# NAPA VALLEY GROUNDWATER SUSTAINABILITY

Executive Summary

A Basin Analysis Report for the

Napa Valley Subbasin

*FINAL DRAFT REPORT*

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*November 30, 2016*

# EXECUTIVE SUMMARY

# NAPA VALLEY GROUNDWATER SUSTAINABILITY:

## A BASIN ANALYSIS REPORT FOR THE NAPA VALLEY SUBBASIN

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## OVERVIEW

In response to the 2014 Sustainable Groundwater Management Act (SGMA), Napa County has prepared a Basin Analysis Report, an Alternative Submittal per the requirements of Water Code Section 10733.6 (b)(3). This analysis of basin conditions demonstrates that the basin has operated within its sustainable yield over a period of at least 10 years. The Basin Analysis Report covers the entire Napa Valley Subbasin, which has been designated by the State as a medium priority basin and is subject to specific requirements under SGMA. While the report analyzes areas outside the Subbasin to determine how those areas affect recharge and runoff in the Subbasin, the areas outside the Subbasin are not subject to SGMA.

Since 2008, the County and others' efforts, have been instrumental in implementing groundwater management actions to better understand groundwater conditions, establish monitoring to track conditions, conduct education and outreach, and develop other programs to maintain groundwater sustainability. These efforts have included the adoption of Goals and Policies in the 2008 General Plan and creation of the Groundwater Resources Advisory Committee (GRAC; 2011 to 2014) for implementation and community outreach.

Groundwater conditions in the Napa Valley Subbasin have been and continue to be assessed using current and historical groundwater level and groundwater quality data. An extensive network of over 100 wells is used in this endeavor. Groundwater level trends in the Napa Valley Subbasin are stable in a majority of wells having long-term groundwater level records. While several wells have shown at least some degree of response to recent drought conditions, levels are generally higher than they were in the same wells during the 1976 to 1977 drought.

The Napa River system is affected by a number of factors, groundwater being only one of them. It can also be more sensitive during dry (low rainfall) years and also drier periods within the year. The Napa River system has experienced these temporal and seasonal effects over many decades (since the 1930s), particularly during the summer to fall period. More recently, new groundwater monitoring wells and surface water monitoring facilities have been constructed under a California Department of Water Resources grant. These new monitoring wells provide for the collection of continuous groundwater level and stream data to better assess the spatial and temporal interconnection of surface water and groundwater resources. The timing and occurrence/amount of precipitation and natural groundwater recharge events affect the amount of groundwater baseflow discharged to the Napa River system.

While outflows from the Subbasin, including groundwater pumping, affect the surface water system, monitoring indicates that effects on the Napa River due to more or less groundwater pumping have not changed over time. Additionally, groundwater pumping is a relatively small outflow component compared to surface water stormflows and groundwater baseflow discharged to the River and ultimately to the San Pablo Bay. Flow and other aspects of the Napa River are affected by many factors beyond the County's control (e.g., precipitation and climate change), and some factors potentially within the County or State's control (e.g., upstream damming or withdrawal of water from tributaries and

historical removal of natural wetlands and floodplains). These are not under the purview of SGMA, though the Board of Supervisors is addressing many of them in other appropriate forums.

Groundwater and surface water supplies, including water imports serving municipal areas, in the Napa Valley Subbasin are dependent on population trends and land uses and their associated water demands. Long-term conditions in the Napa Valley Subbasin during the 1988 to 2015 base period (e.g., Basin Analysis Report study period) have been marked by stable land uses and stable supplies of imported surface water. While most of the population in the Subbasin lives in the four incorporated municipalities (Cities of Napa, St. Helena, Calistoga, and Town of Yountville), the majority of the land is outside the municipalities and used for agriculture. Municipal water use for the entire Valley was 16,655 AFY in 1988 and 14,729 AFY in 2015 (i.e., an average of 18,700 acre-feet per year (AFY)) over the 1988 to 2015 study period). The majority of this water is provided by reservoirs, increasing amounts of imported State Water Project water, and to a much smaller extent groundwater. Over the 28-year base period, water uses in the unincorporated part of the Subbasin have increased from about 4,000 AFY to about 5,000 AFY, and are mostly supplied by groundwater.

Agricultural water supplies include groundwater pumped from the Subbasin, recycled water, surface water diverted from the Napa River system within the Subbasin, and surface water diverted from the Subbasin watershed (i.e., hillside areas). On average, the rate of total water use (surface water and groundwater) by agriculture within the Subbasin has decreased slightly from approximately 18,000 AFY in 1988 to approximately 16,000 AFY in 2015. With variations in the water supply mix on a year-to-year basis, surface water use has decreased by about 8,900 AFY, while groundwater utilization has increased by about 7,400 AFY over the same period. These changes are affected by a number of factors, including increases from new and expanded wineries and vineyards, balanced against greatly improved conservation practices and decreased residential population in the unincorporated areas. The analysis includes estimated additional groundwater needs for wineries and vineyards looking forward through 2025, based upon the past five years of development proposals within the Subbasin.

A combined surface water and groundwater watershed-scale water budget for the Subbasin was developed to assess inflows and outflows to the Subbasin and to determine the average annual change in groundwater storage over the base period (using a model with a monthly time step). The magnitude of the surface water components in the budget demonstrates that large quantities of water that move through the Subbasin in most years are the predominant factor as compared to the amounts of groundwater pumped from the Subbasin or flowing out of the Subbasin as subsurface outflow. Average annual changes in groundwater storage over the base period are positive, indicating that current groundwater pumping rates are below the sustainable yield for the Subbasin. The average annual increase in storage is estimated to be 5,900 AFY, which is consistent with stable to slightly above average cumulative precipitation inputs over the 28-year base period. A separate independent analysis of groundwater levels and corresponding spring-to-spring changes was also conducted to compute the change in groundwater storage; this analysis also shows positive average annual changes in groundwater storage for the 1988 to 2015 base period.

The analyses presented in the Napa Valley Subbasin Basin Analysis Report demonstrate that the basin has operated within its sustainable yield over a period of more than 20 years. Stable groundwater levels observed during recent drought conditions (from 2012 through 2015) suggest that recent rates of

groundwater pumping have not exceeded the sustainable yield of the Subbasin. The sustainable yield analysis establishes the maximum amount of water that can be withdrawn annually from the Subbasin groundwater supply without causing an undesirable result. The sustainable yield is within approximately 17,000 AFY to 20,000 AFY. By comparison, groundwater pumping has averaged about 18,000 AFY during the 2012 to 2015 drought.

During the past 7 years, Napa County has made significant progress towards implementing groundwater-related studies and recommendations provided by those studies. In conformance with SGMA, the intent of the GRAC, and the vision of the Napa County Board of Supervisors (April 2014), the *Napa Valley Subbasin SGMA Sustainability Goal* is:

> *To protect and enhance groundwater quantity and quality for all the people who live and work in Napa County, regardless of the source of their water supply. The County and everyone living and working in the county will integrate stewardship principles and measures in groundwater development, use, and management to protect economic, environmental, and social benefits and maintain groundwater sustainability indefinitely without causing undesirable results, including unacceptable economic, environmental, or social consequences.*

The Napa Valley Subbasin Basin Analysis Report will implement SGMA monitoring and reporting requirements and also provide additional recommendations to maintain or improve groundwater conditions and ensure overall water resources sustainability. In order to meet the goals established by the Board of Supervisors, it is critical that the County continue to invest in the Groundwater Program to expand the range of information and understanding of this complex water resources system. Where the County has discretionary authority, permit holders should be required to monitor their use, and data must be made available for analysis when needed. Abusive water use, when identified, must be corrected. Education and outreach should be made available to all users; only by collaborating as a community and sharing stewardship responsibilities can the people living and working in Napa County ensure that water resources are sustainable. This report should be treated as a dynamic "living" document that continually informs the County and the public of water resources conditions and actions that need to be implemented to maintain sustainability.

# ES 1 INTRODUCTION

## ES 1.1 Purpose of Basin Analysis Report

In response to the 2014 Sustainable Groundwater Management Act, Napa County has prepared this Alternative Submittal, Basin Analysis Report, per the requirements of Water Code Section 10733.6 (b)(3) where an analysis of basin conditions demonstrates that the basin has operated within its sustainable yield over a period of at least 10 years. This Basin Analysis Report covers the entire Napa Valley Subbasin, which has been designated as a medium priority basin and is subject to the Act.

## ES 1.2 Background

Long-term, systematic monitoring programs are essential to provide data that allow for improved evaluation of water resources conditions and to facilitate effective water resources planning. For this reason, Napa County embarked on a countywide project referred to as the "Comprehensive Groundwater Monitoring Program, Data Review, and Policy Recommendations for Napa County's Groundwater Resources" (Comprehensive Groundwater Monitoring Program) in 2009, to meet action items identified in the 2008 General Plan update (Napa County, 2009). The program emphasizes developing a sound understanding of groundwater conditions and implementing an expanded groundwater monitoring and data management program as a foundation for future coordinated, integrated water resources planning and dissemination of water resources information.

The program covers the continuation and refinement of countywide groundwater level and quality monitoring efforts (including many basins, subbasins and/or subareas throughout the county) for the purpose of understanding groundwater conditions (i.e., seasonal and long-term groundwater level trends and also quality trends) and availability. This information is critical to enable integrated water resources planning and the dissemination of water resources information to the public and state and local decision-makers.

Napa County's Comprehensive Groundwater Monitoring Program involved many tasks that led to the preparation of five technical memoranda and a key foundational report on *Napa County Groundwater Conditions and Groundwater Monitoring Recommendations* (LSCE, 2011a). This report and the other related documents can be found at: **http://www.napawatersheds.org/**. This program detailed eighteen recommended near-term to long-term "implementation steps" (LSCE, 2011; Report Executive Summary) directed towards groundwater sustainability. The County has implemented most of the recommended steps since completion of that report and has also implemented many additional actions.

On June 28, 2011, the Napa County Board of Supervisors adopted a resolution to establish a Groundwater Resources Advisory Committee (GRAC), and an outreach effort for applicants began. On September 20, 2011, the Board of Supervisors appointed 15 residents to the GRAC, and the GRAC held its first organizational meeting on October 27, 2011. The GRAC was created to assist County staff and technical consultants with recommendations, including development of groundwater sustainability objectives that can be achieved through voluntary means and incentives and building community support for these activities and next steps.

Napa County's combined efforts through the Comprehensive Groundwater Monitoring Program along with the related AB 303 Public Outreach Project on groundwater (CCP, 2010) and the efforts of the GRAC and the Watershed Information & Conservation Council (WICC) of Napa County create a foundation for the County's continued efforts to increase public outreach and participation in water resources understanding, planning, and management. Although the County did not have a formal groundwater management plan under SB 1938, the County's and others' efforts have been instrumental in the implementation of functionally equivalent groundwater management actions to better understand groundwater conditions, establish monitoring to track conditions, conduct education and outreach, and other programs to maintain groundwater sustainability.

## ES 1.3 Sustainable Groundwater Management Act

In September 2014, the California Legislature passed the Sustainable Groundwater Management Act (SGMA). SGMA changes how groundwater is managed in the state. SGMA defines "sustainable groundwater management" as the management and use of groundwater in a manner that can be maintained during the planning and implementation horizon without causing undesirable results (Section 10721 (u)). Undesirable results, as defined by SGMA, means one or more effects caused by groundwater conditions occurring throughout the basin (Section 10721 (w)) (see Section 6.2). SGMA applies to basins or subbasins that the California Department of Water Resources (DWR) designates as medium- or high-priority basins. Previously under the California Statewide Groundwater Elevation Monitoring Program (CASGEM), DWR classified California's groundwater basins and subbasins as either high, medium, low, or very low priority. The priority classifications are based on eight criteria that include the overlying population, the reliance on groundwater, and the number of wells in a basin or subbasin. In Napa County, the Napa Valley Subbasin was ranked medium priority. All other Napa County basins and subbasins were ranked as very low-priority (see **Figure 1-1**).

For most basins designated by DWR as medium or high priority, SGMA requires the designation of groundwater sustainability agencies (GSA) and the adoption of groundwater sustainability plans (GSP); however, there is an alternative to a GSP, provided that the local entity (entities) can meet certain requirements. Under SGMA, Section 10733.6, a local entity (or entities) can pursue an Alternative to a GSP provided that certain sustainability objectives are met. An Alternative to a GSP may include:

> (b) (3) "An analysis of basin conditions that demonstrates that the basin has operated within its sustainable yield over a period of at least 10 years. The submission of an alternative described by this paragraph shall include a report prepared by a registered professional engineer or geologist who is licensed by the state and submitted under that engineer's or geologist's seal."
>
> The County would need to submit the alternative plan no later than January 1, 2017, and every five years thereafter.
>
> (d)The assessment required by subdivision (a) shall include an assessment of whether the alternative is within a basin that is in compliance with Part 2.11 (commencing with Section 10920). If the alternative is within a basin that is not in compliance with Part 2.11 (commencing with Section 10920), the department shall find the alternative does not satisfy the objectives of this part.

## ES 2 PHYSICAL SETTING AND HYDROGEOLOGY

The Napa Valley Subbasin lies entirely within Napa County, and is overlain in part by the City of Napa, Town of Yountville, City of St. Helena, and City of Calistoga. No part of the City of American Canyon is included in the basin boundaries. Napa County has been subdivided into a series of groundwater subareas based on watershed boundaries, groundwater basins, and the County's environmental resource planning areas, for the purposes of local planning, understanding and studies. These subareas include the Knoxville, Livermore Ranch, Pope Valley, Berryessa, Angwin, Central Interior Valleys, Eastern Mountains, Southern Interior Valleys, Jameson/American Canyon, Napa River Marshes, Carneros, Western Mountains, Calistoga, St. Helena, Yountville, Napa, and Milliken-Sarco-Tulucay (MST)). The Napa Valley Subbasin includes four subareas: Calistoga, St. Helena, Yountville, and Napa.

Geologically, the Napa Valley Subbasin is an active zone of complex tectonic deformation and downwarping generally associated with the San Andreas Fault. Most of the faults are northwest trending, and this region of the Coast Range is characterized by low mountainous ridges separated by intervening stream valleys. The geology of the Napa Valley has been studied and published for over a hundred years. Three major geologic units in the Napa Valley area include: Mesozoic rocks (pre-65 million years which underlie all of Napa County), Tertiary volcanic and sedimentary rocks (older Cenozoic volcanic and sedimentary deposits 65 million years old to 2.5 million years old, including the Tertiary Sonoma Volcanics), and Quaternary sedimentary deposits (including younger Cenozoic volcanic and sedimentary volcanics including the Quaternary alluvium of the Valley Floor, from 2.6 million years old to present).

The geologic setting of the Napa Valley Subbasin provides a basis for understanding the physical properties of the aquifer system and the structural properties that influence groundwater flow. The complex structural geology of the Napa Valley plays an important role in providing potential natural barriers to groundwater flow near certain faults. An updated hydrogeologic conceptual model has been developed to understand the hydrogeologic conditions and responses to management actions, and also to account for the major physical components and interactions of surface water and groundwater systems within the Subbasin (LSCE and MBK, 2013). The major hydrogeologic conceptual model components can be divided into three main categories: Subbasin Inflows, Subbasin Outflows, and Subbasin Groundwater Storage.

Subbasin Inflows include:

- Root Zone Groundwater Recharge (net inflow from total applied water minus evaporation and/or transpiration)
- Net Napa Valley Subbasin Uplands Runoff (total runoff minus stream infiltration)
- Napa Valley Subbasin Uplands Subsurface Inflow, and
- Surface Water Deliveries

Subbasin Outflows include:

- Surface Water Outflow: Stormflow and Baseflow
- Subsurface Groundwater Outflow

- Consumptive Use by Surface Water Diversions and Groundwater Pumping, and
- Urban Wastewater Outflow

Subbasin Groundwater Storage consists of Quaternary Alluvial Deposits Groundwater Storage. The Quaternary Alluvial Deposits comprise the primary aquifer units of the Napa Valley Subbasin.

Groundwater recharge is a key component of the water balance, and important for understanding the spatial distribution of groundwater recharge for interpreting groundwater conditions and trends for sustainable groundwater management. In the Napa Valley Subbasin, groundwater recharge primarily occurs via infiltration and deep percolation of rainfall and applied irrigation water (i.e., the volume of total water applied to the land surface (naturally or otherwise) minus the amount evaporated and/or transpired by native vegetation, crops, bare ground or hardscape areas. Precipitation falling on upland areas adjacent to the Napa Valley can also contribute groundwater to the Napa Valley Subbasin via percolation and lateral movement. Recharge of groundwater also occurs through surface water infiltration of water flowing within stream and river channels, occurring during times and at locations where groundwater levels are below the stream stage.

## ES 3 MONITORING NETWORK AND PROGRAM

In order to characterize groundwater and related surface water conditions in the basin and evaluate changing conditions, a monitoring network is designed to collect data of sufficient quality, frequency, and distribution. Napa County has developed its monitoring network to monitor the impacts to the beneficial uses or users of groundwater, monitor the changes in groundwater conditions relative to measurable objectives and minimum thresholds, and to quantify annual changes in water budget components. The monitoring network and program allows for analysis of groundwater data on a short-term, seasonal, and long-term basis to determine trends in groundwater and related surface conditions.

Groundwater levels are monitored throughout the Subbasin to assess the sustainability indicators of: chronic lowering of groundwater levels and reduction of groundwater storage. Groundwater quality is monitored to assess the sustainability indicators of: seawater intrusion and degraded water quality. Surface water-groundwater monitoring is performed to assess the sustainability indicator of: depletions of interconnected surface water.

The current groundwater level monitoring network consist of 113 wells, most of which (100) are monitored by Napa County, the remainder are part of the California Department of Water Resources and the State Water Resources Control Board (SWRCB) Geotracker programs. Groundwater quality monitoring in the Napa Valley Subbasin consists of 81 sites with data collected primarily at sites regulated by the SWRCB through the Division of Drinking Water and the Geotracker program, although data from other public agencies are available as well (including DWR and the U.S. Geological Survey. Groundwater level and groundwater quality monitoring site locations in the monitoring network are well-distributed throughout the subbasin, considering factors such as data availability, current population, and groundwater utilization.

With the purpose of furthering the understanding of surface water-groundwater interaction, in 2014, Napa County constructed five well clusters consisting of a shallow and deep monitoring well and a near-

by surface water at each monitoring point at each location (this is referred to as the Napa County Surface Water-Groundwater Monitoring Project). These sites consist of one shallow monitoring well, one deeper monitoring well, and a location in the nearby river/creek. These locations record water levels, river/creek stage, temperature, and electrical conductivity hourly.

Monitoring results and assessments of groundwater conditions and the suitability and effectiveness of the monitoring network itself are provided in the form of: 1) Annual Groundwater Monitoring Progress and Data Reports, and 2) Annual CASGEM reporting of water levels for those monitoring sites included in the CASGEM network.

These reports provide data to the public in the form of tabulated data accessible via database management systems (DMS), the CASGEM online database, and publicly available report documents through the County. Reports include stated goals and objectives of the groundwater monitoring program and include recommended modifications to the program and network, as needed.

The monitoring program involves utilizing Best Management Practices, including: standardized monitoring protocols for groundwater level measurements and groundwater quality sampling; standardized collection and reporting of site information (e.g., unique site identification, type of site, type of measurements taken, monitoring frequency, location, reference point elevation, well casing perforation data, well depth information, well completion reports, identification of principal aquifers monitored, well capacity, well casing diameter, etc.).

# ES 4 GROUNDWATER AND SURFACE WATER CONDITIONS

## ES 4.1 Groundwater Levels

The assessment of groundwater conditions of the Napa Valley Subbasin is based on historical groundwater levels and groundwater quality, as well as the incorporation of interconnected surface water. The subareas of the Napa Valley Subbasin are the Calistoga, St. Helena, Yountville, and Napa subareas from north to south respectively. Groundwater level conditions in each of these areas are examined in context of the Napa Valley Subbasin as a whole. Generally, groundwater flows over the length of the Napa Valley through the older and younger alluvium from Calistoga to San Pablo Bay, and the alluvium for purposes of the analyses described herein is assumed to represent an unconfined part of the aquifer system. Groundwater trends and conditions in the Napa Valley Subbasin are largely dependent upon precipitation inputs, so groundwater levels are reviewed in context of seasonality (spring and fall) and water year types.

Groundwater hydrographs are selected for representative wells to illustrate typical groundwater elevations (and corresponding depth to groundwater) over time. Groundwater level trends in the Napa Valley Subbasin are stable in the majority of wells with long-term groundwater level records. While many wells have shown at least some degree of response to recent drought conditions, levels are generally higher than they were in the same wells during the 1976 to 1977 drought. The majority of wells with long-term groundwater level records exhibit stable trends, however, a few wells located near the Napa Valley margin in the northeastern Napa Subarea, southwestern Yountville Subarea, and

southeastern St. Helena Subarea show periods of declines in groundwater levels, particularly during the recent drought.

## ES 4.2 Groundwater Quality

Groundwater quality records from representative monitoring sites provide information on important constituents whose concentrations influence the quality of water for irrigation and human consumption. Despite a typical lack of historical groundwater quality records in Napa County, available data suggest that groundwater is generally of good quality throughout most subareas. Poor groundwater quality does, however, exist in the south and the north-central parts of the County. The poor groundwater quality includes concentrations of naturally occurring metals such as arsenic, iron, and manganese that exceed drinking water standards throughout the county. Naturally occurring elevated levels of boron are also prevalent in most subareas. Subareas south of the Napa Valley Floor, such as the Carneros and Napa River Marshes, have poor quality water due to naturally elevated levels of salinity and chloride. The Calistoga Subarea of the Napa Valley Floor also has poor quality water in many wells due to hydrothermal conditions resulting in higher concentrations of metals. Nitrate concentrations are not a concern throughout the county, but tend to be somewhat higher in agricultural areas in the Napa Valley Floor.

## ES 4.3 Surface Water

Surface water in the Napa Valley Subbasin is dominated by the Napa River fed by its many ephemeral, intermittent, and more notable perennial surface water tributaries. The Napa River flows southeast-southward out of the Coast Ranges, through Napa Valley, and into the lowland marshes before entering San Pablo Bay at American Canyon. Historically, the Napa River near the City of Napa generally flows between several hundred to several thousand cubic feet per second (CFS) during peak winter conditions, and then tapers off to about 1 CFS during the fall.

In the Napa River, a hydrologic process called baseflow (i.e., when groundwater discharges to surface water) occurs in both gaining and losing stream reaches, as a result of basin-wide groundwater conditions in the Napa Valley as they are expressed within a given stream channel where surface water drainage can occur. Baseflow can be related to groundwater discharge, and an analysis of baseflow in the Napa River has been performed on Napa River flow data near St. Helena and Napa. Hydrographs of Napa River flows have been analyzed and dismantled to understand what components make up the surface water flow (i.e., how much of the river flow is attributable to baseflow and how much of the river flow is attributable to stormwater discharge or runoff). The study of the relationship between Napa River baseflow and groundwater levels within the Subbasin is ongoing, but shows a relationship between water year type, total water year precipitation, among other factors that can contribute water to the River. When groundwater levels have temporarily declined during drier years or seasonal dry periods during the year, the river system can also be more sensitive during drier years and also drier periods of the year when baseflow is diminished. The Napa River has experienced these effects over many decades (since the 1930s), particularly during the summer to fall period. The timing and occurrence of natural recharge events (i.e., the timing and amount of precipitation and opportunity for recharge) significantly affect the amount of groundwater baseflow discharged to the Napa River system. Outflows from the Subbasin, including groundwater pumping, also affect the surface water system;

groundwater pumping is a relatively smaller outflow component compared to stormflows and baseflow discharged to the San Pablo Bay.

In order to further the understanding of the relationships between groundwater baseflow in the Napa River and precipitation, groundwater levels, and groundwater pumping in the Napa Valley Subbasin, statistical analyses were performed to evaluate correlations between these variables over multiple time periods. For the longest continuous period of record available, groundwater level measurements and total annual precipitation data were compared independently to data describing periods of little to no flow[1] in the Napa River at two stream gages: Napa River near Napa (USGS station 11458000) and Napa River near St. Helena (USGS station 11456000). The results indicate that some of the variability in the first day of no flow conditions in a given water year and the length of the no flow period is related to variability in groundwater levels near the Napa River (strong correlations at a representative monitoring well) as well as to the amount of precipitation in that water year (moderate to strong correlations). These results support the understanding that no flow conditions in the Napa River have been historically and continue to be influenced by annual precipitation and groundwater levels near the Napa River[2].

The relationship between groundwater pumping in the Subbasin and baseflow in the Napa River was evaluated for the 1988 to 2015 hydrologic base period evaluated in this Basin Analysis Report. A subset of more recent years, 1995 to 2015, was also analyzed in order to test whether a substantial change has occurred in the relationship between pumping and baseflow in more recent years. The 1995 to 2015 period was chosen to allow for an approximately equal number of years with above average and below average precipitation in order to minimize the potentially confounding influence of variations in precipitation on the analysis. For the period from 1988 to 2015, linear correlation coefficients show relatively strong relationships between groundwater pumping and baseflow and both the first day of no flow conditions and the length of no flow conditions for a given water year. Correlations evaluated for the more recent 1995 to 2015 period show relatively moderate to strong relationships between baseflow conditions and groundwater pumping. These results indicate that, as with annual precipitation and groundwater levels, some of the variability in no flow conditions is related to the variability in groundwater pumping. Additionally, the results do not indicate a substantial change in the relationship between no flow conditions and rates of groundwater pumping between the base period and more recent years.

While the individual correlation coefficients address the relative strength of relationships between baseflow in the Napa River and precipitation, groundwater levels, and groundwater pumping in the Napa Valley Subbasin individually, a multiple linear regression analysis was performed to assess the degree to which groundwater pumping and precipitation, as independent variables, together correlate with baseflow at the Napa River Near Napa gage. Regression coefficients suggest that the influence of precipitation and groundwater pumping on baseflow were, on average, 79% and 21%, respectively for the 1988 to 2015 period. The multiple regression results show that precipitation and groundwater

[1] These analyses use an effective no flow ceiling of 0.1 cubic feet per second (CFS) to avoid under representation of no flow conditions due to uncertainties in streamflow measurements.
[2] Groundwater pumping data were not included in the linear correlation coefficient analysis because pumping data were only available for the water years 1988 to 2015 as part of the water budget analysis performed for this Basin Analysis Report.

pumping are the primary controls of baseflow in the Subbasin, with precipitation being the much more dominant variable.

## ES 4.4 Seawater/Freshwater Interface

The natural seawater/freshwater interface occurs south of the Napa Valley Subbasin; its exact location has not been determined. Tidal fluctuations in San Pablo Bay influence water level elevations along the lower Napa River. The magnitude and timing of these fluctuations indicate a close connection between tidal-surface water-river water where mixing of fresh and saline waters can occur. South of the Subbasin, several wells have been historically monitored. The highest historically observed concentrations of naturally occurring salt-related constituents, such as chloride and total dissolved solids concentrations, are observed in the three groundwater subareas south of the Napa Valley Subbasin in the Napa River Marshes, Jameson/American Canyon, and Carneros Subareas.

## ES 4.5 Potential for Managed Groundwater Recharge

The potential for groundwater recharge is an important aspect of understanding groundwater conditions. Soil factors relating to the potential for groundwater recharge on agricultural lands were recently mapped by O'Geen et al. (2015) as part of the development of a Soil Agricultural Groundwater Banking Index (SAGBI). The SAGBI considers various parameters including soil characteristics and interprets them on how they influence groundwater recharge. Other factors considered include land slope, root zone residence time (related to hydraulic conductivity, drainage, etc.), deep percolation, any chemical limitations (such as soil salinity), and surface conditions (erosion and crusting). Based on slope (topographic limitation), the SAGBI suggests that most areas of the Napa Valley Floor have relatively high recharge potential. In terms of root zone residence time, the areas with the highest recharge potential are generally located along the valley margins and in proximity to distributary fan areas or along active river channels, and increase in occurrence toward the northern end of the Valley Floor. Taking all of the factors of the SAGBI into consideration, areas of higher recharge potential appear to correspond largely with the soil hydraulic properties indicated by the root zone residence time and deep percolation factor rating, and is consistent with mapped areas of various shallow and permeable geologic units throughout the Napa Valley Subbasin. Assuming no deep ripping, the SAGBI rating of recharge potential indicates "Excellent" potential in areas of exposed Napa Valley Alluvium, most notably in the vicinity of an alluvial fan-head area where Sulphur Creek flows over and into the Napa Valley Subbasin.

# ES 5 HISTORICAL, CURRENT, AND PROJECTED WATER SUPPLY

The water supply in the Napa Valley Subbasin is dependent on population trends and land uses and their associated water demands. Census data from the U.S. Census Bureau is available to assess the population in Napa County from 1980, 1990, 2000, 2006, and 2010. An increasing trend in population is observed between 1980 and 2010, growing across all four of the incorporated municipalities in the Subbasin, from 62,549 to 90,817. While most of the population in the Subbasin lives in the four incorporated municipalities (City of Napa, St. Helena, Calistoga, and Yountville), the majority of the land is outside the municipalities and used for agriculture.

Wine grape production has long been a substantial component of land use in Napa County. Detailed land use surveys of Napa County performed by DWR in 1987, 1999, and 2011 indicate that agricultural land uses overall, and vineyard acreages in particular, were consistent over that 24-year period. These three recent land use surveys provide total acreages of agricultural classes, native classes, and urban/semi-agricultural classes within the subbasin (including agricultural processing facilities such as wineries), as well as separating out different agricultural class acreages for vineyards, orchards, pasture, grain, truck/field crops, and land that is idle.

Sources that provide water to the growing population and that support the agricultural land uses include groundwater pumped from the Subbasin, surface water within the Subbasin, recycled water, and State Water Project water. The amounts of each of those sources vary according to the land use and location in the Subbasin.

Agricultural water supplies include groundwater pumped from the Subbasin, recycled water, surface water diverted from the Napa River system within the Subbasin, and surface water diverted from the Subbasin watershed. Due to a lack of available data, a root zone water balance model was developed to quantify the rates of water application to meet evapotranspiration demands by crops or other irrigated vegetation. Results from the root zone model provide calculated values for applied water demands for all irrigated crops in the Subbasin, and accounts for applications of groundwater, surface water, and recycled water to meet crop water demands. On average, the rate of total water use by agriculture in the Subbasin has decreased slightly from approximately 18,000 AFY to approximately 16,000 AFY, with variations on a year-to-year basis. A decline in the use of surface water as a source and an increase in groundwater use from 1988 to 2015 is noted. Use of recycled water for irrigation of all crops has been stable over time, but may increase in the future.

In addition to the water demand associated with the agricultural land use types, farmers of perennial crops in the Subbasin (including but not limited to wine grapes) may apply additional water in some years to protect against frost damage. The need for frost protection varies based on many factors including crop type, stage of crop development, and the duration and intensity of a given frost event. The average annual demand for frost protection is estimated to be 116 acre-feet per year from 1988 to 2015.

Another cultural practice that has the potential to change the water use requirement of crops in the Subbasin is the practice of actively draining shallow groundwater from the root zone to benefit crop health at certain stages of growth, which can be accomplished by installing drain tiles in the soil below a field. No public data on the specifics of drain tiles in the Subbasin are available at this time, but the prevalence of farm ponds across the Valley and the incentive to reuse water when possible suggests that a portion of the drained water offsets groundwater pumping.

Municipal water use data is available by municipality for the City of Napa, City of St. Helena, City of Calistoga, and the Town of Yountville. Long-term municipal water use for the entire Valley has averaged 18,700 acre-feet per year over the base period (Water Years (WY) 1988-2015). The majority of this water use is provided by local surface water supplies, increasing amounts of imported State Water Project water, and groundwater. The City of Napa utilizes imported State Water Project water, local surface waters from Lake Hennessey and the Milliken Reservoir, as well as a growing contribution from recycled water. The City of St. Helena receives some imported surface water from the State Water Project, as

well as local surface water from Bell Canyon, and groundwater. The City of Calistoga uses imported surface water from the State Water Project, local surface water from the Kimball Reservoir, groundwater, and a relatively constant amount of recycled water. The Town of Yountville receives surface water from the State Water Project and locally from the Rector Reservoir.

In addition to the uses to meet agriculture and municipal demands, water use occurs throughout the unincorporated parts of the Subbasin to meet a variety of demands. These uses include domestic indoor water uses, irrigation uses, and commercial winery uses. Over the base period of 1988 to 2015, water uses in the unincorporated part of the Subbasin have increased from about 4,000 AFY to about 5,000 AFY, and are mostly supplied by groundwater.

Total water uses for all categories of water types have remained stable from 1988 through 2015, despite the observed population growth. Total annual use fluctuates over that time from a low of about 21,000 acre-feet per year to as much as 40,000 acre-feet per year. Driven largely by the transition in agricultural sources of supply, groundwater has increased as a proportion of the overall sources of supply during this time period, while diversions of local surface water (particularly from the Napa River System within the Subbasin itself) have declined by about half of initial levels.

## ES 6 SUSTAINABLE YIELD ANALYSIS

SGMA requirements include the development of a water budget as well as an estimate of sustainable yield for subbasins deemed high or medium priority. Water budget analyses are provided for the base period (1988-2015), water year 2015, and for projected hydrology (in the future). The base period determination and water budget analyses are tools that together are used to estimate sustainable yield for the Napa Valley Subbasin. The selection of a base period is necessary to remove any bias in the groundwater data in order to develop the water budget and determine the sustainable yield (e.g., water levels during a wet period would result in a higher amount of sustainable yield, and a period of dry conditions would result in a lower amount of sustainable yield). For the Napa Valley Subbasin, the base period selected spans from WY 1988 to 2015, as this period of time represents:

- Long-term annual water supply
    - Long-term mean water supply, or the measure of whether the basin has experienced natural groundwater recharge during a particular time period and also what the primary component is that contributes to natural groundwater recharge (in this case, precipitation).
    - Long-term precipitation records and daily average streamflow discharges for the Napa River are used.
- Inclusion of both wet and dry stress periods
    - This removes any bias that might shift the sustainable yield number away from what is representative
- Antecedent dry conditions

  - This is intended to minimize differences in groundwater in the unsaturated (vadose) zone at the beginning and at the end of the base period, assuming that any water unaccounted for in the unsaturated zone is minimized.

- Adequate data availability
  - Available hydrologic and land and water use data is sufficient during the base period.
- Inclusion of current cultural conditions
  - There are relatively stable trends in major land uses, particularly the agricultural classes which are most dependent on water sources within the subbasin.
  - Based on three snapshots in time of the land use and water use (1987, 1999, and 2011), the acreages of agriculture classes, native classes, and urban/semi-agricultural classes remain very similar.
  - Vineyards dominate the agricultural land use, and the amount of irrigated acreage in the Napa Valley Subbasin fluctuates very little between those three snapshots (ranging between almost 17,000 acres to over 21,000 acres).
- Current water management conditions
  - Water sources for agricultural and urban entities during the base period are consistently from groundwater, surface water from local water ways, and imported surface water delivered from the State Water Project via the North Bay Aqueduct.

Water Year 2015 is of particular interest in the SGMA Basin Analysis Report, and its hydrologic conditions specific to the Napa Valley Subbasin are provided in this document. 2015 was the fourth consecutive year of below average precipitation for the area. Groundwater level trends in 2015 are stable in the majority of wells with long-term groundwater level records, with some wells showing at least some degree of response to recent drought conditions. Groundwater quality trends also show stable conditions through 2015.

Projected subbasin water budgets rely on projected hydrologic inputs, which are available from a climate change projection tool from the U.S. Geological Survey's Basin Characterization Model (BCM) (Flint, 2013). The BCM provides hydrologic data for the "warm and moderate rainfall" scenario, based on the comparison of historical climate data between 1951 and 1980 and climate projections from 2070 to 2099.

The water budget developed for SGMA provides a quantitative approach to assessing the total annual volume of groundwater and surface entering and exiting the basin, including the change in volume of water stored. The main hydrologic processes affecting the subbasin include:

- Surface Water Inflows
  - Inflows to the Subbasin as streamflow from the Napa River Watershed Uplands;
  - Inflows to the Subbasin conveyed from municipal reservoirs located in the Napa River Watershed Uplands;

  - Inflows to the Subbasin from outside the Watershed through State Water Project facilities

- Surface Water Outflows
  - Outflows from the Subbasin as runoff and groundwater discharge to the Napa River
- Groundwater Inflows
  - Inflows to the subbasin from groundwater recharge and subsurface inflows from the bedrock of the Napa River Watershed Uplands adjacent to the Subbasin
- Groundwater Outflows
  - Outflows from the Subbasin that enter the adjoining Napa-Sonoma Lowlands Subbasin;
  - Outflows from the Subbasin due to evapotranspiration and groundwater pumping
- Changes in annual groundwater storage

In order to quantify one of the most difficult components, the recharge component, a GIS-based root zone model was developed. The root zone model is a complex tool based on the water balance within the soil root zone taking into consideration: precipitation, irrigation, evapotranspiration, land use, runoff, soil root zone depths, soil moisture, and vertical hydraulic conductivity in order to estimate groundwater recharge percolating below the soil root zone. The root zone model results indicate that during the base period (WY 1988-2015), groundwater recharge always exceeds groundwater pumping within the Subbasin on a year-to-year basis, resulting in a net positive contribution to groundwater storage.

A combined surface water and groundwater watershed-scale water budget for the Subbasin was developed using all of the components listed above and including the results from the root zone model. The results of the water budget show variations in Net Subbasin Storage from year to year that are largely driven by fluctuations in the Uplands Runoff and Streamflow components. The magnitude of the surface water components demonstrates that large quantities of water move through the Subbasin in most years compared to the amounts of water pumped from the Subbasin or flowing out of the Subbasin as subsurface outflow. Average annual changes in storage over the base period are positive, indicating that current groundwater pumping rates are below the sustainable yield for the Subbasin. The magnitude of annual changes in storage indicate the sensitivity of water budget components to environmental factors and data uncertainties. For this reason, the average annual change in storage represents a more useful measure of Subbasin conditions. The average annual increase in storage of 5,900 AFY is consistent with stable to slightly above average cumulative precipitation inputs over the 28-year base period.

A projected water budget is developed using the “warm and moderate rainfall” future climate scenario from the BCM that includes projections for precipitation and reference evapotranspiration; streamflow is projected based on a regression of precipitation and streamflow; water demands are based on most recent municipal demand and land use data; and water supply is based on most recent imported surface water deliveries. Future development in the larger Subbasin watershed is not explicitly considered as

part of the projected Subbasin water budget; however, any reductions in runoff or subsurface inflow to the Subbasin as a result of future development are believed to be minor relative to the overall inflow volumes.

To complement the water budget analysis described above, an analysis of changes in groundwater storage computed separately through observed changes in groundwater levels over the base period is provided. Groundwater contours and potentiometric surfaces are utilized along with the depth to the base of the aquifer to determine the groundwater storage volume (multiplying the saturated aquifer volume with an estimated specific yield). Large year-to-year fluctuations in calculated groundwater storage using this technique occur likely due to the relative spacing of available groundwater level data throughout the subbasin and the uncertainty of the interpolated depth to water grids, but these fluctuations follow trends observed in precipitation records for the same base period.

A sensitivity analysis was performed to understand how small changes in certain parameters can affect the resulting water budget outcomes. Sensitivity in the root zone model to crop coefficient values, root depths, and soil moisture retention were analyzed for estimated average annual vineyard irrigation in the subbasin. Another sensitivity analysis was performed on the groundwater level change in storage analysis to demonstrate what impact an uncertainty of one foot difference in groundwater levels across the subbasin would have as well as the uncertainty of the specific yield value selected.

Long-term conditions in the Napa Valley Subbasin during the base period of WY 1988-2015 have been marked by stable land uses and stable supplies of imported surface water. Groundwater utilization has increased over time. Results from the Root Zone Model and water budget analyses, as well as the groundwater level change in storage analysis show positive average annual changes in storage over this period. As the basin is currently managed, stable groundwater levels observed during recent drought conditions (from 2012 through 2015) suggest that recent rates of groundwater pumping have not exceeded the sustainable yield of the Subbasin. As a result, the sustainable yield analysis establishes the maximum amount of water that can be withdrawn annually from the Subbasin groundwater supply without causing an undesirable result is within 17,000 acre-feet per year to approximately 20,000 acre-feet per year. The sustainable yield is not a constant value and could change with variations in water budget components or as a result of management decisions that could lead to increased or decreased sustainable yields in the future.

# ES 7 NAPA VALLEY SUBBASIN SUSTAINABILITY GOALS

## ES 7.1 Sustainability Goals

Napa County's Groundwater Resources Advisory Council defined "groundwater sustainability" as (GRAC, February 2014):

> *Groundwater sustainability depends on the development and use of groundwater in a manner that can be maintained indefinitely without causing unacceptable economic, environmental, or social consequences, while protecting economic, environmental, and social benefits.*

The GRAC has developed the following sustainability goal:

> *GRAC Sustainability Goal: To protect and enhance groundwater quantity and quality for all the people who live and work in Napa County, regardless of the source of their water supply.*

In order to achieve this sustainability goal, the GRAC developed the following five (5) Sustainability Objectives that were presented and accepted by the Napa County Board of Supervisors in April 2014:

1. Initiate and carry out outreach and education efforts.
    a. Develop public outreach programs and materials to make everyone who lives and works in the County aware that the protection of water supplies is a shared responsibility and everyone needs to participate.
    b. Through education, enable people to take action.
2. Optimize existing water supplies and systems.
    a. Support landowners in implementing best sustainable practices.
    b. Enhance the water supply system and infrastructure – including but not limited to system efficiencies, reservoir dredging, recycled water, groundwater storage and recharge, conjunctive use – to improve water supply reliability.
3. Continue long-term monitoring and evaluation.
    a. Collect groundwater and surface water data and maintain a usable database that can provide information about the status of the county's groundwater and surface water resources and help forecast future supplies.
    b. Evaluate data using best analytical methods in order to better understand characteristics of the county's groundwater and water resources systems.
    c. Share data and results of related analytical efforts while following appropriate confidentiality standards.
4. Improve our scientific understanding of groundwater recharge and groundwater-surface water interactions.
5. Improve preparedness to address groundwater issues that might emerge.
    a. Improve preparedness for responding to long-term trends and evolving issues, such as adverse groundwater trends (including levels and quality), changes in precipitation and temperature patterns, and saltwater intrusion.
    b. Improve preparedness for responding to acute crises, such as water supply disruptions and multi-year drought conditions.

These supplemental recommendations, developed by the GRAC in February 2014 well before SGMA was adopted, emphasize the County's intent to integrate groundwater stewardship and sustainability planning in future planning and resource management.

In conformance with SGMA and the intent of the GRAC (February 2014) and the County Board of Supervisors (April 2014), the GRAC sustainability goal is expanded to:

> *Napa Valley Subbasin SGMA Sustainability Goal: To protect and enhance groundwater quantity and quality for all the people who live and work in Napa County, regardless of the source of their water supply. The County and everyone living and working in the county will integrate stewardship principles and measures in groundwater development, use, and management to protect economic, environmental, and social benefits and maintain groundwater sustainability indefinitely without causing undesirable results, including unacceptable economic, environmental, or social consequences.*

## ES 7.2 SGMA Sustainability Indicators and Metrics to Maintain Sustainability

The current understanding of hydrogeologic conditions and management measures demonstrates that the basin has already been operated within the sustainable yield for at least 10 years. On a subbasin scale, the water budget details developed for this document show that the basin has been operated within the sustainable yield, and the Napa County Board of Supervisors establishment of the GRAC, acceptance of the GRAC's sustainability goal and objectives for all of Napa County, and implementation of key GRAC recommendations demonstrates the County's intent to maintain sustainable conditions indefinitely.

According to SGMA definitions, Undesirable Results include: chronic lowering of groundwater levels (overdraft); significant and unreasonable reduction of groundwater storage; significant and unreasonable seawater intrusion; significant and unreasonable land subsidence that substantially interferes with surface land uses and; depletions of interconnected surface water that have significant and unreasonable adverse impacts on beneficial uses of the surface water. For the Napa Valley Subbasin, the basin is generally full, benefitting from: high precipitation, corresponding high potential for substantial amounts of recharge, and land use dominated by vineyards that have a comparatively low water requirement. Other water uses (e.g., municipal and uses in unincorporated areas of the Subbasin) have remained generally stable (e.g., municipal uses have been approximately 17,000 over the base period) and unincorporated area uses have increased slightly from 4,000 AFY to 5,000 AFY. Overall, total water use (agricultural, municipal and uses in unincorporated areas) has decreased over the 28-year base period.

There is, however, an interplay between the groundwater systems of the subbasin and the river system, which has shown that when groundwater levels have temporarily declined during drier years or seasonal dry periods during the year, the river system can also be more sensitive to seasonally lower flows during drier years and also drier periods of the year when baseflow is, or is prone to being, diminished. This historical occurrence of diminished baseflow could be considered an undesirable result, but it only occurs at some locations during the summer to fall period. Since the river system is considered to be the most sensitive sustainability indicator in the Napa Valley Subbasin, the measurable objectives and minimum thresholds developed in this document are recommended to ensure groundwater sustainability or improve groundwater conditions, and provide ongoing monitoring targets devised to address potential future effects on surface water.

SGMA defines "representative monitoring" as "a monitoring site within a broader network of sites that typifies one or more conditions within the basin or an area of the basin" (Section 351). A subset of monitoring sites in the Napa Valley Subbasin has been developed for the purpose of monitoring groundwater conditions that are representative of the basin or an area of the basin (Section 354.36). For SGMA purposes for the Napa Valley Subbasin, these 18 sites are where sustainability indicators are monitored, and minimum thresholds and measurable objectives are defined. Many sites are monitored for more than one sustainability indicator.

The representative monitoring sites are designed to monitor the sustainability indicators including: chronic lowering of groundwater levels, reduced groundwater storage, seawater intrusion, degraded groundwater quality, land subsidence, and streamflow depletion. Minimum thresholds (in feet above mean sea level) to avoid chronic lowering of groundwater levels, land subsidence, reduced groundwater storage, and streamflow depletion are provided in the Basin Analysis Report for sixteen representative monitoring sites (and one additional representative monitoring site that is too far from the Napa River and is not used for streamflow depletion); minimum thresholds to avoid degraded groundwater quality (e.g., for nitrate) are provided in this document for seven representative monitoring sites; a minimum threshold to avoid seawater intrusion is provided in this document for one representative monitoring site (for TDS concentration).

Measurable objectives, or specific quantifiable goals for maintaining or improving groundwater conditions, are provided in this document for streamflow depletion and other sustainability indicators, again using 16 of the representative monitoring sites. The measurable objective to maintain or improve groundwater quality is set for seven representative monitoring sites; for one representative monitoring site to avoid seawater intrusion; and for 17 of the representative monitoring sites for avoiding chronic lowering of groundwater levels, reducing groundwater storage, and land subsidence. The measurable objectives and minimum thresholds developed for this document do not require the subbasin to be divided into "management areas", but the County is planning to evaluate a study (planned to begin in fall 2016) to determine if potential groundwater management measures or controls (similar to those that have been successfully implemented in the MST Subarea) or a Management Area designation are warranted.

## ES 8 MONITORING DATA MANAGEMENT AND REPORTING

Groundwater data in the Napa Valley Subbasin is managed, used, and shared, utilizing Napa County's Data Management System (DMS). Data are collected from a variety of sources and monitoring programs, including public and volunteered wells, and also permit-required monitoring. The DMS has been constructed to incorporate existing and new data about groundwater resources in Napa County, and that data are used on an ongoing basis by the County to evaluate county-wide (and Subbasin-wide) groundwater supply and quality conditions and functions as a secure central data storage location. Data security and confidentiality is of utmost importance; Napa County employs a tiered approach that allows property owners to choose their level of participation and sharing.

There are three main data collection programs that are part of the monitoring data management: the Napa County Program, the DWR Water Data Library (WDL), and the CASGEM Program. Data from other sources include several different public agencies that collect and maintain groundwater data, including

DWR, the USGS, the California Department of Public Health (CDPH), and the State Water Resources Control Board (SWRCB; GeoTracker; GeoTracker-GAMA ;and Division of Drinking Water).

Napa County has historically routinely reported groundwater level data to DWR for inclusion in the WDL, and as of 2012, the County also reports a subset of the groundwater level data to DWR as part of the CASGEM program. Monitoring data stored in the County's DMS will be submitted to DWR electronically for SGMA purposes[3], and a copy of the monitoring data will be included in the Annual Report, submitted electronically on forms provided by DWR.

There are five different outlets for reporting the groundwater conditions in the Napa Valley Subbasin:

- Annual Groundwater Monitoring Progress and Data Report
    - Reviews the groundwater monitoring program and network;
    - Reviews the year's monitoring data in context with the historical record, water level and quality trend analyses, and consideration of issues of interest
- Annual CASGEM Reporting
    - Summarizes the results and findings of the countywide CASGEM program, and is integrated into the County's Annual Progress Report
- Triennial Countywide Reporting on Groundwater Conditions
    - Recommended report that contains countywide groundwater level and quality conditions and other monitoring network modifications;
    - Recommended to include summaries of the groundwater level and quality data, figures illustrating groundwater level trends, figures showing contours of equal groundwater elevation, figures illustrating groundwater quality trends, and a summary of coordinated efforts with other local, state, and federal agencies.
- SGMA Annual Report
    - This report will use GSP Section 356.2 as guidelines for reporting groundwater conditions for the preceding water year with additions and modifications appropriate for the Napa Valley Subbasin
    - This report will include: general information covered by report; detailed description and graphical representation of groundwater conditions of the basin managed in the Plan (including groundwater elevation data in the form of contour maps and hydrographs, groundwater extraction estimates, surface water supply used or available for use, and total water use); changes in groundwater storage (including change in storage maps and graphs); and a description of monitoring, data evaluation, and other actions in support of continued sustainability, including implementation of projects or management actions since the previous annual report.

[3] All submittals to DWR will be made subject to the terms and conditions of any monitoring agreements between well owners and Napa County.

- SGMA Five-Year Update
    - Every five years, the County will prepare an updated Basin Analysis Report to assess whether the basin is in compliance with California Water Code Part 2.11 (commencing with Section 10920)
    - The report would evaluate the sustainability of the basin in terms of sustainability indicators, corresponding measurable objective, and minimum thresholds.
    - The report would provide an assessment of the adequacy of monitoring data for evaluating whether the basin has continued to be operated within its sustainable yield.

## ES 9 SUSTAINABLE GROUNDWATER MANAGEMENT

Many management actions, education and outreach, and projects have been implemented by Napa County, along with other potential future programs, to achieve the sustainability goal for the basin. Napa County's General Plan (2008, amended in June 2009) outlines water resources goals and policies. It recognizes that "water is one of the most complex issues related to land use planning, development, and conservation… and in Napa County, more than two dozen agencies have some say in decisions and regulations affecting water quality and water use." With the adoption of SGMA in 2014, the County is actively continuing outreach and education efforts that promote water resources sustainability. The General Plan in 2008 set forth six goals within the Conservation Element relating to the County's water resources, including surface water and groundwater. Complementing these goals are twenty-eight policies and ten water resources action items that address monitoring needs (on a watershed basis, for surface water, and for groundwater), resources analyses and studies, basin-level watershed management plans, establishing standards for well pump testing and reporting, and collaboration with other agencies (including SWRCB, DWR, CDPH, CalEPA, and applicable County and City agencies).

Napa County has developed a Groundwater Ordinance to regulate groundwater usage and well development through its Code of Ordinances, Title 13. The ordinances are designed to be relevant and support the General Plan objectives through the establishment of specific water resources goals. One such ordinance, the conservation ordinance, is intended to regulate the extraction and use, and to promote the preservation of the county's groundwater resources. Compliance with this particular ordinance applies to development of new water systems or improvements to an existing water system that may use groundwater and imposes conditions on that use if it exceeds pre-determined thresholds, as well as ensuring the most current efficiency standards (the State's Water Efficient Landscape Ordinance, or WELO).

Napa County has developed guidelines for developing a Water Availability Analysis (WAA), which supports the preparation and evaluation of applications related to discretionary projects submitted to the County for approval to comply with the California Environmental Quality Act (CEQA) Guidelines. A WAA is required for any discretionary project that may utilize groundwater or will increase the intensity of groundwater use of any parcel through an existing, improved, or new water supply system, and is not prescriptive, as project specific conditions may require more, less, or different analyses in order to meet the requirements of CEQA. The procedure of the WAA determines if a proposal may have an adverse

impact on the groundwater basin as a whole or on the water levels of neighboring non-project wells or on surface waters.

Three major avenues that Napa County employs to promote education and collaboration with regards to water resources sustainability include: the establishment of the Watershed Information & Conservation Council (WICC), Well Owner Outreach and Self-Directed Well Monitoring Education, and Napa County's participation in San Francisco Bay Area and Westside's Integrated Water Resources Management Plan (IRWMPs). The WICC represents the diversity of Napa County's community and assists the County's Board of Supervisors in their decision-making process, serving as a conduit for citizen input by gathering, analyzing, and recommending options related to the management of watershed resources countywide. Well owner outreach was performed to help educate and encourage participation in groundwater monitoring, contacting friends, neighbors, and others, resulting in approximately 48 volunteered wells being added to the monitoring program (as of spring 2016). The County has also launched a new service for County residents that are interested in monitoring the status of their own wells, providing a water-depth measuring device available on a short-term loan basis, providing the opportunity for residents to learn first-hand how water depth changes and recharge occurs in their well over the course of a year. Information distributed by the WICC to the public has been available online in an electronic newsletter, called Sustainable Napa County E-News.

Napa County has actively collaborated with the San Francisco Bay and Westside Regional Water Management Groups (RWMGs) to update the IRWMP for the San Francisco Bay and to develop a new IRWMP for the Westside Sacramento Region. Participation in these two IRWMPs has enabled further coordination and sharing of information on water resources management planning programs and projects, as well as other information for IRWMP grand funding and implementation.

Implementation of the monitoring and reporting actions outlined in this Report over time may require the incremental implementation of a variety of management strategies or actions to ensure the long-term sustainability of the Napa Valley Subbasin. Actions may include future changes to local land use controls, well permitting, groundwater metering and usage limits, changes to County ordinances, and direct coordination with other municipal agencies to effectively protect and sustain groundwater and surface water resources. As evident by results of this Report, the Napa Valley Subbasin has been operating within its sustainable yield for more than 20 years and far-reaching management actions are not necessary at this time.

It is recommended that the standard Conditions of Approval used by Napa County for discretionary projects be revised to include, for all future projects, groundwater monitoring and water use monitoring, reporting data to the County when requested, and use of project wells for monitoring when requested and needed to support this Report, and provisions for permit modification based on monitoring results.

Napa County will conduct ongoing assessments (annual and five-year updates) of groundwater conditions in the Napa Valley Subbasin. These assessments will be supported by new information from monitoring efforts, as well as changes in water use, and will discuss any potential changes in subbasin groundwater conditions. The assessments will also include management actions implemented and their effects on subbasin conditions, and additional management tools or actions needed to maintain subbasin sustainability.

Best Management Practices (BMPs) are already in place for several aspects of the County's existing monitoring and reporting programs. This Basin Analysis Report has included protocols and data/reporting standards, and the five-year Basin Analysis Report update will include additional BMPs (which are either in use but not yet formally documented, or not yet released by DWR) for the County to consider adopting.

## ES 10 FINDINGS AND RECOMMENDATIONS

### ES 10.1 Findings

In response to the 2014 Sustainable Groundwater Management Act, Napa County has prepared this Alternative Submittal, Basin Analysis Report, per the requirements of Water Code Section 10733.6 (b)(3) where an analysis of basin conditions demonstrates that the basin has operated within its sustainable yield over a period of at least 10 years. This Basin Analysis Report covers the entire Napa Valley Subbasin, which has been designated as a medium priority basin and is subject to the Act.
This Executive Summary has presented Findings stemming from the analyses conducted as part of this Basin Analysis Report and in consideration of prior activities by Napa County, the GRAC, the WICC, and others.

### ES 10.2 Recommendations

As discussed above, Napa County has made much progress towards implementing recommendations made in 2011 as part of the Comprehensive Groundwater Monitoring Program. The recommendations and the status of actions on these recommendations are summarized in **Table ES-1**. The GRAC provided groundwater sustainability objectives and metrics to accomplish those objectives in February 2014 (**Appendix A**). These objectives/recommendations (where not duplicative of earlier recommendations) are also summarized in **Table ES-1**.

As an outcome of this Basin Analysis Report, additional recommendations, numbered 13 through 25, are summarized in **Table ES-1**.

**Table ES-1. Summary of Recommended Implementation Steps**

| Item | Summary Description | Implementation Time Frame[1] | Relative Priority Ranking [2] | Status/ Anticipated Completion |
|---|---|---|---|---|
| **Napa County Groundwater Conditions and Groundwater Monitoring Recommendations (2011)** | | | | |
| 1.1a | Entry of archived data not previously available, link WellMA table information, add well construction data from wells the County monitors, add recent surface water delivery information, add municipal pumping data, and other information along with development and implementation of quality control protocols for inputting new data and reviewing existing data discrepancies | **Near to Long Term** | **1** | **Complete** |
| 1.1b | Establishment of a map-interface with the DMS to enhance the use of the database by non-database users | **Near Term to Mid Term** | **3** | **2018** |
| 2.1a | Input CASGEM groundwater level data into the DMS | **Ongoing** | **1** | **Complete** |
| 2.1b | Establish data format to meet DWR guidelines for electronic data transfer | **Near Term** | **1** | **Complete** |
| 2.1c | Optimize CASGEM monitoring well network per DWR guidelines by filling in data gaps where identified | **Mid to Long Term** | **3** | **Complete** |
| 3.1a | Update County field procedures for measuring groundwater levels | **Near Term** | **1** | **Complete** |

| Item | Summary Description | Implementation Time Frame[1] | Relative Priority Ranking [2] | Status/ Anticipated Completion |
|---|---|---|---|---|
| 3.1b | Develop and/or expand aquifer-specific groundwater monitoring network in Napa Valley Floor, Pope Valley and Carneros Subareas by identifying existing wells with well construction data and constructing new aquifer-specific monitoring wells as needed where data gaps may exist | **Near to Mid Term** | **2** | **Ongoing** |
| 3.1c | Develop aquifer-specific groundwater monitoring network in other Subareas by identifying existing monitored wells with well construction data and constructing new wells where data gaps may exist | **Mid to Long Term** | **3** | **Ongoing** |
| 4.1a | Update geologic cross sections for the Napa Valley Floor and Carneros Subareas (previous ones were 50 years old) | **Near to Mid Term** | **2** | **Complete** |
| 4.1b | Develop new geologic cross sections in those areas with the greatest short- and long-term growth and/or land use potential | **Near to Long Term** | **2** | **2019** |
| 4.1c | Investigate groundwater/surface water interactions and the effect of recharge and pumping on groundwater levels in the Napa Valley Floor Subareas, along with the Carneros Subarea to assess the sustainability of groundwater resources. May include groundwater modeling, as needed. | **Near to Mid Term** | **1** | **Complete/ Ongoing** |

| Item | Summary Description | Implementation Time Frame[1] | Relative Priority Ranking [2] | Status/ Anticipated Completion |
|---|---|---|---|---|
| 5.1a | Prepare workplan for the purposes of preparing a Groundwater Sustainability Plan; workplan includes steps to implement County Monitoring Program and CASGEM Program | **Near Term** | **1** | **Complete (Basin Analysis Report; Monitoring Program and CASGEM Plan)** |
| 5.1b | Utilize the Watershed Information & Conservation Council (WICC) Board for various public outreach components related to groundwater sustainability planning | **Near Term** | **2** | **Ongoing** |
| 5.1c | Develop objectives for public outreach, including information sharing and education about the County's groundwater resources | **Near to Mid Term** | **2** | **Complete** |
| 5.1d | Preparation of a Groundwater Sustainability Plan for Napa County | **Near to Mid Term** | **2** | **Complete (Basin Analysis Report)** |
| 5.2a | Public outreach, including information sharing and education about the County's groundwater resources | **Ongoing** | **3** | **Ongoing** |
| 6.1a | Updating of Ordinances 13.04, 13.12, and 13.15 | **Mid Term** | **2** | **Complete** |
| 6.1b | Update Groundwater Permitting Process | **Mid Term** | **3** | **Complete** |

| Item | Summary Description | Implementation Time Frame[1] | Relative Priority Ranking [2] | Status/ Anticipated Completion |
|---|---|---|---|---|
| **Groundwater Resources Advisory Committee (February 2014)** | | | | |
| 7 | Develop and widely distribute public outreach programs and materials; educate people about opportunities for taking action | **Near Term/ Ongoing** | **1** | **Ongoing** |
| 8 | Support landowners in implementing best sustainable practices; Solicit information on, and widely share best practices with regard to water use in vineyards, wineries, and other agricultural/commercial applications | **Near Term/ Ongoing** | **1** | **Ongoing** |
| 9 | Enhance the water supply system and infrastructure to improve water supply reliability (regional and local) | **Near Term (evaluate and rank opportunities); Long Term – seek funding for high value projects** | **2** | **Ongoing** |
| 10 | Share groundwater conditions data and results; updates through BOS/WICC/Other | **Near Term/ Ongoing** | **1** | **Ongoing** |
| 11 | Continue to improve scientific understanding of groundwater recharge and groundwater- surface water interactions | **Near Term/ Ongoing** | **1** | **Ongoing** |

| Item | Summary Description | Implementation Time Frame[1] | Relative Priority Ranking [2] | Status/ Anticipated Completion |
|---|---|---|---|---|
| 12 | Improve preparedness for responding to long- term trends and evolving issues; improve preparedness for responding to acute crises, such as water supply disruptions and multiyear drought conditions | **Long Term** | **3** | **2020** |
| **Basin Analysis Report for the Napa Valley Subbasin (2016)** | | | | |
| 13 | Address groundwater monitoring data gaps to improve spatial distribution of water level measurements in the alluvial aquifer | **Near Term** | **1** | **Ongoing** |
| 14 | Evaluate and address groundwater monitoring data gaps to improve spatial distribution of water level measurements in the semi-confined to confined portions of the aquifer system | **Near Term** | **1** | **Ongoing** |
| 15 | Implement Napa County groundwater quality monitoring program; includes water quality monitoring in a subset of current monitoring network wells | **Near Term** | **1** | **Ongoing** |
| 16 | Coordinate with existing discretionary permit applicants (e.g., wineries and others) regarding existing groundwater level and/or water quality information) | **Near Term** | **1** | **2018** |

| Item | Summary Description | Implementation Time Frame[1] | Relative Priority Ranking [2] | Status/ Anticipated Completion |
|---|---|---|---|---|
| 17 | Coordinate with RCD and others regarding current stream gaging and supplemental needs for SGMA purposes; consider areas that may also benefit from nearby shallow nested groundwater monitoring wells (similar to LGA SW/GW facilities) | **Near- to Mid Term** | **2** | **2019** |
| 18 | Install test hole(s) and multiple completion monitoring wells at south end of Napa Valley Subbasin/Napa Sonoma Lowlands Subbasin for improved understanding of freshwater/salt water interface | **Mid Term** | **2** | **2020** |
| 19 | Evaluate strategic recharge opportunities, particularly along Subbasin margin and in consideration of hydrogeologic factors and O'Geen (2015) mapping | **Near- to Mid Term** | **2** | **2019** |
| 20 | Evaluate distribution of Groundwater Dependent Ecosystems and relationships to depth to groundwater; coordinate evaluation with BMPs or guidance developed by DWR, Nature Conservancy, California Native Plant Society or others | **Near Term** | **1** | **2019** |
| 21 | Review of and coordination with BMPs published on DWR's web site (DWR is due to post BMPS by January 1, 2017) | **Near Term** | **1** | **2018** |

| Item | Summary Description | Implementation Time Frame[1] | Relative Priority Ranking [2] | Status/ Anticipated Completion |
|---|---|---|---|---|
| 22 | Evaluate and address uncertainties in historical water budgets to improve calibration of budget components and reduce uncertainty of projected future water budgets | **Near- to Mid Term** | **1-2** | **2020** |
| 23 | Revise the standard Conditions of Approval used by Napa County for discretionary projects to include, for all future projects, groundwater monitoring and water use monitoring, reporting data to the County when requested, and use of project wells for monitoring when requested and needed to support this plan, and provisions for permit modification based on monitoring results | **Near Term** | **2** | **2017** |
| 24 | Expand the capacity to encourage groundwater stewardship/groups through education, facilitation, and equipment | **Near term** | **2** | **2018** |
| 25 | Develop an improved understanding of surface water and groundwater uses in unincorporated areas in the County, and trends in those uses | **Near Term** | **1** | **2019** |

[1] Implementation schedule reflects relative multi-year time frames for completing or conducting the task. Near, Mid, and Long Terms are reflective of 3, 5, and 10 year periods.

[2] Priority ranking is on a scale of 1 to 3 with 1 being the highest priority and 3 being the lowest.