Appendix E

Conceptual Stormwater Control Plan

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CONCEPTUAL STORMWATER CONTROL PLAN

Amargosa Farm Road Solar Project

Nye County, Nevada

Job No.: SML0801.000
Date: December 2008

Prepared By:
Slater Hanifan Group, Inc.
5740 S. Arville Street, Suite 216
Las Vegas, Nevada 89118
Phone: (702) 284-5300 ▪ Fax: (702) 284-5399

Prepared For:
Solar Millennium, LLC
1625 Shattuck Ave., Suite 270
Berkeley, CA 94709
Phone: (510) 524-4517 ▪ Fax: (510) 524-5516

Mark J. Failla, P.E.
NV Professional Engineer No. 14566

Assisted By: Steve Jones, P.E.

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1 INTRODUCTION

1.1 Project Overview & Study Purpose

Solar Millennium, LLC is proposing to develop approximately 7,810 acres of property for utilization of solar power generation. Exhibit A included in Appendix A is a location map for the project and provides the limits of the property boundary. The initial phase of the project focuses on utilization of approximately 4,100 acres of the total 7,810 acres.

The purpose of this study is to provide a conceptual stormwater control plan for development of the initial 4,100 acres project site. More specifically this study provides the following:

- Summary of site research and data collection
- Discussion of FEMA floodzone impacts
- Discussion of local design requirements
- Summary of existing and proposed hydrologic analyses
- Summary of conceptual stormwater control facilities

This study is intended to provide only a conceptual stormwater plan for protection of the project site from onsite and offsite storm flows. As such, this study provides only a summary of results and conclusions and supporting hydrologic and hydraulic computations have been purposely omitted. This study is not suitable for submittal to Nye County in support of detailed grading and improvements plans and it is acknowledged that technical studies in support of future improvement plans will be required.

1.2 Site Description

The project site is located in Amargosa Valley, Nye County, Nevada approximately four miles southwest of the intersection of State Route 373 and U.S. Highway 95. Amargosa Farm Road (Farm Road) traverses the southern portion of the property in an east/west direction. Farm Road will be relocated as a part of this project along the frontage of the solar field in order to accommodate the modular layout of the field.

The project site is flat with an average 1-percent slope falling from northeast to southwest across the site. The site consists of desert shrub with numerous defined, intermittent and braided washes traversing in a southwesterly direction.

The project site is located with the watershed of the Forty-Mile Wash as determined by USGS quad maps and the USGS National Hydrography Data Set. The Forty-Mile Wash consists of an approximate 330 square mile drainage area measured to the southern property line of the project site. The section of the Forty-Mile Wash impacting the site is considered alluvial based on site field investigation and review of aerial photography. The apex of the Forty-Mile Wash is clearly identifiable approximately one-half mile north of Interstate 95.

1.3 FEMA Flood Zone Designation

The project site is currently located in a Federal Emergency Management Agency (FEMA) Zone X as depicted on the effective Flood Insurance Rate Map (FIRM) Panels 320018 4125C, 320018 4150C, 320018 4225 C and 320018 4250C dated September 28, 1990. A Zone X is defined by FEMA to be areas determined to be outside the 0.2% annual chance floodplain. Zone X designations are not regulated by FEMA. Exhibit B identifies the project site on the current effective FIRMs and has been included in Appendix A for reference.

The Forty-Mile Wash, north of U.S. Highway 95 is located within a FEMA designated Zone A Special Flood Hazard Area (SFHA). A Zone A SHFA is defined by FEMA to be areas subject to inundation by the 1% annual chance flood event, no base flood elevations determined. Zone A designations are regulated by FEMA. It is noted that although the portion of the Forty-Mile Wash located within the project site is not located within a FEMA Zone A, the site will clearly exhibit impacts due to flooding. As such, FEMA has no regulatory authority within the project site and it will not be required to submit any information to FEMA for development of the project area.

1.4 Regional Flood Control Master Plan

No regional flood control master plan exists for this area of Nye County.

2 METHODOLOGY

2.1 Compliance

The methodologies utilized in the preparation of this study are in compliance with the *Nye County Guidelines for Design and Review of Development Engineering Submissions, dated February* 2005, (Nye County Guidelines, Reference 1) and the *Clark County Regional Flood Control District's Hydrologic and Drainage Design Manual* (CCRFCD Manual, Reference 2). Per the Nye County Guidelines, the CCRFCD Manual is to be used for all methodologies not covered in the Nye County Guidelines.

2.2 Hydrologic Modeling

Modeling: The SCS Unit Hydrograph Method (SCS Method) within the U.S. Army Corp of Engineers HEC-1 Flood Hydrograph Package was utilized to determine peak flow rates. The SCS Method utilizes precipitation, drainage area, curve number and lag time parameters to determine peak flow rates.

Precipitation: Rainfall depths have been obtained from the NOAA Atlas 14 Precipitation Server. Six-hour precipitation values were obtained for the 10-year, 25-year and 100-year storm events for onsite basin analysis and 100-year only were obtained for offsite analysis. Precipitation values were obtained for the site and each individual offsite basin at the centroid of each area. Appropriate drainage area reduction factors (DARFs) referenced from the CCRFCD Manual have been applied to watersheds exceeding 0.5 square mile in area. The Storm Distribution No.3 (SDN 3) from Table 503

in the CCRFCD Manual was used for drainage areas less than 8 square miles. The SDN4 was used for drainage areas greater than 8 square miles and less than 12 square miles. The SDN5 was used for drainage areas greater than or equal to 12 square miles.

Curve Number: The SCS curve number loss rate methodology was utilized to approximate infiltration for the drainage subbasins. Soils data utilized for the hydrologic analyses presented in this study have been referenced from the NRCS Web Soil Survey and the NRCS Soil Data Mart websites. This survey delineates soil types and provides the Hydrological Soil Group (HSG) designation for each soil unit. Curve numbers (CN) were developed for the subbasins based upon existing and proposed condition land use.

Lag Time: The lag time is defined as the time measured from the center of mass of effective rainfall to the time to peak of the outflow hydrograph. The lag time is related to the time of concentration as 0.6 times the time of concentration.

The time of concentration is defined as the time required for runoff to flow from the hydraulically most distant point of a subbasin to the outlet point of the subbasin. Per the CCRFCD Manual, time of concentration (T_C) is a combination of an initial overland time (T_i), and travel time (T_t) in a ditch, channel, gutter, storm sewer, etc.

For offsite drainage areas larger than 1 square mile, the CCRFCD Manual recommends the use of a USBR derived equation to determine the lag time and was utilized for the hydrologic analyses. For onsite basins exceeding 1 square mile, lag times were determined utilizing methodologies from Section 602 of the CCRFCD Manual as they were determined to result in more reasonable results.

2.3 Hydraulic Modeling

Flood Control Facilities: Flood control facilities were conceptually sized and analyzed by normal depth methodologies utilizing the Flowmaster Version 7.0 software by Haestad Methods.

Flood Plain Analysis: The existing condition flood plain analysis was conceptually analyzed utilizing the HEC-RAS computer program by the U.S. Army of Engineers. It is noted that the HEC-RAS program may not be the most appropriate methodology to analyze the alluvial fan condition that impacts the site and that a more appropriate method such as Flo-2D may be required for future evaluation for the project.

3 EXISTING DRAINAGE CONDITION

3.1 Definition of Existing Condition

The existing condition considers the offsite and onsite land use and drainage patterns as they currently exist.

3.2 Discussion of Existing Condition

The contributing drainage area to the Forty-Mile Wash was determined to be approximately 330 square miles measured to the southern property boundary. Various subbasins were evaluated in order to determine peak flows rates in areas of interest. Exhibit C included in Appendix A identifies the offsite drainage areas utilized in the hydrologic evaluation.

Concentration points PT1, PT2 and PT3, as well as Subbasins SUB10 and SUB11 were created to determine existing condition peak flow rates at key locations along the southern property line. These locations have been utilized for comparison to the proposed condition peak flow rates at the same location in order to ensure that existing condition peak flows at the property boundary will not be exceeded by development of the project site. Exhibit D included in Appendix A identifies the onsite drainage areas utilized in the hydrologic evaluation.

In order to estimate the limits of the existing Forty-Mile Wash 100-year flood plain impacting the site a HEC-RAS hydraulic model was prepared. Exhibit H included in Appendix A depicts the estimated 100-year flood plain limits through the project site.

3.3 Summary of Existing Condition Flows

Exhibits C and D included in Appendix A provide a summary of peak 100-year flow rates determined for the existing condition drainage areas evaluated by this study. The following table provides a summary of peak 100-year flow rates determined at the key locations discussed above.

Table 1: Existing Condition Peak Flow at Key Locations

Subbasin/Concentration Point	Q_{100} (cfs)
PT1	9,596
PT2	129
PT3	262
SUB10	880
SUB11	482

4 PROPOSED DRAINAGE CONDITION

4.1 Definition of Proposed Condition

The proposed condition is identical to the existing condition with the exception that onsite areas were assessed with a developed land use, and drainage patterns were routed based on proposed conveyance facilities.

4.2 Discussion of Proposed Condition

The proposed condition was assessed in order to determine impacts due to development of the site and to support flood control facility design for protecting the project site. The general concept of the proposed conceptual stormwater control plan is to limit post-development peak flow rates to pre-development limits, and return the flow to the same location and in the same manner as the existing condition in accordance with Nevada Drainage Law.

Concentration points PT1, RPT2 and PT4, as well as Subbasins 789 and SUB11 were created to provide comparison to the same locations evaluated for the existing condition along the southern property line. Exhibit E included in Appendix A identifies the drainage areas utilized in the proposed condition hydrologic evaluation for use in facility design and for comparison to existing conditions.

In order to assess onsite drainage conditions and to determine onsite facility design, Subbasins SITEA, SITEB, SITEC and SITED were subdivided based on proposed drainage patterns. Peak 10, 25 and 100-year storm flows were pro-rated from the parent basin (i.e.: SITEA, SITEB, etc.) in order to determine onsite peak flow rates at key locations necessary for onsite facility design. Prorated Subbasins A-A, B-A, C-A, D-A, A-B, B-B, C-B, and D-B were created based on typical proposed onsite drainage patterns and have also been identified on Exhibit E.

4.3 Summary of Proposed Condition Flows

Exhibits E included in Appendix A provides a summary of peak 100-year flow rates determined for the proposed condition drainage areas evaluated by this study. The following table provides a summary of peak 100-year flow rates determined at the key locations discussed above.

Table 2: Proposed Condition Peak Flow at Key Locations

Subbasin/Concentration Point	Q_{100} (cfs)
PT1	9594
RPT2	121
PT4	846
SUB789	133
SUB11	482

The following table provides a comparative summary of the existing and proposed condition discharge flow values at equivalent locations.

Table 3: Comparison Summary – Existing Condition vs. Proposed Condition

Comparison Location (Existing/Proposed)	Existing Condition Flow Q_{100}	Proposed Condition Flow Q_{100}
PT1/PT1	9,596	9,594
PT2/RPT2	129	121
PT3/789	262	133
SUB10/PT4	880	846
SUB11/SUB11	482	482

Review of the table above indicates that post-development peak flowrates will be limited to pre-development conditions based on the proposed conceptual stormwater control plan.

5 CONCEPTUAL STORMWATER CONTROL FACILTITES

5.1 Alternatives Assessment

Various alternatives were considered in the assessment of protecting the project site from offsite storm flows. The alternative assessment generally considered feasibility, construction cost and community advantages. The following two alternatives were considered the most viable:

1. Provide a regional offsite detention basin at the apex of the Forty-Mile Wash located north of U.S. Highway 95: This alternative would effectively and considerably reduce existing condition peak storm flow downstream of U.S. Highway 95. This alternative would allow reduction in size of perimeter flood control facilities necessary for protection of the project site. Additionally, this alternative would benefit all properties downstream of the detention basin. Since this alternative requires the detention basin to be located at the apex of the Forty-Mile Wash, the primary negative is that the detention basin would be located outside of the current BLM Land Grant request area.

2. Provide 100% interception and conveyance for the entire existing condition flow from the Forty-Mile Wash: This alternative would provide site perimeter flood control facilities with sufficient capacity to intercept and convey the peak 100-year storm event flow from the Forty-Mile Wash. This alternative is considered more expensive than Alternative No. 1; however it would be entirely located on the subject project and not reliant on offsite property.

Although Alternative No.1 appears to be a viable and financially more attractive choice; for purposes of this study, Alternative No.2 was selected due to the fact that it is within the current site boundary. As the project progresses it is likely that Alternative No.1 will be pursued with Nye County and BLM further.

5.2 Offsite Runoff – Stormwater Control Facilities

As discussed above and for purposes of this study, Alternative No. 2 was selected to intercept and convey offsite flow. In general, the protection of the property from the Forty-Mile Wash will be provided by means of a continuous concrete lined channel around the northern and western perimeter of the site. The channel has been designed to effectively intercept the 100-year storm event offsite runoff and convey the concentrated flow to the southwest corner of the property. The southwest corner of the property has been identified as the historic discharge location of the Forty-Mile Wash (Concentration Point PT1). The channel will discharge within the property limits and energy dissipation facilities will be provided in order to disperse the concentrated flow back to a shallow sheet flow condition prior to leaving the property boundary. As discussed in Section 4.3, the flow will be returned to the Forty-Mile Wash in the historic quantity, location and manner in accordance with Nevada Drainage Law.

Additionally, a concrete lined channel is proposed along the eastern side of the solar field in order to intercept and collect flows impacting the Phase 1 development from the east. Similar to the Forty-Mile Wash channel, the concentrated flow will be released on property in its historic location (Concentration Point PT4) and an energy dissipation facility will be provided in order to return the flow to a shallow sheet flow condition prior to leaving the property. The flow will be returned in the historic quantity, location and manner in accordance with Nevada Drainage Law.

Perimeter channels are recommended to be concrete lined due to the high velocity potential and for maintenance reasons.

Exhibit F, included in Appendix A, provides the locations, design flows, design slopes and facility geometry for the conceptual perimeter facilities considered necessary to protect the site from offsite storm flows.

5.3 Onsite Runoff – Stormwater Control Facilities

Due to the size of the solar field area, the site itself has potential to generate large storm flows during a rain event. For this reason, onsite stormwater control facilities are necessary to protect onsite facilities, and to convey stormwater runoff to historic discharge locations in both quantity and manner of flow.

In order to assess onsite facilities, the solar field project area was divided into four typical quadrants identified as SITEA, SITEB, SITEC and SITED (see Exhibit E). Each quadrant is assumed to have equivalent storm flow and facility designs. The general concept is that each quadrant will consist of a series of open channel facilities (Minor Channels) intercepting and conveying stormwater runoff to a concrete lined channel facility (Major Channels) located along the west side of each quadrant. Each of the four Major Channels is designed to intercept and convey the 100-year storm event design

flow from each section. All Minor Channels within each section are designed to intercept and convey the 25-year storm event to the Major Channels. This concept was selected in order to reduce costs for onsite drainage facilities, while still providing desired flood protection. All Major Channels are recommended as concrete lined for purposes of reliability and maintenance.

Exhibit G, included in Appendix A, provides the locations, design flows, design slopes and facility geometry for the conceptual onsite facilities considered necessary to protect the site from storm flows.

In addition to onsite channel facilities, an onsite detention basin is considered necessary in order to limit post-development flows at Concentration Point PT2 to pre-development limits. The onsite detention basin facility location and size is indicated on Exhibit G.

As a result of the anticipated re-alignment of Amargosa Farm Road along the southern boundary of the solar field area, numerous underground culvert facilities will be necessary to convey storm flow from the onsite open channel facilities below the roadway. The locations of the culvert facilities have been located on Exhibit G.

6 CONCLUSION

The hydrologic and hydraulic analyses, and the stormwater control facilities presented in this study are considered conceptual. Detailed technical analyses will be required in support of future grading and improvement plans as required by Nye County.

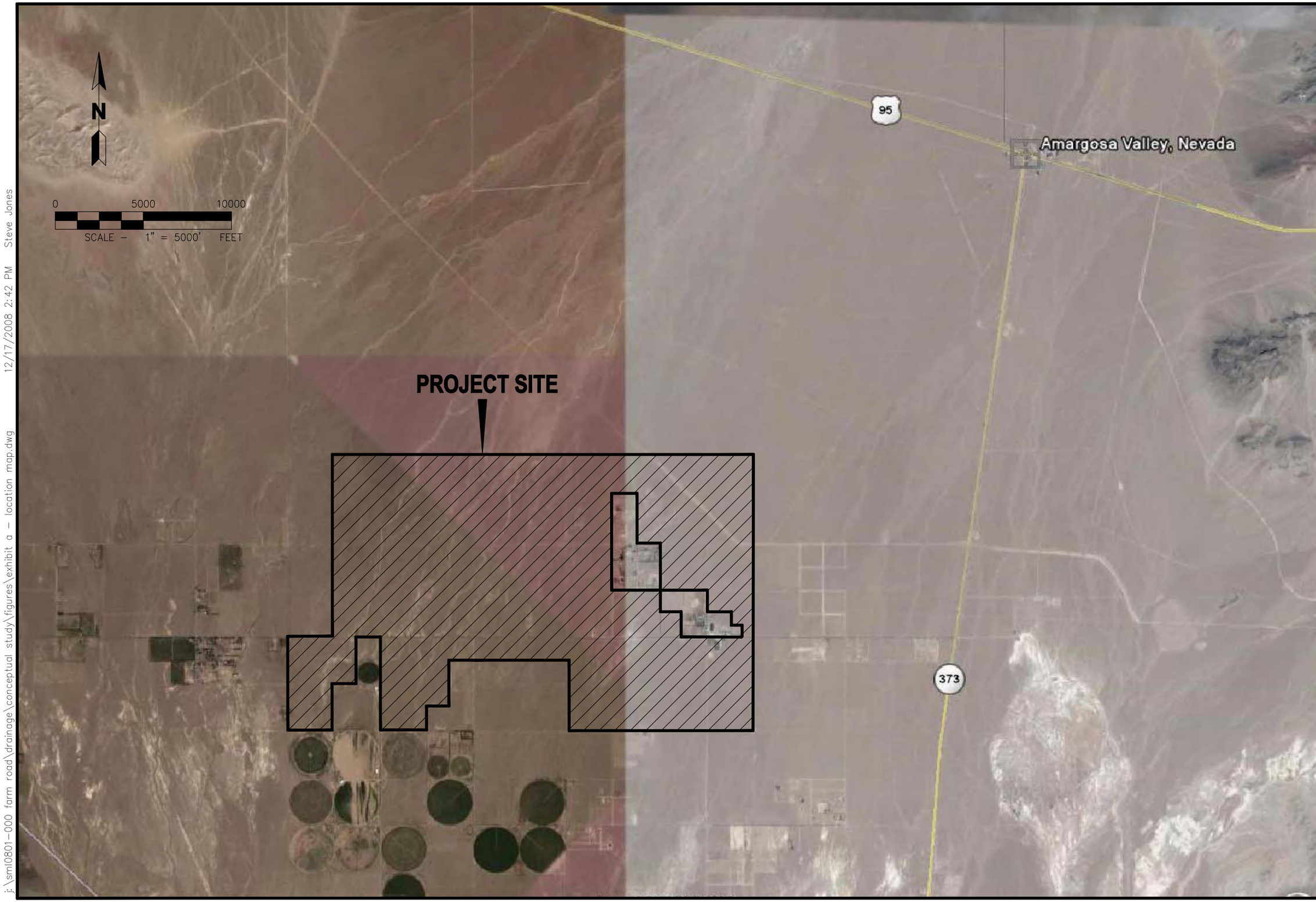
The conceptual stormwater control facilities presented in this study provide a design in accordance with Nevada Drainage Law. More specifically, the design presents a drainage concept that returns offsite and onsite developed flow to historic locations in both quantity and manner, thus not resulting in any adverse impacts to downstream property owners.

A conceptual grading plan and typical drainage channel sections have been included in Appendix B.

7 REFERENCES

1. *Hydrologic Criteria and Drainage Design Manual.* Clark County Regional Flood Control District, 1990.

2. *Guidelines for Design and Review of Development Engineering Submissions*, February 2005, Nye County Department of Public Works.



SLATER HANIFAN GROUP
CONSULTING ENGINEERS & PLANNERS
5740 S. ARVILLE STREET #216, LAS VEGAS, NV 89118
PHONE (702) 284-5300 FAX (702) 284-5300

NO.	DESCRIPTION	DATE	BY	APP. DATE	APP.

SOLAR MILENNIUM, LLC

AMARGOSA FARM ROAD SOLAR PROJECT
LOCATION MAP

DATE: 11/17/08
DRAFTER: SMJ
DESIGNER: SMJ
CHECKED: MJF
PROJECT NO.
SML0801.000

EXHIBIT A
SHEET 1 OF 1

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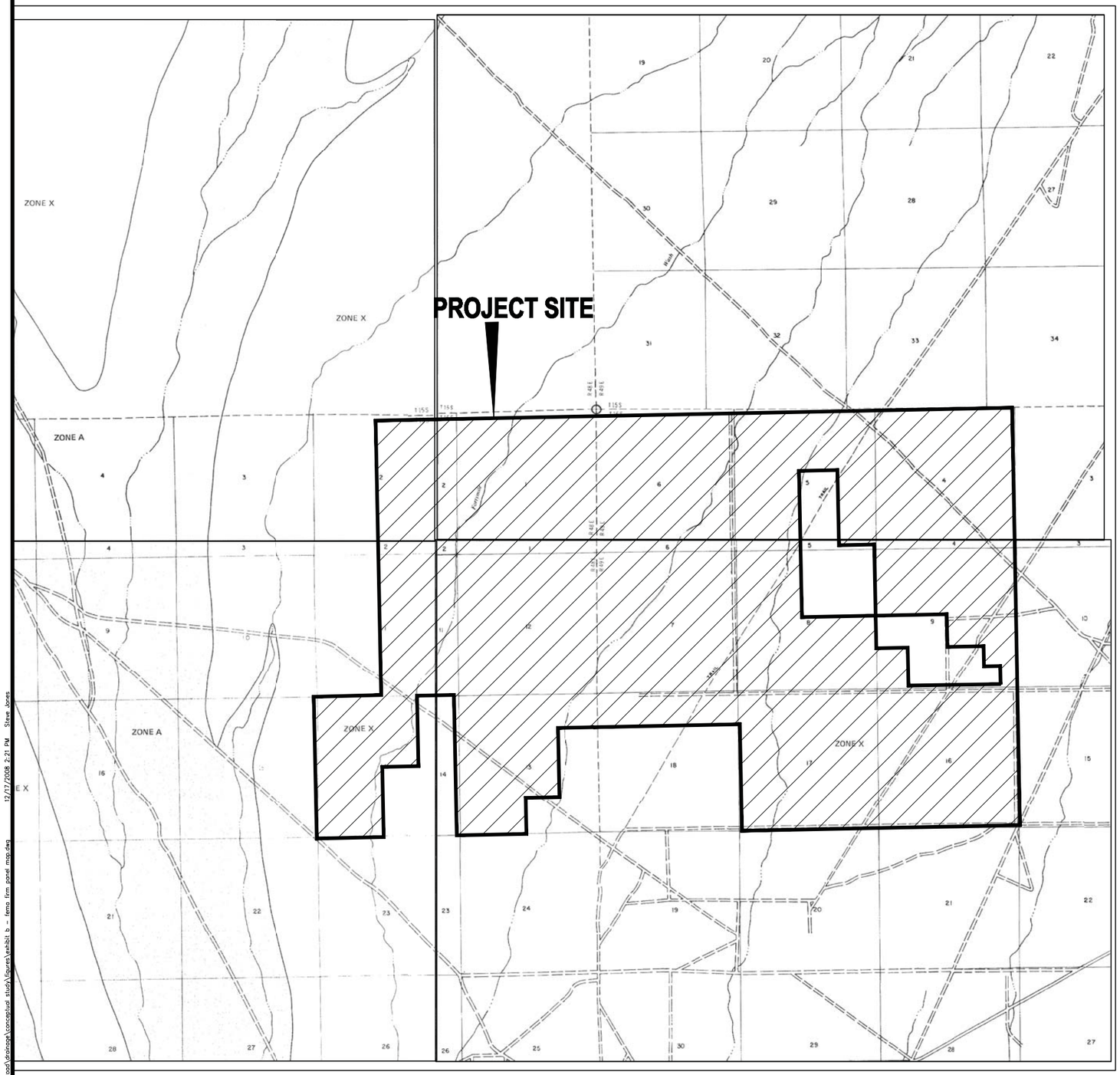

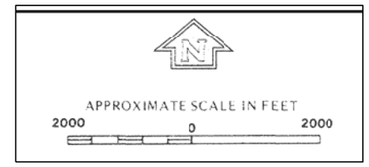

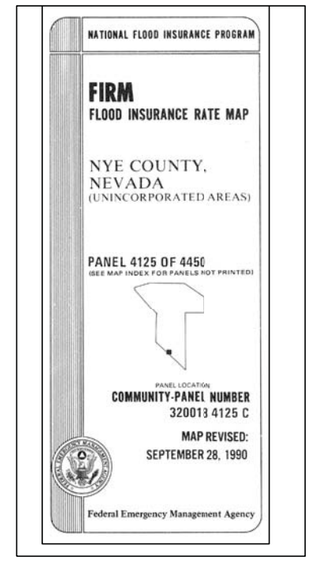

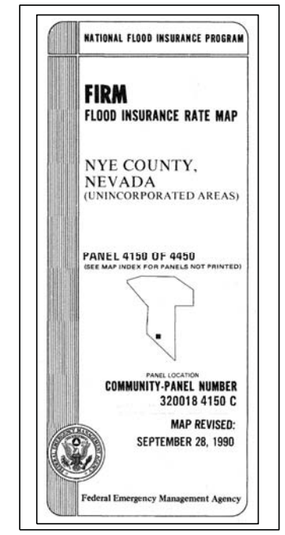

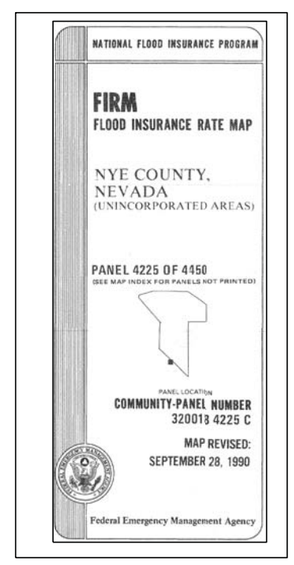

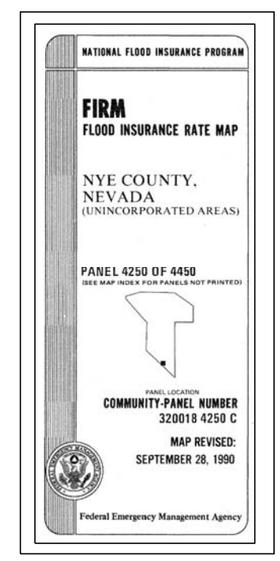

SLATER HANFAN GROUP
CONSULTING ENGINEERS & PLANNERS
8740 S. ARVILLE STREET #216, LAS VEGAS, NV 89115
PHONE (702) 284-5300 FAX (702) 284-5300

NO.	DESCRIPTION	DATE	BY	APP. DATE	APP.

SOLAR MILENNIUM, LLC

AMARGOSA FARM ROAD SOLAR PROJECT

FEMA FIRM PANEL MAP

DATE: 11/17/08
DRAFTER: SMJ
DESIGNER: SMJ
CHECKED: MJF
PROJECT NO.
SML0801-000

EXHIBIT B
SHEET 1 OF 1

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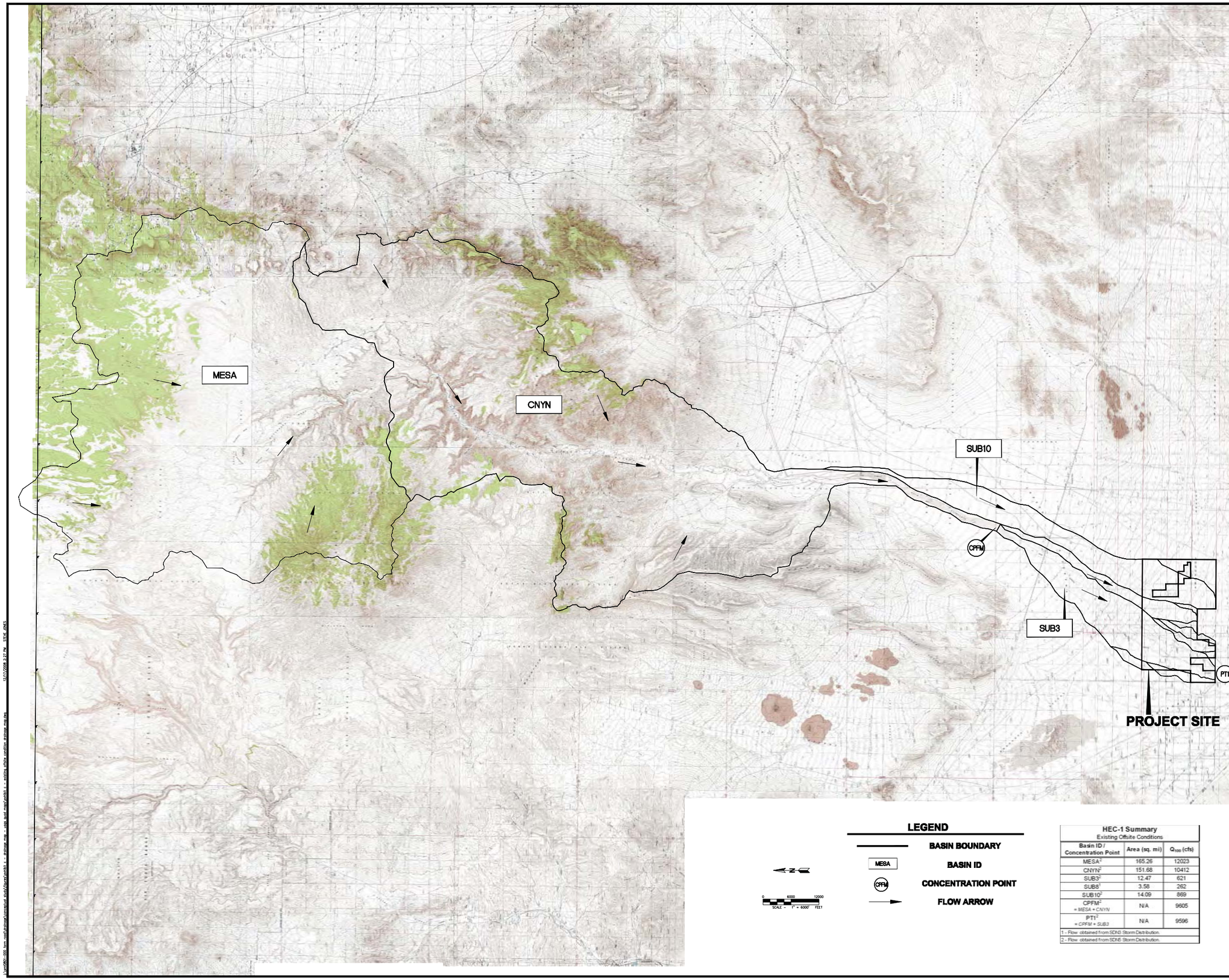

HEC-1 Summary
Existing Offsite Conditions

Basin ID / Concentration Point	Area (sq. mi)	Q_{100} (cfs)
MESA[2]	165.26	12023
CNYN[2]	151.68	10412
SUB3[2]	12.47	621
SUB8[1]	3.58	262
SUB10[2]	14.09	869
CPFM[2] = MESA + CNYN	N/A	9605
PT1[2] = CPFM + SUB3	N/A	9596

1 - Flow obtained from SDN3 Storm Distribution.
2 - Flow obtained from SDN5 Storm Distribution.

SLATER HANIFAN GROUP
CONSULTING ENGINEERS & PLANNERS
6140 S. ANVILLE STREET #214, LAS VEGAS, NV 89118
PHONE (702) 384-6999 FAX (702) 384-6999

NO.	DESCRIPTION	DATE	BY	APP. DATE	APP.

SOLAR MILENNIUM, LLC
AMARGOSA FARM ROAD SOLAR PROJECT
EXISTING CONDITION OFFSITE DRAINAGE MAP

DATE: 11/26/08
DRAFTER: SMJ
DESIGNER: SMJ
CHECKED: MJF
PROJECT NO.
SML0601.000

EXHIBIT C
SHEET 1 OF 1

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