

Sustainable Water Management Strategy for Specialty Crop Expansion in the Sacramento Valley:

Executive Summary

Prepared for
Sacramento Area Council of Governments



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EXECUTIVE SUMMARY

The Sacramento Area Council of Governments (SACOG) is an association of local governments in the six-county Sacramento Region of El Dorado, Placer, Sacramento, Sutter, Yolo, and Yuba counties (excluding the Tahoe Basin in Placer and El Dorado counties) and the 22 cities therein. SACOG provides planning and funding for the region and serves as a forum for the study and resolution of regional issues. SACOG prepares the region's long range plan which considers both transportation and land use. Through the lens of rural planning, SACOG has actively engaged in a Rural-Urban Connections Strategy (RUCS) Program that has studied ways to enhance rural economies and natural assets. The RUCS Program includes a scenario analysis modeling tool that links a parcel-level crop map with environmental and economic factors, including a comprehensive profile of per acre operational cost and return metrics for each crop.

The study described in this report looks at how new agricultural crops and markets coupled with improved irrigation techniques will support new specialty crop acreage in the SACOG area. While new and improved irrigation techniques can result in better crop yields and decreased water demands, increases in irrigation efficiency also result in reduced groundwater recharge from irrigation return flows.

SACOG received grant funding from the California Department of Food and Agriculture (CDFA) to evaluate the feasibility of recharging groundwater on agricultural lands within the SACOG portion of the Sacramento Valley to benefit specialty crop production. The primary goal of the project is to bring together a broad range of different factors impacting groundwater recharge and infiltration and to identify areas across the region that are most suited for strategic flooding of specialty crop fields; in other words, areas that will most efficiently and effectively facilitate recharge, while minimizing cost to the specialty crop producer. Ultimately, this feasibility information will be incorporated into SACOG's RUCS model to evaluate the potential benefits of recharging groundwater on agricultural land for the benefit of specialty crops.

TASK 1 – HYDROGEOLOGIC ASSESSMENT AND CONCEPTUAL MODEL

Existing hydrogeologic information for the Sacramento and San Joaquin Valley portion of the SACOG area was reviewed, and a summary conceptual model focused on identifying the key factors relevant to groundwater recharge feasibility was prepared. This high-level review of an area of approximately 3,000 square miles included the following specific tasks:

1. Review and summary of hydrogeologic characteristics of the region.
2. Review and summary of geological suitability for groundwater recharge.
3. General estimation of agricultural water use.
4. Documentation of groundwater elevations and depths.
5. Recommendations for the hydrogeologic factors to be developed for recharge feasibility assessment.

The regional hydrogeological conceptual model is a simplified representation of the groundwater system including the geology, water quality, extent, and flow of groundwater. This review of the hydrogeological components was intended to provide a regional conceptualization of the hydrogeologic factors important to assessing recharge in the Sacramento and San Joaquin Valley portion of the SACOG area and provide datasets to use in spatial recharge feasibility assessment tools. The following recommendations for the application of these information and data to the evaluation of recharge suitability in the Study Area were developed from Task 1 work:

1. Develop indexed geographic coverages of vertical and horizontal hydraulic conductivity for application to the combined recharge suitability index.
2. Develop indexed geographic coverages of unsaturated aquifer thickness from the depth to groundwater datasets presented in this report.
3. Consider developing geographic water use coverage for agriculture. These data were not available for this assessment but may be useful for targeting recharge in the future.

TASK 2 – SUMMARY OF REGIONAL WATER CONVEYANCE INFRASTRUCTURE AND HYDROLOGY

Task 2 focused on recent trends and shifts in irrigation conveyance systems and techniques, including conversion of surface irrigation systems to pressurized systems low-flow systems. This evaluation included the following components:

1. Spatial evaluation of irrigation system types by location
2. General evaluation of changes in irrigation systems in the last 25 years
3. Analysis and summary of applied water by irrigation type and specialty crop
4. Estimation of yields supported by applied water
5. Where possible, determination of water source used for irrigation
6. Where possible, documentation of changes to groundwater recharge that have occurred as a result of conversion to pressurized irrigation techniques

Quantitative and qualitative information on the availability of water from an irrigation water supply and conveyance perspective was compiled to inform scenario development for the RUCS model.

The majority of districts are predominately using surface/gravity irrigation; however, specialty crops may not reflect this proportion. Approximately 20 percent of the land area in the study area has changed from surface irrigation methods to low-flow irrigation methods in the last 25 years. Estimated applied water for each specialty crop within the SACOG region based on 2014 land use mapping was calculated for each primary irrigation type. Typical yield values for each specialty crop were also compiled for this report; however, there is little research on the impact of increasing applied water. Preliminary survey information from field agronomists and farmers in the San Joaquin Valley was used to estimate recharge water in excess of crop water demand that could be applied at different

periods of the year/crop cycle. Surface water availability information was reviewed for irrigation districts within the SACOG region which have specialty crops and where groundwater recharge potential was evaluated; however, this information varied by district and was only closely reviewed for areas where groundwater recharge suitability was feasible.

TASK 3 - RECHARGE-SPECIFIC CONCEPTUAL MODEL

Task 3 focused on evaluating groundwater recharge suitability relative to subsurface characteristics, surface soil properties, and crop type, and includes the following components:

1. Identification and description of recharge suitability factors and criteria used to assess infiltration.
2. Application of groundwater suitability index
3. Evaluation of specialty crops' influence on infiltration rates.
4. Development of per acre metrics for groundwater recharge potential by soil and specialty crop types.
5. Evaluation of nutrient load to groundwater potential from surface flooding on specialty crops

The main objective of this work is to apply an index and overlay method, using GIS, to determine a cumulative recharge suitability score for each field in the SACOG area, and develop ratings of good, fair and poor for groundwater recharge suitability. The results are supplemented and supported by narrative and/or qualitative information on the suitability of crops, soil, and hydrogeologic regions for recharge, and the availability and supply of irrigation water throughout the Study Area.

Good and fair ratings for hydrogeologic, soil and crop suitability converge in the southern portion of Sacramento County, central portion of Yolo County, along the Sutter Buttes, and near the intersection of Yuba, Placer, and Sutter counties. The total acreage of good ratings in the final recharge index is 32,179 during wet conditions and 42,345 acres during dry conditions. Approximately 37% of the fields with good ratings are idle while the remainder are primarily almonds, walnuts, grapes, plums, prunes, or apricots. Throughout the study area, specialty crop fields with good overall potential for recharge are limited and scattered compared to the total specialty crop acreage. Surface water suitability was not included in this evaluation at this time because of the scarcity of information available on surface water availability, though water supply and infrastructure were discussed in stakeholder meetings in Task 4.

TASK 4 – STAKEHOLDER ENGAGEMENT

Stakeholder engagement included seven meetings in total. Project updates were provided to stakeholders at three Northern California Water Association meetings in June 2017, December 2017 and June 2018. At the remaining four meetings, stakeholders were convened to present technical findings and receive feedback on these findings and other

perceptions about groundwater recharge strategies. Attendees included local growers, water district/provider staff, and local planning entities. The stakeholder meetings were held in three targeted areas where groundwater recharge suitability was dominantly good, relative to other areas in the SACOG region. Groundwater conditions, current recharge activities, potential recharge preferences, and challenges with recharge differed in all three areas. Table 1 is a comparison of these factors in the three target areas.

Table 1. Comparison of Groundwater Recharge Considerations in SACOG Region Areas with Good Recharge Potential

Target Area	Groundwater Conditions	Current Recharge	Potential Recharge	Concerns & Barriers	Opportunities
Yuba/Sutter /Placer Counties Corner	<ul style="list-style-type: none"> • Generally good high natural recharge on rice fields • Limited aquifer capacity to store additional water except in western Placer county. 	<ul style="list-style-type: none"> • Little active recharge other than winter flooding of rice fields 	<ul style="list-style-type: none"> • Possibly on orchards in western Placer county; recently increased in acreage and increased water demand 	<ul style="list-style-type: none"> • Growers and irrigation districts do not perceive urgent need for recharge • Relatively good groundwater conditions • Preference for selling available surface water out of the area. 	<ul style="list-style-type: none"> • Local groundwater agencies are involved in broader region-wide effort to sustain groundwater levels, including groundwater banking
South Sacramento County	<ul style="list-style-type: none"> • High incidence of overdraft in aquifer overall • Cones of depression in specific areas 	<ul style="list-style-type: none"> • No active recharge • Pilot studies are beginning because growers see need 	<ul style="list-style-type: none"> • Grape vineyards have the highest potential, and are currently being studied 	<ul style="list-style-type: none"> • Infrastructure to convey surface water is lacking • Area is reliant on groundwater • New infrastructure will be expensive 	<ul style="list-style-type: none"> • Growers see need for recharge and are taking the lead • GSAs will ultimately be able to negotiate incentives to maximize recharge at lowest cost.
Yolo County	<ul style="list-style-type: none"> • Generally good • Some cones of depression in urban areas that are being corrected. 	<ul style="list-style-type: none"> • Some active recharge using winter diversion through unlined canals 	<ul style="list-style-type: none"> • Various non-crop land sites and farmland have potential to expand total recharge quantities if water can be obtained. 	<ul style="list-style-type: none"> • Cost of regulatory permitting for new diversions; expansion of permanent crops is increasing water demand 	<ul style="list-style-type: none"> • Water supplies are available • Several cropland and non-cropland opportunities exist in the area

TASK 5– SCENARIO DEVELOPMENT

SACOG ran the RUCS modeling tool on the following four scenarios, informed by technical information developed in Tasks 1, 2 and 3, and stakeholder knowledge and perceptions collected in Task 4:

- **Base Case - Recharge flooding with 2014 land use crops**
 - Establishes how much additional water volume could achieve with current (2014) cropping and land use patterns, through implementation of an on-farm recharge program throughout the region
 - Limited to only fields with good or fair soil and hydrogeologic suitability
 - Estimated recharge potential of a winter recharge-flooding program
- **Expanding flood tolerant specialty crops on idle lands**
 - Estimates the potential groundwater recharge benefits if idle cropland in areas with ‘good’ or ‘fair’ surface and subsurface suitability were to grow flooding-tolerant specialty crops
 - Crops are expanded in acreage based on their relative proportion in the base case and are allocated based on cropping production factors
- **Recharge flooding with specialty crop expansion**
 - Estimates the potential groundwater recharge benefits if all cropland in areas with ‘good’ or ‘fair’ surface and subsurface suitability were converted to grow flooding-tolerant specialty crops
 - Crops are expanded in acreage based on their relative proportion in the entire base case geography
- **Fallowing for recharge under SGMA plans**
 - Fallow 10 percent of the non-specialty crops grown on land with ‘good’ or ‘fair’ recharge potential (converting these lands to ‘idle’)
 - Fallowed lands would be managed as dedicated winter recharge sites to provide additional recharge capacity

The scenario analysis from the RUCS tool showed that in the base case, the annual specialty crops – which make up less than half of recharge acreage but are responsible for nearly three quarters of total potential recharge – provide a more robust opportunity for recharge, as compared with permanent specialty crops, such as orchards or vineyards. Annual specialty crop growers are able to flood their crops during winter months, when crops are not in the ground, so these growers are better able to apply recharge water liberally, without concern for harming their trees or vine stock.

In the idle conversion scenario, recharge capacity fell 44 percent when idle lands were replaced by specialty crops due to the increase in perennial crops which are more restricted in their recharge capacity compared to idle land. However, the conversion from idle land to specialty crops provides significant economic advantages including 15 percent higher return on investment. It also still provides some opportunity for recharge, with the scenario results showing estimated on-farm recharge potential still exceeded irrigated demand by 35 percent.

The non-specialty conversion scenario showed that the addition of more specialty crop acreage increased return on investment by 20 percent compared to the base case; however, this also came with an increase in labor cost. The scenario also showed increased recharge capacity with nearly 125,000 additional acres of recharge potential, which could yield up to an additional 3.4 million acre-feet of water each season. While adding specialty crop acreage increases returns, the irrigation water demand is 'hardened', decreasing flexibility for farmers to fallow crops when water supplies are limited or spike. This increased demand makes recharge efforts that much more critical when surplus water is available.

The 10 percent non-specialty crop fallowing scenario had the most modest change to the base case of any of the scenarios analyzed. This scenario is a strategy that stakeholders on the ground are considering as a measure to improve groundwater supply and reliability for existing and future specialty crop production. Fallowing 13,900 acres of non-specialty crop land brought modest decreases in overall returns, compared with the base case. Despite the small economic impact, this scenario helps to reduce irrigated water demand by nearly 20,000 acre-feet per year and provides an additional 16 percent, or 334,000 acre-feet, of recharge volume.

The scenario results show that annual specialty crops grown on suitable soils provide the greatest recharge potential of the identified specialty crops; however – with the exception of tomatoes – these crops do not currently represent a significant acreage in the region. While crop constraints limit the recharge capacity of orchard and vineyard crops, compared with annual specialty crops, these croplands are still able to generate recharge. The permanent water demand of established orchard and vineyard crops make recharge even more important. With full grower participation and adequate water supply, the region's growers could restore twice as much water as their crops would need for irrigation. This study highlights the potential for specialty crop growers to improve the reliability of their groundwater supplies.