Alamo Solar Site
Hydrologic Analysis

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San Bernardino County Hydrology Manual

List of Acronyms

AC	alternating current
AMC	antecedent moisture condition
APN	Assessor Parcel Number
AT&SF	Atchison, Topeka and Santa Fe Railroad
CDFG	California Department of Fish and Game
cfs	cubic feet per second
CUP	Conditional Use Permit
DEM	Digital Elevation Model
FEMA	Federal Emergency Management Agency
FIRM	Flood Insurance Rate Map
GIS	Geographic Information System
kV	kilovolts
MW	Megawatts
NOAA	National Oceanographic and Atmospheric Administration
NRCS	Natural Resources Conservation Service
PC	photovoltaic cell
RC	Resource Conservation
RL	Rural Living
SBCHM	San Bernardino County Hydrology Manual
SCS	Soil Conservation Service
USGS	United States Geological Survey

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1.0 INTRODUCTION

This report presents the pre- and post-development hydrologic analyses of the proposed Alamo Solar (Project) site. The goal of this hydrologic analysis is to evaluate the drainage impacts of the proposed Project. Results of the hydrologic analysis were used to determine whether mitigation measures that could be incorporated into the Project design would be required.

First, the existing hydrological, and drainage conditions of the proposed Project site were studied and analyzed. Second, post-development hydrological and drainage conditions and evaluating post-development runoff that could cause downstream impacts within the watershed were evaluated. Finally, conceptual mitigation measures suitable to mitigate the adverse impacts to the downstream watershed area were developed.

Detailed design of the Project’s drainage facilities would follow approval of the Project’s Contitional Use Permit.

2.0 BACKGROUND

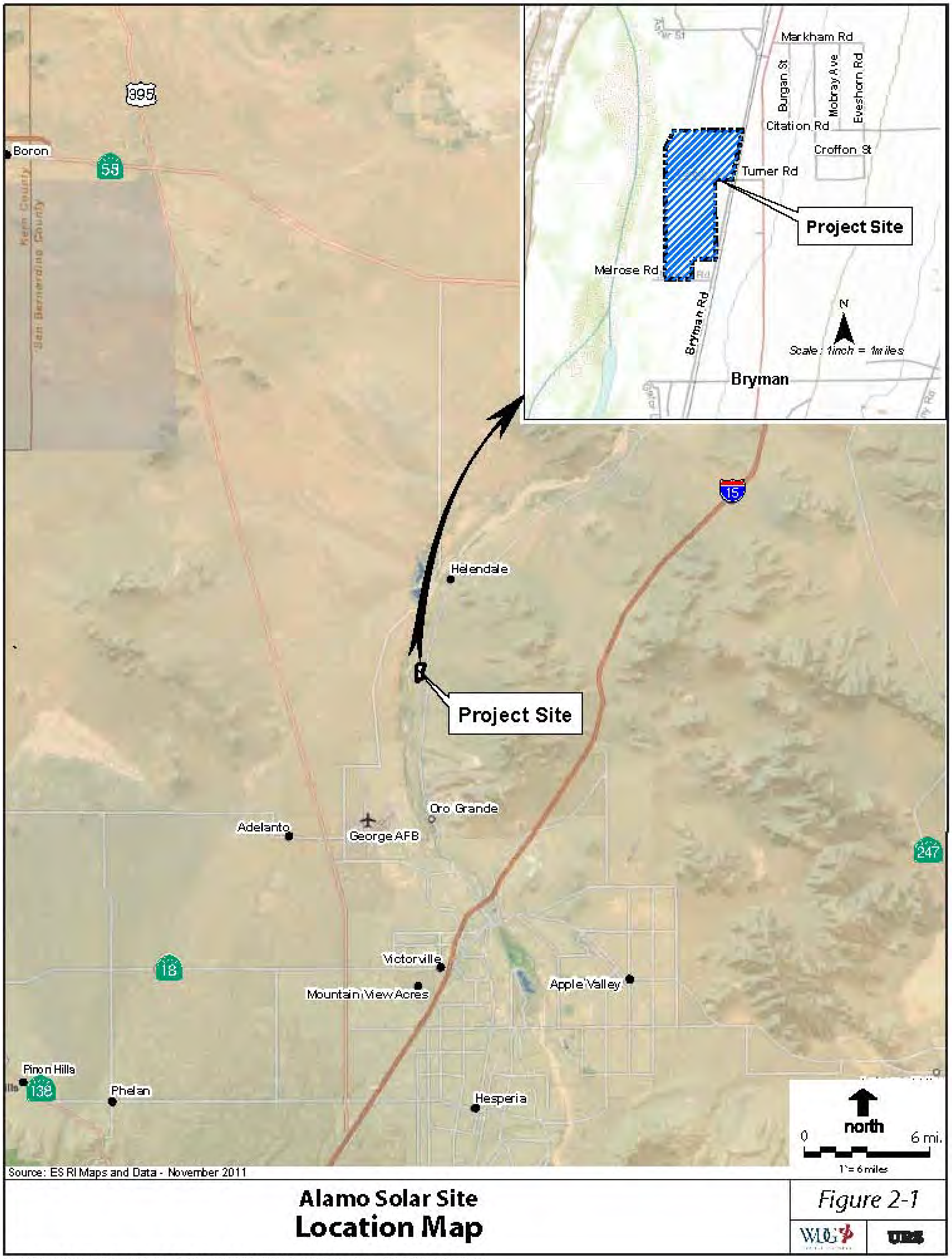
The Project is being developed by Alamo Solar, LLC (Applicant) to provide solar photovoltaic (PV) power to serve the electrical load requirements of California. The Project would generate approximately 17 megawatts (MW) alternating current (AC) on approximately 95 acres of the 128-acre site.

The location of the Project site is shown on Figure 2-1.

The proposed Project will connect with the existing Southern California Edison (SCE) Victor-Helendale 33-kilovolt (kV) transmission line that runs north-south along National Trails Highway (Route 66). Connecting to the SCE line will require constructing approximately 0.25 mile of new 33-kV transmission line. The line will be constructed within an existing SCE easement along an existing access road; no new right of way will be required. The electricity produced by the Project will be marketed to SCE through a long-term power purchase agreement.

The Project is designed to have a useful life of approximately 20 to 30 years, although the life span could be extended by upgrades and refurbishments. In the event that the solar project is decommissioned, the facility be removed and the site prepared for subsequent land use.

Figure 2-1. Project Location Map



3.0 PROJECT DESCRIPTION

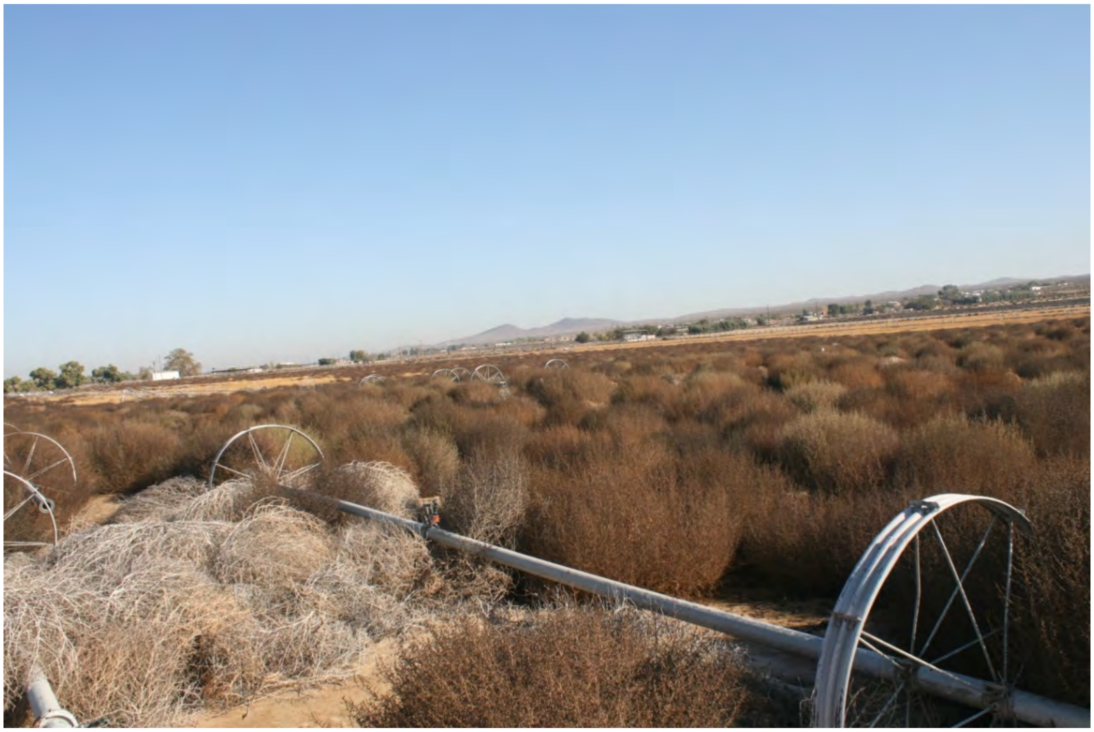
The Applicant proposes to construct a PV solar facility on the approximately 128-acre site. Construction will take place on approximately 95 acres of the proposed Project site.

The proposed site is located at Assessor Parcel Numbers (APNs) 0470-041-01 and 0470-021-09. The Project site is bordered to the north by agricultural lands; to the east by Bryman Road, the Atchison, Topeka, and Santa Fe (AT&SF) Railroad, National Trails Highway State Route 66 (Route 66), and agricultural uses and vacant undeveloped lands; to the south by a combination of rural residential development and fallow agricultural land; and to the west by the Mojave River and agricultural uses.

The Project site is situated within the Mojave Desert and has a slope of approximately 1 percent overall. The site generally slopes in the north-westerly direction with elevations of approximately 2,513 to 2,492 feet above mean sea level. The Project site ground cover is comprised of Russian Thistle Stand and Mustard Stand vegetation.

Figure 3-1 shows the proposed Project site, looking north. The site has a wateshed area of approximately 1,545 acres.

Figure 3-1. Alamo Site, Looking North



3.1 PROJECT LOCATION AND LEGAL DESCRIPTION

The Project site includes APNs 0470-041-01 and 0470-021-09. The preliminary title reports state that the legal description is as follows:

- APN 0470-041-01: W/2, NW/4, S19, T7N, R4W except the right of way of the AT&SF Railroad; and state and county roads or highways.
- APN 0470-021-09: SW/4, SW/4, S18, and a portion of SW/4, SW/4, S18; and that portion of the SE/4, SW/4, S18, lying W of the W Line of the AT&SF Railroad, in T7N, R4W both of the San Bernardino Base & Meridian in the County of San Bernardino, State of California.

3.2 CONCEPTUAL PROJECT LAYOUT

The 128-acre unmanned solar power generation facility would include the following major components: non-reflective PV solar module arrays mounted on fixed tilt or single-axis trackers and a racking system supported by pole-driven I-beams, inverters and transformers on pads, buried collector lines, and switchgear. Approximately 0.25 mile of new 33-kV transmission line parallel to Turner Road would be constructed within an existing power line easement connecting to an existing on-site 33-kV transmission line running along Route 66. The solar power generation facility would also include a small, unmanned communications enclosure that would contain metering and supervisory data acquisition and control equipment. The enclosure would measure approximately 600 square feet in size and would be approximately 8 to 12 feet high.

Figure 3-2 shows the conceptual site plan. Figure 3-3 shows the typical elevation of solar panels that could potentially be installed on the site. The proposed Project is currently at a preliminary level and the exact solar panel, array, and locations are not yet specifically determined. However, the selected solar panel is not expected to differ significantly from the one shown on Figure 3-3.

The Project would require minimal site grading, with a minimal impact to existing drainage patterns and overall topography of the site. Where grading is required, cut-and-fills shall generally be balanced, resulting in minimal import or export of earthen material. Final drainage design will be completed following a detailed topographic site survey overlaid with proposed site development grading.

No off-site improvements are anticipated with the exception to the development of site access points. Typical site access will be 25 feet wide, accommodating 75-foot turning radii in both directions. The proposed site access will be fully developed including a 75-foot-long drive apron (accommodating a 65-foot-long combination tractor/trailer), and a 20-inch-deep roadway section consisting of 12 inches of roadway base material overlaid with 8 inches of asphalt paving. Track racking systems may be used to clear

Figure 3-2. Conceptual Site Plan

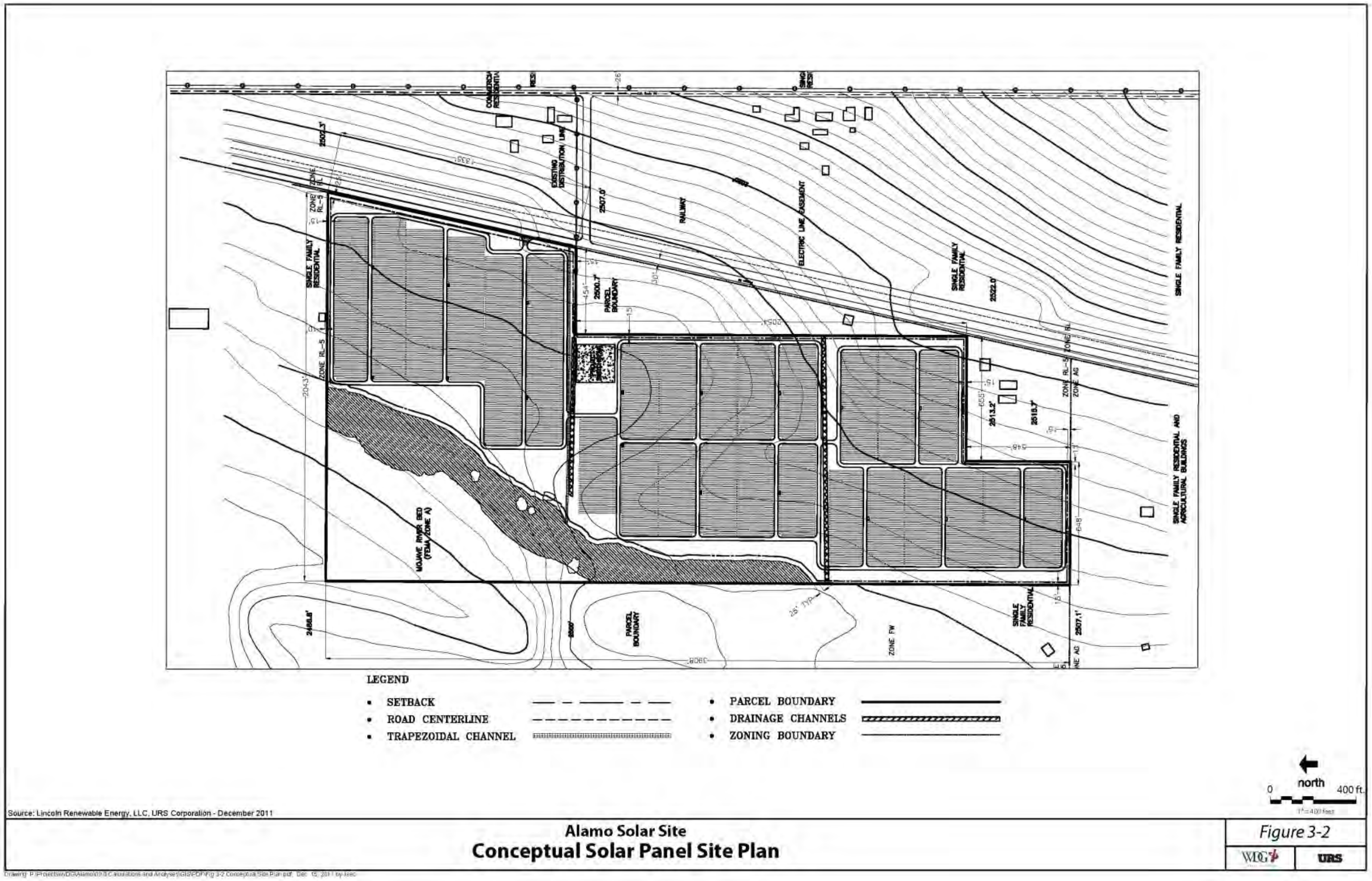
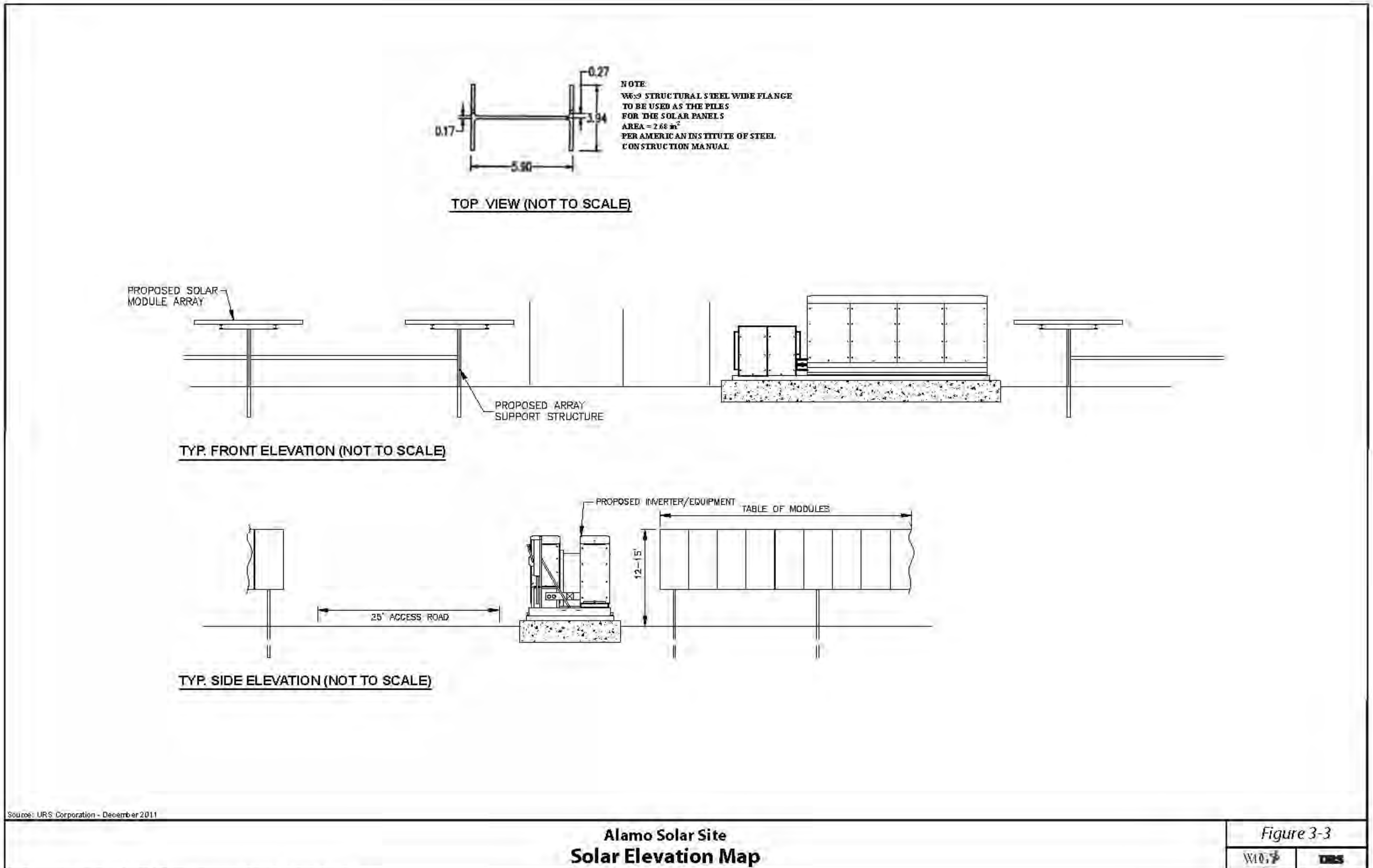


Figure 3-3. Typical Solar Elevation



vehicles exiting the site of debris and soil prior to entering the public right-of-way, as required to meet stormwater quality regulations.

The base course would be installed at the beginning of the Project to facilitate the construction of the solar plant. The top course would be installed over a sprayed binder course post-construction.

Internal site circulation would include a 25-foot-wide perimeter road made of pervious materials, such as compacted crushed stone or other viable stabilized traffic surface. The actual depth of roadway sections would be determined during final design based on anticipated loading and traffic indices. However, it is anticipated that the road base course would be a minimum of six inches thick. The top course thickness would be a minimum of two inches thick.

Maintenance roads with access to the solar panels would be 12 feet wide and improved (minimally graded, dirt or gravel) to provide truck access. Upon completion of the proposed Project, vegetation or dust palliatives would be used if needed to control wind and water erosion during operations.

The solar facility would be unmanned. Several part-time employees would visit the site periodically (e.g., monthly or bi-monthly) and a few times a year the employees or a contractor would visit the site to wash the PV panels. Panel washing would require approximately 1 to 2 acre-feet of water per year and, based on an assumed use of medium-sized water tankers, would require approximately 130 truckloads (260 truck trips) for delivery of this water. Water would be purchased from a local purveyor. No on-site wells would be used.

Figure 3-4 shows the existing jurisdictional waters within the Project site.

3.3 PROJECT CONSTRUCTION AND SCHEDULE

Construction of the proposed Project is estimated to require approximately 123 workers at its peak. Construction is estimated to start in 2014 and would take approximately nine months to complete. Approximately 10 to15 acre-feet of water would be used during construction for dust suppression and ancillary construction activities.

Best management practices for erosion control would be used to avoid and minimize impacts on the environment during construction and operations and maintenance. A Water Quality Management Plan that includes a Stormwater Pollution Prevention Plan and an Erosion and Sediment Control Plan would be prepared and implemented to avoid and minimize impacts on water quality during construction and operations.

Figure 3-4. Jurisdictional Areas

3.4 EXISTING LAND USE CLASSIFICATION

Currently, the Project site is being used for agricultural purposes. The parcel's land use zoning is classified as RL-5 (Rural Living – 5 acre parcel minimum). The RL land use zoning provides sites for rural residential uses, incidental agricultural uses, and similar and compatible uses. The northern parcel includes an abandoned single-family residence and associated outbuildings that would be removed during construction.

Land uses in the vicinity of the proposed Project include RL-5 and floodway to the west by RL-5 and floodway, RL-5 to the north, and RL to the east. Existing land use adjacent to the Project site consists primarily of undeveloped land, agricultural land, County lands, floodway, and a few scattered single-family residences both occupied and abandoned.

Under the County of San Bernardino Code Chapter 82.04, an energy generating facility would be permitted upon approval of a Conditional Use Permit (CUP).

3.5 SITE DRAINAGE

A flood map search (http://msc.fema.gov/) for FEMA Flood Insurance Rate Map (FIRM) panel ID numbers 06071C5150H confirms the proposed Project has been mapped by FEMA for flood zone hazards. The northwestern corner of the site lies within the 100-year floodplain of the Mojave River. The 100-year floodplain limits and the twenty-five foot offset of the California Department of Fish and Game (CDFG) environmental limit of the Mojave River are shown on Figure 7-1. No construction will take place in these areas. The CDFG building setback is more conservative than the limit of the 100-year floodplain, and governs the setback requirement for site construction.

Based on visual observations during a site visit and the type of facility proposed, it is expected that the proposed solar panel construction would not significantly change the runoff characteristics of the site during a major storm event. Because the imperviousness of the site would not be greatly changed as a result of the construction, the impact of increased rainfall runoff due to the construction would be negligible. Although a final site design is not yet prepared, it is estimated from preliminary site designs that the increase in the imperviousness of the site would be approximately 4.6 percent. Existing vegetation would be removed as a result of construction activities. No on-site irrigation is being planned to promote re-vegetation of the site.

The site topography can be characterized as uniform in surface profile with a slight slope in the northwesterly direction. Based on field observations, the site is characterized mainly by land that was used for row crops in the southwesterly part of the site, while the easterly third of the site and the area north of Turner Road is characterized by brush cover.

During storm events, runoff across the site is in the form of sheet flow discharging into the Mojave River. Two main sheet flow patterns are recognizable—sheet flow along the westerly boundary of the site, and sheet flow at the central northern part of the site. When a major storm occurs that produces runoff, the post-construction flows will continue to drain as they do under the existing condition.

The two main grading options would follow the existing contours, keeping a slight ridge down the center of the site, or to straight grade the site, essentially "tipping" the terrain to flow northwesterly toward the Mojave River. Based on the solar panel design proposed for the site, negligible grading will take place, and the majority of the existing vegetation at the site would be removed. The selected design minimally changes the routes and watercourses that storm flows would follow.

The types of soils present in this area have moderate to low runoff potential. It is expected that conditions which are present at the site, and which have been formed by past storm events, would not be disturbed and would continue to pass storm flows after completion of the Project as they have in the past. Because the post-construction site would essentially leave flow patterns unaltered, no mitigation is necessary. With incorporation of the conceptual drainage plan described in Section 7.0, the proposed Project is not expected to significantly affect the flow patterns of the existing drainage courses or swales.

Based on the solar panel design proposed for the site, minor grading is anticipated.

The Atchison Topeka & Santa Fe Railroad forms the eastern portion of the property. The railroad tracks are elevated approximately 5 feet above the ground. This elevated railroad track is almost like a dam on the eastern boundary of the property. During storm events, runoff from the watershed upstream of the Project site passes through two 3-foot-diameter culverts under the railroad track and through the site along Turner Road.

Typical of arid regions, the area experiences short-duration, high-intensity rainfall storm events producing potentially high rates of runoff when the initial infiltration rates are exceeded.

The soil in the watershed is predominantly Soil Group D. This soil type is characterized as having high runoff potential due to very slow infiltration rates when thoroughly wetted.

Access roads would be constructed to enhance access within the Project site. Although the access roads would impact the existing drainage, the impact is expected to be low and not significantly change the flow patterns across the Project site.

Existing surface vegetation consists of Russian Thistle Stand and Mustard Stand. Vegetation would be cleared to allow for the construction of the solar panels and access roads. Grubbing would occur on all gravel access roads, and in any areas where the roots would impede the pier structure. The installations of the solar panels also require trenching along and below access roads for the installation of multiple cable systems. Under and along almost every internal access road, trenches as deep as 48 inches would house the cables in a sand bed that would be backfilled with excavated material from the site.

At locations where foundations are installed for the inverters, it is expected that minor cuts would be required to place the foundations on a level pad. It is expected that the fill from these cuts would be placed around the pre-cast foundation in order to divert small, localized flows away from the foundation and prevent undermining of the same.

3.6 LAYOUT OF SOLAR PANELS

The layout of the solar panels would be aligned in rows in the north-south direction throughout the site. Each solar panel would be attached to two pole-driven W6x9 I-beams using a support structure. The rows of solar panels would be separated by access ways, approximately 5 feet wide. A 25-foot-wide gravel access road would be constructed around the perimeter of the site. In addition, 12-foot-wide access roads would traverse the site and solar panel arrays to allow vehicle access for routine maintenance. The site would also incorporate approximately 17 inverters; a switching station in an enclosure measuring approximately 200 by 200 feet in plan view; an unmanned communications enclosure measuring approximately 20 by 30 feet in plan view; and two Conex boxes for equipment storage. The conceptual site layout is shown on Figure 3-2.

3.7 SUPPORT PEDESTAL DRAINAGE AND EROSION DESIGN

Rainfall on the solar panels would drain freely to the ground. In general, the rain would run off the lower edge of the PV panel. The edge of the panels would be approximately 24 inches above the ground, and the runoff would be approximately 25 gallons in a 10-year storm (5-minute – 10-year rain event per 200 square feet of panels). This volume of water is expected to run off the panels over a 5-minute period. Based on the volume of water falling from each panel, the height of the fall, and the soil conditions, it is not expected that erosion beyond a micro level will occur. It is expected that water will fall from the PV panels and pond at a drip point before infiltrating or gradually migrating into the existing drainage patterns. If, over time, minor erosion were noted at the drip points, small gravel pads could be added to help dissipate the energy of the falling water. If, minor erosion were noted near the foundations, minor grading could restore support for the individual foundations, and keep surface flows from undermining the foundations in future storm events.

3.8 INCREASE IN IMPERVIOUSNESS DUE TO CONSTRUCTION

Increase in impervious area of the site due to the construction of the piles, concrete pads for the inverters, and the access roads is estimated to be to be very minimal, approximately 4.6 percent increase. The biggest increase in impervious area will be attributed to the access roads that are expected to increase runoff in the areas where access roads are constructed, but overall, the total area of the access roads would be small in comparison with the entire site. The gravel roads would allow some level of infiltration.

3.9 SPECIFIC REQUIREMENTS OF SAN BERNARDINO COUNTY

The Project site lies within the zoning area labeled Resource Conservation (RC) within the County of San Bernardino, California. The minimum lot size for this zoning designation is a 200 acres. The Project is classified specifically as an electrical power generation project and would require a CUP from the County. A public hearing would be held to review the Project and the County Planning Commission would set the guidelines of approval for obtaining the permit consistent with development requirements. Major factors the Commission will consider for approval include: adequate shape and size of the parcel for the type of use described, adequate access to the site, any adverse impact on abutting properties, and use of the parcel consistent with its land use classification. The minimum setbacks for this type of project are 25 feet each from the front and sides and 15 feet from the rear.

Once a CUP is obtained, the County would issue Conditions of Approval, and a Conditional Grading Compliance section would be contained within the Conditions of Approval. This section would require the developer to meet the minimum standards set forth by the County for grading activities. Projects fall into this designation if the total grading exceeds 5,000 cubic yards and the Project has been conditionally approved. Other items included would be erosion control and other mitigation measures adopted as specific conditions of approval set forth by the planning commission. The grading activities would be monitored by a quality control engineer, and the reports of this activity would be filed with the County Building Official, as required.

4.0 WATERSHED CHARACTERISTICS

To evaluate the pre- and post-development conditions at the Project site, the *San Bernardino County Hydrology Manual* (SBCHM) and its 2010 addendum was utilized as a guide. The runoff calculations for the 100-year pre- and post-development conditions were performed in accordance with the SBCHM guidelines.

4.1 EXTENT OF WATERSHED BOUNDARY

Contour data at 5-foot intervals were extracted from an Intermap GIS database to determine the extent of the watershed boundary, as shown on Figure 4-1. The Digital Elevation Model (DEM) purchased from Intermap was converted to an ArcGIS shapefile using Intermap's Global Mapper software. The 5-foot contour intervals were generated using the Intermap DEM and provided suitable accuracy for the hydrologic analysis. The shapefile is a vector file in GIS format. A third party converter, Shp to CAD software, was used to convert the shapefile to AutoCAD format. The converted file contains a set of 3-D polyline objects, which are contours with vertical elevations attached.

4.2 CURVE NUMBER DETERMINATION

The Soil Conservation Service (SCS) Curve Number Method uses a soil cover complex number for computing excess precipitation. The selection of an appropriate Curve Number is related to the following parameters: hydrologic Soil Group (A, B, C, or D), land use, treatment class (cover), and antecedent moisture condition (AMC). The soil group is determined from published soil maps for the area (published by the Natural Resources Conservation Service [NRCS], SCS). The 2010 Hydrology Manual Addendum for Arid Regions contained a map (Figure ADD-1) that was used for selecting the appropriate AMC. The AMC determined from this effort was then used in selecting the corresponding SCS curve number.

Soil Group determination is discussed further in Section 4.4.1.

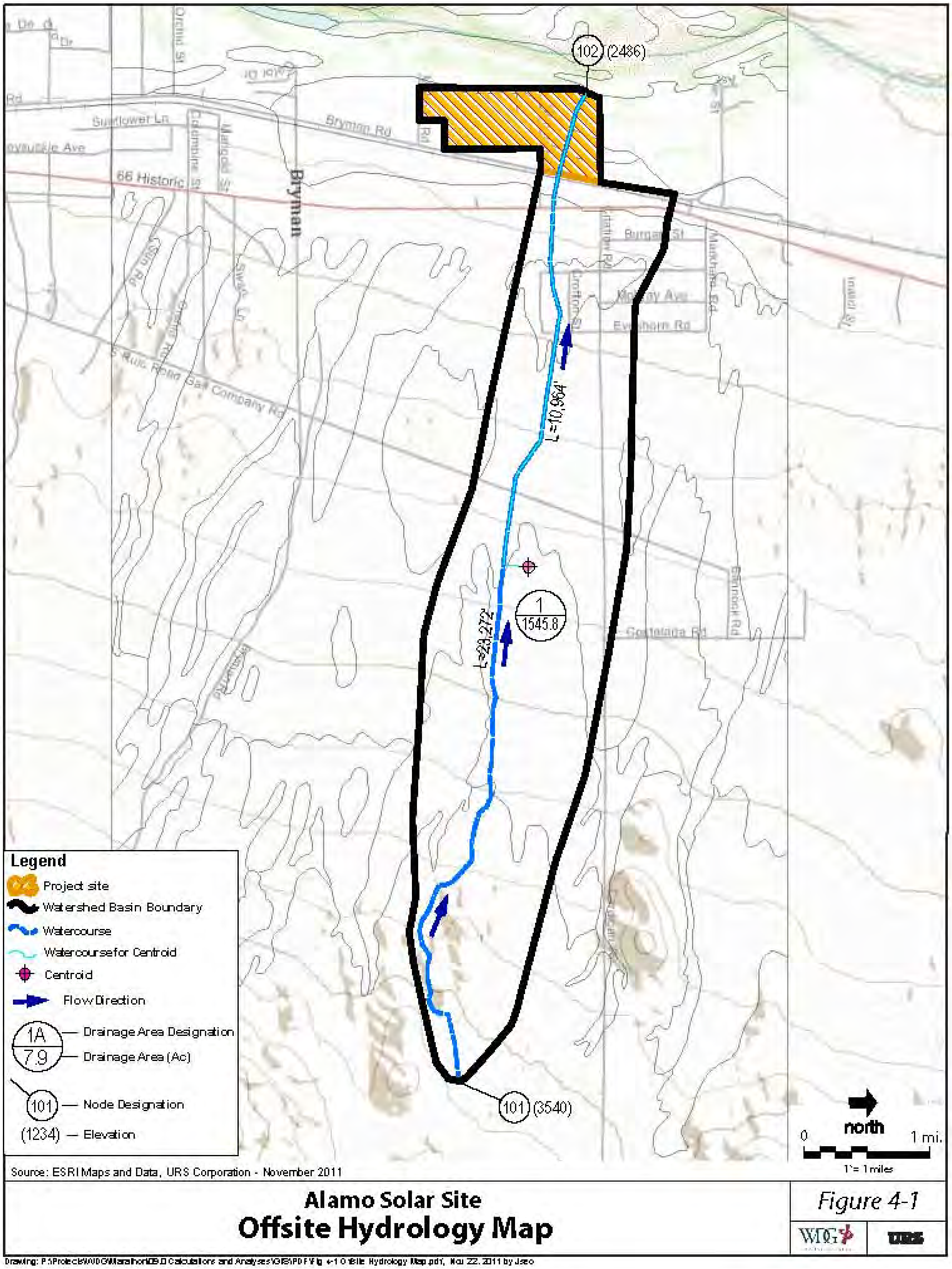
4.3 SOIL HYDROLOGIC CONDITIONS AND GROUND COVER

Watershed losses are attributed primarily to the soil type and the ground cover type. These two characteristics must be determined to assess the soil's potential to convey runoff.

4.3.1 Soil Type Determination

The SBCHM provides maps delineating the soil types for areas that have been assessed in the County. The Soil Maps provided in the SBCHM have been superseded by the updated soil survey information conducted by the NRCS. The NRCS provides access to download the soil data for the Project vicinity in GIS format. The soil survey delineates the soil types found within the study area. The user is also provided a database that summarizes a variety of soil characteristics including the hydrologic soil group designation, by soil type. ArcGIS (Version 10) was utilized by linking the soil type with the database in order to provide the hydrologic soil group designation for watershed area.

Figure 4-1. Off-site Hydrology Map



Tables 4-1 and 4-2 summarize the hydrologic soil group designation breakdown for each sub-area within the watershed. Figure 4-2 illustrates the hydrologic soil group designations within the watershed area and Figure 5-1 illustrates on-site hydrologic sub-areas.

The soil data is available online at http://soildatamart.nrcs.usda.gov/State.aspx

Table 4-1. Off-site Soil Group Designations

	Hydrologic Soil Group Summary for Off-site Area (%)			
Sub-area	A	B	C	D
1	43.8	3.4	34.9	17.9

Table 4-2. On-site Soil Group Designations

	Hydrologic Soil Group Summary for On-site Area (%)			
Sub-area	A	B	C	D
1	85.9	14.1	–	–
2	43.6	56.4	–	–

The definitions of the hydrologic soil groups are:

Group A – Low runoff potential. Soils having 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.

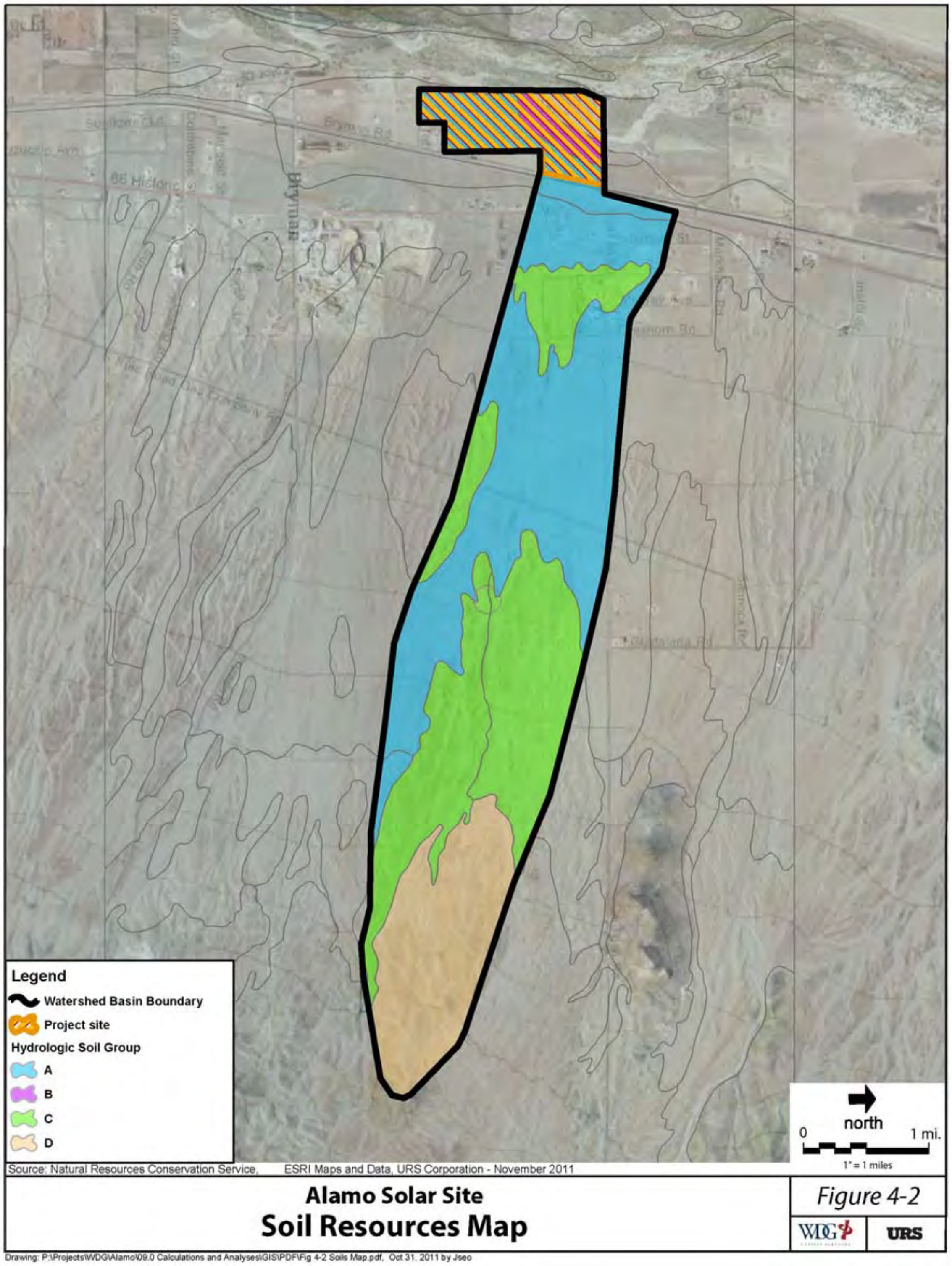
Group B – Soils having moderate infiltration rates when thoroughly wetted and consisting chiefly of moderately deep to deep, moderately well to well-drained, sandy-loam soils with moderately-fine to moderately-coarse textures. These soils have a moderate rate of water transmission.

Group C – Soils having slow infiltration rates when thoroughly wetted, and consisting chiefly of silty loam soils with a layer that 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 runoff 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.

Based on Tables 4-1 and 4-2, it can be seen that the watershed area consists of predominantly Soil Group A and C with approximately 43.8 and 34.9 percent, respectively. Soil Group B and D are also present in the tributary watershed with approximately 3.4 and 17.9 percent, respectively. The Project site itself consists of Soil

Figure 4-2. Off-site Soil Map



Group A (64.7 percent) and Soil Group B (35.3 percent). Thus, the on-site area has soil groups that can be described as having low to moderate runoff potential. The off-site area is a mixture of all soil types with predominantly low runoff potential and soils with slow infiltration rates.

4.3.2 Ground Cover

The SBCHM provides definitions for a variety of common ground cover types that are typically found throughout the County. The ground cover type was determined by visual inspection at the proposed site during a site visit. The SBCHM Figure C-3 provides cover type definitions as a reference in determining the area's Curve Number.

Figure 4-3 shows the vegetation map of the watershed.

Following a site visit that was conducted on November 8, 2011, it was determined that the watershed was composed of two ground cover types. The southeastern portion of the watershed has vegetation determined as Mustard Stand. This area was most likely used for crop farming in the recent past. Based on SBCHM classification, this area was determined to have a good vegetative cover based on visual inspection over 75 percent vegetation coverage of the ground surface. The west and north areas of the site were determined to be Russian Thistle Stand, a natural brush type cover. The Russian Thistle Stand vegetation was determined as poor coverage because less than 50 percent of the ground surface appeared to be covered by vegetation.

As described previously, the vegetation would be removed during construction, resulting in poor vegetation cover post-construction.

Based upon these determinations, an area-averaged curve number was determined for each sub-area of the watershed, and are summarized in Tables 4-3, 4-4, and 4-5.

Table 4-3. Off-site Curve Number Determination

	Curve Number Determination Off-site Area		
Sub-area	Soil Types	Ground Cover Type	Area-Averaged Curve Number
1	A,B,C,D	Chaparral, Broadleaf (Fair)	60.3

Table 4-4. On-site Pre-Development Curve Number Determination

	Curve Number Determination On-site Area		
Sub-area	Soil Types	Ground Cover Type	Area-Averaged Curve Number
1	A,B	Russian Thistle Stand and Mustard Stand vegetation	66.7
2	A,B	Russian Thistle Stand and Mustard Stand vegetation	70.2

Table 4-5. On-site Post-Development Curve Number Determination

	Curve Number Determination On-site Area		
Sub-area	Soil Types	Ground Cover Type	Area-Averaged Curve Number
1	A,B	Fallow Land (graded but not tilled or seeded)	79.0
2	A,B	Fallow Land (graded but not tilled or seeded)	82.2

Figure 4-3. Vegetation Map

4.4 RAINFALL DATA

The procedure outlined in the SBCHM for determining point precipitation has been revised by the San Bernardino Department of Public Works and presented in the *County of San Bernardino Hydrology Manual Addendum for Arid Regions*. This addendum describes the use of the National Oceanographic and Atmospheric Administration (NOAA) Atlas 14, which was published in 2004 and revised in 2006, as a replacement for NOAA Atlas II rainfall records, published in 1973, which were the precipitation values reported in the SBCHM.

NOAA Atlas 14 information is provided at http://hdsc.nws.noaa.gov/hdsc/pfds/.

The website provides access to the NOAA Atlas 14 point precipitation frequency estimates by providing tabulated rainfall values for various return frequencies and durations given a specific location. Given the designated watershed boundaries as depicted on Figure 4-1, the location of the centroid for each sub-area was determined. The centroid was used as the representative location to determine the point rainfall values for each sub-area. Tables 4-6 and 4-7 provide a summary of the 100-year rainfall values determined for the watershed and the Project area for each sub-area. The NOAA 14 precipitation data can be found in Appendix B.

Table 4-6. 100-year Rainfall Depths for Off-site Hydrology Analysis

	100-Year Storm Event Depths					
Sub-area	5-Min (inches)	30-Min (inches)	1-Hr (inches)	3-Hr (inches)	6-Hr (inches)	24-Hr (inches)
1	0.343	0.811	1.03	1.51	1.93	3.24

Table 4-7. 100-year Rainfall Depths for On-site Hydrology Analysis

	100-Year Storm Event Depths					
Sub-area	5-Min (inches)	30-Min (inches)	1-Hr (inches)	3-Hr (inches)	6-Hr (inches)	24-Hr (inches)
1	0.337	0.787	0.989	1.42	1.79	2.92
2	0.334	0.780	0.984	1.41	1.78	2.91

4.5 BASIN FACTOR, OR MANNING'S N VALUES

The basin factor ($\bar{n}$) is a representative value for the watershed area being analyzed. The value is estimated based on criteria listed in the SBCHM and field observations. The estimation of the basin factor requires the incorporation of four characteristics regarding the study area. These characteristics include the following:

1. *Slope of drainage area*. Important features include uniformity of slope, ridges, canyons, and how steep the slope is (i.e. moderate vs. severe);

2. *Drainage improvements in the watercourse*. This is a determination of the extent of improvements in the watershed;

3. *Ground Cover*. The percentage and type of ground cover greatly affect the hydraulic properties of the watershed; and

4. *Main watercourse features*. Features of main watercourse, including improved channels, number and degree of bends, waterfalls, etc.

Figure E-2 of the SBCHM provides a summary of the characteristics of common basin factors. Based upon the site visit, basin factors of 0.040 and 0.035 were established for off-site and on-site flows, respectively. The basin factors were established due to a mountainous area to the east, meandering watercourse, mixed ground cover, and lack of drainage improvements observed in the field. These findings are consistent with Figure E-2 of the SBCHM. The primary difference between on-site and off-site flows is that there is a gradual 1-percent slope across the site, while the upper canyon portion of the off-site flows is much steeper. Also, the on-site flow is not as meandering as the off-site flow.

5.0 RUNOFF ESTIMATION

Runoff estimation was performed in two steps. First, the runoff for the watershed contributing to the Project site was estimated and classified as off-site. Similar parameters were used to estimate the on-site runoff. The SBCHM provides specific directions on when to use the rational method or the unit hydrograph approach depending on the contributing area size. The following sections provide a description of the assumptions used in developing the runoff estimates and then outline the procedures adopted for both the off-site and on-site runoff estimates.

5.1 ASSUMPTIONS

The following assumptions were made based on best engineering judgment in developing the hydrology calculations and should be revisited during detailed design in the future to refine the results presented in this report:

1. Lag Methodology for unit hydrograph calculations was implemented using the empirical formula from the SBCHM for ease of use. A uniform basin factor of 0.04 was used for the entire site, which is consistent with the basin factor descriptions given on Figure E-2 of the SBCHM.

2. Rainfall intensities for the unit hydrograph were determined for the centroid of the combined on- and off-site watershed.

3. Curve numbers were determined by taking an area average for each of the sub-areas.

4. In the post-development condition, flows from panels will hit the drip line of each individual panel, travel down to the soil below, and flow in the same drainage pattern as the pre-development condition.

5. The hydrology calculations have been performed for the 100-year, 24-hour storm event only per discussions with San Bernardino County Flood Control District staff.

5.2 OFF-SITE HYDROLOGY—UNIT HYDROGRAPH METHOD

Based on the size of the sub-watershed established for each of the tributary watershed contributing flows to the Project site, which exceeds 640 acres (1 square mile), the unit hydrograph approach was selected as the appropriate method for estimating the runoff from the watershed. The Civil Design software, developed according to the SBCHM guidelines, was used in estimating the unit hydrograph. The following is a summary of the methodology followed:

Step 1 – Watershed Delineation
The extent of the watershed boundary was determined using contours generated from Intermap DEM. Following the determination of the watershed boundary, AutoCAD was used to calculate the watershed area.

Step 2 – Lag Methodology
Lag for a watershed is the elapsed time (in hours) from the beginning of unit-effective-rainfall to the instant that the summation hydrograph for the point of concentration reached 50 percent of ultimate discharge. The SBCHM empirical formula (Equation E.2) was used for calculating the lag-time because of the natural condition of the watershed area.

The empirical formula requires calculations of the L (length of longest watercourse), L_{ca} (length along the longest watercourse, measured upstream to a point opposite the centroid of the area), and the difference in elevation between the concentration point and upstream end of the watershed. Lengths, elevations and centroid location were determined using AutoCAD software. The lag time was determined as shown in Table 5-1.

Step 3 – Selection of Manning's "$\bar{n}$ " Value
The value for the basin factor, $\bar{n}$, is the visually estimated average basin factor from Figure E-2 of the SBCHM. Refer to Section 4.5 for a detailed description.

Step 4 – Selection of S-graph
A combination of the Mountain and Desert S-graphs was selected as applicable to the drainage basin.

Step 5 – Selection of Design Storm
The 100-year, 24-hour storm event was selected as the design storm. Coordinates of the watershed sub-area's centroid for the proposed Project site were entered into the NOAA Atlas 14 site to obtain point precipitation data.

Step 6 – Determination of Precipitation Values
Precipitation values were estimated as outlined in Table 4-5 in Section 4.4.

Step 7 – Selection of Soil Types
Soil types were estimated as outlines in Table 4-1 in Section 4.3.

Unit Hydrograph Data Input Summary
Table 5-1 provides a summary of the unit hydrograph data input into Civil Design, summarized by area.

Table 5-1. Civil Design Input Data for Alamo

	Description	Area 1
1	Enter the design storm frequency (year)	100
2	Enter flow length (feet)	23,272
	Flow length (miles)	4.41
3	Enter the centroidal length (feet)	10,964
	Centroidal length conversion (miles)	2.08
4	Enter upstream elevation	3,540
	Enter downstream elevation	2,486
	Elevation Difference	1,054
5	Enter watershed area (acres)	1,545.8
6	Enter the S-graph proportions (decimal)	
	Valley Developed	-
	Valley Undeveloped	-
	Foothill	1.0
	Mountain	-
	Desert	-
7	Basin factor, $\bar{n}$	0.04
8	Enter the pervious fraction	1.0
9	Enter the area averaged Curve Number	69.7
10	Enter area-averaged point rainfall (inches)	
	5-minute	0.343
	30-minute	0.811
	1-Hour	1.03
	3-Hour	1.51
	6-Hour	1.93
	24-Hour	3.24

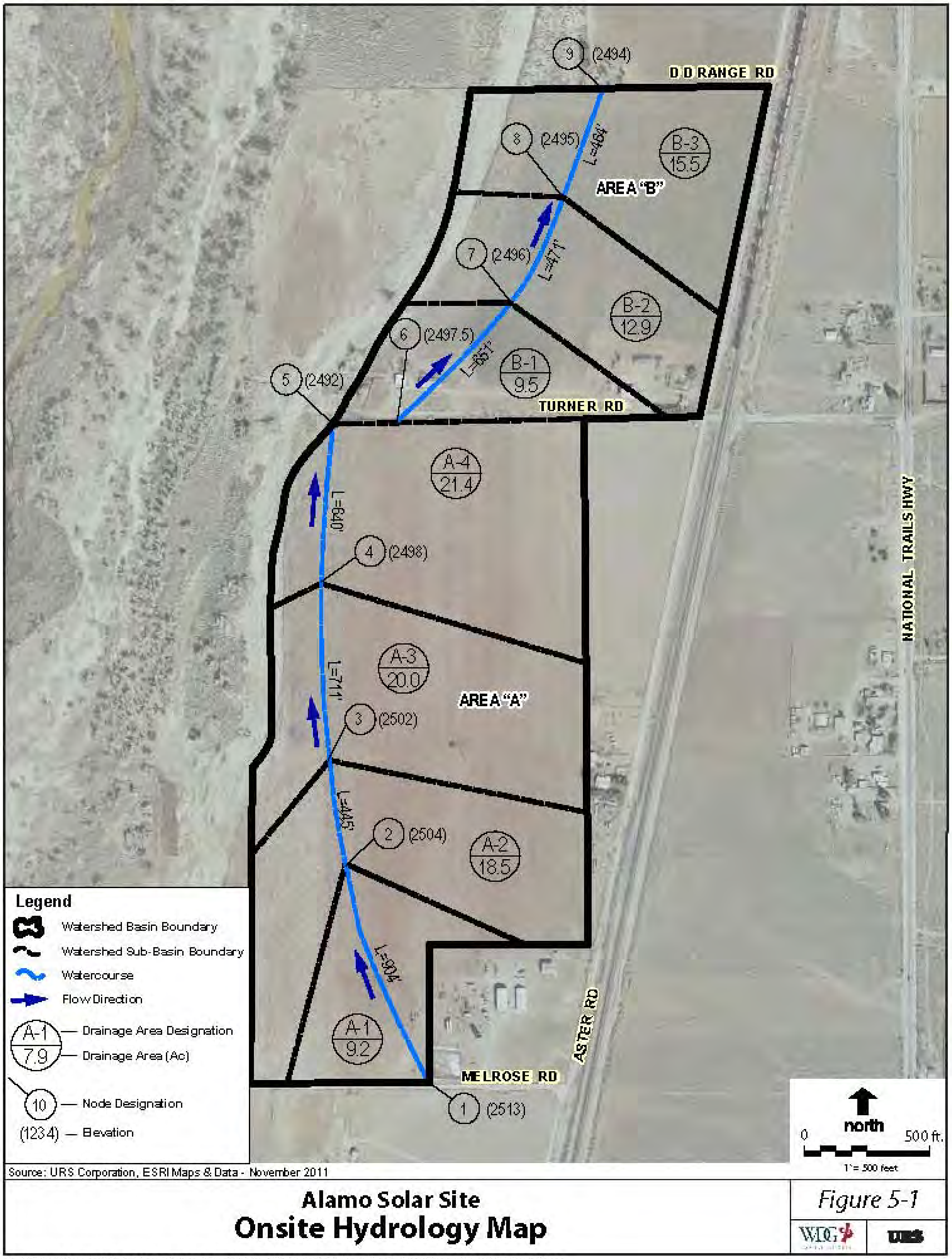
5.3 ON-SITE HYDROLOGY—RATIONAL METHOD

Due to the small size of the on-site area, less than 640 acres, the Rational Method was selected as the appropriate methodology for determining the runoff from the site. The following describes the steps used in estimating the total runoff from the site using the Rational Method.

Figure 5-1 shows the delineation of the on-site hydrology map for the Rational Method analysis.

Step 1 – Watershed Delineation
The Project site was delineated into seven sub-area tributaries to various concentration points and the areas, elevations and flow lengths were calculated using AutoCAD.

Figure 5-1. On-site Hydrology Map



Step 2 – Selection of Design Storm
The 100-year storm event was selected as the design storm. The coordinates for the centroids of each sub-area were entered into the NOAA Atlas 14 site to obtain point precipitation data.

Step 3 – Determination of Precipitation Values
Precipitation values were estimated as described in Table 4-6 in Section 4.4.

Step 4 – Selection of Soil Types
Soil types were estimated as described in Table 4-2 in Section 4.3.

Step 5 – Pre-development Runoff Estimate Using Civil Design
The Civil Design software developed specifically according to the SBCHM was used to calculate the peak flow rates for the on-site hydrology analysis using the parameters outlined in the previous steps.

Step 6 – Determination of Increased Impervious Area
The increase in impervious area was determined using the site layout presented on Figure 3-2. The switchgear area and access roads were considered 100 percent impervious, as they would be compacted during construction. The estimated increase in imperviousness as described earlier is approximately 4.6 percent.

Step 7 – Post-development Runoff Using Civil Design
Similar to the pre-development runoff estimation, Civil Design was used to calculate the peak flow rates for the post-development condition.

6.0 RESULTS

Table 6-1 below summarizes the results for the off-site hydrology analysis (Unit Hydrograph Method). The analysis allowed for the determination of the off-site peak flow from the upstream watershed. It should be noted that the off-site area flows are conveyed through a dual 36-inch culvert under the railroad track on the eastern part of the site, almost centrally located within the Project site and flows westerly along Turner Road from the culvert outlet to the Mojave River. In the post-development condition, a channel parallel to Turner Road would be constructed to transport these flows westerly to the Mojave River, following almost the exact path as the existing condition.

Table 6-1. Off-site Unit Hydrograph Results

Off-Site Unit Hydrograph Results	
Sub-area	Flow Rate (cfs)
1	1,230.5

The total peak flow for the watershed tributary to the site is on the magnitude of 1,230.5 cubic feet per second (cfs). The total peak flow for the site itself is only 20.1 cfs in the pre-development condition. In the post-development condition, the peak flow for the site is 57.6 cfs. The post-development on-site increase in flow is 37.5 cfs (187 percent). However, when the increase of 37.5 cfs is compared to the entire watershed flow of 1,230.5 cfs, the increase is only 3.0 percent of the total flow tributary to the site, which is negligible. Therefore, mitigation of the site for this slight increase is not warranted. Table 6-2 below summarizes the results for the on-site hydrology analysis.

Table 6-2. On-site Rational Method Results

On-Site Hydrology Results			
Sub-area	Pre-Development Condition Flow Rate (cfs)	Post-Development Condition Flow Rate (cfs)	Difference Between Pre- and Post- Conditions
1	8.3	32.2	23.9
2	11.8	25.4	13.6
Total	20.1	57.6	37.5

7.0 CONCEPTUAL DRAINAGE PLAN

The Project's conceptual drainage plan is illustrated on Figure 7-1. With this plan, post-development drainage patterns will not alter existing flow paths and additional mitigation is not necessary. The logic used in developing this plan and details of the plan itself are summarized below.

Under existing conditions, during heavy rain events the small washes on-site become conduits for water flow. Although the watershed itself is predominantly soil groups A and C, the soil types on the Project site are predominantly soil groups A and B, which are characterized as having moderate to low run-off potential. It is expected that the conditions which are present at the site currently, and which have been formed by past storm events, would continue to provide passage for storm flows through the site during storm events after completion of the Project. Water falling on the solar units will sheet flow across the face of the solar panels, fall to the ground, and then travel in the same drainage pattern as it flows in the pre-development condition.

The solar units themselves cover a large area, but the calculated impervious footprint of the solar panel piers is less than one percent of the site. However, a conservative impervious value of 4.6 percent has been chosen to analyze the post-development storm event that accounts for the solar piers, access roadways, and the support gear foundations such as the inverters.

Based on the site visit to observe the drainage patterns and the results of the runoff calculations performed as part of this study, it was determined that keeping the channel along Turner Road would be sufficient to maintain adequate runoff through the Project site without causing backup for flows upstream or creating concentrated flows downstream. It should be noted that since this site is bordered on the east by the AT&SF Railroad which acts as a dam, with a controlled discharge from the dual 3-foot-diameter culverts, slight increase in impermeable surfaces of 4.6 percent on the Project site as a result of construction would cause very little effect on backup. Also, because the flows from the site discharge directly into the Mojave River, the potential to cause concentrated flows downstream as a result of drainage changes at the site is non-existent.

The channel along Turner Road that, under existing conditions, directs flows through the site would function in the same manner following construction. This channel currently conveys flows westerly from the outlet of the dual 36-inch-diameter culverts on the westerly side of the AT&SF Railroad. The post-development pattern will not alter the existing flow path. Prior to construction, the site will be cleared of vegetation, except near ditches. A post-development condition of "fallow" was selected because it indicates land is plowed but not tilled or seeded. During construction, all vegetation would be cleared, but some of root mass might remain and some of the vegetation might regrow. Due to the configuration of the solar panels and their blockage of direct sunlight, it is unknown how these plants will survive in the post-construction condition. The overall goal of the conceptual drainage design is to keep the site drainage as close to the natural design as possible. Following review and approval of the proposed conceptual drainage layout shown on Figure 7-1, the drainage plan would be refined during detailed design.

Figure 7-1. Conceptual Drainage Plan

8.0 CONCLUSIONS AND RECOMMENDATIONS

The increase in flows from pre-development to post-development conditions at the Project site are estimated at 20.1 cfs and 57.6 cfs, respectively, an increase of approximately 187 percent. This results in an increase of 37.5 cfs in runoff across the Project site as a result of construction.

The total runoff contributory to the Project site from the upstream watershed is estimated at approximately 1,230.5 cfs. The increase in runoff as a result of construction is only 37.5 cfs, approximately 3.0 percent of the total flow of 1,230.5 cfs tributary to the Project site.

The increase in impervious area of the Project site is approximately 4.6 percent. The existing drainage patterns at the site would be kept as they are, or as close as possible to their existing condition. The perimeter road at the site would utilize minimal concrete structures for culverts. Minimal solar panel footings using I-beams would reduce the imperviousness of the site compared to using concrete footings.

These results demonstrate that the increase in runoff associated with the Project development is negligible. As a result, URS recommends the following:

1. Maintain the existing Turner Road channel on-site as shown on Figure 7-1.

2. Following approval by San Bernardino County Flood Control District, develop the conceptual plan presented in this report into a detailed design which will further refine the results of the calculations presented in this report, and provide culvert sizes, and drawings showing site drainage for construction.

The proposed channel through the site would require annual maintenance at a minimum to ensure that these facilities remain functional during storm events and are not clogged by debris.

Appendix A

Site Photographs

FIGURE A1.

FIGURE A2.

FIGURE A3.

FIGURE A4.

FIGURE A5.

FIGURE A6.

FIGURE A7.

FIGURE A8.

FIGURE A9.

FIGURE A10.

FIGURE A11.

FIGURE A12.

Appendix B

Rainfall Data

Off-Site Hydrology

Rainfall Data

Area 1

NOAA Atlas 14, Volume 6, Version 2
Location name: California, US*
Coordinates: 34.6872, -117.3116
Elevation: 2860ft*
* source: Google Maps

POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Sarah Dietz, Sarah Heim, Lillian Hiner, Kazungu Maitaria, Deborah Martin, Sandra Pavlovic, Ishani Roy, Carl Trypaluk, Dale Unruh, Fenglin Yan, Michael Yekta, Tan Zhao, Geoffrey Bonnin, Daniel Brewer, Li-Chuan Chen, Tye Parzybok, John Yarchoan

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)[1]

Duration	Average recurrence interval(years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	**0.082** (0.067–0.101)	**0.114** (0.094–0.140)	**0.159** (0.130–0.195)	**0.197** (0.160–0.244)	**0.252** (0.198–0.323)	**0.296** (0.228–0.388)	**0.343** (0.259–0.461)	**0.395** (0.289–0.544)	**0.468** (0.329–0.671)	**0.527** (0.359–0.783)
10-min	**0.117** (0.097–0.144)	**0.164** (0.134–0.201)	**0.227** (0.186–0.280)	**0.282** (0.229–0.350)	**0.361** (0.284–0.463)	**0.424** (0.327–0.556)	**0.492** (0.371–0.660)	**0.565** (0.414–0.780)	**0.670** (0.472–0.962)	**0.756** (0.514–1.12)
15-min	**0.142** (0.117–0.174)	**0.198** (0.163–0.243)	**0.275** (0.225–0.339)	**0.341** (0.277–0.424)	**0.436** (0.343–0.559)	**0.513** (0.396–0.672)	**0.595** (0.448–0.798)	**0.684** (0.501–0.943)	**0.810** (0.570–1.16)	**0.914** (0.622–1.36)
30-min	**0.194** (0.159–0.237)	**0.269** (0.221–0.331)	**0.375** (0.307–0.462)	**0.465** (0.378–0.577)	**0.594** (0.468–0.762)	**0.699** (0.539–0.915)	**0.811** (0.611–1.09)	**0.932** (0.683–1.28)	**1.10** (0.777–1.59)	**1.25** (0.847–1.85)
60-min	**0.246** (0.203–0.302)	**0.343** (0.282–0.421)	**0.476** (0.391–0.587)	**0.591** (0.480–0.734)	**0.755** (0.595–0.969)	**0.889** (0.686–1.16)	**1.03** (0.777–1.38)	**1.19** (0.868–1.63)	**1.40** (0.988–2.02)	**1.58** (1.08–2.35)
2-hr	**0.342** (0.281–0.419)	**0.462** (0.380–0.568)	**0.628** (0.515–0.774)	**0.770** (0.626–0.956)	**0.972** (0.765–1.25)	**1.14** (0.876–1.49)	**1.31** (0.986–1.76)	**1.49** (1.10–2.06)	**1.76** (1.24–2.52)	**1.97** (1.34–2.92)
3-hr	**0.408** (0.336–0.501)	**0.546** (0.449–0.671)	**0.736** (0.603–0.907)	**0.898** (0.730–1.12)	**1.13** (0.888–1.45)	**1.31** (1.01–1.72)	**1.51** (1.14–2.03)	**1.72** (1.26–2.37)	**2.01** (1.42–2.89)	**2.25** (1.53–3.34)
6-hr	**0.540** (0.444–0.663)	**0.718** (0.590–0.882)	**0.960** (0.787–1.18)	**1.17** (0.948–1.45)	**1.46** (1.15–1.87)	**1.69** (1.30–2.21)	**1.93** (1.45–2.59)	**2.19** (1.60–3.02)	**2.55** (1.80–3.66)	**2.84** (1.93–4.22)
12-hr	**0.672** (0.553–0.825)	**0.905** (0.744–1.11)	**1.22** (1.00–1.50)	**1.48** (1.21–1.84)	**1.85** (1.46–2.38)	**2.14** (1.65–2.81)	**2.45** (1.84–3.28)	**2.76** (2.03–3.81)	**3.20** (2.25–4.60)	**3.55** (2.41–5.27)
24-hr	**0.860** (0.763–0.989)	**1.18** (1.05–1.36)	**1.61** (1.43–1.86)	**1.97** (1.73–2.29)	**2.46** (2.09–2.96)	**2.85** (2.36–3.50)	**3.24** (2.63–4.09)	**3.66** (2.88–4.74)	**4.23** (3.19–5.71)	**4.67** (3.41–6.53)
2-day	**0.999** (0.887–1.15)	**1.39** (1.23–1.61)	**1.92** (1.70–2.22)	**2.36** (2.06–2.74)	**2.95** (2.50–3.55)	**3.42** (2.84–4.20)	**3.89** (3.15–4.90)	**4.39** (3.46–5.69)	**5.07** (3.83–6.85)	**5.60** (4.09–7.83)
3-day	**1.08** (0.957–1.24)	**1.52** (1.34–1.75)	**2.10** (1.86–2.43)	**2.59** (2.27–3.01)	**3.25** (2.75–3.91)	**3.76** (3.12–4.62)	**4.29** (3.47–5.40)	**4.83** (3.81–6.26)	**5.58** (4.22–7.54)	**6.17** (4.51–8.63)
4-day	**1.14** (1.01–1.31)	**1.61** (1.42–1.85)	**2.24** (1.98–2.58)	**2.75** (2.41–3.20)	**3.46** (2.93–4.16)	**4.00** (3.32–4.92)	**4.56** (3.70–5.75)	**5.15** (4.05–6.67)	**5.94** (4.49–8.02)	**6.56** (4.79–9.17)
7-day	**1.22** (1.09–1.41)	**1.72** (1.53–1.98)	**2.40** (2.12–2.77)	**2.96** (2.59–3.44)	**3.72** (3.15–4.48)	**4.31** (3.58–5.30)	**4.91** (3.98–6.18)	**5.53** (4.35–7.16)	**6.37** (4.81–8.60)	**7.02** (5.12–9.81)
10-day	**1.28** (1.14–1.48)	**1.81** (1.60–2.08)	**2.52** (2.22–2.91)	**3.11** (2.72–3.62)	**3.92** (3.32–4.72)	**4.55** (3.78–5.59)	**5.19** (4.20–6.54)	**5.85** (4.61–7.58)	**6.75** (5.10–9.12)	**7.44** (5.43–10.4)
20-day	**1.46** (1.29–1.68)	**2.08** (1.84–2.40)	**2.94** (2.60–3.40)	**3.67** (3.21–4.27)	**4.69** (3.97–5.64)	**5.49** (4.55–6.74)	**6.31** (5.11–7.95)	**7.16** (5.64–9.28)	**8.32** (6.29–11.2)	**9.21** (6.72–12.9)
30-day	**1.63** (1.45–1.87)	**2.35** (2.08–2.70)	**3.36** (2.97–3.88)	**4.22** (3.70–4.91)	**5.45** (4.62–6.56)	**6.42** (5.33–7.89)	**7.43** (6.02–9.36)	**8.48** (6.68–11.0)	**9.91** (7.49–13.4)	**11.0** (8.04–15.4)
45-day	**1.89** (1.67–2.17)	**2.74** (2.42–3.15)	**3.95** (3.49–4.56)	**5.00** (4.39–5.83)	**6.54** (5.55–7.87)	**7.79** (6.47–9.57)	**9.08** (7.36–11.4)	**10.4** (8.23–13.5)	**12.3** (9.31–16.6)	**13.8** (10.1–19.3)
60-day	**2.06** (1.83–2.37)	**3.00** (2.65–3.45)	**4.36** (3.85–5.03)	**5.55** (4.87–6.47)	**7.32** (6.20–8.81)	**8.77** (7.28–10.8)	**10.3** (8.35–13.0)	**11.9** (9.39–15.4)	**14.2** (10.7–19.2)	**16.0** (11.7–22.3)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

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PF graphical

On-Site Hydrology

Rainfall Data

Area A

NOAA Atlas 14, Volume 6, Version 2
Location name: California, US*
Coordinates: 34.6863, -117.3458
Elevation: 2507ft*
* source: Google Maps

POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Sarah Dietz, Sarah Heim, Lillian Hiner, Kazungu Maitaria, Deborah Martin, Sandra Pavlovic, Ishani Roy, Carl Trypaluk, Dale Unruh, Fenglin Yan, Michael Yekta, Tan Zhao, Geoffrey Bonnin, Daniel Brewer, Li-Chuan Chen, Tye Parzybok, John Yarchoan

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)[1]

Duration	Average recurrence interval(years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	**0.081** (0.067–0.099)	**0.112** (0.092–0.138)	**0.156** (0.128–0.192)	**0.194** (0.157–0.240)	**0.247** (0.195–0.317)	**0.291** (0.224–0.381)	**0.337** (0.254–0.452)	**0.387** (0.283–0.533)	**0.458** (0.322–0.657)	**0.515** (0.350–0.765)
10-min	**0.116** (0.095–0.142)	**0.161** (0.133–0.198)	**0.224** (0.184–0.276)	**0.277** (0.226–0.344)	**0.354** (0.279–0.455)	**0.417** (0.321–0.546)	**0.483** (0.364–0.648)	**0.554** (0.406–0.764)	**0.656** (0.461–0.942)	**0.738** (0.502–1.10)
15-min	**0.140** (0.115–0.172)	**0.195** (0.160–0.239)	**0.271** (0.222–0.334)	**0.335** (0.273–0.417)	**0.429** (0.337–0.550)	**0.504** (0.389–0.660)	**0.584** (0.440–0.784)	**0.670** (0.491–0.924)	**0.793** (0.558–1.14)	**0.893** (0.607–1.33)
30-min	**0.189** (0.155–0.232)	**0.262** (0.216–0.322)	**0.365** (0.299–0.449)	**0.452** (0.368–0.561)	**0.577** (0.455–0.741)	**0.679** (0.524–0.889)	**0.787** (0.593–1.06)	**0.903** (0.662–1.25)	**1.07** (0.752–1.53)	**1.20** (0.818–1.79)
60-min	**0.237** (0.195–0.291)	**0.330** (0.271–0.405)	**0.458** (0.376–0.564)	**0.568** (0.462–0.705)	**0.725** (0.571–0.930)	**0.853** (0.658–1.12)	**0.989** (0.745–1.33)	**1.13** (0.831–1.56)	**1.34** (0.944–1.93)	**1.51** (1.03–2.24)
2-hr	**0.326** (0.268–0.400)	**0.440** (0.362–0.541)	**0.598** (0.491–0.737)	**0.733** (0.597–0.911)	**0.926** (0.729–1.19)	**1.08** (0.835–1.42)	**1.25** (0.939–1.67)	**1.42** (1.04–1.96)	**1.67** (1.17–2.40)	**1.87** (1.27–2.77)
3-hr	**0.384** (0.316–0.471)	**0.513** (0.422–0.631)	**0.692** (0.567–0.852)	**0.844** (0.686–1.05)	**1.06** (0.835–1.36)	**1.24** (0.954–1.62)	**1.42** (1.07–1.90)	**1.62** (1.18–2.23)	**1.89** (1.33–2.71)	**2.11** (1.43–3.13)
6-hr	**0.499** (0.411–0.613)	**0.663** (0.545–0.815)	**0.887** (0.728–1.09)	**1.08** (0.877–1.34)	**1.35** (1.06–1.73)	**1.56** (1.21–2.05)	**1.79** (1.35–2.40)	**2.03** (1.49–2.79)	**2.36** (1.66–3.39)	**2.62** (1.78–3.89)
12-hr	**0.609** (0.501–0.747)	**0.822** (0.676–1.01)	**1.11** (0.912–1.37)	**1.35** (1.10–1.68)	**1.69** (1.33–2.17)	**1.96** (1.51–2.57)	**2.24** (1.69–3.00)	**2.53** (1.85–3.49)	**2.93** (2.06–4.20)	**3.24** (2.20–4.81)
24-hr	**0.758** (0.672–0.872)	**1.05** (0.930–1.21)	**1.44** (1.27–1.66)	**1.76** (1.55–2.05)	**2.21** (1.87–2.66)	**2.56** (2.12–3.15)	**2.92** (2.36–3.67)	**3.29** (2.59–4.26)	**3.80** (2.87–5.13)	**4.19** (3.06–5.86)
2-day	**0.877** (0.778–1.01)	**1.23** (1.09–1.42)	**1.71** (1.52–1.98)	**2.11** (1.85–2.45)	**2.65** (2.24–3.18)	**3.06** (2.54–3.76)	**3.49** (2.83–4.40)	**3.93** (3.10–5.09)	**4.53** (3.42–6.11)	**4.98** (3.64–6.96)
3-day	**0.945** (0.838–1.09)	**1.34** (1.19–1.54)	**1.88** (1.66–2.17)	**2.31** (2.03–2.69)	**2.91** (2.47–3.50)	**3.37** (2.79–4.14)	**3.83** (3.11–4.83)	**4.31** (3.40–5.59)	**4.97** (3.75–6.71)	**5.47** (3.99–7.65)
4-day	**0.992** (0.880–1.14)	**1.41** (1.25–1.63)	**1.99** (1.76–2.30)	**2.46** (2.15–2.86)	**3.09** (2.62–3.72)	**3.58** (2.97–4.40)	**4.07** (3.30–5.13)	**4.59** (3.61–5.94)	**5.28** (3.99–7.12)	**5.80** (4.24–8.11)
7-day	**1.05** (0.931–1.21)	**1.50** (1.33–1.73)	**2.12** (1.88–2.45)	**2.63** (2.31–3.07)	**3.33** (2.82–4.01)	**3.86** (3.21–4.75)	**4.40** (3.56–5.54)	**4.94** (3.89–6.40)	**5.67** (4.29–7.66)	**6.22** (4.54–8.69)
10-day	**1.09** (0.965–1.25)	**1.56** (1.39–1.80)	**2.22** (1.97–2.57)	**2.77** (2.43–3.22)	**3.52** (2.99–4.24)	**4.10** (3.40–5.04)	**4.68** (3.79–5.89)	**5.27** (4.15–6.82)	**6.06** (4.58–8.18)	**6.65** (4.85–9.29)
20-day	**1.21** (1.07–1.39)	**1.78** (1.58–2.05)	**2.60** (2.29–3.00)	**3.28** (2.88–3.82)	**4.26** (3.61–5.13)	**5.02** (4.17–6.17)	**5.80** (4.70–7.31)	**6.61** (5.20–8.56)	**7.66** (5.79–10.3)	**8.46** (6.17–11.8)
30-day	**1.33** (1.18–1.53)	**1.98** (1.76–2.29)	**2.94** (2.60–3.40)	**3.77** (3.30–4.39)	**4.96** (4.21–5.98)	**5.91** (4.91–7.27)	**6.88** (5.57–8.67)	**7.88** (6.21–10.2)	**9.22** (6.97–12.4)	**10.2** (7.45–14.3)
45-day	**1.53** (1.36–1.76)	**2.31** (2.05–2.66)	**3.47** (3.06–4.00)	**4.49** (3.93–5.22)	**6.00** (5.09–7.23)	**7.24** (6.01–8.90)	**8.51** (6.90–10.7)	**9.83** (7.74–12.7)	**11.6** (8.78–15.7)	**13.0** (9.47–18.1)
60-day	**1.65** (1.47–1.90)	**2.51** (2.23–2.89)	**3.82** (3.37–4.41)	**4.99** (4.37–5.81)	**6.74** (5.72–8.12)	**8.20** (6.80–10.1)	**9.73** (7.88–12.3)	**11.3** (8.90–14.6)	**13.5** (10.2–18.2)	**15.1** (11.1–21.2)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

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PF graphical

Area B

NOAA Atlas 14, Volume 6, Version 2
Location name: California, US*
Coordinates: 34.6895, -117.3434
Elevation: 2500ft*
* source: Google Maps

POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Sarah Dietz, Sarah Heim, Lillian Hiner, Kazungu Maitaria, Deborah Martin, Sandra Pavlovic, Ishani Roy, Carl Trypaluk, Dale Unruh, Fenglin Yan, Michael Yekta, Tan Zhao, Geoffrey Bonnin, Daniel Brewer, Li-Chuan Chen, Tye Parzybok, John Yarchoan

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)[1]

Duration	Average recurrence interval(years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	**0.081** (0.066–0.099)	**0.112** (0.092–0.138)	**0.156** (0.128–0.192)	**0.193** (0.157–0.239)	**0.246** (0.193–0.315)	**0.289** (0.223–0.378)	**0.334** (0.252–0.448)	**0.383** (0.281–0.528)	**0.453** (0.319–0.651)	**0.510** (0.347–0.757)
10-min	**0.116** (0.095–0.142)	**0.161** (0.132–0.197)	**0.223** (0.183–0.275)	**0.276** (0.224–0.343)	**0.352** (0.277–0.452)	**0.414** (0.319–0.542)	**0.479** (0.361–0.643)	**0.549** (0.403–0.757)	**0.649** (0.457–0.932)	**0.731** (0.497–1.09)
15-min	**0.140** (0.115–0.172)	**0.194** (0.160–0.239)	**0.270** (0.221–0.332)	**0.334** (0.271–0.415)	**0.426** (0.335–0.546)	**0.500** (0.386–0.655)	**0.579** (0.436–0.777)	**0.664** (0.487–0.916)	**0.785** (0.553–1.13)	**0.884** (0.601–1.31)
30-min	**0.188** (0.155–0.231)	**0.262** (0.215–0.322)	**0.363** (0.298–0.447)	**0.449** (0.365–0.558)	**0.573** (0.451–0.735)	**0.673** (0.519–0.882)	**0.780** (0.587–1.05)	**0.894** (0.655–1.23)	**1.06** (0.744–1.52)	**1.19** (0.809–1.77)
60-min	**0.238** (0.196–0.292)	**0.330** (0.272–0.406)	**0.458** (0.376–0.564)	**0.567** (0.461–0.704)	**0.723** (0.569–0.928)	**0.850** (0.655–1.11)	**0.984** (0.741–1.32)	**1.13** (0.827–1.56)	**1.33** (0.939–1.92)	**1.50** (1.02–2.23)
2-hr	**0.327** (0.269–0.401)	**0.441** (0.362–0.542)	**0.598** (0.490–0.737)	**0.731** (0.595–0.908)	**0.922** (0.726–1.18)	**1.08** (0.830–1.41)	**1.24** (0.932–1.66)	**1.41** (1.03–1.94)	**1.65** (1.16–2.37)	**1.85** (1.26–2.75)
3-hr	**0.385** (0.317–0.472)	**0.514** (0.422–0.631)	**0.691** (0.566–0.851)	**0.842** (0.684–1.05)	**1.06** (0.832–1.36)	**1.23** (0.948–1.61)	**1.41** (1.06–1.89)	**1.60** (1.18–2.21)	**1.87** (1.32–2.69)	**2.09** (1.42–3.10)
6-hr	**0.498** (0.410–0.611)	**0.661** (0.544–0.813)	**0.884** (0.725–1.09)	**1.07** (0.873–1.33)	**1.34** (1.06–1.72)	**1.55** (1.20–2.03)	**1.78** (1.34–2.38)	**2.01** (1.47–2.77)	**2.34** (1.65–3.36)	**2.60** (1.77–3.85)
12-hr	**0.605** (0.498–0.742)	**0.819** (0.673–1.01)	**1.11** (0.909–1.37)	**1.35** (1.10–1.68)	**1.69** (1.33–2.17)	**1.95** (1.51–2.56)	**2.23** (1.68–2.99)	**2.52** (1.84–3.47)	**2.91** (2.05–4.18)	**3.22** (2.19–4.78)
24-hr	**0.751** (0.666–0.864)	**1.04** (0.925–1.20)	**1.44** (1.27–1.66)	**1.76** (1.54–2.05)	**2.21** (1.87–2.66)	**2.55** (2.12–3.14)	**2.91** (2.36–3.66)	**3.28** (2.58–4.24)	**3.78** (2.86–5.10)	**4.17** (3.04–5.83)
2-day	**0.873** (0.775–1.01)	**1.23** (1.09–1.42)	**1.72** (1.52–1.98)	**2.11** (1.85–2.46)	**2.65** (2.24–3.19)	**3.06** (2.54–3.76)	**3.49** (2.82–4.39)	**3.92** (3.09–5.08)	**4.51** (3.41–6.09)	**4.96** (3.62–6.94)
3-day	**0.941** (0.834–1.08)	**1.34** (1.19–1.54)	**1.87** (1.66–2.16)	**2.31** (2.03–2.69)	**2.90** (2.46–3.49)	**3.36** (2.79–4.13)	**3.82** (3.09–4.81)	**4.29** (3.38–5.56)	**4.94** (3.73–6.67)	**5.43** (3.97–7.60)
4-day	**0.988** (0.877–1.14)	**1.41** (1.25–1.63)	**1.98** (1.75–2.29)	**2.45** (2.15–2.85)	**3.08** (2.61–3.71)	**3.56** (2.96–4.38)	**4.05** (3.28–5.10)	**4.56** (3.59–5.90)	**5.24** (3.96–7.07)	**5.75** (4.20–8.04)
7-day	**1.05** (0.930–1.21)	**1.50** (1.33–1.73)	**2.12** (1.87–2.44)	**2.62** (2.30–3.05)	**3.31** (2.81–3.98)	**3.84** (3.18–4.72)	**4.36** (3.53–5.50)	**4.90** (3.86–6.35)	**5.62** (4.25–7.59)	**6.16** (4.50–8.61)
10-day	**1.09** (0.964–1.25)	**1.56** (1.38–1.80)	**2.21** (1.96–2.56)	**2.75** (2.41–3.20)	**3.49** (2.96–4.21)	**4.06** (3.37–4.99)	**4.63** (3.75–5.83)	**5.21** (4.10–6.75)	**5.99** (4.53–8.09)	**6.57** (4.80–9.19)
20-day	**1.21** (1.07–1.39)	**1.78** (1.58–2.05)	**2.58** (2.28–2.98)	**3.25** (2.85–3.79)	**4.21** (3.57–5.07)	**4.95** (4.11–6.09)	**5.72** (4.63–7.20)	**6.50** (5.12–8.42)	**7.53** (5.69–10.2)	**8.31** (6.06–11.6)
30-day	**1.33** (1.18–1.53)	**1.98** (1.75–2.28)	**2.92** (2.58–3.37)	**3.73** (3.27–4.34)	**4.90** (4.15–5.90)	**5.82** (4.83–7.15)	**6.76** (5.48–8.52)	**7.73** (6.09–10.0)	**9.03** (6.83–12.2)	**9.99** (7.30–14.0)
45-day	**1.53** (1.36–1.76)	**2.31** (2.04–2.66)	**3.44** (3.04–3.98)	**4.44** (3.89–5.17)	**5.92** (5.02–7.13)	**7.12** (5.91–8.75)	**8.35** (6.77–10.5)	**9.63** (7.58–12.5)	**11.4** (8.58–15.3)	**12.7** (9.25–17.7)
60-day	**1.66** (1.47–1.91)	**2.51** (2.22–2.89)	**3.79** (3.35–4.38)	**4.94** (4.33–5.75)	**6.64** (5.63–8.00)	**8.05** (6.68–9.90)	**9.53** (7.72–12.0)	**11.1** (8.70–14.3)	**13.2** (9.94–17.8)	**14.7** (10.8–20.6)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

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PF graphical

Appendix C

Off-Site Unit Hydrograph Calculations

Area 1

UNIT HYDROGRAPH METHOD SUMMARY
ALAMO SOLAR PROJECT
SAN BERNARDINO COUNTY

1.	Enter the design storm return frequency (year)		100
2.	Enter flow length, L (feet)		23,272
	Flow length (miles)		4.41
3.	Enter the centroidal length, L_{ca} (feet)		10,964
	Centroidal length (miles)		2.08
4.	Enter upstream elevation		3540
	Enter downstream elevation		2486
	Difference in elevation		1054
5.	Enter the watershed area (acres)		1545.8
6.	Enter the S-Graph proportions (decimal)		
		Valley Developed	
		Valley Undeveloped	
		Foothill	1.0
		Mountain	
		Desert	
7.	Basin Factor, n=		0.04
8.	Enter the pervious fraction		1.0
9.	Enter the area averaged Curve Number		60.3
10.	Enter area-averaged point rainfall (inches)		
		5-Minute	0.343
		30-Minute	0.811
		1-Hour	1.03
		3-Hour	1.51
		6-Hour	1.93
		24-Hour	3.24

CURVE NUMBER AREA-AVERAGING

ALAMO AVERAGE CURVE NUMBER

SAN BERNARDINO COUNTY

Cover Type	SOIL GROUP	(1) CURVE NUMBER	(2) Area (acres)	(3) Weighting (1)*(2)	PERCENTAGE BREAKDOWN
Chaparral, Broadleaf (Fair)	A	40	677.2	27087.6	43.8%
Chaparral, Broadleaf (Fair)	B	63	51.4	3235.9	3.3%
Chaparral, Broadleaf (Fair)	C	75	540.0	40496.9	34.9%
Chaparral, Broadleaf (Fair)	D	81	277.3	22458.1	17.9%

TOTAL MAP AREA= **1545.8**

TOTAL WEIGHTING= **93278.5**

TOTAL AVERAGED VALUE= **60.3**

```
       U n i t   H y d r o g r a p h   A n a l y s i s

       Copyright (c) CIVILCADD/CIVILDESIGN, 1989 - 2004, Version 7.0

              Study date  12/07/11

++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
------------------------------------------------------------------------

San Bernardino County Synthetic Unit Hydrology Method
              Manual date - August 1986


Program License Serial Number 6264

---------------------------------------------------------------------
WDG SOLAR - ALAMO
PRE-DEVELOPMENT CONDITION
100-YEAR 24-HOUR STORM EVENT
BY: NRK
--------------------------------------------------------------------

       Storm Event Year = 100

       Antecedent Moisture Condition = 3

 English (in-lb) Input Units Used

 English Rainfall Data (Inches) Input Values Used

 English Units used in output format



Area averaged rainfall intensity isohyetal data:
       Sub-Area        Duration        Isohyetal
       (Ac.)            (hours)         (In)
Rainfall data for year 100
         1545.80           1           1.03
--------------------------------------------------------------------
Rainfall data for year 100
         1545.80           6           1.93
--------------------------------------------------------------------
Rainfall data for year 100
         1545.80          24           3.24
--------------------------------------------------------------------
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++

******** Area-averaged max loss rate, Fm ********


SCS curve  SCS curve     Area     Area     Fp(Fig C6)    Ap      Fm
No.(AMCII) NO.(AMC 3)    (Ac.)    Fraction     (In/Hr)  (dec.)   (In/Hr)
 60.3      79.2       1545.80      1.000     0.383    1.000    0.383

Area-averaged adjusted loss rate Fm (In/Hr) =  0.383

********* Area-Averaged low loss rate fraction, Yb **********

Area       Area          SCS CN    SCS CN      S     Pervious
 (Ac.)      Fract         (AMC2)    (AMC3)           Yield Fr
  1545.80   1.000         60.3      79.2       2.62     0.427

Area-averaged catchment yield fraction, Y =  0.427
Area-averaged low loss fraction, Yb =  0.573
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Watercourse length =   23241.00(Ft.)
Length from concentration point to centroid =   10964.00(Ft.)
```

```
Elevation difference along watercourse =    1054.00(Ft.)
Mannings friction factor along watercourse =  0.040
Watershed area =    1545.80(Ac.)
Catchment Lag time =   0.786 hours
Unit interval =   5.000 minutes
Unit interval percentage of lag time = 10.6032
Hydrograph baseflow =     0.00(CFS)
Average maximum watershed loss rate(Fm) =  0.383(In/Hr)
Average low loss rate fraction (Yb) = 0.573 (decimal)
FOOTHILL S-Graph Selected
Computed peak 5-minute rainfall =  0.343(In)
Computed peak 30-minute rainfall =  0.811(In)
Specified peak 1-hour rainfall =  1.030(In)
Computed peak 3-hour rainfall =  1.510(In)
Specified peak 6-hour rainfall =  1.930(In)
Specified peak 24-hour rainfall =  3.240(In)


Note: user specified rainfall values used.
Rainfall depth area reduction factors:
Using a total area of    1545.80(Ac.) (Ref: fig. E-4)

5-minute factor = 0.928     Adjusted rainfall =  0.318(In)
30-minute factor = 0.928    Adjusted rainfall =  0.752(In)
1-hour factor = 0.928       Adjusted rainfall =  0.955(In)
3-hour factor = 0.991       Adjusted rainfall =  1.496(In)
6-hour factor = 0.995       Adjusted rainfall =  1.921(In)
24-hour factor = 0.998      Adjusted rainfall =  3.234(In)
---------------------------------------------------------------------

                      U n i t   H y d r o g r a p h
+++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Interval          'S' Graph          Unit Hydrograph
Number            Mean values            ((CFS))
---------------------------------------------------------------------
               (K =     18694.52 (CFS))

  1                0.672                125.540
  2                2.130                272.586
  3                4.152                378.090
  4                6.637                464.574
  5                9.681                568.934
  6               13.466                707.678
  7               18.579                955.902
  8               25.009               1201.928
  9               35.412               1944.927
 10               49.863               2701.541
 11               57.343               1398.215
 12               62.364                938.741
 13               66.414                757.078
 14               69.899                651.545
 15               72.778                538.201
 16               75.286                468.954
 17               77.721                455.148
 18               79.742                377.844
 19               81.689                363.975
 20               83.374                314.915
 21               84.901                285.439
 22               86.350                270.969
 23               87.629                239.017
 24               88.878                233.626
 25               89.939                198.235
 26               90.956                190.227
 27               91.879                172.459
 28               92.727                158.577
 29               93.533                150.660
 30               94.219                128.227
 31               94.887                124.932
 32               95.432                101.871
 33               95.941                 95.146
 34               96.408                 87.359
```

35	96.832	79.289
36	97.231	74.519
37	97.536	57.102
38	97.827	54.299
39	97.999	32.111
40	98.126	23.787
41	98.253	23.787
42	98.380	23.787
43	98.504	23.165
44	98.612	20.206
45	98.718	19.822
46	98.824	19.822
47	98.930	19.822
48	99.021	16.996
49	99.086	11.989
50	99.149	11.893
51	99.213	11.893
52	99.277	11.926
53	99.353	14.353
54	99.438	15.858
55	99.523	15.858
56	99.608	15.858
57	99.689	15.181
58	99.739	9.294
59	99.781	7.929
60	99.824	7.929
61	99.866	7.929
62	99.903	6.964
63	99.925	4.146
64	99.947	3.964
65	99.968	3.964
66	99.989	3.964
67	100.000	2.053

Peak Unit Number	Adjusted mass rainfall (In)	Unit rainfall (In)
1	0.3181	0.3181
2	0.4438	0.1257
3	0.5392	0.0954
4	0.6191	0.0799
5	0.6892	0.0700
6	0.7522	0.0631
7	0.7933	0.0411
8	0.8307	0.0374
9	0.8651	0.0344
10	0.8971	0.0320
11	0.9271	0.0300
12	0.9554	0.0282
13	0.9871	0.0317
14	1.0174	0.0303
15	1.0465	0.0291
16	1.0744	0.0279
17	1.1014	0.0269
18	1.1274	0.0260
19	1.1525	0.0252
20	1.1769	0.0244
21	1.2006	0.0237
22	1.2236	0.0230
23	1.2460	0.0224
24	1.2679	0.0218
25	1.2892	0.0213
26	1.3100	0.0208
27	1.3303	0.0203
28	1.3502	0.0199
29	1.3697	0.0195
30	1.3888	0.0191
31	1.4075	0.0187
32	1.4259	0.0184
33	1.4439	0.0180
34	1.4616	0.0177
35	1.4790	0.0174

36	1.4961	0.0171
37	1.5110	0.0148
38	1.5256	0.0146
39	1.5399	0.0143
40	1.5540	0.0141
41	1.5679	0.0139
42	1.5816	0.0137
43	1.5951	0.0135
44	1.6083	0.0133
45	1.6214	0.0131
46	1.6343	0.0129
47	1.6470	0.0127
48	1.6596	0.0125
49	1.6720	0.0124
50	1.6842	0.0122
51	1.6962	0.0121
52	1.7081	0.0119
53	1.7199	0.0118
54	1.7315	0.0116
55	1.7430	0.0115
56	1.7544	0.0114
57	1.7656	0.0112
58	1.7767	0.0111
59	1.7877	0.0110
60	1.7985	0.0109
61	1.8093	0.0107
62	1.8199	0.0106
63	1.8304	0.0105
64	1.8409	0.0104
65	1.8512	0.0103
66	1.8614	0.0102
67	1.8715	0.0101
68	1.8815	0.0100
69	1.8914	0.0099
70	1.9013	0.0098
71	1.9110	0.0097
72	1.9207	0.0097
73	1.9307	0.0100
74	1.9406	0.0099
75	1.9504	0.0098
76	1.9601	0.0097
77	1.9698	0.0097
78	1.9793	0.0096
79	1.9888	0.0095
80	1.9982	0.0094
81	2.0076	0.0094
82	2.0169	0.0093
83	2.0261	0.0092
84	2.0352	0.0091
85	2.0443	0.0091
86	2.0533	0.0090
87	2.0622	0.0089
88	2.0711	0.0089
89	2.0799	0.0088
90	2.0887	0.0088
91	2.0974	0.0087
92	2.1060	0.0086
93	2.1146	0.0086
94	2.1231	0.0085
95	2.1316	0.0085
96	2.1400	0.0084
97	2.1483	0.0083
98	2.1566	0.0083
99	2.1648	0.0082
100	2.1730	0.0082
101	2.1812	0.0081
102	2.1893	0.0081
103	2.1973	0.0080
104	2.2053	0.0080
105	2.2133	0.0079
106	2.2211	0.0079

107	2.2290	0.0079
108	2.2368	0.0078
109	2.2446	0.0078
110	2.2523	0.0077
111	2.2600	0.0077
112	2.2676	0.0076
113	2.2752	0.0076
114	2.2827	0.0075
115	2.2902	0.0075
116	2.2977	0.0075
117	2.3051	0.0074
118	2.3125	0.0074
119	2.3198	0.0073
120	2.3271	0.0073
121	2.3344	0.0073
122	2.3416	0.0072
123	2.3488	0.0072
124	2.3560	0.0072
125	2.3631	0.0071
126	2.3702	0.0071
127	2.3773	0.0071
128	2.3843	0.0070
129	2.3913	0.0070
130	2.3982	0.0069
131	2.4051	0.0069
132	2.4120	0.0069
133	2.4189	0.0069
134	2.4257	0.0068
135	2.4325	0.0068
136	2.4392	0.0068
137	2.4459	0.0067
138	2.4526	0.0067
139	2.4593	0.0067
140	2.4659	0.0066
141	2.4725	0.0066
142	2.4791	0.0066
143	2.4857	0.0065
144	2.4922	0.0065
145	2.4987	0.0065
146	2.5051	0.0065
147	2.5116	0.0064
148	2.5180	0.0064
149	2.5244	0.0064
150	2.5307	0.0064
151	2.5370	0.0063
152	2.5433	0.0063
153	2.5496	0.0063
154	2.5559	0.0062
155	2.5621	0.0062
156	2.5683	0.0062
157	2.5745	0.0062
158	2.5806	0.0062
159	2.5867	0.0061
160	2.5928	0.0061
161	2.5989	0.0061
162	2.6050	0.0061
163	2.6110	0.0060
164	2.6170	0.0060
165	2.6230	0.0060
166	2.6290	0.0060
167	2.6349	0.0059
168	2.6408	0.0059
169	2.6467	0.0059
170	2.6526	0.0059
171	2.6584	0.0059
172	2.6643	0.0058
173	2.6701	0.0058
174	2.6759	0.0058
175	2.6816	0.0058
176	2.6874	0.0057
177	2.6931	0.0057

178	2.6988	0.0057
179	2.7045	0.0057
180	2.7102	0.0057
181	2.7158	0.0056
182	2.7215	0.0056
183	2.7271	0.0056
184	2.7327	0.0056
185	2.7382	0.0056
186	2.7438	0.0056
187	2.7493	0.0055
188	2.7548	0.0055
189	2.7603	0.0055
190	2.7658	0.0055
191	2.7713	0.0055
192	2.7767	0.0054
193	2.7821	0.0054
194	2.7875	0.0054
195	2.7929	0.0054
196	2.7983	0.0054
197	2.8037	0.0054
198	2.8090	0.0053
199	2.8143	0.0053
200	2.8196	0.0053
201	2.8249	0.0053
202	2.8302	0.0053
203	2.8355	0.0053
204	2.8407	0.0052
205	2.8459	0.0052
206	2.8511	0.0052
207	2.8563	0.0052
208	2.8615	0.0052
209	2.8667	0.0052
210	2.8718	0.0051
211	2.8769	0.0051
212	2.8821	0.0051
213	2.8872	0.0051
214	2.8922	0.0051
215	2.8973	0.0051
216	2.9024	0.0051
217	2.9074	0.0050
218	2.9124	0.0050
219	2.9175	0.0050
220	2.9225	0.0050
221	2.9274	0.0050
222	2.9324	0.0050
223	2.9374	0.0050
224	2.9423	0.0049
225	2.9472	0.0049
226	2.9522	0.0049
227	2.9571	0.0049
228	2.9620	0.0049
229	2.9668	0.0049
230	2.9717	0.0049
231	2.9765	0.0048
232	2.9814	0.0048
233	2.9862	0.0048
234	2.9910	0.0048
235	2.9958	0.0048
236	3.0006	0.0048
237	3.0054	0.0048
238	3.0101	0.0048
239	3.0149	0.0047
240	3.0196	0.0047
241	3.0243	0.0047
242	3.0290	0.0047
243	3.0337	0.0047
244	3.0384	0.0047
245	3.0431	0.0047
246	3.0477	0.0047
247	3.0524	0.0046
248	3.0570	0.0046

249	3.0617	0.0046
250	3.0663	0.0046
251	3.0709	0.0046
252	3.0755	0.0046
253	3.0801	0.0046
254	3.0846	0.0046
255	3.0892	0.0046
256	3.0937	0.0045
257	3.0983	0.0045
258	3.1028	0.0045
259	3.1073	0.0045
260	3.1118	0.0045
261	3.1163	0.0045
262	3.1208	0.0045
263	3.1253	0.0045
264	3.1297	0.0045
265	3.1342	0.0044
266	3.1386	0.0044
267	3.1430	0.0044
268	3.1474	0.0044
269	3.1519	0.0044
270	3.1563	0.0044
271	3.1606	0.0044
272	3.1650	0.0044
273	3.1694	0.0044
274	3.1737	0.0044
275	3.1781	0.0043
276	3.1824	0.0043
277	3.1868	0.0043
278	3.1911	0.0043
279	3.1954	0.0043
280	3.1997	0.0043
281	3.2040	0.0043
282	3.2083	0.0043
283	3.2125	0.0043
284	3.2168	0.0043
285	3.2210	0.0043
286	3.2253	0.0042
287	3.2295	0.0042
288	3.2337	0.0042

Unit Period (number)	Unit Rainfall (In)	Unit Soil-Loss (In)	Effective Rainfall (In)
1	0.0042	0.0024	0.0018
2	0.0042	0.0024	0.0018
3	0.0043	0.0024	0.0018
4	0.0043	0.0024	0.0018
5	0.0043	0.0025	0.0018
6	0.0043	0.0025	0.0018
7	0.0043	0.0025	0.0018
8	0.0043	0.0025	0.0018
9	0.0043	0.0025	0.0019
10	0.0043	0.0025	0.0019
11	0.0044	0.0025	0.0019
12	0.0044	0.0025	0.0019
13	0.0044	0.0025	0.0019
14	0.0044	0.0025	0.0019
15	0.0044	0.0025	0.0019
16	0.0044	0.0025	0.0019
17	0.0045	0.0026	0.0019
18	0.0045	0.0026	0.0019
19	0.0045	0.0026	0.0019
20	0.0045	0.0026	0.0019
21	0.0045	0.0026	0.0019
22	0.0045	0.0026	0.0019
23	0.0046	0.0026	0.0019
24	0.0046	0.0026	0.0019
25	0.0046	0.0026	0.0020
26	0.0046	0.0026	0.0020

27	0.0046	0.0027	0.0020
28	0.0046	0.0027	0.0020
29	0.0047	0.0027	0.0020
30	0.0047	0.0027	0.0020
31	0.0047	0.0027	0.0020
32	0.0047	0.0027	0.0020
33	0.0047	0.0027	0.0020
34	0.0047	0.0027	0.0020
35	0.0048	0.0027	0.0020
36	0.0048	0.0027	0.0020
37	0.0048	0.0028	0.0021
38	0.0048	0.0028	0.0021
39	0.0048	0.0028	0.0021
40	0.0049	0.0028	0.0021
41	0.0049	0.0028	0.0021
42	0.0049	0.0028	0.0021
43	0.0049	0.0028	0.0021
44	0.0049	0.0028	0.0021
45	0.0050	0.0028	0.0021
46	0.0050	0.0029	0.0021
47	0.0050	0.0029	0.0021
48	0.0050	0.0029	0.0021
49	0.0051	0.0029	0.0022
50	0.0051	0.0029	0.0022
51	0.0051	0.0029	0.0022
52	0.0051	0.0029	0.0022
53	0.0051	0.0030	0.0022
54	0.0052	0.0030	0.0022
55	0.0052	0.0030	0.0022
56	0.0052	0.0030	0.0022
57	0.0052	0.0030	0.0022
58	0.0053	0.0030	0.0022
59	0.0053	0.0030	0.0023
60	0.0053	0.0030	0.0023
61	0.0053	0.0031	0.0023
62	0.0054	0.0031	0.0023
63	0.0054	0.0031	0.0023
64	0.0054	0.0031	0.0023
65	0.0054	0.0031	0.0023
66	0.0055	0.0031	0.0023
67	0.0055	0.0032	0.0023
68	0.0055	0.0032	0.0024
69	0.0056	0.0032	0.0024
70	0.0056	0.0032	0.0024
71	0.0056	0.0032	0.0024
72	0.0056	0.0032	0.0024
73	0.0057	0.0032	0.0024
74	0.0057	0.0033	0.0024
75	0.0057	0.0033	0.0024
76	0.0057	0.0033	0.0025
77	0.0058	0.0033	0.0025
78	0.0058	0.0033	0.0025
79	0.0059	0.0034	0.0025
80	0.0059	0.0034	0.0025
81	0.0059	0.0034	0.0025
82	0.0059	0.0034	0.0025
83	0.0060	0.0034	0.0026
84	0.0060	0.0034	0.0026
85	0.0061	0.0035	0.0026
86	0.0061	0.0035	0.0026
87	0.0061	0.0035	0.0026
88	0.0062	0.0035	0.0026
89	0.0062	0.0036	0.0026
90	0.0062	0.0036	0.0027
91	0.0063	0.0036	0.0027
92	0.0063	0.0036	0.0027
93	0.0064	0.0036	0.0027
94	0.0064	0.0037	0.0027
95	0.0064	0.0037	0.0027
96	0.0065	0.0037	0.0028
97	0.0065	0.0037	0.0028

98	0.0065	0.0038	0.0028
99	0.0066	0.0038	0.0028
100	0.0066	0.0038	0.0028
101	0.0067	0.0038	0.0029
102	0.0067	0.0039	0.0029
103	0.0068	0.0039	0.0029
104	0.0068	0.0039	0.0029
105	0.0069	0.0039	0.0029
106	0.0069	0.0040	0.0030
107	0.0070	0.0040	0.0030
108	0.0070	0.0040	0.0030
109	0.0071	0.0041	0.0030
110	0.0071	0.0041	0.0030
111	0.0072	0.0041	0.0031
112	0.0072	0.0041	0.0031
113	0.0073	0.0042	0.0031
114	0.0073	0.0042	0.0031
115	0.0074	0.0043	0.0032
116	0.0075	0.0043	0.0032
117	0.0075	0.0043	0.0032
118	0.0076	0.0043	0.0032
119	0.0077	0.0044	0.0033
120	0.0077	0.0044	0.0033
121	0.0078	0.0045	0.0033
122	0.0079	0.0045	0.0034
123	0.0079	0.0046	0.0034
124	0.0080	0.0046	0.0034
125	0.0081	0.0046	0.0035
126	0.0081	0.0047	0.0035
127	0.0082	0.0047	0.0035
128	0.0083	0.0048	0.0035
129	0.0084	0.0048	0.0036
130	0.0085	0.0049	0.0036
131	0.0086	0.0049	0.0037
132	0.0086	0.0049	0.0037
133	0.0088	0.0050	0.0037
134	0.0088	0.0051	0.0038
135	0.0089	0.0051	0.0038
136	0.0090	0.0052	0.0038
137	0.0091	0.0052	0.0039
138	0.0092	0.0053	0.0039
139	0.0094	0.0054	0.0040
140	0.0094	0.0054	0.0040
141	0.0096	0.0055	0.0041
142	0.0097	0.0055	0.0041
143	0.0098	0.0056	0.0042
144	0.0099	0.0057	0.0042
145	0.0097	0.0055	0.0041
146	0.0097	0.0056	0.0042
147	0.0099	0.0057	0.0042
148	0.0100	0.0057	0.0043
149	0.0102	0.0059	0.0044
150	0.0103	0.0059	0.0044
151	0.0105	0.0060	0.0045
152	0.0106	0.0061	0.0045
153	0.0109	0.0062	0.0046
154	0.0110	0.0063	0.0047
155	0.0112	0.0064	0.0048
156	0.0114	0.0065	0.0048
157	0.0116	0.0067	0.0050
158	0.0118	0.0067	0.0050
159	0.0121	0.0069	0.0051
160	0.0122	0.0070	0.0052
161	0.0125	0.0072	0.0054
162	0.0127	0.0073	0.0054
163	0.0131	0.0075	0.0056
164	0.0133	0.0076	0.0057
165	0.0137	0.0078	0.0058
166	0.0139	0.0080	0.0059
167	0.0143	0.0082	0.0061
168	0.0146	0.0084	0.0062

169	0.0171	0.0098	0.0073
170	0.0174	0.0100	0.0074
171	0.0180	0.0103	0.0077
172	0.0184	0.0105	0.0078
173	0.0191	0.0109	0.0081
174	0.0195	0.0112	0.0083
175	0.0203	0.0117	0.0087
176	0.0208	0.0119	0.0089
177	0.0218	0.0125	0.0093
178	0.0224	0.0128	0.0096
179	0.0237	0.0136	0.0101
180	0.0244	0.0140	0.0104
181	0.0260	0.0149	0.0111
182	0.0269	0.0154	0.0115
183	0.0291	0.0167	0.0124
184	0.0303	0.0174	0.0129
185	0.0282	0.0162	0.0121
186	0.0300	0.0172	0.0128
187	0.0344	0.0197	0.0147
188	0.0374	0.0214	0.0160
189	0.0631	0.0319	0.0312
190	0.0700	0.0319	0.0381
191	0.0954	0.0319	0.0635
192	0.1257	0.0319	0.0938
193	0.3181	0.0319	0.2863
194	0.0799	0.0319	0.0480
195	0.0411	0.0235	0.0175
196	0.0320	0.0184	0.0137
197	0.0317	0.0182	0.0135
198	0.0279	0.0160	0.0119
199	0.0252	0.0144	0.0107
200	0.0230	0.0132	0.0098
201	0.0213	0.0122	0.0091
202	0.0199	0.0114	0.0085
203	0.0187	0.0107	0.0080
204	0.0177	0.0102	0.0076
205	0.0148	0.0085	0.0063
206	0.0141	0.0081	0.0060
207	0.0135	0.0077	0.0057
208	0.0129	0.0074	0.0055
209	0.0124	0.0071	0.0053
210	0.0119	0.0068	0.0051
211	0.0115	0.0066	0.0049
212	0.0111	0.0064	0.0047
213	0.0107	0.0062	0.0046
214	0.0104	0.0060	0.0044
215	0.0101	0.0058	0.0043
216	0.0098	0.0056	0.0042
217	0.0100	0.0057	0.0043
218	0.0097	0.0056	0.0042
219	0.0095	0.0054	0.0041
220	0.0093	0.0053	0.0040
221	0.0091	0.0052	0.0039
222	0.0089	0.0051	0.0038
223	0.0087	0.0050	0.0037
224	0.0085	0.0049	0.0036
225	0.0083	0.0048	0.0036
226	0.0082	0.0047	0.0035
227	0.0080	0.0046	0.0034
228	0.0079	0.0045	0.0034
229	0.0078	0.0044	0.0033
230	0.0076	0.0044	0.0033
231	0.0075	0.0043	0.0032
232	0.0074	0.0042	0.0032
233	0.0073	0.0042	0.0031
234	0.0072	0.0041	0.0031
235	0.0071	0.0040	0.0030
236	0.0069	0.0040	0.0030
237	0.0069	0.0039	0.0029
238	0.0068	0.0039	0.0029
239	0.0067	0.0038	0.0028

240	0.0066	0.0038	0.0028
241	0.0065	0.0037	0.0028
242	0.0064	0.0037	0.0027
243	0.0063	0.0036	0.0027
244	0.0062	0.0036	0.0027
245	0.0062	0.0035	0.0026
246	0.0061	0.0035	0.0026
247	0.0060	0.0035	0.0026
248	0.0060	0.0034	0.0025
249	0.0059	0.0034	0.0025
250	0.0058	0.0033	0.0025
251	0.0058	0.0033	0.0025
252	0.0057	0.0033	0.0024
253	0.0056	0.0032	0.0024
254	0.0056	0.0032	0.0024
255	0.0055	0.0032	0.0024
256	0.0055	0.0031	0.0023
257	0.0054	0.0031	0.0023
258	0.0054	0.0031	0.0023
259	0.0053	0.0031	0.0023
260	0.0053	0.0030	0.0023
261	0.0052	0.0030	0.0022
262	0.0052	0.0030	0.0022
263	0.0051	0.0029	0.0022
264	0.0051	0.0029	0.0022
265	0.0050	0.0029	0.0022
266	0.0050	0.0029	0.0021
267	0.0050	0.0028	0.0021
268	0.0049	0.0028	0.0021
269	0.0049	0.0028	0.0021
270	0.0048	0.0028	0.0021
271	0.0048	0.0028	0.0020
272	0.0048	0.0027	0.0020
273	0.0047	0.0027	0.0020
274	0.0047	0.0027	0.0020
275	0.0046	0.0027	0.0020
276	0.0046	0.0026	0.0020
277	0.0046	0.0026	0.0020
278	0.0045	0.0026	0.0019
279	0.0045	0.0026	0.0019
280	0.0045	0.0026	0.0019
281	0.0044	0.0026	0.0019
282	0.0044	0.0025	0.0019
283	0.0044	0.0025	0.0019
284	0.0044	0.0025	0.0019
285	0.0043	0.0025	0.0018
286	0.0043	0.0025	0.0018
287	0.0043	0.0024	0.0018
288	0.0042	0.0024	0.0018

Total soil rain loss = 1.61(In)
Total effective rainfall = 1.62(In)
Peak flow rate in flood hydrograph = **1230.54**(CFS)

+++

24 - H O U R   S T O R M
R u n o f f   H y d r o g r a p h

Hydrograph in 5 Minute intervals ((CFS))

Time(h+m)	Volume Ac.Ft	Q(CFS)	0	325.0	650.0	975.0	1300.0
0+ 5	0.0016	0.23	Q	|	|	|	|
0+10	0.0065	0.72	Q	|	|	|	|
0+15	0.0162	1.40	Q	|	|	|	|
0+20	0.0316	2.24	Q	|	|	|	|
0+25	0.0542	3.28	Q	|	|	|	|
0+30	0.0856	4.56	Q	|	|	|	|
0+35	0.1290	6.30	Q	|	|	|	|

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 0+40       0.1874      8.48  Q          |          |          |          |
 0+45       0.2701     12.02  Q          |          |          |          |
 0+50       0.3867     16.92  Q          |          |          |          |
 0+55       0.5210     19.50  Q          |          |          |          |
 1+ 0       0.6673     21.25  Q          |          |          |          |
 1+ 5       0.8236     22.69  Q          |          |          |          |
 1+10       0.9884     23.94  Q          |          |          |          |
 1+15       1.1605     24.99  Q          |          |          |          |
 1+20       1.3390     25.92  Q          |          |          |          |
 1+25       1.5237     26.82  Q          |          |          |          |
 1+30       1.7138     27.60  Q          |          |          |          |
 1+35       1.9090     28.34  Q          |          |          |          |
 1+40       2.1088     29.01  Q          |          |          |          |
 1+45       2.3128     29.62  Q          |          |          |          |
 1+50       2.5209     30.21  Q          |          |          |          |
 1+55       2.7327     30.75  Q          |          |          |          |
 2+ 0       2.9481     31.28  Q          |          |          |          |
 2+ 5       3.1667     31.74  Q          |          |          |          |
 2+10       3.3885     32.20  Q          |          |          |          |
 2+15       3.6131     32.62  VQ         |          |          |          |
 2+20       3.8406     33.03  VQ         |          |          |          |
 2+25       4.0707     33.42  VQ         |          |          |          |
 2+30       4.3033     33.77  VQ         |          |          |          |
 2+35       4.5382     34.11  VQ         |          |          |          |
 2+40       4.7753     34.42  VQ         |          |          |          |
 2+45       5.0144     34.72  VQ         |          |          |          |
 2+50       5.2555     35.00  |Q         |          |          |          |
 2+55       5.4984     35.27  |Q         |          |          |          |
 3+ 0       5.7432     35.54  |Q         |          |          |          |
 3+ 5       5.9896     35.78  |Q         |          |          |          |
 3+10       6.2376     36.01  |Q         |          |          |          |
 3+15       6.4869     36.20  |Q         |          |          |          |
 3+20       6.7375     36.38  |Q         |          |          |          |
 3+25       6.9893     36.56  |Q         |          |          |          |
 3+30       7.2424     36.75  |Q         |          |          |          |
 3+35       7.4967     36.93  |Q         |          |          |          |
 3+40       7.7523     37.11  |Q         |          |          |          |
 3+45       8.0091     37.29  |Q         |          |          |          |
 3+50       8.2672     37.48  |Q         |          |          |          |
 3+55       8.5266     37.66  |Q         |          |          |          |
 4+ 0       8.7872     37.84  |Q         |          |          |          |
 4+ 5       9.0490     38.01  |Q         |          |          |          |
 4+10       9.3120     38.19  |Q         |          |          |          |
 4+15       9.5762     38.36  |Q         |          |          |          |
 4+20       9.8417     38.54  |Q         |          |          |          |
 4+25      10.1084     38.73  |Q         |          |          |          |
 4+30      10.3764     38.92  |Q         |          |          |          |
 4+35      10.6458     39.11  |QV        |          |          |          |
 4+40      10.9164     39.30  |QV        |          |          |          |
 4+45      11.1884     39.49  |QV        |          |          |          |
 4+50      11.4617     39.68  |QV        |          |          |          |
 4+55      11.7363     39.86  |QV        |          |          |          |
 5+ 0      12.0121     40.05  |QV        |          |          |          |
 5+ 5      12.2892     40.24  |QV        |          |          |          |
 5+10      12.5676     40.43  |QV        |          |          |          |
 5+15      12.8473     40.61  |QV        |          |          |          |
 5+20      13.1283     40.80  |QV        |          |          |          |
 5+25      13.4106     40.99  |QV        |          |          |          |
 5+30      13.6942     41.18  |QV        |          |          |          |
 5+35      13.9791     41.37  |QV        |          |          |          |
 5+40      14.2653     41.56  |QV        |          |          |          |
 5+45      14.5529     41.75  |QV        |          |          |          |
 5+50      14.8417     41.94  |QV        |          |          |          |
 5+55      15.1320     42.14  |QV        |          |          |          |
 6+ 0      15.4235     42.34  |QV        |          |          |          |
 6+ 5      15.7165     42.54  |Q V       |          |          |          |
 6+10      16.0109     42.74  |Q V       |          |          |          |
 6+15      16.3066     42.95  |Q V       |          |          |          |
 6+20      16.6039     43.16  |Q V       |          |          |          |
 6+25      16.9025     43.37  |Q V       |          |          |          |
 6+30      17.2027     43.58  |Q V       |          |          |          |
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6+35	17.5043	43.80	Q V			
6+40	17.8074	44.02	Q V			
6+45	18.1121	44.24	Q V			
6+50	18.4183	44.46	Q V			
6+55	18.7261	44.69	Q V			
7+ 0	19.0355	44.92	Q V			
7+ 5	19.3465	45.16	Q V			
7+10	19.6591	45.40	Q V			
7+15	19.9734	45.63	Q V			
7+20	20.2894	45.88	Q V			
7+25	20.6070	46.13	Q V			
7+30	20.9264	46.38	Q V			
7+35	21.2476	46.63	Q V			
7+40	21.5705	46.89	Q V			
7+45	21.8953	47.15	Q V			
7+50	22.2219	47.42	Q V			
7+55	22.5503	47.69	Q V			
8+ 0	22.8806	47.97	Q V			
8+ 5	23.2129	48.24	Q V			
8+10	23.5471	48.53	Q V			
8+15	23.8832	48.81	Q V			
8+20	24.2214	49.10	Q V			
8+25	24.5616	49.40	Q V			
8+30	24.9039	49.70	Q V			
8+35	25.2483	50.00	Q V			
8+40	25.5949	50.32	Q V			
8+45	25.9436	50.63	Q V			
8+50	26.2945	50.95	Q V			
8+55	26.6476	51.28	Q V			
9+ 0	27.0031	51.61	Q V			
9+ 5	27.3608	51.95	Q V			
9+10	27.7210	52.29	Q V			
9+15	28.0835	52.64	Q V			
9+20	28.4485	53.00	Q V			
9+25	28.8160	53.36	Q V			
9+30	29.1860	53.73	Q V			
9+35	29.5586	54.10	Q V			
9+40	29.9339	54.49	Q V			
9+45	30.3118	54.87	Q V			
9+50	30.6924	55.27	Q V			
9+55	31.0758	55.67	Q V			
10+ 0	31.4621	56.09	Q V			
10+ 5	31.8513	56.50	Q V			
10+10	32.2434	56.94	Q V			
10+15	32.6385	57.37	Q V			
10+20	33.0367	57.82	Q V			
10+25	33.4380	58.27	Q V			
10+30	33.8426	58.74	Q V			
10+35	34.2504	59.21	Q V			
10+40	34.6615	59.70	Q V			
10+45	35.0760	60.19	Q V			
10+50	35.4941	60.70	Q V			
10+55	35.9157	61.21	Q V			
11+ 0	36.3409	61.75	Q V			
11+ 5	36.7699	62.29	Q V			
11+10	37.2027	62.84	Q V			
11+15	37.6394	63.41	Q V			
11+20	38.0801	63.99	Q V			
11+25	38.5249	64.58	Q V			
11+30	38.9739	65.20	Q V			
11+35	39.4272	65.82	Q V			
11+40	39.8850	66.47	Q V			
11+45	40.3472	67.12	Q V			
11+50	40.8142	67.80	Q V			
11+55	41.2859	68.49	Q V			
12+ 0	41.7625	69.21	Q V			
12+ 5	42.2440	69.91	Q V			
12+10	42.7304	70.62	Q V			
12+15	43.2216	71.33	Q V			
12+20	43.7178	72.05	Q V			
12+25	44.2189	72.76	Q V			

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12+30      44.7251     73.49  | Q     V |         |         |         |
12+35      45.2360     74.19  | Q     V |         |         |         |
12+40      45.7518     74.88  | Q     V |         |         |         |
12+45      46.2715     75.46  | Q     V |         |         |         |
12+50      46.7945     75.95  | Q     V |         |         |         |
12+55      47.3226     76.68  | Q      V|         |         |         |
13+ 0      47.8567     77.54  | Q      V|         |         |         |
13+ 5      48.3970     78.46  | Q      V|         |         |         |
13+10      48.9441     79.44  | Q      V|         |         |         |
13+15      49.4983     80.47  | Q      V|         |         |         |
13+20      50.0601     81.57  | Q      V|         |         |         |
13+25      50.6297     82.70  | Q      V|         |         |         |
13+30      51.2077     83.92  | Q      V|         |         |         |
13+35      51.7942     85.16  | Q      V|         |         |         |
13+40      52.3899     86.50  | Q       V         |         |         |
13+45      52.9951     87.88  | Q       V         |         |         |
13+50      53.6105     89.34  | Q       V         |         |         |
13+55      54.2362     90.86  | Q       V         |         |         |
14+ 0      54.8732     92.48  | Q       V         |         |         |
14+ 5      55.5224     94.27  | Q       V         |         |         |
14+10      56.1856     96.30  | Q       V         |         |         |
14+15      56.8640     98.49  |  Q      V         |         |         |
14+20      57.5589    100.90  |  Q      |V        |         |         |
14+25      58.2716    103.49  |  Q      |V        |         |         |
14+30      59.0041    106.36  |  Q      |V        |         |         |
14+35      59.7587    109.55  |  Q      |V        |         |         |
14+40      60.5380    113.16  |  Q      |V        |         |         |
14+45      61.3476    117.55  |  Q      |V        |         |         |
14+50      62.1935    122.83  |  Q      |V        |         |         |
14+55      63.0694    127.19  |  Q      | V       |         |         |
15+ 0      63.9749    131.47  |   Q     | V       |         |         |
15+ 5      64.9103    135.83  |   Q     | V       |         |         |
15+10      65.8779    140.49  |   Q     | V       |         |         |
15+15      66.8791    145.37  |   Q     | V       |         |         |
15+20      67.9169    150.70  |   Q     |  V      |         |         |
15+25      68.9926    156.18  |   Q     |  V      |         |         |
15+30      70.1081    161.98  |   Q     |  V      |         |         |
15+35      71.2665    168.19  |    Q    |  V      |         |         |
15+40      72.4731    175.19  |    Q    |  V      |         |         |
15+45      73.7440    184.54  |    Q    |   V     |         |         |
15+50      75.1046    197.56  |     Q   |   V     |         |         |
15+55      76.5948    216.37  |     Q   |   V     |         |         |
16+ 0      78.2829    245.12  |      Q  |    V    |         |         |
16+ 5      80.3918    306.21  |        Q|    V    |         |         |
16+10      82.9616    373.13  |         |Q   V    |         |         |
16+15      85.9526    434.29  |         |  Q  V   |         |         |
16+20      89.3655    495.55  |         |    Q V  |         |         |
16+25      93.3186    574.00  |         |      Q  |         |         |
16+30      97.9924    678.63  |         |       V Q         |         |
16+35     103.5344    804.71  |         |        V|   Q     |         |
16+40     110.0003    938.85  |         |         |V      Q |         |
16+45     117.7969   1132.06  |         |         | V       |   Q     |
16+50     126.2717   1230.54  |         |         |   V     |      Q  |
16+55     132.1418    852.33  |         |         |    VQ   |         |
17+ 0     136.6808    659.07  |         |         Q     V   |         |
17+ 5     140.5981    568.79  |         |      Q  |     V   |         |
17+10     144.1213    511.57  |         |    Q    |      V  |         |
17+15     147.2814    458.84  |         |   Q     |       V |         |
17+20     150.1757    420.25  |         | Q       |       V |         |
17+25     152.9047    396.25  |         | Q       |        V|         |
17+30     155.3943    361.48  |         |Q        |        V|         |
17+35     157.7398    340.57  |         Q         |         V         |
17+40     159.9065    314.61  |        Q|         |         V         |
17+45     161.9268    293.35  |        Q|         |         |V        |
17+50     163.8283    276.10  |       Q |         |         |V        |
17+55     165.6005    257.32  |      Q  |         |         |V        |
18+ 0     167.2861    244.74  |      Q  |         |         | V       |
18+ 5     168.8507    227.19  |     Q   |         |         | V       |
18+10     170.3376    215.89  |     Q   |         |         | V       |
18+15     171.7403    203.67  |     Q   |         |         | V       |
18+20     173.0660    192.49  |    Q    |         |         |  V      |
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18+25     174.3254    182.86  |    Q    |         |         |  V      |
18+30     175.5011    170.72  |    Q    |         |         |  V      |
18+35     176.6222    162.78  |    Q    |         |         |  V      |
18+40     177.6663    151.60  |   Q     |         |         |   V     |
18+45     178.6605    144.36  |   Q     |         |         |   V     |
18+50     179.6086    137.66  |   Q     |         |         |   V     |
18+55     180.5078    130.56  |   Q     |         |         |   V     |
19+ 0     181.3612    123.93  |  Q      |         |         |   V     |
19+ 5     182.1519    114.80  |  Q      |         |         |   V     |
19+10     182.9004    108.69  |  Q      |         |         |    V    |
19+15     183.5849     99.39  |  Q      |         |         |    V    |
19+20     184.2322     93.99  | Q       |         |         |    V    |
19+25     184.8614     91.35  | Q       |         |         |    V    |
19+30     185.4748     89.07  | Q       |         |         |    V    |
19+35     186.0719     86.70  | Q       |         |         |    V    |
19+40     186.6503     83.99  | Q       |         |         |    V    |
19+45     187.2147     81.94  | Q       |         |         |    V    |
19+50     187.7662     80.07  | Q       |         |         |     V   |
19+55     188.3041     78.10  | Q       |         |         |     V   |
20+ 0     188.8242     75.52  | Q       |         |         |     V   |
20+ 5     189.3252     72.75  | Q       |         |         |     V   |
20+10     189.8166     71.35  | Q       |         |         |     V   |
20+15     190.3007     70.28  | Q       |         |         |     V   |
20+20     190.7786     69.39  | Q       |         |         |     V   |
20+25     191.2540     69.03  | Q       |         |         |     V   |
20+30     191.7246     68.33  | Q       |         |         |     V   |
20+35     192.1872     67.17  | Q       |         |         |     V   |
20+40     192.6404     65.81  | Q       |         |         |     V   |
20+45     193.0821     64.13  |Q        |         |         |      V  |
20+50     193.5053     61.44  |Q        |         |         |      V  |
20+55     193.9178     59.90  |Q        |         |         |      V  |
21+ 0     194.3230     58.84  |Q        |         |         |      V  |
21+ 5     194.7208     57.76  |Q        |         |         |      V  |
21+10     195.1094     56.43  |Q        |         |         |      V  |
21+15     195.4867     54.78  |Q        |         |         |      V  |
21+20     195.8572     53.79  |Q        |         |         |      V  |
21+25     196.2214     52.88  |Q        |         |         |      V  |
21+30     196.5789     51.91  |Q        |         |         |      V  |
21+35     196.9270     50.54  |Q        |         |         |      V  |
21+40     197.2661     49.25  |Q        |         |         |      V  |
21+45     197.6003     48.53  |Q        |         |         |      V  |
21+50     197.9303     47.91  |Q        |         |         |      V  |
21+55     198.2561     47.31  |Q        |         |         |       V |
22+ 0     198.5781     46.74  |Q        |         |         |       V |
22+ 5     198.8962     46.19  |Q        |         |         |       V |
22+10     199.2107     45.67  |Q        |         |         |       V |
22+15     199.5217     45.16  |Q        |         |         |       V |
22+20     199.8293     44.67  |Q        |         |         |       V |
22+25     200.1337     44.19  |Q        |         |         |       V |
22+30     200.4349     43.73  |Q        |         |         |       V |
22+35     200.7330     43.29  |Q        |         |         |       V |
22+40     201.0282     42.86  |Q        |         |         |       V |
22+45     201.3205     42.44  |Q        |         |         |       V |
22+50     201.6100     42.03  |Q        |         |         |       V |
22+55     201.8968     41.64  |Q        |         |         |       V |
23+ 0     202.1809     41.25  |Q        |         |         |       V |
23+ 5     202.4624     40.87  |Q        |         |         |       V |
23+10     202.7414     40.51  |Q        |         |         |       V |
23+15     203.0179     40.15  |Q        |         |         |       V |
23+20     203.2919     39.80  |Q        |         |         |       V |
23+25     203.5637     39.46  |Q        |         |         |        V|
23+30     203.8331     39.12  |Q        |         |         |        V|
23+35     204.1003     38.79  |Q        |         |         |        V|
23+40     204.3653     38.47  |Q        |         |         |        V|
23+45     204.6281     38.16  |Q        |         |         |        V|
23+50     204.8888     37.86  |Q        |         |         |        V|
23+55     205.1474     37.56  |Q        |         |         |        V|
24+ 0     205.4041     37.26  |Q        |         |         |        V|
24+ 5     205.6572     36.75  |Q        |         |         |        V|
24+10     205.9049     35.98  |Q        |         |         |        V|
24+15     206.1462     35.03  |Q        |         |         |        V|
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    24+20      206.3799      33.93  |Q         |         |         |        V|
    24+25      206.6048      32.66  |Q         |         |         |        V|
    24+30      206.8193      31.14  Q          |         |         |        V|
    24+35      207.0204      29.20  Q          |         |         |        V|
    24+40      207.2051      26.83  Q          |         |         |        V|
    24+45      207.3645      23.14  Q          |         |         |        V|
    24+50      207.4892      18.11  Q          |         |         |        V|
    24+55      207.5957      15.46  Q          |         |         |        V|
    25+ 0      207.6897      13.66  Q          |         |         |        V|
    25+ 5      207.7737      12.20  Q          |         |         |        V|
    25+10      207.8491      10.94  Q          |         |         |        V|
    25+15      207.9171       9.89  Q          |         |         |        V|
    25+20      207.9789       8.97  Q          |         |         |        V|
    25+25      208.0346       8.09  Q          |         |         |        V|
    25+30      208.0852       7.35  Q          |         |         |        V|
    25+35      208.1309       6.64  Q          |         |         |        V|
    25+40      208.1724       6.02  Q          |         |         |        V|
    25+45      208.2101       5.47  Q          |         |         |        V|
    25+50      208.2441       4.94  Q          |         |         |        V|
    25+55      208.2749       4.47  Q          |         |         |        V|
    26+ 0      208.3025       4.02  Q          |         |         |        V|
    26+ 5      208.3276       3.63  Q          |         |         |        V|
    26+10      208.3501       3.26  Q          |         |         |        V|
    26+15      208.3702       2.93  Q          |         |         |        V|
    26+20      208.3883       2.62  Q          |         |         |        V|
    26+25      208.4044       2.33  Q          |         |         |        V|
    26+30      208.4188       2.09  Q          |         |         |        V|
    26+35      208.4315       1.85  Q          |         |         |        V|
    26+40      208.4428       1.65  Q          |         |         |        V|
    26+45      208.4529       1.47  Q          |         |         |        V|
    26+50      208.4619       1.30  Q          |         |         |        V|
    26+55      208.4698       1.15  Q          |         |         |        V|
    27+ 0      208.4767       1.00  Q          |         |         |        V|
    27+ 5      208.4829       0.89  Q          |         |         |        V|
    27+10      208.4883       0.79  Q          |         |         |        V|
    27+15      208.4933       0.73  Q          |         |         |        V|
    27+20      208.4980       0.68  Q          |         |         |        V|
    27+25      208.5023       0.63  Q          |         |         |        V|
    27+30      208.5064       0.58  Q          |         |         |        V|
    27+35      208.5101       0.54  Q          |         |         |        V|
    27+40      208.5135       0.50  Q          |         |         |        V|
    27+45      208.5166       0.46  Q          |         |         |        V|
    27+50      208.5195       0.42  Q          |         |         |        V|
    27+55      208.5221       0.38  Q          |         |         |        V|
    28+ 0      208.5245       0.35  Q          |         |         |        V|
    28+ 5      208.5268       0.32  Q          |         |         |        V|
    28+10      208.5288       0.30  Q          |         |         |        V|
    28+15      208.5307       0.28  Q          |         |         |        V|
    28+20      208.5325       0.25  Q          |         |         |        V|
    28+25      208.5340       0.23  Q          |         |         |        V|
    28+30      208.5354       0.20  Q          |         |         |        V|
    28+35      208.5365       0.17  Q          |         |         |        V|
    28+40      208.5375       0.14  Q          |         |         |        V|
    28+45      208.5382       0.11  Q          |         |         |        V|
    28+50      208.5388       0.09  Q          |         |         |        V|
    28+55      208.5393       0.08  Q          |         |         |        V|
    29+ 0      208.5398       0.06  Q          |         |         |        V|
    29+ 5      208.5401       0.05  Q          |         |         |        V|
    29+10      208.5403       0.03  Q          |         |         |        V|
    29+15      208.5405       0.03  Q          |         |         |        V|
    29+20      208.5406       0.02  Q          |         |         |        V|
    29+25      208.5407       0.01  Q          |         |         |        V|
    29+30      208.5407       0.00  Q          |         |         |         V
-----------------------------------------------------------------------
```

Appendix D
On-Site Rational Method Calculations
Pre-Development Condition

Area A

URS

ALAMO ONSITE HYDROLOGY, AREA A, PRE-DEVELOPMENT

Flow Path		Flow Path Elevations			Subarea		Land Use[1]				Soil Type			
From Node	To Node	From Node	To Node	ΔH, ft	Name	Area, Ac	Desc.	CN	Flow Path Length, ft	Comments	A	B	C	D
1	2	2513.0	2504.0	9.0	A-1	9.2	Undev	64.9	904.0	A-1 6.7% IMP Post Condition	0.91	0.09	-	-
2	3	2504.0	2502.0	2.0	A-2	18.5	Undev	64.7	445.0	A-2 3.1% IMP Post Condition	0.99	0.01	-	-
3	4	2502.0	2498.0	4.0	A-3	20.0	Undev	65.8	711.0	A-3 4.3% IMP Post Condition	0.95	0.05	-	-
4	5	2498.0	2492.0	6.0	A-3	21.4	Undev	70.1	640.0	A-3 7.8% IMP Post Condition	0.64	0.36	-	-
				21.0					2700.0					

*NOTE: Impervious Percentage for Post Condition includes 1% for Solar Foundations.

Enter 100-Year area-averaged point rainfall (inches):

	Area A	Area B
5-Minute	0.337	0.334
30-Minute	0.787	0.780
1-Hour	**0.989**	**0.984**
3-Hour	1.420	1.410
6-Hour	1.790	1.780
24-Hour	2.920	2.910

PRE-DEVELOPMENT CURVE NUMBER AREA-AVERAGING

ALAMO AVERAGE CURVE NUMBER

SAN BERNARDINO COUNTY

Area Name	Cover Type	SOIL GROUP	(1) CURVE NUMBER	(2) Area (acres)	(3) Weighting (1)*(2)	PERCENTAGE BREAKDOWN
A-1	Row Crops (Good) (MUSTARD)	A	67	2.8	187.6	30.6%
A-1	Open Brush (Poor) (RUSSIAN THISTLE)	A	62	5.6	347.2	61.1%
A-1	Row Crops (Good) (MUSTARD)	B	78	0.8	59.3	#VALUE!
			TOTAL MAP AREA=	**9.2**		
				TOTAL WEIGHTING=	**594.1**	
			TOTAL AVERAGED VALUE=	**64.9**		
A-2	Row Crops (Good) (MUSTARD)	A	67	9.7	649.9	52.4%
A-2	Open Brush (Poor) (RUSSIAN THISTLE)	A	62	8.7	539.4	47.0%
A-2	Open Brush (Poor) (RUSSIAN THISTLE)	B	76	0.1	7.6	0.5%
			TOTAL MAP AREA=	**18.5**		
				TOTAL WEIGHTING=	**1196.9**	
			TOTAL AVERAGED VALUE=	**64.7**		
A-3	Row Crops (Good) (MUSTARD)	A	67	12.5	837.5	62.5%
A-3	Open Brush (Poor) (RUSSIAN THISTLE)	A	62	6.6	409.2	33.0%
A-3	Open Brush (Poor) (RUSSIAN THISTLE)	B	76	0.9	68.4	4.5%
			TOTAL MAP AREA=	**20.0**		
				TOTAL WEIGHTING=	**1315.1**	
			TOTAL AVERAGED VALUE=	**65.8**		
A-4	Row Crops (Good) (MUSTARD)	A	67	11.8	790.6	54.9%
A-4	Open Brush (Poor) (RUSSIAN THISTLE)	A	62	2.0	124.0	9.3%
A-4	Row Crops (Good) (MUSTARD)	B	78	3.7	288.6	17.2%
A-4	Open Brush (Poor) (RUSSIAN THISTLE)	B	76	4.0	304.0	18.6%
			TOTAL MAP AREA=	**21.5**		
				TOTAL WEIGHTING=	**1507.2**	
			TOTAL AVERAGED VALUE=	**70.1**		

```
                San Bernardino County Rational Hydrology Program

                    (Hydrology Manual Date - August 1986)

 CIVILCADD/CIVILDESIGN  Engineering Software, (c) 1989-2005 Version 7.1
       Rational Hydrology Study        Date: 12/07/11
------------------------------------------------------------------------
WDG SOLAR - ALAMO
PRE-DEVELOPMENT CONDITION - ONSITE AREA
100-YEAR RATIONAL METHOD, AREA A
BY: NRK
------------------------------------------------------------------------


Program License Serial Number 6264

------------------------------------------------------------------------
 *********   Hydrology Study Control Information **********

------------------------------------------------------------------------
Rational hydrology study storm event year is   100.0
Computed rainfall intensity:
Storm year =   100.00   1 hour rainfall =     0.989 (In.)
Slope used for rainfall intensity curve b =  0.6000
Soil antecedent moisture condition (AMC) = 1


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       1.000 to Point/Station       2.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
Soil classification AP and SCS  values input by user
USER INPUT of soil data for subarea
SCS curve number for soil(AMC 2)  = 64.90
Adjusted SCS curve number for AMC 1 = 44.90
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.868(In/Hr)
Initial subarea data:
Initial area flow distance =   904.000(Ft.)
Top (of initial area) elevation =  2513.000(Ft.)
Bottom (of initial area) elevation =  2504.000(Ft.)
Difference in elevation =     9.000(Ft.)
Slope =    0.00996  s(%)=      1.00
TC = k(0.815)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =   31.193 min.
Rainfall intensity =      1.464(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.367
Subarea runoff =      4.942(CFS)
Total initial stream area =        9.200(Ac.)
Pervious area fraction = 1.000
Initial area Fm value =    0.868(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       2.000 to Point/Station       3.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
______________________________________________________________________
Estimated mean flow rate at midpoint of channel =      0.000(CFS)
Depth of flow =   0.101(Ft.), Average velocity =   0.610(Ft/s)
       ******* Irregular Channel Data ***********
-----------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
       1             0.00             2.00
       2            34.00             0.00
       3           139.00             0.00
       4           203.00             2.00
Manning's 'N' friction factor =   0.035
-----------------------------------------------------------------
Sub-Channel flow  =      6.652(CFS)
  '     '       flow top width =    109.972(Ft.)
```

```
  '     '    velocity=    0.610(Ft/s)
  '     '       area =     10.907(Sq.Ft)
  '     '       Froude number =     0.341

Upstream point elevation =  2504.000(Ft.)
Downstream point elevation =  2502.000(Ft.)
Flow length =   445.000(Ft.)
Travel time  =   12.16 min.
Time of concentration =   43.35 min.
Depth of flow =   0.101(Ft.)
Average velocity =   0.610(Ft/s)
Total irregular channel flow =     6.652(CFS)
Irregular channel normal depth above invert elev. =   0.101(Ft.)
Average velocity of channel(s) =   0.610(Ft/s)
 Adding area flow to channel
Soil classification AP and SCS  values input by user
USER INPUT of soil data for subarea
SCS curve number for soil(AMC 2)  = 64.70
Adjusted SCS curve number for AMC 1 = 44.70
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.870(In/Hr)
Rainfall intensity =      1.202(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.249
Subarea runoff =      3.358(CFS) for   18.500(Ac.)
Total runoff =      8.300(CFS)
Effective area this stream =       27.70(Ac.)
Total Study Area (Main Stream No. 1) =       27.70(Ac.)
Area averaged Fm value =    0.869(In/Hr)
Depth of flow =   0.116(Ft.), Average velocity =   0.665(Ft/s)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        3.000 to Point/Station        4.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
______________________________________________________________________
Estimated mean flow rate at midpoint of channel =      0.000(CFS)
Depth of flow =   0.292(Ft.), Average velocity =   0.927(Ft/s)
       ******* Irregular Channel Data ***********
-----------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
       1              0.00             2.00
       2            148.00             0.00
       3            183.00             0.25
       4            239.00             3.50
Manning's 'N' friction factor =   0.035
-----------------------------------------------------------------
Sub-Channel flow  =      8.347(CFS)
  '     '       flow top width =     57.313(Ft.)
  '     '    velocity=    0.927(Ft/s)
  '     '       area =      9.003(Sq.Ft)
  '     '       Froude number =     0.412

Upstream point elevation =  2502.000(Ft.)
Downstream point elevation =  2498.000(Ft.)
Flow length =   711.000(Ft.)
Travel time  =   12.78 min.
Time of concentration =   56.14 min.
Depth of flow =   0.292(Ft.)
Average velocity =   0.927(Ft/s)
Total irregular channel flow =     8.347(CFS)
Irregular channel normal depth above invert elev. =   0.292(Ft.)
Average velocity of channel(s) =   0.927(Ft/s)
 Adding area flow to channel
Soil classification AP and SCS  values input by user
USER INPUT of soil data for subarea
SCS curve number for soil(AMC 2)  = 65.80
Adjusted SCS curve number for AMC 1 = 45.96
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.856(In/Hr)
The area added to the existing stream causes a
a lower flow rate of Q =      7.116(CFS)
```

```
therefore the upstream flow rate of Q =      8.300(CFS) is being used
Rainfall intensity =      1.029(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.145
Subarea runoff =      0.000(CFS) for   20.000(Ac.)
Total runoff =      8.300(CFS)
Effective area this stream =       47.70(Ac.)
Total Study Area (Main Stream No. 1) =       47.70(Ac.)
Area averaged Fm value =    0.864(In/Hr)
Depth of flow =   0.291(Ft.), Average velocity =   0.925(Ft/s)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        4.000 to Point/Station       5.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
______________________________________________________________________
Estimated mean flow rate at midpoint of channel =      0.000(CFS)
Depth of flow =   0.096(Ft.), Average velocity =   0.854(Ft/s)
       ******* Irregular Channel Data ***********
-----------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
       1             0.00             2.00
       2            30.00             0.00
       3           130.00             0.00
       4           160.00             2.00
Manning's 'N' friction factor =   0.035
-----------------------------------------------------------------
Sub-Channel flow  =      8.329(CFS)
  '     '       flow top width =    102.883(Ft.)
  '     '    velocity=    0.854(Ft/s)
  '     '       area =      9.749(Sq.Ft)
  '     '       Froude number =     0.489

Upstream point elevation =  2498.000(Ft.)
Downstream point elevation =  2492.000(Ft.)
Flow length =   640.000(Ft.)
Travel time  =   12.48 min.
Time of concentration =   68.62 min.
Depth of flow =   0.096(Ft.)
Average velocity =   0.854(Ft/s)
Total irregular channel flow =     8.329(CFS)
Irregular channel normal depth above invert elev. =   0.096(Ft.)
Average velocity of channel(s) =   0.854(Ft/s)
 Adding area flow to channel
Soil classification AP and SCS  values input by user
USER INPUT of soil data for subarea
SCS curve number for soil(AMC 2)  = 70.10
Adjusted SCS curve number for AMC 1 = 51.12
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.796(In/Hr)
The area added to the existing stream causes a
a lower flow rate of Q =      4.344(CFS)
therefore the upstream flow rate of Q =      8.300(CFS) is being used
Rainfall intensity =      0.912(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.069
Subarea runoff =      0.000(CFS) for   21.400(Ac.)
Total runoff =      8.300(CFS)
Effective area this stream =       69.10(Ac.)
Total Study Area (Main Stream No. 1) =       69.10(Ac.)
Area averaged Fm value =    0.843(In/Hr)
Depth of flow =   0.096(Ft.), Average velocity =   0.853(Ft/s)
End of computations, Total Study Area =          69.10 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.
Note: These figures do not consider reduced effective area
effects caused by confluences in the rational equation.

Area averaged pervious area fraction(Ap) = 1.000
Area averaged SCS curve number =  66.7
```

Area B

URS

ALAMO ONSITE HYDROLOGY, AREA B, PRE-DEVELOPMENT

Flow Path		Flow Path Elevations			Subarea		Land Use[1]				Soil Type			
From Node	To Node	From Node	To Node	ΔH, ft	Name	Area, Ac	Desc.	CN	Flow Path Length, ft	Comments	A	B	C	D
6	7	2516.0	2504.0	12.0	B-1	9.5	Undev	72.9	965.0	B-1 4.6% IMP Post Condtion	0.22	0.78	-	-
7	8	2504.0	2496.0	8.0	B-2	12.9	Undev	69.5	859.0	B-2 2.9% IMP Post Condtion	0.46	0.54	-	-
8	9	2496.0	2494.5	1.5	B-3	15.5	Undev	69.0	1089.0	B-3 3.6% IMP Post Condition	0.50	0.50	-	-

*NOTE: Impervious Percentage for Post Condition includes 1% for Solar Foundations.

Enter 100-Year area-averaged point rainfall (inches):

	Area A	Area B
5-Minute	0.337	0.334
30-Minute	0.787	0.780
1-Hour	**0.989**	**0.984**
3-Hour	1.420	1.410
6-Hour	1.790	1.780
24-Hour	2.920	2.910

PRE-DEVELOPMENT CURVE NUMBER AREA-AVERAGING
ALAMO AVERAGE CURVE NUMBER
SAN BERNARDINO COUNTY

Area Name	Cover Type	SOIL GROUP	(1) CURVE NUMBER	(2) Area (acres)	(3) Weighting (1)*(2)	PERCENTAGE BREAKDOWN
B-1	Open Brush (Poor) (RUSSIAN THISTLE)	A	62	2.1	130.2	22.1%
B-1	Open Brush (Poor) (RUSSIAN THISTLE)	B	76	7.4	562.4	77.9%
			TOTAL MAP AREA=	**9.5**		
				TOTAL WEIGHTING=	**692.6**	
			TOTAL AVERAGED VALUE=	**72.9**		
B-2	Open Brush (Poor) (RUSSIAN THISTLE)	A	62	6.0	372.0	46.5%
B-2	Open Brush (Poor) (RUSSIAN THISTLE)	B	76	6.9	524.4	53.5%
			TOTAL MAP AREA=	**12.9**		
				TOTAL WEIGHTING=	**896.4**	
			TOTAL AVERAGED VALUE=	**69.5**		
B-3	Open Brush (Poor) (RUSSIAN THISTLE)	A	62	7.7	477.4	49.7%
B-3	Open Brush (Poor) (RUSSIAN THISTLE)	B	76	7.8	592.8	50.3%
			TOTAL MAP AREA=	**15.5**		
				TOTAL WEIGHTING=	**1070.2**	
			TOTAL AVERAGED VALUE=	**69.0**		

```
                San Bernardino County Rational Hydrology Program

                    (Hydrology Manual Date - August 1986)

 CIVILCADD/CIVILDESIGN  Engineering Software, (c) 1989-2005 Version 7.1
       Rational Hydrology Study        Date: 12/07/11
------------------------------------------------------------------------
WDG SOLAR - ALAMO
PRE-DEVELOPMENT CONDITION - ONSITE AREA
100-YEAR RATIONAL METHOD, AREA B
BY: NRK
------------------------------------------------------------------------


Program License Serial Number 6264

------------------------------------------------------------------------
 *********   Hydrology Study Control Information **********

------------------------------------------------------------------------
Rational hydrology study storm event year is   100.0
Computed rainfall intensity:
Storm year =   100.00   1 hour rainfall =     0.989 (In.)
Slope used for rainfall intensity curve b =  0.6000
Soil antecedent moisture condition (AMC) = 1


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        6.000 to Point/Station       7.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
Soil classification AP and SCS  values input by user
USER INPUT of soil data for subarea
SCS curve number for soil(AMC 2)  = 72.90
Adjusted SCS curve number for AMC 1 = 54.48
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.754(In/Hr)
Initial subarea data:
Initial area flow distance =   651.000(Ft.)
Top (of initial area) elevation =  2497.500(Ft.)
Bottom (of initial area) elevation =  2496.000(Ft.)
Difference in elevation =     1.500(Ft.)
Slope =    0.00230  s(%)=       0.23
TC = k(0.686)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =   30.863 min.
Rainfall intensity =      1.474(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.440
Subarea runoff =      6.156(CFS)
Total initial stream area =        9.500(Ac.)
Pervious area fraction = 1.000
Initial area Fm value =    0.754(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        2.000 to Point/Station       3.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
______________________________________________________________________
Estimated mean flow rate at midpoint of channel =      0.000(CFS)
Depth of flow =   0.333(Ft.), Average velocity =   0.902(Ft/s)
       ******* Irregular Channel Data ***********
-----------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
       1             0.00              2.00
       2            10.00              0.00
       3            35.00              0.00
       4            45.00              2.00
Manning's 'N' friction factor =   0.035
-----------------------------------------------------------------
Sub-Channel flow  =      8.010(CFS)
  '     '       flow top width =     28.332(Ft.)
```

```
  '     '    velocity=    0.902(Ft/s)
  '     '       area =      8.884(Sq.Ft)
  '     '       Froude number =     0.284

Upstream point elevation =  2496.000(Ft.)
Downstream point elevation =  2495.000(Ft.)
Flow length =   471.000(Ft.)
Travel time  =    8.71 min.
Time of concentration =   39.57 min.
Depth of flow =   0.333(Ft.)
Average velocity =   0.902(Ft/s)
Total irregular channel flow =     8.010(CFS)
Irregular channel normal depth above invert elev. =   0.333(Ft.)
Average velocity of channel(s) =   0.902(Ft/s)
 Adding area flow to channel
Soil classification AP and SCS  values input by user
USER INPUT of soil data for subarea
SCS curve number for soil(AMC 2)  = 69.50
Adjusted SCS curve number for AMC 1 = 50.40
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.805(In/Hr)
Rainfall intensity =      1.270(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.345
Subarea runoff =      3.652(CFS) for   12.900(Ac.)
Total runoff =      9.808(CFS)
Effective area this stream =       22.40(Ac.)
Total Study Area (Main Stream No. 1) =       22.40(Ac.)
Area averaged Fm value =    0.783(In/Hr)
Depth of flow =   0.376(Ft.), Average velocity =   0.972(Ft/s)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        3.000 to Point/Station        4.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
______________________________________________________________________
Estimated mean flow rate at midpoint of channel =      0.000(CFS)
Depth of flow =   0.397(Ft.), Average velocity =   1.014(Ft/s)
       ******* Irregular Channel Data ***********
-----------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
       1              0.00             2.00
       2             10.00             0.00
       3             35.00             0.00
       4             45.00             2.00
Manning's 'N' friction factor =   0.035
-----------------------------------------------------------------
Sub-Channel flow  =     10.877(CFS)
  '     '       flow top width =     28.974(Ft.)
  '     '    velocity=    1.014(Ft/s)
  '     '       area =     10.724(Sq.Ft)
  '     '       Froude number =     0.294

Upstream point elevation =  2495.000(Ft.)
Downstream point elevation =  2494.000(Ft.)
Flow length =   464.000(Ft.)
Travel time  =    7.62 min.
Time of concentration =   47.19 min.
Depth of flow =   0.397(Ft.)
Average velocity =   1.014(Ft/s)
Total irregular channel flow =    10.877(CFS)
Irregular channel normal depth above invert elev. =   0.397(Ft.)
Average velocity of channel(s) =   1.014(Ft/s)
 Adding area flow to channel
Soil classification AP and SCS  values input by user
USER INPUT of soil data for subarea
SCS curve number for soil(AMC 2)  = 69.00
Adjusted SCS curve number for AMC 1 = 49.80
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.812(In/Hr)
Rainfall intensity =      1.142(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
```

```
rational method)(Q=KCIA) is C = 0.274
Subarea runoff =      2.040(CFS) for   15.500(Ac.)
Total runoff =     11.848(CFS)
Effective area this stream =       37.90(Ac.)
Total Study Area (Main Stream No. 1) =       37.90(Ac.)
Area averaged Fm value =    0.795(In/Hr)
Depth of flow =   0.418(Ft.), Average velocity =   1.047(Ft/s)
End of computations, Total Study Area =           37.90 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.
Note: These figures do not consider reduced effective area
effects caused by confluences in the rational equation.

Area averaged pervious area fraction(Ap) = 1.000
Area averaged SCS curve number =  70.1
```

Appendix E
On-Site Rational Method Calculations
Post-Development Condition

Area A

ALAMO ONSITE HYDROLOGY, AREA A, POST-DEVELOPMENT

Flow Path		Flow Path Elevations			Subarea		Land Use[1]				Soil Type			
From Node	To Node	From Node	To Node	ΔH, ft	Name	Area, Ac	Desc.	CN	Flow Path Length, ft	Comments	A	B	C	D
1	2	2513.0	2504.0	9.0	A-1	9.2	Undev	81.4	904.0	A-1 6.7% IMP Post Condition	0.91	0.09	-	-
2	3	2504.0	2502.0	2.0	A-2	18.5	Undev	77.0	445.0	A-2 3.1% IMP Post Condition	0.99	0.01	-	-
3	4	2502.0	2498.0	4.0	A-3	20.0	Undev	77.4	711.0	A-3 4.3% IMP Post Condition	0.95	0.05	-	-
4	5	2498.0	2492.0	6.0	A-3	21.4	Undev	80.2	640.0	A-3 7.8% IMP Post Condition	0.64	0.36	-	-

*NOTE: Impervious Percentage for Post Condition includes 1% for Solar Foundations.

Enter 100-Year area-averaged point rainfall (inches):

	Area A	Area B
5-Minute	0.337	0.334
30-Minute	0.787	0.780
1-Hour	**0.989**	**0.984**
3-Hour	1.420	1.410
6-Hour	1.790	1.780
24-Hour	2.920	2.910

POST-DEVELOPMENT CURVE NUMBER AREA-AVERAGING
ALAMO AVERAGE CURVE NUMBER
SAN BERNARDINO COUNTY

Area Name	Cover Type	SOIL GROUP	(1) CURVE NUMBER	(2) Area (acres)	(3) Weighting (1)*(2)	PERCENTAGE BREAKDOWN
A-1	Fallow	A	77	8.4	646.8	51.2%
A-1	Fallow	B	86	8.0	688.0	48.8%
			TOTAL MAP AREA=	**16.4**		
				TOTAL WEIGHTING=	**1334.8**	
			TOTAL AVERAGED VALUE=	**81.4**		
A-2	Fallow	A	77	18.4	1416.8	99.5%
A-2	Fallow	B	86	0.1	8.6	0.5%
			TOTAL MAP AREA=	**18.5**		
				TOTAL WEIGHTING=	**1425.4**	
			TOTAL AVERAGED VALUE=	**77.0**		
A-3	Fallow	A	77	19.1	1470.7	95.5%
A-3	Fallow	B	86	0.9	77.4	4.5%
			TOTAL MAP AREA=	**20.0**		
				TOTAL WEIGHTING=	**1548.1**	
			TOTAL AVERAGED VALUE=	**77.4**		
A-4	Fallow	A	77	13.7	1054.9	64.0%
A-4	Fallow	B	86	7.7	662.2	36.0%
			TOTAL MAP AREA=	**21.4**		
				TOTAL WEIGHTING=	**1717.1**	
			TOTAL AVERAGED VALUE=	**80.2**		

IMPERVIOUS AREA ESTIMATE

ALAMO AREA A - POST-PROJECT CONDITION

SAN BERNARDINO COUNTY

	ESTIMATE DESCRIPTION	ESTIMATED AREA	
AREA A-1	Piles	4008	ft^2
	Compacted Dirt Road	22942.5	ft^2
	TOTAL IMPERVIOUS AREA=	**0.62**	ACRES
AREA A-2	Piles	7884	ft^2
	Compacted Dirt Road	16587.0	ft^2
	TOTAL IMPERVIOUS AREA=	**0.56**	ACRES
AREA A-3	Piles	8581	ft^2
	Compacted Dirt Road	27907.8	ft^2
	TOTAL IMPERVIOUS AREA=	**0.84**	ACRES
AREA A-4	Piles	9235	ft^2
	Switchgear	40000	
	Compacted Dirt Road	23228.5	ft^2
	TOTAL IMPERVIOUS AREA=	**1.66**	ACRES

```
                San Bernardino County Rational Hydrology Program

                    (Hydrology Manual Date - August 1986)

 CIVILCADD/CIVILDESIGN  Engineering Software, (c) 1989-2005 Version 7.1
       Rational Hydrology Study        Date: 12/07/11
------------------------------------------------------------------------
WDG SOLAR - ALAMO
POST-DEVELOPMENT CONDITION - ONSITE AREA
100-YEAR RATIONAL METHOD, AREA A
BY: NRK
------------------------------------------------------------------------


Program License Serial Number 6264

------------------------------------------------------------------------
 *********   Hydrology Study Control Information **********

------------------------------------------------------------------------
Rational hydrology study storm event year is   100.0
Computed rainfall intensity:
Storm year =   100.00   1 hour rainfall =     0.989 (In.)
Slope used for rainfall intensity curve b =  0.6000
Soil antecedent moisture condition (AMC) = 1


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       1.000 to Point/Station       2.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
Soil classification AP and SCS  values input by user
USER INPUT of soil data for subarea
SCS curve number for soil(AMC 2)  = 81.40
Adjusted SCS curve number for AMC 1 = 64.96
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.609(In/Hr)
Initial subarea data:
Initial area flow distance =   904.000(Ft.)
Top (of initial area) elevation =  2513.000(Ft.)
Bottom (of initial area) elevation =  2504.000(Ft.)
Difference in elevation =     9.000(Ft.)
Slope =    0.00996  s(%)=      1.00
TC = k(0.572)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =   21.877 min.
Rainfall intensity =      1.812(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.598
Subarea runoff =      9.961(CFS)
Total initial stream area =       9.200(Ac.)
Pervious area fraction = 1.000
Initial area Fm value =    0.609(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       2.000 to Point/Station       3.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
______________________________________________________________________
Estimated mean flow rate at midpoint of channel =      0.000(CFS)
Depth of flow =   0.168(Ft.), Average velocity =   0.847(Ft/s)
       ******* Irregular Channel Data ***********
-----------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
       1             0.00             2.00
       2            34.00             0.00
       3           139.00             0.00
       4           203.00             2.00
Manning's 'N' friction factor =   0.035
-----------------------------------------------------------------
Sub-Channel flow  =     15.556(CFS)
  '     '       flow top width =    113.250(Ft.)
```

```
  '     '    velocity=    0.847(Ft/s)
  '     '       area =     18.374(Sq.Ft)
  '     '       Froude number =     0.370

Upstream point elevation =  2504.000(Ft.)
Downstream point elevation =  2502.000(Ft.)
Flow length =   445.000(Ft.)
Travel time  =    8.76 min.
Time of concentration =   30.64 min.
Depth of flow =   0.168(Ft.)
Average velocity =   0.847(Ft/s)
Total irregular channel flow =    15.556(CFS)
Irregular channel normal depth above invert elev. =   0.168(Ft.)
Average velocity of channel(s) =   0.847(Ft/s)
 Adding area flow to channel
Soil classification AP and SCS  values input by user
USER INPUT of soil data for subarea
SCS curve number for soil(AMC 2)  = 77.00
Adjusted SCS curve number for AMC 1 = 59.40
Pervious ratio(Ap) = 0.9400     Max loss rate(Fm)=     0.647(In/Hr)
Rainfall intensity =      1.480(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.514
Subarea runoff =     11.133(CFS) for   18.500(Ac.)
Total runoff =     21.094(CFS)
Effective area this stream =       27.70(Ac.)
Total Study Area (Main Stream No. 1) =       27.70(Ac.)
Area averaged Fm value =    0.634(In/Hr)
Depth of flow =   0.202(Ft.), Average velocity =   0.951(Ft/s)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        3.000 to Point/Station        4.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
______________________________________________________________________
Estimated mean flow rate at midpoint of channel =      0.000(CFS)
Depth of flow =   0.440(Ft.), Average velocity =   1.301(Ft/s)
       ******* Irregular Channel Data ***********
-----------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
       1             0.00             2.00
       2           148.00             0.00
       3           183.00             0.25
       4           239.00             3.50
Manning's 'N' friction factor =   0.035
-----------------------------------------------------------------
Sub-Channel flow  =     24.044(CFS)
  '     '       flow top width =     70.817(Ft.)
  '     '    velocity=    1.301(Ft/s)
  '     '       area =     18.486(Sq.Ft)
  '     '       Froude number =     0.449

Upstream point elevation =  2502.000(Ft.)
Downstream point elevation =  2498.000(Ft.)
Flow length =   711.000(Ft.)
Travel time  =    9.11 min.
Time of concentration =   39.75 min.
Depth of flow =   0.440(Ft.)
Average velocity =   1.301(Ft/s)
Total irregular channel flow =    24.043(CFS)
Irregular channel normal depth above invert elev. =   0.440(Ft.)
Average velocity of channel(s) =   1.301(Ft/s)
 Adding area flow to channel
Soil classification AP and SCS  values input by user
USER INPUT of soil data for subarea
SCS curve number for soil(AMC 2)  = 77.40
Adjusted SCS curve number for AMC 1 = 59.88
Pervious ratio(Ap) = 0.9500     Max loss rate(Fm)=     0.647(In/Hr)
Rainfall intensity =      1.266(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
```

```
rational method)(Q=KCIA) is C = 0.445
Subarea runoff =      5.802(CFS) for   20.000(Ac.)
Total runoff =     26.896(CFS)
Effective area this stream =       47.70(Ac.)
Total Study Area (Main Stream No. 1) =       47.70(Ac.)
Area averaged Fm value =    0.640(In/Hr)
Depth of flow =   0.461(Ft.), Average velocity =   1.346(Ft/s)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       4.000 to Point/Station       5.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
______________________________________________________________________
Estimated mean flow rate at midpoint of channel =      0.000(CFS)
Depth of flow =   0.205(Ft.), Average velocity =   1.401(Ft/s)
       ******* Irregular Channel Data ***********
-----------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
       1              0.00             2.00
       2             30.00             0.00
       3            130.00             0.00
       4            160.00             2.00
Manning's 'N' friction factor =   0.035
-----------------------------------------------------------------
Sub-Channel flow  =     29.584(CFS)
  '     '       flow top width =    106.147(Ft.)
  '     '    velocity=    1.401(Ft/s)
  '     '       area =     21.118(Sq.Ft)
  '     '       Froude number =     0.553

Upstream point elevation =  2498.000(Ft.)
Downstream point elevation =  2492.000(Ft.)
Flow length =   640.000(Ft.)
Travel time  =    7.61 min.
Time of concentration =   47.36 min.
Depth of flow =   0.205(Ft.)
Average velocity =   1.401(Ft/s)
Total irregular channel flow =    29.584(CFS)
Irregular channel normal depth above invert elev. =   0.205(Ft.)
Average velocity of channel(s) =   1.401(Ft/s)
 Adding area flow to channel
Soil classification AP and SCS  values input by user
USER INPUT of soil data for subarea
SCS curve number for soil(AMC 2)  = 80.20
Adjusted SCS curve number for AMC 1 = 63.28
Pervious ratio(Ap) = 0.9200     Max loss rate(Fm)=     0.583(In/Hr)
Rainfall intensity =      1.140(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.409
Subarea runoff =      5.306(CFS) for   21.400(Ac.)
Total runoff =     32.203(CFS)
Effective area this stream =       69.10(Ac.)
Total Study Area (Main Stream No. 1) =       69.10(Ac.)
Area averaged Fm value =    0.622(In/Hr)
Depth of flow =   0.216(Ft.), Average velocity =   1.447(Ft/s)
End of computations, Total Study Area =           69.10 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.
Note: These figures do not consider reduced effective area
effects caused by confluences in the rational equation.

Area averaged pervious area fraction(Ap) = 0.945
Area averaged SCS curve number =  78.7
```

Area B

URS

ALAMO ONSITE HYDROLOGY, AREA B, POST-DEVELOPMENT

Flow Path		Flow Path Elevations			Subarea		Land Use[1]				Soil Type			
From Node	To Node	From Node	To Node	ΔH, ft	Name	Area, Ac	Desc.	CN	Flow Path Length, ft	Comments	A	B	C	D
6	7	2516.0	2504.0	12.0	B-1	9.5	Undev	84.0	965.0	B-1 4.6% IMP Post Condtion	0.22	0.78	-	-
7	8	2504.0	2496.0	8.0	B-2	12.9	Undev	81.8	859.0	B-2 2.9% IMP Post Condtion	0.46	0.54	-	-
8	9	2496.0	2494.5	1.5	B-3	15.5	Undev	81.5	1089.0	B-3 3.6% IMP Post Condition	0.50	0.50	-	-

*NOTE: Impervious Percentage for Post Condition includes 1% for Solar Foundations.

Enter 100-Year area-averaged point rainfall (inches):

	Area A	Area B
5-Minute	0.337	0.334
30-Minute	0.787	0.780
1-Hour	**0.989**	**0.984**
3-Hour	1.420	1.410
6-Hour	1.790	1.780
24-Hour	2.920	2.910

POST-DEVELOPMENT CURVE NUMBER AREA-AVERAGING
ALAMO AVERAGE CURVE NUMBER
SAN BERNARDINO COUNTY

Area Name	Cover Type	SOIL GROUP	(1) CURVE NUMBER	(2) Area (acres)	(3) Weighting (1)*(2)	PERCENTAGE BREAKDOWN
B-1	Fallow	A	77	2.1	161.7	22.1%
B-1	Fallow	B	86	7.4	636.4	77.9%
			TOTAL MAP AREA=	**9.5**		
				TOTAL WEIGHTING=	**798.1**	
			TOTAL AVERAGED VALUE=	**84.0**		
B-2	Fallow	A	77	6.0	462.0	46.5%
B-2	Fallow	B	86	6.9	593.4	53.5%
			TOTAL MAP AREA=	**12.9**		
				TOTAL WEIGHTING=	**1055.4**	
			TOTAL AVERAGED VALUE=	**81.8**		
B-3	Fallow	A	77	7.7	592.9	49.7%
B-3	Fallow	B	86	7.8	670.8	50.3%
			TOTAL MAP AREA=	**15.5**		
				TOTAL WEIGHTING=	**1263.7**	
			TOTAL AVERAGED VALUE=	**81.5**		

IMPERVIOUS AREA ESTIMATE
ALAMO AREA B - POST-PROJECT CONDTION
SAN BERNARDINO COUNTY

	ESTIMATE DESCRIPTION	ESTIMATED AREA	
AREA B-1	Piles	4138	ft^2
	Compacted Dirt Road	15002.5	ft^2
	TOTAL IMPERVIOUS AREA=	**0.44**	ACRES
AREA B-2	Piles	5619	ft^2
	Compacted Dirt Road	11001.3	ft^2
	TOTAL IMPERVIOUS AREA=	**0.38**	ACRES
AREA B-3	Piles	6752	ft^2
	Compacted Dirt Road	17617.9	ft^2
	TOTAL IMPERVIOUS AREA=	**0.56**	ACRES

```
                San Bernardino County Rational Hydrology Program

                    (Hydrology Manual Date - August 1986)

 CIVILCADD/CIVILDESIGN  Engineering Software, (c) 1989-2005 Version 7.1
       Rational Hydrology Study        Date: 12/07/11
------------------------------------------------------------------------
WDG SOLAR - ALAMO
POST-DEVELOPMENT CONDITION - ONSITE AREA
100-YEAR RATIONAL METHOD, AREA B
BY: NRK
------------------------------------------------------------------------


Program License Serial Number 6264

------------------------------------------------------------------------
 *********   Hydrology Study Control Information **********

------------------------------------------------------------------------
Rational hydrology study storm event year is   100.0
Computed rainfall intensity:
Storm year =   100.00   1 hour rainfall =     0.989 (In.)
Slope used for rainfall intensity curve b =  0.6000
Soil antecedent moisture condition (AMC) = 1


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        6.000 to Point/Station       7.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
Soil classification AP and SCS  values input by user
USER INPUT of soil data for subarea
SCS curve number for soil(AMC 2)  = 84.00
Adjusted SCS curve number for AMC 1 = 68.60
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.554(In/Hr)
Initial subarea data:
Initial area flow distance =   651.000(Ft.)
Top (of initial area) elevation =  2497.500(Ft.)
Bottom (of initial area) elevation =  2496.000(Ft.)
Difference in elevation =     1.500(Ft.)
Slope =    0.00230  s(%)=       0.23
TC = k(0.541)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =   24.310 min.
Rainfall intensity =      1.701(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.607
Subarea runoff =      9.803(CFS)
Total initial stream area =        9.500(Ac.)
Pervious area fraction = 1.000
Initial area Fm value =    0.554(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        2.000 to Point/Station       3.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
______________________________________________________________________
Estimated mean flow rate at midpoint of channel =      0.000(CFS)
Depth of flow =   0.463(Ft.), Average velocity =   1.107(Ft/s)
       ******* Irregular Channel Data ***********
-----------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
       1              0.00             2.00
       2             10.00             0.00
       3             35.00             0.00
       4             45.00             2.00
Manning's 'N' friction factor =   0.035
-----------------------------------------------------------------
Sub-Channel flow  =     14.009(CFS)
  '     '       flow top width =     29.632(Ft.)
```

```
  '     '    velocity=    1.107(Ft/s)
  '     '       area =     12.654(Sq.Ft)
  '     '       Froude number =     0.299

Upstream point elevation =  2496.000(Ft.)
Downstream point elevation =  2495.000(Ft.)
Flow length =   471.000(Ft.)
Travel time  =    7.09 min.
Time of concentration =   31.40 min.
Depth of flow =   0.463(Ft.)
Average velocity =   1.107(Ft/s)
Total irregular channel flow =    14.009(CFS)
Irregular channel normal depth above invert elev. =   0.463(Ft.)
Average velocity of channel(s) =   1.107(Ft/s)
 Adding area flow to channel
Soil classification AP and SCS  values input by user
USER INPUT of soil data for subarea
SCS curve number for soil(AMC 2)  = 81.80
Adjusted SCS curve number for AMC 1 = 65.52
Pervious ratio(Ap) = 0.9400     Max loss rate(Fm)=     0.564(In/Hr)
Rainfall intensity =      1.459(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.554
Subarea runoff =      8.311(CFS) for   12.900(Ac.)
Total runoff =     18.115(CFS)
Effective area this stream =       22.40(Ac.)
Total Study Area (Main Stream No. 1) =       22.40(Ac.)
Area averaged Fm value =    0.560(In/Hr)
Depth of flow =   0.539(Ft.), Average velocity =   1.214(Ft/s)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        3.000 to Point/Station        4.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
______________________________________________________________________
Estimated mean flow rate at midpoint of channel =      0.000(CFS)
Depth of flow =   0.598(Ft.), Average velocity =   1.304(Ft/s)
       ******* Irregular Channel Data ***********
-----------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
       1              0.00              2.00
       2             10.00              0.00
       3             35.00              0.00
       4             45.00              2.00
Manning's 'N' friction factor =   0.035
-----------------------------------------------------------------
Sub-Channel flow  =     21.822(CFS)
  '     '       flow top width =     30.979(Ft.)
  '     '    velocity=    1.304(Ft/s)
  '     '       area =     16.734(Sq.Ft)
  '     '       Froude number =     0.313

Upstream point elevation =  2495.000(Ft.)
Downstream point elevation =  2494.000(Ft.)
Flow length =   464.000(Ft.)
Travel time  =    5.93 min.
Time of concentration =   37.33 min.
Depth of flow =   0.598(Ft.)
Average velocity =   1.304(Ft/s)
Total irregular channel flow =    21.821(CFS)
Irregular channel normal depth above invert elev. =   0.598(Ft.)
Average velocity of channel(s) =   1.304(Ft/s)
 Adding area flow to channel
Soil classification AP and SCS  values input by user
USER INPUT of soil data for subarea
SCS curve number for soil(AMC 2)  = 81.50
Adjusted SCS curve number for AMC 1 = 65.10
Pervious ratio(Ap) = 0.9600     Max loss rate(Fm)=     0.582(In/Hr)
Rainfall intensity =      1.315(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
```

```
rational method)(Q=KCIA) is C = 0.510
Subarea runoff =      7.318(CFS) for   15.500(Ac.)
Total runoff =     25.432(CFS)
Effective area this stream =       37.90(Ac.)
Total Study Area (Main Stream No. 1) =       37.90(Ac.)
Area averaged Fm value =    0.569(In/Hr)
Depth of flow =   0.654(Ft.), Average velocity =   1.376(Ft/s)
End of computations, Total Study Area =           37.90 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.
Note: These figures do not consider reduced effective area
effects caused by confluences in the rational equation.

Area averaged pervious area fraction(Ap) = 0.963
Area averaged SCS curve number =  82.2
```