Appendix 5.15C
Conceptual Project Drainage Plan

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RICE SOLAR ENERGY PROJECT

CONCEPTUAL DRAINAGE STUDY

RIVERSIDE COUNTY

CALIFORNIA

Prepared By:

WorleyParsons Group, Inc.

October 9th 2009

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NOTICE

The information presented in this document was compiled and interpreted exclusively for the purposes of a conceptual drainage study for Rice Solar Energy Project. WorleyParsons provided this report for Rice Solar Energy, LLC for the purpose noted above.

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RICE SOLAR ENERGY PROJECT

REV	DESCRIPTION	ORIG	REVIEW	WORLEY-PARSONS APPROVAL	DATE	CLIENT APPROVAL	DATE
0	Issued for Use	J Dahlgren	B. Anders	B. Anders	05-Aug-09	N/A	
1	Issued for Use	J Forrest	B. Anders	B. Anders	09-Oct-09	N/A	

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I. PROJECT LOCATION

Rice Solar Energy, LLC, an affiliate of Solar Reserve, LLC, (herein "Rice Solar Energy LLC" or "Applicant") proposes to construct, own, and operate a solar electrical generating plant on a 3,324 acre parcel of land ("Property") in an unincorporated area of eastern Riverside County, California, situated immediately south of State Route (SR) 62 at milepost 109 (refer **Figure 1** and **2**). The Rice Solar Energy Project (herein "RSEP" or "Project") will occupy 1,410 acres ("Site") of the Property, with solar thermal power generating technology which includes solar tracking heliostats that reflect solar energy to a central receiver, mounted on a tower.

The RSEP site is located in a very sparsely settled portion of the Colorado Desert, a sub region of the Sonoran Desert. Access to the RESP site will be directly off SR-62. The RSEP site is surrounded by private land to the west and north, and uninhabited public lands managed by the Bureau of Land Management (BLM) to the east and south. SR-62, a railroad operated by California-Arizona Railroad, and the Colorado River Aqueduct, operated by the Metropolitan Water District of Southern California (MWD), are located just north of the RSEP site in San Bernardino County. The Property is presently zoned for Natural Assets (N-A), and Controlled Development Area (W-2) according to Riverside County Zoning Ordinance (Ordinance 348). The Site will be located within the W-2 zoning area.

A crossroads settlement known as Rice was once located just west of the RSEP site, at the junction of SR-62 with Blythe-Midland Road but has been abandoned and little remains. The nearest residence and permanent settlement to the RSEP is Vidal Junction which is 14.8 miles east-northeast (15.4 miles by road) at the junction of SR-62 and US Route 95. The nearest residence and permanent settlement to the west of the RSEP is Iron Mountain Pumping Plant operated by MWD, where there are several residences. The Iron Mountain Pumping Plant is located 17.8 miles west-northwest of the RSEP site (20.9 miles by road).

During World War II, the RSEP site was part of the Desert Training Center (DTC) complex (also known as the California-Arizona Maneuver Area or CAMA) of airfields and military training camps and used as a training airfield, Rice Army Airfield, between 1942 and early 1944. The airfield was closed by the military in August 1944, but used privately during the 1950s, and then abandoned sometime before 1958.

The Property is situated south of the Turtle Mountains within the broad Rice Valley and has a very slight slope (less than 2% overall). The RSEP site is located at approximately 750 to 920 feet above mean sea level (amsl) and has gently sloping southerly facing slope on the lower portions of alluvial fans that emanate from the Turtle Mountains (refer **Figure 2**). The elevation of the valley floor within Rice Valley is approximately 675 feet amsl. The general landscape in the vicinity of the RSEP site is creosote bush scrub. There are sand dunes known as the Rice Valley Dunes to the south of the RSEP site which formerly contained the "Rice Valley Dunes Off-Highway Vehicle Recreation area." However the BLM closed this

area due to lack of use and potential risk of encountering unexploded ordinance left from the use of Rice Army Airfield as part of the DTC.

Stormwater runoff occurs primarily during thunderstorms and the surface runoff from the mountains drains towards the center of the valley, except in the eastern part of the valley, where Big Wash drains to the Colorado River. There are no perennial streams in the planning area and most of the moisture from rain is lost through evapotranspiration.

The RSEP footprint including the utility lines lies entirely within an area designated by the Federal Emergency Management Agency (FEMA) as Zone D (refer **Section VII** and **Appendix A**).

Off-site stormwater flows originate from an area north of SR-62, the Arizona-California Railroad, and the Colorado River Aqueduct. As the railroad and aqueduct parallel the highway (east west) small dikes have been constructed to control the flow of water across these features (north to south). The dikes direct the offsite flows from the north to specific channels/culverts over the aqueduct, under the railroad and then across SR-62 through small "dips" in the roadway. Due to the type of terrain, the minor slopes, and the offsite flows being isolated, the storm water management dose not pose a significant concern.

II. PROJECT DESCRIPTION

Rice Solar Energy LLC is proposing to develop a net 150-megawatt (MW) solar thermal power generating project with integral thermal storage, a central receiver tower, and a tracking heliostat field. In this process, reflected solar energy heats molten salt (a mixture of sodium nitrate and potassium nitrate) in the central receiver tower. The molten salt acts as a heat transfer medium, capturing solar energy and conveying it to a large insulated thermal storage tank. Molten salt is pumped from the tank through a series of heat exchangers which produce utility-grade steam from water and drives a conventional steam turbine which turns an electrical generator. The salt is stored in molten form with little loss of the sun's energy, so the RSEP facility can generate electricity at any time, including during nighttime or on cloudy days.

The solar thermal technology will provide 100 percent of the power generated by the RSEP; no supplementary energy source (e.g. natural gas to generate electricity at night) is proposed to be used for electric energy production. Rice Solar Energy LLC proposes to use dry cooling technology (air-cooled condenser) for power plant cooling. Raw process water will be supplied from two onsite groundwater wells, and will be treated and used for steam-cycle makeup, heliostat washing, boiler blowdown and other domestic needs.

A short transmission line is proposed to be constructed from the Site to the south east, across BLM managed land, to an existing 161kV/230kV Western Transmission Line.

Over the majority of the Site no grading will be required. The only areas of nominal grading will be the power block, which will be graded to create a generally uniform elevation for construction of the plant power island facilities, the roads and associated ditches, and the detention and evaporation pond areas. The heliostats can be installed without grading except in locations where minor grading will be required to provide a smooth surface for truck access. It is expected that any grading within the heliostat field will be completed with cuts and fills of less than 6 inches. Vegetation within the heliostat area will be cut or removed only as needed to allow installation of the heliostats. The root structure of vegetation will be allowed to remain to enhance soil stability and to facilitate potential re-growth. **Photo 1** shows the typical existing surface and vegetation and was taken at the location of Test Pit 12 (Identified as B-12 in the "Preliminary Geotechnical Engineering Report, dated August 5, 2009, by Terracon) which is located within the west half of the proposed heliostat field.

Photo 1: Typical existing surface and vegetation

As outlined in **Section I,** off-site storm water flows are sourced from an area north of SR-62, the California-Arizona Railroad and the Aqueduct. There is one dike immediately east of the Site and another dike immediately west of the Site, therefore the drainage sheds associated with flows need to be addressed in the design of the Site.

Based on site visits and a review of aerial photos it is known that the off site storm flows have been redirected south of SR-62 in the past (refer **Figure 3**). Small dikes were constructed to divert off site flows around the air field. These small dikes can be seen in aerials and the redirected flows show up on USGS Maps of the area (refer **Figure 2** and **3**). These small dikes divert(ed) off site flows to the east and west of where these off site flows cross SR-62. Over time, and because of a lack of maintenance, these dikes have been breached and a portion the off site storm flows have returned to sheet flow after crossing SR-62.

For development of the Site, small ditches will be constructed on the outside of the Site, along the perimeter of the north portion of the heliostat field to direct these off site flows around the Site. The ditches, along with the elevated perimeter road will be the features that redirect the off site flows around the heliostat fields, similar to the dikes historically constructed in the early 1940's which also directed off site flows around the airfield. The ditches have been sized to contain the stormwater runoff in a 100 year, 24 hour storm event.

On-site storm water run off within the heliostat field will be allowed to sheet flow along its current drainage pattern, from north to south. In the southern portion of the heliostat field, an expansive and shallow detention basin will be constructed to detain any increase in storm

flows, and to allow a location for sediment control. The detention basin shall attenuate the post developed 100 year, 24 hour storm event run off, and discharge at the pre developed 100 year, 24 hour storm event flow rate.

Conceptual grading plans and designs of the roads and ditches are included in Attachment F. Detailed design of the roads, ditches, detention basin and other facilities will be included with the final drainage design.

III. OBJECTIVE

The hydrologic and hydraulic conditions associated with the development of approximately 1,410 acres for the Project are conceptually addressed in this study.

This conceptual drainage study addresses existing drainage patterns associated with pre-developed conditions and the future post development drainage flows through and around the Site. The objective of the study is to ensure the solar power plant development does not impact on the downstream drainage system and properties. This objective was achieved by undertaking the follow activities:

- Determine the drainage watershed boundary for the Project site (including off-site sources);
- Determine the quantity of stormwater run-off entering the Project site;
- Determine the quantity of stormwater run-off within the Project site under pre-developed conditions;
- Determine the quantity of stormwater run-off within the Project site under post-developed conditions;
- Evaluate the difference in stormwater run-off quantities between pre-developed and post developed conditions and estimate the required size of on-site detention basins;
- Determine the alignment and sizing of drainage channels to facilitate off-site stormwater run-off; and

In order to accomplish this, hydrology calculations are performed using TR-55 (SCS Method) to determine the rate of pre and post development stormwater run-on and run-off in the watershed.

The USDA Natural Resources Conservation Service and Riverside Hydrology manual are 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 watershed boundaries from available state watershed information, contour intervals, and available soils mapping information. The watershed is then further broken down into sub-basins as required to determine the flow from off site drainage locations (where the off-site dikes focus the flows) as they approach the Site. Nodes shall be placed at appropriate locations to evaluate the pre and post development stormwater flows, and to ensure that the Site post-development discharge is kept at or below the pre-developed discharge.

IV. DRAINAGE SUMMARY

Drainage modeling and calculations were performed using Bentley PondPack Ver. 10.1. The objective of not exceeding the pre-developed flows at the points of interest were accomplished (refer to **Table 1**). Detention basins shall be designed to ensure that the Site post-development discharge is kept at or below the pre-developed discharge.

Table 1: 100 year, 24 hour Pre Developed and Post Development Flows in Sub-Basin 9

	Pre Developed Flow (cfs)	Post Developed Flow (cfs)
Outlet	96	285
Detention Basin	N/A	To obtain an outlet volume of less than 96 cfs requires a detention basin size estimated at 30 ac-ft

cfs = cubic feet per second

N/A = not applicable

V. HYDROLOGY

The hydrology analysis was performed and analyzed as set forth in the Riverside Hydrology Manual. USDA Natural Resources Conservation Service (NRCS formerly SCS) Technical release 55 (TR-55) is used to assign curve numbers (CN) in calculating runoff. TR-55 is also used to compute time of concentration. Time of concentration is based on sheet flow, shallow concentrate, and channel flow.

As outlined in **Section II**, the Site will predominantly use channels to convey runoff around the Project Site. For large drainage areas, the Riverside County Hydrology Manual requires using the (NRCS/SCS) Unit Hydrograph Methodology for drainage calculation.

A. RAINFALL

In the 100 year, 24 hour storm event, 3.32 inches of rainfall shall fall (refer to **Appendix B**). Based on the Site location, the (NRCS/SCS) Type II rainfall distribution was used when performing calculations.

B. SOILS

Soil classification was made using data from USDA Natural Resources Conservation Service (refer to **Appendix C**). The soil type within the pre-developed watershed and post-developed watershed is listed in **Table 2**.

Table 2: Soil Types

Soil Type	Off-site Watershed Areas (acres)	On-site Basin 9 Pre and Post Development Watershed Area (acres)
A	2074	1369
B	1821	0
C	673	0
TOTAL	**4568**	**1369**

The soil on site is classified as typical durorthids, loamy-skeletal mixed, hyperthermic and shallow, and typical torripsamments, mixed, hyperthermic. A soil list for the watershed is included in **Appendix C**.

C. HYDROLOGIC LOSSES

With the hydrologic soil group established, hydrologic losses can be computed using (NRCS/SCS) runoff curve numbers (CN) found by using TR-55 runoff curve numbers (refer to **Appendix C**). The sub-region and associated curve numbers are input into PondPack, which calculates a weighted CN for the total area to be used for the runoff computations. The hydrologic cover type was assumed to be desert shrub and allocated as "fair" for pre development and "poor" for post development conditions.

D. PRE DEVELOPED CONDITIONS

The pre-developed drainage plans (refer to **Appendix D**) were prepared to estimate the runoff for all drainage areas at the Site. The total watershed area is 5,937 acres, of which 4,568 is off-site. The watershed was divided into eight upstream sub-basins (sub-basin 1, 2, 3, 4, 5, 6, 7 and 8) and one onsite sub-basin (sub-basin 9). The area of each sub basin is shown in **Table 3**.

Table 3: Pre Developed Conditions, Sub-basin Areas

SUB-BASIN NUMBER	**AREA** (Acre)
1	1,472
2	2,398
3	10
4	98
5	89
6	186
7	212
8	103
9	1,369

Drainage was estimated using USGS quadrangle maps. It is assumed that flows are unimpeded at all crossings structures that exist. This assumption is conservative because it does not take into account any storage or reduction in peak flows that may be associated with an undersized crossing structure.

The calculations of the 100 year, 24 hour storm flows under pre-developed conditions for off-site and on-site areas are summarized in **Appendix D**. The 100 year, 24 hour storm flows

were calculated using PondPack software. The software generates required runoff hydrographs for each of the drainage area separately, rainfall distribution used in this calculation is Type II 24 hour rainfall and the 100 year rainfall events were obtained from NOAA Atlas 2 Rainfall Depth – Duration – Frequency Maps reproduced for the Riverside area (refer to **Appendix B**).

E. POST DEVELOPED CONDITIONS

The post-developed drainage plans are located in **Appendix E**. The total watershed area under post-developed conditions is approximately 1,369 acres (sub-basin 9 only). As outlined in **Section II**, flows from offsite shall be diverted in two channels that flow around the perimeter of Basin 9:

- Flows from sub-basin 7 will be diverted through a drainage channel on the west side perimeter of sub-basin 9 and will eventually turn back into sheet flow at an outlet past sub-basin 9.
- Flows from sub-basin 8 will be diverted through a drainage channel on the east side perimeter of sub-basin 9 and will eventually turn back into sheet flow at an outlet past sub-basin 9.
- Flows from sub-basins 1-6 will be diverted into existing channels and berms on the east and west side of sub-basin 9, that will route the flow back to sheet flow at outlets past the perimeter of Basin 9.

In addition, a detention basin has been included in the model to capture all run off from sub-basin 9. The sub areas for post developed conditions are shown in **Table 4**.

Table 4: Post Developed Conditions, Sub Basin Areas

SUB-BASIN NUMBER	**AREA** (Acre)
9	1,369
TOTAL	**1,369**

There is an increase in impervious area on Site due to:

- Paved Access Roads (around the Site and connecting to off-site existing roadways);
- Administration Building;
- Warehouse; and

- Power Block Concrete surfacing.

It has been assumed that each of the heliostats will freely drain onto the ground. The ground surface may be slightly more impervious in post developed conditions due to the footings of the heliostats.

The calculations of the 100 year, 24 hour storm event flows under post-developed conditions are summarized in **Appendix E**. The 100 year storm flows were calculated using PondPack software. The preliminary volumes required for the detention basin is 30 acre-feet for sub-basin 9. Further specifics for the detention pond (i.e. outlet design, risers, and spillway structures) shall be undertaken during detailed design, occurring in a later phase of this project.

VI. HYDRAULICS

A. SUMMARY

Channels were designed using open channel flow criteria.

B. DESIGN CONSIDERATIONS

1. DESIGN STORM FREQUENCY

100 year, 24 hour event with the water surface contained within all channels.

2. DESIGN STORM DURATION

The goal in the storm drain design is to convey the maximum peak flow for a given design storm. This involves choosing a storm with the same duration as the time-of-concentration for the watershed (critical duration). As the storm is passed down the collection system, the time-of-concentration at each point downstream of the headwater sheds will increase according to shed minimum time-of-concentration plus travel time in structures.

3. MINOR LOSSES

A Manning's roughness coefficient n value of 0.020 was assumed for the channels.

4. VEGETATION, CLEARING, AND GRUBBIING

The site's natural vegetation will remain in place and undisturbed throughout the Property, and will only be disturbed or removed within the limits of the Site as needed to construct the facilities. As discussed in **Section II**, grading will be limited to that required to generate a smooth surface within the heliostat field. Vegetation will be cut or removed as needed, but root structures will be left in place where possible (i.e. no grading is required). A concerted effort will not be employed to "grub" the root system of the onsite vegetation.

5. GRADING, EXCAVATION, AND SLOPES:

Only portions of the Site (the heliostat field) will be lightly graded to create a relatively smooth condition. Localized areas where abrupt changes of grade occur will be graded to allow for vehicle access within the heliostat field. Nominal grading will be required to elevate the roads, cut the ditches, build the evaporation ponds, and to level the power island location. Slopes will be a maximum of 3H:1V, and will be flatter where possible to allow vehicle access from and to road shoulders, and across ditches. The site will not

generate excess soil, nor require import. The site will be graded to balance by generation of needed material within the heliostat field or by very minor fills within the heliostat field.

C. CROSS SECTIONS

Preliminary channel cross sections are shown on the Conceptual Grading Plan (refer to **Appendix F**). The width and depth of the channels vary depending on location. Further specifics for the channels (i.e. individual cross sections, material selection, compaction, stabilization) shall be undertaken during detailed design, occurring in a later phase of this project.

VII. FLOOD MANAGEMENT

As outlined in **Section I**, FEMA has not mapped the Project site for the presence of flood plains (allocated as Zone D on FIRM Map *Number 06065CIND2A Sheet 2, Site is in Grid *06065C0575G, which equates to an area with possible but undetermined flood hazards as no analysis for flood hazards has been conducted) (*refer **Appendix A**). The RSEP site is not located in a flood hazard area identified in the Riverside County General Plan Safety Element.

As outlined in **Section II**, there are two existing dikes that direct upstream stormwater run off towards the RSEP site (refer **Figure 3**). In a 100 year storm event, the upstream stormwater would flow across SR-62 (dips in the road are approximately 40 to 60 feet wide), breach the degraded berms and sheet flow until it either infiltrated into Rice Valley Groundwater Basin, or drained in the Rice Valley dry playa, located approximately 2 miles south of the Project site.

Under developed conditions, upstream stormwater would continue to flow across SR-62 and sheet flow across the land. As shown on **Figure 3**, sheet flow from the west does not currently flow toward the Site, Therefore, the ditch along the north western perimeter of the Site has been sized to contain stormwater run off from the off-site catchment immediately north west of the site (sub-basin 7) (refer to **Appendix F** for proposed cross section). Existing sheet flow to the east of the Site does currently enter the Site, however this stormwater run off will be intercepted in the proposed channel around the north eastern perimeter of the Site. This channel has also been sized to contain the 100 year, 24 hour storm event from the upstream catchment (sub-basins 2, 5 and 6) plus any stormwater run off from the off-site catchment immediately north east of the site (sub-basin 8) (refer to **Appendix F** for proposed cross section).

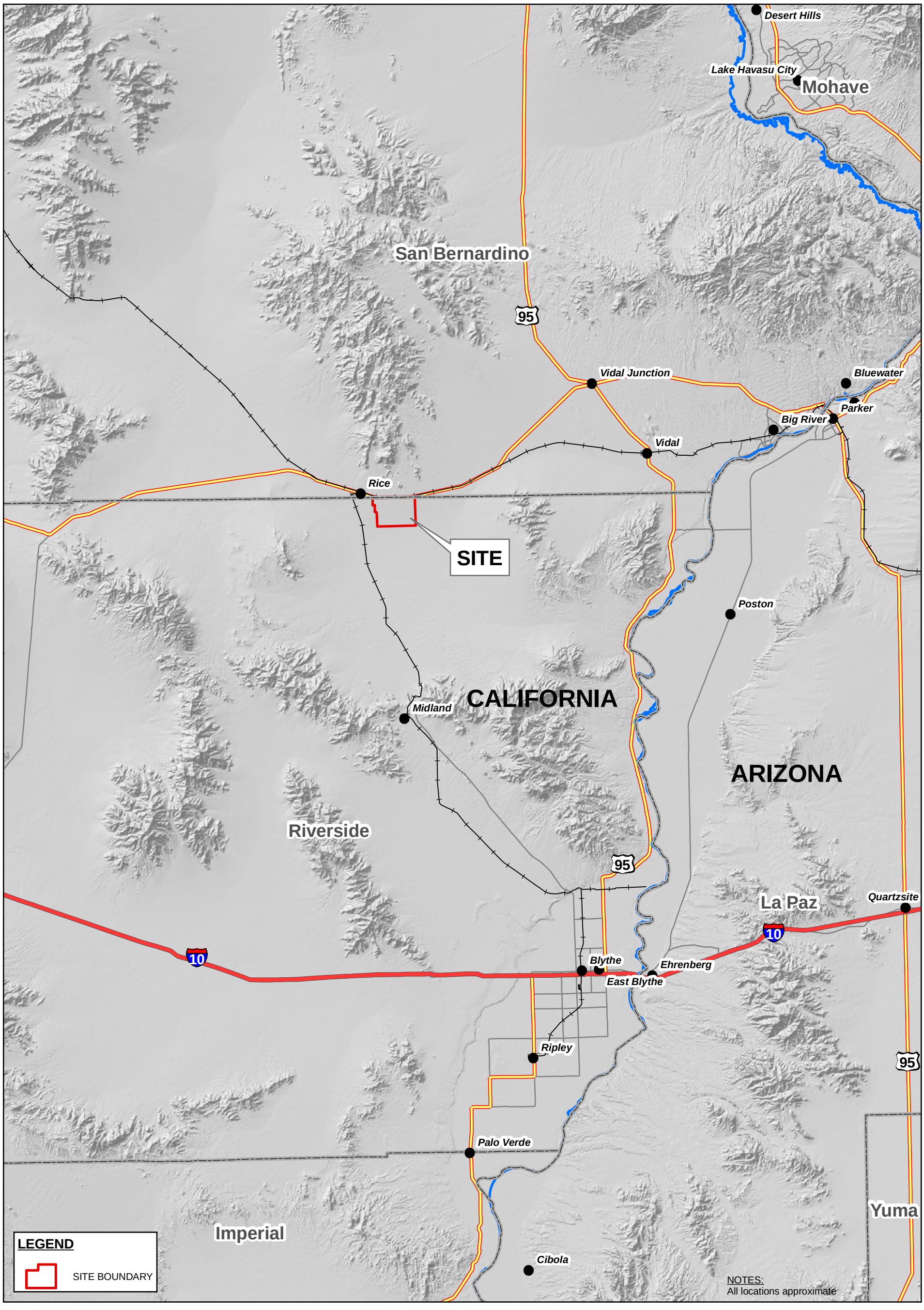
At the outlet of the proposed channels, the stormwater runoff will transition to sheet flow, through rip rap to act as an energy dissipater. As shown in **Figure 3**, the existing stormwater currently sheets flows from north to south into the Rice Valley dry playa, therefore the outlet of the proposed channel is consistent with the existing conditions.

Additionally, any flow from the 100 year storm event leaving the Project site will be controlled and discharged through the use of the detention basin at flow rates equal to or less than prior to the Project development, negating any effect from the Project site runoff.

All offsite water from the upstream catchment that crosses SR-62 and hits the Site will be contained within the proposed channels and stormwater run-off will be routed around the Project site for the purposes of project design. Implementation of this design approach will protect the project and its components from storm/flood flows, as there are no existing flood hazards mapped, flood flows are controlled north of the site (railway line and aqueduct act as an embankment), cross SR-62 through defined dips in the roadway, and either spread out to a broad, shallow, sheet flow which does not impact the Site (on the west side of the Site) or are captured in a ditch (similar to how the flows were controlled historically), routed around the site, and allowed to spread out to a broad shallow sheet flow south of the Site.

It is noted that that Rice Valley is dominated by surface sand and storm flows have never been reported to accumulate or pond within the valley, indicating a lack of flood hazard potential from the south. As discussed above, the railroad and aqueduct block off-site flow from reaching the site from the north, and concentrate these flows at specific controlled locations, one of which has flows that do not reach the Site (the west side). The concentrated flow on the east side, that will reach the site, will be captured in the perimeter drainage ditch and elevated perimeter road system, and routed around the site. Therefore, it is appropriate to ensure the 100 year flows are contained within this ditch during detailed design of the Project. This can be accomplished be preparing the Hydraulic Grade Line (HGL) of the 100 year storm flow within the diversion channels when the detailed design of these ditches is undertaken. The HGL will be calculated to confirm that the sizing and geometry of the diversion berm and channel system are such that the 100 year storm flows are contained within the diversion channels, passed around the Project site, and dispersed back to sheet flow downstream of the Project Site. This can be undertaken prior to or during detailed design using Bentley Flowmaster or similar software.

FIGURES



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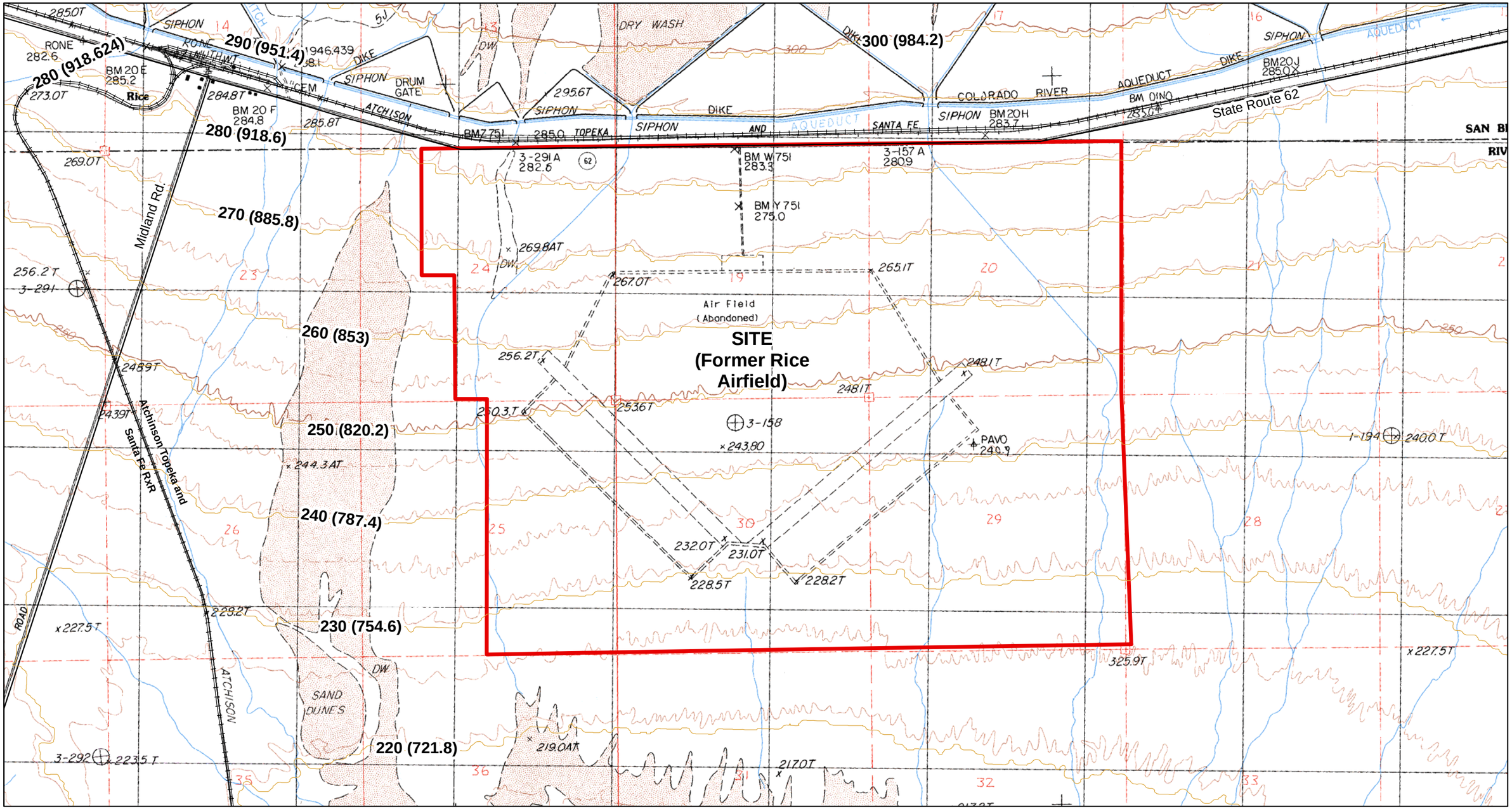
PROJECT LOCATION



NOTES:
Contours are in Meters and Feet -
220 m (721.8 ft)
SOURCE:
USGS 7.5' Quad Sheet, Rice
All Locations approximate

N
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0 4,000
Feet

SOLAR RESERVE, LLC

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TOPOGRAPHY MAP

SWL	BA	9/2009
52006711	2	

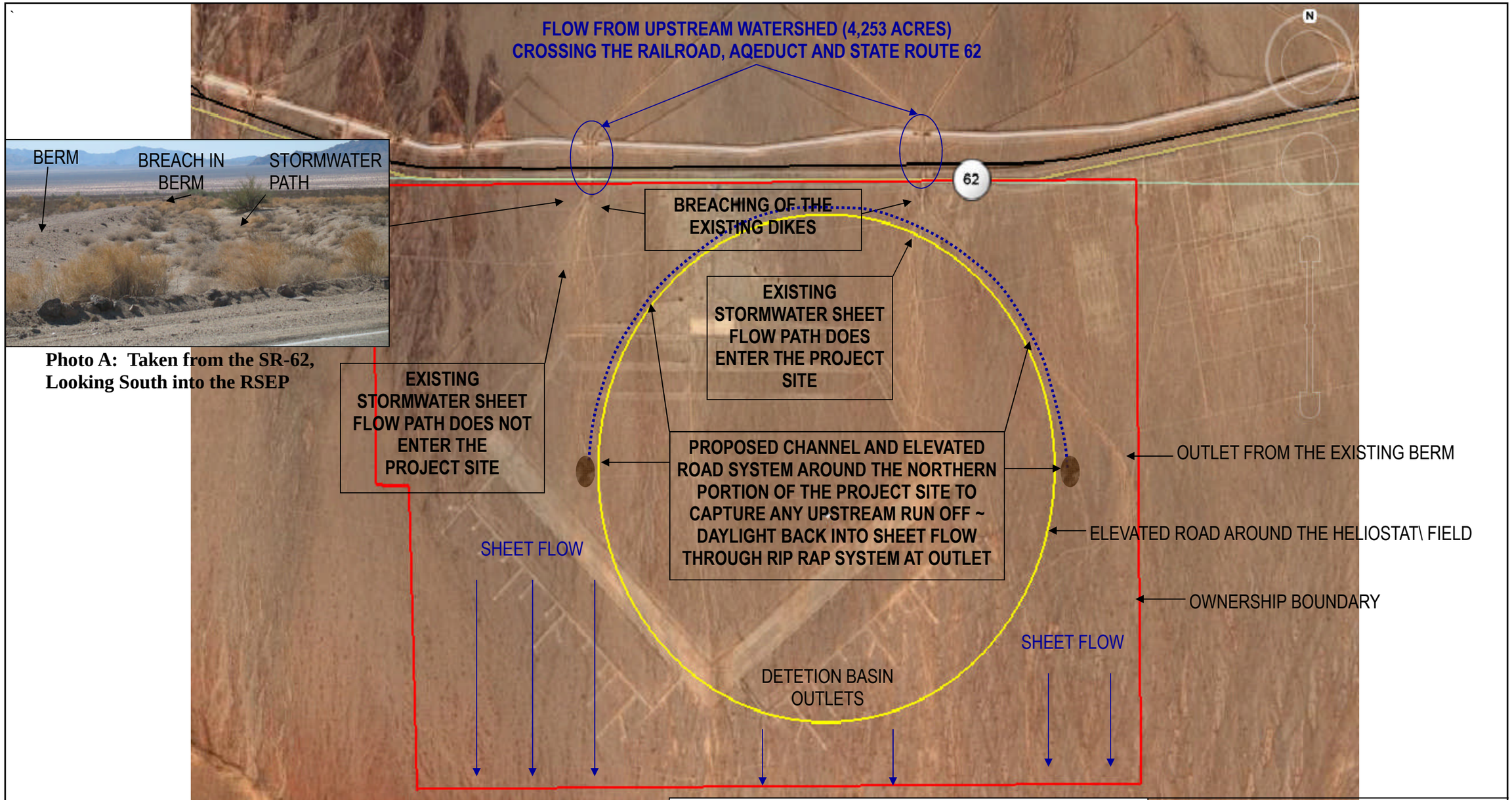


Photo A: Taken from the SR-62, Looking South into the RSEP

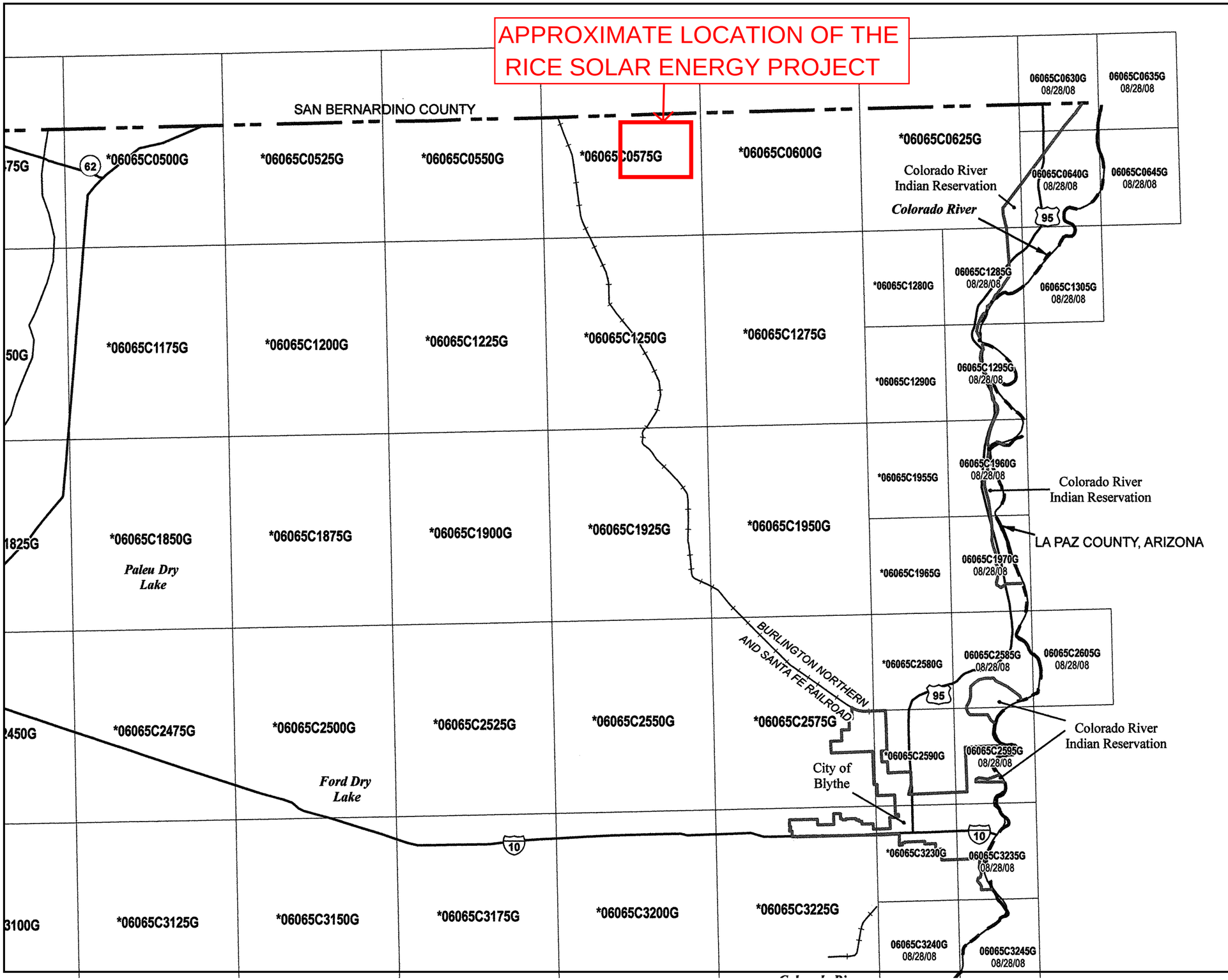
NOT TO SCALE

Source: Google Earth, 2009
Photos from B.Anders, Rice Solar Energy Project Site Visit 2008

RICE SOLAR ENERGY LLC RICE SOLAR ENERGY PROJECT	WorleyParsons resources & energy		
DRAINAGE SCHEME EXHIBIT	10/2009	JF	3

APPENDICES

APPENDIX A – FLOOD MAPS



Chambers

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NFIP

NATIONAL FLOOD INSURANCE PROGRAM

MAP INDEX

FIRM

FLOOD INSURANCE RATE MAP

RIVERSIDE COUNTY, CALIFORNIA

AND INCORPORATED AREAS

(SEE LISTING OF COMMUNITIES TABLE)

MAP INDEX

SHEET 2 OF 2

PANELS PRINTED: 630, 635, 640, 645, 1285, 1295, 1305, 1960, 1970, 2300, 2585, 2595, 2605, 2950, 2975, 3235, 3240, 3245, 3785, 3795, 3805

(SEE SHEET 1 FOR ADDITIONAL PANELS PRINTED)

MAP NUMBER
06065CIND2A

EFFECTIVE DATE
AUGUST 28, 2008

This is an official copy of a portion of the above referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect changes or amendments which may have been made subsequent to the date on the title block. For the latest product information about National Flood Insurance Program flood maps check the FEMA Flood Map Store at www.msc.fema.gov

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APPENDIX B – RAINFALL PRECIPITATION

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POINT PRECIPITATION FREQUENCY ESTIMATES FROM NOAA ATLAS 14

California 34.065 N 114.8 W 807 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: Tue Feb 17 2009

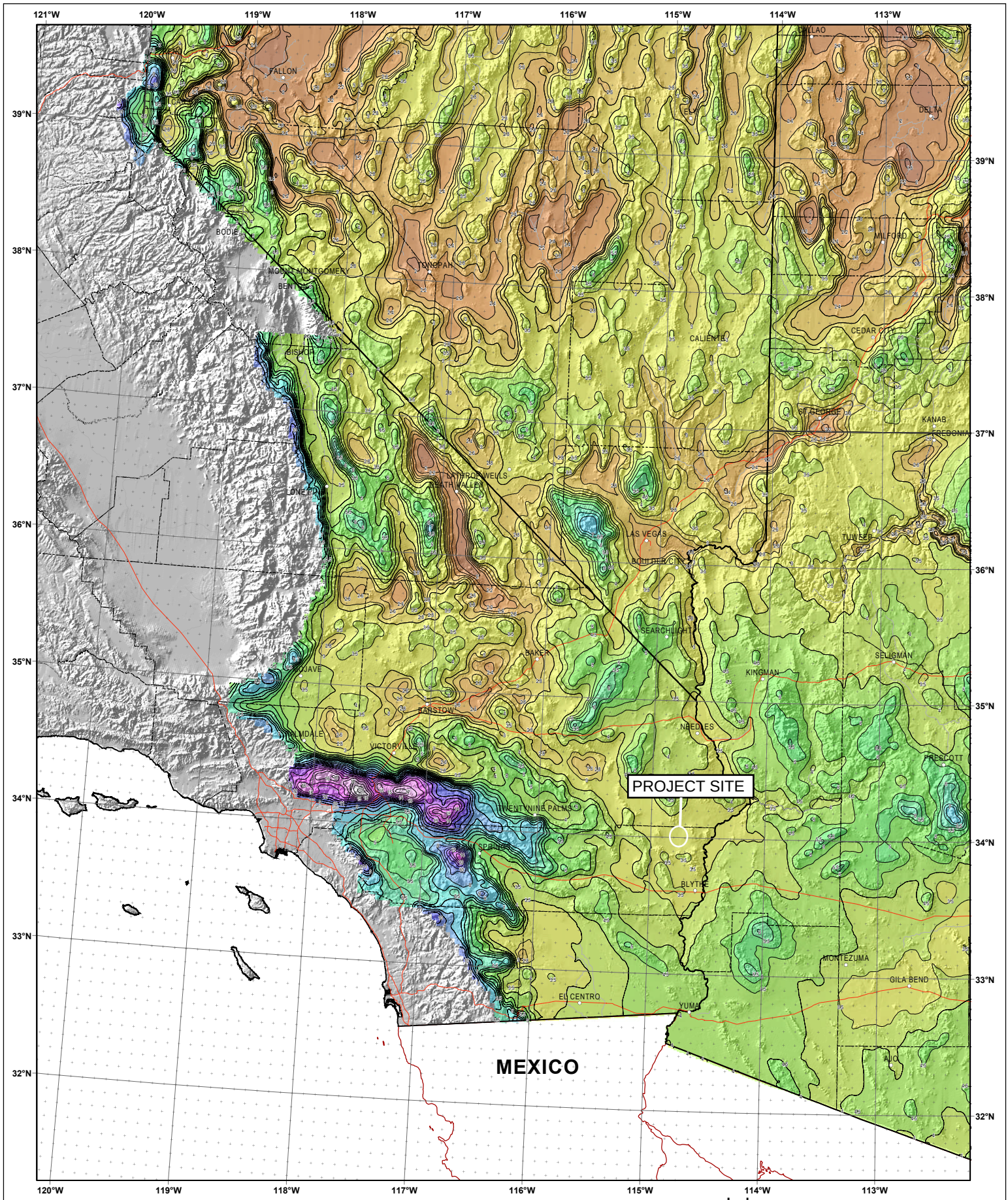
Precipitation Frequency Estimates (inches)

ARI* (years)	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	60 day
1	0.11	0.17	0.21	0.28	0.34	0.42	0.47	0.59	0.70	0.83	0.88	0.98	1.06	1.10	1.25	1.41	1.56	1.71
2	0.15	0.23	0.29	0.39	0.48	0.58	0.65	0.80	0.96	1.10	1.16	1.29	1.40	1.46	1.66	1.88	2.09	2.30
5	0.24	0.37	0.46	0.62	0.77	0.91	1.00	1.21	1.44	1.55	1.63	1.80	1.95	2.05	2.35	2.66	2.98	3.28
10	0.32	0.49	0.61	0.82	1.01	1.19	1.30	1.54	1.81	1.91	1.99	2.20	2.37	2.51	2.87	3.23	3.63	4.00
25	0.44	0.68	0.84	1.13	1.40	1.62	1.75	2.02	2.35	2.42	2.50	2.76	2.95	3.14	3.58	4.00	4.50	4.96
50	0.55	0.84	1.04	1.41	1.74	2.00	2.14	2.44	2.80	2.82	2.91	3.20	3.40	3.65	4.13	4.60	5.17	5.70
100	0.68	1.04	1.29	1.73	2.14	2.45	2.60	2.89	3.28	3.32	3.35	3.67	3.88	4.18	4.71	5.21	5.84	6.46
200	0.83	1.27	1.57	2.12	2.62	2.97	3.13	3.40	3.81	3.84	3.88	4.17	4.39	4.74	5.32	5.83	6.53	7.22
500	1.07	1.64	2.03	2.73	3.38	3.78	3.98	4.25	4.67	4.72	4.77	4.88	5.08	5.53	6.14	6.68	7.45	8.25
1000	1.30	1.98	2.45	3.30	4.09	4.53	4.75	5.03	5.47	5.52	5.58	5.63	5.64	6.15	6.80	7.34	8.16	9.05

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

ARI** (years)	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	60 day
1	0.13	0.20	0.25	0.34	0.42	0.50	0.56	0.69	0.82	0.94	0.99	1.10	1.19	1.25	1.42	1.59	1.77	1.94
2	0.19	0.28	0.35	0.48	0.59	0.69	0.77	0.94	1.12	1.24	1.31	1.45	1.57	1.65	1.88	2.12	2.37	2.60
5	0.30	0.46	0.56	0.76	0.94	1.09	1.19	1.41	1.66	1.75	1.83	2.03	2.19	2.31	2.65	2.99	3.37	3.71
10	0.39	0.60	0.74	1.00	1.24	1.42	1.54	1.80	2.09	2.15	2.23	2.47	2.66	2.82	3.24	3.64	4.10	4.53
25	0.54	0.82	1.02	1.38	1.70	1.93	2.06	2.36	2.72	2.74	2.81	3.09	3.31	3.54	4.04	4.50	5.09	5.62
50	0.68	1.03	1.27	1.72	2.12	2.39	2.53	2.85	3.25	3.28	3.28	3.59	3.83	4.11	4.68	5.18	5.85	6.48
100	0.83	1.27	1.57	2.12	2.62	2.94	3.09	3.40	3.83	3.87	3.91	4.13	4.38	4.73	5.35	5.89	6.64	7.37
200	1.02	1.56	1.93	2.60	3.22	3.59	3.74	4.02	4.47	4.52	4.56	4.72	4.97	5.39	6.06	6.62	7.44	8.28
500	1.33	2.03	2.51	3.38	4.19	4.62	4.82	5.09	5.56	5.62	5.67	5.73	5.80	6.33	7.06	7.64	8.56	9.51
1000	1.62	2.46	3.06	4.12	5.09	5.59	5.82	6.10	6.57	6.63	6.70	6.77	6.83	7.11	7.87	8.47	9.43	10.49

* 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 a partial duration series. **ARI** is the Average Recurrence Interval.
Please refer to NOAA Atlas 14 Document for more information. NOTE: Formatting prevents estimates near zero to appear as zero.



SOUTHEASTERN CALIFORNIA

NOAA Atlas 14, Volume 1, Version 4
Semiarid Southwestern United States

Prepared by U.S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
NATIONAL WEATHER SERVICE
OFFICE OF HYDROLOGIC DEVELOPMENT
HYDROMETEOROLOGICAL DESIGN STUDIES CENTER
June 2006

SCALE 1:2,000,000
(when printed/viewed at ANSI C size)
0 10 20 30 40 50 Miles
0 5 10 20 30 40 50 60 70 Kilometers

Isopluvials of 24 hour precipitation (inches)
with Average Recurrence Interval of 100 years

See NOAA Atlas 14 documentation for factors to convert to Annual Exceedance Probabilities for all estimates below 25 years

N

Inches

1.53 - 1.60	2.61 - 2.80	5.01 - 5.50	9.01 - 10.00	15.01 - 16.00
1.61 - 1.80	2.81 - 3.00	5.51 - 6.00	10.01 - 11.00	16.01 - 17.00
1.81 - 2.00	3.01 - 3.50	6.01 - 6.50	11.01 - 12.00	17.01 - 18.00
2.01 - 2.20	3.51 - 4.00	6.51 - 7.00	12.01 - 13.00	18.01 - 19.00
2.21 - 2.40	4.01 - 4.50	7.01 - 8.00	13.01 - 14.00	
2.41 - 2.60	4.51 - 5.00	8.01 - 9.00	14.01 - 15.00	

Projection: Lambert Conformal Conic; Datum NAD83; Standard Parallels: 38° and 45°; Central Meridian 112°.

APPENDIX C – SOIL CLASSIFICATION

Curve Number (CN) Determination

The SCS Curve Number Method uses a coil cover complex number (CN) for computing excess precipitation. The CN is related to hydrologic soil group (A, B, C, or D), land use, treatment class (cover), and antecedent moisture condition. The soil group is determined from published soil maps for the area (usually published by the NRCS (SCS))

The definitions of the hydrologic soil groups are:

> *Group A – Low run off potential. Soils having a high infiltration rates even when thoroughly wetted and consisting chiefly of deep, well drained sands or gravels. These soils have a high rate of water transmission.*
>
> *Group B – Soils having moderate infiltration rates when thoroughly wetted and consisting chiefly of moderately deep to deep, moderately well to well drained sandy-loam soils with moderately fine to moderately coarse textures. These soils have a moderate rate of water transmission.*
>
> *Group C – Soils having slow infiltration rates when thoroughly wetted and consisting chiefly of silty loam soils with a layer than impedes downward movement of water, or soils with moderately fine to fine texture. These soils have a slow rate of water transmission.*
>
> *Group D – High run off potential. Soils having very slow infiltration rates when thoroughly wetted and consisting chiefly of clay soils with high swelling potential, soils with a permanent high water table, soils with a claypan or clay layer at or near the surface, and shallow soils over nearly impervious material. These soils have a very slow rate of water transmission.*

The Hydrologic Soil Classifications were obtained from:

SSURGO – Soil Survey Geographic Data Base U.S. Department of Agriculture, Natural Resources Conservation Service.

Specific Soil taxonomy for the watershed is shown in the following maps.

WorleyParsons
resources & energy

RICE SOLAR ENERGY FACILITY
CONCEPTUAL DRAINAGE STUDY

SOIL TAXONOMY MAP

SOURCE: http://soils.usda.gov/technical/classification/taxonomy/

WorleyParsons
resources & energy

Rice Solar Energy Facility
Conceptual Drainage Study

Soil Taxonomy List
Source: http://soils.usda.gov/technical/classification/taxonomy/

ID. NAME,CLASS

0. CAJON,"TYPIC TORRIPSAMMENTS, MIXED, THERMIC"

1. NICKEL,"TYPIC CALCIORTHIDS, LOAMY-SKELETAL, MIXED, THERMIC"

2. TECOPA,"LITHIC TORRIORTHENTS, LOAMY-SKELETAL, MIXED (CALCAREOUS), THERMIC"

3,TECOPA,"LITHIC TORRIORTHENTS, LOAMY-SKELETAL, MIXED (CALCAREOUS), THERMIC"

4. BADLAND

5. GUNSIGHT,"TYPIC CALCIORTHIDS, LOAMY-SKELETAL, MIXED, HYPERTHERMIC"

6. ROSITAS,"TYPIC TORRIPSAMMENTS, MIXED, HYPERTHERMIC"

7. CALVISTA,"LITHIC CAMBORTHIDS, LOAMY, MIXED, THERMIC"

8. CALVISTA,"LITHIC CAMBORTHIDS, LOAMY, MIXED, THERMIC"

9. BADLAND

10. TECOPA,"LITHIC TORRIORTHENTS, LOAMY-SKELETAL, MIXED (CALCAREOUS), THERMIC"

11. NICKEL,"TYPIC CALCIORTHIDS, LOAMY-SKELETAL, MIXED, THERMIC"

12. UPSPRING,"LITHIC TORRIORTHENTS, LOAMY-SKELETAL, MIXED (CALCAREOUS), THERMIC"

13. HYDER, "LITHIC TORRIORTHENTS, LOAMY-SKELETAL, MIXED (CALCAREOUS), HYPERTHERMIC "

14. HYDER, "LITHIC TORRIORTHENTS, LOAMY-SKELETAL, MIXED (CALCAREOUS), HYPERTHERMIC "

15. LAPOSA,"TYPIC CAMBORTHIDS, LOAMY-SKELETAL, MIXED, HYPERTHERMIC"

16. HYDER, "LITHIC TORRIORTHENTS, LOAMY-SKELETAL, MIXED (CALCAREOUS), HYPERTHERMIC "

17. CAJON,"TYPIC TORRIPSAMMENTS, MIXED, THERMIC"

18. UPSPRING,"LITHIC TORRIORTHENTS, LOAMY-SKELETAL, MIXED (CALCAREOUS),

THERMIC"

19. TECOPA,"LITHIC TORRIORTHENTS, LOAMY-SKELETAL, MIXED (CALCAREOUS), THERMIC"

20. ROSITAS,"TYPIC TORRIPSAMMENTS, MIXED, HYPERTHERMIC"

21. ROSITAS,"TYPIC TORRIPSAMMENTS, MIXED, HYPERTHERMIC"

22. GUNSIGHT,"TYPIC CALCIORTHIDS, LOAMY-SKELETAL, MIXED, HYPERTHERMIC"

23. TECOPA,"LITHIC TORRIORTHENTS, LOAMY-SKELETAL, MIXED (CALCAREOUS), THERMIC"

24. HYDER, "LITHIC TORRIORTHENTS, LOAMY-SKELETAL, MIXED (CALCAREOUS), HYPERTHERMIC "

25. HYDER, "LITHIC TORRIORTHENTS, LOAMY-SKELETAL, MIXED (CALCAREOUS), HYPERTHERMIC "

26. GUNSIGHT,"TYPIC CALCIORTHIDS, LOAMY-SKELETAL, MIXED, HYPERTHERMIC"

27. TECOPA,"LITHIC TORRIORTHENTS, LOAMY-SKELETAL, MIXED (CALCAREOUS), THERMIC"

28. ROSITAS,"TYPIC TORRIPSAMMENTS, MIXED, HYPERTHERMIC"

29. HYDER, "LITHIC TORRIORTHENTS, LOAMY-SKELETAL, MIXED (CALCAREOUS), HYPERTHERMIC "

30. ROSITAS,"TYPIC TORRIPSAMMENTS, MIXED, HYPERTHERMIC"

31. PLAYAS

32. GUNSIGHT,"TYPIC CALCIORTHIDS, LOAMY-SKELETAL, MIXED, HYPERTHERMIC"

33. TECOPA,"LITHIC TORRIORTHENTS, LOAMY-SKELETAL, MIXED (CALCAREOUS), THERMIC"

34. CIBOLA, "TYPIC TORRIFLUVENTS, FINE-SILTY OVER SANDY OR SANDY-SKELETAL, MIXED (CALCAREOUS), HYPERTHERMIC "

35. TECOPA,"LITHIC TORRIORTHENTS, LOAMY-SKELETAL, MIXED (CALCAREOUS), THERMIC"

36. TECOPA,"LITHIC TORRIORTHENTS, LOAMY-SKELETAL, MIXED (CALCAREOUS), THERMIC"

37. ROSITAS,"TYPIC TORRIPSAMMENTS, MIXED, HYPERTHERMIC"

38. LAPOSA,"TYPIC CAMBORTHIDS, LOAMY-SKELETAL, MIXED, HYPERTHERMIC"

39. GUNSIGHT,"TYPIC CALCIORTHIDS, LOAMY-SKELETAL, MIXED, HYPERTHERMIC"

40. SCHENCO, "TYPIC TORRIORTHENTS, LOAMY-SKELETAL, MIXED (CALCAREOUS),

HYPERTHERMIC, SHALLOW "

41. LITHIC TORRIORTHENTS, LITHIC TORRIORTHENT S

42. GUNSIGHT,"TYPIC CALCIORTHIDS, LOAMY-SKELETAL, MIXED, HYPERTHERMIC"

43. GUNSIGHT,"TYPIC CALCIORTHIDS, LOAMY-SKELETAL, MIXED, HYPERTHERMIC"

44. TECOPA,"LITHIC TORRIORTHENTS, LOAMY-SKELETAL, MIXED (CALCAREOUS), THERMIC"

45. CIBOLA, "TYPIC TORRIFLUVENTS, FINE-SILTY OVER SANDY OR SANDY-SKELETAL, MIXED (CALCAREOUS), HYPERTHERMIC "

46. LAPOSA,"TYPIC CAMBORTHIDS, LOAMY-SKELETAL, MIXED, HYPERTHERMIC"

47. GUNSIGHT,"TYPIC CALCIORTHIDS, LOAMY-SKELETAL, MIXED, HYPERTHERMIC"

48. TECOPA,"LITHIC TORRIORTHENTS, LOAMY-SKELETAL, MIXED (CALCAREOUS), THERMIC"

49. TECOPA,"LITHIC TORRIORTHENTS, LOAMY-SKELETAL, MIXED (CALCAREOUS), THERMIC"

50. CIBOLA, "TYPIC TORRIFLUVENTS, FINE-SILTY OVER SANDY OR SANDY-SKELETAL, MIXED (CALCAREOUS), HYPERTHERMIC "

APPENDIX D – PRE-DEVELOPED CONDITIONS

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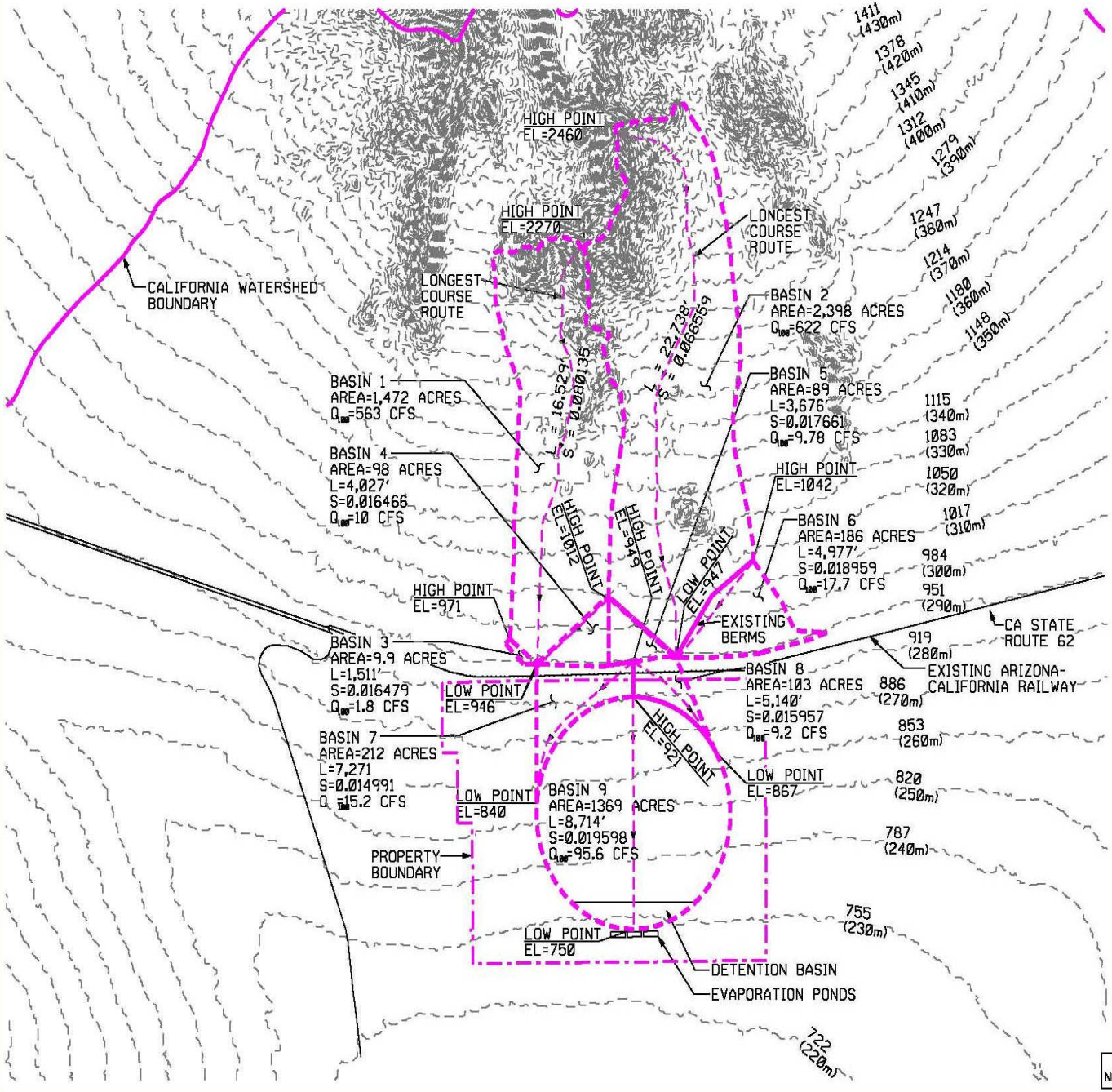
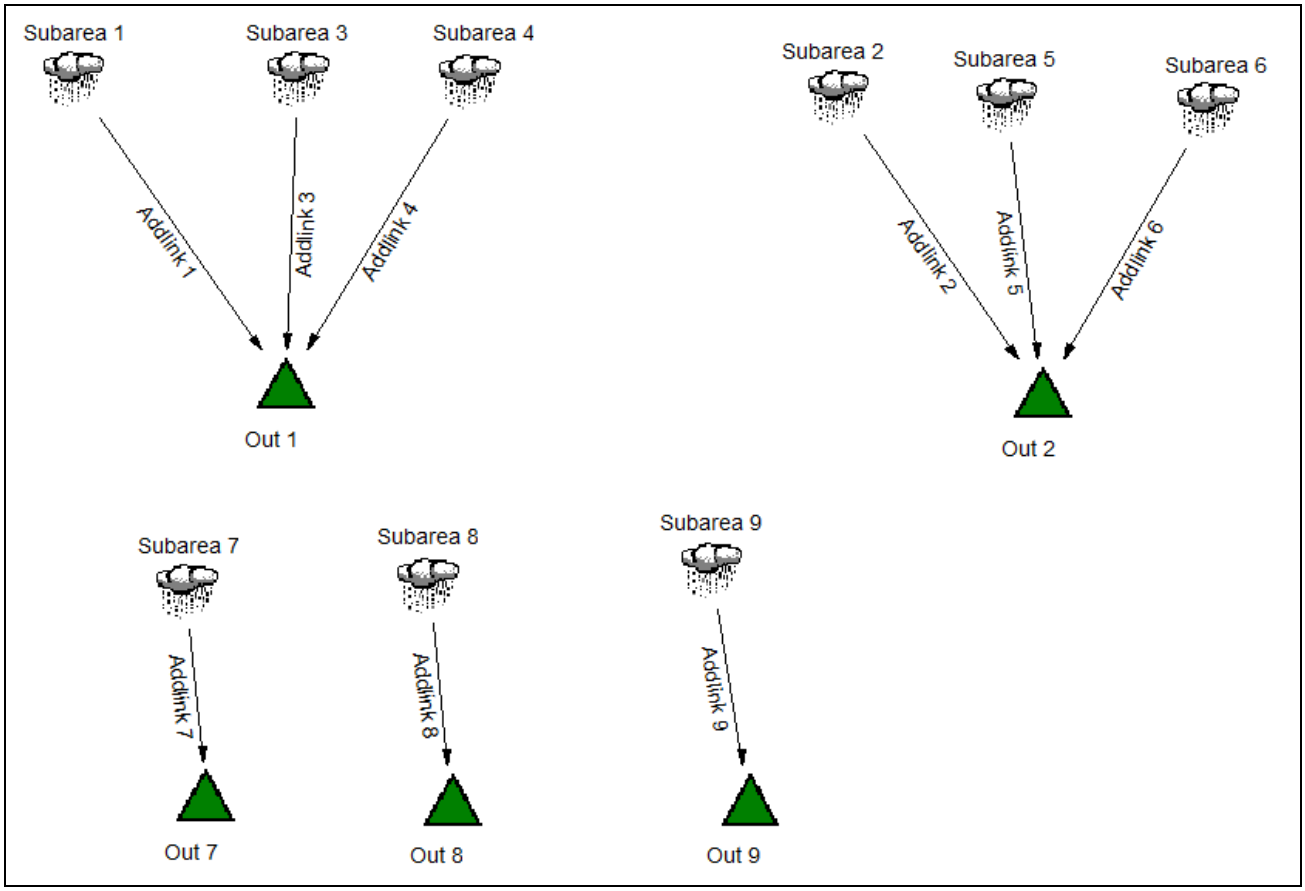


BENTLEY PONDPACK MODEL IMAGE – PRE DEVELOPED CONDITIONS FOR RICE SOLAR ENERGY PROJECT



EXCEPTS FROM THE BENTLEY PONDPACK MODEL – PRE DEVELOPED CONDITIONS FOR RICE SOLAR ENERGY PROJECT

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Rain Dir: T:\01-Projects\Solar Reserve\Project Rice\Engineering\Civil\H&H\PondPack\

==========
JOB TITLE
==========

Project Date: 2/24/2009
Project Engineer: Bob.Anders
Project Title: Watershed Results
Project Comments:
Model of Project Rice in Riverside County, CA

S/N:
PondPack Ver: Compute Time: Date:

MASTER DESIGN STORM SUMMARY

Network Storm Collection: MyStorms

Return Event	Total Depth in	Rainfall Type	RNF ID
Pre100	3.3200	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	Return Type	Event	HYG Vol ac-ft	Trun	Qpeak hrs	Max Qpeak cfs	Max WSEL ft	Pond Storage ac-ft
*OUT 1	JCT	100	106.603		12.6000	572.05		
*OUT 2	JCT	100	166.203		12.9500	637.90		
*OUT 7	JCT	100	5.071		12.8000	15.15		
*OUT 8	JCT	100	2.468		12.5000	9.16		
*OUT 9	JCT	100	32.779		12.8500	95.57		
SUBAREA 1	AREA	100	104.017		12.6000	563.40		
SUBAREA 2	AREA	100	159.622		12.9500	621.96		

SUBAREA 3	AREA	100	.237	12.1000	1.83
SUBAREA 4	AREA	100	2.349	12.4000	10.00
SUBAREA 5	AREA	100	2.133	12.3000	9.78
SUBAREA 6	AREA	100	4.449	12.4500	17.70
SUBAREA 7	AREA	100	5.071	12.8000	15.15
SUBAREA 8	AREA	100	2.468	12.5000	9.16
SUBAREA 9	AREA	100	32.779	12.8500	95.57

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RUNOFF CURVE NUMBER DATA
::::::

Type.... Runoff CN-Area
Name.... SUBAREA 4

Soil/Surface Description	CN	Area acres	Impervious Adjustment %C	%UC	Adjusted CN
Desert shrub - fair	55	98.090			55.00

COMPOSITE AREA & WEIGHTED CN ---> 98.090 55.00 (55)
::::::

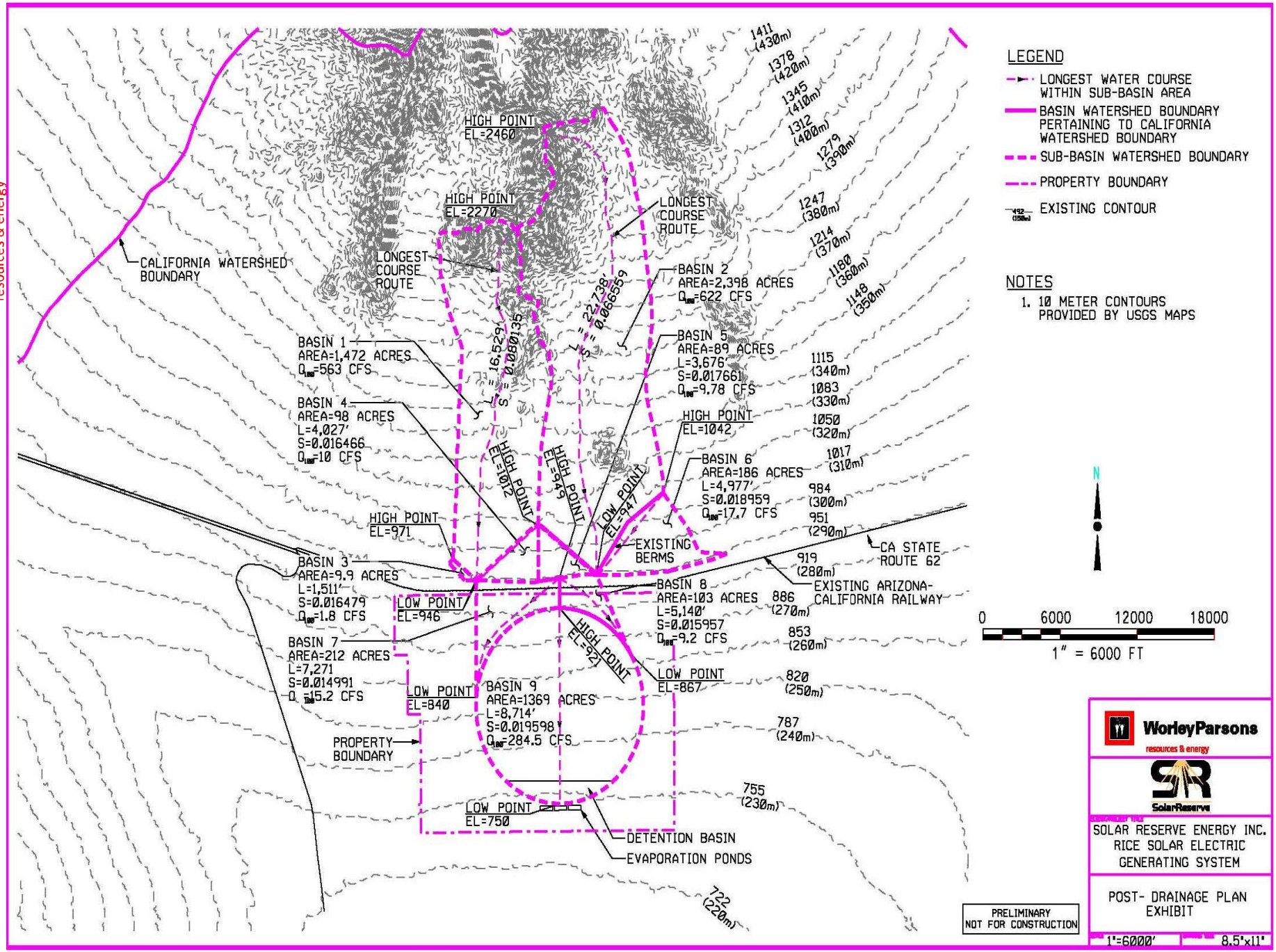
Type.... Runoff CN-Area
Name.... SUBAREA 7

Soil/Surface Description	CN	Area acres	Impervious Adjustment %C	%UC	Adjusted CN
Desert shrub - fair	55	211.790			55.00

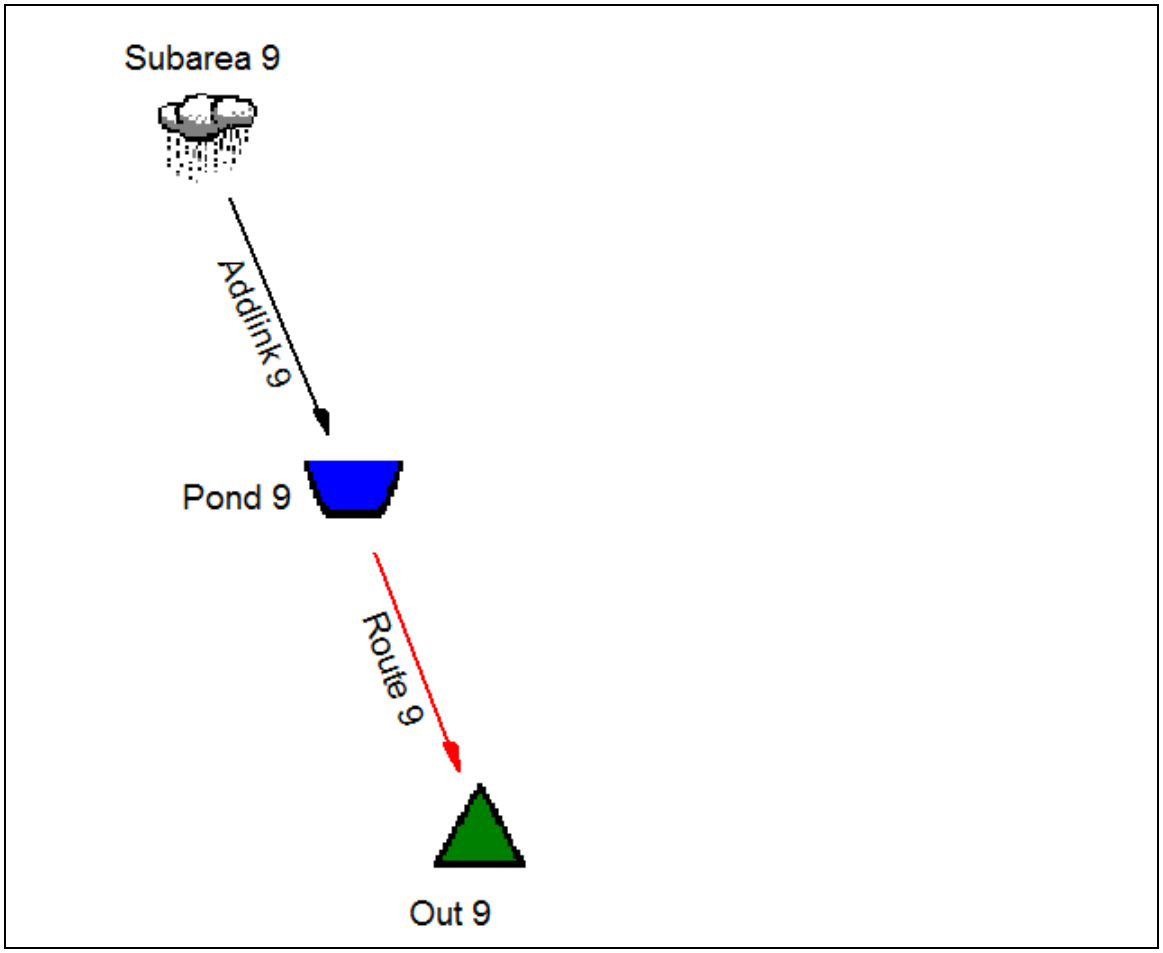
COMPOSITE AREA & WEIGHTED CN ---> 211.790 55.00 (55)
::::::

APPENDIX E – POST-DEVELOPED CONDITIONS

WorleyParsons
resources & energy



BENTLEY PONDPACK MODEL IMAGE – POST DEVELOPED CONDITIONS FOR RICE SOLAR ENERGY PROJECT



EXCEPTS FROM THE BENTLEY PONDPACK MODEL – POST DEVELOPED CONDITIONS FOR RICE SOLAR ENERGY PROJECT

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Rain Dir: T:\01-Projects\Solar Reserve\Project Rice\Engineering\Civil\H&H\PondPack\

==========
JOB TITLE
==========

Project Date: 2/23/2009
Project Engineer: Bob.Anders
Project Title: Pre Watershed Results
Project Comments:
Model of Project Rice in Riverside County, CA

S/N:
PondPack Ver: Compute Time: Date:

MASTER DESIGN STORM SUMMARY

Network Storm Collection: MyStorms

Return Event	Total Depth in	Rainfall Type	RNF ID
Dev100	3.3200	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)

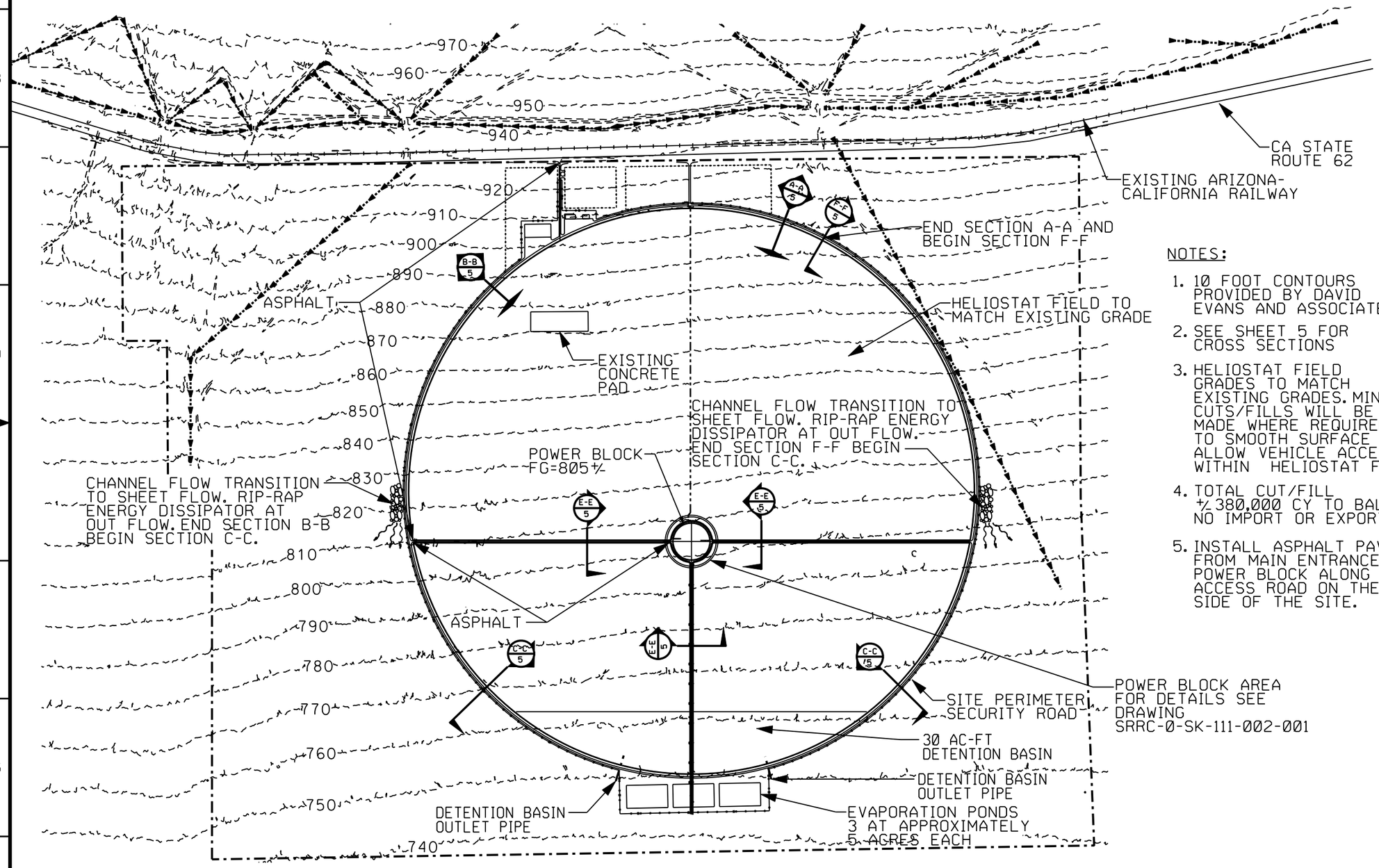
Node ID	Return Type	Event	HYG Vol ac-ft	Trun	Qpeak hrs	Max Qpeak cfs	Max WSEL ft	Pond Storage ac-ft
*OUT 9	JCT	100	65.494		12.7500	284.52		
POND 9	IN POND	100	65.494		12.7500	284.52		
POND 9	OUT POND	100	65.494		12.7500	284.52		
SUBAREA 9	AREA	100	65.494		12.7500	284.52		

Type.... Runoff CN-Area
Name.... SUBAREA 9

File.... T:\01-Projects\Solar Reserve\Project Rice\Engineering\Civil\H&H\PondPack\PROJECTRICEPOST_9.PPW

RUNOFF CURVE NUMBER DATA
::::::

APPENDIX F – CONCEPTUAL GRADING PLANS



LEGEND:

- PROPERTY BOUNDARY
- 492 EXISTING CONTOUR
- EXISTING BERM

N

0 1600 3200

1" = 1600 FT

NOTES:

1. 10 FOOT CONTOURS PROVIDED BY DAVID EVANS AND ASSOCIATES
2. SEE SHEET 5 FOR CROSS SECTIONS
3. HELIOSTAT FIELD GRADES TO MATCH EXISTING GRADES. MINOR CUTS/FILLS WILL BE MADE WHERE REQUIRED TO SMOOTH SURFACE TO ALLOW VEHICLE ACCESS WITHIN HELIOSTAT FIELD.
4. TOTAL CUT/FILL +/- 380,000 CY TO BALANCE. NO IMPORT OR EXPORT.
5. INSTALL ASPHALT PAVEMENT FROM MAIN ENTRANCE TO POWER BLOCK ALONG THE ACCESS ROAD ON THE WEST SIDE OF THE SITE.

REV	DATE	DESCRIPTION	DRAWN	CHECKED	LEAD DESIGNER	ENGINEER/TECH SPEC	LEAD DISC ENGINEER	PROJ ENGR MANAGER	PROJECT MANAGER
C	08 24 09	UPDATE EVAPORATION POND							
B	08 04 09	ISSUED FOR PERMITTING	CM	JD	CM	JD	BA	BA	BA
A	07 01 09	ISSUED FOR PERMITTING	CM	JD	CM	JD	BA	BA	BA

PRELIMINARY STATUS — DATE — REPRESENTS GENERAL DESIGN CONCEPTS BASED ON ASSUMPTIONS. REVIEWED NOT CHECKED.

APPROVED STATUS — DATE — REPRESENTS REVIEWED AND APPROVED DESIGN. ANY PORTION MARKED "HOLD" RETAINS PRELIMINARY STATUS.

ORIGINATING PERSONNEL

DRAWN BY: C. MAHER
CHECKED BY: J. DAHLGREN
LEAD DESIGNER: C. MAHER
ENGINEER/TECH SPECIALIST: J. DAHLGREN
PROJECT ENGINEERING MANAGER: B. ANDERS
PROJECT MANAGER: B. ANDERS

PROFESSIONAL ENGINEER'S SEAL

Zero Harm — Leadership, No Incidents, Safe Behavior

WorleyParsons resources & energy

SolarReserve

CLIENT/PROJECT TITLE: RICE SOLAR ENERGY PROJECT

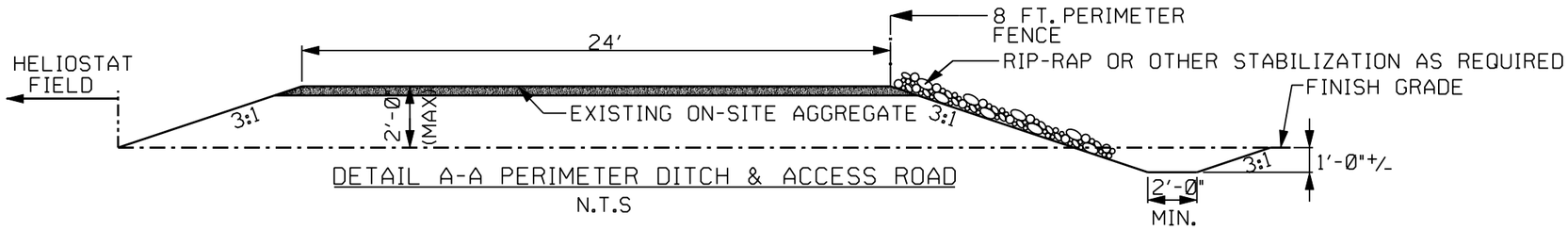
CONCEPTUAL GRADING AND DRAINAGE PLAN

SCALE: 1"=1600' — DRAWING SIZE: 11"x17"

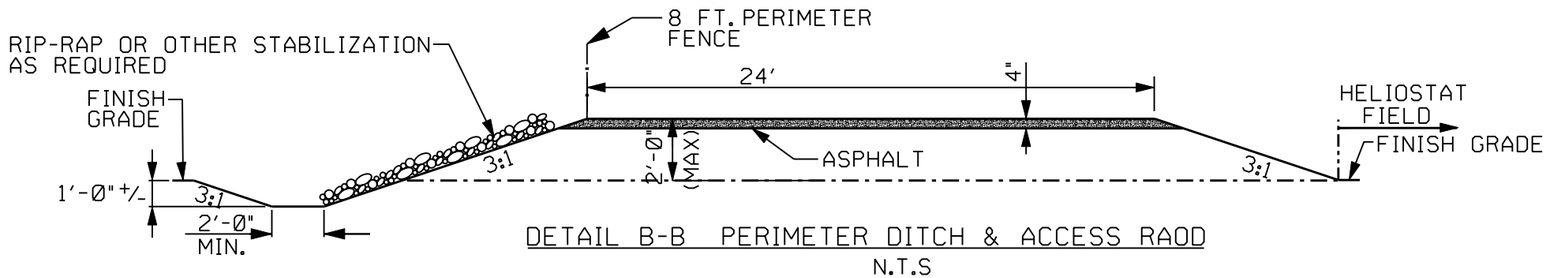
WORLEYPARSONS DWG. NO.: SRRC-0-SK-112-735-004 — REV: C

PRELIMINARY NOT FOR CONSTRUCTION

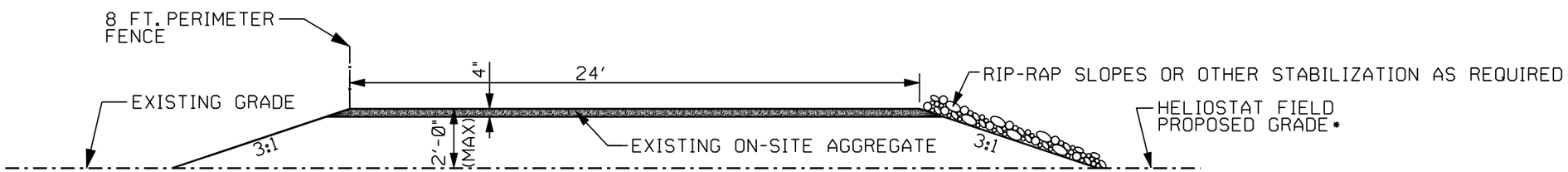
SRRC-0-SK-112-735-004.dgn 8/31/2009 12:50:49 PM



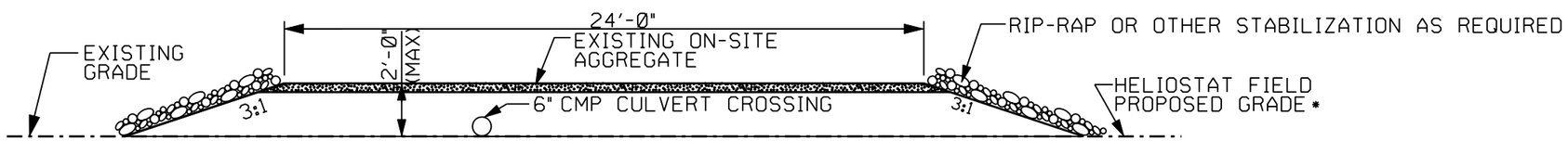
DETAIL A-A PERIMETER DITCH & ACCESS ROAD
N.T.S



DETAIL B-B PERIMETER DITCH & ACCESS RAOD
N.T.S

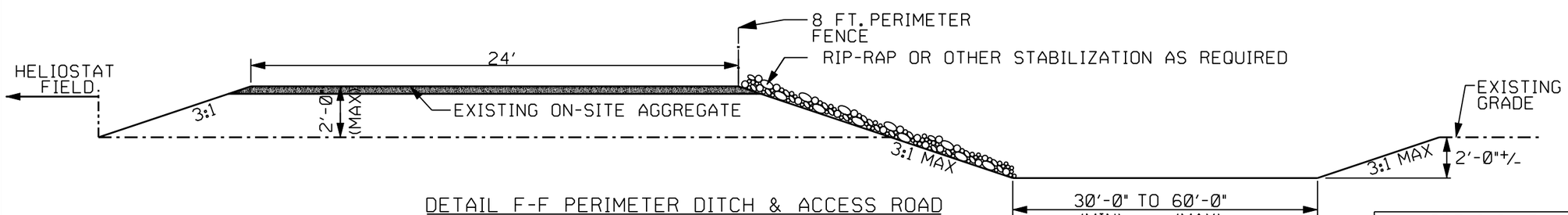


DETAIL C-C SOLAR FIELD AGGREGATE OR TREATED NATIVE SOIL ROAD WITHOUT DITCH
N.T.S



NOTE: PROVIDE 6" CMP CULVERT CROSSINGS IN EAST-WEST ROAD AT 100' INTERVALS MAX, AS REQUIRED.

DETAIL E-E SOLAR FIELD AGGREGATE BASE ACCESS ROAD WITHOUT DITCH
N.T.S



DETAIL F-F PERIMETER DITCH & ACCESS ROAD
N.T.S

NOTE:
1. "HELIOSTAT FIELD PROPOSED GRADE" IS AT EXISTING SURFACE GRADE, EXCEPT WHERE MINOR RUTS / DEPRESSIONS MUST BE GRADED TO ALLOW VEHICLE ACCESS WITHIN HELIOSTAT FIELD.
2. GABION DROP STRUCTURES MAY BE INSTALLED IN DITCHES TO LIMIT DITCH SLOPE AND VELOCITY WITHIN THE PERIMETER DITCHES.

PRELIMINARY
NOT FOR CONSTRUCTION

REV	DATE	DESCRIPTION	DRAWN	CHECKED	LEAD DESIGNER	ENGINEER/TECH SPEC	LEAD DISC ENGINEER	PROJ ENGR MANAGER	PROJECT MANAGER
C	08 24 09	ISSUED FOR REVISION	CM	JD	CM	JD	BA	BA	BA
B	08 05 09	ISSUED FOR PERMITTING	CM	JD	CM	JD	BA	BA	BA
A	07 11 09	ISSUED FOR PERMITTING	CM	JD	CM	JD	BA	BA	BA

PRELIMINARY STATUS — DATE — REPRESENTS GENERAL DESIGN CONCEPTS BASED ON ASSUMPTIONS. REVIEWED NOT CHECKED.
LOE
APPROVED STATUS — DATE — REPRESENTS REVIEWED AND APPROVED DESIGN. ANY PORTION MARKED "HOLD" RETAINS PRELIMINARY STATUS.
LOE

ORIGINATING PERSONNEL
DRAWN BY: C. MAHER
CHECKED BY: J. DAHLGREN
LEAD DESIGNER: C. MAHER
ENGINEER/TECH SPECIALIST: J. DAHLGREN
PROJECT ENGINEERING MANAGER: B. ANDERS
PROJECT MANAGER: B. ANDERS

PROFESSIONAL ENGINEER'S SEAL

Zero Harm — Leadership, No Incidents, Safe Behavior

WorleyParsons resources & energy

SolarReserve

CLIENT/PROJECT TITLE
RICE SOLAR ENERGY PROJECT

CONCEPTUAL GRADING AND DRAINAGE PLAN CROSS SECTIONS

SCALE 1"=1000' — DRAWING SIZE 11"x17"
WORLEYPARSONS DWG. NO. SRRC-0-SK-112-735-005 — REV C

$$DESIGN-FILE-NAME$$ $$$DATE$$$ $$$$TIME$$$$

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