Appendix A – Agricultural Farmland Modeling Detail and Source Data Summary

FMMP Data was merged for all 8 SJV counties. The resulting dataset's FMMP classifications were then extracted to create two datasets, one containing prime farmland, farmland of statewide importance, and unique farmland. The other dataset contained grazing lands, local farmland, non-agricultural and natural vegetation, semi-agricultural and rural commercial lands, vacant or disturbed lands, and areas that were not mapped. Classifications that were not included from FMMP for the second dataset include water, confined animal agriculture, rural residential land, and urban & built up land.

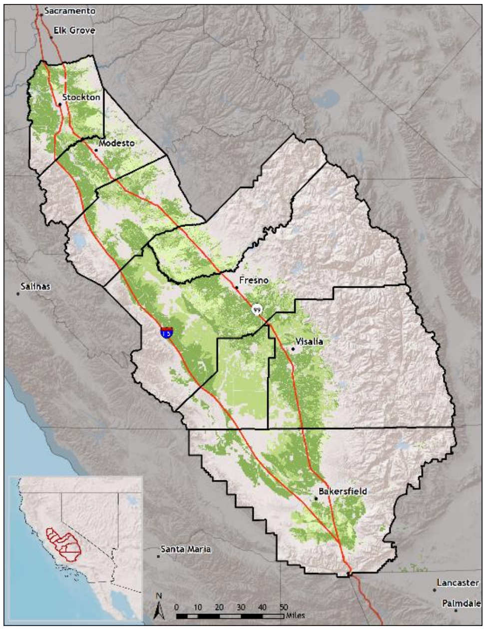
The first dataset containing prime farmland, farmland of statewide importance, and unique farmland was then unioned with the citrus areas polygon (that had been converted from a raster), the excellent and good groundwater recharge class areas, and the areas that had both moderately or strongly saline areas **and** poor, very poor, non-agricultural, or not applicable for storie index classes. Using the classification definitions above, the resulting attribute table was queried to create the final agricultural farmland classifications for the top 4 classes (rare priority agricultural areas, priority agricultural areas, important agricultural areas, and potential important agricultural areas).

The second dataset containing all areas that were NOT prime farmland, farmland of statewide importance, or unique farmland were unioned with areas that had both moderately or strongly saline areas **and** poor, very poor, non-agricultural, or not applicable for storie index classes. The westlands water district area was unioned with all salinity impaired soils (slightly, moderately, and strongly). Both datasets (NOT prime, statewide, or unique and WWD drainage impaired lands) attribute tables were queried and given final classifications using the above classifications definitions. The westlands water district impaired drainage area was then erased from the second dataset and merged after.

Once the separate dataset had been given their final classifications they were merged and dissolved to create the final output for the agricultural farmland stakeholder group. To finalize the output all areas that were protected lands (fee owned lands) and conservation easement properties were erased and removed.

The agricultural farmland model was developed in ArcGis 10.3 through the model builder interface.

1.A Prime Farmland, Farmland of Statewide Importance, & Unique Farmland
http://sjvp.databasin.org/galleries/6cd8766390d943af9bd6362841d6b92a



The three classes (Prime Farmland, Farmland of Statewide Importance, & Unique Farmland) were extracted from the 2012 FMMP datasets for all 8 counties within the San Joaquin Valley. This extracted layer was then used as the base layer to have groundwater recharge overlaid, and citrus crops overlaid upon that intersection yielding the top three classifications.

Prime Farmland: Irrigated land with the best combination of physical and chemical features able to sustain long term production of agricultural crops. This land has the soil quality, growing season, and moisture supply needed to produce sustained high yields. Land must have been used for production of irrigated crops at some time during the four years prior to the mapping date.

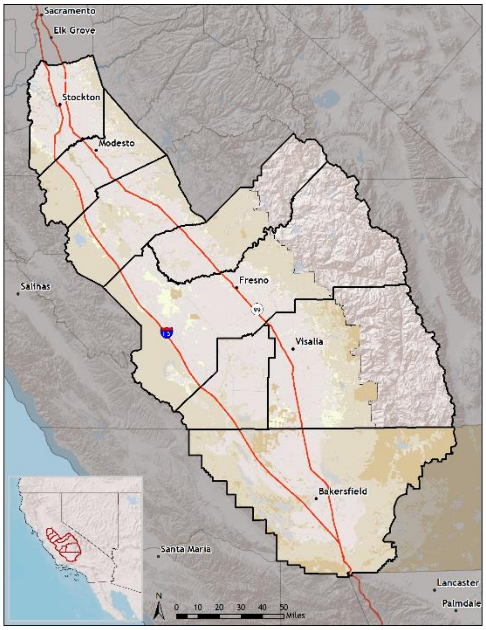
Farmland of Statewide Importance: Irrigated land similar to Prime Farmland that has a good combination of physical and chemical characteristics for the production of agricultural crops. This land has minor shortcomings, such as greater slopes or less ability to store soil moisture than Prime Farmland. Land must have been used for production of irrigated crops at some time during the four years prior to the mapping date.

Unique Farmland: Lesser quality soils used for the production of the state's leading agricultural crops. This land is usually irrigated, but may include non-irrigated orchards or vineyards as found in some climatic zones in California. Land must have been cropped at some time during the four years prior to the mapping date.

1.B

NOT Prime Farmland, Farmland of Statewide Importance, & Unique Farmland

After extracting the three classes (Prime Farmland, Farmland of Statewide Importance, & Unique Farmland) from the 2012 FMMP datasets for all 8 counties within the San Joaquin Valley, the rest of the classes within the FMMP datasets were extracted (Farmland of Local Importance, Grazing Land, Semi-Agricultural and Rural Commercial Land, Vacant or Disturbed Land, Nonagricultural or Natural Vegetation). These classes were not extracted (Urban & Build-up Land, Rural Residential Land, Confined Animal Agriculture, and Water) to avoid conflicts with urban areas, rural housing, dairies/feedlots, and existing wetlands/water storage areas.



Farmland of Local Importance: Land of importance to the local agricultural economy as determined by each county's board of supervisors and a local advisory committee.

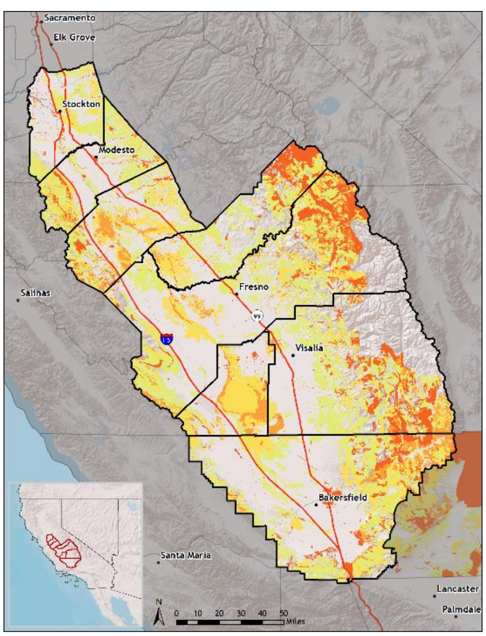
Grazing Land: Land on which the existing vegetation is suited to the grazing of livestock. This category was developed in cooperation with the California Cattlemen's Association, University of California Cooperative Extension, and other groups interested in the extent of grazing activities.

Semi-Agricultural and Rural Commercial Land: Includes farmsteads, agricultural storage and packing sheds, unpaved parking areas, composting facilities, equine facilities, firewood lots, and campgrounds.

Vacant or Disturbed Land: Includes open field areas that do not qualify for an agricultural category, mineral and oil extraction areas, off road vehicle areas, electrical substations, channelized canals, and rural freeway interchanges. Nonagricultural or Natural Vegetation: Includes heavily wooded, rocky or barren areas, riparian and wetland areas, grassland areas which do not qualify for grazing land due to their size or land management restrictions, small water bodies and recreational water ski lakes. Constructed wetlands are also included in this category.

2.A Poor, Very Poor, Non-Agricultural, and Not Applicable for Storie Index Classes

These classes were extracted from county SSURGO data for all 8 counties in the San Joaquin Valley, representing the California revised soil storie index classes. These classes represented areas that would impair soil structure, quality, and likely agricultural production without significant management by the landowner.

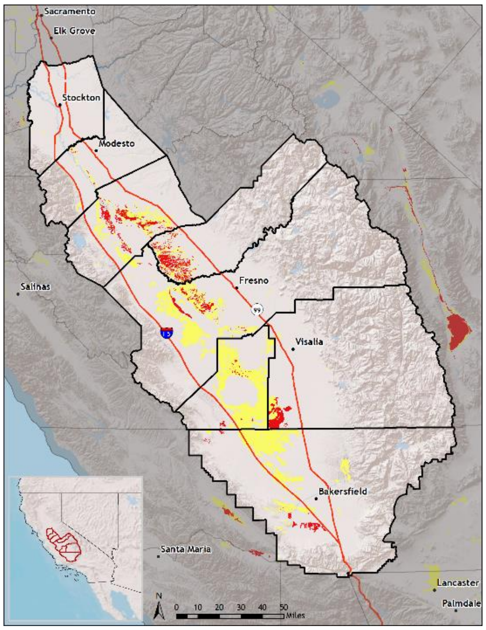


Poor Soil Storie Class (Class 4): Soils have very severe limitations that restrict the choice of plants or require very careful management, or both.

Very Poor Soil Storie Class (Class 5): Soils have little or no hazard of erosion but have other limitations, impractical to remove, that limit their use mainly to pasture, range, forestland, or wildlife food and cover.

Non-Agricultural Soil Storie Class (Class 6): soils have severe limitations that make them generally unsuited to cultivation and that limit their use mainly to pasture, range, forestland, or wildlife food and cover.

Not Applicable for Soil Storie Index Class: Soils and miscellaneous areas have limitations that preclude their use for commercial plant production and limit their use to recreation, wildlife, or water supply or for esthetic purposes.



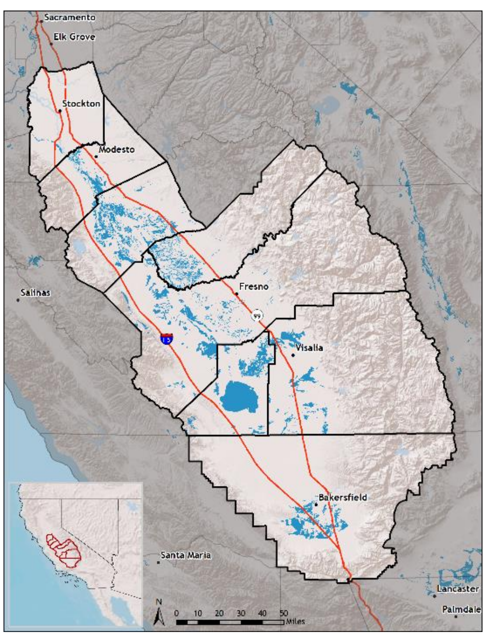
3.A

Moderately Saline and Strongly Saline Soil Classifications

These classes were extracted from statewide SSURGO data for California. These classes represented areas that would impair agricultural production without significant and proper drainage, and high water availability to flush salts out of the root zone for cultivation. Soils having high Electrical Conductivity (mmhos cm-1, equivalent to dS m-1), as determined by a threshold value of 4 or more impairs most crop growth.

Moderately Saline: 8 to less than 16 mmhos cm-1

Strongly Saline: greater or equal to 16 mmhos cm-1

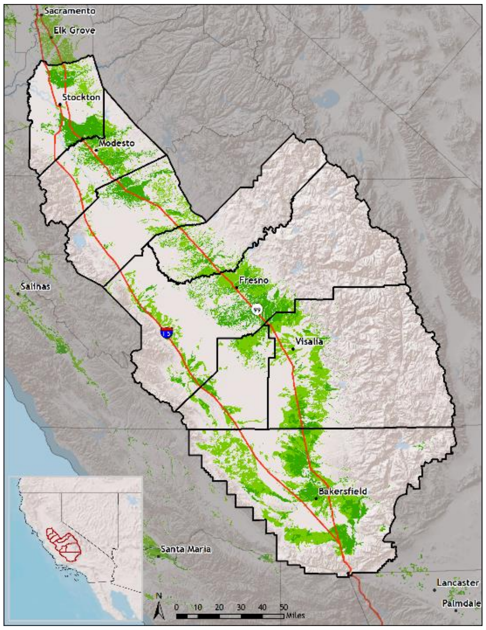


3.B

Slightly Saline - Used only in Westlands Water District Impaired Drainage Area

Given that, soils having high Electrical Conductivity (mmhos cm-1, equivalent to dS m-1), as determined by a threshold value of 4 or more impairs most crop growth, any areas within the drainage impaired areas in WWD were viewed as significantly impaired lacking significant and proper drainage, and most likely lacking high water availability to flush salts out of the root zone for cultivation.

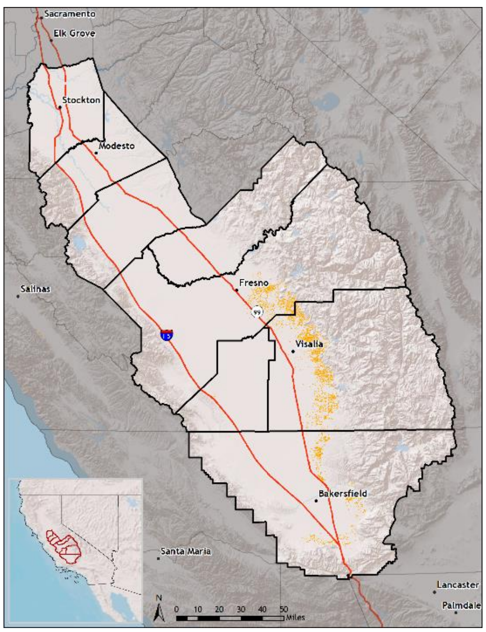
Slightly Saline: 4 to less than 8 mmhos cm-1



4.A

Excellent and Good Groundwater Recharge Area Classifications - Soil Agricultural Groundwater Banking Index (SAGBI)

Selecting the excellent and good groundwater recharge area classifications revealed areas that were ranked in the highest classes for agricultural groundwater banking potential. These areas had positive markers for deep percolation, root zone residence time, chemical limitations, topographic limitations, and surface condition.

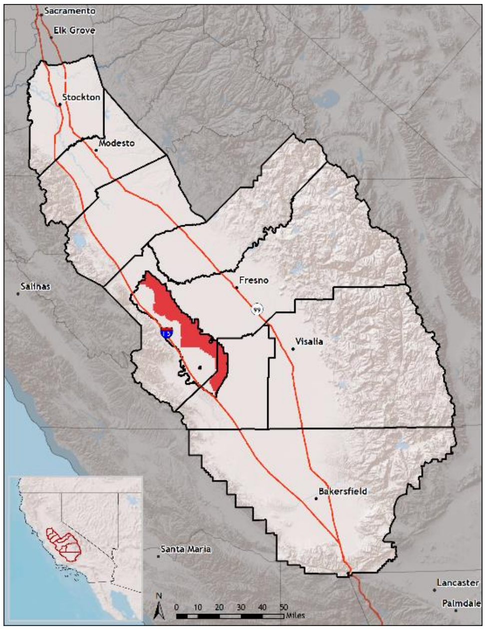


5.A

Citrus Crops within the California CDL 2014 Dataset

Citrus crops (Values 72 'Citrus' and 212 'Oranges') were extracted from the California 2014 CDL dataset to give a proxy for microclimates within the San Joaquin Valley[1]. Microclimates within the region represent highly valued acreage that allows for the production of high value crops such as citrus.

[1] California Agriculture 64(3):129-134. DOI: 10.3733/ca.v064n03p129. July-September 2010. (http://californiaagriculture.ucanr.org/landingpage.cfm?article=ca.v064n03p129&fulltext=yes)



6.A

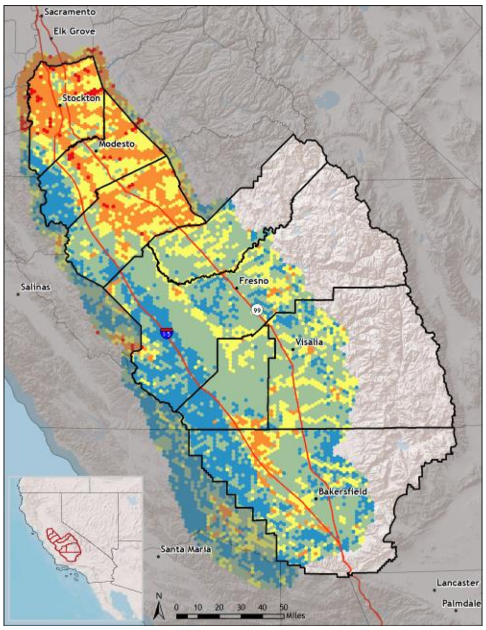
Drainage Impaired area within Westland Water District Dataset

The drainage impaired area within Westlands Water District is an area within the San Joaquin Valley that has not received adequate drainage for irrigated agriculture for many years. When drainage was provided, environmental damage from natural selenium concentrations in the soil brought severe consequences for waterfowl in the Kesterson Wildlife Refuge. Due to ~100,000 acres of this impaired drainage area likely to be permanently fallowed, and uncertainties surrounding water for this district given a high water table, this area was broadly highlighted as least conflict by the agricultural conservation group.

Appendix B – Environmental Conservation Source Data Summary and Model Detail

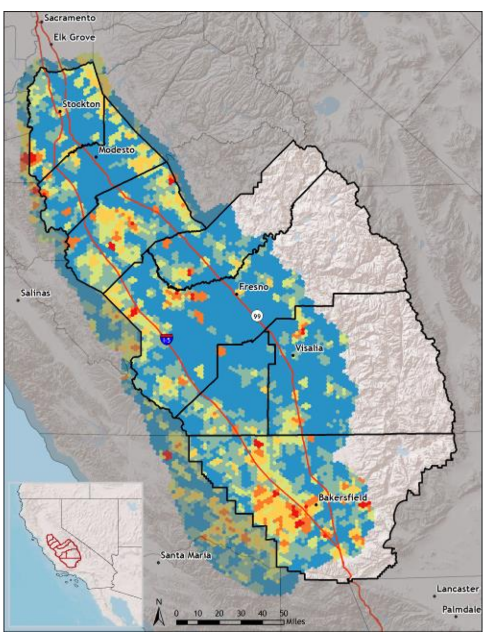
Source Data

1. Conservation Elements



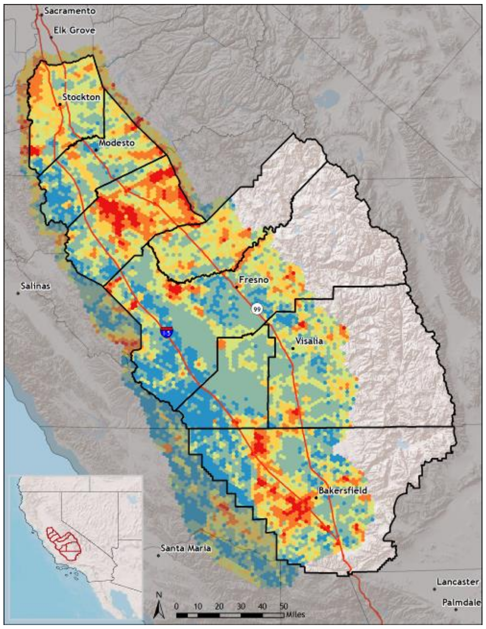
ACE IIv2 – Sensitive Habitat Rank (SenHabRank)

Rank of sensitive habitat within the study area. This data was extracted from the statewide dataset of sensitive habitat rank (1-5) and normalized from 0-1. See the ACE-II Project Report (September 2015) for full descriptions of definitions of data (https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=24326&inline=1). The ACE-II sensitive habitat layers represent those hexagons where wetlands, riparian, rare natural communities, and/or high value salmonid habitat are present. If a sensitive habitat of any size was mapped as present in a hexagon, the hexagon was designated a presence for that habitat type regardless of habitat size or quality. Sensitive habitats were designated as present or absent only and hexagons were not ranked by any measure of sensitive habitat conservation value. The sensitive habitat layers are therefore very broad-scale representations of the distribution of these habitat types.



ACE IIv2 – Rarity Weighted Richness Index (RWITotEC)

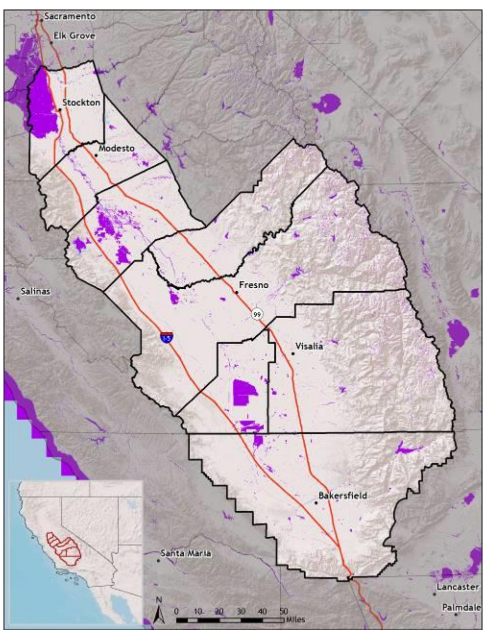
Rarity weighted richness within the study area. Data was extracted from each ecoregion within the study area to allow for an even comparison between each region. ACE-II Project Report (September 2015) definition of data: Rarity-weighted richness represents the "irreplaceability" of an area based on the presence of special status species weighted by their degree of rarity. Areas with a high rarity-weighted richness index (RWI) support rare species with few documented occurrences; these areas would be expected to support unique habitats or suites of species that are limited in distribution and likely of high conservation concern. The RWI was calculated by taking the inverse of the number of hexagons occupied by each rare taxon [RWI = Σ 1/(# occupied hexagons per taxon)], so that taxa with the smallest distributions have the largest values. All RWI values were then summed per hexagon by taxonomic group. Data for each taxonomic group were normalized separately to give each taxonomic group equal weight (maximum value of 1). Statewide normalized values for the six taxonomic groups were summed to determine statewide total RWI. Ecoregionally normalized values for the six taxonomic groups were summed to determine total RWI.



ACE IIv2 – Biological Index (BioTotEC)

Biological Index within the study area. Data was extracted from each ecoregion within the study are to allow for an even comparison between each region. ACE-II Project Report (September 2015) definition of data: The ACE-II biological index surface is a composite of four indices relevant to conservation value: native species richness, rare species richness, "irreplaceability" (i.e., rarity-weighted richness), and the presence of sensitive habitats. The four indices were summed using a weighted-additive model framework (see the weighted-additive model section for further detail), with all four layers given equal weight in the model. Hexagons with a high biological index score represent those areas with high species richness, high levels of rarity and irreplaceability, and/or sensitive habitats.

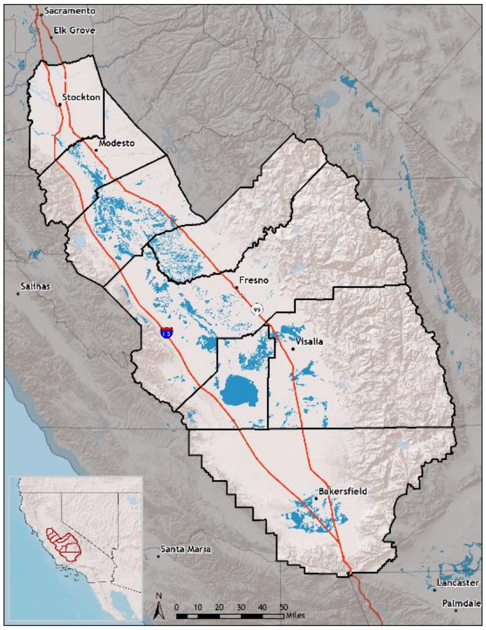
2. Wetland Density



National Wetland Inventory (California Wetlands) – United States Department of Fish and Wildlife

This shapefile was used directly from the NWI geodatabase with no alterations made. The file was clipped during processing and unioned with the California Department of Fish and Wildlife wetlands data layer.

The dataset includes wetlands surveyed from aerial imagery within California. All delineated areas of wetlands and open water are defined by Cowardin et al. (1979). For details see https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=24326&inline=1.



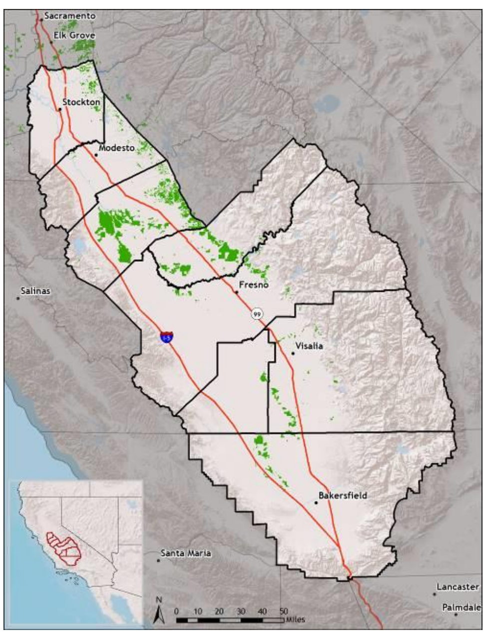
California Central Valley Wetlands and Riparian Classes – California Department of Fish and Wildlife

Starting with the raster file for the state from CDFW, all cells with the following values were extracted and converted to a shapefile.

Value	Description
1	Open Water
2	Seasonally Flooded Estuarine Emergents
3	Permanently Flooded Estuarine Emergents
6	Seasonally Flooded Palustrine Emergents
7	Permanently Flooded Palustrine Emergents

The file was clipped during processing and unioned with the NWI wetland data layer.

3. Vernal Pool Density

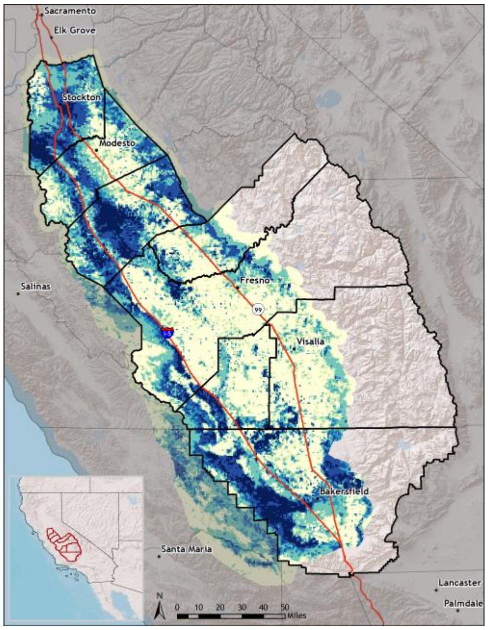


Great Valley Vernal Pool Habitats

This shapefile was overlayed with the unioned wetlands data layer and ran through the erase tool to remove any areas that may have been overlapping in data coverage. The file was clipped during processing and summed with the wetlands data layer.

All areas shown in this file were defined as "vernal pool habitat", which included vernal pools themselves and the surrounding upland (typically grassland) habitat matrix. These data were created as part of a study in vernal pool distribution across the San Joaquin and Sacramento Valleys by Holland et al (2014).

4. Species Distribution Models

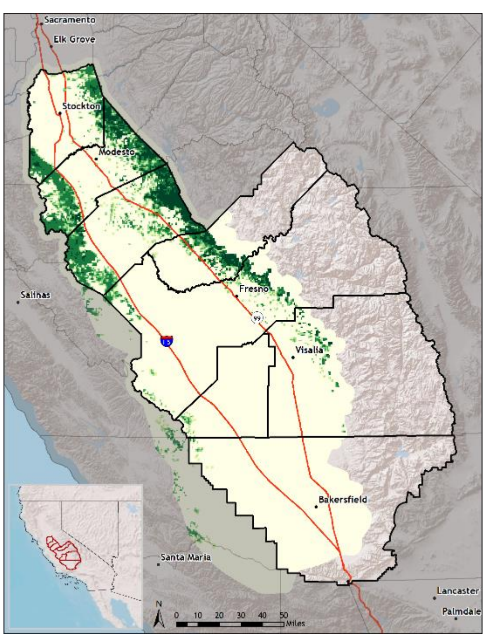


Species Habitat Entire – Species Distribution Models

The following binary species distribution model outputs (ie. habitat [1] or not habitat [0]) were averaged to produce a derived output of habitat suitability for multiple species of concern in the region, when their habitat range was considered to be uniform across the entire study region:

Species (common name)	Species Distribution Model Used
Burrowing Owl	Maxent
Coast Horned Lizard	Maxent
Giant Garter Snake	Maxent
Swainson's Hawk	Maxent (Species Occurrences Added)
Tricolored Blackbird	Maxent (Species Occurrences Added)
Western Spadefoot Toad	Maxent
American Badger	Maxent
San Joaquin Kit Fox	Algebraic Land Use Model (Cypher et al, 2013)

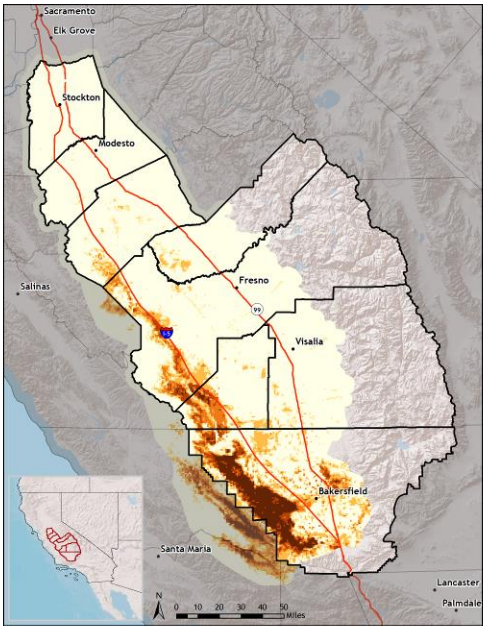
http://www.canids.org/CBC/16/san_joaquin_kit_fox_habitat_suitability.pdf



Species Habitat Foothills – Species Distribution Models

The following binary species distribution model outputs (ie. habitat [1] or not habitat [0]) were averaged to produce a derived output of habitat suitability for multiple species of concern in the region, when their habitat range was considered to be confined to the foothill areas in the northern portion of the study region.

Species (common name)	Species Distribution Model Used
California Red-Legged Frog	Maxent
California Tiger Salamander	Maxent
Succulent Owl's Clover	Maxent



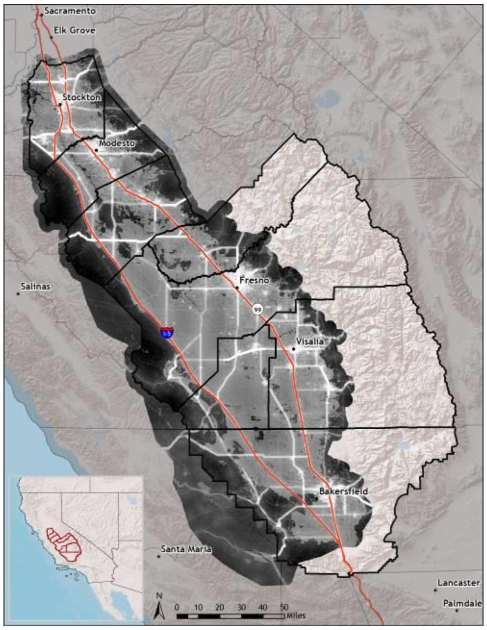
Species Habitat Southwest – Species Distribution Models

The following binary species distribution model outputs (ie. habitat [1] or not habitat [0]) were averaged to produce a derived output of habitat suitability for multiple species of concern in the region, when their habitat range was considered to be confined to the southwestern areas in the study region.

Species (common name)	Species Distribution Model Used
San Joaquin Wooly-threads	Maxent
Nelson's Antelope Squirrel	Maxent
Kern Mallow	Maxent
Blunt Nosed Leopard Lizard	Maxent (Joseph Stewart, UCSC – Peer Review in progress)
Giant Kangaroo Rat	Maxent (William Bean et al, 2014)

http://onlinelibrary.wiley.com/doi/10.1111/j.1755-263X.2011.00218.x/full

5. Landscape Permeability

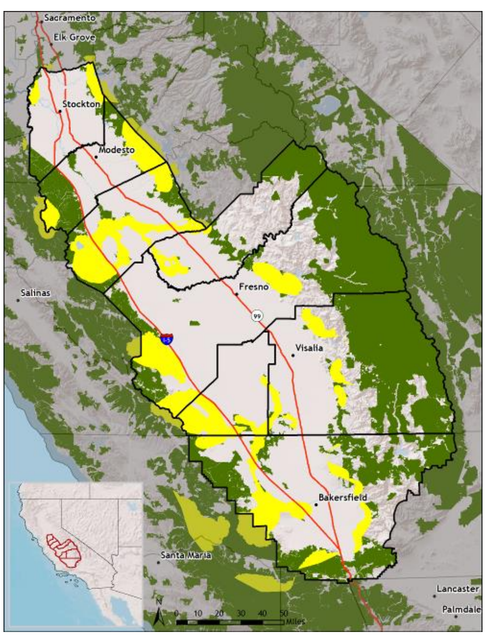


Permeability for the Western United States – Theobald, 2013

Model tries to capture the degree of human modification representing relative landscape permeability for ecological process and species movement. This data was created by Dave Theobald in 2013, in the same fashion as his work that was published in 2012. This data was shared by The Nature Conservancy for this project.

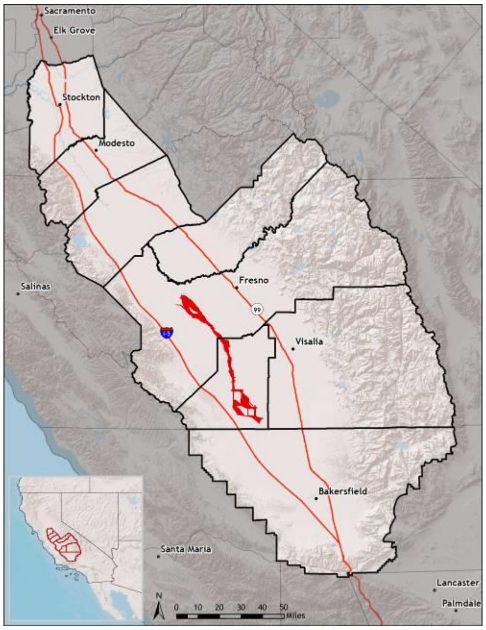
https://www.wildlife.ca.gov/conservation/planning/connectivity/CEHC

6. Selected Corridors



California Essential Connectivity (Corridors and Blocks) – California Department of Fish and Wildlife

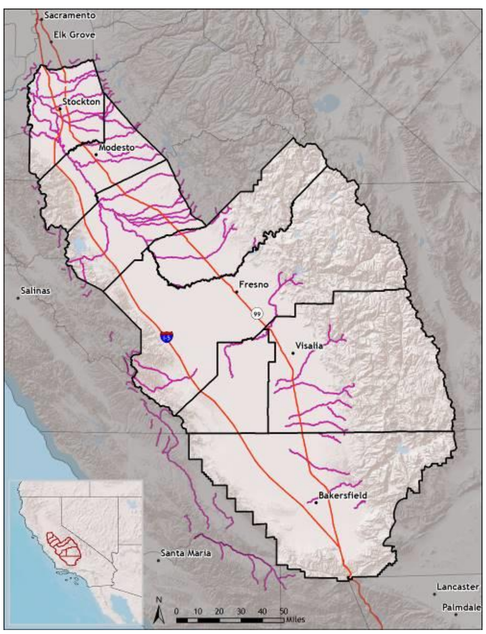
Data produced in 2010 through a collaborative multi-agency working group. Natural landscape blocks and the essential corridors connecting them were identified throughout California. This data was clipped and to the study area and unioned with the Fresno slough corridor, the main river corridors, and the San Joaquin Kit Fox permeable land use areas. http://consbio.org/products/reports/california-essential-habitat-connectivity-project-a-strategy-for-conservation-a-connected-california



Fresno Slough Corridor – Patrick Huber Corridor Analysis

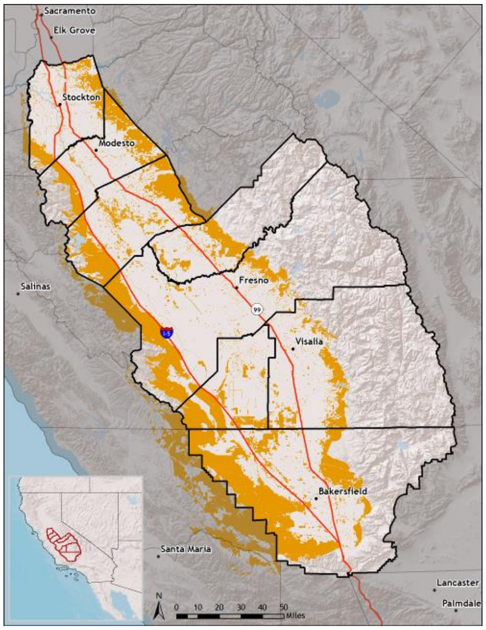
Data published in 2010 by Patrick Huber. The data used was extracted from a larger corridor and reserve assessment for the San Joaquin and Sacramento Counties. The corridor extracted was primarily along the Fresno slough, likely one of the last north-south movement corridors in the center of the San Joaquin Valley. This data was unioned with the California essential connectivity corridors and blocks, the main river corridors, and the San Joaquin Kit Fox permeable land use areas.

http://link.springer.com.proxy.library.ucsb.edu:2048/article/10.1007/s10980-010-9447-4#page-1



Main River Corridors within the Study Area – including 500m buffer

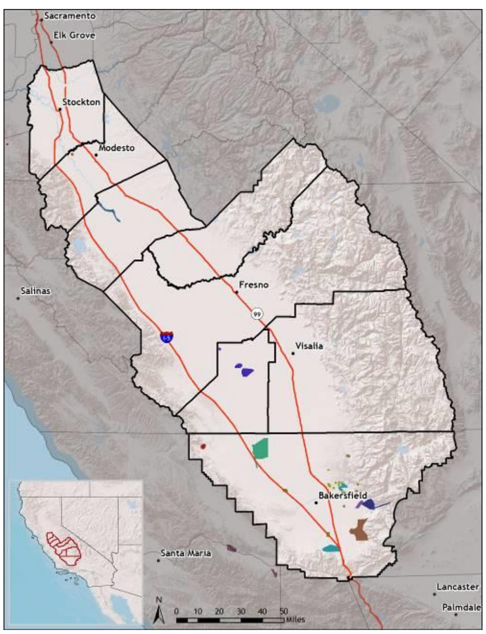
River flowline data downloaded from the California Nevada River Forecast Center were given a 500m buffer to produce a flowline of main river corridors within the San Joaquin Valley. This corridor was extracted to show the naturally occurring corridors that are used by species on the heavily altered valley floor. This data was clipped to the study area and unioned with the California essential connectivity corridors and blocks, the Fresno slough corridor, and the San Joaquin Kit Fox permeable land use areas.



San Joaquin Kit Fox Permeable Land Use – Cypher, 2013

Using data that had been produced as part of the Cypher et al. 2013 paper, the permeability attribute was used to determine land uses that would allow movement of animals. Using this dataset, San Joaquin Kit Fox and their permeability of the landscape were used as a proxy for other species of concern. Using the same process as used by Butterfield et al. 2013, (http://scienceforconservation.org/downloads/WSJV_Solar_Assessment_Data) all areas with a permeability score =< 10 were considered permeable. This data was then clipped to the study area and unioned with the California essential connectivity corridors and blocks, the Fresno slough corridor, and the main river corridors.

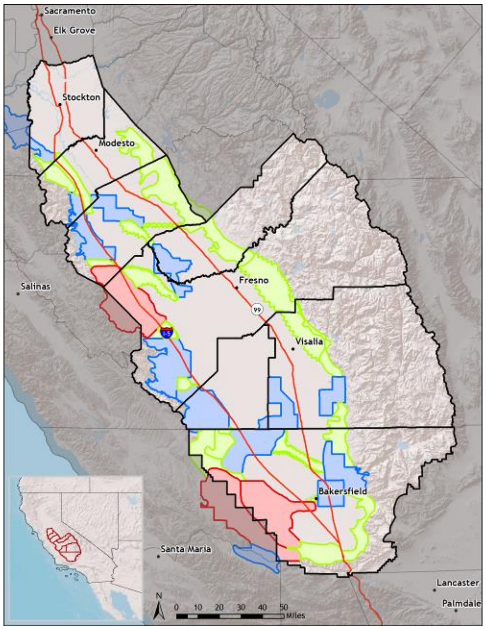
7. Conservation Priorities



Lands for Specialty Preserves – Endangered Species Recovery Program

This data set proposes natural lands targeted for protection as specialty preserves for maintaining wildlife values in the San Joaquin Valley. The information was put together by the Endangered Species Recovery Program and incorporated with the federal recovery plan produced by the U.S. Fish and Wildlife Service.

This data was then clipped to the study area and unioned with the other 6 conservation priority area spatial datasets.

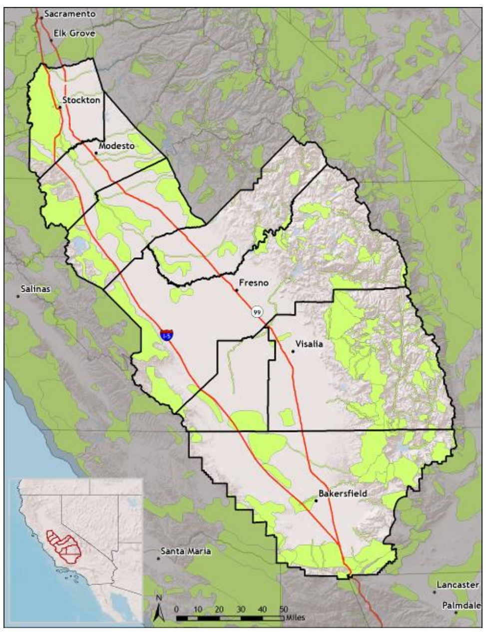


San Joaquin Valley Kit Fox Recovery Areas – Core, Satellite, and Linkage

Recovery areas delineated in 2007 by the United States Fish and Wildlife Service. All areas identified as core, linkage, or satellite areas were delineated with direction from the San Joaquin Kit Fox Recovery Plan of 1998, with the areas identified based upon known species occurrences, available habitat, and descriptions from the 1998 recovery plan.

This data was then clipped to the study area and unioned with the other 6 conservation priority area spatial datasets.

http://www.fws.gov/ecos/ajax/docs/five_year_review/doc3222.pdf

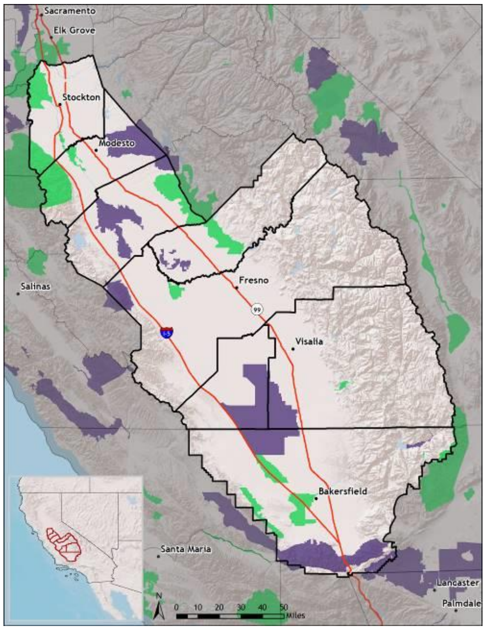


The Nature Conservancy Portfolio Areas

The portfolio areas identified by The Nature Conservancy. These are areas that The Nature Conservancy has prioritized for conservation often derived from their ecoregional assessments.

This data was then clipped to the study area and unioned with the other 6 conservation priority area spatial datasets.

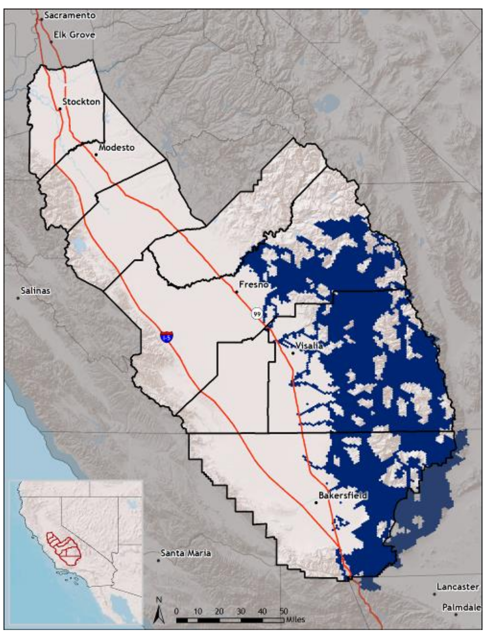
http://www.uspriorityareas.tnc.org/



Audubon Important Bird Areas – Global and State Significance

Important bird areas identified by the Audubon California. Areas identified in this dataset reveal critical terrestrial and inland water habitats for avian species.

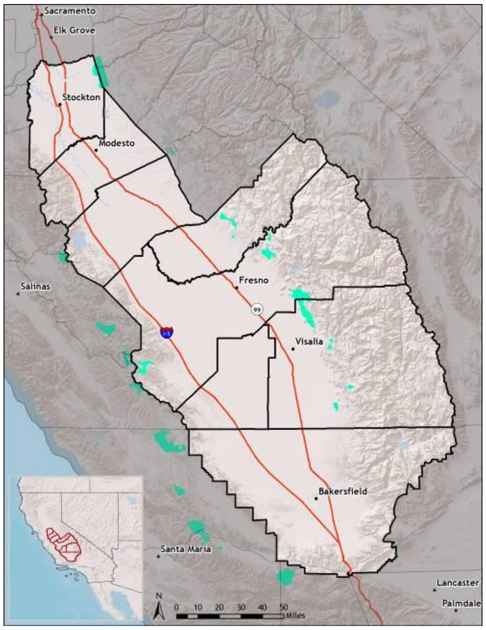
This data was then clipped to the study area and unioned with the other 6 conservation priority area spatial datasets.



Southern Sierra Partnership Priorities – Core Conservation Areas, Primary buffer and connector areas, and Secondary buffer and connector areas

Regional conservation design generated by the Southern Sierra Partnership as part of the report : "Climate-adapted Conservation Plan for the Southern Sierra Nevada and Tehachapi Mountains."

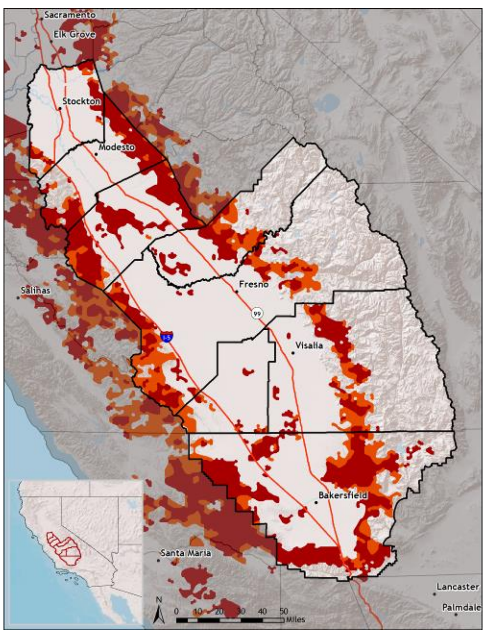
This data was then clipped to the study area and unioned with the other 6 conservation priority area spatial datasets.



Environmental Stakeholder Satellite Areas of Concern: Eastern and Western natural vegetation foothill areas

Areas of existing conservation priority that were not captured in the other datasets.

This data was then clipped to the study area and unioned with the other 6 conservation priority area spatial datasets.

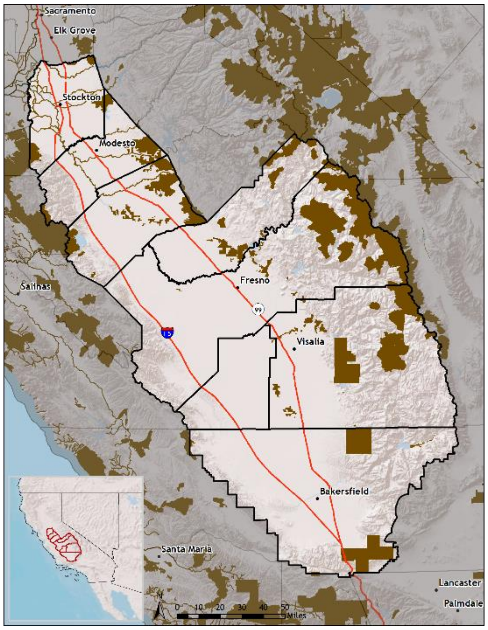


California Rangeland Conservation Coalition Priorities: Critical and Important Areas

These areas identified through a comprehensive planning exercise undertaken by the California Rangeland Conservation Coalition – sought to map and delineate areas that would meet certain conservation goals based upon vegetation systems and species characteristics.

This data was then clipped to the study area and unioned with the other 6 conservation priority area spatial datasets.

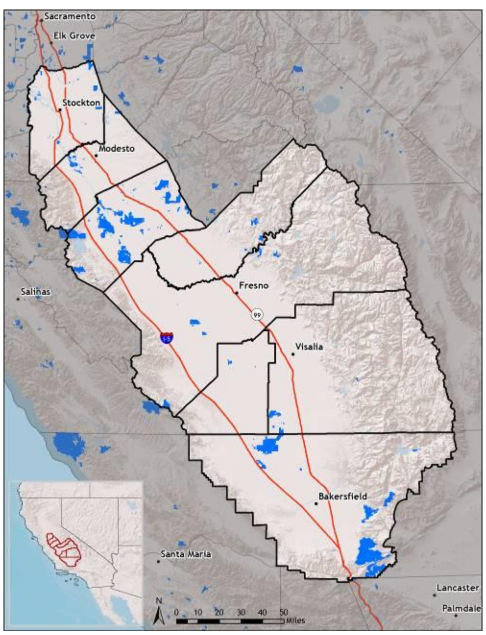
8. Federally Designated Critical Habitat



United States Fish and Wildlife – Federally Designated Critical Habitat
Federally designated critical habitat includes all areas noted during a listing of a candidate species that are essential to the species conservation. All areas that are designated as critical habitat for a threatened or endangered species are areas found to contain essential elements for the continued existence of the species that may require management and protection. Protection of these areas is made when a federal nexus is created during some form of development – this does not exclude development in these areas, but creates an extra barrier to ensure the protection of the species in question.

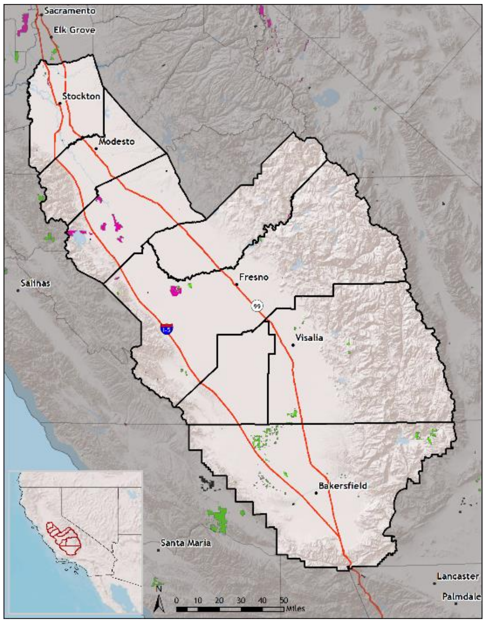
This data was then clipped to the study area and used directly as the designated critical habitat layer.

9. Designated Lands



California Conservation Easements Database, 2015 (GreenInfo)
Conservation easement lands are any areas that are restricted from certain forms of development to achieve conservation purposes. Uses allowed on the lands may include some development, but commercial solar development would likely not qualify as a right for the landowner.

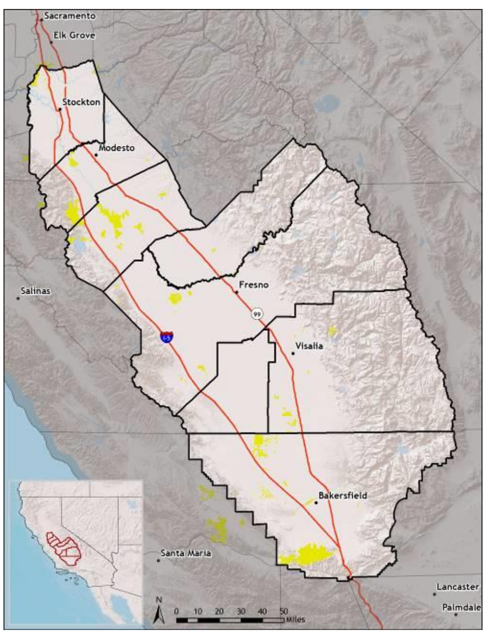
This data was then clipped to the study area and unioned with the CDFW owned and operated lands, California protected areas database lands, and the protected areas database gap status 1 and 2 lands.



California Department of Fish and Wildlife – Owned and Operated Lands

This dataset is a subset of the larger California Department of Fish and Wildlife Lands dataset. It exclusively includes lands that are owned (fee title) and operated by the department. Operated lands include: wildlife areas, ecological reserves, and public/fishing access properties that are leases or agreements with other agencies.

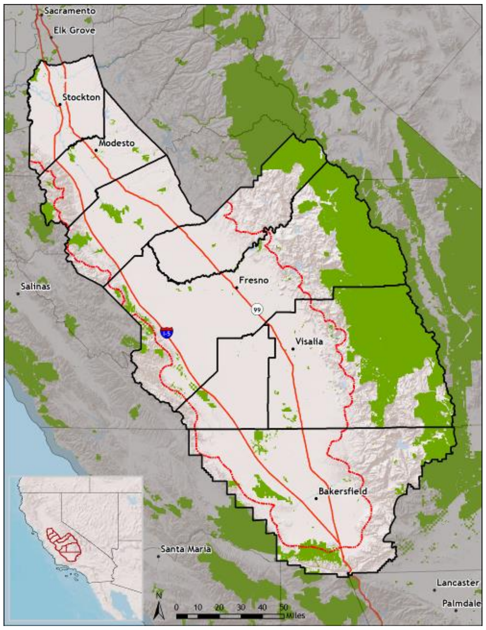
This data was then clipped to the study area and unioned with the California conservation easements database lands, the California protected areas database lands, and the protected areas database gap status 1 and 2 lands.



California Protected Areas DataBase, 2015 (GreenInfo)

This dataset is a subset of the larger California protected areas database including all fee protected lands within the state. All 'no public access', 'restricted access' or 'unknown access' polygons were extracted from the larger dataset. This was done to include areas that are reserved for special protection from development and human impacts.

This data was then clipped to the study area and unioned with the California conservation easements database lands, CDFW owned and operated lands, and the protected areas database gap status 1 and 2 lands.



PAD-US (CBI Edition) Version 2.1, California
This dataset is a subset of the larger protected areas database for California including all fee protected lands within the state. All areas that were gap status 1 and gap status 2 were extracted from the larger dataset. This was done to include areas that are reserved for special protection from development and human impacts.

GAP Status 1: An area having permanent protection from conversion of natural land cover and a mandated management plan in operation to maintain a natural state within which disturbance events (of natural type, frequency, intensity, and legacy) are allowed to proceed without interference or are mimicked through management.

GAP Status 2: An area having permanent protection from conversion of natural land cover and a mandated management plan in operation to maintain a primarily natural state, but which may receive uses or management practices that degrade the quality of existing natural communities, including suppression of natural disturbance.

This data was then clipped to the study area and unioned with the California conservation easements database lands, CDFW owned and operated lands, and the California protected areas database lands.

EEMS Logic Model

All results seen in this document on the San Joaquin Valley Gateway for the environmental conservation stakeholder group were produced using the EEMS (Environmental Evaluation Modeling System) framework. EEMS is a spatial model framework developed by the Conservation Biology Institute, which allows for integration and comparison of widely varying data types. EEMS is a logic model framework, that like other logic models produces a cognitive map presenting spatial datasets and their logical relationships to show how a complex topic was evaluated. EEMS is a tree based, 'fuzzy' logic modeling system; this logic model is an open source alternative to the EDMS (Ecosystem Management Decision Support) software package. Using this EEMS model framework many complex spatially explicit questions can be answered concerning values within landscapes (e.g. cultural/anthropogenic value, and biological/ecological value).

The EEMS model framework allows for comparison of widely varying datasets by allowing users to assign true and false thresholds for different spatial layer datasets. The scale used is from -1 to +1 moving from completely false to completely true. Setting false and true thresholds allows for the user to set boundaries on input datasets when necessary and applicable, with the data then being stretched between -1 to +1 effectively normalizing all data inputs on the same scale. All data inputs undergo this normalizing (“fuzzy logic method”) regardless if they are ordinal, nominal, or continuous.

Completely False (-1) **Unknown (0)** **Completely True (+1)**

Using this normalized approach in the EEMS framework provides many key advantages (DRECP Conservation Value Logic Model 2014):

1. Normalizing values (within “fuzzy logic”) yields a continuum of data that is more realistic of true values across a landscape, providing ‘shades of grey’ compared to the traditional modeling methods using binary values
2. The model produced is highly transparent and its process is easy to visualize using DataBasin
3. Layers produced (final and intermediate results) provide greater value over single map modeling methods
4. Editing the model is an easier process allowing the testing of different assumptions, and inclusion of new data as it becomes available

Model Development

The modeling process to produce the final output of conservation value and least conflict areas involved five phases: Identify Current Research and Data Available, Preprocess Data, Summarize Data by Reporting Unit, Execute Logic EEMS Model, Evaluate Output and Determine Least Conflict Cutoff Value (Table 1). The first and last step were done exclusively through online conferences with the stakeholder group participants, with the intermediary three steps carried out using ArcGis 10.3 through the model builder interface.

Table 1. Phases of the Modeling Process

Model/Phase	Model Overview
1. Identify Current Research and Data Available	- Identify spatial data that is ubiquitous across the study area and discuss relevance of similar datasets
2. Preprocess Data	- Consolidate and process data - Clip to region of interest and project to NAD 83 California Teale Albers (meters)

Model/Phase	Model Overview
3. Summarize Data by Reporting Unit	- Calculate a count of density value for all component of the model. Adds attributes of each input dataset to the reporting units dataset. This feature class is used for the EEMS model.
4. Execute Logic EEMS Model	- Apply "fuzzy logic" based on the hierarchal model framework. Calculate values for each 1km cell
5. Evaluate Output and Determine Least Conflict Cutoff Value	- Review distribution of conservation value within study region and determine a cutoff value which will create the least conflict area for the environmental conservation group

Logic Modeling Thresholds and Operators

When the Logic EEMS Model is ran, all of the preprocessed data that populated the fields in the reporting units shapefile undergo normalization to allow for comparison. This is where the data is converted to "fuzzy" space. The user defines the range of values along a truth continuum (shown below) when values are converted to "fuzzy" space - normalized.

Individual thresholds used for the components of the model are shown below in Table 2. There were 10 derived inputs that required normalization for this modeling exercise.

Table 2. Primary Components of Modeling process, range of values, mean, standard deviation, and true/false thresholds for each $1km^2$ reporting unit.

Model Input	Range	Mean	St. Dev	Data Type	True Threshold	False Threshold
High Conservation Elements	1-0.16	0.43	0.17	Index	0.79	0.25
High Wetland Value	100-0	8.18	22.98	Percent Area	40	0
High Habitat Entire	0.85-0	0.12	0.12	Average	0.42	0
High Habitat Foothills	1-0	0.04	0.13	Average	0.30	0

Model Input	Range	Mean	St. Dev	Data Type	True Threshold	False Threshold
High Habitat Southwest	1-0	0.08	0.20	Average	0.62	0
High Corridor Value	100-0	53.23	45.6	Percent Area	1	0
High Permeability Value	1-0	0.47	0.22	Index	0	0.7
High Conservation Priorities	100-0	68.29	45.19	Percent Area	1	0.5
High Designated Critical Habitat	1-0	0.08	0.277	Binary	1	0.5
High Designated Lands	100-0	10.09	27.83	Percent Area	37.92	0

When evaluating the true and false thresholds above, keep in mind that the thresholds set the points (-1 to +1) between which the data will be stretched or compressed in between. During the initial model runs the thresholds were set to +/-2 standard deviations from the mean with alterations made throughout to reflect upon stakeholder feedback and critiques of the output.

After the input components undergo normalization (using the thresholds) they are put through the hierarchal structure of the EEMS logic model (see figure X). Operators are used to exert logic within the model and the operators used within this model are described in Table 3 below.

Table 3. Logic Operators used within the Environmental Conservation Stakeholder Model.

Operator	Input Data	Description
Max (Fuzzy Or)	Raw/Fuzzy	Returns the Highest (TRUEst) value of the inputs
Average (Fuzzy Union)	Raw/Fuzzy	Returns the mean of the inputs
Weighted Sum	Fuzzy	Finds the weighted sum for each row of the input fields. Multiplies each field by its weight before adding.
Average Highest 2 (Selected Union)	Fuzzy	Finds the union value (mean) of the specified number of TRUEst of FALSEst inputs.

The environmental conservation stakeholder model contains weighting of inputs in one location, when combining the wetland and vernal pool areas. This weighted sum on the final run was ran with weighting of 1 for both the vernal pools dataset and the wetlands dataset. Since both of these datasets were made to be mutually exclusive the output is binary, representing presence of vernal pools and wetlands with no valuation of their importance in this model.

Logic models produce intermediate and final maps on a "fuzzy scale" from -1 (completely false) to +1 (completely true). The range of continuous values for cells can be represented and organized in multiple ways using GIS binning such as natural breaks, geometric interval and others. When viewing the unstretched data online and its intermediate maps all binning was done using a modified EDMS classification composed of six classes: Very High, High, Moderately High, Moderately Low, Low, and Very Low. The value for each of the six classes is shown below in Table 4.

Table 4. Class Value Ranges.

Values	Legend
1.00 to 0.75	Very High
0.75 to 0.50	High
0.50 to 0.00	Moderately High
0.00 to -0.50	Moderately Low
-0.50 to -0.75	Low
-0.75 to -1.00	Very Low

Appendix C – High Level Technical Assessment of the Big Creek Corridor (Southern California Edison Company)

Solar and the San Joaquin Valley

High Level Technical Assessment of the Big Creek Corridor

November 6, 2015

Southern California Edison Company

Prepared by

Jomarie Manansala
Kevin Richardson

Generation Interconnection Planning

TABLE OF CONTENTS

I. EXECUTIVE SUMMARY

Solar and the San Joaquin Valley is a stakeholder-led process that was kicked off on June 10, 2015, with the objectives of identifying least-conflict lands in the San Joaquin Valley for solar development, addressing generation and transmission siting challenges, and fostering knowledge-sharing and collaboration.

Stakeholders in this process inquired about existing and possible expanded transmission capacity in the San Joaquin Valley. This technical assessment approximates these transmission capacity scenarios on the Southern California Edison (SCE) transmission facilities most relevant to solar development in the southeastern portion of the San Joaquin Valley. The goal of this assessment was not to promote any specific upgrade, but to set transmission capacity expectations regarding large scale solar development in the southeastern part of the San Joaquin Valley pursuing interconnection into SCE transmission facilities.

To accomplish this task, existing information and a high level power flow analysis was performed using Western Electricity Coordinating Council (WECC) base cases. A fictitious generator was modeled to represent future San Joaquin Valley Solar generation projects and its output was increased until transmission constraints were identified. Table 1 identifies the approximate transmission capacity on the SCE facilities most relevant to the San Joaquin Valley Solar area.

Table 1. Transmission Capacity in Big Creek Corridor from a San Joaquin Valley Solar Perspective

#	Stakeholder Questions	Approximate Transmission Capacity	Explanation
1	What is the existing capacity?	0 MW assuming high Big Creek Hydro output	• Existing and queued generation together exceed the south of Magunden flow limit • Currently queued generation in this area is 700 MW
		18 to 656 MW assuming low Big Creek Hydro output	• Low Big Creek Hydro output from temporary drought conditions may create the opportunity for energy only interconnections • The 18 to 656 MW temporarily replaces the missing hydro output during drought
2	What additional capacity would be provided by maximizing existing corridors?	Additional 563 to 1,580 MW	• Hypothetical upgrade used assumed tearing down approximately 114 miles of single-circuit 220 kV lines and replacing them with double-circuit 220 kV lines • Multiple downstream line and reactive support limitations prevent the full utilization of the new hypothetical 220 kV double-circuit facilities studied
3	What additional capacity would be provided from a new corridor?	Additional 563 to 1,580 MW	• Assuming a corridor is not already maximized • It is unlikely construction of a new ROW would be approved when existing corridors are not maximized • Multiple downstream line and reactive support limitations prevent the full utilization of a new hypothetical 220 kV double-circuit corridor
		No additional capacity without fixing other downstream constraints	• Assuming a corridor is already maximized • If a corridor is already maximized, the same downstream line and reactive support limitations would prevent the new corridor from providing additional capacity

The hypothetical upgrades studied have a unit cost guide[1] price tag of approximately $569 million for only the tear down of the existing single-circuit facilities, the construction of new double-circuit facilities, and equipping substation switchrack positions for the new circuits. Actual cost of such a project would be greater due to other associated elements not mentioned here. In addition to the downstream transmission line and reactive support limitations noted in this assessment, other limitations, including but not limited to subtransmission, distribution, short circuit duty, and stability issues, could further impact the approximate transmission capacity in this area. SCE supports appropriate solar development in the San Joaquin Valley Solar area and offers this assessment as a first step with setting realistic and reasonable expectations for generation development pursuing interconnection into the SCE transmission facilities described in this technical assessment.

[1] http://www.caiso.com/Documents/SCE2015FinalPerUnitCostGuide.xls

II. PURPOSE AND INTRODUCTION

Solar and the San Joaquin Valley is a stakeholder-led process that was kicked off on June 10, 2015, with the objectives of identifying least-conflict lands in the San Joaquin Valley for solar development, addressing generation and transmission siting challenges, and fostering knowledge-sharing and collaboration.

Stakeholders in this process inquired about existing and possible expanded transmission capacity in the San Joaquin Valley. Specifically, stakeholders wanted to know:

1. How much existing transmission capacity is available in the San Joaquin Valley Solar area?
2. How much additional transmission capacity would be available if existing transmission corridors were maximized?
3. How much additional transmission capacity would be available if new transmission corridors were created?

On July 24, 2015, SCE submitted a draft study plan to the San Joaquin Valley Solar Transmission Subgroup, which noted the scope, results, and timelines of previous collaborative study efforts, such as the Renewable Energy Transmission Initiative[2] (RETI), the Desert Renewable Energy Conservation Plan (DRECP) Transmission Technical Group[3] (TTG), the Tehachapi Collaborative Study Group[4], and the Central California Clean Energy Transmission Project[5] (C3ETP). The proposed draft study plan outlined a high level power flow analysis methodology for the purpose of addressing the three stakeholder transmission capacity questions.

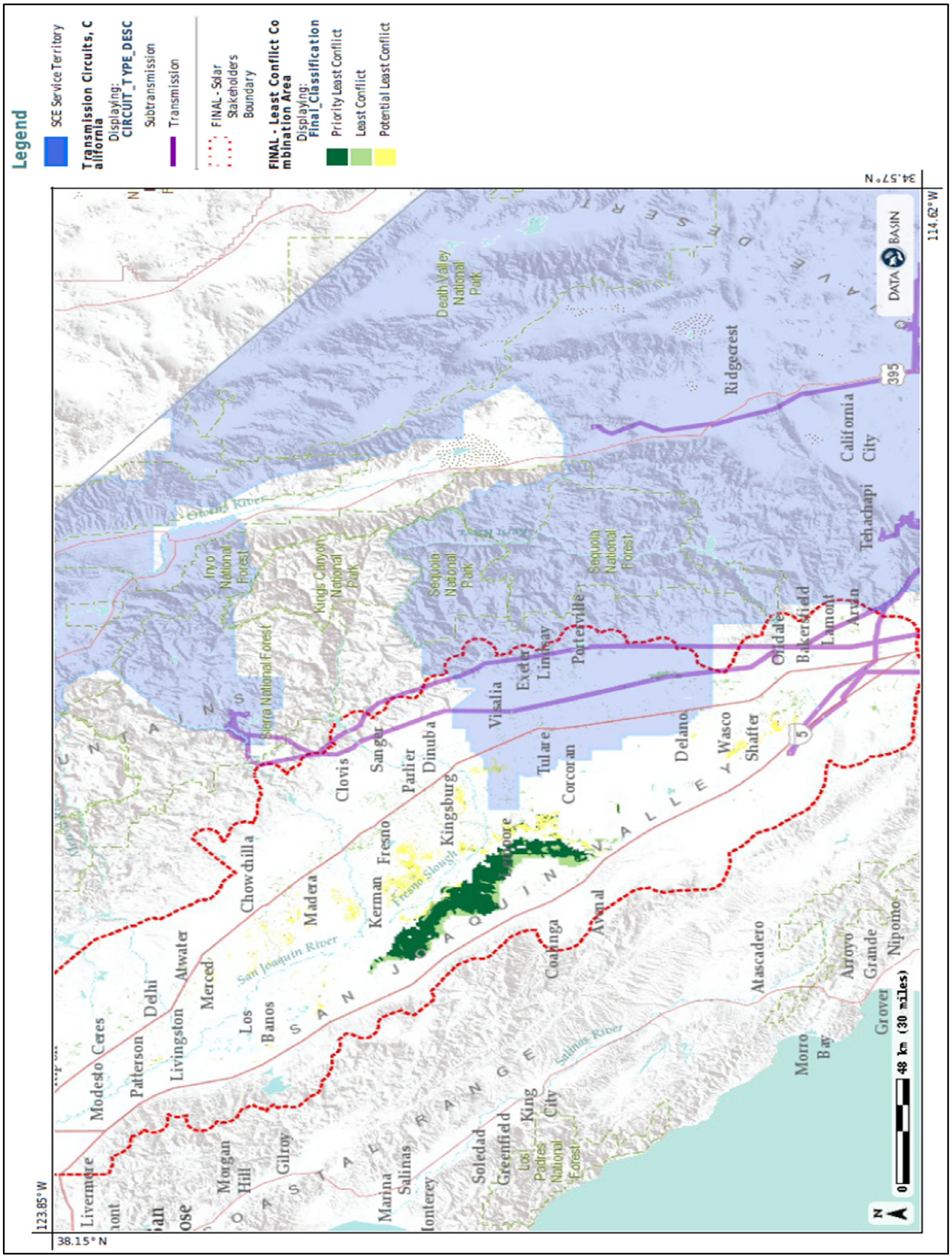
This technical assessment provides a rough order of magnitude of the available transmission capacity on the SCE transmission facilities most likely to serve transmission level solar development in the southeastern portion of the San Joaquin Valley. The goal of this assessment was not to promote any specific upgrade, but to set transmission capacity expectations regarding large scale solar development in the southeastern part of the San Joaquin Solar area pursuing interconnection into SCE transmission facilities.

[2] http://www.energy.ca.gov/reti/reti_1.html
[3] http://www.drecp.org/draftdrecp/files/Appendix_K_TTG_Report.pdf
[4] http://docs.cpuc.ca.gov/Published/Graphics/48819.pdf
[5] https://www.caiso.com/1f42/1f42daf7415e0.html

III. SCE'S BIG CREEK CORRIDOR

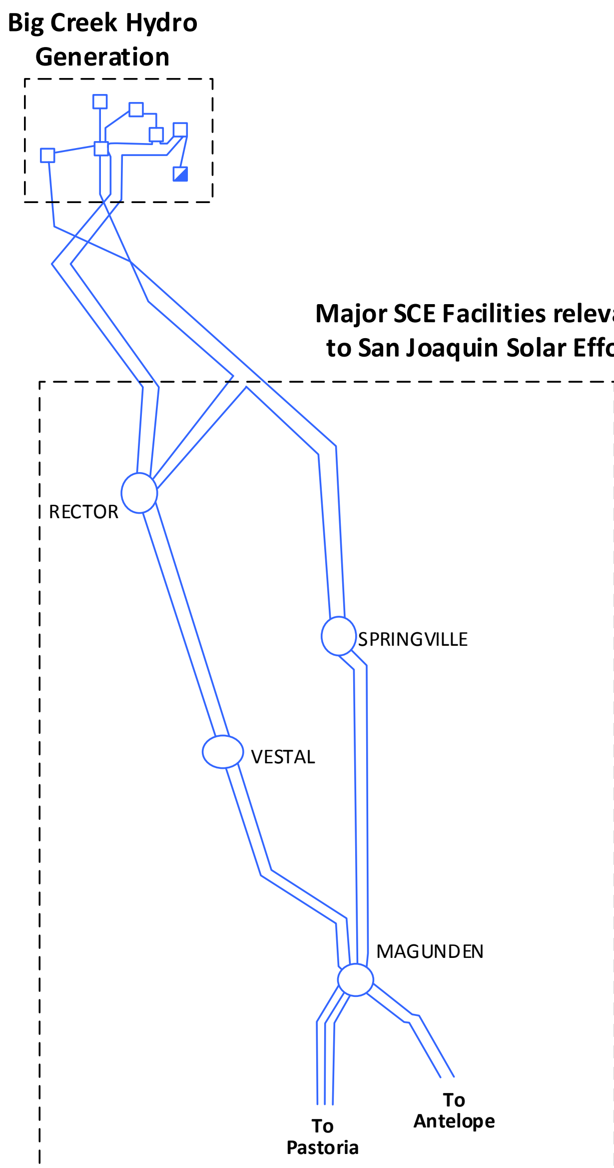
SCE's service territory and relevant 220 kilovolt (kV) transmission facilities are shown in relation to the San Joaquin Valley Solar study area in Figure 1.

Figure 1. San Joaquin Valley Solar Area and SCE Service Territory



The relevant SCE facilities likely to serve transmission level solar development in the southeastern part of the San Joaquin Valley Solar area are depicted in Figure 2.

Figure 2. SCE Big Creek 220 kV Corridor



SCE's Big Creek Corridor is composed of 220 kV transmission lines located north of Magunden Substation, travelling from Shaver Lake south to the Bakersfield area. Local generation capacity in this area consists of approximately 1,029 MW of Big Creek Hydro, 226 MW of small generation out of SCE's Rector and Vestal Substations, and 663 MW of generation out of SCE's Magunden Substation. Also affecting Big Creek Corridor power flows are the 770 MW Pastoria Energy Facility and the 720 MW Edmonston Pumping Plant, which are facilities located approximately 30 miles south of Magunden Substation.

Due to existing thermal overload and generator instability concerns, there are two local Remedial Action Schemes (RAS) that maintain system reliability under the loss of certain facilities, and a Static Var System (SVS) located at Rector Substation to maintain local area steady state voltage limits and to provide dynamic voltage support. As of November 6, 2015, there were approximately 700 MW of queued generation interconnection requests in the Big Creek Corridor, as noted in the CAISO[6] and SCE[7] generation interconnection queues, and as depicted in Table 2.

Table 2. Current Queued Generation Interconnection Requests in the Big Creek Corridor

#	Project I.D.	Point of Interconnection	MW
1	WDT433	Vestal 230/66 kV	40.00
2	WDT938	Vestal 230/66 kV	40.00
3	WDT1269	Vestal 230/66 kV	20.00
4	WDT1300	Vestal 230/66 kV	20.00
5	WDT1301	Vestal 230/66 kV	20.00
6	WDT1289	Vestal 230/66 kV	10.00
7	WDT1287	Vestal 230/66 kV	40.00
8	GFID5812	Vestal 230/66 kV	4.00
9	GFID7190	Vestal 230/66 kV	5.00
10	GFID8329	Vestal 230/66 kV	1.99
11	GFID8052	Vestal 230/66 kV	0.93
12	WDT394	Vestal 230/66 kV	20.00
13	WDT390	Vestal 230/66 kV	20.00
14	WDT439	Vestal 230/66 kV	20.00
15	WDT603	Vestal 230/66 kV	15.00
16	GFID7192	Rector 230/66 kV	0.37
17	GFID2868	Rector 230/66 kV	0.90
18	GFID8153BCT	Rector 230/66 kV	2.00
19	GFID8324	Rector 230/66 kV	1.00
20	GFID8327	Rector 230/66 kV	1.00
21	GFID8022	Rector 230/66 kV	2.68
22	GFID8194	Rector 230/66 kV	0.10
23	GFID8388	Rector 230/66 kV	1.27
24	GFID8174	Rector 230/66 kV	1.12
25	WDT1002	Rector 230/66 kV	0.75
26	Q1210	Springville 230 kV bus	412.00
27	GFID4276	Big Creek 230/66 kV	0.25
		Total =	700.36

In the CAISO's 2015-2016 Transmission Planning Process, SCE identified potential reliability concerns in the Big Creek Corridor due to drought conditions, and proposed the Big Creek Corridor TCSC Project[8] in order to maintain system reliability. The Big Creek Corridor TCSC Project would install four strategically located thyristor controlled series capacitors (TCSC) for the purpose of dynamically adjusting line impedances in order to avoid overloads during certain outage conditions.

[6] http://www.caiso.com/Documents/ISOGeneratorInterconnectionQueueExcel.xls
[7] https://www.sce.com/nrc/aboutsce/regulatory/openaccess/wdat/wdat_queue.xls
[8] http://www.caiso.com/Documents/PresentationPTOProposedMitigationSolutions_Sep22_2015.pdf (p. 59)

IV. STUDY ASSUMPTIONS AND METHODOLGY

In previous and current study efforts, such as the C3ETP and the 2015-2016 CAISO Transmission Planning Process[9], SCE contemplated a new double-circuit 220 kV line from Rector Substation in Visalia, to Magunden Substation in Bakersfield, located within existing right of way (ROW). To better understand the feasibility of routing and constructing such an upgrade, a preliminary rights check was performed at the beginning of this technical assessment on select 220 kV ROW within the Big Creek Corridor. The preliminary rights check provided information on:

- Existing corridor width
- Restrictions on the number of structures
- Restrictions on the placement of structures
- Restrictions on the structure heights
- Restrictions on the number of circuits

Based on the information provided in the preliminary rights check, the previous SCE analyses in the C3ETP and the 2015-2016 CAISO Transmission Plan, and licensing and construction experiences from SCE's recently completed San Joaquin Cross Valley Loop Project,[10] the following hypothetical 220 kV upgrades were studied in order to maximize ROW in the Big Creek Corridor:

- Tear down the existing 33 mile single-circuit Rector-Vestal No.2 220 kV line and rebuild it with a double-circuit 220 kV line using 2B-1590 ACSR conductor within the existing ROW

- Tear down the existing 36 mile single-circuit Magunden-Vestal No.2 220 kV line and rebuild it with a double-circuit 220 kV line using 2B-1590 ACSR conductor within the existing ROW

- Tear down the northern 45 miles of the existing single-circuit Antelope-Magunden No.1 220 kV line and rebuild it with a double-circuit 220 kV line using 2B-1590 ACSR conductor, in mostly existing ROW, and terminate it into the existing Whirlwind 220 kV Switchrack

Under this hypothetical scenario, Rector Substation would serve as a collector substation for the southeastern portion of the San Joaquin Valley Solar area. These new hypothetical 220 kV upgrades would attempt to deliver the bulk of the San Joaquin Valley solar power to SCE's existing Whirlwind Substation, where the power would be stepped up from 220 kV to 500 kV to make use of the Tehachapi Renewable Transmission Project[11] facilities and capacity. These hypothetical upgrades are depicted in Figure 3.

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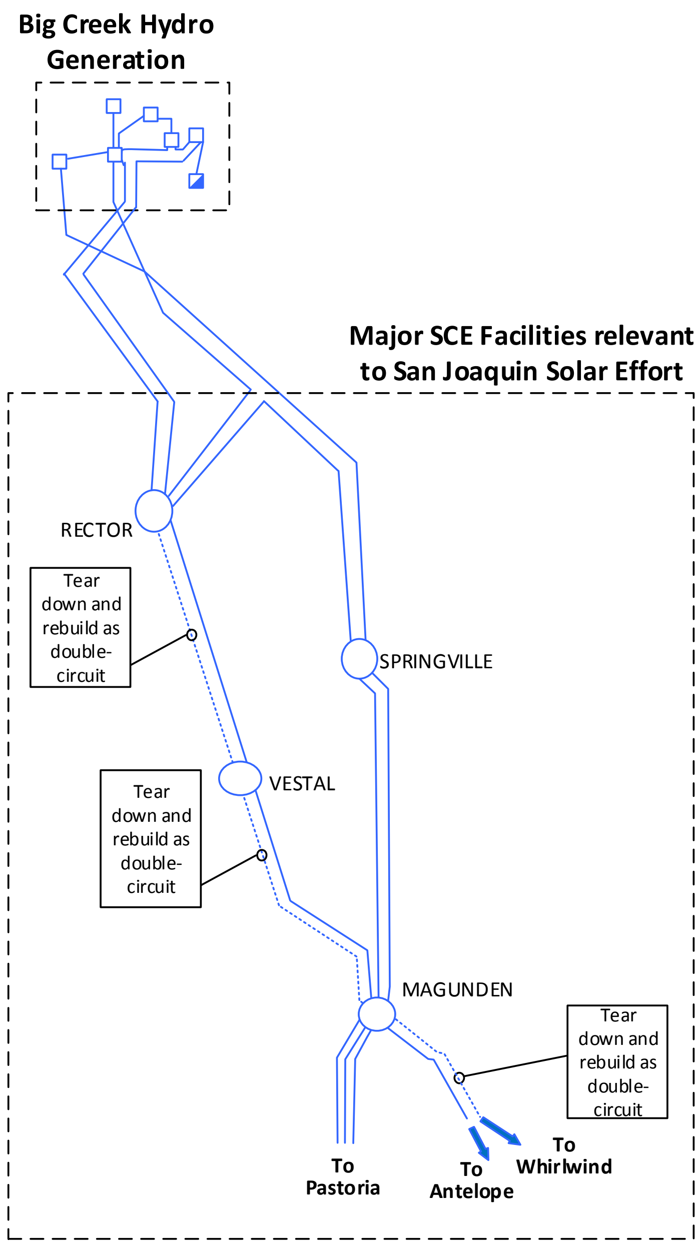
[9] http://www.caiso.com/Documents/PresentationPTOProposedMitigationSolutions_Sep22_2015.pdf (p. 63)
[10] https://www.sce.com/wps/portal/home/about-us/reliability/upgrading-transmission/san-joaquin/
[11] https://www.sce.com/trtp

Figure 3. Hypothetical Big Creek Corridor 220 kV Upgrade



These upgrades have a unit cost[12] price tag of approximately $569 million for only the tear down of the existing single-circuit facilities, the construction of new double-circuit facilities, and equipping substation switchrack positions for the new circuits, as shown in Table 3. Actual cost of such a project would likely be greater due to other associated elements, such as environmental mitigation, not mentioned here.

[12] http://www.caiso.com/Documents/SCE2015FinalPerUnitCostGuide.xls

Table 3. Unit Cost Break-down of Hypothetical Upgrade

Scope	Unit Cost	Quantity	Subtotal
Single-circuit line tear down	$665,000	114	$75,810,000
New double-circuit line using lattice structures	$4,058,000	114	$462,612,000
Double breaker switchrack position at Rector	$3,761,000	2	$7,522,000
Double breaker switchrack position at Vestal	$3,761,000	2	$7,522,000
Double breaker switchrack position at Magunden	$3,761,000	2	$7,522,000
Double breaker switchrack position at Whirlwind	$3,761,000	2	$7,522,000
		Total =	**$568,510,000**

To assess the existing capacity of the Big Creek Corridor, the following resources were used:

- Recent SCE analyses used in the CAISO Transmission Planning Process
- Recent SCE analyses used in the CAISO Generation Interconnection Process and the SCE Wholesale Distribution Access Tariff (WDAT) Process
- Existing SCE Big Creek Corridor Nomograms[13]

To assess the additional capacity provided by maximizing a corridor, the following methodology was used:

- WECC 2025 Peak Base Cases depicting:
  - High Big Creek Hydro generation dispatch without SCE proposed TCSC Project modeled
    - Pastoria Energy Facility online, Edmonston Pumping Plant offline
    - Pastoria Energy Facility offline, Edmonston Pumping Plant online
  - High Big Creek Hydro generation dispatch with SCE proposed TCSC Project modeled at 35% Series Compensation
    - Pastoria Energy Facility online, Edmonston Pumping Plant offline
    - Pastoria Energy Facility offline, Edmonston Pumping Plant online
  - High Big Creek Hydro generation dispatch with SCE proposed TCSC Project modeled at 70% Series Compensation
    - Pastoria Energy Facility online, Edmonston Pumping Plant offline
    - Pastoria Energy Facility offline, Edmonston Pumping Plant online
  - Low Big Creek Hydro generation dispatch without SCE proposed TCSC Project modeled
    - Pastoria Energy Facility online, Edmonston Pumping Plant offline
    - Pastoria Energy Facility offline, Edmonston Pumping Plant online
  - Low Big Creek Hydro generation dispatch with SCE proposed TCSC Project modeled at 35% Series Compensation
    - Pastoria Energy Facility online, Edmonston Pumping Plant offline
    - Pastoria Energy Facility offline, Edmonston Pumping Plant online

[13] A nomogram is a set of operating or scheduling rules which are used to ensure that simultaneous operating limits from different systems and/or areas are respected.

- Low Big Creek Hydro generation dispatch with SCE proposed TCSC Project modeled at 70% Series Compensation
  - Pastoria Energy Facility online, Edmonston Pumping Plant offline
  - Pastoria Energy Facility offline, Edmonston Pumping Plant online

- Existing Rector-Vestal No.2, Magunden-Vestal No.2, and Antelope-Magunden No.1 220 kV lines removed from case and replaced with hypothetical 220 kV double-circuit facilities. The Antelope-Magunden No.1 220 kV line would be replaced by Magunden-Whirlwind No.1 and No.2 220 kV lines.

- Fictitious generator representing San Joaquin Valley area solar generation modeled at the Rector 220 kV Bus with its output increased until a base case overload or system constraint occurred[14]
  - Power flow analysis then performed on select single and double contingency outages to ensure system reliability
  - Additional mitigation and overloads noted where applicable

To assess the additional capacity provided by creating a new corridor, conclusions were drawn from the "existing capacity" and "corridor maximization" analyses.

V. STUDY RESULTS

A. Existing Transmission Capacity in SCE's Big Creek Corridor

In order to maintain system reliability, SCE's Big Creek Corridor has a Base Case south of Magunden flow limitation of 1,200 MW. To approximately deduce the existing capacity in the Big Creek Corridor under current conditions, generation is subtracted from the 1,200 MW South of Magunden flow limit, while load is added, in order to derive the available capacity as shown in Table 4.

Table 4. Approximate Existing Transmission Capacity in the Big Creek Corridor

South of Magunden Flow Limit (MW)	Big Creek Gen Output (MW)	Rector/Vestal Gen Output (MW)	Omar/Sycamore Gen Output (MW)	Big Creek Corridor Load (MW)	Available Capacity (MW) with no Queued Gen*	Queued Generation	Available Capacity (MW) with Queued Gen*
1200	(1029)	(226)	(663)	1276	558	(700)	-142
1200	(1029)	(226)	(663)	638	-80	(700)	-780
1200	(231)	(226)	(663)	1276	1356	(700)	656
1200	(231)	(226)	(663)	638	718	(700)	18

* Negative numbers indicate generation curtailments are required

These results are consistent with recent generation interconnection requests into the Big Creek Corridor. Specifically, smaller Rule 21 projects on the distribution level have been failing fast track transmission dependency tests due to the stability issues in the Big Creek Corridor, but since these projects are considered Energy Only resources by the CAISO, and not modeled in the CAISO Deliverability Study, congestion

[14] The fictitious generation modeled at the Rector 220 kV Bus was modeled as full capacity deliverability status and not energy only status.

management is currently being used to interconnect generation resources coupled with the fact that existing RAS is in place to mitigate reliability issues.

B. Additional Transmission Capacity Provided by Maximizing Existing Corridors

As mentioned in the study assumptions and methodology section, the Rector-Vestal No.2, Magunden-Vestal No.2, and Antelope-Magunden No.1 single-circuit transmission lines were replaced in a 2025 Peak WECC Base Case with a double-circuit line that ultimately connected into the Whirlwind 220 kV Switchrack. Tables 5 to 10 provide the approximate additional transmission capacity considering various combinations of high and low Big Creek and Pastoria Energy Facility generation, Edmonston Pumping Plant load, and proposed TCSC Project[15] series compensation levels.

Table 5. 2025 Peak Base Case, High Big Creek Generation Dispatch, No Proposed TCSC Project

Max Output of Fictitious Rector Generator (MW) without Queued Generation	1st Constraint Identified		2nd Constraint Identified		3rd Constraint Identified	
	Line Name	% Rating	Line Name	% Rating	Line Name	% Rating
Pastoria Energy Facility online, Edmonston Pumping Plant offline						
1,038	Pardee-Pastoria-Warne 220 kV T/L	100	Bailey-Pastoria 220 kV T/L	86	Pardee-Pastoria 220 kV T/L	74
Pastoria Energy Facility offline, Edmonston Pumping Plant online						
728	Magunden-Pastoria No. 2 220 kV T/L	100	Magunden-Pastoria No. 1 220 kV T/L	93	Magunden-Pastoria No. 3 220 kV T/L	73

[15] Since the Big Creek Corridor TCSC Project was not yet approved at the time of this study, scenarios were run with and without it.

Table 6. 2025 Peak Base Case, High Big Creek Generation Dispatch, Proposed TCSC Project at 35% Series Compensation

Max Output of Fictitious Rector Generator (MW) without Queued Generation	1st Constraint Identified		2nd Constraint Identified		3rd Constraint Identified	
	Line Name	% Rating	Line Name	% Rating	Line Name	% Rating
Pastoria Energy Facility online, Edmonston Pumping Plant offline						
1,040	Pardee-Pastoria-Warne 220 kV T/L	100	Bailey-Pastoria 220 kV T/L	86	Pardee-Pastoria 220 kV T/L	74
Pastoria Energy Facility offline, Edmonston Pumping Plant online						
733	Magunden-Pastoria No. 2 220 kV T/L	100	Magunden-Pastoria No. 1 220 kV T/L	93	Magunden-Pastoria No. 3 220 kV T/L	73

Table 7. 2025 Peak Base Case, High Big Creek Generation Dispatch, Proposed TCSC Project at 70% Series Compensation

Max Output of Fictitious Rector Generator (MW) without Queued Generation	1st Constraint Identified		2nd Constraint Identified		3rd Constraint Identified	
	Line Name	% Rating	Line Name	% Rating	Line Name	% Rating
Pastoria Energy Facility online, Edmonston Pumping Plant offline						
1,046	Pardee-Pastoria-Warne 220 kV T/L	100	Bailey-Pastoria 220 kV T/L	86	Pardee-Pastoria 220 kV T/L	74
Pastoria Energy Facility offline, Edmonston Pumping Plant online						
563	Magunden-Pastoria No. 2 220 kV T/L	100	Magunden-Pastoria No. 1 220 kV T/L	93	Magunden-Pastoria No. 3 220 kV T/L	73

Table 8. 2025 Peak Base Case, Low Big Creek Generation Dispatch, No Proposed TCSC Project

<table>
<tr><th rowspan="2">Max Output of Fictitious Rector Generator (MW) without Queued Generation</th><th colspan="2">1st Constraint Identified</th><th colspan="2">2nd Constraint Identified</th><th colspan="2">3rd Constraint Identified</th></tr>
<tr><th>Line Name</th><th>% Rating</th><th>Line Name</th><th>% Rating</th><th>Line Name</th><th>% Rating</th></tr>
<tr><td colspan="7">Pastoria Energy Facility online, Edmonston Pumping Plant offline, (2) new 220 kV shunt capacitor banks required at Springville Substation and (4) new shunt capacitor banks required at Vestal Substation</td></tr>
<tr><td>1,558</td><td colspan="2">Base Case divergence due to voltage collapse</td><td>Pardee-Pastoria-Warne 220 kV T/L</td><td>87</td><td>Bailey-Pastoria 220 kV T/L</td><td>75</td></tr>
<tr><td colspan="7">Pastoria Energy Facility offline, Edmonston Pumping Plant online, (1) new 220 kV shunt capacitor bank required at Springville Substation and (4) new shunt capacitor banks required at Vestal Substation</td></tr>
<tr><td>1,410</td><td colspan="2">Base Case divergence due to voltage collapse</td><td>Magunden-Pastoria No. 2 220 kV T/L</td><td>94</td><td>Magunden-Pastoria No. 1 220 kV T/L</td><td>88</td></tr>
</table>

Table 9. 2025 Peak Base Case, Low Big Creek Generation Dispatch, Proposed TCSC Project at 35% Series Compensation

<table>
<tr><th rowspan="2">Max Output of Fictitious Rector Generator (MW) without Queued Generation</th><th colspan="2">1st Constraint Identified</th><th colspan="2">2nd Constraint Identified</th><th colspan="2">3rd Constraint Identified</th></tr>
<tr><th>Line Name</th><th>% Rating</th><th>Line Name</th><th>% Rating</th><th>Line Name</th><th>% Rating</th></tr>
<tr><td colspan="7">Pastoria Energy Facility online, Edmonston Pumping Plant offline, (1) new 220 kV shunt capacitor bank required at Springville Substation and (4) new 220 kV shunt capacitor banks required at Vestal Substation</td></tr>
<tr><td>1,560</td><td colspan="2">Base Case divergence due to voltage collapse</td><td>Pardee-Pastoria-Warne 220 kV T/L</td><td>87</td><td>Bailey-Pastoria 220 kV T/L</td><td>75</td></tr>
<tr><td colspan="7">Pastoria Energy Facility offline, Edmonston Pumping Plant online, (3) new 220 kV shunt capacitor banks required at Vestal Substation</td></tr>
<tr><td>1,497</td><td colspan="2">Base Case divergence due to voltage collapse</td><td>Magunden-Pastoria No. 2 220 kV T/L</td><td>97</td><td>Magunden-Pastoria No. 1 220 kV T/L</td><td>90</td></tr>
</table>

Table 10. 2025 Peak Base Case, Low Big Creek Generation Dispatch, Proposed TCSC Project at 70% Series Compensation

Max Output of Fictitious Rector Generator (MW) without Queued Generation	1st Constraint Identified		2nd Constraint Identified		3rd Constraint Identified	
	Line Name	% Rating	Line Name	% Rating	Line Name	% Rating
Pastoria Energy Facility online, Edmonston Pumping Plant offline, (1) new 220 kV shunt capacitor bank needed at Springville Substation and (4) new 220 kV shunt capacitor banks needed at Vestal Substation						
1,580	Base Case divergence due to voltage collapse		Pardee-Pastoria-Warne 220 kV T/L	88	Bailey-Pastoria 220 kV T/L	75
Pastoria Energy Facility offline, Edmonston Pumping Plant online, (3) new 220 kV shunt capacitor banks needed at Springville Substation and (4) new 220 kV shunt capacitor banks needed at Magunden Substation						
1,572	Base Case divergence due to voltage collapse		Magunden-Pastoria No. 2 220 kV T/L	99	Magunden-Pastoria No. 1 220 kV T/L	93

Under high Big Creek Hydro dispatch scenarios, the following 220 kV lines were identified to be downstream constraints, which limited the full utilization of the hypothetical 220 kV upgrades:

1. Pardee-Pastoria-Warne 220 kV line (39 miles)
2. Pardee-Pastoria 220 kV line (39 miles)
3. Bailey-Pastoria 220 kV line (12 miles)
4. Magunden-Pastoria No.1 220 kV line (29 miles)
5. Magunden-Pastoria No.2 220 kV line (29 miles)
6. Magunden-Pastoria No.3 220 kV line (29 miles)

Under the low Big Creek Hydro dispatch scenarios, voltage collapse due to insufficient reactive support was the capacity limiting constraint, followed by the same downstream 220 kV line limitations noted in the High Big Creek Hydro dispatch scenarios.

Additional reactive support, such as new capacitor banks at the Springville, Vestal, and Magunden Substations, as well as additional 220 kV line rebuilds and/or reconductoring would be needed in order to fully utilize the additional transmission capacity of a 220 kV solution in the Big Creek Corridor area.

C. Additional Transmission Capacity Provided by a New Corridor

Under the assumption existing corridors are not already maximized, it is unlikely permitting agencies would approve construction of new ROW. However, if such a ROW was approved, it would likely be limited by the same downstream 220 kV line constraints and reactive support issues that were identified in the “maximizing a corridor” scenario. Furthermore, under the assumption that ROWs have already been maximized, a new corridor would again not provide additional transmission capacity given the downstream constraints this technical assessment identified.

VI. CONCLUSIONS

Table 11 identifies the approximate transmission capacity on the SCE facilities most relevant to the San Joaquin Valley Solar effort.

Table 11. Transmission Capacity in Big Creek Corridor from a San Joaquin Valley Solar Perspective

#	Stakeholder Questions	Approximate Transmission Capacity	Explanation
1	What is the existing capacity?	0 MW assuming high Big Creek Hydro output	• Existing and queued generation together exceed the south of Magunden flow limit • Currently queued generation in this area is 700 MW
		18 to 656 MW assuming low Big Creek Hydro output	• Low Big Creek Hydro output from temporary drought conditions may create the opportunity for energy only interconnections • The 18 to 656 MW temporarily replaces the missing hydro output during drought
2	What additional capacity would be provided by maximizing existing corridors?	Additional 563 to 1,580 MW	• Hypothetical upgrade used assumed tearing down approximately 114 miles of single-circuit 220 kV lines and replacing them with double-circuit 220 kV lines • Multiple downstream line and reactive support limitations prevent the full utilization of the new hypothetical 220 kV double-circuit facilities studied
3	What additional capacity would be provided from a new corridor?	Additional 563 to 1,580 MW	• Assuming a corridor is not already maximized • It is unlikely construction of a new ROW would be approved when existing corridors are not maximized • Multiple downstream line and reactive support limitations prevent the full utilization of a new hypothetical 220 kV double-circuit corridor
		No additional capacity without fixing other downstream constraints	• Assuming a corridor is already maximized • If a corridor is already maximized, the same downstream line and reactive support limitations would prevent the new corridor from providing additional capacity

The hypothetical 220 kV single-circuit tear down and rebuild to double-circuit studied in this technical assessment would have a unit cost[16] price tag of approximately $569 million. In addition to the downstream transmission line and reactive support limitations noted in this assessment, other limitations, including but not limited to subtransmission, distribution, short circuit duty, and stability issues, could further impact the approximate transmission capacity in this area. SCE supports appropriate solar development in the San Joaquin Valley Solar area and offers this assessment as a first step with setting realistic and reasonable expectations for generation development pursuing interconnection into the SCE transmission facilities described in this technical assessment. Such generation interconnections would need to request interconnection through the existing CAISO[17] and SCE WDAT[18] generation interconnection processes, as this assessment is not a substitute for the existing processes.

[16] http://www.caiso.com/Documents/SCE2015FinalPerUnitCostGuide.xls
[17] http://www.caiso.com/planning/Pages/GeneratorInterconnection/Default.aspx
[18] https://www.sce.com/wps/portal/home/business/generating-your-own-power/Grid-Interconnections/