Salvia dorrii	1998	No pretreatment. Sown directly in Metro-Mix 200®.	31
Salvia mojavensis	1998	No pretreatment. Sown directly in Metro-Mix 200®.	28

TABLE 3-2
Methodologies used for seed germination and resulting germination rates.

Species	Date	Methodologies	Percent germination
Shrubby encelia	1998	No pretreatment. Sown directly in Metro-Mix 200®.	75
Shrub live oak (*Quercus turbinella*)	1998	No pretreatment. Sown directly in Metro-Mix 200®.	57
Sticky snakeweed	1998	Batch 1: no pretreatment, sown directly in Metro-Mix 200®. Batch 2: 24 h leaching. Batch 3: alternating day-night temperature and photoperiod (details unspecified)	(1) 59, 37; (2) 12; (3) 16
Turpentine-brush	1998	No pretreatment. Sown directly in Metro-Mix 200®.	73, 51, 31
Utah juniper	Feb 1996	Mixed with moist vermiculite, placed in plastic bag and stratified for 3 months either at room temperature (Batch 1) or in a refrigerator (Batch 2). Seeds rinsed and placed on wicking tray.	2, 3
	1999	200 seeds scarified in 17.5N H_2SO_4 for 2 h, stratified at 2°C for 8 weeks and brought to ambient temperature for 8 weeks.	0
Viguiera	1998	No pretreatment. Sown directly in Metro-Mix 200®.	79
Winterfat	1998	Outer seed coat removed. Sown directly in Metro-Mix 200®.	24, 86, 88

Notes:
Source: Bamberg Ecological, 2005

[a] Three parts calcined clay: two parts medium-grade vermiculite : one part standard organic potting mix

°Celsius = degrees Celsius
H_2O = water
H_2SO_4 = sulfuric acid
n/s ≡ not specified

TABLE 3-3
Methodologies used for plant propagation from cuttings and resulting rooting percentages, CMM, 1996-1998

Species	Date	Methodologies	Percent rooting
Blackbush	Jun 1996	196 cuttings taken from greenhouse-grown plants. Batch 1: dipped in a 0.1% indole butyric acid[a] (Hormex No. 1). Batch 2: in 0.3% solution of same (Hormex No. 3). Cuttings planted in medium-grade vermiculite, placed under 50% shade cloth on a mist bench, and received 1 minute of misting every daylight hour.	85, 61
Boxthorn (*Lycium andersonii*)	May 1997	196 cuttings from North nursery. Batch 1: Hormex No. 3. Batch 2: Hormex No. 8.	22, 28
Boxthorn (*L. cooperi*)	May 1997	Unspecified number of cuttings from North nursery. Two batches treated as *L. andersonii* above.	14, 6
Creosote bush	Jan 1996	12 cuttings taken from greenhouse plants, dipped in 0.8% indole 3 butyric acid (Hormex No. 8), planted in vermiculite, watered with distilled water, and placed under grow lights in the headhouse.	8[b]
Fourwing saltbush	May 1996	196 15- to18-centimeter-long cuttings taken from ends of shoots growing on the CMM site. Leaves removed from base of each cutting. Batch 1: dipped in Hormex No. 3; Batch 2: dipped in Hormex No. 8. All planted in vermiculite. Containers were placed on the mist bench in the greenhouse.	57, 66
	Nov 1997	78 cuttings from plants propagated from seed, treated w/ Hormex No. 8, planted in medium-grade vermiculite.	17 (not final)
Golden cholla	Aug 1996	217 cuttings taken from north of greenhouse, cured for 2 weeks in greenhouse, potted in calcined material in 1-gallon pots.	100
	1998	Cuttings healed for 2 weeks. Planted directly in calcined clay.	100
Mojave prickly-pear	Aug 1996	170 cuttings taken near Hart cemetery, cured for 2 weeks in greenhouse, and potted in calcined material in 1-gallon pots.	100
	1998	Cuttings healed for 2 weeks. Planted directly in calcined clay.	100
Pima rhatany/ purple heather	May, Aug 1996	May: 98 6- to16–centimeter-long cuttings taken from ends of shoots in field, planted in vermiculite, and placed on mist bench. Aug: 196 cuttings taken from field. Batch 1 treated w/ Hormex No. 3, Batch 2 treated w/ Hormex No. 8.	1, 0, 6

Notes:
Source: Bamberg Ecological, 2005

[a] Indole butyric acid is a rooting hormone.
[b] This rate was considered successful; as it was the first attempt of three to successfully grow creosote bush from cuttings.

Cultural Resources (126-129)

BACKGROUND

The California Register of Historical Resources (CRHR) eligibility status of and the proposed project's effects on the Boulder Dam-San Bernardino 115-kV line, CA-SBR-10315H, and related cultural resources have been the subject of an ongoing discussion among the applicant and the staffs of both the Energy Commission and the Bureau of Land Management (12/12/07 Data Requests 36–39 (CEC Log No. 43714), 5 February 2008 Energy Commission Staff Comment on Response to Data Request 37, and 6 February 2008 BLM Staff Comment on Applicant's Draft Survey Report). The BLM and the State Historic Preservation Officer concluded a consensus determination on 22 October 1993 that the subject transmission line was eligible for inclusion in the National Register of Historic Places, and, as a consequence of this consensus determination, pursuant to 14 CCR § 4851(a)(1), it was automatically listed in the California Register of Historical Resources.

It is the opinion of the Energy Commission and BLM staffs that the interconnection of the proposed project to the transmission line could cause a substantial adverse change in the ability of the CRHR-listed line to convey its historical significance, which constitutes a significant impact under CEQA. Energy Commission staff needs a CRHR eligibility status assessment that is less than five years old for the Boulder Dam-San Bernardino 115-kV transmission line, so the line's eligibility needs to be reassessed, including an evaluation of the physical integrity of the line, the project's impacts on the line's ability to convey its significance, and the possibility that the line is one element of a historic district that encompasses multiple linear facilities within the entirety of the original BLM Right-of-Way (R.O.W.) Grant No. R 01730 to the Southern Sierras Power Company.

To accurately gauge the project's potential impact on the Boulder Dam-San Bernardino 115-kV transmission line, staff needs a detailed description of the precise character of the project's interconnection to this line. The description of the interconnection to the transmission line and to the larger R.O.W. historic district needs to provide sufficient detail for staff to assess the scale of the effect on both resources and to develop appropriate mitigation measures, if that effect is ultimately found to be a substantial adverse change in the significance of one or both resources.

DATA REQUEST

126. Please have a qualified architectural historian assess whether the Boulder Dam-San Bernardino 115-kV line (CA-SBR-10315H) and linear archaeological feature CA-SBR-12574H are resources that share a historical association as contributors to a potential BLM R.O.W. Grant No. R 01730 Historic District, and whether other such elements may also exist in the project area, including:

a. If the above resources share a historical association, a formal CRHR evaluation of the historic district;

b. A historical context for the historic district

Response: As stated in Applicant's May 29, 2008 letter, the Applicant objects to this data request as irrelevant and burdensome. Without waiving that objection, at the July 2, 2008 workshop, the Applicant agrees to provide a response to this question for the section of 115 kV transmission line that runs through the Ivanpah SEGS site. JRP Historical Consultants is in the process of preparing the analysis. However, it will take another 30 to 60 days to respond to this question.

127. Please have a qualified architectural historian formally reassess the CRHR status of CA-SBR-10315H as both an element of the above historic district and as a individual historical resource, including:

a. The historical significance of the Boulder Dam-San Bernardino 115-kV transmission line;

b. A historical context for the Boulder Dam-San Bernardino 115-kV transmission line;

c. An assessment of all seven aspects of the line's integrity—location, design, materials, workmanship, setting, feeling, and association.

Response: As stated in Applicant's May 29, 2008 letter, the Applicant objects to this data request as irrelevant and burdensome. Without waiving that objection, at the July 2, 2008 workshop, the Applicant agrees to provide a response to this question for the section of 115 kV transmission line that runs through the Ivanpah SEGS site. JRP Historical Consultants is in the process of preparing the analysis. However, it will take another 30 to 60 days to respond to this question.

128. Please have a qualified architectural historian assess impact of the proposed project's interconnection on the Boulder Dam-San Bernardino 115-kV line, and, on the potential BLM R.O.W. Grant No. R 01730 historic district, including:

a. A precise physical description of the proposed project's interconnection to the transmission line;

b. An assessment of the significance of the interconnection's impact on the Boulder Dam-San Bernardino 115-kV line relative to the portion of the that line extant in the project area;

c. A justification of the above recommendation;

d. Mitigation measures proposed to reduce any substantial adverse impact.

Response: As stated in Applicant's May 29, 2008 letter, the Applicant objects to this data request as irrelevant and burdensome. Without waiving that objection, at the July 2, 2008 workshop, the Applicant agrees to provide a response to this question for the section of 115 kV transmission line that runs through the Ivanpah SEGS site. JRP Historical

Consultants is in the process of preparing the analysis. However, it will take another 30 to 60 days to respond to this question.

129. Please provide the qualifications of the architectural historian addressing these data requests, indicating that he/she meets the Secretary of the Interior's Professional Standards for an Architectural Historian.

Response: As stated in Applicant's May 29, 2008 letter, the Applicant objects to this data request as irrelevant and burdensome. Without waiving that objection, at the July 2, 2008 workshop, the Applicant agrees to provide a response to this question for the section of 115 kV transmission line that runs through the Ivanpah SEGS site. JRP Historical Consultants is in the process of preparing the analysis. However, it will take another 30 to 60 days to respond to this question.

Project Description (131)

BACKGROUND

Data Requests #1-3 asked for justification for requesting the 7,040 acre footprint in the BLM ROW applications when 3,400 acres were identified for plant construction and operations in the AFC. The requests also asked for identification of detailed construction, ground disturbance and reclamation measures on the other 3,640 acre footprint. Responses from the applicant did not answer the questions and asserted the lands could be utilized for unforeseen circumstances that may arise during licensing. This answer does not satisfy BLM. Only lands proposed for use by project facilities will be carried forward in the joint analysis. Other lands need to be dropped from the BLM ROW application.

DATA REQUEST

131. Adjust all acreage calculations and legal land descriptions for the area required for the project.

Response: During the June 23rd workshop, additional clarification was requested about use of the area between Ivanpah 1 and 2 and the acreages contained in Tables 5 and 6 of Attachment DR131-1. Tables 5 and 6 are reprinted below with modifications to the numbers shown in **bold text**. In addition, Table 7 has been added along with Figure DR131-1 showing the acreage between Ivanpah 1 and 2 and providing a description of the uses of that area.

TABLE 5
Areas of Permanent Disturbance

FACILITY DESCRIPTION	ACRES
Ivanpah 3	1,843.15
Ivanpah 2	920.74
Ivanpah 1	913.50
Administration / Warehouse & Parking (Area H)	5.71
Substation (Area C)	**31.34**
Transmission Towers	0.003
Wells	0.01
Detention Pond D, E and Diversion Channel (Area B)	**29.11**
Kern River Gas Line Tap Station	**0.34**
FACILITY SUBTOTAL	**3,743.90**

LINEAR DESCRIPTION	LENGTH (in feet)	ACRES
Colosseum Road Improvement 30' Wide (Asphalt)	10,111	6.96
Colosseum Road Realignment	6,706	4.62
Gas Line 12' Access Road	2,011	0.55
Gas Line 12' Corridor between Ivanpah 1 & 2[a]	--	--
Water Line - 12' Permanent Disturbance	1,393	0.38
12' Access Road to Monitoring Well	830	0.23
Transmission Line – 20’ Paved Access Road to Substation	2,000	0.92
Transmission Line – 12’ Dirt Access Road along Gen-tie line	**2,527**	**0.70**
12' Trail Around Ivanpah 3 -- Rerouted[b]	--	--
12' Trail to Access Mining Claim -- New	1,492	0.41
LINEAR SUBTOTAL		**14.77**
TOTAL AREA OF PERMANENT DISTURBANCE		**3,758.67**

NOTES:
[a] Gas line will be located under the paved road
[b] Area for this trail is included in the Ivanpah 3 area

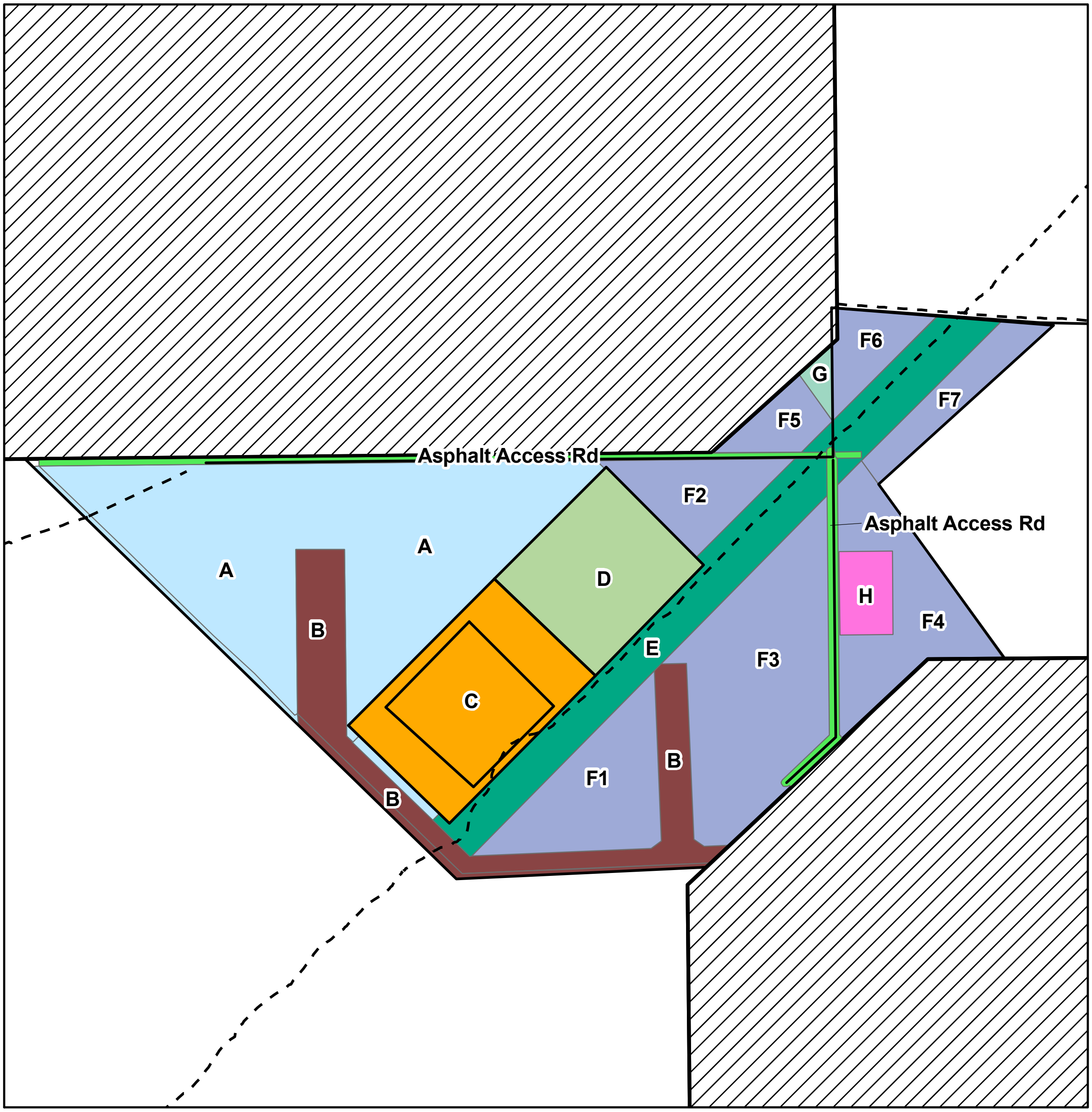
TABLE 6
Areas of Temporary Disturbance

LINEAR DESCRIPTION	**LENGTH (in feet)**	**ACRES**
Gas Line 75' Construction Disturbance from tap to Ivanpah 3	2,011	2.91
Gas Line corridor between Ivanpah 1 & 2	--	--
Kern River Gas Line Tap Construction Area (200’ x 200’)	--	0.92
Southwest Gas Construction Laydown (Area G)	--	**1.60**
Water Line - 50' Construction Disturbance[b]	**1,393**	**--**
Substation Construction Laydown (Area D)		**25.70**
Construction Logistics Area (Areas A and F1 – F7)		**232.20**
TOTAL TEMPORARY DISTURBANCE		**263.33**
Existing Transmission Line Corridor[c]		**47.90**

NOTES:
[a] Included in the construction of the asphalt road.
[b] Included in the Construction Logistics Area
[c] Assumed no impact to this area because impacts will be small, if at all.

TABLE 7
Acreages of Area Between Ivanaph 1 and Ivanaph 2 (see Figure DR131-1)

Description	Permanent	Temporary
West Construction Laydown Area (Area A, used for potential equipment & material storage)		99.40
Detention Pond D, E and Diversion Channel (Area B)	29.10	
Substation (Area C)	35.60	
Substation Construction Laydown (Area D)		25.70
Existing Transmission Line Corridor (Area E)		47.90
Construction Parking and Laydown Area (Areas F1, F2, F3, F5 general construction parking and equipment laydown; F4: contractor trailers; F6 & F7, would include equipment laydown and equipment wash areas)		132.80
Southwest Gas Construction Laydown (Area G)		1.60
Administration / Warehouse & Parking (Area H)	5.70	
TOTAL	**70.40**	**307.40**

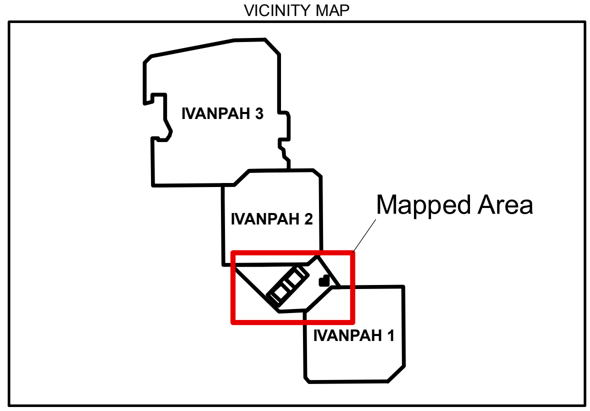


LEGEND

Construction Logistics Area

- A: 99.4 acres
- B: 29.1 acres
- C: 35.6 acres
- D: 25.7 acres
- E: 47.9 acres
- F1: 21.5 acres
- F2: 12.6 acres
- F3: 45.5 acres
- F4: 30.7 acres
- F5: 6.1 acres
- F6: 7.0 acres
- F7: 9.4 acres
- H: 5.7 acres
- G: 1.6 acres
- Asphalt Access Rd: Not included in acreage calculations
- Project Site

VICINITY MAP



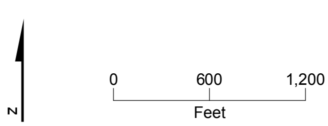


FIGURE DR131-1
CONSTRUCTION LOGISTICS AREA
IVANPAH SOLAR ELECTRIC GENERATING SYSTEM

Soil and Water Resources (137, 139, 140 & 145)

BACKGROUND

The heliostat washing results in nearly all groundwater produced dripping onto the ground and thereafter evaporating into the atmosphere. At first the increased water would likely promote plant growth which will include weeds. We are also concerned about the weed control program and that it include an approved herbicide treatment, which could be mobilized by heliostat wash water.

Through time as that water evaporates salts are left behind which will ultimately result in reduced permeability and reduced ability of the soils to support vegetation particularly post-project. ISEGS has also identified that chemicals will be added during the de-ionization process to prevent scaling and corrosion.

DATA REQUEST

137. What will be the chemical constituents and concentrations of water used to wash heliostats? Discuss and quantify the buildup of these constituents in the soils through the life of the project and how the impact would be mitigated and the lands eventually reclaimed and rehabilitated.

Response: A revised water balance diagram is provided as Figure DR137-1. As shown in this diagram, water from the groundwater wells will enter the raw and fire water tank. From the tank, a small amount of water will go to the drinking water purifier for potable uses while the majority of the flow will be sent to the deionized (DI) treatment plant. Water will be deionized, essentially all of the dissolved solids or mineral ions will be removed from the water. The DI treatment process will use either a reverse osmosis (RO) system or an ion-bed exchange. From the DI system, the water will then go through mixed bed ion exchange polisher unit that will further reduce mineral content. After the mixed bed ion exchange polisher unit, water will be stored in the boiler makeup storage tank for use as process water or mirror wash water. Expected water quality for the process water and mirror wash water is provided in Table DR137-1.

Heliostat washing will 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 DR137-1, below, along with the estimated loading of each constituent over the 50-year life of the project. Total soil buildup of these constituents over the life of the project will be negligible (Table DR137-1). Note also that concentrations of copper and iron in the wash water are well below drinking water Maximum Contaminant Levels (MCLs) for those constituents (1,000 and 300 micrograms per liter [µL] for copper and iron, respectively).

TABLE DR137-1
Estimated Wash Water Quality and 50-Year Buildup

Constituent	Concentration	Estimated 50-year buildup (lbs/acre)
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	

mg/L = milligrams per liter

µS/cm = microSiemens/cm
dS/m = deciSiemens per meter

The amount of wash water that is expected to infiltrate the soil during washing is also minimal (0.005 inch across the site; Table DR137-2). 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.) 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, since sodium concentrations are negligible.

Using the water sources and the management practices described above, no adverse impacts will result from heliostat wash water.

TABLE DR137-2
Estimated Wash Water Volume and Depth per Application

Location	Number of Heliostats	Plant 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

Note: Wash cycle is defined is the 2-week interval in which each heliostat within a unit will be washed.

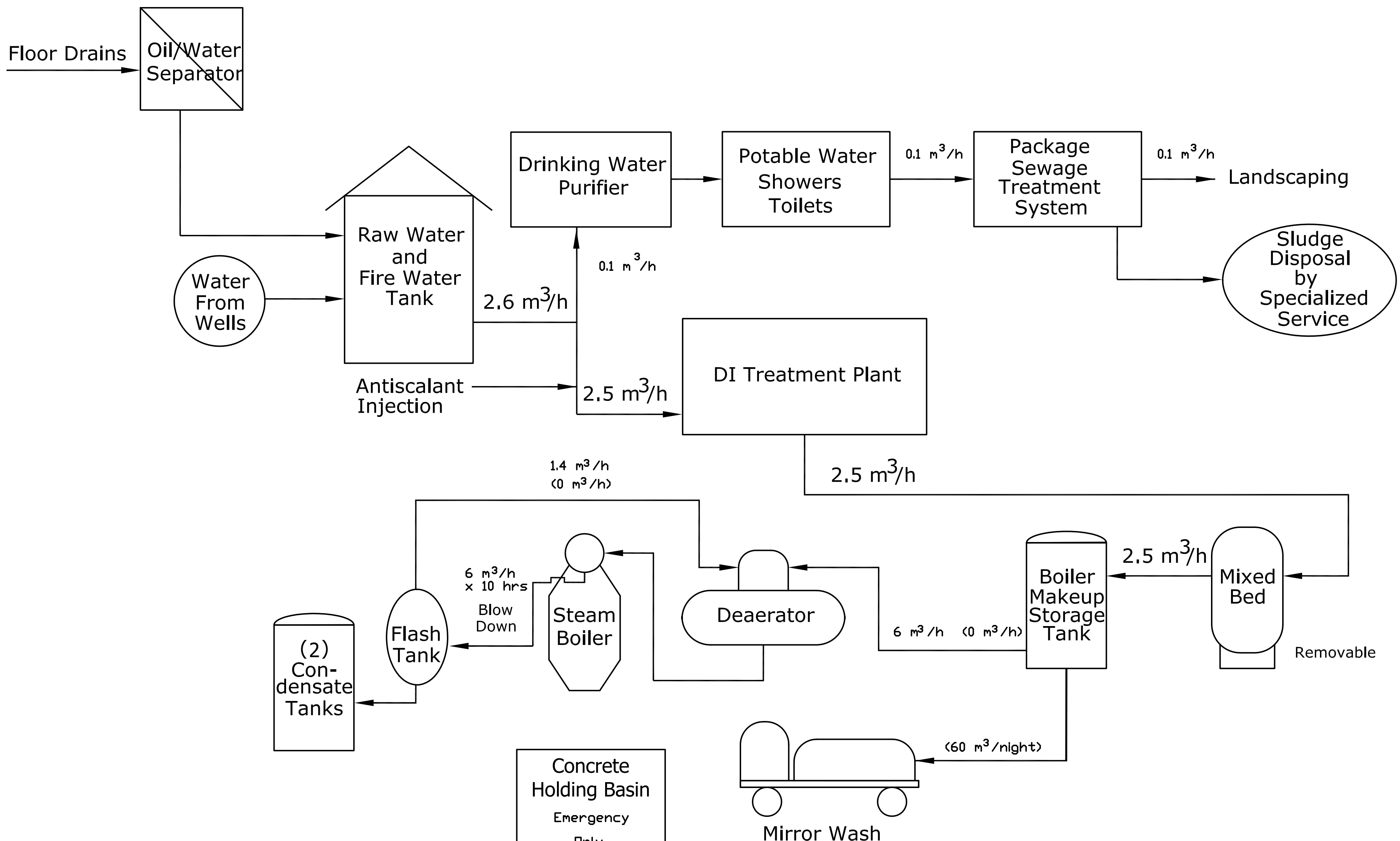


FIGURE DR137-1
100 MW WATER BALANCE DIAGRAM
IVANPAH SOLAR ELECTRIC GENERATING SYSTEM

Source: DWG 01-PB-F-D-100 Rev A

CH2MHILL

ES062007009SAC Figure_DR137-1.ai 07.17.08 tdaus

BACKGROUND

In the Mojave Desert, rainfall usually occurs during brief but intense storms. An average of three inches per year of rainfall can be expected at the project site. The water that does not infiltrate into the ground or evapotranspire flows as surface runoff and at times can result in flash flood conditions. Conditions at the site indicate past surface flows have had enough energy to transport gravel and cobbles across the project site. The plants on the grade of the bajada (coalescing alluvial fans), on which the project is proposed, help retain sediment and reduce erosion potential from runoff. Removing all the vegetation to the root system would dramatically alter the surface runoff pattern that has naturally developed and likely allow transport and deposition of coarser material on distal portions of the fan and ultimately the Ivanpah Dry Lake bed. At such a large scale, up to 3,400 acres of vegetation removal and ground disturbance, management of the surface water flows will require extensive engineering. The project applicant has already stated they would supply a final grading plan.

DATA REQUEST

139. As part of the final grading plan, please describe in detail, using illustrations and written descriptions as necessary, the following:

   a. How sheet and channel flow across the project site, over roads, around the heliostats, and off the site would be managed through engineering controls.

Response: Existing small to moderate ephemeral washes are to remain intact at locations capable of being traversed by installation equipment. Large ephemeral washes that are subject to damaging heliostats or power block equipment are to be routed through detention ponds and/or diversion channels either through or along the outer perimeter of each solar field. The large washes are then to be graded to the extent necessary to provide equipment access. At locations where stormwater crosses roads (all surface types) as sheet flow, existing grade is to be maintained. In situations where concentrated stormwater cross paved roads, culverts are to be provided to pass the 100-year, 24-hour storm event as required by San Bernardino County. At locations where concentrated stormwater crosses unpaved roads or trails, a slight grading of the channel bank is to be performed in order to provide vehicular access across the wash (provide an earthen ramp).

Detention ponds sized for the respective sites' 100-year, 24-hour storm event are to be placed upstream in each facility drainage area (on the high or western side of the site) to detain and release a volume of concentrated offsite stormwater run-on equivalent to the volume required for conventional onsite stormwater detention and runoff. Stormwater received in excess of the volume required for detention will be permitted to surcharge the ponds and will be directed to long broad crested weirs armored with native stone to convey the excess stormwater across the site as sheet flow. At pond locations with exceptionally large concentrated offsite stormwater run-on, a portion of the excessive flow is to be directed to bypass channels for redirection and velocity control prior to release within the site as sheet flow. Stormwater falling directly onto each facility will be conveyed through each site combined with the excess stormwater from the ponds and will not require additional detention. As the stormwater passes through the heliostat fields and around the power blocks and power towers (Ivanpah 3 only) check dams and rock filters are to be placed in locations where stormwater may concentrate to control velocity and redistribute water as sheet flow to prevent scouring.

Additional details of the engineering controls to manage sheet and channel flow across the site are described below.

A. Hydrology

1. Hydrology calculations are to be performed using TR-55 (Soil Conservation Service [SCS] Method) to determine the amount of pre and post development stormwater run-on and run-off for each basin or sub-basin within each facility.

2. The San Bernardino County Hydrology manual will be used to classify soil characteristics, expected soil types and other design criteria necessary for use with the TR-55 calculations. Offsite flows are to be determined using the western watershed boundaries from available state watershed information, contour intervals, and available soils mapping information. Watersheds are to be further broken down into sub-basins as required to determine the western flow from the ephemeral washes as they approach the project area. This process is necessary to determine the offsite flow required to design the bypass channels, detention ponds and roadway culverts through the developed project site. Channels are to be designed using Bentley Flow Master to determine flow rates, cross sections, acceptable velocities and materials necessary to prevent scouring.

3. Storm Drainage System

   a. The storm drainage system is to be designed as a system of diversions channels, detention ponds, bypass channels, swales, and ephemeral washes (new and existing) to direct the flow of off-site (run-on) and onsite stormwater (run-off) through and around each facility prior to discharge onto the adjacent downstream areas as sheet flow for all storm events less than or equal to a 100 year, 24 hour storm event. Natural drainage features are to remain intact where practical.

   b. The stormwater drainage system is to be designed by using the SCS method (TR-55) by determining the amount of rainfall during a specific rainfall storm event. This method is in accordance with requirements specified in the most current version of San Bernardino County Hydrology Manual.

   c. All surface runoff during and after construction is to be controlled in accordance with the requirements of the General Permit for Stormwater Discharges Associated with Construction Activity (General Construction Permit), the requirements of the San Bernardino Water Quality Management Plan manual, and all other applicable laws, ordinances, regulations, and standards.

d. Culverts and diversion channels are to be designed so that a minimum ground surface slope of 0.5 percent shall be provided to provide positive, puddle-free drainage.

e. Storm drainage channels may be lined with a non-erodible material such as compacted riprap, geo-synthetic matting, or engineered vegetation to reduce erosion.

f. Pipe culverts are to be used where drainage channels cross roads. Culverts are to be reinforced concrete, corrugated metal pipe (CMP), or smooth-lined polyethylene (SLPE) pipe.

4. Power Block Drainage

a. The power block is to be elevated at least 1.5 feet above surrounding roadway. Stormwater run-on to the power block area, including run-off from the power block itself, is to be collected in a system of swales and ditches that discharge to an adjacent detention pond.

5. Detention and Bypass

a. The Ivanpah SEGS detention ponds are to be placed upstream in each facility drainage area to detain and release an equivalent volume of concentrated off-site stormwater run-on to the volume required for conventional onsite stormwater detention and runoff. Stormwater falling onto the site will be directed through as system of stone filters and check dams (for erosion control) prior to off-site release as sheet flow. An exception to this will be the power block and substation/administration areas which will have their own detention facilities. This concept will have the advantage of controlling the run-on from large ephemeral washes prior to the release of stormwater through bypass channels or across the site as sheet flow. This method is intended to protect onsite soils and equipment by controlling the velocity and direction of stormwater prior to reaching the heliostat fields.

b. Each diversion channel and detention pond is to be sized using the design requirements dictated in the San Bernardino County Hydrology Manual. Each detention pond will be designed using output from Haestad's Pond Pack computer program. Likewise, these output flows are to be used to determine the approximate amount of stormwater entering the diversion channel, either from the detention pond or from offsite run-on.

c. Ivanpah 1, 2,and 3 are to be divided into sub–basins and each sub-basin will be designed to have a detention pond sized to detain a volume of stormwater equivalent to the difference between pre and post development runoff from the 100-year, 24-hour storm event as prescribed in the San Bernardino County Hydrology Manual.

d. Sub-basin detention ponds located along each facility's western boundary are to be designed to collect stormwater as both sheet flow and run-on from ephemeral washes discharging onto the site from the undeveloped western watersheds (See Figure DR139a-1). Detained stormwater is to be released back onsite through a controlled outlet structure and diversion channel for dispersal as sheet flow. Excess stormwater from the detention ponds (additional stormwater volumes greater than the required detention volume) is to over flow the detention pond as sheet flow through an armored weir spanning the length of the detention pond. In addition, the stormwater run-on from large ephemeral washes, in excess of the volume required for detention, may bypass the pond system through a series of diversion channels prior to dispersal across the site as sheet flow.

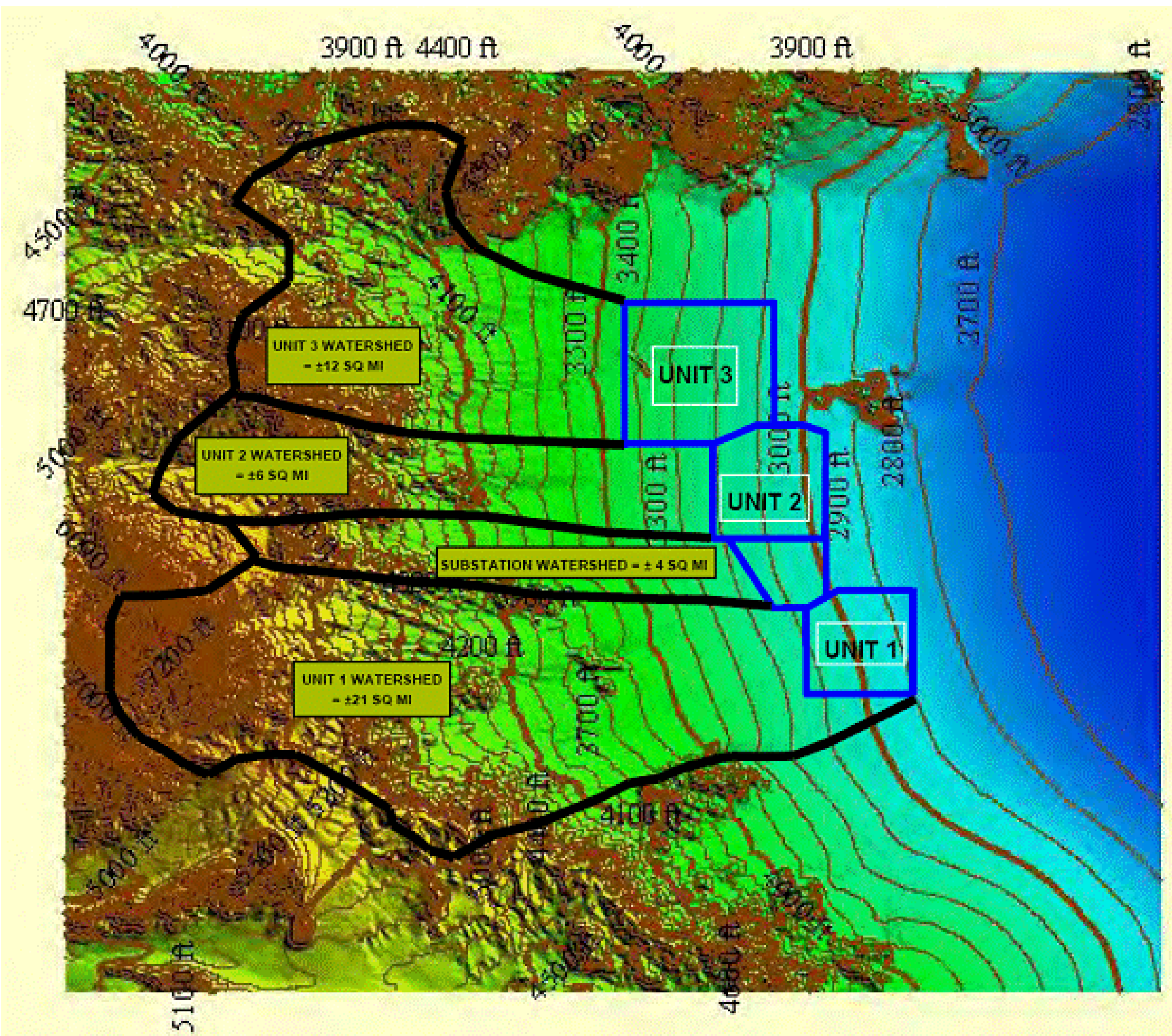


FIGURE DR139a-1

e. Detention pond weirs are to be used to distribute surplus western flow across the facility as sheet flow. Native stone riprap (if available) is to be placed across the length of the weir and down the spillway of the detention pond to control velocities and prevent scouring.

f. Each detention pond will be cleaned of sediment as required and bottom grades shall be reestablished as originally designed. Each pond is to be provided with a cleanout elevation rod that indicates when sediment is to be removed. All sediment is to be disposed of onsite.

g. Bypass channels within the project site are to be sized to redirect excess offsite stormwater (above that required for detention) up to the 100-year, 24-hour storm event. Bypassing will be either around the site (as shown north of Ivanpah 3 and between Ivanpah 2 and 3) or through the facility (as in Ivanpah 1 and 2). See drawings IVAN-1-DW-024-112-005, IVAN-2-DW-024-112-006, and IVAN-3-DW-024-112-007 (provided with Attachment DR130-2, Data Response 130, Set 2A).

h. Staged release – The Ivanpah 3 northwestern and southwestern diversion channels may be designed (if required) with a flow-by intercept weir downstream of the detention pond to disperse stormwater back through out the eastern heliostat fields. In addition, a controlled outlet structure may be placed in the diversion channels to disperse controlled amounts of stormwater back into the heliostat field as sheet flow to prevent concentrating flows in a single outfall area.

6. Facility Detention Ponds

a. Ivanpah 1

The Ivanpah 1 Detention Pond A is to collect stormwater from the undeveloped western watershed. The excess stormwater will either be released into sub-basin A and B as sheet flow, released into a bypass channel or a combination of the two (see Figure DR139a-2). Pond A is to be sized to detain the volume of water equivalent to the difference between sub-basins A's post-developed (approximately 820 cubic feet per second [cfs]) and pre-developed (approximately 493 cfs) stormwater volumes which discharge along the sub-basin's eastern boundary.

Pond B is to collect stormwater from the undeveloped western watershed, stormwater from sub-basin B's post development and surface runoff from the Ivanpah 1 power block.

Surface runoff is to be conveyed by a system of swales and channels around power block area into Detention Pond B (see Figure DR139a-2). Pond B is to be sized to detain the volume of water equivalent to the difference between sub-basins B's post-developed (approximately 210 cfs) and pre-developed (approximately 123 cfs) stormwater volume.

The stormwater from Pond B will sheet flow back into sub-basin B prior to discharging along the eastern sub-basin boundary.

Pond C is to collect stormwater from the pre-developed western watershed. The increase in stormwater runoff will either be released into sub-basin C as sheet flow, released into a bypass channel or a combination of the two (see Figure DR139a-2). Pond C is to be sized to detain the volume of water equivalent to the difference between sub-basins A's post-developed (approximately 415 cfs) and pre-developed (approximately 245 cfs) stormwater volume which discharges along the eastern sub-basin boundary.

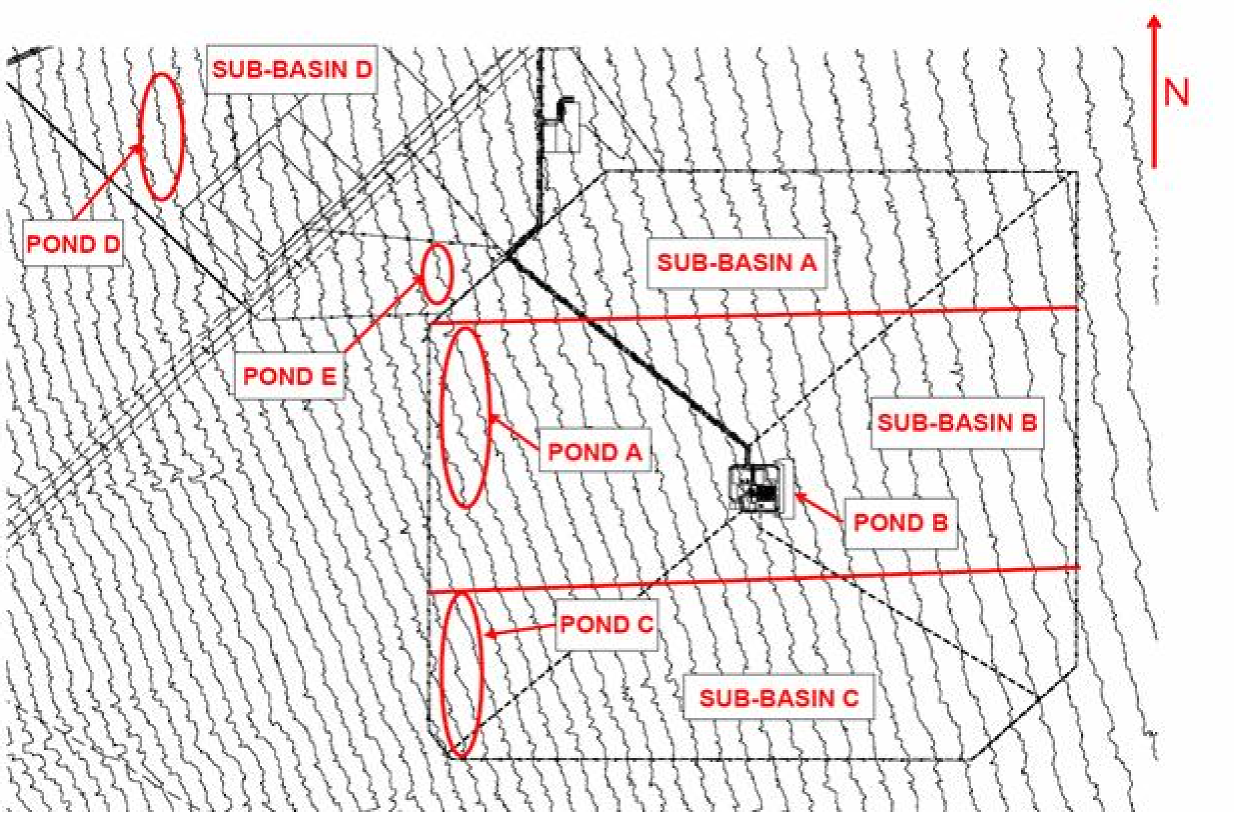


FIGURE DR139a-2

b. Sub-station and Administration Area

Pond D and E are to collect stormwater from the undeveloped western watershed and sub-basin D post-development area. Both ponds are to be sized to detain a volume of water equivalent to the difference between sub-basin D's post-developed (approximately 720 cfs) and pre-developed (approximately 440 cfs) stormwater volumes. Stormwater from ponds D and E are to sheet flow into sub-basin D prior to the discharging along the eastern sub-basin boundary (See Figure DR139a-3).

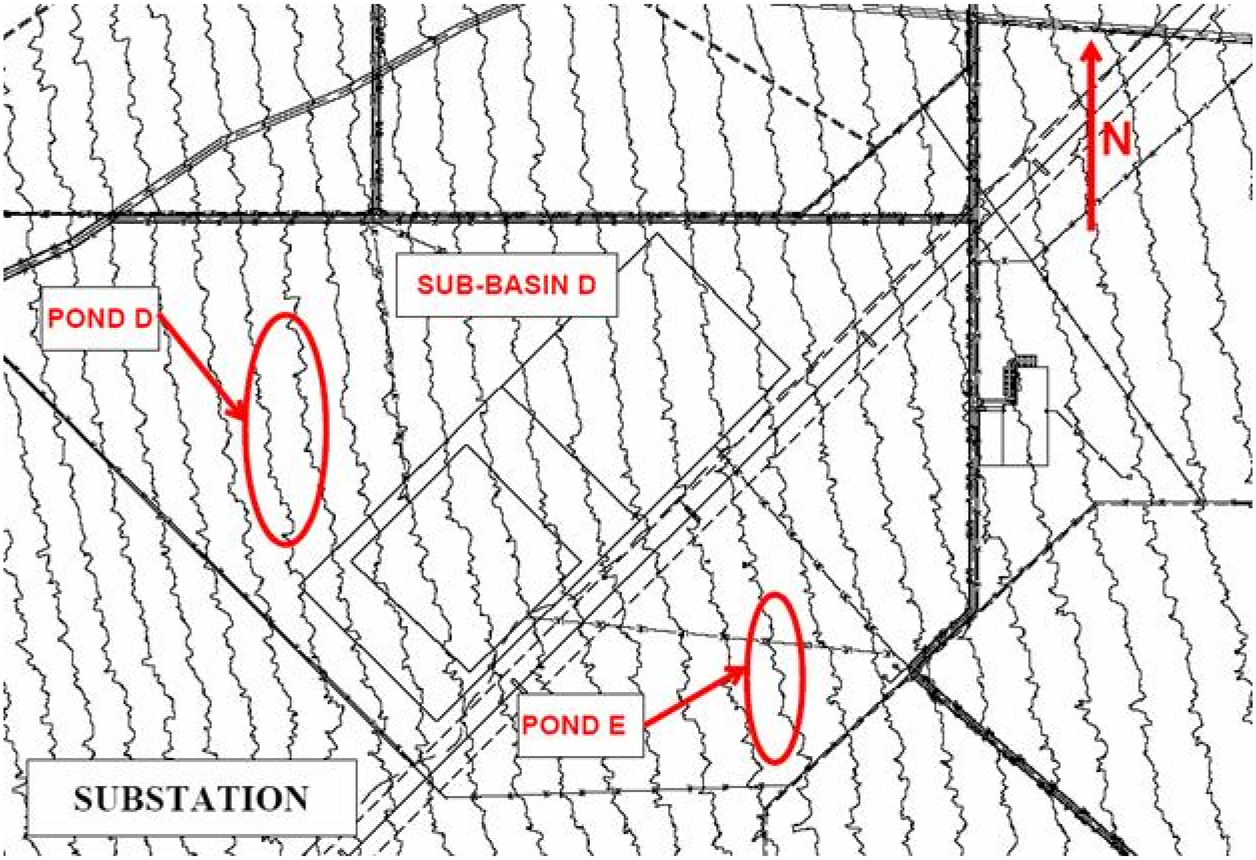


FIGURE DR139a-3

c. Ivanpah 2

Ponds F and H are to collect stormwater from the undeveloped western watershed and divert the stormwater into a bypass channel directed north of the Ivanpah 2 power block. Ponds F and H are to be sized to detain a volume of water equivalent to the difference between sub-basins F and H's developed (approximately 517 cfs and 415 cfs, respectively) and pre-developed (approximately 311 cfs and 517 cfs, respectively) stormwater volumes. The stormwater from Ponds F and H is to be sheet flow back into sub-basin F and H prior to discharging to the eastern site boundary.

All excess stormwater brought onto the site from the western watershed will either be released into sub-basin F and H as sheet flow, released into a bypass channel or a combination of the two (see Figure DR139a-4).

Pond G is to collect stormwater from the undeveloped western watershed, stormwater from sub-basin G's post development and surface runoff from the Ivanpah 2 power block. Surface runoff is to be conveyed by a system of swales, channels, or trenches around power block area into Detention Pond G.

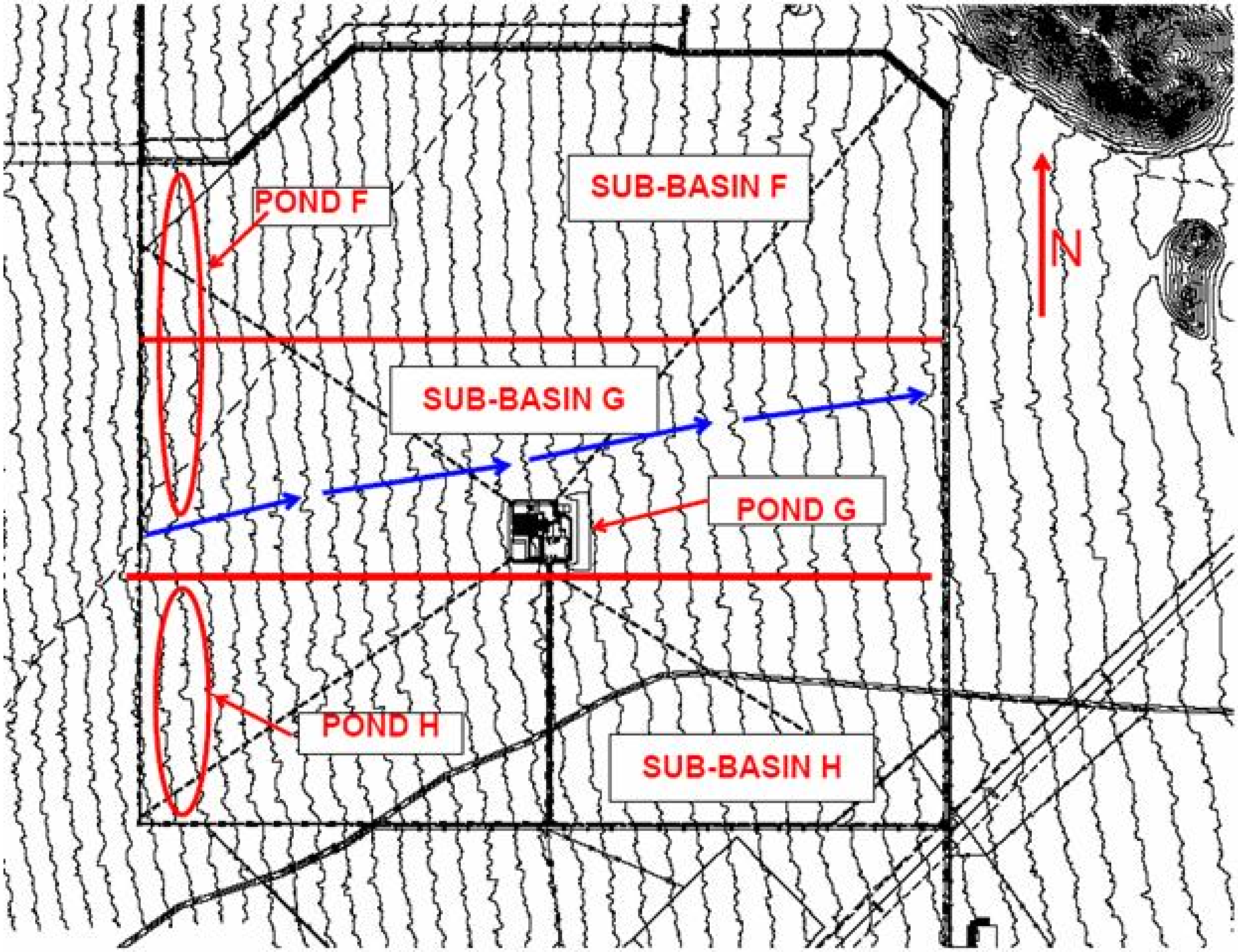


FIGURE DR139a-4

Pond G is to be sized to detain a volume of water equivalent to the difference between sub-basins G's developed (approximately 311 cfs) and pre-developed (approximately 517 cfs) stormwater volumes. The stormwater from Pond G will sheet flow back into sub-basin G, prior to discharging along the sub-basin's eastern boundary (see Figure DR139a-4, above).

d. Ivanpah 3

Pond I is to collect stormwater from the undeveloped western watershed. The excess stormwater will either be released into sub-basin I as sheet flow, released into a bypass channel or a combination of the two (see Figure DR139a-5). Pond I is to be sized to detain a volume of water equivalent to the difference between sub-basins I's developed (approximately 925 cfs) and pre-developed (approximately 560 cfs) stormwater volumes which discharges along the eastern sub-basin boundary.

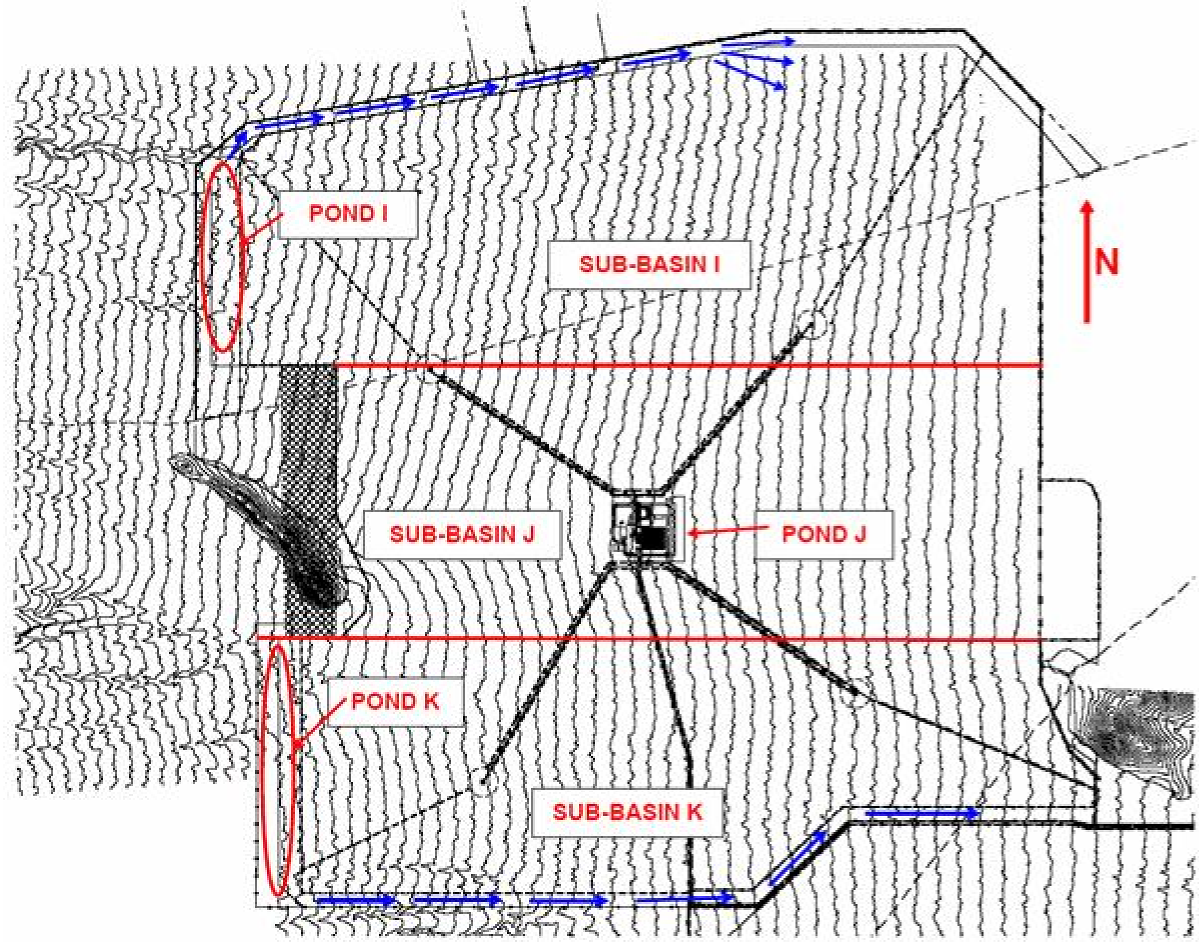


FIGURE DR139a-5

Pond J is to collect stormwater from the undeveloped western watershed, stormwater from sub-basin J's post development and surface runoff from the Ivanpah 3 power block. Surface runoff is to be conveyed by a system of swales, channels, or trenches around power block area into detention Pond J. Pond J is to be sized to detain a volume of water equivalent to the difference between sub-basins J's developed (approximately 590 cfs) and pre-developed (approximately 350 cfs) stormwater volumes. The stormwater from Pond J will sheet flow back into sub-basin J prior to discharging along the sub-basin boundary (see Figure DR139a-5, above).

Pond K is to collect stormwater from the undeveloped western watershed. The excess stormwater will either be released into sub-basin K as sheet flow, released into a bypass channel or a combination of the two. Pond K is to be sized to detain a volume of water equivalent to the difference between sub-basins K's developed (approximately 825 cfs) and pre-developed (approximately 480 cfs) stormwater volumes which discharges along the sub-basin's eastern boundary (see Figure DR139a-5, above).

B. Stormwater

1. Stormwater Drainage Design

   a. Offsite stormwater drainage is to be collected using a system of swales, berms, ponds, existing ephemeral washes, and diversion channels to control and direct stormwater through and around the project site. Onsite drainage is to drain across the site as sheet flow where possible and is to be collected and routed to the interior drainage system as required.

   b. Culvert and diversion channels shall be designed so that a minimum ground surface slope of 0.5 percent shall be provided to provide positive, puddle-free drainage.

   c. Storm drainage channels are to be lined with a non-erodible material such as compacted riprap, geo-synthetic matting, or engineered vegetation.

2. Pipe Culverts

   a. Pipe culverts shall be used where drainage channels cross roads. Culverts shall be reinforced concrete, plastic coated corrugated metal pipe (CMP) or smooth-lined, corrugated polyethylene (SLPE) pipe.

3. Power Block Drainage

   a. Power block is to be elevated at least 1.5 feet above surrounding roadway. Stormwater run-on to power block area, including run-off from the power block itself, is to be collected in a system of swales and ditches that discharge to an adjacent detention pond.

C. Erosion and Sediment Control Measures

1. Because the proposed site is located on federal land under the control of the Bureau of Land Management (BLM), the project is not under the direct authority of San Bernardino County. However, for design purposes, the erosion and sedimentation control Best Management Practices (BMPs) are going to be designed to meet the requirements of San Bernardino County, unless other specific direction is provided by the BLM.

2. The proposed site is currently zoned for Resource Conservation so the protection of soil resources will be an important factor in the design of the Ivanpah SEGS erosion and sedimentation controls.

   a. Open spaces between every other heliostat row will be preserved and left undisturbed maintaining existing vegetation (as possible due to site topography and access requirements) to minimize wind and water erosion.

   b. Stone filters and check dams will be strategically placed throughout the project site to provide areas for sediment deposition and to promote the sheet flow of stormwater prior to leaving the project site. Where available, native materials (rock and gravel) are to be used for the construction of the stone filter and check dams. A stone crusher may be provided onsite to utilize local stone for the production of gravel.

c. Ephemeral washes that convey offsite drainage onto the site are to be directed to detention ponds and diversion channels to control velocities and redirect the flow of water.

d. Diversion berms are to be utilized to redirect stormwater.

e. Erosion and sedimentation control calculations will be performed to verify acceptable stormwater velocities, calculate BMP clean out frequencies and to size riprap.

f. Diversion channels will be armored as required to prevent erosion and scouring.

g. Silt fences are to be utilized 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.

h. Periodic maintenance will 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 are intended to minimize soil erosion and promote sheet flow. A detail drawing of the proposed stone filters, check dams, and local berms have been provided in Attachment 130-2, Data Response 130, Set 2A (see sheets IVAN-1-DW-024-112-005, IVAN-2-DW-024-112-006, and IVAN-3-DW-024-112-007).

i. Erosion and sedimentation control BMP design is to be in accordance with applicable government codes and standards.

D. Site Stabilization

1. Site areas disturbed during construction are to be permanently stabilized by aggregate paving, bituminous paving, or seeding with native seed.
2. Site areas disturbed during construction are to be temporarily stabilized with mulch produced from local materials.
3. Detention pond inlet and weirs are to be topped with local stone (riprap) to protect against erosion.
4. All areas to be seeded are to use solely indigenous plant species.

b. Calculations showing the stormwater engineered controls have sufficient capacity for a 100-year, 24-hour storm event.

Response: The preliminary stormwater hydrology calculations for Detention Pond C (in Ivanpah 1) are provided as Attachment DR139b-1A.

ATTACHMENT DR139b-1A

Preliminary Stormwater Calculations for Detention Pond C in Ivanpah 1

WorleyParsons
resources & energy

CALCULATION COVER SHEET

CLIENT: BRIGHTSOURCE ENERGY

PROJECT: IVANPAH SOLAR FIELD UNIT 1

SUBJECT: POND C HYDROLOGY CALCULATION

JOB NUMBER: 52003205 WBS NUMBER:

CALCULATION NO.: PAGE 1 OF 6

DESCRIPTION/PURPOSE

Design a system to collect site runoff and a stormwater detention pond that is capable of reducing the peak flow after development to a level less than or equal to that before development.

The western boundary detention ponds of Ivanpah 1 are to be designed to collect both sheet flow and direct the ephemeral washes from the undeveloped areas of the watershed to the west. Pond C is to be sized for the 2 year 24 hour, 10 year 24 hour and 100 year 24 hour storm events based on San Bernardino County Hydrology Manual. Stormwater will then be released back onsite as sheet flow through controlled outlet structures or directed to by-pass channels. Additional stormwater from the detention pond (additional stormwater greater than the required pond volume) may over-flow through a system of control structures into either a by-pass channel or over a weir spanning the length of the detention pond.

METHOD OF ANALYSIS

Hydrology calculations are to be performed using TR-55 (SCS Method) to determine the amount of pre and post development stormwater run-on and run-off for Ivanpah 1. The San Bernardino County Hydrology manual will be used to classify soil characteristics, expected soil types and other design criteria necessary for use with the TR-55 calculations.

CODES AND STANDARDS

1. Williamson and Schmid, Civil Engineers, San Bernardino County Hydrology Manual, Irvine, CA, 1986.

INFORMATION SOURCES

1. "Pond Pack" Version 8.0, Haestad Methods Inc., Waterbury, CT.
2. "Flow Master" Bentley Systems, Inc., Exton, PA.
3. "Global Mapper" Global Mapper Software, LLC, Olathe, KS.
4. "NOAA" National Weather Service, Silver Spring, MD.
5. Urban Hydrology for Small Watersheds, TR No. 55, June 1986
6. Rainfall Frequency Atlas of the United States, Technical Paper No. 40, May 1961
7. Hydrology & Hydraulics Systems, Second Edition, Ram S. Gupta, 2001
8. Hydrology Water Quantity Quality Control, Second Edition, Wanielista, Kersten and Eaglin, 1997

ASSUMPTIONS

All assumptions are included in the body of the calculation.

CONCLUSIONS OR RESULTS

The post-development stormwater collection and management system was analyzed and the peak flows were below the corresponding pre-development levels.

PRELIMINARY

WorleyParsons
resources & energy

CALCULATION COVER SHEET

CLIENT: BRIGHTSOURCE ENERGY

PROJECT: IVANPAH SOLAR FIELD UNIT 1

SUBJECT: POND C HYDROLOGY CALCULATION

JOB NUMBER: 52003205 WBS NUMBER:

CALCULATION NO.: PAGE 2 OF 6

REV	DATE	DESCRIPTION	PAGES REVISED	PAGES ADDED	PAGES DELETED	BY/DATE	REV/DATE	LDE/DATE
3								
2								
1								
0	7/17/08	ORIGINAL ISSUE	NA	NA	NA	Burnette/Gilbert BB/GNG	Housewright LKH	D. Wilson [illegible] for DW

STORMWATER DRAINAGE DESIGN CRITERIA

1. The stormwater drainage system is to be designed by using the Soil Conservation Service (SCS) method (TR-55). This method is in accordance with requirements specified in the most current version of San Bernardino County Hydrology Manual. NOAA Atlas 14 will be used to determine site specific rainfall storm event precipitation based on various return frequencies.
2. Select SCS curve numbers for different surfaces in the drainage area.
3. Each pond is to be sized for the 2 year 24 hour, 10 year 24 hour and 100 year 24 hour storm events based on San Bernardino County Hydrology Manual.
4. Compare pre-development, post-development runoff to sub-area C and post-development bypass runoff for 2, 10, and 100-year rainfalls.

STORMWATER DRAINAGE DESIGN CALCULATIONS

General Approach:

Pond C will collect stormwater from the western watershed (this offsite flow collected by Pond C will leave the site either by being directed into a controlled outlet structure or into a bypass channel or into Pond A of Area 1). Pond C is to be sized to detain the volume of water equivalent to the difference between sub-area C's post-developed and pre-developed stormwater volume which discharges along the eastern sub-area boundary. The stormwater from Pond C will sheet flow back into sub-area C prior to discharging along the eastern sub-area boundary.

Drainage Area:

Drainage areas were measured from Attachment A.

Rainfall Frequency: (See Attachment C)

Storm Event	Frequency
2yr - 24hour	1.05
10yr - 24hour	1.96
100yr - 24hour	3.34

Site Soils: (See Attachment B)

Soil Name	Hydrologic Soil Group	Curve Number (Pre-Developed)
Copperworld Association	D	88
Arizo Loamy Sands	A	71
Popups Sandy Loam	B	82

Curve Numbers are from the San Bernardino County Hydrology Manual.

RUNOFF CALCULATIONS

Pre-Development Analysis

General

The total area of Ivanpah 1 is approximately 915 acres. Sub-area C is approximately 305 acres. Sub-area C's watershed area is approximately 7710 acres. This site is located in San Bernardino County California. The ground on 1 is gently sloping at an average of 5%. The site is currently undeveloped. The cover was assumed to be Arizo loamy sand for soil group A.

Results

The table below summarizes the peak flows for the pre-development conditions.

PRE-DEVELOPMENT PEAK FLOW (CFS)			
	2-year storm	10-year storm	100-year storm
Sub-area C	0.40	33.35	191.20
Western Onsite Flow	563.47	2487.12	6185.15
Total Flow	563.87	2520.47	6376.35

The PondPack results are shown in Attachment D

Post-Development Analysis

General

The western boundary detention ponds of Ivanpah 1 is to be designed to collect both sheet flow and direct the ephemeral washes from the undeveloped watershed from the west. Pond C is to be sized for the 2 year 24 hour, 10 year 24 hour and 100 year 24 hour storm events. Stormwater will then be released back onsite as sheet flow through controlled outlet structures or directed to a by-pass channels. Additional stormwater from the detention pond (additional stormwater greater than the required pond volume) may over-flow through a system of control structures into either a by-pass channel or over a weir spanning the length of the detention pond. Detention pond weirs are to be used to distribute surplus western flow across the unit as sheet flow. Native stone Rip Rap (if available) is to be placed across the length of the weir and down the spillway of the detention pond to control velocities and prevent scouring.

The first objective of the post-development analysis was to determine the amount of post-development flow that will cross the site. The second objective is to determine the allowable outflow of the proposed detention pond and size the detention pond accordingly.

It was assumed that only 40% of sub-area C would be disturbed.

Results

PondPack was used to analyze the flow characteristics through the detention pond during the 2, 10, 100-year storms.

The table below summarizes the peak flows for the post-development conditions.

POST-DEVELOPMENT PEAK FLOW (CFS)			
	2-year storm	10-year storm	100-year storm
Sub-area C	1.66	56.08	233.02
Pond C Outflow	494.9	2237.21	6137.61
Total Flow	496.56	2293.29	6370.63

The PondPack results are shown in Attachment E

STORMWATER MANAGEMENT POND DESIGN

In order to minimize the impact of the surrounding area, it was important that the peak flow during and after site development remained less than or equal to the pre-development peak flow. The Table summarizes the peak flow before and after site development.

PEAK FLOWS (CFS)				
	Pre-Developed	Post Developed Sub-area C	Pond C Outflow	Post-Developed Peak Discharge
2-year storm	563.87	1.66	494.9	496.56
10-year storm	2520.47	56.08	2237.21	2293.29
100-year storm	6376.35	233.02	6137.61	6370.63

For each design storm, the peak flow into the stormwater system will remain below pre-developed levels.

Pond Discharge Structure

The proposed outlet structures will consist of 2 rectangular weirs and three box culverts. The rectangular weir on the east side of Pond C (this weir is used to distribute surplus western flow across the facility as sheet flow) is at elevation 105 and is 900 ft wide. The rectangular weir on the north of Pond C (this weir overflows into Pond A) is at elevation 105.5 and is 80 ft wide. The three box culverts are 100 ft long, 15 ft in height and 5 ft wide.

WorleyParsons resources & energy	CLIENT NAME: BRIGHTSOURCE ENERGY PROJECT NAME: IVANPAH SOLAR FIELD UNIT 1				JOB NO.: 52003205
STANDARD CALCULATION SHEET	**SUBJECT: STORMWATER CALCULATION**				**CALC NO.:**
	REVISION	0	1	2	3
	ORIGINATOR:	RSB/BNG			
	REVIEWER:	CKH			
	DATE:	7-17-08			

ATTACHMENTS

Attachment A – Drainage Sub-Area C

Attachment B – Soil Information

Attachment C – Rainfall Information

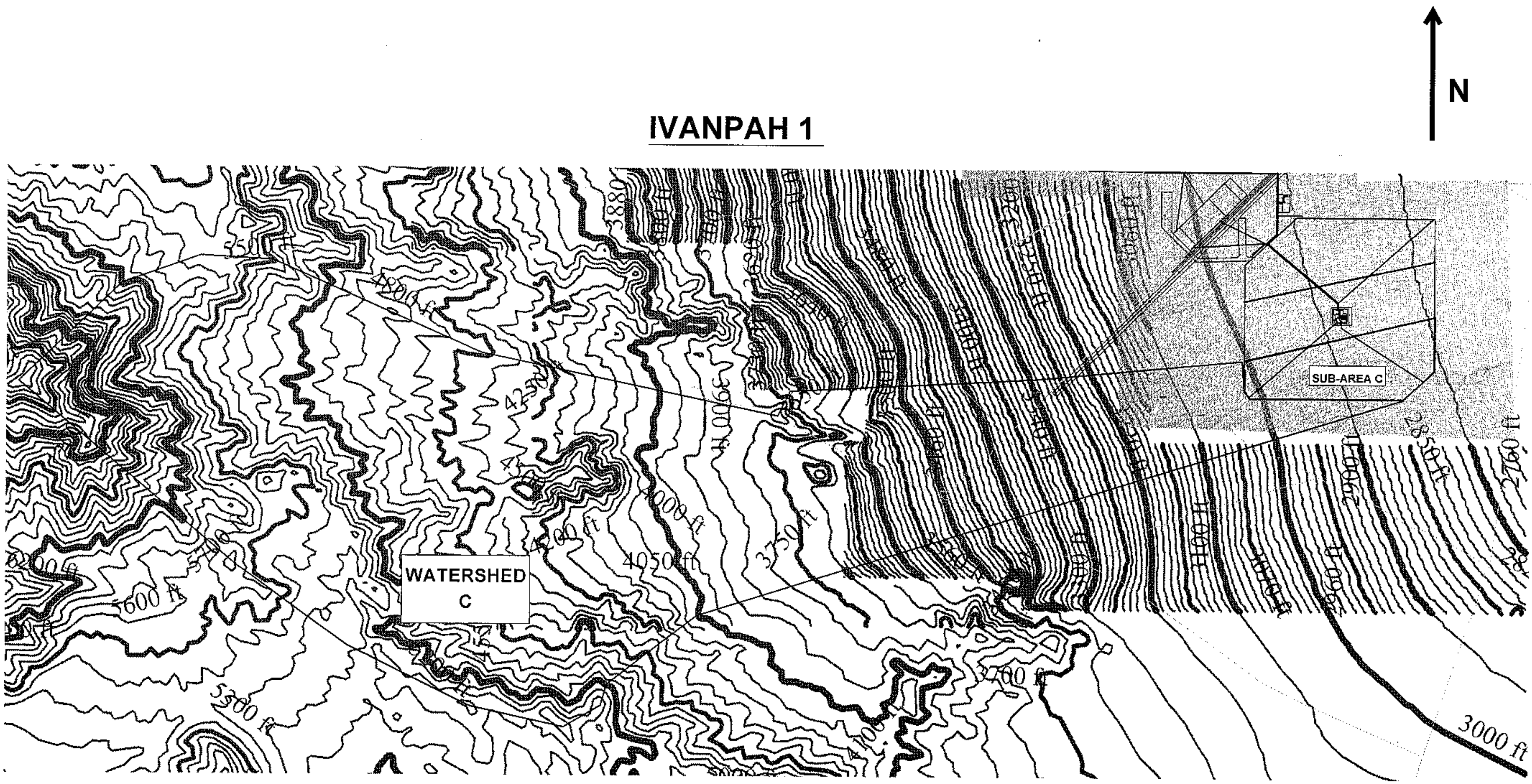
Attachment D – Pre-Development Analysis (PondPack)

Attachment E – Post Development Analysis (PondPack)

WorleyParsons resources & energy	CLIENT NAME: BRIGHTSOURCE ENERGY PROJECT NAME: IVANPAH SOLAR FIELD UNIT 1			JOB NO.: 52003205	
STANDARD CALCULATION SHEET	SUBJECT: STORMWATER CALCULATION			CALC NO.:	
	REVISION	0	1	2	3
	ORIGINATOR:	RSB/BNG			
	REVIEWER:	CKH			
	DATE:	7-17-08			

ATTACHMENT A
DRAINAGE SUB-AREA C

IVANPAH 1



WATERSHED = 7710 ACRES

SUB-AREA C = 305 ACRES

WorleyParsons
resources & energy

STANDARD CALCULATION SHEET	CLIENT NAME: BRIGHTSOURCE ENERGY PROJECT NAME: IVANPAH SOLAR FIELD UNIT 1				JOB NO.: 52003205
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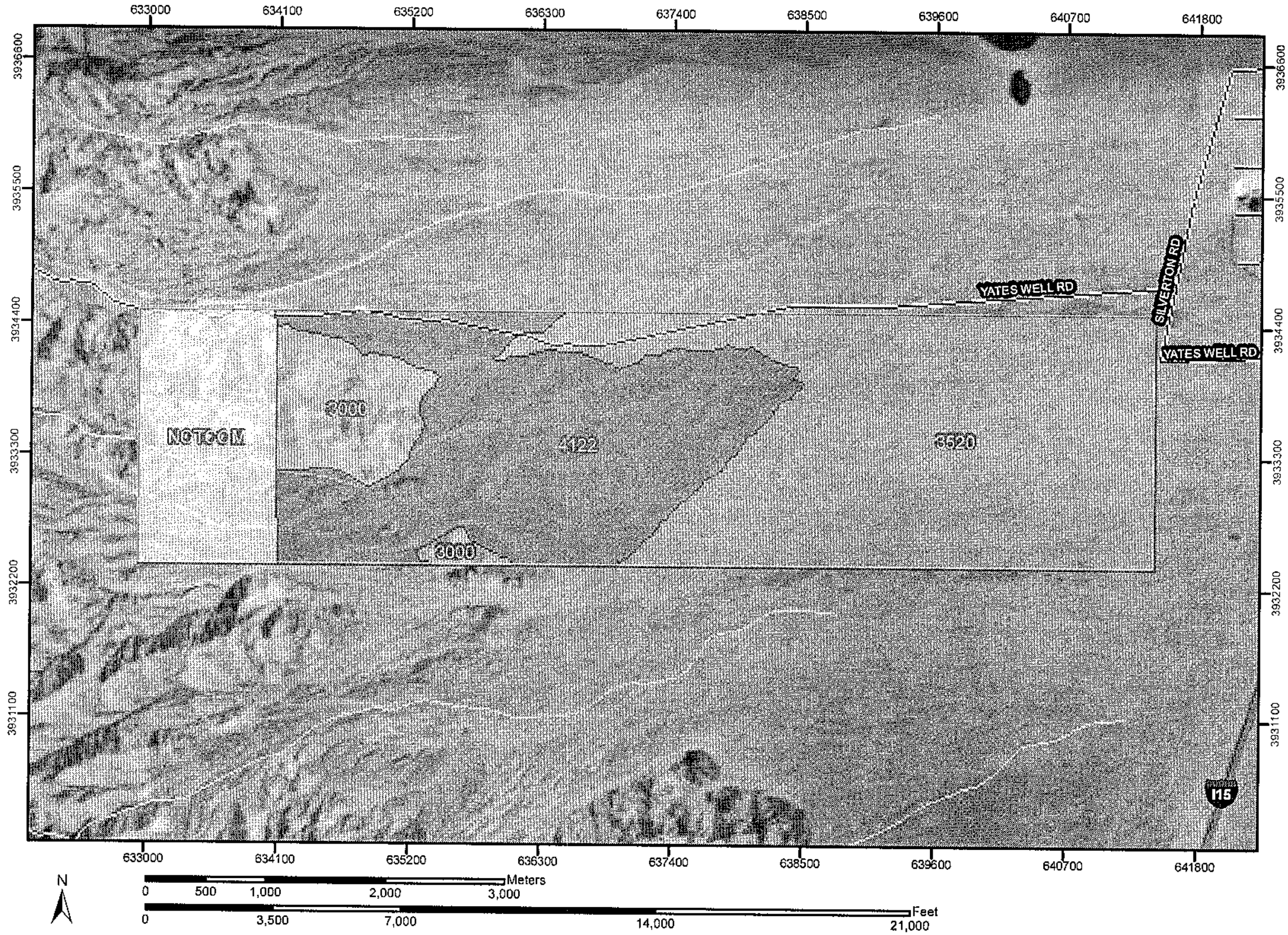
	ORIGINATOR:	RSB/BNG			
	REVIEWER:	CKH			
	DATE:	7-17-08			

ATTACHMENT B
SOIL INFORMATION

Hydrologic Soil Group–Mojave Desert Area, Northeast Part, California; and Mojave National Preserve Area, California



MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Units

Soil Ratings
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Political Features

Municipalities
- Cities
- Urban Areas

Water Features
- Oceans
- Streams and Canals

Transportation
- Rails

Roads
- Interstate Highways
- US Routes
- State Highways
- Local Roads
- Other Roads

MAP INFORMATION

Original soil survey map sheets were prepared at publication scale. Viewing scale and printing scale, however, may vary from the original. Please rely on the bar scale on each map sheet for proper map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: UTM Zone 11N

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Mojave Desert Area, Northeast Part, California
Survey Area Data: Version 2, Mar 19, 2007

Soil Survey Area: Mojave National Preserve Area, California
Survey Area Data: Version 2, Mar 19, 2007

Your area of interest (AOI) includes more than one soil survey area. These survey areas may have been mapped at different scales, with a different land use in mind, at different times, or at different levels of detail. This may result in map unit symbols, soil properties, and interpretations that do not completely agree across soil survey area boundaries.

Date(s) aerial images were photographed: 5/23/1994; 5/29/1994; 10/2/1995

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Hydrologic Soil Group

Hydrologic Soil Group— Summary by Map Unit — Mojave Desert Area, Northeast Part, California				
Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
3000	Copperworld association, 30 to 60 percent slopes	D	358.1	8.0%
3520	Arizo loamy sand, 2 to 8 percent slopes	A	2,038.3	45.7%
4122	Popups sandy loam, 4 to 30 percent slopes	B	1,454.5	32.6%

Hydrologic Soil Group— Summary by Map Unit — Mojave National Preserve Area, California				
Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
NOTCOM	Mapping not complete		604.6	13.6%

Totals for Area of Interest (AOI)	4,455.3	100.0%

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: *None Specified*

Tie-break Rule: Lower

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	REVISION	0	1	2	3
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	REVIEWER:	CKH			
	DATE:	7-17-08			

ATTACHMENT C
RAINFALL INFORMATION

POINT PRECIPITATION FREQUENCY ESTIMATES FROM NOAA ATLAS 14

California 35.578 N 115.486 W 3156 feet

from "Precipitation-Frequency Atlas of the United States" NOAA Atlas 14, Volume 1, Version 4
G.M. Bonnin, D. Martin, B. Lin, T. Parzybok, M.Yekta, and D. Riley
NOAA, National Weather Service, Silver Spring, Maryland, 2006

Extracted: Wed Jun 11 2008

Precipitation Frequency Estimates (inches)

AEP* (1-in-Y)	5 min	10 min	15 min	30 min	60 min	120 min	3 hr	6 hr	12 hr	24 hr	48 hr	4 day	7 day	10 day	20 day	30 day	45 day	(
2	0.16	0.24	0.29	0.40	0.49	0.61	0.69	0.86	1.03	1.05	1.15	1.30	1.45	1.58	1.84	2.13	2.40	2.
5	0.25	0.38	0.47	0.63	0.78	0.95	1.05	1.30	1.57	1.58	1.71	1.94	2.14	2.34	2.75	3.22	3.66	4.
10	0.32	0.48	0.60	0.80	0.99	1.21	1.33	1.63	1.94	1.96	2.11	2.38	2.60	2.83	3.34	3.93	4.49	5.
25	0.41	0.63	0.78	1.05	1.30	1.58	1.72	2.08	2.46	2.48	2.66	2.95	3.17	3.43	4.07	4.81	5.52	6.
50	0.50	0.76	0.94	1.26	1.56	1.91	2.05	2.45	2.87	2.90	3.09	3.40	3.60	3.87	4.61	5.45	6.28	7.
100	0.59	0.90	1.11	1.50	1.85	2.28	2.41	2.87	3.31	3.34	3.55	3.86	4.03	4.31	5.13	6.08	7.02	8.
200	0.69	1.05	1.31	1.76	2.18	2.69	2.84	3.32	3.77	3.80	4.04	4.34	4.49	4.73	5.64	6.69	7.75	9.
500	0.85	1.30	1.61	2.17	2.68	3.33	3.49	4.00	4.45	4.49	4.74	5.02	5.15	5.35	6.31	7.48	8.69	1(
1000	0.99	1.51	1.88	2.53	3.13	3.91	4.08	4.61	5.05	5.10	5.32	5.62	5.73	5.91	6.80	8.06	9.39	11

* These precipitation frequency estimates are based on an annual maxima series. AEP is the Annual Exceedance Probability.
Please refer to the documentation for more information. NOTE: Formatting forces estimates near zero to appear as zero.

* Upper bound of the 90% confidence interval
Precipitation Frequency Estimates (inches)

AEP** (1-in-Y)	5 min	10 min	15 min	30 min	60 min	120 min	3 hr	6 hr	12 hr	24 hr	48 hr	4 day	7 day	10 day	20 day	30 day	45 day	(
2	0.19	0.29	0.35	0.48	0.59	0.74	0.82	1.01	1.19	1.20	1.31	1.48	1.64	1.79	2.09	2.40	2.73	3.
5	0.30	0.45	0.56	0.75	0.93	1.15	1.26	1.52	1.80	1.82	1.96	2.20	2.41	2.64	3.11	3.64	4.14	4.
10	0.38	0.58	0.72	0.96	1.19	1.46	1.59	1.90	2.23	2.25	2.41	2.70	2.93	3.20	3.78	4.44	5.07	5.
25	0.50	0.76	0.95	1.28	1.58	1.92	2.06	2.44	2.82	2.85	3.05	3.36	3.59	3.90	4.62	5.44	6.26	7.
50	0.61	0.92	1.14	1.54	1.90	2.32	2.46	2.88	3.30	3.31	3.57	3.90	4.11	4.43	5.26	6.20	7.16	8.
100	0.73	1.11	1.37	1.85	2.29	2.77	2.91	3.38	3.82	3.86	4.14	4.47	4.64	4.97	5.91	6.97	8.08	9.
200	0.87	1.32	1.63	2.20	2.72	3.30	3.44	3.93	4.39	4.46	4.79	5.09	5.24	5.51	6.56	7.75	8.99	1(
500	1.09	1.66	2.06	2.77	3.43	4.14	4.29	4.80	5.24	5.38	5.77	6.03	6.13	6.33	7.46	8.80	10.27	1
1000	1.30	1.98	2.45	3.30	4.09	4.91	5.06	5.59	6.02	6.17	6.63	6.88	6.93	7.11	8.15	9.63	11.24	1

* The **upper** bound of the confidence interval at 90% confidence level is the value which 5% of the simulated quantile values for a given frequency are greater than.
** These precipitation frequency estimates are based on an annual maxima series. AEP is the Annual Exceedance Probability.

Please refer to the documentation for more information. NOTE: Formatting prevents estimates near zero to appear as zero.

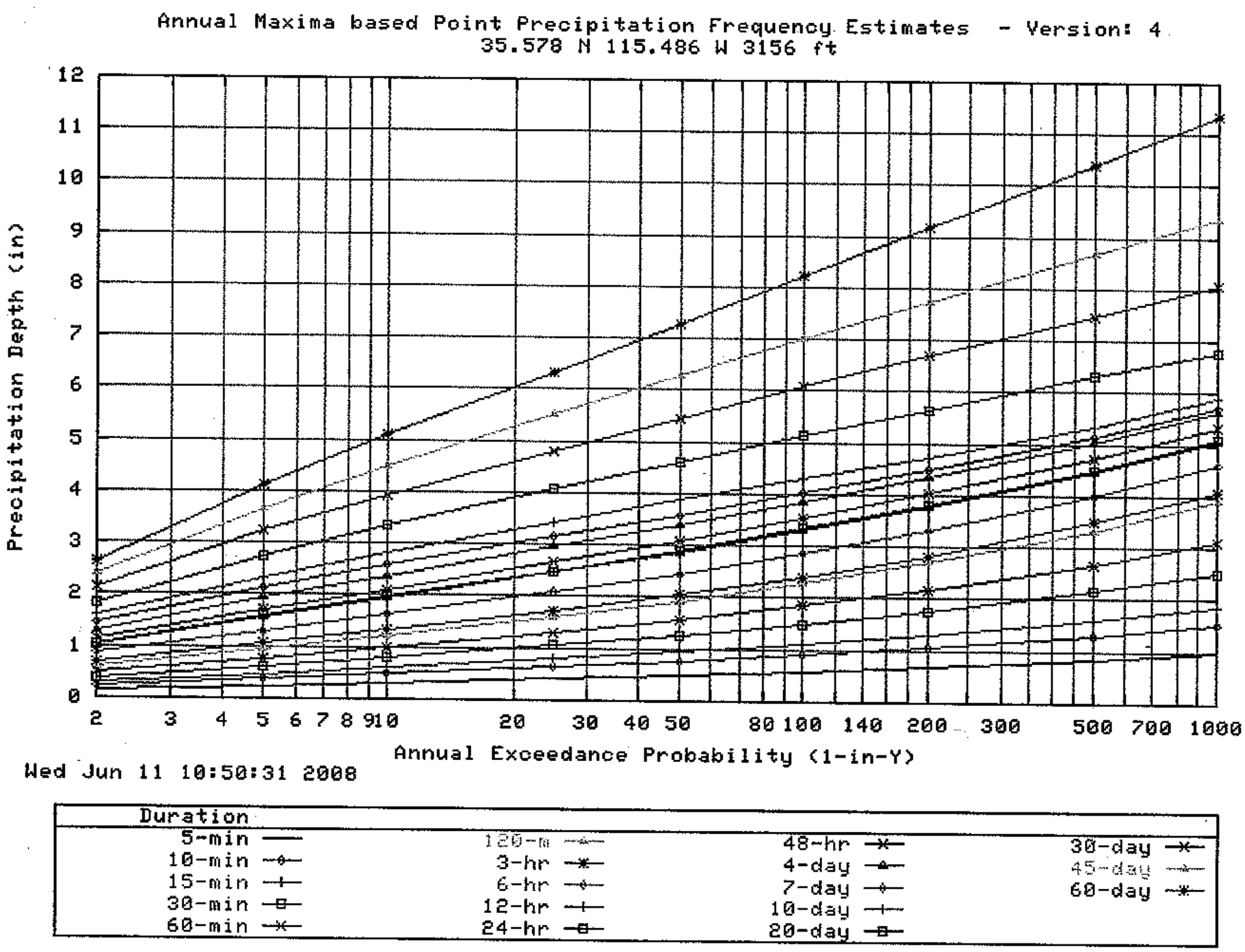
* Lower bound of the 90% confidence interval
Precipitation Frequency Estimates (inches)

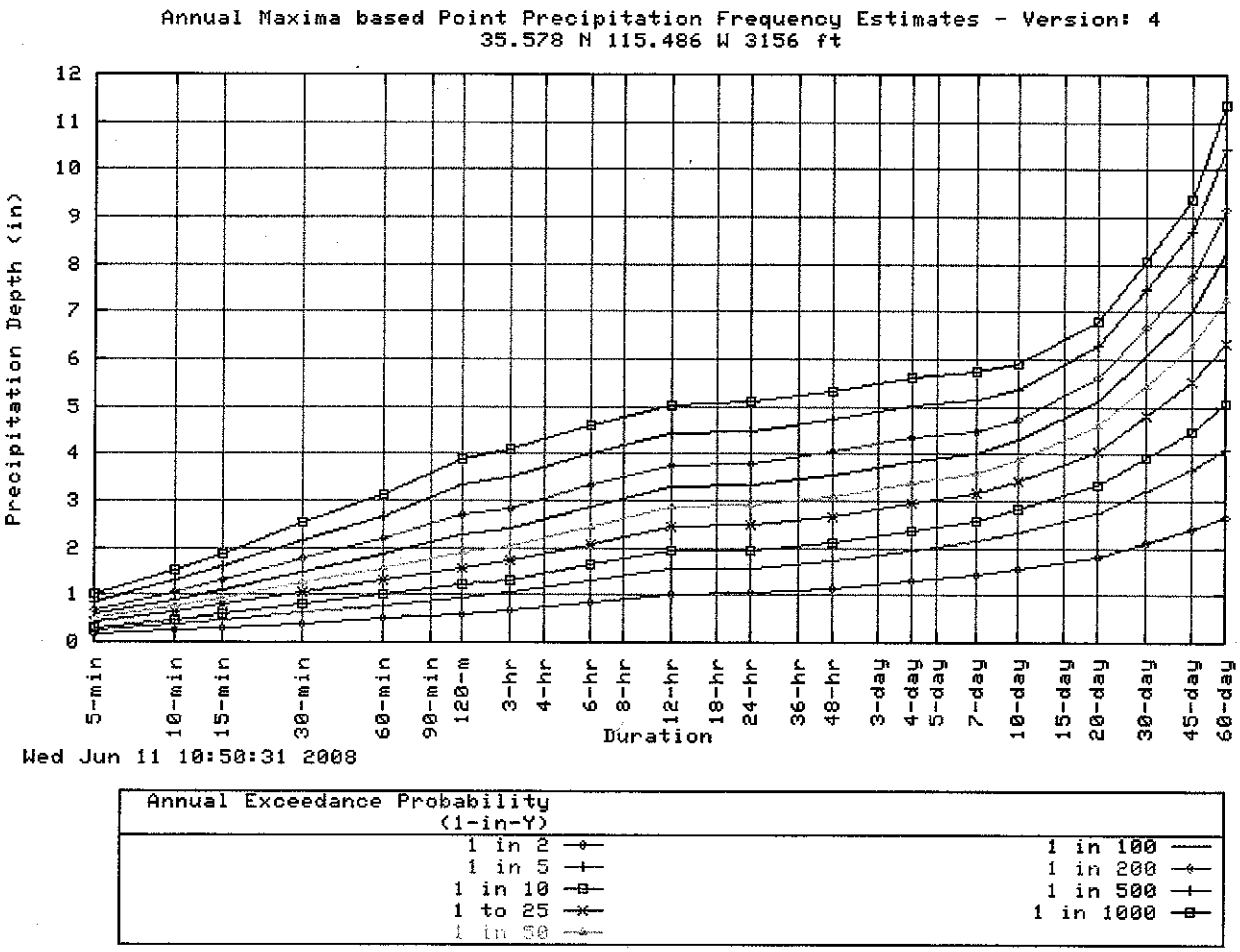
AEP** (1-in-	5 min	10 min	15 min	30 min	60 min	120 min	3 hr	6 hr	12 hr	24 hr	48 hr	4 day	7 day	10 day	20 day	30 day	45 day	(

Y)																		
2	0.13	0.19	0.24	0.32	0.40	0.51	0.58	0.74	0.89	0.91	1.01	1.15	1.28	1.39	1.61	1.86	2.10	2
5	0.20	0.30	0.38	0.51	0.63	0.78	0.88	1.11	1.35	1.36	1.51	1.71	1.89	2.05	2.41	2.82	3.20	3
10	0.25	0.39	0.48	0.64	0.80	0.98	1.10	1.37	1.67	1.68	1.84	2.08	2.28	2.47	2.92	3.43	3.92	4
25	0.33	0.50	0.62	0.84	1.04	1.27	1.41	1.74	2.09	2.10	2.29	2.55	2.75	2.97	3.53	4.17	4.77	5
50	0.39	0.60	0.74	1.00	1.23	1.52	1.66	2.03	2.42	2.44	2.62	2.89	3.09	3.32	3.96	4.68	5.38	6
100	0.46	0.70	0.86	1.16	1.44	1.78	1.93	2.34	2.75	2.78	2.95	3.23	3.41	3.66	4.36	5.16	5.95	6
200	0.53	0.81	1.00	1.35	1.67	2.06	2.23	2.66	3.10	3.13	3.29	3.57	3.75	3.97	4.76	5.61	6.49	7
500	0.64	0.97	1.21	1.62	2.01	2.48	2.67	3.14	3.58	3.61	3.73	4.01	4.21	4.40	5.22	6.16	7.15	8
1000	0.73	1.11	1.38	1.85	2.29	2.84	3.06	3.54	4.00	4.04	4.07	4.39	4.60	4.78	5.54	6.55	7.61	9

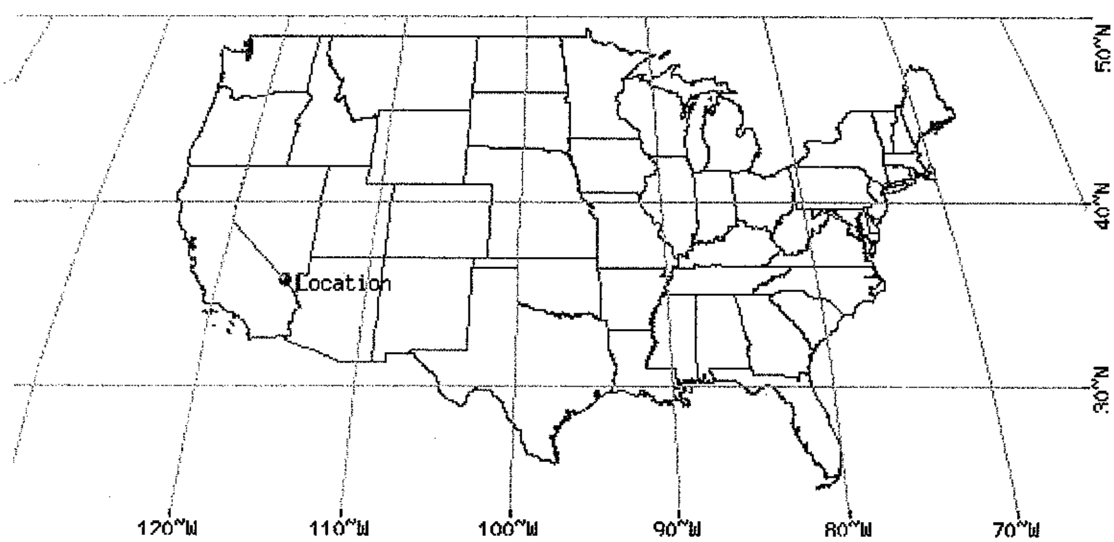
* The **lower** bound of the confidence interval at 90% confidence level is the value which 5% of the simulated quantile values for a given frequency are less than.
** These precipitation frequency estimates are based on an annual maxima series. **AEP** is the Annual Exceedance Probability.
Please refer to the documentation for more information. NOTE: Formatting prevents estimates near zero to appear as zero.

Text version of tables

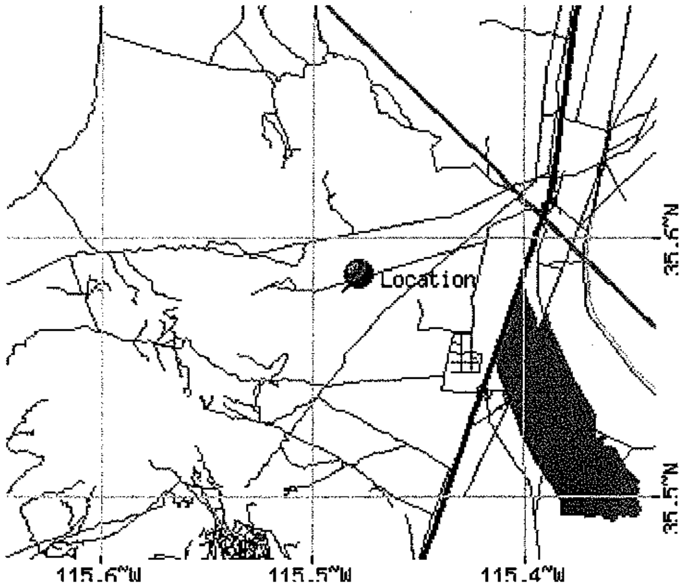




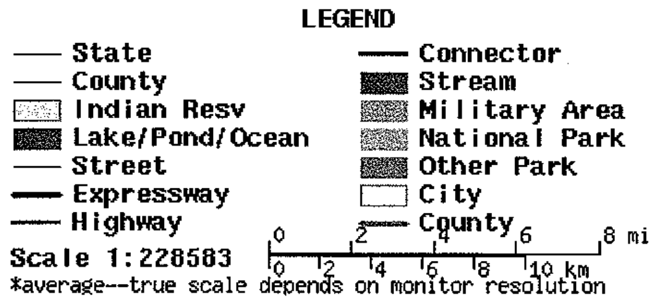
Maps -



These maps were produced using a direct map request from the U.S. Census Bureau Mapping and Cartographic Resources **Tiger Map Server**.



Please read disclaimer for more information.



Other Maps/Photographs -

View USGS digital orthophoto quadrangle (DOQ) covering this location from TerraServer; **USGS Aerial Photograph** may also be available
from this site. A DOQ is a computer-generated image of an aerial photograph in which image displacement caused by terrain relief and camera tilts has been removed. It combines the image characteristics of a photograph with the geometric qualities of a map. Visit the USGS for more information.

Watershed/Stream Flow Information -

Find the Watershed for this location using the U.S. Environmental Protection Agency's site.

Climate Data Sources -

Precipitation frequency results are based on data from a variety of sources, but largely NCDC. The following links provide general information
about observing sites in the area, regardless of if their data was used in this study. For detailed information about the stations used in this study,
please refer to our documentation.

Using the **National Climatic Data Center's (NCDC)** station search engine, locate other climate stations within:

[+/-30 minutes] ...OR... [+/-1 degree] of this location (35.578/-115.486). Digital ASCII data can be obtained directly from **NCDC**.

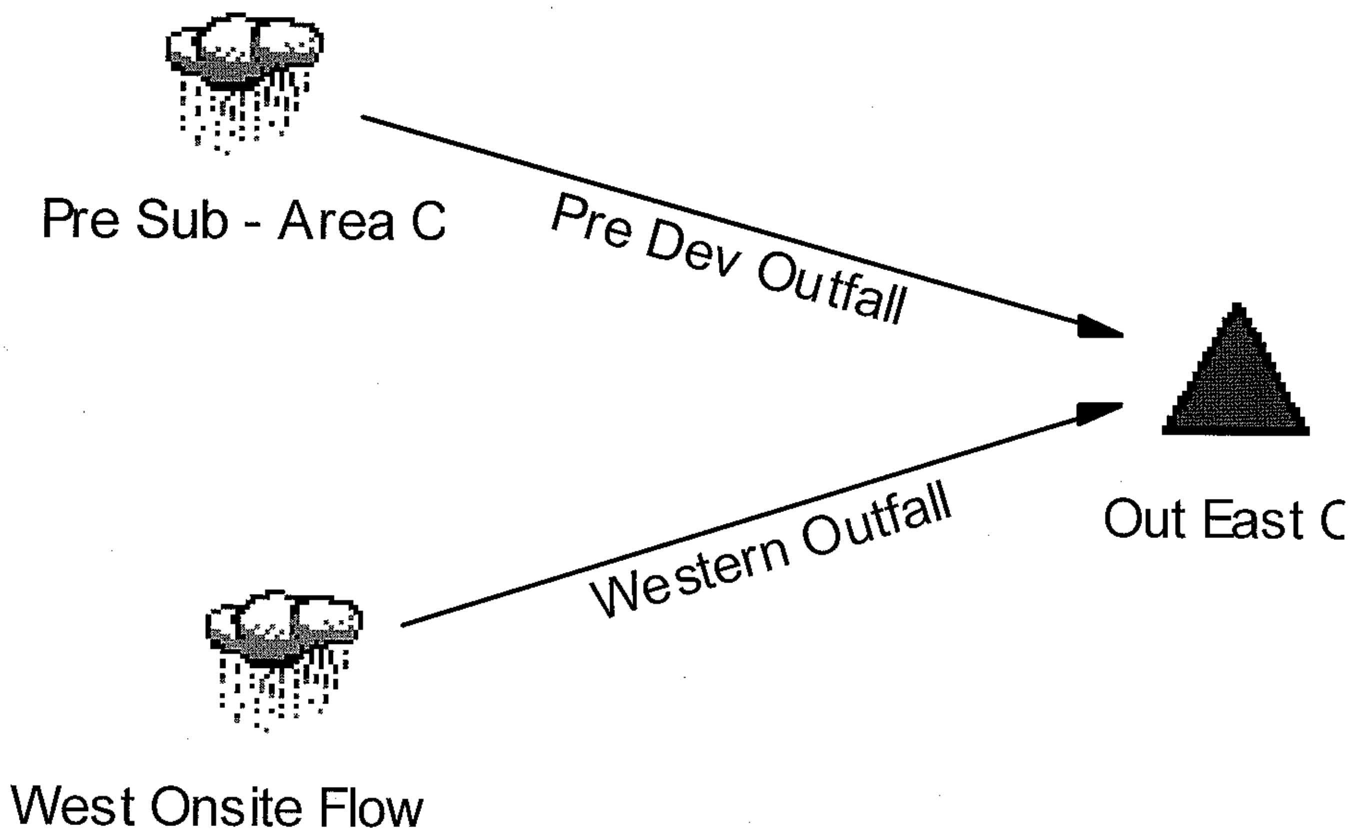
Find Natural Resources Conservation Service (NRCS) SNOTEL (SNOwpack TELemetry) stations by visiting the **Western Regional Climate Center's state-specific SNOTEL station maps**.

Hydrometeorological Design Studies Center
DOC/NOAA/National Weather Service
1325 East-West Highway
Silver Spring, MD 20910
(301) 713-1669
Questions?: HDSC.Questions@noaa.gov

Disclaimer

WorleyParsons resources & energy	CLIENT NAME: BRIGHTSOURCE ENERGY PROJECT NAME: IVANPAH SOLAR FIELD UNIT 1				JOB NO.: 52003205
STANDARD CALCULATION SHEET	SUBJECT: STORMWATER CALCULATION				CALC NO.:
	REVISION	0	1	2	3
	ORIGINATOR:	RSB/BNG			
	REVIEWER:	CKH			
	DATE:	7-17-08			

ATTACHMENT D
POND C – PRE-DEVELOPMENT


Pre Sub - Area C
Pre Dev Outfall
Out East C
Western Outfall
West Onsite Flow

JOB TITLE

Project Date: 7/17/2008
Project Engineer: rachel.burnette
Project Title: Ivanpah 1_Pond C
Project Comments:

Table of Contents (continued)

MASTER DESIGN STORM SUMMARY

Network Storm Collection: Ivanpah 1

Return Event	Total Depth in	Rainfall Type	RNF ID
Dev 2	1.0500	Synthetic Curve	TypeII 24hr
Dev 10	1.9600	Synthetic Curve	TypeII 24hr
Dev 25	2.4800	Synthetic Curve	TypeII 24hr
Dev100	3.3400	Synthetic Curve	TypeII 24hr

MASTER NETWORK SUMMARY
SCS Unit Hydrograph Method

(*Node=Outfall; +Node=Diversion;)
(Trun= HYG Truncation: Blank=None; L=Left; R=Rt; LR=Left&Rt)

Node ID	Type	Return Event	HYG Vol ac-ft	Trun	Qpeak hrs	Qpeak cfs	Max WSEL ft	Max Pond Storage ac-ft
*OUT EAST C	JCT	2	143.006		12.9000	563.47		
*OUT EAST C	JCT	10	530.074		12.7500	2509.28		
*OUT EAST C	JCT	25	797.110		12.7500	3869.38		
*OUT EAST C	JCT	100	1276.397		12.7500	6279.76		
PRE SUB - AREA C	AREA	2	.320		17.7000	.40		
PRE SUB - AREA C	AREA	10	6.353		12.4000	33.35		
PRE SUB - AREA C	AREA	25	12.231		12.3500	81.05		
PRE SUB - AREA C	AREA	100	24.488		12.3000	191.20		
WEST ONSITE FLOW	AREA	2	142.686		12.9000	563.47		
WEST ONSITE FLOW	AREA	10	523.721		12.7500	2487.12		
WEST ONSITE FLOW	AREA	25	784.878		12.7500	3823.38		
WEST ONSITE FLOW	AREA	100	1251.908		12.7500	6185.15		

NETWORK SUMMARY -- NODES
(Trun.= HYG Truncation: Blank=None; L=Left; R=Rt; LR=Left & Rt)

DEFAULT Design Storm File,ID = Ivanpah 1

Storm Tag Name = Dev 2

Data Type, File, ID = Synthetic Storm TypeII 24hr
Storm Frequency = 2 yr
Total Rainfall Depth= 1.0500 in
Duration Multiplier = 1
Resulting Duration = 24.0000 hrs
Resulting Start Time= .0000 hrs Step= .1000 hrs End= 24.0000 hrs

	Node ID	Type	HYG Vol ac-ft	Trun.	Qpeak hrs	Qpeak cfs	Max WSEL ft
Outfall	OUT EAST C	JCT	143.006		12.9000	563.47	
	PRE SUB - AREA C	AREA	.320		17.7000	.40	
	WEST ONSITE FLOW	AREA	142.686		12.9000	563.47	

NETWORK SUMMARY -- NODES
(Trun.= HYG Truncation: Blank=None; L=Left; R=Rt; LR=Left & Rt)

DEFAULT Design Storm File,ID = Ivanpah 1

Storm Tag Name = Dev100

Data Type, File, ID = Synthetic Storm TypeII 24hr
Storm Frequency = 100 yr
Total Rainfall Depth= 3.3400 in
Duration Multiplier = 1
Resulting Duration = 24.0000 hrs
Resulting Start Time= .0000 hrs Step= .1000 hrs End= 24.0000 hrs

	Node ID	Type	HYG Vol ac-ft	Trun.	Qpeak hrs	Qpeak cfs	Max WSEL ft
Outfall	OUT EAST C	JCT	1276.397		12.7500	6279.76	
	PRE SUB - AREA C	AREA	24.488		12.3000	191.20	
	WEST ONSITE FLOW	AREA	1251.908		12.7500	6185.15	

NETWORK SUMMARY -- NODES
(Trun.= HYG Truncation: Blank=None; L=Left; R=Rt; LR=Left & Rt)

DEFAULT Design Storm File,ID = Ivanpah 1

Storm Tag Name = Dev 10

Data Type, File, ID = Synthetic Storm TypeII 24hr
Storm Frequency = 10 yr
Total Rainfall Depth= 1.9600 in
Duration Multiplier = 1
Resulting Duration = 24.0000 hrs
Resulting Start Time= .0000 hrs Step= .1000 hrs End= 24.0000 hrs

	Node ID	Type	HYG Vol ac-ft	Trun.	Qpeak hrs	Qpeak cfs	Max WSEL ft
Outfall	OUT EAST C	JCT	530.074		12.7500	2509.28	
	PRE SUB - AREA C	AREA	6.353		12.4000	33.35	
	WEST ONSITE FLOW	AREA	523.721		12.7500	2487.12	

NETWORK SUMMARY -- NODES
(Trun.= HYG Truncation: Blank=None; L=Left; R=Rt; LR=Left & Rt)

DEFAULT Design Storm File,ID = Ivanpah 1

Storm Tag Name = Dev 25

Data Type, File, ID = Synthetic Storm TypeII 24hr
Storm Frequency = 25 yr
Total Rainfall Depth= 2.4800 in
Duration Multiplier = 1
Resulting Duration = 24.0000 hrs
Resulting Start Time= .0000 hrs Step= .1000 hrs End= 24.0000 hrs

	Node ID	Type	HYG Vol ac-ft	Trun.	Qpeak hrs	Qpeak cfs	Max WSEL ft
Outfall	OUT EAST C	JCT	797.110		12.7500	3869.38	
	PRE SUB - AREA C	AREA	12.231		12.3500	81.05	
	WEST ONSITE FLOW	AREA	784.878		12.7500	3823.38	

NETWORK SUMMARY -- LINKS
(UN=Upstream Node; DL=DNstream End of Link; DN=DNstream Node)
(Trun.= HYG Truncation: Blank=None; L=Left; R=Rt; LR=Left & Rt)

DEFAULT Design Storm File,ID =   Ivanpah 1

Storm Tag Name   = Dev 10

Data Type, File, ID = Synthetic Storm   TypeII 24hr
Storm Frequency   = 10 yr
Total Rainfall Depth= 1.9600 in
Duration Multiplier = 1
Resulting Duration = 24.0000 hrs
Resulting Start Time= .0000 hrs Step= .1000 hrs End= 24.0000 hrs

Link ID	Type		HYG Vol ac-ft	Trun.	Peak Time hrs	Peak Q cfs	End Points
PRE DEV OUTFALL	ADD	UN	6.353		12.4000	33.35	PRE SUB - AREA C
		DL	6.353		12.4000	33.35	
		DN	530.074		12.7500	2509.28	OUT EAST C
WESTERN OUTFALL	ADD	UN	523.721		12.7500	2487.12	WEST ONSITE FLOW
		DL	523.721		12.7500	2487.12	
		DN	530.074		12.7500	2509.28	OUT EAST C

NETWORK SUMMARY -- LINKS
(UN=Upstream Node; DL=DNstream End of Link; DN=DNstream Node)
(Trun.= HYG Truncation: Blank=None; L=Left; R=Rt; LR=Left & Rt)

DEFAULT Design Storm File,ID = Ivanpah 1

Storm Tag Name = Dev 25

Data Type, File, ID = Synthetic Storm TypeII 24hr
Storm Frequency = 25 yr
Total Rainfall Depth= 2.4800 in
Duration Multiplier = 1
Resulting Duration = 24.0000 hrs
Resulting Start Time= .0000 hrs Step= .1000 hrs End= 24.0000 hrs

Link ID	Type		HYG Vol ac-ft	Trun.	Peak Time hrs	Peak Q cfs	End Points
PRE DEV OUTFALL	ADD	UN	12.231		12.3500	81.05	PRE SUB - AREA C
		DL	12.231		12.3500	81.05	
		DN	797.110		12.7500	3869.38	OUT EAST C
WESTERN OUTFALL	ADD	UN	784.878		12.7500	3823.38	WEST ONSITE FLOW
		DL	784.878		12.7500	3823.38	
		DN	797.110		12.7500	3869.38	OUT EAST C

NETWORK SUMMARY -- LINKS
(UN=Upstream Node; DL=DNstream End of Link; DN=DNstream Node)
(Trun.= HYG Truncation: Blank=None; L=Left; R=Rt; LR=Left & Rt)

DEFAULT Design Storm File,ID = Ivanpah 1

Storm Tag Name = Dev 2

Data Type, File, ID = Synthetic Storm TypeII 24hr
Storm Frequency = 2 yr
Total Rainfall Depth= 1.0500 in
Duration Multiplier = 1
Resulting Duration = 24.0000 hrs
Resulting Start Time= .0000 hrs Step= .1000 hrs End= 24.0000 hrs

Link ID	Type		HYG Vol ac-ft	Trun.	Peak Time hrs	Peak Q cfs	End Points
PRE DEV OUTFALL	ADD	UN	.320		17.7000	.40	PRE SUB - AREA C
		DL	.320		17.7000	.40	
		DN	143.006		12.9000	563.47	OUT EAST C
WESTERN OUTFALL	ADD	UN	142.686		12.9000	563.47	WEST ONSITE FLOW
		DL	142.686		12.9000	563.47	
		DN	143.006		12.9000	563.47	OUT EAST C

NETWORK SUMMARY -- LINKS
(UN=Upstream Node; DL=DNstream End of Link; DN=DNstream Node)
(Trun.= HYG Truncation: Blank=None; L=Left; R=Rt; LR=Left & Rt)

DEFAULT Design Storm File,ID = Ivanpah 1

Storm Tag Name = Dev100

Data Type, File, ID = Synthetic Storm TypeII 24hr
Storm Frequency = 100 yr
Total Rainfall Depth= 3.3400 in
Duration Multiplier = 1
Resulting Duration = 24.0000 hrs
Resulting Start Time= .0000 hrs Step= .1000 hrs End= 24.0000 hrs

Link ID	Type		HYG Vol ac-ft	Trun.	Peak Time hrs	Peak Q cfs	End Points
PRE DEV OUTFALL	ADD	UN	24.488		12.3000	191.20	PRE SUB - AREA C
		DL	24.488		12.3000	191.20	
		DN	1276.397		12.7500	6279.76	OUT EAST C
WESTERN OUTFALL	ADD	UN	1251.908		12.7500	6185.15	WEST ONSITE FLOW
		DL	1251.908		12.7500	6185.15	
		DN	1276.397		12.7500	6279.76	OUT EAST C

NETWORK RUNOFF NODE SEQUENCE

Runoff Data		Apply to Node		Receiving Link
SCS UH	PRE SUB - AREA C Subarea	PRE SUB - AREA C	Add Hyd	PRE SUB - AREA C
SCS UH	WEST ONSITE FLOW Subarea	WEST ONSITE FLOW	Add Hyd	WEST ONSITE FLOW

NETWORK ROUTING SEQUENCE

Link Operation	UPstream Node	DNstream Node
Add Hyd PRE DEV OUTFALL	Subarea PRE SUB - AREA C	Jct OUT EAST C
Add Hyd WESTERN OUTFALL	Subarea WEST ONSITE FLOW	Jct OUT EAST C

Title... Project Date: 7/17/2008
Project Engineer: rachel.burnette
Project Title: Ivanpah 1_Pond C
Project Comments:

DESIGN STORMS SUMMARY

Design Storm File,ID = Ivanpah 1

Storm Tag Name = Dev 2

Data Type, File, ID = Synthetic Storm TypeII 24hr
Storm Frequency = 2 yr
Total Rainfall Depth= 1.0500 in
Duration Multiplier = 1
Resulting Duration = 24.0000 hrs
Resulting Start Time= .0000 hrs Step= .1000 hrs End= 24.0000 hrs

Storm Tag Name = Dev 10

Data Type, File, ID = Synthetic Storm TypeII 24hr
Storm Frequency = 10 yr
Total Rainfall Depth= 1.9600 in
Duration Multiplier = 1
Resulting Duration = 24.0000 hrs
Resulting Start Time= .0000 hrs Step= .1000 hrs End= 24.0000 hrs

Storm Tag Name = Dev 25

Data Type, File, ID = Synthetic Storm TypeII 24hr
Storm Frequency = 25 yr
Total Rainfall Depth= 2.4800 in
Duration Multiplier = 1
Resulting Duration = 24.0000 hrs
Resulting Start Time= .0000 hrs Step= .1000 hrs End= 24.0000 hrs

Storm Tag Name = Dev100

Data Type, File, ID = Synthetic Storm TypeII 24hr
Storm Frequency = 100 yr
Total Rainfall Depth= 3.3400 in
Duration Multiplier = 1
Resulting Duration = 24.0000 hrs
Resulting Start Time= .0000 hrs Step= .1000 hrs End= 24.0000 hrs

DESIGN STORMS SUMMARY

```
Design Storm File,ID =                Ivanpah 1


Storm Tag Name       = Dev  2
----------------------------------------------------------------------
Data Type, File, ID = Synthetic Storm    TypeII  24hr
Storm Frequency      = 2 yr
Total Rainfall Depth= 1.0500 in
Duration Multiplier =  1
Resulting Duration  = 24.0000 hrs
Resulting Start Time= .0000 hrs  Step= .1000 hrs  End= 24.0000 hrs


Storm Tag Name       = Dev 10
----------------------------------------------------------------------
Data Type, File, ID = Synthetic Storm    TypeII  24hr
Storm Frequency      = 10 yr
Total Rainfall Depth= 1.9600 in
Duration Multiplier =  1
Resulting Duration  = 24.0000 hrs
Resulting Start Time= .0000 hrs  Step= .1000 hrs  End= 24.0000 hrs


Storm Tag Name       = Dev 25
----------------------------------------------------------------------
Data Type, File, ID = Synthetic Storm    TypeII  24hr
Storm Frequency      = 25 yr
Total Rainfall Depth= 2.4800 in
Duration Multiplier =  1
Resulting Duration  = 24.0000 hrs
Resulting Start Time= .0000 hrs  Step= .1000 hrs  End= 24.0000 hrs


Storm Tag Name       = Dev100
----------------------------------------------------------------------
Data Type, File, ID = Synthetic Storm    TypeII  24hr
Storm Frequency      = 100 yr
Total Rainfall Depth= 3.3400 in
Duration Multiplier =  1
Resulting Duration  = 24.0000 hrs
Resulting Start Time= .0000 hrs  Step= .1000 hrs  End= 24.0000 hrs
```

::
TIME OF CONCENTRATION CALCULATOR
::

Segment #1: Tc: TR-55 Sheet

Mannings n	.0250
Hydraulic Length	300.00 ft
2yr, 24hr P	1.0500 in
Slope	.040000 ft/ft
Avg.Velocity	.67 ft/sec

Segment #1 Time: .1241 hrs

Segment #2: Tc: TR-55 Shallow

Hydraulic Length	6000.00 ft
Slope	.040000 ft/ft
Unpaved	
Avg.Velocity	3.23 ft/sec

Segment #2 Time: .5165 hrs

Total Tc: .6406 hrs

```
-----------------------------------------------------------------------
Tc Equations used...
-----------------------------------------------------------------------

==== SCS TR-55 Sheet Flow ==========================================

     Tc = (.007 * ((n * Lf)**0.8)) / ((P**.5) * (Sf**.4))

     Where:  Tc = Time of concentration, hrs
             n  = Mannings n
             Lf = Flow length, ft
             P  = 2yr, 24hr Rain depth, inches
             Sf = Slope, %

==== SCS TR-55 Shallow Concentrated Flow ===============================

     Unpaved surface:
     V  = 16.1345 * (Sf**0.5)

     Paved surface:
     V  = 20.3282 * (Sf**0.5)

     Tc = (Lf / V) / (3600sec/hr)

     Where:  V  = Velocity, ft/sec
             Sf = Slope, ft/ft
             Tc = Time of concentration, hrs
             Lf = Flow length, ft
```

::
TIME OF CONCENTRATION CALCULATOR
::

Segment #1: Tc: TR-55 Sheet

Mannings n	.0300
Hydraulic Length	300.00 ft
2yr, 24hr P	1.0500 in
Slope	.500000 ft/ft

Avg.Velocity 1.59 ft/sec

Segment #1 Time: .0523 hrs

Segment #2: Tc: TR-55 Shallow

Hydraulic Length	21797.35 ft
Slope	.130000 ft/ft
Unpaved	

Avg.Velocity 5.82 ft/sec

Segment #2 Time: 1.0408 hrs

Segment #3: Tc: TR-55 Channel

Flow Area	42.0000 sq.ft
Wetted Perimeter	23.97 ft
Hydraulic Radius	1.75 ft
Slope	.050000 ft/ft
Mannings n	.0250
Hydraulic Length	21600.00 ft

Avg.Velocity 19.37 ft/sec

Segment #3 Time: .3098 hrs

Total Tc: 1.4029 hrs

Tc Equations used...

==== SCS TR-55 Sheet Flow ====

```
Tc = (.007 * ((n * Lf)**0.8)) / ((P**.5) * (Sf**.4))

Where:  Tc = Time of concentration, hrs
        n  = Mannings n
        Lf = Flow length, ft
        P  = 2yr, 24hr Rain depth, inches
        Sf = Slope, %
```

==== SCS TR-55 Shallow Concentrated Flow ====

```
Unpaved surface:
V  = 16.1345 * (Sf**0.5)

Paved surface:
V  = 20.3282 * (Sf**0.5)

Tc = (Lf / V) / (3600sec/hr)

Where:  V  = Velocity, ft/sec
        Sf = Slope, ft/ft
        Tc = Time of concentration, hrs
        Lf = Flow length, ft
```

==== SCS Channel Flow ==

```
R  = Aq / Wp
V  = (1.49 * (R**(2/3)) * (Sf**-0.5)) / n

Tc = (Lf / V) / (3600sec/hr)

Where:  R  = Hydraulic radius
        Aq = Flow area, sq.ft.
        Wp = Wetted perimeter, ft
        V  = Velocity, ft/sec
        Sf = Slope, ft/ft
        n  = Mannings n
        Tc = Time of concentration, hrs
        Lf = Flow length, ft
```

RUNOFF CURVE NUMBER DATA

::

Soil/Surface Description	CN	Area acres	Impervious Adjustment %C	Impervious Adjustment %UC	Adjusted CN
Pre Dev Conditions	71	305.000			71.00
COMPOSITE AREA & WEIGHTED CN --->		305.000			71.00 (71)

::

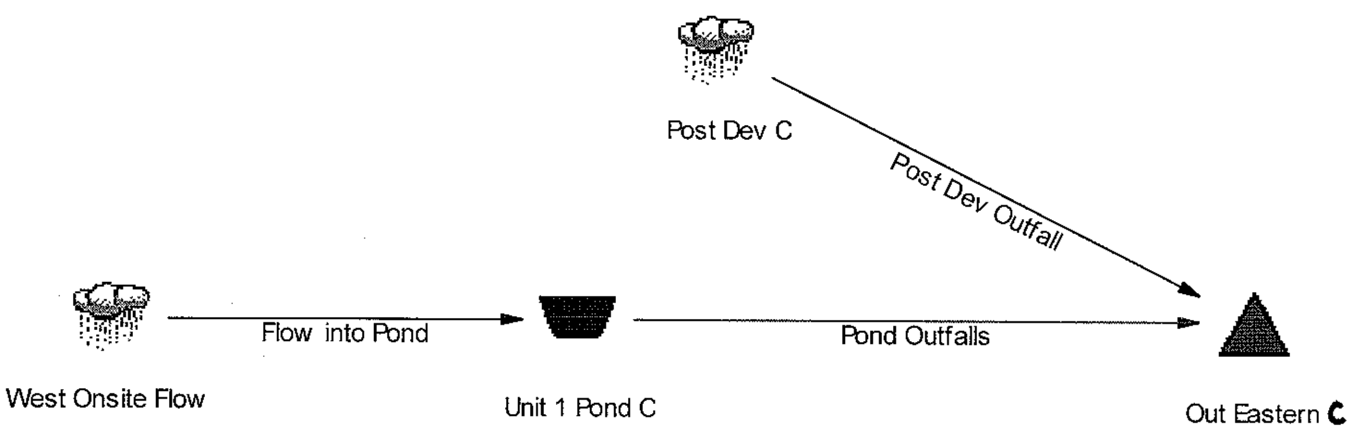
RUNOFF CURVE NUMBER DATA

Soil/Surface Description	CN	Area acres	Impervious Adjustment %C	Impervious Adjustment %UC	Adjusted CN
Mountain Range (Copperworld Associa	91	4840.000			91.00
Dessert Area (Popups Sandy Loam)	82	1667.000			82.00
Dessert Area to Site (Arizo Loamy S	71	1168.000			71.00
COMPOSITE AREA & WEIGHTED CN --->		7675.000			86.00 (86)

WorleyParsons resources & energy	CLIENT NAME: BRIGHTSOURCE ENERGY PROJECT NAME: IVANPAH SOLAR FIELD UNIT 1			JOB NO.: 52003205	
STANDARD CALCULATION SHEET	SUBJECT: STORMWATER CALCULATION			CALC NO.:	
	REVISION	0	1	2	3
	ORIGINATOR:	RSB/BNG			
	REVIEWER:	CKH			
	DATE:	7-17-08			

Page E of

ATTACHMENT E
POND C – POST-DEVELOPMENT



Post Dev C
Post Dev Outfall
Flow into Pond
Pond Outfalls
West Onsite Flow
Unit 1 Pond C
Out Eastern C

JOB TITLE

Project Date: 7/17/2008
Project Engineer: Brian.Gilbert
Project Title: Ivanpah 1 - Pond C Post Development
Project Comments:

MASTER DESIGN STORM SUMMARY

Network Storm Collection: Ivanpah 1

Return Event	Total Depth in	Rainfall Type	RNF ID
Dev 2	1.0500	Synthetic Curve	TypeII 24hr
Dev 10	1.9600	Synthetic Curve	TypeII 24hr
Dev 25	2.4800	Synthetic Curve	TypeII 24hr
Dev100	3.3400	Synthetic Curve	TypeII 24hr

MASTER NETWORK SUMMARY
SCS Unit Hydrograph Method

(*Node=Outfall; +Node=Diversion;)
(Trun= HYG Truncation: Blank=None; L=Left; R=Rt; LR=Left&Rt)

Node ID	Type	Return Event	HYG Vol ac-ft	Trun	Qpeak hrs	Qpeak cfs	Max WSEL ft	Max Pond Storage ac-ft
*OUT EASTERN C	JCT	2	143.691		13.2000	496.56		
*OUT EASTERN C	JCT	10	532.907		13.1000	2259.62		
*OUT EASTERN C	JCT	25	801.111		13.1000	3300.21		
*OUT EASTERN C	JCT	100	1282.141		12.8000	6251.71		
POST DEV C	AREA	2	1.005		13.1000	1.66		
POST DEV C	AREA	10	9.186		12.4000	56.08		
POST DEV C	AREA	25	16.234		12.3500	114.46		
POST DEV C	AREA	100	30.233		12.3000	233.02		
UNIT 1 POND CIN	POND	2	142.686		12.9000	563.47		
UNIT 1 POND CIN	POND	10	523.721		12.7500	2487.12		
UNIT 1 POND CIN	POND	25	784.878		12.7500	3823.38		
UNIT 1 POND CIN	POND	100	1251.908		12.7500	6185.15		

MASTER NETWORK SUMMARY
SCS Unit Hydrograph Method

(*Node=Outfall; +Node=Diversion;)
(Trun= HYG Truncation: Blank=None; L=Left; R=Rt; LR=Left&Rt)

Node ID	Type	Return Event	HYG Vol ac-ft	Trun	Qpeak hrs	Qpeak cfs	Max WSEL ft	Max Pond Storage ac-ft
UNIT 1 POND COUT	POND	2	142.686		13.2000	494.90	95.43	16.073
UNIT 1 POND COUT	POND	10	523.721		13.1000	2237.21	100.46	55.337
UNIT 1 POND COUT	POND	25	784.878		13.1500	3262.06	104.32	91.058
UNIT 1 POND COUT	POND	100	1251.908		12.8000	6137.61	106.43	112.599
WEST ONSITE FLOW	AREA	2	142.686		12.9000	563.47		
WEST ONSITE FLOW	AREA	10	523.721		12.7500	2487.12		
WEST ONSITE FLOW	AREA	25	784.878		12.7500	3823.38		
WEST ONSITE FLOW	AREA	100	1251.908		12.7500	6185.15		

NETWORK SUMMARY -- NODES
(Trun.= HYG Truncation: Blank=None; L=Left; R=Rt; LR=Left & Rt)

DEFAULT Design Storm File,ID = Ivanpah 1

Storm Tag Name = Dev 10

Data Type, File, ID = Synthetic Storm TypeII 24hr
Storm Frequency = 10 yr
Total Rainfall Depth= 1.9600 in
Duration Multiplier = 1
Resulting Duration = 24.0000 hrs
Resulting Start Time= .0000 hrs Step= .1000 hrs End= 24.0000 hrs

	Node ID	Type	HYG Vol ac-ft	Trun.	Qpeak hrs	Qpeak cfs	Max WSEL ft
Outfall	OUT EASTERN C	JCT	532.907		13.1000	2259.62	
	POST DEV C	AREA	9.186		12.4000	56.08	
	UNIT 1 POND CIN	POND	523.721		12.7500	2487.12	
	UNIT 1 POND COUT	POND	523.721		13.1000	2237.21	100.46
	WEST ONSITE FLOW	AREA	523.721		12.7500	2487.12	

NETWORK SUMMARY -- NODES
(Trun.= HYG Truncation: Blank=None; L=Left; R=Rt; LR=Left & Rt)

DEFAULT Design Storm File,ID = Ivanpah 1

Storm Tag Name = Dev 25

Data Type, File, ID = Synthetic Storm TypeII 24hr
Storm Frequency = 25 yr
Total Rainfall Depth= 2.4800 in
Duration Multiplier = 1
Resulting Duration = 24.0000 hrs
Resulting Start Time= .0000 hrs Step= .1000 hrs End= 24.0000 hrs

	Node ID	Type	HYG Vol ac-ft	Trun.	Qpeak hrs	Qpeak cfs	Max WSEL ft
Outfall	OUT EASTERN C	JCT	801.111		13.1000	3300.21	
	POST DEV C	AREA	16.234		12.3500	114.46	
	UNIT 1 POND CIN	POND	784.878		12.7500	3823.38	
	UNIT 1 POND COUT	POND	784.878		13.1500	3262.06	104.32
	WEST ONSITE FLOW	AREA	784.878		12.7500	3823.38	

NETWORK SUMMARY -- NODES
(Trun.= HYG Truncation: Blank=None; L=Left; R=Rt; LR=Left & Rt)

DEFAULT Design Storm File,ID = Ivanpah 1

Storm Tag Name = Dev 2

Data Type, File, ID = Synthetic Storm TypeII 24hr
Storm Frequency = 2 yr
Total Rainfall Depth= 1.0500 in
Duration Multiplier = 1
Resulting Duration = 24.0000 hrs
Resulting Start Time= .0000 hrs Step= .1000 hrs End= 24.0000 hrs

	Node ID	Type	HYG Vol ac-ft	Trun.	Qpeak hrs	Qpeak cfs	Max WSEL ft
Outfall	OUT EASTERN C	JCT	143.691		13.2000	496.56	
	POST DEV C	AREA	1.005		13.1000	1.66	
	UNIT 1 POND CIN	POND	142.686		12.9000	563.47	
	UNIT 1 POND COUT	POND	142.686		13.2000	494.90	95.43
	WEST ONSITE FLOW	AREA	142.686		12.9000	563.47	

NETWORK SUMMARY -- LINKS
(UN=Upstream Node; DL=DNstream End of Link; DN=DNstream Node)
(Trun.= HYG Truncation: Blank=None; L=Left; R=Rt; LR=Left & Rt)

DEFAULT Design Storm File,ID = Ivanpah 1

Storm Tag Name = Dev 25

Data Type, File, ID = Synthetic Storm TypeII 24hr
Storm Frequency = 25 yr
Total Rainfall Depth= 2.4800 in
Duration Multiplier = 1
Resulting Duration = 24.0000 hrs
Resulting Start Time= .0000 hrs Step= .1000 hrs End= 24.0000 hrs

Link ID	Type		HYG Vol ac-ft	Trun.	Peak Time hrs	Peak Q cfs	End Points
FLOW INTO POND	ADD	UN	784.878		12.7500	3823.38	WEST ONSITE FLOW
		DL	784.878		12.7500	3823.38	
		DN	784.878		12.7500	3823.38	UNIT 1 POND CIN
POND OUTFALLS	PONDrt	UN	784.878		12.7500	3823.38	UNIT 1 POND CIN
POND OUTFALLS			784.878		13.1500	3262.06	UNIT 1 POND COUT
		DL	784.878		13.1500	3262.06	
		DN	801.111		13.1000	3300.21	OUT EASTERN C
POST DEV OUTFALL	ADD	UN	16.234		12.3500	114.46	POST DEV C
		DL	16.234		12.3500	114.46	
		DN	801.111		13.1000	3300.21	OUT EASTERN C

NETWORK SUMMARY -- LINKS
(UN=Upstream Node; DL=DNstream End of Link; DN=DNstream Node)
(Trun.= HYG Truncation: Blank=None; L=Left; R=Rt; LR=Left & Rt)

DEFAULT Design Storm File,ID = Ivanpah 1

Storm Tag Name = Dev 10

Data Type, File, ID = Synthetic Storm TypeII 24hr
Storm Frequency = 10 yr
Total Rainfall Depth= 1.9600 in
Duration Multiplier = 1
Resulting Duration = 24.0000 hrs
Resulting Start Time= .0000 hrs Step= .1000 hrs End= 24.0000 hrs

Link ID	Type		HYG Vol ac-ft	Trun.	Peak Time hrs	Peak Q cfs	End Points
FLOW INTO POND	ADD	UN	523.721		12.7500	2487.12	WEST ONSITE FLOW
		DL	523.721		12.7500	2487.12	
		DN	523.721		12.7500	2487.12	UNIT 1 POND CIN
POND OUTFALLS	PONDrt	UN	523.721		12.7500	2487.12	UNIT 1 POND CIN
POND OUTFALLS			523.721		13.1000	2237.21	UNIT 1 POND COUT
		DL	523.721		13.1000	2237.21	
		DN	532.907		13.1000	2259.62	OUT EASTERN C
POST DEV OUTFALL	ADD	UN	9.186		12.4000	56.08	POST DEV C
		DL	9.186		12.4000	56.08	
		DN	532.907		13.1000	2259.62	OUT EASTERN C

NETWORK SUMMARY -- LINKS
(UN=Upstream Node; DL=DNstream End of Link; DN=DNstream Node)
(Trun.= HYG Truncation: Blank=None; L=Left; R=Rt; LR=Left & Rt)

DEFAULT Design Storm File,ID = Ivanpah 1

Storm Tag Name = Dev 2

Data Type, File, ID = Synthetic Storm TypeII 24hr
Storm Frequency = 2 yr
Total Rainfall Depth= 1.0500 in
Duration Multiplier = 1
Resulting Duration = 24.0000 hrs
Resulting Start Time= .0000 hrs Step= .1000 hrs End= 24.0000 hrs

Link ID	Type		HYG Vol ac-ft	Trun.	Peak Time hrs	Peak Q cfs	End Points
FLOW INTO POND	ADD	UN	142.686		12.9000	563.47	WEST ONSITE FLOW
		DL	142.686		12.9000	563.47	
		DN	142.686		12.9000	563.47	UNIT 1 POND CIN
POND OUTFALLS	PONDrt	UN	142.686		12.9000	563.47	UNIT 1 POND CIN
POND OUTFALLS			142.686		13.2000	494.90	UNIT 1 POND COUT
		DL	142.686		13.2000	494.90	
		DN	143.691		13.2000	496.56	OUT EASTERN C
POST DEV OUTFALL	ADD	UN	1.005		13.1000	1.66	POST DEV C
		DL	1.005		13.1000	1.66	
		DN	143.691		13.2000	496.56	OUT EASTERN C

NETWORK SUMMARY -- NODES
(Trun.= HYG Truncation: Blank=None; L=Left; R=Rt; LR=Left & Rt)

DEFAULT Design Storm File,ID = Ivanpah 1

Storm Tag Name = Dev100

Data Type, File, ID = Synthetic Storm TypeII 24hr
Storm Frequency = 100 yr
Total Rainfall Depth= 3.3400 in
Duration Multiplier = 1
Resulting Duration = 24.0000 hrs
Resulting Start Time= .0000 hrs Step= .1000 hrs End= 24.0000 hrs

	Node ID	Type	HYG Vol ac-ft	Trun.	Qpeak hrs	Qpeak cfs	Max WSEL ft
Outfall	OUT EASTERN C	JCT	1282.141		12.8000	6251.71	
	POST DEV C	AREA	30.233		12.3000	233.02	
	UNIT 1 POND CIN	POND	1251.908		12.7500	6185.15	
	UNIT 1 POND COUT	POND	1251.908		12.8000	6137.61	106.43
	WEST ONSITE FLOW	AREA	1251.908		12.7500	6185.15	

NETWORK SUMMARY -- LINKS
(UN=Upstream Node; DL=DNstream End of Link; DN=DNstream Node)
(Trun.= HYG Truncation: Blank=None; L=Left; R=Rt; LR=Left & Rt)

DEFAULT Design Storm File,ID = Ivanpah 1

Storm Tag Name = Dev100

Data Type, File, ID = Synthetic Storm TypeII 24hr
Storm Frequency = 100 yr
Total Rainfall Depth= 3.3400 in
Duration Multiplier = 1
Resulting Duration = 24.0000 hrs
Resulting Start Time= .0000 hrs Step= .1000 hrs End= 24.0000 hrs

Link ID	Type		HYG Vol ac-ft	Trun.	Peak Time hrs	Peak Q cfs	End Points
FLOW INTO POND	ADD	UN	1251.908		12.7500	6185.15	WEST ONSITE FLOW
		DL	1251.908		12.7500	6185.15	
		DN	1251.908		12.7500	6185.15	UNIT 1 POND CIN
POND OUTFALLS	PONDrt	UN	1251.908		12.7500	6185.15	UNIT 1 POND CIN
POND OUTFALLS			1251.908		12.8000	6137.61	UNIT 1 POND COUT
		DL	1251.908		12.8000	6137.61	
		DN	1282.141		12.8000	6251.71	OUT EASTERN C
POST DEV OUTFALL	ADD	UN	30.233		12.3000	233.02	POST DEV C
		DL	30.233		12.3000	233.02	
		DN	1282.141		12.8000	6251.71	OUT EASTERN C

NETWORK RUNOFF NODE SEQUENCE

Runoff Data	Apply to Node	Receiving Link
SCS UH WEST ONSITE FLOW	Subarea WEST ONSITE FLOW	Add Hyd WEST ONSITE FLOW
SCS UH POST DEV C	Subarea POST DEV C	Add Hyd POST DEV C

NETWORK ROUTING SEQUENCE

Link Operation	UPstream Node	DNstream Node
Add Hyd FLOW INTO POND	Subarea WEST ONSITE FLOW	Pond UNIT 1 POND CIN
POND ROUTE TOTAL OUTFLOW...		
Total Pond Outflow	Pond UNIT 1 POND CIN	Outflow UNIT 1 POND COUT
SET POND ROUTING LINK TO TOTAL POND OUTFLOW...		
Outlet POND OUTFALLS	Outflow UNIT 1 POND COUT	Jct OUT EASTERN C
Add Hyd POST DEV OUTFALL	Subarea POST DEV C	Jct OUT EASTERN C

Title... Project Date: 7/17/2008
Project Engineer: Brian.Gilbert
Project Title: Ivanpah 1 - Pond C Post Development
Project Comments:

DESIGN STORMS SUMMARY

Design Storm File,ID = Ivanpah 1

Storm Tag Name = Dev 2

Data Type, File, ID = Synthetic Storm TypeII 24hr
Storm Frequency = 2 yr
Total Rainfall Depth= 1.0500 in
Duration Multiplier = 1
Resulting Duration = 24.0000 hrs
Resulting Start Time= .0000 hrs Step= .1000 hrs End= 24.0000 hrs

Storm Tag Name = Dev 10

Data Type, File, ID = Synthetic Storm TypeII 24hr
Storm Frequency = 10 yr
Total Rainfall Depth= 1.9600 in
Duration Multiplier = 1
Resulting Duration = 24.0000 hrs
Resulting Start Time= .0000 hrs Step= .1000 hrs End= 24.0000 hrs

Storm Tag Name = Dev 25

Data Type, File, ID = Synthetic Storm TypeII 24hr
Storm Frequency = 25 yr
Total Rainfall Depth= 2.4800 in
Duration Multiplier = 1
Resulting Duration = 24.0000 hrs
Resulting Start Time= .0000 hrs Step= .1000 hrs End= 24.0000 hrs

Storm Tag Name = Dev100

Data Type, File, ID = Synthetic Storm TypeII 24hr
Storm Frequency = 100 yr
Total Rainfall Depth= 3.3400 in
Duration Multiplier = 1
Resulting Duration = 24.0000 hrs
Resulting Start Time= .0000 hrs Step= .1000 hrs End= 24.0000 hrs

File.... Y:\Ivanpah\Civil\90%\90% Calc\Ivanpah 1\Pond C\Post Dev onsite run off-Pond C\Iva

DESIGN STORMS SUMMARY

Design Storm File,ID = Ivanpah 1

Storm Tag Name = Dev 2

Data Type, File, ID = Synthetic Storm TypeII 24hr
Storm Frequency = 2 yr
Total Rainfall Depth= 1.0500 in
Duration Multiplier = 1
Resulting Duration = 24.0000 hrs
Resulting Start Time= .0000 hrs Step= .1000 hrs End= 24.0000 hrs

Storm Tag Name = Dev 10

Data Type, File, ID = Synthetic Storm TypeII 24hr
Storm Frequency = 10 yr
Total Rainfall Depth= 1.9600 in
Duration Multiplier = 1
Resulting Duration = 24.0000 hrs
Resulting Start Time= .0000 hrs Step= .1000 hrs End= 24.0000 hrs

Storm Tag Name = Dev 25

Data Type, File, ID = Synthetic Storm TypeII 24hr
Storm Frequency = 25 yr
Total Rainfall Depth= 2.4800 in
Duration Multiplier = 1
Resulting Duration = 24.0000 hrs
Resulting Start Time= .0000 hrs Step= .1000 hrs End= 24.0000 hrs

Storm Tag Name = Dev100

Data Type, File, ID = Synthetic Storm TypeII 24hr
Storm Frequency = 100 yr
Total Rainfall Depth= 3.3400 in
Duration Multiplier = 1
Resulting Duration = 24.0000 hrs
Resulting Start Time= .0000 hrs Step= .1000 hrs End= 24.0000 hrs

```
::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::
TIME OF CONCENTRATION CALCULATOR
::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::

------------------------------------------------------------------------

Segment #1:  Tc: TR-55 Sheet

Mannings n            .0300
Hydraulic Length    300.00 ft
2yr, 24hr P         1.0500 in
Slope              .040000 ft/ft

Avg.Velocity           .58 ft/sec

                                       Segment #1 Time:     .1436 hrs
------------------------------------------------------------------------

Segment #2:  Tc: TR-55 Shallow

Hydraulic Length   6437.00 ft
Slope              .040000 ft/ft
Unpaved

Avg.Velocity          3.23 ft/sec

                                       Segment #2 Time:     .5541 hrs
------------------------------------------------------------------------

                                             ========================
                                              Total Tc:     .6977 hrs
                                             ========================
```

Tc Equations used...

==== SCS TR-55 Sheet Flow ====

```
Tc = (.007 * ((n * Lf)**0.8)) / ((P**.5) * (Sf**.4))

Where:  Tc = Time of concentration, hrs
        n  = Mannings n
        Lf = Flow length, ft
        P  = 2yr, 24hr Rain depth, inches
        Sf = Slope, %
```

==== SCS TR-55 Shallow Concentrated Flow ====

```
Unpaved surface:
V  = 16.1345 * (Sf**0.5)

Paved surface:
V  = 20.3282 * (Sf**0.5)

Tc = (Lf / V) / (3600sec/hr)

Where:  V  = Velocity, ft/sec
        Sf = Slope, ft/ft
        Tc = Time of concentration, hrs
        Lf = Flow length, ft
```

::

TIME OF CONCENTRATION CALCULATOR

::

Segment #1: Tc: TR-55 Sheet

Mannings n	.0300	
Hydraulic Length	300.00	ft
2yr, 24hr P	1.0500	in
Slope	.500000	ft/ft
Avg.Velocity	1.59	ft/sec

Segment #1 Time: .0523 hrs

Segment #2: Tc: TR-55 Shallow

Hydraulic Length	21797.35	ft
Slope	.130000	ft/ft
Unpaved		
Avg.Velocity	5.82	ft/sec

Segment #2 Time: 1.0408 hrs

Segment #3: Tc: TR-55 Channel

Flow Area	42.0000	sq.ft
Wetted Perimeter	23.97	ft
Hydraulic Radius	1.75	ft
Slope	.050000	ft/ft
Mannings n	.0250	
Hydraulic Length	21600.00	ft
Avg.Velocity	19.37	ft/sec

Segment #3 Time: .3098 hrs

========================

Total Tc: 1.4029 hrs

========================

Tc Equations used...

==== SCS TR-55 Sheet Flow ====

```
Tc = (.007 * ((n * Lf)**0.8)) / ((P**.5) * (Sf**.4))

Where:  Tc = Time of concentration, hrs
        n  = Mannings n
        Lf = Flow length, ft
        P  = 2yr, 24hr Rain depth, inches
        Sf = Slope, %
```

==== SCS TR-55 Shallow Concentrated Flow ====

```
Unpaved surface:
V  = 16.1345 * (Sf**0.5)

Paved surface:
V  = 20.3282 * (Sf**0.5)

Tc = (Lf / V) / (3600sec/hr)

Where:  V  = Velocity, ft/sec
        Sf = Slope, ft/ft
        Tc = Time of concentration, hrs
        Lf = Flow length, ft
```

==== SCS Channel Flow ==

```
R  = Aq / Wp
V  = (1.49 * (R**(2/3)) * (Sf**-0.5)) / n

Tc = (Lf / V) / (3600sec/hr)

Where:  R  = Hydraulic radius
        Aq = Flow area, sq.ft.
        Wp = Wetted perimeter, ft
        V  = Velocity, ft/sec
        Sf = Slope, ft/ft
        n  = Mannings n
        Tc = Time of concentration, hrs
        Lf = Flow length, ft
```

RUNOFF CURVE NUMBER DATA

::

Soil/Surface Description	CN	Area acres	Impervious Adjustment %C	Impervious Adjustment %UC	Adjusted CN
Post Dev Conditions	75	305.000			75.00
COMPOSITE AREA & WEIGHTED CN --->		305.000			75.00 (75)

::

RUNOFF CURVE NUMBER DATA

Soil/Surface Description	CN	Area acres	Impervious Adjustment %C	Impervious Adjustment %UC	Adjusted CN
Mountain Range (Copperworld Associa	91	4840.000			91.00
Dessert Area (Popups Sandy Loam)	82	1667.000			82.00
Dessert Area to Site (Arizo Loamy S	71	1168.000			71.00
COMPOSITE AREA & WEIGHTED CN --->		7675.000			86.00 (86)

File.... Y:\Ivanpah\Civil\90%\90% Calc\Ivanpah 1\Pond C\Post Dev onsite run off-Pond C\Iva

TIME vs. ELEVATION (ft)

Time hrs	Output Time increment = .0500 hrs Time on left represents time for first value in each row.				
11.5500	93.00	93.00	93.00	93.00	93.00
11.8000	93.01	93.02	93.03	93.05	93.08
12.0500	93.12	93.18	93.25	93.33	93.43
12.3000	93.56	93.69	93.84	93.99	94.15
12.5500	94.31	94.47	94.61	94.75	94.88
12.8000	95.00	95.10	95.19	95.26	95.32
13.0500	95.37	95.40	95.42	95.43	95.43
13.3000	95.42	95.40	95.37	95.34	95.30
13.5500	95.26	95.22	95.18	95.14	95.09
13.8000	95.05	95.01	94.96	94.92	94.88
14.0500	94.84	94.80	94.76	94.72	94.68
14.3000	94.65	94.61	94.58	94.55	94.52
14.5500	94.49	94.46	94.43	94.40	94.38
14.8000	94.35	94.33	94.30	94.28	94.26
15.0500	94.24	94.22	94.20	94.18	94.16
15.3000	94.14	94.13	94.11	94.10	94.08
15.5500	94.07	94.06	94.05	94.04	94.02
15.8000	94.01	94.00	93.99	93.98	93.97
16.0500	93.96	93.95	93.94	93.93	93.93
16.3000	93.92	93.91	93.90	93.89	93.88
16.5500	93.87	93.86	93.85	93.85	93.84
16.8000	93.83	93.82	93.82	93.81	93.80
17.0500	93.80	93.79	93.78	93.78	93.77
17.3000	93.77	93.76	93.76	93.75	93.75
17.5500	93.74	93.74	93.73	93.73	93.73
17.8000	93.72	93.72	93.71	93.71	93.71
18.0500	93.70	93.70	93.70	93.69	93.69
18.3000	93.69	93.68	93.68	93.68	93.67
18.5500	93.67	93.67	93.67	93.66	93.66
18.8000	93.66	93.65	93.65	93.65	93.65
19.0500	93.64	93.64	93.64	93.64	93.63
19.3000	93.63	93.63	93.63	93.62	93.62
19.5500	93.62	93.62	93.61	93.61	93.61
19.8000	93.60	93.60	93.60	93.60	93.59
20.0500	93.59	93.59	93.59	93.58	93.58
20.3000	93.58	93.58	93.57	93.57	93.57
20.5500	93.57	93.56	93.56	93.56	93.56
20.8000	93.55	93.55	93.55	93.55	93.54
21.0500	93.54	93.54	93.54	93.54	93.53
21.3000	93.53	93.53	93.53	93.53	93.53
21.5500	93.53	93.52	93.52	93.52	93.52
21.8000	93.52	93.52	93.52	93.52	93.51
22.0500	93.51	93.51	93.51	93.51	93.51

TIME vs. ELEVATION (ft)

Time hrs	Output Time increment = .0500 hrs Time on left represents time for first value in each row.				
22.3000	93.51	93.51	93.51	93.51	93.51
22.5500	93.51	93.50	93.50	93.50	93.50
22.8000	93.50	93.50	93.50	93.50	93.50
23.0500	93.50	93.50	93.50	93.50	93.50
23.3000	93.50	93.50	93.49	93.49	93.49
23.5500	93.49	93.49	93.49	93.49	93.49
23.8000	93.49	93.49	93.49	93.49	93.49
24.0500	93.49	93.48	93.48	93.48	93.48
24.3000	93.48	93.48	93.47	93.47	93.47
24.5500	93.46	93.46	93.45	93.45	93.44
24.8000	93.43	93.42	93.41	93.40	93.39
25.0500	93.38	93.37	93.36	93.35	93.34
25.3000	93.32	93.31	93.30	93.29	93.28
25.5500	93.26	93.25	93.24	93.23	93.22
25.8000	93.21	93.20	93.19	93.18	93.17
26.0500	93.16	93.16	93.15	93.14	93.13
26.3000	93.13	93.12	93.11	93.11	93.10
26.5500	93.10	93.09	93.09	93.08	93.08
26.8000	93.07	93.07	93.06	93.06	93.06
27.0500	93.05	93.05	93.05	93.04	93.04
27.3000	93.04	93.04	93.04	93.03	93.03
27.5500	93.03	93.03	93.03	93.02	93.02
27.8000	93.02	93.02	93.02	93.02	93.02
28.0500	93.02	93.01	93.01	93.01	93.01
28.3000	93.01	93.01	93.01	93.01	93.01
28.5500	93.01	93.01	93.01	93.01	93.01
28.8000	93.01	93.01	93.01	93.00	93.00
29.0500	93.00	93.00	93.00	93.00	93.00
29.3000	93.00	93.00	93.00	93.00	93.00
29.5500	93.00	93.00	93.00	93.00	93.00
29.8000	93.00	93.00	93.00	93.00	93.00
30.0500	93.00	93.00	93.00	93.00	93.00
30.3000	93.00	93.00	93.00	93.00	93.00
30.5500	93.00	93.00	93.00	93.00	93.00
30.8000	93.00	93.00	93.00	93.00	93.00
31.0500	93.00	93.00	93.00	93.00	93.00
31.3000	93.00	93.00	93.00	93.00	93.00
31.5500	93.00	93.00	93.00	93.00	93.00
31.8000	93.00	93.00	93.00	93.00	93.00
32.0500	93.00	93.00	93.00	93.00	93.00
32.3000	93.00	93.00	93.00	93.00	93.00
32.5500	93.00	93.00	93.00	93.00	93.00
32.8000	93.00				

TIME vs. ELEVATION (ft)

Output Time increment = .0500 hrs
Time on left represents time for first value in each row.

Time hrs					
9.5000	93.00	93.00	93.00	93.00	93.00
9.7500	93.00	93.00	93.00	93.00	93.00
10.0000	93.00	93.00	93.00	93.00	93.00
10.2500	93.00	93.01	93.01	93.01	93.01
10.5000	93.02	93.02	93.03	93.03	93.04
10.7500	93.04	93.05	93.06	93.07	93.08
11.0000	93.10	93.11	93.13	93.14	93.16
11.2500	93.18	93.21	93.23	93.26	93.29
11.5000	93.32	93.36	93.40	93.45	93.51
11.7500	93.58	93.66	93.76	93.90	94.07
12.0000	94.27	94.51	94.79	95.11	95.46
12.2500	95.84	96.25	96.68	97.11	97.53
12.5000	97.94	98.33	98.69	99.01	99.31
12.7500	99.58	99.82	100.03	100.20	100.32
13.0000	100.41	100.45	100.46	100.43	100.36
13.2500	100.26	100.13	99.98	99.81	99.62
13.5000	99.42	99.21	98.99	98.77	98.56
13.7500	98.37	98.18	98.01	97.85	97.69
14.0000	97.55	97.41	97.27	97.15	97.03
14.2500	96.92	96.81	96.71	96.61	96.52
14.5000	96.43	96.34	96.26	96.18	96.11
14.7500	96.04	95.97	95.91	95.85	95.79
15.0000	95.73	95.68	95.63	95.59	95.54
15.2500	95.50	95.46	95.42	95.38	95.34
15.5000	95.31	95.28	95.24	95.21	95.19
15.7500	95.16	95.13	95.11	95.08	95.06
16.0000	95.03	95.01	94.99	94.97	94.95
16.2500	94.93	94.91	94.88	94.86	94.84
16.5000	94.83	94.81	94.79	94.77	94.75
16.7500	94.74	94.72	94.71	94.69	94.68
17.0000	94.66	94.65	94.64	94.63	94.61
17.2500	94.60	94.59	94.58	94.57	94.56
17.5000	94.55	94.55	94.54	94.53	94.52
17.7500	94.51	94.50	94.50	94.49	94.48
18.0000	94.48	94.47	94.46	94.45	94.45
18.2500	94.44	94.43	94.43	94.42	94.41
18.5000	94.41	94.40	94.39	94.39	94.38
18.7500	94.37	94.37	94.36	94.35	94.35
19.0000	94.34	94.34	94.33	94.32	94.32
19.2500	94.31	94.31	94.30	94.29	94.29
19.5000	94.28	94.27	94.27	94.26	94.26
19.7500	94.25	94.24	94.24	94.23	94.23
20.0000	94.22	94.21	94.21	94.20	94.20

TIME vs. ELEVATION (ft)

Time hrs	Output Time increment = .0500 hrs Time on left represents time for first value in each row.				
20.2500	94.19	94.18	94.18	94.17	94.17
20.5000	94.16	94.15	94.15	94.14	94.14
20.7500	94.13	94.13	94.12	94.12	94.11
21.0000	94.11	94.10	94.10	94.09	94.09
21.2500	94.08	94.08	94.08	94.07	94.07
21.5000	94.07	94.06	94.06	94.06	94.05
21.7500	94.05	94.05	94.05	94.04	94.04
22.0000	94.04	94.04	94.04	94.03	94.03
22.2500	94.03	94.03	94.03	94.02	94.02
22.5000	94.02	94.02	94.02	94.02	94.02
22.7500	94.01	94.01	94.01	94.01	94.01
23.0000	94.01	94.01	94.00	94.00	94.00
23.2500	94.00	94.00	94.00	94.00	93.99
23.5000	93.99	93.99	93.99	93.99	93.99
23.7500	93.99	93.99	93.98	93.98	93.98
24.0000	93.98	93.98	93.98	93.97	93.97
24.2500	93.97	93.96	93.96	93.95	93.95
24.5000	93.94	93.93	93.92	93.90	93.89
24.7500	93.87	93.86	93.84	93.82	93.80
25.0000	93.78	93.75	93.73	93.71	93.69
25.2500	93.66	93.64	93.62	93.59	93.57
25.5000	93.55	93.53	93.51	93.49	93.47
25.7500	93.45	93.44	93.42	93.40	93.38
26.0000	93.36	93.35	93.33	93.32	93.30
26.2500	93.29	93.27	93.26	93.25	93.23
26.5000	93.22	93.21	93.20	93.19	93.18
26.7500	93.17	93.16	93.15	93.14	93.13
27.0000	93.13	93.12	93.11	93.11	93.10
27.2500	93.10	93.09	93.08	93.08	93.08
27.5000	93.07	93.07	93.06	93.06	93.06
27.7500	93.05	93.05	93.05	93.04	93.04
28.0000	93.04	93.04	93.03	93.03	93.03
28.2500	93.03	93.03	93.02	93.02	93.02
28.5000	93.02	93.02	93.02	93.02	93.02
28.7500	93.01	93.01	93.01	93.01	93.01
29.0000	93.01	93.01	93.01	93.01	93.01
29.2500	93.01	93.01	93.01	93.01	93.01
29.5000	93.01	93.00	93.00	93.00	93.00
29.7500	93.00	93.00	93.00	93.00	93.00
30.0000	93.00	93.00	93.00	93.00	93.00
30.2500	93.00	93.00	93.00	93.00	93.00
30.5000	93.00	93.00	93.00	93.00	93.00
30.7500	93.00	93.00	93.00	93.00	93.00
31.0000	93.00	93.00	93.00	93.00	93.00

TIME vs. ELEVATION (ft)

Time hrs	Output Time increment = .0500 hrs Time on left represents time for first value in each row.				
31.2500	93.00	93.00	93.00	93.00	93.00
31.5000	93.00	93.00	93.00	93.00	93.00
31.7500	93.00	93.00	93.00	93.00	93.00
32.0000	93.00	93.00	93.00	93.00	93.00
32.2500	93.00	93.00	93.00	93.00	93.00
32.5000	93.00	93.00	93.00	93.00	93.00
32.7500	93.00	93.00	93.00	93.00	93.00
33.0000	93.00	93.00	93.00	93.00	93.00
33.2500	93.00	93.00	93.00	93.00	

TIME vs. ELEVATION (ft)

Output Time increment = .0500 hrs
Time on left represents time for first value in each row.

Time hrs					
8.4000	93.00	93.00	93.00	93.00	93.00
8.6500	93.00	93.00	93.00	93.00	93.00
8.9000	93.00	93.00	93.00	93.00	93.00
9.1500	93.01	93.01	93.01	93.01	93.01
9.4000	93.02	93.02	93.03	93.03	93.04
9.6500	93.04	93.05	93.06	93.07	93.08
9.9000	93.09	93.10	93.11	93.12	93.13
10.1500	93.15	93.16	93.18	93.19	93.21
10.4000	93.23	93.25	93.27	93.29	93.31
10.6500	93.34	93.36	93.39	93.42	93.45
10.9000	93.48	93.52	93.55	93.59	93.62
11.1500	93.66	93.70	93.74	93.78	93.82
11.4000	93.87	93.92	93.97	94.03	94.09
11.6500	94.16	94.24	94.33	94.45	94.60
11.9000	94.79	95.02	95.29	95.61	96.00
12.1500	96.41	96.87	97.38	97.92	98.47
12.4000	99.03	99.60	100.18	100.75	101.30
12.6500	101.80	102.28	102.72	103.11	103.44
12.9000	103.73	103.97	104.14	104.25	104.32
13.1500	104.32	104.26	104.15	103.99	103.78
13.4000	103.54	103.26	102.95	102.63	102.29
13.6500	101.95	101.60	101.25	100.91	100.58
13.9000	100.26	99.95	99.66	99.38	99.10
14.1500	98.83	98.59	98.36	98.16	97.98
14.4000	97.80	97.65	97.50	97.37	97.24
14.6500	97.13	97.02	96.92	96.82	96.73
14.9000	96.65	96.57	96.49	96.42	96.35
15.1500	96.29	96.22	96.17	96.11	96.06
15.4000	96.01	95.96	95.92	95.88	95.83
15.6500	95.79	95.76	95.72	95.69	95.65
15.9000	95.62	95.59	95.56	95.53	95.50
16.1500	95.48	95.45	95.42	95.39	95.37
16.4000	95.34	95.32	95.29	95.27	95.24
16.6500	95.22	95.20	95.18	95.16	95.14
16.9000	95.12	95.11	95.09	95.07	95.06
17.1500	95.04	95.03	95.01	95.00	94.99
17.4000	94.98	94.96	94.95	94.94	94.93
17.6500	94.92	94.90	94.89	94.88	94.87
17.9000	94.86	94.85	94.84	94.84	94.83
18.1500	94.82	94.81	94.80	94.79	94.78
18.4000	94.77	94.77	94.76	94.75	94.74
18.6500	94.73	94.73	94.72	94.71	94.70
18.9000	94.70	94.69	94.68	94.67	94.67

TIME vs. ELEVATION (ft)

Time hrs	Output Time increment = .0500 hrs Time on left represents time for first value in each row.				
19.1500	94.66	94.65	94.64	94.64	94.63
19.4000	94.62	94.61	94.61	94.60	94.59
19.6500	94.58	94.58	94.57	94.56	94.55
19.9000	94.55	94.54	94.53	94.53	94.52
20.1500	94.51	94.50	94.50	94.49	94.48
20.4000	94.47	94.47	94.46	94.45	94.44
20.6500	94.43	94.43	94.42	94.41	94.40
20.9000	94.40	94.39	94.38	94.38	94.37
21.1500	94.37	94.36	94.35	94.35	94.34
21.4000	94.34	94.33	94.33	94.32	94.32
21.6500	94.32	94.31	94.31	94.31	94.30
21.9000	94.30	94.30	94.29	94.29	94.29
22.1500	94.28	94.28	94.28	94.28	94.27
22.4000	94.27	94.27	94.27	94.26	94.26
22.6500	94.26	94.26	94.26	94.25	94.25
22.9000	94.25	94.25	94.25	94.24	94.24
23.1500	94.24	94.24	94.24	94.24	94.23
23.4000	94.23	94.23	94.23	94.23	94.22
23.6500	94.22	94.22	94.22	94.22	94.22
23.9000	94.21	94.21	94.21	94.21	94.21
24.1500	94.20	94.20	94.20	94.19	94.19
24.4000	94.18	94.17	94.16	94.15	94.13
24.6500	94.12	94.10	94.08	94.06	94.04
24.9000	94.02	93.99	93.97	93.94	93.91
25.1500	93.88	93.85	93.82	93.79	93.76
25.4000	93.73	93.70	93.67	93.65	93.62
25.6500	93.59	93.57	93.55	93.53	93.50
25.9000	93.48	93.46	93.45	93.43	93.41
26.1500	93.39	93.37	93.35	93.34	93.32
26.4000	93.30	93.29	93.28	93.26	93.25
26.6500	93.24	93.22	93.21	93.20	93.19
26.9000	93.18	93.17	93.16	93.15	93.14
27.1500	93.14	93.13	93.12	93.11	93.11
27.4000	93.10	93.10	93.09	93.08	93.08
27.6500	93.07	93.07	93.07	93.06	93.06
27.9000	93.05	93.05	93.05	93.05	93.04
28.1500	93.04	93.04	93.04	93.03	93.03
28.4000	93.03	93.03	93.03	93.02	93.02
28.6500	93.02	93.02	93.02	93.02	93.02
28.9000	93.01	93.01	93.01	93.01	93.01
29.1500	93.01	93.01	93.01	93.01	93.01
29.4000	93.01	93.01	93.01	93.01	93.01
29.6500	93.01	93.01	93.00	93.00	93.00
29.9000	93.00	93.00	93.00	93.00	93.00

TIME vs. ELEVATION (ft)

Time hrs	Output Time increment = .0500 hrs Time on left represents time for first value in each row.				
30.1500	93.00	93.00	93.00	93.00	93.00
30.4000	93.00	93.00	93.00	93.00	93.00
30.6500	93.00	93.00	93.00	93.00	93.00
30.9000	93.00	93.00	93.00	93.00	93.00
31.1500	93.00	93.00	93.00	93.00	93.00
31.4000	93.00	93.00	93.00	93.00	93.00
31.6500	93.00	93.00	93.00	93.00	93.00
31.9000	93.00	93.00	93.00	93.00	93.00
32.1500	93.00	93.00	93.00	93.00	93.00
32.4000	93.00	93.00	93.00	93.00	93.00
32.6500	93.00	93.00	93.00	93.00	93.00
32.9000	93.00	93.00	93.00	93.00	93.00
33.1500	93.00	93.00	93.00	93.00	93.00
33.4000	93.00	93.00	93.00	93.00	93.00

TIME vs. ELEVATION (ft)

Time hrs	Output Time increment = .0500 hrs Time on left represents time for first value in each row.				
6.9000	93.00	93.00	93.00	93.00	93.00
7.1500	93.00	93.00	93.00	93.00	93.00
7.4000	93.00	93.00	93.00	93.00	93.00
7.6500	93.01	93.01	93.01	93.01	93.01
7.9000	93.02	93.02	93.03	93.03	93.04
8.1500	93.04	93.05	93.06	93.06	93.07
8.4000	93.08	93.09	93.10	93.11	93.12
8.6500	93.13	93.15	93.16	93.17	93.19
8.9000	93.21	93.22	93.24	93.26	93.28
9.1500	93.30	93.32	93.34	93.36	93.39
9.4000	93.41	93.44	93.47	93.49	93.52
9.6500	93.55	93.58	93.60	93.63	93.66
9.9000	93.68	93.71	93.74	93.77	93.79
10.1500	93.82	93.85	93.88	93.91	93.94
10.4000	93.97	94.00	94.03	94.07	94.10
10.6500	94.13	94.17	94.20	94.24	94.28
10.9000	94.32	94.36	94.40	94.45	94.50
11.1500	94.55	94.60	94.65	94.71	94.77
11.4000	94.83	94.90	94.97	95.05	95.13
11.6500	95.23	95.35	95.48	95.65	95.86
11.9000	96.14	96.47	96.85	97.31	97.85
12.1500	98.43	99.07	99.80	100.60	101.47
12.4000	102.37	103.29	104.23	105.15	105.84
12.6500	106.19	106.34	106.41	106.43	106.42
12.9000	106.41	106.37	106.32	106.26	106.19
13.1500	106.11	106.02	105.92	105.80	105.69
13.4000	105.58	105.47	105.34	105.20	105.06
13.6500	104.91	104.71	104.49	104.23	103.94
13.9000	103.63	103.30	102.96	102.60	102.25
14.1500	101.90	101.55	101.20	100.87	100.55
14.4000	100.24	99.95	99.67	99.41	99.16
14.6500	98.91	98.68	98.48	98.29	98.12
14.9000	97.97	97.83	97.70	97.59	97.48
15.1500	97.38	97.29	97.20	97.12	97.04
15.4000	96.97	96.90	96.84	96.78	96.72
15.6500	96.67	96.62	96.57	96.52	96.48
15.9000	96.43	96.39	96.35	96.31	96.27
16.1500	96.23	96.19	96.16	96.12	96.08
16.4000	96.05	96.02	95.99	95.95	95.92
16.6500	95.89	95.86	95.84	95.81	95.79
16.9000	95.76	95.74	95.72	95.69	95.67
17.1500	95.65	95.63	95.62	95.60	95.58
17.4000	95.56	95.55	95.53	95.52	95.51

TIME vs. ELEVATION (ft)

Time hrs	Output Time increment = .0500 hrs Time on left represents time for first value in each row.				
17.6500	95.49	95.48	95.46	95.45	95.44
17.9000	95.42	95.41	95.40	95.39	95.38
18.1500	95.36	95.35	95.34	95.33	95.32
18.4000	95.31	95.30	95.29	95.28	95.27
18.6500	95.26	95.25	95.23	95.22	95.21
18.9000	95.20	95.19	95.18	95.17	95.16
19.1500	95.15	95.15	95.14	95.13	95.12
19.4000	95.11	95.10	95.09	95.08	95.07
19.6500	95.06	95.05	95.04	95.03	95.02
19.9000	95.01	95.00	94.99	94.98	94.97
20.1500	94.96	94.95	94.94	94.93	94.92
20.4000	94.91	94.90	94.89	94.88	94.87
20.6500	94.86	94.85	94.84	94.83	94.82
20.9000	94.81	94.80	94.79	94.78	94.78
21.1500	94.77	94.76	94.75	94.75	94.74
21.4000	94.74	94.73	94.72	94.72	94.71
21.6500	94.71	94.70	94.70	94.69	94.69
21.9000	94.69	94.68	94.68	94.67	94.67
22.1500	94.67	94.66	94.66	94.66	94.66
22.4000	94.65	94.65	94.65	94.64	94.64
22.6500	94.64	94.64	94.63	94.63	94.63
22.9000	94.63	94.62	94.62	94.62	94.62
23.1500	94.61	94.61	94.61	94.61	94.60
23.4000	94.60	94.60	94.60	94.60	94.59
23.6500	94.59	94.59	94.59	94.59	94.58
23.9000	94.58	94.58	94.58	94.57	94.57
24.1500	94.57	94.56	94.56	94.55	94.54
24.4000	94.53	94.52	94.51	94.49	94.47
24.6500	94.45	94.43	94.40	94.37	94.34
24.9000	94.30	94.27	94.23	94.20	94.16
25.1500	94.12	94.08	94.04	94.00	93.97
25.4000	93.93	93.89	93.85	93.82	93.78
25.6500	93.75	93.72	93.68	93.65	93.63
25.9000	93.60	93.57	93.55	93.53	93.50
26.1500	93.48	93.46	93.44	93.42	93.40
26.4000	93.38	93.37	93.35	93.33	93.32
26.6500	93.30	93.29	93.27	93.26	93.24
26.9000	93.23	93.22	93.21	93.20	93.19
27.1500	93.18	93.17	93.16	93.15	93.14
27.4000	93.13	93.12	93.12	93.11	93.10
27.6500	93.10	93.09	93.09	93.08	93.08
27.9000	93.07	93.07	93.06	93.06	93.06
28.1500	93.05	93.05	93.05	93.04	93.04
28.4000	93.04	93.04	93.03	93.03	93.03

TIME vs. ELEVATION (ft)

Time hrs	Output Time increment = .0500 hrs Time on left represents time for first value in each row.				
28.6500	93.03	93.03	93.02	93.02	93.02
28.9000	93.02	93.02	93.02	93.02	93.01
29.1500	93.01	93.01	93.01	93.01	93.01
29.4000	93.01	93.01	93.01	93.01	93.01
29.6500	93.01	93.01	93.01	93.01	93.01
29.9000	93.01	93.00	93.00	93.00	93.00
30.1500	93.00	93.00	93.00	93.00	93.00
30.4000	93.00	93.00	93.00	93.00	93.00
30.6500	93.00	93.00	93.00	93.00	93.00
30.9000	93.00	93.00	93.00	93.00	93.00
31.1500	93.00	93.00	93.00	93.00	93.00
31.4000	93.00	93.00	93.00	93.00	93.00
31.6500	93.00	93.00	93.00	93.00	93.00
31.9000	93.00	93.00	93.00	93.00	93.00
32.1500	93.00	93.00	93.00	93.00	93.00
32.4000	93.00	93.00	93.00	93.00	93.00
32.6500	93.00	93.00	93.00	93.00	93.00
32.9000	93.00	93.00	93.00	93.00	93.00
33.1500	93.00	93.00	93.00	93.00	93.00
33.4000	93.00	93.00	93.00	93.00	93.00
33.6500	93.00	93.00	93.00	93.00	

TIME vs. VOLUME (ac-ft)

Output Time increment = .0500 hrs
Time on left represents time for first value in each row.

Time hrs					
11.5500	.000	.000	.003	.010	.022
11.8000	.044	.096	.189	.320	.504
12.0500	.767	1.115	1.544	2.076	2.740
12.3000	3.518	4.384	5.325	6.331	7.364
12.5500	8.417	9.458	10.438	11.373	12.250
12.8000	13.046	13.735	14.344	14.863	15.279
13.0500	15.605	15.851	16.008	16.073	16.060
13.3000	15.980	15.842	15.656	15.428	15.171
13.5500	14.895	14.606	14.306	14.003	13.703
13.8000	13.406	13.113	12.818	12.526	12.238
14.0500	11.956	11.681	11.415	11.157	10.907
14.3000	10.667	10.436	10.213	9.999	9.795
14.5500	9.596	9.399	9.209	9.025	8.848
14.8000	8.677	8.512	8.355	8.204	8.059
15.0500	7.920	7.788	7.662	7.541	7.426
15.3000	7.317	7.212	7.112	7.017	6.927
15.5500	6.840	6.758	6.679	6.604	6.531
15.8000	6.462	6.396	6.330	6.265	6.201
16.0500	6.138	6.075	6.013	5.952	5.891
16.3000	5.831	5.772	5.713	5.655	5.598
16.5500	5.542	5.488	5.434	5.382	5.332
16.8000	5.283	5.235	5.189	5.144	5.100
17.0500	5.058	5.018	4.978	4.940	4.903
17.3000	4.868	4.834	4.800	4.768	4.737
17.5500	4.708	4.679	4.651	4.624	4.597
17.8000	4.572	4.547	4.523	4.499	4.477
18.0500	4.454	4.432	4.411	4.390	4.370
18.3000	4.350	4.330	4.310	4.291	4.273
18.5500	4.254	4.236	4.217	4.199	4.182
18.8000	4.164	4.146	4.129	4.112	4.095
19.0500	4.078	4.061	4.044	4.027	4.010
19.3000	3.993	3.976	3.960	3.943	3.926
19.5500	3.910	3.893	3.876	3.860	3.843
19.8000	3.826	3.810	3.793	3.776	3.759
20.0500	3.743	3.726	3.709	3.692	3.676
20.3000	3.659	3.642	3.626	3.609	3.593
20.5500	3.576	3.560	3.544	3.528	3.513
20.8000	3.498	3.483	3.468	3.454	3.440
21.0500	3.427	3.414	3.401	3.389	3.377
21.3000	3.366	3.355	3.345	3.335	3.325
21.5500	3.316	3.307	3.299	3.291	3.283
21.8000	3.275	3.268	3.261	3.255	3.249
22.0500	3.242	3.237	3.231	3.225	3.220

TIME vs. VOLUME (ac-ft)

Output Time increment = .0500 hrs
Time on left represents time for first value in each row.

Time hrs					
22.3000	3.215	3.210	3.205	3.201	3.196
22.5500	3.192	3.187	3.183	3.179	3.175
22.8000	3.171	3.167	3.164	3.160	3.156
23.0500	3.152	3.149	3.145	3.141	3.137
23.3000	3.133	3.128	3.124	3.120	3.115
23.5500	3.111	3.107	3.102	3.098	3.093
23.8000	3.088	3.084	3.079	3.074	3.069
24.0500	3.064	3.058	3.051	3.043	3.033
24.3000	3.022	3.008	2.991	2.971	2.948
24.5500	2.921	2.889	2.852	2.811	2.766
24.8000	2.715	2.661	2.603	2.540	2.475
25.0500	2.407	2.336	2.263	2.188	2.113
25.3000	2.036	1.960	1.883	1.808	1.733
25.5500	1.659	1.587	1.517	1.448	1.382
25.8000	1.317	1.255	1.194	1.136	1.080
26.0500	1.026	.975	.925	.877	.832
26.3000	.788	.747	.707	.669	.633
26.5500	.599	.566	.535	.505	.477
26.8000	.450	.425	.401	.378	.357
27.0500	.336	.317	.299	.281	.265
27.3000	.249	.235	.221	.208	.195
27.5500	.184	.173	.162	.153	.143
27.8000	.135	.126	.119	.111	.104
28.0500	.098	.092	.086	.081	.076
28.3000	.071	.066	.062	.058	.054
28.5500	.051	.048	.044	.042	.039
28.8000	.036	.034	.032	.030	.028
29.0500	.026	.024	.023	.021	.020
29.3000	.019	.017	.016	.015	.014
29.5500	.013	.012	.012	.011	.010
29.8000	.010	.009	.008	.008	.007
30.0500	.007	.006	.006	.006	.005
30.3000	.005	.005	.004	.004	.004
30.5500	.004	.003	.003	.003	.003
30.8000	.003	.002	.002	.002	.002
31.0500	.002	.002	.002	.001	.001
31.3000	.001	.001	.001	.001	.001
31.5500	.001	.001	.001	.001	.001
31.8000	.001	.000	.000	.000	.000
32.0500	.000	.000	.000	.000	.000
32.3000	.000	.000	.000	.000	.000
32.5500	.000	.000	.000	.000	.000
32.8000	.000				

TIME vs. VOLUME (ac-ft)

Time hrs	Output Time increment = .0500 hrs Time on left represents time for first value in each row.				
9.5000	.000	.000	.000	.000	.000
9.7500	.000	.001	.001	.002	.003
10.0000	.005	.007	.011	.015	.021
10.2500	.029	.038	.050	.065	.082
10.5000	.103	.128	.158	.192	.231
10.7500	.276	.327	.383	.447	.520
11.0000	.600	.689	.787	.896	1.015
11.2500	1.145	1.289	1.448	1.619	1.809
11.5000	2.021	2.257	2.516	2.825	3.208
11.7500	3.645	4.159	4.841	5.741	6.825
12.0000	8.126	9.748	11.649	13.806	16.232
12.2500	18.951	21.920	25.070	28.288	31.491
12.5000	34.657	37.727	40.574	43.167	45.605
12.7500	47.916	49.936	51.657	53.086	54.188
13.0000	54.902	55.271	55.337	55.078	54.486
13.2500	53.614	52.512	51.229	49.779	48.200
13.5000	46.522	44.780	43.012	41.242	39.573
13.7500	38.006	36.545	35.187	33.900	32.704
14.0000	31.582	30.512	29.503	28.561	27.673
14.2500	26.822	26.016	25.256	24.533	23.849
14.5000	23.195	22.572	21.976	21.414	20.885
14.7500	20.384	19.904	19.445	19.010	18.595
15.0000	18.201	17.829	17.478	17.143	16.826
15.2500	16.528	16.238	15.960	15.695	15.442
15.5000	15.201	14.971	14.751	14.542	14.342
15.7500	14.150	13.967	13.791	13.622	13.459
16.0000	13.302	13.150	13.000	12.850	12.703
16.2500	12.558	12.414	12.273	12.135	11.999
16.5000	11.866	11.738	11.615	11.495	11.380
16.7500	11.269	11.163	11.060	10.961	10.866
17.0000	10.775	10.687	10.602	10.521	10.443
17.2500	10.368	10.296	10.227	10.160	10.096
17.5000	10.034	9.974	9.917	9.861	9.807
17.7500	9.755	9.704	9.654	9.604	9.555
18.0000	9.506	9.457	9.409	9.362	9.315
18.2500	9.269	9.223	9.178	9.133	9.088
18.5000	9.044	9.000	8.957	8.914	8.871
18.7500	8.829	8.786	8.744	8.703	8.661
19.0000	8.620	8.579	8.538	8.497	8.456
19.2500	8.415	8.375	8.334	8.294	8.253
19.5000	8.213	8.173	8.132	8.092	8.052
19.7500	8.012	7.972	7.932	7.892	7.851
20.0000	7.811	7.771	7.731	7.691	7.651

TIME vs. VOLUME (ac-ft)

Output Time increment = .0500 hrs
Time on left represents time for first value in each row.

Time hrs					
20.2500	7.612	7.572	7.532	7.493	7.454
20.5000	7.415	7.377	7.339	7.301	7.265
20.7500	7.229	7.193	7.159	7.125	7.093
21.0000	7.061	7.030	7.001	6.972	6.945
21.2500	6.918	6.893	6.868	6.845	6.823
21.5000	6.801	6.781	6.761	6.743	6.725
21.7500	6.707	6.691	6.675	6.660	6.645
22.0000	6.631	6.617	6.604	6.592	6.579
22.2500	6.567	6.556	6.544	6.533	6.523
22.5000	6.512	6.502	6.492	6.482	6.473
22.7500	6.463	6.454	6.445	6.436	6.427
23.0000	6.418	6.410	6.401	6.393	6.385
23.2500	6.376	6.368	6.359	6.350	6.342
23.5000	6.333	6.324	6.315	6.306	6.296
23.7500	6.287	6.278	6.269	6.259	6.250
24.0000	6.240	6.228	6.215	6.201	6.183
24.2500	6.161	6.136	6.106	6.067	6.021
24.5000	5.968	5.906	5.833	5.750	5.658
24.7500	5.557	5.446	5.327	5.201	5.068
25.0000	4.930	4.788	4.642	4.494	4.346
25.2500	4.196	4.047	3.902	3.759	3.619
25.5000	3.484	3.354	3.229	3.107	2.985
25.7500	2.866	2.747	2.631	2.517	2.405
26.0000	2.297	2.191	2.089	1.989	1.894
26.2500	1.801	1.712	1.627	1.545	1.466
26.5000	1.390	1.318	1.249	1.183	1.120
26.7500	1.059	1.002	.947	.895	.846
27.0000	.799	.754	.712	.672	.634
27.2500	.597	.563	.531	.500	.471
27.5000	.443	.417	.392	.369	.347
27.7500	.326	.307	.288	.271	.254
28.0000	.238	.224	.210	.197	.184
28.2500	.173	.162	.152	.142	.133
28.5000	.124	.116	.109	.102	.095
28.7500	.089	.083	.078	.073	.068
29.0000	.064	.060	.056	.052	.049
29.2500	.046	.043	.040	.037	.035
29.5000	.033	.031	.029	.027	.025
29.7500	.023	.022	.021	.019	.018
30.0000	.017	.016	.015	.014	.013
30.2500	.012	.011	.011	.010	.009
30.5000	.009	.008	.008	.007	.007
30.7500	.006	.006	.005	.005	.005
31.0000	.004	.004	.004	.004	.003

TIME vs. VOLUME (ac-ft)

Output Time increment = .0500 hrs
Time on left represents time for first value in each row.

Time hrs					
31.2500	.003	.003	.003	.003	.002
31.5000	.002	.002	.002	.002	.002
31.7500	.002	.002	.001	.001	.001
32.0000	.001	.001	.001	.001	.001
32.2500	.001	.001	.001	.001	.000
32.5000	.000	.000	.000	.000	.000
32.7500	.000	.000	.000	.000	.000
33.0000	.000	.000	.000	.000	.000
33.2500	.000	.000	.000	.000	

TIME vs. VOLUME (ac-ft)

Time hrs	Output Time increment = .0500 hrs Time on left represents time for first value in each row.				
8.4000	.000	.000	.000	.000	.000
8.6500	.000	.001	.002	.003	.004
8.9000	.006	.009	.013	.018	.025
9.1500	.033	.043	.056	.071	.089
9.4000	.110	.134	.162	.194	.229
9.6500	.269	.313	.361	.413	.471
9.9000	.533	.599	.671	.748	.829
10.1500	.916	1.009	1.108	1.212	1.322
10.4000	1.440	1.563	1.694	1.833	1.980
10.6500	2.134	2.298	2.471	2.655	2.849
10.9000	3.054	3.268	3.486	3.707	3.936
11.1500	4.174	4.419	4.675	4.944	5.228
11.4000	5.525	5.843	6.190	6.559	6.944
11.6500	7.392	7.937	8.569	9.326	10.320
11.9000	11.617	13.186	15.047	17.344	20.064
12.1500	23.100	26.502	30.315	34.463	38.853
12.4000	43.360	48.029	52.927	57.888	62.677
12.6500	67.210	71.560	75.644	79.295	82.487
12.9000	85.272	87.578	89.270	90.404	91.018
13.1500	91.058	90.492	89.377	87.779	85.755
13.4000	83.402	80.725	77.834	74.802	71.692
13.6500	68.530	65.368	62.280	59.287	56.390
13.9000	53.630	51.036	48.555	46.179	43.900
14.1500	41.747	39.770	37.972	36.359	34.912
14.4000	33.576	32.364	31.265	30.236	29.282
14.6500	28.403	27.594	26.828	26.107	25.434
14.9000	24.808	24.219	23.664	23.135	22.637
15.1500	22.164	21.717	21.299	20.904	20.529
15.4000	20.175	19.837	19.512	19.202	18.907
15.6500	18.627	18.358	18.102	17.857	17.622
15.9000	17.396	17.179	16.969	16.766	16.568
16.1500	16.371	16.177	15.985	15.797	15.612
16.4000	15.430	15.252	15.079	14.913	14.753
16.6500	14.598	14.450	14.308	14.171	14.040
16.9000	13.913	13.793	13.676	13.565	13.458
17.1500	13.355	13.256	13.161	13.070	12.980
17.4000	12.892	12.806	12.723	12.642	12.563
17.6500	12.486	12.412	12.339	12.268	12.198
17.9000	12.131	12.065	12.000	11.936	11.874
18.1500	11.813	11.753	11.694	11.635	11.578
18.4000	11.521	11.466	11.410	11.356	11.302
18.6500	11.248	11.195	11.142	11.090	11.038
18.9000	10.986	10.935	10.884	10.833	10.782

TIME vs. VOLUME (ac-ft)

Output Time increment = .0500 hrs
Time on left represents time for first value in each row.

Time hrs					
19.1500	10.732	10.682	10.632	10.582	10.532
19.4000	10.482	10.432	10.383	10.333	10.284
19.6500	10.234	10.185	10.135	10.086	10.037
19.9000	9.988	9.938	9.889	9.840	9.791
20.1500	9.742	9.693	9.643	9.593	9.541
20.4000	9.490	9.438	9.386	9.334	9.283
20.6500	9.232	9.182	9.132	9.083	9.035
20.9000	8.989	8.943	8.899	8.856	8.815
21.1500	8.775	8.736	8.699	8.663	8.629
21.4000	8.596	8.565	8.534	8.505	8.478
21.6500	8.451	8.426	8.401	8.378	8.355
21.9000	8.333	8.312	8.292	8.273	8.254
22.1500	8.236	8.218	8.201	8.184	8.168
22.4000	8.153	8.137	8.122	8.108	8.093
22.6500	8.079	8.065	8.052	8.039	8.025
22.9000	8.012	8.000	7.987	7.975	7.962
23.1500	7.950	7.938	7.926	7.915	7.903
23.4000	7.891	7.880	7.868	7.857	7.845
23.6500	7.834	7.823	7.812	7.800	7.789
23.9000	7.778	7.767	7.755	7.741	7.726
24.1500	7.708	7.686	7.659	7.628	7.590
24.4000	7.543	7.485	7.419	7.342	7.251
24.6500	7.149	7.036	6.912	6.777	6.633
24.9000	6.481	6.320	6.149	5.969	5.783
25.1500	5.593	5.400	5.204	5.009	4.817
25.4000	4.628	4.442	4.262	4.088	3.920
25.6500	3.759	3.605	3.459	3.320	3.187
25.9000	3.058	2.931	2.806	2.683	2.564
26.1500	2.448	2.334	2.225	2.119	2.016
26.4000	1.917	1.822	1.731	1.643	1.559
26.6500	1.478	1.401	1.327	1.256	1.189
26.9000	1.125	1.064	1.006	.950	.897
27.1500	.847	.800	.755	.712	.671
27.4000	.633	.596	.561	.529	.498
27.6500	.468	.441	.414	.389	.366
27.9000	.344	.323	.303	.285	.267
28.1500	.250	.235	.220	.206	.193
28.4000	.181	.169	.158	.148	.138
28.6500	.130	.121	.113	.106	.099
28.9000	.093	.087	.081	.076	.071
29.1500	.066	.062	.058	.054	.051
29.4000	.048	.045	.042	.039	.036
29.6500	.034	.032	.030	.028	.026
29.9000	.024	.023	.021	.020	.019

TIME vs. VOLUME (ac-ft)

Output Time increment = .0500 hrs
Time on left represents time for first value in each row.

Time hrs					
30.1500	.018	.016	.015	.014	.013
30.4000	.013	.012	.011	.010	.010
30.6500	.009	.008	.008	.007	.007
30.9000	.006	.006	.006	.005	.005
31.1500	.005	.004	.004	.004	.004
31.4000	.003	.003	.003	.003	.003
31.6500	.002	.002	.002	.002	.002
31.9000	.002	.002	.001	.001	.001
32.1500	.001	.001	.001	.001	.001
32.4000	.001	.001	.001	.001	.001
32.6500	.000	.000	.000	.000	.000
32.9000	.000	.000	.000	.000	.000
33.1500	.000	.000	.000	.000	.000
33.4000	.000	.000	.000	.000	.000

TIME vs. VOLUME (ac-ft)

Output Time increment = .0500 hrs
Time on left represents time for first value in each row.

Time hrs					
6.9000	.000	.000	.000	.000	.000
7.1500	.001	.001	.002	.003	.005
7.4000	.008	.011	.015	.021	.028
7.6500	.037	.047	.060	.075	.093
7.9000	.113	.136	.163	.192	.225
8.1500	.261	.301	.344	.392	.443
8.4000	.498	.557	.621	.688	.760
8.6500	.836	.917	1.002	1.092	1.187
8.9000	1.287	1.393	1.503	1.620	1.742
9.1500	1.870	2.004	2.144	2.290	2.443
9.4000	2.601	2.766	2.937	3.114	3.291
9.6500	3.467	3.641	3.815	3.988	4.162
9.9000	4.335	4.509	4.684	4.860	5.038
10.1500	5.218	5.402	5.589	5.780	5.976
10.4000	6.179	6.386	6.593	6.804	7.020
10.6500	7.239	7.466	7.701	7.946	8.199
10.9000	8.463	8.743	9.035	9.341	9.664
11.1500	9.996	10.339	10.698	11.078	11.481
11.4000	11.904	12.358	12.859	13.392	13.956
11.6500	14.626	15.459	16.433	17.576	19.105
11.9000	21.103	23.487	26.323	29.801	33.900
12.1500	38.484	43.658	49.698	56.610	64.245
12.4000	72.427	81.048	90.162	99.373	106.422
12.6500	110.051	111.685	112.412	112.599	112.519
12.9000	112.352	112.006	111.429	110.757	110.042
13.1500	109.216	108.269	107.212	106.057	104.893
13.4000	103.754	102.582	101.282	99.891	98.476
13.6500	96.892	94.968	92.709	90.126	87.294
13.9000	84.268	81.124	77.890	74.590	71.304
14.1500	68.077	64.912	61.834	58.901	56.115
14.4000	53.470	51.001	48.677	46.479	44.367
14.6500	42.374	40.543	38.899	37.402	36.076
14.9000	34.890	33.800	32.810	31.914	31.094
15.1500	30.322	29.609	28.952	28.342	27.772
15.4000	27.237	26.730	26.253	25.801	25.375
15.6500	24.974	24.592	24.229	23.885	23.552
15.9000	23.229	22.916	22.615	22.321	22.036
16.1500	21.758	21.487	21.222	20.962	20.710
16.4000	20.465	20.225	19.990	19.763	19.544
16.6500	19.332	19.128	18.933	18.746	18.565
16.9000	18.392	18.227	18.067	17.914	17.767
17.1500	17.626	17.490	17.360	17.235	17.115
17.4000	16.999	16.888	16.781	16.678	16.578

TIME vs. VOLUME (ac-ft)

Output Time increment = .0500 hrs
Time on left represents time for first value in each row.

Time hrs					
17.6500	16.479	16.383	16.288	16.195	16.104
17.9000	16.015	15.927	15.841	15.756	15.673
18.1500	15.592	15.511	15.432	15.354	15.277
18.4000	15.201	15.125	15.051	14.977	14.904
18.6500	14.832	14.760	14.689	14.618	14.548
18.9000	14.478	14.408	14.339	14.270	14.202
19.1500	14.133	14.065	13.997	13.929	13.862
19.4000	13.794	13.727	13.660	13.593	13.526
19.6500	13.459	13.392	13.325	13.258	13.192
19.9000	13.125	13.059	12.990	12.920	12.850
20.1500	12.780	12.709	12.638	12.567	12.495
20.4000	12.424	12.354	12.284	12.214	12.145
20.6500	12.077	12.011	11.945	11.881	11.819
20.9000	11.758	11.699	11.641	11.586	11.533
21.1500	11.482	11.432	11.385	11.339	11.296
21.4000	11.254	11.214	11.176	11.140	11.105
21.6500	11.072	11.039	11.009	10.979	10.951
21.9000	10.924	10.897	10.872	10.848	10.824
22.1500	10.801	10.779	10.758	10.737	10.716
22.4000	10.696	10.677	10.658	10.639	10.621
22.6500	10.603	10.585	10.568	10.551	10.534
22.9000	10.517	10.501	10.485	10.469	10.453
23.1500	10.437	10.422	10.406	10.391	10.376
23.4000	10.361	10.346	10.331	10.316	10.301
23.6500	10.286	10.272	10.257	10.242	10.228
23.9000	10.213	10.199	10.183	10.164	10.144
24.1500	10.120	10.091	10.054	10.011	9.960
24.4000	9.895	9.816	9.726	9.619	9.491
24.6500	9.344	9.181	9.001	8.805	8.595
24.9000	8.373	8.141	7.902	7.655	7.405
25.1500	7.153	6.902	6.651	6.404	6.156
25.4000	5.909	5.663	5.423	5.191	4.965
25.6500	4.746	4.537	4.337	4.146	3.964
25.9000	3.791	3.627	3.472	3.325	3.187
26.1500	3.052	2.920	2.791	2.666	2.543
26.4000	2.425	2.310	2.199	2.091	1.988
26.6500	1.888	1.793	1.701	1.613	1.529
26.9000	1.449	1.372	1.298	1.228	1.162
27.1500	1.098	1.037	.980	.925	.873
27.4000	.823	.777	.732	.690	.650
27.6500	.612	.576	.542	.510	.479
27.9000	.450	.423	.398	.373	.350
28.1500	.329	.308	.289	.270	.253
28.4000	.237	.222	.208	.194	.182

TIME vs. VOLUME (ac-ft)

Output Time increment = .0500 hrs
Time on left represents time for first value in each row.

Time hrs					
28.6500	.170	.159	.149	.139	.130
28.9000	.122	.114	.107	.100	.093
29.1500	.087	.082	.076	.071	.067
29.4000	.063	.058	.055	.051	.048
29.6500	.045	.042	.039	.037	.034
29.9000	.032	.030	.028	.026	.025
30.1500	.023	.022	.020	.019	.018
30.4000	.016	.015	.014	.013	.013
30.6500	.012	.011	.010	.010	.009
30.9000	.008	.008	.007	.007	.006
31.1500	.006	.006	.005	.005	.005
31.4000	.004	.004	.004	.004	.003
31.6500	.003	.003	.003	.003	.002
31.9000	.002	.002	.002	.002	.002
32.1500	.002	.001	.001	.001	.001
32.4000	.001	.001	.001	.001	.001
32.6500	.001	.001	.001	.001	.000
32.9000	.000	.000	.000	.000	.000
33.1500	.000	.000	.000	.000	.000
33.4000	.000	.000	.000	.000	.000
33.6500	.000	.000	.000	.000	

Elevation (ft)	Planimeter (sq.in)	Area (acres)	A1+A2+sqr(A1*A2) (acres)	Volume (ac-ft)	Volume Sum (ac-ft)
93.00	-----	6.2500	.0000	.000	.000
94.00	-----	6.5000	19.1238	6.375	6.375
95.00	-----	6.8800	20.0673	6.689	13.064
96.00	-----	7.1900	21.1033	7.034	20.098
97.00	-----	7.5000	22.0334	7.344	27.443
98.00	-----	7.8300	22.9932	7.664	35.107
99.00	-----	8.1500	23.9684	7.989	43.096
100.00	-----	8.5000	24.9732	8.324	51.421
101.00	-----	8.7900	25.9338	8.645	60.065
102.00	-----	9.1200	26.8635	8.954	69.020
103.00	-----	9.4400	27.8386	9.280	78.299
104.00	-----	9.7700	28.8136	9.605	87.904
105.00	-----	10.1000	29.8036	9.935	97.839
106.00	-----	10.4000	30.7489	10.250	108.088
107.00	-----	10.7000	31.6489	10.550	118.638

POND VOLUME EQUATIONS

* Incremental volume computed by the Conic Method for Reservoir Volumes.

Volume = (1/3) * (EL2-EL1) * (Area1 + Area2 + sq.rt.(Area1*Area2))

where: EL1, EL2 = Lower and upper elevations of the increment
Area1,Area2 = Areas computed for EL1, EL2, respectively
Volume = Incremental volume between EL1 and EL2

REQUESTED POND WS ELEVATIONS:

Min. Elev.= 93.00 ft
Increment = .50 ft
Max. Elev.= 107.00 ft

****
OUTLET CONNECTIVITY
****

---> Forward Flow Only (UpStream to DnStream)
<--- Reverse Flow Only (DnStream to UpStream)
<---> Forward and Reverse Both Allowed

Structure	No.		Outfall	E1, ft	E2, ft
Culvert-Box	C0	--->	TW	93.000	107.000
Weir-Rectangular	W1	--->	TW	105.000	107.000
Weir-Rectangular	W0	--->	TW	105.500	107.000
TW SETUP, DS Channel					

```
OUTLET STRUCTURE INPUT DATA


Structure ID       = C0
Structure Type     = Culvert-Box
------------------------------------
No. Barrels        =         3
Barrel Height      =      5.00 ft
Barrel Width       =     15.00 ft
Upstream Invert    =     93.00 ft
Dnstream Invert    =     92.00 ft
Horiz. Length      =    100.00 ft
Barrel Length      =    100.01 ft
Barrel Slope       =    .01000 ft/ft

OUTLET CONTROL DATA...
Mannings n         =     .0130
Ke                 =     .5000  (forward entrance loss)
Kb                 =   .002130  (per ft of full flow)
Kr                 =     .5000  (reverse entrance loss)
HW Convergence     =      .001  +/- ft

INLET CONTROL DATA...
Equation form      =         1
Inlet Control K    =     .0260
Inlet Control M    =    1.0000
Inlet Control c    =    .03470
Inlet Control Y    =     .8100
T1 ratio (HW/D)    =     1.173
T2 ratio (HW/D)    =     1.360
Slope Factor       =     -.500
Calc inlet only    = Yes

Use unsubmerged inlet control Form 1 equ. below T1 elev.
Use   submerged inlet control Form 1 equ. above T2 elev.

In transition zone between unsubmerged and submerged inlet control,
interpolate between flows at T1 & T2...
At T1 Elev =      98.87 ft  --->  Flow =     586.97 cfs
At T2 Elev =      99.80 ft  --->  Flow =     670.82 cfs
```

OUTLET STRUCTURE INPUT DATA

```
Structure ID        = W1
Structure Type      = Weir-Rectangular
------------------------------------
# of Openings       =        1
Crest Elev.         =    105.00 ft
Weir Length         =    900.00 ft
Weir Coeff.         =  1.500000

Weir TW effects      (Use adjustment equation)


Structure ID        = W0
Structure Type      = Weir-Rectangular
------------------------------------
# of Openings       =        1
Crest Elev.         =    105.50 ft
Weir Length         =     80.00 ft
Weir Coeff.         =  1.500000

Weir TW effects      (Use adjustment equation)


Structure ID        = TW
Structure Type      = TW SETUP, DS Channel
------------------------------------
FREE OUTFALL CONDITIONS SPECIFIED

CONVERGENCE TOLERANCES...
Maximum Iterations=    40
Min. TW tolerance =    .01 ft
Max. TW tolerance =    .01 ft
Min. HW tolerance =    .01 ft
Max. HW tolerance =    .01 ft
Min.  Q tolerance =    .00 cfs
Max.  Q tolerance =    .00 cfs
```

RATING TABLE FOR ONE OUTLET TYPE

Structure ID = CO (Culvert-Box)

Mannings open channel maximum capacity: 1783.18 cfs
Upstream ID = (Pond Water Surface)
DNstream ID = TW (Pond Outfall)

NUMBER OF BARRELS = 3
EACH FLOW = SUM OF BARRELS x FLOW FOR ONE BARREL

WS Elev, Device Q		Tail Water		Notes
WS Elev. ft	Q cfs	TW Elev ft	Converge +/-ft	Computation Messages
93.00	.00	Free Outfall		
				Upstream HW & DNstream TW < Inv.El
93.50	50.93	Free Outfall		
				INLET CONTROL... Equ.1: HW =.50 dc=.341 Ac=5.1216
94.00	136.76	Free Outfall		
				INLET CONTROL... Equ.1: HW =1.00 dc=.660 Ac=9.8950
94.50	245.48	Free Outfall		
				INLET CONTROL... Equ.1: HW =1.50 dc=.974 Ac=14.6146
95.00	371.93	Free Outfall		
				INLET CONTROL... Equ.1: HW =2.00 dc=1.285 Ac=19.2793
95.50	513.84	Free Outfall		
				INLET CONTROL... Equ.1: HW =2.50 dc=1.594 Ac=23.9148
96.00	669.48	Free Outfall		
				INLET CONTROL... Equ.1: HW =3.00 dc=1.902 Ac=28.5281
96.50	836.56	Free Outfall		
				INLET CONTROL... Equ.1: HW =3.50 dc=2.206 Ac=33.0964
97.00	1013.95	Free Outfall		
				INLET CONTROL... Equ.1: HW =4.00 dc=2.508 Ac=37.6234
97.50	1202.20	Free Outfall		
				INLET CONTROL... Equ.1: HW =4.50 dc=2.810 Ac=42.1470
98.00	1399.61	Free Outfall		
				INLET CONTROL... Equ.1: HW =5.00 dc=3.110 Ac=46.6430
98.50	1605.03	Free Outfall		
				INLET CONTROL... Equ.1: HW =5.50 dc=3.407 Ac=51.1019
99.00	1796.98	Free Outfall		
				INLET CONTROL... Transition: HW =6.00
99.50	1931.49	Free Outfall		
				INLET CONTROL... Transition: HW =6.50
100.00	2083.40	Free Outfall		
				INLET CONTROL... Submerged: HW =7.00

RATING TABLE FOR ONE OUTLET TYPE

Structure ID = C0 (Culvert-Box)

Mannings open channel maximum capacity: 1783.18 cfs
Upstream ID = (Pond Water Surface)
DNstream ID = TW (Pond Outfall)

NUMBER OF BARRELS = 3
EACH FLOW = SUM OF BARRELS x FLOW FOR ONE BARREL

WS Elev. ft	Q cfs	TW Elev ft	Converge +/-ft	Computation Messages
100.50	2251.63	Free Outfall		
		INLET CONTROL...		Submerged: HW =7.50
101.00	2408.41	Free Outfall		
		INLET CONTROL...		Submerged: HW =8.00
101.50	2554.89	Free Outfall		
		INLET CONTROL...		Submerged: HW =8.50
102.00	2693.94	Free Outfall		
		INLET CONTROL...		Submerged: HW =9.00
102.50	2826.12	Free Outfall		
		INLET CONTROL...		Submerged: HW =9.50
103.00	2952.58	Free Outfall		
		INLET CONTROL...		Submerged: HW =10.00
103.50	3073.31	Free Outfall		
		INLET CONTROL...		Submerged: HW =10.50
104.00	3190.04	Free Outfall		
		INLET CONTROL...		Submerged: HW =11.00
104.50	3302.19	Free Outfall		
		INLET CONTROL...		Submerged: HW =11.50
105.00	3410.91	Free Outfall		
		INLET CONTROL...		Submerged: HW =12.00
105.50	3516.20	Free Outfall		
		INLET CONTROL...		Submerged: HW =12.50
106.00	3618.62	Free Outfall		
		INLET CONTROL...		Submerged: HW =13.00
106.50	3717.90	Free Outfall		
		INLET CONTROL...		Submerged: HW =13.50
107.00	3814.89	Free Outfall		
		INLET CONTROL...		Submerged: HW =14.00

RATING TABLE FOR ONE OUTLET TYPE

Structure ID = W1 (Weir-Rectangular)

Upstream ID = (Pond Water Surface)
DNstream ID = TW (Pond Outfall)

WS Elev, Device Q		Tail Water		Notes
WS Elev. ft	Q cfs	TW Elev ft	Converge +/-ft	Computation Messages
93.00	.00	Free Outfall		HW & TW below Inv.El.=105.000
93.50	.00	Free Outfall		HW & TW below Inv.El.=105.000
94.00	.00	Free Outfall		HW & TW below Inv.El.=105.000
94.50	.00	Free Outfall		HW & TW below Inv.El.=105.000
95.00	.00	Free Outfall		HW & TW below Inv.El.=105.000
95.50	.00	Free Outfall		HW & TW below Inv.El.=105.000
96.00	.00	Free Outfall		HW & TW below Inv.El.=105.000
96.50	.00	Free Outfall		HW & TW below Inv.El.=105.000
97.00	.00	Free Outfall		HW & TW below Inv.El.=105.000
97.50	.00	Free Outfall		HW & TW below Inv.El.=105.000
98.00	.00	Free Outfall		HW & TW below Inv.El.=105.000
98.50	.00	Free Outfall		HW & TW below Inv.El.=105.000
99.00	.00	Free Outfall		HW & TW below Inv.El.=105.000
99.50	.00	Free Outfall		HW & TW below Inv.El.=105.000
100.00	.00	Free Outfall		HW & TW below Inv.El.=105.000
100.50	.00	Free Outfall		HW & TW below Inv.El.=105.000
101.00	.00	Free Outfall		HW & TW below Inv.El.=105.000

RATING TABLE FOR ONE OUTLET TYPE

Structure ID = W1 (Weir-Rectangular)

Upstream ID = (Pond Water Surface)
DNstream ID = TW (Pond Outfall)

WS Elev. ft	Q cfs	TW Elev ft	Converge +/-ft	Computation Messages
101.50	.00	Free Outfall		HW & TW below Inv.El.=105.000
102.00	.00	Free Outfall		HW & TW below Inv.El.=105.000
102.50	.00	Free Outfall		HW & TW below Inv.El.=105.000
103.00	.00	Free Outfall		HW & TW below Inv.El.=105.000
103.50	.00	Free Outfall		HW & TW below Inv.El.=105.000
104.00	.00	Free Outfall		HW & TW below Inv.El.=105.000
104.50	.00	Free Outfall		HW & TW below Inv.El.=105.000
105.00	.00	Free Outfall		H=.00; Htw=.00; Qfree=.00;
105.50	477.30	Free Outfall		H=.50; Htw=.00; Qfree=477.30;
106.00	1350.00	Free Outfall		H=1.00; Htw=.00; Qfree=1350.00;
106.50	2480.11	Free Outfall		H=1.50; Htw=.00; Qfree=2480.11;
107.00	3818.38	Free Outfall		H=2.00; Htw=.00; Qfree=3818.38;

RATING TABLE FOR ONE OUTLET TYPE

Structure ID = W0 (Weir-Rectangular)

Upstream ID = (Pond Water Surface)
DNstream ID = TW (Pond Outfall)

WS Elev, Device Q		Tail Water		Notes
WS Elev. ft	Q cfs	TW Elev ft	Converge +/-ft	Computation Messages
93.00	.00	Free Outfall		HW & TW below Inv.El.=105.500
93.50	.00	Free Outfall		HW & TW below Inv.El.=105.500
94.00	.00	Free Outfall		HW & TW below Inv.El.=105.500
94.50	.00	Free Outfall		HW & TW below Inv.El.=105.500
95.00	.00	Free Outfall		HW & TW below Inv.El.=105.500
95.50	.00	Free Outfall		HW & TW below Inv.El.=105.500
96.00	.00	Free Outfall		HW & TW below Inv.El.=105.500
96.50	.00	Free Outfall		HW & TW below Inv.El.=105.500
97.00	.00	Free Outfall		HW & TW below Inv.El.=105.500
97.50	.00	Free Outfall		HW & TW below Inv.El.=105.500
98.00	.00	Free Outfall		HW & TW below Inv.El.=105.500
98.50	.00	Free Outfall		HW & TW below Inv.El.=105.500
99.00	.00	Free Outfall		HW & TW below Inv.El.=105.500
99.50	.00	Free Outfall		HW & TW below Inv.El.=105.500
100.00	.00	Free Outfall		HW & TW below Inv.El.=105.500
100.50	.00	Free Outfall		HW & TW below Inv.El.=105.500
101.00	.00	Free Outfall		HW & TW below Inv.El.=105.500

RATING TABLE FOR ONE OUTLET TYPE

Structure ID = W0 (Weir-Rectangular)

Upstream ID = (Pond Water Surface)
DNstream ID = TW (Pond Outfall)

WS Elev. ft	Q cfs	TW Elev ft	Converge +/-ft	Computation Messages
101.50	.00	Free Outfall		HW & TW below Inv.El.=105.500
102.00	.00	Free Outfall		HW & TW below Inv.El.=105.500
102.50	.00	Free Outfall		HW & TW below Inv.El.=105.500
103.00	.00	Free Outfall		HW & TW below Inv.El.=105.500
103.50	.00	Free Outfall		HW & TW below Inv.El.=105.500
104.00	.00	Free Outfall		HW & TW below Inv.El.=105.500
104.50	.00	Free Outfall		HW & TW below Inv.El.=105.500
105.00	.00	Free Outfall		HW & TW below Inv.El.=105.500
105.50	.00	Free Outfall		H=.00; Htw=.00; Qfree=.00;
106.00	42.37	Free Outfall		H=.50; Htw=.00; Qfree=42.37;
106.50	119.70	Free Outfall		H=1.00; Htw=.00; Qfree=119.70;
107.00	219.63	Free Outfall		H=1.50; Htw=.00; Qfree=219.63;

***** COMPOSITE OUTFLOW SUMMARY ****

WS Elev, Total Q		Converge		Notes
Elev. ft	Q cfs	TW Elev ft	Error +/-ft	Contributing Structures
93.00	.00	Free Outfall		None contributing
93.50	50.93	Free Outfall		C0
94.00	136.76	Free Outfall		C0
94.50	245.48	Free Outfall		C0
95.00	371.93	Free Outfall		C0
95.50	513.84	Free Outfall		C0
96.00	669.48	Free Outfall		C0
96.50	836.56	Free Outfall		C0
97.00	1013.95	Free Outfall		C0
97.50	1202.20	Free Outfall		C0
98.00	1399.61	Free Outfall		C0
98.50	1605.03	Free Outfall		C0
99.00	1796.98	Free Outfall		C0
99.50	1931.49	Free Outfall		C0
100.00	2083.40	Free Outfall		C0
100.50	2251.63	Free Outfall		C0
101.00	2408.41	Free Outfall		C0
101.50	2554.89	Free Outfall		C0
102.00	2693.94	Free Outfall		C0
102.50	2826.12	Free Outfall		C0
103.00	2952.58	Free Outfall		C0
103.50	3073.31	Free Outfall		C0
104.00	3190.04	Free Outfall		C0
104.50	3302.19	Free Outfall		C0
105.00	3410.91	Free Outfall		C0 +W1
105.50	3993.49	Free Outfall		C0 +W1 +W0
106.00	5011.00	Free Outfall		C0 +W1 +W0
106.50	6317.71	Free Outfall		C0 +W1 +W0
107.00	7852.89	Free Outfall		C0 +W1 +W0

c. Erosion and deposition predictions on the up-slope and down-slope sides of the projects.

Response: The Revised Universal Soil Loss Equation (RUSLE2) can be used to predict soil erosion and deposition on the up-gradient and down-gradient sides of the three project areas (Phase I-Phase III). RUSLE2 estimates soil loss and sediment yield from rill and interrill erosion caused by rainfall and its associated overland flow, using factors that represent climatic erosivity, soil erodibility, topography, cover management, and support practices (Draft RUSLE2 User's Guide, 2002). The equation structure is as follows:

$$a_i = r_i k_i l_i S c_i p_i$$

where, a_i = average annual soil loss, r_i = erosivity factor, k_i = soil erodibility factor, l_i = soil length factor, S = slope steepness factor, c_i = cover management factor, p_i = supporting practices factor, all on the i^{th} day. Average annual soil loss is computed by summation of a_i.

As an example, details are provided below for calculation of onsite and offsite erosion and sediment yield for Sub-area C, a portion of Ivanpah 1 associated with one of two planned surface water detention ponds. This procedure can be duplicated to determine erosion and sediment yield on the up-gradient and down-gradient sides of the other sub-areas.

The areas of interest for this initial calculation include (a) the subwatershed area up-gradient and draining to Sub-area C; and (2) Sub-area C itself. These areas are shown on Figure 139c-1. Mapped soil types were identified across each area of interest, and the acreage of the landscape occupied by each soil type was calculated using GIS data. It should be noted that, for this initial exercise, the entire upper watershed was not fully mapped, particularly the west-northwestern portion of the watershed and this presents a significant source of error for the soil loss estimate. To conduct the soil loss estimate for the watershed, the aerial photograph was used to "complete the mapping" within the watershed (shown as dashed lines on Figure 139c-1) and the areas of the newly estimated soil mapping units were added to the adjacent soil units. This resulted in the addition of 3,767 acres of previously uncharacterized area to the 7,742-acre watershed (almost 49 percent of the entire watershed).

Due to the incomplete soil mapping in the ISEGS project area, all the future soil loss estimates would encounter a similar problem. The gaps in the soil mapping are portrayed on Figure 139c-2. The lack of soil mapping information means that boundaries of soil units in unmapped portions of the upper watersheds will have to be approximated using the aerial photograph.

Another source of error for the soil loss estimate was associated with the soil data contained within the RUSLE2 program provided on-line by the NRCS at the following URL: http://fargo.nserl.purdue.edu/rusle2_dataweb/RUSLE2_Index.htm

Four out of five of the mapped soil units shown on Figure 139c-1 did not have soil profiles within the RUSLE2 database. A soil profile for [3520] Arizo loamy sand was found in the database for a nearby soil survey. However, no soil profiles were available for [4122] Popups sandy loam, 4 to 30 percent slopes (1,294 acres of watershed); [3000] Copperworld Association, 30 to 60 percent slopes (1,403 aces of watershed); [5000] Copperworld-Lithic Ustic Haplargids Association, 30 to 60 percent slopes (1,034 aces of watershed); and [5300] Lithic Ustic Haplocalcids gravelly sandy loam, 30 to 60 percent slopes (3,321 aces of watershed). These four units represent an estimated 7,052 acres (or 91 percent) of the upper watershed. Surrogate soil profiles were used to estimate soil loss within RUSLE2 for the four soil types listed above. For the [4122] Popups sandy loam soil type, a generic sandy loam profile with low to medium organic matter and slow permeability was used to approximate a weakly cemented duripan found at an approximately 3-foot depth. For the remaining three soil units: [3000] Copperworld Association; [5000] Copperworld-Lithic Ustic Haplargids Association; and [5300] Lithic Ustic Haplocalcids gravelly sandy loam, an estimate of soil loss was calculated using a roughly similar soil profile from the San Bernardino County Mojave River Area Soil Survey, [166] Trigger Rock Outcrop Complex, gravelly sandy loam. Table 139c-1 shows results, using the above approach.

TABLE 139c-1
Soil Erosion and Sediment Yield on the Up-Gradient and Down-Gradient Sides of Sub-area C

Subwatershed	Area (acres)	Pre-Project Sediment Yield Prediction (tons/year)	Notes
Pre-Project Conditions			
1 – Up-gradient of Sub-area C	7,742	973	This represents the amount of sediment potentially entering Sub-area C
2 – Down-gradient side of Sub-area C	305	980	This represents the amount of sediment potentially discharged from Sub-area C under current conditions
Post-Project Construction Conditions			
3 – Down-gradient side of Sub-area C	305	7.63	This represents the amount of sediment that would be discharged from Sub-area C after detention basin has intercepted upper watershed sediments

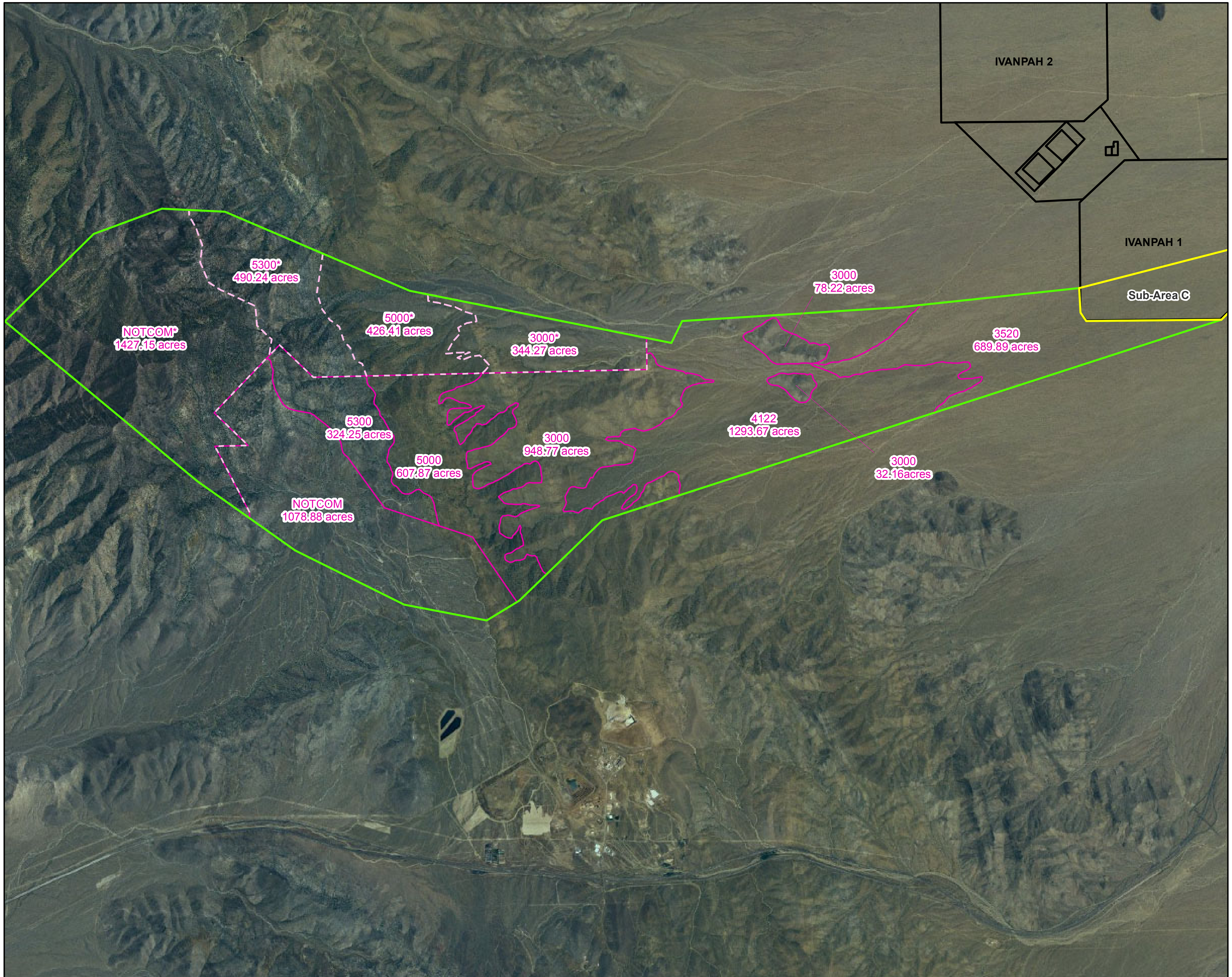
Using RUSLE2 to estimate soil losses and then integrating these soil losses within the watershed (i.e., cumulative soil loss) is a very conservative approach because it assumes that all the soil detached from a soil unit within the watershed is delivered to the bottom of the watershed. In our case, we are using this estimate to approximate how much soil will be delivered to the sedimentation basin on the up-gradient side of Sub-area C within the Ivanpah 1 facility. For reasons discussed in the background section of this response, not all detached soil will be transmitted through the bajada channels, but rather will settle out depending on water flow velocities and channel geometry. The intensity of the rainfall event also plays a critical role in how much sediments will be detached and how far they will move. The RUSLE2 estimates may not adequately predict the variability of soil movement anticipated in these arid systems. However, based on this approach and an approximate weight of 1 ½ tons per cubic yard of soil, it is estimated that each year 973 tons (or 649 cubic yards) of soil could reach the sedimentation basin on the up-gradient side of Sub-area C.

DISCUSSION

Because low impact development (LID) practices will be incorporated into the project design, construction and operation, the increase in sediment yield from the site is not expected to be substantially greater than pre-project condition. Vegetation will remain undisturbed between every other heliostat row and in all areas where access is not required. Where only limited grading is required on the sites, natural vegetation will be cut off at ground surface, and many species, such as *Larrea tridentata*, may resprout. Above- and below-ground portions of plants will only be removed in areas that require more extensive grading. By limiting disturbance to existing vegetation, plants will continue to filter both water- and wind-carried sediment.

Detention basins that will be sized for 100-year, 24-hour storm event will be placed on the up-gradient side of each sub-area, and will capture concentrated flows that would normally flow into major washes on each site. The basins will be sized for the amount of rainfall that would be expected on each sub-area (not on upper portions of the watershed); thus, while concentrated flows that could result in damage to heliostats will be discouraged, sheet flooding will still be allowed to occur. Check dams will be placed down-gradient of the detention basins to shorten the slope length, capture sediment, and prevent flows from concentrating into rills or gullies. Where necessary, run-on will be diverted around the site and then spread and made to sheet flow offsite. Following storm events, a site inspection will be performed and modifications made, as necessary, to placement of check dams, rocks, and other devices to manage runoff.

Design will specifically be performed to ensure post-project hydrology remains similar to pre-project conditions. The site is located on active alluvial fans, that, by definition, are formed via erosion and depositional processes. Taken together, design, construction, and operation of the project should ensure that the amount of sediment leaving the site(s), contributing to alluvial fan development and ultimately discharging to the Ivanpah Dry Lake is not increased beyond current conditions.



LEGEND

- Project Site
- Sub-Area C
- Upper Watershed
- Soils
- Estimated Soils*

Soil ID's and Descriptions:

3000: Copperworld Association
30-60 percent slopes
3520: Arizo loamy sand
2-8 percent slopes
4122: Popups sandy loam
4-30 percent slopes
5000: Copperworld-Lithic Ustic Haplargids Association
30-60 percent slopes
5300: Lithic Ustic Haplocalcids gravelly sandy loam
30 to 60 percent slopes
NOTCOM: Obsolete term for unmapped areas

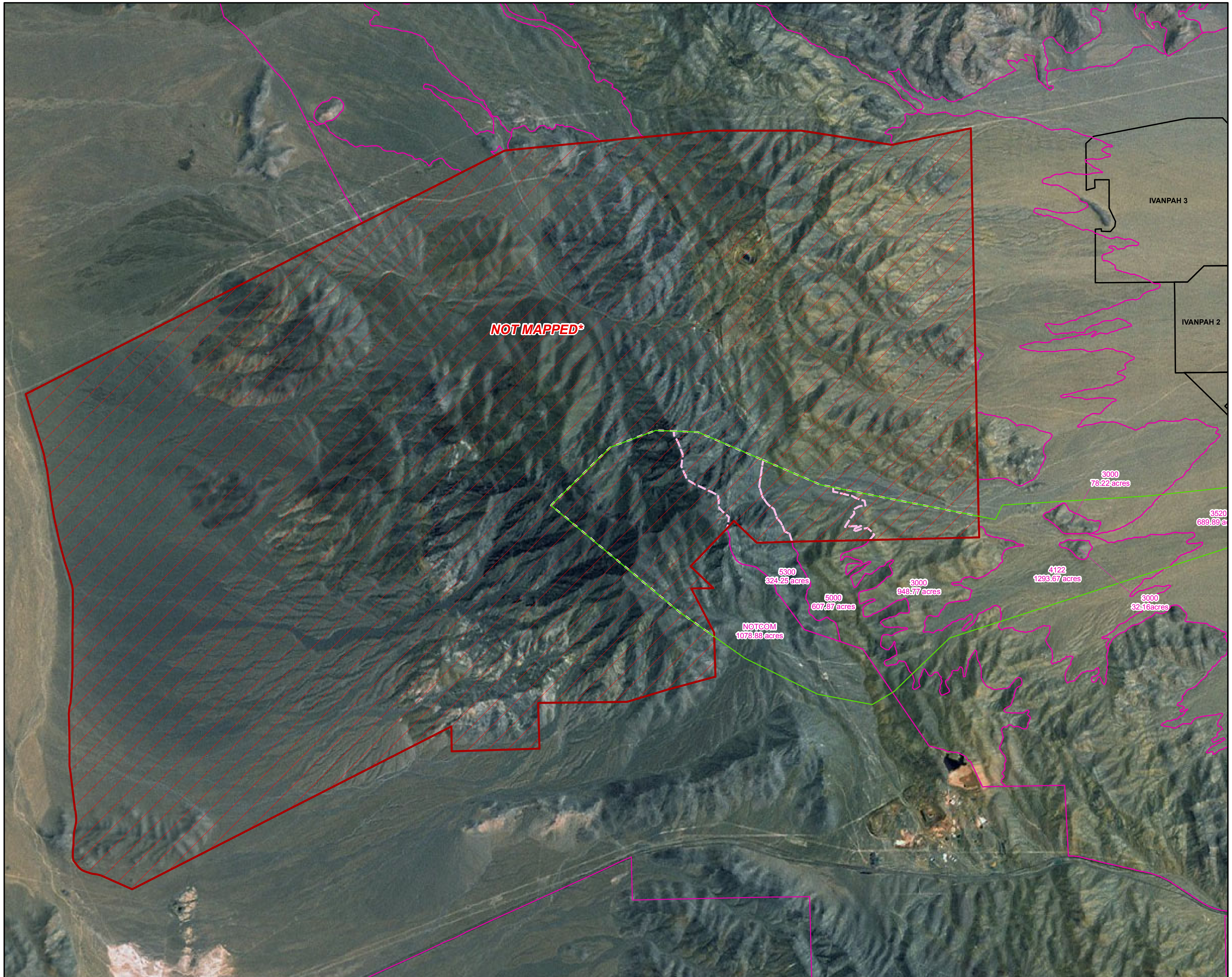
**Soil types estimated based on aerial and surrounding NRCS soil types.*

Source: NRCS, Soil Survey 2007

N

0 2,000 4,000
Feet

FIGURE DR139c-1
SOIL TYPES
IVANPAH SOLAR ELECTRIC GENERATING SYSTEM



VICINITY MAP

LEGEND

- Project Site
- Watersheds
- Soils
- Estimate Soils

Soil ID's and Descriptions:

3000: Copperworld Association
30-60 percent slopes

3520: Arizo loamy sand
2-8 percent slopes

4122: Popups sandy loam
4-30 percent slopes

5000: Copperworld-Lithic Ustic Haplargids Association
30-60 percent slopes

5300: Lithic Ustic Haplocalcids gravelly sandy loam
30 to 60 percent slopes

NOTCOM: Obsolete term for unmapped areas

**Area not included in NRCS' soil data*

Source: NRCS, Soil Survey 2007

N

0 2,000 4,000
Feet

FIGURE DR139c-2
SOIL TYPES
IVANPAH SOLAR ELECTRIC GENERATING SYSTEM

d. Please describe the engineering controls in the event of a hazardous or non-hazardous spill.

Response: In the case of an event, hazardous and non-hazardous spills shall be handled in accordance with all local, state, and Federal regulations. Engineering controls for the Ivanpah SEGS will include such items as containment dikes and berms around oil storage and oil-bearing equipment, double-wall piping (as required), sand bags and use of spill prevention kits, as needed. Such controls will be described in the final Construction and Industrial Stormwater Pollution Prevention Plan (see AFC Appendixes 5.15A and 5.15B for drafts of these plans).

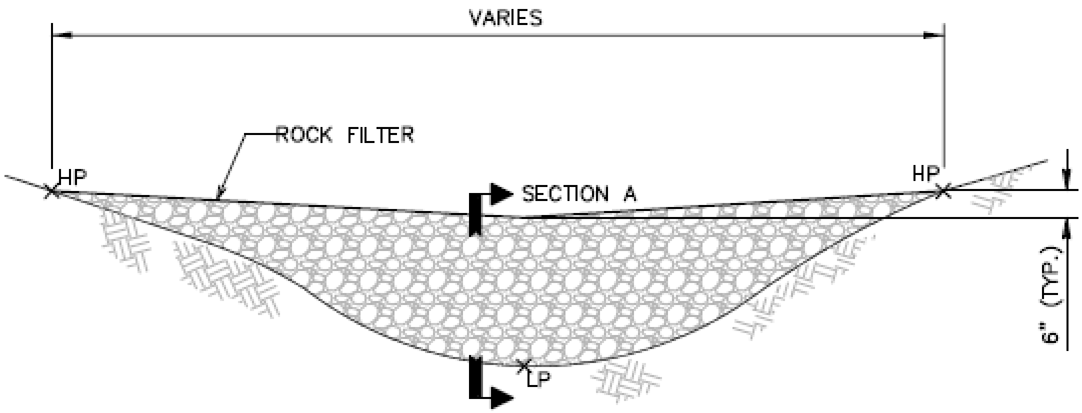
e. Please explain in writing and with illustrations how the principles of Low Impact Development would be integrated into the final grading plan.

Response: Low Impact Development (LID) is a stormwater management strategy concerned with maintaining or restoring the natural hydrologic functions of a site to achieve natural resource protection objectives and fulfill environmental regulatory requirements. LID principles are to be utilized to the maximum extent possible throughout the Ivanpah site design as prescribed by the Low Impact Development Design Manual specified by San Bernardino County (Low Impact Development Design Strategies, Prince George's County Maryland Department of Environmental Resources Programs and Planning Division).

Methods of LID to be utilized include maintaining natural drainage courses, limiting impervious cover, minimizing grading and maintaining existing topography and associated drainage divides to encourage dispersed flow paths. It is the intent of the project grading design to provide only the minimum disturbance required to provide access for the installation equipment and materials necessary to install and operate each facilities power block, power towers, and heliostat array. Paved roads are to be limited to those required by the San Bernardino Fire Department. Grading is to be restricted and natural vegetation is to remain undisturbed, to the extent possible, between every other heliostat row and site locations where access is not required (see note on drawings IVAN-1-DW-024-112-005, IVAN-2-DW-024-112-006 and IVAN-3-DW-024-112-007, provided in Attachment 130-2, Data Response 130, Set 2A). In locations where access is required and the existing terrain will support the access of installation equipment and materials, grading is to be limited and access is to be improved by cutting the vegetation at the ground leaving the plant root structures intact. In locations where access is required and the existing terrain will not support the access of installation equipment and materials, grading is to be provided ranging from minor leveling (small cuts and fills) to conventional grading (see the "Plan of Development Grading Plans" IVAN-1-DW-024-112-005, IVAN-2-DW-024-112-006 and IVAN-3-DW-024-112-007, provided in Attachment 130-2, Data Response 130, Set 2A). Natural drainage features are to be maintained where practical and grading is to be designed to promote sheet flow where possible.

Existing small to moderate ephemeral washes are to remain intact at locations capable of being traversed by installation equipment. Large ephemeral washes that could result in flows that damage heliostats or power block equipment are to be routed through detention ponds and/or diversion channels either through or along the outer perimeter of each solar field (see drawings IVAN-1-DW-024-112-002, IVAN-2-DW-024-112-003 and IVAN-3-DW-024-112-004, provided in Attachment 130-2, Data Response 130, Set 2A). The large washes will be graded to the extent necessary to provide equipment access. At locations where stormwater crosses roads (all surface types) as sheet flow, existing grade is to be maintained. In situations where concentrated stormwater cross paved roads, culverts are to be provided to pass the 100-year, 24-hour storm event as required by San Bernardino County. At locations where concentrated stormwater crosses unpaved roads or trails, a slight grading of the channel bank is to be performed in order to provide vehicular access across the wash (provide an earthen ramp).

Detention ponds sized for the sites 100-year, 24-hour storm event are to be placed upstream in each facility drainage area (on the high or western side of the site) to detain and release a volume of concentrated offsite stormwater run-on equivalent to the volume required for conventional onsite stormwater detention and runoff (see drawing IVAN-0-DW-048-111-001, provided in Attachment 130-2, Data Response 130, Set 2A). This concept will have the advantage of providing LID by controlling the sites stormwater run-on from the large ephemeral washes that approach the sites from the west. Stormwater received in excess of the volume required for detention will be permitted to surcharge the ponds and will be directed to long broad crested weirs armored with native stone to convey the excess stormwater across the site as sheet flow. At pond locations with exceptionally large concentrated offsite stormwater run-on, a portion of the excessive flow is to be directed to bypass channels for redirection and velocity control prior to release within the site as sheet flow. Stormwater falling directly onto each facility will be conveyed through each site combined with the excess stormwater from the ponds and will not require additional detention. As the stormwater passes through the heliostat fields and around the power blocks and power towers (Ivanpah 3 only) check dams and rock filters are to be placed in locations where stormwater has the potential to concentrate to control velocity and redistribute water as sheet flow to prevent scouring (see Figures 139e-1 and 139e-2). It is the intent of this method of LID to protect onsite soils and equipment by managing the sites stormwater velocity and direction. An additional benefit of check dams will be the capture of sediment within the site close to the source to minimize possible onsite and offsite impact.



NOTES:
1. SEDIMENT TRAP TO BE CLEANED OUT WHEN VOLUME BECOMES HALF FULL.
2. ROCK FILTER TO BE INSPECTED & REPAIRED AS NEEDED.
3. STONE SIZES RANGE FROM 0.75 TO 5 INCHES. (CLEAN OF FINES)
4. THESE STRUCTURES ARE USED FOR DRAINAGE AREAS UP TO 5 ACRES.
5. ROCK FILTER DAM SHOULD BE KEYED INTO SWALE OR CHANNEL BOTTOM AT A MINIMUM OF 6 INCHES.
6. CONTRACTOR TO USE NATIVE STONE AS AVAILABLE.

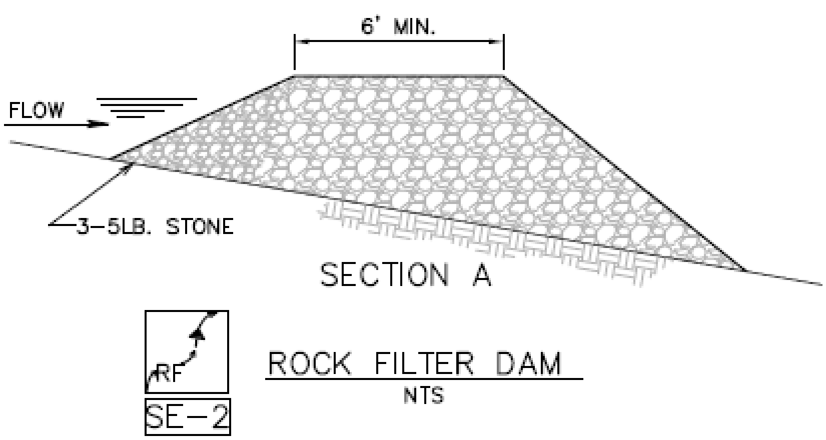


FIGURE 139e-1

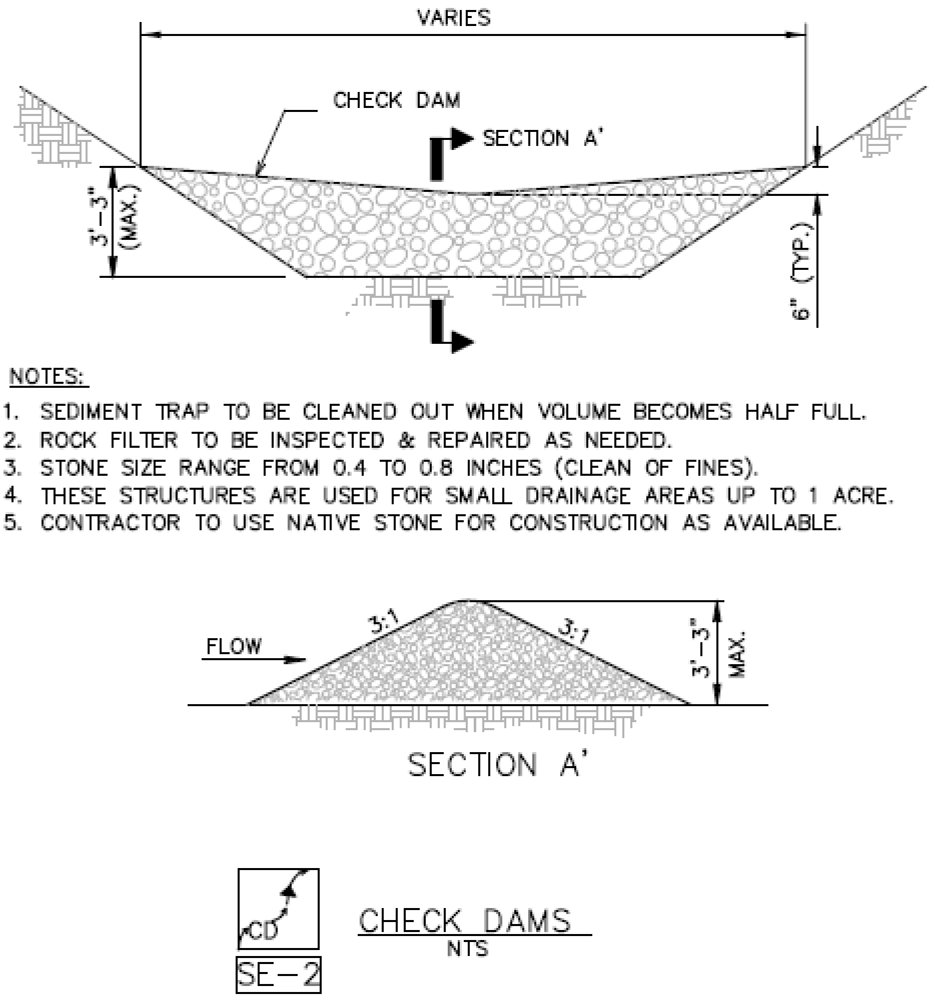


FIGURE 139e-2

BACKGROUND

Some elements of Data Request 58, the Drainage Erosion and Sediment Control Plan (DESCP), were not answered.

DATA REQUEST

140. Please provide a final DESCP with all elements answered, including those itemized below.

    a. Typical best management practices (BMPs) were provided in the draft DESCP. Due to the size of the project site, site-specific BMPs for both the construction and operation phases need to be identified on topographic maps for all areas except the power block area where BMPs have already been identified on topographic maps. Please provide these site-specific BMPs for the construction and operation phases.

Response: A copy of the updated DESCP is provided as Attachment DR140-1A. Due to its size, 5 copies are being provided to both the CEC and BLM. Electronic copies will be provided to the parties upon request.

b. In Section 4.0 of the draft DESCP, a timing and maintenance schedule was provided, but only a general level of detail. A detailed schedule of the timing of the BMPs to be employed and a maintenance schedule for all BMPs needs to be provided for each phase of the project construction and operation. Please provide this detailed schedule.

Response: A detailed schedule of the BMPs to be employed and a maintenance schedule for those BMPs is currently under preparation and will be submitted around mid-August, 2008.

d Page 10 of the draft DESCP, Table 3.4-1, cut volumes of soil are greater than the fill volumes. The text states that there will be no soil exported offsite. This apparent difference needs to be reconciled and explained.

Response: See Attachment DR140-1A.

e. Page 17 of the draft DESCP states that there will be a concrete washout area used during construction. The location and size of this washout area need to be shown on a map of the project site and discussed in the text.

Response: A concrete washout area that will be used during construction will be located near the site entrance/exit at Colosseum Road in area F7 shown in Figure DR131-1.

BACKGROUND

In response to Data Requests 63, the applicant provided a map of proposed stockpile locations to be used during construction. The stockpile locations for storing cut soil seem too small given the size of the project and the expected volume of soil and vegetation expected to be generated.

DATA REQUEST

145. Please provide calculations supporting that the size of the stockpile locations are sufficient to support the volume of soil and vegetation expected to be generated.

Response: The location and area of each unit soil stockpile was provided to indicate a temporary location where cut material will be stored prior to reuse on the project site. Stockpiles are intended to be used for only short periods of time and excavated materials will be continually removed from the stockpile and used for fill in other areas of the project site. Additionally, some cut materials will be taken directly to fill locations and not stockpiled first. Thus, the proposed stockpile locations are not intended to support the entire volume of soil and vegetation generated during construction activities. Each stock pile area will be conservatively sized to support the worse case scenario and will be protected by approved BMPs to minimize erosion.

Visual Resources (148)

BACKGROUND

CEC and BLM staff continue to be concerned about potential visual effects to recreational visitors within the project viewshed, which includes the Ivanpah dry lakebed, Joshua Tree Highway, and heavily used recreational destinations within the Mojave National Preserve. BLM staff have identified a list of sensitive recreational key points of observation (KOPs) for purposes of analysis in the Staff Assessment/EIS.

DATA REQUEST

148. Please provide candidate KOP photographs of the above sites for staff review, prior to development of the simulations.

Response: The simulations will be provided by the end of July, 2008.