Sustainable Conservation

District Recharge Program Guidance

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Introduction

Groundwater recharge programs play a vital role in providing long-term sustainability of water resources, especially in overdrafted subbasins. With the increasing challenges posed by climate change, population growth, competing water demands, and the passing of the Sustainable Groundwater Management Act (SGMA), it has become imperative for water districts, groundwater sustainability agencies (GSAs), and their technical consultants to design and implement recharge programs that go beyond traditional and conventional recharge approaches. This guidance document aims to provide comprehensive support to these stakeholders in developing effective and multibenefit groundwater recharge programs and projects.

The purpose of this guidance document is to equip water districts, GSAs, and their technical consultants with the necessary considerations, publicly available tools, and examples to design and refine groundwater recharge programs that address the specific needs and priorities of all stakeholders in their subbasins. By incorporating strategic and innovative approaches, these programs can maximize results benefiting various parts of a watershed, including water quantity and quality, flood risk reduction, ecosystem enhancement, and long-term sustainable economic development.

Key objectives include the following:

- **Aligning recharge programs with Groundwater Sustainability Plans (GSPs) and other regional plans,** emphasizing the importance of designing recharge programs that align with the overarching goals and priorities outlined in the subbasin's GSP and other regional plans. By considering subbasin-wide objectives, such as community drinking water needs, flood mitigation, and ecosystem restoration, recharge programs can contribute to a comprehensive and integrated approach to groundwater management.

- **Expanding beyond conventional groundwater recharge approaches**. Conventional recharge programs often focus solely on replenishing groundwater levels for industry and urban water demands. This document encourages stakeholders to explore and incorporate innovative strategies that yield multiple benefits. Examples include restoring reaches of rivers and other natural waterways to allow flood flows and stormwater runoff to expand and reduce flooding, targeting managed aquifer recharge projects within communities' spheres of influence to strengthen their drinking water resiliency, and promoting conjunctive use of surface water and groundwater to reduce groundwater pumping in overdrafted regions.

- **Integrating multiple stakeholder perspectives**. Effective groundwater recharge programs require transparency, collaboration, and engagement with

diverse stakeholders, including community members, environmental organizations, agricultural industry representatives, and industrial users. This guidance document emphasizes the importance of incorporating stakeholder input throughout the program's development, providing inclusivity, transparency, and long-term support.

- **Enhancing technical considerations**. The document provides a comprehensive set of criteria; resources such as publicly available tools and documents; and examples for evaluating site suitability, recharge method selection best suited for the region, water quality considerations, and monitoring strategies. These technical considerations intend to guide stakeholders in making informed decisions that optimize the efficiency and effectiveness of their recharge programs.

Developing robust groundwater recharge programs is a critical step toward helping ensure sustainable water management in the face of evolving challenges. By using this guidance document, water districts, GSAs, and their technical consultants can design recharge programs that not only replenish groundwater supplies, but also deliver additional benefits to their communities, ecosystems, and local economies.

The information in this guidance document is derived from practical experience gained over more than a decade of working on recharge projects and programs with growers, water districts, and GSAs. These recommendations are based on firsthand observations, results, and lessons learned from implementing groundwater recharge initiatives in collaboration with farmers, water managers, agencies, researchers, and industry.

It is important to note that this paper is not a scientific study but rather a compilation of practical knowledge and field experience. While the information provided is grounded in real-world applications, it is not intended to present formal research findings or statistical analyses. Instead, it draws heavily on the expertise and contributions of academic researchers, local water managers, and their technical consultants who have made significant contributions to the field of groundwater recharge.

Defining Groundwater Recharge Program Goals

Prior to developing a groundwater recharge program, the entire subbasin’s water needs, challenges, and resources should be evaluated. Reviewing available data and results from the local GSP, Regional Flood Management Plan, Habitat Conservation Plan, and

any plans addressing community drinking water resiliency, will help define groundwater recharge program goals that can provide solutions that address the region's most pressing challenges. Recharge programs that address multiple challenges and result in greater benefits to more stakeholders are also more likely to be awarded grants from competitive funding sources and may aid in receiving permits required for implementation.

Targeted recharge can support achievement of GSP goals such as:

- **Flood management.** Divert flood flows off waterways to reduce flood impacts on communities, cities, rural homes, and farmland.
- **Meeting agricultural water demand.** Increase local groundwater supply and reduce detrimental impacts to the local agricultural economy from land fallowing, which would have a ripple effect on local businesses from shippers, handlers, processing facilities, and their labor forces, who typically are residents of nearby communities.
- **Community drinking water security.** Provide sustainable water supply and protect water quality for communities dependent on groundwater for drinking water.
- **Subsidence reduction.** Slow the rate of land settling or sinking caused by groundwater overdraft in regions where affected infrastructure could include canals, dams, roads, highways, bridges, and pipelines.
- **Ecosystem enhancement**. Coordinate recharge programs to reduce harm to local habitat (e.g., by protecting instream flows) while also improving ecological outcomes, such as incorporating floodplain restoration or recharging areas to benefit groundwater-dependent ecosystems.

Recharge programs can combine two or more of the above targeted recharge goals to achieve multiple societal benefits.

Water Rights and Water Sources

Existing Surface Water Rights

It is critical to know what surface water rights currently exist in the subbasin to help ensure that any actions the district, GSAs, and/or landowners or growers may take do not violate water rights or result in unintended consequences. It is also important to understand existing water rights because it may influence the decision on whether to go through the regulatory process to adjust them or apply for new water rights.

A Note on Beneficial Use: Existing permits to divert surface water define the beneficial use that the water will ultimately be used for, which is typically irrigation use in the case of most irrigation district permits. Recharge to groundwater involves temporary storage and is not a beneficial use on its own. Recharge that is conducted for later extraction for irrigation requires a water right permit that specifies the ultimate beneficial use of irrigation. GSAs may have other recharge goals to address undesirable results of groundwater pumping, such as reducing subsidence or supporting groundwater-dependent ecosystems. These non-extractive beneficial uses need to be defined in the water right permit if the intent is to leave the recharged water in the aquifer.

The following are some questions to answer about existing water rights that allow for groundwater recharge projects in the district or subbasin:

Purpose of Use

- What is the beneficial use that is specified under the existing permit to divert surface water?
- What extractive or non-extractive recharge goals does the district or GSA have, and do they align with existing surface water rights?

Time of Use

- Are there limitations on the times of year when surface water can be diverted from natural waterways or water conveyance systems to be used for recharge?
- Once surface water is recharged, are there conditions on when the recharged water can be pumped out?

Place of recharge and place of use

- Where can surface water be diverted and conveyed in the district or subbasin, and are those locations covered by existing permits? Are there certain regions within the district or subbasin where recharge cannot be implemented due to place of use limitations?
- Are there any lands outside of the water district(s) where surface water can physically be diverted for recharge, and are those places included in the permit?
- What is the permitted area in which recharged water can be pumped for ultimate beneficial use? Aligning the permissible place of use with water demand needs can inform where recharge should be targeted.

Diversion quantity

- Do annual or seasonal diversion limits allow enough water to meet irrigation demands while leaving additional water available to divert water for recharge?

Water Sources

It is important to understand what water sources may be present in a district or subbasin because they may or may not be available or suitable for groundwater recharge. Typical water sources are described below.

Major Surface Water Sources with Appropriative Rights

Water sources that are already used for irrigation and that have appropriative rights can also be used for recharge if the existing water right permits it. However, water rights permits contain strict timeframes and volume amounts that may or may not align with the recharge season.

Floodwater

If a district or GSA does not have water rights allowing for recharge, but emergency floodwater diversions are triggered and authorized by local flood control authorities, this water may be diverted off water ways. Under this authority, the diverted water may result in incidental recharge but may not be diverted for recharge and later extraction and use without obtaining a water right permit. Water that is incidentally recharged is still a benefit to the groundwater basin and may be allocated through the GSA's annual allocation process.

In 2023, the Governor issued a series of temporary executive orders clarifying that in areas where imminent flood risk has been announced by a local flood agency, floodwater could be used for recharge outside of the water rights process. Similar langiage was subsequently codified by Senate Bill 122.

Rural Runoff and Overland Flows

In rural areas where local surface water runoff occurs, some landowners have constructed ponds or berms with native vegetation to detain, filter, and recharge this water before it feeds into streams or rivers.

Urban Runoff and Stormwater Flows

Many cities have stormwater basins, with earthen bottoms, that collect and recharge stormwater. Other cities release their stormwater flows into irrigation district canals that can be used to deliver to farm fields for recharge.

Note: Although there are flood reduction and recharge benefits with urban stormwater flow projects, risks to groundwater contamination must be evaluated due to potential

pollutants often found in urban runoff, which can include automobile fluids, brake residue, and other common urban pollutants.

Coordination and Operations Agreements

Since the passage of SGMA, recharge project partnerships between water districts, cities, and counties have become more common to make use of rural and urban stormwater basins for recharge. In some cases, the city or county owns, operates, and maintains an urban stormwater basin during the winter. The water district delivers spring or summer excess surface water at a discounted water rate, and all parties divide the recharge credits at a previously agreed upon percentage. There are also examples of city stormwater runoff conveyed into water district canals and delivered to district facilities, dedicated basins, or farmland for recharge purposes.

Unused Surface Water Allocations

Some water districts have additional unused water in their canals or reservoirs at the end of the irrigation season and have offered this water to growers for private land recharge. Two examples include:

- Using surface water allocations for recharge before it exits a district.
    - Water district coordinates delivering surface water that remains in water district canals at the end of the irrigation season, which would normally drain out of the district, to cooperative growers who divert this water onto their fields to implement on-farm recharge.
- Offering reduced rate surface water allocations to growers willing to implement on-farm recharge after they have completed harvest.
    - One of the benefits of this strategy is creating additional reservoir capacity prior to the upcoming rainy season by releasing surface water for recharge that normally would not have been used. Post-Harvest Recharge Programs offered by San Joaquin Valley water districts have been received well by their growers because it coincides with the beneficial agricultural management practice of refilling the soil profile with moisture after deficit irrigation leading up to harvest. Districts should encourage and possibly monitor the volume of water applied by participating growers to see that sufficient water is applied that will contribute to recharge.
    - It should be noted that there is a risk of having a reduced surface water supply with this option if the upcoming winter is dry and district surface water storage has already been released for recharge. But conjunctive management programs help balance lost surface water supplies and storage with more water stored underground.

Evaluating Potential Water Sources for Recharge

When considering water sources for recharge, an analysis should be conducted prior to implementation to determine whether using these water sources is technically and economically feasible and whether there will be any unintended consequences caused by these types of projects. Some questions to consider follow:

- Which of these water sources are available in the subbasin?
- Is there interconnectivity to existing conveyance system(s) to transport these water sources to recharge locations?
- Would using any of these water sources divert them from habitat or other environmental purposes?
- Would using any of these water sources result in challenges from other water rights holders?
- What is the economic feasibility of using these water sources for recharge in the subbasin?
    - Are infrastructure improvements and permitting required, and what are their associated costs?
    - If using surface water allocations for a post-harvest recharge program, what is the cost of surface water and is it cost effective for recharge?
    - Does the district currently have sufficient locations to recharge the available water sources, or would additional recharge sites need to be established and at what cost? (See next section for evaluation of recharge types and site suitability.)

Changing or Applying for New Water Rights

After analyzing existing water rights and water sources in a subbasin and any limitations to these existing water rights, changing or applying for new water rights might be desired to reach the subbasin's goals. An existing water right can be modified through a petition to the State Water Resources Control Board to change the place or purpose of use or to add new points of diversion. A new water right is needed for additional quantity, source, or season of diversion. It should also be noted that applying for new water rights should only be considered as a last resort.

Recharge programs that seek to capture peak flood flows during the winter and early spring non-irrigation season frequently require new water rights permits. Following is

information about the different water rights pathways available to increase the quantity of water diverted and expand the season of diversion.

Permanent or Temporary Water Rights

If a district or GSA does not have water rights allowing for the intended quantity of groundwater recharge, then applying for new temporary and/or permanent water rights are an option to meet a subbasin's GSP goals. Below are links to resources for various permits:

- Temporary permits
  - **180-day permit**: The 180-day temporary permit for groundwater recharge may be appropriate for short-term projects where an urgent need exists. These permits expire 180 days after the date of issuance.
  - **5-year permit**: The 5-year temporary permit for groundwater recharge is a temporary authorization for local agencies to divert water to underground storage. The 5-year temporary authorization can be a first step in pursuing a long-term project and permanent authorization.
- Streamlined Process for Standard Groundwater Recharge Water Rights
  - The Division of Water Rights developed a streamlined permitting process for diversions of water from high flow events to underground storage. The streamlined process assists GSAs and other local agencies working to address SGMA and adverse impacts caused by extractions.

Recharge Program Design

The following sections describe the actions that districts have taken to design successful recharge programs. These include a thorough assessment of current district recharge potential and barriers, comparison of recharge types, and selection of recharge projects that align with district or GSA groundwater management goals.

Assessing Recharge Potential and Barriers

Districts and GSAs should consider the following recommendations when designing a robust recharge program. Considerations include minimizing potential detrimental impacts to water quality, prioritizing recharge to lands not actively farmed, understanding preferred timing of floodwater delivery, and being prepared prior to the flood season.

Review Existing Regional Plans

After the SGMA passed, most subbasins in California invested significant public and private resources to perform studies and better understand the physical characteristics of their watersheds and to develop a plan to achieve groundwater sustainability. Much of this information is summarized in their GSPs, but there are additional plans and historic data which should be evaluated prior to developing a groundwater recharge program. Below is a list of some examples of water plans to review when developing a recharge program.

- **Groundwater Sustainability Plans.** Align with the local GSP and their identified recharge programs and projects plus associated benefits

- **Flood-Managed Aquifer Recharge (Flood-MAR) Studies.** Use the California Department of Water Resources Flood-MAR Watershed Studies' results and framework as they are developed.

    - For regions that have a completed Flood-MAR Watershed Study, interpret the study's results to plan and implement practical recharge projects that address the subbasin's goals and objectives to meet the most critical groundwater issues and prioritize sites with multiple societal benefits.

    - For regions that do not have a completed watershed study, use the methodology of the Merced Watershed Study, or another completed Watershed Study, to customize recharge programs to meet the subbasin's groundwater goals and objectives.

- **Groundwater Recharge Assessment Tool (GRAT).**

    - For districts and subbasins with a Flood-MAR GRAT, use this decision support tool and process to maximize recharge and prioritize recharge projects with multiple societal benefits.

    - For districts and subbasins with individually developed GRAT, use this decision support tool and process to maximize recharge that targets locally defined groundwater sustainability goals.

- **Regional Flood Management Plans (RFMP).** Review the local RFMP to understand and align local flood management goals with the diversion potential of a groundwater recharge program. This will help to maximize recharge in the subbasin and reduce unmanaged flooding. Strategically placing groundwater recharge projects and green infrastructure improvements, such as expanded floodplains, can reduce flooding while also improving recharge, habitat, and water quality.

- **Other relevant plans,** including Habitat Conservation Plans (HCPs), Integrated Regional Water Management Plans (IRWMPs), and community drinking water plans. Strategically siting recharge activities with habitat restoration and community drinking water replenishment projects within a watershed context can lead to multiple benefits for groundwater level improvements, including ecological and community resiliency.

Examine Regional Hydrogeologic Suitability

Understanding hydrogeologic suitability includes examination of soil permeability and texture; connectivity to the aquifer, including presence of impermeable clay layers; and the depth to groundwater, which helps to establish the subsurface water storage capacity). Other items to consider and evaluate are current groundwater flow gradients and predicting how those gradients may change over time so as to better forecast the fate of the water recharged.

- **Gather local knowledge about soils**. Growers who have actively farmed fields for many years are typically very knowledgeable about soil infiltration rates of their fields and where sandy streaks and heavier soils are located. They are also typically very aware of the depth to the aquifer if they have groundwater pumps near the site. However, connectivity to the aquifer can be harder to determine without deeper analysis.

- **Use publicly available tools to help understand hydrogeologic suitability**. There are some publicly available tools which can be referenced to understand hydrogeologic suitability at a regional scale. Below are two indices which are available to the public.

    - Soil Agricultural Groundwater Banking Index (SAGBI). Developed by U.C. Davis, SAGBI provides an index of a site's recharge potential based on permeability of the top 6 feet of soil. The Modified SAGBI also includes factors for human alterations that would influence soil infiltration, like deep ripping and the use of soil amendments like gypsum.

    - LandIQ Recharge Suitability Index (RSI). This index incorporates SAGBI and underlying geologic characteristics from the Central Valley Hydrologic Model along with depth to groundwater. Since the passage of SGMA, some subbasins have developed local geologic suitability analyses, which may provide more local specificity than the LandIQ RSI.

- **Use results of GSP groundwater models**. GSA consultants have developed conceptual models, and in some cases numerical models, during preparation of the local GSPs that contain detailed information about the spatial hydrologic

suitability of district lands for recharge. These models also provide insights into the likely fate of recharged water within the aquifer.

District Operational Considerations for Siting Recharge Projects

Several factors go into siting recharge projects at the water district level, including working with conveyance systems, protecting water quality, and prioritizing fields based on field and regional recharge suitability. Conveyance and water quality considerations are described below. These factors should be assessed and weighed during the development of a district recharge program because some considerations conflict with others.

Conveyance

One of the first considerations when siting recharge projects is evaluating existing surface water conveyance systems, both at the district and field levels. When designing an on-farm recharge program, it is also important to prioritize fields that have existing flood irrigation systems that allow surface water to be conveyed across a field suited for recharge, or to determine whether temporary surface water conveyance systems can be installed. After determining which regions or specific subsets of fields in your subbasin have surface water conveyance, evaluate the regional hydrogeologic suitability of the area to determine whether recharge would be suitable.

District Level

- It would be wise to prioritize potential recharge sites that have turnouts from main laterals. Main laterals not only have the largest capacity, but also are typically the canals that are first charged with the surface water and the last to drain. Whether designing a winter or post-harvest recharge program, sites along main laterals will have the longest window of time and the most capacity to deliver water to a recharge site.

- Significant recharge can be obtained by filling unlined district canals during the non-irrigation season. This must be coordinated with seasonal maintenance activities as discussed later.

Field Level

- Prioritize delivery of flood releases for recharge on fields that currently have the greatest turnout flow capacity.

- The 2023 Sustainable Conservation On-Farm Recharge Methods Manual outlines various field selection and management strategies to maximize recharge and avoid crop health and water quality impacts.

Protecting Water Quality

Water quality considerations when planning and implementing groundwater recharge projects or programs are mentioned in various sections of this document. For more detailed information on water quality in relation to recharge, there are links to reports in this section. However, a few high-level considerations are also listed that districts and GSAs should keep in mind when designing recharge programs and projects.

Identify High-Risk Recharge Exclusion Areas and Potential Contaminants

- High-risk sites that negatively impact water quality, such as superfund sites, landfills, and manure lagoons, should be excluded from consideration for recharge activities. In this case, avoiding leaching in the first place is the best management strategy. It may also be prudent to establish a "no-recharge" zone around these areas to minimize mobilization of potential contaminants.

- An analysis and consideration of contaminants associated with these sites must also be considered; not only on the site itself, but also neighboring sites since subsurface flows could influence those areas as well.

Develop Relative Risk Assessment

- It is important to identify larger exclusion areas but, even at a smaller level, fields that receive surface water for recharge should be evaluated for potential water quality impacts. Understanding legacy loading history and existing groundwater quality conditions below each recharge location is important prior to implementing recharge. Current farming practices at on-farm recharge sites should be managed to minimize excess soil nutrients and pesticide residues prior to recharge events. For more detailed guidance, see Protecting Groundwater Quality While Replenishing Aquifers.

Identify Community/Domestic Drinking Water Wells

- One of the most important factors to consider when designing a recharge program is the location of community and domestic drinking water wells that could be impacted by recharge activities. Recharge has the potential to cause local groundwater degradation by flushing legacy and ongoing contaminants into the groundwater. In areas with good existing water quality with respect to nitrate, caution should be exercised to avoid worsening currently drinkable water. Alternatively, areas that have poor existing groundwater quality may have the highest potential to benefit from recharge since the introduction of more water may dilute existing contaminant concentrations.

Prioritize Lands Not Actively Farmed

- Water quality risks of recharge can be reduced by selecting lands that are not currently farmed. These fields would not have annual applications of fertilizers

and pesticides, although they may still have legacy accumulations below the root zone from prior farm management. District recharge basins and on-farm recharge basins pose the least risk to drinking water since large volumes of water could be applied when floodwater is available at any time of year.

- Temporary or permanently fallowed fields offer less water quality risks and greater recharge potential than actively farmed fields. This is described in more detail in the “Comparison of recharge types” section below.

Comparison of Recharge Types

There are several forms of recharge options to consider when developing a groundwater recharge program. This section is organized by examples of recharge types typically found on public property and on private property. Some of these recharge types are used in both public and private settings.

Some considerations for both public and private recharge options are their potential water quality impacts, costs, and potential implementation challenges, such as time needed to acquire necessary funding and permits. When implementing an on-farm recharge program, a district may want to consider incentives to increase adoption, education, and outreach to minimize potential negative impacts to crop yield, crop health, and water quality.

District-Owned Recharge Types

Public recharge facilities are most commonly owned, operated, and maintained by water districts, and they may also include facilities owned by cities, counties, or other municipalities.

- Recharging unlined canals allows for both conveyance and recharge.

- Dedicated recharge basins are typically owned by water districts. However, some examples include joint efforts with districts and neighboring cities, counties, towns, or other municipalities. At times, the facility (e.g., a stormwater basin), is owned and operated by a city. But when it is not being used for urban runoff, the water district can provide excess surface water, and both agencies split the groundwater recharge credit.

- Dry wells are used to increase infiltration and recharge below a shallow impermeable clay or hardpan layer. They avoid introducing surface water directly into the aquifer. These projects have less stringent surface water quality requirements compared to injection wells because the input water for dry wells gets filtered by the soil and deeper geology.

- Injection wells are drilled to reach the aquifer. The surface water used on these wells is typically pressurized and injected. Since these wells reach the water table, the quality of the injected water must typically meet drinking water quality standards so that groundwater quality is not compromised. This often requires filtration or treatment of the surface water supply.

- Ephemeral streams, sloughs, and retired gravel quarries are alternative recharge types available to public agencies.

- Floodplains and other habitat areas may be prioritized for recharge by districts to meet multibenefit societal objectives.

Private Land Recharge Types

Recharge conducted on private land is becoming more common. This section briefly describes some private land recharge methods, some of which are also deployed by water districts on their publicly owned land.

On-Farm Recharge

On-farm recharge in its simplest form is delivering surface water to cropland for the purpose of recharging the aquifer. This typically entails applying surface water in excess of the crop's evapotranspiration rate. However, it can also be surface water applied to a fallow field.

- *On-farm recharge on actively farmed fields.*
  The ideal timing to implement on-farm recharge on actively farmed fields is during dormancy of perennial crops and prior to planting annual crops. However, most peak flood releases typically occur in late winter through spring when perennial crops have already leafed out and after annual crops have been planted. Post-harvest recharge is the next preferred timing to implement on-farm recharge on actively farmed fields. Considerations of residual soil nitrogen levels and in-season nutrient and agrochemical input management are critical to avoid potential impacts to crop health, yields, and groundwater quality.

- *On-farm recharge on fallow fields.* The benefits of on-farm recharge over fallow fields rather than actively farmed fields is that it minimizes potential groundwater quality impacts from farm management inputs into active fields and the grower avoids potential crop health risks. These reasons typically allow for more surface water to be applied on fallow fields than on actively farmed fields. However, even though the recharge is on fallow fields, an analysis of legacy nutrients and contaminants present in each parcel still needs to be considered. Due to these factors, using on-farm recharge on fallow fields should likely be prioritized over recharge on actively farmed fields.

Micro Basins

Micro basins are dedicated recharge basins on private property. Some can be just as large, if not larger, than water district dedicated recharge basins. They can either be owned, maintained, and operated by the landowner; or they can be leased from private landowners while operation and maintenance is performed by the water district.

Subterranean Recharge

Subterranean recharge applies surface water through tile drains, or perforated pipes, that have been installed below a crop's root zone. Benefits include minimized risks to crop health and water quality because nutrients present in the root zone are not leached. Consideration of legacy nitrates and other potential contaminants in the vadose zone is still critical.

Dry Wells

There are examples of dry wells at both the district and grower levels. See the detailed description in the District-Owned Recharge Types section directly above.

Injection Wells

There are examples of injection wells at both the district and grower levels. See the detailed description in the District-Owned Recharge Types section directly above.

Align Recharge Projects with Program Goals

After reviewing the recharge goals, examining water sources and water rights, identifying recharge potential and barriers, and understanding various recharge types, the next step is to select recharge project types that align with the district and GSA recharge program goals. Listed here are some considerations to help in this process.

Reevaluate and Prioritize the District Recharge Program Goals

- Which of the district's recharge goals can be achieved given the subbasin's characteristics?
- What is the best way to prioritize and rank the district's recharge goals?
- When recharge water is limited, where should that water go first in order to achieve the maximum benefits for the greatest number of stakeholders?

Identify and Prioritize Mix of Recharge Projects

Select projects that address the district's prioritized recharge program goals and identify those that include more than one benefit that could be prioritized for use of available

surface water. For example, can recharge projects be developed that simultaneously help reduce flood risk and improve a community's drinking water supply or quality?

Consider whether recharge projects with multiple benefits should be prioritized over single benefit projects, especially in years when limited amounts of water for recharge is available.

Implementing a Recharge Program

To successfully implement a district or GSA recharge program, it is important to customize it in a way that increases the likelihood of cost-effective adoption and its desired impact. Some questions a district or GSA should evaluate include the following:

- How can the program be structured best within existing district operations and what internal changes might need to be made?
- What would appeal to growers to increase their buy-in and active participation in the program?
- In what order should a recharge program be implemented?

A recurring theme throughout this document is that each district, subbasin, and watershed has unique characteristics. This section lists some considerations that should be helpful to most districts and GSAs when implementing a recharge program.

District Preparedness

Canal Maintenance

If possible, the water district will schedule and perform off-season canal maintenance prior to high precipitation and flood release months to enable maximum conveyance flexibility for recharge should flood releases become available.

Labor Availability for Recharge

Water district staff responsible for conveying water to fields may not be available during the non-growing season. However, if flood releases are triggered during this time, this staff would be critical to deliver water to recharge sites. Explore flexible contracts as a staffing option rather than disallowing leave for employees during typical water district "off seasons."

Grower Engagement

Education and Outreach

In order to encourage the widespread adoption of recharge on private lands, districts can leverage partnerships and invest in their own programs to increase grower awareness and confidence in recharge methods.

Facilitate Private Land Recharge Field Days and Workshops

Water districts can host or collaborate with other organizations on on-farm recharge field days or workshops. Presentations by water district upper management, staff, board members, and other growers in or near the district who have on-farm recharge implementation experience are especially effective in spreading practical experiences to other growers considering adopting on-farm recharge on their fields.

Collaborate with Partner Organizations

Districts can also engage with other organizations to provide technical information, such as the following:

- Local Resource Conservation Districts
- Technical Service Agencies, in particular the U.S. Department of Agriculture Natural Resources Conservation Service (USDA NRCS)
- The Almond Board of California and other agricultural industry organizations
- U.C. Extension Specialists and Cooperative Extension Farm Advisors specializing in the region’s primary crops
- Non-governmental organizations with on-farm recharge, land repurposing, community assistance, or restoration expertise

Cooperate in Private Land Recharge Research and Monitoring and Demonstration Sites

Districts that cooperate with academic, agency or private researchers have gained valuable local knowledge and increased the visibility of demonstration projects. These cooperative partnerships have resulted in:

- Improved mapping of subsurface recharge potential through use of geophysics.
- Evaluation of water quality effects of on-farm recharge on groundwater.

- Establishment of demonstration projects with district growers to expand grower awareness and refine district delivery, management, and incentive options.

Promote Early Adopter Growers

Districts can collaborate with and encourage growers who are willing to be early adopters of on-farm recharge, micro basins or other types of recharge on their property. Growers willing to implement and highlight their recharge activities are vital in increasing adoption by other growers in the district and throughout the subbasin. Districts can highlight and provide speaking opportunities for in-district and other nearby growers who have implemented on-farm recharge on their cropland. These “Farmers Talking with Farmers” events may encourage greater adoption of private land recharge.

Establish District Pilot Sites

Promoting and establishing on-farm recharge pilot sites, often hosted by the early adopter growers, can be a vital aspect of a water district’s education and outreach program.

Stages of Implementation

It is important to put thought into and strategize the order in which to implement the phases of designing, planning, and rolling out groundwater recharge programs. Below are some examples.

Pilot, Monitoring, and Demonstration Sites

- Pilot sites can simply document data such as the volume and dates of water applied per site and site information like crops, soil types, and rootstock of a perennial crop. Pilot sites can also document management practices that the host grower used to apply and manage the water for recharge.

- Monitoring sites are typically more rigorous than pilot sites. They might employ soil moisture sensors, monitor crop health and yield, and establish control sites to compare with the recharge sites. Their data collection and analysis may also be more involved if the district is willing to invest or partner with academic and/or private researchers.

- Regardless of the level of data collection and analysis, when initially developing an on-farm recharge program, it is important to establish demonstration sites to evaluate potential and to demonstrate the concept to other growers.

Promoting Pilot, Monitoring, and/or Demonstration Sites

- Once successful pilot sites are in place, they offer ideal stories to tell by highlighting the benefits and challenges for other growers to learn and implement on their own properties.

Establishing Incentives

The most successful on-farm recharge programs in California can be found in water districts and GSAs that offer incentives to growers and landowners. Below are examples of some of the financial incentives to encourage private land recharge provided by Central Valley water districts:

- No cost floodwater and discounted surface water allocations for on-farm recharge.

- Fallowing leases for groundwater demand reduction. These agreements can be established for short- to medium-term durations with landowners to fallow their fields either at the end of the productive life of an orchard or vineyard or on annual cropland prior to planting.

- Fallowing leases can also be coupled with habitat restoration along strategic reaches of natural waterways that also provide ancillary recharge and flood risk reduction benefits. These projects could also include financial incentives from state funds that pay for conservation easements and/or flood easements as well, depending on the site.

- Cost-share programs for growers investing in subsurface recharge systems on cropland with orchards and vineyards.

- Partner with USDA NRCS to provide surface water to district growers that receive federal cost-share funding to implement on-farm recharge or micro basin projects.

Some water districts and GSAs have integrated incentives into more comprehensive recharge and water supply programs to achieve their SGMA objectives. These incentives might include the following:

- **Promoting In lieu recharge**. Districts are promoting the use of surface water in lieu of groundwater pumping for irrigation purposes by offering annual surface water sales or formally annexing non-district lands within district boundaries to expand surface water availability.

- **Groundwater allocations and credits.** The most extensive implementation of on-farm recharge can be found in districts that have groundwater pumping

allocations and the ability for growers to increase their groundwater allocations by recharging surface water on their farms.

Sustainable Conservation has produced a summary of district recharge programs led by irrigation districts in the Central Valley, as a companion to this document.

Monitoring, Metering, and Reporting

When implementing a recharge program, monitoring, metering, and reporting is essential to provide accurate accounting of water delivered for recharge and actual recharge occurring in the district or subbasin.

As of 2023, approximately six water districts have already developed water accounting dashboards. Some are currently in their beta phase and are being tested by water district staff and have not been offered to all growers in the district. The few that are being used by growers districtwide have experienced very positive results in improved surface and groundwater management at the field level. Because of this, districts should consider developing and offering an online water metrics dashboard that allows landowners and growers to take more ownership in managing their surface and groundwater allocations. Incentivizing the monitoring and accounting of groundwater use is appreciated by growers because they are allowed to increase their pumping allocation by implementing recharge on their property. The ability for growers to transfer their groundwater pumping allocations between their fields in the same district or GSA also incentivizes multibenefit land repurposing. The fields they have transferred their pumping allocations away from can be repurposed for recharge, solar panels, habitat restoration, and other demand-reduction purposes.

Document Local Recharge Program Goals and Strategies

After reviewing the criteria in this document and determining what is best suited for a particular subbasin, the prioritized portfolio of recharge projects and implementation strategies can be documented and be included as a modification or supplemental document to the local GSP. It is recommended that the documents are created by teaming with technical consultants to help ensure alignment with the GSP projects and management actions. The documents should also address subbasin goals, and pathways toward achievement are to be outlined that minimize risks of triggering any unintended consequences, such as negative impacts on community drinking water, surface water flow conditions, or subsidence.

Examples of Success

Establishing a successful, districtwide recharge program does not happen overnight. The most successful recharge programs in California are found in water districts that

have been willing to invest time and resources in these strategies for many years. In this section, we provide examples of two irrigation district recharge programs.

Madera Irrigation District

Madera Irrigation District (MID) has almost 10 years of experience designing and implementing districtwide on-farm recharge programs. Since they began planning their on-farm recharge programs, they have implemented the program during three wet years (2017, 2019, and 2023), and they have refined their program after each year of implementation. Their upper management and board members have been highlighted in numerous media outlets describing their recharge efforts. One of the most impressive things about MID's on-farm recharge programs is that their growers continue to voluntarily increase their participation in private land recharge for the improvement of the subbasin's groundwater supply. Below is a list of some of the MID strategies.

Financial Incentives Provided to Growers

- **Reduced cost water for on-farm recharge**. The MID Board approved using district funds to decrease water costs to incentivize growers to purchase water to implement on-farm recharge on their cropland and micro basins. At times, the water was provided for free to encourage maximum use for recharge.

- **Surface water bill discount**. In 2022–2023, MID provided a surface water bill credit to growers who were awarded cost-share funding from the USDA NRCS Pilot Recharge Program for implementing on-farm recharge or constructing micro basins. The MID credit was calculated as 15 percent of the USDA NRCS contract (up to $100,000) and further incentivizes these growers to use surface water for irrigation, which reduces the amount of groundwater pumping in their district and subbasin.

On-Farm Recharge Education and Outreach

- **Hosting on-farm recharge grower workshops and field days**. MID presented on-farm recharge program results from previous years and discussed the benefits to the district and subbasin.

- **Providing speaking opportunities.** Speaking opportunities for external organizations actively working with on-farm recharge included agencies, non-governmental organizations, the local resource conservation district, and agricultural industry groups.

- **Promoting "Farmers talking with Farmers" events.** These events disseminated growers' lessons-learned when implementing on-farm recharge.

Using the Groundwater Recharge Assessment Tool (GRAT)

MID served as the beta test site for development of the GRAT decision support tool and has used GRAT to help determine optimal locations for on-farm recharge and district dedicated recharge basins.

Tulare Irrigation District

Tulare Irrigation District (TID) has a long history of developing dedicated recharge basins as part of their conjunctive use strategy. The district has access to 1,300 acres of already developed recharge basins, and they now require a multibenefit approach for any new recharge basins.

In conjunction with their dedicated basins, TID made the decision to further expand their recharge potential. They developed program policies best suited for their district and began offering surface water for recharge to their growers in 2017 and 2019. TID has learned from their previous years' recharge program results. They have made adjustments to best suit their district's characteristics thereby increasing the number of growers participating and the volume of water being recharged. TID incentivized growers to participate by offering groundwater credits for a portion of the water recharged on their fields, which can be used to meet future crop water demand. Below are some details of TID's incentives.

Financial Incentives

- In the past, TID offered reduced cost or no cost water for growers that committed seasonally fallowed fields to receive water for groundwater recharge, but no groundwater credit was allowed.

- The district now offers recharge water supplies at reduced or no cost, and landowners receive a groundwater credit to meet future crop evapotranspiration.

Integrating Incentives as Part of a Groundwater Recharge Program

- TID implemented an emergency ordinance that allocated annual evapotranspiration limits that are generally less than what is needed to meet existing crop demands. This created an incentive for growers to increase their allocations by participating in recharge practices.

- The development of a water dashboard allows growers to manage their surface and groundwater use and facilitates increased groundwater pumping allocations when implementing recharge on their fields.

Education and Outreach

- The GSA established committees made up of water district directors and representatives from disadvantaged communities, environmental groups, cities, and counties to discuss recharge strategies and benefits.
- TID conducted extensive grower outreach and solicitation of input to build support for the groundwater pumping allocation system and the water dashboard.
- The district hired staff with the sole purpose to support growers in their understanding of the SGMA, evapotranspiration allocations, and to assist growers with the funding and logistics of groundwater recharge projects.
- Staff developed several outreach tools and materials ahead of program implementation and allocations that helped landowners understand the direction of the programs. When implementation took place, many landowners were ready.

Future Recharge Strategies

- Multibenefit recharge is required for future dedicated basins. Although TID has limited plans for developing new dedicated recharge basins, the district still plans to build recharge basins in targeted areas where they can gain multiple benefits, including community drinking water benefits and recharge in areas with overdraft. TID acquired funding and is starting to implement a community drinking water recharge project (the Okieville Dedicated Recharge Basin) for the disadvantaged community of Okieville.

Summary of Early Recharge Adopters

All watersheds in California are unique and have their own local characteristics that differ from their neighboring subbasins. However, MID and TID both share some similarities that led to their successful recharge programs, which can hopefully influence other districts and GSAs that also want to design their own recharge programs. Below are some characteristics these districts share that contributed to their successful recharge programs.

- Listening to and collaborating with external organizations.
- Progressive upper management and district board members that were willing to 1) be early adopters and invest district resources of funding and staff time to provide water for recharge, and 2) educate and incentivize their growers about successful methods and benefits of on-farm recharge.

- Growers accepted and adopted recharge as an investment in long-term improvements for their farming operations, their neighbors, their subbasin, and the district.