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Preliminary Hydrology Study for

Sienna Solar Energy Project

San Bernardino County, CA

August 2018 (Revised April 12, 2022)

Prepared For:

8minutenergy RENEWABLES

Westwood

Preliminary Hydrology Study for

Sienna Solar Energy Project

Prepared for:

Prepared by:
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Date: 08/22/2018 (Revised 02/28/2022)

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EXHIBITS

APPENDICES

OVERVIEW

The purpose of the study is to describe the hydrology of the proposed Sienna Solar Energy Project ("the Project") and any impacts that the hydrology may play in the design of the solar array.

The revisions in the report that took place on 04/12/2022 only encompass updating the report for a new project boundary and do not cover any model updates.

The Project encompasses ~1,855 acres located in unincorporated San Bernardino County. It is situated approximately 3.5 miles north of Lucerne Valley, California. Power generated or stored by the Project will be delivered from the sites to a nearby substation. The Project is comprised of 27 parcels totaling roughly 1,855 acres.

The project sites are located in a dry lake bed that has no outlet. The watershed area encompasses ~390 square miles of the surrounding area. The project area in the dry lakebed has no slope while the watershed area leading to it has areas of steep slopes in the mountains and more moderate slopes leading to the dry lakebed.

FEMA has not completed a study to determine flood hazard for the selected location, therefore no FEMA permitting is anticipated.

The onsite and offsite hydrologic modeling in this report was created using FLO2D modeling software and a number of other hydrologic techniques. FLO-2D hydrologic/hydraulic modeling software was utilized to determine flow depths and velocities throughout the site. Additionally, historic review of high water marks and previously determined lake boundaries were used to check the accuracy of the models given the complex nature of the watershed contributing to the lake bed. Finally, historical accounts of flooding in the valley were compared to modeling results. (Appendix D) Overall, significant flooding should be expected across the majority of the lake bed due to the large drainage area that is tributary to Lucerne Lake. All of these models converge on a 100-year flood depth of 4 to 6 feet across the lake bed. The Westernmost parcels will experience the deepest flooding depths of 1 to 2 feet. The other parcels to the east experience slightly lower depths depending on location. Portions of the eastern parcels higher flood and higher velocities based on proximity to dry washes. See Exhibit 6A for a full description of results.

The Project will need to conform to the County building code requirements to stay 1' above the high water mark as determined in this report or future modeling. Since the dry lake that covers the project boundary is the terminus of the watershed, no downstream impacts are anticipated.

DATA SOURCES

The models and methods for this project utilize a combination of public and private data as shown in Table 1.

Table 1: Data Sources

Data Type	Format	Source	Use
Elevation	LiDAR las	Westwood	Onsite FLO-2D Model Elevations
Elevation	5-Meter Digital Elevation Model (DEM)	Intermap Nextmap5	Near site FLO-2D Model Elevations
Elevation	10-Meter Digital Elevation Model (DEM)	USGS	Watershed Delineation, Offsite FLO-2D Model Elevations
Precipitation	PDF File	NOAA Atlas 14	Design storms
HUC-12 Drainage Boundary	Shapefile	USGS	Define Model Extents
HUC-10 Drainage Boundary	Shapefile	USGS	Define Model Extents
Site Boundary	KMZ	8minutenergy	Define Model Extents
2014 Aerial Photography	ArcGIS Map Service	USDA FSA	Reference

ONSITE HYDROLOGY

The project area is located approximately 3.5 miles north of Lucerne Valley in San Bernardino County, CA. The project sites are located in and adjacent to a dry lakebed (Lucerne (dry) Lake) which is extremely flat with no outlet. This area has not been mapped by FEMA so no FEMA permitting is anticipated for this project. The national wetlands inventory classifies Lucerne (dry) Lake as a wetland and parcels within the project are within the wetland boundary. Soils within the dry lakebed are classified as a playa which is impermeable clay and most closely relates to a "D" soil which has high runoff potential and very little infiltration. The majority of soils in the offsite watersheds are classified as "A" soils which have low runoff potential and high infiltration. Typical of arid regions, the project areas and surrounding offsite watersheds experience short-duration, high-intensity rainfall storm events producing potentially high rates of runoff when the initial infiltration rates are exceeded. No water was present in the aerial photo review of the sites but water should be expected in the dry lakebed after rainfall events for extended periods of time due to the water having to evaporate rather than infiltrate.

OFFSITE HYDROLOGY

The total offsite watershed is ~390 square miles surrounding the project area and can be broken into 5 different contributing watersheds. These watersheds will contribute a large amount of volume to the dry lakebed but the velocities will be less of a concern from these contributing areas outside of the washes. The potential hydrologic issues in this general landscape are flooding in Lucerne Lake.

FLO-2D Modeling Inputs

FLO-2D is a physical process model that routes rainfall runoff and flood hydrographs over flow surfaces or in channels using the dynamic wave approximation to the momentum equation. FLO-2D offers advantages over 1-D models and unit hydrograph methods by allowing for breakout flows and visualization of flows across a potential site. This is particularly useful on a flat site that receives offsite flows, such as the project site. The primary inputs are a DTM (elevation data), curve numbers and precipitation. No hydraulic structures were modeled (roads/berms are overtopped).

Due to the large watershed size a model with 150' grid cells was used. The models were run modifying the curve number for varying AMC conditions throughout the contributing watersheds per the San Bernardino County Hydrology Manual Addendum.

Precipitation data downloaded from the NOAA Atlas 14 (Appendix A) for a 100-year, 24-hour rainfall is 3.57 inches for the project parcels. In order to properly model the watershed the downloaded rainfall data was spatially varied across all of the offsite and onsite watersheds (Exhibit 5). By using the 100-year rainfall event allows for the best initial analysis in order to determine the worst areas of flooding and erosion. The rainfall was also adjusted based on an aerial reduction factor of 0.8 in order to account for the large size of the watershed.

Flown LiDAR elevation data was used for the onsite areas and Intermap Nextmap 5 meter and USGS 10m DEM data for the contributing watersheds was incorporated into the DTM using the export to xyz file function in Global Mapper. These XYZ files are read directly into FLO-2D.

USDA-NRCS SSURGO soil data provides soil types within the project boundary and full coverage of the contributing watershed. Soils vary greatly throughout the watershed area with Hydrologic Soil Group (HSG) B and D soils predominating in the project boundary (Exhibit 3). Land cover was obtained from the USDA 2013 Crop Data Layer. Exhibit 4 displays the Land Cover Classes for the entire watershed. Curve numbers adjusted based on their AMC factor (San Bernardino County 2010) and were applied to each grid cell in the FLO-2D model based on intersecting the grid with the curve numbers (Exhibit 5).

Lucerne (dry) Lake Flooding Extents and Discussion

Lucerne (dry) Lake is the terminus for ~390 sq. miles of drainage from the surrounding desert landscape and mountains. Due to the varying terrain, soils, and rainfall the exact high water level is difficult to explicitly determine. However, using a variety of modeling and visual techniques, a range of water depths in the lake for the 100-year storm have been determined based upon assuming an updated bottom lakebed elevation of 2,849' based on an average lakebed bottom from the LiDAR elevation data. FLO-2D software was used to model the lake hydrology for the variable rainfall with an AMC factor condition scenario. The results of these depths in the lakebed vary, but show 4'-6' of flooding in the dry lakebed and are the results that have the highest amount of confidence. The USGS topographic map dry lake extent was digitized and compared against the FLO-2D and HydroCAD results in Exhibit 6A. The extents of the dry lake were also digitized from aerial imagery and can also be seen on Exhibit 6A.

The digitized topographic map is based on the interpretation of the lakebed from the original USGS topographic survey of the area. This area and the aerial imagery interpretation line may under predict the high water level of the lake because the extent is based primarily on the presence or absence of vegetation. Although the presence of vegetation can be correlated to high water levels, it generally correlates better to a more common event such as a 2-year or a 10-year return period.

PROPOSED CONDITIONS

The proposed use of the sites will be a solar facility. The solar facility will consist of solar modules mounted above grade on a racking system, access roads, electrical equipment and a perimeter security fence. The solar modules are located above the ground and the finished ground conditions will be restored to pre-construction conditions.

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 should be completed following a detailed topographic site survey overlaid with proposed site development grading. The solar array will need to be elevated above any ponding water onsite in the 100-year event which should be determined during final design.

SAN BERNARDINO COUNTY REQUIRMENTS/STATE REQUIREMENTS

CivilD modeling software per the Unit Hydrograph San Bernardino County Hydrology Method will need to be used to calculate the offsite watershed runoff for the 100-year storm event that contributes to the Lucerne (dry) Lake where the Projects are located. In addition CivilD modeling software per the Rational Method San Bernardino County Hydrology Method will need to be used to calculate the onsite watershed runoff for the 100-year storm event. Each land parcel will need to be modeled separately. An increase in impervious area for each parcel is expected due to the construction of the piles, concrete pads for the inverters and the access roads. The increase is estimated to be very minimal. The largest increase in impervious area will be expected to come from the access road construction, but overall, the total area of the access roads would be small in comparison with the entire site. If gravel access roads are used this will allow for some level of infiltration. Based on previous experience with San Bernardino County, only minor (if any) permanent stormwater management features (basins, etc.) are expected to be required on the site. The State of CA also requires retention based on the added amount of impervious to the site. Based on previous experience the expected impervious is around 4% of the site. This will require a storage of 0.50 ac-ft onsite (Appendix E).

RESULTS AND DESIGN INFORMATION

Overall, significant flooding should be expected across the sites and high velocities should be expected in Sand Wash and other contributing washes. See Exhibit 1 for the contributing watersheds, NHD flow lines and proposed project location. FEMA has not completed a study to determine flood hazard for the selected location. Due to Lucerne (dry) Lake being the low point for ~390 square miles of drainage and not having an outlet high flood depths are expected for the 100-year storm event. The Project will need to conform to the County building code requirements to stay 1' above the high water mark as determined in this report or future modeling. The proposed project will discharge in a manner similar to the existing flow pattern for the storm events and does not alter drainage patterns. CEQA Appendix IX Hydrology and Water Quality has been filled out and can be found in Appendix C based on the 2016 CEQA Stature and Guidelines.

This study shows that the dry lake bed is expected to have a 100-year max water depth of between 4' and 6' based on the unknowns associated with studying a dry lake bed with a large, arid drainage area.

The parcels along the edge of the lake bed will have lower flood depths as seen on Exhibit 6A and higher velocities as seen on Exhibit 7A. The max 100-year flooding depths on these parcels is expected to be around 1'-4' depending on the location in the parcel. Any channelized or ponding areas should be avoided or accounted for the solar layout if possible.

NEXT STEPS

1. Following approval by San Bernardino County Flood Control District, develop the conceptual plan presented in this report into a detailed design will further refine the results of the calculations present in this report.

Included Output Files:

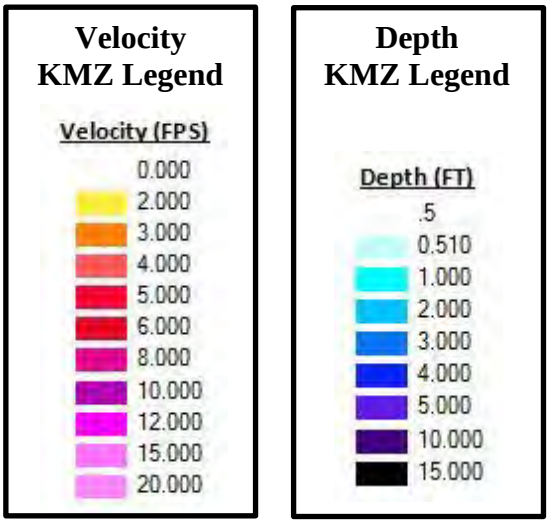
1. Shapefile of Flow Depth
   2018-07-24_Sienna_Preliminary_Flow_Depth_at_Cell.shp
   Attribute "ID" = Grid Cell Number
   Attribute "VAR" = Max Flow Depth (Feet)

2. KMZ of Flow Depth
   2018-07-24_Sienna_Prelim_Flow_Depth.kmz
   Overlay in Google Earth for graphical representation.

3. Shapefile of Velocity
   2018-07-24_Sienna_Preliminary_Velocity_at_Cell.shp
   Attribute "ID" = Grid Cell Number
   Attribute "VAR" = Velocity (FPS)

4. KMZ of Velocity

2018-07-24_Sienna_Prelim_Velocity.kmz
Overlay in Google Earth for graphical representation.



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State Standard For Hydrologic Modeling Guidelines. August, 2007. Arizona Department of Water Resources Flood Mitigation Section.

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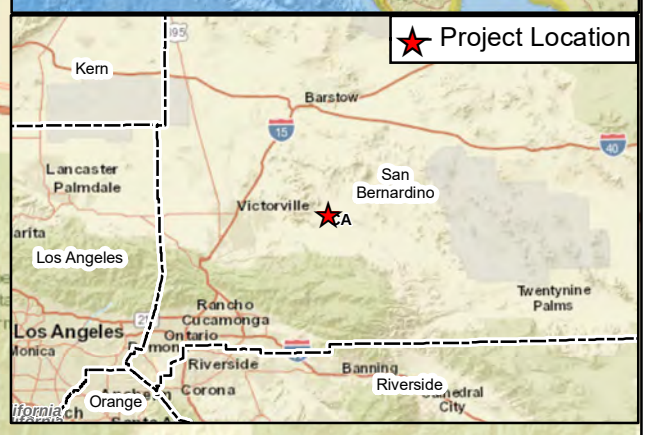
National Weather Service in San Diego. Updated May 2017. A History of Significant Weather Events in Southern California: Organized by Weather Type.

Exhibits

Map Document: N:\0012746.00\GIS\Hydro Exhibits\Preliminary Hydro\2022-02-28\Sienna_EX1LocationMap_180619.mxd mshildreth 2/28/2022 2:31:35 PM



Data Source(s): Westwood (2022)
ESRI NAIP Basemap Imagery (Accessed 2018),
USGS (2018).

Legend

- Project Boundary
- FLO-2D Boundary
- County Boundary

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N

0 Mile 4

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San Bernardino County, California

Exhibit 1: Location Map

February 28, 2022

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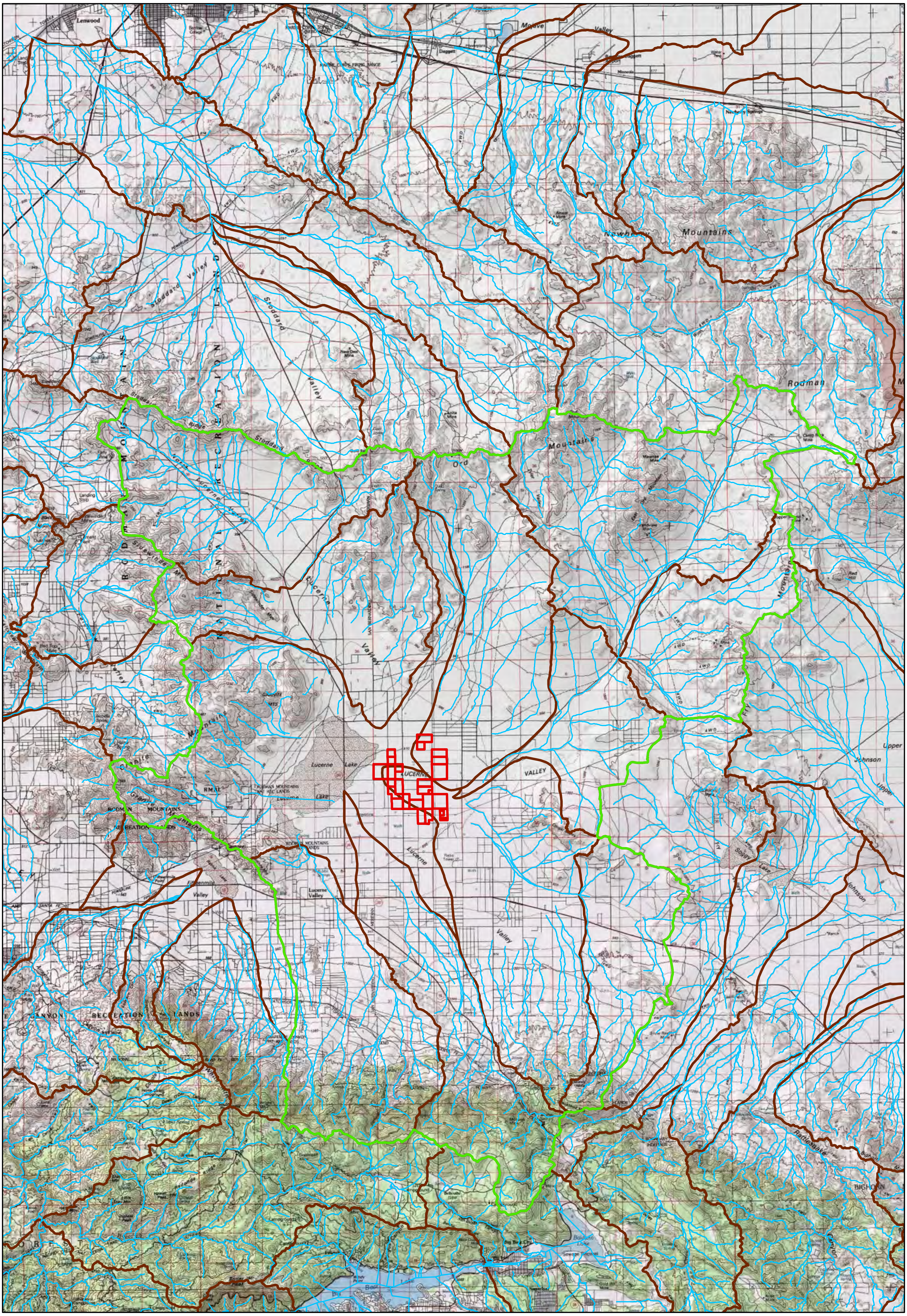

Data Source(s): Westwood (2022)
ESRI NAIP Basemap Imagery (Accessed 2018),
USGS (2018).

Legend

- Project Boundary
- FLO-2D Boundary
- County Boundary
- HUC 12 Boundary
- NHD Flowline

N

0 3 Mile

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Exhibit 2: Base Hydrology Map

February 28, 2022

Map Document: N:\0012746.00\GIS\Hydro Exhibits\Preliminary Hydro\2022-02-28\Sienna_EX3SoilsMap_180619.mxd mshildreth 2/28/2022 2:35:45 PM

Data Source(s): Westwood (2022)
ESRI NAIP Basemap Imagery (Accessed 2018),
USGS (2018).

Legend

- Project Boundary
- FLO-2D Boundary
- County Boundary

Hydrologic Soils Group

- A
- B
- C
- D

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Exhibit 3: Soils Map

N

0 3 Mile

February 28, 2022

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Map Document: N:\0012746.00\GIS\Hydro Exhibits\Preliminary Hydro\2022-02-28\Sienna_EX4LandcoverMap_180619.mxd mshildreth 2/28/2022 2:36:34 PM

N

0 3 Mile

Data Source(s): Westwood (2022)
ESRI NAIP Basemap Imagery (Accessed 2018),
USGS (2018).

Legend

Project Boundary
FLO-2D Boundary
County Boundary

Landcover

Barren
Cultivated
Developed
Fallow
Forested
Prairie/Pasture
Shrubland
Water

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San Bernardino County, California

Exhibit 4: Landcover Map

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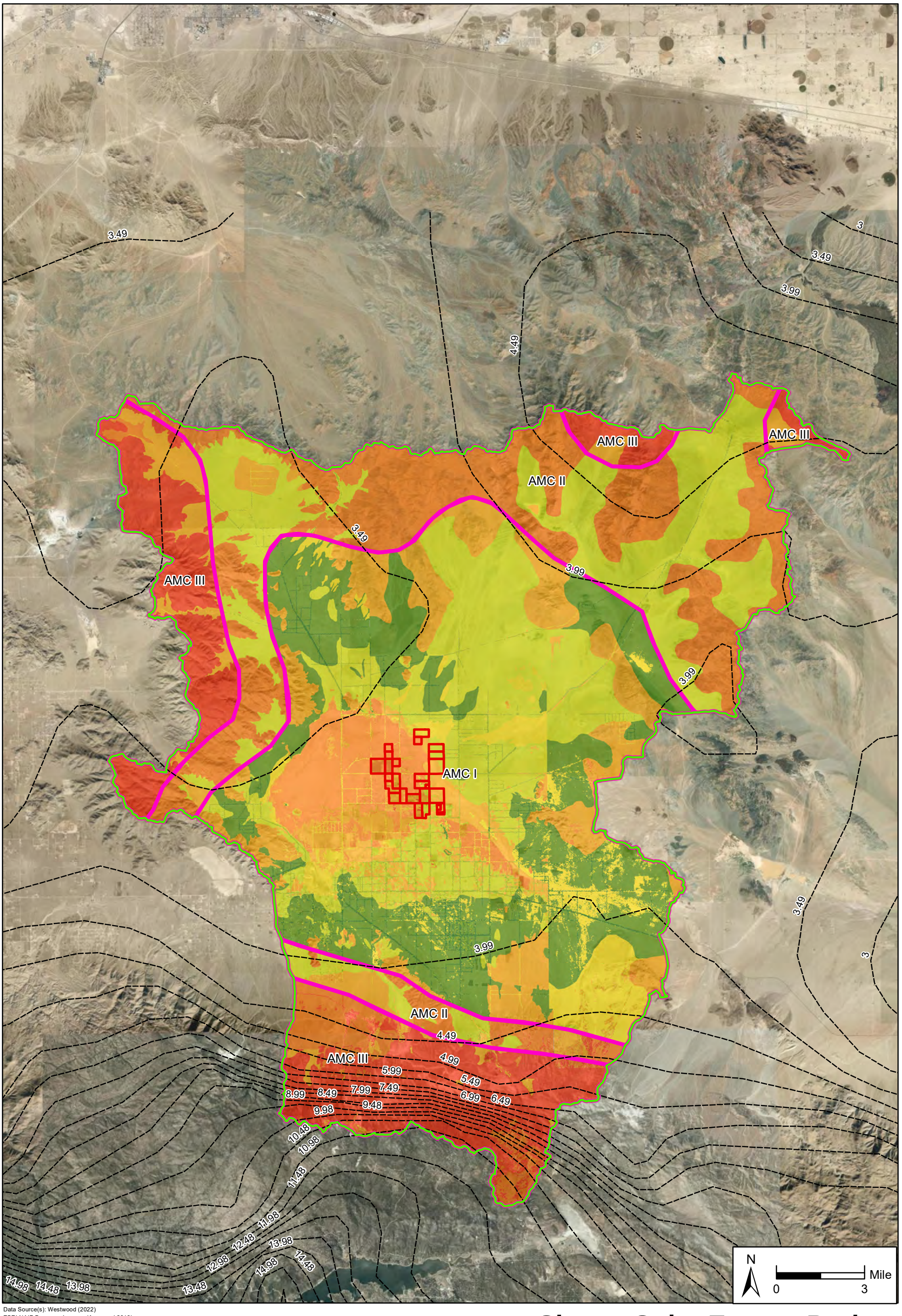
Map Document: N:\0012746.00\GIS\Hydro Exhibits\Preliminary Hydro\2022-02-28\Sienna_EX5CurveNumberMap_180619.mxd mshildreth 2/28/2022 2:39:19 PM



Data Source(s): Westwood (2022)
ESRI NAIP Basemap Imagery (Accessed 2018),
USGS (2018).

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Exhibit 5: Curve Number Map

February 28, 2022

Legend

- Project Boundary
- FLO-2D Boundary
- County Boundary

Curve Number

- 20 - 29
- 30 - 39
- 40 - 49
- 50 - 59
- 60 - 69
- 70 - 79
- 80 - 89
- 90 - 99

- AMC Condition
- 100-Year Variable Rainfall (in)

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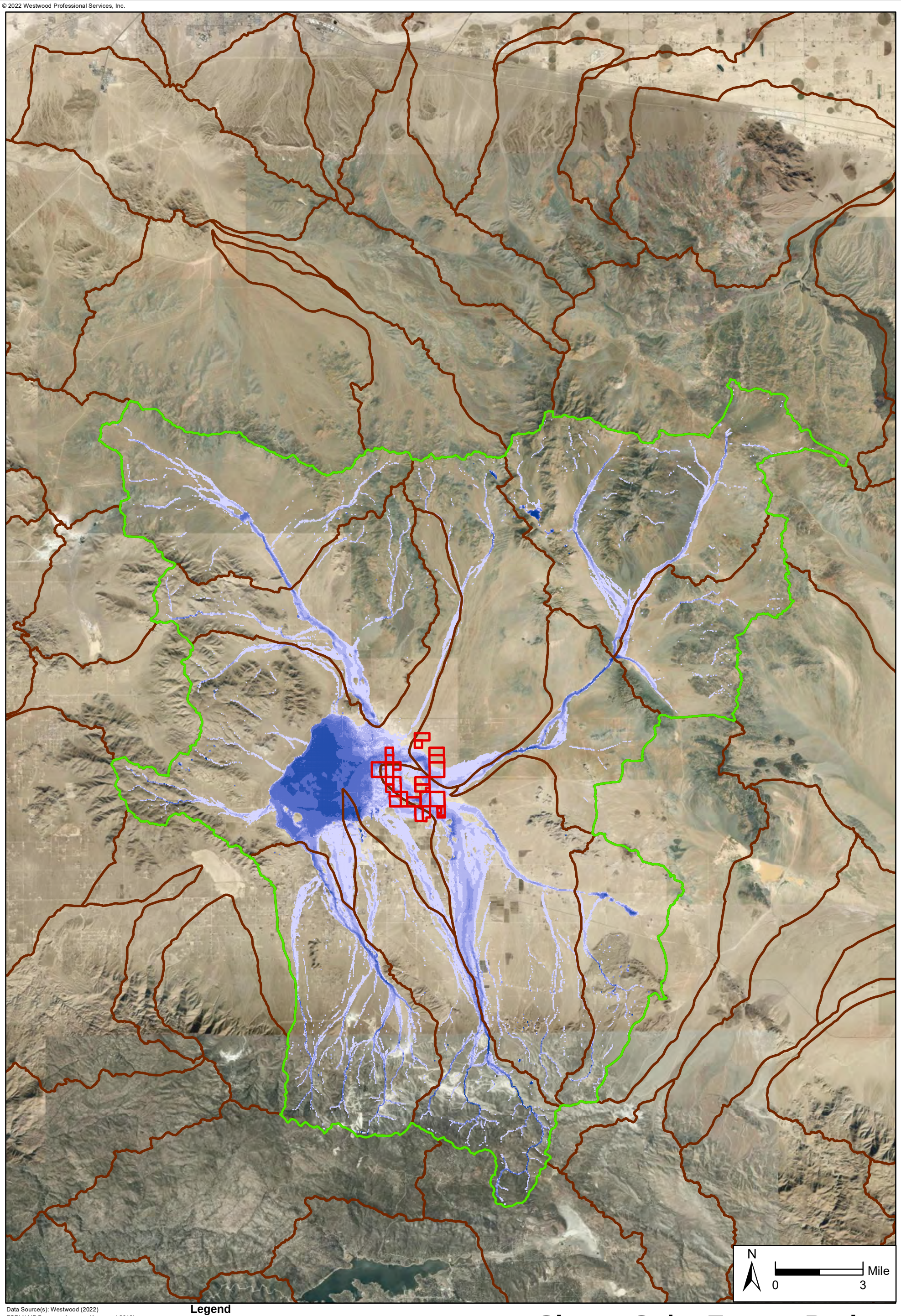
Map Document: N:\0012746.00\GIS\Hydro Exhibits\Preliminary Hydro\2022-02-28\Sienna_EX6MaxDepthSpatiallyVariedAMCMap_180619.mxd mshildreth 2/28/2022 2:41:25 PM



Data Source(s): Westwood (2022)
ESRI NAIP Basemap Imagery (Accessed 2018),
USGS (2018).

Legend

- Project Boundary
- Project Parcel
- FLO-2D Boundary
- County Boundary
- HUC 12 Boundary

Max Flow Depth (ft)

0.50 - 1.00
1.01 - 1.50
1.51 - 2.00
2.01 - 2.50
2.51 - 3.00
3.01 - 4.00
4.01 - 6.00
6.01 - 8.00
8.01+

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Exhibit 6: Max Flow Depth 100-Year Map

February 28, 2022

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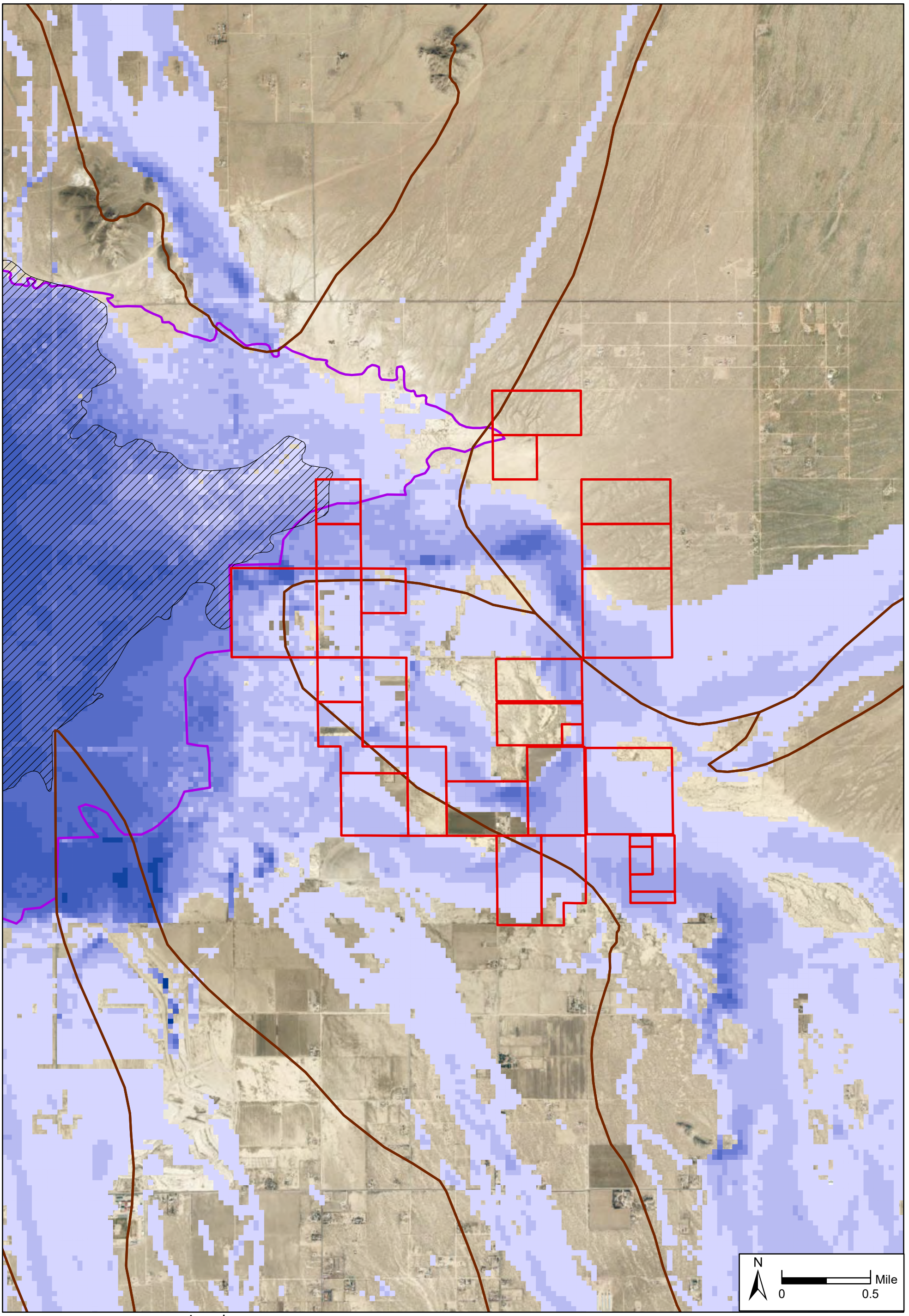

Data Source(s): Westwood (2022)
ESRI NAIP Basemap Imagery (Accessed 2018),
USGS (2018).

Legend

- Project Boundary
- Project Parcel
- FLO-2D Boundary
- County Boundary
- HUC 12 Boundary
- Digitized USA Topo Lake Outline
- Visually Digitized Dry Lake Outline

Max Flow Depth (ft)

0.50 - 1.00
1.01 - 1.50
1.51 - 2.00
2.01 - 2.50
2.51 - 3.00
3.01 - 4.00
4.01 - 6.00
6.01 - 8.00
8.01+

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San Bernardino County, California

Exhibit 6A: Max Flow Depth 100-Year Project Area Map

February 28, 2022

Map Document: N:\0012746.00\GIS\Hydro Exhibits\Preliminary Hydro\2022-02-28\Sienna_EX7PeakVelocitySpatiallyVariedAMCMap_180619.mxd mshildreth 2/28/2022 2:51:35 PM

N

0 Mile 3

Data Source(s): Westwood (2022)
ESRI NAIP Basemap Imagery (Accessed 2018),
USGS (2018).

Legend

- Project Boundary
- Project Parcel
- FLO-2D Boundary
- County Boundary
- HUC 12 Boundary

Peak Velocity (fps)

1.00 - 1.50
1.51 - 2.00
2.01 - 2.50
2.51 - 3.00
3.01 - 4.00
4.01+

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Exhibit 7: Peak Velocity 100-Year Map

February 28, 2022

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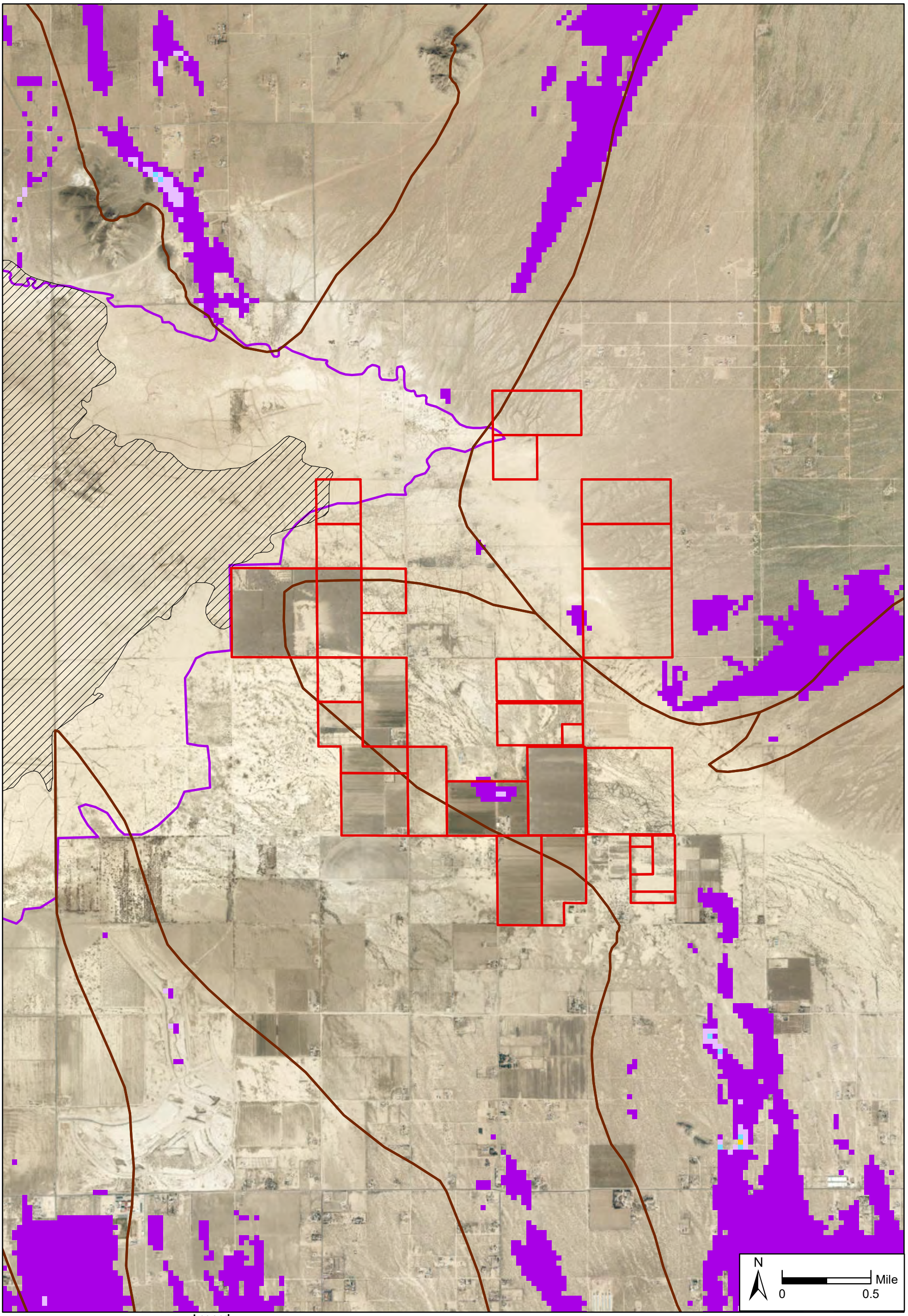

Data Source(s): Westwood (2022)
ESRI NAIP Basemap Imagery (Accessed 2018),
USGS (2018).

Legend

- Project Boundary
- Project Parcel
- FLO-2D Boundary
- County Boundary
- HUC 12 Boundary
- Digitized USA Topo Lake Outline
- Visually Digitized Dry Lake Outline

Peak Velocity (fps)

1.00 - 1.50
1.51 - 2.00
2.01 - 2.50
2.51 - 3.00
3.01 - 4.00
4.01+

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Exhibit 7A: Peak Velocity 100-Year Project Area Map

February 28, 2022

Appendix A

*Atlas 14 Rainfall Data**

At Project Site, See Exhibit 5 for regional rainfall depths.

NOAA Atlas 14, Volume 6, Version 2
Location name: Lucerne Valley, California, USA*
Latitude: 34.5051°, Longitude: -116.9574°
Elevation: 2851.47 ft**
* source: ESRI Maps
** source: USGS

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	0.086 (0.071-0.106)	0.118 (0.097-0.145)	0.163 (0.134-0.200)	0.201 (0.164-0.249)	0.257 (0.202-0.329)	0.302 (0.233-0.395)	0.351 (0.265-0.470)	0.403 (0.296-0.555)	0.478 (0.336-0.685)	0.538 (0.366-0.798)
10-min	0.124 (0.102-0.152)	0.169 (0.139-0.207)	0.233 (0.191-0.287)	0.288 (0.235-0.357)	0.368 (0.290-0.472)	0.433 (0.335-0.567)	0.503 (0.379-0.674)	0.578 (0.424-0.796)	0.685 (0.482-0.982)	0.771 (0.525-1.14)
15-min	0.150 (0.123-0.183)	0.204 (0.168-0.251)	0.282 (0.231-0.347)	0.348 (0.284-0.432)	0.445 (0.351-0.570)	0.524 (0.405-0.685)	0.609 (0.459-0.815)	0.699 (0.513-0.962)	0.828 (0.583-1.19)	0.933 (0.635-1.38)
30-min	0.209 (0.172-0.256)	0.285 (0.235-0.350)	0.393 (0.323-0.484)	0.486 (0.396-0.603)	0.621 (0.490-0.796)	0.731 (0.565-0.956)	0.849 (0.640-1.14)	0.975 (0.715-1.34)	1.16 (0.813-1.66)	1.30 (0.886-1.93)
60-min	0.274 (0.226-0.336)	0.375 (0.308-0.460)	0.517 (0.424-0.636)	0.638 (0.520-0.792)	0.816 (0.643-1.05)	0.960 (0.742-1.26)	1.12 (0.841-1.49)	1.28 (0.940-1.76)	1.52 (1.07-2.17)	1.71 (1.16-2.54)
2-hr	0.370 (0.305-0.453)	0.492 (0.405-0.604)	0.664 (0.546-0.818)	0.812 (0.661-1.01)	1.02 (0.808-1.31)	1.20 (0.924-1.57)	1.38 (1.04-1.85)	1.57 (1.15-2.16)	1.84 (1.30-2.64)	2.05 (1.40-3.04)
3-hr	0.439 (0.362-0.538)	0.580 (0.477-0.711)	0.776 (0.637-0.954)	0.944 (0.769-1.17)	1.19 (0.935-1.52)	1.38 (1.07-1.81)	1.59 (1.20-2.13)	1.81 (1.33-2.49)	2.11 (1.49-3.02)	2.34 (1.60-3.48)
6-hr	0.570 (0.470-0.699)	0.749 (0.617-0.919)	0.997 (0.818-1.23)	1.21 (0.985-1.50)	1.51 (1.19-1.94)	1.76 (1.36-2.30)	2.01 (1.52-2.70)	2.28 (1.67-3.14)	2.66 (1.87-3.81)	2.95 (2.01-4.37)
12-hr	0.687 (0.566-0.842)	0.930 (0.765-1.14)	1.27 (1.04-1.56)	1.55 (1.26-1.92)	1.95 (1.54-2.50)	2.28 (1.76-2.98)	2.61 (1.97-3.50)	2.97 (2.18-4.09)	3.45 (2.43-4.95)	3.84 (2.61-5.69)
24-hr	0.856 (0.759-0.985)	1.20 (1.07-1.39)	1.68 (1.48-1.94)	2.08 (1.82-2.42)	2.65 (2.24-3.19)	3.10 (2.57-3.81)	3.57 (2.90-4.50)	4.08 (3.21-5.28)	4.78 (3.62-6.45)	5.34 (3.91-7.46)
2-day	1.00 (0.887-1.15)	1.43 (1.26-1.65)	2.02 (1.79-2.34)	2.52 (2.21-2.93)	3.21 (2.72-3.86)	3.76 (3.12-4.62)	4.34 (3.52-5.47)	4.96 (3.91-6.42)	5.81 (4.40-7.85)	6.49 (4.75-9.07)
3-day	1.07 (0.953-1.24)	1.55 (1.37-1.78)	2.21 (1.95-2.55)	2.76 (2.42-3.21)	3.52 (2.99-4.24)	4.13 (3.43-5.08)	4.77 (3.86-6.00)	5.45 (4.29-7.05)	6.40 (4.84-8.63)	7.17 (5.24-10.0)
4-day	1.13 (0.998-1.30)	1.63 (1.44-1.88)	2.34 (2.07-2.71)	2.94 (2.57-3.42)	3.76 (3.19-4.53)	4.42 (3.67-5.43)	5.11 (4.14-6.43)	5.84 (4.60-7.56)	6.87 (5.20-9.27)	7.69 (5.62-10.7)
7-day	1.19 (1.06-1.37)	1.75 (1.55-2.01)	2.55 (2.25-2.94)	3.22 (2.82-3.75)	4.18 (3.54-5.03)	4.94 (4.10-6.07)	5.72 (4.64-7.21)	6.56 (5.17-8.49)	7.72 (5.84-10.4)	8.64 (6.31-12.1)
10-day	1.24 (1.10-1.42)	1.83 (1.62-2.11)	2.70 (2.38-3.11)	3.43 (3.01-4.00)	4.50 (3.81-5.41)	5.34 (4.43-6.56)	6.22 (5.04-7.83)	7.14 (5.63-9.24)	8.45 (6.39-11.4)	9.47 (6.92-13.2)
20-day	1.35 (1.20-1.56)	2.07 (1.83-2.39)	3.14 (2.78-3.63)	4.08 (3.57-4.75)	5.45 (4.62-6.56)	6.57 (5.45-8.07)	7.73 (6.27-9.74)	8.96 (7.06-11.6)	10.6 (8.04-14.3)	11.9 (8.73-16.7)
30-day	1.49 (1.32-1.72)	2.31 (2.04-2.66)	3.56 (3.14-4.11)	4.67 (4.09-5.44)	6.33 (5.37-7.62)	7.67 (6.37-9.43)	9.07 (7.35-11.4)	10.5 (8.31-13.6)	12.5 (9.49-16.9)	14.1 (10.3-19.6)
45-day	1.70 (1.51-1.95)	2.66 (2.35-3.06)	4.14 (3.66-4.79)	5.49 (4.81-6.39)	7.54 (6.39-9.07)	9.23 (7.66-11.3)	11.0 (8.90-13.8)	12.8 (10.1-16.6)	15.3 (11.6-20.6)	17.1 (12.5-23.9)
60-day	1.84 (1.63-2.11)	2.89 (2.56-3.33)	4.56 (4.03-5.27)	6.08 (5.33-7.08)	8.39 (7.11-10.1)	10.3 (8.57-12.7)	12.4 (10.0-15.6)	14.4 (11.4-18.7)	17.3 (13.1-23.3)	19.4 (14.2-27.0)

[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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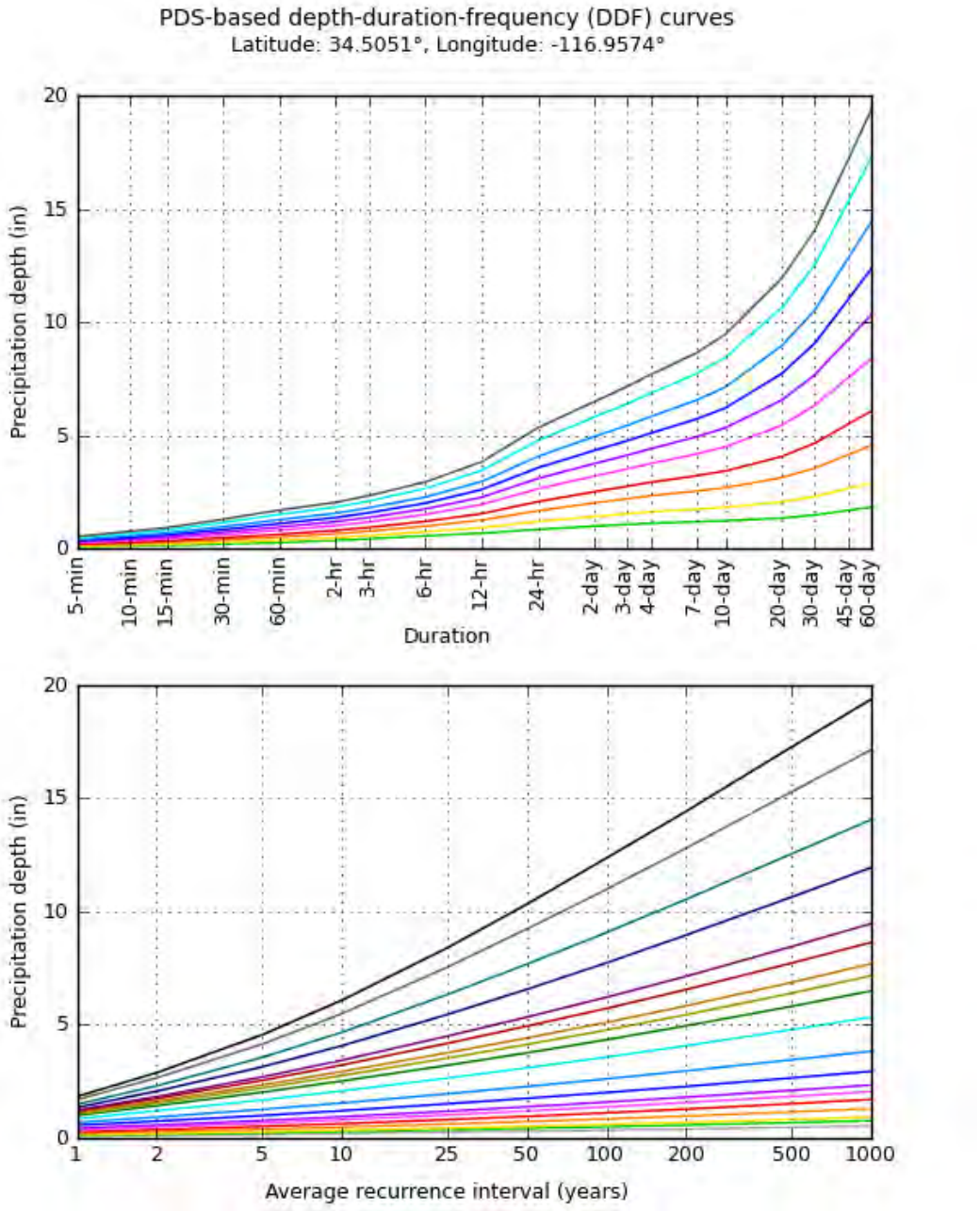
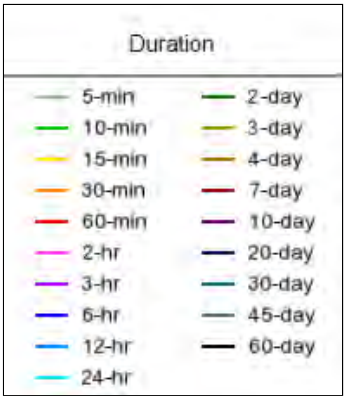
PF graphical





NOAA Atlas 14, Volume 6, Version 2

Created (GMT): Thu Jun 29 18:01:10 2017

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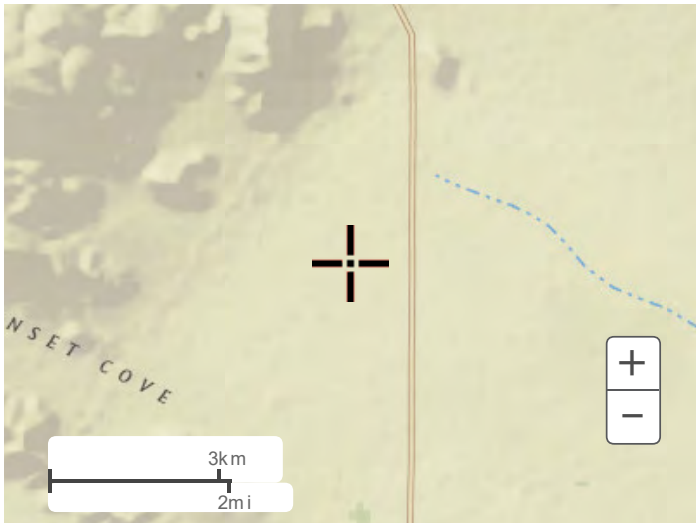
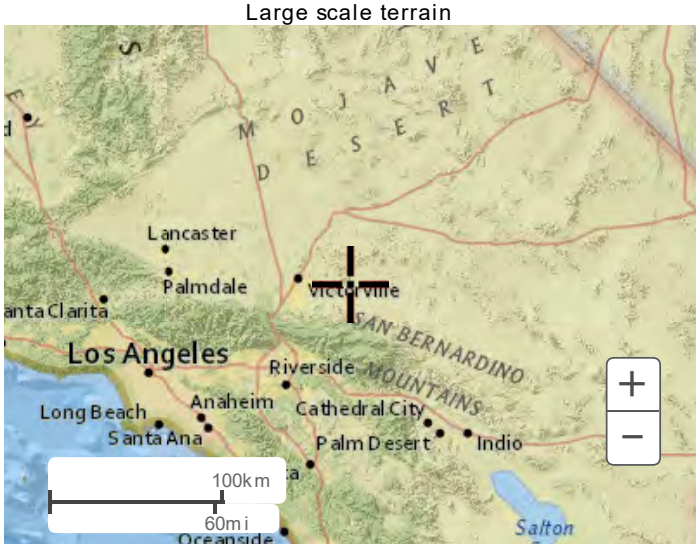
Maps & aerials

Small scale terrain



Large scale terrain



Large scale map

Large scale aerial

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US Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service
National Water Center
1325 East West Highway
Silver Spring, MD 20910
Questions?: HDSC.Questions@noaa.gov

Appendix B

Curve Number Table

Table 2. Semi-Arid Curve Numbers (adapted from NEH 630)

Class	Value	Classification Description	Curve Number				
			Soil Type*				
			A	B	C	D	W
Water	11	Open Water - areas of open water, generally with less than 25% cover of vegetation or soil.	98	98	98	98	100
	12	Perennial Ice/Snow - areas characterized by a perennial cover of ice and/or snow, generally greater than 25% of total cover.	98	98	98	98	100
Developed	21	Developed, Open Space - areas with a mixture of some constructed materials, but mostly vegetation in the form of lawn grasses. Impervious surfaces account for less than 20% of total cover. These areas most commonly include large-lot single-family housing units, parks, golf courses, and vegetation planted in developed settings for recreation, erosion control, or aesthetic purposes.	46	65	77	82	100
	22	Developed, Low Intensity - areas with a mixture of constructed materials and vegetation. Impervious surfaces account for 20% to 49% percent of total cover. These areas most commonly include single-family housing units.	61	75	83	87	100
	23	Developed, Medium Intensity – areas with a mixture of constructed materials and vegetation. Impervious surfaces account for 50% to 79% of the total cover. These areas most commonly include single-family housing units.	77	85	90	95	100
	24	Developed High Intensity -highly developed areas where people reside or work in high numbers. Examples include apartment complexes, row houses and commercial/industrial. Impervious surfaces account for 80% to 100% of the total cover.	89	92	94	95	100
Barren	31	Barren Land (Rock/Sand/Clay) - areas of bedrock, desert pavement, scarps, talus, slides, volcanic material, glacial debris, sand dunes, strip mines, gravel pits and other accumulations of earthen material. Generally, vegetation accounts for less than 15% of total cover.	77	86	91	94	100
Forest	41	Deciduous Forest - areas dominated by trees generally greater than 5 meters tall, and greater than 20% of total vegetation cover. More than 75% of the tree species shed foliage simultaneously in response to seasonal change.	43	55	70	77	100
	42	Evergreen Forest - areas dominated by trees generally greater than 5 meters tall, and greater than 20% of total vegetation cover. More than 75% of the tree species maintain their leaves all year. Canopy is never without green foliage.	43	55	70	77	100
	43	Mixed Forest - areas dominated by trees generally greater than 5 meters tall, and greater than 20% of total vegetation cover. Neither deciduous nor evergreen species are greater than 75% of total tree cover.	43	55	70	77	100
Shrubland	51	Dwarf Scrub - Alaska only areas dominated by shrubs less than 20 centimeters tall with shrub canopy typically greater than 20% of total vegetation. This type is often co-associated with grasses, sedges, herbs, and non-vascular vegetation.	55	71	81	89	100
	52	Shrub/Scrub - areas dominated by shrubs; less than 5 meters tall with shrub canopy typically greater than 20% of total vegetation. This class includes true shrubs, young trees in an early successional stage or trees stunted from environmental conditions.	55	71	81	89	100
Herbaceous	71	Grassland/Herbaceous - areas dominated by gramanoid or herbaceous vegetation, generally greater than 80% of total vegetation. These areas are not subject to intensive management such as tilling, but can be utilized for grazing.	55	71	81	89	100
	72	Sedge/Herbaceous - Alaska only areas dominated by sedges and forbs, generally greater than 80% of total vegetation. This type can occur with significant other grasses or other grass like plants, and includes sedge tundra, and sedge tussock tundra.	55	71	81	89	100
	73	Lichens - Alaska only areas dominated by fruticose or foliose lichens generally greater than 80% of total vegetation.	55	71	81	89	100
	74	Moss - Alaska only areas dominated by mosses, generally greater than 80% of total vegetation.	55	71	81	89	100
Planted/Cultivated	81	Pasture/Hay – areas of grasses, legumes, or grass-legume mixtures planted for livestock grazing or the production of seed or hay crops, typically on a perennial cycle. Pasture/hay vegetation accounts for greater than 20% of total vegetation.	55	71	81	89	100
	82	Cultivated Crops – areas used for the production of annual crops, such as corn, soybeans, vegetables, tobacco, and cotton, and also perennial woody crops such as orchards and vineyards. Crop vegetation accounts for greater than 20% of total vegetation. This class also includes all land being actively tilled.	67	78	85	89	100
	83	Small Grains	63	75	83	87	100
Wetlands	91	Woody Wetlands - areas where forest or shrubland vegetation accounts for greater than 20% of vegetative cover and the soil or substrate is periodically saturated with or covered with water.	45	66	77	83	100
	92	Emergent Herbaceous Wetlands - Areas where perennial herbaceous vegetation accounts for greater than 80% of vegetative cover and the soil or substrate is periodically saturated with or covered with water.	45	66	77	83	100

*A/D, B/D and C/D soils lumped as D soils, W denotes water

**Curve Numbers for NLCD Codes 41-43 have been increased from 30 to 43 as many of these areas are partially grazed Woods-grass combination.

Appendix C

CEQA Appendix IX Hydrology And Water Quality

IX. HYDROLOGY AND WATER QUALITY -- Would the project:	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less Than Significant Impac	No Impact
a) Violate any water quality standards or waste discharge requirements?	❐	❐	❐	☒
b) Substantially deplete groundwater supplies or interfere substantially with groundwater recharge such that there would be a net deficit in aquifer volume or a lowering of the local groundwater table level (e.g., the production rate of pre-existing nearby wells would drop to a level which would not support existing land uses or planned uses for which permits have been granted)?	❐	❐	❐	☒
c) Substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, in a manner which would result in substantial erosion or siltation on- or off-site?	❐	❐	❐	☒
d) Substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, or substantially increase the rate or amount of surface runoff in a manner which would result in flooding on- or off-site?	❐	❐	❐	☒
e) Create or contribute runoff water which would exceed the capacity of existing or planned stormwater drainage systems or provide substantial additional sources of polluted runoff?	❐	❐	❐	☒
f) Otherwise substantially degrade water quality?	❐	❐	❐	☒
g) Place housing within a 100-year flood hazard area as mapped on a federal Flood Hazard Boundary or Flood Insurance Rate Map or other flood hazard delineation map?	❐	❐	❐	☒

h) Place within a 100-year flood hazard area structures which would impede or redirect flood flows?	❒	❒	❒	☒
i) Expose people or structures to a significant risk of loss, injury or death involving flooding, including flooding as a result of the failure of a levee or dam?	❒	❒	❒	☒
j) Inundation by seiche, tsunami, or mudflow?	❒	❒	❒	☒

Appendix D
Anecdotal Flooding Accounts

Westwood

7699 Anagram Drive
Eden Prairie, MN 55344

Main (952) 937-5150
Fax (952) 937-5822

westwoodps.com
(888) 937-5150

MEMORANDUM

Date: August 24, 2018

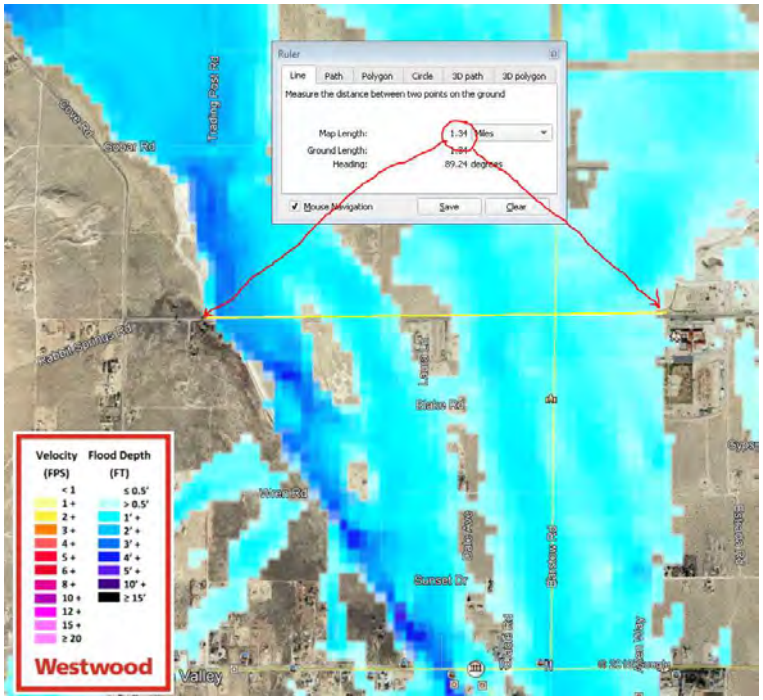
Re: **Sienna Preliminary Hydrology Study Anecdotal Flooding Accounts**
Westwood Project #R0012746.00

To: 8minuteenergy

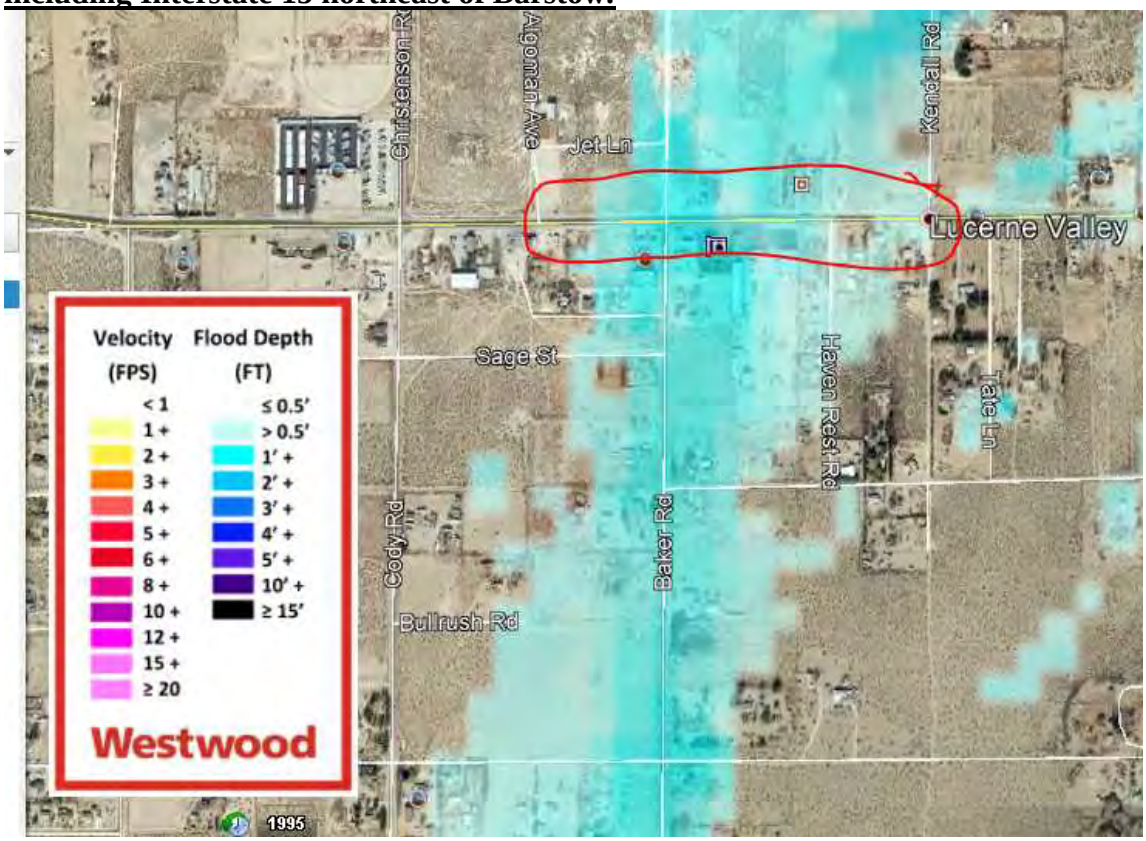
From: Westwood Professional Services

This memo serves to provide validation to the hydrologic model produced for the preliminary hydrology study for Sienna Solar Project. The anecdotal reports come from *A History of Significant Weather Events in Southern California: Organized by Weather Type* produced by the National Weather Service in San Diego in May 2017.

9/5/1958: A heavy thunderstorm struck the Lucerne Valley area. Floodwaters covered Rabbit Springs Rd up to one foot deep for over a mile.



8/12/1972 Tropical Storm Diane sent moisture into the region which produced thunderstorms across Southern California. 2.1 inches of rain fell in Lucerne Valley in less than one hour. 0.38" fell in Riverside, and 0.31" in Big Bear Lake. Flash floods left a foot of silt on downtown Lucerne Valley and closed several highways, including Interstate 15 northeast of Barstow.



Appendix E

California Water Balance Calculator

Owner Info | Developer Info | Site Info | Risk | Addl. Site Info | Post Construction | Billing Info | Attachments | Certification | Reports | Inspections | Print | Status History | Linked Users | NOTs | COIs

Is the project located within a permitted Phase I or Phase II Municipal Separate Storm Sewer System (MS4) area? No

Note: Non-traditional small MS4s that lie within a Phase I or II MS4 area but are NOT designated must comply with the Construction General Permit post construction calculator.

Will the project use an alternative method to calculate runoff volume or use different site design measures than those listed in the CGP calculator? No

Will the project be subdivided into smaller sub-areas or drainage management areas? No

INPUT FOR WATERSHED: Enter watershed details and click on the Compute & Save button.

I.a. Name: Sienna

I.b. County: San Bernardino

I.c. Closest Location: Victorville Pump Plant

I.d. Size(acres): 1855

Pre-Construction INPUT

I.e. Dominant Soil Type: Group D Soils - Very low infiltration. Clay loam, silty clay loam, sandy clay, silty clay, or clay. Infiltration rate 0 to 0.05 inch/hr when wet.

I.f. Existing Dominant Non-built Land Use Type: Natural Desert

I.g. Existing rooftop impervious area(acres): 0

I.h. Existing non-rooftop impervious area(acres): 0

Post-Construction INPUT

I.i. Proposed Dominant Non-built Land Use Type: Natural Desert

I.j. Proposed rooftop impervious area(acres): 0

I.k. Proposed non-rooftop impervious area(acres): 74.2

Compute & Save

OUTPUT:

O.a. Existing Runoff Curve Number:	88	O.d. Proposed Runoff Curve Number:	88.4
O.b. Design Storm(inches):	0.46	O.e. Net Credit of Volume Credits(Cubic feet):	
O.c. Pre-project Runoff Volume(Cubic Feet):	152,269.31	O.f. Post-project Runoff Volume(Cubic Feet):	174,070.84
O.g. Post-project Runoff Volume minus Volume Credits(Cubic Feet):			

***Post-project Runoff Volume > Pre-project Runoff Volume. Please perform volume credit calculations by clicking on the links below.