Napa County Water Conservation Workplan

A Guide for Vineyards, Wineries, and Other Water Users

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NAPA COUNTY WATER CONSERVATION WORKPLAN

A GUIDE FOR VINEYARDS, WINERIES, AND OTHER WATER USERS

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The Napa County Groundwater Sustainability Technical Advisory Group (TAG) is made up of five experts who provide guidance on the implementation of the Groundwater Sustainability Plan. The TAG has provided input on the direction, scope, and breadth of this Workplan. The Napa County Groundwater Sustainability Agency appreciates the contributions of the five members listed below:

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ORGANIZATIONS

During GSP implementation and throughout the development of multiple Workplans (including this Workplan), many organizations and individuals provided valuable input. The Napa County Groundwater Sustainability Agency appreciates the contributions of the organizations listed below:

California Department of Fish and Wildlife (CDFW)
California Sustainable Winegrowing Alliance
Napa County Farm Bureau
Napa County Resource Conservation District
Napa County Flood Control District
Napa Green
Napa Valley Grapegrowers Association
Napa Valley Vintners Association
National Marine Fisheries Service (NMFS)
Save Napa Valley Foundation
University of California Davis – Center for Watershed Sciences
University of California Berkley Extension
Winegrowers of Napa County

On behalf of the Napa County Groundwater Sustainability Agency, thank you to all of the community members who participated in public meetings, information sessions, and various outreach events. Your input was vital to shaping this Workplan

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LIST OF ACRONYMS AND ABBREVIATIONS

Acronym	Meaning
AB	Assembly Bill
AF	Acre-Feet
AFY	Acre-feet per year
ARS	USDA Agricultural Research Service
BMP	Best Management Practices
BOD	Biochemical Oxygen Demand
Cal Poly	California Polytechnic State University San Luis Obispo
CCSW	Certified California Sustainable Winegrowing
CDFA	California Department of Food and Agriculture
CIC	Conservation Incentive Contracts
CSWA	California Sustainable Winegrowing Alliance
DU	Distribution Uniformity
DWR	Department of Water Resources
EPA	Environmental Protection Agency
EQIP-CIC	Environmental Quality Incentives Program Conservation Incentives Contracts
ESG	Environmental, Social, and Governance
ET	Evapotranspiration
FFF	Fish Friendly Farming
GPR Workplan	Groundwater Pumping Reduction Workplan: Napa Valley Subbasin
GSA	Groundwater Sustainability Agency
GSP	Groundwater Sustainability Plan
GSPAC	Groundwater Sustainability Plan Advisory Committee
HSP	Healthy Soils Program
ITRC	Irrigation Training and Research Center
ITRC	Irrigation Training and Research Center

Acronym	Meaning
M&I	Municipal and Industrial
MWELO	Model Water Efficient Landscape Ordinance
NCGSA	Napa County Groundwater Sustainability Agency
NRCS	Natural Resources Conservation Service
PMA	Projects and Management Actions
RCD	Resource Conservation District
SB	Senate Bill
SGMA	Sustainable Groundwater Management Act
SIP	Sustainability in Practice
SMC	Sustainable Management Criteria
Subbasin	Napa Valley Groundwater Subbasin
SWEEP	State Water Efficiency and Enhancement Program
SWP	State Water Project
SWRCB	State Water Resources Control Board
TAG	Technical Advisory Group
TDR	Temperature Domain Reflectometry
UCCE	University of California Cooperative Extension
USDA	U.S. Department of Agriculture
UV	Ultraviolet
WC Workplan	Napa County Water Conservation Workplan
WDR	Waste Discharge Requirements
WY	Water Year

EXECUTIVE SUMMARY

The first recorded six-year drought in California history was from 1987-1993. Since then, there was a five-year drought in 2012-2017, as well as two, three-year droughts in 2007-2009 and 2020-2022. These events are part of a changing California climate where "we are experiencing extreme, sustained drought conditions in California and across the American West caused by hotter, drier weather. Our warming climate means that a greater share of the rain and snowfall we receive will be absorbed by dry soils, consumed by thirsty plants, and evaporated into the air" (California's Water Supply Strategy, Adapting to a Hotter, Drier Future. Governor's Office, August 2022). Napa County is experiencing these same weather extremes with increasing hotter, drier years, and less frequent wet years. The patterns of rainfall have also changed with more extreme rainfall events. In general, groundwater levels in the underlying aquifer of the Napa Subbasin are highly responsive to annual rainfall.

To adapt to the changing climate and build climate resiliency across Napa County, water conservation needs to become a way of life. This Water Conservation (WC) Workplan outlines water conservation practices that could be implemented for all users.

The WC Workplan was first envisioned during the development of the Napa Valley Subbasin Groundwater Sustainability Plan (GSP), which was submitted to and approved by the California Department of Water Resources. Following adoption of the GSP, the Napa County Groundwater Sustainability Agency (NCGSA) is now implementing the GSP to ensure that the Napa Valley Subbasin (Subbasin) achieves and maintains sustainable groundwater conditions. As required by the GSP Regulations (California Code of Regulations Title 23, 23 CCR 354.44), this includes developing a series of Projects and Management Actions that will be (or may be) implemented in the Subbasin to achieve the sustainability goal:

- To protect and enhance groundwater quantity and quality for all beneficial uses and users of groundwater and interconnected surface water in the Napa Valley Subbasin both now and in the future.
- The NCGSA will implement sustainable management criteria and an adaptive management approach supported by the best available information and best available science, resulting in the absence of undesirable results within 20 years *from GSP adoption.*

While the WC Workplan is focused on groundwater resources within the Subbasin, many of the practices and tools outlined can be implemented throughout Napa County. The WC Workplan summarizes the opportunities, costs, and potential funding sources for achieving water conservation that results in a reduction in total groundwater pumping and a reduction in net depletion from the Subbasin aquifer system. The specific objectives of the Workplan are:

- Summarize current water use and water conservation practices in the Subbasin.
- List and describe water conservation practices that may be expanded or adopted in the Subbasin by different water users.
- Identify technical assistance, funding opportunities, and other technical resources that are available for businesses and individuals seeking to implement water conservation practices.
- Describe how water conservation will be measured and monitored, and how businesses and individuals can assist.

The GSP specified Management Action #1: Water Conservation to encourage water users to continue to implement water conservation practices and provide flexibility as to how, and to some degree, when the conservation is achieved. The GSP section on the water conservation management action contains all the information required by 23 CCR 354.44, including the Measurable Objective expected to benefit from the management action, which is the sustainability indicator for depletions of interconnected surface water. The reduction in groundwater pumping necessary to reduce streamflow depletion to levels consistent with the sustainability goal is estimated to be a 10 percent reduction in pumping from the average annual historical (2005 to 2014) pumping in the Subbasin of about 15,000 acre-feet. A 10 percent reduction in Subbasin-wide pumping was incorporated in the GSP as an interim Measurable Objective (approved by the GSP Advisory Committee) for the sustainability indicator for depletions of interconnected surface water. The GSP indicates that "steps to achieve this objective would begin following NCGSA adoption of the GSP. Members of the GSPAC considered a pumping reduction to be feasible, and one means of achieving this objective is to expand water conservation efforts throughout the Subbasin." Although the reduction in pumping is a Subbasin-wide goal, it may also be achieved through site-specific, focused efforts, particularly those that reduce depletion of interconnected surface water. This may be accomplished by combining reductions in pumping with other demand management and/or supply augmentation approaches.

This Water Conservation (WC) Workplan outlines water conservation practices that could be implemented to reduce groundwater pumping and achieve sustainability. This WC Workplan is a companion document to the Napa County Water Groundwater Pumping Reduction Workplan: Napa Valley Subbasin (GPR Workplan). The GPR Workplan describes water conservation measures, costs, and potential Subbasin-wide benefits of each measure. In contrast to this Workplan, the GPR Workplan is developed as a technical analysis of water conservation practices and includes an implementation plan by the NCGSA for achieving the groundwater sustainability goal. This WC Workplan is related to the GPR Workplan but targeted to the water user that is interested in implementing water conservation practices.

ES-1. Water Conservation Goal

The Subbasin water conservation goal is to reduce Subbasin-wide groundwater pumping and achieve the groundwater sustainability goal.

ES-2. Recent and Historic Groundwater Use

Estimates of groundwater pumping in the Subbasin for 2005 through 2022 indicate an increase in pumping, especially during the recent hotter, drier years in Water Years 2020, 2021, and 2022. Hotter, drier conditions increase crop evapotranspiration (ET) and, as a result, the demand for water by agriculture. The average annual groundwater pumping for 2005 to 2014 was about 15,000 acre-feet (AF) and is similar to the current estimate of sustainable yield of 15,000 AFY. The average annual groundwater pumping for the period 2015 to 2022 was 18,150 AF (**Table ES-1**), which is significantly greater than the sustainable yield. Increased groundwater pumping and lack of recharge due to hotter, drier conditions led to lowered groundwater levels in Water Years 2021 and 2022.

Table ES-1. Historic and Recent Groundwater Extraction by Sector					
Water Year Range	Water Use Sector (AF)				Total Groundwater Extraction (AF)
	Agricultural	Rural Residential	Municipal	Wineries	
Average (2005-2014)	11,110	2,680	390	820	**15,000**
Average (2015-2022)	13,780	3,230	350	790	**18,150**

ES-3. Water Conservation Best Management Practices

The WC Workplan developed a list of voluntary water conservation best management practices (BMPs) for human-related needs including rural domestic, agricultural, and industrial water users. Environmental uses of groundwater are intentionally excluded from this WC Workplan as there are no expectations to reduce environmental uses of groundwater. Best management practices are categorized by those that apply to: (i) all water users, (ii) vineyards, (iii) wineries, (iv) other industrial/commercial, and (iv) urban and residential customers. Practices in WC Workplan include:

- **Water measurement**. Measuring water (using meters or other methods) provides new information to water users that allow them to take actions to reduce water use.
- **Recycled water**. Recycled water is treated wastewater that is then delivered for other uses, typically landscape irrigation and agriculture.
- **Benchmarking**. Benchmarking programs provide water users with an anonymous summary of how their water use compares to a group of similar (anonymous) peers to encourage water savings.
- **Irrigation system efficiency improvements**. This includes a range of actions from fixing leaks to improving irrigation system management and distribution.
- **Distribution uniformity testing**. Testing irrigation systems to evaluate how evenly water is distributed to the field helps identify areas where the system is performing poorly, which can help prevent over or under-irrigation.
- **Plant and soil moisture monitoring**. There are multiple technologies available to vineyards to monitor plant and soil moisture to precisely schedule crop irrigation and protect productivity and fruit quality.
- **Soil management**. Managing soil health with cover crops, mulching, and other practices can provide water benefits by improving infiltration and soil retention.
- **Canopy management**. Vineyard canopies are carefully managed for productivity and fruit quality, specific actions can be taken to reduce crop consumptive water use and save water.
- **Row orientation**. At planting or replanting the orientation of the rows affects sun and wind exposure, which affects crop consumptive water use.

- **Rootstock selection**. Vineyard rootstocks are selected for pest and disease resistance and some varieties provide drought tolerance that can help manage water during times of shortage.
- **Waterless sanitation**. Wineries must use water for cleaning and other activities at the winery, and new technologies are available to reduce water use in this process.
- **Processing water reuse**. Winery process wastewater must currently be treated and managed, additional treatment can make the water usable for landscaping or vineyard irrigation purposes.
- **WaterSense devices.** "WaterSense" devices are products certified by the U.S. Environmental Protection Agency that are at least 20 percent more water efficient than other products on the market. Installation of these in homes and businesses can generate substantial water savings.
- **Other Urban Water Conservation Opportunities**. Other water conservation opportunities for urban (M&I) water users include planting drought-tolerant or native landscaping for residential and commercial buildings, additional outreach and education efforts to landscape design professionals, use of reclaimed water for outdoor irrigation, use of mulches to reduce outdoor irrigation demand, and general improvements in outdoor irrigation scheduling and management.

Each practice was evaluated for its potential water savings and what it would cost to adopt. Costs include both up-front costs (e.g., to purchase new equipment) as well as ongoing annual costs (e.g., additional management labor time). Potential water savings are expressed as a percent over typical/average water use when a practice is implemented. Water savings are generally not additive. For example, benchmarking results in water savings because water users make investments or change water use behavior, which may include investing in low-flow water fixtures (WaterSense). **Table ES-2** summarizes the potential water savings and costs of adoption to water users for each practice.

Table ES-2. Summary of Water Conversation Practices			
Practice	**Upfront Cost**	**Annual Costs**	**Potential Water Savings**
Unit	**$ (units as indicated)**	**$ (units as indicated)**	**% (relative to baseline water use)**
Water Practices for All Water Users			
Water Measurement[3]	$600 - $2,500/well	$100/well	5%
Recycled Water	N/A	$362 - $720/AF	100% (In lieu)
Benchmarking	N/A	N/A	10%
Vineyard-Specific Water Practices (Established)			
Irrigation System Efficiency[2,3]	$2,500/acre	$126/acre	6 – 20%
Distribution Uniformity[1]	$1,200 - $2,000/field	Varies based on needed maintenance	9 – 23%
Plant Water and Soil Moisture Monitoring[2,3]			5 – 16%
High Tech, Low Labor (TDR)	$1,640 – $3,500/sensor	$32/acre	
Medium Tech and Labor (Neutron Probe)	$5,000 - $10,000/sensor	$40/acre	
Low Tech, High Labor (Tensiometers)	$100 - $600/sensor	$32/acre	
Soil Management (Cover Crop) [3,4]	$154/acre	$260/acre	4 – 14%
Canopy Management	N/A	$360/acre	15%
Vineyard-Specific Water Practices (New Plantings)			
Row Orientation	Low	N/A	18 – 30%
Rootstock Selection	Low	N/A	Data Gaps
Winery-Specific Water Practices			
Waterless Sanitation	$50,000	Data Gaps	80%
Processing Water Treatment and Reuse	Data Gaps	Data Gaps	100% (In lieu)
Municipal, Industrial, and Residential Water Practices			
WaterSense Devices[5]	$2,710/household	N/A	20%
Other Urban Water Conservation[6]	Data Gaps	Data Gaps	Data Gaps

[1] *Eligible for cost-share funding or other technical support through the Napa RCD.*

[2] *Eligible for cost-share funding through the State Water Efficiency and Enhancement Program (SWEEP).*

[3] *Eligible for cost-share funding through the Environmental Quality Incentives Program Conservation Incentives Contracts (EQIP-CIC).*

[4] *Eligible for cost-share funding through the Healthy Soils Program (HSP).*

[5] *Eligible for financial assistance programs in select municipalities in Napa County.*

[6] *Example opportunities include improved outdoor irrigation management, low water use landscaping, and use of reclaimed water for outdoor irrigation. Detailed cost and scalability data were not available for initial workplan development. Additional information will be provided as part of education and outreach for Workplan implementation.*

ES-4. Financial Assistance Programs

The cost of adopting water conservation practices can be a barrier to adoption. There are a number of financial assistance programs available that can offset costs. These programs can provide free equipment or services, such as technical assistance, or financial incentives such as cost-share reimbursements, incentive payments, or rebates.

ES-4.1. Agriculture Financial Assistance Programs

A range of local, state, and federal programs can help agricultural producers with improving on-farm water efficiency through technical assistance, technology adoption, and practice adoption. Example programs include:

- **Napa County Resource Conservation District (RCD) Irrigation Evaluations**: The Napa RCD offers irrigation evaluations free, a service that is valued at $2,000. The RCD also supports growers with applications to state and federal grant programs such as the State Water Efficiency and Enhancement Program (SWEEP) and Environmental Quality Incentives Program (EQIP).
- **State Water Efficiency & Enhancement Program, California Department of Food and Agriculture (CDFA)**: SWEEP provides funding for on-farm projects that save water and reduce greenhouse gas emissions. SWEEP has historically funded projects that incorporate soil moisture probes, weather stations, plant water stress monitoring, evapotranspiration monitoring, plant health monitoring (e.g., NDVI), pump retrofits, low-volume irrigation systems, and more.
- **Healthy Soils Incentive Program, CDFA**: HSP, also offered by CDFA, incentivizes the adoption of farm and ranch management practices that improve soil health and reduce greenhouse gases. Projects in Napa County that are commonly funded include cover cropping, mulching, compost application, and planting native vegetation in the form of hedgerows.
- **Environmental Quality Incentives Program, U.S. Department of Agriculture (USDA) Natural Resources Conservation Service**: NRCS provides technical assistance and offers financial assistance programs to address natural resource concerns on agricultural lands. Examples of projects include cover cropping, irrigation water management, mulching, and on-farm recharge, among others. Conservation practices must address a particular NRCS resource concern at the time of application.

ES-4.2. Urban and Residential Financial Assistance Programs

Financial assistance programs are available to help residents and businesses reduce water use. In general, programs run by municipalities are only going to be available to water users within (or at least near to) the city limits of that municipality or its service area. County-wide programs and resources are often available to more users. Example programs include:

- **Water Conservation Kits:** The following cities and towns offer free water conservation kits, which include items such as a low-flow shower head, a garden hose nozzle, a shower timer, sink aerators, and more: City of Calistoga[1], City of Napa[2], and City of St. Helena[3].
- **Rebate Programs**: The City of American Canyon[4] has a $100 rebate program for toilet replacement with a WaterSense toilet. The City of St. Helena[5] has several rebates available for toilet replacement, irrigation controllers, greywater, rainwater harvesting, and recirculation.
- **Cash-for-Grass Programs:** The following cities and towns have cash-for-grass programs, in which the city will pay customers to remove turfgrass: American Canyon[6], City of Napa[7], Town of Yountville[8], and City of St. Helena[9].

ES-5. Incentivizing Adoption of Water Conservation Practices

This WC Workplan develops a list of alternatives to encourage adoption of water conservation practices. These range from outreach, education, and financial incentives to programs that encourage behavioral change. Programs to encourage behavioral change include benchmarking and certification programs.

Outreach and education. There are multiple resources available to Subbasin water users that are considering implementing water conservation practices (see Section ES-6, below). Outreach and education activities encourage water conservation by informing water users about the need to conserve water and ways that they can take voluntary actions to reduce water use.

Financial incentives. The WC Workplan and its companion document the GPR Workplan outline a list of potential financial incentives that could be available to encourage water users to adopt water conservation practices. Water conservation practices reduce strain on groundwater resources and directly reduce the cost of implementing the GSP in the Subbasin. In addition, water users that meter or measure water use, and can share that data with the Groundwater Sustainability Agency, also reduce the cost of implementing the GSP. The Napa County Groundwater Sustainability Agency is continuing to evaluate options for passing these cost savings on to water users that implement water conservation practices or provide data.

[1] https://www.ci.calistoga.ca.us/city-hall/departments-services/public-works-department/water-wastewater-treatment/water-conservation
[2] https://www.cityofnapa.org/593/Free-Water-Saving-Devices
[3] https://www.cityofsthelena.org/publicworks/page/water-conservation-rebates
[4] https://portal.laserfiche.com/f0791/forms/PWtoiletrebate
[5] https://www.cityofsthelena.org/publicworks/page/water-conservation-rebates
[6] https://www.cityofamericancanyon.org/government/public-works/environmental-services/water-conservation
[7] https://www.cityofnapa.org/585/Cash-For-Grass
[8] https://www.townofyountville.com/350/Water-Conservation-Plan
[9] https://www.cityofsthelena.org/publicworks/page/water-conservation-rebates

Certification programs. Certification programs verify that specific management practices or other standards are met. A certifier is typically a third-party that is responsible for setting standards, working with businesses to become certified, and then verifying that businesses comply with the required management practices over time. Adopting specific management practices or production standards can provide numerous benefits to the Subbasin and the broader Napa County community. Adoption of best practices conserves water, soil, and other natural resources, improves air and water quality, and can improve wildlife habitat. Several certification programs exist for vineyards and wineries. Examples include Napa Green, California Sustainable Winegrowing Alliance, SIP Certified, Lodi Rules, and Fish Friendly Farming.

Benchmarking. Benchmarking programs provide water users with an anonymous summary of how their water use compares to a group of similar (anonymous) peers to encourage water savings. For example, many energy providers provide customers with a summary of how their energy use compares to that of their (anonymous) peers. By simply providing this information to customers, these programs have been demonstrated to result in changes in customer energy (or water) usage. A conceptual water benchmarking program for the Subbasin was developed.

ES-6. Stakeholder Resources

For stakeholders looking to stay engaged and expand their knowledge on water conservation in Napa County, there are several opportunities to participate in public meetings. Stakeholders may also get involved with other noteworthy organizations offering comprehensive programming and resources, a handful of which are described below. These entities serve as valuable hubs for learning, collaboration, and staying informed about the latest advancements in sustainable water management practices.

ES-6.1. Napa County Groundwater Sustainability Agency

The NCGSA has two ongoing forums for public meetings and input by the public: the NCGSA Board of Directors and the Technical Advisory Group (TAG). The TAG was formed as a group of independent subject matter experts to consider and make technical recommendations to the NCGSA Board and staff on the various projects and workplans to help implement the GSP. NCGSA and TAG meetings are open to the public, whereby the public may participate in person or virtually. To learn more about NCGSA and TAG meetings, visit the NCGSA's Get Involved[10] webpage.

Furthermore, the NCGSA sends regular emails related to public meetings of the NCGSA and TAG, groundwater and water policies, drought, and more. To sign up for these email updates, stakeholders should visit the Newsletter Subscription Signup Form[11].

[10] https://www.countyofnapa.org/3079/Get-Involved
[11] https://countyofnapa.us12.list-manage.com/subscribe?u=e561ed61f04917d7c09de30fa&id=3a9af85d67

ES-6.2. Other Resources

A number of other local organizations provide valuable resources for Napa stakeholders to learn about water conservation, including: Napa County RCD[12], Napa County University of California Cooperative Extension[13], the Napa County Watershed Information & Conservation Council[14], U.S. Department of Agriculture Natural Resources Conservation Service[15] (NRCS) with a local service center in Napa, Napa Green[16], California Sustainable Winegrowing Alliance[17], Napa Valley Grapegrowers[18], Napa County Farm Bureau[19], Winegrowers of Napa County[20], and Napa Valley Vintners[21].

[12] https://naparcd.org/our-services/
[13] https://cenapa.ucanr.edu/
[14] https://www.napawatersheds.org/
[15] https://www.nrcs.usda.gov/conservation-basics/conservation-by-state/california
[16] https://napagreen.org/
[17] https://www.sustainablewinegrowing.org/
[18] https://www.napagrowers.org/
[19] https://www.napafarmbureau.org/
[20] https://www.napawinegrowers.com/
[21] https://napavintners.com/

1 INTRODUCTION

The Napa Valley Subbasin Groundwater Sustainability Plan (GSP) was submitted January 31, 2022 to and approved by the California Department of Water Resources on January 26, 2023. The Napa County Groundwater Sustainability Agency is now implementing the GSP to ensure that the Napa Valley Subbasin (Subbasin) achieves and maintains sustainable groundwater conditions. The Napa Valley Subbasin GSP includes projects and management actions for achieving the sustainability goal as required by GSP Regulations. It defines undesirable results associated with overuse of the groundwater resource, sets targets for managing groundwater levels and other sustainable management criteria, and defines a series of projects and management actions (PMAs) that will be implemented to achieve sustainable groundwater conditions in the Subbasin over a 20-year implementation period and into the future.

Increasing variability in precipitation patterns is placing strains on the Subbasin groundwater resources that support economically important farming, winery, commercial, and residential industries across Napa County. In particular, drought conditions in Water Years 2020 through 2022 resulted in the Subbasin exceeding its minimum thresholds for sustainable groundwater conditions. To increase resilience to future droughts and comply with state law, including the 2014 Sustainable Groundwater Management Act (SGMA), the Napa County Groundwater Sustainability Agency (NCGSA) is evaluating ways to use surface water and groundwater resources more wisely and efficiently.

The GSP specified projects and management actions that the NCGSA will take to implement the GSP. Following adoption of the GSP, initial GSP implementation for Management Action #1: Water Conservation (WC) has involved development of the WC Workplan as specified in the GSP. The GSP section on the WC management action contains all the information required by 23 CCR 354.44, including the Measurable Objective expected to benefit from the management action, which is the sustainability indicator for depletions of interconnected surface water. Management Action #1: WC is intended to encourage water users to continue to implement water conservation practices and provide flexibility as to how, and to some degree, when the conservation is achieved. The Napa County WC Workplan was conceptually defined during the GSP development process with input from stakeholders and the Groundwater Sustainability Plan Advisory Committee (GSPAC) Workgroup. The workplan is one of several approaches described in the GSP to achieve sustainable groundwater management, and is targeted to all users of groundwater, including agriculture, wineries and other industrial users, and domestic users. The purpose of this Napa County WC Workplan is to:

- **Define current water use and water conservation practices in the Napa Valley Subbasin**. Many businesses and individuals have already invested in water conservation practices, and it is critical to document current practices to understand where such measures have not yet occurred or where additional conservation measures may be feasible.
- **List and describe water conservation practices that may be expanded or adopted in the Napa Valley Subbasin**. The WC Workplan defines water conservation practices, potential water savings, and costs.

- **Document technical assistance, funding opportunities, and other technical resources that are available for businesses and individuals seeking to implement water conservation practices**. Implementing water conservation practices takes time and can require substantial upfront costs. There are a range of local organizations that provide technical assistance and state and federal funding opportunities to implement water management practices.
- **Describe and analyze approaches to measuring and monitoring water conservation practices, and current data limitations**. Measuring water conservation practices requires a careful accounting of baseline conditions against which water savings can be measured. This requires defining how water conservation is measured as well as developing the necessary data to measure any savings.
- **Outline engagement opportunities and other resources for interested stakeholders.** The WC Workplan describes how stakeholders may get involved with the NCGSA and other organizations that are advancing water conservation.

The GSP specified Management Action #1: Water Conservation to encourage water users to continue to implement water conservation practices and provide flexibility as to how, and to some degree, when the conservation is achieved. The GSP section on the water conservation management action contains all the information required by 23 CCR 354.44, including the Measurable Objective expected to benefit from the management action, which is the sustainability indicator for depletions of interconnected surface water. The reduction in groundwater pumping necessary to reduce streamflow depletion to levels consistent with the sustainability goal is estimated to be a 10 percent reduction in pumping from the average annual historical (2005 to 2014) pumping in the Subbasin of about 15,000 acre-feet. A 10 percent reduction in Subbasin-wide pumping was incorporated in the GSP as an interim Measurable Objective (approved by the GSP Advisory Committee) for the sustainability indicator for depletions of interconnected surface water. The GSP indicates that "steps to achieve this objective would begin following NCGSA adoption of the GSP. Members of the GSPAC considered a pumping reduction to be feasible, and one means of achieving this objective is to expand water conservation efforts throughout the Subbasin." Although the reduction in pumping is a Subbasin-wide goal, it may also be achieved through site-specific, focused efforts, particularly those that reduce depletion of interconnected surface water. This may be accomplished by combining reductions in pumping with other demand management and/or supply augmentation approaches.

The target audience of this WC Workplan is stakeholders, businesses, and individuals in the Subbasin that are interested in implementing water conservation practices. A companion document, the Groundwater Pumping Reduction: Napa Valley Subbasin (GPR) Workplan, includes additional technical details on individual conservation practices and supporting analyses and lays out an implementation plan for NCGSA to achieve groundwater pumping reduction.

It is important to emphasize that water conservation measures need to be measured and need to result in a reduction in net water use in the Napa Valley Subbasin. To be effective for groundwater sustainability, water conservation practices must result in a reduction in net groundwater pumping (pumping net of recharge). Activities that, for example, reduce deep percolation from irrigation would not be effective because they may also reduce recharge to usable groundwater. Measuring the impact of water conservation practices is particularly challenging compared to operations and projects that may have a more defined, specific footprint. For example, water conservation measures implemented at the household, winery, or vineyard scale have relatively small individual footprints but may be applied over a large area to generate substantial total benefits. As described in this WC Workplan and the companion GPR Workplan, implementation of water conservation practices will be supported by continued outreach, data development, and careful measurement of water savings.

Together, voluntary water conservation actions taken across sectors will play a vital role in complying with SGMA, and more importantly improving the health of the Napa Valley Subbasin and the businesses, communities, and ecosystems dependent on it. The WC Workplan focuses on balancing economic viability, environmental health, social equity, and community responsibility as components of overarching sustainability interests and water conservation goals.

1.1 Water Conservation Goal

The WC Workplan is one of several projects and management actions described in the GSP to achieve sustainable groundwater management. The goal of the water conservation measures in the WC Workplan is to reduce Subbasin-wide groundwater pumping and achieve the groundwater sustainability goal.

The WC Workplan focuses on voluntary actions that water users in the Subbasin can take to conserve water. It also describes potential funding sources, incentives, education and outreach programs, and other ways that stakeholders can become involved in the GSP and conserving water for the benefit of the Subbasin.

1.2 Public Input

The WC Workplan was developed under the guidance of a Technical Advisory Group and with substantial input from local stakeholders. On June 23, 2020, the NCGSA appointed a 25-member Groundwater Sustainability Plan Advisory Committee for the Napa Valley Subbasin. The GSPAC provided broad stakeholder representation and was charged with advising the NCGSA on matters related to preparation of the GSP, including policies and recommendations for groundwater management. On November 8, 2021, the GSPAC unanimously approved a recommendation for the formation of a Technical Advisory Group (TAG) to aid in the implementation of the Napa Valley Subbasin GSP.

In accordance with SGMA, the NCGSA Board adopted the GSP on January 11, 2022 and submitted the Napa Valley Subbasin GSP to the California Department of Water Resources (DWR) on January 31, 2022. GSP implementation began on January 11, 2022 as soon as the NCGSA Board approved the GSP.

On February 8, 2022, the NCGSA approved GSA staff's recommendation to take immediate action to form the TAG. On August 10, 2022, the five-member TAG convened its first monthly meeting. The TAG's core charge is to provide well-informed, practical recommendations to the NCGSA as the GSA carries out GSP implementation, taking into account the best available scientific information and best practices in groundwater management. The TAG's charge includes consideration of groundwater conditions where some GSP representative monitoring sites are exhibiting exceedances of GSP-defined sustainable management criteria (SMC) or triggers and invoking adaptive management approaches, including analyses and response actions to address SMC exceedances or triggers, and identifying potential projects and/or management actions to avoid undesirable results.

The NCGSA has actively engaged stakeholders and the broader community in the formulation of the WC Workplan through a multifaceted approach. This engagement includes the collection and integration of input garnered from public meetings, alongside targeted presentations to stakeholder groups and individual consultations with invested parties. Furthermore, the NCGSA has undertaken insightful interviews to gather feedback and suggestions concerning prospective policy enhancements. This collaborative input has been instrumental in shaping the content of this document and its companion, the GPR Workplan.

Stakeholder outreach included a wide range of local businesses, associations, and other groups involved with water use and conservation practices in the Subbasin. Some of these groups include:

- Winegrowers of Napa County
- Napa Valley Grapegrowers Association
- Napa Valley Vintners Association
- Napa County Farm Bureau
- California Sustainable Winegrowing Alliance
- SIP Certified
- Fish Friendly Farming
- Napa Green
- Napa County Resource Conservation District (RCD)
- Napa County LandSmart
- University of California Cooperative Extension
- Napa Sanitation District (NapaSan)
- Napa Service Center, Natural Resources Conservation Service

1.3 Structure of the WC Workplan

The WC Workplan is structured as follows.

- **Section 2** provides an overview of water use in the Napa Valley Subbasin to provide context for the need for water conservation measures.
- **Section 3** describes a range of voluntary actions to increase water conservation for urban, commercial, industrial, rural residential, and agricultural water users.
- **Section 4** summarizes financial assistance available to implement water conservation practices.
- **Section 5** summarizes ways to encourage voluntary adoption of water conservation practices including through expanding certification programs that are currently available in the Subbasin.

- **Section 6** summarizes other resources that are available to Subbasin stakeholders.
- **Section 7** summarizes findings and recommendations.
- **Section 8** lists references cited in the document.

2 BACKGROUND

To help maintain groundwater quantity and quality throughout Napa County, the County has taken progressive actions to protect and manage groundwater since the mid-1960s through careful land use zoning policies, attention to groundwater monitoring, and permitting processes. Since 2008, Napa County has been implementing a groundwater management program to better understand groundwater conditions, establishing monitoring to track conditions, conducting education and outreach, and developing programs to assess and maintain groundwater sustainability.

The policies set forth under the Conservation element of the Napa County General Plan (2008) are key focuses in implementing County policies pertaining to protecting natural resources (including surface water and groundwater) for the environment and future generations. The County's General Plan has long recognized and prioritized the use of available groundwater for agricultural and rural residential uses (Napa County General Plan Goal CON-11, 2008). In 2014, SGMA was passed, which required the formation of local Groundwater Sustainability Agencies (GSAs) to develop and implement GSPs to ensure sustainable management of groundwater. The Napa County GSA was formed to manage the Napa Valley Subbasin. The GSP identifies a range of strategies and PMAs to comply with SGMA, including water conservation and reducing groundwater pumping.

Estimates of groundwater pumping in the Subbasin for 1988 through 2022 (**Figure 2-1**) indicate an increase in pumping, especially during the recent hotter, drier years in Water Years 2020, 2021, and 2022. The average annual groundwater pumping for 2005 to 2014 was about 15,000 acre-feet (AF). This occurred before SGMA initiation, and the average volume pumped was similar to the current estimate of sustainable yield of 15,000 AFY. The average annual groundwater pumping for the period 2015 to 2022 was 18,150 AF (**Figure 2-2**), which is significantly greater than the 2005 to 2014 period and the sustainable yield (**Figure 2-1**). Increased groundwater pumping and lack of recharge due to hotter, drier conditions led to lowered groundwater levels and Minimum Threshold exceedances. Undesirable Results (as defined in the GSP) occurred in Water Years 2021 and 2022 for two sustainability indicators – interconnected surface water and reduction in groundwater storage. As described in the GSP, once Minimum Thresholds have been exceeded and/or Undesirable Results have occurred, the NCGSA should assess the causal factors relating to the exceedance(s) and initiate appropriate management actions.

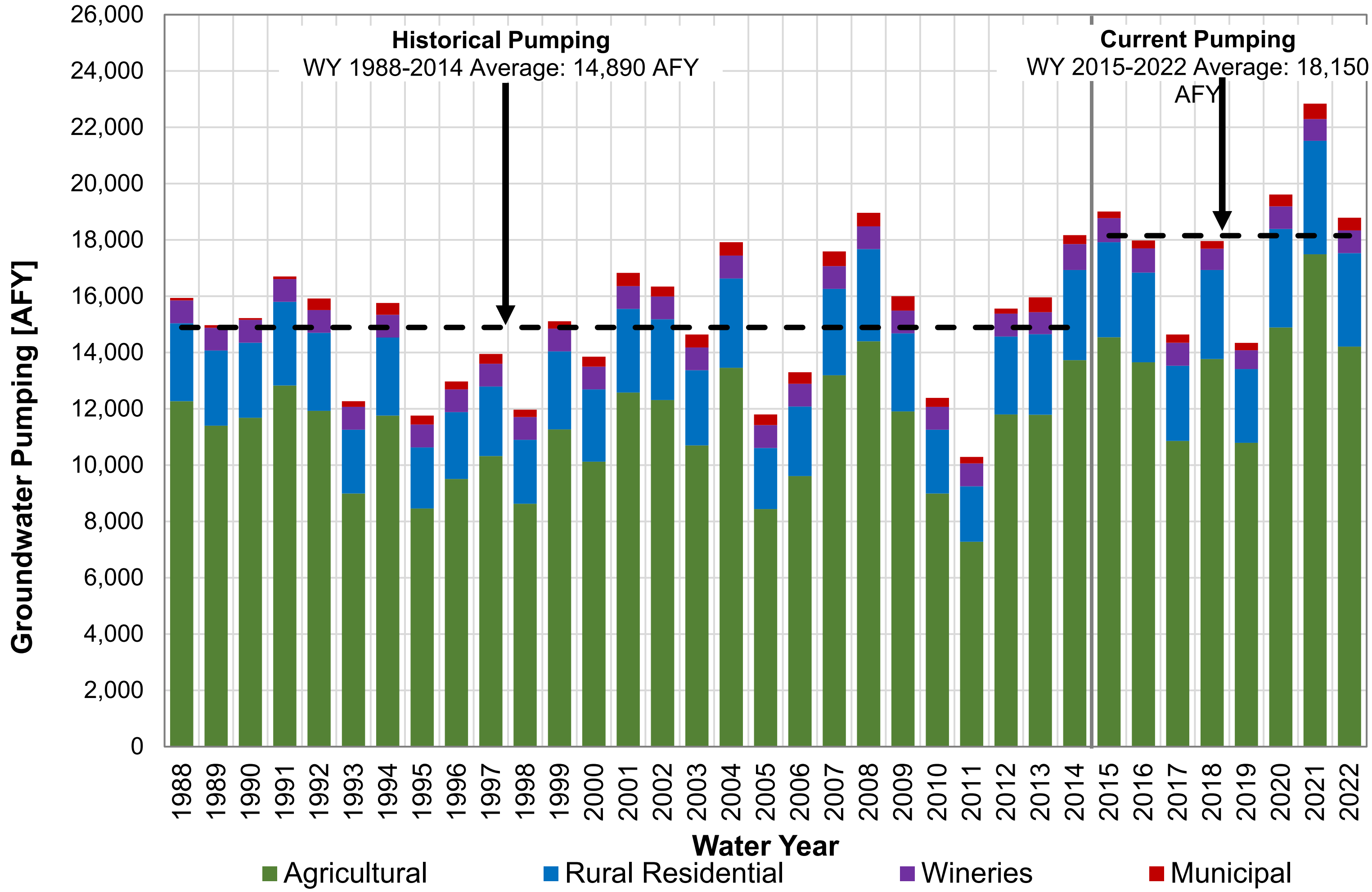

Figure 2-1. Historic and Current Pumping Distribution by Users in Napa Valley

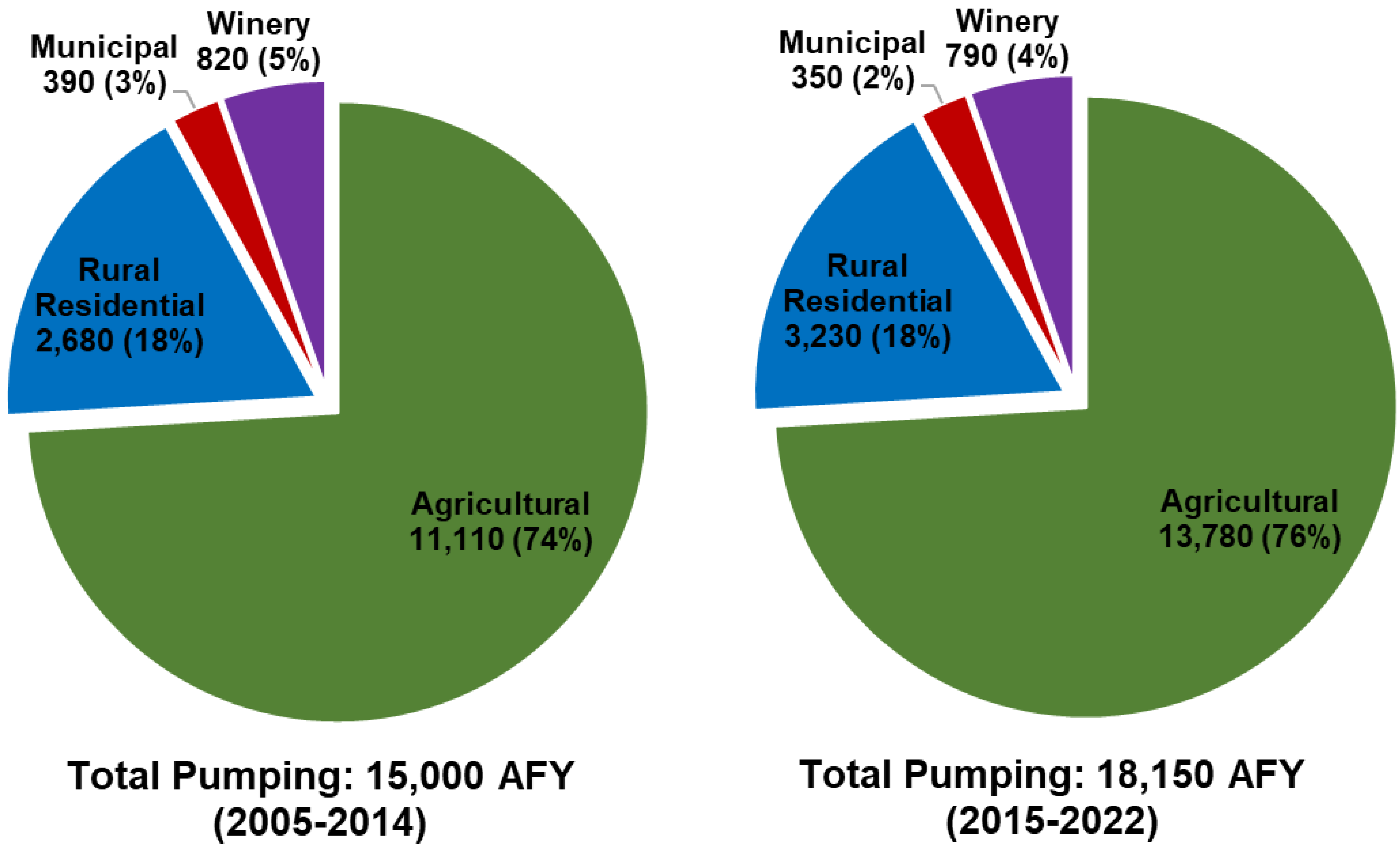

Figure 2-2. Average Pumping Distribution by Users in Napa Valley (2005-2014 vs. 2015-2022)

Ongoing water conservation by the entire community living, working, and visiting Napa County is important to achieve and maintain water sustainability, including both surface water and groundwater, which are interconnected in the Napa Valley Subbasin. The impacts of climate change are important to consider, and there is a need to rethink how water resources are used to maintain livelihoods and protect the environment. Public education is critical to shift from short-term (day-to-day) views of conditions (drought or no drought) to creating conservation-oriented habits, changing lifestyles, applying modern approaches regardless of current conditions, and establishing capacity to prepare for extreme events and, most importantly, to build resilience and achieve long-term sustainability. This means embracing water conservation as a way of life – rain or shine. This also means continually promoting groundwater replenishment and increasing groundwater reserves to lessen the effects of much less recharge during very dry years.

A companion document, the GPR Workplan, outlines the programs and analysis to achieve groundwater sustainability and reduce Subbasin pumping , as specified in the GSP, to achieve the sustainability goal. This WC Workplan is a tool and resource for local growers, vintners, other businesses, and residents to learn about, consider, and implement water conservation measures that can collectively help achieve sustainability.

2.1 Municipal & Industrial Water Use

Within the Subbasin, there are four municipalities that provide water: the City of Calistoga, City of St. Helena, Town of Yountville, and City of Napa. In addition to municipalities, there are various community, non-community, and state small water systems. There are six community water systems, 61 non-community water systems, and two state small water systems within the Subbasin that are outside of the municipal water system service areas.

In 1988, deliveries from the State Water Project (SWP) through the North Bay Aqueduct began to augment local supplies. Since the SWP deliveries began through 2022, the SWP has supplied between 13 to 60 percent of municipal and small public water systems within the Napa Valley. Total water use by municipalities and small public water systems over the past 10 years (2012-2022) has ranged from approximately 15,420 AF to 19,180 AF with SWP accounting for 47 percent, surface water diversions for 38 percent, groundwater pumping for 9 percent, and recycled water for 6 percent (**Figure 2-3**).

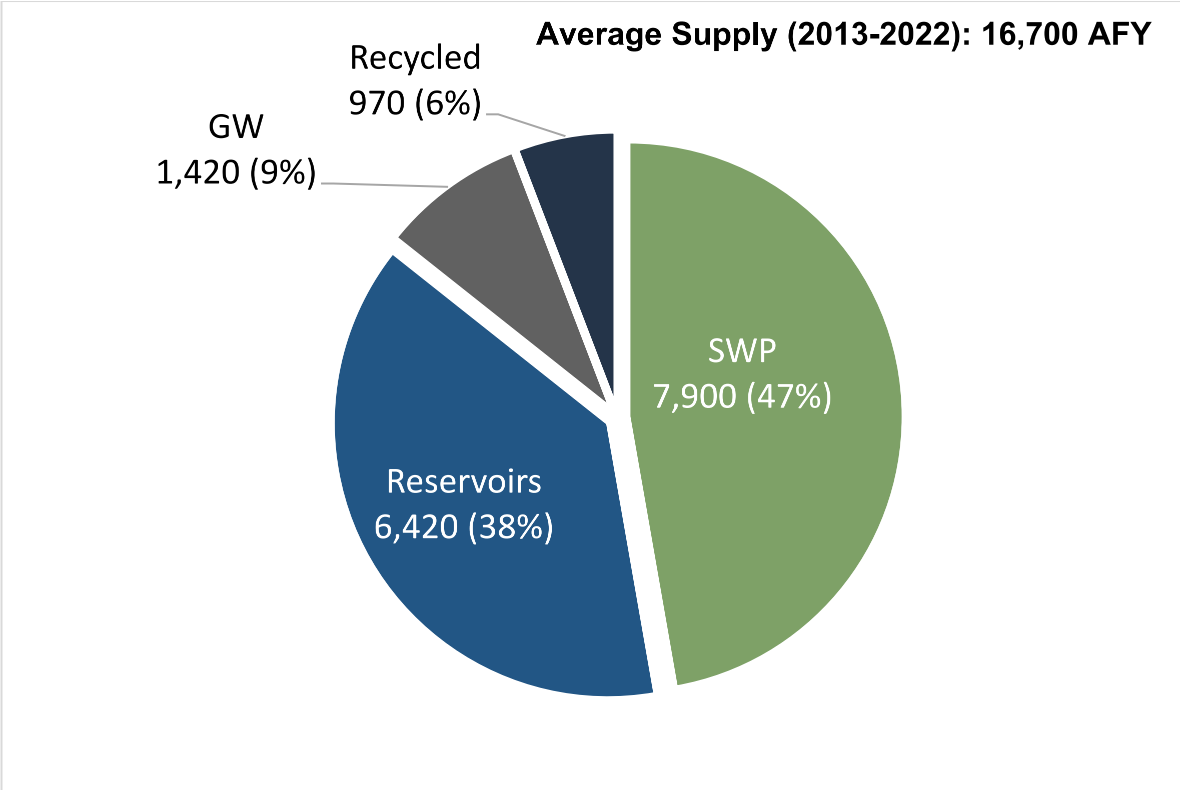

Figure 2-3. Average Water Use of Municipalities and Small Public Water Systems by Source (2012-2022)

2.2 Rural Domestic Water Use

Self-supplied water users in the Subbasin include residential, commercial, and industrial water users that do not meet minimum requirements for designation as a public water system. Self-supplied users derive water supplies primarily from groundwater in the Subbasin and from surface water diversions within the Subbasin.

A common example of self-supplied users are single family homes and some small wineries supplied by a private well or other private water source. Water supplies for these users provide for domestic indoor uses, landscaping irrigation uses, and commercial winery uses. In addition to estimating small winery water use, domestic water use was determined from annual population estimates using U.S. Census Bureau Census Block. For the purposes of this report, rural domestic pumping is used interchangeably with self-supplied users. Over the past 10 years, self-supplied users are estimated to use between 2,400 to 3,800 AFY.

2.3 Vineyard Water Use

Groundwater pumping accounts for approximately 45 percent of total water use, or around 15,000 AF per year, in the Napa Valley Subbasin over the 2005 – 2014 historical period (LSCE, 2022). Agricultural groundwater pumping accounts for approximately three-quarters of total historical Subbasin groundwater pumping (GSP Annual Report: LSCE, 2023). Since vineyards are the largest share of agricultural acreage in the Subbasin, expanding the use of water conservation practices on vineyards has the potential to provide the greatest sustainability benefits in the Subbasin.

Vineyards are a critical driver of local economic activity in Napa County. Vineyards support a balanced economy by creating skilled and unskilled job opportunities for farm workers, managers, and other businesses that provide inputs to and process outputs from local grape growing operations. Many vineyards already implement a range of water conservation practices to carefully manage fruit production and quality. Expanding the adoption of water conservation practices on vineyards may require additional investments by vineyard managers and landowners. Grape prices and returns to vineyards vary significantly by region, variety, and over time as market conditions change. Therefore, it is important to evaluate the cost of adopting additional water conservation practices and develop appropriate incentives to encourage additional, voluntary adoption. Cost constraints can influence the degree to which some of the practices identified can be implemented, and as such the costs of adopting new practices have been carefully analyzed as part of this Workplan and the companion document, the GPR Workplan.

2.3.1 Crop Profile

The gross value of crop and livestock production in Napa County is around $921 million annually[22]. Wine grape production accounts for over 90 percent of the total value. Other row crops, field crops, and livestock generate around $5 million in gross value annually. In addition to the farm-gate gross value of the crops (value of the crops measured at the farm-level prior to processing), farming (primarily grapes) supports jobs, income, and economic activity in linked industries in Napa County ranging from farm workers to farm input suppliers, transportation, farm management, wineries, and the large hospitality/tourism sector that provides services to the visitors that come to enjoy the region's premium wines.

The Napa Valley produces some of the most premium winegrapes in the state. The Napa Valley is in Crush District 4[23], which accounts for approximately 4 percent of the state total winegrapes crushed by volume, including around 5.5 percent of all red winegrapes and 13 percent of all cabernet sauvignon grapes. By value, the Napa Valley is a much larger share of the state's wine industry. As of 2022, the average value of all white winegrapes in the Napa Valley was $3,360 per ton, or about five times the state average of $680 per ton. More premium red winegrapes averaged $6,800 per ton in 2022, or more than seven times the state average of $955 per ton.

[22] Napa County Agricultural Commissioner. Annual Crop and Livestock Report. 2022.
[23] Crush Districts, formally known as California Grape Pricing Districts, are defined by California Department of Food and Agriculture.

Figure 2-4 illustrates trends in gross value of winegrapes produced in Napa County since 1980. All values are adjusted for inflation and reported in current (2023) dollars. The industry has been steadily growing as acreage has expanded and more importantly the value of Napa grapes has continued to increase. The gross value of the crop production topped $1 billion in 2018 and 2019, before dropping in 2020 due to crop losses from fires and other pandemic disruptions. The industry recovered in 2021 and 2022, with the current value of $921 million as of 2022.

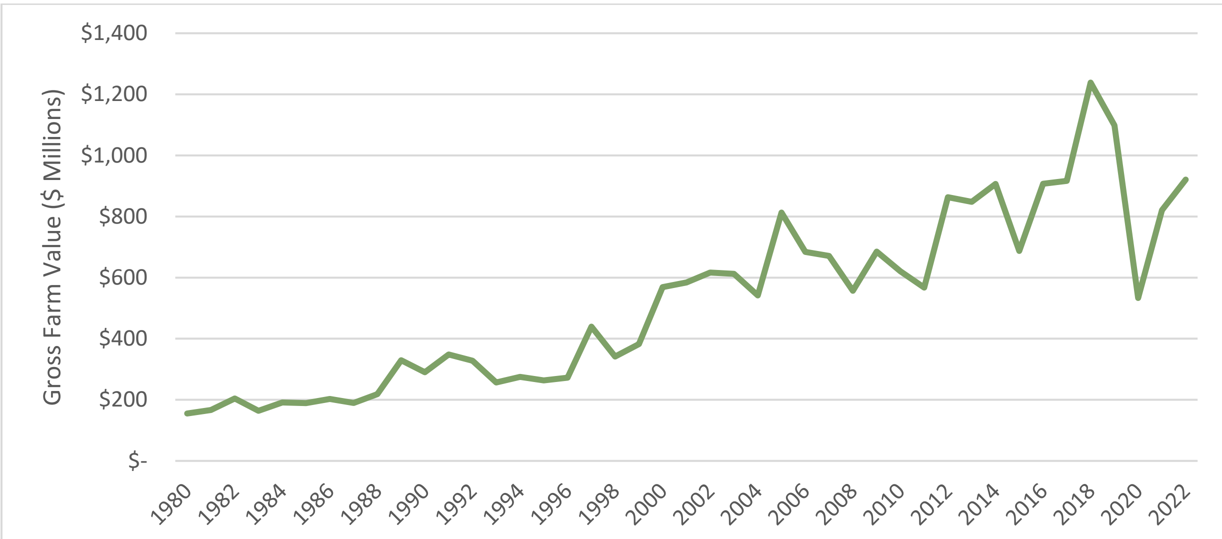

Figure 2-4. Historical Trends in Napa County Gross Value of Winegrape Production, 1980 – 2022 (inflation-adjusted)

The increasing value of the Napa County winegrape industry is driven by the higher value per unit produced. Production acreage has only expanded modestly, with average annual growth at about 1 percent per year since 2006. The current production area of winegrapes in Napa County equals approximately 46,000 acres, of which approximately 80 percent are red winegrapes (**Figure 2-5**). Other crops account for less than 2,000 acres across the entire county and represent an even smaller share of total industry value. County cropland additionally includes 50,000 to 70,000 acres of open space grazing and rangeland that supports local livestock operations[24].

[24] The Subbasin accounts for less than half of the winegrape acreage within Napa County. It has experienced very little growth in agricultural land use in recent years and small decline over the past 30 years. The Subbasin had approximately 20,800 acres of vineyards in 2019, 20,200 acres in 2011, and 22,400 acres in 1987 (LSCE, 2023).

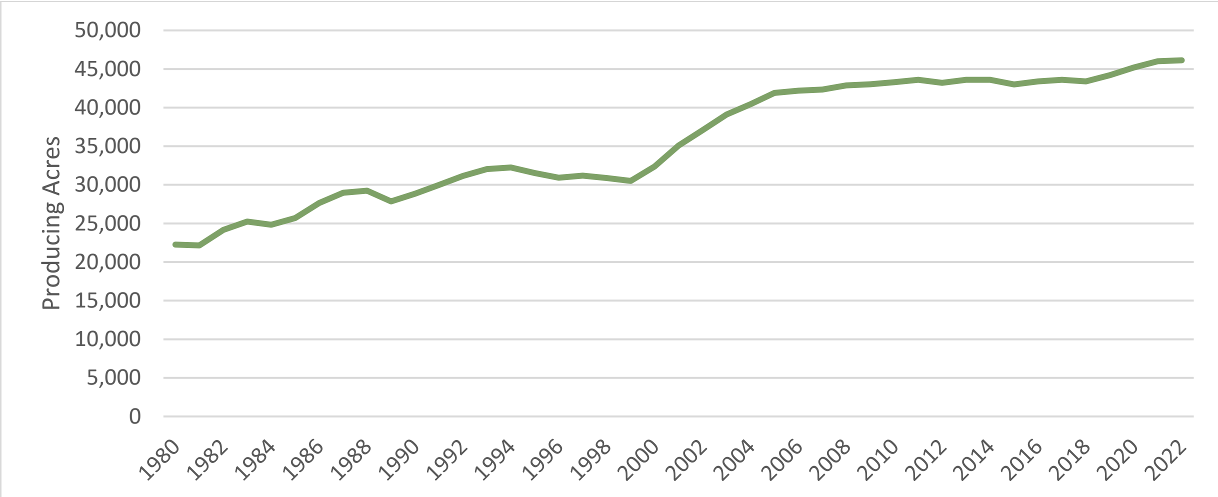

Figure 2-5. Historical Trends in Napa County Winegrape Producing Acreage, 1980 – 2022

The crop profile for the Napa Valley Subbasin is a mixture of high-quality winegrapes that are predominately crushed locally, bottled, and then consumed both locally and exported around the world. The industry is a critical component of the entire Napa County economy, supporting everything from local farmworker, manager, and operator positions to regional support industries, wineries, and the supporting hospitality industry. In addition to winegrapes, the county includes a mixture of pastureland and other minor specialty crops for various local markets. The Napa Valley Subbasin covers a portion of Napa County and does not include all irrigated acreage.

2.3.2 Existing Vineyard Water Conservation Practices

Napa vineyards have made significant strides in the adoption of various water conservation technologies and practices, showcasing a strong commitment to sustainable viticulture. These efforts have led to tangible water savings and improved resource management within the region. However, despite these commendable advancements, there remains an untapped potential for further scaling the adoption of innovative water conservation approaches.

The California Code of Sustainable Winegrowing, developed by the California Sustainable Winegrowing Alliance (CSWA), provides a list of vineyard water management criteria (California Sustainable Winegrowing Alliance et al, 2020). Practices range from creating a basic irrigation management plan to adaptive management utilizing plant water and soil moisture sensing methods. Irrigation system efficiency and distribution uniformity are stressed to maintain optimal water use. The CSWA 2020 survey of 2,402 certified vineyards found that a vast majority of vineyards are implementing some of these practices. Napa Green has also reported that most vineyards are already implementing 60-70 percent of sustainability practices to become certified (Napa Green, 2023). In short, most vineyards carefully manage irrigation practices, but data show there is potential for wider adoption of some practices, even within certification programs.

Table 2-1. Water Conservation Practice Adoption by Vineyards	
Vineyard Practice	**Adoption Rate in CSWA Certification Program (2020)**
Water Management Strategy	100%
Water Measurement	36% use meters 52% use other methods
Distribution Uniformity	43% tested in last 5 years 93% tested in last 7 years
Plant Water or Soil Moisture Monitoring	32%

Source: CSWA 2020.

2.4 Winery Water Use

Wineries are an important industry in the Subbasin. Wineries are estimated to pump approximately 5 percent of total groundwater in the Subbasin. Wineries use water for a variety of essential purposes throughout the winemaking process. Water is crucial for tasks such as cleaning and sanitizing equipment, facilities, and tanks, which ensure the quality and safety of the wine. It is also required during the crushing and pressing stages, as well as for fermentation and aging processes. Water plays a pivotal role in maintaining the hygiene of tanks and bottling lines. Implementing water measurement and monitoring at each stage of the process is an emerging trend that allows a winery to identify where efficiency improvements will have the largest impact.

Finally, water is also used for landscaping of the property, which may represent a substantial amount of the winery's total water use. To reduce pressure on groundwater resources, many wineries are using or blending treated winery wastewater for landscape irrigation. Other wineries are connecting to recycled water programs to reduce groundwater pumping demands. Some wineries are changing landscape designs to reduce water requirements.

Wineries certified by the California Sustainable Winegrowing Alliance have demonstrated adoption of several winery best management practices, signaling the winemaking community's interest in sustainable practices. Napa Green has also reported that most wineries are already implementing 60-70 percent of sustainability practices to become certified (Napa Green, 2023). **Table 2-2** shows practice-specific adoption rates as a range for different practices. Importantly, data show there is room for improvement in many of these areas, even for certified sustainable wineries.

Table 2-2. Water Conservation Practice Adoption by Wineries	
Winery Practice	**Adoption Rate in CSWA Certification Program (2020)**
Water Metering	84% use meters 42% monitor use as part of a conservation program 21% installed a separate meter for landscaping/irrigation
Process Water Reuse	48% use some process water for irrigation
Tank Washing	86% use high-pressure, low-volume nozzles 38% use temperature-controlled hot water 7% use an alternative sanitation technology

Source: CSWA 2020.

3 BEST MANAGEMENT PRACTICES FOR WATER CONSERVATION

Best management practices for water conservation in rural domestic, agricultural, and industrial uses were identified. The sections below provide a concise yet comprehensive overview of typical practices. By implementing the portfolio of practices that make the most sense for their home or business, stakeholders can work collaboratively towards a more resilient and sustainable water future for the region.

3.1 Measuring Water Use

Measuring water use is necessary for quantifying the water savings that a water conservation practice achieves across the Subbasin. It also allows an individual water user to understand how much water they are currently using and how that use changes as they implement water conservation practices. In addition, simply measuring water use can provide water users with new information that allows them to make changes that reduce water use, even without investing in additional water conservation technology or equipment.

Achieving a reduction in groundwater pumping by expanding water measurement in the Subbasin includes two components: (i) expanding the adoption of water measurement technologies, and (ii) making that information easily available to water users to affect changes in water use behavior/practices. Improving water measurement can result in savings in total pumping, net depletion, or both.

Water measurement involves quantifying the amount of water applied or consumed by residential, commercial and industrial, and agricultural users. Methods for different water using industries (see also Section 2.4) broadly include:

- **Agriculture**. Typical water measurement practices include metering, crop coefficients (an indirect water measurement strategy), and more recently remote sensing of evapotranspiration (ET) using satellite data. The installation of water meters on wells records the volume of water passing through the meter in units such as acre-feet, cubic meters, or gallons. Crop coefficients are used for irrigation scheduling purposes by applying the coefficient for the crop to a reference crop (used to estimate reference ET) to determine seasonal crop irrigation needs. Remote sensing data provide more precise measurement of field ET that can be used both for irrigation scheduling and for tracking crop water use. However, ET measurement may not allow for differentiation between groundwater use and other water sources without additional monitoring.

- **Commercial and industria**l. Measurement of indoor and outdoor (e.g., landscaping) water uses for commercial and industrial businesses that are connected to a municipal supply system is typically accomplished through meters. This data forms the basis of volumetric billing. For businesses that have a private well, the well may be metered to track water use.
- **Residential**. Similar to commercial and industrial water users, residential customers that are connected to a municipal water supply system or are typically metered. Rural residential users typically rely on a domestic well that can be metered to track water use.

Water measurement can provide accurate and reliable data on water use, enabling users to monitor their usage patterns and make informed decisions about conservation. By tracking water use, individuals and businesses can identify areas where water is being used inefficiently and implement measures to conserve water. However, measurement data must be accessible to the water user so that the user can easily interpret the data and make corresponding changes to their use habits. Access to water use data and new technology has been demonstrated to result in reductions in water use:

- **Agriculture**. Remote sensing of ET using satellite data is now available to growers on a weekly and daily basis. For example, technologies available in California include Tule Tech (Tule Technologies, 2023), IrriWatch (IrriWatch, 2023), OpenET (OpenET, 2023), and Land IQ (Land IQ, 2023), which can provide daily and monthly ET information to growers. Outside of California, for example in Kansas, growers must meter and report water use to the state. Grower tools including TAPP H2O allow growers to have information about metered water usage (Mammoth Water, 2023).
- **Residential**. Tracking residential water use helps residents detect leaks and make other adjustments at the home to reduce use. For example, smart meter technology for residential users can collect and synthesize water consumption data through an automated system that can also detect waste or inefficiencies and trigger alerts. Automated outdoor irrigation systems, such as offered by Rachio, provide use data and can automatically adjust applied water based on weather conditions (Rachio, 2023). Recent studies indicate that providing residential users with information on their water use results in durable conservation behavior (Cominola et al., 2021).
- **Commercial and industria**l. Commercial and industrial approaches to water measurement vary by industry. Water measurement technologies include traditional meters and smart meters to track water use. Commercial and industrial water users generally respond the same way as residential water users to additional measurement/metering data.

The following subsections provide an overview of the different water measurement technologies for measuring groundwater pumping or ET (water demand) at various scales. This includes meters, remotely sensed (satellite) data, and various land-based sensors. These technologies apply to various water conservation practices.

3.1.1 Meters

Metering offers a method to quantify gross applied/delivered water use. Meters are typically installed for each well and quantify the total amount of water that is pumped through the pipe. Meters offer a high degree of accuracy when properly maintained, and quantify the water applied from that single source (groundwater) rather than the total crop water use, which uses a range of sources including precipitation, soil moisture, and potentially surface water or recycled water.

Monitoring the amount of applied water can provide valuable insights into groundwater use patterns and enable informed decision-making. Metering is useful across sectors, including tracking irrigation and frost protection, winery operations, and domestic uses. This practice plays a crucial role in promoting water conservation through several key mechanisms. For example, metering improves awareness so that users are informed of their actual applied groundwater, which increases the likelihood that users take actions to reduce waste. Metering fosters a sense of accountability, encouraging responsible water use and discouraging excessive consumption. It can help identify areas of high water use for targeted conservation efforts. Metering can also help identify the presence of leaks that might otherwise go unnoticed.

3.1.2 Remote Sensing

In addition to measuring water use through metering, agricultural uses can leverage new technologies that estimate the crop's ET. Remote sensing has emerged as a cost-effective and scalable tool to estimate consumptive water use and support water conservation efforts. Remote sensing uses technologies such as satellites, drones, and sensors to collect data remotely, enabling the assessment of various water-related parameters without direct contact. Remote sensing is particularly valuable for monitoring water consumption on regional and global scales, aiding in water resource management in water-scarce regions.

Remote sensing has several known challenges, including imperfect estimations of crop water use. Further, remote sensing cannot distinguish between sources of water. If an agricultural field uses more than one source of water, such as precipitation, groundwater, surface water, and recycled water, remote sensing estimations are unable to detect what portion of the crop's ET comes from which source. This can be a challenge for management and quantifying one source of water use or savings, such as groundwater.

Remote sensing has also had challenges with accurately estimating finer resolutions of applied water use. While remotely sensed ET data are an imperfect estimate of field-level crop water use, the data are being continually improved through ground-truthing and studies to correlate field-level ET and sensor data with OpenET estimates.

Remote sensing can estimate the ET of dry-farmed vineyards. Even though these vineyards are not using applied groundwater, they still use groundwater through deep rooting systems. These groundwater use amounts could not be estimated through a metered system since no groundwater is applied.

As remote sensing technologies advance, they provide practical and affordable means to estimate water use and water savings. These data should be used cautiously given the limitations noted above, but still offer a range of benefits related to monitoring that are difficult to achieve at scale with other methods.

Satellite-Based Measurement

The development of satellite-based methods to estimate ET data holds substantial promise to lower costs of water monitoring. These methods use satellite images to capture visible and near-infrared light, as well as thermal sensors to measure temperature, from which information about the plant health, stress levels, soil moisture levels, and ET estimates can be derived. Satellites can also detect changes in landscape management, including land cover and irrigation patterns. While these data have previously been difficult to access, a number of public and private solutions have emerged to make these data more accessible.

- **OpenET**[25] is an open-source platform for field-level agricultural ET data that have made satellite-based ET data particularly accessible and low-cost. OpenET uses a combination of satellite data, crop type data, weather station data, and models to calculate ET (OpenET, 2023; Melton et al., 2023). OpenET uses six different algorithms to estimate ET, as well as creating its own "ensemble" that averages the estimates. Daily, monthly, and yearly data are available publicly on the OpenET website and cover the entire western United States. Its spatial resolution is 30m x 30m.
- **Land IQ**[26] is a private solution to estimating agricultural ET data. Land IQ differs from OpenET in that they maintain multiple ground stations and use the data to calibrate and interpret ET data. Land IQ covers more than 3 million acres in the California Southern San Joaquin Valley and supports more than 35 crop types. These data are available monthly or annually; the spatial resolution is 10m x 10m.
- **IrriWatch**[27] is another private solution for estimating agricultural ET data using the SEBAL method. The data are focused on irrigation, crop production, soil health, and climate. It supports approximately 120 crop types, 12 soil types, and nine irrigation types that the user can specify. Its coverage spans the US as well as many other countries. Its spatial resolution is 10m x 10m.

While many of the satellite-based ET products include publicly available satellite imagery, there is a growing demand and supply of commercial imagery that provides data at a finer spatial and temporal resolution. Multiple companies now provide satellite imagery at resolutions over one hundred times more refined than that used in OpenET.

GRAPEX

The Grape Remote sensing Atmospheric Profile and Evapotranspiration eXperiment (GRAPEX; Kustas et al., 2022) is a program housed in the USDA Agricultural Research Service (ARS). The mission of GRAPEX is to, "refine and apply a multi-scale remote sensing … ET toolkit for mapping crop water use and crop stress for improved irrigation scheduling and water management in vineyards …" To date, there have been two special issues in the scientific journal Irrigation Science. There are a total of 20 journal articles outlining advances in

[25] https://openetdata.org/
[26] https://www.landiq.com/land-iq-et
[27] https://irriwatch.com/

cutting edge energy balance modeling, uncertainty in measurements, and machine learning in vineyards, to name a few. Advances provided from the GRAPEX program are being reviewed and assessed for inclusion in how Napa County can measure water use and provide additional data to stakeholders.

Land-Based Sensors

In-field sensors measure crop water use and ET with a higher degree of accuracy. Daily water use and stresses can be monitored, which can inform irrigation scheduling decisions. Land-based sensor companies, such as Tule Technologies[28], measure key parameters such as soil moisture content, temperature, humidity, wind speed, and solar radiation to accurately measure ET.

Many land-based sensors are used to provide data to control grape quality. In addition to grape quality, sensors outlined below provide important information to understand how water use moves through a vineyard and subbasin.

ET Field Measurements

On a field scale, ET can be estimated in two ways, eddy covariance and surface renewal. Eddy covariance estimates ET continuously at a single point by using high-frequency measurements of wind speed and water vapor concentration. Using these measurements in addition to other site-specific information, the total ET can be continuously measured. Typically, the cost of installation, maintenance, and data processing make eddy covariance a research tool and not a management tool. Eddy covariance is regarded as the 'gold standard' of ET measurements and is used to validate and calibrate other methods of ET estimation. Surface renewal uses high-frequency air temperature measurements to estimate the heat fluxes within a field. The estimated heat flux is used within an energy balance equation to estimate the ET of a field. The application of surface renewal methods has been compared to various other water use estimation methods, including eddy covariance, and found to be comparable (Parry & Shapland et al., 2019). Surface renewal has become available commercially for use.

3.2 Water Conservation Practices for All Water Users

Increasing water conservation has become a state policy priority for urban water users. For example, in 2015 Executive Order B-29-15 issued by Governor Brown introduced water conservation targets for urban providers. In 2018, Assembly Bill (AB) 1668 and Senate Bill (SB) 606 of 2018 outlined standards for urban retail water suppliers (suppliers) for the efficient use of water and performance measures for municipal and industrial (M&I) water use. The State Water Resources Control Board recently issued draft regulations to implement these laws (DWR, 2022).

The following sections provide an overview of water conservation practices that apply to M&I as well as agricultural water users.

[28] https://tule.ag/sensors/

3.2.1 Water Metering

Metering water involves installing flow meters on lines from wells, other pumps, or conveyance systems. Metering quantifies the amount of water consumed or used, providing valuable insights into consumption patterns and enabling informed decision-making. Metering is useful across sectors, including to track irrigation and frost protection, winery operations, and domestic uses. Metering fosters a sense of accountability, encouraging responsible water use and discouraging excessive consumption. It can help identify areas of high water use for targeted conservation efforts. Metering can also help conserve water through detection of malfunctions, leaks, or other needed repairs. These malfunctions may go undetected without metering, but active monitoring can rapidly identify and address issues.

Studies have found the potential for residents to reduce water use by 15 - 20 percent using metering and price structures (Pacific Institute, 2014). Cominola et al. (2021) observed an 8 percent long-term reduction in residential water use after receiving metered usage data. A conservative 5 percent potential water savings was applied to agriculture (vineyards), wineries and other industrial, and municipal and rural domestic water users.

Adding a single flow meter to an agricultural, industrial, or domestic well was selected as a representative cost because it represents the main potential for groundwater or other water savings under this practice and can be implemented by most well/landowners. The capital cost of a flowmeter and installation is around $600 - $2,500 (Sanger), which typically has a 20-year life (Irrigation King, 2023). Regular maintenance of flow meters is crucial to ensure accurate and reliable measurement. Conducting thorough inspections and calibrations at least every two years guarantees the precision of these devices. The user can expect annual maintenance, periodic calibration, and general operating costs of around $100.

Table 3-1. Water Measurement Cost Summary (Per Well)

Practice	Water Savings Potential, %	Upfront Costs ($)	O&M Costs ($/year)
Water Metering / Measurement	5%	$600 – $2,500	$100

3.2.2 Recycled Water

Recycled water, also known as reclaimed water or treated wastewater, is wastewater that has undergone treatment and disinfection to remove impurities and contaminants. Recycled water is suitable for various non-potable purposes, such as landscapes, golf courses, agricultural irrigation, firefighting, and some industrial processes. Recycled water, as an in-lieu recharge activity, helps conserve other freshwater, including groundwater, by providing an alternative or replacement source of water to meet various non-potable needs. In the Subbasin, recycled water is produced by the Napa Sanitation District, Cities of American Canyon and Calistoga, and Town of Yountville. Recycled water is also under development for the City of St. Helena. Recycled water is a source of water that can replace other sources of water such as surface water and groundwater pumping. While most of these programs offset surface water use rather than groundwater use, recycled water programs bring a benefit to the Subbasin by reducing diversions of surface water, resulting in more water being left in storage or in streams.

Using NapaSan's 2023 standard rate structure of $2.21 per 1,000 gallons, this translates to a cost of approximately $720 per AF (Carollo, 2022). Storage rates, which are available in February and March, are $1.11 per 1,000 gallons, or $362 per AF. Taking advantage of the lower storage rates can be beneficial for growers with on-site storage, for use later in the season.

Table 3-2. Recycled Water Cost Summary

Practice	Water Savings Potential, %	Upfront Costs ($)	O&M Costs ($/year)
Recycled Water	100% (In Lieu)	N/A	$362 - $720 / AF

3.2.3 Benchmarking

Benchmarking stimulates changes in practices by showing individuals (e.g., water users) how their performance over time compares to an anonymous peer group. Benchmarking programs have been effectively applied in energy and residential water usage. A water benchmarking program establishes a structured framework for tracking and assessing water use, defines comparable anonymous water user types, and provides this information to water users. Then each water user can make changes to reduce water use.

Benchmarking in the energy sector has been proven to generate year-over-year energy savings of 2.4 percent (Energy Star 2012), amounting to 30 percent savings in the past decade (U.S. Environmental Protection Agency, 2022). Benchmarking could benefit all types of water users, especially agricultural water users as they use the majority of water in the Subbasin. A 10 percent reduction in total pumping is applied for a more conservative estimate of agricultural water conservation potential using benchmarking.

A pilot benchmarking program would create anonymized peer groups based on controls that most affect irrigation intensity. These controls can be adjusted over time as more data become available. In the interim, the pilot benchmarking program would also allow growers to assess water usage across their own portfolio spatially and temporally. Interested parties should contact the NCGSA or join its newsletter to learn more about the development of a pilot benchmarking program. The program would likely be offered free to stakeholders covered by the County or NCGSA.

Table 3-3. Benchmarking Pilot Program Cost Summary

Practice	Water Savings Potential, %	Upfront Costs ($)	O&M Costs ($/year)
Benchmarking Pilot Program	10%	$0	$0

3.3 Water Conservation Practices for Agriculture and Vineyards

A robust water management strategy helps achieve optimal vine health, grape quality, and sustainable water use. Such a strategy should be tailored to encompass key factors including grape growing objectives, soil characteristics, topography, available irrigation water quantity and quality, as well as cost-effectiveness. Various water management approaches can be adopted, each tailored to the unique conditions of the vineyard. These may encompass strategies like delaying the onset of irrigation, dry farming, regulated deficit irrigation, or partial root zone drying. By aligning water management with specific vineyard attributes, growers can make informed decisions to maximize efficiency and productivity. Along with ensuring proper performance of irrigation systems, efficient irrigation water management is fundamental to ensure that growers can maintain proper crop health in times when water is limited. Effective water management is not just about how water is delivered, but also when, how often, and how much.

The Napa County RCD offers technical assistance related to the development and implementation of irrigation water management plans to any interested growers. The Napa County RCD also hosts irrigation water management workshops every summer in English and in Spanish. These workshops are conducted in small groups of less than 20 participants and incorporate hands-on-learning activities to educate farmers and farm workers about effective irrigation scheduling.

The following sections summarize key strategies to conserve groundwater on vineyards.

3.3.1 Irrigation System Efficiency

The Napa Valley produces some of the highest value winegrapes in the world. Vineyard irrigation is carefully managed during the various stages of plant growth and fruit development to maximize productivity and manage fruit quality. Most Napa Valley vineyards are irrigated with low-volume precision pressurized systems that can include buried or (typically) above ground drip wire systems. These typically include one or two emitters per vine that target irrigation to the vine root system. However, depending on factors, including grape variety, soil, vineyard location and effective rainfall, some vineyards are dry farmed—meaning no supplemental irrigation water is applied—in all or some years.

Improving irrigation system efficiency is a broad term that encompasses a range of irrigation scheduling, application, system improvements to deliver applied irrigation water more effectively to the crop. As described earlier in this section, Napa Valley vineyard irrigation systems and irrigation practices are managed for crop productivity and fruit quality. A substantial share of irrigated vineyards use pressurized on-farm irrigation systems that allow for smaller, more precise, and steadier flow rates at more frequent intervals, and for longer durations relative to gravity-fed systems.

Drip irrigation is used here as an example practice[29]. Drip irrigation is widely adopted in Napa, reflecting growers' preference to have a high degree of irrigation control to produce high quality wine grapes

[29] Other practices, such as soil moisture monitoring, canopy management, etc. are described separately in subsequent subsections.

(Ohmart, 2000, Sanden, 2008, and LCWC, 2014). However, these systems can degrade over time and require replacement at end-of-life. Most emitters have a life span of about 15 years, but vineyards have a substantially longer economic life. Ideally, emitters should be replaced close to the 15-year mark even if they are not malfunctioning. In practice most vineyards keep the same emitters for the entire life of the vineyard. This negatively impacts irrigation system DU in the last few years of vineyard life. Replacement of drip irrigation systems at their life's end is important to maintain efficient irrigation and control. The adoption of drip irrigation yields an estimated reduction in total pumping of 6 to 20 percent assuming it is replacing typical sprinkler irrigation systems (eVineyard, 2023).

The amortized cost of irrigation system equipment is $165/acre, the cost to install the drip line to drip wire on the trellis is $250/acre, and the O&M cost to check, repair, and maintain efficiency of the irrigation system is $125/acre, according to U.C. Cooperative Extension budgets (Kurtural, 2020). The irrigation system is considered part of the establishment costs, as it will be removed when the vineyard is removed. Therefore, the irrigation system has a life of about 27 years. At a 6 percent interest rate, the total equipment cost is approximately $2,200 per acre. Adding the installation costs of $250 per acre, this totals approximately $2,500 per acre in upfront costs.

Table 3-4. Irrigation System Efficiency Cost Summary

Practice	Water Savings Potential, %	Upfront Costs ($)	O&M Costs ($/year)
Drip Irrigation	6 – 20%	$2,500	$126/acre

3.3.2 Plant Water and Soil Moisture Monitoring

Ongoing monitoring of available water for vine consumption is a key component in an efficient irrigation management plan. Several options exist for monitoring available and consumed water and can be grouped into two categories, monitoring water available for vine use via soil moisture monitoring techniques, and monitoring water uptake and use by plant moisture monitoring techniques. Both methods are important irrigation scheduling technologies that provide information that can be used to adjust applied water during the irrigation phase of vine growth (adaptive irrigation management).

Soil moisture monitoring shows available water for vine use and can be accomplished by either measuring volumetric water content or by measuring soil water tension. Both methods rely on probes or sensors that can either be stationary with central recording devices or handheld. Generally, soil moisture monitoring sensors can be affected by soil type and condition and operate in a small range such that the appropriate method should be determined based on the vineyard soil composition and deployed in several locations throughout the vineyard. Experience and familiarity with the vineyard help determine appropriate locations.

Vine water use and stress is another option for measuring irrigation effectiveness. Measurement methods such as leaf pressure bombs, sap flow monitors, and ET monitors allow for precision adaptive irrigation management but tend to come at a higher cost than soil moisture monitoring methods. As with the soil moisture monitoring techniques, vine water use and monitoring techniques can either use stationary sensors that need to be placed throughout the vineyard or handheld sensors that can be used in multiple locations. There are tradeoffs between the two types of vine monitoring techniques. Stationary sensors will provide constant real-time data but in specific locations. Mobile sensors are more flexible and can be used throughout but require operators to walk the vineyard. Pressure bombs can be taken on individual leaves to measure vine stress but only offer a single observation. ET can be continuously monitored by sensor and data logging systems such as Tule Technologies. Vine sap flow monitors can be permanently affixed to vines to measure continuous water flow. An industry white paper by Fruition Sciences (2023) reports there is a substantial opportunity to reduce vineyard water use.

Costs depend on the technology that is adopted. These have been grouped into three categories: (1) high tech, low labor, such as a time temperature domain reflectometry (TDR); (2) medium tech, medium labor, such as a neutron probe; and (3) low tech, high labor, such as tensiometers.

High Tech, Low Labor (Time Temperature Domain Reflectometry). One of the available high-tech options for monitoring soil/vine moisture is TDR for soil moisture monitoring (Acclima, 2023). With TDR, sensors are placed semi-permanently in the ground, which then send soil moisture readings electronically to the logger that can be downloaded or stored in a cloud service. Most data loggers have output that needs to be periodically downloaded. Monitoring soil moisture allows farmers to apply the appropriate amount of water to their vines and avoid over or under irrigation. Continuous monitoring will show available moisture for plant uptake and help schedule irrigation for when the vine needs it most.

For a typical field size of 25 acres, approximately four sensors and a data logger would be used, at a capital cost of $3,500, or $140 per acre. Annual costs include vineyard manager time to monitor the system and implement changes in response to information. In addition, there may be additional costs for cloud storage and other add-on services of approximately $300 per year.

Handheld TDR meters are also available that technicians can use to take several readings throughout a field. These applications are mostly used in turf fields such as golf courses but could be adapted to other situations. The moisture data can be combined with other soil variable attributes such as temperature. Services are also offered by some manufacturers in conjunction with the soil moisture meters that would allow for vineyard mapping integration and data storage for additional fees.

Handheld TDR meters are approximately $1,500 each but require additional rods of varying lengths that are placed in the soil. Rods cost approximately $70 each. For two rods and a handheld TDR, this totals $1,640 in capital costs, plus the addition of labor to walk the field of $32 per acre per year. Specific costs depend on field size and number of sensors.

Medium Tech, Medium Labor (neutron probe). Medium technology options that also require some labor include neutron probes. Neutron probes are accurate over all soil types and come in a portable carrying case. They are heavy, very expensive, and use radioactive materials that require training and licensing to use. The readings cover a wide area, and the neutron probe is not affected by environmental factors such as temperature or barometric pressure. Therefore, it is good for use in most soil conditions. The technology is not widely applied in the Subbasin.

Once in place in the soil, the probe emits neutrons in all directions that collide with hydrogen atoms in water. This creates a readable signal that is translated into a number, such as inches of water per foot of soil, which is displayed on the device or stored in onboard memory that can be accessed by the user. While this type of sensor can be highly accurate, it is substantially more costly than most other methods.

The capital cost of a neutron probe ranges from $5,000 to $10,000 per unit. Based on a field size of 25 acres, this translates to a capital cost of $200 - $400 per acre. In addition, because the probe includes radioactive material, the user must be certified and trained to handle the probe creating additional costs over standard irrigation labor, for an estimated labor cost of $40 per acre per year. These costs vary based on field size.

Low Tech, High Labor (tensiometers). Lower technology solutions are also available that typically require more labor and management. Tensiometers measure how tight water is held in the soil and therefore the level of energy needed for the plant to draw moisture out of the soil. Tensiometers have been commercially in use for several decades with the first proposed use in the early 1900s. They provide a simple way to measure soil moisture. The meters need to be chosen specific to the type of soil in the vineyard and depth of vine roots.

The meters only read soil tension in a small area so need to be placed in multiples throughout a vineyard to get an accurate representation of soil moisture. They either come with a gauge attached to the meter or can be hardwired to data collection devices with cloud-based software systems for continuous reading, at an additional cost.

Tensiometers with single gauges cost between $100 and $200 per unit. Operational costs are approximately $32 per acre to cover manual labor. Two sensors are recommended per 20-acre field placed side-by-side at different depths (Peacock et al, 1998).

Tensiometers supported by central data gathering units and continuous readout software cost between $400-$600 per unit pair. They do not require additional labor time (walking the field) like their low-tech counterparts but would require a software subscription of approximately $300 per year.

These costs would vary based upon field size and number of sensors.

Table 3-5. Plant Water and Soil Moisture Monitoring Cost Summary

Practice	Water Savings Potential, %	Upfront Costs ($)	O&M Costs ($/year)
Time Temperature Domain Reflectometry	5 – 16%	$3,500	$300
Handheld TDR		$1,640	$32/acre
Neutron Probe		$5,000 - $10,000	$40/acre
Tensiometers – single gauge		$100 - $200	$32/acre
Tensiometers – central data unit		$400 - $600	$300

3.3.3 Distribution Uniformity

Distribution uniformity (DU) measures how uniformly irrigation water is applied across a vineyard within an irrigation block (Zellman, 2016). Perfectly uniform application means the same amount of water would be applied to each vine. In practice, emitters become clogged over time or there are other system leaks that cause differences in the amount of water that is applied to different areas of a vineyard. Other causes for uneven irrigation application include pressure variations due to elevation changes or improperly set regulating valves.

A DU test can be a helpful diagnostic tool for growers. DU tests are conducted after an irrigation system is established to create a baseline to compare to in subsequent tests. DU is measured by calculating the uniformity of water distribution across emitters, measured as a percentage. The target for vineyards is greater than 95 percent (Burt, 2004). When DU is low (below 85 percent) parts of the vineyard tend to be overwatered, which in addition to wasting water can degrade winegrape quality. According to industry standards, DU tests should be performed at a minimum of once every three to five years to identify and remedy inefficiencies.

DU issues can be addressed by performing appropriate maintenance, including backwashing and filter cleaning, flushing of lines, and monitoring pump pressures (Zellman, 2016). DU tests range in cost from $1,200–$2,000 per field (JAIN by Rivulis, 2020; Garcia, M., 2023). It is estimated that vineyards could reduce 18 percent of applied water for those with a DU of 90 percent and reduce 46 percent of applied water for those with a DU of 70 percent (Zellman, 2016). A more conservative range of 9 – 23 percent is applied. While the water savings vary greatly by vineyard and DU result, this represents a significant opportunity to reduce applied water.

Table 3-6. DU Cost Summary

Practice	Water Savings Potential, %	Upfront Costs ($)	O&M Costs ($/year)
Distribution Uniformity Test	9 – 23%	$1,200 - $2,000 per field	Varies based on maintenance needed

3.3.4 Soil Management via Cover Cropping

Healthy soils are the foundation of productive, sustainable agricultural systems. Healthy soils allow water to infiltrate and retain water more efficiently. Example practices to improve soil health (increase soil organic matter[30]) include cover crops, applying compost, and limiting tillage operations. These enhance soil health by improving soil structure through the formation of stable aggregates. This can increase the soil water holding capacity.

The USDA estimates that increasing soil organic matter content by 1 percent has the potential to increase soil water holding capacity by an additional 0.08 acre-feet per acre (Rust, 2015). Maintaining soil cover

[30] Healthy soils have 5 – 15% organic matter, while unhealthy soils have less than 5% (Bricault, 2014).

year-round with the use of cover crops or mulching can regulate soil temperature and substantially reduce evaporative losses. It is common to have extreme wet events in between dry years (as Napa County experienced in Fall 2021 and Winter 2022/23) and maintaining soil health prevents erosion and increases water infiltration during such events. Cover cropping is estimated to result in water savings of 4 - 14 percent (Jerkins, 2012). Cover crops can either be annual crops that are tilled into the soil, or permanent crops that do not involve tillage.

The Napa County RCD offers technical assistance related to soil health management to any interested growers. The Napa County RCD also hosts soil health workshops every summer in English and in Spanish. These workshops are conducted in small groups of less than 20 participants and incorporate hands-on-learning activities to educate farmers and farm workers about sustainable farming practices that enhance soil health. The Napa County RCD also helps with the development and implementation of carbon farm plans, which outline strategies for increasing soil carbon sequestration through the implementation of sustainable farming practices.

Costs to develop a cover crop include soil preparation, seed and seeding, fertilizer and fertilizing, and mowing. Costs to plant a cover crop are estimated at $154 per acre, with annual mowing (two times) and discing (one time) costs totaling $260 per acre (Kurtural et al, 2020). This translates to a total cost of $414 per acre.

Table 3-7. Cover Cropping Cost Summary

Practice	Water Savings Potential, %	Upfront Costs ($)	O&M Costs ($/year)
Cover Cropping	4 – 14%	$154/acre	$260/acre

3.3.5 Vine Canopy Management

Grapevine canopy includes all the components of the plant above the roots, such as the leaves, flowers, shoots, trunk, and fruit. Managing the vineyard canopy is an important component of effective grape growing that affects fruit ripening, quality, yield, and overall plant vigor. Canopy management practices typically include winter pruning of the vines (suckering), shoot thinning and positioning to remove excess shoots and leaves throughout the growing season, and fruit cluster thinning in mid to late summer.

Canopy management is critical for positioning and thinning shoots to allow vines to develop good fruit clusters, allow air movement through the vines and around the clusters, and manage fruit quality. The University of California Cooperative Extension (UCCE) estimates that annual cash costs (excluding equipment and other capital) are around $3,600 annually for the main canopy management activities. For farms that are more labor intensive (less mechanized canopy management), these costs can be substantially greater. Rieger (2011) evaluated alternative canopy management systems and found that improving canopy management can achieve up to a 15 percent reduction in applied water for vineyards (Rieger, 2011).

The cost to improve canopy management is in training, management, and additional field labor time. There is no additional capital investment in new equipment or machinery. As summarized above, annual costs for canopy management total around $3,600 per acre (Kurtural et al, 2020). Based on interviews with industry experts it was estimated that vineyards that are implementing insufficient canopy management practices likely incur lower costs because they are utilizing less labor and materials for these practices. It was estimated that optimal canopy management practices would be about 10 percent of the full budget cost of $3,600 per acre. Therefore, the estimated cost of improving canopy management equals approximately $360 per acre per year.

Table 3-8. Canopy Management Cost Summary

Practice	Water Savings Potential, %	Upfront Costs ($)	Additional O&M Costs ($/year)
Improved Canopy Management	15%	N/A	$360 / acre

3.3.6 Row Orientation for New Plantings

To establish a new vineyard, the old vineyard must first be removed and cleaned up, disposing of the old grapevines and trellis systems. The field has an opportunity for redesign, including new spacing and orientation of the vine rows. The field can be surveyed, and the optimal design determined for the new vineyard. Cover crops can be planted in the row middles, and the trellis system reinstalled. This redesign process typically occurs in the fall/winter of the year prior to replanting. Selecting the optimal orientation of vineyard rows can reduce ET by reducing the amount of sun exposure of the vines. This is a long-term strategy since re-orienting rows can only be adopted at replanting. Other benefits can be obtained from correctly orienting rows when replanting a vineyard. In addition to optimizing sun exposure, proper row orientation can minimize erosion potential.

Recent research has demonstrated an 18 percent reduction in vine transpiration for an optimized row orientation under controlled conditions (Buesa et al, 2020). Anecdotal evidence from local sources also provides promising insights. The Napa Valley Grapegrowers, for instance, have reported water savings of around 30 percent through strategic row orientation. Although specific results may vary depending on factors like climate, soil type, and grape variety, these observations underscore the potential of this approach to contribute to water conservation efforts in the Napa Valley Subbasin.

Adjusting row orientation is a feasible option only during the replanting phase. There may be minimal additional capital investment for selecting row orientation as it may require shorter as opposed to longer rows. However, the marginal cost depends on the vineyard and is estimated to be relatively small regardless. Similarly, there are no additional annual management costs for adoption. However, there may be modest costs for additional labor associated with canopy management and vineyard manager time to select row orientation.

An individual operation would work with an experienced vineyard manager to develop site-specific details, including specifics on favorable row directions, whether training or trellis infrastructure be used to overcome unfavorable row direction, or other retrofit possibilities.

Table 3-9. Row Orientation Cost Summary

Practice	Water Savings Potential, %	Upfront Costs ($)	O&M Costs ($/year)
Row Orientation	18 – 30%	Low	N/A

Note: no additional costs above standard plan/re-plant costs.

3.3.7 Rootstock Selection for New Plantings

Rootstock selection and grafting is a fundamental process of vineyard establishment. Different rootstocks have been developed over time to resist various pests, disease, and external stressors like drought. As increased frequency of drought is forecasted and may be exacerbated by limited access to groundwater, rootstock drought resistance will become an integral part of vineyard adaptability and sustainability. The practice of selecting drought-tolerant rootstocks represents a prudent investment in vineyard resilience against water and heat stresses. While its direct impact on water savings may not be extensively quantified, the broader benefits of reduced vine damage and improved vigor mean that rootstock selection may be a valuable component of water-efficient vineyard management. This approach, undertaken during the replanting process, offers vineyards a low to no-cost avenue for enhancing the vines' adaptive capacity.

Academic research has focused primarily on rootstock selection's impact under drought conditions. There is limited information on quantified water savings. Most research has focused on how rootstock selection may reduce overall damage to the vines resulting from water and heat stress (Williams, 2010). Rootstock selection is most important for addressing pathogens and other stressors. An individual operation would work with an experienced vineyard manager to appropriate rootstocks that are commercially viable and suitable based on field-specific conditions.

Selecting drought-tolerant rootstocks is only done at replanting and the vast majority of vines are grafted to rootstock for pathogen protection; therefore, there is no marginal capital investment, nor is there additional O&M for adoption of drought tolerant varieties. As a result, rootstock selection is a low to no-cost water management practice that vineyards should consider at the time of replanting.

Table 3-10. Rootstock Selection Cost Summary

Practice	Water Savings Potential, %	Upfront Costs ($)	O&M Costs ($/year)
Rootstock Selection	Data Gaps	Low	N/A

Note: no additional costs above standard plan/re-plant costs.

3.4 Water Conservation Practices for Wineries

Napa's wineries play a key role in groundwater conservation with opportunities to incorporate various strategies across their operations. Example practices that can provide opportunities for water conservation include:

- **Crush operations**. Using indoor or shaded settings prevents excessive heat and the resulting "baking" of waste materials on surface equipment. Pre-cleaning surfaces with brushes, using a high pressure/low volume nozzle with a shut-off valve, and using tools like brooms and squeegees also reduce water use (California Sustainable Winegrowing Alliance).
- **Cellar operations**. Practices include tank and line cleaning, reusing tank rinse water, and using high-pressure/low-volume equipment for cleaning. Best management practices for tank washing include temperature-controlled hot water with shut-off nozzles and alternative technologies for efficient cleaning, such as waterless sanitation.
- **Landscaping at a winery**. Practices include using drought-tolerant plants, mulching, and recycled water. Treating and reusing winery wastewater for irrigation is a viable option to reduce water consumption and reliance on groundwater.

Throughout the winemaking process, water measurement and monitoring can improve understanding of water use patterns and help detect any issues, such as leaks. Certification programs such as Napa Green work with wineries to monitor water use and implement best practices.

3.4.1 Waterless Sanitation

Tank sanitation involves cleaning and sterilizing tanks before they are used. Waterless sanitation has emerged as a method to clean and sterilize without the use of water. In waterless sanitation, the goal is to achieve the same level of cleanliness and microbial control as traditional methods while conserving water resources. Waterless sanitation has gained some popularity in the wine industry due to its water-saving benefits. In addition to the water savings benefits, waterless sanitation can be more energy-efficient than some water-based methods.

Ultraviolet (UV) sanitation methods are used as an example of a waterless sanitation practice. UV sanitation does not use water, steam, chemicals, or ozone to sanitize, representing a substantial savings in materials (water, energy, and chemicals) and other related costs. UV sanitation is used by several larger wineries in the Subbasin (G3 Enterprises, 2023). Waterless sanitation by UV light reduces water use by an estimated 80 percent (BlueMorph UV, 2023).

The cost of switching to waterless sanitation depends on the size of the winery. Quackenbush (2015) estimates that the initial investment cost is around $50,000. This includes the UV sanitation device, the rolling cart, and necessary probe and power hookups (Quackenbush, 2015). Annual operating costs are reported to be lower than standard water-based sanitation practices; Jackson Family Wines estimated a 60 percent reduction in labor and 50 percent reduction in energy costs (Quackenbush, 2015), though the baseline of these costs is unknown.

Table 3-11. Waterless Sanitation Cost Summary			
Practice	Water Savings Potential, %	Upfront Costs ($)	O&M Costs ($/year)
Waterless Sanitation	80%	$50,000	Data Gaps

3.4.2 Processing Water and Reuse

Wastewater is a byproduct of the winemaking process from grape processing to cleaning and bottling. The ratio of wastewater to wine produced is 6:1 for typical wineries but ranges from 12:1 to 3:1 (Ochs, 2023). This waste (i.e., used process water) can be turned into a resource by treating and reusing processing water for landscaping or vineyard irrigation. Given the potentially large volumes of wastewater produced, this is a substantial opportunity to replace groundwater with processing water and reduce groundwater use, an in-lieu use strategy. Approximately 50 percent of wineries certified by California Sustainable Winegrowing Alliance already reuse some amount of winery process water for purposes such as irrigation (California Sustainable Winegrowing Alliance, 2020).

Wineries must already treat their wastewater to comply with applicable regulations under the Statewide General Waste Discharge Requirements (WDRs) for Wineries (State Water Resources Control Board, 2021). However, wineries may incur additional costs to treat it to the quality necessary for irrigation. In particular, treated winery process water may still contain contaminants such as nitrogen, salinity, and biochemical oxygen demand (BOD) that could harm vineyards, grasses, or other plants. Depending on the cleaning chemicals used in the winery, salinity may pose an issue when applying winery process water. There exist cleaning chemicals and mechanical techniques for tank cleaning that produce significantly fewer compounds that can cause issues with applying winery wastewater (McCullough et al., 2016). One method used recently for carbon-neutral wastewater treatment by vineyards is a filtration method powered by worms (Wine Industry Advisor, 2023). In addition to being more environmentally sensitive, these techniques were also found to be more economical than the standard caustic cleaners. Coupling these tank cleaning methods with the use of winery wastewater for vineyard irrigation has the potential to reduce overall groundwater reliance.

Rather than used winery process water being viewed as waste, this water can be used for vineyard or landscape irrigation. Therefore, this is a replacement (in lieu) source of water that can reduce groundwater pumping by the same amount.

The marginal costs to treat this wastewater to a sufficient quality for irrigation purposes is not currently known. This is a data gap that will be addressed in the future.

Table 3-12. Treated Winery Wastewater Cost Summary			
Practice	Water Savings Potential, %	Upfront Costs ($)	O&M Costs ($/year)
Treated Winery Wastewater	100% (In Lieu)	Data Gap	Data Gap

3.5 Water Conservation Practices for Rural Domestic, Municipal, and Industrial Users

Municipal, industrial, and rural residential users account for approximately 20 percent of the Subbasin's annual groundwater use. Residents and other urban users can implement conservation and water-saving practices as a way of life (NCGSA Meeting; March 28, 2023). Household and industrial water conservation also provides benefits including lower utility bills (energy and/or water). Outdoor water usage, particularly for landscaping, represents a substantial portion of household water use and consumption. For example, the City of Napa estimates that about half of its potable drinking water is used outdoors (City of Napa, 2023). Indoor water use accounts for a substantial share of delivered water, but less consumptive water use. Water-efficient fixtures such as low-flow toilets, aerated faucets, and efficient showerheads can contribute to substantial water and cost savings without compromising performance.

3.5.1 WaterSense Devices

The U.S. Environmental Protection Agency (EPA) has developed standards for water-efficient products; by meeting these standards, products earn the "WaterSense" label. These products must be at least 20 percent more water efficient than the other products on the market. For comprehensive information on water-saving strategies, residents can explore the resources provided by Save Our Water[31], EPA WaterSense[32], and Energy Star[33].

The costs to adopt WaterSense devices are summarized in **Table 3-13**. This includes irrigation controllers and irrigation sprinklers for outdoor use, which account for approximately half of household water use. Other WaterSense devices include faucets for the kitchen and bathroom, toilets, and shower heads. For a two-bath household with a lawn, this sums to an estimated $920 in hardware costs and $1,790 in installation costs, totaling $2,710. Most of the products have a lifetime of 10 – 15 years. The exact device type and number of devices would vary by household size or business size and their specific needs.

[31] https://saveourwater.com/
[32] https://www.epa.gov/watersense
[33] https://www.energystar.gov/products

Table 3-13. WaterSense Cost Summary			
Practice	**Water Savings Potential, %**	**Upfront Costs ($)**	**O&M Costs ($/year)**
Irrigation Controller	20%	$325	N/A
Irrigation Sprinklers (10)		$475	N/A
Kitchen Faucet		$205	N/A
Bathroom Faucet (2)		$370	N/A
Toilet (2)		$1,150	N/A
Shower Head (2)		$185	N/A
Total, Per 2-Bath Household		**$2,710**	N/A

3.5.2 Outdoor Water Use

On average, outdoor water use for landscaping can account for 30% to 60% of total household water consumption in areas with extensive gardens, lawns, and landscaping. Therefore, water for landscaping is an important way that residents can reduce water use. Water scheduling is an easy and cost-effective strategy, which does not require any new hardware. Adjusting watering schedules based on weather conditions, and during cooler times of the day, such as early morning or late evening, helps reduce evaporation. Residents should also monitor their irrigation system regularly to make sure it's not over-irrigating and resulting in runoff or watering the street or sidewalk.

Other ways to reduce outdoor water use include potentially upgrading irrigation systems, such as installing drip irrigation or a smart controller in gardens and landscapes to deliver water directly to plant roots. Further, consider removing turf grass and choosing drought-resistant and native plants for landscaping that requires less irrigation water (e.g., cash-for-grass programs that pay for turf removal). Applying organic mulch around plants and trees helps to retain soil moisture, prevent weed growth, and improve soil health. Residents should also use a broom instead of a hose to clean outdoor areas and should install a shut-off nozzle to the hose to reduce waste. Finally, collecting rainwater in barrels or cisterns for use in gardens and landscapes reduces groundwater use. To learn more about water-smart landscaping in Napa, visit Water-Wise Gardening in the Napa Valley[34].

3.5.3 Indoor Water Use

Simple ways to reduce indoor water use include washing produce in a container rather than under running water; washing clothes or running the dishwasher only with full loads; taking shorter showers, and turning the water off while brushing teeth, washing hands, or shaving. Further, because it takes more water to wash dishes by hand than by dishwasher, it's important to use the dishwasher as much as possible.

34 https://napa.watersavingplants.com/

Water-efficient fixtures are essential components in promoting responsible water usage within households. These fixtures, such as low-flow toilets, water-saving faucets (i.e., with aerators) and efficient showerheads, are designed to optimize water consumption while maintaining performance. By reducing the flow rate of water without compromising functionality, water-efficient fixtures can significantly lower water usage, resulting in substantial water and cost savings over time. More information about water-efficient appliances is provided in Section 3.5.1. To find certified water-efficient appliances, visit EPA WaterSense[35].

3.5.4 Checking for Leaks

Routinely inspecting faucets, pipes, and irrigation systems for leaks is another way to conserve. Even minor leaks can lead to substantial water losses over time. Smart water meters can help monitor and check for leaks. Leaks can be checked manually by recording the meter reading, refraining from using water for an hour, and then rechecking the reading. If the meter readings remain unchanged, there are no leaks. However, if there's a discrepancy in the readings, it indicates a leak that should be promptly addressed. Regular leak checks using water meters can help prevent water loss and support sustainable water management practices.

4 FINANCIAL ASSISTANCE FOR ADOPTION OF PRACTICES

Various financial assistance programs can provide support in offsetting the costs associated with the adoption of specific water conservation technologies and practices. These programs help water users implement innovative solutions to conserve water. The subsequent section reviews some of these initiatives that are available through local, state, and federal agencies.

4.1 Agriculture

A variety of state, federal, and local programs are available to support the adoption of practices and technologies for agriculture. Selected programs available for Napa vineyards, including the types of projects they fund, are summarized below.

Other potential funding sources for implementing water conservation practices will be reviewed as they are identified, including other state and federal grant programs. Financial assistance would be tailored to conditions in the Subbasin to encourage adoption. Examples of recent state and federal grant programs include DWR's LandFlex program, the Department of Conservation's Multibenefit Land Repurposing program, and the National Oceanic and Atmospheric Administration (NOAA) Voluntary Drought Initiative (VDI) program. The NOAA VDI was available in both Sonoma and Napa Counties, but there was limited adoption of the program in Napa relative to Sonoma.

[35] https://www.epa.gov/watersense

4.1.1 Napa County RCD Irrigation System Evaluation

The Napa County RCD[36] (Napa County RCD, 2023) has been offering Mobile Irrigation Lab services since 2014 to assess the performance of vineyard drip irrigation systems for irrigation distribution uniformity. These assessments have been conducted following protocols developed by California Polytechnic State University San Luis Obispo (Cal Poly) Irrigation Training and Research Center (ITRC).

As discussed in **Section 3.3**, DU refers to how evenly an irrigation system applies water across a field and whether the application rate matches the rate expected for the emitter type installed. Testing for DU and irrigation system performance is recommended every three to five years. These assessments provide an opportunity for growers to understand their irrigation system performance and identify potential areas for improvement.

Since 2014, Napa County RCD has conducted 181 evaluations covering about 6,000 acres of vineyards in Napa County. The average DU score for this group of vineyards is 80 percent, which is considered inadequate. This demonstrates opportunities to improve irrigation system performance and water use efficiency. According to Napa County RCD, the most common system performance issues involved: (1) inadequate pressure in irrigation lines due to poor water quality/filtration, inadequate system design, or inadequate acreage being irrigated in a given irrigation session; (2) excessive emitter clogging due to poor water quality/filtration; and (3) emitters used past their operational lifetime.

Addressing existing system inefficiencies can result in increased water savings. For example, if a vineyard with an irrigation system is over-discharging water on average by 15 percent, this amounts to an excess amount applied of about 24,516 gallons of water per acre per irrigation season, or 0.08 AFY per acre (i.e., assuming a vine spacing 6 feet x 8 feet and the presence of 1.0 gallons/hour emitters).

The Napa County RCD offers irrigation evaluations for free, a service that is valued at $2,000. The RCD also supports growers with applications to state and federal grant programs such as the State Water Efficiency and Enhancement Program and Environmental Quality Incentives Program, described below.

4.1.2 State Water Efficiency & Enhancement Program, California Department of Food and Agriculture

The State Water Efficiency and Enhancement Program[37] (SWEEP; CDFA, 2023), offered by the California Department of Food and Agriculture Office of Environmental Farming and Innovation, provides funding for on-farm projects that save water and reduce greenhouse gas emissions. Projects can be designed to address deficiencies in irrigation distribution uniformity as identified in the irrigation system evaluations conducted by the Napa County RCD. In such cases, SWEEP can pay for improvements in pumping efficiency and to address any shortcomings in the water distribution system.

[36] https://naparcd.org/agriculture/
[37] https://www.cdfa.ca.gov/oefi/sweep/

Projects can include improvements in filtration and replacement of irrigation lines and emitters, or on improving irrigation management with the use of technology. SWEEP has historically funded projects that incorporate soil moisture probes, weather stations, plant water stress monitoring, evapotranspiration monitoring (e.g., Tule), plant health monitoring (e.g., Normalized Difference Vegetation Index (NDVI)), pump retrofits, drip and low-pressure irrigation systems, and more. All SWEEP applicants are encouraged to incorporate the installation and use of flow meters, if not already present, to track water use savings over the course of the project. The program also supports projects that result in enhanced energy efficiency and reduction in greenhouse gas emissions from replacing diesel pumps with electric alternatives and by installing variable frequency drives.

SWEEP is typically well funded, with $110 million allocated for the funding period in 2023 and more funding expected for the upcoming years. SWEEP projects can be funded for up to $200,000 per agricultural operation. It is recommended to submit applications as early as possible as the program is competitive. The Napa County RCD currently has funding from CDFA to assist farmers one-on-one with project design and application materials and with implementation if the project is awarded.

4.1.3 Healthy Soils Incentive Program, California Department of Food and Agriculture

The Healthy Soils Incentive Program[38] (HSP; CDFA, 2023b), offered by CDFA, is another financial assistance program that incentivizes the adoption of farm and ranch management practices that improve soil health and reduce greenhouse gases. Improving soil health is also linked to improving the infiltration rates and water holding capacity of soil, discussed in **Section 3**. As a result, this additional infiltration benefit can recharge groundwater and support aquifer health. While the adoption of soil health practices can require a substantial initial investment, HSP can offset some of those costs.

Projects in Napa County that are commonly funded include: cover cropping, mulching, compost application, and planting native vegetation in the forms of hedgerows. All of these practices also provide water saving benefits on farms. HSP projects can be funded for up to $100,000 per agricultural operation, but this amount may increase with some reporting that the 2024 maximum amount is up to $200,000. It is important to follow up with the funding agency to understand current program requirements and limits. The Napa County RCD currently has funding from CDFA to assist farmers one-on-one with project design and application materials and with implementation of these projects.

4.1.4 Natural Resources Conservation Service Programs, U.S. Department of Agriculture

The USDA Natural Resources Conservation Service provides technical assistance and offers a range of financial assistance programs to address natural resource concerns on agricultural lands. NRCS works with landowners and agricultural producers to provide site-specific technical assistance to help them make informed decisions and implement voluntary conservation. NRCS supports a broad variety of cost-share

[38] https://www.cdfa.ca.gov/oefi/healthysoils/IncentivesProgram.html

programs and financial assistance through programs including Environmental Quality Incentives Program[39] (EQIP) and Conservation Incentive Contracts[40] (CIC).

Eligible projects include conservation practices that may either improve water use efficiency or address aspects of water flow. Examples include cover cropping, irrigation water management, mulching, on-farm recharge, among others. Conservation practices must address a particular NRCS resource concern at the time of application.

Resource concerns that NRCS may include in a plan to address water use or management are summarized in **Table 4-1**. NRCS maintains standards and specifications for all Conservation Practices in **Section 3** of the electronic Field Office Technical Guide[41].

Table 4-1. Summary of NRCS Resource Concerns

Resource Concern	Objective	Conservation Practices
Inefficient Irrigation Water Use	Manage irrigation water efficiently.	Microirrigation System, Irrigation Water Management, Sprinkler System, Irrigation Pipeline, Structure for Water Control, and Mulching may all be planned to improve the efficiency of irrigation water application.
Groundwater Depletion	Reduce the risk of natural resource degradation, or limitation to land use caused by groundwater depletion.	Groundwater Recharge Basin or Trench and On-Farm Recharge can be used to recharge a specific aquifer (these practices are interim practices and limited for funding to pilot projects in specific counties, not including Napa County at this time).
Soil organic matter depletion	Implement a soil health management system that addresses organic matter depletion and strengthens soil function and processes that support plant productivity, biological activity and water and nutrient cycling.	Conservation Cover, Cover Crop, Residue and Tillage Management, and Soil Carbon Amendment can be integrated into a soil health management system that builds soil organic matter and improves water infiltration and storage.
Soil compaction	Implement a soil health management system that reduces soil compaction, improving plant productivity, biological activity, infiltration, and aeration.	Conservation Cover, Cover Crop, and Residue and Tillage Management can be integrated into a soil health management system that reduces compaction and improves water infiltration.
Sediment Transported to Surface Water	Limit sediment loss from site to surface waters.	Conservation Cover, Field Border, Filter Strip, Critical Area Planting, and Grassed Waterway can be used to slow water and reduce transport of sediment.

[39] https://www.nrcs.usda.gov/programs-initiatives/eqip-environmental-quality-incentives
[40] https://www.nrcs.usda.gov/sites/default/files/2022-10/Conservation Incentive Contracts.pdf
[41] https://efotg.sc.egov.usda.gov/#/state/CA/documents/section=4

More information about NRCS programs may be found by contacting the local NRCS office in Napa below:

Napa Service Center, Natural Resources Conservation Service
1303 Jefferson St., Ste. 500B, Napa, CA
(707) 690-3911
Contact: Evelyn Denzin, evelyn.denzin@usda.gov

4.2 Residential, Municipal & Industrial, and Wineries

Financial assistance programs are available to help residents and businesses reduce water use. These programs include cash-for-grass, in which customers are paid to pull out turfgrass, free water conservation kits, and rebates for water-efficient devices. Program summaries and links for additional information include:

- **Water Conservation Kits:** The following cities and towns offer free water conservation kits, which include items such as a low-flow shower head, a garden hose nozzle, a shower timer, sink aerators, and more: City of Calistoga[42], City of Napa[43], and City of St. Helena[44].
- **Rebate Programs**: The City of American Canyon[45] has a $100 rebate program for toilet replacement with a WaterSense toilet. The City of St. Helena[46] has several rebates available for toilet replacement, irrigation controllers, greywater, rainwater harvesting, and recirculation.
- **California Department of Water Resources**: DWR provides resources and links to other information on its Water Use and Efficiency website[47]. Of particular note is the Model Water Efficient Landscape Ordinance (MWELO) page[48] which provides useful information on reducing urban landscape water use.
- **California Water Efficiency Partnership**: The partnership provides information, resources, and tools for improving residential, commercial, and industrial water use efficiency at its website[49].
- **Cash-for-Grass Programs:** The following cities and towns have cash-for-grass programs, in which the city will pay customers to remove turfgrass: American Canyon[50], City of Napa[51], Town of Yountville[52], and City of St. Helena[53].

[42] https://www.ci.calistoga.ca.us/city-hall/departments-services/public-works-department/water-wastewater-treatment/water-conservation
[43] https://www.cityofnapa.org/593/Free-Water-Saving-Devices
[44] https://www.cityofsthelena.org/publicworks/page/water-conservation-rebates
[45] https://portal.laserfiche.com/f0791/forms/PWtoiletrebate
[46] https://www.cityofsthelena.org/publicworks/page/water-conservation-rebates
[47] https://water.ca.gov/Programs/Water-Use-And-Efficiency/Urban-Water-Use-Efficiency
[48] https://water.ca.gov/Programs/Water-Use-And-Efficiency/Urban-Water-Use-Efficiency/Model-Water-Efficient-Landscape-Ordinance
[49] https://calwep.org/
[50] https://www.cityofamericancanyon.org/government/public-works/environmental-services/water-conservation
[51] https://www.cityofnapa.org/585/Cash-For-Grass
[52] https://www.townofyountville.com/350/Water-Conservation-Plan
[53] https://www.cityofsthelena.org/publicworks/page/water-conservation-rebates

4.3 Incentives for Water Conservation Practices

The NCGSA will be evaluating the potential to incentivize the adoption of water conservation practices for vineyards, wineries, urban, and rural residential users. Such incentives could include cost-share, reimbursements, in-kind services, and other NCGSA programs. For example, many of the urban and residential programs are not available for those residents or businesses outside of the named municipalities described in **Section 4.2**, and the NCGSA may investigate offering similar programs for residents that are within the Subbasin but outside of the municipalities listed above.

Stakeholders that are interested in technology or practice adoption for water savings are encouraged to contact the NCGSA and stay engaged with the Technical Advisory Group.

5 CERTIFICATION PROGRAMS FOR VINEYARDS AND WINERIES

Certification is a process for assuring compliance with defined management practices, specific criteria, or other standards. A certifier is typically a third-party that is responsible for setting standards, working with businesses to become certified, and then verifying that businesses comply with the required management practices over time. Businesses that meet the requirements are then "certified," which can provide benefits including regulatory compliance, labeling, market access, and general promotions/marketing. Adopting specific management practices or production standards also provides benefits to the Subbasin and the broader community in Napa County by conserving water, soil, and other natural resources, improving air and water quality, and supporting wildlife habitat.

There are established certification programs for vineyards and wineries. Examples in California that are described in more detail in subsequent sections of this Workplan include Napa Green, California Sustainable Winegrowing Alliance, SIP Certified, Lodi Rules, and Fish Friendly Farming.

Certification programs are a structured framework for encouraging voluntary adoption of water conservation practices. The WC and GPR Workplans describe approaches to incentivize participation in certification programs to scale conservation practices for water in the Subbasin. Any incentives and other aspects of certification program design would be developed as part of a stakeholder-driven public process. Interested parties are encouraged to attend public NCGSA Board meetings and TAG meetings.

5.1 Private Benefits of Certification Programs

In addition to improving water efficiency and promoting sustainable practices, certification provides private benefits to certified vineyards and wineries. Certified vineyards and wineries can credibly communicate their commitment to consumers, the trade, and peers using various logos and claims. Other private benefits of certification include:

- **Continuous business improvement:** By organizing goals and providing access to free educational tools and resources, certification programs offer a centralized hub for improving business operations, efficiency, and best practices as the industry evolves. For example, the California Code of Sustainable Winegrowing program offers workshops, educational tools, and resources on sustainable grapegrowing and winegrowing (Wine Institute, 2023).

- **Efficiency improvements:** Certification can help growers improve financial outcomes and reduce business risk by following best practices that reduce resource use and associated business costs. Certifying both vineyard and winery operations simultaneously can also lead to operational efficiencies.
- **Regulatory compliance**: Some certification programs streamline the regulatory compliance process. For example, Fish Friendly Farming (FFF) is a certification program that ensures compliance with the State Water Resources Control Board (SWRCB) water quality standards for agricultural uses. Vineyards can maintain compliance through third-party institutions such as FFF and the LandSmart RCD program.
- **Marketing and value-added:** Participating in certification programs can create additional value by signaling to consumers that the wine was produced using certain practices. Labels can allow businesses to realize a price premium relative to non-labeled competitors.
- **Intrinsic value:** Some businesses and individuals choose to participate in a certification program because they feel that certain grape and wine production practices are good for the environment and the "right thing to do."
- **Environmental, Social, and Governance (ESG) standards:** ESG standards specify how a company manages its environmental, social, and governance impacts on society. There is increasing interest in ESG standards across agricultural supply chains, including in the wine industry. For example, some wine distributors now require some form of ESG documentation from their suppliers. Certification can document progress and compliance and allow businesses to access additional markets.
- **Credibility and recognition:** Participating in a recognized certification program provides recognition within the industry. The assurance of being involved in a program vetted by internationally recognized sustainability standards and by engaging various stakeholders further adds credibility to the certification.

Certification programs can also provide direct value to businesses by increasing brand recognition. A certification is effectively a label that allows a business, such as a winery or grape grower, to signal that its product possesses attributes that would otherwise not be (easily) known or verifiable by their customer. For example, a well-known certification program is the USDA National Organic Program. Growers that meet the program requirements can market and label their product as organic. This typically allows the producer to sell its product at a price premium. That is, through the certification program the producer can realize additional business value.

A review of certification label benefits was conducted to illustrate the range of price premiums over conventional or unlabeled equivalent goods (see **Table 6-1**). The review focused on labels for fresh produce and wines. For example, Organic Wine in the European Union garnered a price premium of $9-$10 per bottle while Fair Label Wine in the European Union garnered $7-$8 per bottle.

Table 5-1. Price Premiums for Certification and Labeling		
Certification / Label	**Price Premium Over Conventional / Unlabeled**	**Source**
Organic Wine (E.U.)	$9 - $10 per bottle	Piracci, Boncinelli, Casini (2022)
Fair Labor Wine (E.U.)	$7 - $8 per bottle	Piracci, Boncinelli, Casini (2022)
Environmentally Friendly Food (Averaged at Retail)	17 – 26 percent	Li & Kallas (2021)
Organic Food (Averaged at Retail)	28 – 48 percent	Li & Kallas (2021)
Sustainable Apples	$1.45 - $1.79 per lb	Sackett, Shupp, & Tonsor (2016)
Organic Apples	$1.57 - $1.93 per lb	Sackett, Shupp, & Tonsor (2016)

The label value of specific certification programs available to Subbasin vineyards and wineries has not been independently established. The price premium can be evaluated as part of future certification program design in the Subbasin.

5.2 Certification Programs for Vineyards and Wineries

A series of interviews with certification programs in Napa County was conducted. According to Napa Green, 40 percent of California's certified wineries are in Napa County. Fish Friendly Farming states that 92 percent of the vineyards in Napa County are FFF-certified under its regulatory compliance program for water quality. **Table 5-2** provides a summary of some of the top voluntary, third-party certification programs for vineyards and wineries in Napa County. Programs vary by the third-party audit process and the requirements to become and remain certified. The following subsections provide a more detailed summary of each program and links for additional information for each of the certification programs.

Table 5-2. Certification Programs for Vineyards and Wineries			
Certification Program	**Program Summary**	**Vineyard Certification Available?**	**Winery Certification Available?**
Certified California Sustainable Winegrowing (CCSW)	Administered by California Sustainable Winegrowing Alliance (CSWA), CCSW certifies that vineyards and wineries to implement sustainable practices in their operations. It covers a wide range of topics, including soil health, water conservation, and energy efficiency. With more than 230,000 certified acres and nearly 190 wineries, it is one of the most widely adopted certification programs in California.	Yes	Yes
Fish Friendly Farming (FFF)	FFF promotes environmentally responsible practices in vineyards and farms to protect water quality and fish habitat. It focuses on sustainable land management, reducing sediment and chemical	Yes	No

Table 5-2. Certification Programs for Vineyards and Wineries			
Certification Program	**Program Summary**	**Vineyard Certification Available?**	**Winery Certification Available?**
	runoff, and enhancing the overall health of watersheds and wildlife habitat.		
LandSmart	LandSmart is a certification program developed by the Napa Resource Conservation District that works with vineyard managers and landowners to develop vineyard conservation plans, which largely focus on water quality and habitat health.	Yes	No
Lodi Rules	Developed by the Lodi Winegrape Commission, this program emphasizes sustainable farming practices, economic viability, and social responsibility. With nearly 70,000 certified acres, is one of the most widely adopted certification programs.	Yes	No
Napa Green	Napa Green is a certification program designed for vineyards and wineries in the Napa Valley, California. It includes on sustainable and environmentally friendly practices, with focus on climate action, regenerative agriculture, and social equity.	Yes	Yes
Sustainability in Practice (SIP) Certified	SIP Certified focuses on three pillars of sustainability: environmental stewardship, social responsibility, and economic viability. The program requires compliance with rigorous standards and third-party audits. With over 46,000 certified acres, is one of the most widely adopted vineyard certification programs.	Yes	Yes

5.2.1 California Sustainable Winegrowing Alliance, Wine Institute and California Association of Winegrape Growers

The California Sustainable Winegrowing Alliance[54] (CSWA) was formed in 2003 and created by the Wine Institute and the California Association of Winegrape Growers. Its Sustainable Winegrowing Program aims to develop voluntary and high standards for sustainable winegrowing. Its certification program, Certified California Sustainable Winegrowing (CCSW), is available for both vineyards and wineries. CSWA is a popular certification program in Napa County, having certified 43 wineries and 259 vineyards on nearly 15,000 acres. The program requires continuous improvement. Verification is conducted annually and through third-party audits.

[54] https://www.sustainablewinegrowing.org/

Vineyard Certification: According to CCSW certification requirements, for a vineyard to become certified, it must have a minimum of 85 percent of its 144 practices ranking as sustainable, as well as meeting 60 required practice categories. Vineyards must measure and report water and nitrogen use annually. Annual evaluations score the vineyard performance in categories including Sustainable Business Strategy, Viticulture, Soil Management, Vineyard Water Management, Pest Management, Wine Quality, Ecosystem Management, Energy Efficiency, Material Handling, Solid Waste Management, Sustainable Purchasing, Human Resources, Neighbors and Community, and Air Quality and Climate Protection.

Winery Certification: According to CCSW certification requirements, for a winery to become certified, it must have a minimum of 85 percent of its 105 practices ranking as sustainable, as well as meeting 41 required practice categories. Wineries must measure and report water and energy use as well as greenhouse gas emissions. Furthermore, for a winery to be CCSW-labeled, it must have at least 85 percent of its grapes sourced from certified vineyards and 100 percent of its grapes sourced from California. Wineries must also undergo a supply audit to verify grape sourcing. Annual evaluations score the winery performance in categories including Sustainable Business Strategy, Pest Management, Wine Quality, Ecosystem Management, Energy Efficiency, Winery Water Conservation and Water Quality, Material Handling, Solid Waste Reduction and Management, Sustainable Purchasing, Human Resources, Neighbors and Community, and Air Quality and Climate Protection.

Other notable aspects of the CCSW program are that it has educational events to learn best practices from the community of certified viticulturists and winemakers. Further, the development of the California Code of Sustainable Winegrowing Workbook[55], which was first developed in 2002 and is periodically updated, provides a framework for self-assessment and the ability to identify improvement for sustainability. Other sustainability resources are available on their website[56].

More information about the CSWA and its certification programs is available on the CSWA website[57].

5.2.2 Fish Friendly Farming

The Fish Friendly Farming[58] (FFF) program was developed in 1999 and is run by the California Land Stewardship Institute, developed in 2004 to oversee the program. FFF started in a single watershed but has grown to operate in 10 counties and on more than 150,000 acres of vineyards and other farmland. A primary benefit of the FFF program is compliance with the Irrigated Lands Regulatory Program (ILRP), which regulates water quality and requires measures to prevent contamination by pesticides, fertilizers, and sediments that impair water bodies. Napa County is in the San Francisco Regional Water Quality Control Board area (Region 2), which includes management for runoff and water quality in the Napa River watershed for federally listed steelhead populations. The region is currently under representative monitoring and regulations affecting unpaved roads and vineyards 5 acres or larger in size, which have been found to be a source of sediment discharge (California Regional Water Quality Control Board, 2017).

55 https://www.sustainablewinegrowing.org/orderdownloadworkbook.php
56 https://www.sustainablewinegrowing.org/resources.php
57 https://www.sustainablewinegrowing.org/
58 https://www.fishfriendlyfarming.org/

By meeting the certification criteria and becoming certified with FFF, growers can verify regulatory compliance with development of a sufficient Farm Plan as required by the Region 2 Waste Discharge Requirements. FFF only has a vineyard/agricultural certification program. Approximately 92 percent of Napa County vineyards are certified by FFF program (L. Marcus, Personal Communications, April 4, 2023).

Vineyard Certification: To become certified with FFF, a Farm Conservation Plan is tailored to the specific vineyard, which evaluates how the property and practices impact the local natural resources. FFF works with growers to provide technical assistance for implementation of the Farm Conservation Plan, which may include restoration and revegetation, or implementation of management practices such as cover crops. Following completion of the plan, the site is audited and certified through a third party, which may include the National Marine Fisheries Service, North Coast Regional Water Quality Control Board, Natural Resources Conservation Service, and/or the County Agricultural Commissioner (Fish Friendly Farming, 2023). Recertification occurs every five years.

More information about FFF and its certification program is available on its website[59].

5.2.3 LandSmart

LandSmart[60] is a program developed by the RCDs in Napa, Sonoma, Mendocino, and Gold Ridge with the USDA NRCS (LandSmart, 2023). The program works with vineyard managers and landowners to develop vineyard conservation plans, which largely focus on water quality and habitat health. Similarly, to the FFF program, participation in LandSmart is a way to achieve regulatory compliance with regional water quality regulations. Approximately 15 percent of Napa County vineyards are certified by LandSmart (interview with Frances Knapczyk, April 6, 2023). LandSmart offers agricultural/vineyard certifications but no winery certifications.

Vineyard Certification: Vineyard Conservation Plans are developed for the specific property, including planted areas and roads, by understanding its relationship to natural resources such as riparian corridors and streams (LandSmart, 2023). The Plans will cover a range of sustainability measures for implementation, including: water supply, erosion control, nutrient management, pest management, management of riparian areas, and other issues of interest to the vineyard manager/landowner (LandSmart, 2023). Recently, LandSmart also began supporting development of Carbon Farm Plans. LandSmart offers several resources[61] for growers to learn more about natural resources management.

More information about LandSmart can be found at their website[62].

[59] https://www.fishfriendlyfarming.org/get-involved
[60] https://naparcd.org/landsmart/
[61] https://landsmart.org/category/publications/
[62] https://naparcd.org/landsmart/

5.2.4 LODI RULES

LODI RULES[63] is a sustainable certification program developed in 2005. It grew out of a farmer education program on pest management by the Lodi Winegrape Commission. LODI RULES has grown to certify nearly 50 wineries and more than 1,200 vineyards on 70,000 acres in California, Washington, and Israel. While this program does not have a substantial presence in Napa, its certification criteria offer insights into best management practices for vineyards. Their standards must be (1) related to their core standards of environment, people, and business, (2) measurable and auditable, (3) economically feasible, and (4) grounded in science (LODI RULES, 2023). LODI RULES reports that some wineries pay a premium for certified grapes, in the range of $25 - $50 per ton (LODI RULES, 2023). The certification is made available to both wineries and vineyards.

Vineyard Certification: To become certified by LODI RULES, vineyards must meet a minimum of 50 percent of the scoring criteria in each of the chapters and score a total of 70 percent in all of the chapters. Some criteria are required to become certified. Certification is verified by a third-party auditor annually. Current standards and criteria for vineyard certification are listed in the LODI RULES for Sustainable Winegrowing Certification Standards[64].

More information about the LODI RULES program can be found on their website[65].

5.2.5 Napa Green

Napa Green, formally known as Napa Green Land, was originally developed in 2004 as a way to improve water quality by reducing erosion (Napa Green, 2023). In 2021, Napa Green restructured its certification program and standards to encompass regenerative agriculture, climate, and social equity (Napa Green, 2023). Napa Green, with other partners, launched the RISE Climate and Wine Symposium, a workshop and seminar series devoted to advancing sustainable solutions in the winemaking community. As of 2023, approximately 20 vineyards in Napa County are a Napa Green Certified Vineyard, with another 40 in the process of getting certified, representing approximately 7,000 acres of Napa's vineyards (interview with Anna Brittain, September 7, 2023). Approximately one-third of wineries in Napa County are Napa Green certified.

Vineyard Certification: The Napa Green vineyard certification encompasses six main components: irrigation assessments and water use efficiency; implementing carbon farming and regenerative practices; social equity, justice, and inclusion; tree and forest preservation; pesticide management; and conservation burning (Napa Green, 2023). Across the six core elements, minimum criteria are specified as well as elective criteria. The full description of vineyard standards is available for download on the Napa

[63] https://www.lodirules.org/
[64] https://www.lodigrowers.com/wp-content/uploads/2023/01/LODI-RULES-Binder-Standards-Accredited-4th-Ed.-2022-clean-copy-with-intro-1.11.23.pdf
[65] https://www.lodirules.org/

Green website[66]. In addition to third-party audits at the time of certification, annual desk audits are completed. Recertification is required every three years. Continuing education is also required.

Winery Certification: To become certified by Napa Green, a winery must implement a range of sustainability practices that encompass energy efficiency; water efficiency; waste prevention through recycling, composting, and purchasing requirements; reduction of greenhouse gas emissions; and social equity. The full description of winery standards is available for download on the Napa Green website[67]. In addition to promoting sustainability, the Napa Green winery certification program has saved members approximately $4 million in energy costs (Napa Green, 2023).

More information about Napa Green and its certification programs is available on their website[68].

5.2.6 SIP Certified

Sustainability in Practice (SIP) Certified[69] began as a tool and pilot program by the Vineyard Team in 2008. The tool provided a mechanism for growers to self-assess their practices for sustainability for water, soil, habitat, and human resources (SIP Certified, 2023). It has since grown to certify five wineries and 46,000 acres of vineyards in California, Oregon, and Michigan. The certification focuses on three core elements: environmental stewardship, social responsibility, and economic viability (SIP Certified, 2023). While SIP Certified does not have a substantial presence in Napa, the program's sustainability criteria offer insights for Napa.

Vineyard Certification: To become SIP Certified, vineyards must score a minimum of 75 percent across total available points across 14 categories. Categories include conservation and biological diversity; vineyard management; winery management; soil conservation; water conservation and quality; energy efficiency; pollution and waste; purchasing; social equity; pest management; grape sourcing; continuing education; business management; and year-end reporting. In addition, vineyards must adhere to minimum criteria to be SIP Certified. Verification is conducted through third-party audits.

Winery Certification: To become SIP Certified, a winery must have at least 85 percent of its grapes sources from vineyards that are SIP Certified, which would be verified by inspection.

More information about SIP Certified's standards and certification program can be found on its website[70].

5.3 Incentives for Becoming Certified

Certification is voluntary. Given the positive impact that certification may have on water management and other goals, the NCGSA may consider incentivizing participation in certification. Activities to develop incentives may include:

[66] https://napagreen.org/ngv-download-form/
[67] https://napagreen.org/ngw-download-form/
[68] https://napagreen.org/
[69] https://www.sipcertified.org/
[70] https://app.sipcertified.org/preview/docs

- Evaluating existing certification programs to identify those that include water management and conservation practices that would provide a benefit to the Subbasin.
- Developing minimum water management criteria for a conceptual certification program. Such criteria may include practices and technologies that the NCGSA has identified as cost-effective for scaling water savings in the Napa Valley Subbasin. These minimum criteria could determine whether a certification is eligible for NCGSA or other incentives.
- Assessing the financial and economic benefits of certification to quantify the value to Subbasin businesses that choose to become certified. This analysis would be coupled with outreach and education to increase awareness of potential benefits of certification.
- Exploring opportunities for types and levels of incentives. Incentives may include but are not limited to, cost-sharing, grants, reimbursement, outreach, education, and reduced fees.

Stakeholders that are certified or are interested in becoming certified should contact the NCGSA, TAG, and participate in other public meetings (see **Section 6**, below).

6 STAKEHOLDER RESOURCES

There are opportunities for stakeholders to participate in public meetings, stay engaged with GSP implementation, provide input on the WC and GPR Workplans, and pursue water conservation practices. In addition to the NCGSA there are multiple private and public organizations that offer programming and resources for water conservation practices. These entities serve as valuable hubs for learning, collaboration, and staying informed about the latest advances in water management practices. By staying engaged stakeholders can be updated on industry trends and contribute to water conservation in the Subbasin. This helps lower the cost of GSP implementation and supports the long-term viability of the region's wine industry and economy.

6.1 Outreach and Engagement

In addition to the stakeholders and audiences described in other sections of this Workplan, the NCGSA, through partnerships and collaboration with other entities with similar goals, will engage the broader public to build community support for conservation. This form of engagement operates in concert with other local, regional, state, tribal, and federal water conservation, and sustainability campaigns as well as integration with K-12 school based science curriculum. Examples include recent statewide and western conservation campaigns initiated in response to severe drought and school-based programs that encouraged students to turn off the water while brushing their teeth.

Macro messages advance overarching themes. The Napa Valley Subbasin macro messaging may be tailored to feature the value of groundwater as an economic engine and the importance of sustainable use to Napa's quality of life. It may also include general messaging regarding Napa's dynamic (surface and groundwater) water system, groundwater sustainability, and what individuals and other entities can do to support sustainable use in their homes and businesses.

Additional macro messages may be developed for the wine drinking public and larger tourism audiences. For example, messages on the importance of keeping Napa, Napa, and how individuals can contribute to this by supporting businesses and entities committed to sustainable water management practices demonstrated through certifications or similar programs.

Macro messages are delivered on a continuous schedule and utilize multiple delivery mechanisms from use of social media and public service announcements to utility bill inserts. National annual campaigns, such as the US Water Alliance's "Value of Water," and "Imagine a Day Without Water", offer event-based outreach opportunities.

All forms of outreach and engagement will be documented. Documentation will include the date and type of communication and engagement that occurred, the venues and participants involved, and any key outcomes.

6.2 NCGSA Board and Technical Advisory Group Engagement

The NCGSA has two forums for public meetings and input by the public: the NCGSA Board of Directors and the TAG. The NCGSA Board meetings typically happen in conjunction with the Napa County Board of Supervisors meetings. The TAG was formed as a group of independent subject matter experts to consider and make technical recommendations to the NCGSA Board and staff on the various projects and workplans to help implement the GSP. TAG meetings typically occur on the second Thursday of each month at 1:30 pm. NCGSA and TAG meetings are open to the public for in person or virtual participation. To learn more about NCGSA and TAG meetings, visit the Napa County GSA's Get Involved[71] webpage.

The NCGSA sends regular emails related to public meetings of the NCGSA and TAG, groundwater and water policies, drought, and more. To sign up for these email updates, stakeholders should visit the Newsletter Subscription Signup Form[72].

6.3 Napa County Resource Conservation District

The Napa County RCD is a community-based and non-regulatory entity dedicated to advancing responsible watershed management through voluntary community stewardship and expert guidance. The Napa County RCD supports natural resource conservation by actively engaging communities, imparting knowledge, offering technical proficiency, and conducting scientific studies. The Napa County RCD's commitment is rooted in employing voluntary, cooperative, and scientifically-grounded approaches to safeguard and preserve the invaluable natural assets within Napa's watersheds.

Napa County RCD offers a range of services to the Napa community, including youth and volunteer programs and educational workshops. Its agricultural-specific services include irrigation evaluations, soil

[71] https://www.countyofnapa.org/3079/Get-Involved
[72] https://countyofnapa.us12.list-manage.com/subscribe?u=e561ed61f04917d7c09de30fa&id=3a9af85d67

health assessments, habitat projects, carbon farm plans, and more. To get involved with the Napa County RCD or learn more about their programs, visit the Napa County RCD website[73].

6.4 Certification Programs for Vineyards and Wineries

Participating in a certification program supports GSP implementation and groundwater sustainability within the viticulture and winemaking industry. These programs provide a structured framework for evaluating and improving environmental, social, and economic aspects of operations. Achieving certification showcases a commitment to sustainability, which enhances the reputation and credibility of the vineyard or winery among consumers, industry peers, and customers. Certification programs also provide access to staff and a broader community of peers for expert guidance, best practices, and innovative strategies for maximizing quality, conserving resources, and promoting community well-being.

To learn more about certification programs in Napa, visit Napa Green[74] and the California Sustainable Winegrowing Alliance[75].

6.5 University of California Cooperative Extension

The University of California Cooperative Extension brings cutting-edge research home to Napa County through publications, workshops and seminars, training opportunities, volunteer programs, and one-on-one consultations. Topic areas include water resources, viticulture, and wildlife, among others. To learn more about their programs and events, visit the Napa County UCCE website[76].

6.6 Other Organizations and Resources

Several other organizations provide useful tools and resources for water resource conservation, including the Napa County Watershed Information & Conservation Council[77], U.S. Department of Agriculture Natural Resources Conservation Service[78] with a local service center in Napa, Napa Valley Grapegrowers[79], Napa County Farm Bureau[80], and Winegrowers of Napa County[81]. These industry groups can provide input and information regarding GSP implementation and frequently make resources available to the public. For example, Napa Valley Grapegrowers has created a webpage[82] dedicated to sustainable water and irrigation use, as well as a webpage about the GSP[83] and ways to reduce groundwater pumping.

[73] https://naparcd.org/our-services/
[74] https://napagreen.org/
[75] https://www.sustainablewinegrowing.org/
[76] https://cenapa.ucanr.edu/
[77] https://www.napawatersheds.org/
[78] https://www.nrcs.usda.gov/conservation-basics/conservation-by-state/california
[79] https://www.napagrowers.org/
[80] https://www.napafarmbureau.org/
[81] https://www.napawinegrowers.com/
[82] https://www.napagrowers.org/water--irrigation.html
[83] https://www.napagrowers.org/groundwater-sustainability-plan.html

6.7 Data Needs and Measuring Water Conservation

Estimating and measuring water conservation efforts requires a deep understanding of how water moves through a vineyard. It is necessary to characterize various vineyard management styles, tools, and techniques, including groundwater and surface water use, drainage, soil types, row orientation, land-based sensors, soil moisture monitoring, and plant moisture monitoring.

The NCGSA is actively seeking stakeholders that are interested in partnering to provide data to support GSP implementation. This could include 'Pilot Sites' that are implementing different water management and conservation practices. The partnership would characterize the effectiveness of water management methods, improve understanding of the costs and effectiveness of methods to voluntarily reduce groundwater pumping in the Subbasin. For example, land-based sensor data from Pilot Sites would help inform ET estimates and refine the understanding of spatial and temporal variability in water use across the Subbasin. Information would describe historical, current, and planned vineyard management practices, including drivers for changes in practices, the benefits realized, and the objectives for future changes (such as building climate resiliency).

Businesses that are interested in participating as a Pilot Site should contact the NCGSA.

6.8 Implementation Plan

This WC Workplan was developed in parallel with the companion GPR Workplan. The WC Workplan is designed to be a stakeholder-facing tool and resource to outline voluntary water conservation measures for consideration and implementation in their homes or businesses. The GPR Workplan outlines the strategy for the NCGSA to reduce pumping and achieve the groundwater sustainability goal in the Napa Valley Subbasin.

The GPR Workplan includes a multi-component implementation plan that focuses on voluntary adoption of water savings practices and technologies. It further prioritizes filling important data gaps, working with community organizations to increase education, and identifying the most cost-effective voluntary practices for conservation. The intent is that the combination of the NCGSA's efforts and resources, and voluntary adoption of water conservation measures, will be sufficient to achieve sustainability and groundwater pumping reduction, avoiding any mandatory measures.

7 SUMMARY

Napa County is home to a vibrant wine industry that has demonstrated its commitment to sustainability. As the NCGSA implements its GSP, it is working with partners across sectors to reduce groundwater pumping and achieve sustainability in the Napa Valley Subbasin. This WC Workplan was developed to review the existing water conservation efforts in the Subbasin, define new practices, and identify voluntary opportunities to generate quantifiable water savings.

The WC Workplan included the following:

- **Overview of water use in the Subbasin**. An overview of current surface water and groundwater use and summary of the need for reducing groundwater pumping was presented.
- **Voluntary measures for water conservation**. All sectors can contribute to water conservation. A suite of potential practices was developed. For each practice, the cost and potential water savings were assessed.
- **Incentives to encourage adoption**. Incentives to encourage voluntary adoption were evaluated. This included potential financial incentives as well as certification programs that provide benefits for Subbasin water users.
- **Funding opportunities**. Implementing water conservation practices requires water users to invest in new practices and technologies. Some activities are eligible for funding through state and federal opportunities such as the CDFA SWEEP and USDA NRCS EQIP programs, reducing costs of adoption. Potential funding opportunities were presented in this Workplan.
- I**mplementation plan**. A multi-component plan for implementation was developed. This includes leveraging current conservation practices and an adaptive management process to update the GPR Workplan as additional data become available.

All Subbasin water users are encouraged to review the full suite of water savings practices they can deploy and implement those that work best for their business or home. Water users are encouraged to stay up-to-date with these efforts by signing up for the GSA's newsletters[84] and by reviewing the GPR Workplan, a companion workplan that outlines the strategies for achieving reductions in groundwater pumping in the Subbasin. Importantly, the GPR Workplan also outlines a contingency plan for developing mandatory measures should voluntary adoption of water practices prove insufficient for meeting the requirements of the GSP.

[84] https://www.countyofnapa.org/3079/Get-Involved

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