

APPENDIX D WATER SUPPLY ASSESSMENT AND PRELIMINARY HYDROLOGY REPORT

July 25, 2022







Lead Agency:

Sacramento Municipal Utility District
6201 S Street
Sacramento, CA 95817
or
P.O. Box 15830
Sacramento, CA 95852-0830
Attn: Amy Spitzer, Environmental Specialist, Environmental Services (916) 732-5384 or amy.spitzer@smud.org

Prepared by:

AECOM 2020 L Street, Suite 300 Sacramento, CA 95811 Contact: Jody Fessler (916) 414-5800



TABLE OF CONTENTS

| ACRO | NYMS AND OTHER ABBREVIATIONS | 2 |
|-------------------------------|---|----------------|
| 1 | INTRODUCTION | 3 |
| 2 | PROJECT WATER DEMAND | 6 |
| 3 | WATER RESOURCE ANALYSIS | |
| 4 | COMPARISON OF SUPPLY AND DEMAND | 18 23 |
| 5 | CONCLUSIONS | 27 |
| 6 | REFERENCES | 28 |
| APPE Appen | dix A Dust Control Water Estimation | |
| Figure | Site Location Map with Proposed Project Elements Agricultural Wells in the Project Area Groundwater Levels just North of the Project Area | 21 |
| TABL | ES | |
| Table 2 Table 3 Table 4 | Existing Land Use | 14 14 20 |



ACRONYMS AND OTHER ABBREVIATIONS

AB Assembly Bill

AFY acre-feet per year

BESS battery energy storage system
CAW California American Water

CEQA California Environmental Quality Act

CIMIS California Irrigation Management Information System

DWR California Department of Water Resources

ETo crop evapotranspiration

eWRIMS Electronic Water Rights Information Management System

GSAs groundwater sustainability agencies

Kc crop coefficient

MGD million gallons per day

ETc evapotranspiration for a specific crop

PCWA Placer County Water Agency

PV photovoltaic SB Senate Bill

SGMA Sustainable Groundwater Management Act

SMUD Sacramento Municipal Utility District
SWRCB State Water Resources Control Board



1 INTRODUCTION

1.1 PURPOSE OF THE DOCUMENT

California Water Code §10910 (also known as Senate Bill (SB) 610 or the Water Supply Assessment statute) requires as part of the approval for certain types of projects, a specific analysis of whether there is a sufficient water supply available to serve the proposed project. Per the statute, a water supply assessment is required for development projects that are both subject to the California Environmental Quality Act (CEQA) and considered a "project" under California Water Code §10912. For new industrial facilities, a project is defined as a proposed industrial, manufacturing, or processing plant, or industrial park planned to house more than 1,000 persons, occupying more than 40 acres of land, or having more than 650,000 square feet of floor area. Because the Country Acres Solar Project (proposed project) would be considered a "project" under California Water Code §10912(a)(5), it is subject to SB 610 requirements including preparation of a water supply assessment.

This water supply assessment has been prepared in accordance with California Water Code §10910 *et seq.* to identify water demands for the proposed project and identify if there is sufficient supplies to serve the project demand over the next 30 years.

1.2 PROJECT BACKGROUND

Sacramento Municipal Utility District (SMUD) proposes to build and operate the proposed project: a photovoltaic (PV) solar power and battery storage renewable energy generation facility interconnected to SMUD's transmission grid in southwestern Placer County, California. Project components include PV solar panels, battery storage facilities, and interconnection facilities including a generation substation, switch station, and interconnection lines to the existing SMUD transmission system. SMUD plans to purchase the solar power generated from the renewable energy generation facility through a contract with a third party, who would design, construct and operate the project. The Project is proposed to support SMUD's 2030 Zero Carbon Plan.

The project would be located on up to approximately 1,170 acres of land in rural, western Placer County, California, west of the City of Roseville, north of Baseline Road and east of South Brewer Road (Figure 1). The project area encompasses several parcels and includes a northern segment and a southern segment connected by an easement for access and collection lines. Up to 910 acres of land would be leased by SMUD and up to 225 acres of land would be purchased by SMUD for the project. The remainder of the approximately 1,170 acres includes the easements for access and collection lines.

Existing land uses within the project area include agricultural rice fields and almond orchards, and some annual non-native grassland with seasonal wetlands. Existing agricultural land use on the project site is described in Table 1. Irrigation wells exist throughout the project site. These wells are powered either via overhead electrical distribution lines, diesel, or propane fuel.



Table 1. Existing Land Use

| Land Cover Type | Project Area (acres) | Impact Footprint (acres) |
|------------------------|----------------------|--------------------------|
| Rice Field | 872.8 | 829.8 |
| Almond Orchard | 131.5 | 110.2 |
| Irrigated Pasture | 0.03 | 0.02 |
| Non-Agricultural Lands | 165.6 | 93.6 |
| Total Area | 1,169.9 | 1,033.6 |

Note: The impact footprint is based on overlay of 10% design features and a map of habitat types prepared in support of CEQA compliance; as presented in the biological resources section of the Draft EIR for the project.

While much of the project area is currently in agricultural production (rice, orchards), seasonal wetlands, cattail marsh, vernal pools, drainages, riparian vegetation, and creeks also occur within the project area. Curry Creek is the drainage that bisects the project area. Curry Creek and many of the other drainages and creeks in the area have been channelized and exhibit perennial or near-perennial hydrology as influenced by adjacent rice field and pasture irrigation practices.

Construction of the project would take approximately 18 months to 2 years to complete. Initial mobilization would include preparing and constructing site access road improvements, removal of existing agricultural operations, establishing temporary construction trailers and sanitary facilities, preparing construction staging areas, and preparing access areas near existing onsite wells. Once site mobilization is complete, construction of the PV solar panels, battery storage facilities, and interconnection facilities would commence.

Once construction is complete, the project would operate seven days per week. One regular onsite employee may be required, and some personnel may visit the site to monitor, maintain, and if needed, repair, the system. Both the switch station and the substation are planned with site control center buildings. The buildings would be less than 3,600 square feet in size and include restrooms connected to a septic system. Access to potable water would be either via treated groundwater or water delivery, if needed.

Compatible agricultural activities such as grazing and/or pollinator habitat would be integrated into the solar operations. Water would be needed to establish pollinator habitat and/or for use in stock watering.

At the end of the project's useful life (anticipated to be 30 years or more), the project will be decommissioned. Currently, standard decommissioning practices include dismantling and repurposing, salvaging/recycling, or disposing of the solar energy improvements, and site stabilization. Additional environmental analysis will be conducted prior to decommissioning, when future land use of the site is known.



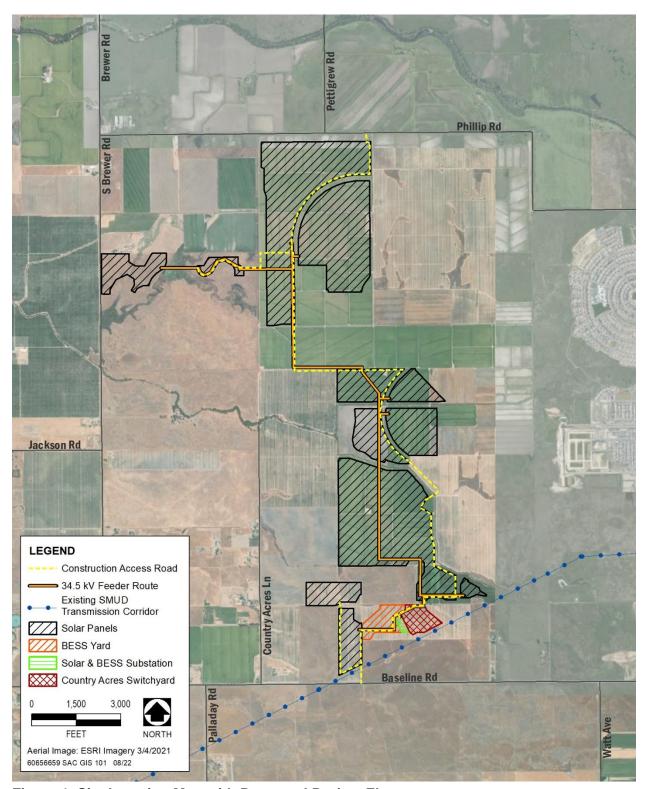


Figure 1. Site Location Map with Proposed Project Elements



2 PROJECT WATER DEMAND

2.1 CONSTRUCTION WATER DEMAND

Water would be used during construction for the following activities:

- Dust control,
- Compaction/backfill,
- Pouring concrete foundations for the inverter enclosures and transformers, the battery
 energy storage system (BESS), generation substation and switchyard components, and
 interconnection poles and for use at the associated concrete washout stations, and
- Potable water and sanitary facilities would be needed for the temporary construction office and the expected average workforce of 177 persons.

Water used for dust control and for compaction/backfill is expected to be sourced from onsite wells. Non-potable water for concrete foundations and concrete washout stations, and for temporary sanitary facilities, is expected to be trucked to the project site. Potable water for the temporary construction office and the construction work force is also expected to be trucked to the site. ¹

The primary water demand associated with construction would be for compaction and dust control. It is estimated that these construction activities would require approximately 100 acrefeet of non-potable water from on-site wells (see Appendix A).

2.2 OPERATION AND MAINTENANCE WATER DEMAND

Water would be used for the following operations and maintenance activities:

- PV panels may be periodically washed with water during project operation. To
 conservatively estimate potential panel washing operational water use, it is estimated that
 solar panels would be washed once per year in case of excessive soiling.
- The site control center buildings include restrooms connected to a septic system. Water for the site control buildings is expected to be sourced from onsite wells. Landscaping at the site control center buildings is not anticipated at this time.
- In addition, pumped groundwater would likely be needed to support compatible agricultural activities such as grazing and/or pollinator habitat.

The primary water demand during operation and maintenance of the project is expected to be the PV panel washing. It is estimated that 5 acre-feet of water will be used for washing the solar

¹ For the purposes of a water supply assessment, hauled water is not considered as a source of water (California Water Code §10910(i)).



panels once a year (estimate provided by SMUD). The project would either use water from existing on-site wells, or a new well would be installed for the project.

It is assumed that there would be two restrooms at the site control center buildings for use by the one regular onsite employee and by the personnel that would visit the site to monitor, maintain, and repair the system. Sanitary water use in industrial settings can be estimated at 10 to 25 gallons per person per shift or 20 and 35 gallons per day per employee for domestic demands (EPA 2021). Assuming a conservative average of two employees each using 35 gallons of water per day, estimated water use would be less than 0.1 acre-feet per year (AFY).

Groundwater is expected to be pumped to support limited agricultural activities such as grazing and/or establishment of pollinator habitat. Sheep grazing is one of the activities being considered in fenced areas near the solar arrays. Although sheep obtain most of their water requirements from forage consumption, stock watering of 0.5 to 1 gallons of water per head per day may also be needed (NRCS 1979). Assuming five ewes per acre over 1,033.6 acres with additional water requirements of 1 gallon per ewe per day, sheep supported on the solar fields would consume up to 5.8 AFY of pumped groundwater. It is assumed for the purpose of this analysis that up to 5.8 AFY of pumped groundwater would be used in a variety of future agricultural activities near the solar arrays.



3 WATER RESOURCE ANALYSIS

This section provides a summary of the requirements for a water supply assessment; it describes the water resources in the project area including the surface water drainage basin and the regional groundwater basin; and it provides information from water resource management plans which characterize these water supplies.

3.1 WATER SUPPLY ASSESSMENTS

This water supply assessment has been prepared in accordance with California Water Code §10910 *et seq.* to address the following questions.

- **Public water systems, §10910(b)-(c).** Is the project site within (or near) the service area for a public water system² that may supply water to the project?
 - Was the projected water demand associated with a proposed project accounted for in the most recently adopted urban water management plan?
 - If project demands were not accounted for in the urban water management plan, does the city, county, or public water system's total projected water supplies available during normal, single dry, and multiple dry water years during a 20-year projection meet the projected water demand associated with the proposed project, in addition to existing and planned future uses, including agricultural and manufacturing uses?
- **Entitlements, §10910(d)-(e)**. Are there existing water supply entitlements, water rights, or water service contracts relevant to the identified water supply for the proposed project?
 - How much water was received in prior years from the city, county, or public water systems (and will new infrastructure be required to deliver the water supply)?
 - Are there other public water systems or water service contract holders (which receive a water supply, or have existing water supply entitlements, water rights, or water service contracts) to the same source of water?
- Groundwater, §10910(f). Does the water supply for the proposed project include groundwater?
 - If so, information contained in the urban water management plan relevant to the identified water supply for the proposed project should be reviewed and groundwater basin or basins for the water supply should be described. The following information should be included: if the groundwater basin is adjudicated, overdrafted, or projected to be overdrafted, and if the groundwater sustainability agency has adopted a groundwater sustainability plan.
 - If groundwater is received from the city, county, or public water system, the amount and location
 of the groundwater pumping should be described, and the sufficiency of the groundwater to
 meet the projected water demand associated with the proposed project should be analyzed.

² A "public water system" is for the provision of piped water to the public for human consumption.



Note that for the purposes of this analysis, hauled water is not considered as a source of water, consistent with California Water Code §10910(i).

3.2 WATER RESOURCES

Regional water supplies are sourced from groundwater and surface water, with only a limited amount of recycled water/treated wastewater use in some urban areas. Most urban areas in Placer County (other than for the city of Lincoln) use surface water for their primary needs and only use groundwater during emergency, drought, or other conditions. Most agricultural areas have both surface water and groundwater supplies and conjunctively use these resources. As discussed below, water supplies within the project area are almost exclusively sourced from the groundwater basin.

3.2.1 Surface Water

The project site is within the Sacramento River Basin which covers approximately 26,500 square miles and is bounded by the Sierra Nevada to the east, the Coast Ranges to the west, the Cascade Range and Trinity Mountains to the north, and the Sacramento-San Joaquin Delta to the south. The primary tributaries to the Sacramento River are the Pit, Feather, and American Rivers. The project site is located within the southern portion of the basin in an area which has eastside drainages that discharge to the Sacramento River between its confluence with the Feather and American Rivers. The northern portion of the project site drains to Curry Creek and the southern end of the project site drains towards the Natomas East Main Drainage Canal (also referred to as Steelhead Creek).

The Steelhead Creek watershed encompasses approximately 25,000 acres in the greater Sacramento metropolitan area including portions of southwestern Placer County and northeastern Sacramento County. The southern portion of the project site drains towards an unnamed tributary to the Natomas East Main Drainage Canal located south of Sankey Road. The Natomas East Main Drainage Canal flows south from Sutter County into Sacramento County to a point just north the American River, where it turns west and discharges into the Sacramento River immediately upstream from its confluence with the American River.

The Curry Creek subwatershed encompasses approximately 10,200 acres in Placer and Sutter counties. Curry Creek discharges into the Pleasant Grove Creek Canal west of the project site and approximately 0.5 mile south of Pleasant Grove Creek in Sutter County. Water in the Pleasant Grove Creek Canal flows north, where it discharges into the Natomas Cross Canal (which flows southwest), and then discharges into the Sacramento River near Verona. Curry Creek was historically dry or very nearly dry in the summer months, but is now intermittent in some areas due to runoff from adjacent urban development and rice farming.

Curry Creek originates approximately 3 miles southeast of the project site in grassland habitat and flows west towards the project site as a relatively natural ephemeral drainage. The mainstem of Curry Creek flows through the middle portion of the project site in an east-west direction, where it is mapped as an intermittent drainage. Two other unnamed tributaries to Curry Creek enter and cross through the project site to the north, and like Curry Creek, they both originate to the east as ephemeral drainages (AECOM 2022).



There are approximately 20 water agencies, water districts, city/county water departments, and/or irrigation districts within the region that provide potable water to residents from supplies derived from surface and groundwater (or a combination of both). Irrigation districts typically provide surface water for agricultural use; they supply only a portion of the water needed for agriculture and the unmet demand is provided by privately owned wells. Surface water is brought into Placer County by water agencies through diversions from the American River from Folsom Reservoir; purchased water from the Yuba, Bear, and American rivers; and from water sourced from local surface waters derived principally from the Yuba River, Bear River, and Deer Creek watersheds (GEI 2021).

The project area is not within a service area for a water agency. The City of Roseville and California American Water (CAW) serve potable water to areas located north, east, and south of the project site and the South Sutter Water District provides agricultural supplies to areas west of the project site. The water used within the project area to flood existing rice fields and irrigate almond orchards is sourced from on-site wells that use groundwater. However, irrigated pastures that border the project area to the north and west appear to be irrigated by overland surface flow, with water pumped from a network of surface canals and ditches which are then allowed to sheet across the landscape toward annual grasslands (AECOM 2022).

3.2.2 Groundwater

The Sacramento Valley Groundwater Basin is the major groundwater basin in the Sacramento River hydrologic region. The project site is located near the center of the Sacramento Valley – North American Basin (North American Subbasin), Basin Code 5-021.64, which underlies northern Sacramento, southern Sutter, and western Placer counties. The subbasin is bounded by the Bear River on the north, the Feather River and Sacramento Rivers on the west, the American River on the south, and the Sierra Nevada foothills on the east. The subbasin encompasses approximately 535 square miles or approximately 342,000 acres of area. Placer, Sacramento, and Sutter counties each cover about one-third of the subbasin.

The North American Subbasin has one principal aquifer (some studies have indicated it includes both an upper and lower aquifer system). Sediments within the aquifer consist of alternating layers of clays, silts, sand, and gravel and although the freshwater bearing sand and gravel layers are not continuous, they are interconnected. Groundwater is recharged from surface infiltration and from inflow from adjacent groundwater subbasins. Recharge areas include those near the Sierra Nevada foothills; areas at some creeks, canals, and rivers; and general infiltration from the surface of the subbasin. Soils within the subbasin can contain claypans and hardpans which severely restrict infiltration; however, agricultural areas can provide large volumes of recharge where water is applied or ponded throughout the growing season (GEI 2021). More permeable soils can be found along local creeks and waterways including those present along the streambed of Curry Creek and its tributaries (NRCS 2022).

Groundwater in the subbasin is used for municipal, industrial, irrigation, domestic, stock watering, frost protection, and other purposes. There are about 3,800 domestic, agricultural, and/or municipal production wells in the subbasin. (Production wells have well casings greater than or equal to 4 inches and a total depth that is greater than or equal to 22 feet.) Most of the production wells in the subbasin are domestic wells, which are de-minimis extractors that pump less than 2 AFY (GEI 2021). There are also larger municipal wells that supply public water



systems. The subbasin is not adjudicated, nor are any of the surrounding groundwater subbasins.

Groundwater contours show a pumping depression in the central portion of the subbasin in Sacramento County that is currently about 20 to 30 feet below mean sea level. Groundwater flows radially toward this depression, from the fringes of the subbasin toward the center. This groundwater pumping depression developed in the 1960s due to agricultural and urban development, and lack of surface water supplies. Conjunctive use projects implemented since the mid-1990s have reversed the decline in groundwater levels; some areas have had substantial recoveries in groundwater elevations (up to 10 to 20 feet). The central groundwater pumping depression has stabilized, with groundwater levels declining during dry periods and recovering during wet periods (GEI 2021).

Historical land subsidence was documented in the early 1990s. Benchmark surveys showed about 0.3 feet of subsidence in some areas most likely due to groundwater levels declining during the 1950s through 1970s. However, since the 1990's, land subsidence has been negligible (GEI 2021).

Total dissolved solids, iron and manganese, arsenic, chromium (total and hexavalent), and nitrate concentrations are currently being monitored on a regional basis within the subbasin to evaluate general water quality conditions. In general, the quality of groundwater in the subbasin is suitable for nearly all uses with the exception of localized water quality issues (GEI 2021).

3.2.3 Recycled Water

Both the cities of Roseville and Lincoln are using recycled water and are planning to increase this use in the future. A portion of the treated wastewater from five wastewater treatment plants in the region is reused for irrigation of beltways, golf courses, and some agriculture along with some water features at golf courses. Recycled water is not a potential source of water supply to the project area.

3.3 WATER RESOURCES MANAGEMENT PLANS AND WATER SUPPLY ANALYSIS

This section includes a discussion of regional water resources management plans, including the groundwater sustainability plan and urban water management plans for the region. Conditions in the groundwater subbasin are further described, as is projected future water supplies.

3.3.1 North American Subbasin Groundwater Sustainability Plan

The Sustainable Groundwater Management Act (SGMA) was passed in 2014. It was created to facilitate sustainable management of groundwater supplies and empower local agencies to adopt groundwater sustainability plans. The SGMA requires that each high and medium priority groundwater basin is operated to a sustainable yield, balancing natural and artificial groundwater recharge with groundwater use, to ensure undesirable results such as chronic lowering of groundwater levels, loss of storage, water quality impacts, land subsidence, and impacts to hydraulically connected streams do not occur. The SGMA is considered part of the



statewide, comprehensive California Water Action Plan which includes water conservation, water recycling, expanded water storage, safe drinking water, and wetlands and watershed restoration.

California's groundwater basins are classified into one of four categories – high-, medium-, low-, or very low-priority – based on components identified in California Water Code §10933(b). Basin priority determines which provisions of the SGMA apply to the basin. The California Department of Water Resources (DWR) determined that the North American Subbasin (which includes the project site) is a high priority basin that is not in a state of critical overdraft.

The SGMA also requires that local agencies form one or more groundwater sustainability agencies (GSAs) and that the agencies located within high- or medium-priority basins adopt groundwater sustainability plans. The West Placer GSA was formed in 2017 to implement the SGMA in west Placer County. The west Placer GSA consists of four public agencies with water management or land use authority in Placer County – County of Placer, City of Roseville, City of Lincoln, and Placer County Water Agency – all of which are water purveyors. In addition, CAW, an investor-owned utility, also participates in the West Placer GSA.

The West Placer GSA and four other GSAs in Sutter, Placer, and Sacramento counties prepared the *North American Subbasin Groundwater Sustainability Plan* (GEI 2021) – a guidance document that explains how the basin will be managed sustainably over a 20-year timeframe. The groundwater sustainability plan defines the sustainable yield of the basin, identifies what would constitute undesirable results, and identifies what projects and actions will be implemented to avoid undesirable results. The North American Subbasin Groundwater Sustainability Plan was adopted by the five GSAs in the subbasin (Reclamation District 1001, Sacramento Groundwater Authority, South Sutter Water District, Sutter County GSA, and West Placer GSA) and was submitted to DWR in January 2022.

The North American Subbasin Groundwater Sustainability Plan provides estimates of current and projected conditions in the subbasin based on the Cosumnes-South American-North American model, a surface and groundwater numerical model that integrates the groundwater aquifer with surface hydrologies, land surface processes, and operations. Riverine inflows from the Bear, Feather, Sacramento, and American rivers were quantified by the model. Local tributaries were also accounted for including Racoon Creek, East Side Canal, Auburn Ravine, Pleasant Grove Creek, Pleasant Grove Creek Canal, Cross Canal, Natomas East Drain, Dry Creek, Magpie Creek, Arcade Creek, Buffalo Creek, and Alder Creek. Inputs and outputs from the land surface system include precipitation, surface water supply, and groundwater supply, as well as evapotranspiration, runoff to the stream system, return flows to the stream system, deep percolation, and other outflows. These surface processes contributed to the overall water balance for the groundwater system.

Water budgets were determined for the following scenarios:

 Recent Operations. Actual/historical conditions were simulated for water years 2009 to 2018 (a 10-year period). This modeling was used to evaluate the availability and reliability of past surface water supplies, the aquifer response, and trends in demands relative to water year type. Note that hydrologic conditions were drier during this 10-year period than the long-term average – eight of the ten water years were below normal, dry, or critical.



- **Current Conditions**. Current land and water use conditions were simulated using historical hydrologic conditions over water years 1970 to 2019 (a 50-year period) to analyze the long-term effects of current land and water use practices on groundwater conditions and to estimate inflows and outflows for the groundwater subbasin.
- Future Conditions with and without climate change. Future land and water use conditions
 were simulated using hydrologic data from water years 1970 to 2019 (a 50-year period) to
 assess future subbasin conditions. Future projected conditions include changes to land use,
 water supplies, and agricultural and urban demand. Climate change conditions were also
 modeled.

The modeling of current and future conditions considers the water budget from a long-term average annual basis to facilitate the assessment of long-term water supply reliability. This is in contrast to annual inflows and the outflows which change to a large degree based on water year type. In wet years, precipitation meets more of the water demand and greater recharge occurs from precipitation and stream flow. In dry years, more groundwater is pumped to meet the agricultural demand not met by precipitation and less recharge occurs from precipitation and stream flow. This contributes to an increase in groundwater storage in wet years and a decrease in dry years. Further, many water agencies practice conjunctive use, using more surface water in wet years and more groundwater in dry years to optimize their water supplies. While agricultural demand for applied water increases in dry years due to lack of precipitation, agricultural surface water supplies remain relatively consistent in most non-critical years (GEI 2021).

Table 2 shows annual average supply and demand by water year type and change in groundwater storage over the 29-year period from 1990 to 2018. This modeling indicates that there has been a net increase in groundwater storage during wet, above normal, and below normal years and a net deficit in groundwater storage in dry and critically dry years. The magnitude of the change in groundwater storage also differs by water year type. Major losses in groundwater storage occurred during critically dry years and substantial gains occurred during wet years. Table 2 also shows the more recent 10-year period between 2009 and 2018 which had two critically dry, two dry, and four below normal years, but still had net gains in groundwater storage.

Table 3 shows long-term annual average inflows and outflows to the groundwater subbasin and the average annual change in groundwater storage; also shown are the more recent operations between 2009 and 2018 as a basis for comparison. The results for future projections include planned growth and land use changes for forecasted conditions with and without climate change. This modeling indicates that the subbasin is currently within balance and projected conditions with climate change would result in only a slight imbalance. The subbasin currently has a surplus of water, which is consistent with measurements of groundwater levels rising in the central portions of the subbasin. This surplus groundwater condition would continue into the future but in lesser amounts. When future conditions are modeled with a central tendency climate change scenario, the subbasin is found to be in a modest overdraft.



Table 2. Historical Supply and Demand for the North American Subbasin

| | | Above | Below | | | Recent Operations |
|--|---------|---------|---------|---------|----------|----------------------|
| Supply and Demand | Wet | Normal | Normal | Dry | Critical | (2009-2018) |
| Water Demand (AFY) | | | | | | |
| Agricultural demand | 417,300 | 431,800 | 434,300 | 449,600 | 436,000 | 410,800 |
| Urban demand | 212,600 | 223,800 | 213,900 | 218,900 | 197,300 | 184,500 |
| Other | 3,500 | 3,500 | 5,700 | 4,300 | 4,100 | 7,500 |
| Total Demand | 633,400 | 659,100 | 653,900 | 672,800 | 637,400 | 602,800 |
| Water Supply (AFY) | | | | | | |
| Agricultural surface water use | 215,500 | 233,900 | 211,300 | 213,100 | 181,900 | 189,900 |
| Urban surface water use | 116,500 | 126,400 | 126,600 | 133,800 | 110,700 | 117,900 |
| Agricultural groundwater use | 181,200 | 177,300 | 202,400 | 215,900 | 233,500 | 200,300 |
| Agricultural residential groundwater use | 20,600 | 20,600 | 20,600 | 20,600 | 20,600 | 20,600 |
| Urban groundwater use | 96,100 | 97,400 | 87,300 | 85,100 | 86,600 | 66,600 |
| Groundwater for remediation | 3,500 | 3,500 | 5,700 | 4,300 | 4,100 | 7,500 |
| Total Supply | 633,400 | 659,100 | 653,900 | 672,800 | 637,400 | 602,800 |
| Average Annual Change in Groundwater Storage (AF) | 102,300 | 29,300 | 12,600 | (7,300) | (66,400) | 31,800 |

Source: GEI 2021

Note: AFY = acre-feet per year

Table 3. North American Subbasin's Average Annual Water Budget

| Groundwater Inflow/Outflow Sources | Recent Operations (2009-2018) | Current Conditions | Future Conditions | Future Conditions (with climate change) |
|---|-------------------------------------|-----------------------|----------------------|--|
| Inflows (AFY) | , | | • | , , |
| Deep percolation | 177,500 | 183,500 | 167,400 | 161,000 |
| Infiltration from streams | 134,000 | 134,500 | 154,300 | 163,600 |
| Groundwater injection | 300 | 200 | 2,100 | 2,100 |
| Other recharge (unlined canal seepage) | 16,700 | 16,700 | 16,400 | 16,400 |
| Subsurface inflow | 54,600 | 49,900 | 53,600 | 56,300 |
| Total Inflow | 383,000 | 384,700 | 393,800 | 399,500 |
| Outflows (AFY) | | | | |
| Discharge to streams | 44,400 | 53,000 | 46,300 | 41,600 |
| Groundwater pumping | 296,400 | 303,400 | 325,200 | 345,100 |
| Subsurface outflow | 10,500 | 13,700 | 16,800 | 16,200 |
| Other flows | | | | 100 |
| Total Outflow | 351,100 | 369,900 | 388,400 | 403,000 |
| Average Annual Change in Groundwater Storage (AF) | 31,800 | 14,900 | 5,400 | (3,500) |

Source: GEI 2021

Note: AFY = acre-feet per year



The North American Subbasin Groundwater Sustainability Plan (GEI 2021) concludes that the subbasin is not experiencing any undesirable results and it is not projected to experience any within the 2042 planning horizon. Because there is some risk in the form of a modest groundwater overdraft of about 3,500 AFY when climate change is considered in the 50-year planning horizon, additional conjunctive use opportunities in the urban municipal supply distribution systems have been identified to avoid future potential undesirable results related to lowering of groundwater levels and depletion of groundwater storage. One of the conjunctive use projects being considered can resolve the deficit and has a net benefit of reducing groundwater pumping by 5,000 AFY. In addition, urban water purveyors have been planning for the completion of a groundwater bank which will increase the use of the subbasin as a storage reservoir.

Although the proposed project is not directly accounted for in the groundwater sustainability modeling, regional long-term changes in land use and water demands (e.g., reductions in agricultural lands and agricultural water demands) are part of the future condition projections.

While the current and projected conditions shown in Table 3 use the same hydrologic period in the modeling, the runoff and percolation conditions differ due to the impact of land conversion from agricultural and native lands to urban land uses. Agricultural water supplies decline due to reduced irrigated acreage. Reduced agricultural uses and native lands results in lower levels of evapotranspiration and return flow from these areas. Urban growth results in increases in urban demand and urban water supplies. Increased urban land and water use increase urban evapotranspiration, urban return flow, and runoff (GEI 2021).

Because the proposed project would reduce irrigated acreage, agricultural demands would decrease. This change in land use would not, however, be associated with a corresponding increase in urban demands, as predicted in the model. Therefore, a net increase in groundwater storage is expected with the proposed project beyond what is predicted above for future conditions.

3.3.2 Western Placer County Groundwater Management Plan

California Water Code §10753 encourages local public agencies/water purveyors to voluntarily adopt formal plans to manage groundwater resources within their jurisdictions. In 2007, the City of Roseville, the City of Lincoln, Placer County Water Agency, and CAW developed the *Western Placer County Groundwater Management Plan* (MWH 2007) in accordance with SB 1938 and Assembly Bill (AB) 3030. This groundwater management plan was a planning tool for groundwater management in the region. It describes groundwater conditions, water use, and groundwater management objectives for west Placer County and provides a "baseline" document for agencies seeking grant funds from the State of California. This plan has recently been replaced by the North American Subbasin Groundwater Sustainability Plan adopted for the region.

3.3.3 Urban Water Management Plans

Although they do not serve the project area, the City of Roseville and CAW both have water service areas near the project site. Urban water suppliers that provides over 3,000 acre-feet of water annually or serves more than 3,000 service connections are required to submit an urban



water management plan. These plans report on the progress that urban water suppliers are making in meeting their water use efficiency targets, provide estimates of current and projected water demands, describe current and projected water sources, describe water management actions that improve supply reliability, and provide an evaluation of the sufficiency of supplies to meet the forecasted demands under both normal and drought conditions.

The City of Roseville's 2020 Urban Management Plan (Water Works Engineers, LLC 2021) describes the City's water supplies and customer demands in its service area. The City of Roseville has more than 46,100 service connections and supplies more than 30,000 acre-feet of water annually to its customers. The City obtains surface water from Folsom Lake through wholesale purchase primarily from the United States Bureau of Reclamation and has additional water contracts with Placer County Water Agency (PCWA) and San Juan Water District. Raw water is conveyed to the City's water treatment plant and is then distributed through the City's 600 miles of water mains to customers. The City also has eight wells, six of which are in service. The operable wells have a combined capacity of approximately 17,500 AFY or 15.6 million gallons per day (MGD). The City is planning to expand its groundwater program as a means to having a more robust water supply available in the event of a water shortage condition.

As part of the water management planning, a supply reliability and drought risk assessment was performed for a single-year and five-year consecutive drought period for both near-term and long-term conditions. Seasonal and climatic shortages in dry or critically dry years increase limitations on the volume of water the City receives from Folsom Lake. The supply and drought risk assessment indicates that there is a potential for minor shortages in the near-term extended drought scenario (on the 5th year of the drought) as well as a potential for shortages over the long-term in both single year and extended drought conditions. The highest level of deficiency identified was less than 8 percent of the annual demand, and was expected to be remedied by basic conservation measures.

CAW is a privately-owned public utility, a subsidiary of American Water. CAW's 2020 Urban Water Management Plan, Sacramento Main District (Murrysmith 2021) describes the West Placer Public Water System service area, water supplies, and customer demands. The West Placer Public Water System has 1,390 municipal connections and supplies approximately 1,120 AFY (1 MGD) to primarily residential and commercial customers. CAW has wholesale water supply agreements with PCWA to supply up to 2 MGD of water supply for the service area. Additional supplies can also be purchased by CAW, as needed.

The West Placer Water System service area is primarily undeveloped and projected water use is expected to increase by about threefold over the next 20 years. The urban water management plan's water supply analysis assumes that additional conveyance capacity will be provided and PCWA will supply sufficient water to meet the entire demand within the West Placer System service area regardless of hydrologic conditions. This assumption is due to PCWA's estimate that there is sufficient water supplies available through the projected build-out conditions for the service area during a series of multiple dry year conditions (Murrysmith 2021).

3.3.4 Agricultural Water Management Plans

Agricultural water suppliers serving more than 25,000 irrigated acres (excluding recycled water deliveries) are required to adopt and submit an Agricultural Water Management Plan. These



plans contain reports on efficient water management practices, annual water budgets, system efficiency objectives, and water use efficiency estimates and they provide a drought plan.

The South Sutter Water District Agricultural Water Management Plan (MBK Engineers 2016) documents the district's efficient water management practices and provides information on water resources, water use, and water budgets for the district's service area. South Sutter Water District was formed in May 1954 to develop, store, and distribute surface water supplies for agricultural irrigation uses. These surface water supplies primarily originate from the Bear River with some supplies from local sloughs, creeks, and ravines (including Pleasant Grove Creek) that originate in the southeastern Sutter County and southwestern Placer County. South Sutter Water District covers 57,012 acres with approximately 85 percent of the area in rice production. Supplemental water is provided to landowners according to acreage. Most of the South Sutter Water District's customers are agriculture-based and often use private wells to obtain the majority of their water supplies.



4 COMPARISON OF SUPPLY AND DEMAND

This section provides a comparison of past and future water demands for the project area and compares those demands to projected regional supplies available over the 20-year and 50-year planning horizon.

4.1 EXISTING WATER USE

4.1.1 Water Rights, Water Supply Entitlements, and/or Water Service Contracts

California law distinguishes between surface water and groundwater. With the exception of "subterranean streams flowing in known and definite channels," if you use groundwater on land that is over the groundwater basin from which you took the water, you have an "overlying groundwater right." Surface water rights are more complicated. Individuals can typically hold riparian rights or appropriative rights. A riparian water right is a right to use the natural flow of water on riparian land. Surface water use by individuals on non-riparian land is typically associated with appropriative rights (SWRCB 2022a).

The State Water Resources Control Board (SWRCB) issues water rights permits for appropriative rights. According to the SWRCB's Electronic Water Rights Information Management System (eWRIMS) database, landowners within the vicinity of the project area have appropriative rights for diversions from tributaries to Curry Creek and/or the Natomas East Main Drain for the purposes of irrigation, stock watering, recreational use, fire protection, and in some cases, for domestic supplies and other incidental uses (SWRCB 2022b).

Existing water rights within the project area include the overlying groundwater rights associated with pumped groundwater used locally. Appropriative rights to surface water would not be used to serve the project during construction or operation and maintenance. In addition, no new water supply entitlements or water service contracts would be obtained for the project. The project area is outside of the existing service areas for nearby water agencies (for both irrigation and municipal supplies) and therefore it is unlikely that existing landowners have any water supply entitlements or water service contracts with the city, county, or public water systems.

4.1.2 Existing Groundwater Wells

Groundwater is currently pumped from onsite wells to meet agricultural demands within the project area. Existing agricultural land uses within the project area include agricultural rice fields and almond orchards. Approximately 830 acres of rice fields and 110 acres of almond orchards would be impacted by the proposed project (see Table 1). These rice fields and almond orchards would cease production during project operations. Existing rice fields are generally located in the northern and central portions of the project site while the southern extent of the project site consists entirely of almond orchards. All almond orchards in and adjacent to the project site are newly planted.



Existing agricultural wells identified within the project area and immediate vicinity are identified in



Table 4 and shown in Figure 2. Groundwater Wells in the Project Area. In addition to the wells described in Table 4, there are other wells in the vicinity of the project area that are associated with residential use, irrigation, or groundwater observations which have been reported to DWR (DWR 2022a). Recent data from 2021 and 2022 have been reported from the observation wells owned by the South Sutter Water District and the City of Roseville (DWR 2022a).

Approximately one-third of the agricultural wells identified in



Table 4 serve agricultural lands that will no longer be in production during project operations (e.g., those located at northern or southern solar fields). As such, there would be substantial reductions in groundwater pumping at these onsite wells compared to existing practices.

Up to ten wells are expected to potentially be used during the operations and maintenance phase of the project. Onsite wells would be used to support PV panel washing and/or compatible agricultural activities. The Silver Streak wells are the two wells that are located in closest proximity to the switch station and the substation, which would have site control buildings with restrooms and sinks. One or both of these wells are expected to be used for domestic needs during project operations. For the purpose of this analysis, it is assumed that agricultural practices in adjacent parcels would be unaffected by the project and will continue into the future. In reality, the adjacent areas have been identified as potential Future Growth Area in the Placer County Conservation Plan and would likely undergo gradual urban development over the next 20 to 50 years.



July 2022

Table 4. Agricultural Wells in the Project Area and Vicinity

| Location | Yield | Horsepower | | |
|---|----------|------------|-------------------------------------|--|
| | | | Carres of Darres | Natas |
| (Well & APN) | (gpm) | (hp) | Source of Power | Notes |
| Northern Solar | | | · · · · · · · · · · · · · · · · · · | I - |
| Well 1 017-090-024 | 1,600 | 50 | PGE 1010088722 | This well is outside the project boundary and not intended for use by the Project. |
| Well 2 017-090-024 | 2,000 | 50 | PGE 1010089309 | Potentially used for construction water and PV panel washing |
| Well 3 017-090-056 | 1,200 | NA | Diesel | Potentially used for construction water and PV panel washing |
| Well 19 017-090-056 | NA | 50 | PGE 1009994085 | This well is outside the project boundary and not intended for use by the Project. |
| Well 20 017-090-056 | NA | NA | PGE 1009917768 | Potentially used for construction water and PV panel washing |
| Well 21 017-090-056 | 1,700 | NA | Diesel | Potentially used for construction water and PV panel washing |
| Well 23 017-090-024 | 1,260 | 50 | PGE 1010093349 | This well is outside the project boundary and not intended for use by the Project. |
| Southern Sola | r Fields | | | The Freject |
| Well 5 017-130-015 | 1,540 | 50 | PGE 1010091138 | Potentially used for construction water and PV panel washing |
| Well 6 017-130-015 | 1,500 | 50 | PGE 1010091143 | Potentially used for construction water and PV panel washing |
| Well 7 017-152-003 | 1,260 | 75 | PGE 1010091141 | This well is outside the project boundary and not intended for use by the Project. |
| Well 10 017-130-015 | 1,500 | 50 | PGE 1006474345 | This well is outside the project boundary and not intended for use by the Project. |
| Well 11 017-130-016 | NA | NA | PGE 1010091142 | Potentially used for construction water and PV panel washing |
| Well 12 017-152-002 | NA | 50 | PGE 1010091163 | This well is inside the project boundary, however it is not intended for use by the Project. |
| Well 24 017-152-003 | NA | NA | Diesel | Potentially used for construction water and PV panel washing |
| Silver Streak Well #1 017-130-061 | 800 | 60 | NA | This well will potentially be used for construction water and O&M activities such as PV panel washing. |
| Silver Streak Well #2 | NA | NA | Electric (PGE service unknown) | This well will potentially be used for construction water and O&M activities such as PV panel washing. |
| 017-130-061 | | | | |
| Adjacent to No | | | 1 | |
| Well 4 017-090-057 | 1,240 | 60 | PGE 1010024147 | This well is outside the project boundary and not intended for use by the Project. |
| Well 16 017-101-043 | 1,400 | 60 | PGE 1009848198 | This well is outside the project boundary and not intended for use by the Project. |
| Well 17 017-101-004 | 1,260 | 50 | PGE 1009848200 | This well is outside the project boundary and not intended for use by the Project. |
| Well 18 017-101-003 | 1,200 | 50 | PGE 1009983896 | This well is outside the project boundary and not intended for use by the Project. |
| Well 22 017-090-056 | NA | 50 | PGE 1009994079 | This well is outside the project boundary and not intended for use by the Project. |
| Well 11219 017-090-017 | NA | NA | NA | This well is outside the project boundary and not intended for use by the Project. |
| Adjacent to So | uthern F | ields | | |
| Well 8 017-152-002 | 2,000 | 60 | PGE 1009983513 | This well is outside the project boundary and not intended for use by the Project. |
| Well 9 017-152-002 | 1,480 | 75 | PGE 1009917767 | This well is outside the project boundary and not intended for use by the Project. |
| Well 13 017-101-045 | 1,200 | 50 | PGE 1010033045 | This well is outside the project boundary and not intended for use by the Project. |
| Well 14 017-101-045 | 1,140 | 50 | PGE 1009847497 | This well is outside the project boundary and not intended for use by the Project. |
| Well 15 017-101-044 | 1,200 | 50 | PGE 1009847500 | This well is outside the project boundary and not intended for use by the Project. |
| | NIA | | oower: apm = aallons per m | |

Source: SMUD 2022. NA = not available; hp = horsepower; gpm = gallons per minute



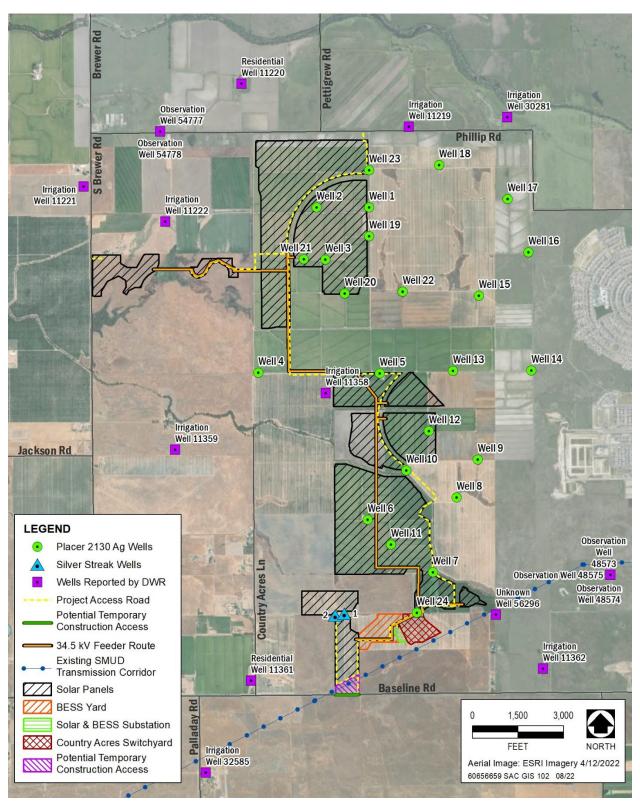


Figure 2. Groundwater Wells in the Project Area and Vicinity



Figure 3 shows the groundwater levels reported to DWR at irrigation well 11219, which is located within a parcel just north of the project site (see Figure 2). Groundwater levels decreased and annual variation increased in the late 1970s, suggesting increased groundwater pumping in the local area since that time. Groundwater levels have fluctuated over the last four decades. Since the 1980s, there have been multi-year declines in groundwater levels and meaningful recoveries. As discussed in Sections 3.2 and 3.3, groundwater levels can vary year-to-year in direct response to groundwater pumping for agricultural demands. Trends in groundwater levels also vary due to the location of the central groundwater pumping depression in the subbasin and due to changes in pumping during different water year types. As shown in Figure 3, water levels have decreased locally during extended periods of drought, but have also recovered during several wet and above normal years.

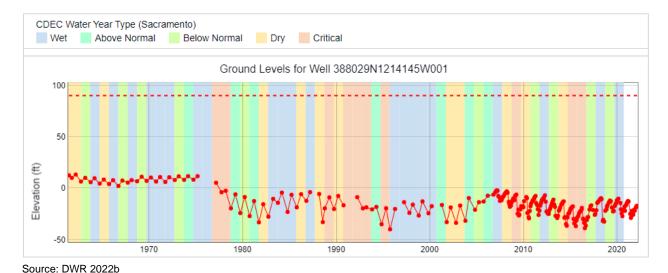


Figure 3. Groundwater Levels just North of the Project Area

4.1.3 Existing Agricultural Demand

Because existing rice fields and almond orchards currently on the project site would cease production during project operations, agricultural water use would be reduced within the project area.

The project's reduction in agricultural demand was calculated based on the estimated crop evapotranspiration for rice fields and almond orchards for the region and the expected reduction in acreage of these irrigated lands. Evapotranspiration is the loss of water to the atmosphere by the combined processes of evaporation from soil and plant surfaces and transpiration from plant tissues.



The evapotranspiration for a specific crop (or ETc) is determined by multiplying the reference crop evapotranspiration (ETo) by the crop coefficient (Kc), as shown in equation 1.

$$ETc = ETo * Kc$$
 (Eqn 1)

Where:

ETc = evapotranspiration rate of the crop (inches per month),

ETo = evapotranspiration rate of the reference plant such as grass (inches per month), and

Kc = the crop coefficient (dimensionless), which varies by crop and stage of growth of the crop.

The ETo used to estimate existing agricultural demands were based on monthly values provided for the California Irrigation Management Information System (CIMIS) reference evapotranspiration for Zone 14 (DWR 2012). Zone 14 includes the portion of the Central Valley at and near the project site. Crop coefficients were estimated by month based on two leaflets prepared by University of California Cooperative Extension which were designed for use with the CIMIS ETo data (University of California Cooperative Extension 1987a, b).

The reduction in agricultural demand due to the conversion of irrigated lands to non-irrigated land use is expected to be more than 3,600 AFY (as shown in Table 5).

Table 5. Project Reduction in Irrigation Demand

| Land Cover Type | Area (acres)¹ | ETc (inches per year) ² | Reduction in Agricultural Demand (AFY) |
|------------------------|---------------|------------------------------------|---|
| Rice Field | 829.8 | 47.6 | 3,293 |
| Almond Orchard | 110.2 | 41.3 | 379 |
| Irrigated Pasture | 0.02 | 13.5 | <1 |
| Non-Agricultural Lands | 93.6 | | |
| Total | 1,033.6 | | 3,673 |

AFY = acre-feet per year

4.2 PROJECTED WATER DEMAND AND DRAWDOWN FROM ONSITE WELLS

The project site is currently served by onsite wells and future demands from the project are expected to be met by existing or new onsite wells. Estimated demands for the project are summarized in Table 6. These demands are substantially less than the agricultural demands that currently exist within the project area (by approximately one to two orders of magnitude).

¹ The impact footprint is based on overlay of 10% design features.

²The ETc was verified based on South Sutter Water District data for rice as described in MBK Engineers (2016). Applied water for rice in South Sutter Water District's service area was 47.32 in/yr in 2011, 49.37 in/yr in 2012, 50.54 in/yr in 2013, 50.70 in/yr in 2014, and 50.07 in/yr in 2015.



July 2022

Table 6. Water Demand from Onsite Wells

| Project Phase | Water Demand | Primary Use |
|---------------------------|-----------------------------------|---|
| Construction | Up to 100 AF over 18 to 24 months | Soil compaction and dust control |
| Operation and Maintenance | Up to 11 AFY | Washing of solar panels; domestic use by onsite employees; and compatible agricultural activities such as grazing and/or pollinator habitat |

AF = acre-feet; AFY = acre-feet per year

Although a net increase in groundwater storage is expected on an average annual basis, localized effects could occur due to project-related groundwater pumping (e.g., if pumping rates are high enough, they could influence the water level in offsite wells).

Groundwater pumped at a well causes a local drawdown effect. The extent of the drawdown depends on various factors, such as subsurface characteristics (e.g., hydraulic conductivity), pumping rates, volume, and duration. Operation of an existing well, or installation of a new groundwater well, could potentially affect offsite wells within the local area.

The radius of influence of a well is the distance at which the localized effects from groundwater pumping is negligible. Effects to groundwater intake at offsite wells would be dependent on the offsite well's screening interval and on groundwater levels. For this analysis, a negligible effect is assumed if drawdown is less than 0.5 foot.

The amount of groundwater drawdown can be calculated using Theis's method for unsteady flow for a well (Kruseman and de Ridder 1991). The Theis equation is summarized below in equations 2 through 4.

$$s = \frac{Q}{4\pi KD} W(u) \tag{Eqn 2}$$

$$W(u) = -0.5772 - lnu + u - \frac{u^2}{2*2!} + \frac{u^3}{3*3!} - \frac{u^4}{4*4!} + \cdots$$
 (Eqn 3)

$$u = \frac{r^2 S}{4KDt} \tag{Eqn 4}$$

Where:

s = drawdown at a distance r from the well (feet)

Q = well discharge (cubic feet per day),

K = hydraulic conductivity (feet per day),

D = depth of the aguifer (feet),

W(u) = Theis well function,

u = the argument of the Theis function,

r = distance from the well (feet),

S = storativity of the aguifer (foot per foot).

t = time since pumping started (days)



The following parameters were used in the Theis equation.

<u>Hydraulic conductivity.</u> The hydraulic conductivity is a measure of the ease with which water can move through pore spaces in soil or fractures in rock. Values are based on well tests or the hydraulic conductivity can be estimated based on data reported by the U.S. Department of Agriculture National Resources Conservation Service web soil survey for site-specific soils. The hydraulic conductivity at a depth below 100 feet is assumed to be 0.26 feet per day (NRCS 2022).

Aquifer depth. Aquifer depth is based on regional or project specific groundwater information. The base of freshwater (or bottom of the aquifer) is estimated at 800 to 900 feet below mean sea level at the site (GEI 2021). The ground surface elevation is approximately 90 feet in this area, and the depth to water is approximately 110 feet (DWR 2022b). Therefore, the average depth of the aquifer was assumed to be about 800 feet.

Storativity. The storativity is a measure of the ability of the aquifer to release water from storage. Approximations for the storativity are different for confined vs. unconfined conditions, with the latter having higher storativity coefficients. Because the central portion of the groundwater subbasin has unconfined to semiconfined conditions depending on depth (GEI 2021), to be conservative unconfined conditions were assumed. Storativity in unconfined aquifers typically range from 0.01 to 0.3, and is approximately equal to the specific yield. The storativity was assumed to equal the specific yield for fine sand (0.21) (Johnson 1967) based on the soil composition/characteristics of the aquifer.

The radius of influence was calculated for pumping scenarios associated with construction, operations, and maintenance activities. For the purpose of this analysis, a negligible effect was assumed if drawdown is less than 0.5 foot.

During construction, 100 AF of water would be needed over an 18-month to 24-month period. Assuming 100 AF would be pumped during an 18-month period that has 375 construction days, the average flow rate would be approximately 11,600 cubic feet per day. Under these conditions, drawdown would be approximately 0.5 feet at a distance of 1,450 feet after 375 days of pumping. Offsite wells and other sensitive receptors are located approximately 1,450 feet or more from existing onsite wells (see



- Table 4). As such, drawdown is expected to be 0.5 foot or less at even the nearest neighboring offsite well when pumping to meet construction demands.
- Approximately 5 AF of water would be needed for PV panel washing. Assuming that the
 annual PV panel washing would occur over 4 weeks (20 construction days), the average
 flow rate would be approximately 10,900 cubic feet per day. Under these conditions,
 drawdown would be approximately 0.5 foot at a distance of 330 feet after 20 days of
 pumping (drawdown effects would be attenuated at greater distances). Effects to
 groundwater levels at offsite wells and other sensitive receptors would be negligible.
- Domestic use of approximately 70 gallons per day (9.4 cubic feet per day) would cause a
 drawdown of less than 0.05 foot at a distance of 100 feet after 30 years of pumping
 (drawdown effects would be attenuated at greater distances). Effects to groundwater levels
 at offsite wells and other sensitive receptors would be negligible.
- Compatible agricultural activities such as grazing and/or establishment of pollinator habitat is assumed to have a water demand of 5.8 AFY. Assuming that water would be drawn from one well in the North Fields and one well in the South Fields, continuous pumping to meet a demand of approximately 350 cubic feet per day per well is expected to cause a drawdown of less than 0.5 foot at a distance of 1,400 feet from the well after 30 years of pumping. Drawdown effects would be attenuated at greater distances. Effects to groundwater levels at offsite wells and other sensitive receptors would be negligible.

Local drawdown effects from pumped groundwater during project construction, operations, and maintenance is expected to be minor to negligible.

4.3 SUFFICIENCY OF SUPPLIES TO MEET THE DEMAND

As discussed in Section 3.3, the groundwater subbasin is currently within balance and projected conditions with climate change results in only a slight imbalance. The subbasin currently has a surplus of water, and this surplus groundwater condition is expected to continue into the future but in lesser amounts. During dry and critically dry water years, there is a net decrease in groundwater storage within the subbasin, but this storage is typically recovered during subsequent wet years. As such, the groundwater subbasin is not projected to experience any undesirable results within in the 2042 planning horizon.

Implementation of the proposed project would require up to 100 AF of groundwater over an 18-month to 24-month period which could occur during normal, single dry, and even multiple dry water years. Approximately 11 AFY would also be needed during a longer 30-year time period. These supplies are available within the groundwater basin and because the project reduces annual outflows from the subbasin due to changes in land use, additional surplus conditions can be expected over the long-term.

When future conditions without the project were modeled with a central tendency climate change scenario, the groundwater subbasin was found to be in a modest overdraft of 3,500 AFY (the net reduction in average annual storage). Implementation of the proposed project would reduce long-term average annual outflows from the groundwater subbasin, thereby reducing risks that could occur under a 50-year planning horizon.



5 CONCLUSIONS

Groundwater and trucked water are the only sources of water supply proposed for the project. Effects to regional water supplies were considered in the context of existing modeling results for current and future conditions in the groundwater basin as analyzed in existing water resource management plans. The proposed project would reduce agricultural demands due to the conversion of irrigated lands to non-irrigated land uses and cause a net increase in groundwater storage on an average annual basis. Adequate supplies to support the project would be available under normal, single dry, and multiple dry water years. As such, there is sufficient supplies to serve the project demand over the next 30 years.



6 REFERENCES

- AECOM 2022. *Draft Aquatic Resources Wetland Delineation Report*, Country Acres Solar Project. Sacramento, CA.
- DWR 2012. California Irrigation Management Information System (CIMIS) Reference Evapotranspiration Zones. Available at: https://cimis.water.ca.gov/Content/pdf/CimisRefEvapZones.pdf.
- DWR 2022a. DWR Periodic Groundwater Measurements, SGMA Data Viewer. Available at: https://sgma.water.ca.gov/webgis/?appid=SGMADataViewer#gwlevels. Additional data on groundwater stations available at: https://gis.data.ca.gov/datasets/3a3e681b894644a9a95f9815aeeeb57f/explore?location=38.780035%2C-121.412242%2C13.52.
- DWR 2022b. Site Code: 388029N1214145W001 State Well Number: 11N05E16H001M Local Well Name: Placer_Ag. DWR Periodic Groundwater Measurements, SGMA Data Viewer. Available at: https://sgma.water.ca.gov/webgis/?appid=SGMADataViewer#gwlevels.
- EPA 2021. Lean & Water Toolkit, Achieving Process Excellence Through Water Efficiency.
 Appendix C. Calculations and "Rules of Thumb" for Estimating Water Use. Available at: https://www.epa.gov/sites/default/files/2013-10/documents/lean-water-toolkit.pdf.
- GEI Consultants 2021. *North American Subbasin Groundwater Sustainability Plan*. Available at: https://nasbgroundwater.org/.
- Johnson 1967. Specific Yield Compilation of Specific Yields for Various Materials. US Geological Survey Water Supply Paper 1662-D.
- Kruseman, GP, and NA de Ridder 1991. Analysis and Evaluation of Pumping Test Data. Second Edition. International Institute for Land Reclamation and Improvement, Publication 47.
- MBK Engineers 2016. South Sutter Water District Agricultural Water Management Plan. March. Available at:

 https://wuedata.water.ca.gov/public/awmp_attachments/7865049064/South%20Sutter%20WD%202015%20AWMP.pdf.
- Murrysmith 2021. California American Water Sacramento Main District Urban Water Management Plan. Available at:

 https://wuedata.water.ca.gov/public/uwmp_attachments/3005384147/California%20Ame rican%20Water%20Sacramento%20Main%20UWMP%20-%20FINAL%2007012021.pdf.
- MWH 2007. West Placer County Groundwater Management Plan. November. Available at: https://cdn.cosmicjs.com/ed265ac0-70b7-11e8-b89a-91a6fa50a41c-WPCGMP_Groundwater_Management_Plan_07.pdf.



- NRCS 1979. Livestock Water. California Technical Note, January 1979. Available at: https://www.nrcs.usda.gov/Internet/FSE DOCUMENTS/nrcs142p2 040384.pdf
- NRCS 2022. Web Soil Survey, Placer County, California, Western Part (CA620). Available at: https://websoilsurvey.sc.egov.usda.gov/App/WebSoilSurvey.aspx.
- SMUD 2022. Personal communication from Amanda Beck on February 4, 2022 transmitting file: "Placer 2130 Ag Wells.kmz". Supplemental data file transmitted on May 12, 2022: "GW Well.xlsx"
- SWRCB 2022a. Water Rights, Frequently Asked questions. Available at: https://www.waterboards.ca.gov/waterrights/board info/fags.html.
- SWRCB 2022b. eWRIMS Electronic Water Rights Information Management System Search for Licenses, Permits and Statements. Available at: https://www.waterboards.ca.gov/waterrights/water_issues/programs/ewrims/.
- University of California Cooperative Extension 1987a. Using Reference Evapotranspiration (ETo) and Crop Coefficients to Estimate Crop Evapotranspiration (ETc) for Agronomic Crops, Grasses, and Vegetable Crops. Leaflet #21427. Available at: https://cimis.water.ca.gov/Content/PDF/21427-KcAgronomicGrassandVeg.pdf.
- University of California Cooperative Extension 1987b. Using Reference Evapotranspiration (ETo) and Crop Coefficients to Estimate Crop Evapotranspiration (ETc) for Trees and Vines. Leaflet #21428. Available at: https://cimis.water.ca.gov/Content/PDF/21428-KcTreesandVines.pdf.
- Water Works Engineers, LLC, 2021. City of Roseville 2020 Urban Water Management Plan. Available at:
 - https://wuedata.water.ca.gov/public/uwmp_attachments/2598478019/Roseville%202020%20Urban%20Water%20Management%20Plan.pdf.

PRELIMINARY HYDROLOGY REPORT

Country Acres Solar & BESS Project Placer County, California

B&V PROJECT NO. 406242

REVISION 2

PREPARED FOR

Sacramento Municipal Utility District

24 JUNE 2022



| Prepared by: | | |
|---------------------------|---------------------------|------|
| | Signature | Date |
| | Gregory V. Johnson, P.E. | |
| | Printed Name | |
| | | |
| | Signature | Date |
| | Alexander L. Wallen, P.E. | |
| | Printed Name | |
| | | |
| Professional Engineer: | | |
| - | Signature | Date |
| | Erik Winata, P.E. | |
| | Printed Name | |
| | <u>C67285</u> | |
| | License No. | |

Table of Contents

| 1.0 | Site Location | | | 1 | |
|---------------|---------------------------------|-----------------------------|---|-----|--|
| 2.0 | Project Description | | | 1 | |
| 3.0 | Preliminary Hydrologic Analysis | | | | |
| | 3.1 Design P | | arameters | | |
| | | 3.1.1 | Precipitation | 3 | |
| | | 3.1.2 | Precipitation Distribution | 3 | |
| | | 3.1.3 | Time-of-Concentration | 4 | |
| | | 3.1.4 | Hydrologic Soil Group | 4 | |
| | | 3.1.5 | Infiltration Characteristics | 4 | |
| | | 3.1.6 | Existing Characteristics | 4 | |
| | | 3.1.7 | Proposed Site Characteristics | 4 | |
| | | 3.1.8 | SCS Unit Hydrograph and Kinematic Wave Transform Comparison | 5 | |
| | 3.2 | Existing | Conditions Analysis | 5 | |
| | 3.3 | Propose | ed Conditions Analysis | 6 | |
| | 3.4 | Stormwater Quantity Results | | | |
| | 3.5 | 5 Stormwater Quality Design | | | |
| 4.0 | Preliminary Hydraulic Analysis | | | | |
| | 4.1 | Hydrology | | | |
| | 4.2 | Hydrau | Hydraulic Model | | |
| | | 4.2.1 | Elevation Data | 14 | |
| | | 4.2.2 | Manning's Values | 17 | |
| | | 4.2.3 | Hydraulic Model Results | 17 | |
| | 4.3 | Scour Calculations | | 17 | |
| | 4.4 | Regulatory Implications | | 18 | |
| | | 4.4.1 | FEMA Regulations and Model | 18 | |
| | | 4.4.2 | Placer County Regulations | 18 | |
| 5.0 | Conclu | ısion | | 19 | |
| 6.0 | Refere | nces | | 20 | |
| Attach | ment A | | Preliminary Hydrology Study Infiltration Characteristics | A-1 | |
| Attachment B. | | | Preliminary Hydrologic Analysis Calculation | B-1 | |
| Attach | ment C. | | Preliminary Hydraulic Analysis Calculation | C-1 | |
| Attachment D. | | | Supplemental Drawings and Exhibits | D-1 | |
| Attach | ment E. | | Kinematic Wave Transform Method Hydrology Analysis | F-1 | |

LIST OF TABLES

| 8 |
|----|
| _ |
| 8 |
| 9 |
| 9 |
| 9 |
| 12 |
| 13 |
| 17 |
| |
| 1 |
| 3 |
| 5 |
| 6 |
| 7 |
| 13 |
| 14 |
| 15 |
| 16 |
| |

1.0 Site Location

The proposed site is located in rural, western Placer County, California, approximately 7 miles west of the City of Roseville. A vicinity map is shown in Figure 1 below.

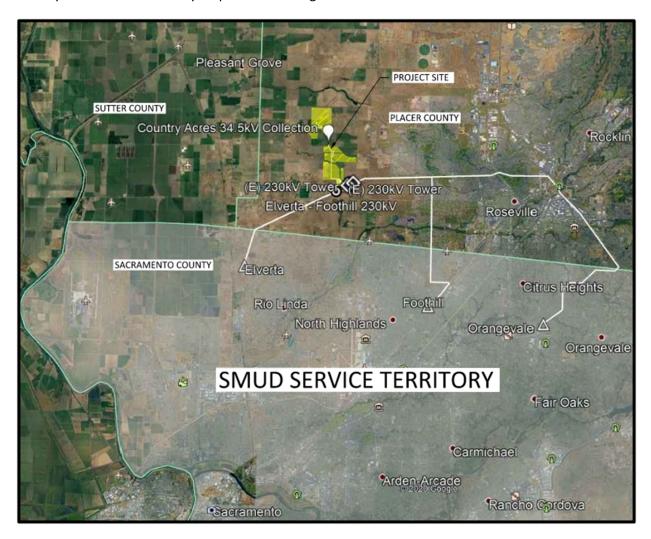


Figure 1 Vicinity Map (Google Earth)

2.0 Project Description

Sacramento Municipal Utility District (SMUD) plans to develop the Country Acres Solar and Battery Energy Storage System (BESS) Project (the Project) on an approximately 1,120-acre site. The Project will potentially have a nameplate solar photovoltaic (PV) plant capacity of 364MWac and BESS plant capacity of 344MW/1,376MWh. The Overall Conceptual Site Layout Drawing, CA-SK-0100, is located in Attachment D, Supplemental Drawings and Exhibits.

The solar PV plant will take up most of the Project site, with the BESS plant, Project Substation and Switching Station likely to be located on the south side of the Project. Access entries to the Project parcels will be provided through existing public paved and unpaved roads. Perimeter and interior aggregate-surfaced access roads will be provided within each Project parcel.

The Point of Interconnection (POI) for the Project will be along the existing 230-kV Elverta-Orangevale and Elverta-Foothill transmission lines that run in the east-west direction along the south side of the Project. The Project capacity will be limited to 344MWac at the POI.

3.0 Preliminary Hydrologic Analysis

The SMUD Country Acres Preliminary Hydrologic Analysis is based on the requirements of the Placer County Stormwater Management Manual and the West Placer County Storm Water Quality Design Manual. Additional guidance was provided by the Placer County Flood Control District and the Placer County Engineering & Surveying Division.

The project site consists primarily of existing rice fields and almond orchards, with additional areas characterized as rangeland. The proposed PV arrays will be installed on 12 parcels ranging in size from 14.69 acres to 232.64 acres, with a total area of 1,064.85 acres. An additional 56.67 acres will be used for a Substation, Switching Station, and BESS areas.

Post-development peak stormwater discharge is limited to the pre-development rate in response to the 2-, 10-, and 100-year design precipitation events. The peak discharges have been estimated using the HEC-HMS Hydrologic Modeling System software package developed by the U.S. Army Corps of Engineers.

Design standards, methodologies, and sources for the analysis are summarized in Table 1, below. HEC-HMS model input parameters are developed in the Design Parameters section of the report, following Table 1.

Table 1 Hydrologic Data and Methodology

| Parameter | Design Standard/Method/Source |
|---|--|
| Topography | Design Topography from USGS lidar (2020) Verified with lidar data from SMUD (2021) |
| Land Use | Aerial Imagery from Google Earth Pro (2021) |
| Soil Information | United States Department of Agriculture (USDA), Natural Resources Conservation Service (NRCS), Web Soil Survey (2019) |
| Design Storm Events | 2-Year, 24-Hour, 10-Year, 24-Hour, and 100-Year (frequency), 24-Hour (duration) |
| Precipitation Depths | Placer County Stormwater Management Manual (1994) 2-Year, 24-Hour = 1.90 inches 10-Year, 24-Hour = 2.98 inches 100-Year, 24-Hour = 4.25 inches |
| Precipitation Distribution | Soil Conservation Service (SCS) Type IA (NRCS, 1986) The SCS is now known as the NRCS. |
| Time of Concentration and Curve Number | SCS TR-55 (NRCS, 1986) |

| Parameter | Design Standard/Method/Source |
|------------------|---|
| Loss Method | Initial and Constant, Placer County Stormwater Management Manual (1994) |
| Transform Method | SCS Unit Hydrograph |

3.1 Design Parameters

Design parameters used as input data for the HEC-HMS models are described below.

3.1.1 Precipitation

Design precipitation values are provided in the Placer County Flood Control and Water Conservation District Stormwater Management Manual, Table 5-A-1, Depth-Duration-Frequency Coefficients, for areas west of the Sierra Nevada Crest. For a 24-Hour event, the 2, 10, and 100-year precipitation depths are 1.90 inches, 2.98 inches, and 4.25 inches, respectively.

3.1.2 Precipitation Distribution

The site is near the boundary for the SCS Type I/Type IA distribution regions, but in the Type IA area, as shown in Figure 2. The SCS Type IA distribution will produce higher peak intensities and greater peak flows than the Type I distribution.

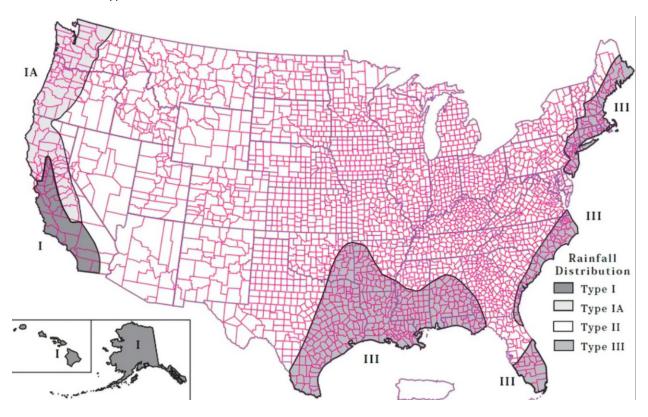


Figure 2 SCS Type Rainfall Distribution Map (NRCS, 1986)

3.1.3 Time-of-Concentration

Time-of-Concentration has been estimated for each parcel in both the pre- and post-development conditions, and also for the Switching Station, Substation, and BESS areas, using the methodology from TR-55, Urban Hydrology for Small Watersheds, developed by the USDA Natural Resources Conservation Service.

3.1.4 Hydrologic Soil Group

The Hydrologic Soil Group (HSG) rating of D was obtained from the Natural Resources Conservation Service Web Soil Survey. An HSG rating of D for the project area is also provided in Figure 3-1 from the West Placer County Storm Water Quality Manual.

3.1.5 Infiltration Characteristics

Infiltration characteristics are estimated for the parcels based on guidance from TR-55 Urban Hydrology for Small Watersheds, Table 2-2, Runoff Curve Numbers, and Table 5-3, Constant Infiltration Rates for Hydrologic Soil-Cover Complexes, from the Placer County Flood Control and Water Conservation District Stormwater Management Manual. Stormwater runoff from pervious and impervious areas is calculated separately in the models.

See Attachment A, Preliminary Hydrology Study Infiltration Characteristics for more information.

3.1.6 Existing Characteristics

The existing vegetation at the project site is primarily comprised of rice fields, with some additional areas that are best described as rangeland. The rice fields are modeled as "Small Grain in Good Condition." For HSG D, the SCS Curve Number for this cover type is 87, and the loss rate is 0.05 inches/hour. For "Rangeland in Good Condition," with HSG D, the SCS Curve Number is 80, and the loss rate is 0.09 inches/hour.

3.1.7 Proposed Site Characteristics

The proposed site where the PV arrays are installed will be seeded to establish grass, but it is conservatively assumed that the grass will be in fair condition, with grass cover established in 50 to 75 percent of the area. For "Grass in Fair Condition," with HSG D, the SCS Curve Number is 84, and the loss rate is 0.07 inches/hour.

Pile foundations supporting the racking tables and inverter skids are modeled as "Impervious Areas," with HSG D, a SCS Curve Number of 98, and a loss rate of 0.00 inches/hour. This assumes that the soil under the PV panels will become saturated in response to the design storm events, specifically the 100-year recurrence interval event, which is used to size the ditches and basins. The existing grades at the site are very flat, which will encourage infiltration.

Ditches and detention basins will be graded to drain completely, seeded to establish grass, and mowed once the grass is established. This cover is modeled as "Grass in Good Condition," with HSG D, resulting in a SCS Curve Number of 80, and a loss rate of 0.09 inches/hour.

Perimeter and intermediate roads at the site will be gravel surfaced. For "Gravel Roads," with HSG D, the SCS Curve Number is 91, and the loss rate is 0.03 inches/hour.

Equipment and foundations in the Switching Station, Substation, and BESS areas are modeled as "Impervious Areas," with a SCS Curve Number of 98, and a loss rate of 0.00 inches/hour.

Areas planted with grass in the Switching Station, Substation, and BESS areas are modeled as "Grass in Good Condition," with HSG D, resulting in a SCS Curve Number of 80, and a loss rate of 0.09 inches/hour.

Areas in the Switching Station and Substation surfaced with loose yard stone are modeled with a SCS Curve Number of 86, and a loss rate of 0.06 inches/hour.

3.1.8 SCS Unit Hydrograph and Kinematic Wave Transform Comparison

A separate hydrology analysis of the watershed within the solar array parcel South #5 was performed using the Kinematic Wave Transform method in accordance with Section V.E.3.b.(6) of the Placer County Stormwater Management Manual (SWMM, page V-19), to compare the results against the SCS Unit Hydrograph Transform method used in the Hydrology Analysis. The analysis found the Kinematic Wave Transform method resulted in higher peak discharges as compared to the SCS UH method. However, post-development peak discharges continued to be less than the corresponding pre-development peak discharge in response to all storm events.

The Switching Station, Substation, and BESS areas were also analyzed using the Kinematic Wave Transform method. The analysis found that post-development peak discharges of these areas were less than the corresponding pre-development peak discharge, in response to all storm events.

Detailed discussions and results of the Kinematic Wave Transform analysis are provided on 6.0Attachment E.

3.2 Existing Conditions Analysis

Separate HEC-HMS models were developed for the parcels containing the PV arrays, and the Switching Station, Substation, and BESS areas, for the site in its existing condition.

The HEC-HMS Basin Model for the PV Array Parcels is shown in Figure 3. Each parcel shown in Figure 2 is identified in the Overall Conceptual Site Layout Drawing, CA-SK-0100, located in Attachment D, Supplemental Drawings and Exhibits. For each parcel, input values for the design parameters described above are developed in the Preliminary Hydrologic Analysis Calculation, included as Attachment B. HEC-HMS is a hydrograph routing software, and runoff hydrographs from each parcel are generated in the model. These hydrographs are then combined at a junction titled "Pre-Total", which provides the peak discharge flowrate for the entire system in response to the design precipitation events.

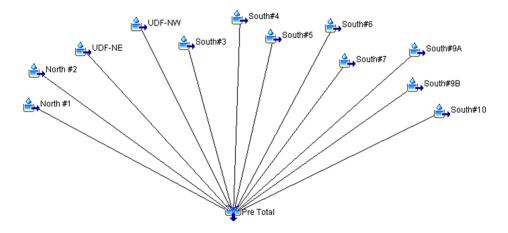


Figure 3 HEC-HMS Basin Model for PV Array Parcels – Existing Conditions

Similarly, a HEC-HMS model was created to develop a discharge hydrograph for the Switching Station, Substation, and BESS areas, in response to the existing conditions. See Attachment B for more details, and the Overall Conceptual Site Layout Drawing, CA-SK-0100, located in Attachment D, Supplemental Drawings and Exhibits for the location of these areas. Detailed layouts of each of these areas are also provided in Attachment D.

3.3 Proposed Conditions Analysis

Separate HEC-HMS models were also developed for the parcels containing the PV arrays, and the Switching Station, Substation, and BESS areas, for the site in its proposed condition.

The HEC-HMS Basin Model for the PV Array Parcels in the proposed condition is shown in Figure 4. Input values were developed for each design parameter in the Preliminary Hydrologic Analysis Calculation, included in Attachment B. In each parcel, impervious and pervious areas are modeled separately and then combined at a junction, which is more conservative than the use of composite infiltration characteristics. The resulting hydrograph from each parcel was then combined at a junction titled "Post-Total", which provides the peak discharge flowrate for the entire system in response to the design precipitation events.

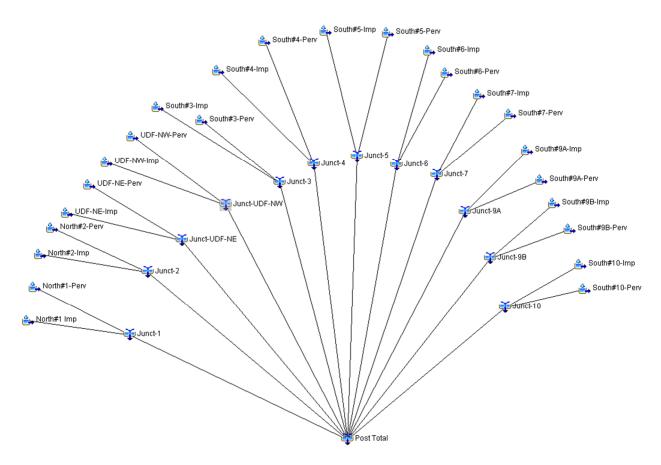


Figure 4 HEC-HMS Basin Model for PV Array Parcels – Proposed Conditions

The HEC-HMS Basin Model for the Switching Station, Substation, and BESS areas in the proposed condition is shown in Figure 5. Similar to the analysis of the parcels, impervious and pervious areas are

modeled separately for each area and then combined at a junction. Substation runoff combines with runoff from the BESS area and is then surface routed to the BESS area detention basins. The two BESS area detention basins are hydraulically connected and modeled as a single basin in HEC-HMS. The runoff hydrograph generated in the Switching Station area is surface routed to the Switching Station area detention basin. Stormwater runoff routed to each of the basins is stored and simultaneously discharged based on the state-discharge relationships developed in Attachment B. The basins' water surface elevations fluctuate based on the volume of stormwater entering and being discharged from the basin during each hydrograph time increment. Stormwater is released from the basins through series of discharge culverts. Detailed detention basin design parameters are provided in Tables 4, 5, and 6. Discharge hydrographs from the Switching Station and BESS area basins are combined at a junction titled, "Post-Total", which proves the peak discharge flowrate for the entire Switching Station, Substation, and BESS area in response to the design precipitation events. See Attachment B for more details on the analysis, and the Stormwater Quantity Results section of this report for more discussion on the detention basins.

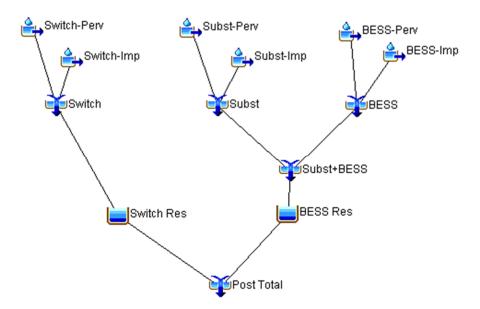


Figure 5 HEC-HMS Basin Model for Switching Station, Substation and BESS Areas – Proposed Conditions

3.4 Stormwater Quantity Results

Results for the 12 parcels containing the proposed PV arrays are presented in Table 2. For each design storm event, the proposed condition peak discharge and stormwater volume are less than the corresponding peak discharge and stormwater volume for the existing condition. These results meet the requirements of Placer County and were achieved without the use of detention basins. See Attachment B for more details.

Table 2 Stormwater Quantity Results for Parcels containing the PV Arrays

| Storm Events | Existing Conditions Peak Discharge (cfs) | Proposed Conditions Peak Discharge (cfs) |
|-------------------|--|--|
| 2-Year, 24-Hour | 254.4 | 208.5 |
| 10-Year, 24-Hour | 434.7 | 369.2 |
| 100-Year, 24-Hour | 646.2 | 557.5 |

| Storm Events | Existing Conditions Stormwater Volume (acre-ft) | Proposed Conditions Stormwater Volume (acre-ft) |
|-------------------|---|--|
| 2-Year, 24-Hour | 54.1 | 42.3 |
| 10-Year, 24-Hour | 134.3 | 113.2 |
| 100-Year, 24-Hour | 240.3 | 219.0 |

Due to post-development surfacing, additional stormwater runoff was generated in the Substation, Switching Station, and BESS areas, and detention basins were needed to meet the discharge requirements. Total peak discharges and stormwater volumes from these areas are presented in Table 3. For each design storm event, the proposed condition peak discharge is less than the corresponding peak discharge for the existing condition. These results meet the requirements of Placer County. See Attachment B for more details.

Table 3 Stormwater Quantity Results for Switching Station, Substation, and BESS Areas

| Storm Events | Existing Conditions Peak Discharge (cfs) | Proposed Conditions Peak Discharge (cfs) |
|-------------------|--|--|
| 2-Year, 24-Hour | 10.3 | 7.9 |
| 10-Year, 24-Hour | 19.4 | 15.6 |
| 100-Year, 24-Hour | 29.8 | 24.2 |

| Storm Events | Existing Conditions Stormwater Volume (acre-ft) | Proposed Conditions Stormwater Volume (acre-ft) |
|-------------------|--|--|
| 2-Year, 24-Hour | 1.5 | 2.1 |
| 10-Year, 24-Hour | 4.3 | 5.4 |
| 100-Year, 24-Hour | 9.2 | 10.7 |

Design parameters for the two basins located in the BESS area and the Switching Station area basin are provided in Tables 4, 5, and 6. The topography of the Substation did not support the development of a detention basin, so Substation runoff was routed to the BESS area basins.

Table 4 BESS Area – Northwest Detention Basin Design Parameters

| Design Parameters | | | |
|--|---------------------------------------|--|--|
| Basin Invert Elevation (ft) | 78.0 | | |
| Basin Crest Elevation (ft) | 80.0 | | |
| Peak Stage for 100-Year Event (ft) | 79.0 | | |
| Peak Storage for 100-Year Event (ac-ft) | 0.9 (total for both BESS area basins) | | |
| Min. Freeboard for 100-Year Event (ft) | 1.0 | | |
| Discharge Culverts – Size, Material, Number | 12-inch diameter, HDPE, 6 | | |
| Discharge Culverts – Upstream Invert Elev., Downstream Invert Elev. (ft), Length (ft) | 78.0, 77.9, 20 | | |

Table 5 BESS Area – Southwest Detention Basin Design Parameters

| Design Parameters | | | |
|--|---------------------------|--|--|
| Basin Invert Elevation (ft) | 77.5 | | |
| Basin Crest Elevation (ft) | 80.0 | | |
| Peak Stage for 100-Year Event (ft) | 79.0 | | |
| Peak Storage for 100-Year Event (ac-ft) | Included in Table 4 value | | |
| Min. Freeboard for 100-Year Event (ft) | 1.0 | | |
| Discharge Culverts – Size, Material, Number | 12-inch diameter, HDPE, 3 | | |
| Discharge Culverts – Upstream Invert Elev., Downstream Invert Elev. (ft), Length (ft) | 77.5, 77.4, 24 | | |

Table 6 Switching Station Area – Detention Basin Design Parameters

| Design Parameters | |
|--|---------------------------|
| Basin Invert Elevation (ft) | 83.5 |
| Basin Crest Elevation (ft) | 85.2 |
| Peak Stage for 100-Year Event (ft) | 84.2 |
| Peak Storage for 100-Year Event (ac-ft) | 0.1 |
| Min. Freeboard for 100-Year Event (ft) | 1.0 |
| Discharge Culverts – Size, Material, Number | 12-inch diameter, HDPE, 8 |
| Discharge Culverts – Upstream Invert Elev., Downstream Invert Elev. (ft), Length (ft) | 83.5, 83.4, 20 |

Most of the stormwater runoff passed through the BESS area basins, which required approximately 0.9 acre-feet of storage in response to the 100-year storm event. Approximately 0.1 acre-feet of storage was required in the Switching Station basin in response to the 100-year event. The basins are designed to completely drain, with a one percent bottom slope directed towards the discharge culverts. The basins are dry between storm events, with grass cover.

As presented in the tables, the basins are very shallow, due to the topography of the site. Only a small reduction in the post-development peak discharges was required, so multiple 12-inch diameter discharge culverts were provided to release the stormwater. The size was selected to allow for sufficient cover on the pipes, with the added benefit of the stormwater discharge being diffused over a large area through the multiple barrels.

The BESS area basins are hydraulically connected with a pipe that matches the basin inverts to allow for acceptable performance regardless of the amount of stormwater runoff directed to each basin.

See Attachment B for more details on the detention basins.

3.5 Stormwater Quality Design

The West Placer Storm Water Quality Design Manual was developed to address stormwater management within the West Placer County region. Placer County maintains an online map that delineates the West Placer County Permit or Project Planning Areas, subject to the requirements of the manual. Parcels within this compliance area need to have a stormwater quality plan completed, depending on the amount of new impervious area added.

Two of the project parcels, UDF-NE and UDF-NW, are located within the compliance boundary. The location of these parcels is illustrated on the Overall Conceptual Site Layout Drawing, CA-SK-0100, located in Attachment D, Supplemental Drawings and Exhibits. Project categorization is provided in Section 2.2 of the manual, based on the amount of impervious surface that is created or replaced. A total of 2,345 square feet of impervious surface is created in parcels UDF-NE and UDF-NW, which is less than the minimum value of 2,500 square feet which defines a small project. Thus, based on Figure 2-3, Project Category Decision Tree, the project is not subject to the requirements of the West Placer Storm Water Quality Design Manual

While the Project is not subject to the requirements of the West Placer Storm Water Quality Design Manual, the proposed development will create a total of approximately 3.27 acres of impervious surfaces. Thus, the Project will be required to treat the post-development stormwater runoffs, in conformance with the Policies of the Placer County General Plan.

During construction phase of the Project, various temporary Best Management Practices (BMPs) such as stabilized construction entrances, silt fences, straw bales, etc. shall be implemented along the perimeter of the Project's parcels to prevent pollutants from leaving the site.

During the operational phase of the Project, it is anticipated that there will be insignificant amount of pollutants resulting from the Project, mostly resulting from infrequent vehicular traffic to address operational or maintenance issues within the Project site. Most of the proposed equipment associated with the Project is not anticipated to be source of pollutants. It is noted, however, that the Main Power Transformers within the Substation and the medium-voltage transformers located within the solar PV and BESS area may contain oil. Oil containment structure will be constructed around each of the Main Power Transformers within the Substation area to contain any oil leaks. Dry type transformers or bio-

degradable oil may be specified for the medium-voltage transformers located within the solar PV and BESS areas as part of stormwater quality mitigation methods. Additionally, given the relatively small total areas of impervious surfaces (approximately 3.27 acres out of the 1,121 acres total Project area), it is anticipated that post-development stormwater runoffs will be treated by way of infiltration through the seeded areas within the Project site, as the runoffs sheet flow across the project parcels prior to draining into various drainageways.

The design and details of the temporary and permanent BMPs will be addressed in the final design of the Project as part of the Project's Erosion Control Plan and Storm Water Pollution Prevention Plan (SWPPP).

4.0 Preliminary Hydraulic Analysis

A preliminary hydraulic analysis along Curry Creek and two unnamed tributaries on the north side of Curry Creek was conducted in order to determine 100-year-flood inundation limits throughout the project sites, to determine changes in the 100-year-flood Water Surface Elevations (WSEs) and velocities that would occur due to the development of the project, and to estimate scour depths at the base of the proposed solar panels.

4.1 Hydrology

The overall watershed for Curry Creek and the unnamed tributaries to the north of Curry Creek were evaluated to determine 100-year-flood peak discharges, which were used as inputs into the subject hydraulic analysis. The latest available 1-Dimensional (1D) Federal Emergency Management Agency (FEMA) hydraulic model includes 100-year-flood peak discharges along Curry Creek; however, the unnamed tributaries are not included. As such, United States Geological Survey (USGS) regression equations (USGS StreamStats Tool) were used to determine estimated 100-year-flood peak discharges along the unnamed tributaries. The tabular data is shown below in Table 7 and

Table 8. The overall watershed, FEMA 100-year-flood cross sections along Curry Creek, and subarea outlets along the unnamed tributaries (used to determine estimated 100-year-flood discharges based on USGS regression equations) are subsequently shown below in Figure 6.

Table 7 Curry Creek FEMA 100-Year-Flood Discharges

| Description | FEMA 100-Year Flood Discharges (cfs) |
|---------------------------|--------------------------------------|
| FEMA Cross Section 4+300 | 1579 |
| FEMA Cross Section 5+400 | 1520 |
| FEMA Cross Section 6+300 | 1519 |
| FEMA Cross Section 10+200 | 957 |

Table 8 Unnamed Tributaries Estimated 100-Year-Flood Discharges

| Description | Estimated 100-Year Flood Discharges (cfs) |
|-------------------|---|
| Subarea #1 Outlet | 892 |
| Subarea #2 Outlet | 536 |
| Subarea #3 Outlet | 455 |
| Subarea #4 Outlet | 173 |
| Subarea #5 Outlet | 706 |
| Subarea #6 Outlet | 550 |

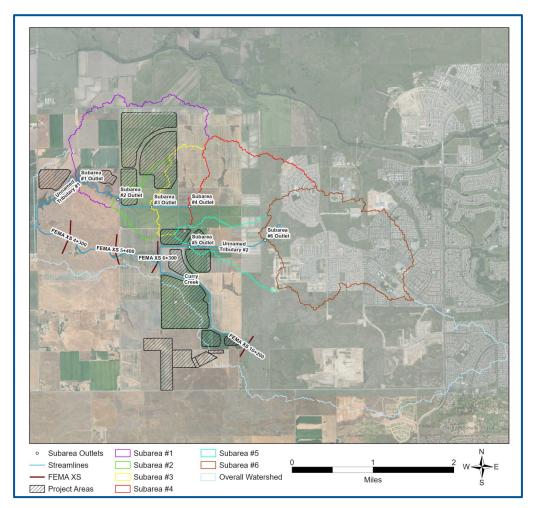


Figure 6 Overall Watershed, Subareas, and 100-Year-Flood Discharge Locations

4.2 Hydraulic Model

Two hydraulic models using United States Army Corps of Engineers (USACE) HEC-RAS software comprise the subject preliminary hydraulic analysis: the 2-Dimensional (2D) hydraulic model and the latest

available 1D FEMA hydraulic model. The majority of the analysis is centered around the 2D model, which is used for design calculations pertaining to depth, velocity, and scour depth along the project areas. The FEMA model provides a preliminary evaluation of the project impact from a regulatory floodplain perspective, which is described in the subsequent "Regulatory Implications – FEMA Model" section. Notably, both models compared existing and proposed conditions to obtain their respective WSE increase estimates. The FEMA model is considered ancillary to the 2D model because it does not include the unnamed tributaries on the north side of Curry Creek. Nonetheless, data from the FEMA model, such as 100-year-flood discharges along Curry Creek and culvert information, were used as inputs in the 2D model.

4.2.1 Elevation Data

The Digital Elevation Model (DEM) for the 2D model was developed from 2020 USGS lidar data (Ref. 4). The DEM is shown below in Figure 7. To better define the geometry in the 2D model, break lines were placed along major topographical changes and pertinent features, such as ridges, channels, road embankments, agricultural earthen dividing berms, and levees to provide additional definition to the natural direction of flow through the system.

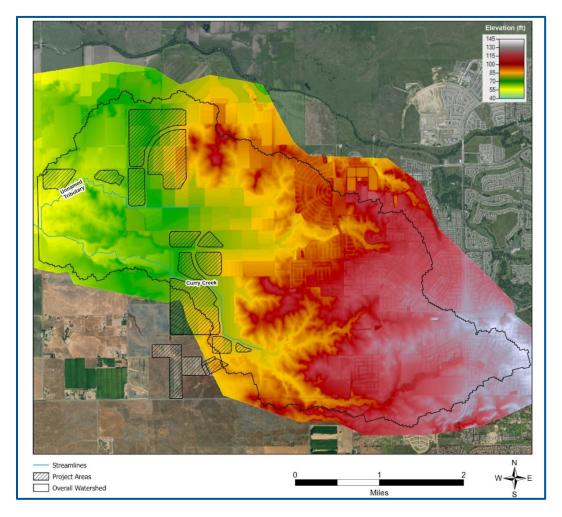


Figure 7 Digital Elevation Model (DEM) — USGS 2020 Lidar

The existing conditions terrain is comprised of agricultural fields and numerous earthen dividing berms. The berms in the 100-year floodplain are approximately 2 to 4-ft tall (from the downstream end) and

approximately 30 to 40-ft wide (upstream to downstream toes). The proposed grading is designed to match existing condition grading patterns as much as possible with minimal modifications. The proposed grading will remove and smooth out a 100-ft wide area for each berm, creating a uniform slope. The typical existing and proposed configurations are shown in Figure 8, and the approximate locations of the removed berms are shown below in Figure 9.

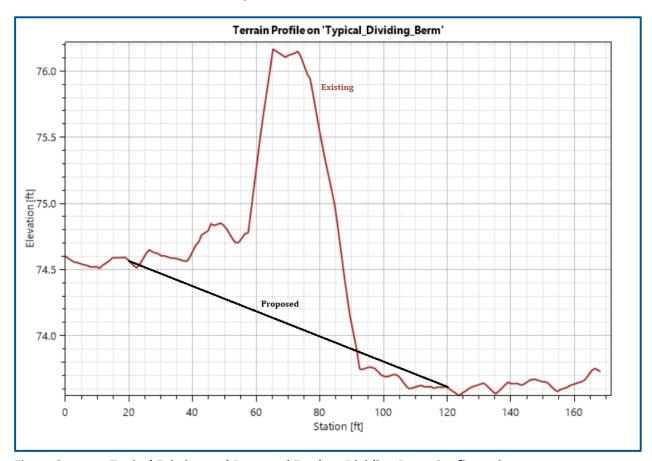


Figure 8 Typical Existing and Proposed Earthen Dividing Berm Configuration

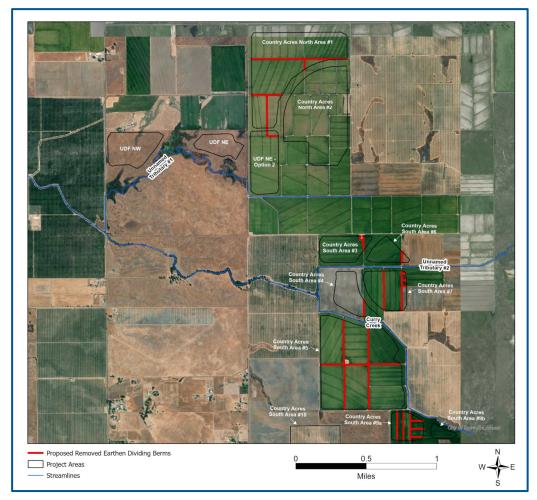


Figure 9 Aerial — Proposed Removed Earthen Dividing Berms

Although there is additional grading in Country Acres North Area #2, it is outside the floodplain and has no impact on the hydraulic analysis.

Notably, due to limitations with the technology, lidar (including the utilized 2020 USGS lidar data) is unable to penetrate water. Consequently, the utilized lidar data excludes elevation data below the water surface present during data collection. The thalweg elevations were not manually edited into the DEM, except for near culvert invert and exit elevations. The subject assumption is expected to marginally increase the conservatism of the model with respect to resultant WSEs.

The FEMA effective models predate the 2020 USGS lidar. As such, the inundation boundaries in the subject analysis will have improved definition compared to the existing FEMA floodplain.

SMUD retained NV5 Geospatial to obtain updated lidar data of the project areas, which was provided to Black & Veatch in December of 2021. The lidar data provided by SMUD generally aligned with the utilized 2020 USGS lidar data along the pertinent inundated areas and provided an additional degree of confidence to the accuracy of the underlying elevation data. There were minor elevation differences along localized areas of the channel thalweg that are not anticipated to appreciably impact the results of the model.

4.2.2 Manning's Values

A detailed analysis was conducted in Australia regarding Manning's (n) values for different land covers specifically for 2D HEC-RAS hydraulic models. Consequently, applicable Manning's (n) values were assigned in accordance with the subject analysis (Australian Rainfall & Runoff Project 15 – Ref. 6) as shown below in Table 9. Notably, depending on the existing agriculture within the project areas, the existing Manning's values may be equal to or greater than the proposed Manning's values. Nonetheless, in order to capture any potential impacts associated with the proposed condition, the Manning's values were conservatively adjusted from 0.04 (representing existing conditions) to 0.06 (representing proposed conditions) in appropriate project areas.

Table 9 Manning's (n) Values

| Description | Manning's (n) Value |
|---|---------------------|
| Proposed Project Area | 0.06 |
| Open Pervious Area, Minimal Vegetation (grassed) | 0.04 |
| Open Pervious Areas, Moderate Vegetation (shrubs) | 0.06 |
| Waterways/channels – Minimal Vegetation | 0.03 |
| Paved Roads/Car Park/Driveways | 0.025 |
| Residential Areas — Low Density | 0.15 |
| Residential Areas — High Density | 0.35 |

4.2.3 Hydraulic Model Results

According to the 2D hydraulic model, the proposed conditions are expected to expand 100-year flood boundaries by a net approximately 40 acres (55-acre expansion and 15 acre reduction), increase 100-year-flood WSEs up to 0.2-feet (ft), and generally increase/decrease velocities by 0.5 feet per second (ft/s) along the inundated project areas. There are localized areas with velocity increases up to 4 ft/s, particularly in areas with removed earthen dividing berms. The WSEs are unchanged throughout the downstream areas of Curry Creek and the unnamed tributaries. See Attachment D for the depth, velocity, and WSE increase exhibits.

4.3 Scour Calculations

It is anticipated that the supports of the solar panels will consist in 8-inch long by 3.5-inch wide steel C-shaped piles. For the purpose of scour depth calculations, the piles hydraulically function as piers. One commonly used standard for calculating scour depth for piers is the Colorado State University (CSU) equation, described in HEC-18 (Ref. 7) and shown below. The subject equation was used to calculate scour depths for the 100-year-flood. In terms of the scour depth (y_s) the equation is:

$$y_s = 2.0aK_1K_2K_3\left(\frac{y_1}{a}\right)^{0.35}Fr_1^{0.43}$$

where:

 y_s = Scour Depth (ft)

 y_1 = Flow depth directly upstream of the pier (ft)

 K_1 = Correction factor for pier nose shape

 K_2 = Correction factor for angle of attack of flow

 K_3 = Correction factor for bed condition

a = Pier width (ft)
L = Length of pier (ft)

 Fr_1 = Froude Number directly upstream of the pier

 V_1 = Mean velocity of flow directly upstream of the pier (fps)

g = Acceleration of gravity (32.2 ft/ s^2)

The piles were considered to have rounded noses $(K_1=1.0)$, the most conservative configuration for the angle of attack correction factor $(K_2=1.81)$, and a plane bed $(K_3=1.1)$. The 2D hydraulic model results for the 100-year-flood depths and the slightly more conservative existing velocities were utilized to calculated potential scour depth heat maps for the proposed project areas. The maximum 100-year-flood scour depth in the proposed project areas was calculated to be 1.5-ft, with over 99% of the proposed project area with scour depths less than 1-ft. See Attachment C for an example of the subject calculation representing the 100-year-flood maximum expected scour depth and Attachment D for the scour depth exhibits.

4.4 Regulatory Implications

4.4.1 FEMA Regulations and Model

The National Flood Insurance Program (NFIP) minimum regulations indicate that development in the flood fringe (outside of the floodway) must not increase the 100-year-flood WSE by more than 1-ft. When calculating WSE increases from a regulatory floodplain perspective, the latest available FEMA hydraulic model is adapted to represent the proposed conditions. As such, the subject FEMA model was obtained, and a preliminary conservative evaluation of the project impact to 100-year-flood WSEs was conducted.

The FEMA model's Manning's values for the appropriate cross sections' overbank areas were conservatively adjusted from 0.04 (representing existing conditions) to 0.06 (representing proposed conditions). The conservative Manning's adjustments without flood mitigation measures result in a maximum estimated 100-year-flood WSE increase of 0.25-ft. This maximum increase is localized to the area near Country Acres South Area #4. Notably, the FEMA model was conservatively adjusted to apply the Manning's changes to the entire overbank areas, whereas the 2D hydraulic model applied the changes solely to the areas where proposed changes are planned to occur. The subject difference along with differences in how flow is routed through the 1D FEMA model and the 2D hydraulic model likely accounted for the differences between the results of the two models. Given the conservatisms used in these calculations, the 0.25-ft increase is considered an upper bound on maximum change in WSEs possible due to the project; therefore, a refinement in the analysis will likely show a lesser impact.

Given that the proposed project areas are in the flood fringe (outside of the floodway) and the maximum estimated WSE increase due to the development is less than 1-ft, the proposed project meets the above-noted NFIP minimum regulation.

4.4.2 Placer County Regulations

Placer County generally does not allow development in the future, fully developed, unmitigated, 100-year floodplain. For this project, the County is considering the following three options: (1) to

recommend changing the configuration of the stream (by placing fill) such that the proposed areas are outside the 100-year floodplain, (2) to allow for an amendment permitting development in the 100-year flood fringe, or (3) to require identifying the fully developed, unmitigated, 100-year floodplain and not allow construction in the subject area. A final determination has not yet been decided by Placer County. The first option to change the configuration of the stream by placing fill would further alter the floodplain from its current condition, reduce its hydraulic carrying capacity, and increase WSEs to a greater degree than allowing for an amendment that permits solar panel development in the flood fringe. Notably, the solar panels themselves will be raised above the 100-year flood WSE, with just the piers in the flood.

5.0 Conclusion

A Preliminary Hydrology Study was performed in support of the SMUD Country Acres Solar Project. Key findings of the study are as follows:

- Stormwater detention is not necessary for the parcels where the proposed PV arrays will be located, contingent on Placer County approval.
- Stormwater detention is required in the Switching Station, Substation, and BESS areas. A total of approximately 1.0 acre-feet of storage is needed in response to the 100-Year, 24-Hour precipitation event.
- Temporary and permanent Best Management Practice (BMP) structures will be installed as part of the Project's stormwater quality mitigation method to prevent pollutions from leaving the Project site during construction and operation phases in conformance with the Policies of the Placer County General Plan. The design and details of the temporary and permanent BMPs will be addressed in the final design of the Project as part of the Project's Erosion Control Plan and Storm Water Pollution Prevention Plan (SWPPP).
- Only minimal grading will be required in the PV array areas. More substantial grading will be required in the Switching Station, Substation and BESS areas.
- Placer County Engineering & Surveying Division reviewed the methodology and infiltration characteristics used in the hydrologic analysis and stated the approach is reasonable and consistent with County Standards.

A Preliminary Hydraulic study was also performed in support of the SMUD Country Acres Solar Project. Key findings of the study are as follows:

- According to the 2D hydraulic model, the proposed conditions are expected to expand 100-year flood boundaries a net approximately 40 acres, increase 100-year-flood WSEs by up to 0.2-ft, generally increase/decrease velocities by 0.5 ft/s, and result in scour depths of less than 1.5-ft at the base of the solar panel supports.
- According to the 2D hydraulic model, the WSEs were unchanged throughout the downstream areas of Curry Creek and the unnamed tributaries.
- According to the FEMA hydraulic model, the proposed conditions are expected to increase 100-year-flood WSEs by a maximum of 0.25-ft along Curry Creek.

6.0 References

- 1. Placer County Flood Control and Water Conservation District, Stormwater Management Manual, Version 3, February 1994.
- 2. West Placer Storm Water Quality Design Manual, April 2016, Revised May 2018.
- 3. USDA Technical Release 55, Urban Hydrology for Small Watersheds, 1986.
- 4. U.S. Geological Survey, 20200108, USGS one-meter x63y430 CA NoCAL Wildfires B5a 2018: U.S. Geological Survey.
- 5. Gotvald, A.J., Barth, N.A., Veilleux, A.G., and Parrett, Charles, 2012, Methods for determining magnitude and frequency of flood in California, based on data through water year 2006: U.S. Geological Survey Scientific Investigations Report 2012-5113, 38 p., 1 pl. (http://pubs.usgs.gov/sir/2012/5113/).
- 6. Australian Rainfall & Runoff Project 15, Two-Dimensional Modelling in Urban and Rural Floodplains, Stage 1&2 Report, P15/S1/009, November 2012.
- 7. US Department of Transportation Federal Highway Administration, Hydraulic Engineering Circular No. 18 (HEC-18), Evaluating Scour at Bridges, Fifth Edition, April 2012.

Attachment A. Preliminary Hydrology Study Infiltration Characteristics



MEMORANDUM

Sacramento Municipal Utility District (SMUD)
Country Acres Solar
Preliminary Hydrology Study – Infiltration Characteristics

B&V Project 406242 B&V File 1000 11/17/2021

To: Phil Frantz, P.E.

Senior Civil Engineer

Engineering & Surveying Division, Placer County

From: Erik Winata, P.E.

Renewable Energy Project Manager

Black & Veatch

OVERVIEW

Black & Veatch is conducting a preliminary hydrology study for the Country Acres Solar project located on an approximately 1,100-acre parcels located about eight miles west of Roseville, within the unincorporated area of Placer County, California.

As part of the preliminary hydrology study, ground infiltration characteristics are determined under the pre- and post-development conditions.

The purpose of this memorandum is obtaining acceptance for the proposed methodology described below, specifically for the PV array portion of the project.

INFILTRATION CHARACTERISTICS

Infiltration characteristics are estimated for the parcels based on guidance from TR-55 Urban Hydrology for Small Watersheds, Table 2-2, Runoff Curve Numbers, and Table 5-3, Constant Infiltration Rates for Hydrologic Soil-Cover Complexes, from the Placer County Flood Control and Water Conservation District Stormwater Management Manual. The Hydrologic Soil Group (HSG) rating of D was obtained from the Natural Resources Conservation Service Web Soil Survey.

Pre-Developed Condition Characteristics:

The existing vegetation at the project site is primarily comprised of rice fields, with some additional areas that are best described as rangeland. The rice fields are modeled as "Small Grain in Good Condition." For HSG D, the SCS Curve Number for this cover type is 87, and the loss rate is 0.05

MEMORANDUM Page 2

inches/hour. For "Rangeland in Good Condition," with HSG D, the SCS Curve Number is 80, and the loss rate is 0.09 inches/hour.

Proposed Site Characteristics:

The proposed site where the solar panels are installed will be seeded to establish grass, but it is conservatively assumed that the grass will be in fair condition, with grass cover established between 50 and 75 percent of the area. For "Grass in Fair Condition," with HSG D, the SCS Curve Number is 89, and the loss rate is 0.07 inches/hour.

The steel pile foundations supporting the solar panel racking tables and the inverter skids are modeled as "Impervious Areas," with HSG D, an SCS Curve Number of 98, and a loss rate of 0.00 inches/hour. This assumes that the soil under the solar panels will become saturated in response to the design storm events, specifically the 100-Year recurrence interval event, which is used to size the ditches and basins. The existing grades at the site are very flat, which will encourage infiltration.

Ditches and detention basins within the site will be graded to drain completely, seeded to establish grass, and mowed once the grass is established. This cover is modeled as "Grass in Good Condition," with HSG D, resulting in an SCS Curve Number of 80, and a loss rate of 0.09 inches/hour.

Perimeter and intermediate access roads within the site are assumed to be gravel surfaced. For "Gravel Roads," with HSG D, the SCS Curve Number is 91, and the loss rate is 0.03 inches/hour.

HYDROLOGY ANALYSIS COMPARISON

Black & Veatch also reviewed the Hydrology Study for the SMUD Rancho Seco II Solar project located in Sacramento County, California, dated November 20, 2019 and prepared by Westwood, for comparison of methodology. The SMUD Rancho Seco II Solar project encompasses approximately 523 acres and is the most recently constructed utility scale solar project in the area.

In Black & Veatch's opinion, the methodology used in the SMUD Rancho Seco II Hydrology Study is similar to the methodology being used in the SMUD Country Acres Preliminary Hydrology Study. Some differences noted in Table 1 below are mainly due to the Country Acres project using design values and methodologies specified in the Placer County Stormwater Management Manual.

MEMORANDUM Page 3

Table 1: Hydrology Analysis Comparison

| ITEM | RANCHO SECO II SOLAR | COUNTRY ACRES SOLAR |
|-------------------------|----------------------|----------------------------------|
| Regulations | Sacramento County | Placer County |
| Design | Final | Preliminary |
| Precipitation Source | NOAA Atlas 14 | Placer County Stormwater Manual* |
| Software | Flo-2D | HEC-HMS/HEC-RAS** |
| Soils Data | NRCS – HSG D | NRCS – HSG D |
| Conveyance | Culvert Designs | No Culvert Designs |
| Storm Events | 10- and 100-Year | 2-, 10-, and 100-Year |
| Infiltration Method | Curve Number | Placer County Constant* |
| Pre- vs. Post- Analysis | Provided | Provided |

^{*} Values specified in the Placer County Stormwater Management Manual

CC: Sarah Cheney, SMUD

^{**} HEC referenced in the Placer County Stormwater Management Manual

Attachment B. Preliminary Hydrologic Analysis Calculation



CALCULATION RECORD

| Client | lient Name Sacramento Municipal Utility District | | | Page _ | 1 | _ of | 75 | |
|---------------------|--|-----------------|-------------------|--------------|----------------|-----------|------|-----|
| Projec | Project Name Country Acres Solar Study | | | Project | No. <u>4</u> | 06242 | | |
| Calcul | Calculation Title Hydrologic Analysis | | | | | | | |
| Calcul | lation No./File No. | | | | | | | |
| Verific | cation Method: | | nd Review | Alterna | te Calculation | ns | | |
| - | ective: Determine onstrate that the sto | | - | _ | | ı event | S. | |
| | Unve | erified Assum | ptions Requiring | g Subsequen | t Verificati | on | | |
| No | | Assumption | on | Verif | ied By | d By Date | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| Refer to | o Page of this | calculation for | additional assump | tions. | | | | |
| | Th | is Section Us | ed for Software-(| Generated Ca | alculations | | | |
| Prog | ram Name/Number | HEC-HMS | | | Vers | sion 4 | .6.1 | |
| Stand | dard B&V Application, list approved devia | on Used? | Yes | | | | | |
| | | | | | | | | |
| Review and Approval | | | | | | | | |
| Rev | Prepared By | Date | Verified By | Date | Approve | d By | Da | ite |
| 0 | G. V. Johnson | 12/17/2021 | | | | | | |
| | | | | | | | 1 | |

Country Acres Solar Study Plant:

Placer County, CA Address: Project No.: 406242 File No. **Hydrologic Analysis** Title:

Table of Contents

| | | PAGE: |
|---------------|---|------------------|
| Attachment A: | SMUD Country Acres Solar Study Hydrologic Analysis | A1 - A75 |
| | 1.0 References | А3 |
| | 2.0 Design Basis | A4 |
| | 3.0 Definition of Units and Constants | A4 |
| | 4.0 Analysis | A4 - A59 |
| | Stormwater Management System | A5 - A6 |
| | Watershed Areas | A 7 |
| | Design Precipitation Events | A8 |
| | Time-of-Concentration - Existing Parcels | A9 - A21 |
| | Time-of-Concentration - Proposed Parcels | A22 - A36 |
| | Hydrologic Soil Group | A37 |
| | Infiltration Characteristics - Pre-Development | A38 - A39 |
| | Infiltration Characteristics - Post-Development | A40 - A47 |
| | Precipitation Distribution | A48 |
| | Proposed Site Basins: Stage-Storage Relationships | A49 |
| | Proposed Site Basins: Stage-Discharge Relationships | A50 - A53 |
| | Hydrologic Model Results - Summary | A54 |
| | Hydrologic Model Results - Parcels | A55 - A63 |
| | Parcels - Pre-Development Output | A55 - A57 |
| | Parcels - Post-Development Output | A58 - A63 |
| | Hydrologic Model Results - Switchyard, Substation and BESS Areas | A64 - A72 |
| | Switch, Subst & BESS - Pre-Development Output | A64 - A66 |
| | Switch, Subst & BESS - Post-Development Output Water Quality Analysis | A67 - A72 A73 |
| | 5.0 Conclusion | A74 - A75 |

Plant: <u>Country Acres Solar Study</u>

Address: Placer County, CA

Project No.: 406242 File No.

Title: <u>Hydrologic Analysis</u>

1.0 REFERENCES:

1) TR55, Urban Hydrology for Small Watersheds, U.S. Department of Agriculture, Soil Conservation Service, June 1986.

- 2) HEC-HMS, Hydrologic Modeling System, U.S. Army Corps of Engineers, Version 4.6.1, Build: 8363 Date: 17Sep2020 DSS: 7-HK JAVA: 11.0.6
- **3)** SMUD Country Acres Solar, BESS Yard Conceptual Layout, Placer County, California, Dwg. No. CA-SK-3000, Rev. B, 12/07/21.
- 4) SMUD Country Acres Solar + BESS, Placer County, CA, B&V Dwg. CA-SK-0004, Rev. M, 21/OCT/21.
- **5)** SMUD Country Acres Solar + BESS, Conceptual Substation General Arrangement, Placer County, CA, B&V Dwg. CA-SK-1000, 11/8/2021.
- **6)** SMUD, 230KV General Arrangement Plan, Country Acres Switch Station, Dwg. No. CAS-E4H-E001, Rev. A, 05/21.
- **7)** NRCS Type IA Precipitation Distribution, HydroCAD Software Solutions LLC, 2015.
- **8)** HY-8 v.7.60, Culvert Analysis Software Package, Federal Highway Administration, Build Date Jul 30, 2019.
- **9)** United States Dept. of Agriculture, Natural Resources Conservation Service, Web Soil Survey, Website: http://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx
- 10) West Placer Storm Water Quality Design Manual, April 2016, Revised May 2018.
- Placer County Online Map: http://maps.placer.ca.gov/Html5viewer/Index.html?
 configBase=http://arcgis/Geocortex/Essentials/REST/sites/LIS Public/viewers/LIS Base-Public/virtualdirectory/Resources/Config/Default
- 12) Fluid Mechanics, 8th Edition, Streeter and Wylie, McGraw-Hill, 1985.
- 13) Introduction to Hydrology, 3rd Edition, Viessman, Jr., Lewis, & Knapp, HarperCollins, 1989.
- **14)** Placer County Flood Control and Water Conservation District, Stormwater Management Manual, Version 3, February 1994.
- 15) Open-Channel Hydraulics, Chow, McGraw-Hill, 1959.
- **16)** Project meeting with Phil Frantz, Placer County Engineering and Surveying Division (ESD), Sarah Cheney, SMUD, and Erik Winata and Greg Johnson, Black & Veatch, 10/1/2021.

Plant: <u>Country Acres Solar Study</u>

Address: Placer County, CA

Project No.: 406242 File No.

Title: <u>Hydrologic Analysis</u>

2.0 DESIGN BASIS:

The proposed project includes the installation of solar PV panels on 12 parcels of land with a total area of 1064.85 acres. Inverter skids and aggregate surfaced access roads will also be constructed on the parcels. The project will be supported by the construction of a substation, switchyard, and BESS area, on an additional 55.75 acres. The project is located in rural west Placer County, California.

The project site will be designed to meet the requirements of the Placer County Stormwater Management Manual (Reference 14). The 2, 10, and 100-Year recurrence interval events shall be used as the design precipitation events. Any additional requirements from the Placer County Flood Control District and Placer County Engineering and Surveying Division will be addressed.

The existing project site will be evaluated based on its area and infiltration characteristics. The proposed final site conditions consider the constructed facilities, along with roads and project surfacing. In the proposed final condition, BMPs are provided if required to meet stormwater quality and quantity requirements.

The HEC-HMS Hydrologic Modeling System software package is used to model the response of the system to the design precipitation events as specified by Placer County. Modeling is performed for the site in its existing, and proposed conditions. (Reference 2)

3.0 DEFINITION OF UNITS AND CONSTANTS:

cfs cubic feet per second

ac-ft acre-feet sq mi square miles sq ft square feet

hr hour in inches ft feet

ft/sec feet per second cu-ft cubic feet

4.0 ANALYSIS:

Required HEC-HMS design input parameters include watershed area, infiltration characteristics, and time lag. Also, stage-area and stage-discharge relationships are required for the proposed finished site BMPs, where required. Design precipitation events and the precipitation distribution are also used in the HEC-HMS models.

Plant: <u>Country Acres Solar Study</u>

Address: Placer County, CA

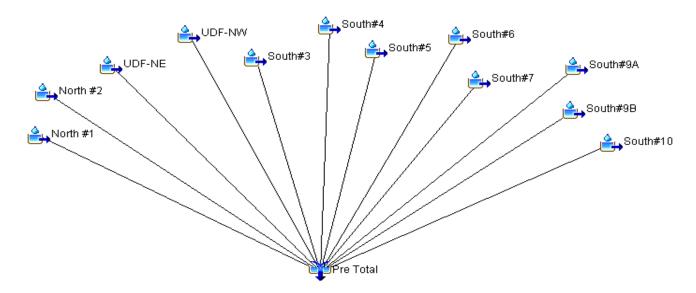
Project No.: 406242 File No.

Title: <u>Hydrologic Analysis</u>

Stormwater Management System:

Pre-Development:

The existing site consists primarily of rice fields, with some areas characterized as rangeland. There are no significant areas of impervious surfacing. The existing parcels are shown in the sketch below. The discharge hydrograph from each parcel is combined at a junction named "Pre Total".



The Switchyard, Substation, and BESS areas are considered in a separate HEC-HMS model, with the areas combined for the pre-development case.

Plant: <u>Country Acres Solar Study</u>

Address: Placer County, CA

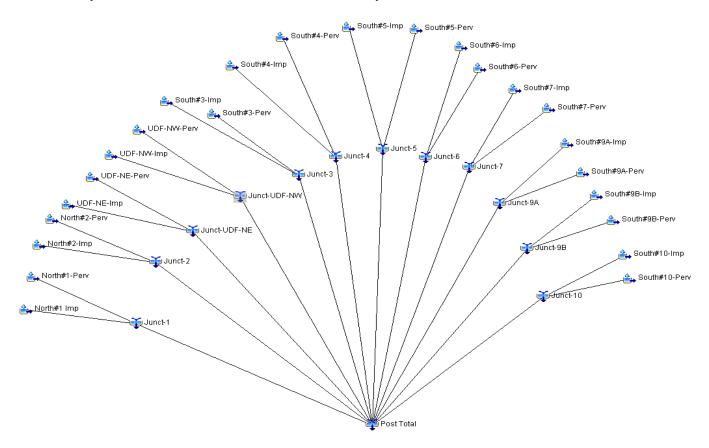
Project No.: 406242 File No.

Title: <u>Hydrologic Analysis</u>

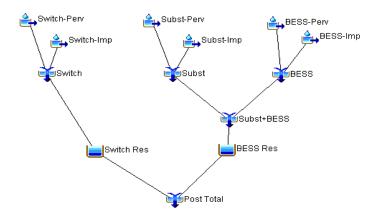
Stormwater Management System:

Post-Development:

The proposed stormwater management system for the parcels is shown in the sketch below. For all subbasins, pervious and impervious surfaces are modeled separately. Runoff from each area is routed to a junction, and all subbasins are combined at the junction "Post Total".



The proposed stormwater management system for the Switchyard, Substation, and BESS areas is shown in the sketch to the right. Switchyard runoff is routed to a basin named "Switch Res", and runoff from the Substation and BESS areas is routed to a basin named "BESS Res". Discharge hydrographs from the two basins are combined at a junction named, "Post Total".



A6

Plant: <u>Country Acres Solar Study</u>

Address: Placer County, CA

Project No.: 406242 File No.

Title: <u>Hydrologic Analysis</u>

Watershed Areas:

The watershed areas for each of the parcels is provided in the table below, from Reference 4.

| Country Acres | Parcel Size | Parcel Size |
|---------------------|--------------|-------------|
| Parcel Title | (acres) | (sq miles) |
| North #1 | 180.54 | 0.28209 |
| North #2 | 176.69 | 0.27608 |
| UDF-NW | 59.04 | 0.09225 |
| UDF-NE | 124.98 | 0.19528 |
| UDF-NE (Option 2) | 61.00 | 0.09531 |
| South #3 | 45.57 | 0.07120 |
| South #4 | 44.78 | 0.06997 |
| South #5 | 232.64 | 0.36350 |
| South #5 (Option 2) | 202.62 | 0.31659 |
| South #6 | 28.30 | 0.04422 |
| South #7 | 55.73 | 0.08708 |
| South #9A | 32.72 | 0.05113 |
| South #9B | 14.69 | 0.02295 |
| South #10 | <u>69.17</u> | 0.10808 |
| Total | 1064.85 | 1.66383 |
| | | |

| Country Acres | Parcel Size | Parcel Size |
|-------------------|--------------|-------------|
| Parcel Title | (acres) | (sq miles) |
| BESS | 40.66 | 0.06353 |
| Substation | 3.75 | 0.00586 |
| Subst - Offsite | 0.83 | 0.00129 |
| <u>Switchyard</u> | <u>11.34</u> | 0.01772 |
| Total | 56.58 | 0.08840 |

Plant: Country Acres Solar Study

Address: Placer County, CA

Project No.: 406242 File No.

Title: <u>Hydrologic Analysis</u>

Design Precipitation Events:

From References 14 and 16, design precipitation events for this site include the 2, 10, and 100-Year, 24-Hour Events. Precipitation frequency data at the site for these events were obtained from Reference 14.

| <u>Event</u> | Precip. (in.) |
|-------------------|---------------|
| 2-Year, 24-Hour | 1.90 |
| 10-Year, 24-Hour | 2.98 |
| 100-Year, 24-Hour | 4.25 |

PLACER COUNTY FLOOD CONTROL AND WATER CONSERVATION DISTRICT STORMWATER MANAGEMENT MANUAL V. HYDROLOGY

Table 5-A-1 Depth-Duration-Frequency Coefficients

150 - 3000 feet elevation West of Sierra Nevada Crest

Depths in inches at 150 feet

| Duration | 2yr | <u>5yr</u> | <u>10yr</u> | 25yr | <u>50yr</u> | 100yr | 200yr | 500yr |
|-----------------|------|------------|-------------|------|-------------|-------|-------|-------|
| 5m | 0.13 | 0.20 | 0.25 | 0.32 | 0.38 | 0.44 | 0.49 | 0.58 |
| 10m | 0.19 | 0.29 | 0.36 | 0.46 | 0.54 | 0.62 | 0.70 | 0.82 |
| 15m | 0.23 | 0.35 | 0.43 | 0.55 | 0.64 | 0.73 | 0.82 | 0.96 |
| 30m | 0.32 | 0.47 | 0.57 | 0.72 | 0.83 | 0.94 | 1.04 | 1.22 |
| 1h | 0.45 | 0.64 | 0.77 | 0.94 | 1.07 | 1.21 | 1.33 | 1.53 |
| 2h | 0.64 | 0.88 | 1.04 | 1.26 | 1.42 | 1.59 | 1.76 | 2.00 |
| 3h | 0.77 | 1.04 | 1.23 | 1.47 | 1.66 | 1.85 | 2.03 | 2.31 |
| 6h | 1.06 | 1.40 | 1.65 | 1.95 | 2.22 | 2.23 | 2.75 | 3.10 |
| 12h | 1.43 | 1.91 | 2.24 | 2.67 | 3.00 | 3.30 | 3.60 | 4.00 |
| 1d | 1.90 | 2.50 | 2.98 | 3.46 | 3.85 | 4.25 | 4.60 | 5.20 |
| 2d | 2.51 | 3.40 | 3.95 | 4.65 | 5.15 | 5.70 | 6.20 | 7.00 |
| 3d | 3.00 | 4.07 | 4.65 | 5.50 | 6.20 | 6.80 | 7.50 | 8.40 |
| 5d | 3.61 | 4.91 | 5.76 | 6.85 | 7.63 | 8.42 | 9.20 | 10.29 |
| 10d | 4.73 | 6.44 | 7.54 | 8.96 | 9.97 | 11.01 | 11.95 | 13.45 |

Plant: Country Acres Solar Study

Address: Placer County, CA

Project No.: 406242 File No.

Title: <u>Hydrologic Analysis</u>

Time-of-Concentration: (from Reference 1)

The time-of-concentration for stormwater runoff to travel across the site from the hydrologically most remote portion of the watershed is determined based on the topography from References 3, 4, 5 and 6. The time-of-concentration is made up of travel time due to sheet flow, shallow concentrated flow, and channel flow. Many watersheds do not have all three flow types. A flow path sketch is provided for each t-o-c calculation.

North #1: Sheet Flow:

Existing Surface Description: crop

Manning's Roughness: 0.06 (Ref. 1)
Flow Length: 300 feet
2-Yr 24-Hr Precip.: 1.9 inches
Land Slope: 0.003 ft/ft

Travel Time: **0.502 hours** (from Ref. 1 equation)

Shallow Concentrated Flow:

Surface Description: unpaved
Flow Length: 1160 feet
Watercourse Slope: 0.007 ft/ft

Average Velocity: 1.35 ft/sec (Ref. 1)

Travel Time: 0.239 hours (length/(3600*Velocity))

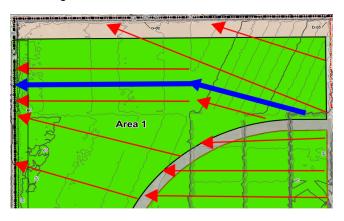
Shallow Concentrated Flow:

Surface Description: unpaved
Flow Length: 2650 feet
Watercourse Slope: 0.002 ft/ft

Average Velocity: 1 ft/sec (Ref. 1)

Travel Time: 0.736 hours (length/(3600*Velocity))

Time-of-Conc.: 1.477 hr
Time Lag = 0.6*Tc = 0.886 hr
Time Lag = 0.6*Tc = 53.2 min



Plant: Country Acres Solar Study

Address: Placer County, CA

Project No.: 406242 File No.

Title: <u>Hydrologic Analysis</u>

Time-of-Concentration: (from Reference 1)

North #2: Sheet Flow:

Existing Surface Description: crop

Manning's Roughness: 0.06 (Ref. 1)
Flow Length: 300 feet
2-Yr 24-Hr Precip.: 1.9 inches
Land Slope: 0.002 ft/ft

Travel Time: **0.663 hours** (from Ref. 1 equation)

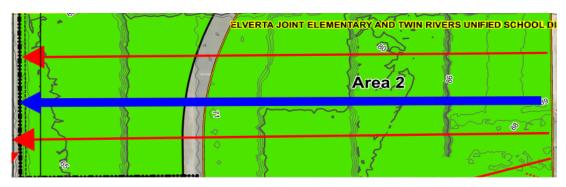
Shallow Concentrated Flow:

Surface Description: unpaved
Flow Length: 3500 feet
Watercourse Slope: 0.007 ft/ft

Average Velocity: 1.35 ft/sec (Ref. 1)

Travel Time: **0.720 hours** (length/(3600*Velocity))

Time-of-Conc.: 1.383 hr Time Lag = 0.6*Tc = 0.830 hr Time Lag = 0.6*Tc = 49.8 min



Plant: Country Acres Solar Study

Address: Placer County, CA

Project No.: 406242 File No.

Title: <u>Hydrologic Analysis</u>

<u>Time-of-Concentration</u>: (from Reference 1)

UDF-NE: Sheet Flow:

Existing Surface Description: crop

Manning's Roughness: 0.06 (Ref. 1)
Flow Length: 300 feet
2-Yr 24-Hr Precip.: 1.9 inches
Land Slope: 0.003 ft/ft

Travel Time: **0.502 hours** (from Ref. 1 equation)

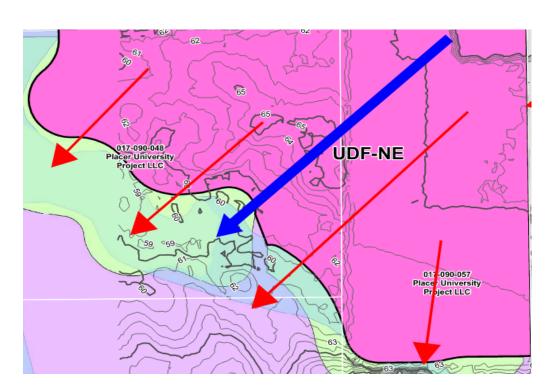
Shallow Concentrated Flow:

Surface Description: unpaved
Flow Length: 2000 feet
Watercourse Slope: 0.005 ft/ft

Average Velocity: 1.15 ft/sec (Ref. 1)

Travel Time: **0.483 hours** (length/(3600*Velocity))

Time-of-Conc.: 0.985 hr Time Lag = 0.6*Tc = 0.591 hr Time Lag = 0.6*Tc = 35.5 min



Plant: <u>Country Acres Solar Study</u>

Address: Placer County, CA

Project No.: 406242 File No.

Title: <u>Hydrologic Analysis</u>

<u>Time-of-Concentration</u>: (from Reference 1)

UDF-NW: Sheet Flow:

Existing Surface Description: rangeland

Manning's Roughness: 0.13 (Ref. 1)
Flow Length: 300 feet
2-Yr 24-Hr Precip.: 1.9 inches
Land Slope: 0.007 ft/ft

Travel Time: **0.706 hours** (from Ref. 1 equation)

Shallow Concentrated Flow:

Surface Description: unpaved
Flow Length: 900 feet
Watercourse Slope: 0.004 ft/ft

Average Velocity: 1.1 ft/sec (Ref. 1)

Travel Time: 0.227 hours (length/(3600*Velocity))

Channel Flow:

Input

Flow Depth (y)=

Channel width (b)=

Roughness Coeff n

Channel Slope (s)=

Side slope (x)=

0.5 feet

0.15

0.0096 ft/ft

50

Calculated Values

Flow Area= 37.5 sq. ft Wetted Perimeter= 100.01 feet

Flow Type= subcritical

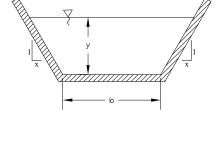
Froude Number 0.18 feet Manning's Formula

Discharge (Q)= 18.99 cfs $Q = \frac{1.49}{n} \ A \ R^{\frac{2}{3}} S^{\frac{1}{2}}$ Flow velocity (v)= 0.51 ft/sec

Flow Length: 416 feet

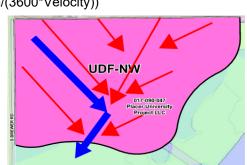
Travel Time: 0.228 hours (length/(3600*Velocity))

Time-of-Conc.: 1.162 hr
Time Lag = 0.6*Tc = 0.697 hr
Time Lag = 0.6*Tc = 41.8 min



A12

Page:



Plant: Country Acres Solar Study

Address: Placer County, CA

Project No.: 406242 File No.

Title: <u>Hydrologic Analysis</u>

Time-of-Concentration: (from Reference 1)

South #3 Sheet Flow:

Existing Surface Description: crop

Manning's Roughness: 0.06 (Ref. 1)
Flow Length: 300 feet
2-Yr 24-Hr Precip.: 1.9 inches
Land Slope: 0.004 ft/ft

Travel Time: **0.467 hours** (from Ref. 1 equation)

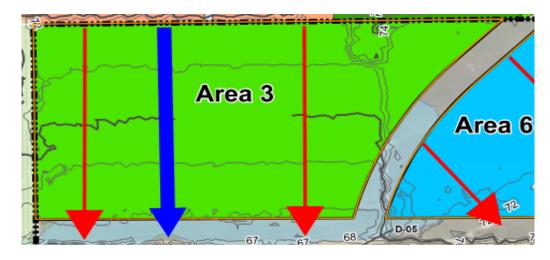
Shallow Concentrated Flow:

Surface Description: unpaved
Flow Length: 750 feet
Watercourse Slope: 0.004 ft/ft

Average Velocity: 1.1 ft/sec (Ref. 1)

Travel Time: **0.189 hours** (length/(3600*Velocity))

Time-of-Conc.: 0.656 hr Time Lag = 0.6*Tc = 0.394 hr Time Lag = 0.6*Tc = 23.6 min



Plant: Country Acres Solar Study

Address: Placer County, CA

Project No.: 406242 File No.

Title: <u>Hydrologic Analysis</u>

Time-of-Concentration: (from Reference 1)

South #4: Sheet Flow:

Existing Surface Description: crop

Manning's Roughness: 0.06 (Ref. 1)
Flow Length: 300 feet
2-Yr 24-Hr Precip.: 1.9 inches
Land Slope: 0.003 ft/ft

Travel Time: **0.502 hours** (from Ref. 1 equation)

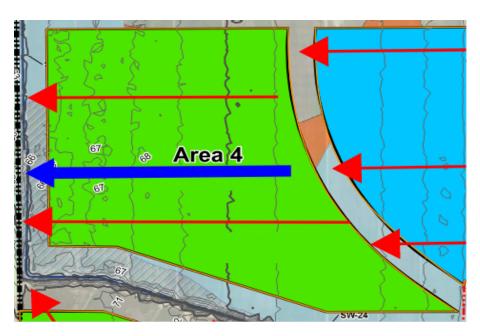
Shallow Concentrated Flow:

Surface Description: unpaved
Flow Length: 1050 feet
Watercourse Slope: 0.003 ft/ft

Average Velocity: 1.10 ft/sec (Ref. 1)

Travel Time: 0.265 hours (length/(3600*Velocity))

Time-of-Conc.: 0.767 hr Time Lag = 0.6*Tc = 0.460 hr Time Lag = 0.6*Tc = 27.6 min



Plant: Country Acres Solar Study

Address: Placer County, CA

Project No.: 406242 File No.

Title: <u>Hydrologic Analysis</u>

Time-of-Concentration: (from Reference 1)

South #5: Sheet Flow:

Existing Surface Description: crop

Manning's Roughness: 0.06 (Ref. 1)
Flow Length: 300 feet
2-Yr 24-Hr Precip.: 1.9 inches
Land Slope: 0.003 ft/ft

Travel Time: **0.502 hours** (from Ref. 1 equation)

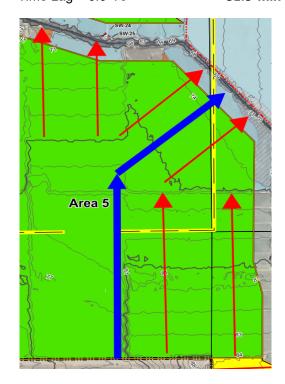
Shallow Concentrated Flow:

Surface Description: unpaved
Flow Length: 1650 feet
Watercourse Slope: 0.006 ft/ft

Average Velocity: 1.25 ft/sec (Ref. 1)

Travel Time: **0.367 hours** (length/(3600*Velocity))

Time-of-Conc.: 0.869 hr Time Lag = 0.6*Tc = 0.521 hr Time Lag = 0.6*Tc = 31.3 min



Plant: Country Acres Solar Study

Address: Placer County, CA

Project No.: 406242 File No.

Title: <u>Hydrologic Analysis</u>

<u>Time-of-Concentration</u>: (from Reference 1)

South #6: Sheet Flow:

Existing Surface Description: crop

Manning's Roughness: 0.06 (Ref. 1)
Flow Length: 300 feet
2-Yr 24-Hr Precip.: 1.9 inches
Land Slope: 0.001 ft/ft

Travel Time: **0.724 hours** (from Ref. 1 equation)

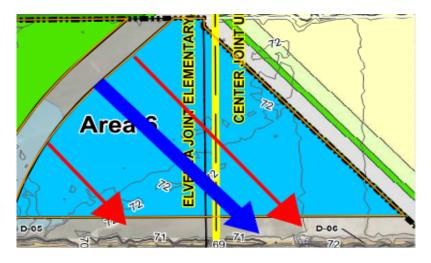
Shallow Concentrated Flow:

Surface Description: unpaved
Flow Length: 1000 feet
Watercourse Slope: 0.001 ft/ft

Average Velocity: 1.00 ft/sec (Ref. 1)

Travel Time: **0.278 hours** (length/(3600*Velocity))

Time-of-Conc.: 1.002 hr
Time Lag = 0.6*Tc = 0.601 hr
Time Lag = 0.6*Tc = 36.1 min



Plant: Country Acres Solar Study

Address: Placer County, CA

Project No.: 406242 File No.

Title: <u>Hydrologic Analysis</u>

Time-of-Concentration: (from Reference 1)

South #7: Sheet Flow:

Existing Surface Description: crop

Manning's Roughness: 0.06 (Ref. 1)
Flow Length: 250 feet
2-Yr 24-Hr Precip.: 1.9 inches
Land Slope: 0.004 ft/ft

Travel Time: **0.403 hours** (from Ref. 1 equation)

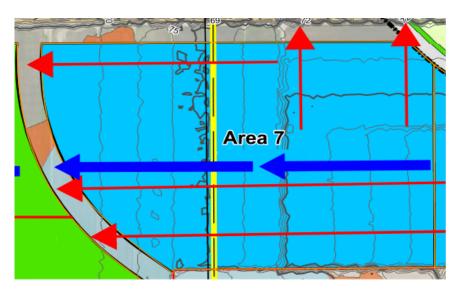
Shallow Concentrated Flow:

Surface Description: unpaved
Flow Length: 2950 feet
Watercourse Slope: 0.005 ft/ft

Average Velocity: 1.15 ft/sec (Ref. 1)

Travel Time: **0.713 hours** (length/(3600*Velocity))

Time-of-Conc.: 1.116 hr Time Lag = 0.6*Tc = 0.670 hr Time Lag = 0.6*Tc = 40.2 min



Plant: Country Acres Solar Study

Address: Placer County, CA

Project No.: 406242 File No.

Title: <u>Hydrologic Analysis</u>

Time-of-Concentration: (from Reference 1)

South #9A: Sheet Flow:

Existing Surface Description: crop

Manning's Roughness: 0.06 (Ref. 1)
Flow Length: 300 feet
2-Yr 24-Hr Precip.: 1.9 inches
Land Slope: 0.002 ft/ft

Travel Time: **0.579 hours** (from Ref. 1 equation)

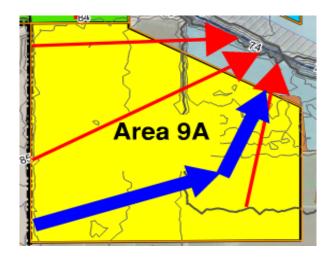
Shallow Concentrated Flow:

Surface Description: unpaved
Flow Length: 1300 feet
Watercourse Slope: 0.004 ft/ft

Average Velocity: 1.1 ft/sec (Ref. 1)

Travel Time: **0.328 hours** (length/(3600*Velocity))

Time-of-Conc.: 0.907 hr Time Lag = 0.6*Tc = 0.544 hr Time Lag = 0.6*Tc = 32.7 min



Plant: Country Acres Solar Study

Address: Placer County, CA

Project No.: 406242 File No.

Title: <u>Hydrologic Analysis</u>

<u>Time-of-Concentration</u>: (from Reference 1)

South #9B: Sheet Flow:

Existing Surface Description: crop

Manning's Roughness: 0.06 (Ref. 1)
Flow Length: 300 feet
2-Yr 24-Hr Precip.: 1.9 inches
Land Slope: 0.003 ft/ft

Travel Time: **0.502 hours** (from Ref. 1 equation)

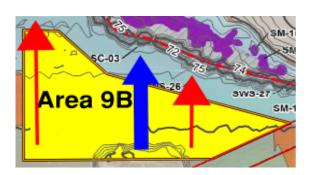
Shallow Concentrated Flow:

Surface Description: unpaved
Flow Length: 420 feet
Watercourse Slope: 0.004 ft/ft

Average Velocity: 1.1 ft/sec (Ref. 1)

Travel Time: **0.106 hours** (length/(3600*Velocity))

Time-of-Conc.: 0.608 hr
Time Lag = 0.6*Tc = 0.365 hr
Time Lag = 0.6*Tc = 21.9 min



Plant: Country Acres Solar Study

Address: Placer County, CA

Project No.: 406242 File No.

Title: <u>Hydrologic Analysis</u>

Time-of-Concentration: (from Reference 1)

South #10: Sheet Flow:

Existing Surface Description: range

Manning's Roughness: 0.13 (Ref. 1)
Flow Length: 300 feet
2-Yr 24-Hr Precip.: 1.9 inches
Land Slope: 0.015 ft/ft

Travel Time: **0.515 hours** (from Ref. 1 equation)

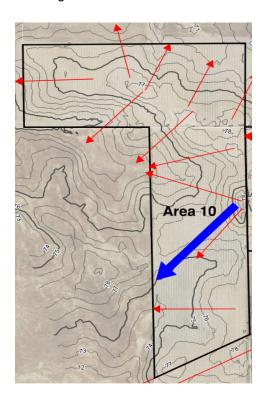
Shallow Concentrated Flow:

Surface Description: unpaved
Flow Length: 1050 feet
Watercourse Slope: 0.004 ft/ft

Average Velocity: 1.1 ft/sec (Ref. 1)

Travel Time: 0.265 hours (length/(3600*Velocity))

Time-of-Conc.: 0.780 hr
Time Lag = 0.6*Tc = 0.468 hr
Time Lag = 0.6*Tc = 28.1 min



Plant: <u>Country Acres Solar Study</u>

Address: Placer County, CA

Project No.: 406242 File No.

Title: <u>Hydrologic Analysis</u>

<u>Time-of-Concentration</u>: (from Reference 1)

For the pre-development case, the Switchyard, Substation, and BESS areas are combined and modeled as one area.

Subst/BESS: Sheet Flow:

Existing Surface Description: range

Manning's Roughness: 0.13 (Ref. 1)
Flow Length: 300 feet
2-Yr 24-Hr Precip.: 1.9 inches
Land Slope: 0.003 ft/ft

Travel Time: **0.932 hours** (from Ref. 1 equation)

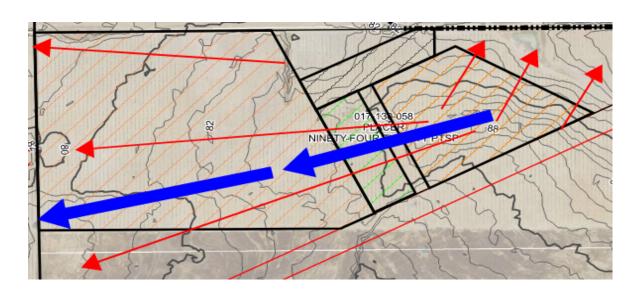
Shallow Concentrated Flow:

Surface Description: unpaved
Flow Length: 2100 feet
Watercourse Slope: 0.005 ft/ft

Average Velocity: 1.15 ft/sec (Ref. 1)

Travel Time: 0.507 hours (length/(3600*Velocity))

Time-of-Conc.: 1.439 hr
Time Lag = 0.6*Tc = 0.864 hr
Time Lag = 0.6*Tc = 51.8 min



Plant: <u>Country Acres Solar Study</u>

Address: Placer County, CA

Project No.: 406242 File No.

Title: <u>Hydrologic Analysis</u>

<u>Time-of-Concentration</u>: (from Reference 1)

Only minimal grading is proposed to prepare the site for the PV panels. Thus, the same flow path and slope is assumed for the existing and proposed site, with the major difference in time of concentration resulting from changing the surface description from crop to grass in fair condition, which is modeled as rangeland.

North #1: Sheet Flow:

Proposed Surface Description: range

Manning's Roughness: 0.13 (Ref. 1)
Flow Length: 300 feet
2-Yr 24-Hr Precip.: 1.9 inches
Land Slope: 0.003 ft/ft

Travel Time: **0.932 hours** (from Ref. 1 equation)

Shallow Concentrated Flow:

Surface Description: unpaved
Flow Length: 1160 feet
Watercourse Slope: 0.007 ft/ft

Average Velocity: 1.35 ft/sec (Ref. 1)

Travel Time: 0.239 hours (length/(3600*Velocity))

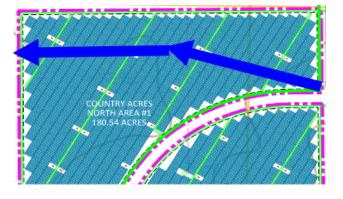
Shallow Concentrated Flow:

Surface Description: unpaved
Flow Length: 2650 feet
Watercourse Slope: 0.002 ft/ft

Average Velocity: 1 ft/sec (Ref. 1)

Travel Time: 0.736 hours (length/(3600*Velocity))

Time-of-Conc.: 1.907 hr Time Lag = 0.6*Tc = 1.144 hr Time Lag = 0.6*Tc = 68.6 min



Plant: <u>Country Acres Solar Study</u>

Address: Placer County, CA

Project No.: 406242 File No.

Title: <u>Hydrologic Analysis</u>

Time-of-Concentration: (from Reference 1)

North #2: Sheet Flow:

Proposed Surface Description: range

Manning's Roughness: 0.13 (Ref. 1)
Flow Length: 300 feet
2-Yr 24-Hr Precip.: 1.9 inches
Land Slope: 0.002 ft/ft

Travel Time: 1.230 hours (from Ref. 1 equation)

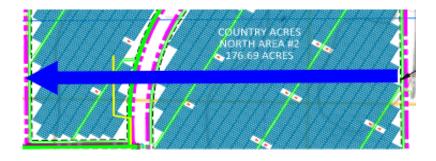
Shallow Concentrated Flow:

Surface Description: unpaved
Flow Length: 3500 feet
Watercourse Slope: 0.007 ft/ft

Average Velocity: 1.35 ft/sec (Ref. 1)

Travel Time: **0.720 hours** (length/(3600*Velocity))

Time-of-Conc.: 1.950 hr Time Lag = 0.6*Tc = 1.170 hr Time Lag = 0.6*Tc = 70.2 min



Plant: Country Acres Solar Study

Address: Placer County, CA

Project No.: 406242 File No.

Title: <u>Hydrologic Analysis</u>

Time-of-Concentration: (from Reference 1)

UDF-NE: Sheet Flow:

Proposed Surface Description: range

Manning's Roughness: 0.13 (Ref. 1)
Flow Length: 300 feet
2-Yr 24-Hr Precip.: 1.9 inches
Land Slope: 0.003 ft/ft

Travel Time: **0.932 hours** (from Ref. 1 equation)

Shallow Concentrated Flow:

Surface Description: unpaved
Flow Length: 2000 feet
Watercourse Slope: 0.005 ft/ft

Average Velocity: 1.15 ft/sec (Ref. 1)

Travel Time: **0.483 hours** (length/(3600*Velocity))

Time-of-Conc.: 1.415 hr
Time Lag = 0.6*Tc = 0.849 hr
Time Lag = 0.6*Tc = 50.9 min



Plant: <u>Country Acres Solar Study</u>

Address: Placer County, CA

Project No.: 406242 File No.

Title: <u>Hydrologic Analysis</u>

<u>Time-of-Concentration</u>: (from Reference 1)

UDF-NW: Sheet Flow:

Proposed Surface Description: range

Manning's Roughness: 0.13 (Ref. 1)
Flow Length: 300 feet
2-Yr 24-Hr Precip.: 1.9 inches
Land Slope: 0.007 ft/ft

Travel Time: **0.706 hours** (from Ref. 1 equation)

Shallow Concentrated Flow:

Surface Description: unpaved
Flow Length: 900 feet
Watercourse Slope: 0.004 ft/ft

Average Velocity: 1.1 ft/sec (Ref. 1)

Travel Time: 0.227 hours (length/(3600*Velocity))

Channel Flow:

Input

Flow Depth (y)= 0.5 feet
Channel width (b)= 50 feet
Roughness Coeff n 0.15Channel Slope (s)= 0.0096 ft/ft
Side slope (x)= 50

Calculated Values

Flow Area= 37.5 sq. ft Wetted Perimeter= 100.01 feet

Flow Type= subcritical

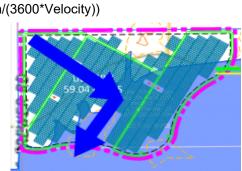
Froude Number 0.18 feet Manning's Formula

Discharge (Q)= 18.99 cfs $Q = \frac{1.49}{n} A R^{\frac{2}{3}} S^{\frac{1}{2}}$ Flow velocity (v)= 0.51 ft/sec

Flow Length: 416 feet

Travel Time: 0.228 hours (length/(3600*Velocity))

Time-of-Conc.: 1.162 hr Time Lag = 0.6*Tc = 0.697 hr Time Lag = 0.6*Tc = 41.8 min



Plant: Country Acres Solar Study

Address: Placer County, CA

Project No.: 406242 File No.

Title: <u>Hydrologic Analysis</u>

Time-of-Concentration: (from Reference 1)

South #3 Sheet Flow:

Proposed Surface Description: range

Manning's Roughness: 0.13 (Ref. 1)
Flow Length: 300 feet
2-Yr 24-Hr Precip.: 1.9 inches
Land Slope: 0.004 ft/ft

Travel Time: **0.866 hours** (from Ref. 1 equation)

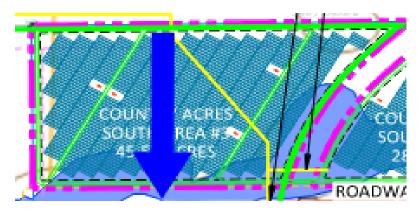
Shallow Concentrated Flow:

Surface Description: unpaved
Flow Length: 750 feet
Watercourse Slope: 0.004 ft/ft

Average Velocity: 1.1 ft/sec (Ref. 1)

Travel Time: **0.189 hours** (length/(3600*Velocity))

Time-of-Conc.: 1.056 hr
Time Lag = 0.6*Tc = 0.634 hr
Time Lag = 0.6*Tc = 38.0 min



Plant: Country Acres Solar Study

Address: Placer County, CA

Project No.: 406242 File No.

Title: <u>Hydrologic Analysis</u>

Time-of-Concentration: (from Reference 1)

South #4: Sheet Flow:

Proposed Surface Description: range

Manning's Roughness: 0.13 (Ref. 1)
Flow Length: 300 feet
2-Yr 24-Hr Precip.: 1.9 inches
Land Slope: 0.003 ft/ft

Travel Time: **0.932 hours** (from Ref. 1 equation)

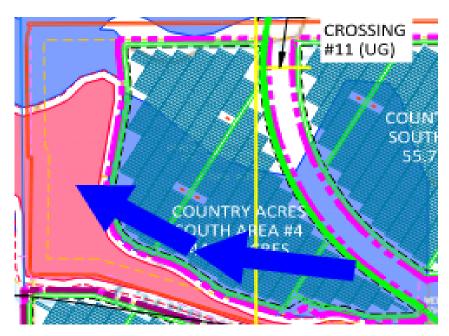
Shallow Concentrated Flow:

Surface Description: unpaved
Flow Length: 1050 feet
Watercourse Slope: 0.003 ft/ft

Average Velocity: 1.10 ft/sec (Ref. 1)

Travel Time: 0.265 hours (length/(3600*Velocity))

Time-of-Conc.: 1.197 hr Time Lag = 0.6*Tc = 0.718 hr Time Lag = 0.6*Tc = 43.1 min



Plant: <u>Country Acres Solar Study</u>

Address: Placer County, CA

Project No.: 406242 File No.

Title: <u>Hydrologic Analysis</u>

<u>Time-of-Concentration</u>: (from Reference 1)

South #5: Sheet Flow:

Proposed Surface Description: range

Manning's Roughness: 0.13 (Ref. 1)
Flow Length: 300 feet
2-Yr 24-Hr Precip.: 1.9 inches
Land Slope: 0.003 ft/ft

Travel Time: **0.932 hours** (from Ref. 1 equation)

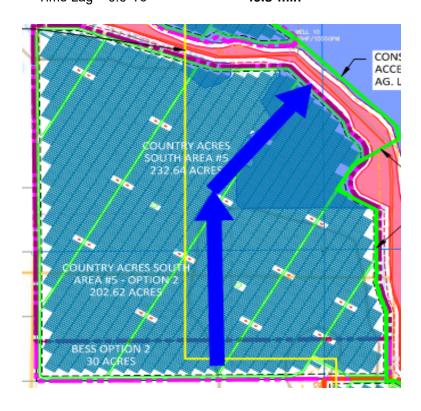
Shallow Concentrated Flow:

Surface Description: unpaved
Flow Length: 1650 feet
Watercourse Slope: 0.006 ft/ft

Average Velocity: 1.25 ft/sec (Ref. 1)

Travel Time: **0.367 hours** (length/(3600*Velocity))

Time-of-Conc.: 1.299 hr
Time Lag = 0.6*Tc = 0.779 hr
Time Lag = 0.6*Tc = 46.8 min



Plant: Country Acres Solar Study

Address: Placer County, CA

Project No.: 406242 File No.

Title: <u>Hydrologic Analysis</u>

Time-of-Concentration: (from Reference 1)

South #6: Sheet Flow:

Proposed Surface Description: range

Manning's Roughness: 0.13 (Ref. 1)
Flow Length: 300 feet
2-Yr 24-Hr Precip.: 1.9 inches
Land Slope: 0.001 ft/ft

Travel Time: 1.345 hours (from Ref. 1 equation)

Shallow Concentrated Flow:

Surface Description: unpaved
Flow Length: 1000 feet
Watercourse Slope: 0.001 ft/ft

Average Velocity: 1.00 ft/sec (Ref. 1)

Travel Time: **0.278 hours** (length/(3600*Velocity))

Time-of-Conc.: 1.622 hr
Time Lag = 0.6*Tc = 0.973 hr
Time Lag = 0.6*Tc = 58.4 min



Plant: <u>Country Acres Solar Study</u>

Address: Placer County, CA

Project No.: 406242 File No.

Title: <u>Hydrologic Analysis</u>

Time-of-Concentration: (from Reference 1)

South #7: Sheet Flow:

Proposed Surface Description: range

Manning's Roughness: 0.13 (Ref. 1)
Flow Length: 250 feet
2-Yr 24-Hr Precip.: 1.9 inches
Land Slope: 0.004 ft/ft

Travel Time: **0.749 hours** (from Ref. 1 equation)

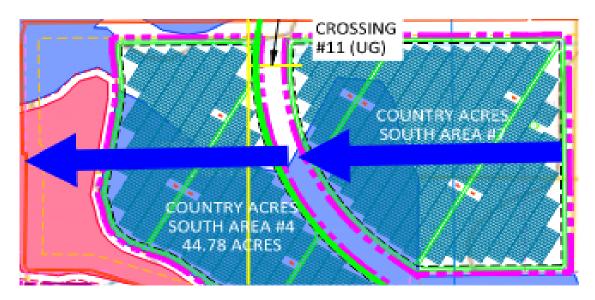
Shallow Concentrated Flow:

Surface Description: unpaved
Flow Length: 2950 feet
Watercourse Slope: 0.005 ft/ft

Average Velocity: 1.15 ft/sec (Ref. 1)

Travel Time: **0.713 hours** (length/(3600*Velocity))

Time-of-Conc.: 1.461 hr Time Lag = 0.6*Tc = 0.877 hr Time Lag = 0.6*Tc = 52.6 min



Plant: Country Acres Solar Study

Address: Placer County, CA

Project No.: 406242 File No.

Title: <u>Hydrologic Analysis</u>

<u>Time-of-Concentration</u>: (from Reference 1)

South #9A: Sheet Flow:

Proposed Surface Description: range

Manning's Roughness: 0.13 (Ref. 1)
Flow Length: 300 feet
2-Yr 24-Hr Precip.: 1.9 inches
Land Slope: 0.002 ft/ft

Travel Time: 1.075 hours (from Ref. 1 equation)

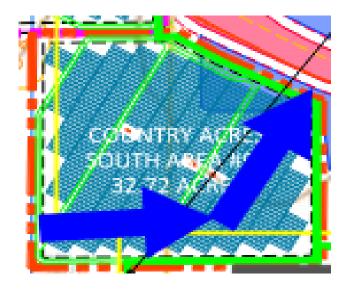
Shallow Concentrated Flow:

Surface Description: unpaved
Flow Length: 1300 feet
Watercourse Slope: 0.004 ft/ft

Average Velocity: 1.1 ft/sec (Ref. 1)

Travel Time: **0.328 hours** (length/(3600*Velocity))

Time-of-Conc.: 1.403 hr
Time Lag = 0.6*Tc = 0.842 hr
Time Lag = 0.6*Tc = 50.5 min



Plant: Country Acres Solar Study

Address: Placer County, CA

Project No.: 406242 File No.

Title: <u>Hydrologic Analysis</u>

<u>Time-of-Concentration</u>: (from Reference 1)

South #9B: Sheet Flow:

Proposed Surface Description: range

Manning's Roughness: 0.13 (Ref. 1)
Flow Length: 300 feet
2-Yr 24-Hr Precip.: 1.9 inches
Land Slope: 0.003 ft/ft

Travel Time: **0.932 hours** (from Ref. 1 equation)

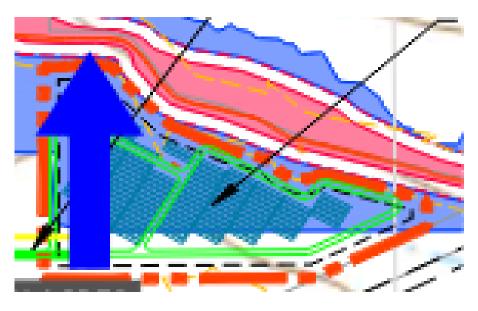
Shallow Concentrated Flow:

Surface Description: unpaved
Flow Length: 420 feet
Watercourse Slope: 0.004 ft/ft

Average Velocity: 1.1 ft/sec (Ref. 1)

Travel Time: **0.106 hours** (length/(3600*Velocity))

Time-of-Conc.: 1.038 hr
Time Lag = 0.6*Tc = 0.623 hr
Time Lag = 0.6*Tc = 37.4 min



Plant: <u>Country Acres Solar Study</u>

Address: Placer County, CA

Project No.: 406242 File No.

Title: <u>Hydrologic Analysis</u>

Time-of-Concentration: (from Reference 1)

South #10: Sheet Flow:

Proposed Surface Description: range

Manning's Roughness: 0.13 (Ref. 1)
Flow Length: 300 feet
2-Yr 24-Hr Precip.: 1.9 inches
Land Slope: 0.015 ft/ft

Travel Time: **0.515 hours** (from Ref. 1 equation)

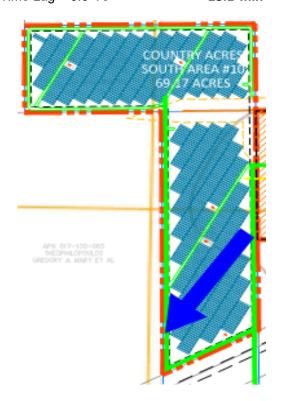
Shallow Concentrated Flow:

Surface Description: unpaved
Flow Length: 1050 feet
Watercourse Slope: 0.004 ft/ft

Average Velocity: 1.1 ft/sec (Ref. 1)

Travel Time: 0.265 hours (length/(3600*Velocity))

Time-of-Conc.: 0.780 hr Time Lag = 0.6*Tc = 0.468 hr Time Lag = 0.6*Tc = 28.1 min



Plant: <u>Country Acres Solar Study</u>

Address: Placer County, CA

Project No.: 406242 File No.

Title: <u>Hydrologic Analysis</u>

<u>Time-of-Concentration</u>: (from Reference 1)

For post-development, the Switchyard, Substation, and BESS areas are modeled separately. Time-of-concentration considers changes due to grading and surfacing.

BESS: Sheet Flow:

Proposed Surface Description: range

Manning's Roughness: 0.13 (Ref. 1)
Flow Length: 300 feet
2-Yr 24-Hr Precip.: 1.9 inches
Land Slope: 0.002 ft/ft

Travel Time: 1.121 hours (from Ref. 1 equation)

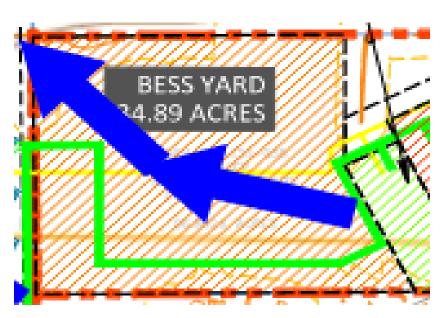
Shallow Concentrated Flow:

Surface Description: unpaved
Flow Length: 1475 feet
Watercourse Slope: 0.004 ft/ft

Average Velocity: 1.1 ft/sec (Ref. 1)

Travel Time: 0.372 hours (length/(3600*Velocity))

Time-of-Conc.: 1.494 hr
Time Lag = 0.6*Tc = 0.896 hr
Time Lag = 0.6*Tc = 53.8 min



Plant: <u>Country Acres Solar Study</u>

Address: Placer County, CA

Project No.: 406242 File No.

Title: <u>Hydrologic Analysis</u>

Time-of-Concentration: (from Reference 1)

SUBSTATION: Sheet Flow:

Proposed Surface Description: range

Manning's Roughness: 0.13 (Ref. 1)
Flow Length: 300 feet
2-Yr 24-Hr Precip.: 1.9 inches
Land Slope: 0.004 ft/ft

Travel Time: **0.866 hours** (from Ref. 1 equation)

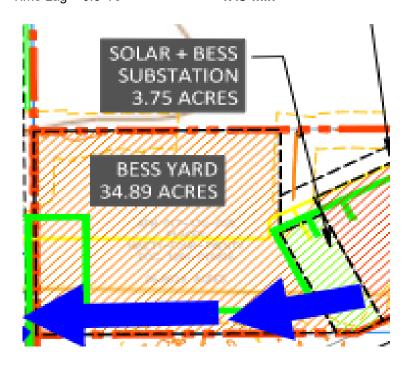
Shallow Concentrated Flow:

Surface Description: unpaved
Flow Length: 1825 feet
Watercourse Slope: 0.004 ft/ft

Average Velocity: 1.1 ft/sec (Ref. 1)

Travel Time: **0.461 hours** (length/(3600*Velocity))

Time-of-Conc.: 1.327 hr Time Lag = 0.6*Tc = 0.796 hr Time Lag = 0.6*Tc = 47.8 min



Plant: <u>Country Acres Solar Study</u>

Address: Placer County, CA

Project No.: 406242 File No.

Title: <u>Hydrologic Analysis</u>

Time-of-Concentration: (from Reference 1)

SWITCHYARD: Sheet Flow:

Proposed Surface Description: gravel

Manning's Roughness: 0.011 (Ref. 1)
Flow Length: 300 feet
2-Yr 24-Hr Precip.: 1.9 inches
Land Slope: 0.010 ft/ft

Travel Time: **0.083 hours** (from Ref. 1 equation)

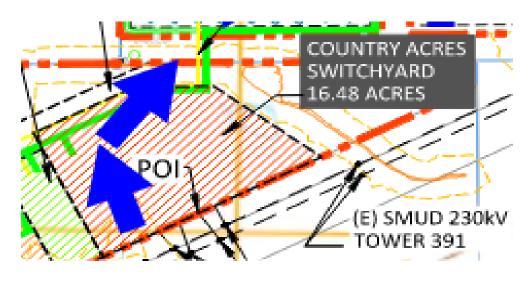
Shallow Concentrated Flow:

Surface Description: unpaved
Flow Length: 300 feet
Watercourse Slope: 0.010 ft/ft

Average Velocity: 1.6 ft/sec (Ref. 1)

Travel Time: 0.052 hours (length/(3600*Velocity))

Time-of-Conc.: 0.135 hr
Time Lag = 0.6*Tc = 0.081 hr
Time Lag = 0.6*Tc = 4.9 min



Plant: <u>Country Acres Solar Study</u>

Address: Placer County, CA

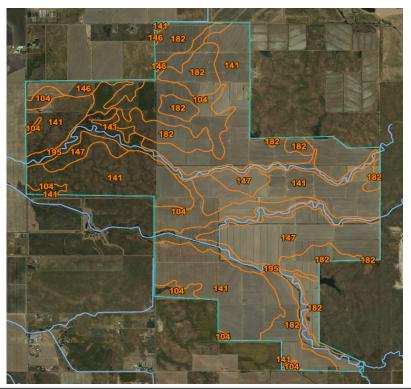
Project No.: 406242 File No.

Title: <u>Hydrologic Analysis</u>

Hydrologic Soil Group:

From the Web Soil Survey (Reference 9), the entire area of interest is, shown below. All map units in the table below are HSG D, with the exception of Unit 147, which makes up 12.2 percent of the area and is HSG C. Thus, for design use HSG **D**.

A HSG rating of **D** for the project area is also provided in Figure 3-1 from the West Placer Storm Water Quality Manual.



| Map Unit Symbol | Map Unit Name | Acres in AOI | Percent of AOI |
|-----------------------------|--|--------------|----------------|
| 104 | Alamo-Fiddyment complex, 0 to 5 percent slopes | 374.5 | 13.2% |
| 141 | Cometa-Fiddyment complex, 1 to 5 percent slopes | 1,253.5 | 44.1% |
| 146 | Fiddyment loam, 1 to 8 percent slopes | 65.0 | 2.3% |
| 147 | Fiddyment-Kaseberg loams, 2 to 9 percent slopes | 346.5 | 12.2% |
| 182 | San Joaquin-Cometa sandy loams, 1 to 5 percent slopes | 480.0 | 16.9% |
| 195 | Xerofluvents, hardpan substratum | 322.8 | 11.4% |
| Totals for Area of Interest | | 2,842.2 | 100.0% |

Plant: <u>Country Acres Solar Study</u>

Address: Placer County, CA

Project No.: 406242 File No.

Title: <u>Hydrologic Analysis</u>

<u>Infiltration Characteristics - Pre-Development:</u>

Infiltration characteristics are modeled based on the SCS Curve Number method (References 1 and 14). From References 9 and 10, the soils at the site are assigned a Hydrologic Soil Group rating of **D**. Area and surfacing values for the existing and proposed site are tabulated below from References 4 and 5. Modeling is based on the initial abstraction, plus the constant infiltration loss.

Pre-Development - Rice Fields

During the growing season, the fields are inundated with water, therefore, design for the condition after the fields are drained, prior to harvest.

SCS Curve Number: Cover type is small grain in good condition, with HSG=D. CN = 87 (Ref. 1)

Constant Infiltration Rate: small grain in good cond., HSG=D, Loss Rate = 0.05 in/hr (Ref.14, Table 5-3)

Potential Maximum Retention, S=(1000/CN - 10) = 1.49 inches (Ref. 1, Eq. 2-4) Intial Abstraction: la = 0.2 S = 0.30 inches (Ref. 1, Eq. 2-2)

Pre-Development - Rangeland

Areas outside the limits of the rice fields are modeled as rangeland in good condition.

SCS Curve Number: Cover type is rangeland in good condition, with HSG=D. CN = 80 (Ref. 1)

Constant Infiltration Rate: Rangeland in good cond., HSG=D, Loss Rate = 0.09 in/hr (Ref.14, Table 5-3)

Potential Maximum Retention, S=(1000/CN - 10) = 2.50 inches (Ref. 1, Eq. 2-4) Intial Abstraction: la = 0.2 S = 0.50 inches (Ref. 1, Eq. 2-2)

| | | | Į | nfiltration | S | la | |
|-----------------------|-----------|-----------|------------|-------------|--------------|--------------|--|
| <u>Surface</u> | Area (sf) | <u>CN</u> | CN*Area | Rate(in/hr) | <u>(in.)</u> | <u>(in.)</u> | |
| North #1 Rice Fields | 7864322 | 87 | 684196049 | 0.05 | 1.49 | 0.30 | |
| North #2 Rice Fields | 7696616 | 87 | 669605627 | 0.05 | 1.49 | 0.30 | |
| UDF-NE Rice Fields | 2500000 | 87 | 217500000 | 0.05 | 1.49 | 0.30 | |
| UDF-NE Rangeland | 2944129 | 80 | 235530304 | 0.09 | 2.50 | 0.50 | |
| UDF-NE Composite | 5444129 | 83.2 | 453030304 | 0.072 | | 0.408 | |
| UDF-NW Rangeland | 2571782 | 80 | 205742592 | 0.09 | 2.50 | 0.50 | |
| South #3 Rice Fields | 1985029 | 87 | 172697540 | 0.05 | 1.49 | 0.30 | |
| South #4 Rice Fields | 1950617 | 87 | 169703662 | 0.05 | 1.49 | 0.30 | |
| South #5 Rice Fields | 10133798 | 87 | 881640461 | 0.05 | 1.49 | 0.30 | |
| South #6 Rice Fields | 1232748 | 87 | 107249076 | 0.05 | 1.49 | 0.30 | |
| South #7 Rice Fields | 2427599 | 87 | 211201096 | 0.05 | 1.49 | 0.30 | |
| South #9A Rice Fields | 1425283 | 87 | 123999638 | 0.05 | 1.49 | 0.30 | |
| South #9B Rice Fields | 639896 | 87 | 55670986.8 | 0.05 | 1.49 | 0.30 | |
| South #10 Rangeland | 3013045 | 80 | 241043616 | 0.09 | 2.50 | 0.50 | |
| Subst, Switch, BESS | 2567426 | 80 | 205394112 | 0.09 | 2.50 | 0.50 | |
| | | | | | | | |

Plant: <u>Country Acres Solar Study</u>

Address: Placer County, CA

Project No.: 406242 File No.

Title: <u>Hydrologic Analysis</u>

<u>Infiltration Characteristics - Pre-Development</u>: (continued)

| <u>Surface</u> | <u>Area (sf)</u> | <u>Area (ac)</u> | Area (sq mi) |
|----------------------|------------------|------------------|--------------|
| North #1 | 7864322 | 180.54 | 0.28209 |
| North #2 | 7696616 | 176.69 | 0.27608 |
| UDF-NE | 5444129 | 124.98 | 0.19528 |
| UDF-NW | 2571782 | 59.04 | 0.09225 |
| South #3 | 1985029 | 45.57 | 0.07120 |
| South #4 | 1950617 | 44.78 | 0.06997 |
| South #5 | 10133798 | 232.64 | 0.36350 |
| South #6 | 1232748 | 28.30 | 0.04422 |
| South #7 | 2427599 | 55.73 | 0.08708 |
| South #9A | 1425283 | 32.72 | 0.05113 |
| South #9B | 639896 | 14.69 | 0.02295 |
| South #10 | 3013045 | 69.17 | 0.10808 |
| Subst, Switch, BESS | <u>2567426</u> | <u>56.58</u> | 0.08840 |
| Parcel Total | 46384866 | 1064.85 | 1.66383 |
| Parcel + Subst, BESS | 48952292 | 1121.43 | 1.75223 |
| | | | |

Plant: <u>Country Acres Solar Study</u>

Address: Placer County, CA

Project No.: 406242 File No.

7696616

Title: <u>Hydrologic Analysis</u>

<u>Infiltration Characteristics - Post-Development:</u>

North #2 - Total Area

| | | | | Infiltration | S | la |
|---|-------------------------------------|------------------------|---|-----------------------------|----------------------|-----------------------------|
| Surface - North #1 | Area (sf) | <u>CN</u> | CN*Area | Rate(in/hr) | <u>(in.)</u> | <u>(in.)</u> |
| Inverters | 3040 | 98 | 297920 | 0.00 | 0.20 | 0.04 |
| Rack Table Piles | 376 | 98 | 36891 | 0.00 | 0.20 | 0.04 |
| Perimeter Road | 265160 | 91 | 24129560 | 0.03 | 0.99 | 0.20 |
| Intermediate Roads | 179520 | 91 | 16336320 | 0.03 | 0.99 | 0.20 |
| Grass - Fair Condition | <u>7416226</u> | 84 | <u>622962981</u> | 0.07 | 1.90 | 0.38 |
| Total Contributing Area = | 7864322 | | 663763672 | | | |
| Impervious CN/Ia | | 98 | 0 | 0.00 | 0.20 | 0.04 |
| Pervious Composite CN = | | 84.4 | | 0.068 | 1.85 | 0.371 |
| Surface | Area (sf) | Area (ac) | Area (sq mi) | | | |
| North #1 - Impervious | 3416 | 0.08 | 0.00012 | | | |
| North #1 - Pervious | 7860906 | 180.46 | 0.28197 | | | |
| North #1 - Total Area | 7864322 | 180.54 | 0.28209 | | | |
| | | | | | | |
| | | | | Infiltration | S | la |
| Surface - North #2 | Area (sf) | <u>CN</u> | CN*Area | Rate(in/hr) | <u>(in.)</u> | <u>(in.)</u> |
| Inverters | 3040 | 98 | 297920 | 0.00 | 0.20 | 0.04 |
| Rack Table Piles | 378 | 98 | 37059 | 0.00 | 0.20 | 0.04 |
| Perimeter Road | 218700 | 01 | | | 0.99 | 0.20 |
| | 218/00 | 91 | 19901700 | 0.03 | 0.55 | |
| Intermediate Roads | 162200 | 91 91 | 19901700 14760200 | 0.03 0.03 | 0.99 | 0.20 |
| Intermediate Roads Grass - Fair Condition | | | | | | |
| | 162200 | 91 | 14760200 | 0.03 | 0.99 | 0.20 |
| Grass - Fair Condition | 162200 <u>7312298</u> | 91 | 14760200 614233053 | 0.03 | 0.99 | 0.20 |
| Grass - Fair Condition Total Contributing Area = | 162200 <u>7312298</u> | 91 84 | 14760200 <u>614233053</u> 649229932 | 0.03 0.07 | 0.99 1.90 | 0.20 0.38 |
| Grass - Fair Condition Total Contributing Area = Impervious CN/Ia | 162200 <u>7312298</u> | 91 84 98 | 14760200 <u>614233053</u> 649229932 | 0.03 0.07 0.00 | 0.99 1.90 0.20 | 0.20 0.38 0.04 |
| Grass - Fair Condition Total Contributing Area = Impervious CN/Ia Pervious Composite CN = | 162200 <u>7312298</u> 7696616 | 91 84 98 84.3 | 14760200 614233053 649229932 0 | 0.03 0.07 0.00 | 0.99 1.90 0.20 | 0.20 0.38 0.04 |

176.69

0.27608

Plant: <u>Country Acres Solar Study</u>

Address: Placer County, CA

Project No.: 406242 File No.

Title: <u>Hydrologic Analysis</u>

UDF-NW -Total Area

<u>Infiltration Characteristics - Post-Development</u>: (continued)

| | | | | Infiltration | S | la |
|---------------------------|----------------|--------------|----------------|--------------|--------------|--------------|
| Surface - UDF-NE | Area (sf) | <u>CN</u> | <u>CN*Area</u> | Rate(in/hr) | <u>(in.)</u> | <u>(in.)</u> |
| Inverters | 1280 | 98 | 125440 | 0.00 | 0.20 | 0.04 |
| Rack Table Piles | 169 | 98 | 16544 | 0.00 | 0.20 | 0.04 |
| Perimeter Road | 223460 | 91 | 20334860 | 0.03 | 0.99 | 0.20 |
| Intermediate Roads | 82240 | 91 | 7483840 | 0.03 | 0.99 | 0.20 |
| Grass - Fair Condition | <u>5136980</u> | 84 | 431506318 | 0.07 | 1.90 | 0.38 |
| Total Contributing Area = | 5444129 | | 459467003 | | | |
| Impervious CN/Ia | | 98 | 0 | 0.00 | 0.20 | 0.04 |
| Pervious Composite CN = | | 84.4 | | 0.068 | 1.85 | 0.371 |
| Surface | Area (sf) | Area (ac) | Area (sq mi) | | | |
| UDF-NE - Impervious | 1449 | 0.03 | 0.00005 | | | |
| UDF-NE - Pervious | 5442680 | 124.95 | 0.19523 | | | |
| UDF-NE -Total Area | 5444129 | 124.98 | 0.19528 | | | |
| | | | | | | |
| | | | | Infiltration | S | la |
| Surface - UDF-NW | Area (sf) | <u>CN</u> | CN*Area | Rate(in/hr) | <u>(in.)</u> | <u>(in.)</u> |
| Inverters | 800 | 98 | 78400 | 0.00 | 0.20 | 0.04 |
| Rack Table Piles | 96 | 98 | 9433 | 0.00 | 0.20 | 0.04 |
| Perimeter Road | 118700 | 91 | 10801700 | 0.03 | 0.99 | 0.20 |
| Intermediate Roads | 54300 | 91 | 4941300 | 0.03 | 0.99 | 0.20 |
| Grass - Fair Condition | <u>2397886</u> | 84 | 201422436 | 0.07 | 1.90 | 0.38 |
| Total Contributing Area = | 2571782 | | 217253269 | | | |
| Impervious CN/Ia | | 98 | 0 | 0.00 | 0.20 | 0.04 |
| Pervious Composite CN = | | 84.5 | | 0.067 | 1.84 | 0.369 |
| <u>Surface</u> | Area (sf) | Area (ac) | Area (sq mi) | | | |
| UDF-NW - Impervious | 896 | 0.02 | 0.00003 | | | |
| <u>UDF-NW - Pervious</u> | <u>2570886</u> | <u>59.02</u> | 0.09222 | | | |
| | | | | | | |

59.04

0.09225

2571782

Plant: <u>Country Acres Solar Study</u>

Address: Placer County, CA

Project No.: 406242 File No.

Title: <u>Hydrologic Analysis</u>

South #4 -Total Area

<u>Infiltration Characteristics - Post-Development</u>: (continued)

| | | | | Infiltration | S | la |
|---------------------------|-----------------|--------------|------------------|--------------|--------------|--------------|
| Surface - South #3 | Area (sf) | <u>CN</u> | CN*Area | Rate(in/hr) | <u>(in.)</u> | <u>(in.)</u> |
| Inverters | 640 | 98 | 62720 | 0.00 | 0.20 | 0.04 |
| Rack Table Piles | 82 | 98 | 8001 | 0.00 | 0.20 | 0.04 |
| Perimeter Road | 104960 | 91 | 9551360 | 0.03 | 0.99 | 0.20 |
| Intermediate Roads | 44220 | 91 | 4024020 | 0.03 | 0.99 | 0.20 |
| Grass - Fair Condition | <u>1835128</u> | 84 | <u>154150714</u> | 0.07 | 1.90 | 0.38 |
| Total Contributing Area = | 1985029 | | 167796816 | | | |
| Impervious CN/Ia | | 98 | 0 | 0.00 | 0.20 | 0.04 |
| Pervious Composite CN = | | 84.5 | | 0.067 | 1.84 | 0.367 |
| Surface | Area (sf) | Area (ac) | Area (sq mi) | | | |
| South #3 - Impervious | 722 | 0.02 | 0.00003 | | | |
| South #3 - Pervious | 1984308 | 45.55 | 0.07118 | | | |
| South #3 -Total Area | 1985029 | 45.57 | 0.07120 | | | |
| | | | | | | |
| | | | | Infiltration | S | la |
| Surface - South #4 | Area (sf) | <u>CN</u> | CN*Area | Rate(in/hr) | <u>(in.)</u> | <u>(in.)</u> |
| Inverters | 640 | 98 | 62720 | 0.00 | 0.20 | 0.04 |
| Rack Table Piles | 81 | 98 | 7977 | 0.00 | 0.20 | 0.04 |
| Perimeter Road | 116580 | 91 | 10608780 | 0.03 | 0.99 | 0.20 |
| Intermediate Roads | 34600 | 91 | 3148600 | 0.03 | 0.99 | 0.20 |
| Grass - Fair Condition | <u>1798715</u> | 84 | <u>151092093</u> | 0.07 | 1.90 | 0.38 |
| Total Contributing Area = | 1950617 | | 164920171 | | | |
| Impervious CN/Ia | | 98 | 0 | 0.00 | 0.20 | 0.04 |
| Pervious Composite CN = | | 84.5 | | 0.067 | 1.83 | 0.367 |
| <u>Surface</u> | Area (sf) | Area (ac) | Area (sq mi) | | | |
| South #4 - Impervious | 721 | 0.02 | 0.00003 | | | |
| South #4 - Pervious | | | | | | |
| South #4 - Pervious | <u> 1949895</u> | <u>44.76</u> | <u>0.06994</u> | | | |

44.78

0.06997

1950617

Plant: <u>Country Acres Solar Study</u>

Address: Placer County, CA

Project No.: 406242 File No.

Title: <u>Hydrologic Analysis</u>

<u>Infiltration Characteristics - Post-Development</u>: (continued)

| | | | | Infiltration | S | la |
|--|--|--|---|--------------------------------------|---|---|
| Surface - South #5 | Area (sf) | <u>CN</u> | CN*Area | Rate(in/hr) | <u>(in.)</u> | <u>(in.)</u> |
| Inverters | 4160 | 98 | 407680 | 0.00 | 0.20 | 0.04 |
| Rack Table Piles | 516 | 98 | 50535 | 0.00 | 0.20 | 0.04 |
| Perimeter Road | 246740 | 91 | 22453340 | 0.03 | 0.99 | 0.20 |
| Intermediate Roads | 219680 | 91 | 19990880 | 0.03 | 0.99 | 0.20 |
| Grass - Fair Condition | <u>9662703</u> | 84 | <u>811667030</u> | 0.07 | 1.90 | 0.38 |
| Total Contributing Area = | 10133798 | | 854569465 | | | |
| Impervious CN/Ia | | 98 | 0 | 0.00 | 0.20 | 0.04 |
| Pervious Composite CN = | | 84.3 | | 0.068 | 1.86 | 0.373 |
| <u>Surface</u> | Area (sf) | Area (ac) | Area (sq mi) | | | |
| South #5 - Impervious | 4676 | 0.11 | 0.00017 | | | |
| South #5 - Pervious | 10129123 | 232.53 | 0.36333 | | | |
| South #5 -Total Area | 10133798 | 232.64 | 0.36350 | | | |
| | | | | | | |
| | | | | | | |
| | | | | Infiltration | S | la |
| Surface - South #6 | <u>Area (sf)</u> | <u>CN</u> | <u>CN*Area</u> | Infiltration Rate(in/hr) | S <u>(in.)</u> | la <u>(in.)</u> |
| <u>Surface - South #6</u> Inverters | <u>Area (sf)</u> 320 | <u>CN</u> 98 | <u>CN*Area</u> 31360 | | | |
| | | | | Rate(in/hr) | <u>(in.)</u> | <u>(in.)</u> |
| Inverters | 320 | 98 | 31360 | Rate(in/hr) 0.00 | <u>(in.)</u> 0.20 | <u>(in.)</u> 0.04 |
| Inverters Rack Table Piles | 320 48 | 98 98 | 31360 4681 | Rate(in/hr) 0.00 0.00 | (in.) 0.20 0.20 | (in.) 0.04 0.04 |
| Inverters Rack Table Piles Perimeter Road | 320 48 82580 | 98 98 91 | 31360 4681 7514780 | Rate(in/hr) 0.00 0.00 0.03 | (in.) 0.20 0.20 0.99 | (in.) 0.04 0.04 0.20 |
| Inverters Rack Table Piles Perimeter Road Intermediate Roads | 320 48 82580 10040 | 98 98 91 91 | 31360 4681 7514780 913640 | Rate(in/hr) 0.00 0.00 0.03 0.03 | (in.) 0.20 0.20 0.99 0.99 | (in.) 0.04 0.04 0.20 0.20 |
| Inverters Rack Table Piles Perimeter Road Intermediate Roads Grass - Fair Condition | 320 48 82580 10040 <u>1139760</u> | 98 98 91 91 | 31360 4681 7514780 913640 <u>95739860</u> | Rate(in/hr) 0.00 0.00 0.03 0.03 | (in.) 0.20 0.20 0.99 0.99 | (in.) 0.04 0.04 0.20 0.20 |
| Inverters Rack Table Piles Perimeter Road Intermediate Roads Grass - Fair Condition Total Contributing Area = | 320 48 82580 10040 <u>1139760</u> | 98 98 91 91 84 | 31360 4681 7514780 913640 95739860 104204321 | Rate(in/hr) 0.00 0.00 0.03 0.03 0.03 | (in.) 0.20 0.20 0.99 0.99 1.90 | (in.) 0.04 0.04 0.20 0.20 0.38 |
| Inverters Rack Table Piles Perimeter Road Intermediate Roads Grass - Fair Condition Total Contributing Area = Impervious CN/Ia | 320 48 82580 10040 <u>1139760</u> | 98 98 91 91 84 | 31360 4681 7514780 913640 95739860 104204321 | Rate(in/hr) 0.00 0.00 0.03 0.03 0.07 | (in.) 0.20 0.20 0.99 0.99 1.90 | (in.) 0.04 0.04 0.20 0.20 0.38 |
| Inverters Rack Table Piles Perimeter Road Intermediate Roads Grass - Fair Condition Total Contributing Area = Impervious CN/Ia Pervious Composite CN = | 320 48 82580 10040 <u>1139760</u> 1232748 | 98 98 91 91 84 98 84.5 | 31360 4681 7514780 913640 <u>95739860</u> 104204321 0 | Rate(in/hr) 0.00 0.00 0.03 0.03 0.07 | (in.) 0.20 0.20 0.99 0.99 1.90 | (in.) 0.04 0.04 0.20 0.20 0.38 |
| Inverters Rack Table Piles Perimeter Road Intermediate Roads Grass - Fair Condition Total Contributing Area = Impervious CN/Ia Pervious Composite CN = | 320 48 82580 10040 1139760 1232748 | 98 98 91 91 84 98 84.5 | 31360 4681 7514780 913640 95739860 104204321 0 | Rate(in/hr) 0.00 0.00 0.03 0.03 0.07 | (in.) 0.20 0.20 0.99 0.99 1.90 | (in.) 0.04 0.04 0.20 0.20 0.38 |

Plant: <u>Country Acres Solar Study</u>

Address: <u>Placer County, CA</u>

Project No.: 406242 File No.

Title: <u>Hydrologic Analysis</u>

<u>Infiltration Characteristics - Post-Development</u>: (continued)

| | | | | Infiltration | S | la |
|--|---|--|---|--------------------------------------|---|---|
| Surface - South #7 | Area (sf) | <u>CN</u> | <u>CN*Area</u> | Rate(in/hr) | <u>(in.)</u> | <u>(in.)</u> |
| Inverters | 800 | 98 | 78400 | 0.00 | 0.20 | 0.04 |
| Rack Table Piles | 108 | 98 | 10600 | 0.00 | 0.20 | 0.04 |
| Perimeter Road | 109620 | 91 | 9975420 | 0.03 | 0.99 | 0.20 |
| Intermediate Roads | 50900 | 91 | 4631900 | 0.03 | 0.99 | 0.20 |
| Grass - Fair Condition | <u>2266171</u> | 84 | <u>190358333</u> | 0.07 | 1.90 | 0.38 |
| Total Contributing Area = | 2427599 | | 205054654 | | | |
| Impervious CN/Ia | | 98 | 0 | 0.00 | 0.20 | 0.04 |
| Pervious Composite CN = | | 84.5 | | 0.067 | 1.84 | 0.369 |
| <u>Surface</u> | Area (sf) | Area (ac) | Area (sq mi) | | | |
| South #7 - Impervious | 908 | 0.02 | 0.00003 | | | |
| South #7 - Pervious | <u>2426691</u> | <u>55.71</u> | 0.08705 | | | |
| South #7 -Total Area | 2427599 | 55.73 | 0.08708 | | | |
| | | | | | | |
| | | | | | | |
| | | | | Infiltration | S | la |
| Surface - South #9A | <u>Area (sf)</u> | <u>CN</u> | <u>CN*Area</u> | Infiltration Rate(in/hr) | S <u>(in.)</u> | la <u>(in.)</u> |
| <u>Surface - South #9A</u> Inverters | <u>Area (sf)</u> 480 | <u>CN</u> 98 | <u>CN*Area</u> 47040 | | | |
| | | | | Rate(in/hr) | <u>(in.)</u> | <u>(in.)</u> |
| Inverters | 480 | 98 | 47040 | Rate(in/hr) 0.00 | <u>(in.)</u> 0.20 | <u>(in.)</u> 0.04 |
| Inverters Rack Table Piles | 480 58 | 98 98 | 47040 5679 | Rate(in/hr) 0.00 0.00 | (in.) 0.20 0.20 | (in.) 0.04 0.04 |
| Inverters Rack Table Piles Perimeter Road | 480 58 81480 | 98 98 91 | 47040 5679 7414680 | Rate(in/hr) 0.00 0.00 0.03 | (in.) 0.20 0.20 0.99 | (in.) 0.04 0.04 0.20 |
| Inverters Rack Table Piles Perimeter Road Intermediate Roads | 480 58 81480 42620 | 98 98 91 91 | 47040 5679 7414680 3878420 | Rate(in/hr) 0.00 0.00 0.03 0.03 | (in.) 0.20 0.20 0.99 0.99 | (in.) 0.04 0.04 0.20 0.20 |
| Inverters Rack Table Piles Perimeter Road Intermediate Roads Grass - Fair Condition | 480 58 81480 42620 1300645 | 98 98 91 91 | 47040 5679 7414680 3878420 109254201 | Rate(in/hr) 0.00 0.00 0.03 0.03 | (in.) 0.20 0.20 0.99 0.99 | (in.) 0.04 0.04 0.20 0.20 |
| Inverters Rack Table Piles Perimeter Road Intermediate Roads Grass - Fair Condition Total Contributing Area = | 480 58 81480 42620 1300645 | 98 98 91 91 84 | 47040 5679 7414680 3878420 109254201 120600020 | Rate(in/hr) 0.00 0.00 0.03 0.03 0.03 | (in.) 0.20 0.20 0.99 0.99 1.90 | (in.) 0.04 0.04 0.20 0.20 0.38 |
| Inverters Rack Table Piles Perimeter Road Intermediate Roads Grass - Fair Condition Total Contributing Area = Impervious CN/Ia Pervious Composite CN = | 480 58 81480 42620 <u>1300645</u> 1425283 | 98 98 91 91 84 98 84.6 | 47040 5679 7414680 3878420 109254201 120600020 0 | Rate(in/hr) 0.00 0.00 0.03 0.03 0.07 | (in.) 0.20 0.20 0.99 0.99 1.90 | (in.) 0.04 0.04 0.20 0.20 0.38 |
| Inverters Rack Table Piles Perimeter Road Intermediate Roads Grass - Fair Condition Total Contributing Area = Impervious CN/Ia | 480 58 81480 42620 1300645 | 98 98 91 91 84 | 47040 5679 7414680 3878420 109254201 120600020 | Rate(in/hr) 0.00 0.00 0.03 0.03 0.07 | (in.) 0.20 0.20 0.99 0.99 1.90 | (in.) 0.04 0.04 0.20 0.20 0.38 |
| Inverters Rack Table Piles Perimeter Road Intermediate Roads Grass - Fair Condition Total Contributing Area = Impervious CN/Ia Pervious Composite CN = Surface South #9A - Impervious | 480 58 81480 42620 1300645 1425283 Area (sf) 538 | 98 98 91 91 84 98 84.6 <u>Area (ac)</u> 0.01 | 47040 5679 7414680 3878420 109254201 120600020 0 Area (sq mi) 0.00002 | Rate(in/hr) 0.00 0.00 0.03 0.03 0.07 | (in.) 0.20 0.20 0.99 0.99 1.90 | (in.) 0.04 0.04 0.20 0.20 0.38 |
| Inverters Rack Table Piles Perimeter Road Intermediate Roads Grass - Fair Condition Total Contributing Area = Impervious CN/Ia Pervious Composite CN = | 480 58 81480 42620 1300645 1425283 | 98 98 91 91 84 98 84.6 | 47040 5679 7414680 3878420 109254201 120600020 0 | Rate(in/hr) 0.00 0.00 0.03 0.03 0.07 | (in.) 0.20 0.20 0.99 0.99 1.90 | (in.) 0.04 0.04 0.20 0.20 0.38 |

Plant: <u>Country Acres Solar Study</u>

Address: <u>Placer County, CA</u>

Project No.: 406242 File No.

Title: <u>Hydrologic Analysis</u>

<u>Infiltration Characteristics - Post-Development</u>: (continued)

| | | | | Infiltration | S | la |
|--|---|--|---|--------------------------------------|---|---|
| Surface - South #9B | Area (sf) | <u>CN</u> | <u>CN*Area</u> | Rate(in/hr) | <u>(in.)</u> | <u>(in.)</u> |
| Inverters | 160 | 98 | 15680 | 0.00 | 0.20 | 0.04 |
| Rack Table Piles | 14 | 98 | 1408 | 0.00 | 0.20 | 0.04 |
| Perimeter Road | 51380 | 91 | 4675580 | 0.03 | 0.99 | 0.20 |
| Intermediate Roads | 8220 | 91 | 748020 | 0.03 | 0.99 | 0.20 |
| Grass - Fair Condition | <u>580122</u> | 84 | <u>48730251</u> | 0.07 | 1.90 | 0.38 |
| Total Contributing Area = | 639896 | | 54170939 | | | |
| Impervious CN/Ia | | 98 | 0 | 0.00 | 0.20 | 0.04 |
| Pervious Composite CN = | | 84.7 | | 0.066 | 1.82 | 0.364 |
| <u>Surface</u> | Area (sf) | Area (ac) | Area (sq mi) | | | |
| South #9B - Impervious | 174 | 0.00 | 0.00001 | | | |
| South #9B - Pervious | 639722 | <u>14.69</u> | 0.02295 | | | |
| South #9B -Total Area | 639896 | 14.69 | 0.02295 | | | |
| | | | | | | |
| | | | | | | |
| | | | | Infiltration | S | la |
| Surface - South #10 | <u>Area (sf)</u> | <u>CN</u> | <u>CN*Area</u> | Infiltration Rate(in/hr) | S <u>(in.)</u> | la <u>(in.)</u> |
| Surface - South #10 Inverters | <u>Area (sf)</u> 800 | <u>CN</u> 98 | <u>CN*Area</u> 78400 | | | |
| <u> </u> | | | | Rate(in/hr) | <u>(in.)</u> | <u>(in.)</u> |
| Inverters | 800 | 98 | 78400 | Rate(in/hr) 0.00 | <u>(in.)</u> 0.20 | <u>(in.)</u> 0.04 |
| Inverters Rack Table Piles | 800 109 | 98 98 | 78400 10709 | Rate(in/hr) 0.00 0.00 | (in.) 0.20 0.20 | (in.) 0.04 0.04 |
| Inverters Rack Table Piles Perimeter Road | 800 109 193580 | 98 98 91 | 78400 10709 17615780 | Rate(in/hr) 0.00 0.00 0.03 | (in.) 0.20 0.20 0.99 | (in.) 0.04 0.04 0.20 |
| Inverters Rack Table Piles Perimeter Road Intermediate Roads | 800 109 193580 50380 | 98 98 91 91 | 78400 10709 17615780 4584580 | Rate(in/hr) 0.00 0.00 0.03 0.03 | (in.) 0.20 0.20 0.99 0.99 | (in.) 0.04 0.04 0.20 0.20 |
| Inverters Rack Table Piles Perimeter Road Intermediate Roads Grass - Fair Condition | 800 109 193580 50380 2768176 | 98 98 91 91 | 78400 10709 17615780 4584580 232526778 | Rate(in/hr) 0.00 0.00 0.03 0.03 | (in.) 0.20 0.20 0.99 0.99 | (in.) 0.04 0.04 0.20 0.20 |
| Inverters Rack Table Piles Perimeter Road Intermediate Roads Grass - Fair Condition Total Contributing Area = | 800 109 193580 50380 2768176 | 98 98 91 91 84 | 78400 10709 17615780 4584580 232526778 254816247 | 0.00 0.00 0.03 0.03 0.03 | (in.) 0.20 0.20 0.99 0.99 1.90 | (in.) 0.04 0.04 0.20 0.20 0.38 |
| Inverters Rack Table Piles Perimeter Road Intermediate Roads Grass - Fair Condition Total Contributing Area = Impervious CN/Ia | 800 109 193580 50380 2768176 | 98 98 91 91 84 98 84.6 | 78400 10709 17615780 4584580 232526778 254816247 0 | Rate(in/hr) 0.00 0.00 0.03 0.03 0.07 | (in.) 0.20 0.20 0.99 0.99 1.90 | (in.) 0.04 0.04 0.20 0.20 0.38 |
| Inverters Rack Table Piles Perimeter Road Intermediate Roads Grass - Fair Condition Total Contributing Area = Impervious CN/Ia Pervious Composite CN = | 800 109 193580 50380 2768176 3013045 | 98 98 91 91 84 | 78400 10709 17615780 4584580 232526778 254816247 | Rate(in/hr) 0.00 0.00 0.03 0.03 0.07 | (in.) 0.20 0.20 0.99 0.99 1.90 | (in.) 0.04 0.04 0.20 0.20 0.38 |
| Inverters Rack Table Piles Perimeter Road Intermediate Roads Grass - Fair Condition Total Contributing Area = Impervious CN/Ia Pervious Composite CN = | 800 109 193580 50380 2768176 3013045 | 98 98 91 91 84 98 84.6 <u>Area (ac)</u> | 78400 10709 17615780 4584580 232526778 254816247 0 | Rate(in/hr) 0.00 0.00 0.03 0.03 0.07 | (in.) 0.20 0.20 0.99 0.99 1.90 | (in.) 0.04 0.04 0.20 0.20 0.38 |
| Inverters Rack Table Piles Perimeter Road Intermediate Roads Grass - Fair Condition Total Contributing Area = Impervious CN/Ia Pervious Composite CN = Surface South #10 - Impervious | 800 109 193580 50380 2768176 3013045 Area (sf) 909 | 98 98 91 91 84 98 84.6 <u>Area (ac)</u> 0.02 | 78400 10709 17615780 4584580 232526778 254816247 0 Area (sq mi) 0.00003 | Rate(in/hr) 0.00 0.00 0.03 0.03 0.07 | (in.) 0.20 0.20 0.99 0.99 1.90 | (in.) 0.04 0.04 0.20 0.20 0.38 |

Plant: <u>Country Acres Solar Study</u>

Address: Placer County, CA

Project No.: 406242 File No.

Title: <u>Hydrologic Analysis</u>

Infiltration Characteristics - Post-Development: (continued)

| | | | | Infiltration | S | la |
|---------------------------|----------------|--------------|----------------|--------------|--------------|--------------|
| Surface - BESS | Area (sf) | <u>CN</u> | CN*Area | Rate(in/hr) | <u>(in.)</u> | <u>(in.)</u> |
| Impervious Areas | 106820 | 98 | 10468360 | 0.00 | 0.20 | 0.04 |
| Access Roads | 170871 | 91 | 15549261 | 0.03 | 0.99 | 0.20 |
| Grass - Good Condition | <u>1493459</u> | 80 | 119476720 | 0.09 | 2.50 | 0.50 |
| Total Contributing Area = | 1771150 | | 145494341 | | | |
| Impervious CN/Ia | | 98 | 0 | 0.00 | 0.20 | 0.04 |
| Pervious Composite CN = | | 81.1 | | 0.084 | 2.34 | 0.469 |
| <u>Surface</u> | Area (sf) | Area (ac) | Area (sq mi) | | | |
| BESS - Impervious | 106820 | 2.45 | 0.00383 | | | |
| BESS - Pervious | <u>1664330</u> | <u>38.21</u> | <u>0.05970</u> | | | |
| BESS -Total Area | 1771150 | 40.66 | 0.06353 | | | |

Determine Curve Number for Yard Stone:

Final site stabilization for portions of the Substation and Switchyard includes a 4" layer of ¾" clean, crushed stone surfacing. This material promotes runoff infiltration and provides the grounding insulation necessary in substations for personnel safety.

Determine Curve Number for loose rock fill with a porosity of 0.4.

S = maximum retention = (0.4)(4 inch layer) = 1.6 inches.

S = (1000/CN - 10) (Ref. 1)

thus,

CN = 1000/(S+10) = 1000/(1.6+10) = 86.2

From Reference 1, Table 2-2, and Reference 14, Table 5-3, infiltration characteristics for a surface with a curve number of 86.2 correlates to a constant infiltration rate of 0.06 inches/hour.

Plant: <u>Country Acres Solar Study</u>

Address: <u>Placer County, CA</u>

Project No.: 406242 File No.

Title: <u>Hydrologic Analysis</u>

<u>Infiltration Characteristics - Post-Development</u>: (continued)

| | | | | Infiltration | S | la |
|--|-------------------------------|--------------------------------|--|---------------------|--------------|---------------------|
| Surface - Switchyard | Area (sf) | <u>CN</u> | <u>CN*Area</u> | Rate(in/hr) | <u>(in.)</u> | <u>(in.)</u> |
| Impervious Areas | 12260 | 98 | 1201480 | 0.00 | 0.20 | 0.04 |
| Access Roads | 61985 | 91 | 5640635 | 0.03 | 0.99 | 0.20 |
| Yard Stone | 175980 | 86.2 | 15169476 | 0.06 | 1.60 | 0.32 |
| Grass - Good Condition | <u>243746</u> | 80 | <u>19499680</u> | 0.09 | 2.50 | 0.50 |
| Total Contributing Area = | 493971 | | 41511271 | | | |
| Impervious CN/Ia | | 98 | 0 | 0.00 | 0.20 | 0.04 |
| Pervious Composite CN = | | 83.7 | | 0.071 | 1.98 | 0.395 |
| Surface | Area (sf) | Area (ac) | Area (sq mi) | | | |
| Switchyard - Impervious | 12260 | 0.28 | 0.00044 | | | |
| Switchyard - Pervious | <u>481711</u> | 11.06 | 0.01728 | | | |
| Switchyard -Total Area | 493971 | 11.34 | 0.01772 | | | |
| | | | | | | |
| | | | | Infiltration | S | la |
| Surface - Substation | Area (sf) | CN | CN*Area | Rate(in/hr) | <u>(in.)</u> | <u>(in.)</u> |
| Impervious Areas | 5200 | 98 | 509600 | 0.00 | 0.20 | 0.04 |
| Access Roads | 19522 | 91 | 1776502 | 0.03 | 0.99 | 0.20 |
| Yard Stone | | | | | | |
| | 72135 | 86.2 | 6218037 | 0.06 | 1.60 | 0.32 |
| Grass - Good Condition | 72135 <u>102493</u> | 86.2 80 | 6218037 <u>8199440</u> | 0.06 0.09 | 1.60 2.50 | 0.32 0.50 |
| | | | | | | |
| Grass - Good Condition | <u>102493</u> | | 8199440 | | | |
| Grass - Good Condition Total Contributing Area = | <u>102493</u> | 80 | 8199440 16703579 | 0.09 | 2.50 | 0.50 |
| Grass - Good Condition Total Contributing Area = Impervious CN/Ia | <u>102493</u> | 98 83.4 | 8199440 16703579 0 | 0.09 0.00 | 2.50 0.20 | 0.50 0.04 |
| Grass - Good Condition Total Contributing Area = Impervious CN/Ia Pervious Composite CN = | <u>102493</u> 199350 | 80 98 | 8199440 16703579 | 0.09 0.00 | 2.50 0.20 | 0.50 0.04 |
| Grass - Good Condition Total Contributing Area = Impervious CN/Ia Pervious Composite CN = Surface | 102493 199350 Area (sf) | 98 83.4 <u>Area (ac)</u> | 8199440 16703579 0 Area (sq mi) | 0.09 0.00 | 2.50 0.20 | 0.50 0.04 |

Plant: <u>Country Acres Solar Study</u>

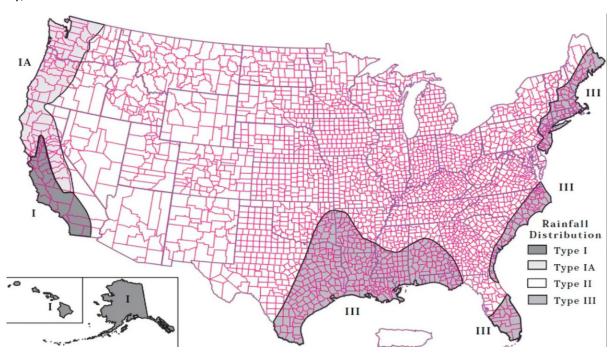
Address: Placer County, CA

Project No.: 406242 File No.

Title: <u>Hydrologic Analysis</u>

Precipitation Distribution:

From the figure from Reference 1, below, use the NRCS Type IA distribution for this site in western Placer County, California.



The cumulative distribution is provided below, from Reference 7.

```
// HydroCAD Rainfall table
// Copyright (c) 2005 HydroCAD Software Solutions LLC
// For details see Rainfall.txt
name=Type IA 24-hr Tabular
timeunits=hours
depthunits=inches
duration=24
comment=Type IA 24-hour tabular mass curve 1982
smoothing=false
depth= 0.0000 0.0100 0.0220 0.0360 0.0510
depth= 0.0670 0.0830
                     0.0990 0.1160 0.1350
depth= 0.1560 0.1790
                     0.2040 0.2330 0.2680
depth= 0.3100 0.4250
                     0.4800
                             0.5200 0.5500
depth= 0.5770 0.6010
                     0.6230 0.6440 0.6640
depth= 0.6830 0.7010
                     0.7190 0.7360 0.7530
depth= 0.7690 0.7850 0.8000 0.8150 0.8300
depth= 0.8440 0.8580 0.8710 0.8840 0.8960
depth= 0.9080 0.9200 0.9320 0.9440 0.9560
depth= 0.9670 0.9780 0.9890 1.000
```

Plant: <u>Country Acres Solar Study</u>

Address: Placer County, CA

Project No.: 406242 File No.

Title: <u>Hydrologic Analysis</u>

Proposed Site Basins: Stage - Storage Relationships:

Due to the post-development surfacing in the switchyard, substation, and BESS areas, additional stormwater runoff is generated, and detention basins are needed to meet the discharge requirements. The topography of the substation area does not support the development of a detention basin, so substation runoff is routed to the BESS area. Detention basins are provided in the BESS and Switchyard areas. These basins are shallow with a relatively large footprint, due to the flat topography.

| BESS AREA: | | Area | Area | Cum. Vol. | Cum. Vol. |
|------------|------------------|----------------|---------|-----------|----------------|
| | Elevation | <u>(sq ft)</u> | (acres) | (cu ft) | <u>(ac-ft)</u> |
| | 77.50 | 2850 | 0.0654 | 0 | 0.0000 |
| | 78.00 | 27076 | 0.6216 | 7482 | 0.0000 |
| | 79.00 | 38292 | 0.8791 | 40166 | 0.9221 |
| | 80.00 | 42000 | 0.9642 | 80312 | 1.8437 |

| SWITCH AREA | : | Area | Area | Cum. Vol. | Cum. Vol. |
|-------------|------------------|----------------|---------|-----------|----------------|
| | Elevation | <u>(sq ft)</u> | (acres) | (cu ft) | <u>(ac-ft)</u> |
| | 83.50 | 2600 | 0.0597 | 0 | 0.0000 |
| | 84.00 | 7000 | 0.1607 | 2400 | 0.0000 |
| | 85.00 | 25625 | 0.5883 | 18713 | 0.4296 |

Plant: <u>Country Acres Solar Study</u>

Address: Placer County, CA

Project No.: 406242 File No.

Title: <u>Hydrologic Analysis</u>

Proposed Site Basins: Stage - Discharge Relationships:

For the proposed site, detention basins are provided for the Switchyard and the BESS area. Substation stormwater runoff passes through the BESS area basins. A basin in the northeast corner of the switchyard controls runoff from the switchyard area, and the BESS area is controlled by basins in the northwest and southwest corners of that area.

Due to the topography, all basins are very shallow, and multiple 12-inch diameter HDPE discharge pipes are used to release the stormwater. The size was selected to optimize discharge capacity, while allowing for required cover over the top of the pipes. The use of multiple pipes diffuses stormwater discharge over a large area. The BESS area basins are connected with a pipe to allow them fill and drain uniformly. Thus, they will be modeled as a single basin. Existing topography allows for discharge invert elevations of 77.5 feet for the southwest basin and 78.0 feet for the northwest basin. The discharge invert elevation for the switchyard basin is 83.5 feet.

The HY-8 Culvert Analysis Package (Federal Highway Admin., Reference 8) is used to determine the stage-discharge relationship of the discharge pipelines. The input parameters and output table for each of the HDPE discharge pipes is provided on the following three pages. The BESS area basins use 3 pipes with invert elevations of 77.5 feet, and 6 pipes with invert elevations of 78.0 feet. The switchyard basin uses 8 pipes with invert elevations of 83.5 feet. BESS area discharge in the table below is interpolated from the output tables.

BESS AREA BASINS:

| Culvert w/Inv. El=77.5' | | | Culvert w/ | Inv. El=78.0' | |
|-------------------------|---------|---------|------------|---------------|--------------|
| | Each | х3 | Each | х6 | Q Total |
| Basin Stage | Q (cfs) | Q (cfs) | Q (cfs) | Q (cfs) | <u>(cfs)</u> |
| 77.5 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 78.0 | 0.54 | 1.62 | 0.00 | 0.00 | 1.62 |
| 78.5 | 1.85 | 5.55 | 0.66 | 3.96 | 9.51 |
| 79.0 | 3.14 | 9.42 | 1.80 | 10.80 | 20.22 |
| 79.5 | 3.97 | 11.91 | 3.14 | 18.84 | 30.75 |
| 80.0 | 4.62 | 13.86 | 3.96 | 23.76 | 37.62 |

SWITCHYARD BASIN:

Culvert w/Inv. El=83.5'

| | Each | х8 |
|-------------|---------|---------|
| Basin Stage | Q (cfs) | Q (cfs) |
| 83.50 | 0.00 | 0.00 |
| 84.06 | 0.80 | 6.40 |
| 84.56 | 2.00 | 16.00 |
| 85.00 | 3.14 | 25.12 |

Plant: <u>Country Acres Solar Study</u>

Address: Placer County, CA

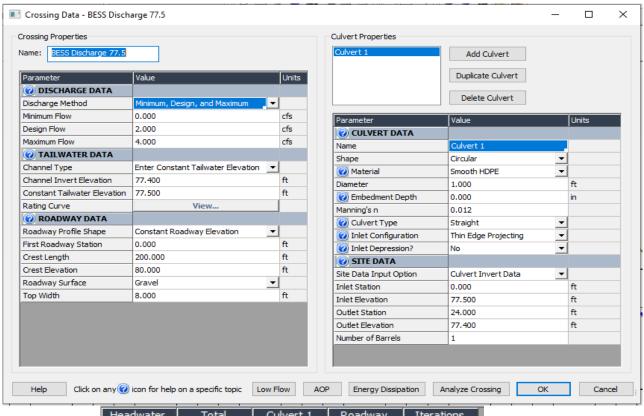
Project No.: 406242 File No.

Title: <u>Hydrologic Analysis</u>

Proposed Site Basins: Stage - Discharge Relationships: (Continued)

BESS Reservoir - Southwest Basin

Discharge pipe analysis for a 12-inch HDPE discharge pipeline approximately 24 feet in length, with an upstream invert elevation of 77.5 feet and a downsteam invert of 77.4 feet. Input data and the rating table are provided below.



| Headwater Elevation (ft) | Total Discharge (cfs) | Culvert 1 Discharge (cfs) | Roadway Discharge (cfs) | Iterations |
|--------------------------------|-----------------------------|---------------------------------|-------------------------------|-------------|
| 77.50 | 0.00 | 0.00 | 0.00 | 1 |
| 77.93 | 0.40 | 0.40 | 0.00 | 1 |
| 78.13 | 0.80 | 0.80 | 0.00 | 1 |
| 78.28 | 1.20 | 1.20 | 0.00 | 1 |
| 78.42 | 1.60 | 1.60 | 0.00 | 1 |
| 78.55 | 2.00 | 2.00 | 0.00 | 1 |
| 78.68 | 2.40 | 2.40 | 0.00 | 1 |
| 78.83 | 2.80 | 2.80 | 0.00 | 1 |
| 79.03 | 3.20 | 3.20 | 0.00 | 1 |
| 79.26 | 3.60 | 3.60 | 0.00 | 1 |
| 79.52 | 4.00 | 4.00 | 0.00 | 1 |
| 80.00 | 4.62 | 4.62 | 0.00 | Overtopping |

Plant: <u>Country Acres Solar Study</u>

Address: Placer County, CA

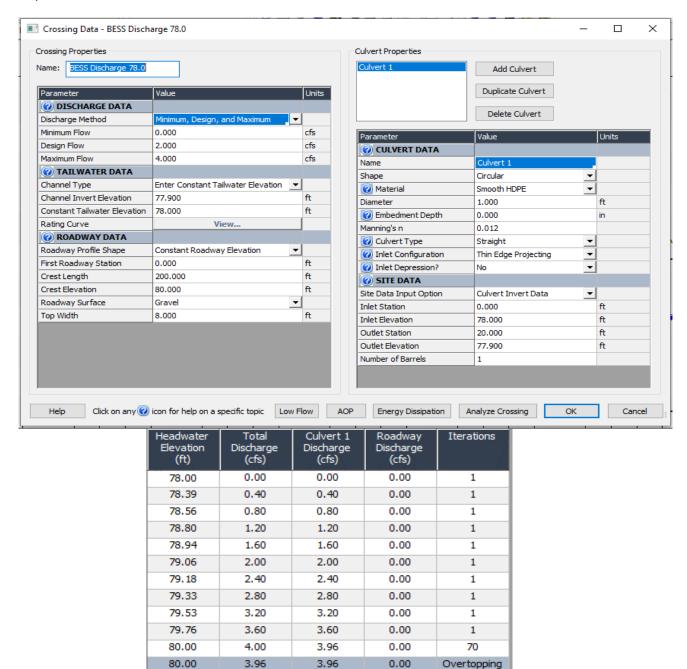
Project No.: 406242 File No.

Title: <u>Hydrologic Analysis</u>

Proposed Site Basins: Stage - Discharge Relationships: (Continued)

BESS Reservoir - Northwest Basin

Discharge pipe analysis for a 12-inch HDPE discharge pipeline approximately 20 feet in length, with an upstream invert elevation of 78.0 feet and a downsteam invert of 77.9 feet. Input data and the rating table are provided below.



Plant: <u>Country Acres Solar Study</u>

Address: Placer County, CA

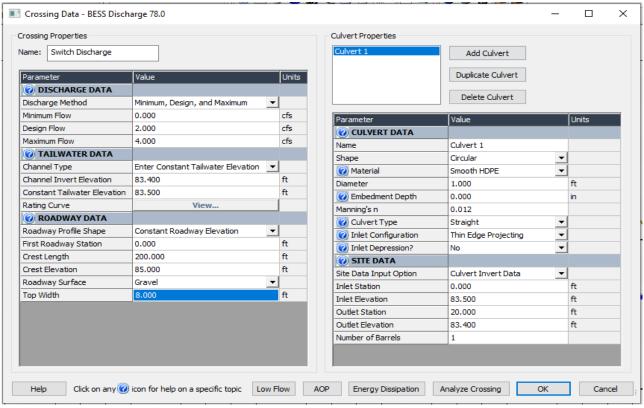
Project No.: 406242 File No.

Title: <u>Hydrologic Analysis</u>

Proposed Site Basins: Stage - Discharge Relationships: (Continued)

Switchyard Reservoir

Discharge pipe analysis for a 12-inch HDPE discharge pipeline approximately 20 feet in length, with an upstream invert elevation of 83.5 feet and a downsteam invert of 83.4 feet. Input data and the rating table are provided below.



| Headwater Elevation (ft) | Total Discharge (cfs) | Culvert 1 Discharge (cfs) | Roadway Discharge (cfs) | Iterations |
|--------------------------------|-----------------------------|---------------------------------|-------------------------------|-------------|
| 83.50 | 0.00 | 0.00 | 0.00 | 1 |
| 83.89 | 0.40 | 0.40 | 0.00 | 1 |
| 84.06 | 0.80 | 0.80 | 0.00 | 1 |
| 84.30 | 1.20 | 1.20 | 0.00 | 1 |
| 84.44 | 1.60 | 1.60 | 0.00 | 1 |
| 84.56 | 2.00 | 2.00 | 0.00 | 1 |
| 84.68 | 2.40 | 2.40 | 0.00 | 1 |
| 84.83 | 2.80 | 2.80 | 0.00 | 1 |
| 85.00 | 3.20 | 3.14 | 0.03 | 51 |
| 85.01 | 3.60 | 3.15 | 0.43 | 5 |
| 85.01 | 4.00 | 3.16 | 0.82 | 4 |
| 85.00 | 3.14 | 3.14 | 0.00 | Overtopping |

Plant: <u>Country Acres Solar Study</u>

Address: Placer County, CA

Project No.: 406242 File No.

Title: <u>Hydrologic Analysis</u>

HYDROLOGIC MODEL RESULTS:

The HEC-HMS Hydrologic Modeling System (Ref. 2) was used to model the performance of the site in response to the 2, 10, and 100-Year, 24-Hour design precipitation events. Models were created for the parcels containing the solar PV panels, and for the Switchyard, Substation and BESS areas. For each design event, the post-development peak discharge was limited to the pre-development value.

For the parcels in existing condition, the peak stormwater discharge in response to the 2, 10, and 100-Year precipitation events was 254.4 cfs, 434.7 cfs, and 646.2 cfs, respectively.

For the parcels in the proposed final condition, the peak stormwater discharge in response to the 2, 10, and 100-Year precipitation events was 208.5 cfs, 369.2 cfs, and 557.5 cfs, respectively. Detention basins were not required to meet the post-development peak discharge limitation.

For the Switchyard, Substation, and BESS areas in the existing condition, the peak stormwater discharge in response to the 2, 10, and 100-Year precipitation events was 10.3 cfs, 19.4 cfs, and 29.8 cfs, respectively.

For the Switchyard, Substation, and BESS areas in the proposed final condition, the peak stormwater discharge in response to the 2, 10, and 100-Year precipitation events was 7.9 cfs, 15.6 cfs, and 24.2 cfs, respectively. Detention basins were provided in the BESS and Switchyard areas in order to meet the post-development peak discharge limitation.

The BESS area basins are hydraulically connected so that they drawdown evenly. The peak stage in the basins in response to the 100-Year event is 79.0 feet. The basins crest elevation is 80.0 feet, which provided 12 inches of freeboard in response to the 100-Year event.

The peak stage in the Switch area basin in response to the 100-Year event is 84.2 feet. The basin crest is set at 85.2 feet, to provide a minimum 12 inches of freeboard.

HEC-HMS results for the site in its existing and proposed conditions, for all events, are provided on Pages A55 - A72.

Plant: Country Acres Solar Study

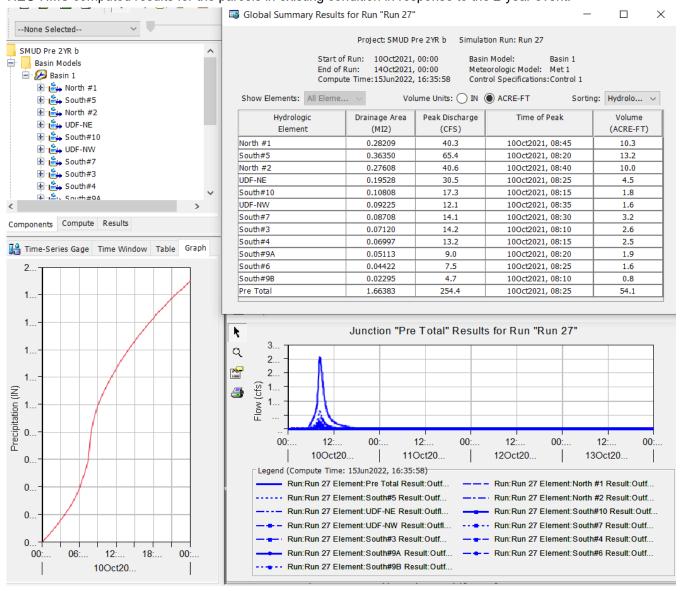
Address: Placer County, CA

Project No.: 406242 File No.

Title: <u>Hydrologic Analysis</u>

HYDROLOGIC MODEL RESULTS - Parcels:

HEC-HMS computed results for the parcels in existing condition in response to the 2-year event.



Plant: Country Acres Solar Study

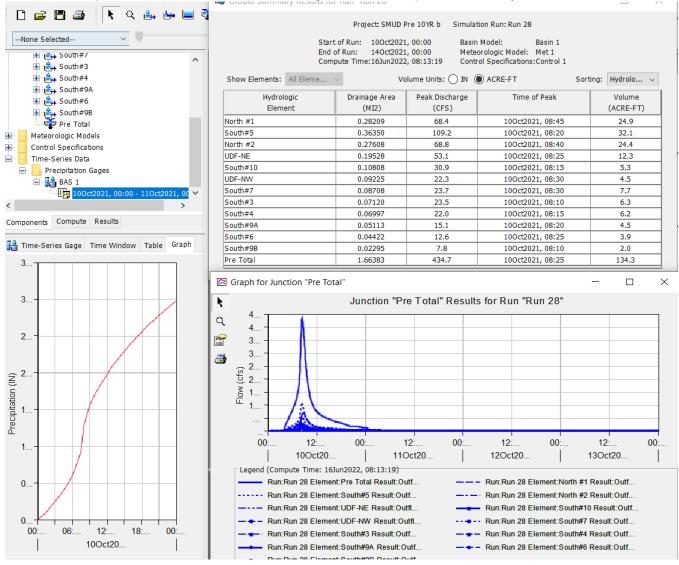
Address: Placer County, CA

Project No.: 406242 File No.

Title: <u>Hydrologic Analysis</u>

HYDROLOGIC MODEL RESULTS - Parcels:

HEC-HMS computed results for the parcels in existing condition in response to the 10-year event.



Plant: Country Acres Solar Study

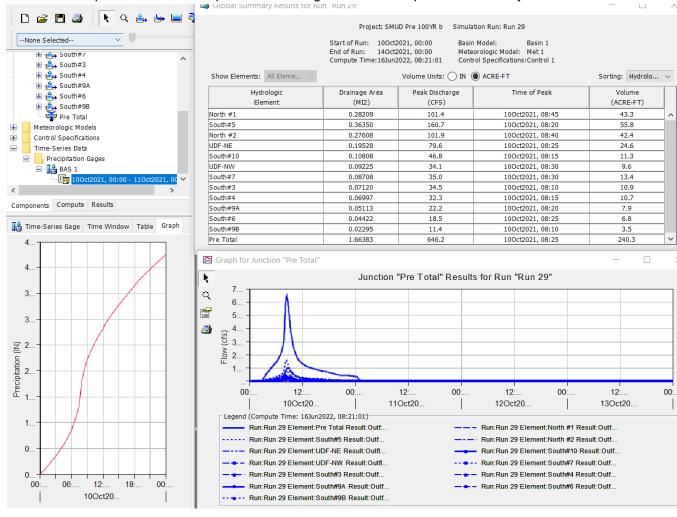
Address: Placer County, CA

Project No.: 406242 File No.

Title: <u>Hydrologic Analysis</u>

HYDROLOGIC MODEL RESULTS - Parcels:

HEC-HMS computed results for the parcels in existing condition in response to the 100-year event.



Plant: Country Acres Solar Study

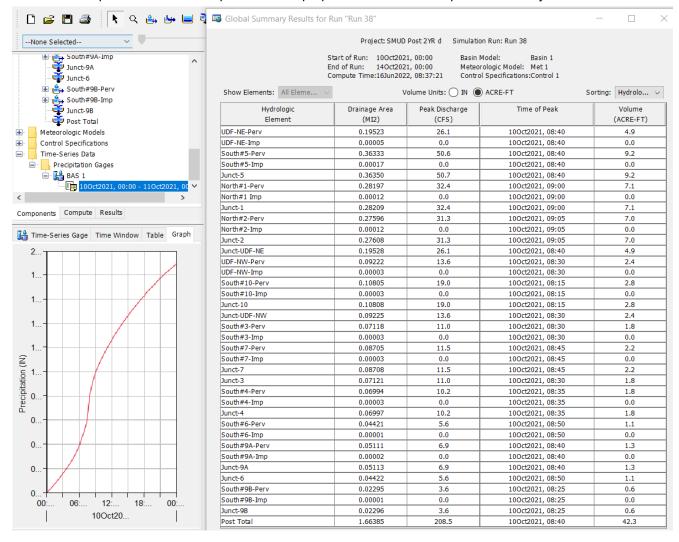
Address: Placer County, CA

Project No.: 406242 File No.

Title: <u>Hydrologic Analysis</u>

HYDROLOGIC MODEL RESULTS - Parcels:

HEC-HMS computed results for the parcels in the proposed condition in response to the 2-year event.



Plant: Country Acres Solar Study

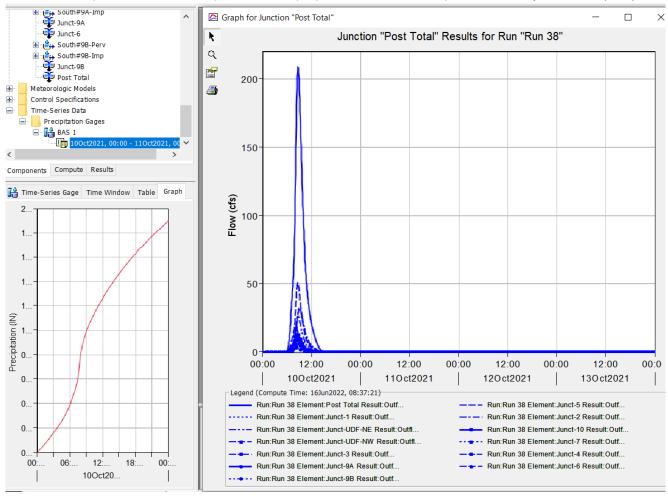
Address: Placer County, CA

Project No.: 406242 File No.

Title: <u>Hydrologic Analysis</u>

HYDROLOGIC MODEL RESULTS - Parcels:

HEC-HMS computed results for the parcels in the proposed condition in response to the 2-year event. (cont)



Plant: Country Acres Solar Study

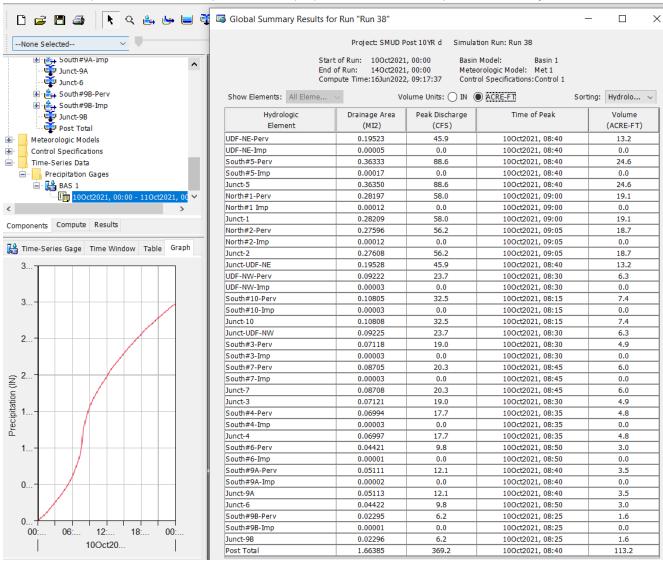
Address: Placer County, CA

Project No.: 406242 File No.

Title: <u>Hydrologic Analysis</u>

HYDROLOGIC MODEL RESULTS - Parcels:

HEC-HMS computed results for the parcels in the proposed condition in response to the 10-year event.



Plant: Country Acres Solar Study

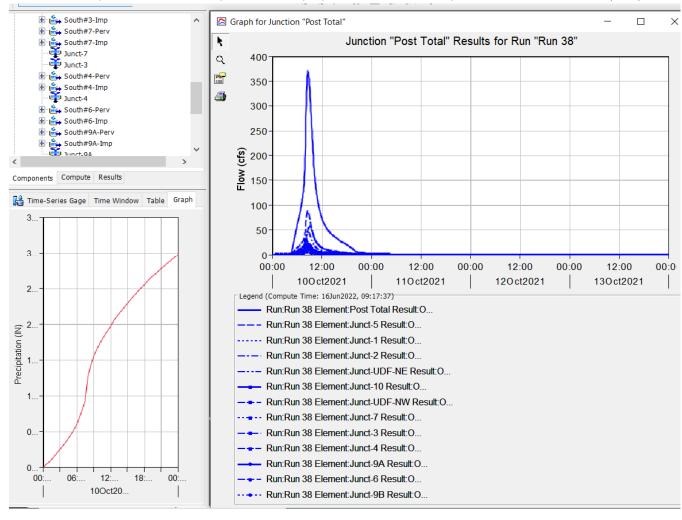
Address: Placer County, CA

Project No.: 406242 File No.

Title: <u>Hydrologic Analysis</u>

HYDROLOGIC MODEL RESULTS - Parcels:

HEC-HMS computed results for the parcels in the proposed condition in response to the 10-YR event. (cont)



Plant: Country Acres Solar Study

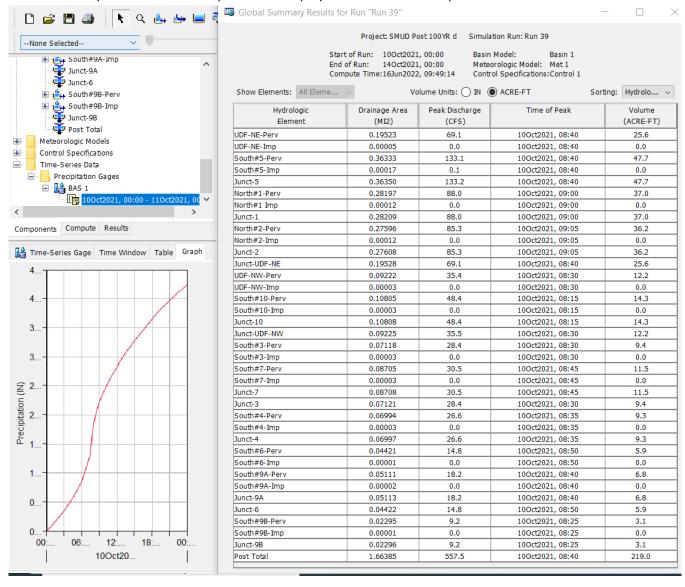
Address: Placer County, CA

Project No.: 406242 File No.

Title: <u>Hydrologic Analysis</u>

HYDROLOGIC MODEL RESULTS - Parcels:

HEC-HMS computed results for the parcels in the proposed condition in response to the 100-YR event.



Plant: Country Acres Solar Study

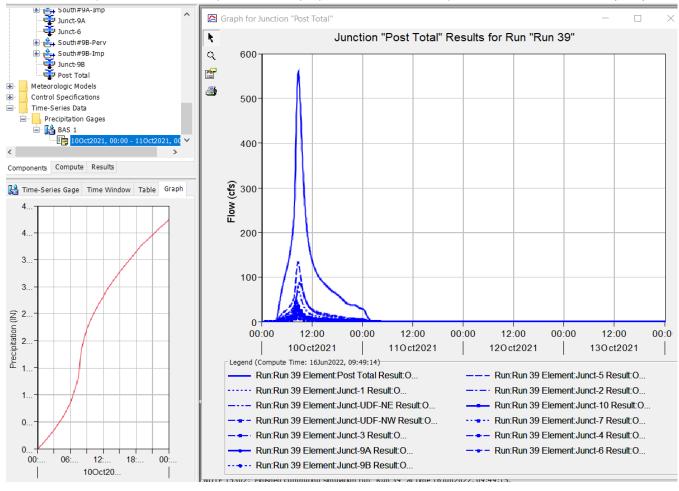
Address: Placer County, CA

Project No.: 406242 File No.

Title: <u>Hydrologic Analysis</u>

HYDROLOGIC MODEL RESULTS - Parcels:

HEC-HMS computed results for the parcels in the proposed condition in response to the 100-YR event. (cont)



Plant: Country Acres Solar Study

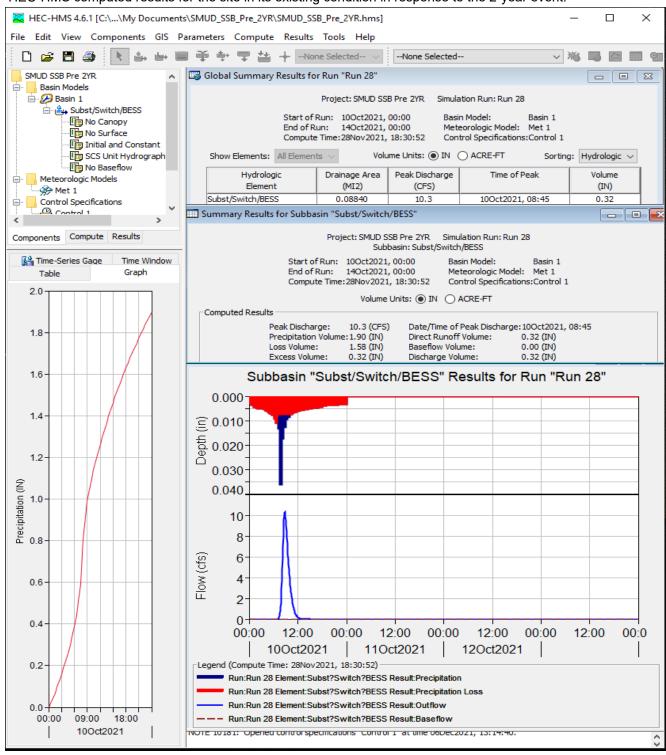
Address: Placer County, CA

Project No.: 406242 File No.

Title: <u>Hydrologic Analysis</u>

HYDROLOGIC MODEL RESULTS - Switchyard, Substation, and BESS Areas:

HEC-HMS computed results for the site in its existing condition in response to the 2-year event.



Plant: Country Acres Solar Study

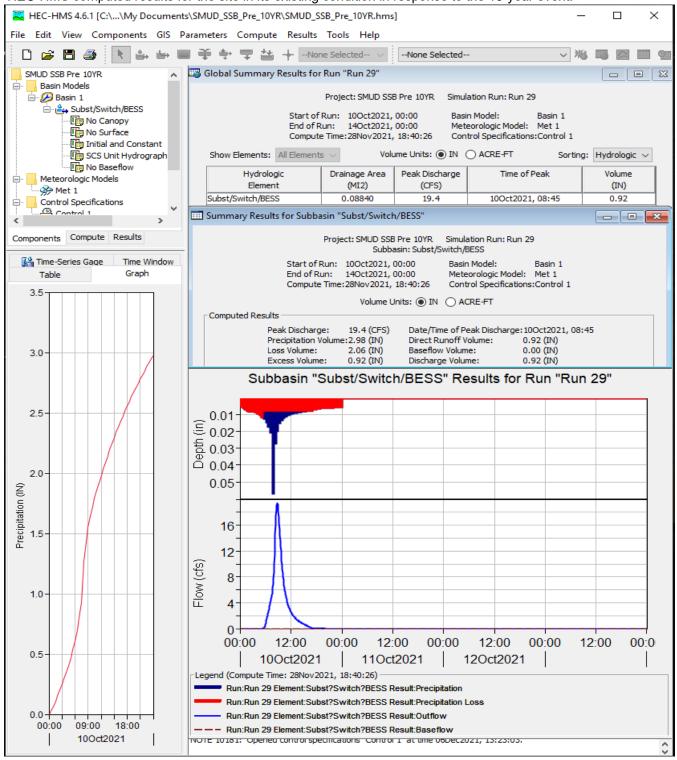
Address: Placer County, CA

Project No.: 406242 File No.

Title: <u>Hydrologic Analysis</u>

HYDROLOGIC MODEL RESULTS - Switchyard, Substation, and BESS Areas:

HEC-HMS computed results for the site in its existing condition in response to the 10-year event.



Plant: Country Acres Solar Study

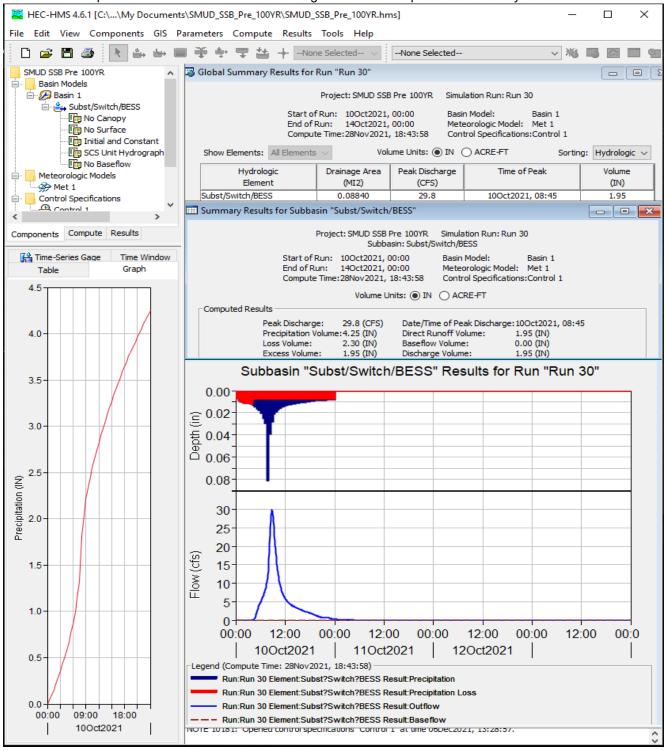
Address: Placer County, CA

Project No.: 406242 File No.

Title: <u>Hydrologic Analysis</u>

HYDROLOGIC MODEL RESULTS - Switchyard, Substation, and BESS Areas:

HEC-HMS computed results for the site in its existing condition in response to the 100-year event.



Plant: Country Acres Solar Study

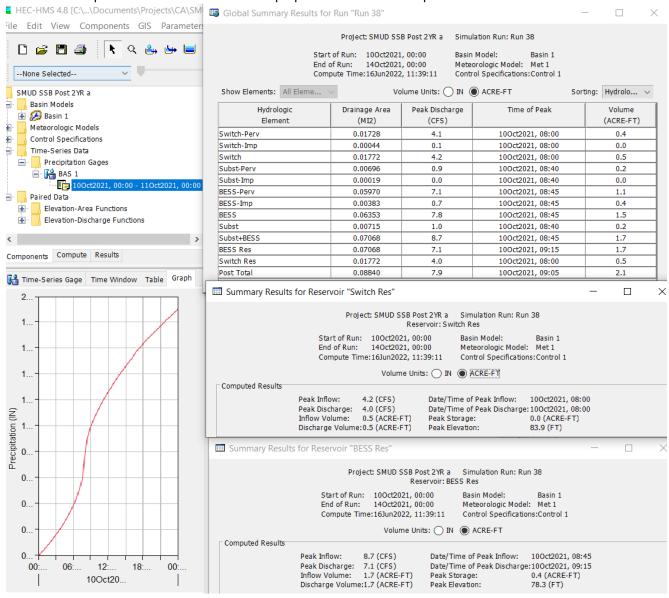
Address: Placer County, CA

Project No.: 406242 File No.

Title: <u>Hydrologic Analysis</u>

HYDROLOGIC MODEL RESULTS - Switchyard, Substation, and BESS Areas:

HEC-HMS computed results for the site in the proposed condition in response to the 2-YR event.



Plant: Country Acres Solar Study

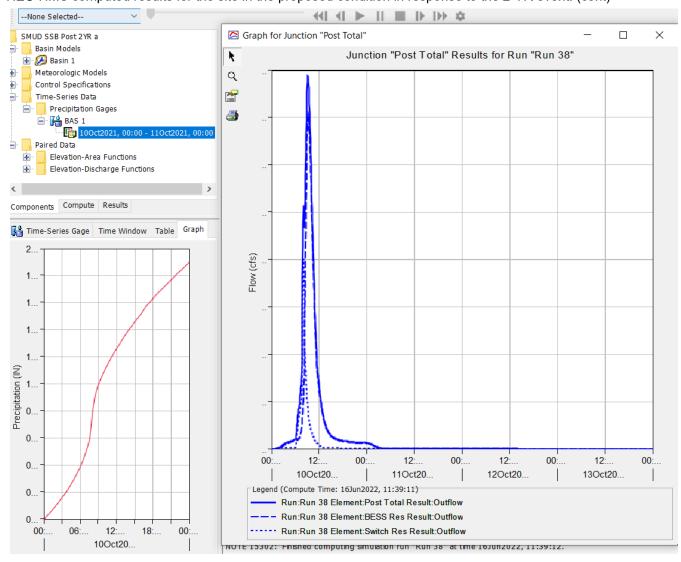
Address: Placer County, CA

Project No.: 406242 File No.

Title: <u>Hydrologic Analysis</u>

HYDROLOGIC MODEL RESULTS - Switchyard, Substation, and BESS Areas:

HEC-HMS computed results for the site in the proposed condition in response to the 2-YR event. (cont)



Plant: Country Acres Solar Study

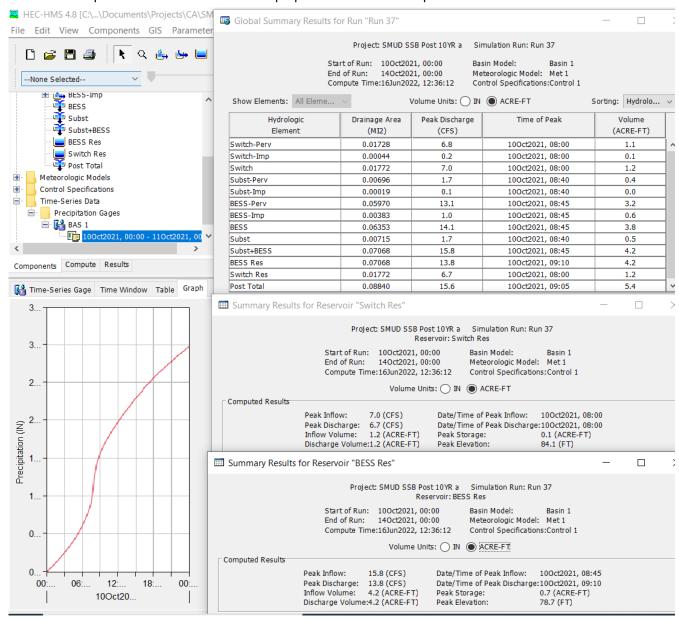
Address: Placer County, CA

Project No.: 406242 File No.

Title: <u>Hydrologic Analysis</u>

HYDROLOGIC MODEL RESULTS - Switchyard, Substation, and BESS Areas:

HEC-HMS computed results for the site in the proposed condition in response to the 10-YR event.



Plant: <u>Country Acres Solar Study</u>

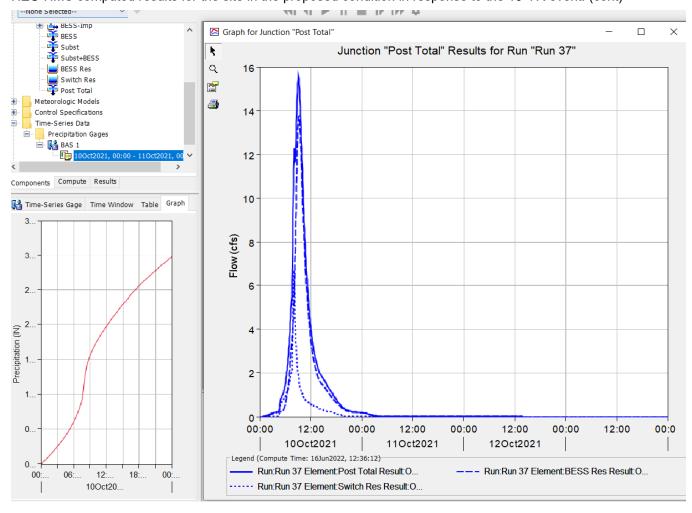
Address: Placer County, CA

Project No.: 406242 File No.

Title: <u>Hydrologic Analysis</u>

HYDROLOGIC MODEL RESULTS - Switchyard, Substation, and BESS Areas:

HEC-HMS computed results for the site in the proposed condition in response to the 10-YR event. (cont)



Plant: Country Acres Solar Study

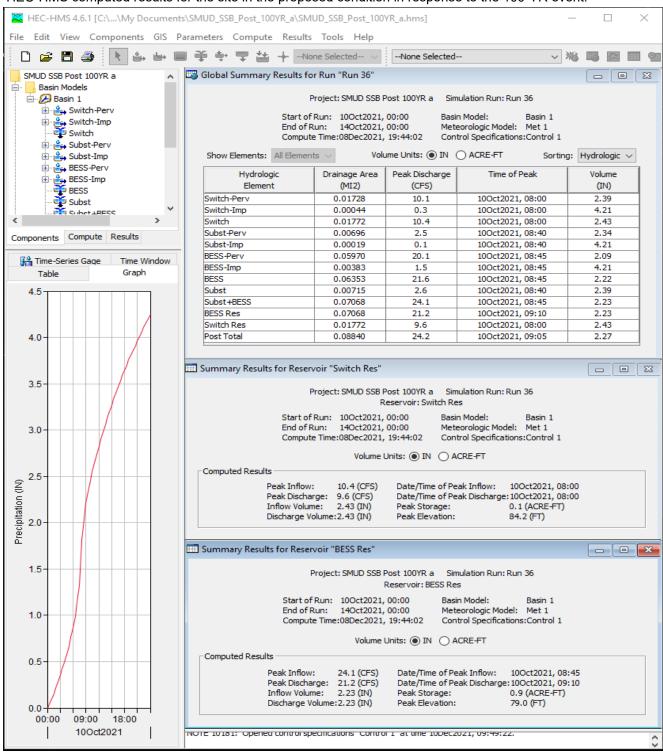
Address: Placer County, CA

Project No.: 406242 File No.

Title: <u>Hydrologic Analysis</u>

HYDROLOGIC MODEL RESULTS - Switchyard, Substation, and BESS Areas:

HEC-HMS computed results for the site in the proposed condition in response to the 100-YR event.



Plant: <u>Country Acres Solar Study</u>

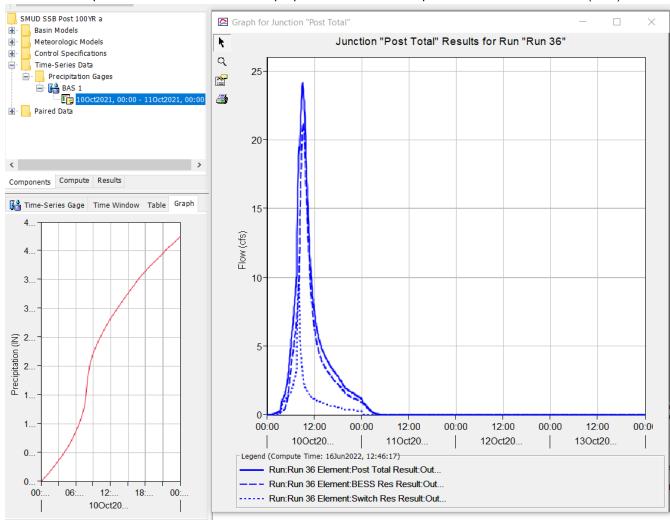
Address: Placer County, CA

Project No.: 406242 File No.

Title: <u>Hydrologic Analysis</u>

HYDROLOGIC MODEL RESULTS - Switchyard, Substation, and BESS Areas:

HEC-HMS computed results for the site in the proposed condition in response to the 100-YR event. (cont)



Plant: <u>Country Acres Solar Study</u>

Address: Placer County, CA

Project No.: 406242 File No.

Title: <u>Hydrologic Analysis</u>

Water Quality Analysis:

The Water Quality Analysis is based on the requirements of the West Placer Storm Water Quality Design Manual (Ref. 10), within the compliance boundary defined by the Placer County Online Map (Ref. 11).

The area outlined in red in the figure below delineates the Project Planning Area which impacts this project. Parcels UDF-NW and UDF-NE are located within this boundary.

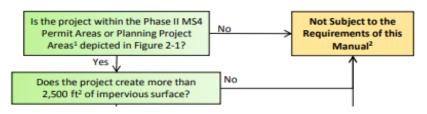


Chapter 2 • Phase II MS4 Permit Requirements

West Placer Storm Water Quality Design Manual

2.2 Project Categorization

The distinction between Small Projects and Regulated Projects is based on the amount of impervious surface that is created or replaced. The decision tree, below, may be used to assist in determining the project category.



A portion of the decision tree from Chapter 2 of the West Placer Storm Water Quality Design Manual is presented above. From Page A41 of this calculation, a total of 2345 square feet of impervious area is created in Parcels UDF-NW and UDF-NE, which is less than the 2500 square feet which defines a small project. Thus, the project is not subject to the requirements of the West Placer Storm Water Quality Design Manual.

Plant: <u>Country Acres Solar Study</u>

Address: Placer County, CA

Project No.: 406242 File No.

Title: <u>Hydrologic Analysis</u>

5.0 CONCLUSION:

The SMUD Country Acres Hydrologic Analysis addresses the requirements of the Placer Country Stormwater Management Manual and the West Placer Storm Water Quality Design Manual. Additional criteria provided by the Placer County Flood Control District and Placer County Engineering and Surveying Division was also addressed.

The proposed project includes the installation of solar PV panels on 12 parcels of land with a total area of 1064.85 acres. Inverter skids and aggregate surfaced access roads will also be constructed on the parcels. The project will be supported by the construction of a substation, switchyard, and BESS area, on an additional 55.75 acres. The project is located in rural west Placer County, California.

Stormwater Quantity Analysis:

The 2, 10, and 100-Year recurrence interval events are the design precipitation events in Placer County. For each event, the post-development peak discharge can not exceed the pre-development value. The parcels containing the proposed solar PV panels are considered separately from the Switchyard, Substation, and BESS areas. The HEC-HMS Hydrologic Modeling System software package was used to model the response of the system to the design precipitation events.

For the parcels in existing condition, the peak stormwater discharge in response to the 2, 10, and 100-Year precipitation events was 254.4 cfs, 434.7 cfs, and 646.2 cfs, respectively.

For the parcels in the proposed final condition, the peak stormwater discharge in response to the 2, 10, and 100-Year precipitation events was 208.5 cfs, 369.2 cfs, and 557.5 cfs, respectively. Detention basins were not required to meet the post-development peak discharge limitation.

For the Switchyard, Substation, and BESS areas in the existing condition, the peak stormwater discharge in response to the 2, 10, and 100-Year precipitation events was 10.3 cfs, 19.4 cfs, and 29.8 cfs, respectively.

For the Switchyard, Substation, and BESS areas in the proposed final condition, the peak stormwater discharge in response to the 2, 10, and 100-Year precipitation events was 7.9 cfs, 15.6 cfs, and 24.2 cfs, respectively. Detention basins were provided in the BESS and Switchyard areas in order to meet the post-development peak discharge limitation.

The BESS area basins are hydraulically connected so that they drawdown evenly. The peak stage in the basins in response to the 100-Year event is 79.0 feet. The basins crest elevation is 80.0 feet, which provides 12 inches of freeboard in response to the 100-Year event.

The peak stage in the Switch area basin in response to the 100-Year event is 84.2 feet. The basin crest is set at 85.2 feet, to provide a minimum 12 inches of freeboard.

Plant: <u>Country Acres Solar Study</u>

Address: Placer County, CA

Project No.: 406242 File No.

Title: <u>Hydrologic Analysis</u>

5.0 CONCLUSION: (continued)

Stormwater Quality Analysis:

Two of the project parcels, UDF-NE and UDF-NW, are located within the compliance boundary that defines areas that are subject to the West Placer Storm Water Quality Design Manual. Project categorization is provided in Section 2.2 of the manual and is based on the amount of impervious surface that is created or replaced. A total of 2345 square feet of impervious surface is created in parcels UDF-NE and UDF-NW, which is less than the minimum value of 2500 square feet which defines a small project. Thus, the project is not subject to the requirements of the West Placer Storm Water Quality Design Manual.

Attachment C. Preliminary Hydraulic Analysis Calculation

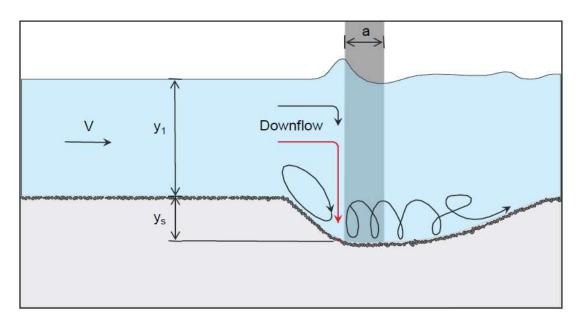
BLACK & VEATCH C-1

Evaluating Scour at Bridges Fifth Edition — Equation 7.3

$$y_s = 2.0aK_1K_2K_3\left(\frac{y_1}{a}\right)^{0.35}Fr_1^{0.43}$$

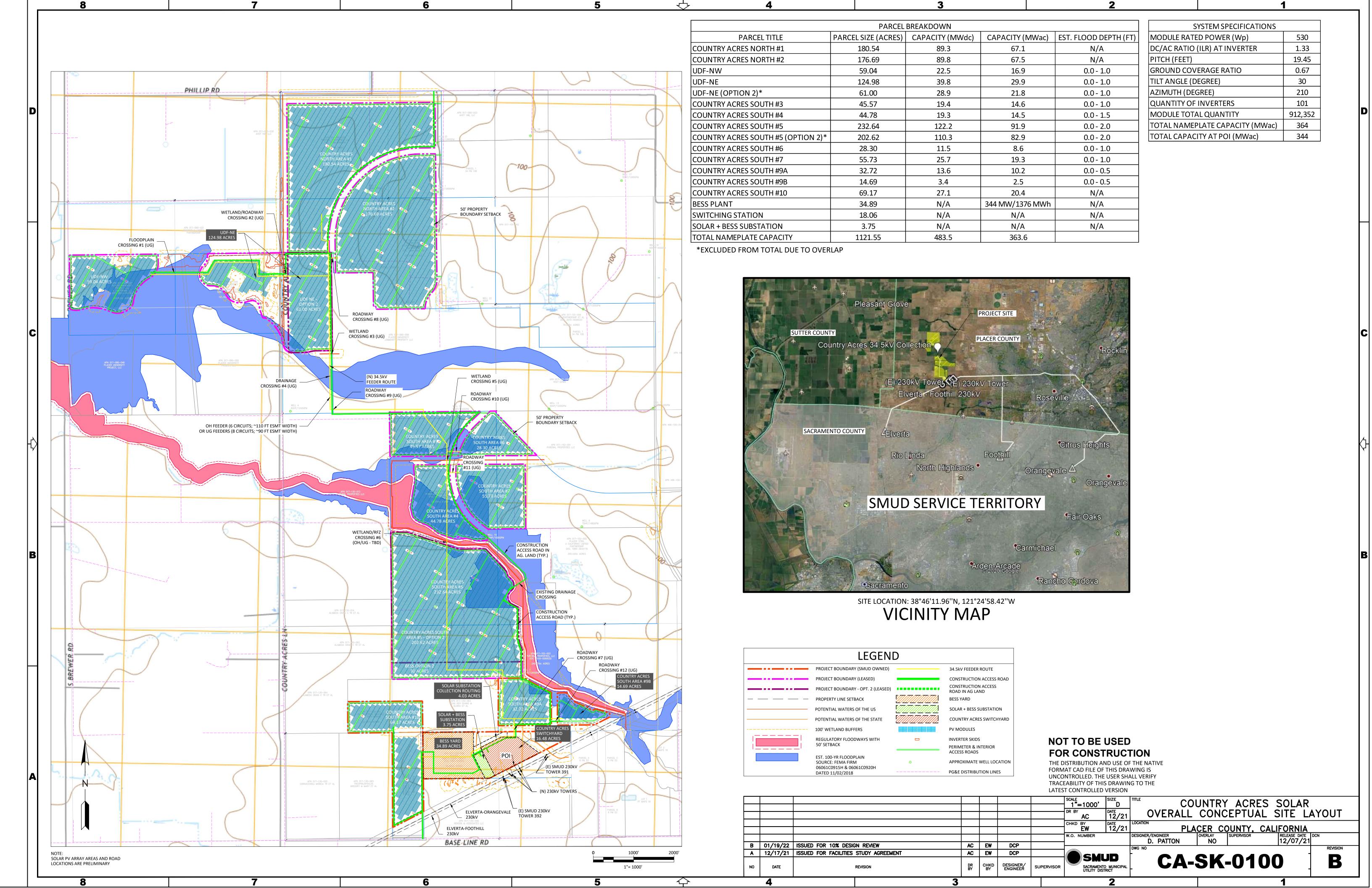
| <u>Symbol</u> | <u>Input</u> | <u>Units</u> | <u>Description</u> |
|---------------|--------------|--------------|-----------------------------------|
| K1 | 1 | N/A | Pier Nose Shape Correction Factor |
| Theta | 66.4 | Degrees | Angle of Attack |
| К3 | 1.1 | N/A | Bed Condition Correction Factor |
| а | 0.29 | ft | Pier Width |
| L | 0.67 | ft | Pier Length |
| y1 | 1.10 | ft | Flow Depth |
| v1 | 3.74 | ft/s | Mean Velocity |

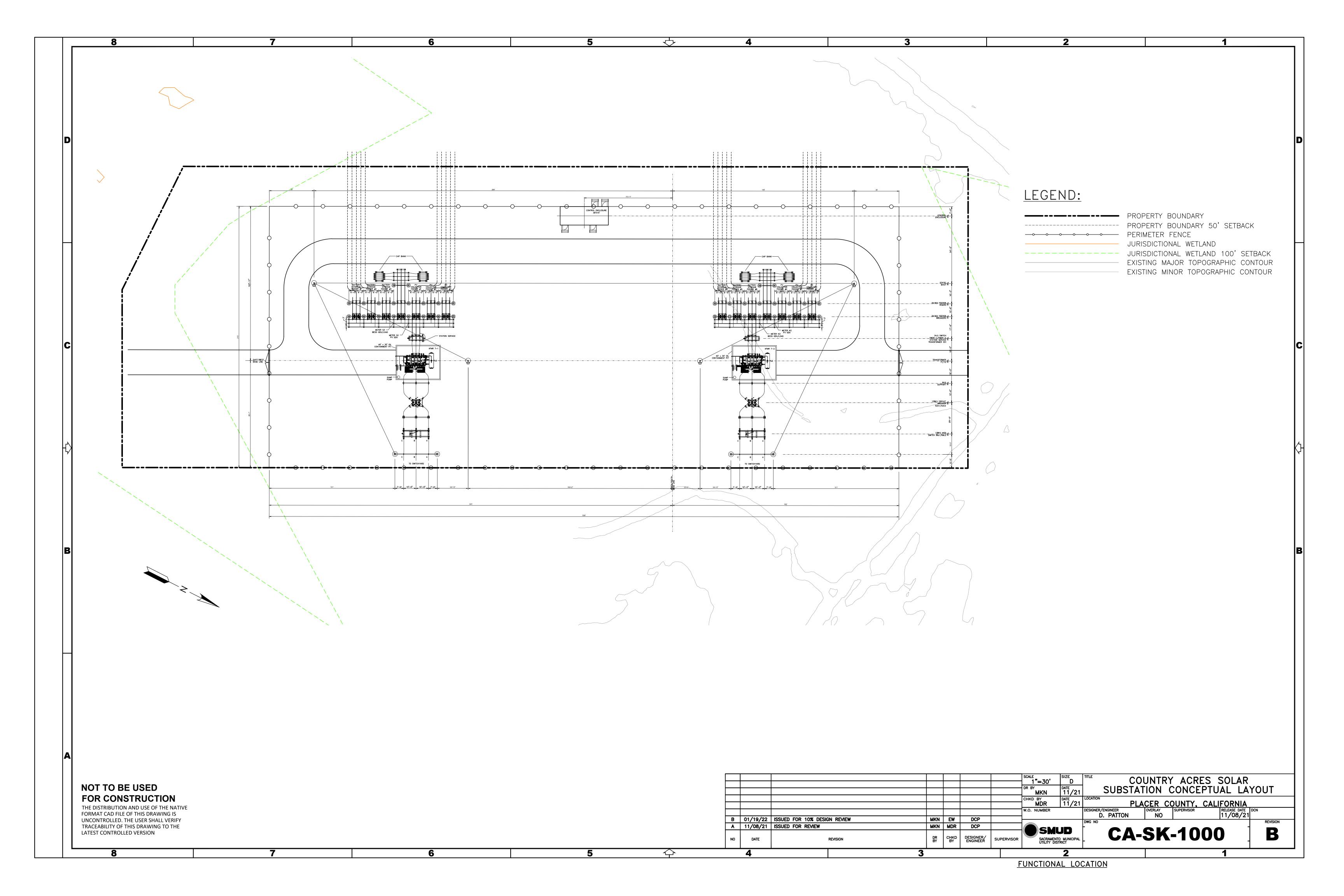
| <u>Symbol</u> | <u>Output</u> | <u>Units</u> | <u>Description</u> |
|---------------|---------------|--------------|-----------------------------------|
| K2 | 1.81 | N/A | Angle of Attack Correction Factor |
| Fr | 0.63 | N/A | Froude Number |
| ys | 1.5 | ft | Scour Depth |

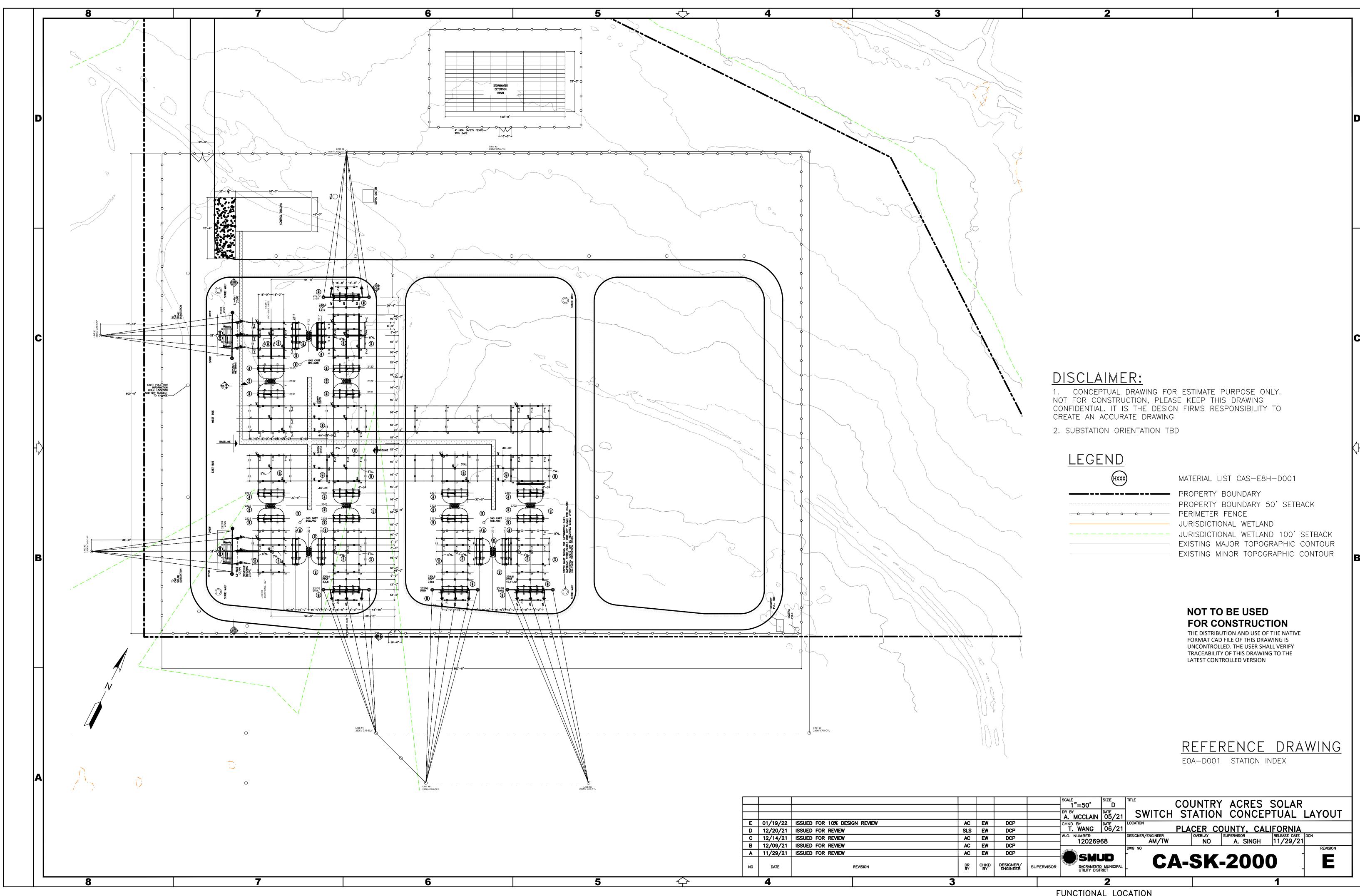


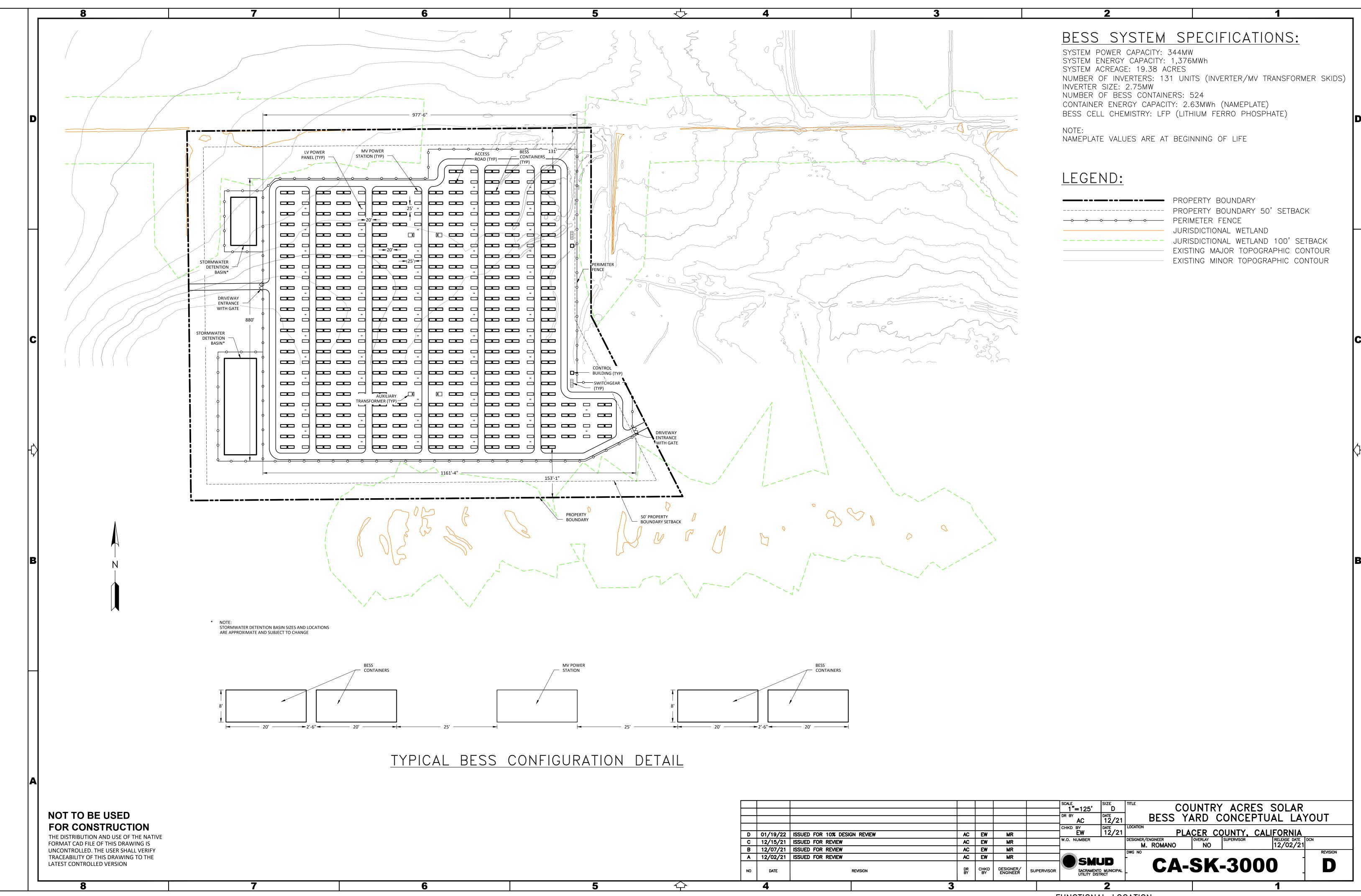
Attachment D. Supplemental Drawings and Exhibits

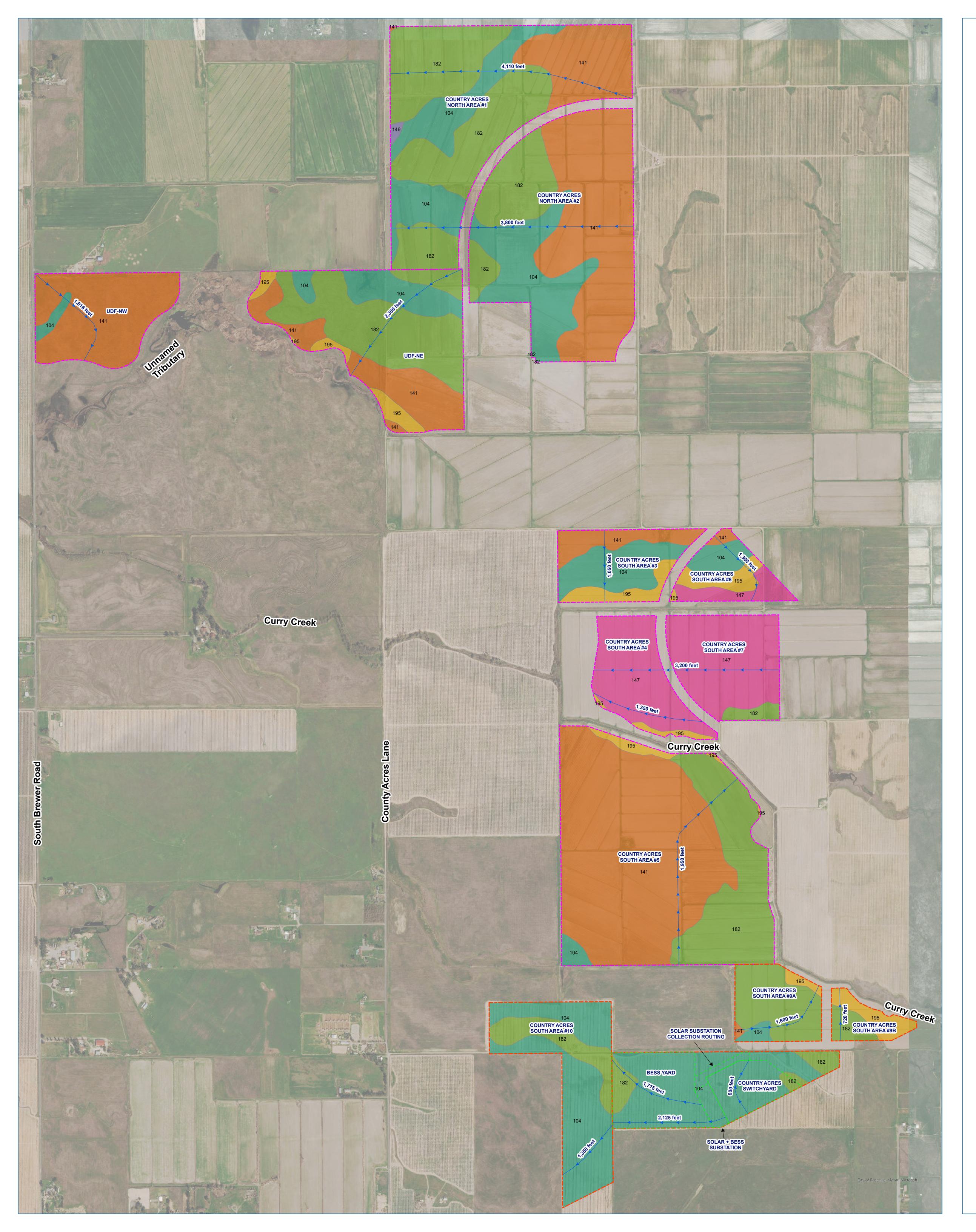
BLACK & VEATCH D-1











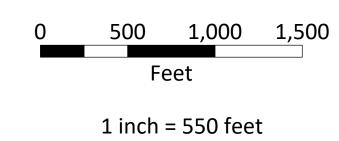
PROJECT WATERSHED MAP

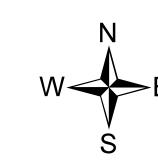
| | PARCEL BREAKDOWN | | | | | | |
|------------------------------|------------------------------|---|----------------------|----------------------|--------------------|---|--------------------------------------|
| WATERSHED TITLE | WATERSHED AREA (ACRES) | HYDRAULICALLY MOST REMOTE FLOWPATH (FT) | SOIL AND COVER TYPES | EXISTING LAND USE | FUTURE LAND USE | FUTURE INFILTRATION RATES (IN/HR) | FUTURE IMPERVIOUS AREA (ACRES) |
| COUNTRY ACRES NORTH AREA #1 | 180.54 | 4110 | 104, 141, 146, 182 | CROP | PV ARRAY | 0.068 | 0.08 |
| COUNTRY ACRES NORTH AREA #2 | 176.69 | 3800 | 104, 141, 182 | CROP | PV ARRAY | 0.068 | 0.08 |
| UDF-NE | 124.98 | 2300 | 104, 141, 182, 195 | CROP | PV ARRAY | 0.068 | 0.03 |
| UDF-NW | 59.04 | 1616 | 104, 141 | RANGELAND | PV ARRAY | 0.067 | 0.02 |
| COUNTRY ACRES SOUTH AREA #3 | 45.57 | 1050 | 104, 141, 195 | CROP | PV ARRAY | 0.067 | 0.02 |
| COUNTRY ACRES SOUTH AREA #4 | 44.78 | 1350 | 147, 195 | CROP | PV ARRAY | 0.067 | 0.02 |
| COUNTRY ACRES SOUTH AREA #5 | 232.64 | 1950 | 104, 141, 182, 195 | CROP | PV ARRAY | 0.068 | 0.11 |
| COUNTRY ACRES SOUTH AREA #6 | 28.30 | 1300 | 104, 141, 147, 195 | CROP | PV ARRAY | 0.067 | 0.01 |
| COUNTRY ACRES SOUTH AREA #7 | 55.73 | 3200 | 147, 182 | CROP | PV ARRAY | 0.067 | 0.02 |
| COUNTRY ACRES SOUTH AREA #9A | 32.72 | 1600 | 104, 141, 195 | CROP | PV ARRAY | 0.067 | 0.01 |
| COUNTRY ACRES SOUTH AREA #9B | 14.69 | 720 | 182, 195 | CROP | PV ARRAY | 0.066 | 0.00 |
| COUNTRY ACRES SOUTH AREA #10 | 69.17 | 1350 | 104, 182 | RANGELAND | PV ARRAY | 0.067 | 0.02 |
| BESS YARD | 34.89 | 1775 | 104, 182 | RANGELAND | BESS YARD | 0.084 | 2.45 |
| SOLAR + BESS SUBSTATION | 3.72 | 2125 | 104 | RANGELAND | SUBSTATION | 0.073 | 0.12 |
| COUNTRY ACRES SWITCHYARD | 18.06 | 600 | 104, 182 | RANGELAND | SWITCHYARD | 0.071 | 0.28 |

| MAP UNIT SYMBOL | MAP UNIT NAME | HYDROLOGIC SOIL RATING | PERCENT OF AOI |
|--------------------|---|------------------------|-------------------|
| 104 | ALAMO-FIDDYMENT COMPLEX, 0 TO 5 PERCENT SLOPES | D | 23% |
| 141 | COMETA-FIDDYMENT COMPLEX, 1 TO 5 PERCENT SLOPES | D | 35% |
| 146 | FIDDYMENT LOAM, 1 TO 8 PERCENT SLOPES | D | 0% |
| 147 | FIDDYMENT-KASEBERG LOAMS, 2 TO 9 PERCENT SLOPES | С | 9% |
| 182 | SAN JOAQUIN-COMETA SANDY LOAMS, 1 TO 5 PERCENT SLOPES | D | 28% |
| 195 | XEROFLUVENTS, HARDPAN SUBSTRATUM | B/D | 4% |
| TOTALS | | | 100% |

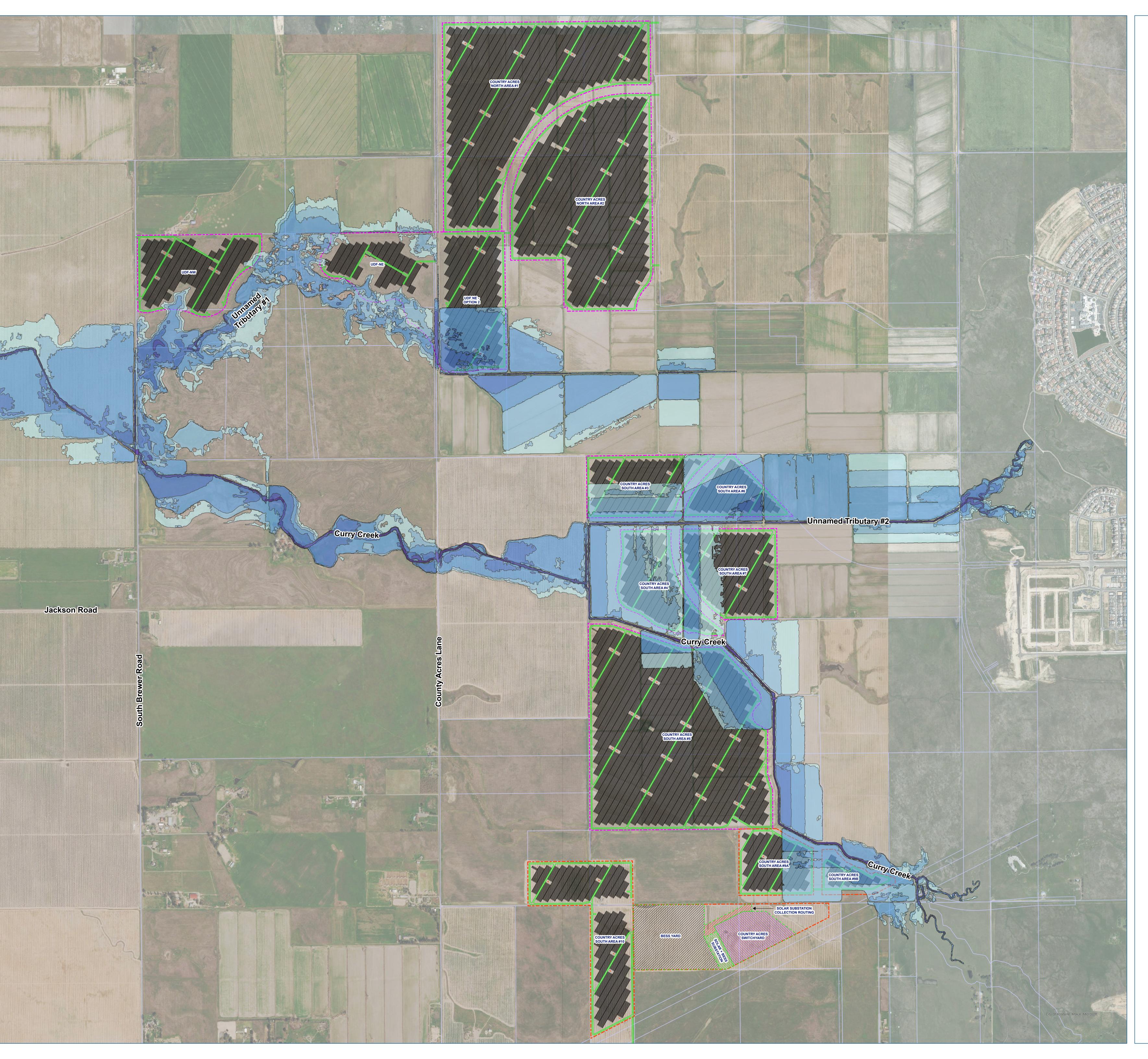
LEGEND

- → HYDRAULICALLY MOST REMOTE FLOW PATH
- ---- PROJECT BOUNDARY (SMUD OWNED)
- ---- PROJECT BOUNDARY (LEASED)
- 104 ALAMO-FIDDYMENT COMPLEX, 0 TO 5 PERCENT SLOPES
- 141 COMETA-FIDDYMENT COMPLEX, 1 TO 5 PERCENT SLOPES
- 146 FIDDYMENT LOAM, 1 TO 8 PERCENT SLOPES
- 147 FIDDYMENT-KASEBERG LOAMS, 2 TO 9 PERCENT SLOPES
- 182 SAN JOAQUIN-COMETA SANDY LOAMS, 1 TO 5 PERCENT SLOPES
- 195 XEROFLUVENTS, HARDPAN SUBSTRATUM









Curry Creek 100-Year-Flood Existing Depths

DEPTH (FT)

< 0.5

0.5 - 1

1 - 2

2 - 3

3 - 5

3 - 5

---- PROJECT BOUNDARY (SMUD OWNED)

---- PROJECT BOUNDARY (LEASED)

PERIMETER & INTERIOR ACCESS ROADS

SOLAR SUBSTATION COLLECTION ROUTING

BESS YARD

SOLAR + BESS SUBSTATION

COUNTRY ACRES SWITCHYARD

PV MODULES

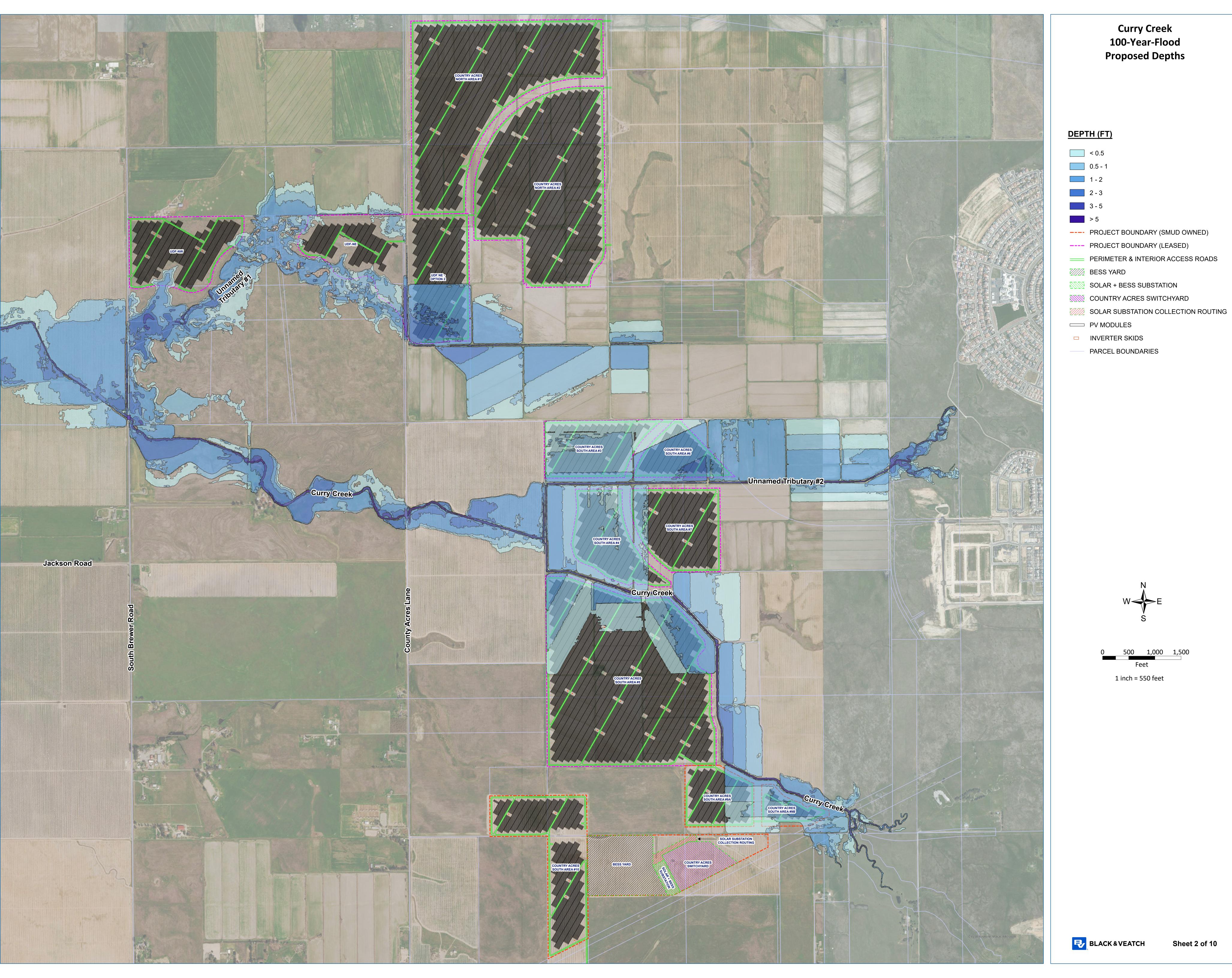
INVERTER SKIDS

PARCEL BOUNDARIES



0 500 1,000 1,500 Feet

1 inch = 550 feet



Curry Creek 100-Year-Flood **Proposed Depths**

DEPTH (FT)

< 0.5

0.5 - 1

1 - 2 2 - 3

3 - 5

> 5

---- PROJECT BOUNDARY (SMUD OWNED)

---- PROJECT BOUNDARY (LEASED)

PERIMETER & INTERIOR ACCESS ROADS

BESS YARD

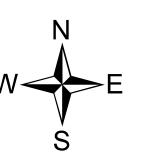
SOLAR + BESS SUBSTATION

COUNTRY ACRES SWITCHYARD

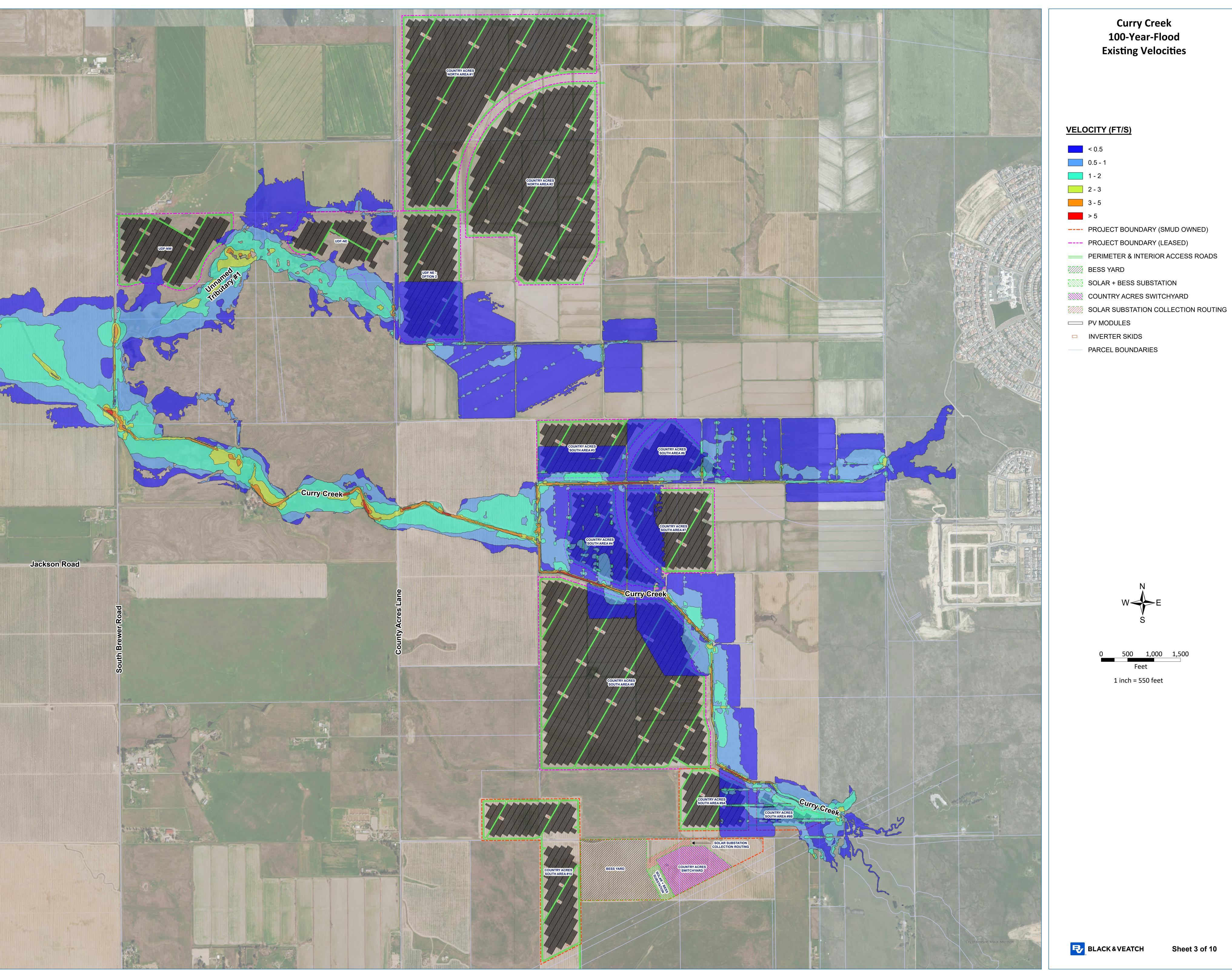
PV MODULES

INVERTER SKIDS

PARCEL BOUNDARIES



1 inch = 550 feet

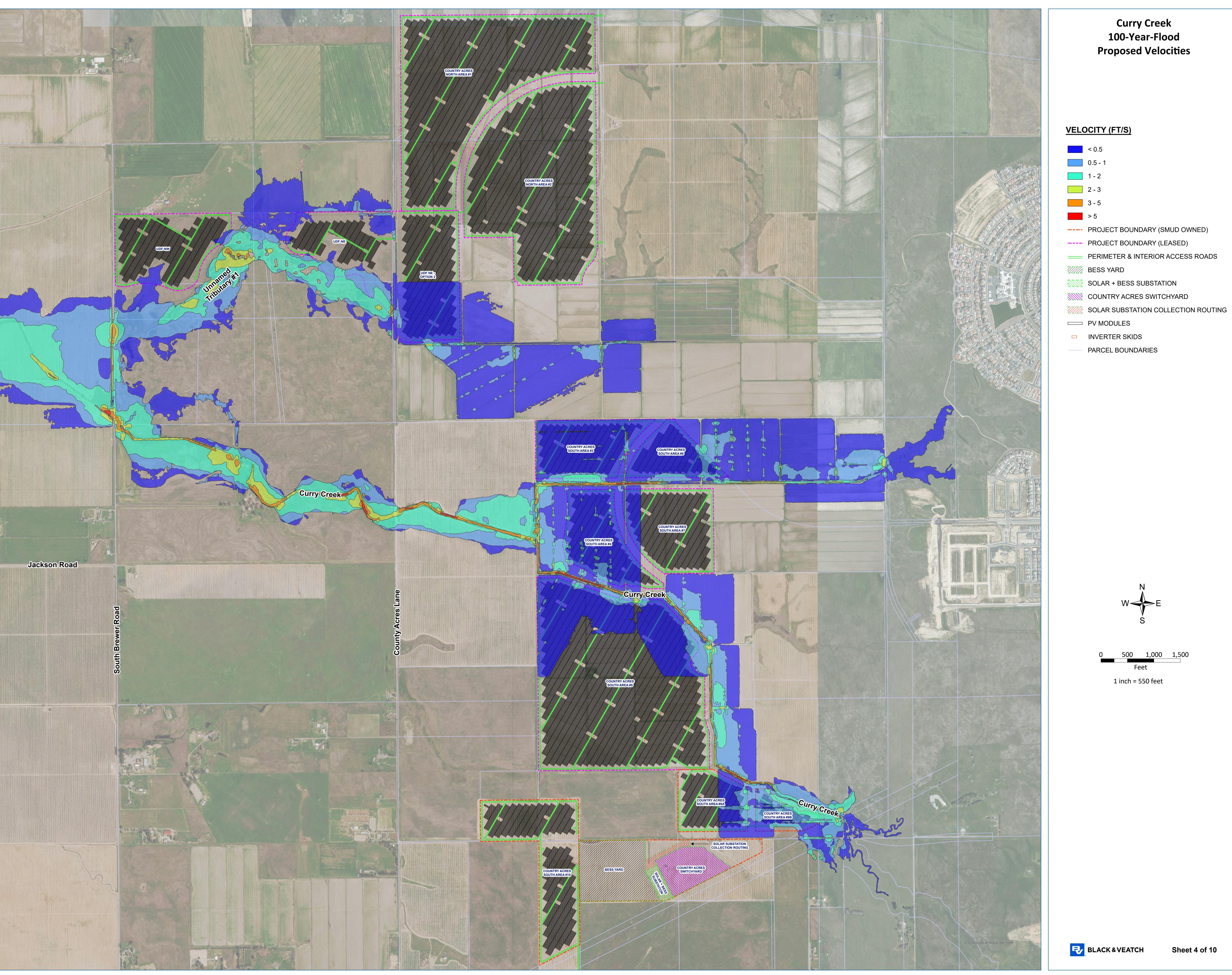


Curry Creek 100-Year-Flood **Existing Velocities**

PERIMETER & INTERIOR ACCESS ROADS

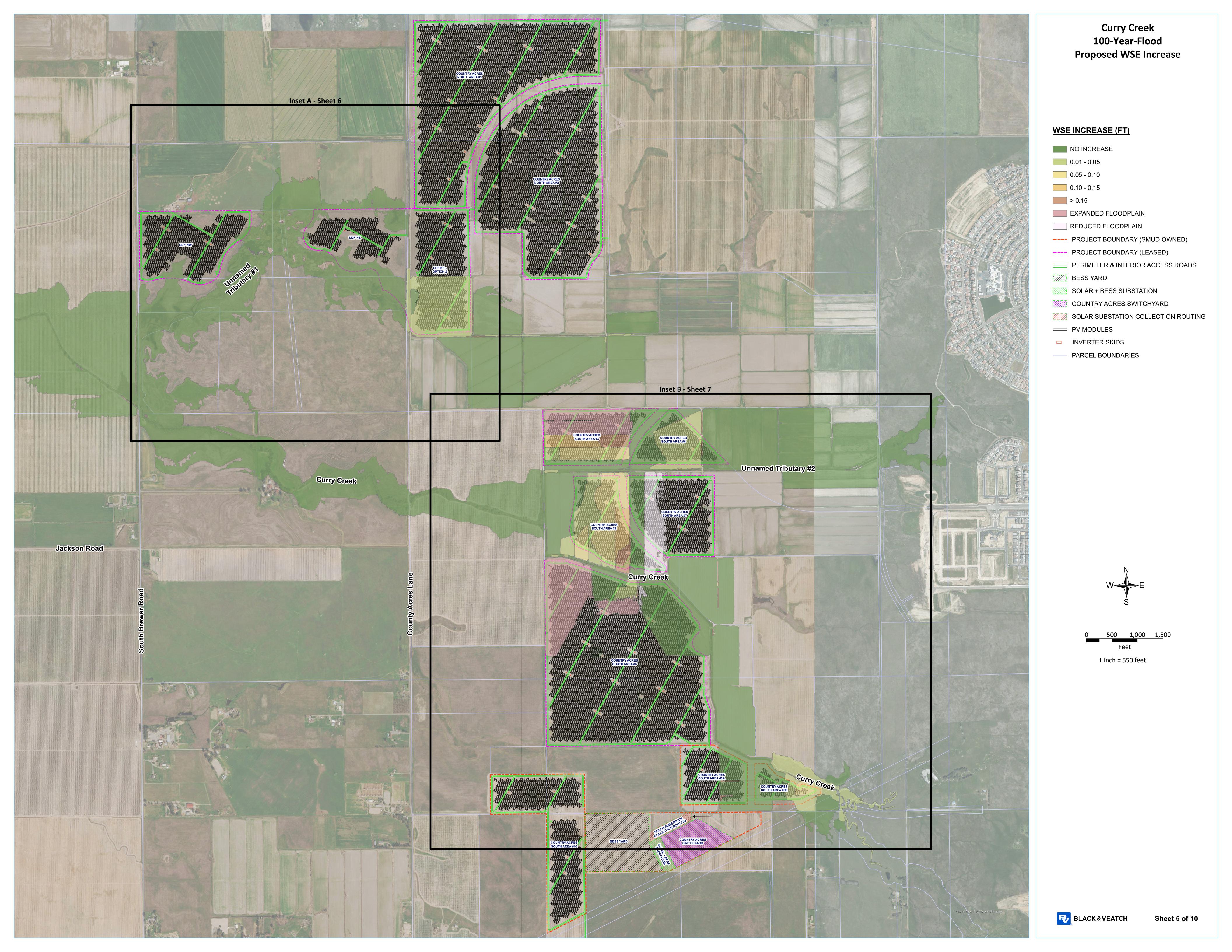
COUNTRY ACRES SWITCHYARD





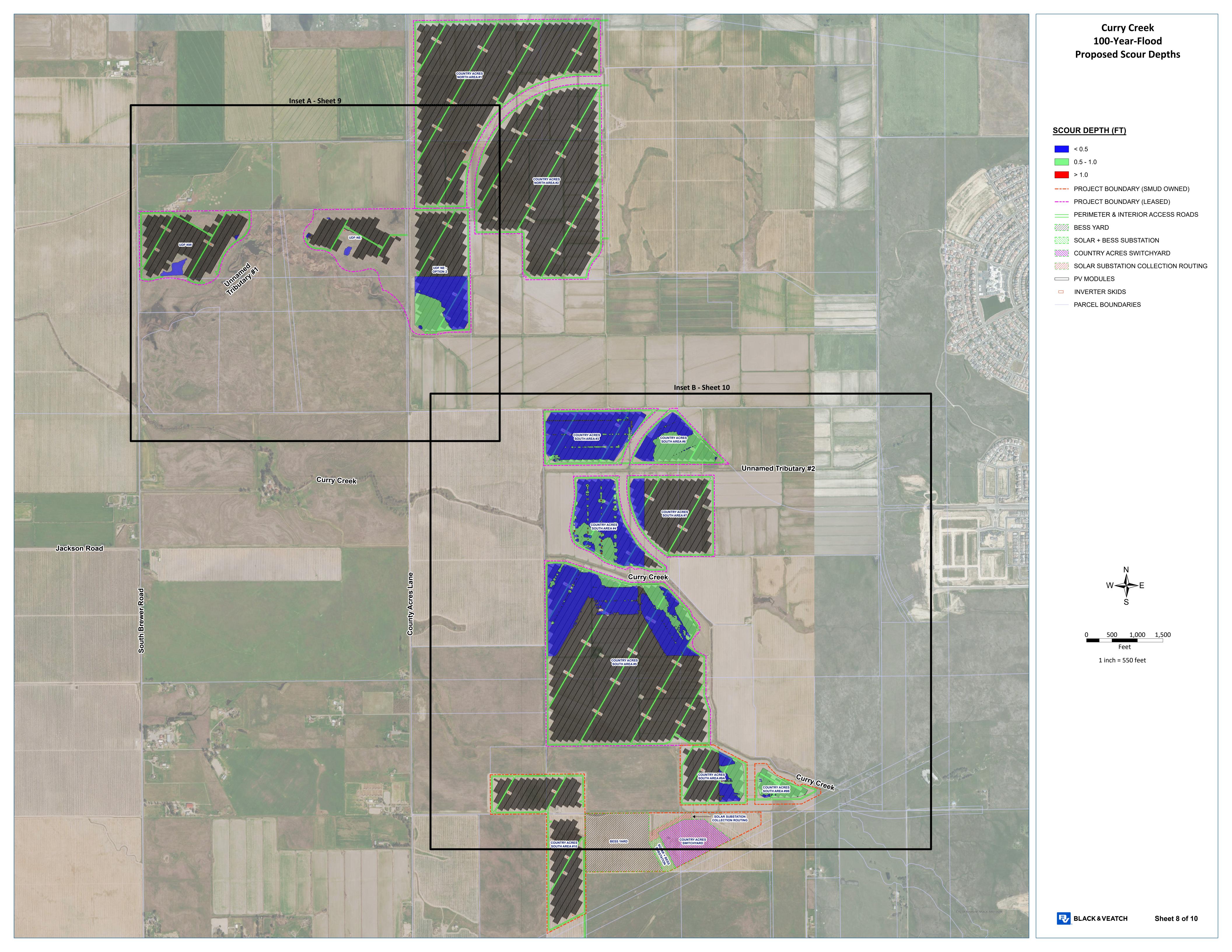
100-Year-Flood **Proposed Velocities**

PERIMETER & INTERIOR ACCESS ROADS

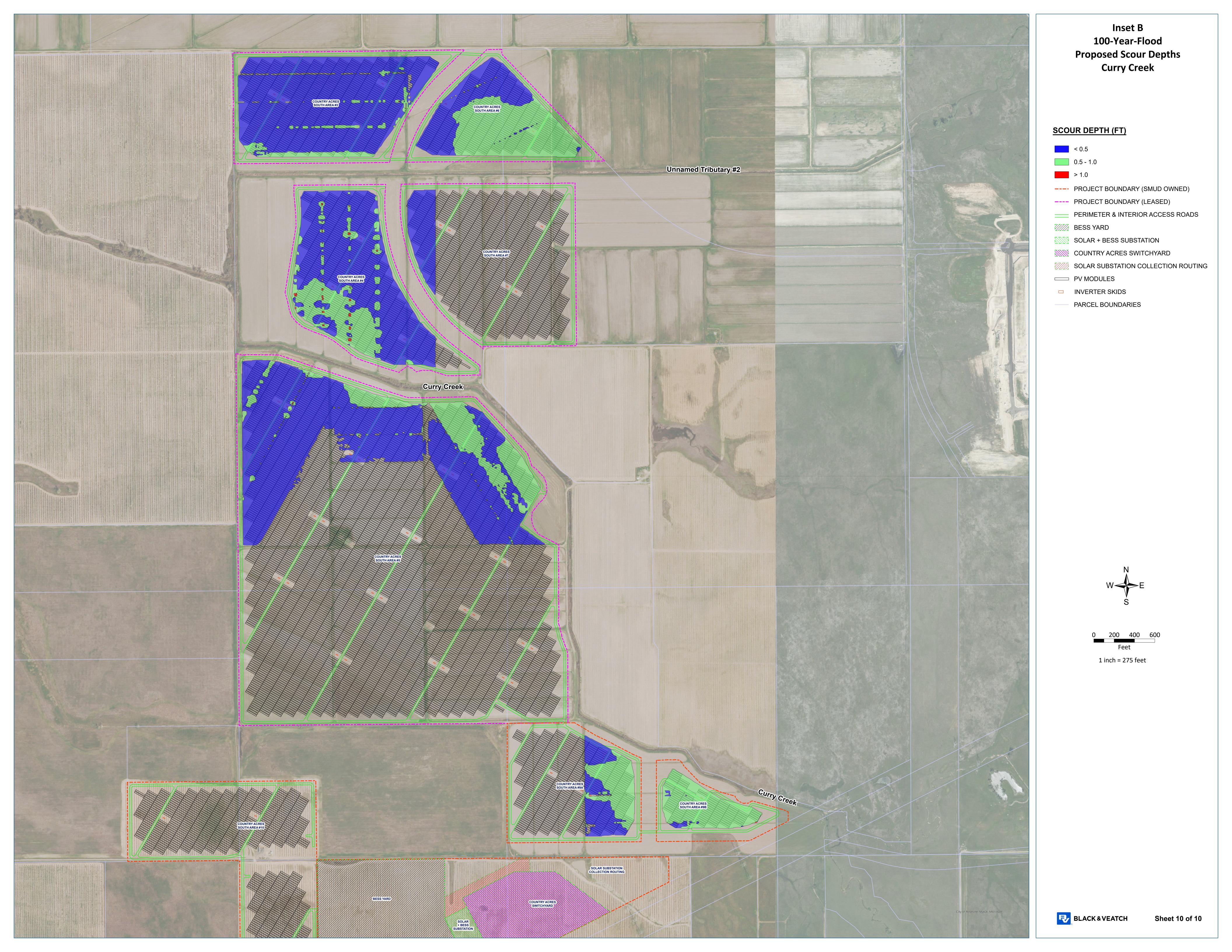












Attachment E. Kinematic Wave Transform Method Hydrology Analysis

BLACK & VEATCH E-1



CALCULATION RECORD

| Client | Client Name Sacramento Municipal Utility District Page 1 of 30 | | | | | | 30 | |
|---------------|---|-----------------|--------------------|--------|---------|------|-------------|-----|
| Projec | Project Name Country Acres Solar Study | | | | | No | 406242 | |
| Calcul | Calculation Title Kinematic Wave Analysis | | | | | | | |
| Calcul | Calculation No./File No. | | | | | | | |
| Verific | Verification Method: Check and Review Alternate Calculations | | | | | | | |
| Switch the tr | Objective: Determine the hydrologic response of one of the solar array parcels and the Substation, Switching Station and BESS Areas to the design precipitation events using the Kinematic Wave Method for the transform, as directed by Placer County. Determine the reduction in stormwater volume for the post-development condition, as compared to the pre. | | | | | | | |
| | | | | | | | | |
| | - | | nptions Requiring | | 1 | on | | |
| No. | | Assumption | <u>on</u> | Verif | ied By | | Date | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| Refer to | Page of this | calculation for | additional assumpt | tions. | | | | |
| | This Section Used for Software-Generated Calculations | | | | | | | |
| Progr | Program Name/Number HEC-HMS Version 4.6.1 | | | | | | | |
| II. | Standard B&V Application Used? Yes No If no, list approved deviation permit number below and attach approved deviation permit. | | | | | | | |
| | | | | | | | | |
| | | | Review and Ap | proval | | | | |
| _ | | | | | | | | _ |
| Rev | Prepared By | Date | Verified By | Date | Approve | d By | Da | ate |
| 0 | G. V. Johnson | 5/23/2022 | | | | | | |

| Rev | Prepared By | Date | Verified By | Date | Approved By | Date |
|-----|---------------|-----------|-------------|------|-------------|------|
| 0 | G. V. Johnson | 5/23/2022 | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |

Plant: <u>Country Acres Solar Study</u>

Address: Placer County, CA
Project No.: 406242 File No.
Title: Kinematic Wave Analysis

Table of Contents

| | | PAGE: |
|---------------|--|------------|
| Attachment A: | SMUD Country Acres Solar Study Kinematic Wave Analysis | A1 - A30 |
| | 1.0 References | А3 |
| | 2.0 Design Basis | A4 |
| | 3.0 Definition of Units and Constants | A 4 |
| | 4.0 Analysis | A4 - A29 |
| | Watershed Areas | A5 |
| | Design Precipitation Events | A5 |
| | Kinematic Wave Transform Model | A5 |
| | South #5 Parcel - Kinematic Wave Analysis | A6 - A7 |
| | Substation, Switchyard and BESS Areas - Kinematic Wave Analysis | A8 - A11 |
| | Hydrologic Model Results - Summary | A12 |
| | Hydrologic Model Results - South #5 Parcel | A13 - A18 |
| | South #5 Parcel - Pre-Development Output | A13 - A15 |
| | South #5 Parcel - Post-Development Output | A16 - A18 |
| | Hydrologic Model Results - Switchyard, Substation and BESS Areas | A19 - A27 |
| | Switch, Subst & BESS - Pre-Development Output | A19 - A21 |
| | Switch, Subst & BESS - Post-Development Output | A22 - A27 |
| | Volume Analysis | A28 - A29 |
| | 5.0 Conclusion | A30 |

Plant: <u>Country Acres Solar Study</u>

Address: Placer County, CA

Project No.: 406242 File No.

Title: Kinematic Wave Analysis

1.0 REFERENCES:

1) SMUD Country Acres Solar Study, Hydrologic Analysis, G.V. Johnson, Black & Veatch, Rev. 0, 12/17/2021.

- 2) HEC-HMS, Hydrologic Modeling System, U.S. Army Corps of Engineers, Version 4.6.1, Build: 8363 Date: 17Sep2020 DSS: 7-HK JAVA: 11.0.6
- **3)** SMUD Country Acres Solar & BESS, Substation, Switchyard, BESS Areas, Dwg No. CA-SK-0101, Rev. C, 03/30/22.
- **4)** SMUD Country Acres Solar & BESS, Overall Conceptual Site Layout, Dwg No. CA-SK-0100, Rev. D, 02/28/22.
- **5)** TR55, Urban Hydrology for Small Watersheds, U.S. Department of Agriculture, Soil Conservation Service, June 1986.
- **6)** HEC-HMS Users Manual, Selecting a Transform Method, Website accessed: 05/16/2022. Selecting a Transform Method (army.mil)
- 7) HEC-HMS Technical Reference Manual, Kinematic Wave Model, Website accessed: 05/16/22. Kinematic Wave Model (army.mil)
- **8)** Placer County Flood Control and Water Conservation District, Stormwater Management Manual, Version 3, February 1994.
- 9) West Placer Storm Water Quality Design Manual, April 2016, Revised May 2018.
- **10)** SMUD Country Acres Hydrology meeting, with representatives from SMUD, AECOM, Black & Veatch, and Placer County, May 12, 2022, 12:00 1:00 pm CDT.

Plant: Country Acres Solar Study

Address: Placer County, CA

Project No.: 406242 File No.

Title: Kinematic Wave Analysis

2.0 DESIGN BASIS:

Provide supplemental analysis, as described below, to the SMUD Country Acres Solar Study, Hydrologic Analysis, by Black & Veatch, dated 12/17/2021.

As directed by Placer County, select one of the solar array parcels and evaluate the performance of the HEC-HMS modeling by revising the transform method from the SCS Unit Hydrograph method to the Kinematic Wave transform method. (Reference 10)

Also, as directed by Placer County, revise the HEC-HMS modeling of the Substation, Switching Station, and BESS Areas to account for the updated areas, and by using the Kinematic Wave transform method. (Reference 10)

Determine the reduction in stormwater volume for the post-development condition, as compared to the pre for the entire project area. (Reference 10)

3.0 DEFINITION OF UNITS AND CONSTANTS:

cfs cubic feet per second

ac-ft acre-feet sq mi square miles sq ft square feet

hr hour in inches ft feet

ft/sec feet per second

cu-ft cubic feet

4.0 ANALYSIS:

The HEC-HMS analysis will use design parameters developed in the SMUD Country Acres Hydrologic Analysis (Reference 1), updated as required for the Kinematic Wave transform method.

Plant: <u>Country Acres Solar Study</u>

Address: Placer County, CA

Project No.: 406242 File No.

Title: Kinematic Wave Analysis

Watershed Areas:

The watershed areas for each of the parcels is provided in Reference 1, except for the BESS, Substation, and Switchyard areas, which are provided in Reference 4 and in the table below.

| Country Acres | Parcel Size | Parcel Size |
|-------------------|---------------|-------------|
| Parcel Title | (acres) | (sq miles) |
| BESS | 23.22 | 0.03628 |
| Substation | 3.65 | 0.00570 |
| <u>Switchyard</u> | <u> 19.79</u> | 0.03092 |
| Total | 46.66 | 0.07291 |

Design Precipitation Events:

Design precipitation events for this site are provided in Reference 1, as shown below.

| <u>Event</u> | Precip. (in.) |
|-------------------|---------------|
| 2-Year, 24-Hour | 1.90 |
| 10-Year, 24-Hour | 2.98 |
| 100-Year, 24-Hour | 4.25 |

Kinematic Wave Transform Model:

The Kinematic Wave Transform Model will be used in the supplemental HEC-HMS analysis based on the physical watershed properties developed in Reference 1, and the design guidance for the method provided in References 6 and 7.

The physical watershed properties, including area, flow length, slope and roughness characteristics, will be used as input data in the model.

In the Kinematic Wave Transform Model, a Plane is used to input the physical properties that the model uses to develop the composite runoff that is directed to a Subcollector. The Subcollector conveys the runoff to a Collector, which discharges to a Channel. The input parameters are similar to the parameters developed to support the SCS Unit Hydrograph method, except the roughness value for the Plane must be increased above the typical values used in the Manning's Equation for open channel flow. Also, the Plane uses the average flow length, which will be input as half the sheet flow length from Reference 1. (References 6 and 7).

Solar Array Parcel South #5 will be evaluated in this analysis.

Plant: <u>Country Acres Solar Study</u>

Address: Placer County, CA

Project No.: 406242 File No.

Title: Kinematic Wave Analysis

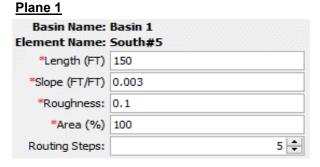
South #5 Parcel - Kinematic Wave Analysis:

Summary of Results:

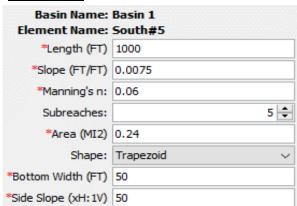
For each precipitation event, use of the Kinematic Wave transform method produced higher peak discharges than the SCS Unit Hydrograph method. Post-development discharges were lower than the corresponding pre-development discharges in response to all storm events.

| | | 2 YR Peak | 10 YR Peak | 100 YR Peak |
|-------------------------|-------------|--------------|--------------|--------------|
| Transform Method | Pre or Post | <u>(cfs)</u> | <u>(cfs)</u> | <u>(cfs)</u> |
| SCS UH | Pre | 65.4 | 109.2 | 160.7 |
| SCS UH | Post | 50.7 | 88.6 | 135.2 |
| Kinematic Wave | Pre | 73.2 | 131.1 | 201.4 |
| Kinematic Wave | Post | 53.9 | 105.3 | 168.5 |

Kinematic Wave Input Data: Pre-Development



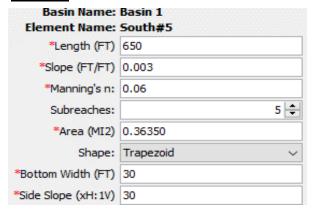
Subcollector

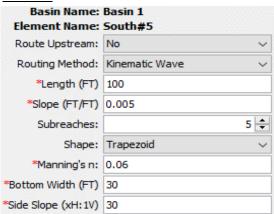


Page:

A6

Collector





Plant: <u>Country Acres Solar Study</u>

Address: Placer County, CA

Project No.: 406242 File No.

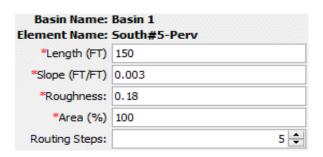
Title: Kinematic Wave Analysis

South #5 Parcel - Kinematic Wave Analysis:

Kinematic Wave Input Data: Post-Development

Shown below is the input data for the post-development HEC-HMS model for the South #5 Parcel, for the pervious portion of the watershed. The impervious Kinematic Wave input data is similar to the pervious, but the areas for the Subcollector and Collector are adjusted to reflect the total impervious area. The 100 foot channel length represents the distance from the parcel to the Curry Creek channel.

Plane 1



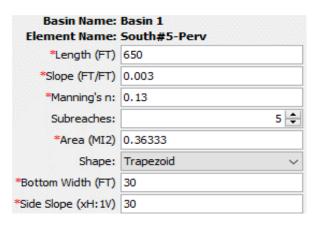
Subcollector

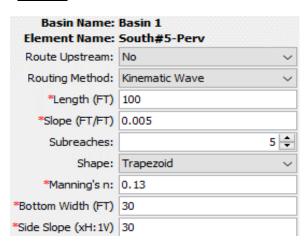
| Basin Name: | Basin 1 |
|----------------------|--------------|
| Element Name: | South#5-Perv |
| *Length (FT) | 1000 |
| *Slope (FT/FT) | 0.0075 |
| *Manning's n: | 0.13 |
| Subreaches: | 5 🕏 |
| *Area (MI2) | 0.24 |
| Shape: | Trapezoid ~ |
| *Bottom Width (FT) | 50 |
| *Side Slope (xH: 1V) | 50 |

Page:

A7

Collector





Plant: <u>Country Acres Solar Study</u>

Address: Placer County, CA

Project No.: 406242 File No.

Title: Kinematic Wave Analysis

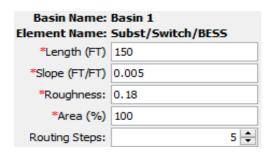
Substation, Switchyard and BESS Areas - Kinematic Wave Analysis:

Summary of Results:

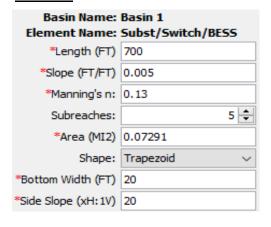
Kinematic Wave results aren't compared to the SCS UH results from Reference 1, because of changes to the watershed areas. Post-development discharges were lower than the corresponding pre-development discharges in response to all storm events. Time-of-concentration flow paths and physical parameters from Reference 1 are still applicable with the revised subbasin areas.

| | | 2 YR Peak | 10 YR Peak | 100 YR Peak |
|-------------------------|-------------|--------------|--------------|--------------|
| Transform Method | Pre or Post | <u>(cfs)</u> | <u>(cfs)</u> | <u>(cfs)</u> |
| Kinematic Wave | Pre | 8.9 | 20.0 | 32.4 |
| Kinematic Wave | Post | 7.0 | 13.1 | 22.7 |

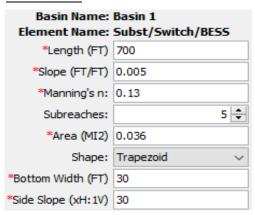
<u>Kinematic Wave Input Data: Pre-Development</u> Plane 1



Collector

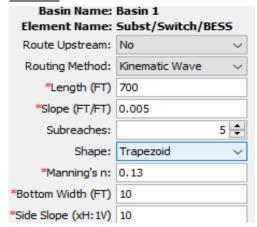


Subcollector



Page:

A8



Plant: <u>Country Acres Solar Study</u>

Address: Placer County, CA

Project No.: 406242 File No.

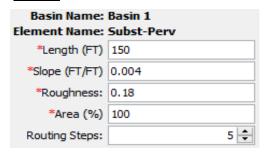
Title: Kinematic Wave Analysis

Substation, Switchyard and BESS Areas - Kinematic Wave Analysis:

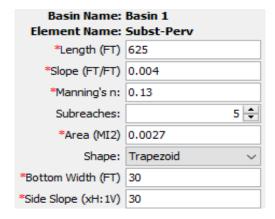
Kinematic Wave Input Data: Post-Development Substation

Shown below is the input data for the post-development HEC-HMS model for the Substation, for the pervious portion of the watershed. The impervious Kinematic Wave input data is similar to the pervious, but the areas for the Subcollector and Collector are adjusted to reflect the total impervious area.

Plane 1



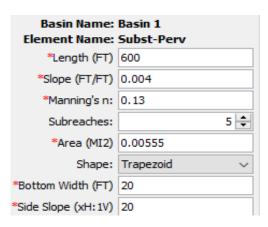
Subcollector

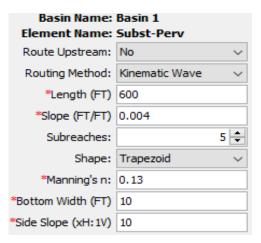


Page:

A9

Collector





Plant: <u>Country Acres Solar Study</u>

Address: Placer County, CA

Project No.: 406242 File No.

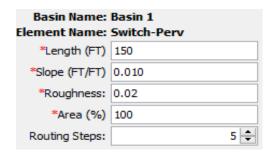
Title: Kinematic Wave Analysis

Substation, Switchyard and BESS Areas - Kinematic Wave Analysis:

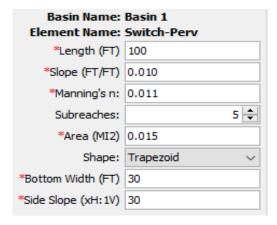
Kinematic Wave Input Data: Post-Development Switchyard

Shown below is the input data for the post-development HEC-HMS model for the Switchyard, for the pervious portion of the watershed. The impervious Kinematic Wave input data is similar to the pervious, but the areas for the Subcollector and Collector are adjusted to reflect the total impervious area.

Plane 1



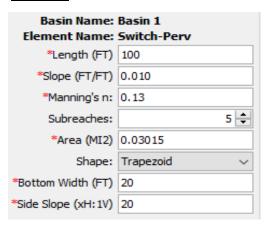
Subcollector

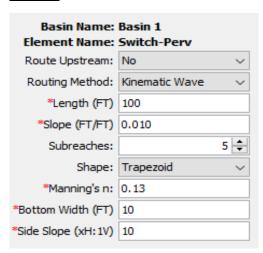


Page:

A10

Collector





Plant: <u>Country Acres Solar Study</u>

Address: Placer County, CA

Project No.: 406242 File No.

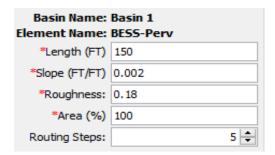
Title: Kinematic Wave Analysis

Substation, Switchyard and BESS Areas - Kinematic Wave Analysis:

Kinematic Wave Input Data: Post-Development BESS Area

Shown below is the input data for the post-development HEC-HMS model for the BESS Area, for the pervious portion of the watershed. The impervious Kinematic Wave input data is similar to the pervious, but the areas for the Subcollector and Collector are adjusted to reflect the total impervious area.

Plane 1



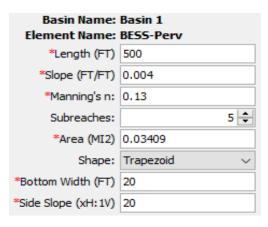
Subcollector

| Basin Name: Element Name: | |
|------------------------------|-------------|
| *Length (FT) | 475 |
| *Slope (FT/FT) | 0.004 |
| *Manning's n: | 0.13 |
| Subreaches: | 5 💠 |
| *Area (MI2) | 0.017 |
| Shape: | Trapezoid ~ |
| *Bottom Width (FT) | 30 |
| *Side Slope (xH: 1V) | 30 |

A11

Page:

Collector



| Basin Name: Element Name: | |
|------------------------------|------------------|
| Route Upstream: | No ~ |
| Routing Method: | Kinematic Wave ∨ |
| *Length (FT) | 500 |
| *Slope (FT/FT) | 0.004 |
| Subreaches: | 5 💠 |
| Shape: | Trapezoid ~ |
| *Manning's n: | 0.13 |
| *Bottom Width (FT) | 10 |
| *Side Slope (xH:1V) | 10 |

Plant: <u>Country Acres Solar Study</u>

Address: Placer County, CA

Project No.: 406242 File No.

Title: Kinematic Wave Analysis

HYDROLOGIC MODEL RESULTS:

Solar array parcel South #5 was analyzed using the Kinematic Wave Transform Method, to compare the results to the use of the SCS Unit Hydrograph Transform Method used in the Hydrology Analysis. Results for each method are provided in the table below.

| | | 2 YR Peak | 10 YR Peak | 100 YR Peak |
|-------------------------|-------------|--------------|--------------|--------------|
| Transform Method | Pre or Post | <u>(cfs)</u> | <u>(cfs)</u> | <u>(cfs)</u> |
| SCS UH | Pre | 65.4 | 109.2 | 160.7 |
| SCS UH | Post | 50.7 | 88.6 | 135.2 |
| Kinematic Wave | Pre | 73.2 | 131.1 | 201.4 |
| Kinematic Wave | Post | 53.9 | 105.3 | 168.5 |

For all events, peak discharges using the Kinemative Wave method exceed peak discharges using the SCS UH method. The percent increase gets larger as the events become more extreme. In response to the 2-Year event, peak discharges with the Kinematic Wave method are roughly 10 percent greater than with the SCS UH method; however, in response to the 100-Year event, the Kinematic Wave peak discharges are 25 percent greater than with the SCS UH method.

The post-development response in comparison to the pre is very similar for both methods. With the Kinematic Wave method predicting slightly more reduction of the post-development peak discharge as compared to the pre. Both models meet the requirement that post-development peak discharges do not exceed the pre.

The Switchyard, Substation, and BESS areas were analyzed using the Kinematic Wave Transform Method. As required, post-development peak discharges are less than the corresponding pre-development peak discharge. Results are provided in the table below.

| | | 2 YR Peak | 10 YR Peak | 100 YR Peak | |
|-------------------------|-------------|--------------|--------------|--------------|--|
| Transform Method | Pre or Post | <u>(cfs)</u> | <u>(cfs)</u> | <u>(cfs)</u> | |
| Kinematic Wave | Pre | 8.9 | 20.0 | 32.4 | |
| Kinematic Wave | Post | 7.0 | 13.1 | 22.7 | |

The detention basins provided in the Hydrology Analysis were included with this modeling. In the BESS area, 0.6 acre-feet of storage is predicted in response to the 100-Year event, with a peak stage of 78.7 feet. In the Switch area, 0.2 acre-feet of storage is predicted in response to the 100-Year event, with a peak stage of 84.6 feet. Embankment crest elevations will be set to provide a minimum of 2 feet of freeboard in response to the 100-Year event.

HEC-HMS results for the modeling of parcel South #5 and the Substation, Switchyard and BESS areas are provided on Pages A13 - A27.

Plant: Country Acres Solar Study

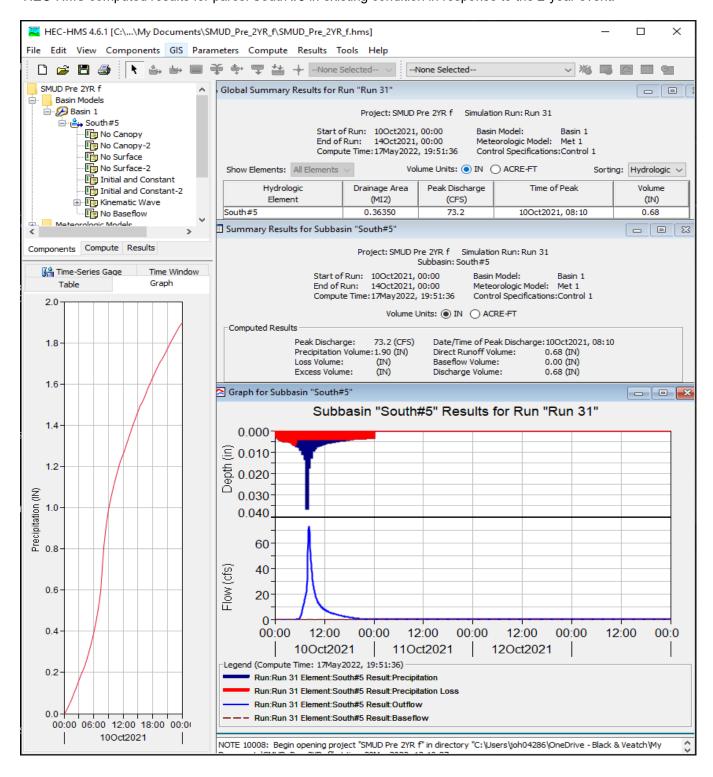
Address: Placer County, CA

Project No.: <u>406242</u> File No.

Title: Kinematic Wave Analysis

HYDROLOGIC MODEL RESULTS - Parcel South #5:

HEC-HMS computed results for parcel South #5 in existing condition in response to the 2-year event.



Plant: Country Acres Solar Study

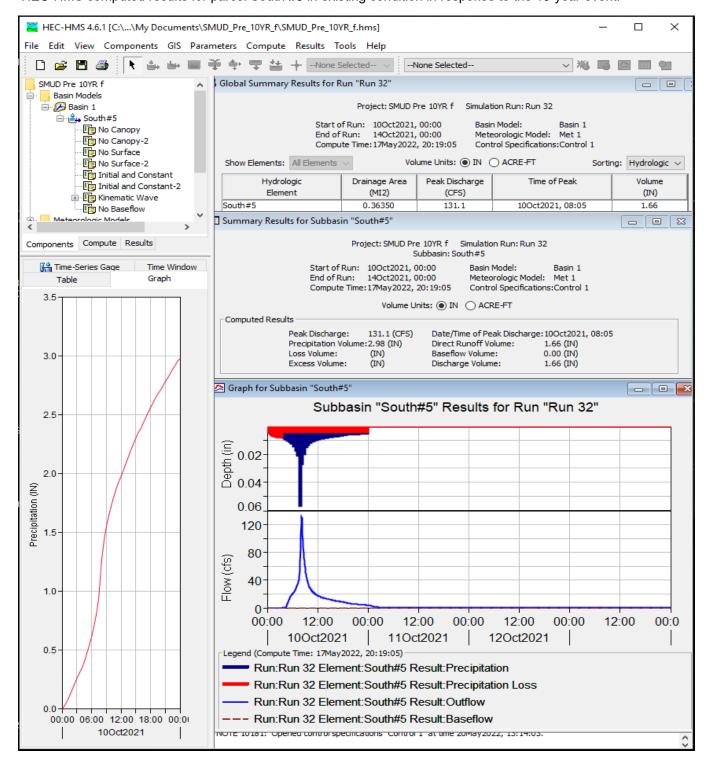
Address: Placer County, CA

Project No.: <u>406242</u> File No.

Title: Kinematic Wave Analysis

HYDROLOGIC MODEL RESULTS - Parcel South #5:

HEC-HMS computed results for parcel South #5 in existing condition in response to the 10-year event.



Plant: <u>Country Acres Solar Study</u>

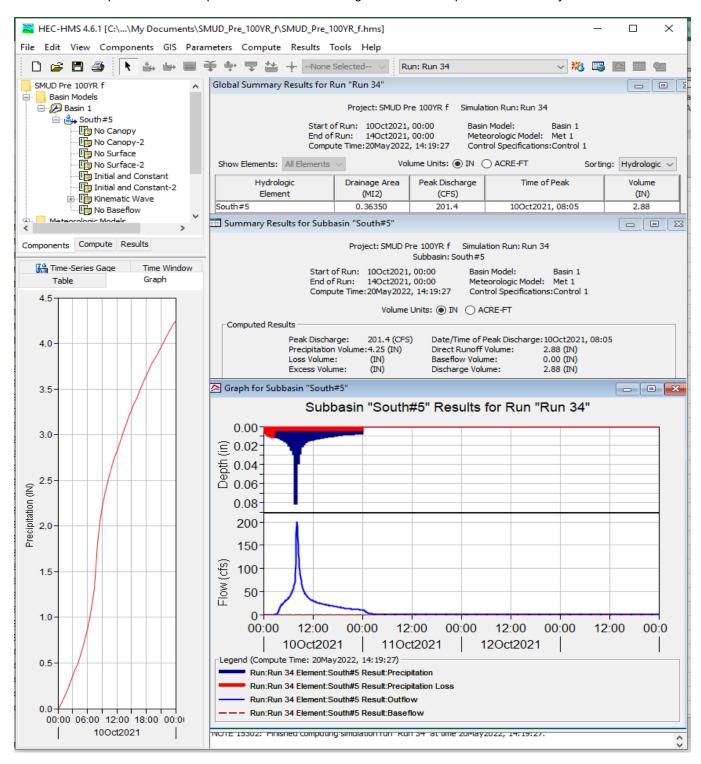
Address: Placer County, CA

Project No.: 406242 File No.

Title: Kinematic Wave Analysis

HYDROLOGIC MODEL RESULTS - Parcel South #5:

HEC-HMS computed results for parcel South #5 in existing condition in response to the 100-year event.



Plant: <u>Country Acres Solar Study</u>

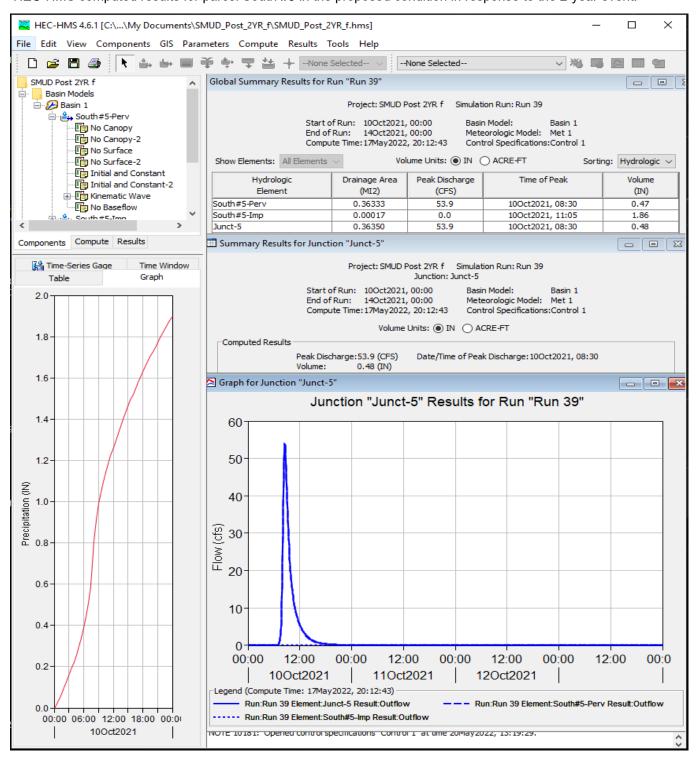
Address: Placer County, CA

Project No.: 406242 File No.

Title: Kinematic Wave Analysis

HYDROLOGIC MODEL RESULTS - Parcel South #5:

HEC-HMS computed results for parcel South #5 in the proposed condition in response to the 2-year event.



Plant: Country Acres Solar Study

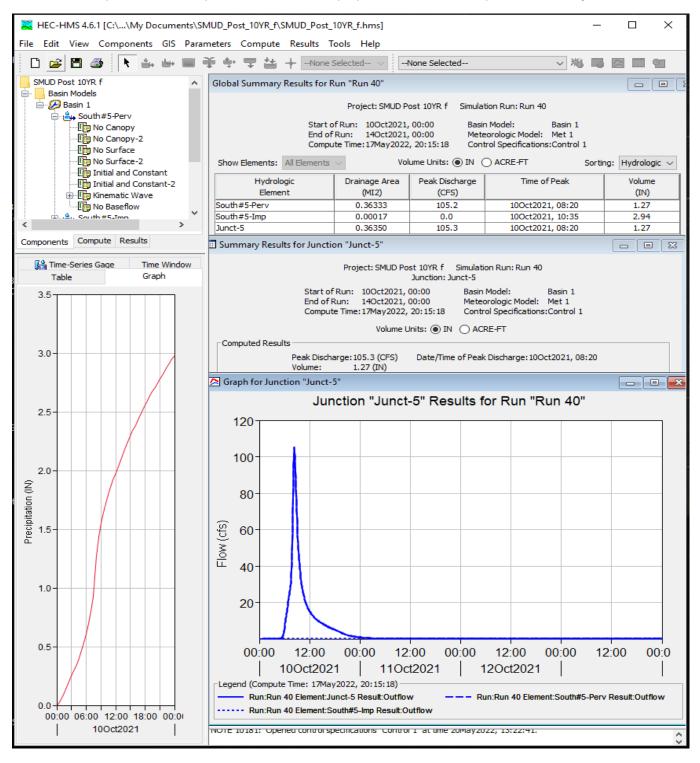
Address: Placer County, CA

Project No.: 406242 File No.

Title: Kinematic Wave Analysis

HYDROLOGIC MODEL RESULTS - Parcel South #5:

HEC-HMS computed results for parcel South #5 in the proposed condition in response to the 10-year event.



Plant: Country Acres Solar Study

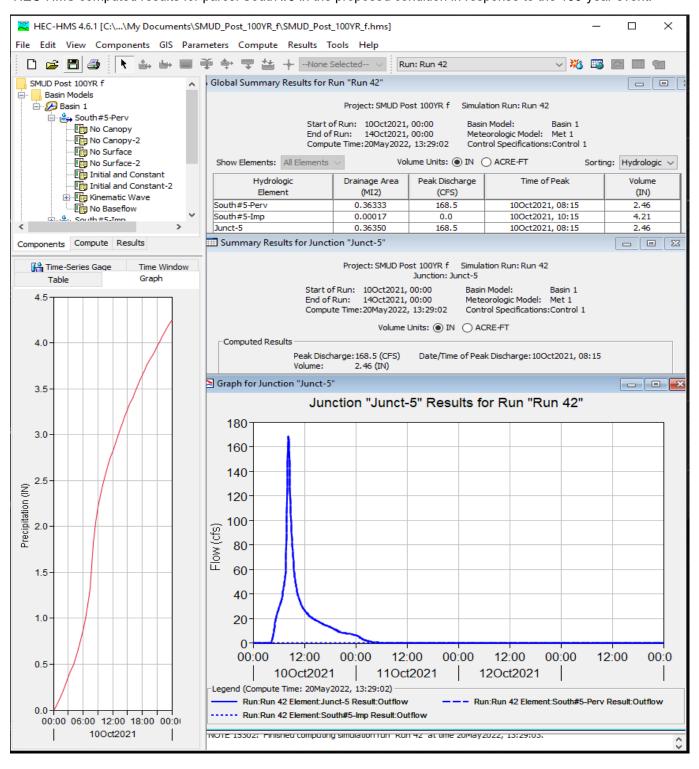
Address: Placer County, CA

Project No.: 406242 File No.

Title: Kinematic Wave Analysis

HYDROLOGIC MODEL RESULTS - Parcel South #5:

HEC-HMS computed results for parcel South #5 in the proposed condition in response to the 100-year event.



Plant: Country Acres Solar Study

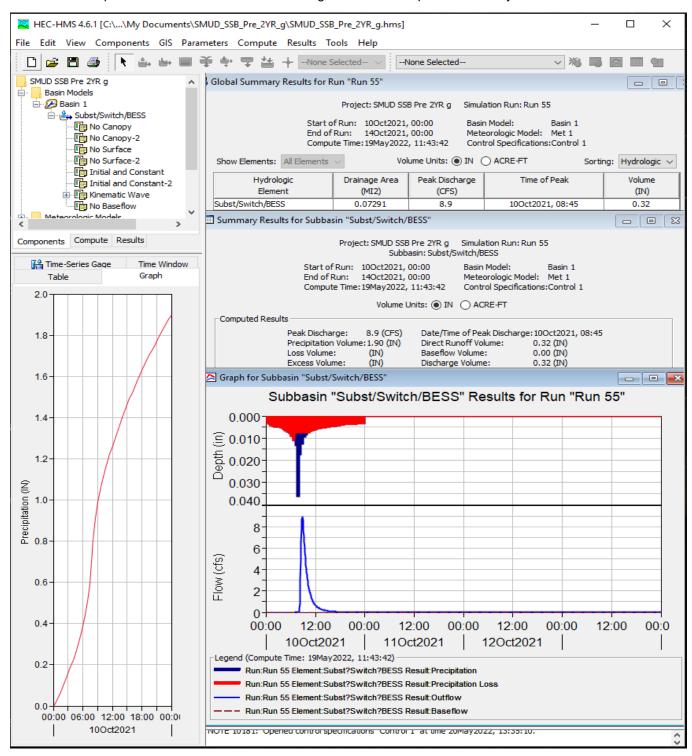
Address: Placer County, CA

Project No.: <u>406242</u> File No.

Title: Kinematic Wave Analysis

HYDROLOGIC MODEL RESULTS - Switchyard, Substation, and BESS Areas:

HEC-HMS computed results for the site in its existing condition in response to the 2-year event.



Plant: Country Acres Solar Study

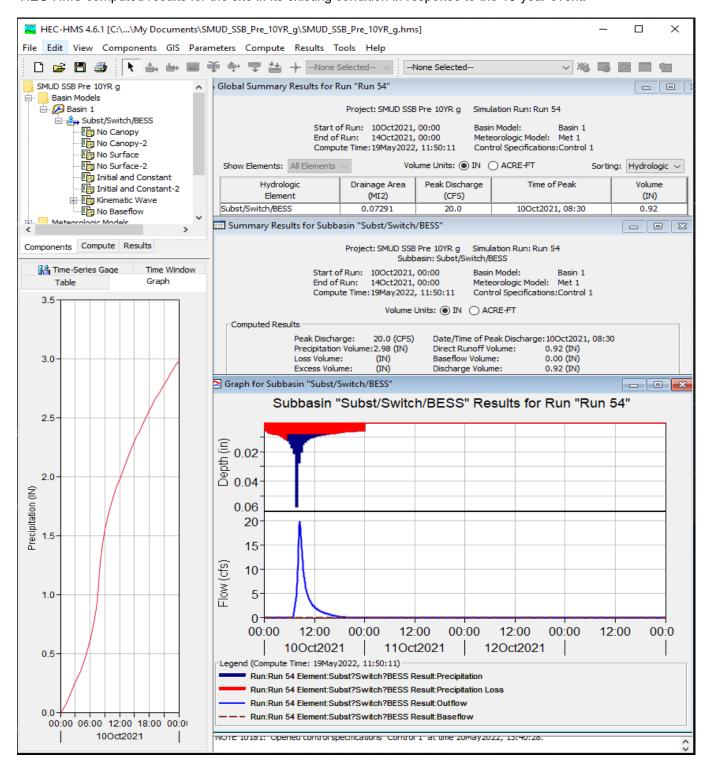
Address: Placer County, CA

Project No.: 406242 File No.

Title: Kinematic Wave Analysis

HYDROLOGIC MODEL RESULTS - Switchyard, Substation, and BESS Areas:

HEC-HMS computed results for the site in its existing condition in response to the 10-year event.



Plant: Country Acres Solar Study

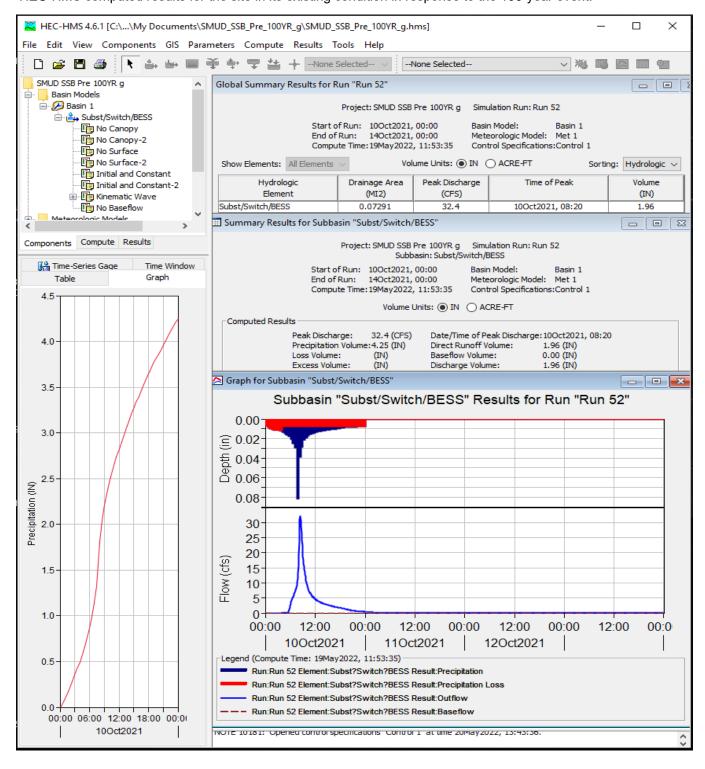
Address: Placer County, CA

Project No.: <u>406242</u> File No.

Title: Kinematic Wave Analysis

HYDROLOGIC MODEL RESULTS - Switchyard, Substation, and BESS Areas:

HEC-HMS computed results for the site in its existing condition in response to the 100-year event.



Plant: Country Acres Solar Study

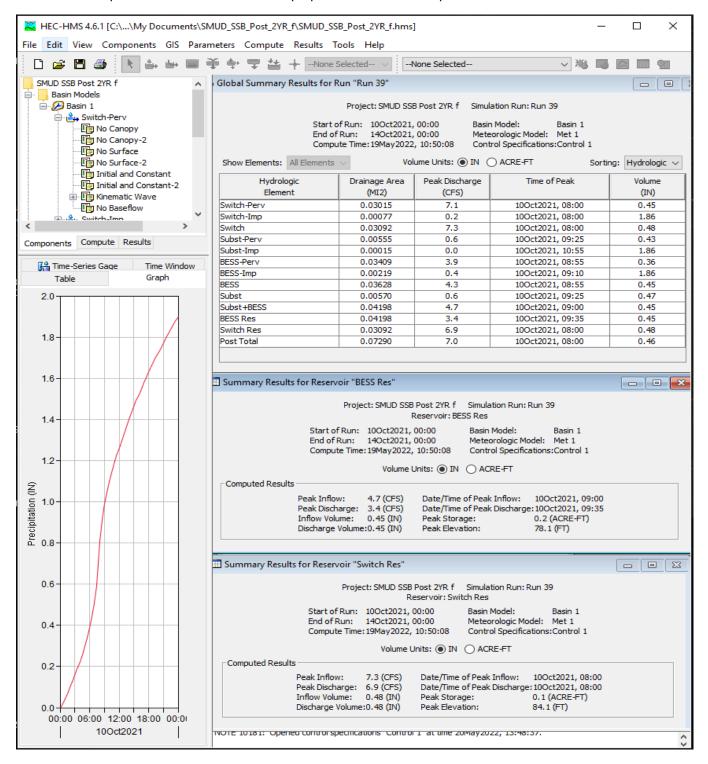
Address: Placer County, CA

Project No.: <u>406242</u> File No.

Title: Kinematic Wave Analysis

HYDROLOGIC MODEL RESULTS - Switchyard, Substation, and BESS Areas:

HEC-HMS computed results for the site in the proposed condition in response to the 2-YR event.



Plant: <u>Country Acres Solar Study</u>

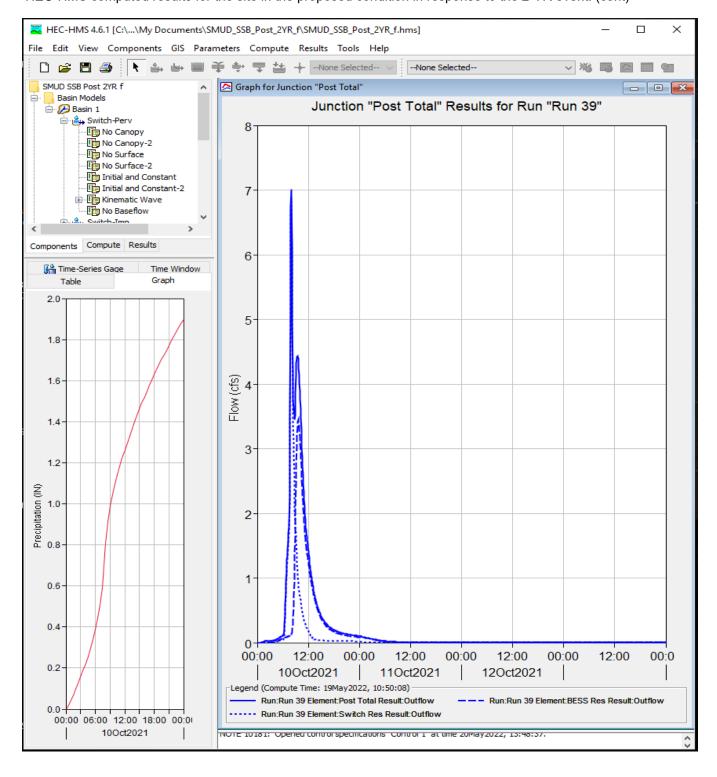
Address: Placer County, CA

Project No.: 406242 File No.

Title: Kinematic Wave Analysis

HYDROLOGIC MODEL RESULTS - Switchyard, Substation, and BESS Areas:

HEC-HMS computed results for the site in the proposed condition in response to the 2-YR event. (cont)



Plant: Country Acres Solar Study

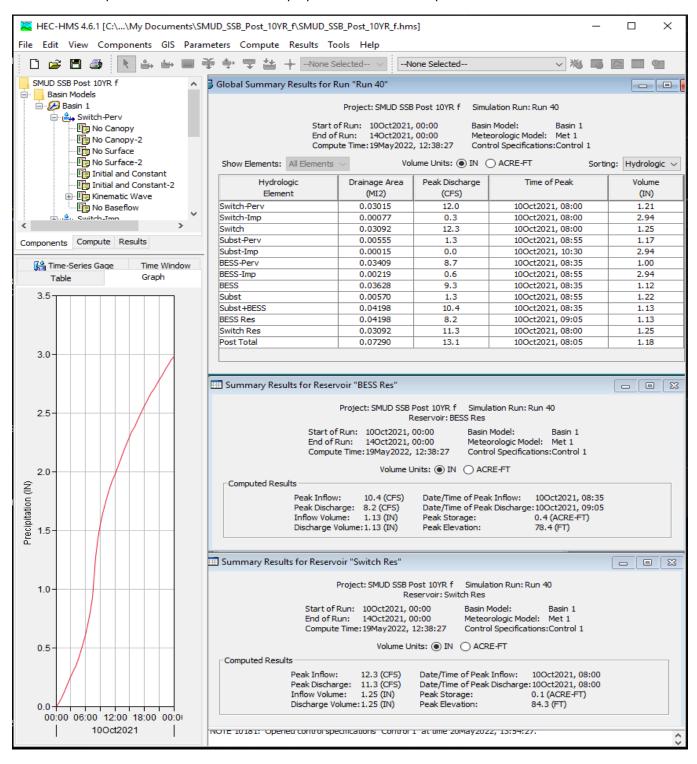
Address: Placer County, CA

Project No.: 406242 File No.

Title: Kinematic Wave Analysis

HYDROLOGIC MODEL RESULTS - Switchyard, Substation, and BESS Areas:

HEC-HMS computed results for the site in the proposed condition in response to the 10-YR event.



Plant: Country Acres Solar Study

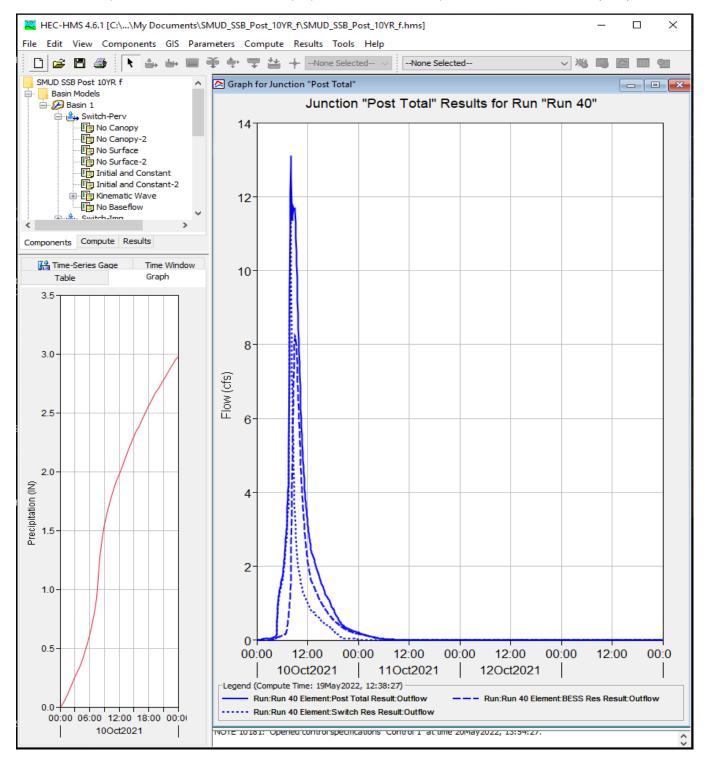
Address: Placer County, CA

Project No.: 406242 File No.

Title: Kinematic Wave Analysis

HYDROLOGIC MODEL RESULTS - Switchyard, Substation, and BESS Areas:

HEC-HMS computed results for the site in the proposed condition in response to the 10-YR event. (cont)



Plant: Country Acres Solar Study

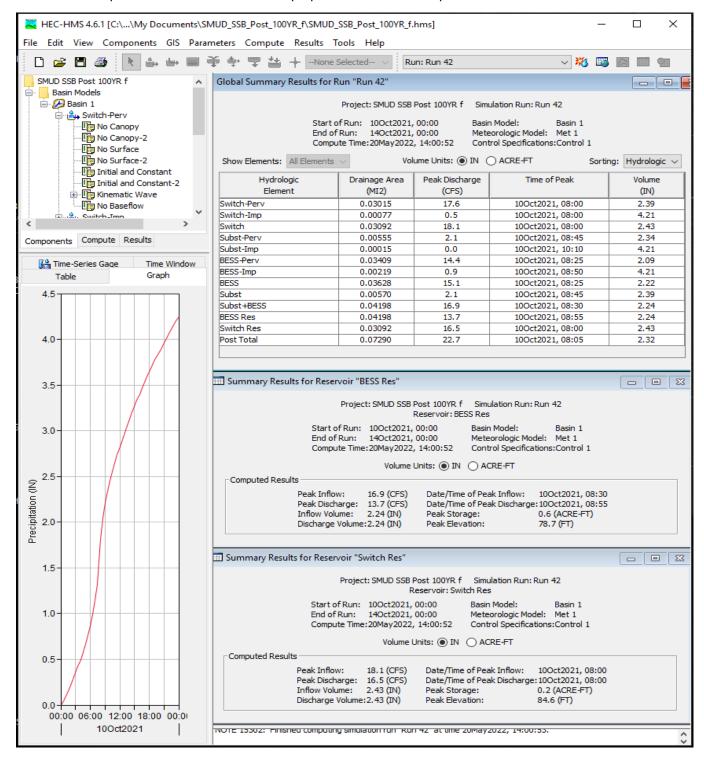
Address: Placer County, CA

Project No.: <u>406242</u> File No.

Title: Kinematic Wave Analysis

HYDROLOGIC MODEL RESULTS - Switchyard, Substation, and BESS Areas:

HEC-HMS computed results for the site in the proposed condition in response to the 100-YR event.



Plant: <u>Country Acres Solar Study</u>

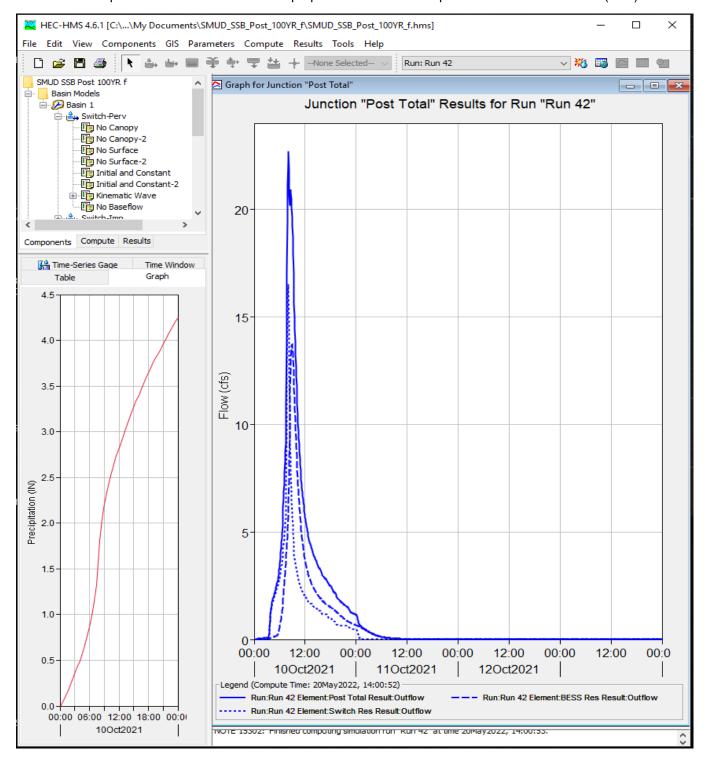
Address: Placer County, CA

Project No.: 406242 File No.

Title: Kinematic Wave Analysis

HYDROLOGIC MODEL RESULTS - Switchyard, Substation, and BESS Areas:

HEC-HMS computed results for the site in the proposed condition in response to the 100-YR event. (cont)



Plant: <u>Country Acres Solar Study</u>

Address: Placer County, CA

Project No.: 406242 File No.

Title: Kinematic Wave Analysis

VOLUME ANALYSIS

The following volume analysis is based on HEC-HMS model output data from the SMUD Hydrologic Analysis (Reference 1) and from this calculation. Parcel data is from Reference 1, and data for the Substation, Switchyard, and BESS areas is from this calculation, which accounts for the revised areas. HEC-HMS model output data is provided on Pages A55 - A72 of the Hydrologic Analysis, and Pages A19 - A27 of this analysis. Runoff volume is provided for each area in inches, which can be converted to acre-feet by converting the inches to feet and multiplying by the area in acres. All volumes are provided in the Global Summary section of the HEC-HMS output.

For the parcels, the pre-development volume is listed as "Pre Total", and the post-development volume is listed as "Post Total". For the Substation, Switching Stations and BESS Areas, the pre-development volume is listed as "Subst/Switch/BESS", and the post-development volume is listed as "Post Total". The page where each volume is located is provided in the tables below. The areas are from the Hydrologic Analysis, Page A7, and this calculation, Page A5. The Volume Reduction for each event listed below is the amount the post volume is less than the pre.

| EVENT: | 2 | YEAR |
|--------|---|------|
| | | |

| | | Volume | Calc | Area | Volume | |
|-------------------|-------------|-------------|--------------------|-------------|-------------------|---|
| Location: | Pre or Post | <u>(in)</u> | <u>Page</u> | <u>(ac)</u> | (ac-ft) | |
| Parcels | Pre | 0.61 | A55 | 1064.85 | 54.13 | |
| Subst/Switch/BESS | Pre | 0.32 | A19 | 46.66 | 1.24 | |
| Parcels | Post | 0.47 | A58 | 1064.85 | 41.71 | |
| Subst/Switch/BESS | Post | 0.46 | A22 | 46.66 | <u>1.79</u> | |
| | | | Volume Reduction = | | <u>11.88</u> ac-f | t |

EVENT: 10 YEAR

| | | Volume | Calc | Area | Volume |
|-------------------|-------------|-------------|-------------|--------------------|----------------|
| Location: | Pre or Post | <u>(in)</u> | <u>Page</u> | <u>(ac)</u> | <u>(ac-ft)</u> |
| Parcels | Pre | 1.51 | A56 | 1064.85 | 133.99 |
| Subst/Switch/BESS | Pre | 0.92 | A20 | 46.66 | 3.58 |
| Parcels | Post | 1.28 | A60 | 1064.85 | 113.58 |
| Subst/Switch/BESS | Post | 1.18 | A24 | 46.66 | <u>4.59</u> |
| | | | Volume F | <u>19.40</u> ac-ft | |

Plant: <u>Country Acres Solar Study</u>

Address: Placer County, CA

Project No.: 406242 File No.

Title: Kinematic Wave Analysis

VOLUME ANALYSIS (continued)

EVENT: 100 YEAR

| | | Volume | Calc | Area | Volume | |
|-------------------|-------------|-------------|--------------------|-------------|------------------|----|
| Location: | Pre or Post | <u>(in)</u> | <u>Page</u> | <u>(ac)</u> | <u>(ac-ft)</u> | |
| Parcels | Pre | 2.71 | A57 | 1064.85 | 240.48 | |
| Subst/Switch/BESS | Pre | 1.96 | A21 | 46.66 | 7.62 | |
| Parcels | Post | 2.47 | A62 | 1064.85 | 219.18 | |
| Subst/Switch/BESS | Post | 2.32 | A26 | 46.66 | 9.02 | |
| | | | Volume Reduction = | | <u>19.90</u> ac- | ft |

Plant: <u>Country Acres Solar Study</u>

Address: Placer County, CA

Project No.: <u>406242</u> File No.

Title: Kinematic Wave Analysis

5.0 CONCLUSION:

The SMUD Country Acres Kinematic Wave Analysis provides the supplemental analysis requested by Placer County.

Solar array parcel South #5 was analyzed using the Kinematic Wave Transform Method, to compare the results to the use of the SCS Unit Hydrograph Transform Method used in the Hydrology Analysis. Using the Kinematic Wave Transform method resulted in higher peak discharges as compared to the SCS UH method. Post-development peak discharges continued to be less than the corresponding pre-development peak discharge in response to all storm events. Detailed discussion of the results is provided on Page A12 of this calculation.

The Switchyard, Substation, and BESS areas were also analyzed using the Kinematic Wave Transform Method. As required, post-development peak discharges were less than the corresponding pre-development peak discharge, in response to all storm events.

The detention basins provided in the Hydrology Analysis were included with this modeling. In the BESS area, 0.6 acre-feet of storage was predicted in response to the 100-Year event, with a peak stage of 78.7 feet. In the Switch area, 0.2 acre-feet of storage was predicted in response to the 100-Year event, with a peak stage of 84.6 feet. Embankment crest elevations will be set to provide a minimum of 2 feet of freeboard in response to the 100-Year event, as directed by Placer County. Detailed discussion of the results is provided on Page A12 of this calculation.

An analysis of the total stormwater volume discharged from the site in response to the design precipitation events is provided on Pages A28 - A29 of this calculation. For the entire project, post-development runoff volume is less than pre-development volume by a total of 11.88 acre-feet, 19.40 acre-feet, and 19.90 acre-feet, in response to the 2, 10, and 100-Year events, respectively.