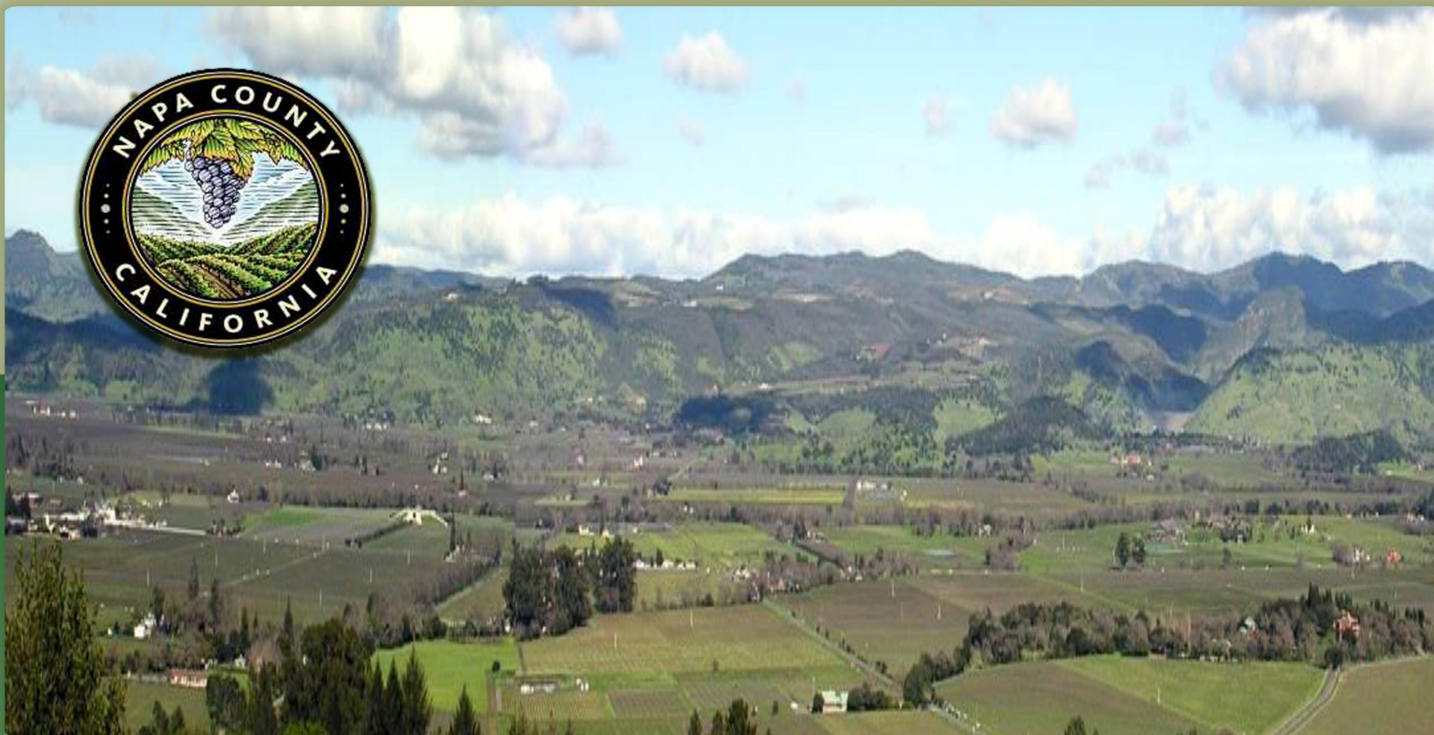

Napa County Comprehensive Groundwater Monitoring Program 2015 Annual Report and CASGEM Update

March 2016

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TABLE OF CONTENTS

APPENDICES

LIST OF TABLES

LIST OF FIGURES

EXECUTIVE SUMMARY

ES 1 INTRODUCTION

Groundwater and surface water are highly important natural resources in Napa County. Together, the County and other municipalities, water districts, commercial and industrial operations, the agricultural community, and the general public, are stewards of the available water resources. Everyone living and working in Napa County has a stake in protecting the county's groundwater resources, including groundwater supplies, groundwater quality, and associated watersheds (GRAC, 2014).

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. 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 *Napa County Groundwater Monitoring Plan 2013* (Plan) was prepared to formalize and augment groundwater monitoring efforts conducted as part of the Comprehensive Groundwater Monitoring Program. The Plan recommended annual reports on groundwater conditions and modifications to the countywide groundwater monitoring program as needed. Additionally, the Plan recommended a comprehensive triennial report. This report is the second Annual Report – *Napa County Comprehensive Groundwater Monitoring Program 2015 Annual Report and CASGEM[1] Update* (Report).

In addition to providing an update on groundwater level conditions and monitoring program modifications, this Report summarizes recent groundwater quality data.

ES 2 GROUNDWATER MONITORING GOALS AND OBJECTIVES

The California Department of Water Resources (DWR) has identified the major groundwater basins and subbasins in and around Napa County. The basins include the Napa-Sonoma Valley (which in Napa County includes the Napa Valley and Napa-Sonoma Lowlands Subbasins), Berryessa Valley, Pope Valley, and a small part of the Suisun-Fairfield Valley Groundwater Basins (**Figure 2-1**). For purposes of local planning, understanding, and studies, the County has been subdivided into a series of groundwater subareas (**Figure 2-2**). These subareas were delineated based on the main watersheds, groundwater basins, and the County's environmental resource planning areas.

Water level and quality objectives established for the countywide Comprehensive Groundwater Monitoring Program are linked to 1) the County's General Plan goals and action items presented in **Section 3.1** of this Report, and 2) hydrogeologic conditions and potential areas of concern (LSCE, 2013a).

[1] CASGEM is the California Statewide Groundwater Elevation Monitoring program implemented under Water Code Part 2.11 Groundwater Monitoring and administered by DWR.

The focus of the countywide groundwater level monitoring includes the following objectives:

- Expand groundwater level monitoring in priority County subareas to improve the understanding of the occurrence and movement of groundwater; monitor local and regional groundwater levels including seasonal and long-term trends; and identify hydraulic connections in aquifer systems and aquifer-specific groundwater conditions, especially in areas where short- and long-term development of groundwater resources are planned;
- Detect the occurrence of, and factors attributable to, natural (e.g., direct infiltration of precipitation, surface water seepage to groundwater, groundwater discharge to streams) or induced factors (e.g., pumping, purposeful recharge operations) that affect groundwater levels and trends;
- Identify appropriate monitoring sites to further evaluate groundwater-surface water interaction and recharge/discharge mechanisms, including whether groundwater utilization is affecting surface water flows;
- Establish a monitoring network to aid in the assessment of changes in groundwater storage; and
- Generate data to better estimate groundwater basin conditions and assess local current and future water supply availability and reliability; update analyses as additional data become available.

Based on the analysis of existing groundwater data and conditions described in the report *Napa County Groundwater Conditions and Groundwater Monitoring Recommendations* (LSCE, 2011a) and with input received from the Groundwater Resources Advisory Committee (GRAC), the key objectives for future groundwater level monitoring for each subarea are summarized in LSCE (2013a) and **Section 3** of this Report.

ES 3 SUSTAINABLE GROUNDWATER MANAGEMENT ACT

In September 2014, the California Legislature passed the Sustainable Groundwater Management Act (Act). 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**).

As noted in **Section 2** of this Report, SGMA applies to basins or subbasins that 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 (**Figure 2-1**).

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. When required, GSPs must be developed to eliminate overdraft conditions in aquifers and to return them to a condition that assures their long-term sustainability within twenty years of GSP implementation. SGMA does not require the development of a GSP for basins that DWR ranks as low- or very low-priority basins; GSPs are voluntary for these basins.

As applicable, SGMA requires that a GSA be identified for medium- and high-priority groundwater basins by June 30, 2017. Counties are presumed to be the GSA for unmanaged areas of medium and high priority basins (Section 10724). However, counties are not required to assume this responsibility. When no entity steps forward, this can lead to state intervention (Section 10735 *et seq*.).

In addition to imposing a number of new requirements on local agencies related to groundwater management, SGMA also provides for state intervention – a "backstop" – when local agencies are unwilling or unable to manage their groundwater basin (Section 10735 *et seq*.).

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.

On February 18, 2016 DWR published draft regulations for the development of GSPs and GSP-alternatives. Napa County staff have met with DWR staff to discuss a possible approach for a GSP-alternative for the Napa Valley Subbasin. County staff have also provided comments to DWR on the draft regulations, which are required under SGMA to be finalized and adopted by June 1, 2016. County staff are currently seeking input from the Napa County Board of Supervisors and preparing for multiple paths forward pending direction from the Supervisors and the content of the final regulations with respect to the requirements for GSP-alternatives.

ES 4 GROUNDWATER MONITORING NETWORK DESIGN AND DEVELOPMENT

Groundwater level monitoring was conducted at a total of 113 sites across Napa County in 2015 (**Table ES-1)**. The overall number and distribution of monitored sites remained consistent with the monitoring conducted in 2014 and was increased relative to the 87 sites reported in the 2011(LSCE, 2013a) (**Table ES-1**).

Out of the total 113 sites monitored in 2015, 100 were monitored by Napa County. Four sites were monitored by DWR. The remaining nine sites were regulated facilities with data reported as part of the State Water Resources Control Board (SWRCB) Geotracker Program.

Minor changes in the sites monitored by Napa County between 2014 and 2015 occurred due to a combination of well-owner requests and decisions by the Napa County Department of Public Works. In the latter case, three wells were discontinued by the County where other nearby monitored wells were determined to be sufficient to meet the monitoring objectives. Three additional wells were added to the County's monitoring networks during 2015 based on requests by well owners for monitoring by the County in areas where additional monitoring sites were needed. As recommended in the 2014 Annual Report, the County also began monthly monitoring of a subset of eight wells in order to provide greater temporal resolution in areas where semi-annual measurements may not accurately reflect the peak groundwater levels.

ES 4.1 Local Groundwater Assistance Grant Program Monitoring

Funding from the DWR 2012 Local Groundwater Assistance Grant Program enabled Napa County to construct ten monitoring wells at five sites in Napa Valley in September 2014. These wells comprise the groundwater monitoring facilities for the Napa County Surface Water-Groundwater Monitoring Project.

Table ES-1 Current Groundwater Level Monitoring Sites in Napa County by Groundwater Subarea

Groundwater Subarea	Number of Monitored Sites Through 2011	Number of Monitored Sites, Fall 2014	Number of Monitored Sites, Fall 2015
Napa Valley Floor-Calistoga	6	10	9
Napa Valley Floor-MST	29	27	27
Napa Valley Floor-Napa	18	21	20
Napa Valley Floor-St. Helena	12	14	14
Napa Valley Floor-Yountville	9	12	14
Carneros	5	12	12
Jameson/American Canyon	1	1	1
Napa River Marshes	1	1	-
Angwin	-	5	5
Berryessa	3	2	3
Central Interior Valleys	1	1	2
Eastern Mountains	-	3	4
Knoxville	1	-	-
Livermore Ranch	-	-	-
Pope Valley	1	1	1
Southern Interior Valleys	-	-	-
Western Mountains	-	2	1
Unknown[1]	-	3	-
Total Sites	**87**	**115**	**113**

[1] In 2014 three sites in the Geotracker regulated groundwater monitoring network were reporting groundwater level data, but had not yet reported location information for the monitored wells.

Water level data collected at the five sites are presented in **Section 5.5**. Data from Sites 1, 3, and 4 show that groundwater levels were above or very near the riverbed at these sites, indicating connectivity between groundwater and surface water. Data from Site 1 indicates that little to no flow occurred between groundwater and the river at that location. Data from Sites 3 and 4 showed variability in the nature of groundwater-surface water connection during 2015, ranging from groundwater flow into the river to the opposite. At both Site 2 and Site 5 the direction of groundwater flow was away from the streambed. At Site 5 water level data indicate that the river was hydraulically connected to groundwater during the first half of the year, until flows in the river ceased in July, and again in December 2015 as storms generated runoff leading to renewed flow in the river. At Site 2, located along Dry Creek, groundwater levels were consistently below the streambed elevation in 2015, indicating that groundwater was disconnected from the stream, although recharge to the groundwater system was likely occurring when water flowed in the creek.

ES 5 SUMMARY OF CONDITIONS AND RECOMMENDATIONS

Groundwater level monitoring was conducted at a total of 113 sites across Napa County in 2015 (**Table ES-1)**. The overall number and distribution of monitored sites remained consistent with the monitoring conducted in 2014 and was increased relative to the 87 sites reported in the 2011(LSCE, 2013a).

Groundwater level trends in the Napa Valley Subbasin of the Napa-Sonoma Valley Groundwater Basin 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, the water levels observed in recent years are generally higher than groundwater levels in the same wells during the 1976 to 1977 drought. Elsewhere in the County long-term groundwater level records are limited, with the exception of the Milliken-Sarco-Tulucay (MST) Subarea.

Although designated as a groundwater subarea for local planning purposes, the majority of the MST is not part of a groundwater basin as mapped by DWR. Groundwater level declines observed in the MST Subarea as early as the 1960s and 1970s have stabilized since about 2008. Groundwater level responses differ within the MST Subarea and even within the north, central, and southern sections of this subarea, indicating that localized conditions, whether geologic or anthropogenic in nature, might be the primary influence on groundwater conditions in the subarea.

While the majority of wells with long-term groundwater level records exhibit stable trends, periods of year to year declines in groundwater levels have been observed in a few wells. These wells are located near the Napa Valley margin in the northeastern Napa Subarea (NapaCounty-75 and Napa County-76), southwestern Yountville Subarea (NapaCounty-135) and southeastern St. Helena Subarea (NapaCounty-132). These locations are characterized in part by relatively thin alluvial deposits, which may contribute to more groundwater being withdrawn from the underlying semi-consolidated deposits.

Water levels in northeastern Napa Subarea wells NapaCounty-75 and Napa County-76, east of the Napa River, have stabilized since 2009, though declines were observed over roughly the prior decade. Despite the recent stability, given the potential for a hydraulic connection between the aquifer units in the vicinity of these wells and the aquifer units of the MST Subarea and an apparent increase in the number of new well permits in the area over the past 10 years[2], further study in this area is recommended.

Water levels at NapaCounty-135 and NapaCounty-132 declined most distinctly between 2013 and 2014. The increased monitoring frequency at these wells through the end of 2015 has shown groundwater levels already recovering to levels comparable to or higher than those of spring 2013. Groundwater level

[2] In a Memorandum to David Morrison, Director of Planning, Building, and Environmental Services, dated December 7, 2015 regarding groundwater conditions in the northeastern corner of the Napa Subarea Steven Lederer, Director of Public Works, noted that “12 of the approximately 30 homes on Petra Drive have applied for new well permits in the past 10 years.”

declines in these wells observed in 2014 could have one or more contributing factors, including variations in groundwater recharge due to changes in the timing and intensity of precipitation and changes in the level of pumping at the monitored well or in the vicinity of the monitored well. Continuation of the increased monitoring frequency through 2016 is recommended to assist with interpretation of conditions at these wells in the future.

Groundwater quality data show stable conditions between 2009 and 2015 compared to the conditions reported previously with data through 2008 (LSCE, 2011a). Water quality standard exceedances in the Napa Valley Floor subareas and Napa Valley Subbasin were limited to the naturally-occurring constituent arsenic, with 4 of 26 sites showing maximum concentrations above the MCL of 10 µg/L. Water quality standard exceedances in the Napa-Sonoma Lowlands Subbasin, including portions of the Carneros and Jameson/American Canyon Subareas, occurred for arsenic (three wells), nitrate (one well), TDS (five wells).

Wells with long-term water quality data show stable TDS and Nitrate concentrations, with the exception of one well (06N04W27L002M) which had a peak of 7.7 mg/L NO3-N (nitrate as nitrogen) in 2007 compared to initial concentrations of 3.4 mg/L NO3-N and 4.0 mg/L NO3-N in 1982 and 1972, respectively. In the Napa-Sonoma Lowlands Subbasin, nitrate concentrations have been stable to decreasing in all five wells with long-term records in the Napa-Sonoma Lowlands Subbasin. Two wells have shown increasing TDS trends, though all four wells with long-term trends were initially at or above the secondary MCL.

The following recommendations have been developed based on the findings presented in this report.

ES 5.1 Northeast Napa Subarea Special Study

Previously observed groundwater level declines in the northeast Napa Subarea, east of the Napa River in the vicinity of NapaCounty-75 and NapaCounty-76, along with reports of increased well replacement activity along Petra Drive have raised questions about the cumulative impacts of existing and potential future groundwater use in this area. In addition to completing the standard project-level planning review of the proposed projects, a focused study of hydrogeologic conditions affecting groundwater availability is advisable for this area. The investigation should be designed to address existing and future water use in the area, sources of groundwater recharge, and the geologic setting in order to address the potential for cumulative impacts of future development. The investigation would also seek to address the influence of previously documented groundwater cones of depression in the MST subarea on both the study area east of the Napa River and the Napa Subarea west of the Napa River.

ES 5.2 Data Gap Refinement

Groundwater levels in two monitored wells located near to the Napa Valley margin showed year to year declines in groundwater levels. Additional information is needed in order to consider the full range of possible causes for these declines and more accurately determine if the present emerging trends. Recommended actions include a review of land use data in these areas and continuation of the increased frequency of data collection at a subset of wells. More frequent data collection could be accomplished, pending agreement with the well owner, by monthly manual groundwater level measurements.

For wells added to the County’s monitoring networks in recent years without a record of key well construction details, continued efforts to locate construction information and link those data with aquifer units is recommended. In cases where a well owner does not have a record of the construction, a review of Well Completion Reports is recommended.

Once final Groundwater Sustainability Plan regulations are published by DWR later in 2016, there may be a need to add one or more wells to the CASGEM network near the southern boundary of the Napa Valley Subbasin. A well or wells in this area would be used to monitor groundwater gradients at the basin boundary where subsurface outflow occurs into the Napa-Sonoma Lowlands Subbasin. This data will be a component of the subbasin water budget that will be a key feature of the quantitative approach to groundwater management described in SGMA. For similar reasons, the County may benefit from updating reference point elevation data for some monitored wells with surveyed values in order more accurately monitor groundwater level gradients and any potential future seawater intrusion.

ES 5.3 Baseline Water Quality Sampling

The groundwater quality monitoring objectives contained in the *Napa County Groundwater Monitoring Plan 2013* (Plan) included the investigating of variations in water quality at different points within the groundwater subareas and at different aquifer units within a given subarea (LSCE, 2013a). The Plan recommended baseline sampling in wells at each of 18 Areas of Interest for additional monitoring and at the then proposed dedicated surface water-groundwater monitoring wells. It is recommended that wells added to the County monitoring networks in these areas be reviewed for suitability in light of the groundwater quality monitoring objectives, with baseline sampling conducted for those wells with sufficient well construction records to enable interpretation of the results for specific aquifer units.

A second round of baseline water quality sampling is also recommended for the five dual-completion monitoring wells constructed in 2014 at surface water-groundwater monitoring sites, as described in the Plan. An initial round of sampling and analysis was completed in June 2015 with a combination of County matching funds, DWR grant funds, and DWR in-kind support. Sampling these wells again in 2016 will provide a more robust baseline dataset that would be used to characterize any inter-annual variability at each well and provide a basis for interpreting future groundwater quality data.

ES 5.4 Coordination with Other Monitoring Efforts

Coordination with other county departments and other agencies that monitor groundwater data or receive groundwater data could provide an additional source of data in places where data are limited. Several local agencies, including Town of Yountville, City of St. Helena, City of Napa, already monitor groundwater levels at locations around the County.

1 INTRODUCTION

1.1 Purpose

Groundwater and surface water are highly important natural resources in Napa County. Together, the County and other municipalities, water districts, commercial and industrial operations, the agricultural community, and the general public, are stewards of the available water resources. Everyone living and working in Napa County has a stake in protecting the county's groundwater resources; including groundwater supplies, quality, and associated watersheds (GRAC, 2014). Without sustainable groundwater resources, the character of the County would be significantly different in terms of its economy, communities, rural character, ecology, housing, and lifestyles.

Similar to other areas in California, businesses and residents of Napa County face many water-related challenges including:

- Sustaining the quality, availability and reliability of local and imported water supplies;
- Meeting challenges arising during drought conditions;
- Avoiding environmental effects due to water use; and
- Changes in long-term availability due to global warming and/or climate change.

To address these challenges, 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. In 2009, 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), to meet identified action items in the 2008 General Plan update. 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.

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 members represented diverse interests, including environmental, agricultural, development, and community interests.

The GRAC was created to assist County staff and technical consultants with recommendations regarding:

- Synthesis of existing information and identification of critical data needs;
- Development and implementation of an ongoing non-regulatory groundwater monitoring program;
- Development of revised well pump test protocols and related revisions to the County's groundwater ordinance;
- Conceptualization of hydrogeologic conditions in various areas of the County and an assessment of groundwater resources as data become available;
- Development of groundwater sustainability objectives that can be achieved through voluntary means and incentives; and
- Building community support for these activities and next steps.

From January 2012 until January 2013, the GRAC reviewed and provided feedback on the development of the *Napa County Groundwater Monitoring Plan 2013* (Plan) (LSCE, 2013a). The Plan was prepared to formalize and augment groundwater monitoring efforts [levels and quality] to better understand the groundwater resources of Napa County, aid in making the County eligible for public funds administered by the California Department of Water Resources (DWR), and regularly evaluate trends to identify changes in levels and/or quality and factors related to those changes that warrant further examination to ensure sustainable water resources. The Plan included refinement of criteria used to identify priority monitoring areas and a proposed expanded monitoring network.

The Napa County groundwater monitoring program relies on both publicly-owned and volunteered private wells. To fulfill its mission and garner community interest and support, the GRAC developed a Communication and Education Plan, designed to implement the Plan through voluntary participation. This effort included the development of an outreach brochure and a series of fact sheets on specific topics.

Some of the many activities accomplished by the GRAC over a two and a half year period included:

- Provided updates to agriculture industry groups, environmental organizations and others;
- Led and supported outreach efforts to well owners for volunteer monitoring wells which has been very successful in adding new wells to the Napa County groundwater monitoring program;
- Held a joint public outreach meeting of the GRAC and Watershed Information and Conservation Council (WICC) Board (July 25, 2013);
- Reviewed and recommended modifications to the Napa County Water Availability Analysis and Groundwater Ordinance; and
- Developed and approved Groundwater Sustainability Objectives (GRAC, 2014).

The Plan recommended annual reports on groundwater conditions and modifications to the countywide groundwater monitoring program as needed. Additionally, the Plan recommended a comprehensive triennial report. This report is the second Annual Report – *Napa County Comprehensive Groundwater Monitoring Program 2015 Annual Report and CASGEM*[3] *Update* (Report).

1.2 Organization of Report

This Report summarizes activities implemented as part of the County's Comprehensive Groundwater Monitoring Program to improve the understanding of groundwater resource conditions and availability. This Report summarizes groundwater monitoring needed to fill the data gaps (i.e., relatively higher monitoring priorities) that were established in the Plan, recommendations made to address these priorities, and activities implemented since 2014. This Report also summarizes the overarching groundwater level and quality monitoring objectives defined by the County and the GRAC. These objectives provide the framework necessary to ensure that the data collected from the countywide monitoring facilities can address these objectives.

This Report includes the following sections:

[3] CASGEM is the California Statewide Groundwater Elevation Monitoring program implemented under Water Code Part 2.11 Groundwater Monitoring and administered by DWR.

Section 2: Hydrogeology of Napa County

- DWR Basins/Subbasins and County Subareas
- Summary of Geology and Groundwater Resources
- Overview of Recent Groundwater Studies and Programs

Section 3: Groundwater Resources Goals and Monitoring Objectives

- Napa County Water Resources Goals and Policies
- Groundwater Level Monitoring Objectives
- Groundwater Quality Monitoring Objectives

Section 4: Groundwater Monitoring Network Design and Development

- Groundwater Level Monitoring
- Surface Water-Groundwater Monitoring

Section 5: Groundwater Level Trends and Flow Directions

- Napa Valley Floor Subareas
- Subareas South of the Napa Valley Floor
- Subareas East and West of the Napa Valley Floor
- Angwin and Pope Valley Subareas
- Napa Valley Surface Water-Groundwater Monitoring

Section 6: Groundwater Quality Conditions and Trends

- Napa Valley Floor Subareas
- Subareas South of the Napa Valley Floor
- Subareas East and West of the Napa Valley Floor
- Angwin and Pope Valley Subareas

Section 7: Coordination and Collaboration

- Integrated Regional Water Management Plans
- Groundwater Sustainability
- Napa County Watershed Information and Conservation Council

Section 8: Summary and Recommendations

- Ongoing Vetting and Review of Potential Monitoring Sites
- Data Gap Refinement
- Baseline Water Quality Sampling
- Coordination with Other Monitoring Efforts
- Existing Activities in the MST Subarea

2 HYDROGEOLOGY OF NAPA COUNTY

This section summarizes the countywide geologic and hydrologic setting, and includes information about DWR groundwater basin/subbasin delineations and a description of the Napa County groundwater monitoring subareas. The studies that form the basis of the understanding of County hydrogeology are referenced, including the work for the *Updated Hydrogeologic Conceptualization and Characterization of Conditions* (LSCE and MBK, 2013).

2.1 DWR Basins/ Subbasins and County Subareas

DWR has identified the major groundwater basins and subbasins in and around Napa County. The basins include the Napa-Sonoma Valley (which in Napa County includes the Napa Valley and Napa-Sonoma Lowlands Subbasins), Berryessa Valley, Pope Valley, and a small part of the Suisun-Fairfield Valley Groundwater Basins (**Figure 2-1**). These basins and subbasins are generally defined based on boundaries to groundwater flow and the presence of water-bearing geologic units. These groundwater basins defined by DWR are not confined within county boundaries, and DWR-designated “basin” or “subbasin” designations do not cover all of Napa County.

Groundwater conditions outside of the DWR-designated basins and subbasins are also very important in Napa County. An example of such an area is the Milliken-Sarco-Tulucay (MST) area, a locally identified groundwater deficient area. For purposes of local planning, understanding, and studies, the County has been subdivided into a series of groundwater subareas (**Figure 2-2**). These subareas were delineated based on the main watersheds, groundwater basins, and the County’s environmental resource planning areas. 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 Subareas and five Napa Valley Floor Subareas (Calistoga, St. Helena, Yountville, Napa, and MST).

DWR has given the Napa Valley Subbasin a “medium priority”[4] ranking according to the criteria specified in California Water Code Part 2.11 Groundwater Monitoring (i.e., this relates to the CASGEM program).

2.2 Summary of Geology and Groundwater Resources

2.2.1 Previous Studies

Previous hydrogeologic studies of Napa County and also mapping efforts are divisible into geologic studies and groundwater studies. The more significant studies and mapping efforts are mentioned in this section. **Table 2-1** shows the chronological sequence of these efforts that span more than six decades. Weaver (1949) presented geologic maps which covered the southern portion of the county and provided a listing of older geologic studies. Kunkel and Upson (1960) examined the groundwater and geology of the northern portion of the Napa Valley. DWR (Bulletin 99, 1962) presented a reconnaissance report on the geology and water resources of the eastern area of the County; Koenig (1963) compiled a regional geologic map which encompasses Napa County. Fox and others (1973) and Sims and others (1973) presented more detailed geologic mapping of Napa County. Faye (1973) reported on the

[4] As part of the CASGEM Program, DWR has developed the Basin Prioritization process. The California Water Code (§10933 and §12924) requires DWR to prioritize California’s groundwater basins and subbasins statewide. As such, DWR developed the CASGEM Groundwater Basin Prioritization Process. Details are available at http://www.water.ca.gov/groundwater/casgem/basin_prioritization.cfm.

groundwater of the northern Napa Valley. Johnson (1977) examined the groundwater hydrology of the MST area.

Helley and others (1979) summarized the flatland deposits of the San Francisco Bay Region, including those in Napa County. Fox (1983) examined the tectonic setting of Cenozoic rocks, including Napa County. Farrar and Metzger (2003) continued the study of groundwater conditions in the MST area.

Wagner and Bortugno (1982) compiled and revised the regional geologic map of Koenig (1963). Graymer and others (2002) presented detailed geologic mapping of the southern and portions of the eastern areas of the County, while Graymer and others (2007) compiled geologic mapping of the rest of Napa County.

In 2005 to 2007, DHI Water & Environment (DHI) contributed to the 2005 *Napa County Baseline Data Report* (DHI, 2006a and Jones & Stokes et al., 2005) which was part of the County's General Plan update (Napa County, 2008). A groundwater model was developed by DHI in conjunction with the Napa Valley and Lake Berryessa Surface Water models to simulate existing groundwater and surface water conditions on a regional basis primarily in the North Napa Valley and the MST and Carneros Subareas (DHI, 2006b). A 2007 technical memorandum, *Modeling Analysis in Support of Vineyard Development Scenarios Evaluation* (DHI, 2007), was prepared to document the groundwater model update which was used to evaluate various vineyard development scenarios.

Additional geologic maps, groundwater studies, and reports are listed in the references of the *Napa County Groundwater Conditions and Groundwater Monitoring Recommendations* (LSCE, 2011a). Additional work has been conducted to update the conceptualization and characterization of hydrogeologic conditions particularly for the Napa Valley Floor (LSCE and MBK, 2013 and LSCE, 2013b).

A new project, "Napa County Groundwater/Surface Water Monitoring Facilities to Track Resource Interrelationships and Sustainability", is currently underway (LSCE, in progress). This project, which is supported through grant funding from DWR, involves the installation of shallow dual-completion groundwater monitoring facilities at five sites adjacent to the Napa River system. The goals of the project are to implement groundwater and surface water monitoring to characterize the interrelationship between these water resources in Napa Valley. The project includes gathering data to:

1. Assess the response to surface water and groundwater use and the potential effect of future climate changes, and
2. Ensure water resources sustainability for the natural environment and future generations. The facilities will enable the collection of new data to augment existing monitoring activities and datasets and will fill groundwater data gaps previously identified by Napa County.

Table 2-1 Summary and Chronology of Hydrogeologic and Geologic Studies and Mapping Efforts in Napa County

Hydrogeologic and/or Geologic Studies and Mapping Efforts	Year of Report or Map Publication							
	1940s	1950s	1960s	1970s	1980s	1990s	2000s	2010-2019
Weaver, 1949	◆							
Kunkel and Upson,1960			◆					
DWR, 1962			◆					
Koenig, 1963			◆					
Fox et al., 1973				◆				
Sims et al., 1973				◆				
Faye, 1973				◆				
Johnson, 1977				◆				
Helley et al., 1979				◆				
Wagner and Bortugno, 1982					◆			
Fox, 1983					◆			
Graymer et al., 2002							◆	
Farrar and Metzger, 2003							◆	
Graymer et al., 2007							◆	
DHI, 2006 and 2007							◆	
LSCE, 2011a								◆
LSCE and MBK, 2013								◆
LSCE, 2013a								◆
LSCE, 2013b								◆
LSCE, 2014								◆
LSCE, 2015								◆

◆ = Report and Map produced

◆ = Report only

◆ = Map only

2.2.2 Precipitation Monitoring and Water Year Classifications

Infiltration of precipitation has been shown to provide significant groundwater recharge in Napa County, particularly in unconsolidated geologic settings (Kunkel and Upson 1960, LSCE and MBK 2013).

Precipitation records in Napa County date to 1906 at the longest continually operating gauge at the Napa State Hospital (GHCND: USC00046074). In a separate analysis precipitation data from the Napa State Hospital gauge in Napa (elevation 35 feet) have been shown to have strong linear correlations (i.e., $R^2 \geq 0.90$) with monthly and annual precipitation totals from two other gauges in Saint Helena (elevation 1,780 feet) and Angwin (elevation 1,815 feet) (2NDNature, 2014). Based on the strength of those correlations, the Napa State Hospital gauge has been recommended for use as an index gauge for the Napa River Watershed.

The water year classification presented in **Table 2-2** is revised from the version developed by 2NDNature (2014) and presented in the 2014 Annual Report (LSCE, 2015). The classification presented here accounts for gaps in the daily precipitation record at the Napa State Hospital gauge. Specifically, missing daily precipitation data in the Napa State Hospital gauge record from water years 1920 through 2015 were estimated based on daily data from the Saint Helena precipitation gauge (GHCND: USC0004764) and Oakville precipitation gauge (elevation: 190 feet, CIMIS Station No. 77). These gauges show very strong linear correlations (i.e., $R^2 > 0.99$) for cumulative daily data from the Napa State hospital gauge. Estimated daily precipitation values were calculated to fill gaps in the Napa State Hospital gauge record using observed values form either the Oakville or Saint Helena gauges and the linear regression for cumulative daily precipitation between those gauges and the Napa State Hospital gauge.

A frequency analysis was used to define very dry, dry, normal, wet, and very wet water year types according to exceedance probabilities calculated from the 96-year period of record for precipitation at the Napa State Hospital gauge from water years 1920 through 2015. Data from water years prior to 1920 were excluded from the frequency analysis due to large gaps in the Napa State Hospital gauge record prior to that year that were not able to be estimated using data from other gauges.

Table 2-2 Napa River Watershed Water Year Classification

Year Type	Water Year Precipitation Total		Annual Precipitation Exceedance Probability (%)	Number of Years in Period of Record
	Lower Bound (inches)	Upper Bound (inches)		
Very Dry		15.19	≥ 91	9
Dry	15.20	19.67	≥ 67	23
Normal	19.68	26.99	≥ 33	33
Wet	27.00	36.75	≥ 10	22
Very Wet	36.76		< 10	9
Napa State Hospital (NSH) Average Annual Water Year Precipitation (1920 – 2015) = 24.86 inches Period of record used for frequency analysis: 1920 – 2015				

2.2.3 Summary of Geology and Groundwater Resources

The geology of Napa County can be divided into three broad geologic units based on their ages and geologic nature. These units are: 1) Mesozoic Basement Rocks (pre-65 million years (my)), which underlie all of Napa County, but are primarily exposed in the Eastern County area and the Western Mountains Subarea, 2) Older Cenozoic Volcanic and Sedimentary Deposits (65 my to 2.5 my), including Tertiary Sonoma Volcanics (Miocene and Pliocene; 10 my to 2.5 my) which are found throughout the county, especially in the mountains surrounding Napa Valley, and 3) Younger Cenozoic Volcanic and Sedimentary Deposits (post 2.6 my to present), including the Quaternary alluvium of the Valley Floor. The two primary water-bearing units in the county are the tuffaceous member of the Sonoma Volcanics and the Quaternary alluvium.

Outside of the Napa Valley Floor, percolation of surface water appears to be the primary source of recharge. The rate of recharge within areas such as the MST Subarea has been shown to be significantly higher where streams and tributaries cross highly permeable outcrops (e.g., the tuffaceous member of the Sonoma Volcanics or shallow alluvium). Direct infiltration of precipitation is a major component of recharge in the main Napa Valley. Recharge throughout much of the county is generally limited by underlying shallow bedrock of low permeability. An additional component of groundwater recharge that is less understood is deep percolation through fractured rock and fault zones. This type of recharge can be very difficult to quantify due to the highly variable size and distribution of faults, fractures, and joints in a given area.

Groundwater Occurrence and Quality in the Sonoma Volcanics

Groundwater occurs in the Sonoma Volcanics in Napa County and yields water to wells. Well yields are highly variable from less than 10 to several hundred gallons per minute (gpm). The most common yields are between 10 to 100 gpm. Faye (1973) reported well-test information which showed an average yield of 32 gpm and an average specific capacity of 0.6 gallons per minute per foot of drawdown. From the available well log data, the Tertiary marine sedimentary rocks are poor groundwater producers either for a lack of water or poor water quality (high salinity). At great depths, groundwater quality in the Tertiary marine sedimentary rocks is generally poor due to elevated chloride concentrations.

According to Kunkel and Upson (1960), groundwater in the Sonoma Volcanics is generally of good quality except in three areas. The first area with poor groundwater quality, the Tulucay Creek drainage basin, east of the City of Napa, contains groundwater with elevated iron, sulfate, and boron. The Suscol area, south of the City of Napa, is the second area where some wells exhibit poor quality groundwater due to elevated chloride concentrations, possibly from leakage from salty water in the Napa River, alluvial material above, or the existence of zones of unusually saline connate water deep within the Sonoma Volcanics. The third area of poor groundwater quality, the Calistoga area in the northern end of the Napa Valley, contains isolated wells with naturally occurring elevated chloride, boron, and some trace metal concentrations.

Kunkel and Upson (1960) reported that the principal water yielding units of the Sonoma Volcanics are the tuffs, ash-type beds, and agglomerates. The lava flows were reported to be generally non-water bearing. However, it may be possible that fractured, fragmental, or weathered lava flows could yield water to wells. The hydrogeologic properties of the volcanic-sourced sedimentary deposits of the Sonoma Volcanics are complex and poorly understood.

Groundwater Occurrence in Other Units and in the Quaternary Sedimentary Deposits

Several hundred wells and test holes on record have been drilled into the exposed Huichica Formation. Well yields tend to be low to modest (< 10 gpm to tens of gpm). Only a few known wells on record are completed in the Clear Lake Volcanics near the northern County line. Three wells report high yields of 400 to 600 gpm. Much of the Clear Lake Volcanics to the south appear to be thinner, limited in extent, and in ridge-top locations where possible groundwater production appears to be less likely.

Groundwater production from Quaternary alluvium is variable, with yields ranging from <10 gpm in the East and West mountainous areas to a high of 3,000 gpm along the Napa Valley Floor where the alluvium is thickest (>200 feet). According to Faye (1973), average yield of wells completed in the alluvium is 220 gpm. Many wells drilled in the alluvium within the last 30 years extend beyond the alluvium and into the underlying Cenozoic units. Kunkel and Upson (1960) report that groundwater in the alluvium is generally of good quality. The groundwater is somewhat hard and of the bicarbonate type, with small concentrations of sulfate, chloride, and total dissolved solids. A few isolated areas have increased chloride and boron concentrations.

2.3 Recent Groundwater Studies and Programs

This section summarizes the recently completed studies by Napa County and the recommendations relevant to ongoing groundwater monitoring that were developed.

2.3.1 Napa County's Comprehensive Groundwater Monitoring Program

In 2009, Napa County implemented a Comprehensive Groundwater Monitoring Program to meet action items identified in Napa County's 2008 General Plan update (Napa County, 2008). 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 (and the Plan (LSCE, 2013a)) 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 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 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.

Napa County's Comprehensive Groundwater Monitoring Program involved many tasks that led to the preparation of five technical memorandums and a 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/. The report documents existing knowledge of countywide groundwater conditions and establishes a framework for the monitoring and reporting of groundwater levels and groundwater quality on a periodic basis. The report also summarizes priorities for groundwater level and quality monitoring for each of the county subareas.

As described above, the *Napa County Groundwater Monitoring Plan 2013* (LSCE, 2013a) was prepared to formalize and augment groundwater monitoring efforts [levels and quality] to better understand the groundwater resources of Napa County, aid in making the County eligible for public funds administered by the California Department of Water Resources (DWR), and regularly evaluate trends to identify changes in levels and/or quality and factors related to those changes that warrant further examination to ensure sustainable water resources. The Plan included refinement of criteria used to identify priority monitoring areas and a proposed expanded monitoring network. During Plan implementation, the GRAC led and supported outreach efforts to well owners for volunteer monitoring wells; the GRAC efforts were very successful in adding new wells to the Napa County groundwater monitoring program.

2.3.2 Napa County Statewide Groundwater Elevation Monitoring (CASGEM)

This section describes the DWR California Statewide Groundwater Elevation Monitoring (CASGEM) program. The wells included by the County in the CASGEM program are a *subset* of the overall network of wells monitored in Napa County.

In November 2009, Senate Bill SBX7 – 6 mandated that the groundwater elevations in all basins and subbasins in California be regularly and systematically monitored with the goal of demonstrating seasonal and long-term trends in groundwater elevations. In accordance with the mandate, DWR developed the CASGEM program. DWR is facilitating the statewide program which began with the opportunity for local entities to apply to DWR to assume the function of regularly and systematically collecting and reporting groundwater level data for the above purpose. These entities are referred to as Monitoring Entities.

Wells designated for inclusion in the CASGEM program are for purposes of measuring groundwater levels on a semi-annual or more frequent basis that are representative of groundwater conditions in the state's groundwater basins and subbasins. A key aspect of the program is to make certain elements of the groundwater level information available to the public.

On December 29, 2010, the County applied to DWR to become the local countywide Monitoring Entity responsible for designating wells as appropriate for monitoring and reporting groundwater elevations for purposes of the CASGEM program.

The wells selected by the County for this program are a *subset* of the overall wells monitored, i.e., the County has a much larger overall monitoring network. The County's participation in the CASGEM program complements other pre-existing groundwater monitoring that has been ongoing in Napa County for some time (the overall historical monitoring record began in 1920).

Following confirmation, the County, as the Monitoring Entity, proceeded to identify a *subset* of monitored wells to be included in the CASGEM network and to prepare a CASGEM Network Plan as required by DWR (LSCE, 2011b and LSCE, 2014). At the time the County's CASGEM Network Plan was initially submitted to DWR, fourteen wells were included in the program. DWR formally designated Napa County as the Monitoring Entity for two basins in August 2014, specifically:

- Napa County was designated as the Monitoring Entity for the 2-2.01 Napa Valley Subbasin (medium priority basin)
- Napa County was designated as the Monitoring Entity for the 2-2.03 Napa-Sonoma Lowlands Subbasin in Napa County (very low priority basin)

During the initial CASGEM monitoring year (beginning 2011), the County continued to monitor 14 wells that had already been part of the group of wells where groundwater levels are measured by the County and reported to DWR semi-annually, or are measured directly by DWR. The current 2014 CASGEM network wells are located primarily on the Napa Valley Floor, Carneros Subarea, and in the MST Subarea. Some of these wells do not have sufficient construction details to define which portion of the aquifer system is represented by measured water levels. Additional data gathering and surveying will be performed, and such information will be provided in future annual reports as it becomes available. Depending on the results of the County's evaluation, future actions may include removal and replacement of CASGEM wells with wells that are more representative of local groundwater conditions to better meet the objectives of the CASGEM program and also overall objectives of the County's Comprehensive Groundwater Monitoring Program.

In addition to the CASGEM well network described herein, the County is currently exploring the availability of additional monitoring wells in the Pope Valley Groundwater Basin[5]. Public outreach is underway through community organizations and other contacts. The Berryessa Valley Groundwater Basin has a very low DWR priority and extremely small utilization of groundwater[6]. Per discussions with DWR, outreach will continue but no monitoring is planned in this groundwater basin at this time. The County has submitted detailed information to DWR to support consideration of the removal of this basin through a Bulletin 118 update or other appropriate process (LSCE, 2014).

The Suisun-Fairfield Valley Basin and the Napa-Sonoma Lowlands Subbasin are two examples of basins that do not conform to county boundaries, and they are also basins with a very low-priority designation from DWR. While these two basins have low groundwater utilization and less extensive monitoring than other basins, they are situated adjacent to the bay and delta water ways and are important areas to monitor for protection against saltwater intrusion. The Suisun-Fairfield Valley Basin, which is mostly in Solano County and has only a very small area (less than 0.3% of the total basin area) in Napa County, is being monitored in its entirety by Solano County Water Agency as the CASGEM Monitoring Entity for Solano County. The monitoring of Napa-Sonoma Lowlands Subbasin, whose area is shared with Solano County in more equitable portions (63% in Napa County, 37% in Solano County), is anticipated to have monitoring that is coordinated between the two respective Monitoring Entities in the future. Currently, all monitoring is within the Napa County portion of the subbasin; in the future, monitoring in this subbasin will expand as necessary to ensure representative coverage and as coordinated between the two Monitoring Entities.

2.3.3 Updated Conceptualization and Characterization of Hydrogeologic Conditions

In 2012, activities were implemented to update the characterization and conceptualization of hydrogeologic conditions (LSCE and MBK, 2013). This work included: 1) an updated Napa Valley hydrogeologic conceptualization, 2) linking well construction information to groundwater level monitoring data, 3) groundwater recharge characterization and estimates, and 4) surface water/groundwater interrelationships.

Updated Napa Valley Geologic Conceptualization

As part of the updated hydrogeologic conceptualization (LSCE and MBK, 2013), eight cross- valley geologic sections were constructed (**Figure 2-3**). About 1,300 water well drillers' reports were reviewed and located on topographic base maps; 191 of these were selected for use in the cross sections.

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[5] DWR Overall Basin Ranking Score is "0.0"; the very low priority basin ranking range is 0-5.4. http://www.water.ca.gov/groundwater/casgem/pdfs/basin_prioritization/NCRO%2074.pdf

[6] DWR Overall Basin Ranking Score is "0.0"; the very low priority basin ranking range is 0-5.4. http://www.water.ca.gov/groundwater/casgem/pdfs/basin_prioritization/NCRO%2062.pdf

Geologic correlations seen on the cross sections were extended between sections by available well control and surficial geologic maps. From the geologic cross-sections and correlations of other water well drillers' reports, the Quaternary alluvium was separated from underlying units, and an isopach (contours of equal thickness) map was constructed.

The alluvium was divided into three facies according to patterns detected in the lithologic record and used to delineate the depositional environment which formed them: fluvial, alluvial fan, and sedimentary basin (LSCE and MBK, 2013 and LSCE, 2013b). The fluvial facies consists of a thin narrow band of stream channel sands and gravels deposited by the Napa River. The sand and gravel beds tend to be thicker and/or more numerous in the fluvial facies area. They are interbedded with finer-grained clay beds of probable floodplain origin. Wells constructed in the fluvial facies tend to be moderately high yielding (for the valley, roughly 50 to 200 gpm). Local areas where thicker sand and gravel beds are reported, the well yields are the highest in the valley, ranging from about 200 to 2,000 gpm.

These areas with thick sand and gravel beds occur in the Yountville Narrows area, which extends about five miles from Oakville south to Ragatz Lane. Local areas of relatively lower well yield values of 200 to 500 gpm occur to the north and south. Hydraulic properties of these deposits are recorded during airlift testing, and drawdown values are generally not reported. Only a few pump test results have been found, and these are in the high yielding area just north of the Yountville Narrows.

The alluvial plain facies of the Quaternary alluvium extends outward from the central fluvial facies and thins to zero thickness at the edge of the valley sides. These deposits appear to have been deposited as tributary streams and alluvial fans. These deposits appear to consist of interbedded sandy clays with thin beds (less than 10 feet thick) of sand and gravel. Wells constructed in the alluvial plain facies tend to be low yielding, ranging from a few gpm to a few tens of gpm. By at least 1970, most wells drilled on the alluvial plain facies were constructed to deeper depths into the underlying Sonoma Volcanics.

The alluvial facies shows some overlap with the shallowest depths to groundwater, as measured in spring 2010 (**Figures 2-4, 2-5, and 2-6**). These areas of overlap occur generally to the west of the Napa River and adjacent to mapped perennial streams, including Hopper Creek, Sulpher Creek, York Creek, Bale Slough (west of Highway 29), and possibly Dry Creek. These areas represent somewhat likely areas of connection between surface waters (including the Napa River and perennial streams described above) and groundwater.

At the northern end of the lower valley, the sedimentary basin facies of the alluvium occurs. This facies is characterized by fine-grained silt, sand, and clays with thin to scattered thicker beds of sand and gravel. The sedimentary facies is believed to be floodplain deposits that extend to the southern marshland/estuary deposits. As noted, the extent of this facies is poorly known due to lack of well control farther south. Limited information indicates low to moderate well yields of a few gpm to possibly up to 100 gpm. Again, the lack of pump test information makes hydraulic properties of the deposits difficult to assess.

Napa Creek and the Napa River east of Highway 29 in the vicinity of downtown Napa show a connection with groundwater in this portion of the Napa Valley (**Figure 2-6**).

Portions of Napa Valley north of Deer Park Road were not characterized according to their Quaternary alluvial facies by LSCE and MBK (2013). However, depths to groundwater in the vicinity of monitored wells indicate the potential for connection between surface water and groundwater in the vicinity of Garnett Creek and Cyrus Creek in and near Calistoga (**Figure 2-6**).

Beneath the alluvium is a complex sequence of Tertiary sedimentary deposits (Huichica Formation) and igneous deposits of the Sonoma Volcanics. These units are strongly deformed by folding and faulting and have complex stratigraphic relationships. From the geologic cross-sections, lateral correlations, and surficial map relationships, a structure contour map (elevations) of the top of these units and the subcrop[7] pattern were developed (LSCE and MBK, 2013). From north of the City of Napa and southward, these deposits are dominated by fine-grained basin fill with few sand and gravels of floodplain, estuary origin. North towards Yountville, sedimentary deposits of the Huichica Formation appear to overlie Sonoma Volcanics andesites and tuffs. Sonoma Volcanics and the older Mesozoic Great Valley sequence are exposed in a structural uplift area in the small hills in the Yountville area.

Further north, a Sonoma Volcanics andesite flow breccia appears to transition into a sedimentary conglomerate along the center of the valley. This unit is encountered in deep, high yielding wells also completed in the overlying alluvium fluvial facies, but it is not clear if this unit also is high yielding. Overlying the conglomerate/breccia on the east is the Tertiary sedimentary deposits sequence (Huichica Formation) of sandstones and mudstones. To the west of the unit occur older Sonoma Volcanics andesites, tuffs in the south, and possibly younger Sonoma Volcanics tuffs interbedded with Tertiary sedimentary deposits (Huichica Formation) of sand and gravels and clays. All of the Tertiary units beneath the Napa Valley Floor appear to be low to moderately water yielding with poor aquifer characteristics (LSCE and MBK, 2013).

Linking Well Construction Information to Groundwater Monitoring Data

As part of the updated hydrogeologic characterization, existing monitoring well construction data from all available public sources were reviewed to determine the distribution of aquifer-specific monitoring data in Napa Valley. This effort addresses recommendations of the Comprehensive Groundwater Monitoring Program to identify and fill data gaps that will allow for analysis of groundwater occurrence and flow as a more robust understanding of the extent of groundwater resources in the county is developed. A major component of this work has been to identify construction information for previously monitored wells in Napa Valley.

Groundwater level monitoring needs identified through the Comprehensive Groundwater Management Program include improved spatial distribution of groundwater level monitoring, additional characterization of subsurface geologic conditions in county subareas to identify aquifer characteristics, further examination of well construction information to define which portion of the aquifer system is represented by water levels measured in the currently monitored wells (and in many cases to link construction information to the monitored wells), and improve the understanding of surface water/groundwater interactions and relationships.

Groundwater Recharge Characterization and Estimates

Another important feature of the updated hydrogeologic investigation was the development of improved characterization of groundwater recharge in the areas of greatest groundwater development, with an emphasis on Napa Valley. Understanding the volume of and mechanisms driving groundwater recharge in the county are essential in determining where and how much groundwater can be produced without incurring negative impacts (LSCE, 2011a). The high permeability of the alluvial sediments in the Napa Valley permits precipitation and surface water to readily infiltrate and recharge groundwater throughout the majority of the valley. These high permeability soils combined with the large volume of

[7] Occurrence of strata in contact with the undersurface of a stratigraphic unit, which in this case includes the strata beneath the alluvium.

water that flows through the Napa River create the potential for significant recharge to occur under the hydrologic circumstances and hydraulic gradient that allow for recharge from the river to groundwater to occur.

Mass balance and streamflow infiltration methods were used to estimate regional and local recharge. Streamflow infiltration can be characterized by comparing the elevation of surface water to the shallowest adjacent groundwater. Detailed remotely sensed elevation data of the mainstem Napa River and several major tributaries were obtained for this purpose. LiDAR data were paired with previously collected groundwater level data and estimates of areas of greatest recharge potential to estimate the potential for recharge to groundwater.

In addition, mass balance recharge estimates have been developed for the Napa River watershed and major tributary watersheds using a range of available data (LSCE and MBK, 2013). Available records for streamflow, precipitation, land use, and vegetative cover throughout these watersheds have been used to develop spatially-distributed estimates of annual hydrologic inputs and outputs in order to solve for the volume of groundwater recharge at the watershed scale. Key components of this work included quantifying the distribution of precipitation across the land surface, quantifying the amount of water that returns to the atmosphere by evapotranspiration, and quantifying the hydraulic properties of soil and alluvial materials through which water must infiltrate to reach groundwater. Estimates developed through the mass balance approach have been evaluated using a sensitivity analysis to determine the degree to which any individual or set of inputs affects the recharge estimate.

Groundwater-Surface Water Interrelationships

Depth to Groundwater Relative to Stream Thalweg

The groundwater surface elevation and the estimated stream thalweg elevation data are important components for characterizing the groundwater-surface water relationship in the Napa Valley area. The spring 2010 contours of equal groundwater elevation were used to provide a snapshot representation of groundwater conditions with which to compare the vertical relationship between groundwater and surface water (LSCE and MBK, 2013 and LSCE, 2013b). This spatial relationship assisted in developing an understanding of the nature of water exchange between the groundwater and surface water systems. This analysis focused specifically on the degree of connectivity between the Napa River thalweg and the elevation of the regional groundwater surface in the Napa Valley in spring 2010.

Calculated depths to groundwater equal to or above the estimated thalweg alignment indicate that for spring 2010 the interpreted groundwater elevation was above the bottom of the Napa River thalweg. The data suggest areas where a direct connection between the water table and the river may have existed in spring 2010 and where groundwater has the potential to discharge into the stream channel. In other areas, the depth to groundwater is below the bottom of the Napa River thalweg such that surface flows in the river have the potential to percolate and recharge the groundwater system.

Despite the uncertainty in the data in parts of the valley, depths to groundwater (both measured and calculated) show generally shallow groundwater throughout much of the valley, particularly in the northern end of the valley. The calculated depths to groundwater appear to be reasonably represented in the Napa Subarea east of the Napa River because this area has the greatest density of monitored sites. **Figure 2-6** presents the depths to groundwater for Napa Valley based on water level measurement for wells constructed in the alluvial aquifer system (LSCE, 2013b). This figure reflects the generally shallow groundwater levels measured particularly along the axis of the valley.

Other Areas of County

Potential connections between surface water and groundwater in other areas of the county are less well known. Perennial water courses have been mapped by Napa County in other portions of the county with state-designated groundwater basins. In the Pope Valley Groundwater Basin, these include Pope Creek, Burton Creek, and Maxwell Creek. In the small portion of the Suisun-Fairfield Valley Groundwater Basin that extends into Napa County, in the Southern Interior Valley Subarea, Wooden Valley Creek is mapped as a probable perennial stream.

Blueline Stream Locations

Napa County's Planning, Building, and Environmental Services Department maintains a GIS dataset of perennial streams throughout the county, included as a part of the larger "bluelines" shapefile (LSCE, 2013b). The dataset includes both unnamed and 48 named streams, creeks, rivers, and other surface water courses classified as known perennial or probable perennial (**Figure 2-7**). The known and probable classifications are a subset of all water courses originally digitized from U.S. Geological Survey (USGS) topographic maps of Napa County. Metadata for the dataset describe the known perennial water courses as those determined by "stream reports or other known data sources", while probable perennial water courses are defined as having been determined by "computer analysis of probable streams". As shown in **Figure 2-7**, known or probable perennial water courses are present in all Napa County subareas except for the Livermore Ranch, Knoxville, Berryessa, and Jameson/American Canyon Subareas.

3 GROUNDWATER RESOURCES GOALS AND MONITORING OBJECTIVES

3.1 Napa County Water Resources Goals and Policies

The County's General Plan (2008, amended June 23, 2009) recognizes, "water is one of the most complex issues related to land use planning, development, and conservation; it is governed and affected by hundreds of federal, state, regional, and local mandates pertaining to pollution, land use, mineral resources, flood protection, soil erosion, reclamation, etc. Every year, the state legislature considers hundreds of bills relating to water issues, and in Napa County, more than two dozen agencies have some say in decisions and regulations affecting water quality and water use."

As part of the General Plan update in 2008, and within the Conservation Element, six goals are set forth 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 (one of which is "reserved" for later description). Napa County's six water resources goals are included below (the entire group of water resources goals, policies, and action items is included in LSCE, 2011a).

> **Goal CON-8:** Reduce or eliminate groundwater and surface water contamination from known sources (e.g., underground tanks, chemical spills, landfills, livestock grazing, and other dispersed sources such as septic systems).
>
> **Goal CON-9:** Control urban and rural storm water runoff and related non-point source pollutants, reducing to acceptable levels pollutant discharges from land-based activities throughout the county.
>
> **Goal CON-10:** Conserve, enhance and manage water resources on a sustainable basis to attempt to ensure that sufficient amounts of water will be available for the uses allowed by this General Plan, for the natural environment, and for future generations.
>
> **Goal CON-11:** Prioritize the use of available groundwater for agricultural and rural residential uses rather than for urbanized areas and ensure that land use decisions recognize the long-term availability and value of water resources in Napa County.
>
> **Goal CON-12:** Proactively collect information about the status of the County's surface and groundwater resources to provide for improved forecasting of future supplies and effective management of the resources in each of the County's watersheds.
>
> **Goal CON-13:** Promote the development of additional water resources to improve water supply reliability and sustainability in Napa County, including imported water supplies and recycled water projects.

Addressing the six water resources goals above, Napa County has produced specific General Plan Action Items related to the focus and objective of this Plan. Those action items include:

> **Action Item CON WR-1:** Develop basin-level watershed management plans for each of the three major watersheds in Napa County (Napa River, Putah Creek, and Suisun Creek). Support each basin-level plan with focused sub-basin (drainage-level) or evaluation area-level implementation strategies, specifically adapted and scaled to address identified water resource problems and

restoration opportunities. Plan development and implementation shall utilize a flexible watershed approach to manage surface water and groundwater quality and quantity. The watershed planning process should be an iterative, holistic, and collaborative approach, identifying specific drainage areas or watersheds, eliciting stakeholder involvement, and developing management actions supported by sound science that can be effectively implemented. [Implements Policies 42 and 44]

Action Item CON WR-4: Implement a countywide watershed monitoring program to assess the health of the County's watersheds and track the effectiveness of management activities and related restoration efforts. Information from the monitoring program should be used to inform the development of basin-level watershed management plans as well as focused sub-basin (drainage-level) implementation strategies intended to address targeted water resource problems and facilitate restoration opportunities. Over time, the monitoring data will be used to develop overall watershed health indicators and as a basis of employing adaptive watershed management planning. [Implements Policies 42, 44, 47, 49, 63, and 64]

Action Item CON WR-6: Establish and disseminate standards for well pump testing and reporting and include as a condition of discretionary projects that well owners provide to the County upon request information regarding the locations, depths, yields, drilling and well construction logs, soil data, water levels and general mineral quality of any new wells. [Implements Policy 52 and 55]

Action Item CON WR-7: The County, in cooperation with local municipalities and districts, shall perform surface water and groundwater resources studies and analyses and work toward the development and implementation of an integrated water resources management plan (IRWMP) that covers the entirety of Napa County and addresses local and state water resource goals, including the identification of surface water protection and restoration projects, establishment of countywide groundwater management objectives and programs for the purpose of meeting those objectives, funding, and implementation. [Implements Policy 42, 44, 61 and 63]

Action Item CON WR-8: The County shall monitor groundwater and interrelated surface water resources, using County-owned monitoring wells and stream and precipitation gauges, data obtained from private property owners on a voluntary basis, data obtained via conditions of approval associated with discretionary projects, data from the State Department of Water Resources, other agencies and organizations. Monitoring data shall be used to determine baseline water quality conditions, track groundwater levels, and identify where problems may exist. Where there is a demonstrated need for additional management actions to address groundwater problems, the County shall work collaboratively with property owners and other stakeholders to prepare a plan for managing groundwater supplies pursuant to State Water Code Sections 10750-10755.4 or other applicable legal authorities. [Implements Policy 57, 63 and 64]

Action Item CON WR-9.5: The County shall work with the SWRCB[8], DWR, DPH, CalEPA, and applicable County and City agencies to seek and secure funding sources for the County to develop and expand its groundwater monitoring and assessment and undertake community-based planning efforts aimed at developing necessary management programs and enhancements.

[8] SWRCB is the California State Water Resources Control Board. DPH is the California Department of Public Health.

The County continues to address the General Plan goals and actions. Additionally, through the efforts embarked upon through the implementation of the County's Comprehensive Groundwater Monitoring Program, those persons whose livelihoods depend upon the county's natural resources can help ensure the sustainability of groundwater resources for future generations and the environment.

Based on the GRAC's charge from the Napa County Board of Supervisors and a review of many definitions in published literature, the GRAC (2014) defined "groundwater sustainability[9]" as:

> *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 concluded that groundwater sustainability is both a goal and a process; most importantly, it is a shared responsibility. Everyone living and working in the county has a stake in protecting groundwater resources; including groundwater supplies, quality, and associated watersheds (GRAC, 2014). The GRAC further found that healthy communities, healthy agriculture and healthy environments exist together and not in isolation. Without sustainable groundwater resources, the character of the county would be significantly different in terms of its economy, communities, rural character, ecology, housing, and lifestyles.

The GRAC also developed a set of groundwater sustainability objectives (GRAC, 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.

[9] The definition for Groundwater Sustainability developed by the GRAC is separate from the definition of Sustainable Groundwater Management applied in the 2014 Sustainable Groundwater Management Act, see Section 7.2 of this Report for additional information.

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 multiyear drought conditions.

3.2 Overarching Groundwater Monitoring Objectives

This section describes the water level and quality objectives established for the countywide Comprehensive Groundwater Monitoring Program[10] (LSCE, 2013a). The overarching groundwater monitoring objectives are linked to 1) the County's General Plan goals and action items presented above, and 2) hydrogeologic conditions and potential areas of concern, including (but not limited to):

- Monitoring trends in groundwater levels and storage (e.g., groundwater balance) to assess and ensure long-term groundwater availability and reliability;
- Monitoring of groundwater-surface water interactions to ensure sufficient amounts of water are available to the natural environment and for future generations;
- Monitoring in significant recharge areas to assess factors (natural and human-influenced) that may affect groundwater recharge (including climate change) and also aid the identification of opportunities to enhance groundwater recharge and storage;
- Monitoring to establish baseline conditions in areas of potential saline water intrusion;
- Monitoring of general water quality to establish baseline conditions, trends, and protect and preserve water quality.
- Identify where data gaps occur in the key subareas and provide infill, replacement, and/or project-specific monitoring (e.g., such as may occur for planned projects or expansion of existing projects) as needed; and
- Coordinate with other entities on the collection, utilization, and incorporation of groundwater level data in the countywide Data Management System (DMS).

Although this Report focuses on an update of the groundwater monitoring network and groundwater level trends and conditions, groundwater quality objectives are also included for completeness.

[10] These objectives were developed by the Napa County GRAC prior to passage of the 2014 Sustainable Groundwater Management Act. SGMA defines Measurable Objectives as quantitative means of evaluating the efficacy of groundwater basin management, which is different from the approach applied by the GRAC.

3.2.1 Groundwater Level Monitoring Objectives

The focus of the countywide groundwater level monitoring program includes the following objectives:

- Expand groundwater level monitoring in priority County subareas to improve the understanding of the occurrence and movement of groundwater; monitor local and regional groundwater levels including seasonal and long-term trends; and identify vertical hydraulic head differences in the aquifer system and aquifer-specific groundwater conditions, especially in areas where short- and long-term development of groundwater resources are planned (this includes additional monitoring of the Tertiary formation aquifer in the area between the NVF-MST Subarea and the northeastern part of the NVF-Napa Subarea to determine whether groundwater water conditions in the NVF-MST are affecting other areas (LSCE and MBK, 2013);
- Detect the occurrence of, and factors attributable to, natural (e.g., direct infiltration of precipitation, surface water seepage to groundwater, groundwater discharge to streams) or induced factors (e.g., pumping, purposeful recharge operations) that affect groundwater levels and trends;
- Identify appropriate monitoring sites to further evaluate groundwater-surface water interaction and recharge/discharge mechanisms, including whether groundwater utilization is affecting surface water flows;
- Establish a monitoring network to aid in the assessment of changes in groundwater storage; and
- Generate data to better estimate groundwater basin conditions and assess local current and future water supply availability and reliability; update analyses as additional data become available.

Based on the analysis of existing groundwater data and conditions described in the report *Napa County Groundwater Conditions and Groundwater Monitoring Recommendations* (LSCE, 2011a) and with input received from the GRAC, the key objectives for future groundwater level monitoring for each subarea are summarized in the Plan (LSCE, 2013a).

3.2.2 Groundwater Quality Monitoring Objectives

The primary objectives of the countywide groundwater quality monitoring program include (LSCE, 2013a):

- Evaluate groundwater quality conditions in the various county subareas and identify differences in water quality spatially between areas and vertically in the aquifer system within a subarea;
- Detect the occurrence of and factors attributable to natural (e.g., general minerals and trace metals) or other constituents of concern;
- Establish baseline conditions in areas of potential saltwater intrusion, including the extent and natural occurrence and/or causes of saltwater beneath the Carneros, Jameson/American Canyon and Napa River Marshes Subareas;
- Assess the changes and trends in groundwater quality; and
- Identify the natural and human factors that affect changes in water quality.

Based on the analysis of existing groundwater data and conditions described in the report *Napa County Groundwater Conditions and Groundwater Monitoring Recommendations* (LSCE, 2011a) and with input received from the GRAC, the key objectives for future groundwater quality monitoring for each subarea are summarized in the Plan (LSCE, 2013a).

4 GROUNDWATER MONITORING NETWORK

4.1 Groundwater Level Monitoring

Groundwater level monitoring was conducted at a total of 113 sites across Napa County in 2015 (**Table 4-1)**. The overall number and distribution of monitored sites remained consistent with the monitoring conducted in 2014 and was increased relative to the 87 sites reported in the 2011(LSCE, 2013a). **Figure 4-1** shows the distribution of sites monitored in 2015 according to the monitoring entity.

Table 4-1 Current Groundwater Level Monitoring Sites in Napa County by Reporting Entity

Entity	Reporting Program	Number of Monitored Sites, Fall 2015
Napa County	CASGEM	28
	State Water Data Library	19
	County Volunteer Groundwater Monitoring Program	48
	Surface Water-Groundwater Monitoring	10
California Department of Water Resources	Volunteered Sites	4
State Water Resources Control Board	Geotracker	9
	Total Sites	**113**

Out of the total 113 sites monitored in 2015, 100 were monitored by Napa County. Four sites were monitored by DWR. The remaining nine sites were regulated facilities with data reported as part of the State Water Resources Control Board (SWRCB) Geotracker Program (**Table 4-1**).

Minor reductions in the number of sites monitored by Napa County between 2014 and 2015 occurred due to a combination of well-owner requests and decisions by the Napa County Department of Public Works. In the latter case, three wells were discontinued by the County where other nearby monitored wells were determined to be sufficient to meet the monitoring objectives. Three additional wells were added to the County's monitoring networks during 2015 based on requests by well owners for monitoring by the County in areas where additional monitoring sites were needed.

Additional summary information for currently monitored sites is provided in **Appendix A**.

Table 4-2 Current Groundwater Level Monitoring Sites in Napa County by Groundwater Subarea

Groundwater Subarea	Number of Monitored Sites Through 2011	Number of Monitored Sites, Fall 2014	Number of Monitored Sites, Fall 2015
Napa Valley Floor-Calistoga	6	10	9
Napa Valley Floor-MST	29	27	27
Napa Valley Floor-Napa	18	21	20
Napa Valley Floor-St. Helena	12	14	14
Napa Valley Floor-Yountville	9	12	14
Carneros	5	12	12
Jameson/American Canyon	1	1	1
Napa River Marshes	1	1	-
Angwin	-	5	5
Berryessa	3	2	3
Central Interior Valleys	1	1	2
Eastern Mountains	-	3	4
Knoxville	1	-	-
Livermore Ranch	-	-	-
Pope Valley	1	1	1
Southern Interior Valleys	-	-	-
Western Mountains	-	2	1
Unknown[1]	-	3	-
Total Sites	**87**	**115**	**113**

[1] In 2014 three sites in the Geotracker regulated groundwater monitoring network were reporting groundwater level data, but had not yet reported location information for the monitored wells.

4.1.1 Napa County Monitoring Network

In 2015, Napa County conducted semi-annual groundwater level monitoring at 82 sites across the county, with the majority of sites located within the Napa Valley Floor Subareas. Eight sites were monitored by Napa County on a monthly interval, to begin to address temporal data gaps identified in the 2014 Annual Monitoring Report (LSCE, 2015). Five sites were monitored using continuously recording instrumentation at dedicated monitoring wells constructed as part of the County's Surface Water–Groundwater Monitoring Project.

4.1.2 CASGEM Monitoring Network

As of fall 2015 the Napa County CASGEM Monitoring Network included 23 privately-owned wells monitored by Napa County and the five dual-completion dedicated monitoring wells from the Surface Water-Groundwater Monitoring Project (**Figure 4-3**). Wells in the CASGEM monitoring network are distributed across all five Napa Valley Floor Subareas (Calistoga, St. Helena, Yountville, Napa, and MST) as well as the Carneros, Angwin, Eastern Mountains, and Western Mountains Subareas (**Table 4-3**). Half of the CASGEM Network wells in Napa County, 14, are located in the medium priority Napa Valley

Subbasin of the Napa-Sonoma Valley Groundwater Basin (**Table 4-4**). In addition, six CASGEM Network wells are located in the very low priority Napa-Sonoma Lowlands Subbasin of the Napa-Sonoma Valley, while eight are not located in any groundwater basin or subbasin.

Table 4-3 Current CASGEM Network Sites in Napa County by Groundwater Subarea

Groundwater Subarea	Number of Monitored Sites, Fall 2015
Napa Valley Floor-Calistoga	1
Napa Valley Floor-MST	4
Napa Valley Floor-Napa	6
Napa Valley Floor-St. Helena	4
Napa Valley Floor-Yountville	4
Carneros	6
Jameson/American Canyon	-
Napa River Marshes	-
Angwin	1
Berryessa	-
Central Interior Valleys	-
Eastern Mountains	1
Knoxville	-
Livermore Ranch	-
Pope Valley	-
Southern Interior Valleys	-
Western Mountains	1
Total Sites	**28**

4.1.3 DWR Monitoring Network

The DWR currently monitors four wells in Napa County as part of its voluntary groundwater monitoring efforts (**Table 4-1**). Three of these sites are monitored at monthly intervals, while one is monitored semi-annually. These wells are located in each of the Napa Valley Floor subareas, excluding the MST Subarea.

Table 4-4 Current CASGEM Network Sites in Napa County by Groundwater Basin

Basin Name	Subbasin Name	Number of Monitored Sites, Fall 2015
Napa-Sonoma Valley	Napa Valley	14
Napa-Sonoma Valley	Napa-Sonoma Lowlands	6
Berryessa Valley	-	-
Pope Valley	-	-
Suisun-Fairfield Valley	-	-
Non-basin Areas	-	8
	Total Sites	**28**

4.1.4 State Water Resources Control Board Geotracker Network

The State Water Resources Control Board (SWRCB) stores environmental data for regulated facilities in California in their Geotracker database, including groundwater levels and groundwater quality. Data from these regulated facilities usually includes manual measurements and samples from groundwater monitoring wells (typically shallow) at each site. Groundwater level data are available for 9 Geotracker sites located throughout Napa County in 2015 (**Table 4-1**). The groundwater level monitoring frequency is typically semi-annual or quarterly, although more frequent measurements are sometimes recorded. Geotracker sites with data reported in 2015 were located in the Napa Valley Floor-Napa, Berryessa, and Central Interior Valleys subareas (**Figure 4-1**).

4.2 Surface Water-Groundwater Monitoring

Funding from the DWR 2012 Local Groundwater Assistance Grant Program enabled Napa County to construct ten monitoring wells at five sites in Napa Valley in September 2014. These wells comprise the groundwater monitoring facilities for the Napa County Surface Water-Groundwater Monitoring Project. In addition to grant funding from DWR, Napa County is providing matching funds to cover a portion of the monitoring well construction and instrumentation costs.

4.2.1 Monitoring Network

Figure 4-4 shows the location of the five project sites, with four sites along the Napa River and one adjacent to Dry Creek. The five sites selected for the project are within the Napa, Yountville, and St. Helena Subareas of the Napa Valley Floor. These are three of the six subareas where paired surface water-groundwater monitoring was recommended in the 2013 Plan (**Table 2-3**).

Each of the five sites includes a dual-completion monitoring well to enable monitoring of groundwater conditions at specific depth intervals. These dual-completion wells consist of two separate casings in a single borehole. Each casing is independent of the other with distinct total depths and screen intervals.

The construction details for each casing were developed based on sites specific hydrogeologic and surface water channel considerations.

In general, groundwater monitoring facilities at each site consist of one shallow casing constructed to represent groundwater conditions at the water table surface and at elevations similar to the adjacent surface water channel. The second casing at each site is constructed to a deeper depth with screen intervals coinciding with aquifer materials and depths likely to be accessed by production wells in the vicinity. Paired casings are separated within the borehole by intermediate seals designed to provide a physical separation such that groundwater conditions reflected by each casing are not influenced by conditions in other portions of the groundwater system.

5 GROUNDWATER LEVEL TRENDS AND FLOW DIRECTIONS

Groundwater data availability in Napa County varies widely among the subareas. The bulk of the historical and current groundwater level and quality data is located in the Napa Valley Floor Subarea with limited to no data in the other Napa County subareas. This section presents discussions of groundwater levels, with a focus on groundwater level characteristics by subarea.

Napa County received below average precipitation at the Napa State Hospital gauge during water years[11] 2012, 2013, 2014, and 2015. Water year 2013 registered as a Dry year on the five stage rating system of Very Dry, Dry, Normal, Wet and Very Wet water year types (**Table 5-1**). Since 1949 when most long-term groundwater monitoring records begin, comparable multi-year periods with below average precipitation occurred in 1990 – 1991 (both Dry), 1976 – 1977 (both Very Dry), and 1959 – 1962 (all Dry), 1954 – 1955 (both Dry), and 1947-1949 (all Dry).

Successive years of below average precipitation in water years 2012 through 2015 provide an important context for the review of recent groundwater level trends. **Figure 5-1** depicts both the annual water year precipitation recorded at the Napa State Hospital gauge along with the cumulative departure from the mean water year precipitation value for water years 1970 through 2015 The cumulative departure values calculated for **Figure 5-1** provide a tally of precipitation received relative to the mean value over time.

Notably, the eight-year span from 1987 through 1994, with only one year of above average precipitation, resulted in a net cumulative departure deficit of 38.55 inches (**Figure 5-1**). This protracted period contrasts with the Very Dry years of 1976 and 1977, which although more acute, produced a less severe net cumulative departure deficit of 26.13 inches. Groundwater level records from the Napa Valley Groundwater Subbasin that include both of these time periods generally show the lowest spring groundwater levels in 1977, as compared to the 1987 to 1994 period. This indicates that the subbasin experienced sufficient recharge to maintain relatively stable spring groundwater levels over an eight-year period when precipitation totals were below average on the whole.

The four year span from 2012 through 2015 produced a net cumulative departure deficit of 17.04 inches.

[11] A water year is defined as the period from October 1 through the following September 30 and is numbered according to the calendar year on its final day. In this way, water years maintain continuity between the times when water supplies typically increase and the following dry season when water demand is greatest.

Table 5-1 Recent Napa State Hospital Annual Precipitation Totals and Napa River Watershed Water Year Types

Water Year	Annual Precipitation (in) (updated values from LSCE)	Water Year Type
2009	21.31	Normal (below average)
2010	28.85	Wet
2011	36.62	Wet
2012	21.75	Normal (below average)
2013	20.26	Normal (below average)
2014	19.67	Dry
2015	20.72	Normal (below average)
Napa State Hospital (NSH) Average Annual Water Year Precipitation (1920 – 2015) = 24.86 inches		

Geologic setting and differences in aquifer zones within a subarea or groundwater subbasin are additional considerations relevant to the interpretation of groundwater levels, particularly for wells constructed entirely or partially within the alluvium in Napa Valley. **Figure 5-2** depicts two wells located relatively near each other at the land surface which exhibit distinct groundwater levels due in part to having been constructed within different aquifer zones. Well 07N05W09Q2 is located near the center of Napa Valley, where the alluvium extends to approximately 200 feet below ground surface (LSCE and MBK, 2013). NapaCounty-138 has a total depth of 321 feet and is located closer to the western edge of Napa Valley in an area where the alluvium extends only about 50 feet below ground surface. The lower static water levels measured in the fall at NapaCounty-138 indicate that the well draws water from a geologic formation below the alluvium. Knowledge of the geologic setting and construction details for a given well are important considerations when interpreting groundwater level data.

Figure 5-3 depicts another example of the influence that aquifer zones can have on water levels in wells located in the same area. In this case, the well located east of the Napa River is constructed in the Sonoma Volcanics, while the wells west of the Napa River are constructed within alluvial sediments. Additional discussion of these wells is provided in **Section 5.1.2**.

The groundwater elevation contours described below are derived from available depth to water measurements made in wells. Prior to interpolating groundwater elevations across the valley, depth to water values were converted to groundwater elevation values by subtracting the measured depth to water from the reference point elevation at each monitored well. In this way the depth to water measurements were related to the North American Vertical Datum 1988 (NAVD88) as a standard point of reference. The resulting groundwater elevation values at each well were used to interpolate groundwater elevation contours throughout the Napa Valley Floor and in the MST area. A contour line represents a line of equal elevation of the water surface similar to the way a topographic map contour line shows a line of equal elevation of ground surface. The direction of groundwater flow is perpendicular to the contour lines.

5.1 Napa Valley Floor Subareas

The Napa Valley Floor Subarea is subdivided into five smaller subareas. From north to south these areas are Calistoga, St. Helena, Yountville, Napa, and the MST. The groundwater level conditions in each of these areas are described below.

Over the length of the Napa Valley, groundwater is contained in and moves primarily through the older and younger alluvium from Calistoga to San Pablo Bay, and is assumed for purposes of contouring groundwater data on a regional basis, to represent a single aquifer. Groundwater levels that were determined to represent a non-alluvial part of the aquifer system were excluded from the contouring dataset.

Interpreted groundwater elevation contours for spring and fall 2015 are shown in **Figures 5-4** and **5-5,** respectively. Groundwater elevation contours for Napa Valley spring 2015 appear similar to those developed for spring 2014 and spring 2010 (LSCE, 2013b and 2015). Contours across these time periods show a generally southeasterly to east-southeasterly groundwater gradient paralleling the valley axis from Calistoga to Yountville with similar groundwater elevation ranges. In the southern portion of the valley, near the City of Napa, contours indicate a more eastward flow direction consistent with the spring 2014 contours. Through the valley, groundwater elevations in spring 2015 ranged from 378 feet near Calistoga to 5 feet along the Napa River near First Street in Napa.

5.1.1 Napa Valley Floor – Calistoga and St. Helena Subareas

The hydrographs for the representative wells illustrated on **Figure 5-6** show groundwater elevations and corresponding depth to groundwater from 1970 to present, as available. Groundwater levels have been generally stable over time in the Calistoga Subarea and northern portion of the St. Helena Subarea. Groundwater levels in the representative wells are frequently very shallow at less than ten feet below the ground surface in the spring. Minor seasonal groundwater level variations of about 10 feet occur between spring and fall in the Calistoga Subarea. Groundwater levels in well 8N6W10Q1 have been lower in the late September to December timeframe in seven years since 2001. However, in every year since 1970, including 2015 groundwater levels returned to within 10 feet of the ground surface the following spring.

Elsewhere in the St. Helena Subarea, groundwater levels exhibit greater seasonal declines of about 20 feet. Groundwater levels at well 7N5W09Q2 have remained relatively stable although somewhat susceptible to dry years. An example of this occurred in 1976 and 1977, two Very Dry years in the Napa River Watershed. In 1976, the spring groundwater level measurement was 19.3 feet below ground surface, lower by more than 10 feet from the prior spring. In 1977, the spring groundwater level measurement was 27.2 feet below ground surface, down almost 8 feet from the spring 1976 measurement. Spring water levels in the same well in 2014 and 2015 were 18.6 feet and 13.2 feet below ground surface, respectively; the spring 2014 and 2015 levels are above the levels measured in 1976 and 1977.

NapaCounty-132 was noted in the 2014 Annual Monitoring Report for possible signs of declining water levels. This well is recorded as having a total depth of 265 feet, screened from 25 feet to 265 feet, in an area where the thickness of alluvial deposits is likely less than 100 feet. The Driller's Log for the well indicates extensive clay (or fine grained, low permeability) layers were encountered, particularly in the upper 100 feet of the boring. In spring 2015 a depth to groundwater of 16.1 feet was measured at this well, which is more comparable to levels seen prior to 2014. A site visit to this well conducted in 2015 showed that much of the surrounding acreage is planted in young vines. A subsequent review of aerial photography showed that a large scale vineyard replanting took place in 2007. Given these observations it is possible that changing irrigation demands have been a factor in this area since 2007.

5.1.2 Napa Valley Floor – Yountville and Napa Subareas

The representative hydrographs shown in **Figure 5-7** show groundwater elevations and corresponding depths to water in the Yountville and Napa Subareas. Long-term groundwater elevations have remained for the most part stable in the Yountville Subarea. In the Yountville Subarea, the depth to groundwater in the spring is generally less than ten feet, similar in nature to the Calistoga and St. Helena Subareas to the north. Seasonal fluctuations vary by proximity to the center of the valley. Along the western and eastern edges of the subarea, levels are more subject to larger seasonal fluctuations. Groundwater elevations in the center of the valley fluctuate seasonally approximately 10 to 25 feet, and near the edge of the valley fluctuate approximately 25 to 35 feet.

In the Napa Subarea, depth to water ranges from about 20 to 50 feet below ground surface during the spring. Seasonal groundwater elevations in this subarea generally fluctuate from 10 to 40 feet. Long-term trends have been generally stable with the exception of the northeastern area at NapaCounty-75 and Napa County-76 where groundwater levels have locally declined by about 20 feet to 30 feet over the past 15 years[12]. Reasons for the declines in water levels at these wells are not yet fully understood. One possible factor is that lowered groundwater elevations in the northern MST Subarea could be drawing water from the northeast corner of the Napa Subarea towards the MST Subarea. Another possible factor is that the northeast corner of the Napa Subarea experiences limited groundwater recharge compared to the rest of the Napa Subarea as a result of being bounded by the East Napa Fault and Soda Creek Fault (**Figure 5-8**).

NapaCounty-75 and NapaCounty-76 are located east of the Napa River and East Napa Fault and west of Soda Creek Fault. Both wells are completed below the alluvium in the Sonoma Volcanics formation. The Sonoma Volcanics formation is also present in the MST Subarea to the east, where previous monitoring has shown several pumping depressions (LSCE, 2011a). The two nearest monitoring wells located west of the Napa River in the northeastern Napa Subarea constructed to depths of 120 feet or less and are completed in the alluvium. These wells have shown stable groundwater level trends. The monitoring well in the alluvium that is closest to the well constructed in the Sonoma Volcanics has shown stable water levels since the 1960s. It appears that the extent of the pumping depression beyond the MST subarea is limited to the northeastern Napa Subarea east of the Napa River.

Although NapaCounty-75 is no longer actively monitored by Napa County, two additional wells have been added to the County's monitoring networks in this area in the last two years, NapaCounty-182 and NapaCounty-228. In addition to adding new monitoring wells in the northeast portion of the Napa Subarea, the County is considering a focused investigation of groundwater conditions and hydrogeologic constraints in the area east of the Napa River and west of the Soda Creek Fault to address concerns regarding groundwater conditions in this area.

In the southwestern part of the Yountville Subarea and at the Napa Valley margin, groundwater levels in well NapaCounty-135 have also declined by about 30 feet since the first measurements were recorded in the late 1970s and early 1980s, with a particularly low spring groundwater level measurement recorded in 2014. In response to these observations Napa County began monitoring this well at monthly intervals in summer 2015. The increased frequency of data collection is intended to fill temporal data

[12] NapaCounty-75 is among the wells that left the monitoring network in 2015. The latest available measurement from this well was recorded in October 2014.

gaps in the record for this well to understand whether groundwater levels are recovering at different times relative to other wells.

Very little construction information is available for NapaCounty-135. All that is known is that it has a total depth of 125 feet. It is located in an area where the total thickness of the alluvium is likely less than 50 feet, based on contours of alluvium thickness developed as part of the Updated Hydrogeologic Conceptualization and Characterization of Conditions Report (LSCE and MBK Engineers, 2013).

In March 2015, the water level at NapaCounty-135 rebounded to a depth of 40.9 feet, comparable to the value recorded in 2013. The dedicated monitoring wells for Site 2 of the Surface Water Groundwater Monitoring Project are less than a mile from NapaCounty-135. Data from those wells will also be used in the future to differentiate between observations at that well and water level trends in the alluvial aquifer system at Site 2.

5.1.3 Napa Valley Floor – Milliken-Sarco-Tulucay (MST) Subarea

Although designated as a groundwater subarea for local planning purposes, the majority of the MST is not part of a groundwater basin as mapped by DWR. In the MST, the aquifer system is composed primarily of the Sonoma Volcanics and associated Tertiary sedimentary deposits. These aquifer materials have different hydraulic properties than the Napa Valley alluvial deposits and the level of communication and connectivity between the two areas is believed to be limited. Groundwater levels used for contour mapping in the MST Subarea generally represent conditions of a composite aquifer system as previously described by Farrar and Metzger (2003).

Historically, groundwater flow directions in the MST Subarea were generally from the Howell Mountains in the east toward the Napa River to the west. Beginning in the 1970s, investigators have identified pumping depressions in the northern, central, and southern parts of the MST (Johnson 1975, Farrar and Metzger 2003). The current coverage of wells does not extend to the former location of the central (and deepest) pumping depression and therefore flow directions cannot be visualized and evaluated; however, the coverage does extend to the former locations of the northern and southern depressions, and they are shown in the spring and fall 2015 groundwater level contour maps (**Figure 5-8** and **5-9**).

In the northern MST, groundwater flow directions in 2015 were more varied than in 2014. The highest groundwater elevations occurred between Monticello Road and Hagen Road along the lower one mile of Sarco Creek. Groundwater flow directions were to the east and north of this area. Flows to the east were towards an area of -40 feet groundwater elevations. Flows to the north were toward Milliken Creek where two monitored wells recorded spring groundwater elevations of -14 feet and -18 feet, respectively. A positive groundwater elevation value of 3 feet recorded at a well along Hardman Avenue indicates a southward flow direction in that vicinity.

In the southern MST, groundwater flow continues to be generally northwest (unchanged direction since 2008) in the spring and fall 2015with a minimum spring groundwater elevation of about -45 feet (NAVD88) in the southern MST; however, the western portion of this area has no coverage of wells with water levels which would be necessary to define the extent of the pumping depression.

Representative hydrographs for the MST illustrated on **Figures 5-10 and 5-11** show groundwater elevations and corresponding depth to groundwater since 1970 in the northern (**Figure 5-10**) and central/southern parts of the MST (**Figure 5-11**). In the northern MST, groundwater levels were stable throughout the late seventies until the mid-1980s (1986), at which time a decline of about 10 to 40 feet occurred. Following this decline, groundwater levels stabilized until the late 1990s to early 2000s. After that time, groundwater levels experienced a gradual decline of about 10 to 30 feet until approximately 2008. After 2008 groundwater levels have shown signs of stabilizing in three of four currently monitored wells in the northern MST (NapaCounty-2, NapaCounty-43, and NapaCounty-122), while NapaCounty-56 has shown continued declines, possibly resulting from recent dry years. Depth to groundwater in the northern part of the MST Subarea currently ranges from about 60 to 200 feet.

An important feature within the northern part of the MST is the Soda Creek Fault that several previous investigators have described as an occasional barrier to groundwater flow. It is described by Weaver (1949) as a normal fault with more than 700 feet vertical displacement downward on the western side. Johnson (1977) and Farrar and Metzger (2003) describe groundwater elevations were about 10 feet higher on the eastern side of the fault during their respective study periods. Recent measurements (post-2000) indicate that groundwater levels are about 20 to 30 feet higher on the eastern side of the fault.

In **Figure 5-11**, groundwater elevations in the central and southern portion of the MST have stabilized since about 2008. The groundwater elevations in the central portion of the MST began to decline in the 1950s and currently have declined up to 250 feet in some locations. The central portion of the MST also corresponds to an area in which the primary aquifer of the Sonoma Volcanics, the tuffaceous member of that unit, is not present. Based on the groundwater level trends and local geologic conditions, some of these trends may be the result of variations in geologic conditions or increasing levels of development relative to conditions 40 to 50 years ago. However, the stability of water levels over the past seven years indicates that rate of groundwater extraction is being balanced by rates of groundwater recharge.

5.2 Subareas South of the Napa Valley Floor

South of the Napa Valley Floor the only subareas with current groundwater level monitoring sites in 2015 were the Carneros and Jameson/American Canyon Subareas.

In 2015, the Carneros Subarea had 12 current groundwater level monitoring sites. The longest period of record among them extended back to October 2011. All four monitored wells are located in the southern half of the subarea at land surface elevations between 100 feet to 25 feet (NAVD88). Patterns of groundwater level fluctuations in these wells have shown annual variations of approximately 5 feet from spring to fall, with groundwater elevations ranging from about 20 feet, relative to mean sea level, to -5 feet, relative to mean sea level. Depths to groundwater below ground surface have varied more widely from 10 feet to 100 feet.

Groundwater elevation contours for spring and fall 2015 (**Figures 5-12** and **5-13**) show flow directions were generally southeast to eastward, with very little seasonal variation.

In the Jameson/American Canyon Subarea the only current groundwater level data are from one well recently volunteered for monitoring. Spring and fall measurements recorded in that well in 2014 and 2015 found depths to groundwater ranging from 5 feet in the spring to 14 feet in the fall.

5.3 Subareas East and West of the Napa Valley Floor

The Eastern Mountains and Western Mountains Subareas flank the Napa Valley Floor Subareas and comprise the uplands of the Napa River Watershed. The geology of these large subareas is complex and highly variable. Recent efforts to expand the Napa County monitoring network have identified five new volunteered monitoring wells between the two subareas (**Table 4-2**).

Groundwater level monitoring data for these wells are limited to no more than two years of semi-annual measurements. The depths to groundwater in these wells ranged from 44 feet to 240 feet from ground surface elevations ranging from 390 feet to 1660 feet, mean sea level.

5.4 Angwin and Pope Valley Subareas

In 2015, groundwater level monitoring in the Angwin and Pope Valley Subareas was performed by Napa County at recently volunteered wells. In the Angwin Subarea five wells were monitored, while one well was monitored in the Pope Valley Subarea (**Table 4-2**).

Groundwater level monitoring data for the Angwin Subarea wells are only available for 2014 and 2015. Depths to groundwater in these wells ranged from 95 feet to 207 feet from ground surface elevations ranging from 1678 feet to 1860 feet, mean sea level.

The only groundwater level monitoring data point for the single volunteered well in Pope Valley is from 2014 and 2015, when the depth to groundwater was measured to 16 feet below ground surface.

5.5 Napa Valley Surface Water-Groundwater Monitoring

Data from Sites 1 (**Figure 5-12**), 3 (**Figure 5-14**), and 4 (**Figure 5-15**) show that groundwater levels were above or very near the riverbed at these sites, indicating connectivity between groundwater and surface water in 2015.

Site 1 is located within the City of Napa and is currently the farthest downstream of the four project monitoring sites along the Napa River (**Figure 4-4**). The river is perennially wetted and tidally-influenced at this site with a 5 to 7 foot tidal range observed during the period of record. Data collected at this site have shown very similar water level elevations at all three monitoring locations including a similar, though dampened, response to the tidal cycles in the two piezometers. Data from Site 1 show that groundwater levels were above the elevation of the riverbed and near to or slightly above the elevation of water in the river channel, indicating a connection between groundwater and surface water.

Data from Sites 3 and 4 along the Napa River showed variability in the nature of groundwater-surface water connection during 2015, ranging from groundwater flow into the river to the opposite. Data from these two sites suggest groundwater flowed into the river channel from January through at least the end of July. Through the late summer and fall of 2015 the data indicate no significant flow of water between groundwater and surface water. Then in December 2015, as storms generated runoff in the watershed and flow in the river channel, the direction of flow was away from the riverbed.

At both Site 2 (**Figure 5-13**) and Site 5 (**Figure 5-16**) the direction of groundwater flow was away from the streambed in 2015.

At Site 5 water level data indicate that the river was hydraulically connected to groundwater during the first half of the year, until flows in the river ceased in July, and again in December 2015 as storms generated runoff leading to renewed flow in the river. At Site 2, located along Dry Creek, groundwater levels were consistently below the streambed elevation in 2015, indicating that groundwater was disconnected from the stream, although recharge to the groundwater system was likely occurring when water flowed in the creek.

Sites 2 and 5 also showed groundwater level differences between the shallow and deep casings of at least 5 feet for most or all of 2015. Given that most groundwater withdrawals in Napa Valley occur from depths greater than 50 feet, these water level differences show how the groundwater system's response to pumping from deeper aquifer units does not necessarily lead to an equivalent reduction in shallow groundwater levels.

Although the period of record at these sites is short compared to many wells monitored by Napa County, **Figure 5-17** demonstrates how the range of groundwater elevations monitored at a Surface Water –Groundwater Network site are comparable to a well constructed in a similar part of the aquifer system nearby. NapaCounty-133 is located approximately 0.5 miles from Site 4 and a similar distance from the Napa River. Data from NapaCounty-133 from 1978 through 2015 show a similar range and stable trend in groundwater elevations from spring to fall across the full period of record, including 2015.

6 GROUNDWATER QUALITY CONDITIONS AND TRENDS

Groundwater quality data in Napa County are collected primarily at sites regulated by the SWRCB through the Division of Drinking Water and Geotracker program, although data are available from other public agencies as well.

For this Report groundwater quality data reported between 2009 and 2015 were reviewed in order to provide an updated understanding of conditions and trends relative to the most recent County-wide review of groundwater quality data published as part of the Napa County Groundwater Conditions and Groundwater Monitoring Recommendations Report (LSCE, 2011a). Between 2009 and 2015, groundwater quality data were available from a total of 81 sites (**Table 6-1 and Figure 6-1**).

In addition to the regulated sites overseen by the SWRCB, data were available from voluntary data collection efforts conducted by Napa County at the ten Surface Water-Groundwater Project monitoring wells and by the U.S. Geological Survey and DWR at privately-owned wells. Water quality data from the ten Napa County Surface Water-Groundwater Project monitoring wells consists of a single round of baseline sampling conducted in June 2015. Results from the monitoring well and surface water samples are included in **Appendix D**.

Table 6-1 Recent Groundwater Quality Monitoring Sites in Napa County by Entity and Monitoring Program

Entity	Reporting Program	Number of Monitored Sites, 2009 - 2015
Napa County	Napa Berryessa Resort Improvement District	2
	Lake Berryessa Resort Improvement District	5
	Surface Water-Groundwater Monitoring Sites	10
California Department of Water Resources	Volunteered Sites	8
State Water Resources Control Board	Division of Drinking Water	35
	Geotracker	3
U.S. Geological Survey	-	18
	Total Sites	**81**

Figures 6-2 through **6-8** summarize the available water quality results reported between 2009 and 2015 for a range of constituents. These figures are intended to provide an indication of recent water quality conditions. **Figures 6-9** through **6-12** present time series plots for wells with the longest records of

nitrate and total dissolved solids data (TDS). These figures provide a perspective on the trends in groundwater quality over time at a given well and location.

6.1 Napa Valley Floor Subareas

Groundwater quality data show generally good water quality with stable conditions in the Napa Valley Floor Subareas between 2009 and 2015 compared to the conditions reported previously based on data reported through 2008 (LSCE, 2011a). Water quality standard exceedances in the Napa Valley Floor subareas and Napa Valley Subbasin included arsenic, with 4 of 26 sites showing maximum concentrations above the Maximum Contaminant Level (MCL) of 10 µg/L (**Figure 6-2**). With a Total Dissolved Solids[13] (TDS) concentration of 683 mg/L the deep monitoring well at Site 1 of the Surface Water-Groundwater Project, in Napa Subarea within the Napa Valley Subbasin, exceeded the secondary MCL of 500 mg/L. The same well and the deep well at Site 3 of the Surface Water-Groundwater Project, located near the Napa River at the boundary of the Napa and Yountville Subareas, had boron concentrations of 1,400 µg/L and 9,100 µg/L, respectively, well above the 1,000 µg/L Notification Level. The results from these dedicated monitoring wells may indicate the dominant influence of a geologic source on water quality in these wells.

Wells with long-term water quality data show stable TDS and nitrate concentrations, with one exception (**Figures 6-9** and **6-11)**. Well (06N04W27L002M) in the Napa Subarea which had a peak of 7.7 mg/L NO3-N (nitrate as nitrogen) in 2011 compared to initial concentrations of 3.4 mg/L NO3-N and 4.0 mg/L NO3-N in 1982 and 1972, respectively.

6.2 Subareas South of the Napa Valley Floor

Subareas south of the Napa Valley Floor may be susceptible to seawater intrusion originating from San Pablo Bay. As documented previously, groundwater in the Carneros and Jameson/American Canyon Subareas show elevated concentrations of several constituents, including TDS, chloride, and Electrical Conductivity (EC) (LSCE, 2011a). Water quality standard exceedances in the Napa-Sonoma Lowlands Subbasin, including portions of the Carneros and Jameson/American Canyon Subareas, occurred for arsenic (three wells), nitrate (one well), TDS (five wells) (**Figures 6-2**, **6-5**, and **6-8**). Sodium concentrations were above the agricultural water quality limit of 69 mg/L at all seven sites (**Figure 6-6**).

In the Napa-Sonoma Lowlands Subbasin and Carneros Subarea, available data show that nitrate concentrations have been stable to decreasing in all five wells with long-term records in the Napa-Sonoma Lowlands Subbasin (**Figures 6-10**). Two wells have shown increasing TDS trends, though all four wells with long-term trends were initially at or above the secondary MCL (**Figure 6-12**).

Construction data for monitored wells in the three subarea south of the Napa Valley Floor are very limited, making it difficult to conclusively determine the source and distribution of observed salinity. For example, it is not clear whether high salinity groundwater in the Carneros Subarea is a result of saltwater intrusion or interaction of groundwater with the geologic units present in and around the subarea.

[13] Total Dissolved Solids is a measure of "all solid material in solution, whether ionized or not. It does not include suspended sediment, colloids, or dissolved gases" (Davis and DeWiest, 1966).

6.3 Subareas East and West of the Napa Valley Floor

Recent groundwater quality data from the Eastern and Western Subareas are limited. The available data show a wide range in water quality. TDS values ranged from 120 mg/L to 941 mg/L across eight sites with data, with three sites above the 500 mg/L secondary MCL (**Figure 6-8**). Boron concentrations ranged from 13 µg/L to 3,560 µg/L, with two exceedances of the 1,000 µg/L Notification Level (Figure 6-3). Sodium concentrations ranged from 7.6 mg/L to 384 mg/L, with two exceedances of the agricultural water quality limit of 69 mg/L at all seven sites (**Figure 6-6**). The pattern of the water quality standard exceedances appears to coincide with areas in the Western Mountains characterized by Great Valley Sequence sedimentary rocks.

6.4 Berryessa and Pope Valley Subareas

Recent groundwater quality data in Berryessa and Pope Valley Subareas are limited to three sites. TDS concentrations at all but one well at one site in the Berryessa Subarea exceeded the 500 mg/L secondary MCL. TDS concentrations ranged from 92 mg/L to 5,600 mg/L (**Figure 6-8**). Boron concentrations were also above the Notification Level at all but one well (**Figure 6-3**). The values ranged from non-detect to 15,000 µg/L (**Figure 6-3**). Nitrate concentrations were elevated, though below the 10 mg/L MCL, at two wells (**Figure 6-5**). Sodium concentrations ranged from non-detect to 1,300 mg/L, with three wells above the agricultural water quality limit of 69 mg/L. Spatial and temporal trends in the data from these Subareas are not evident due to the limited available data.

7 COORDINATION AND COLLABORATION

7.1 Integrated Regional Water Management Plans

Integrated Regional Water Management (IRWM) is defined by DWR as "a collaborative effort to identify and implement water management solutions on a regional scale that increase self-reliance, reduce conflict, and manage water to concurrently achieve social, environmental, and economic objectives" (DWR, 2015a).

7.1.1 Napa County's Participation in San Francisco Bay Area and Westside IRWMPs

In 2005, the County formed the Napa County regional water management group (RWMG), a working group of local water agencies, where the Napa County Flood Control and Water Conservation District served as the lead agency. The County RWMG worked together to draft the Napa-Berryessa Integrated Regional Water Management Plan (IRWMP) Functional Equivalent (Napa-Berryessa Regional Water Management Group, 2005).

In 2009, DWR established IRWM regions that have been accepted through the Regional Acceptance Process (DWR, 2009). Currently, there are two formally accepted regions that include Napa County; these regions are: 1) the San Francisco Bay Area Region (which covers the generally southern part of Napa County and focuses on the Napa River and Suisun Creek watersheds), and 2) the Westside Sacramento Region (which covers the generally northern part of Napa County and focuses on the Putah Creek/Lake Berryessa watershed; the Westside Region also covers parts of Yolo, Solano, Lake, and Colusa Counties).

The County has contributed to two larger regional IRWMPs. The County actively collaborated with the San Francisco Bay and Westside RWMGs to update the IRWMP for the San Francisco Bay (Kennedy Jenks et al., 2013) and to develop a new IRWMP for the Westside Sacramento Region (Kennedy Jenks, 2013). The County's representation and participation in the San Francisco Bay and Westside IRWMPs enables further coordination and sharing of information on water resources management planning programs and projects (particularly those that are a high priority for the County) and other information for IRWMP grant funding and implementation.

7.2 Groundwater Sustainability

In September 2014, the California Legislature passed the Sustainable Groundwater Management Act (Act) (DWR, 2015b). 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 of the following effects caused by groundwater conditions occurring throughout the basin (Section 10721 (w)):

(1) Chronic lowering of groundwater levels indicating a significant and unreasonable depletion of supply if continued over the planning and implementation horizon. Overdraft during a period of drought is not sufficient to establish a chronic lowering of groundwater levels if extractions and recharge are managed as necessary to ensure that reductions in groundwater levels or storage during a period of drought are offset by increases in groundwater levels or storage

during other periods.

(2) Significant and unreasonable reduction of groundwater storage.

(3) Significant and unreasonable seawater intrusion.

(4) Significant and unreasonable degraded water quality, including the migration of contaminant plumes that impair water supplies.

(5) Significant and unreasonable land subsidence that substantially interferes with surface land uses.

(6) Depletions of interconnected surface water that have significant and unreasonable adverse impacts on beneficial uses of the surface water.

7.2.1 DWR Prioritization of Groundwater Basins

As noted in **Section 2** of this Report, DWR has prioritized groundwater basins and subbasins in accordance with the requirements of Water Code Section 10933. SGMA applies to basins or subbasins that DWR designates as medium- or high-priority basins. Previously under CASGEM, DWR ranked California's basins and subbasins. In Napa County, the Napa Valley Subbasin was ranked medium-priority. All other Napa County basins or subbasins were ranked as very low-priority basins.

Under SGMA, DWR must review and update the ranking of each of the basins or subbasins as a very low-, low-, medium-, or high-priority basin based on requirements contained in Section 10933. DWR was required to complete its initial ranking by January 31, 2015. Because of the expediency of this requirement, DWR's CASGEM basin rankings were used to meet this requirement.

Under SGMA, DWR must also consider adverse impacts on local habitat and local streamflows. The factors for basin ranking and prioritization include:

- Overlying population;
- Projected growth of overlying population;
- Public supply wells;
- Total wells;
- Overlying irrigated acreage;
- Reliance on groundwater as the primary source of water;
- Impacts on the groundwater, including overdraft, subsidence, saline intrusion, and other water quality degradation; and
- Any other information determined to be relevant, including adverse impacts on local habitat and local streamflows.

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, pending the local entity (entities) can meet the requirements. When required, GSPs must be developed to eliminate overdraft conditions in aquifers and to return them to a condition that assures their long-term sustainability within twenty years of GSP implementation.

SGMA does not require the development of a GSP for basins that DWR ranks as low- or very low-priority basins; GSPs are voluntary for these basins. SGMA planning requirements also do not apply to adjudicated groundwater basins that are managed by the courts. As discussed below, under certain groundwater basin conditions, local entities can pursue an Alternative Report (i.e., a document other than a GSP).

As applicable, SGMA requires that a GSA be identified for medium- and high-priority groundwater basins by June 30, 2017. Counties are presumed to be the GSA for unmanaged areas of medium- and high priority basins (Section 10724). However, counties are not required to assume this responsibility. When no entity steps forward, this can lead to state intervention (Section 10735 *et seq*.).

SGMA requires GSAs for medium- and high-priority basins to adopt a GSP by January 31, 2022 (Section 10720.7). For basins subject to critical overdraft conditions, the GSP must be adopted by January 31, 2020.

Upon adoption of a GSP, the designated GSA must submit the GSP to DWR for review. SGMA requires that DWR develop regulations for evaluating GSPs by June 1, 2016. On February 18, 2016 DWR released draft GSP regulations. The draft regulations discuss alternatives to a GSP only briefly and appear to require a level of analysis equivalent to that of a GSP. The public comment period for the draft GSP regulations is set to close on April 1, 2016.

Upon completion of its review of a GSP, DWR has the power to request changes to the GSP to address deficiencies. DWR is required to re-evaluate GSPs every five years to ensure continued compliance and sufficiency. After adoption of a GSP, the GSA must submit to DWR an annual compliance report containing basin groundwater data, including groundwater elevation data, annual aggregated extraction data, surface water supply for or available for use for groundwater recharge or in-lieu use, total water use, and any changes in groundwater storage (Section 10728).

In addition to imposing a number of new requirements on local agencies related to groundwater management, SGMA also provides for state intervention – a “backstop” – when local agencies are unwilling or unable to manage their groundwater basin (Section 10735 *et seq*.).

7.2.2 Alternatives to GSPs

Under SGMA, Section 10733.6, a local entity (or entities) can pursue an Alternative to a GSP under the following circumstances:

(a) If a local agency believes that an alternative described in subdivision (b) satisfies the objectives of this part, the local agency may submit the alternative to the department for evaluation and assessment of whether the alternative satisfies the objectives of this part for the basin.

(b) An alternative is any of the following:

(1) A plan developed pursuant to Part 2.75 (commencing with Section 10750) or other law authorizing groundwater management.

(2) Management pursuant to an adjudication action.

(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.

(c) A local agency shall submit an alternative pursuant to this section 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.

On February 18, 2016 DWR published draft regulations for the development of GSPs and GSP-alternatives. Napa County staff have met with DWR staff to discuss an approach for a GSP-alternative for the Napa Valley Subbasin. County staff have also provided comments to DWR on the draft regulations, which are required under SGMA to be finalized and adopted by June 1, 2016. County staff are currently seeking input from the Napa County Board of Supervisors and preparing for multiple paths forward pending direction from the Supervisors and the content of the final regulations with respect to the requirements for GSP-alternatives.

More details about SGMA are available at http://www.water.ca.gov/groundwater/sgm/index.cfm.

7.3 Napa County Watershed Information and Conservation Council

The Watershed Information and Conservation Council[14] (WICC) Board was established in 2002 to serve as an advisory committee to Napa County Board of Supervisors – assisting with the Board's decision making and serving as a conduit for citizen input by gathering, analyzing, and recommending options related to the management of watershed resources (WICC, 2015). The WICC has achieved significant accomplishments in its 12-year history – both alone and in partnership with nonprofits, public agencies, and private landowners.

The WICC Mission is: improving the health of Napa County's watersheds by informing, engaging and fostering partnerships within the community.

The 2015 WICC Strategic Plan outlines five goals, including (WICC, 2015):

- Goal 1: Coordinate and facilitate watershed planning, research, and monitoring efforts among Napa County organizations, agencies, landowners and citizens.
- Goal 2: Strengthen and expand community understanding, connections and involvement to improve the health of Napa County's watersheds.
- Goal 3: Support informed decision-making on topics that affect the health of Napa County's watersheds.
- Goal 4: Improve WICC Board efficiency and effectiveness.
- Goal 5: Explore additional funding opportunities to support the goals of the WICC.

[14] Prior to 2015 this organization was named the Watershed Information Center and Conservancy.

Additionally, Subgoal 1B to Goal 1 includes the WICC serving as the local clearinghouse for groundwater resource data, mapping, and monitoring (Implements: Napa County General Plan Action Item CON WR-4). As part of developing education and outreach for the community regarding groundwater conditions, the WICC is expanding groundwater information on the WICC website at www.napawatersheds.org. This new initiative has involved adding groundwater summary data and graphs for the County's groundwater basins and/or subareas that are already delineated on the website's maps. Specifically, the WICC has established a portion of the WICC website dedicated to groundwater. Data and information are at a watershed scale and not be project or parcel specific scale. Information includes:

- Updates on groundwater resource issues locally and throughout California.
- Articles explaining key technical issues related to groundwater.
- Updates on groundwater mapping and monitoring in Napa County.
- Educational materials and resources on groundwater recharge areas and ways to improve these areas.
- Report on the Napa County Voluntary Groundwater Level Monitoring Program.

8 SUMMARY AND RECOMMENDATIONS

Groundwater level monitoring was conducted at a total of 113 sites across Napa County in 2015 (**Table 4-1)**. The overall number and distribution of monitored sites remained consistent with the monitoring conducted in 2014 and was increased relative to the 87 sites reported in the 2011(LSCE, 2013a).

Groundwater level trends in the Napa Valley Subbasin of the Napa-Sonoma Valley Groundwater Basin 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, the water levels observed in recent years are generally higher than groundwater levels in the same wells during the 1976 to 1977 drought. Elsewhere in the County long-term groundwater level records are limited, with the exception of the Milliken-Sarco-Tulucay (MST) Subarea.

Although designated as a groundwater subarea for local planning purposes, the majority of the MST is not part of a groundwater basin as mapped by DWR. Groundwater level declines observed in the MST Subarea as early as the 1960s and 1970s have stabilized since about 2008. Groundwater level responses differ within the MST Subarea and even within the north, central, and southern sections of this subarea, indicating that localized conditions, whether geologic or anthropogenic in nature, might be the primary influence on groundwater conditions in the subarea.

While the majority of wells with long-term groundwater level records exhibit stable trends, periods of year to year declines in groundwater levels have been observed in a few wells. These wells are located near the Napa Valley margin in the northeastern Napa Subarea (NapaCounty-75 and Napa County-76), southwestern Yountville Subarea (NapaCounty-135) and southeastern St. Helena Subarea (NapaCounty-132). These locations are characterized in part by relatively thin alluvial deposits, which may contribute to more groundwater being withdrawn from the underlying semi-consolidated deposits.

Water levels in northeastern Napa Subarea wells NapaCounty-75 and Napa County-76, east of the Napa River, have stabilized since 2009, though declines were observed over roughly the prior decade (**Figure 5-7**). Despite the recent stability, given the potential for a hydraulic connection between the aquifer units in the vicinity of these wells and the aquifer units of the MST Subarea and an apparent increase in the number of new well permits in the area over the past 10 years[15], further study in this area is recommended.

Water levels at NapaCounty-135 and NapaCounty-132 declined most distinctly between 2013 and 2014 (**Figures 5-6 and 5-7**). The increased monitoring frequency at these wells through the end of 2015 has shown groundwater levels already recovering to levels comparable to or higher than those of spring 2013. Groundwater level declines in these wells observed in 2014 could have one or more contributing factors, including variations in groundwater recharge due to changes in the timing and intensity of precipitation and changes in the level of pumping at the monitored well or in the vicinity of the monitored well. Continuation of the increased monitoring frequency is recommended to assist with interpretation of conditions at these wells in the future.

[15] In a Memorandum to David Morrison, Director of Planning, Building, and Environmental Services, dated December 7, 2015 regarding groundwater conditions in the northeastern corner of the Napa Subarea Steven Lederer, Director of Public Works, noted that "12 of the approximately 30 homes on Petra Drive have applied for new well permits in the past 10 years."

Groundwater quality data show stable conditions between 2009 and 2015 compared to the conditions reported previously with data through 2008 (LSCE, 2011a). Water quality standard exceedances in the Napa Valley Floor subareas and Napa Valley Subbasin were limited to the naturally-occurring constituent arsenic, with 4 of 26 sites showing maximum concentrations above the MCL of 10 µg /L (**Figure 6-2**). Water quality standard exceedances in the Napa-Sonoma Lowlands Subbasin, including portions of the Carneros and Jameson/American Canyon Subareas, occurred for arsenic (three wells), nitrate (one well), TDS (five wells) (**Figures 6-2**, **6-5**, and **6-8**). Construction information for monitored wells those three subarea are very limited, making it difficult to conclusively determine the source and distribution of observed salinity. For example, it is not clear whether high salinity groundwater in the Carneros Subarea is a result of saltwater intrusion or interaction of groundwater with the geologic units present in and around the subarea.

Wells with long-term water quality data in the Napa Valley Subbasin show stable TDS and nitrate concentrations, with one exception (**Figures 6-9** and **6-11)**. Well (06N04W27L002M) in the Napa Subarea which had a peak of 7.7 mg/L NO3-N (nitrate as nitrogen) in 2011 compared to initial concentrations of 3.4 mg/L NO3-N and 4.0 mg/L NO3-N in 1982 and 1972, respectively. In the Napa-Sonoma Lowlands Subbasin, nitrate concentrations have been stable to decreasing in all five wells with long-term records in the Napa-Sonoma Lowlands Subbasin (**Figures 6-10**). Two wells have shown increasing TDS trends, though all four wells with long-term trends were initially at or above the secondary MCL (**Figure 6-12**).

The following recommendations have been developed based on the findings presented in this report.

8.1 Northeast Napa Subarea Hydrogeologic Investigation

Previously observed groundwater level declines in the northeast Napa Subarea, east of the Napa River in the vicinity of NapaCounty-75 and NapaCounty-76, along with reports of increased well replacement activity along Petra Drive have raised questions about the cumulative impacts of existing and potential future groundwater use in this area. In addition to completing the standard project-level planning review of the proposed projects, a focused study of hydrogeologic conditions affecting groundwater availability is advisable for this area. The investigation should be designed to address existing and future water use in the area, sources of groundwater recharge, and the geologic setting in order to address the potential for cumulative impacts of future development. The investigation would also seek to address the influence of previously documented groundwater cones of depression in the MST subarea on both the study area east of the Napa River and the Napa Subarea west of the Napa River.

8.2 Data Gap Refinement

Groundwater levels in two monitored wells located near to the Napa Valley margin showed year to year declines in groundwater levels. Additional information is needed in order to consider the full range of possible causes for these declines and more accurately determine if the present emerging trends. Recommended actions include a review of land use data in these areas and continuation of the increased frequency of data collection at a subset of wells. More frequent data collection could be accomplished, pending agreement with the well owner, by monthly manual groundwater level measurements.

For wells added to the County’s monitoring networks in recent years without a record of key well construction details, continued efforts to locate construction information and link those data with aquifer units is recommended. In cases where a well owner does not have a record of the construction, a review of Well Completion Reports is recommended.

Once final Groundwater Sustainability Plan regulations are published by DWR later in 2016, there may be a need to add one or more wells to the CASGEM network near the southern boundary of the Napa Valley Subbasin. A well or wells in this area would be used to monitor groundwater gradients at the basin boundary where subsurface outflow occurs into the Napa-Sonoma Lowlands Subbasin. This data will be a component of the subbasin water budget that will be a key feature of the quantitative approach to groundwater management described in SGMA. For similar reasons, the County may benefit from updating reference point elevation data for some monitored wells with surveyed values in order more accurately monitor groundwater level gradients and any potential future seawater intrusion.

8.3 Baseline Water Quality Sampling

The groundwater quality monitoring objectives contained in the *Napa County Groundwater Monitoring Plan 2013* (Plan) included the investigating of variations in water quality at different points within the groundwater Subareas and at different aquifer units within a given subarea (LSCE, 2013a). The Plan recommended baseline sampling in wells at each of 18 Areas of Interest for additional monitoring and at the then proposed dedicated surface water-groundwater monitoring wells. It is recommended that wells added to the County monitoring networks in these areas be reviewed for suitability in light of the groundwater quality monitoring objectives, with baseline sampling conducted for those wells with sufficient well construction records to enable interpretation of the results for specific aquifer units.

A second round of baseline water quality sampling is also recommended for the five dual-completion monitoring wells constructed in 2014 at surface water-groundwater monitoring sites, as described in the Plan. An initial round of sampling and analysis was completed in June 2015 with a combination of County matching funds, DWR grant funds, and DWR in-kind support. Sampling these wells again in 2016 will provide a more robust baseline dataset that would be used to characterize any inter-annual variability at each well and provide a basis for interpreting future groundwater quality data.

8.4 Coordination with Other Monitoring Efforts

Coordination with other county departments and other agencies that collect or utilize groundwater data could provide an additional source of data in places where data are limited. Several local agencies, including the Town of Yountville, City of St. Helena, and City of Napa, already monitor groundwater levels at locations around the county. Another potential source of coordination would be a continuation of the in-kind support for laboratory analysis of water quality samples, as occurred in 2015.

8.5 Existing Activities in the MST Subarea

In 1999 the County passed a Groundwater Ordinance which, among other things, limited approval of discretionary permits in the MST Subarea to those projects that could meet the “Fair Share” requirement of 0.3 acre-foot/per acre of land. In 2004, discretionary approvals were further limited to those projects that could meet a “no net increase” standard. These actions were intended to slow the decline of water levels in the MST Subarea while a more permanent solution could be found.

It was recognized at the time that these actions by themselves would not “fix” the problem, but were a good step given the constraints of land use and groundwater law. It is reasonable to assume that these actions restricting increased use of groundwater have had beneficial impacts. However, ministerial projects (such as a single family home on a parcel without any other development, or Track II replants) were not so regulated, nor were existing (pre-1999) water users regulated.

In 2014 construction commenced on a pipeline that will deliver tertiary treated recycled waste water to the MST Subarea. It is expected that customers for approximately 400 acre-feet of recycled water will commence receiving deliveries upon completion of the pipeline in 2016. The pipeline capacity allows for delivery of up to 2,000 acre-feet of water. If customer demand for the recycled water increases, as anticipated, this new source of supply may further offset demand for groundwater in the subarea. Continued monitoring of groundwater levels will improve the understanding of groundwater trends related to any reduced demand for groundwater in the area.

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FIGURES

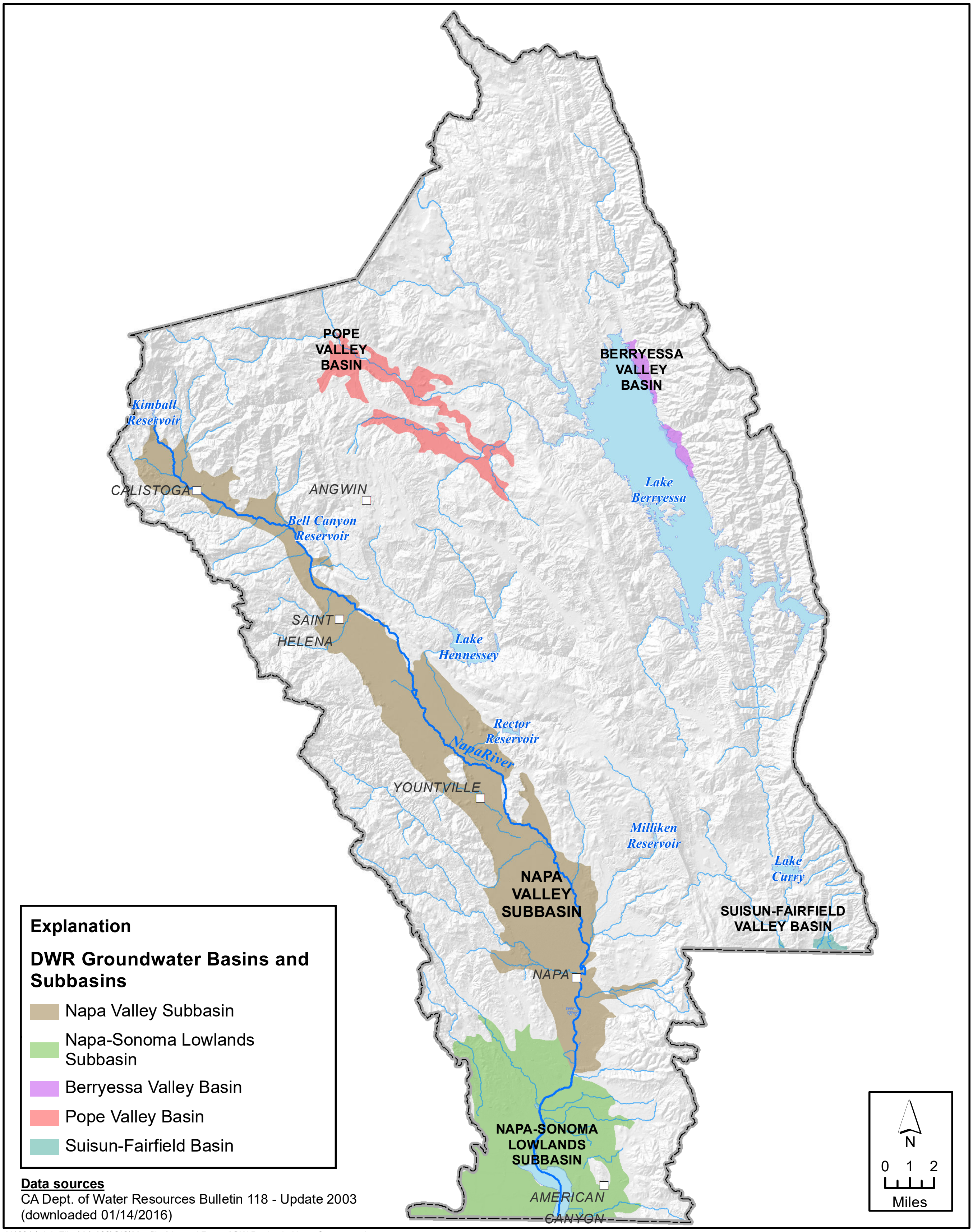

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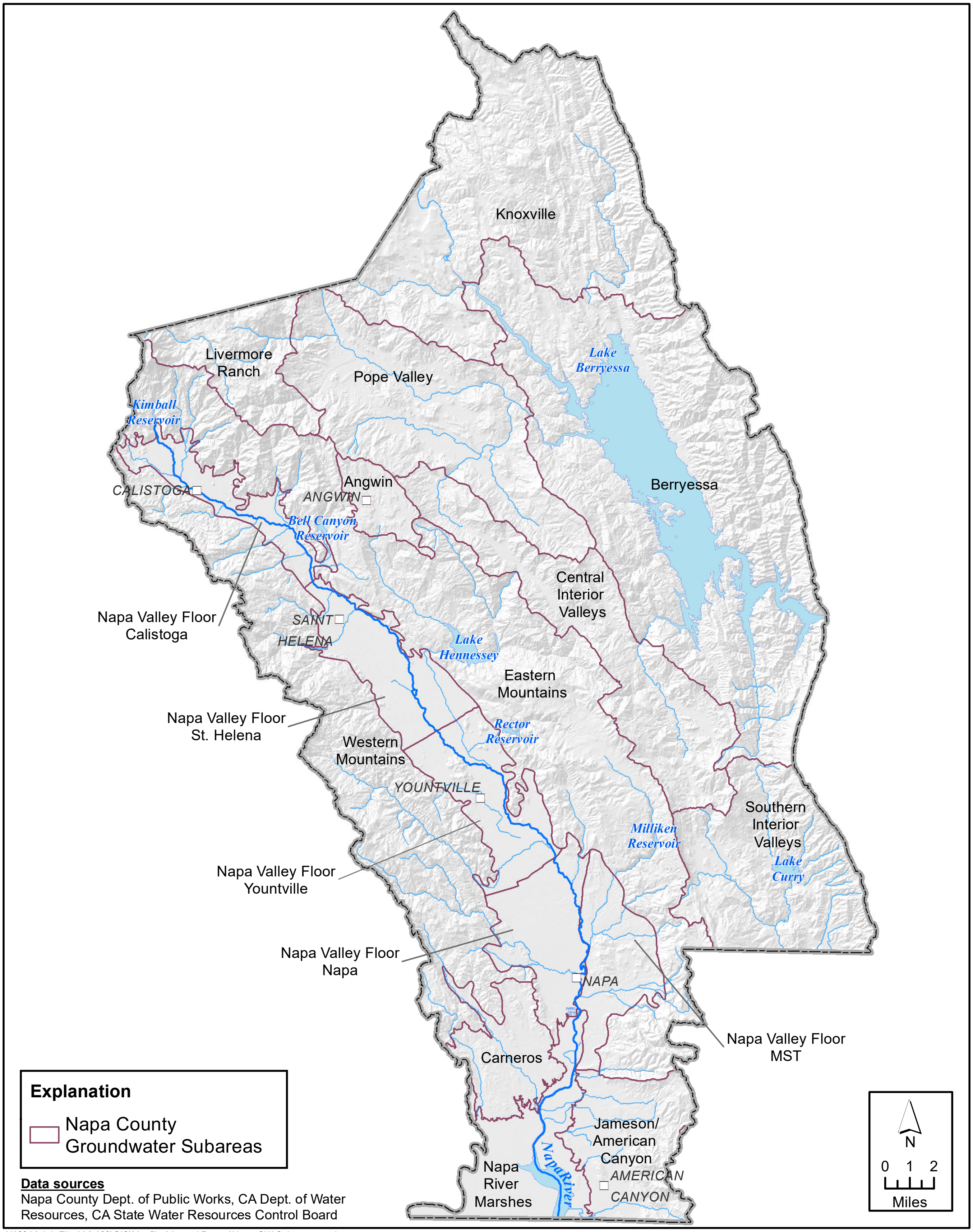
FIGURE 2-1
Groundwater Basins and Subbasins in Napa County, CA



Data sources
Napa County Dept. of Public Works, CA Dept. of Water Resources, CA State Water Resources Control Board

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FIGURE 2-2
Napa County Groundwater Subareas

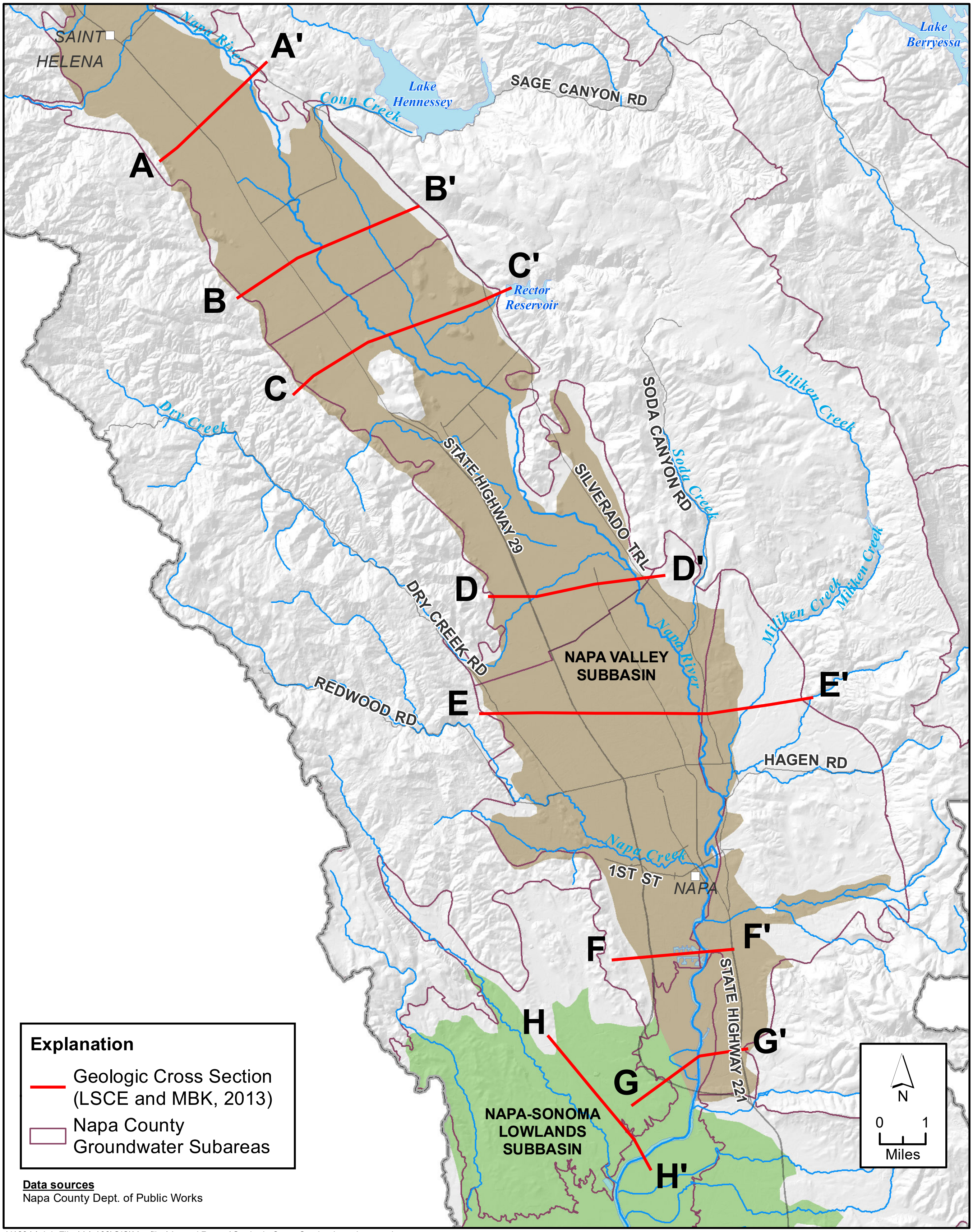

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FIGURE 2-3
Updated Hydrogeologic Conceptualization
Geologic Cross Section Locations

Napa County Comprehensive Groundwater Monitoring Program
2015 Annual Report and CASGEM Update

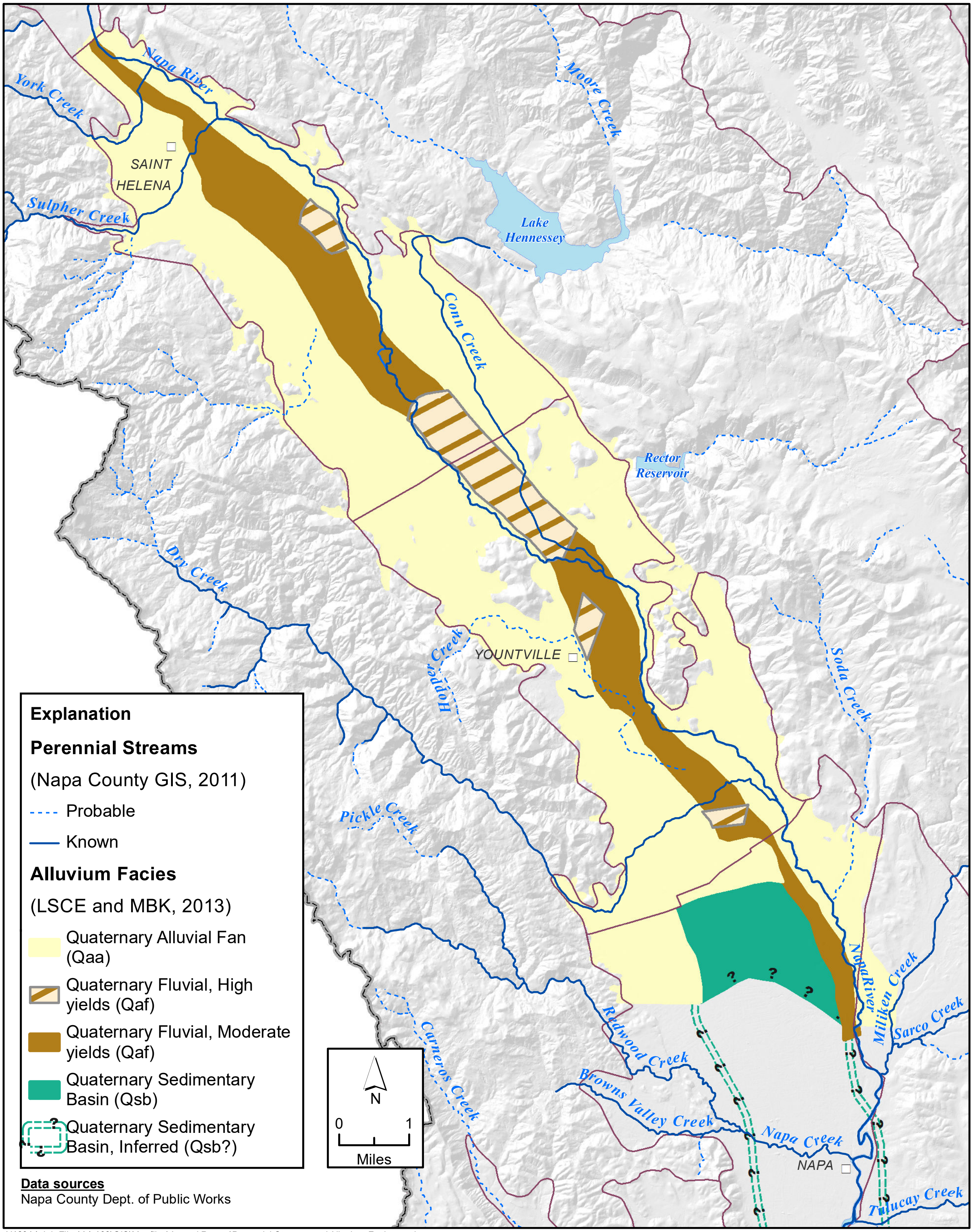

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FIGURE 2-4
Perennial Streams and Alluvium Facies
Napa Valley Floor, Napa County, CA

Napa County Comprehensive Groundwater Monitoring Program
2015 Annual Report and CASGEM Update

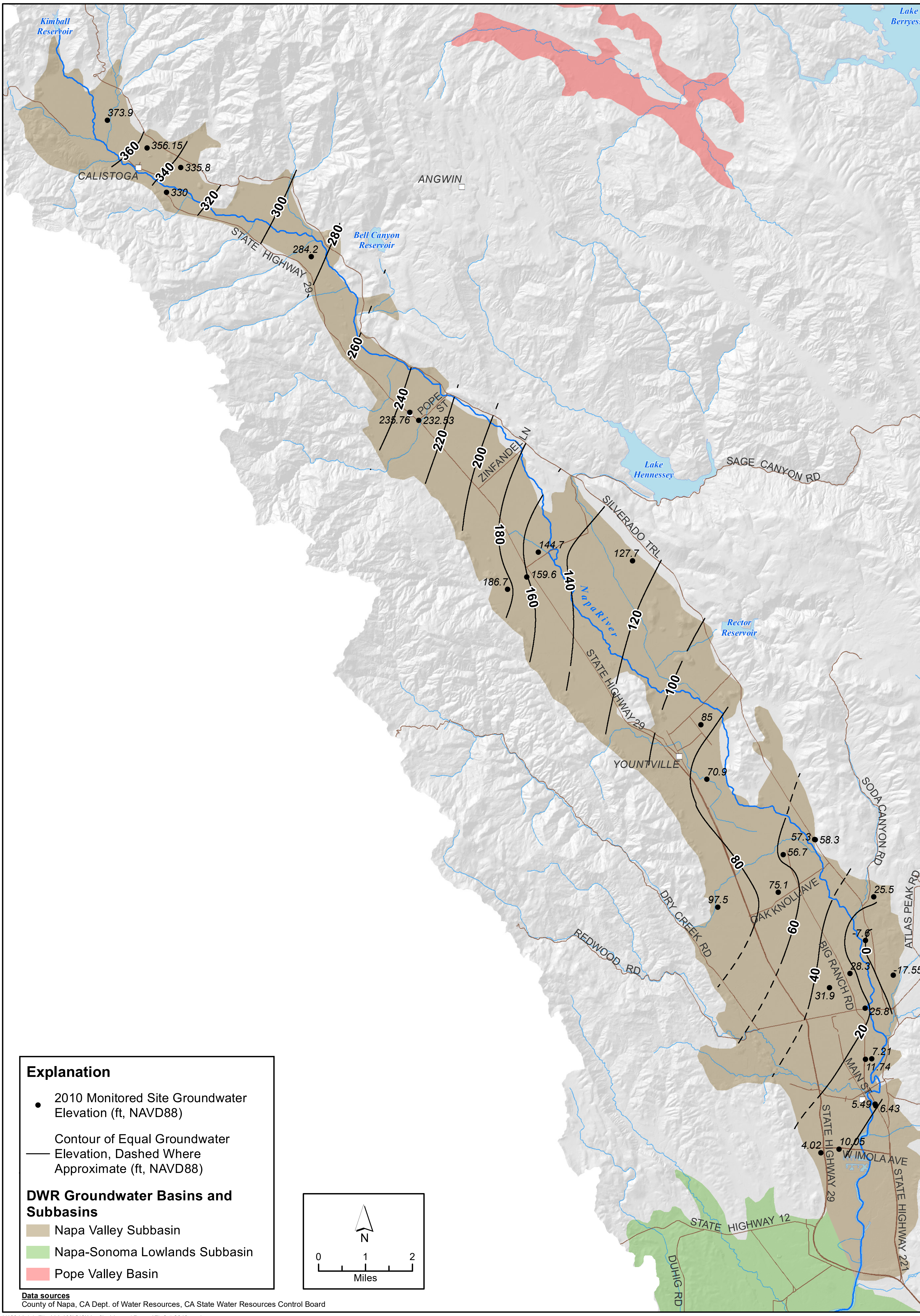

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FIGURE 2-5
Contours of Equal Groundwater Elevation, Spring 2010
Napa Valley Floor, Napa County, CA

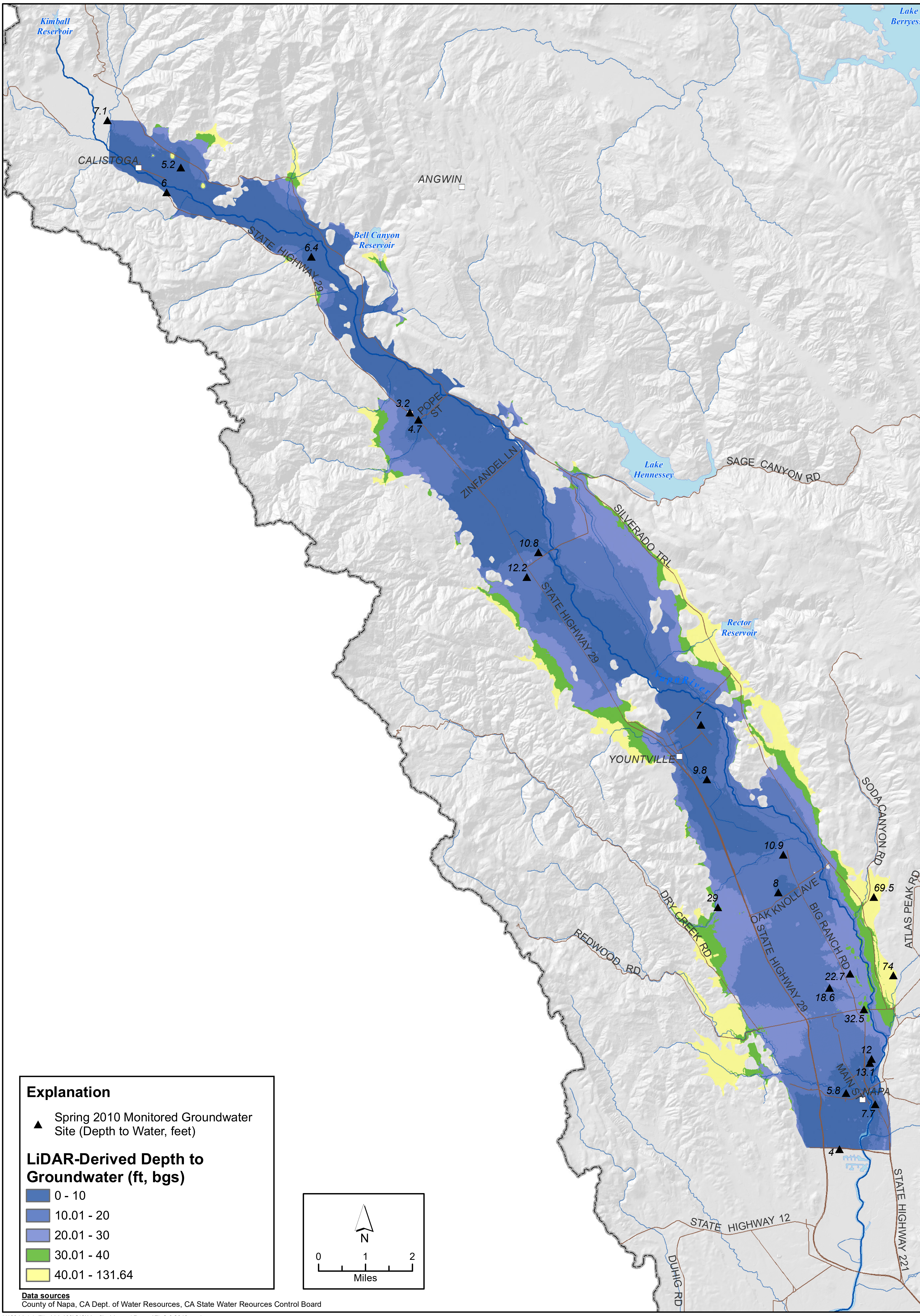

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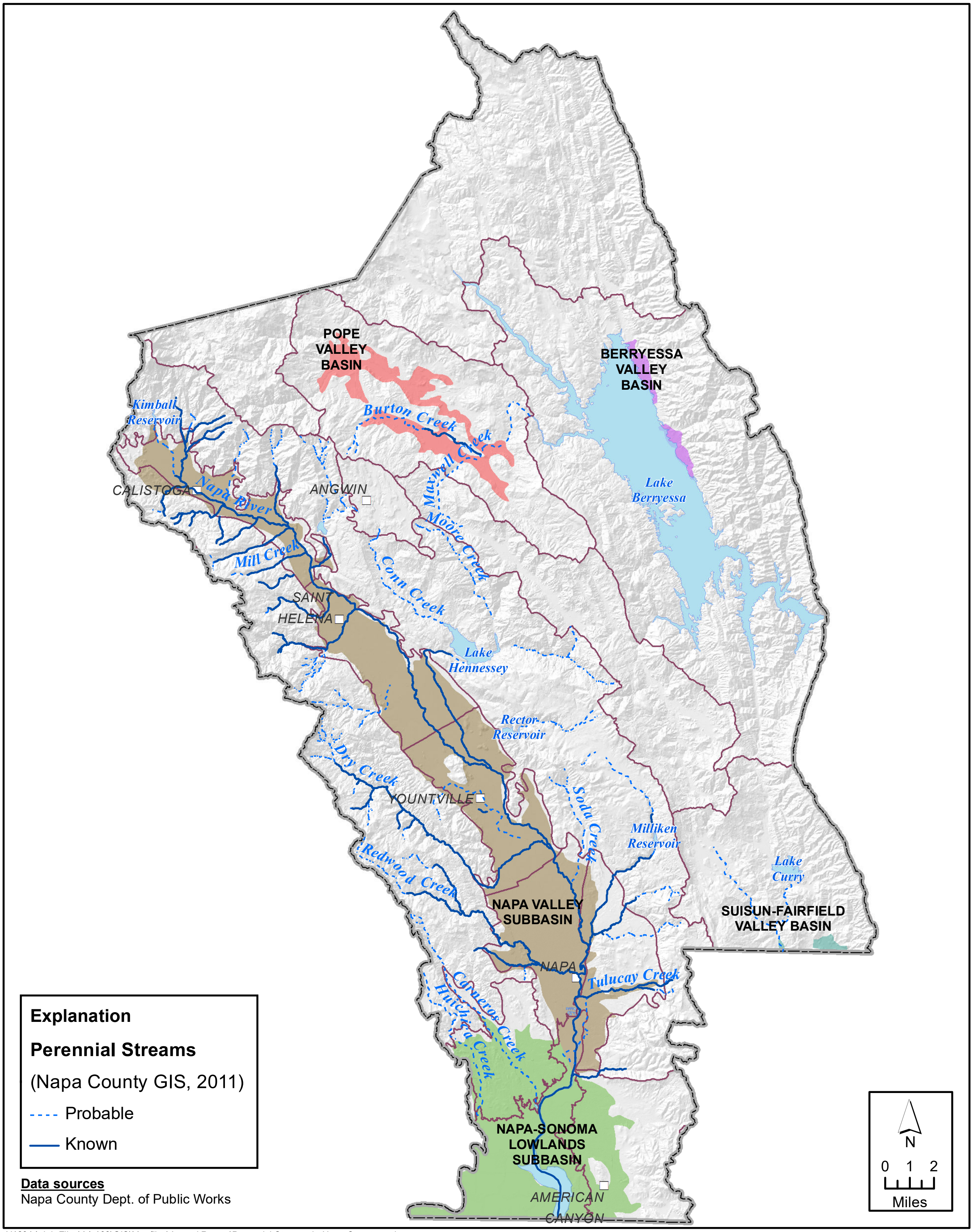
FIGURE 2-6
Spring 2010 Calculated Depth to Groundwater, Napa Valley Floor, Napa County, CA

Napa County Comprehensive Groundwater Monitoring Program
2015 Annual Report and CASGEM Update



Data sources
Napa County Dept. of Public Works

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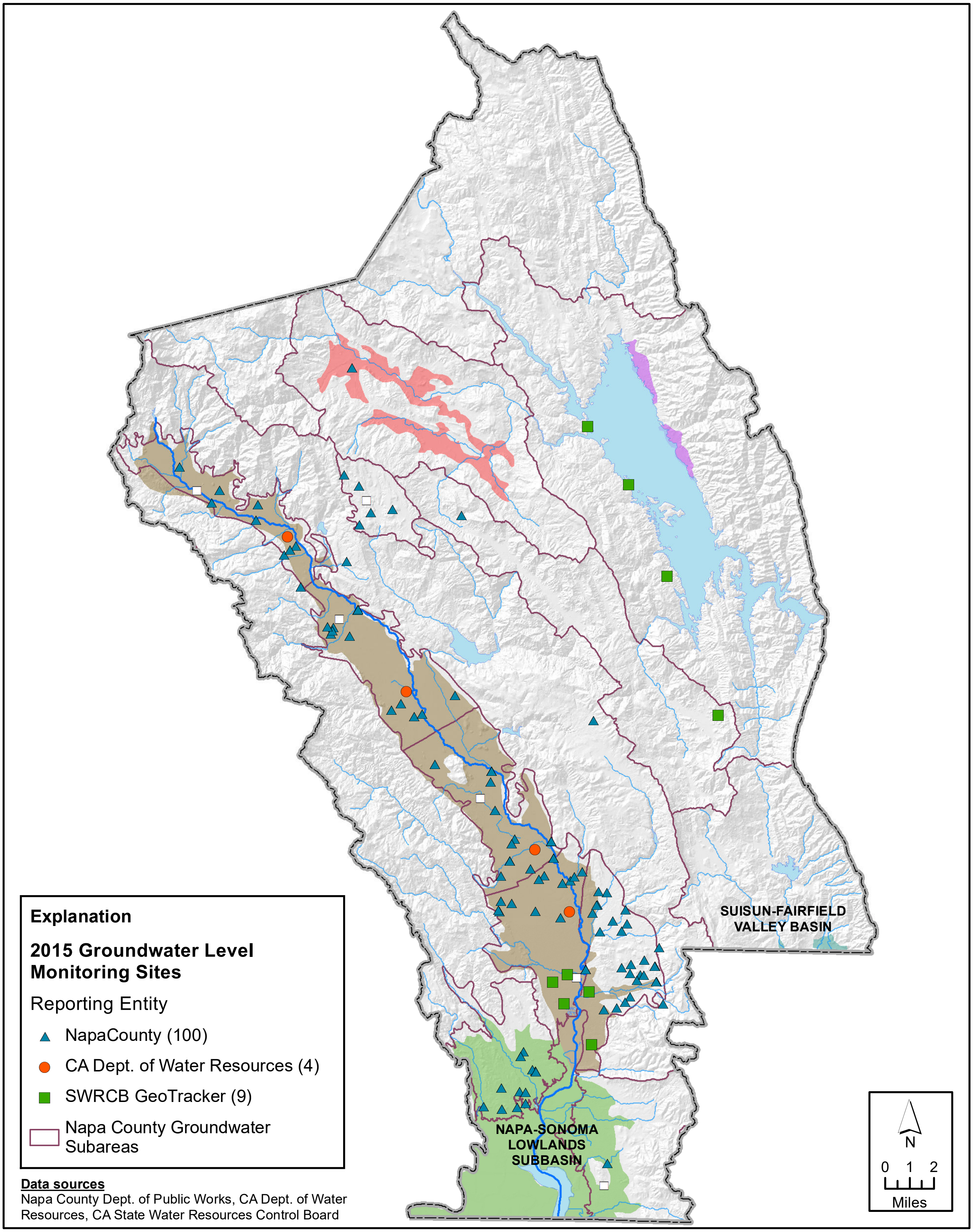
FIGURE 2-7
Perennial Streams in Napa County



Data sources
Napa County Dept. of Public Works, CA Dept. of Water Resources, CA State Water Resources Control Board

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FIGURE 4-1
Current Groundwater Level Monitoring Sites by Reporting Entity

Napa County Comprehensive Groundwater Monitoring Program
2015 Annual Report and CASGEM Update

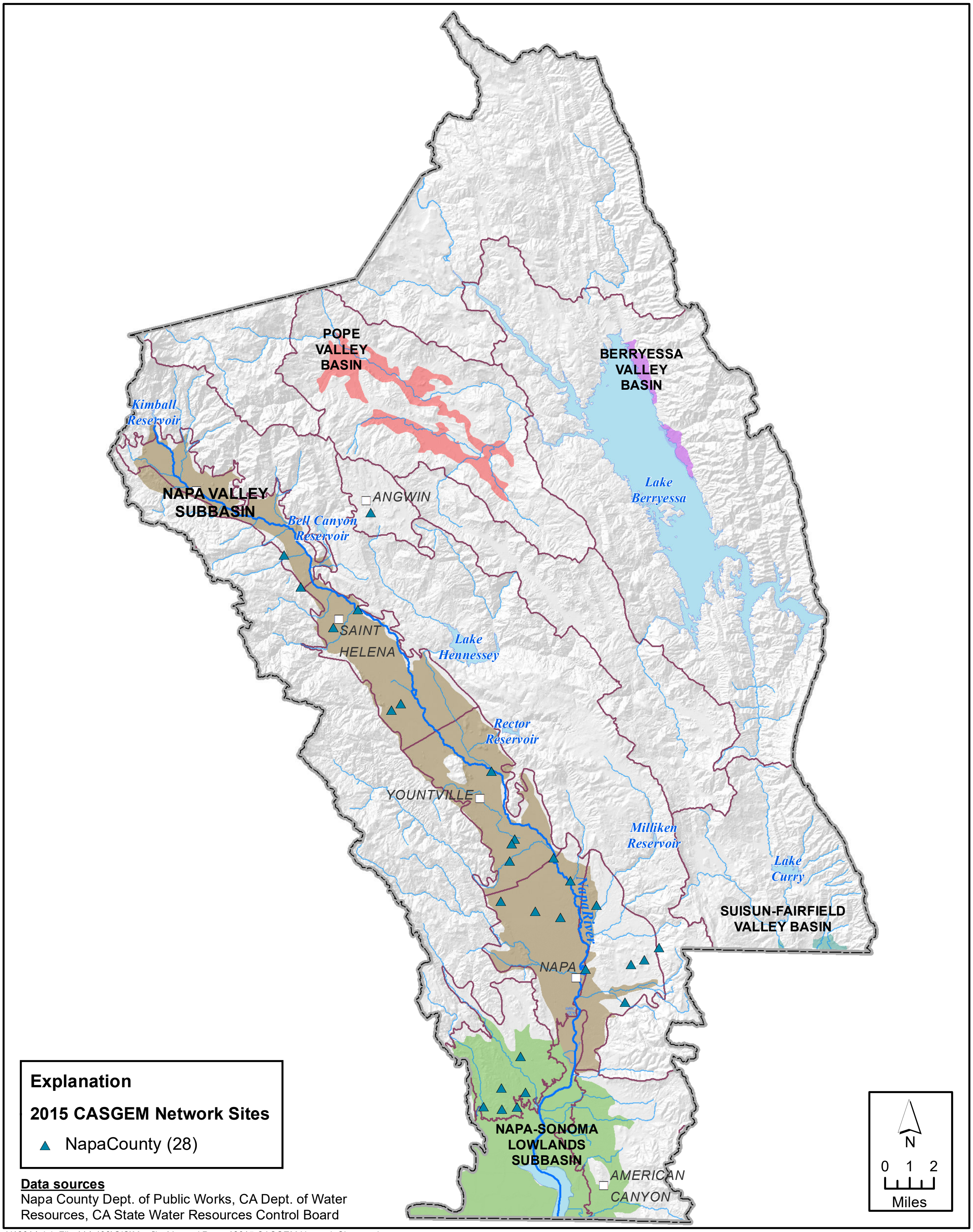

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FIGURE 4-2
2015 CASGEM Network Sites
Napa County, CA

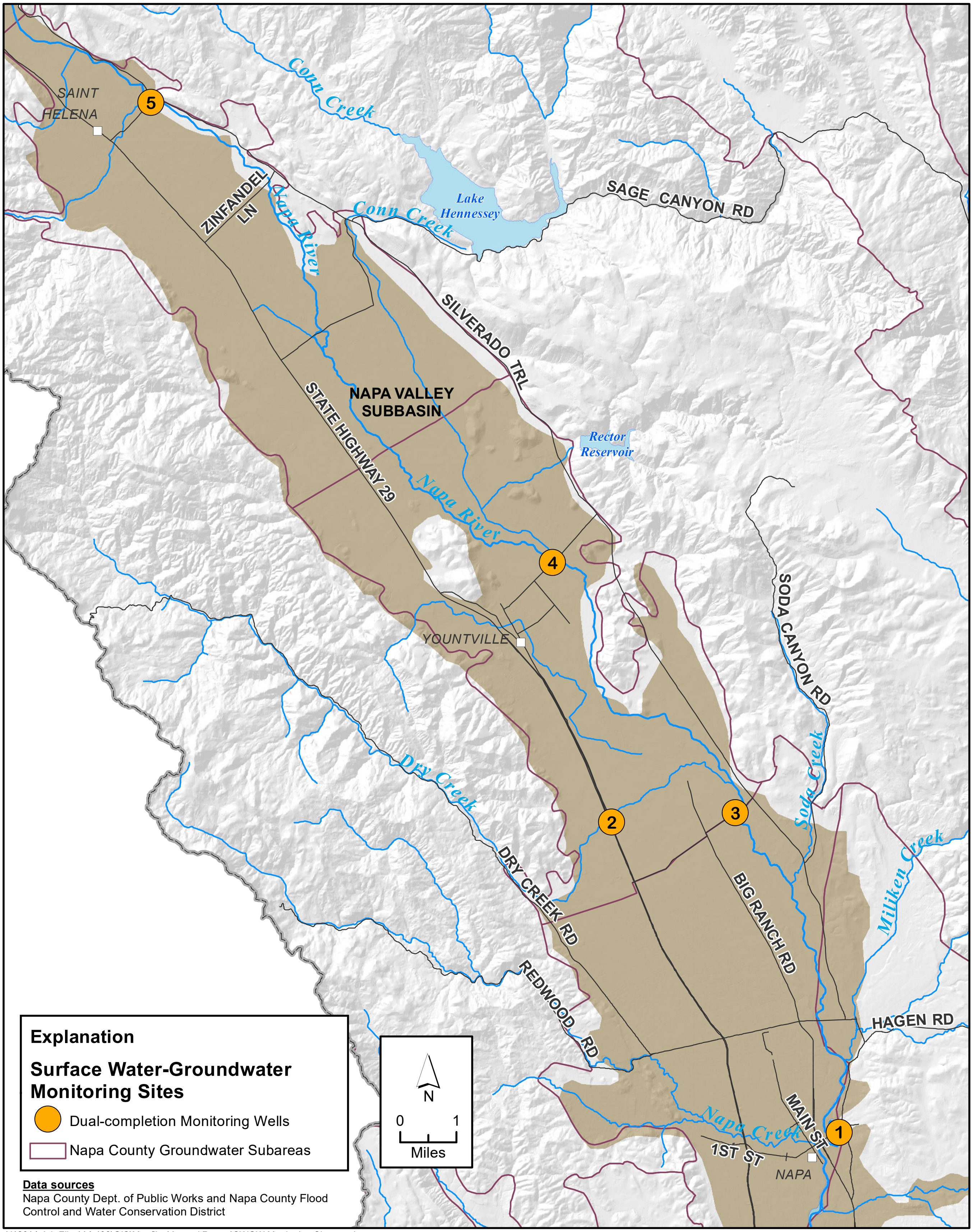

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FIGURE 4-3
Napa County Surface Water-Groundwater Monitoring Sites

Napa County Comprehensive Groundwater Monitoring Program
2015 Annual Report and CASGEM Update

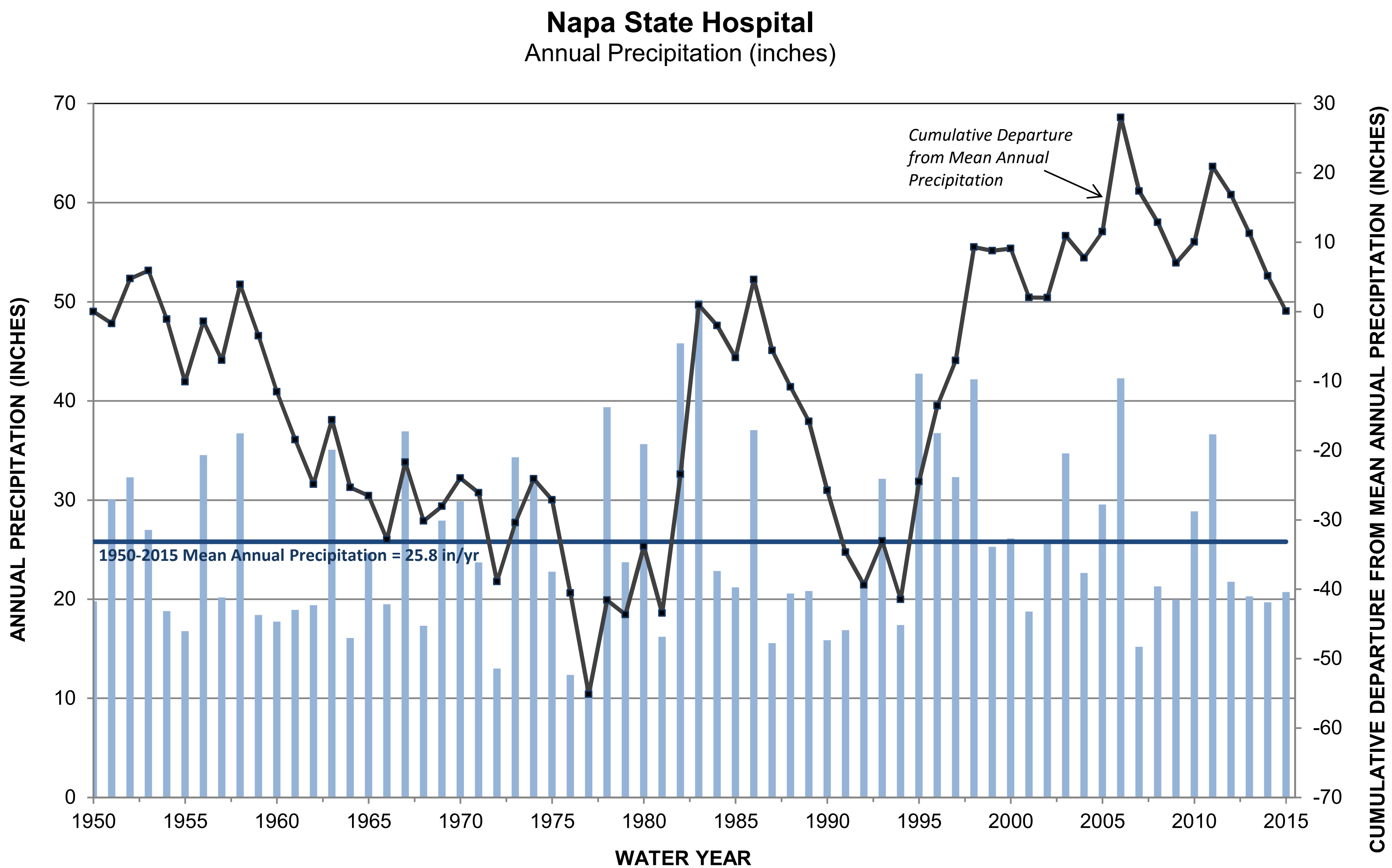

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Figure 5-1
Napa State Hospital Water Year Precipitation and Cumulative Departure , Water Years 1950 - 2015

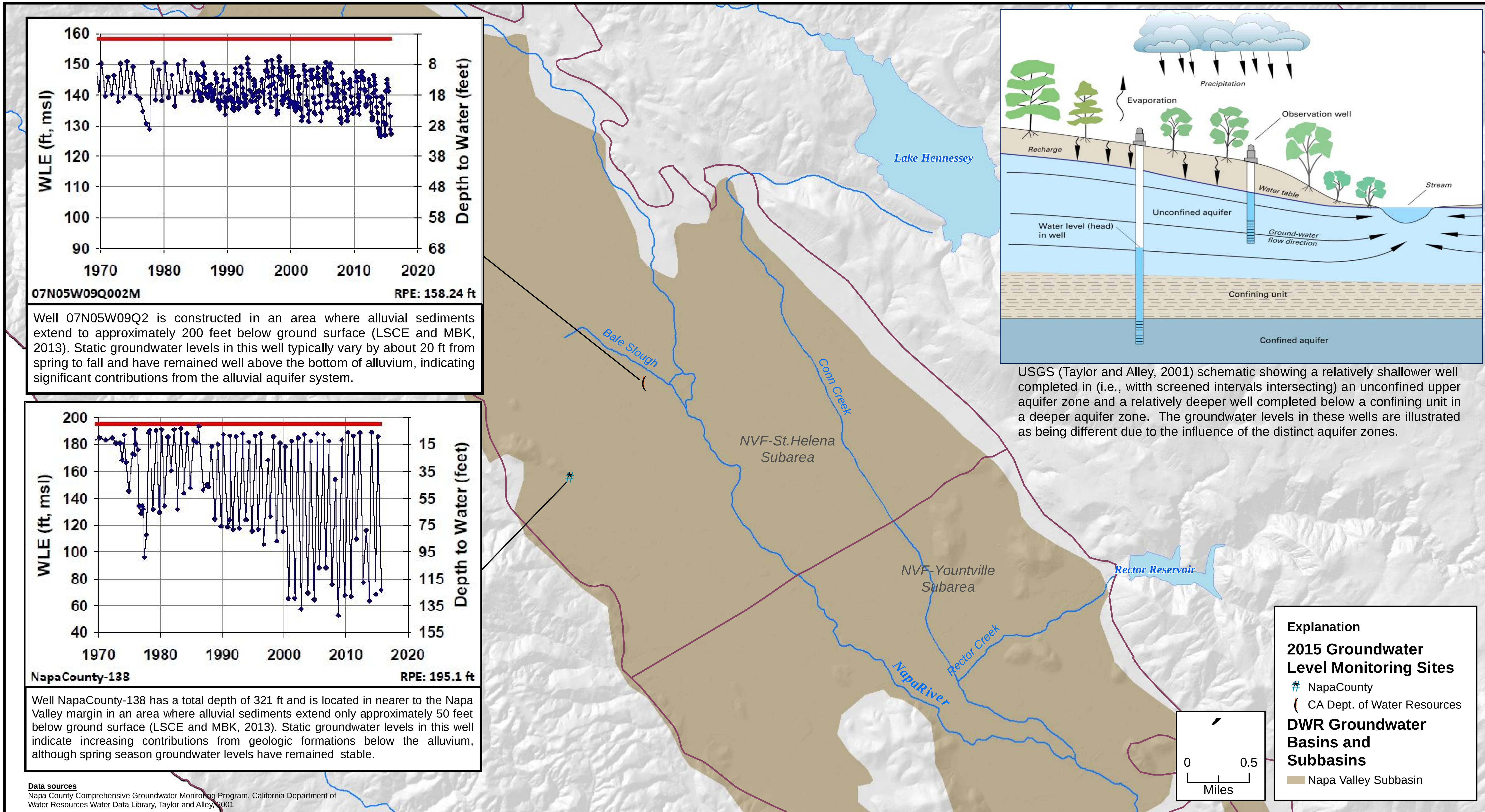

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FIGURE 5-2

Southern St. Helena Subarea Aquifer Zone Schematic and Representative Hydrographs

Napa County Comprehensive Groundwater Monitoring Program
2015 Annual Report and CASGEM Update

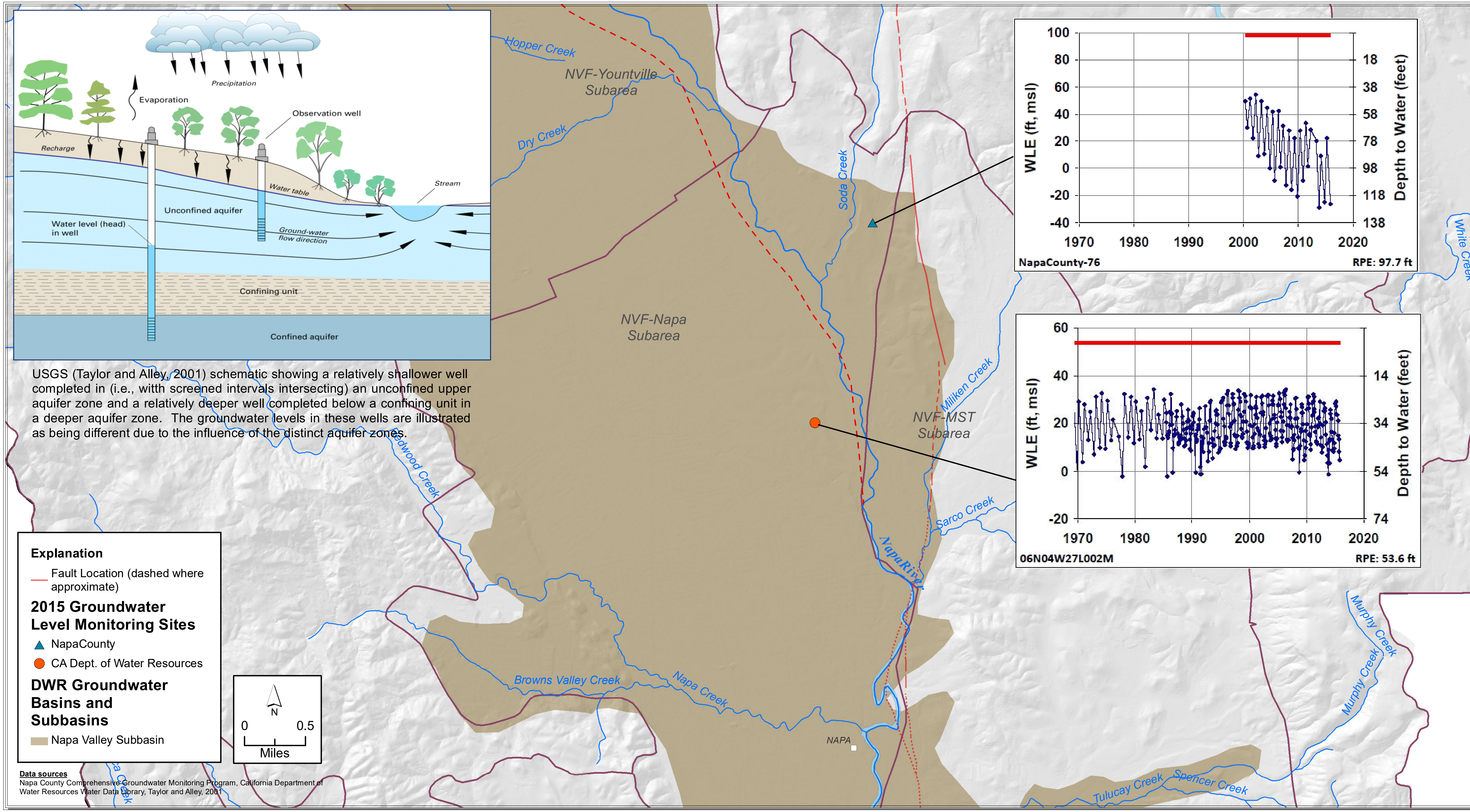

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FIGURE 5-3

Northeast Napa Subarea Aquifer Zone Schematic and Representative Hydrographs

Napa County Comprehensive Groundwater Monitoring Program 2015 Annual Report and CASGEM Update

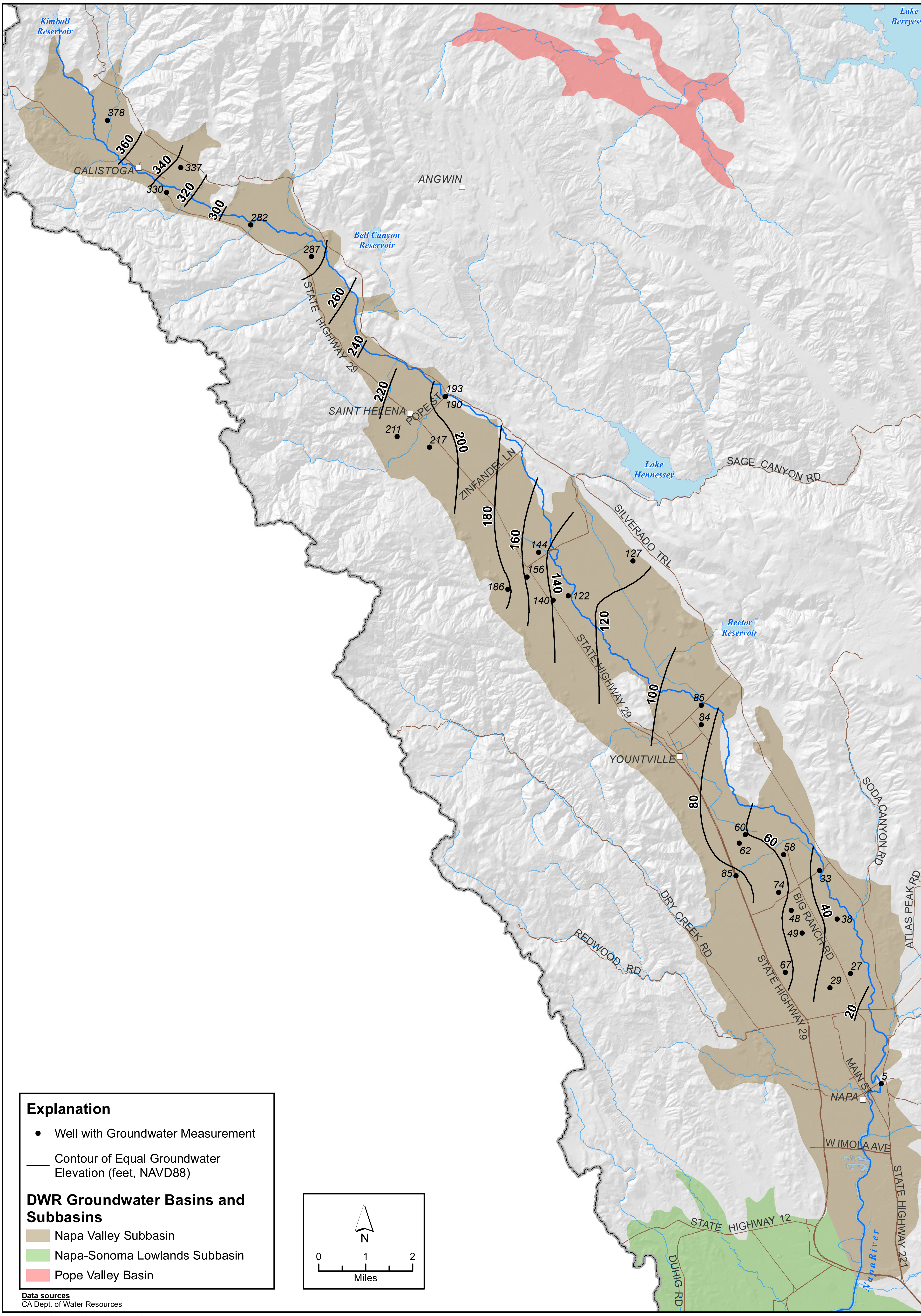

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FIGURE 5-4
Contours of Equal Groundwater Elevation, Spring 2015
Napa Valley Subbasin, Napa County, CA

Napa County Comprehensive Groundwater Monitoring Program
2015 Annual Report and CASGEM Update

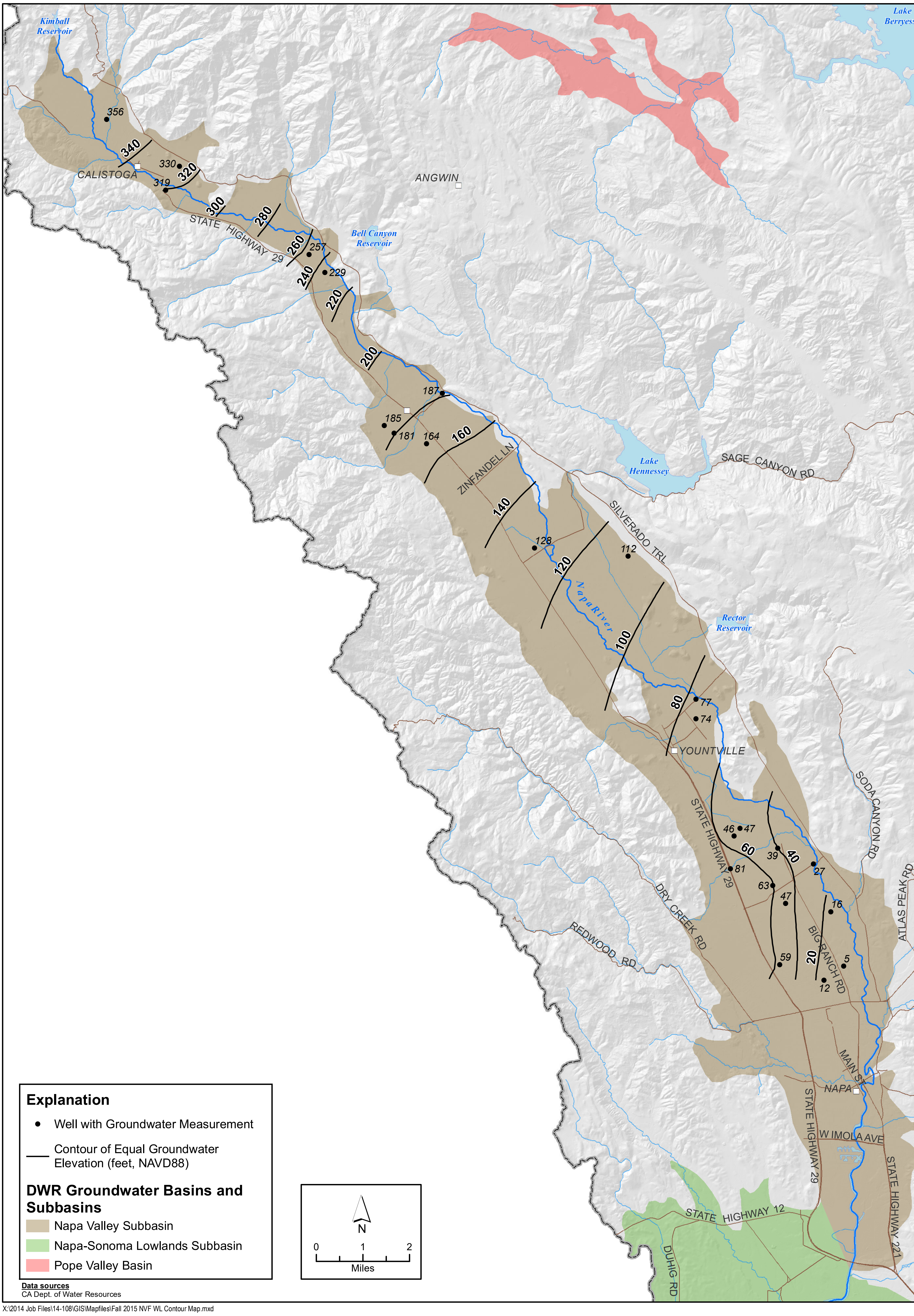

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FIGURE 5-5
Contours of Equal Groundwater Elevation, Fall 2015
Napa Valley Floor, Napa County, CA

Napa County Comprehensive Groundwater Monitoring Program
2015 Annual Report and CASGEM Update

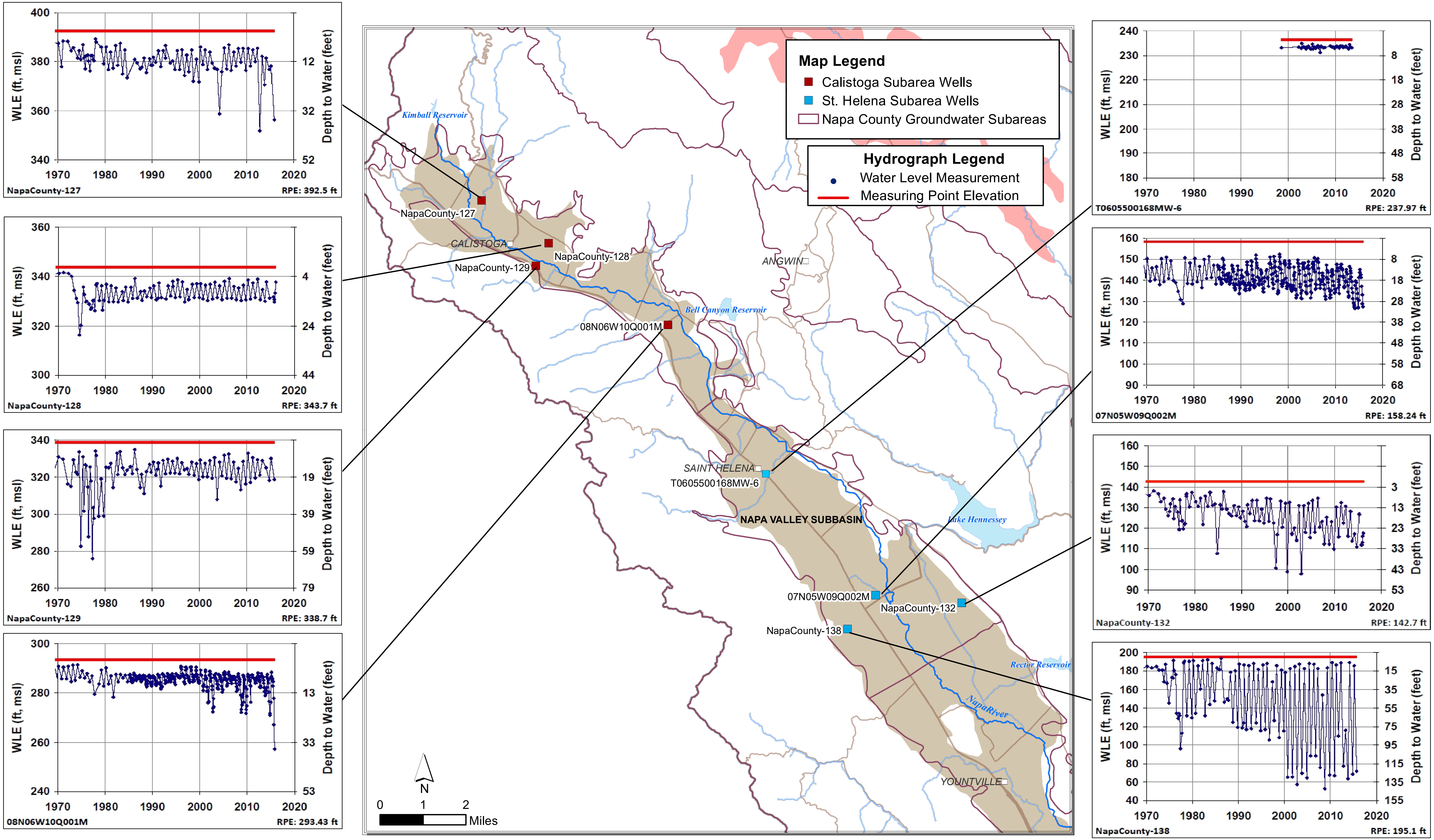

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FIGURE 5-6
Representative Groundwater Hydrographs Northern Napa Valley

Napa County Comprehensive Groundwater Monitoring Program
2015 Annual Report and CASGEM Update

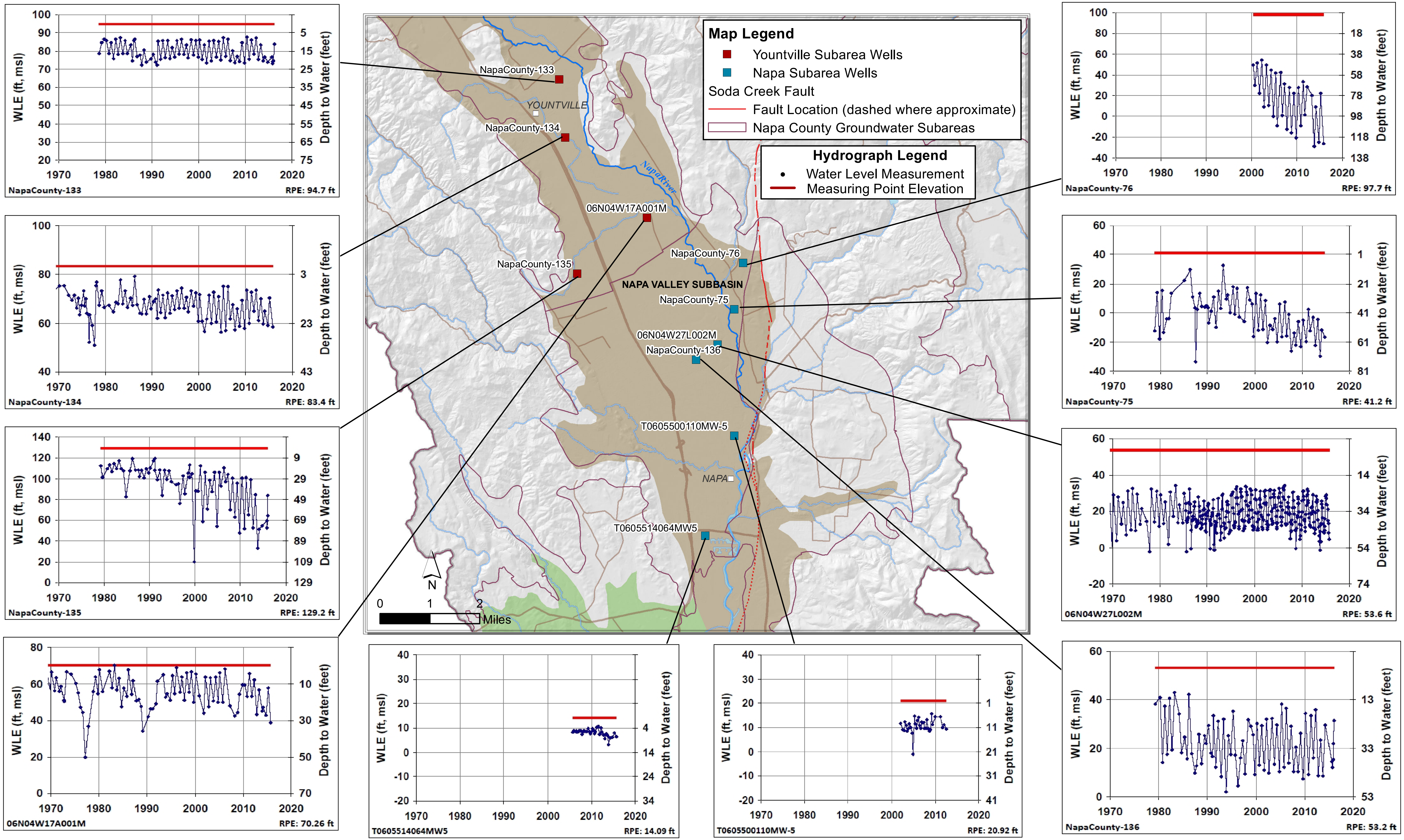

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FIGURE 5-7
Representative Groundwater Hydrographs Southern Napa Valley

Napa County Comprehensive Groundwater Monitoring Program
2015 Annual Report and CASGEM Update

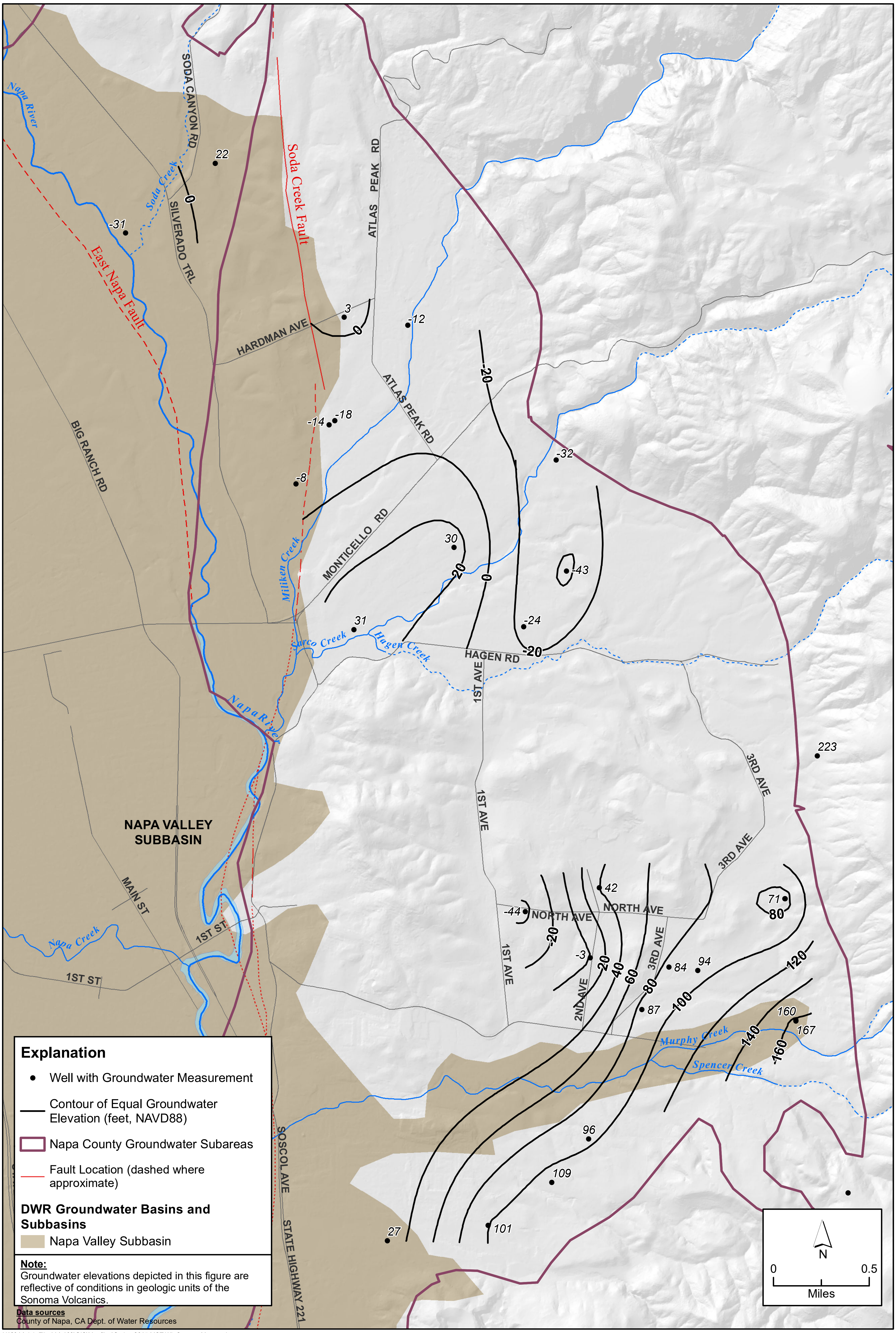

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FIGURE 5-8

Contours of Equal Groundwater Elevation, Spring 2015
MST Subarea, Napa County, CA

Napa County Comprehensive Groundwater Monitoring Program
2015 Annual Report and CASGEM Update

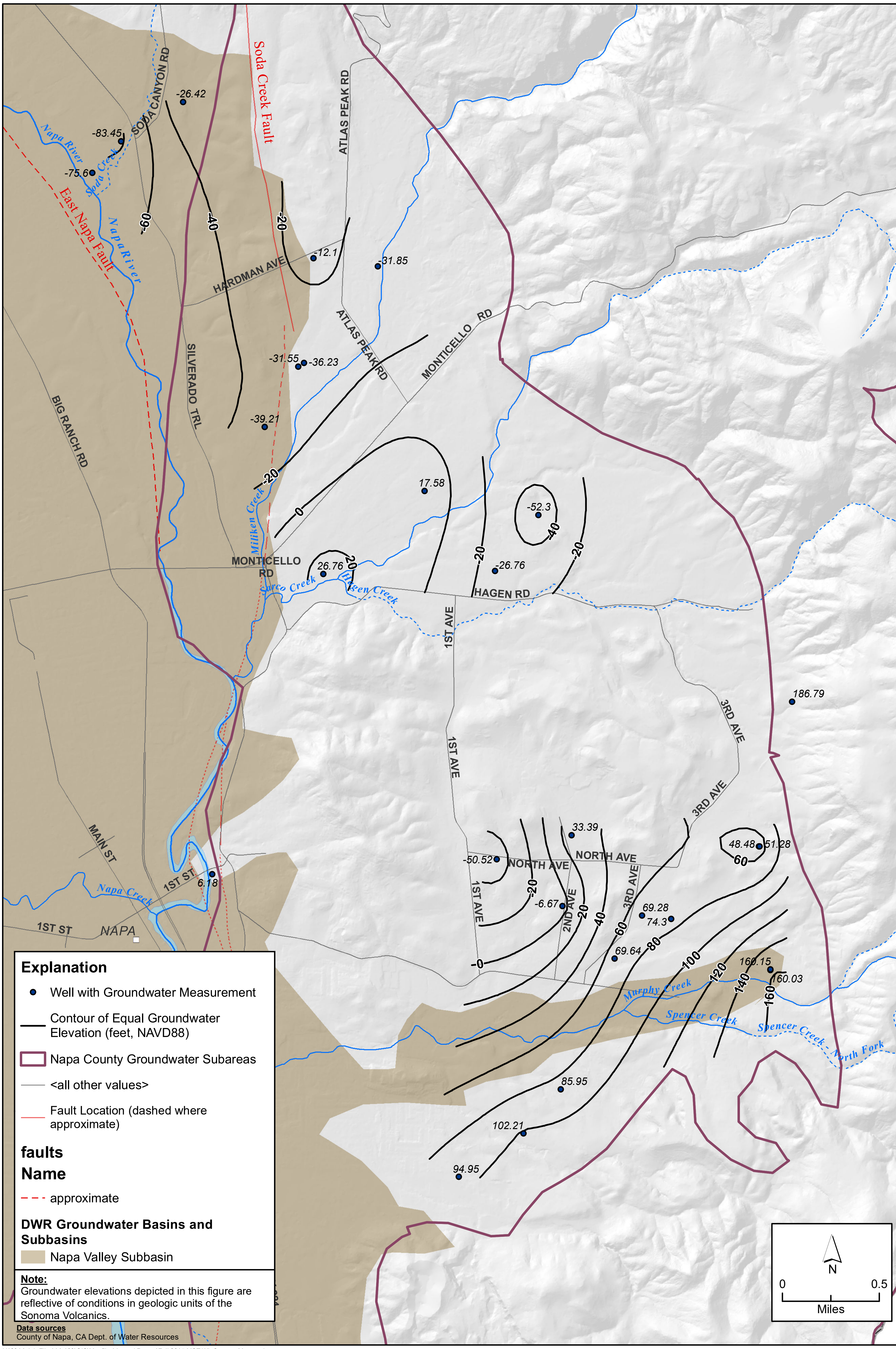

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FIGURE 5-9

Contours of Equal Groundwater Elevation, Fall 2015
MST Subarea, Napa County, CA

Napa County Comprehensive Groundwater Monitoring Program
2015 Annual Report and CASGEM Update

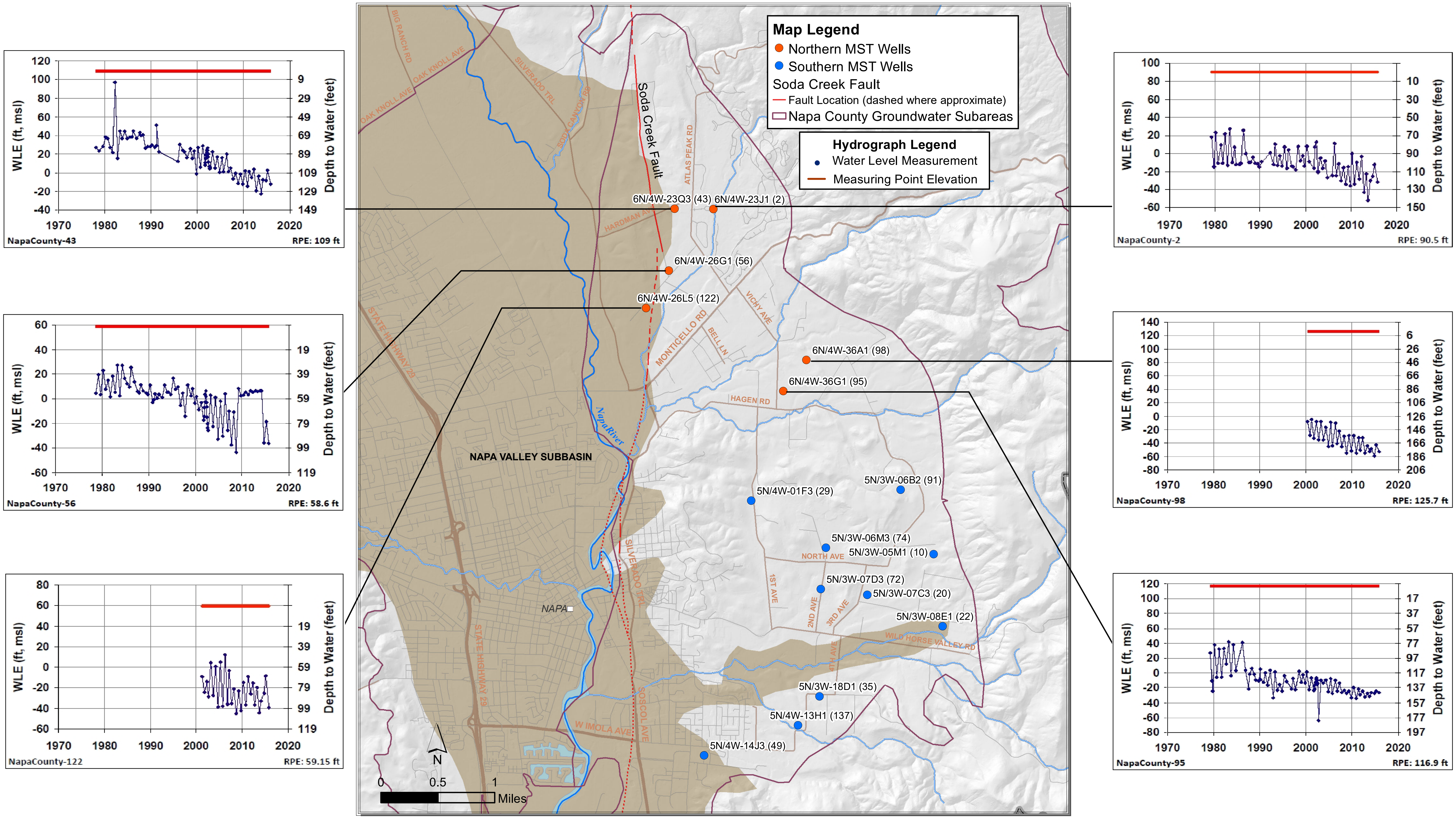

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FIGURE 5-10

Representative Groundwater Hydrographs Northern MST Subarea

Napa County Comprehensive Groundwater Monitoring Program
2015 Annual Report and CASGEM Update

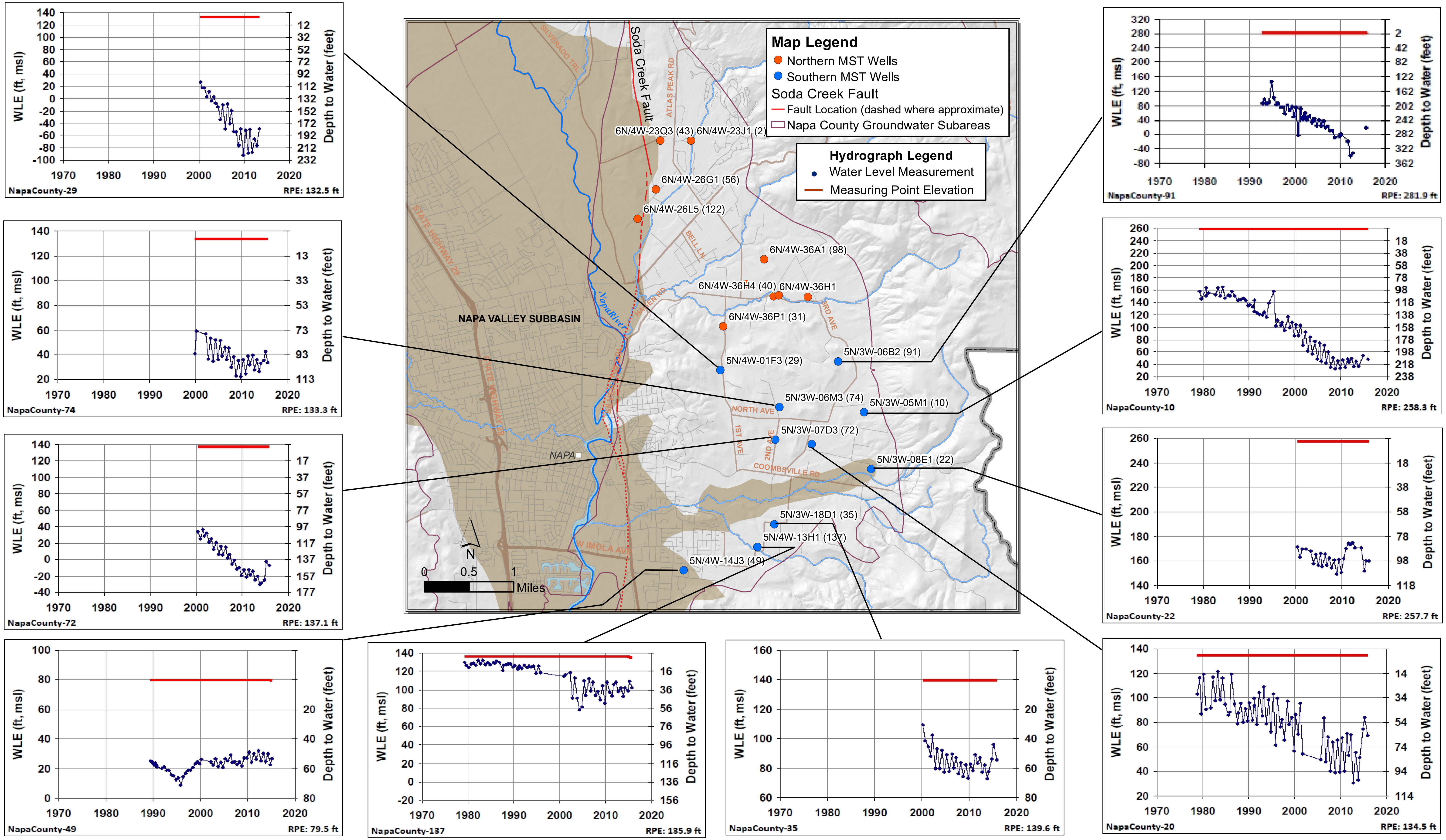

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FIGURE 5-11
Representative Groundwater Hydrographs Southern MST Subarea

Napa County Comprehensive Groundwater Monitoring Program
2015 Annual Report and CASGEM Update

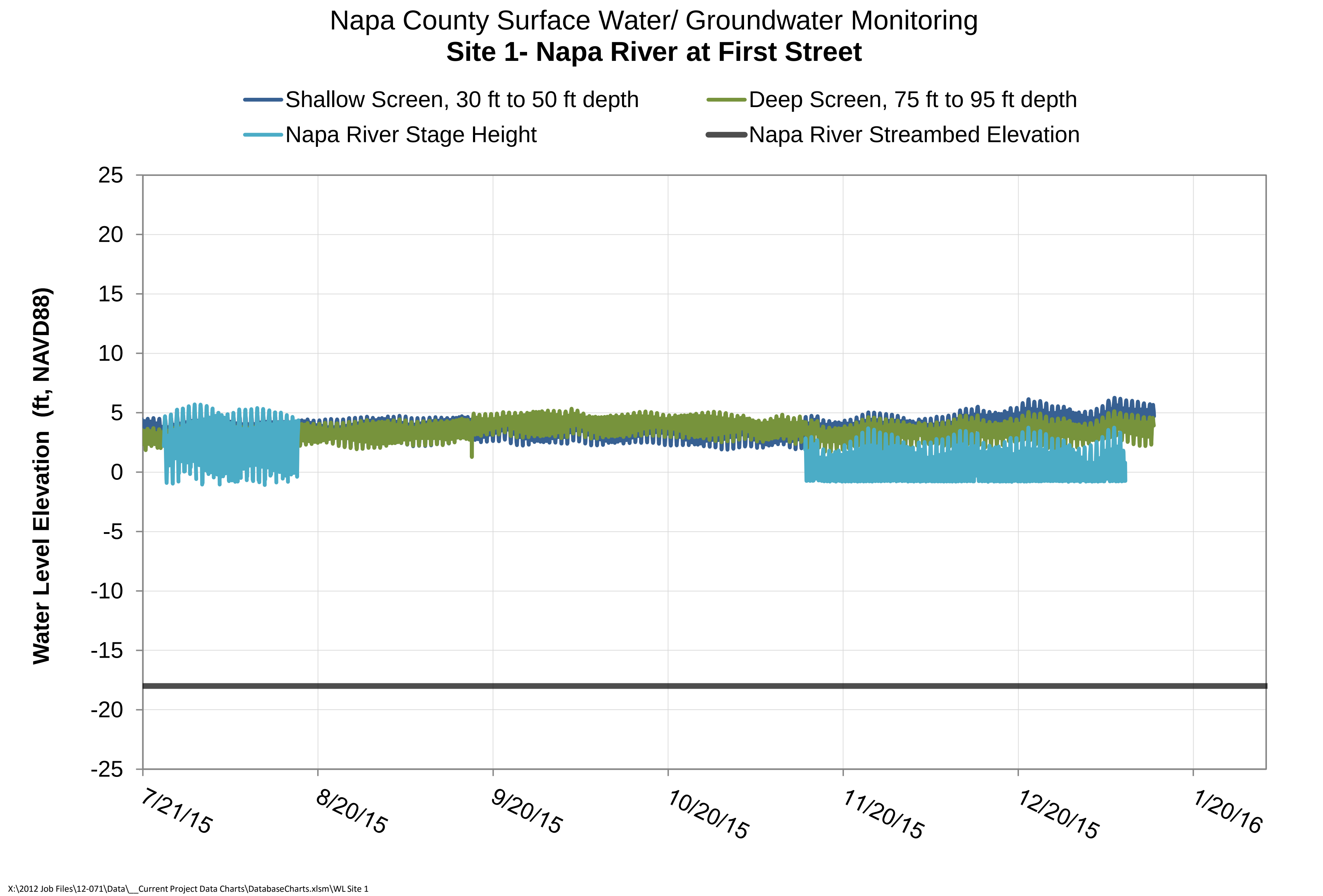

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Figure 5-12
Surface Water-Groundwater Hydrograph
Site 1: Napa River at First Street

Napa County Surface Water/ Groundwater Monitoring

Site 2 - Dry Creek at Highway 29

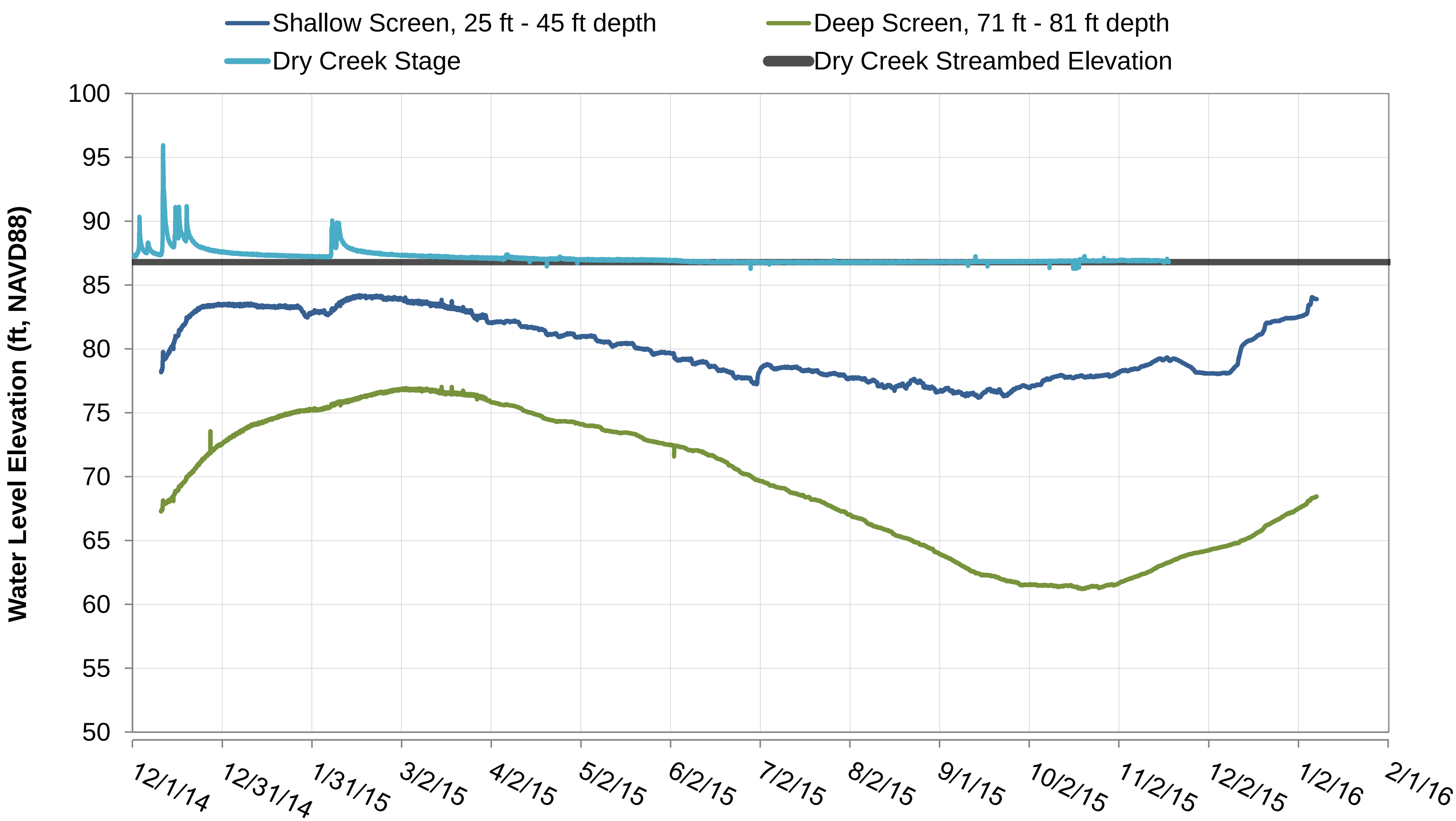

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Figure 5-13
Surface Water-Groundwater Hydrograph
Site 2: Dry Creek at Highway 29

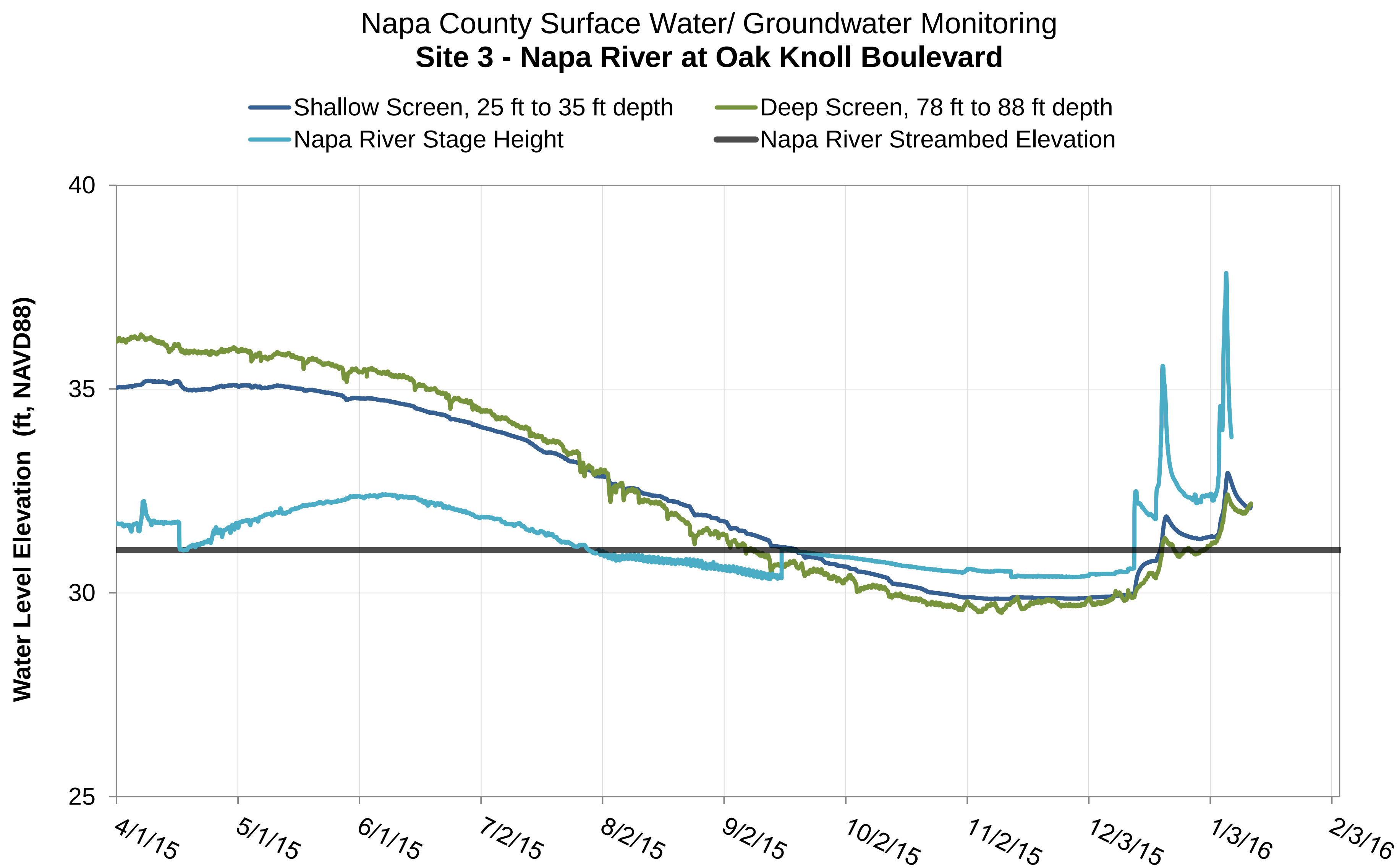

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Figure 5-14
Surface Water-Groundwater Hydrograph
Site 3: Napa River at Oak Knoll Avenue

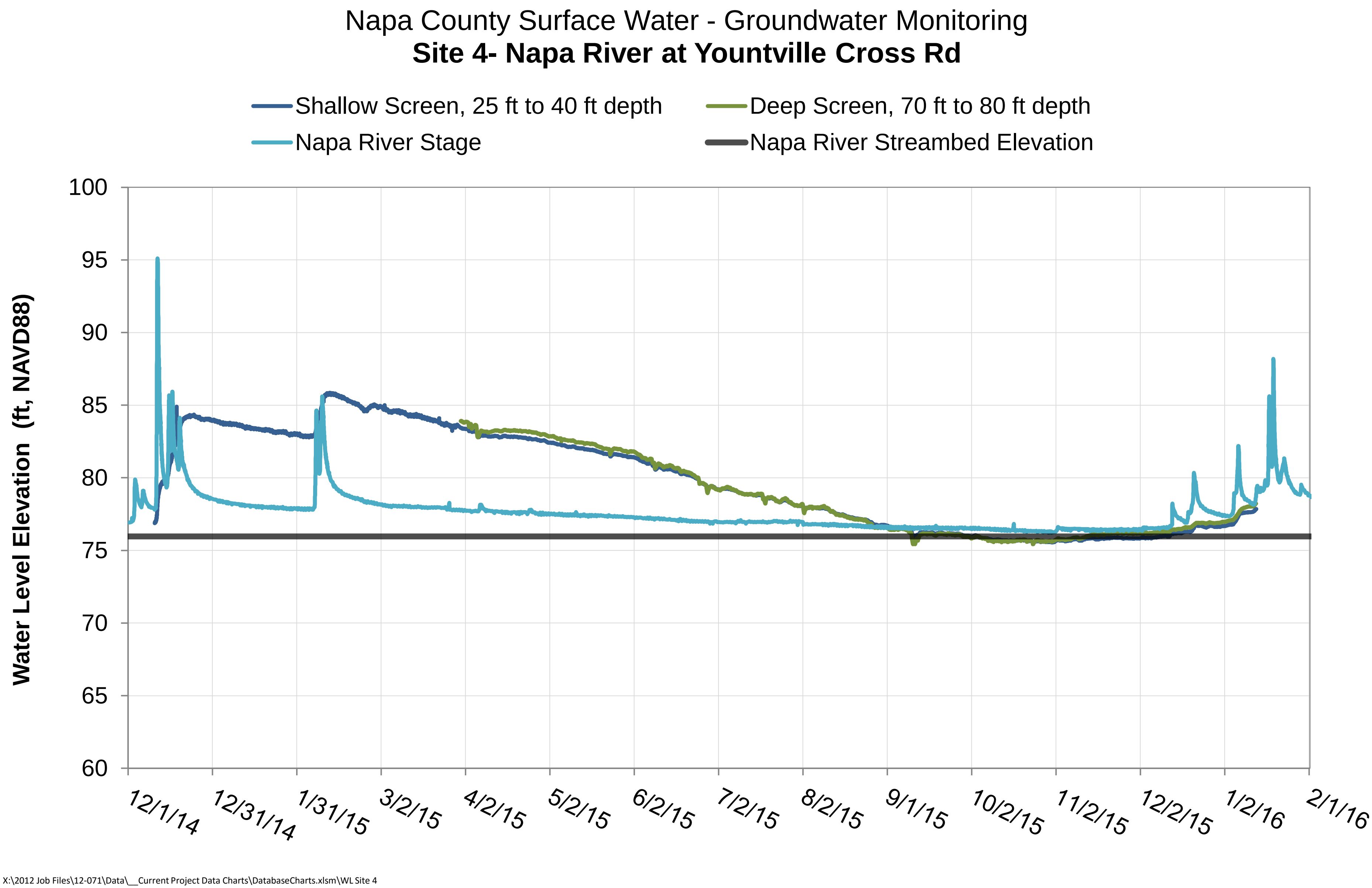

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Figure 5-15
Surface Water-Groundwater Hydrograph
Site 4: Napa River at Yountville Cross Road

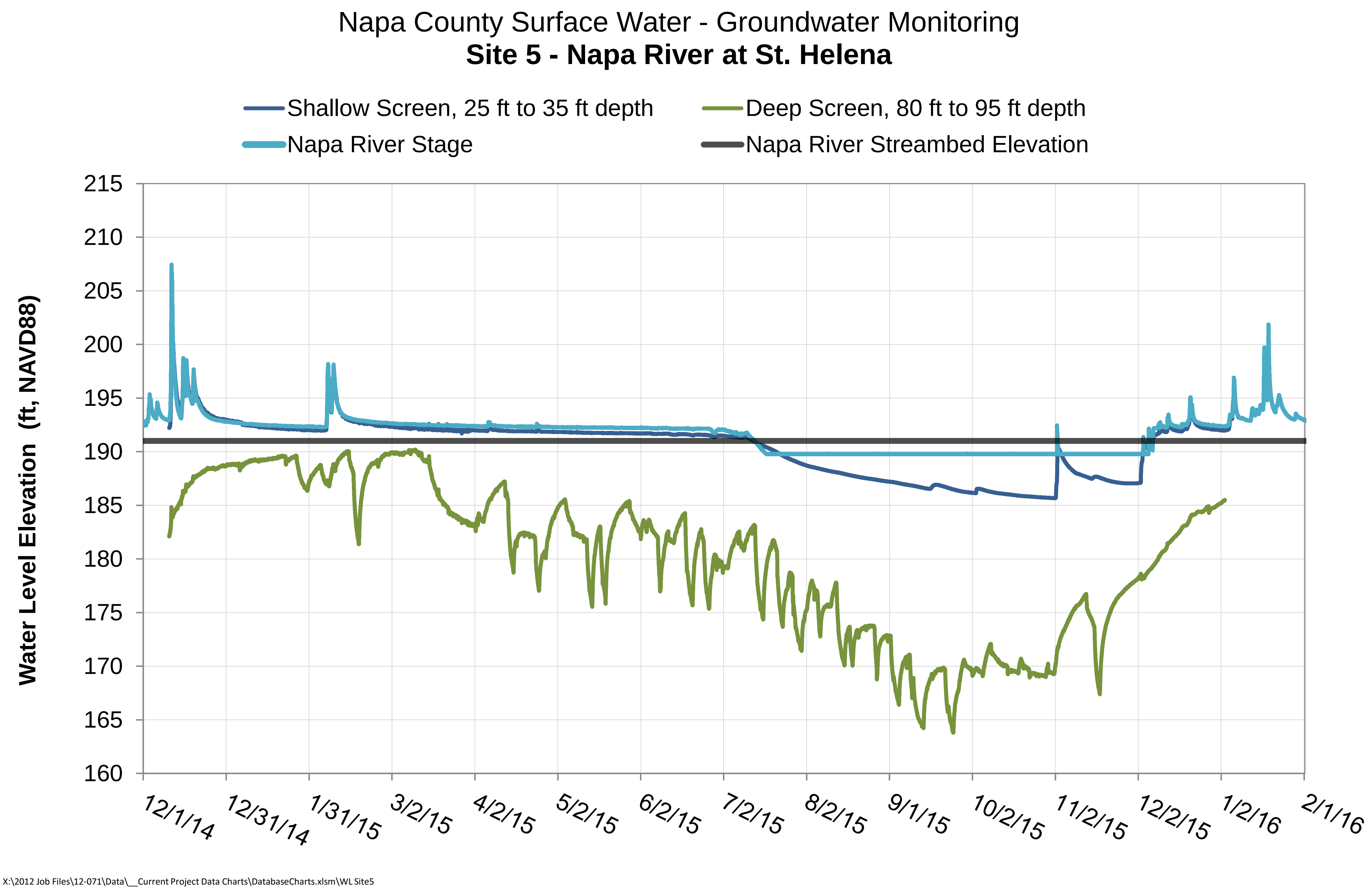

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Figure 5-16
Surface Water-Groundwater Hydrograph
Site 5: Napa River at Pope Street

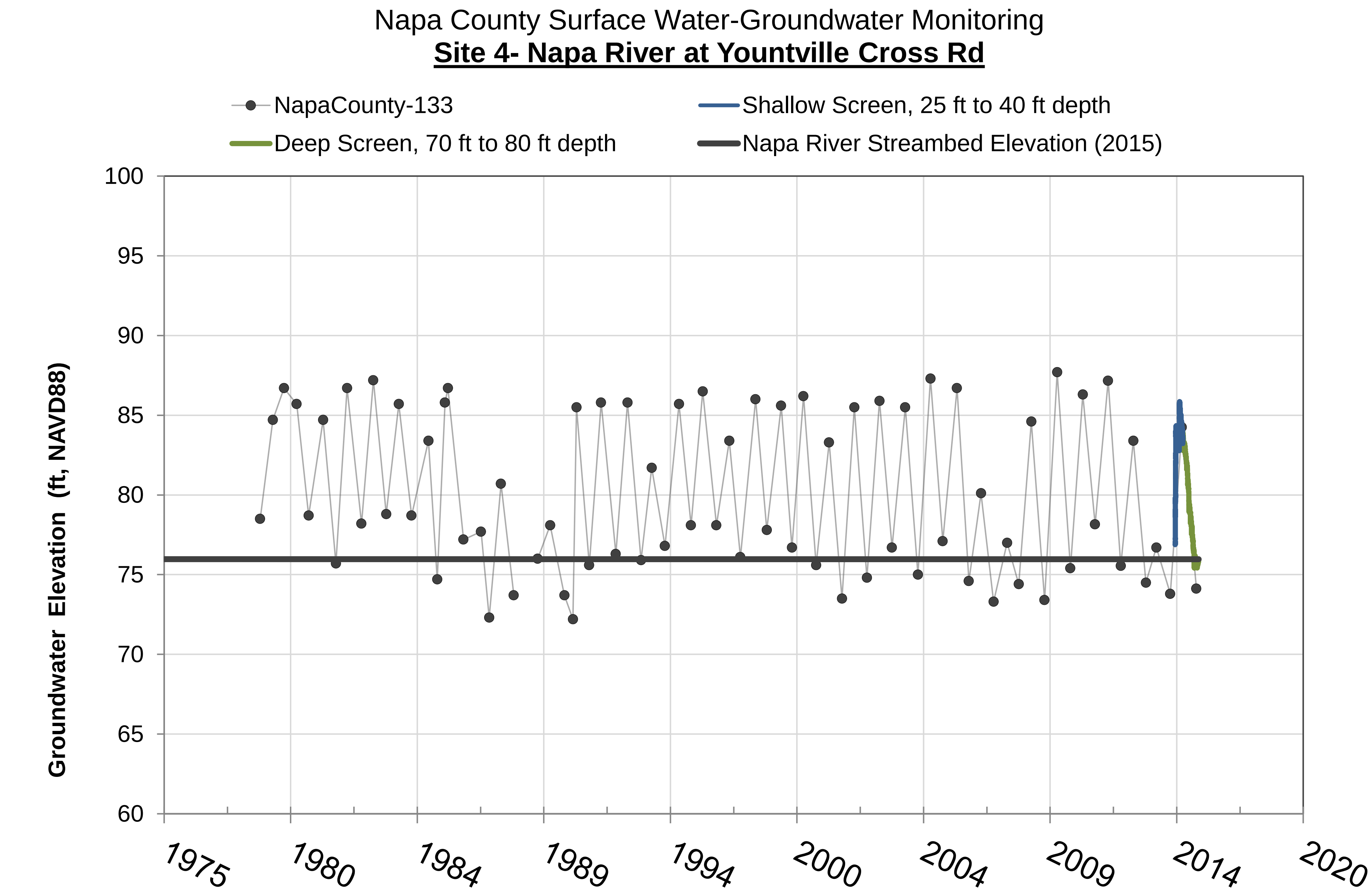

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Figure 5-17
Surface Water-Groundwater Network Site Historical Comparison
Site 4: Napa River at Yountville Cross Road

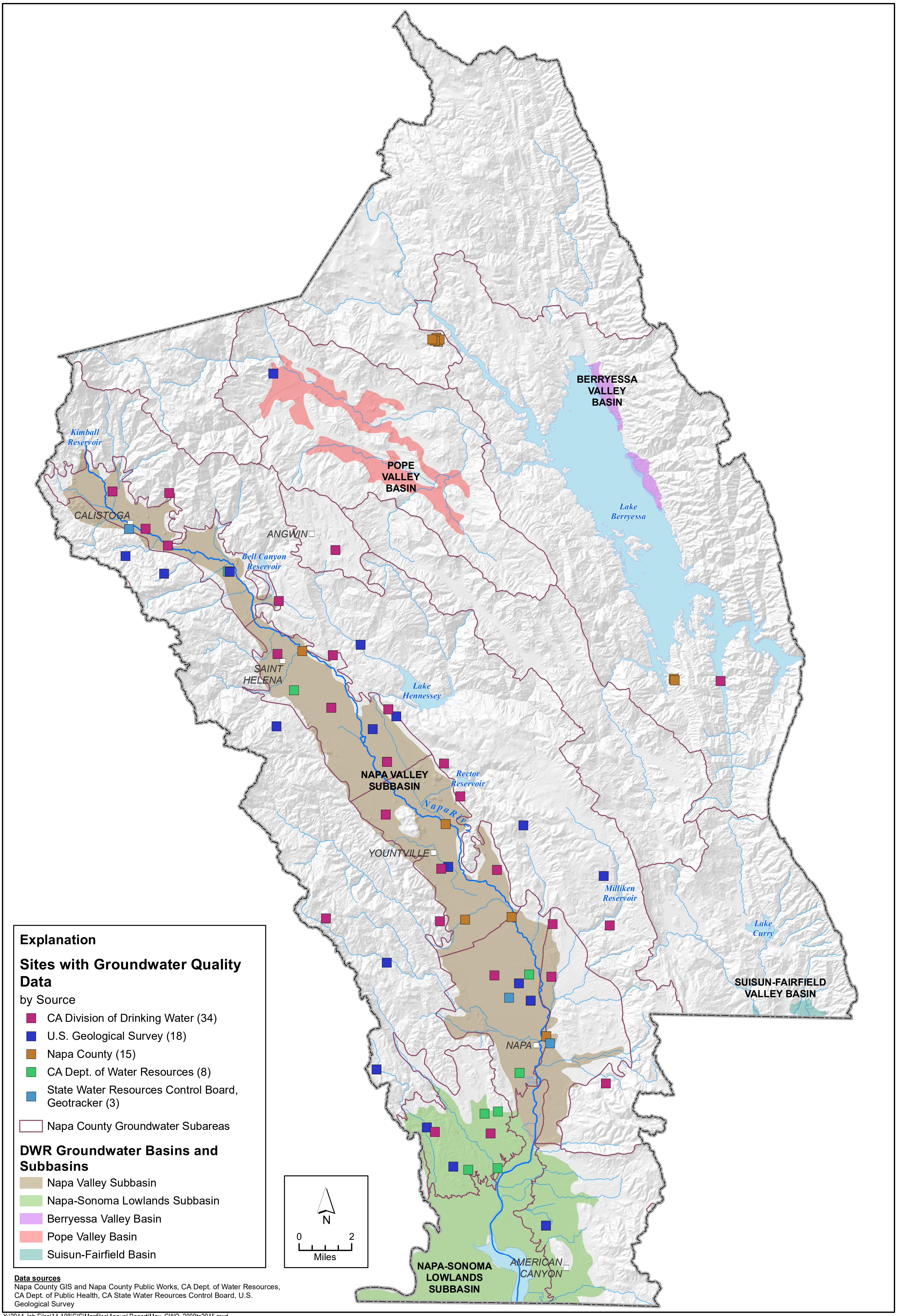

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FIGURE 6-1
Groundwater Quality Sites, 2009 - 2015
Napa County, CA

Napa County Comprehensive Groundwater Monitoring Program
2015 Annual Report and CASGEM Update

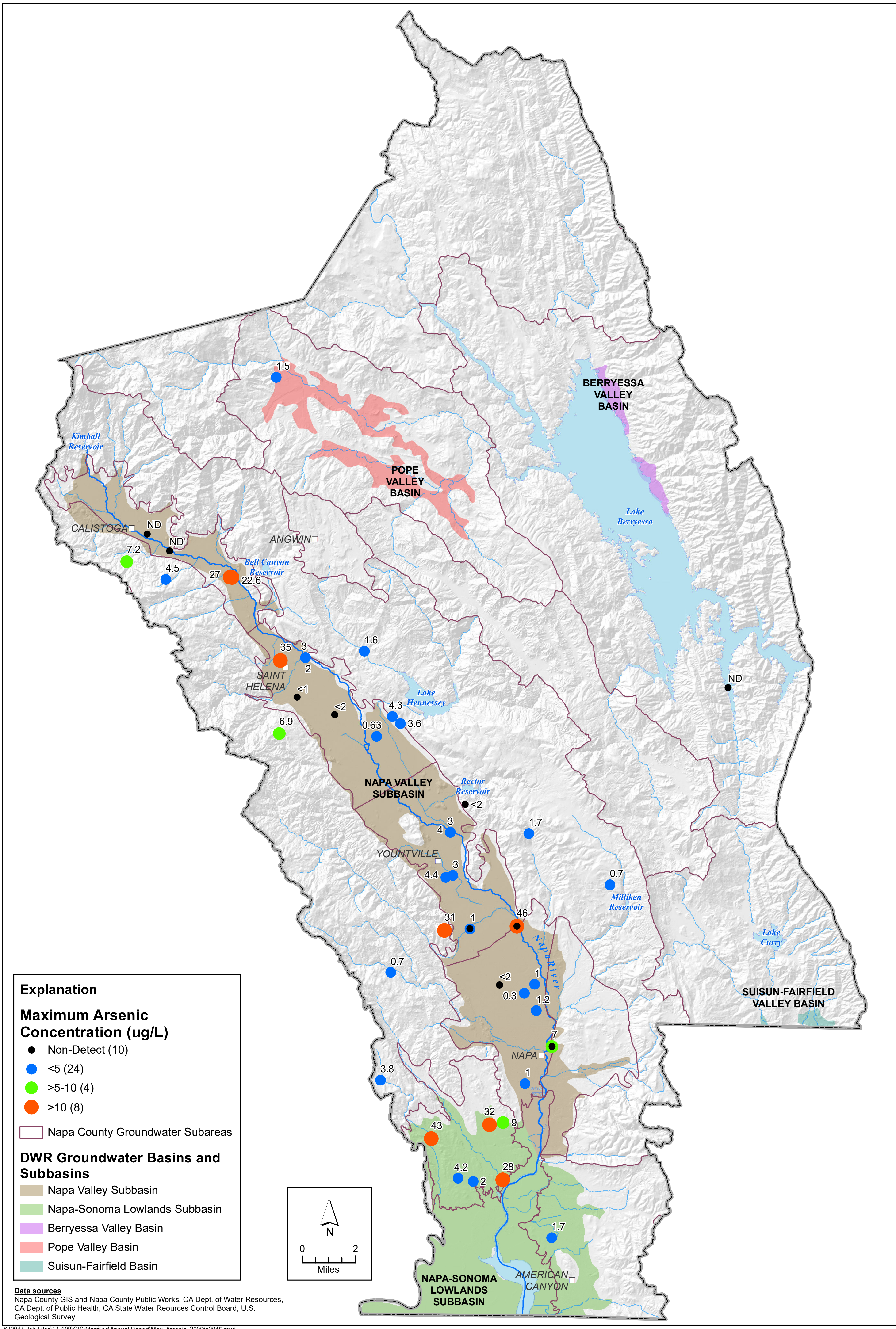

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FIGURE 6-2
Maximum Arsenic Concentrations in Groundwater, 2009 - 2015
Napa County, CA

Napa County Comprehensive Groundwater Monitoring Program
2015 Annual Report and CASGEM Update

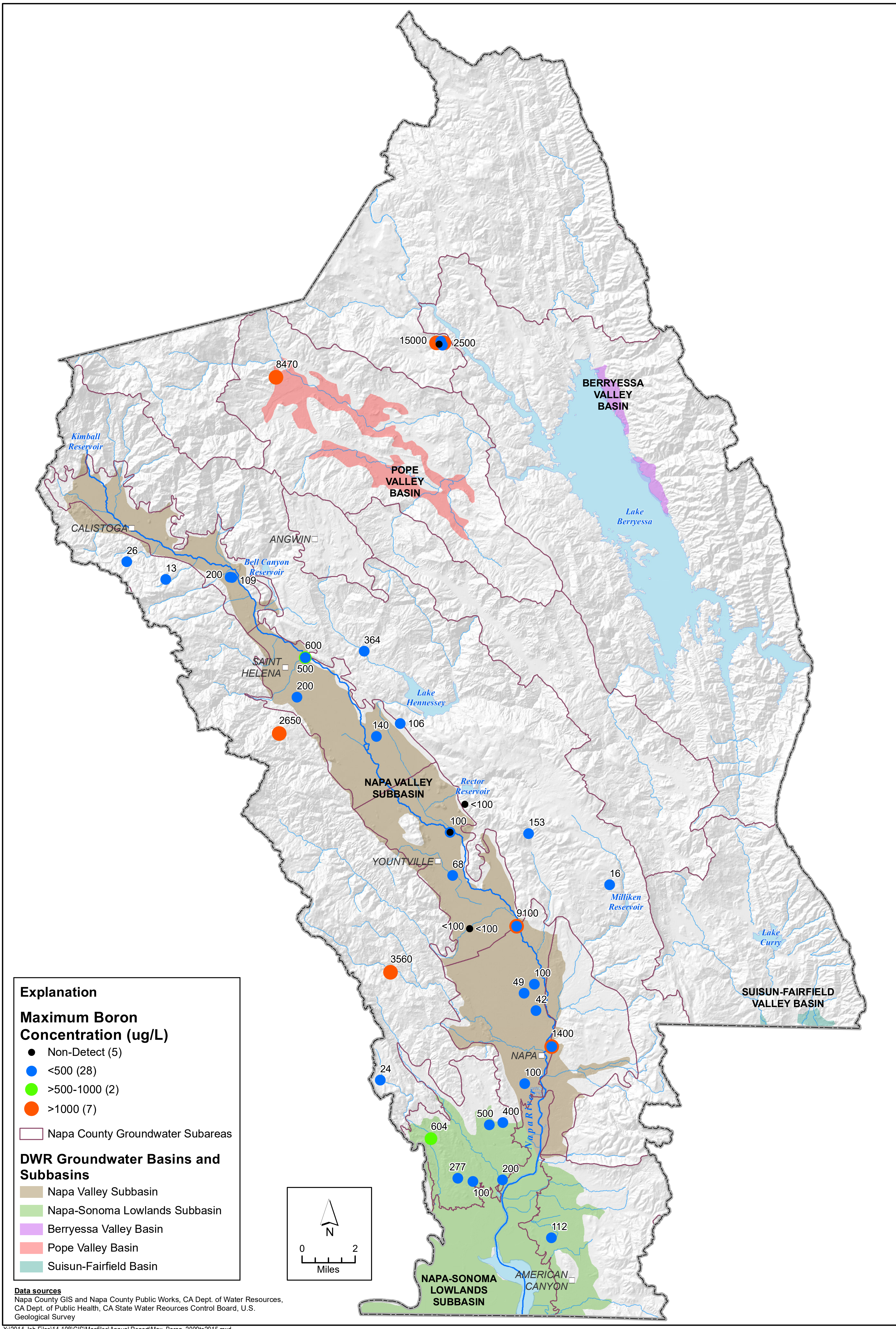

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FIGURE 6-3
Maximum Boron Concentrations in Groundwater, 2009 - 2015
Napa County, CA

Napa County Comprehensive Groundwater Monitoring Program
2015 Annual Report and CASGEM Update

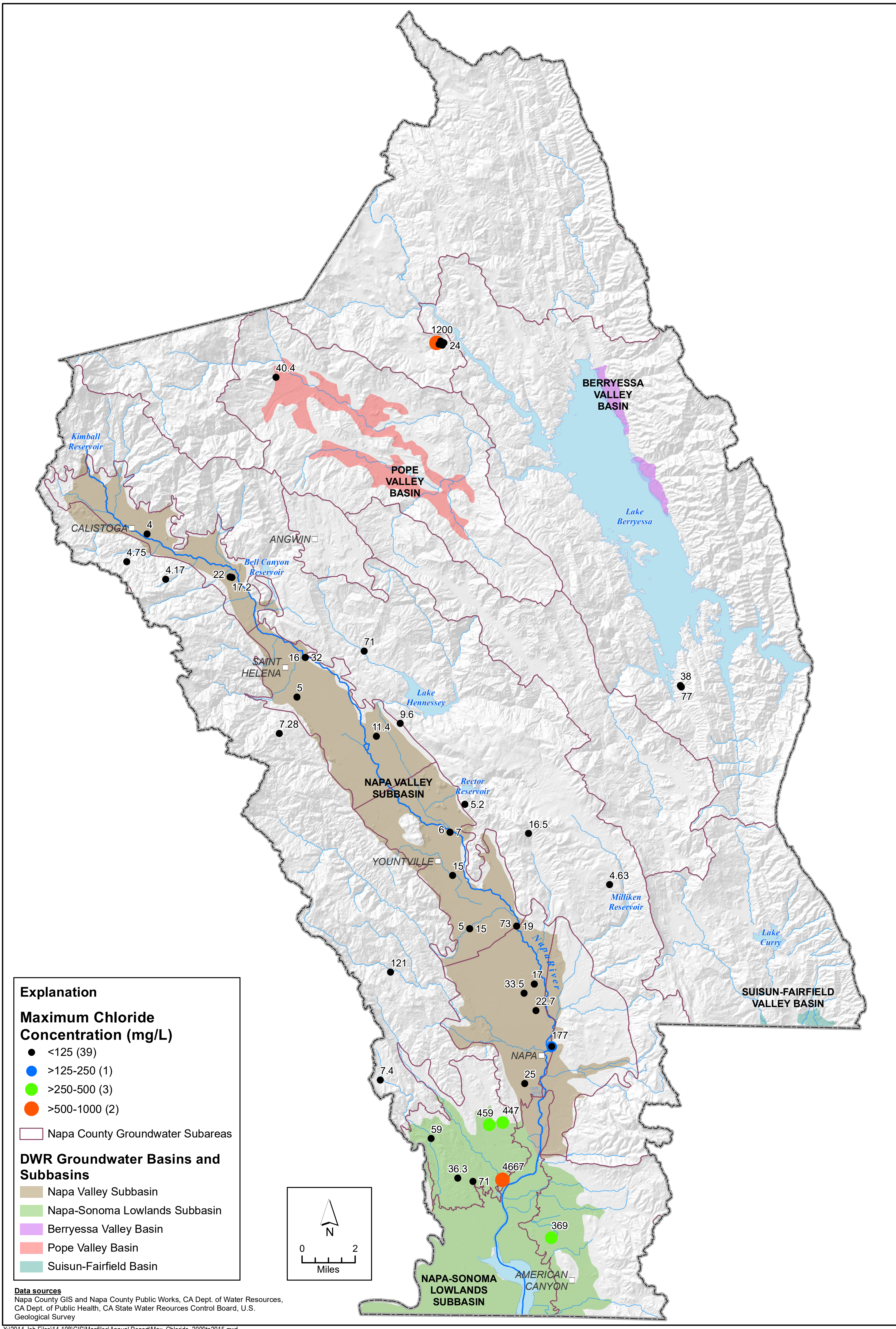

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FIGURE 6-4
Maximum Chloride Concentrations in Groundwater, 2009 - 2015
Napa County, CA

Napa County Comprehensive Groundwater Monitoring Program
2015 Annual Report and CASGEM Update

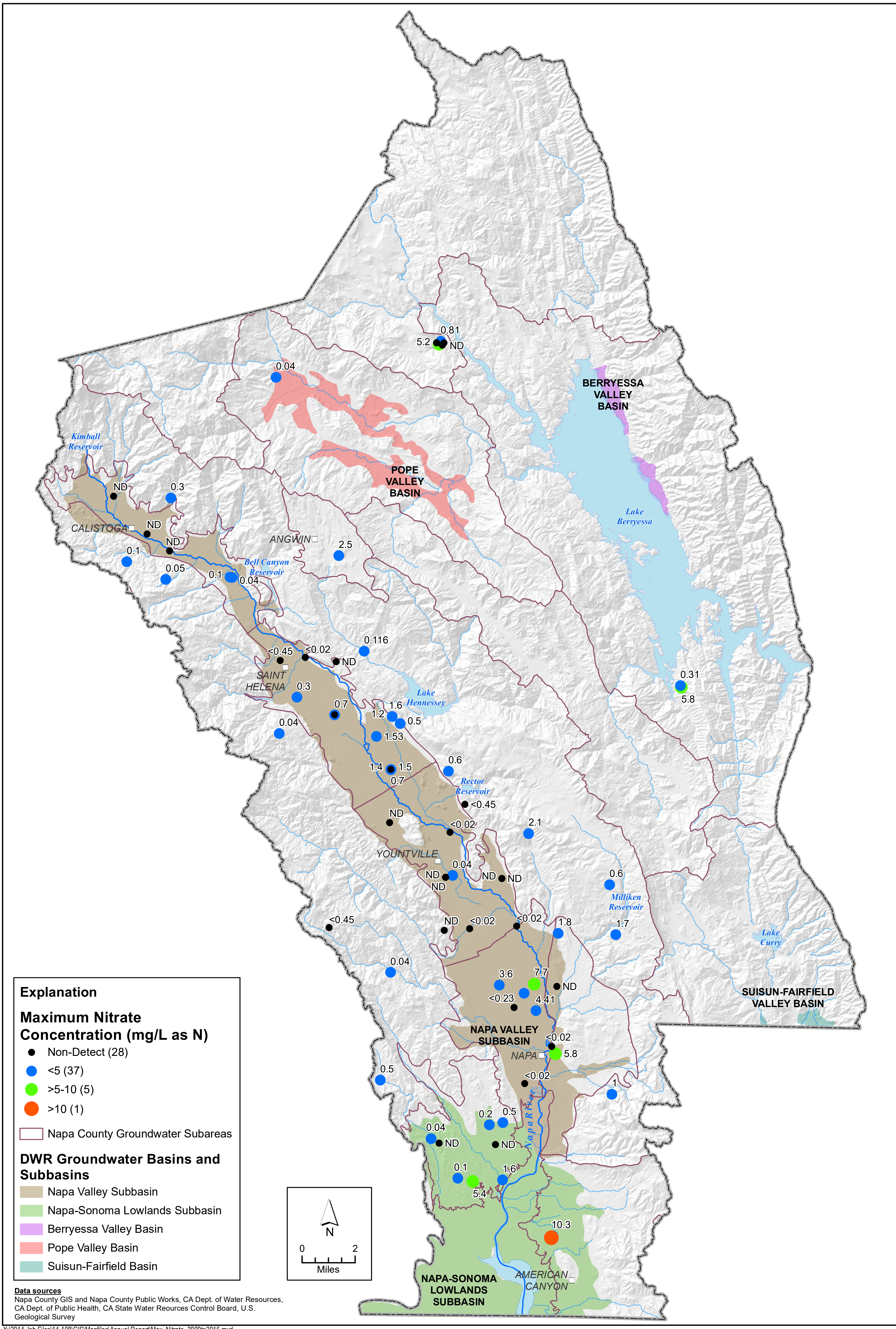

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FIGURE 6-5
Maximum Nitrate Concentrations in Groundwater, 2009 - 2015
Napa County, CA

Napa County Comprehensive Groundwater Monitoring Program
2015 Annual Report and CASGEM Update

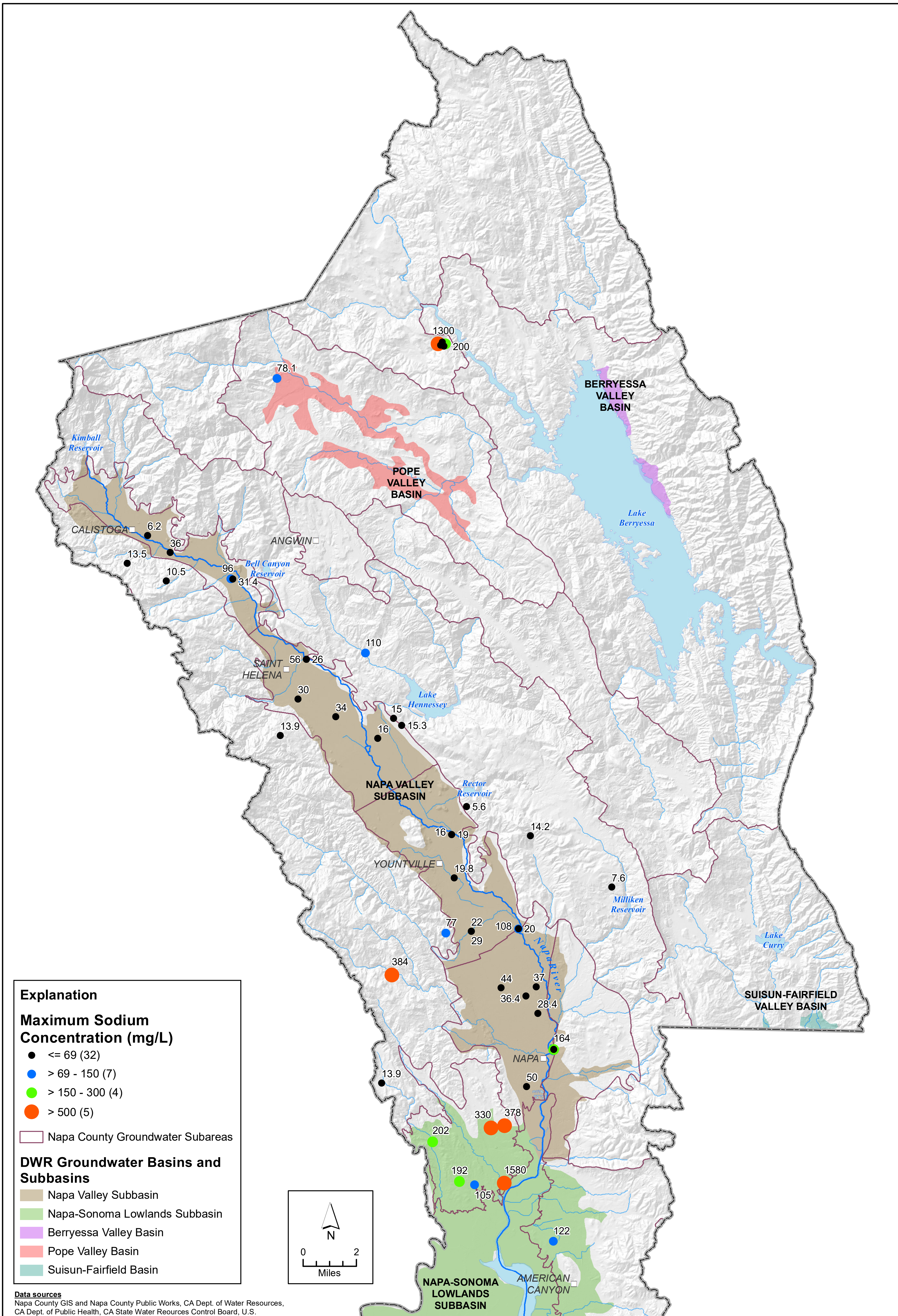

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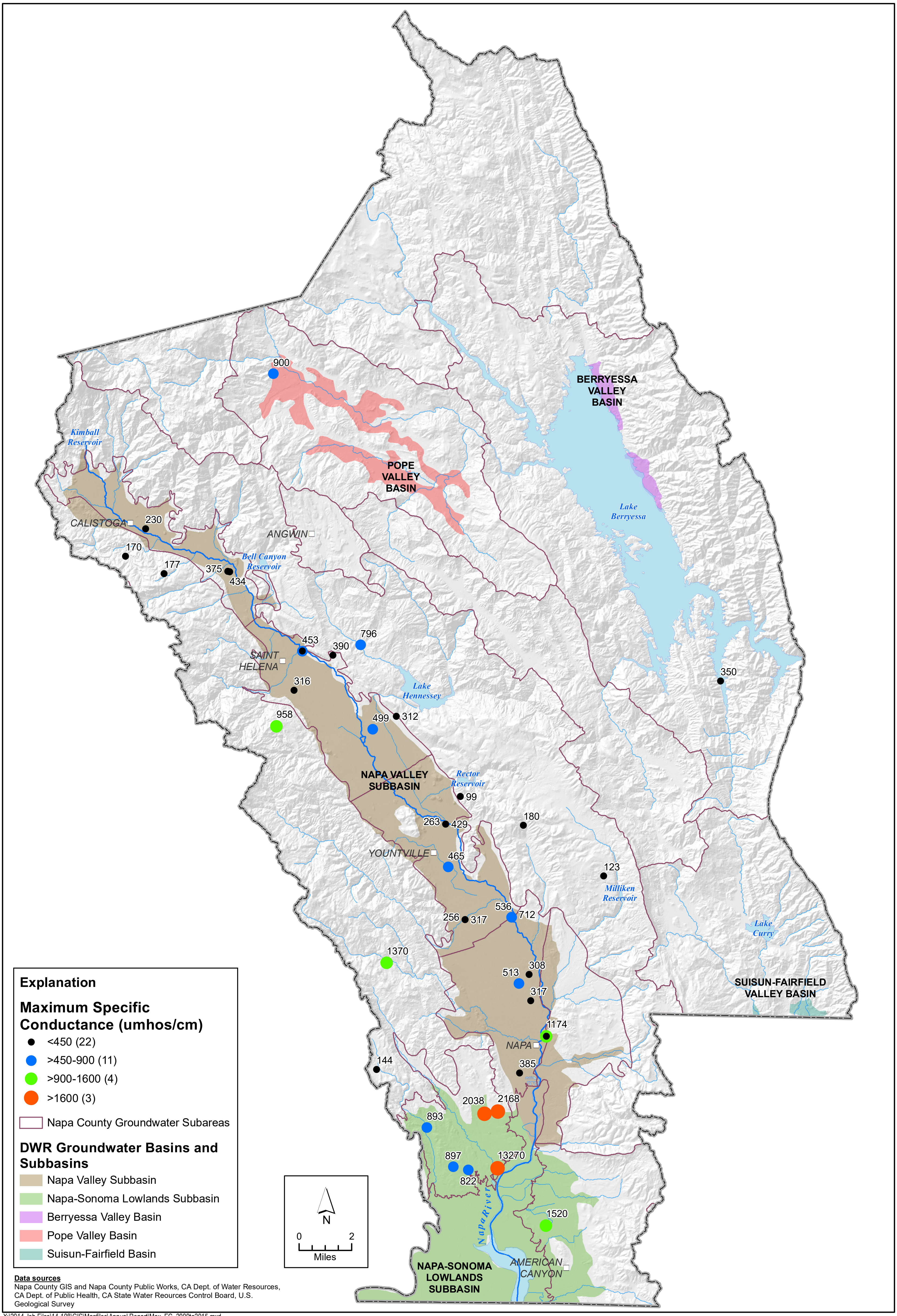
FIGURE 6-6
Maximum Sodium Concentrations in Groundwater, 2009 - 2015
Napa County, CA

Napa County Comprehensive Groundwater Monitoring Program
2015 Annual Report and CASGEM Update



X:\2014 Job Files\14-108\GIS\Mapfiles\Annual Report\Max_EC_2009to2015.mxd

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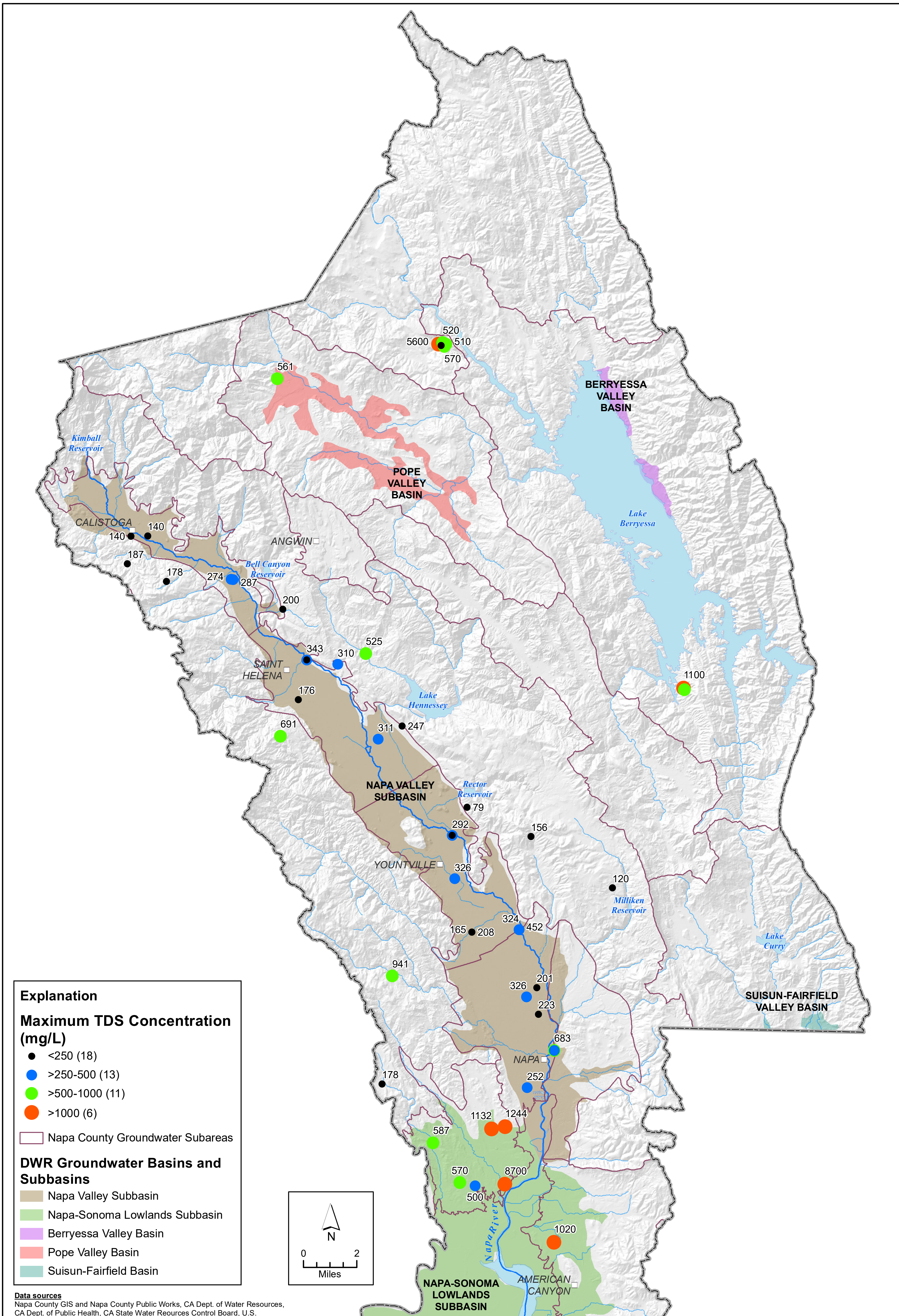
FIGURE 6-7
Maximum Specific Conductance Concentrations in Groundwater, 2009 - 2015
Napa County, CA

Napa County Comprehensive Groundwater Monitoring Program
2015 Annual Report and CASGEM Update



X:\2014 Job Files\14-108\GIS\Mapfiles\Annual Report\Max_TDS_2009to2015.mxd

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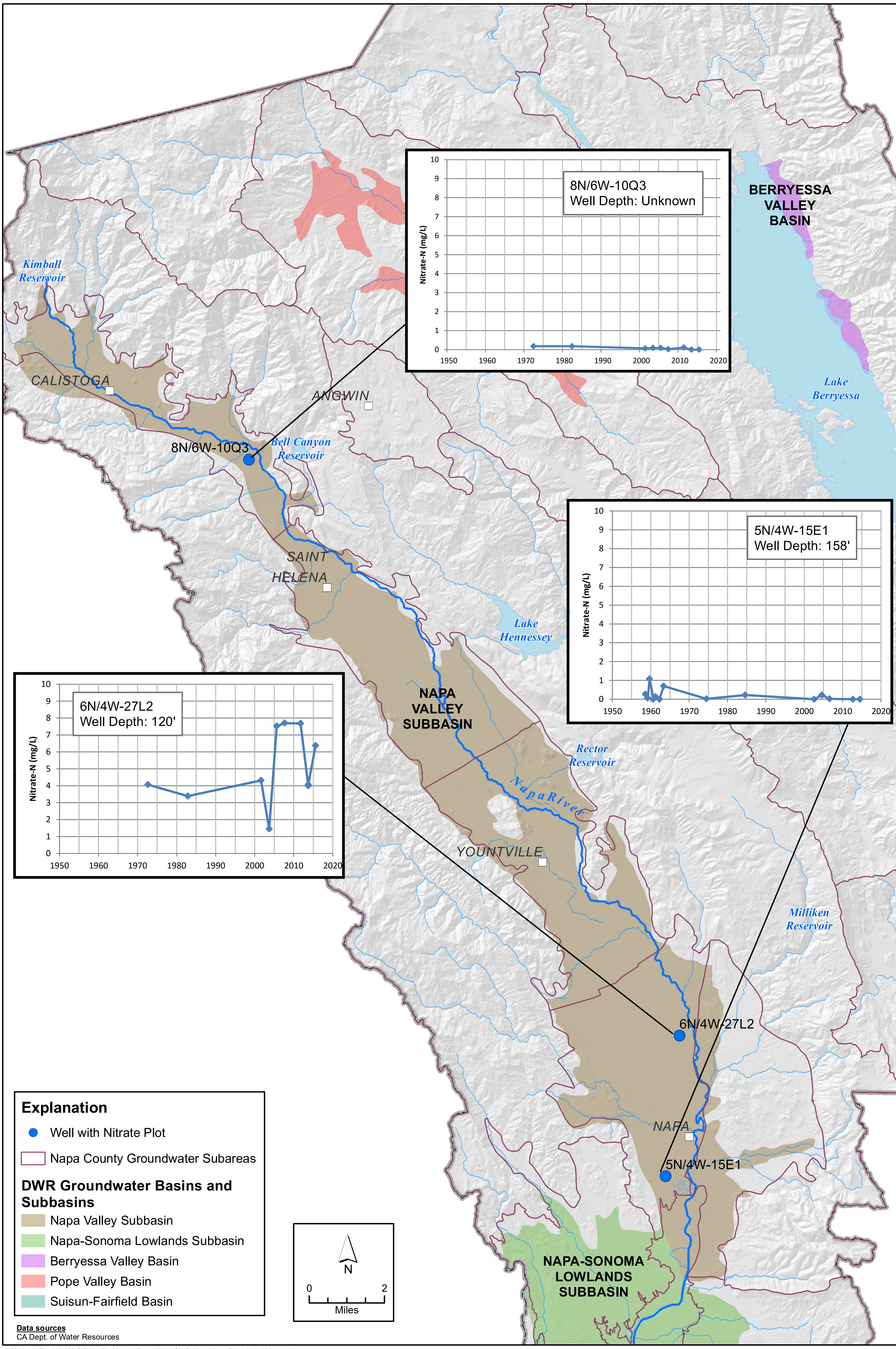
FIGURE 6-8
Maximum TDS Concentrations in Groundwater, 2009 - 2015
Napa County, CA

Napa County Comprehensive Groundwater Monitoring Program
2015 Annual Report and CASGEM Update



X:\2014 Job Files\14-108\GIS\Mapfiles\Annual Report\NapaGWQ_Map_NitratePlots_NapaValley.mxd

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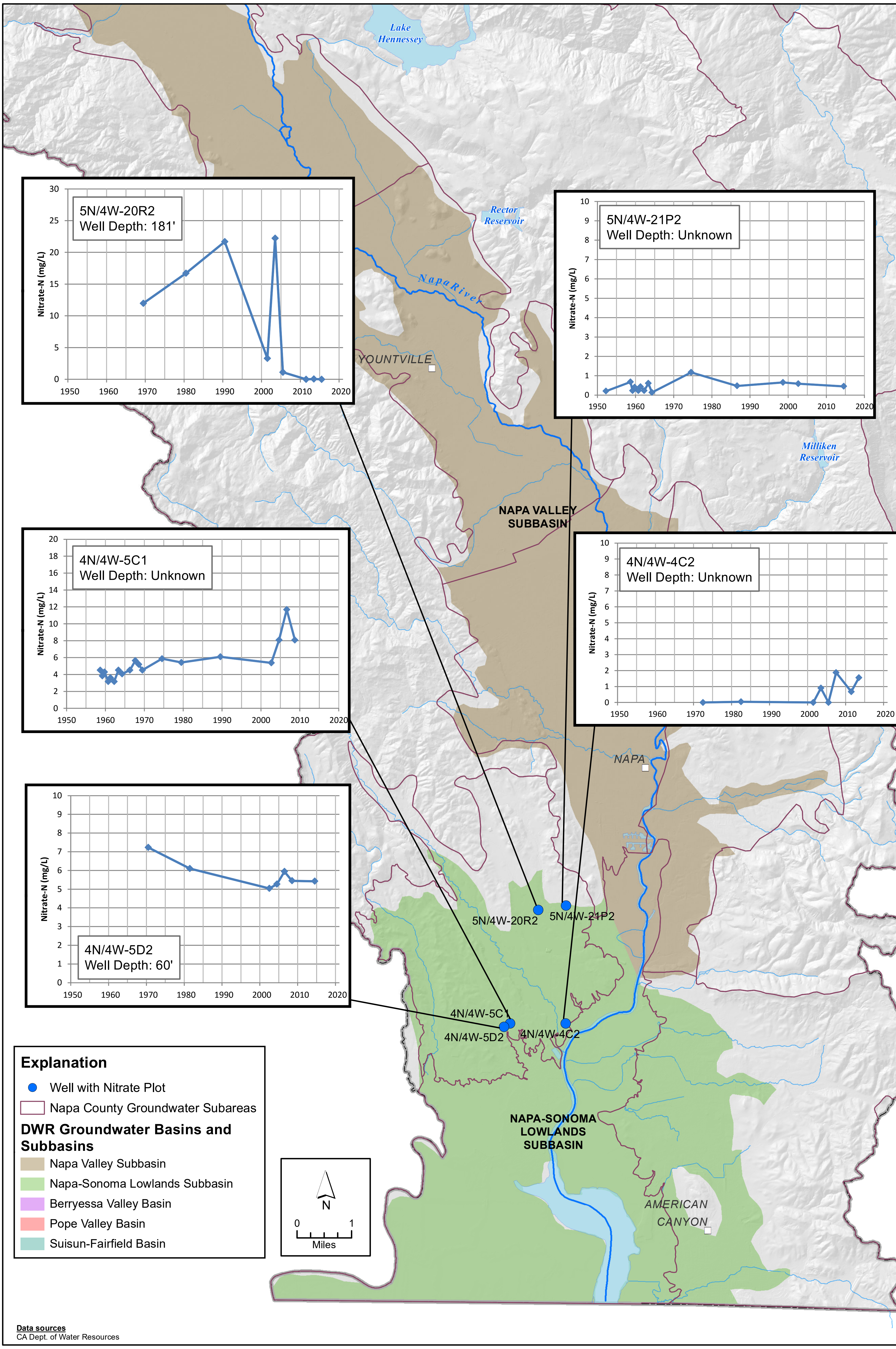
FIGURE 6-9
Nitrate Concentrations Time-Series Plots
Napa Valley Groundwater Subbasin, Napa County, CA



X:\2014 Job Files\14-108\GIS\Mapfiles\Annual Report\NapaGWQ_Map_NitratePlots_Lowlands.mxd

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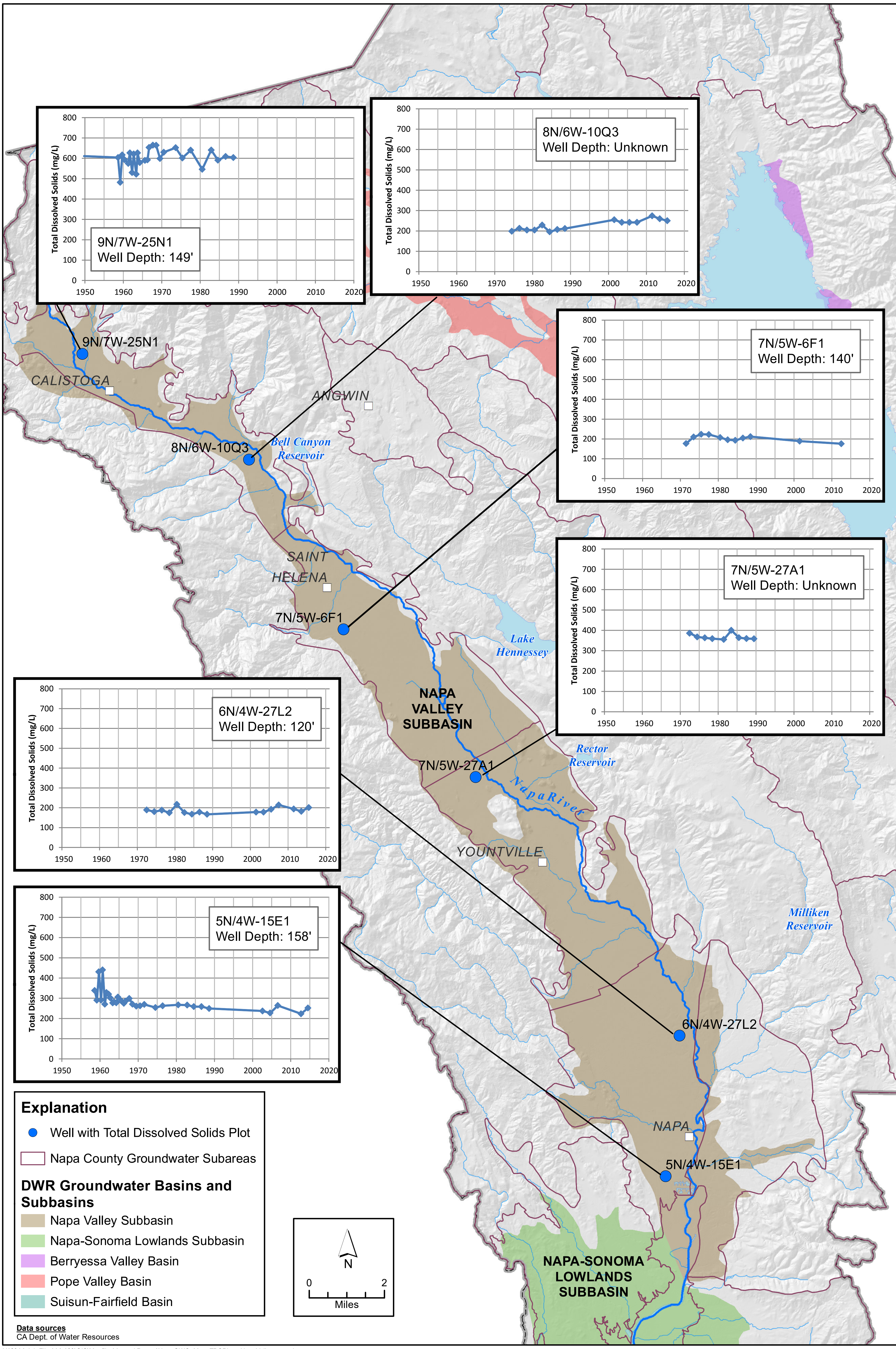
FIGURE 6-10
Nitrate Concentrations Time-Series Plots
Napa-Sonoma Lowlands Groundwater Subbasin, Napa County, CA



X:\2014 Job Files\14-108\GIS\Mapfiles\Annual Report\NapaGWQ_Map_TDSPlots_NapaValley__.mxd

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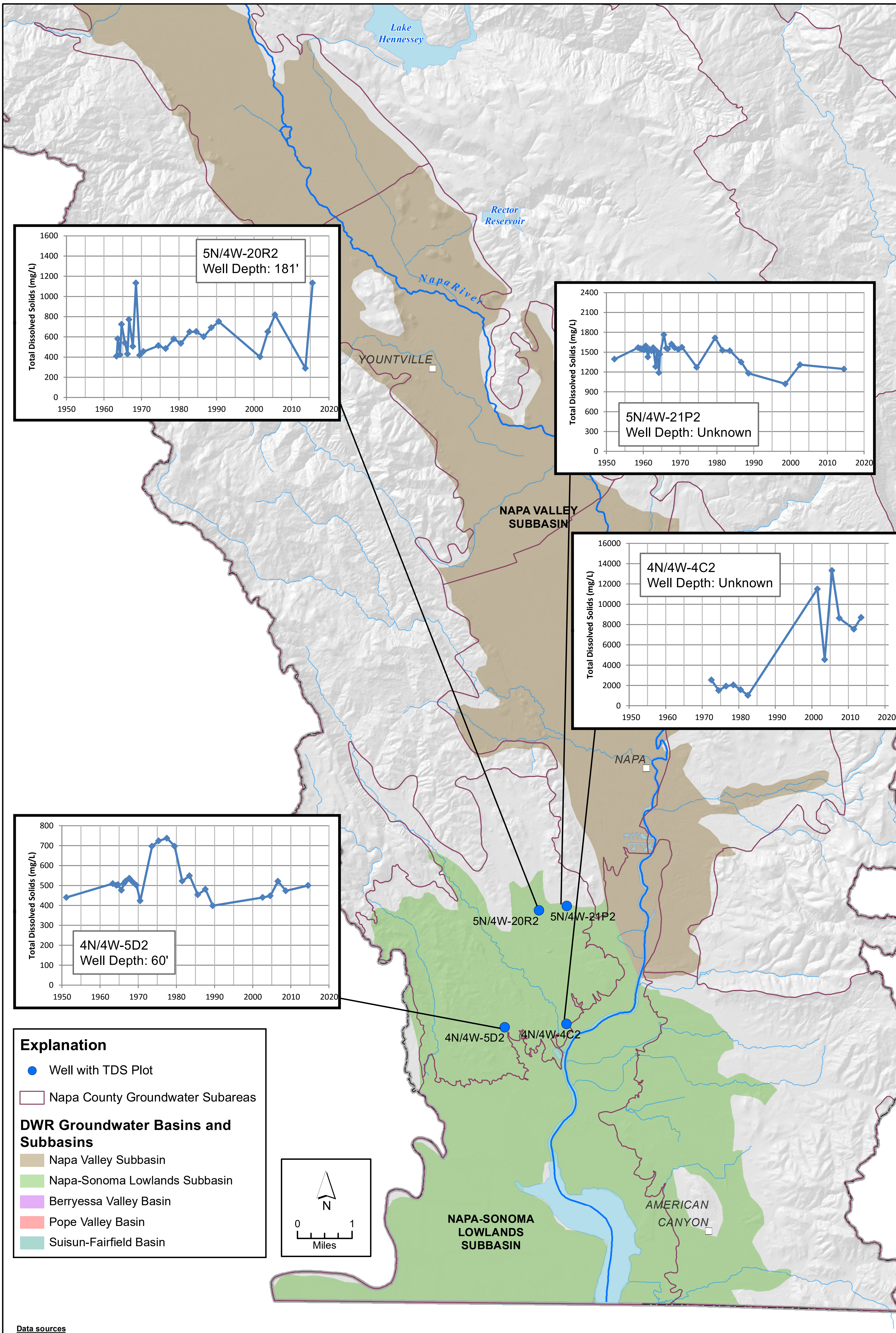
FIGURE 6-11
TDS Concentrations Time-Series Plots
Napa Valley Groundwater Subbasin, Napa County, CA



X:\2014 Job Files\14-108\GIS\Mapfiles\Annual Report\NapaGWQ_Map_TDS_Plots_Lowlands__.mxd

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FIGURE 6-12
TDS Concentrations Time-Series Plots
Napa-Sonoma Lowlands Groundwater Subbasin, Napa County, CA

APPENDIX A

Summary of Current Groundwater Level Monitoring Locations

Subarea	SWN	Well ID	Network as of 2015	Period of Record
Angwin		NapaCounty-165	No Reporting County Only	2014 - 2015
Angwin		NapaCounty-166	No Reporting County Only	2014 - 2015
Angwin		NapaCounty-167	No Reporting County Only	2014 - 2015
Angwin		NapaCounty-168	No Reporting County Only	2014 - 2015
Angwin		NapaCounty-202	CASGEM	2014 - 2015
Berryessa		T0605500298	Geotracker	2004 - 2015
Berryessa		T0605500304	Geotracker	2002 - 2015
Berryessa		T0605591908	Geotracker	2006 - 2015
Carneros	004N004W05C001M	NapaCounty-150	CASGEM	2011 - 2015
Carneros	004N004W05A001M	NapaCounty-153	CASGEM	2012 - 2015
Carneros	005N004W31R001M	NapaCounty-154	CASGEM	2012 - 2015
Carneros	004N004W06M001M	NapaCounty-155	CASGEM	2012 - 2015
Carneros		NapaCounty-176	No Reporting County Only	2014 - 2015
Carneros		NapaCounty-194	No Reporting County Only	2014 - 2015
Carneros		NapaCounty-195	CASGEM	2014 - 2015
Carneros		NapaCounty-200	CASGEM	2014 - 2015
Carneros		NapaCounty-201	CASGEM	2014 - 2015
Carneros		NapaCounty-205	No Reporting County Only	2014 - 2015
Carneros		NapaCounty-206	No Reporting County Only	2014 - 2015
Carneros		NapaCounty-207	No Reporting County Only	2014 - 2015
Central Interior Valleys		L10003756160	Geotracker	1990 - 2015
Central Interior Valleys		NapaCounty-209	No Reporting County Only	2014 - 2015
Eastern Mountains		NapaCounty-175	No Reporting County Only	2014 - 2015
Eastern Mountains		NapaCounty-193	No Reporting County Only	2014 - 2015
Eastern Mountains		NapaCounty-210	No Reporting County Only	2014 - 2015
Jameson American Canyon		NapaCounty-196	No Reporting County Only	2014 - 2015
NVF-Calistoga	008N006W10Q001M	08N06W10Q001M	Monthly DWR	1949 - 2015
NVF-Calistoga	009N007W25N001M	NapaCounty-127	Voluntary Reporting	1962 - 2015
NVF-Calistoga	009N006W31Q001M	NapaCounty-128	CASGEM	1962 - 2016
NVF-Calistoga	008N006W06L004M	NapaCounty-129	Voluntary Reporting	1962 - 2015
NVF-Calistoga		NapaCounty-178	No Reporting County Only	2014 - 2015
NVF-Calistoga		NapaCounty-203	No Reporting County Only	2014 - 2015
NVF-Calistoga		NapaCounty-224	No Reporting County Only	2014 - 2015

Subarea	SWN	Well ID	Network as of 2015	Period of Record
NVF-Calistoga		NapaCounty-225	No Reporting County Only	2014 - 2015
NVF-MST	005N003W05M001M	NapaCounty-10	Voluntary Reporting	1979 - 2015
NVF-MST	005N003W07B00_My	NapaCounty-118	No Reporting County Only	2001 - 2015
NVF-MST	006N004W26L00_M	NapaCounty-122	No Reporting County Only	2001 - 2015
NVF-MST	005N004W13H001M	NapaCounty-137	CASGEM	1979 - 2015
NVF-MST	006N004W25G00_M	NapaCounty-142	No Reporting County Only	2001 - 2015
NVF-MST	005N003W05M00_M	NapaCounty-148	Voluntary Reporting	2009 - 2015
NVF-MST	005N003W08E00_M	NapaCounty-149	No Reporting County Only	2010 - 2015
NVF-MST	005N004W13G004M	NapaCounty-18	No Reporting County Only	2000 - 2015
NVF-MST		NapaCounty-191	CASGEM	2014 - 2015
NVF-MST		NapaCounty-192	No Reporting County Only	2014 - 2015
NVF-MST	006N004W23J001M	NapaCounty-2	Voluntary Reporting	1979 - 2015
NVF-MST	005N003W07C003M	NapaCounty-20	Voluntary Reporting	1978 - 2015
NVF-MST	005N003W08E001M	NapaCounty-22	No Reporting County Only	2000 - 2015
NVF-MST		NapaCounty-226	No Reporting County Only	2015 - 2015
NVF-MST	005N003W18D001M	NapaCounty-35	No Reporting County Only	2000 - 2015
NVF-MST	006N004W23Q003M	NapaCounty-43	CASGEM	1978 - 2015
NVF-MST	005N004W14J003M	NapaCounty-49	CASGEM	1899 - 2015
NVF-MST	006N004W26G001M	NapaCounty-56	Voluntary Reporting	1978 - 2015
NVF-MST	006N004W35G005M	NapaCounty-69	No Reporting County Only	2000 - 2015
NVF-MST	005N003W07D003M	NapaCounty-72	No Reporting County Only	2000 - 2015
NVF-MST	005N003W06M001M	NapaCounty-74	CASGEM	1999 - 2015
NVF-MST	005N003W07F003M	NapaCounty-81	No Reporting County Only	2000 - 2015
NVF-MST	005N003W06B002M	NapaCounty-91	CASGEM	1992 - 2014
NVF-MST	005N003W06A001M	NapaCounty-92	CASGEM	1999 - 2015
NVF-MST	006N004W36G001M	NapaCounty-95	Voluntary Reporting	1979 - 2015
NVF-MST	006N004W36A001M	NapaCounty-98	No Reporting County Only	2000 - 2015
NVF-MST		T0605500200	Geotracker	2014 - 2015
NVF-MST		T10000005248	Geotracker	2013 - 2015
NVF-Napa	006N004W27L002M	06N04W27L002M	Monthly DWR	1966 - 2015
NVF-Napa	006N004W27N001M	NapaCounty-136	CASGEM	1979 - 2016
NVF-Napa	006N004W28Mx	NapaCounty-152	No Reporting County Only	2012 - 2015
NVF-Napa		NapaCounty-182	CASGEM	2014 - 2016

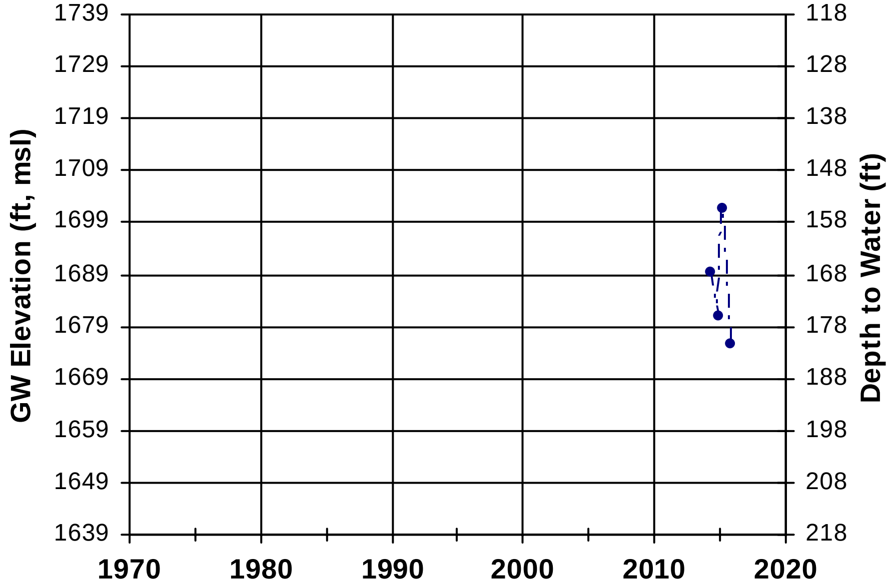
Subarea	SWN	Well ID	Network as of 2015	Period of Record
NVF-Napa		NapaCounty-183	No Reporting County Only	2014 - 2015
NVF-Napa		NapaCounty-184	No Reporting County Only	2014 - 2015
NVF-Napa		NapaCounty-185	No Reporting County Only	2014 - 2016
NVF-Napa		NapaCounty-187	No Reporting County Only	2014 - 2015
NVF-Napa		NapaCounty-188	No Reporting County Only	2014 - 2015
NVF-Napa		NapaCounty-189	No Reporting County Only	2014 - 2015
NVF-Napa		NapaCounty-227	CASGEM	2015 - 2015
NVF-Napa		NapaCounty-228	No Reporting County Only	2015 - 2015
NVF-Napa	006N004W15R003M	NapaCounty-76	No Reporting County Only	2000 - 2015
NVF-Napa		NapaCounty-swgw1	CASGEM	2014 - 2015
NVF-Napa		NapaCounty-swgw3	CASGEM	2014 - 2015
NVF-Napa		SL0605536682	Geotracker	2005 - 2015
NVF-Napa		T0605500009	Geotracker	2005 - 2015
NVF-Napa		T0605514064	Geotracker	2005 - 2015
NVF-Saint Helena	007N005W09Q002M	07N05W09Q002M	Monthly DWR	1949 - 2015
NVF-Saint Helena	007N005W16L001M	NapaCounty-131	CASGEM	1963 - 2015
NVF-Saint Helena	007N005W14B002M	NapaCounty-132	CASGEM	1962 - 2016
NVF-Saint Helena	007N005W16N002M	NapaCounty-138	CASGEM	1949 - 2015
NVF-Saint Helena		NapaCounty-169	CASGEM	2014 - 2015
NVF-Saint Helena		NapaCounty-171	No Reporting County Only	2014 - 2016
NVF-Saint Helena		NapaCounty-172	No Reporting County Only	2014 - 2015
NVF-Saint Helena		NapaCounty-173	No Reporting County Only	2014 - 2015
NVF-Saint Helena		NapaCounty-174	No Reporting County Only	2014 - 2015
NVF-Saint Helena		NapaCounty-177	No Reporting County Only	2014 - 2015
NVF-Saint Helena		NapaCounty-204	No Reporting County Only	2014 - 2015
NVF-Saint Helena		NapaCounty-212	No Reporting County Only	2015 - 2015
NVF-Saint Helena		NapaCounty-swgw5	CASGEM	2014 - 2015
NVF-Yountville	006N004W17A001M	06N04W17A001M	Semi-annual DWR	1949 - 2015
NVF-Yountville	006N004W09Q001M	NapaCounty-125	CASGEM	1979 - 2015
NVF-Yountville	006N004W09Q002M	NapaCounty-126	CASGEM	1984 - 2015
NVF-Yountville	007N004W31M001M	NapaCounty-133	Voluntary Reporting	1978 - 2016
NVF-Yountville	006N004W06L002M	NapaCounty-134	CASGEM	1963 - 2015
NVF-Yountville	006N004W19B001M	NapaCounty-135	Voluntary Reporting	1979 - 2016

Subarea	SWN	Well ID	Network as of 2015	Period of Record
NVF-Yountville	006N004W17R002M	NapaCounty-139	CASGEM	1978 - 2015
NVF-Yountville		NapaCounty-179	CASGEM	2014 - 2015
NVF-Yountville		NapaCounty-180	CASGEM	2014 - 2015
NVF-Yountville		NapaCounty-181	No Reporting County Only	2014 - 2015
NVF-Yountville		NapaCounty-swgw2	CASGEM	2014 - 2015
NVF-Yountville		NapaCounty-swgw4	CASGEM	2014 - 2015
Pope Valley		NapaCounty-211	No Reporting County Only	2014 - 2015
Western Mountains		NapaCounty-208	CASGEM	2014 - 2015
Western Mountains		NapaCounty-213	CASGEM	2014 - 2015

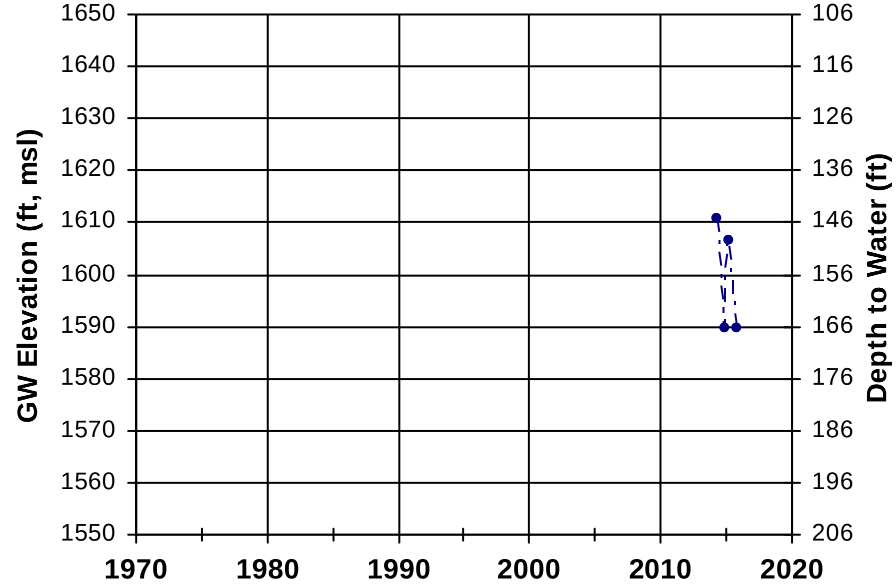
APPENDIX B

Groundwater Level Hydrographs for Current Monitoring Locations

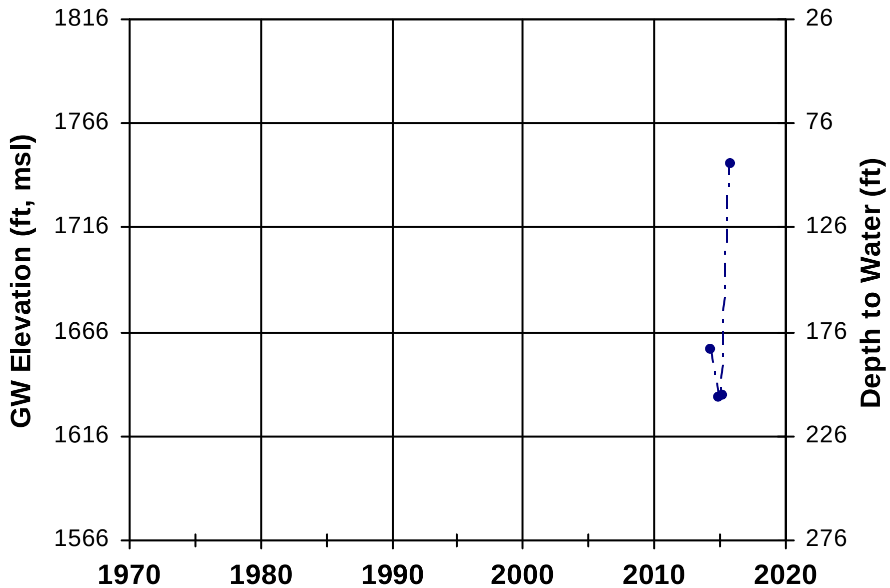
WellID: **NapaCounty-165** RPE: 1857 ft, msl Subarea: Ang
SWN: Unknown Source: NapaCounty



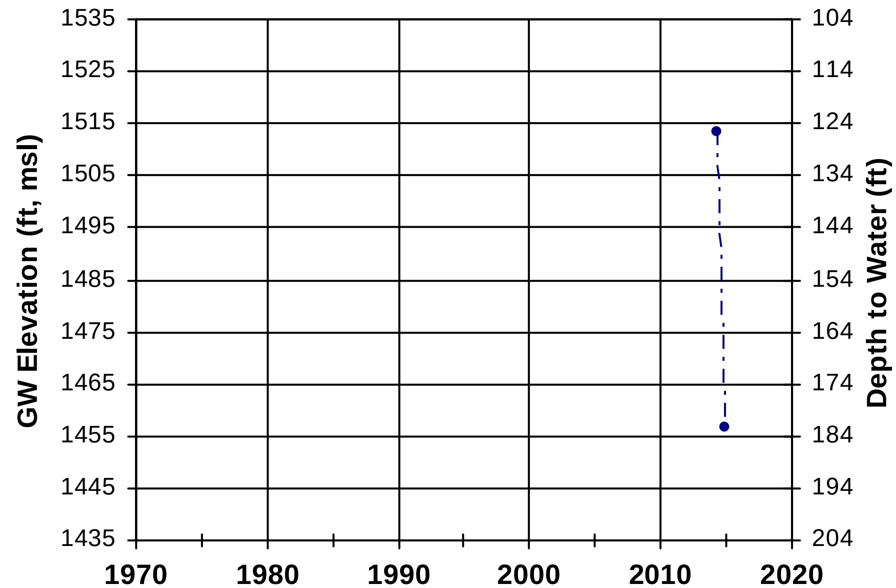
WellID: **NapaCounty-166** RPE: 1755.8 ft, msl Subarea: Ang
SWN: Unknown Source: NapaCounty



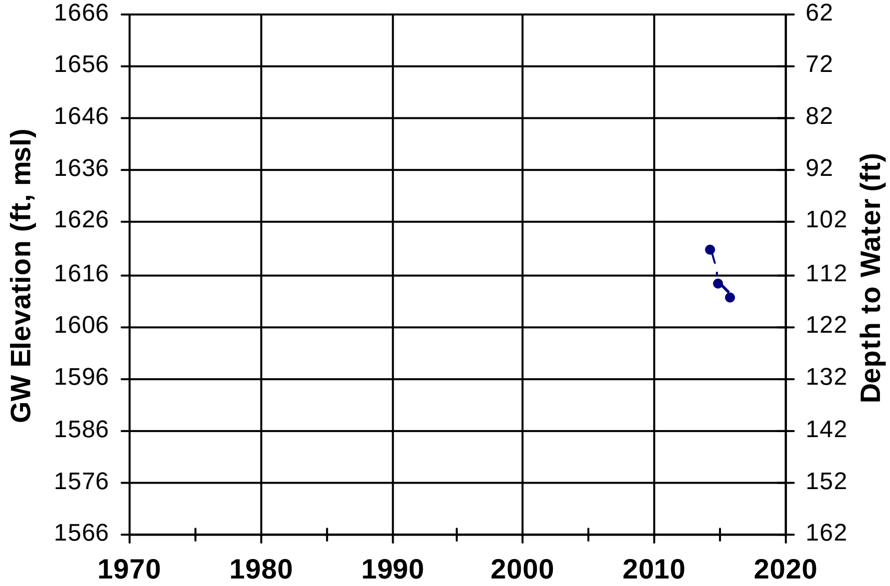
WellID: **NapaCounty-167** RPE: 1842.3 ft, msl Subarea: Ang
SWN: Unknown Source: NapaCounty



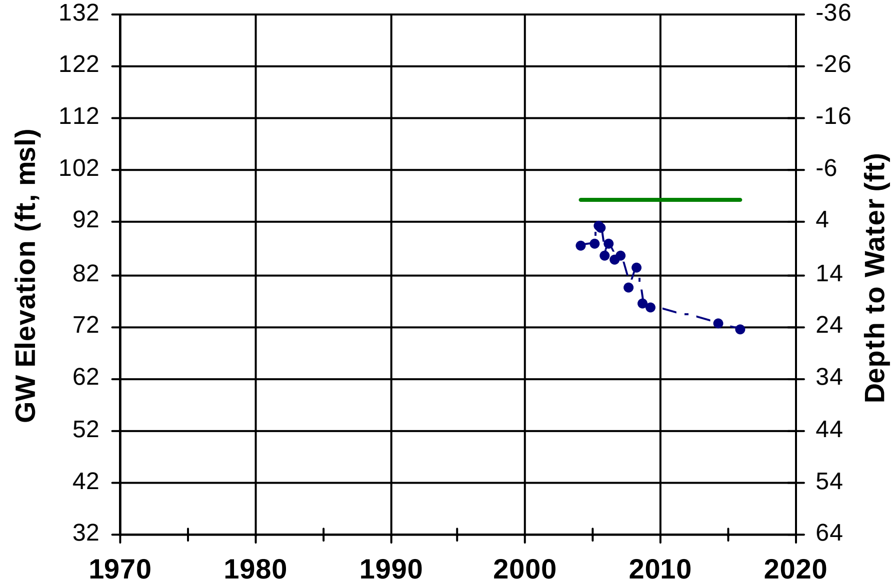
WellID: **NapaCounty-168** RPE: 1639 ft, msl Subarea: Ang
SWN: Unknown Source: NapaCounty



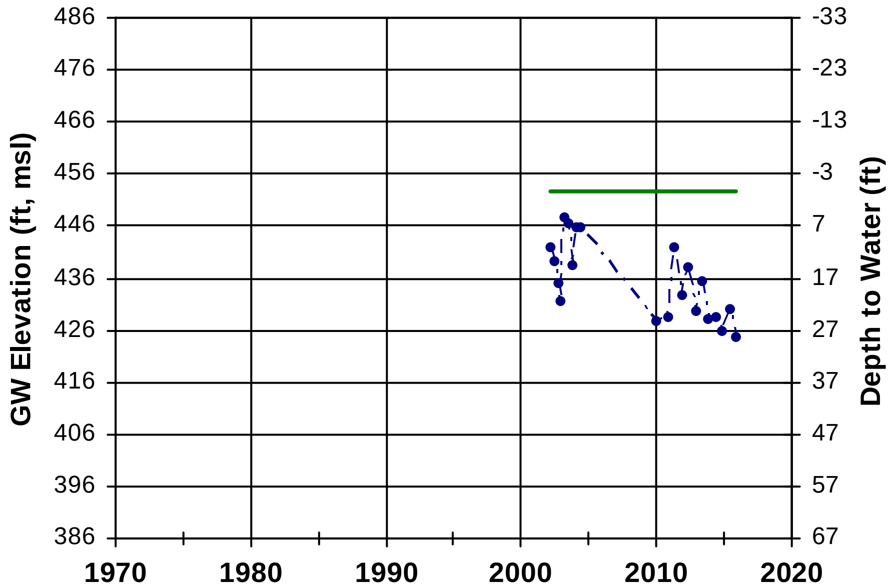
WellID: **NapaCounty-202** RPE: 1728.2 ft, msl Subarea: Ang
SWN: Unknown Source: NapaCounty



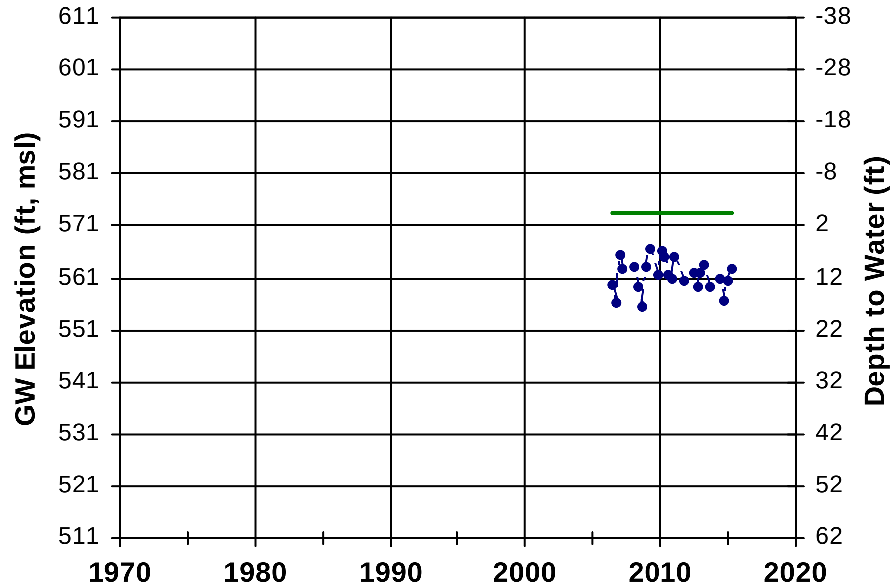
WellID: **T0605500298MW-1** RPE: 96.47 ft, msl Subarea: Berryessa
SWN: Unknown Source: Geotracker



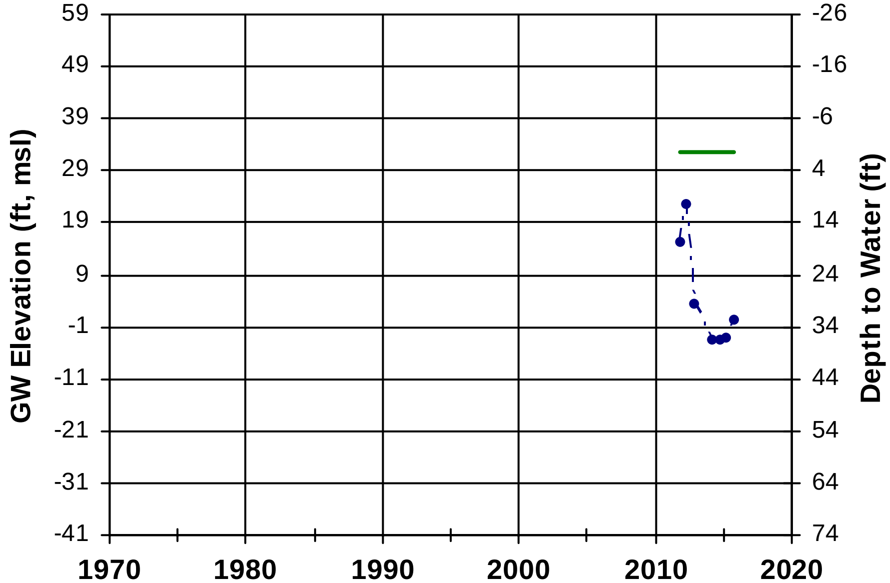
WellID: **T0605500304MW-1** RPE: 452.82 ft, msl Subarea: Berryessa
SWN: Unknown Source: Geotracker



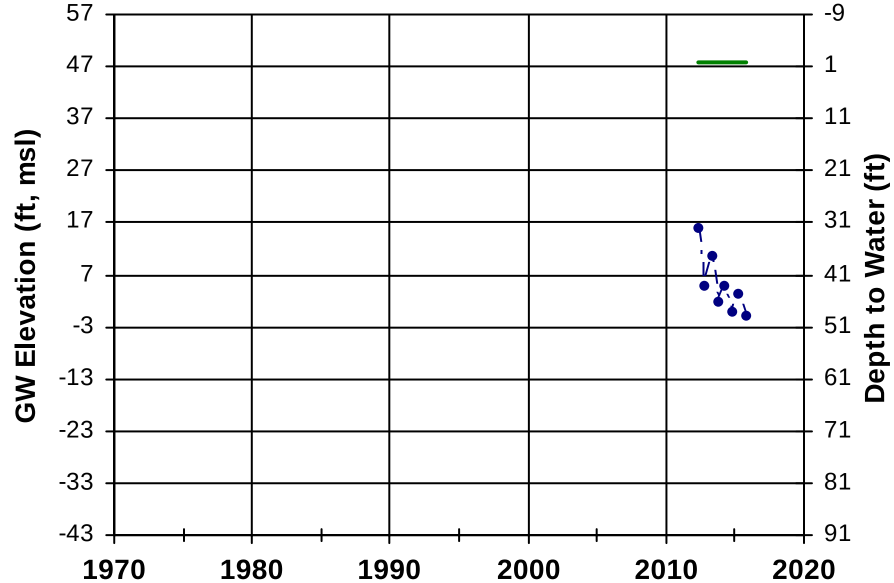
WellID: **T0605591908MW-1** RPE: 573.28 ft, msl Subarea: Berryessa
SWN: Unknown Source: Geotracker



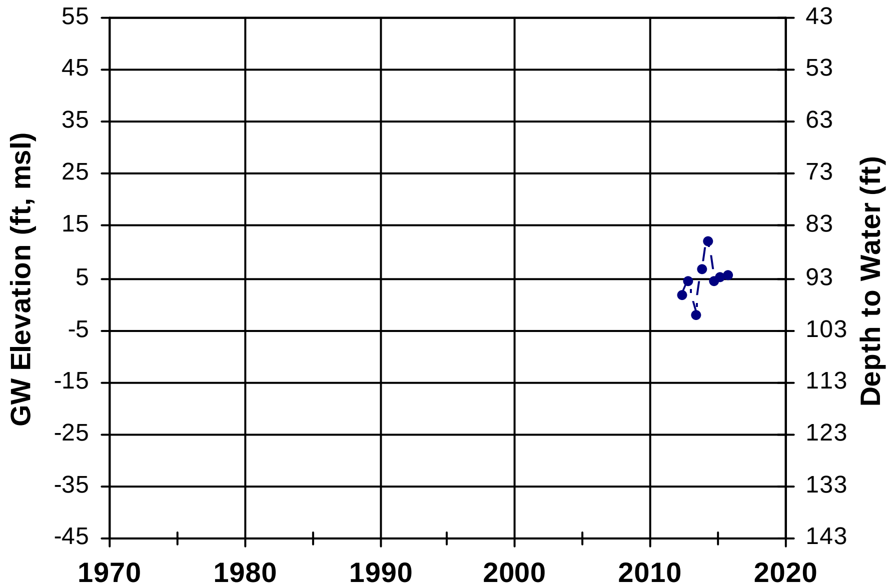
WellID: **NapaCounty-150** RPE: 32.7 ft, msl Subarea: Carn
SWN: 004N004W05C001M Source: NapaCounty



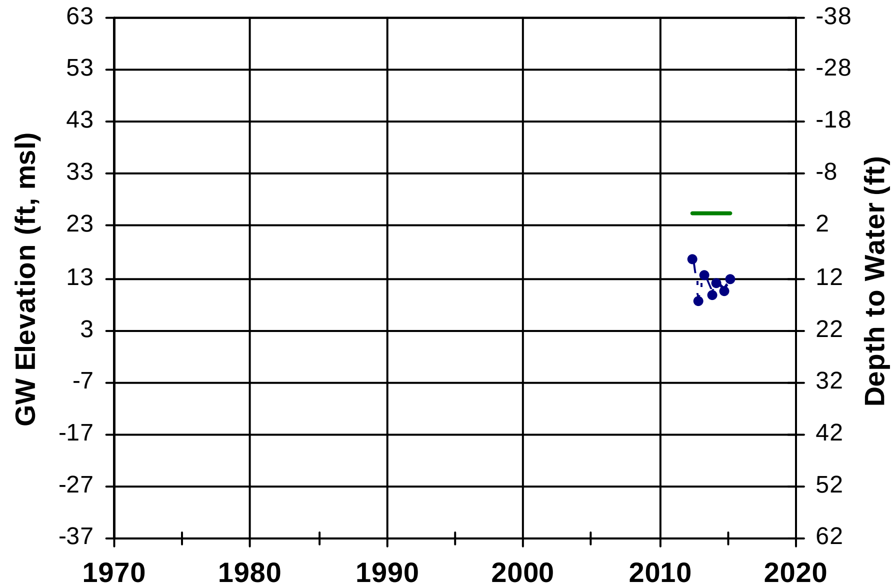
WellID: **NapaCounty-153** RPE: 47.65 ft, msl Subarea: Carn
SWN: 004N004W05A001M Source: NapaCounty



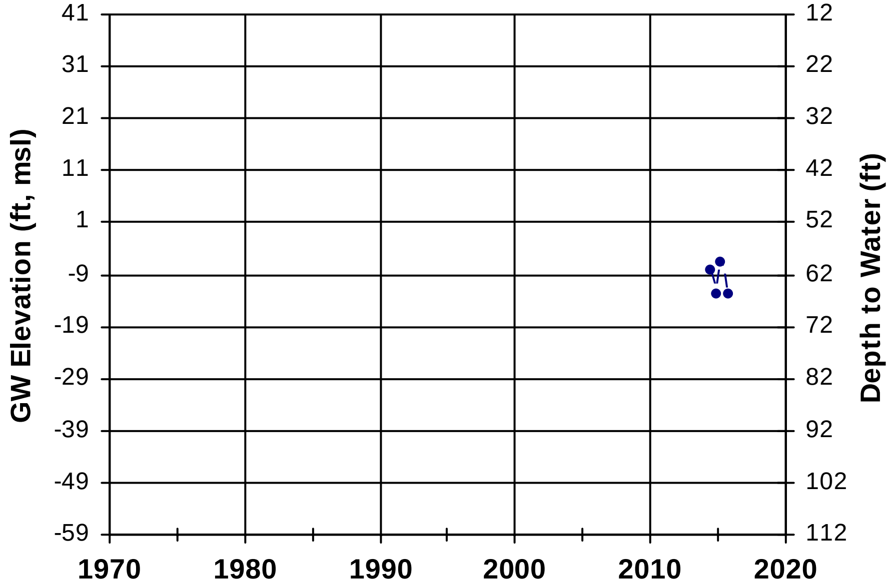
WellID: **NapaCounty-154** RPE: 98.3 ft, msl Subarea: Carn
SWN: 005N004W31R001M Source: NapaCounty



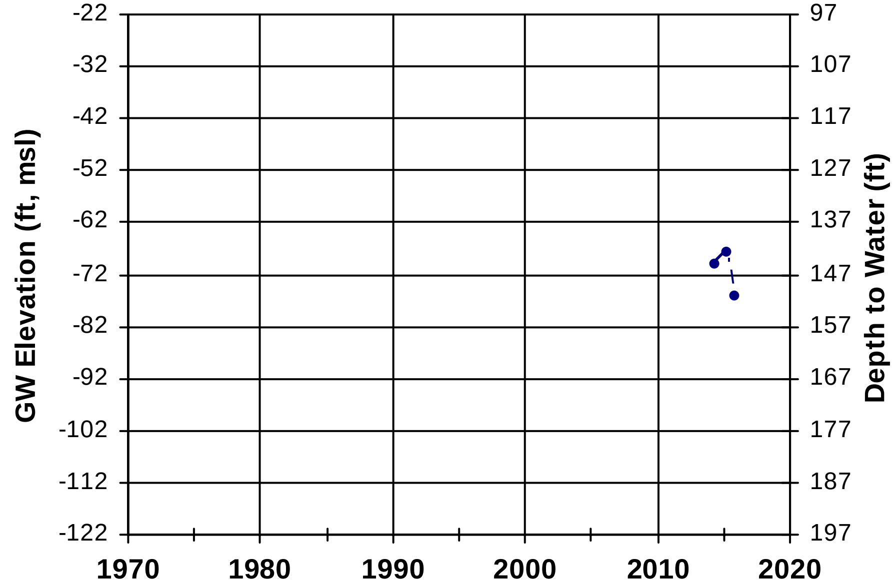
WellID: **NapaCounty-155** RPE: 25.3 ft, msl Subarea: Carn
SWN: 004N004W06M001M Source: NapaCounty



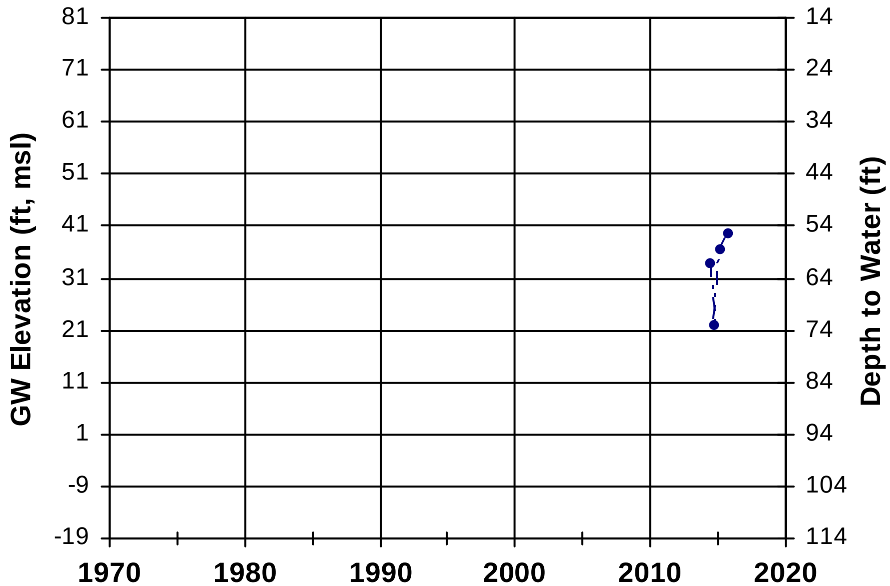
WellID: **NapaCounty-176** RPE: 53.4 ft, msl Subarea: Carn
SWN: Unknown Source: NapaCounty



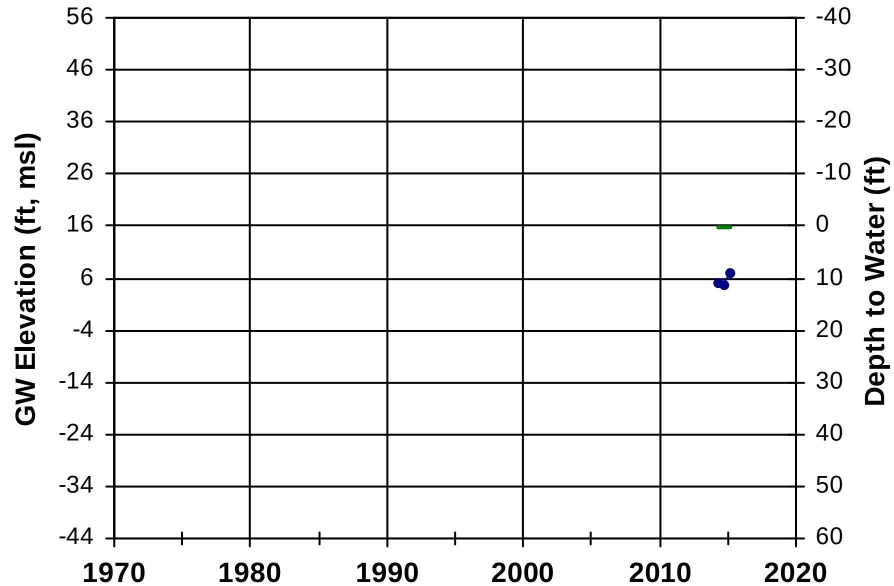
WellID: **NapaCounty-194** RPE: 75.1 ft, msl Subarea: Carn
SWN: Unknown Source: NapaCounty



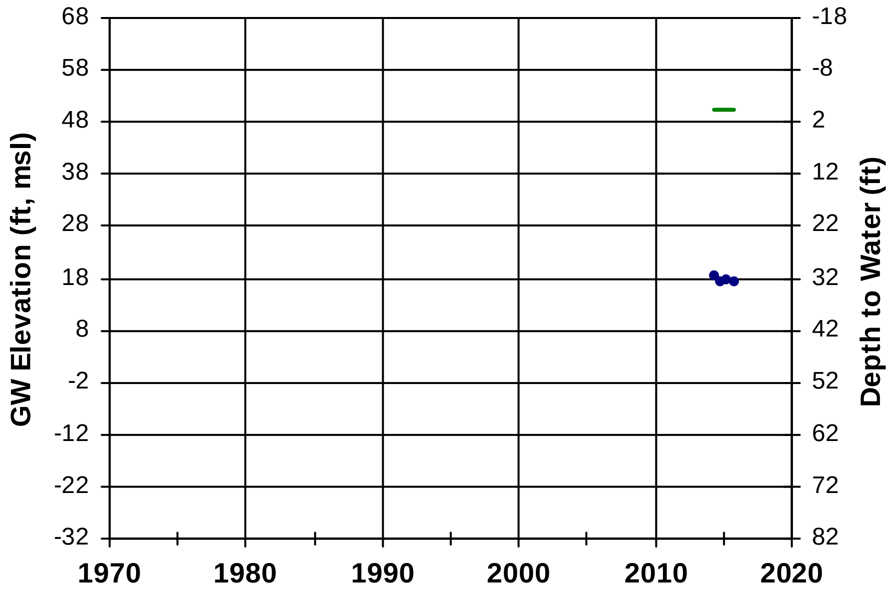
WellID: **NapaCounty-195** RPE: 94.8 ft, msl Subarea: Carn
SWN: Unknown Source: NapaCounty



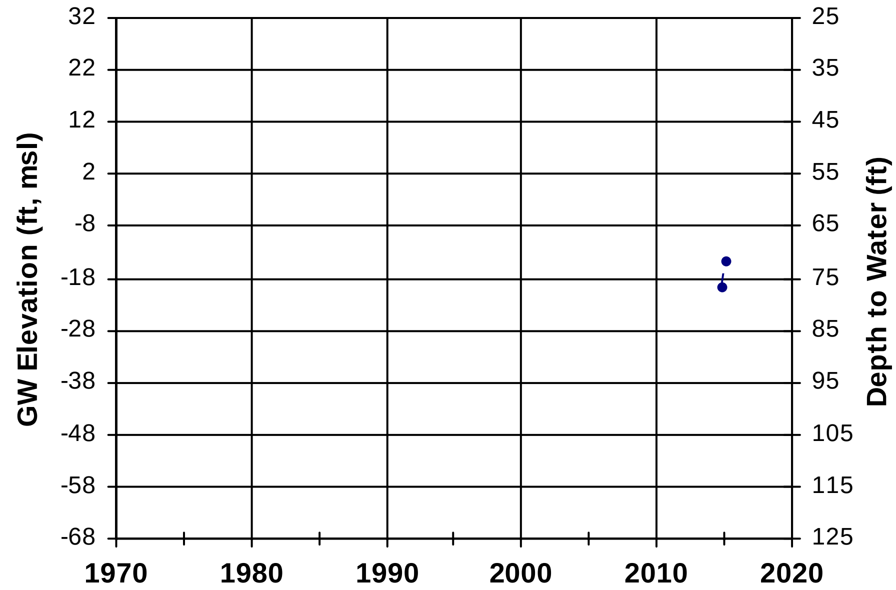
WellID: **NapaCounty-200** RPE: 15.7 ft, msl Subarea: Carn
SWN: Unknown Source: NapaCounty



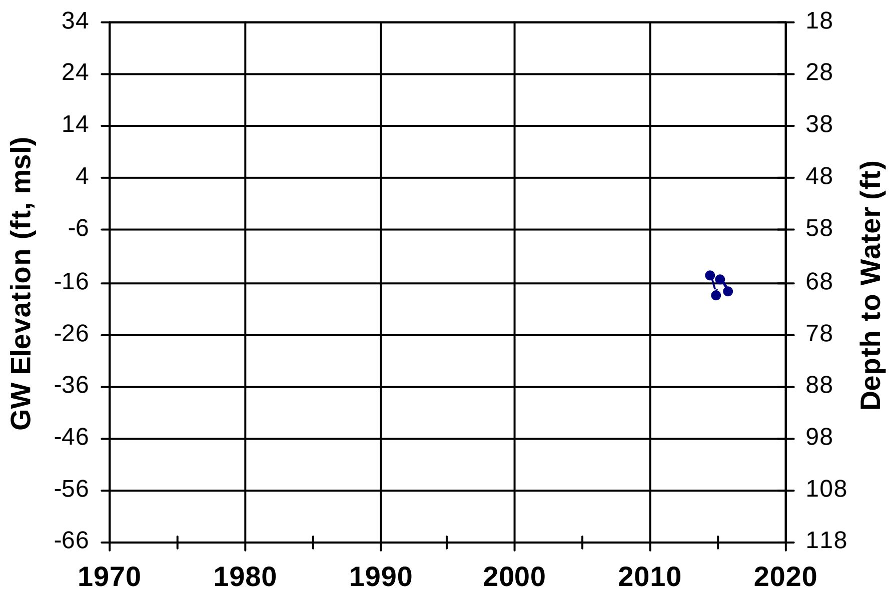
WellID: **NapaCounty-201** RPE: 50.4 ft, msl Subarea: Carn
SWN: Unknown Source: NapaCounty



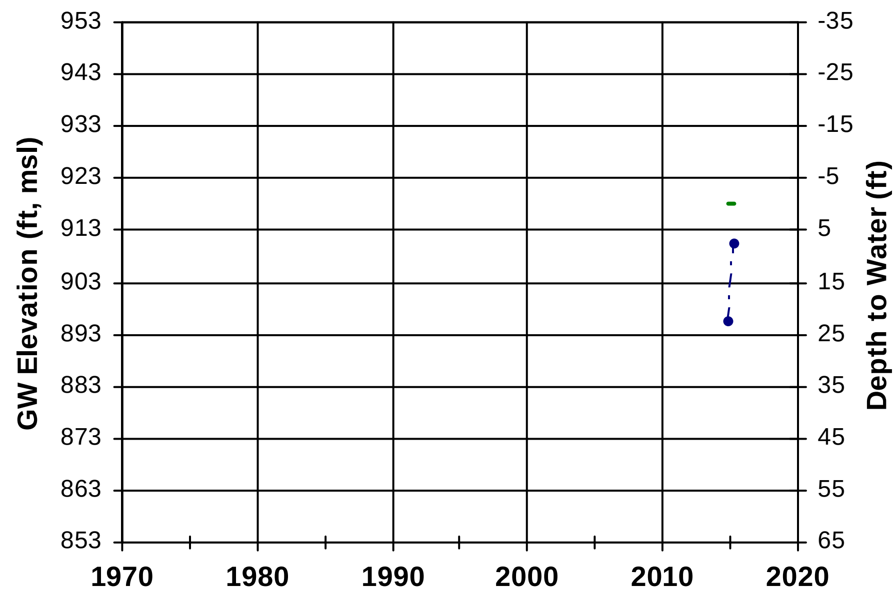
WellID: **NapaCounty-205** RPE: 56.8 ft, msl Subarea: Carn
SWN: Unknown Source: NapaCounty



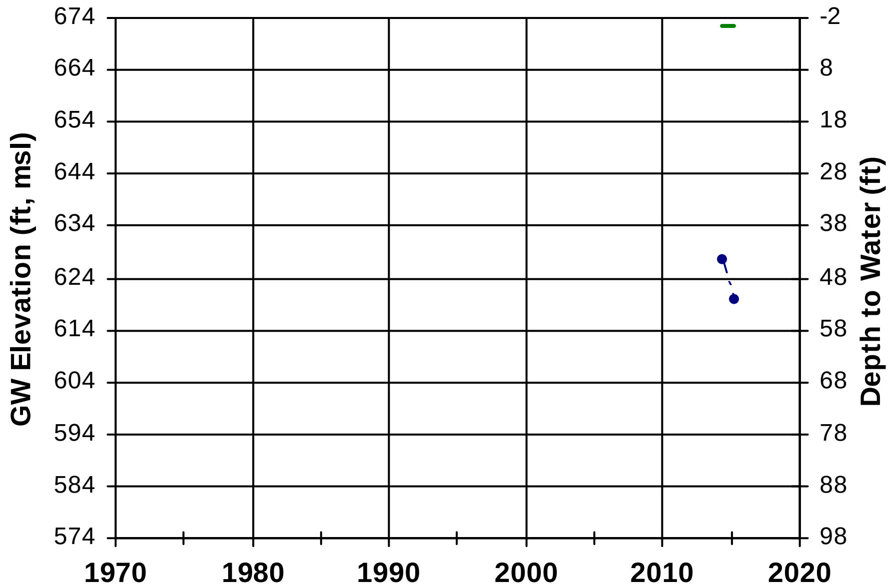
WellID: **NapaCounty-206** RPE: 52.4 ft, msl Subarea: Carn
SWN: Unknown Source: NapaCounty



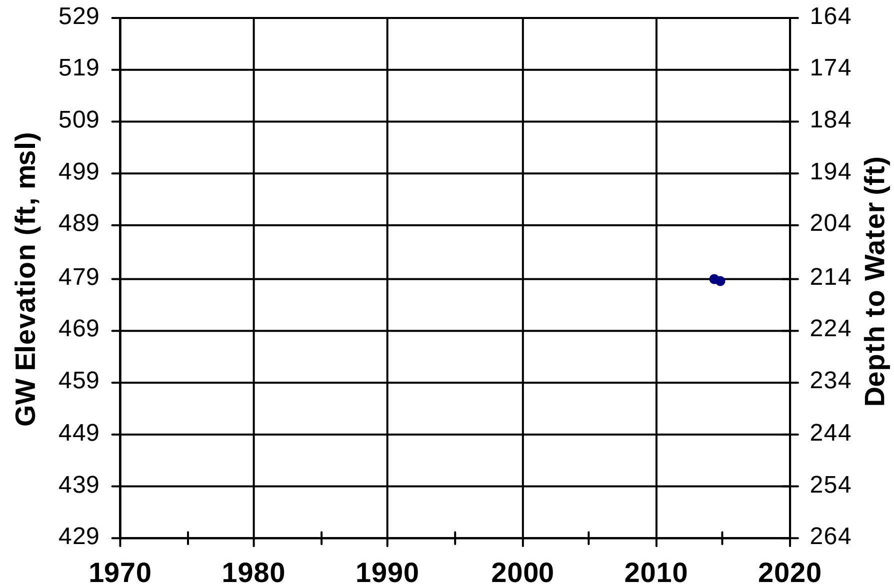
WellID: **NapaCounty-209** RPE: 918 ft, msl Subarea: Cent_Int_Val
SWN: Unknown Source: NapaCounty



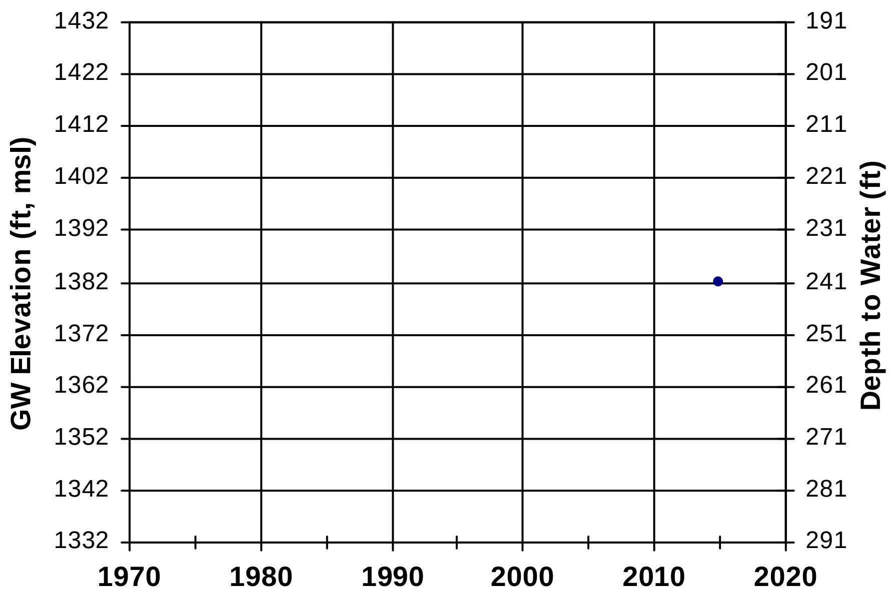
WellID: **NapaCounty-175** RPE: 672.3 ft, msl Subarea: East_Mnts
SWN: Unknown Source: NapaCounty



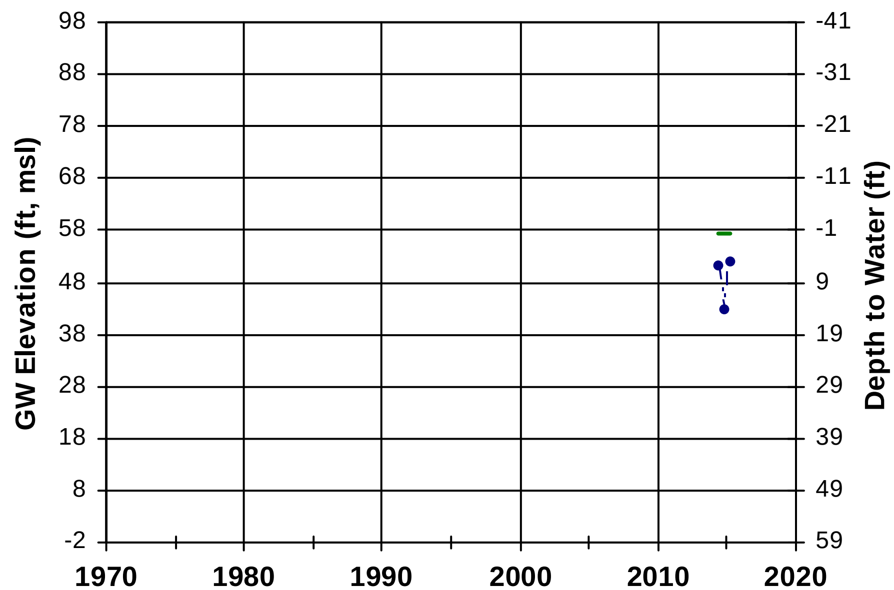
WellID: **NapaCounty-193** RPE: 693.1 ft, msl Subarea: East_Mnts
SWN: Unknown Source: NapaCounty



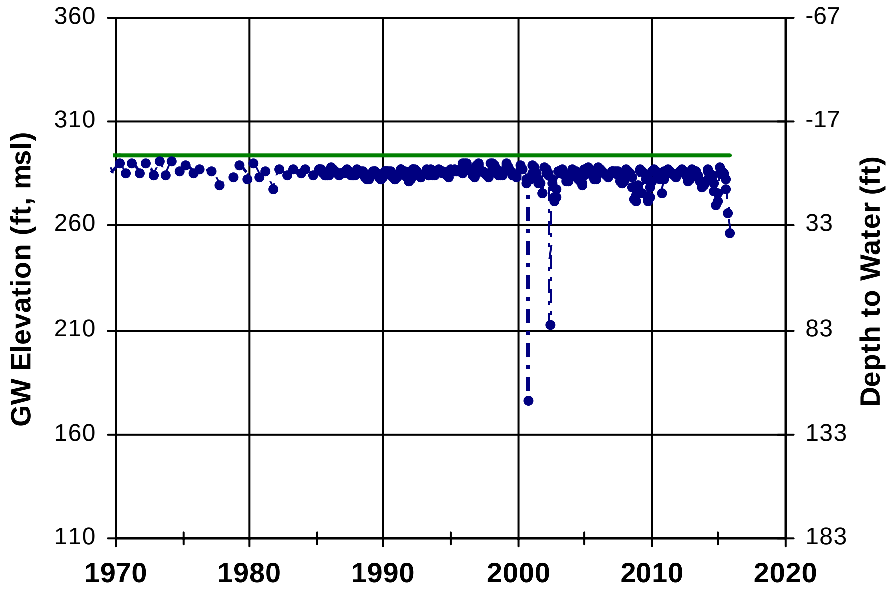
WellID: **NapaCounty-210** RPE: 1622.9 ft, msl Subarea: East_Mnts
SWN: Unknown Source: NapaCounty



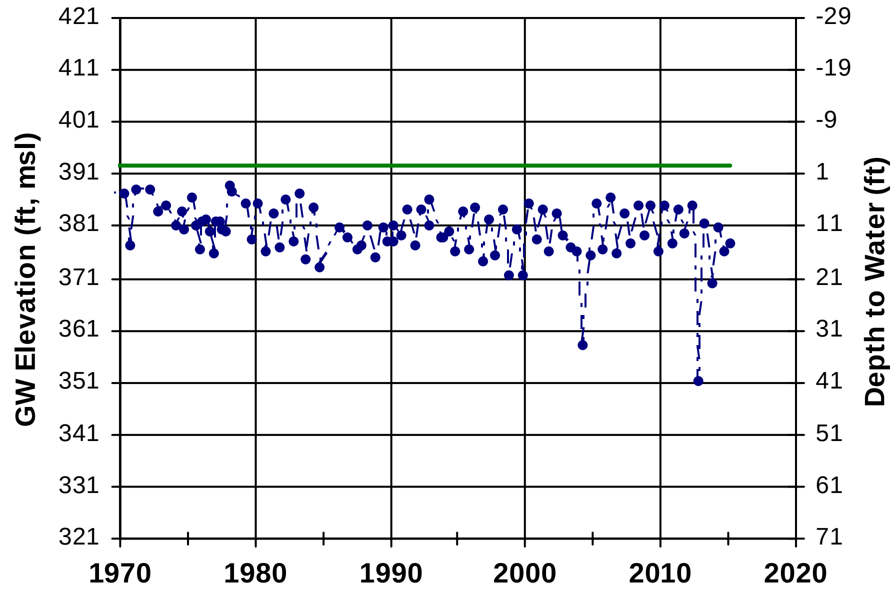
WellID: **NapaCounty-196** RPE: 57.4 ft, msl Subarea: Jam_AmerCan
SWN: Unknown Source: NapaCounty



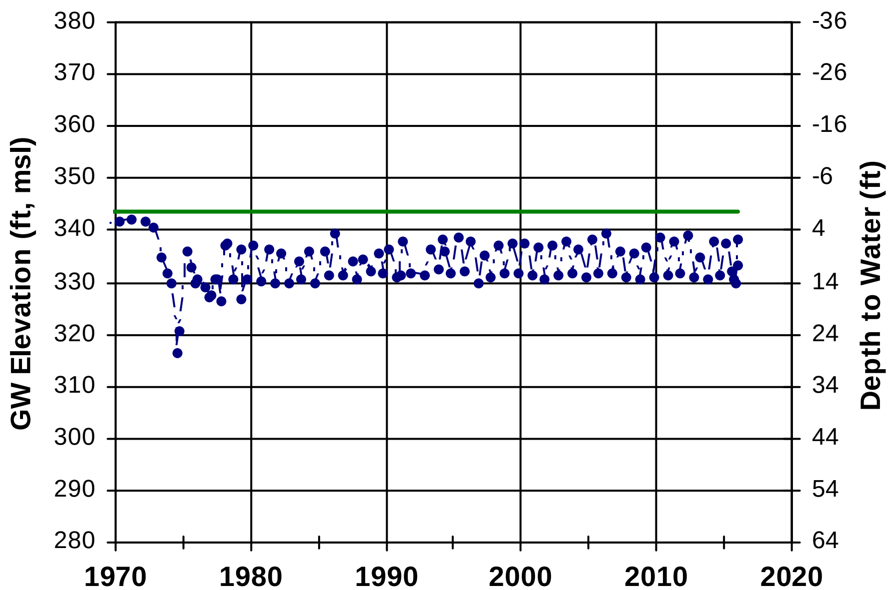
WellID: **08N06W10Q001M** RPE: 293.43 ft, msl Subarea: NVF_Calis
SWN: 008N006W10Q001M Source: DWR



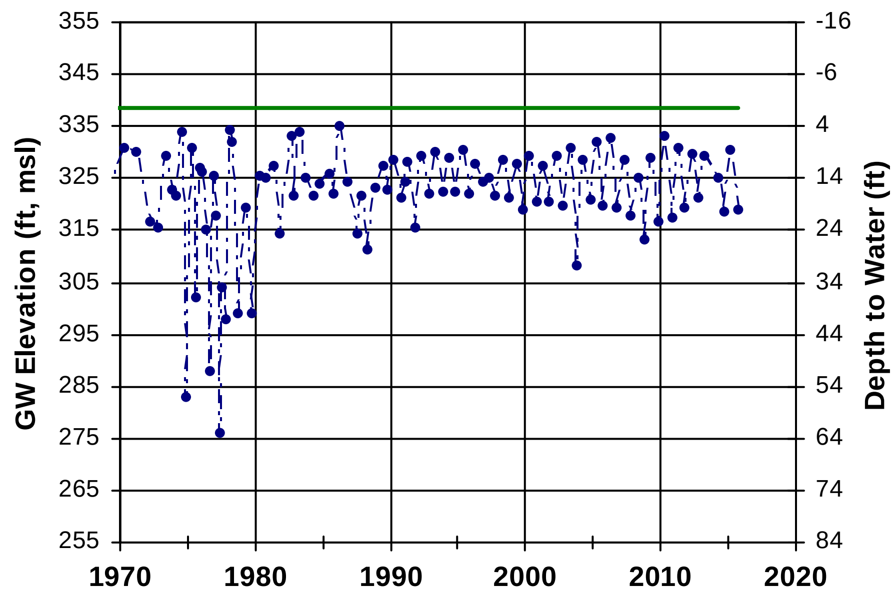
WellID: **NapaCounty-127** RPE: 392.5 ft, msl Subarea: NVF_Calis
SWN: 009N007W25N001M Source: NapaCounty



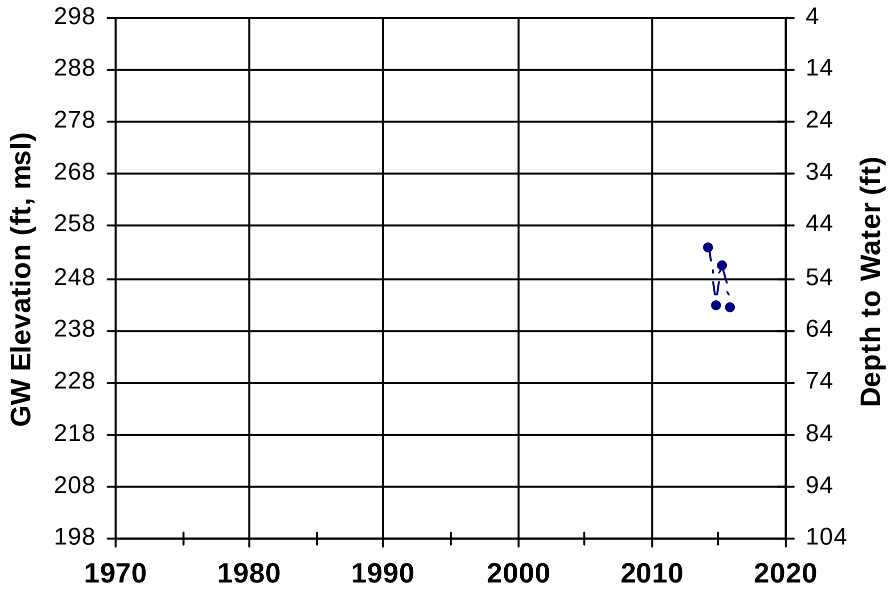
WellID: **NapaCounty-128** RPE: 343.7 ft, msl Subarea: NVF_Calis
SWN: 009N006W31Q001M Source: NapaCounty



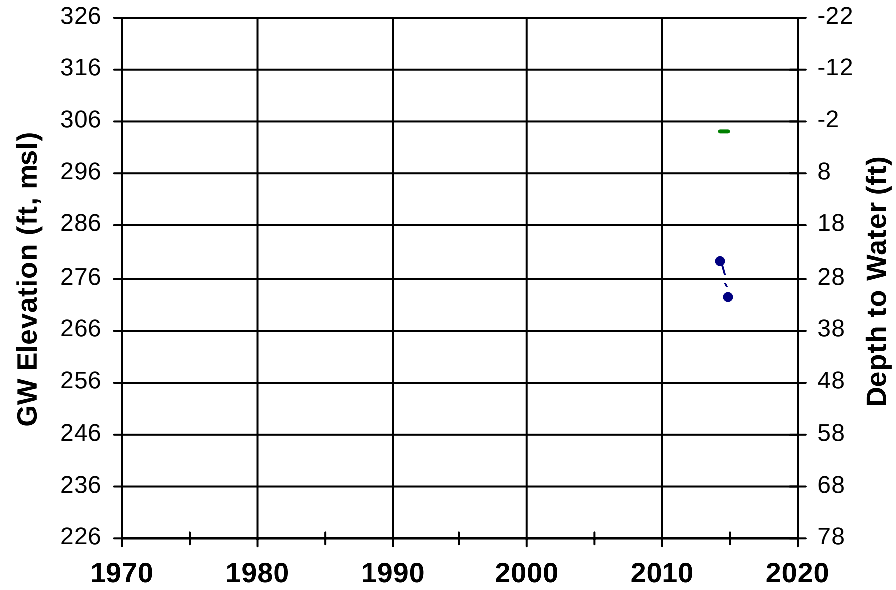
WellID: **NapaCounty-129** RPE: 338.7 ft, msl Subarea: NVF_Calis
SWN: 008N006W06L004M Source: NapaCounty



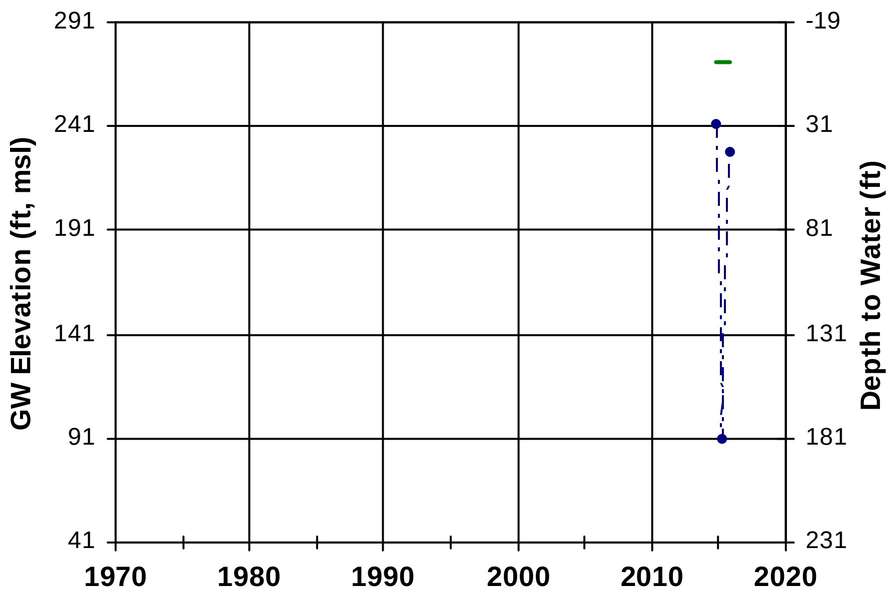
WellID: **NapaCounty-178** RPE: 301.5 ft, msl Subarea: NVF_Calis
SWN: Unknown Source: NapaCounty



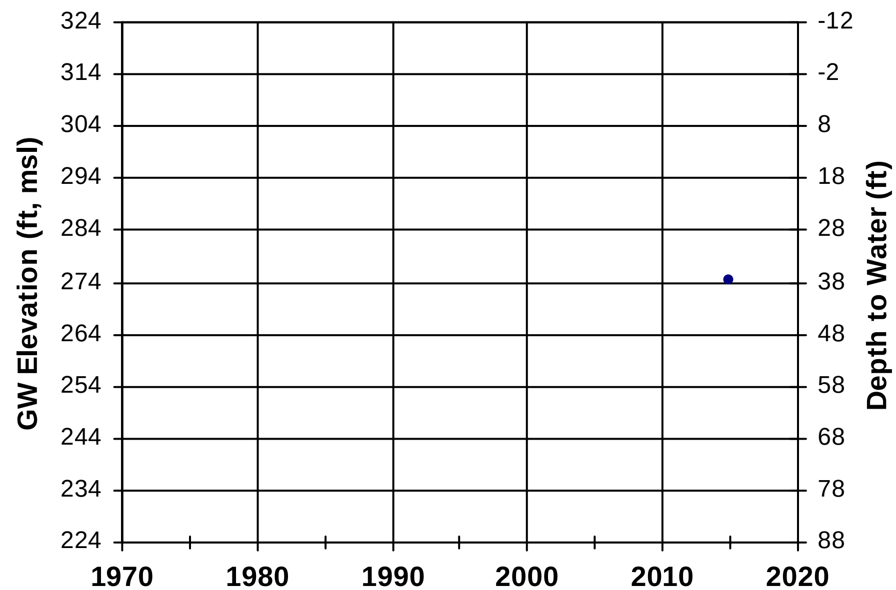
WellID: **NapaCounty-203** RPE: 304 ft, msl Subarea: NVF_Calis
SWN: Unknown Source: NapaCounty

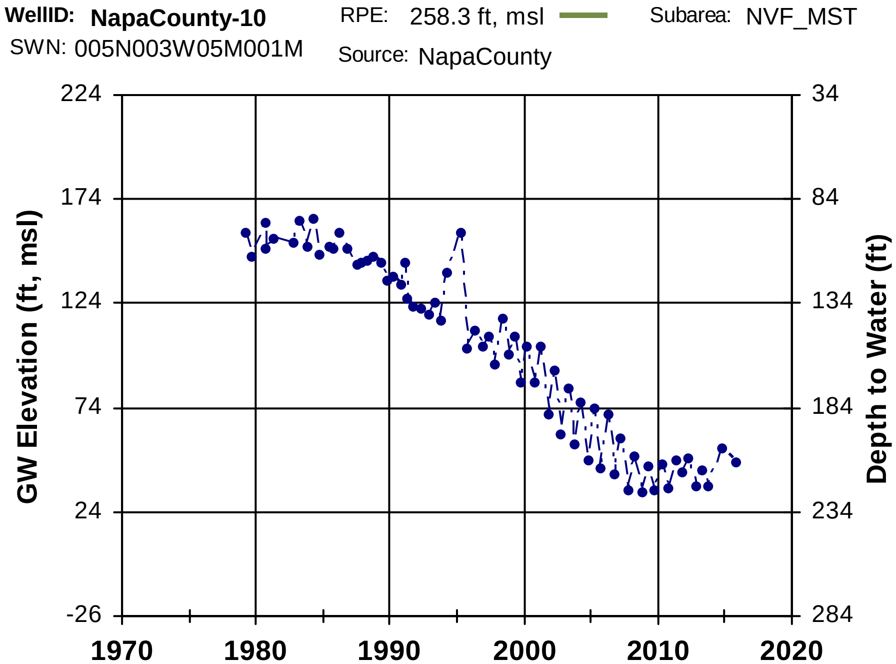


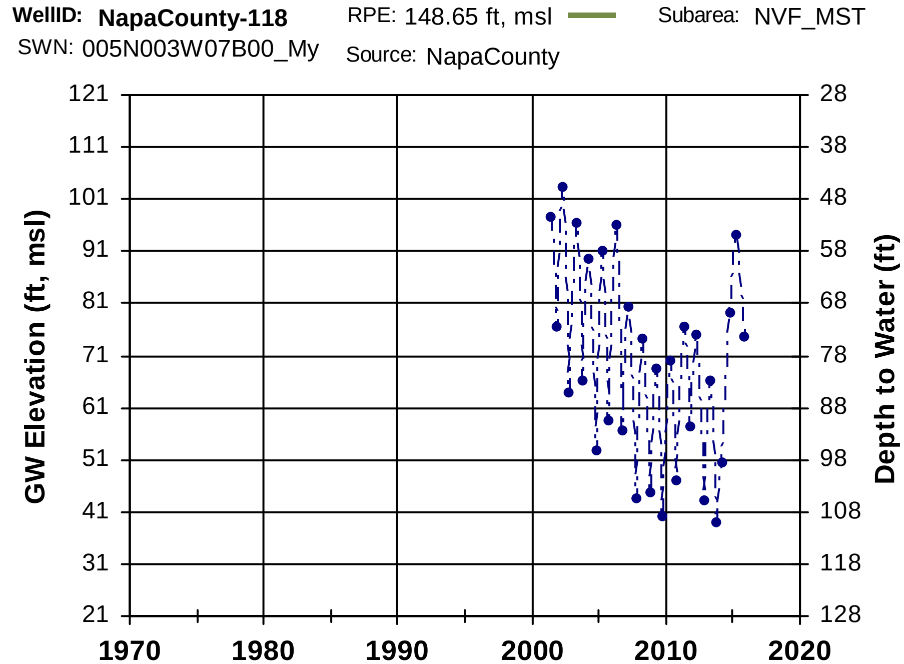
WellID: **NapaCounty-224** RPE: 272 ft, msl Subarea: NVF_Calis
SWN: Unknown Source: NapaCounty

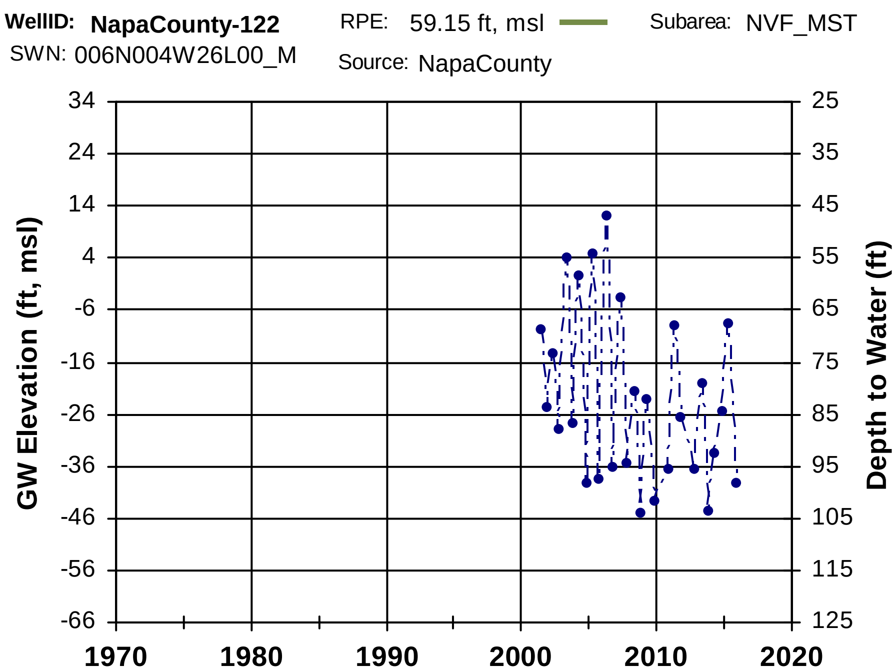


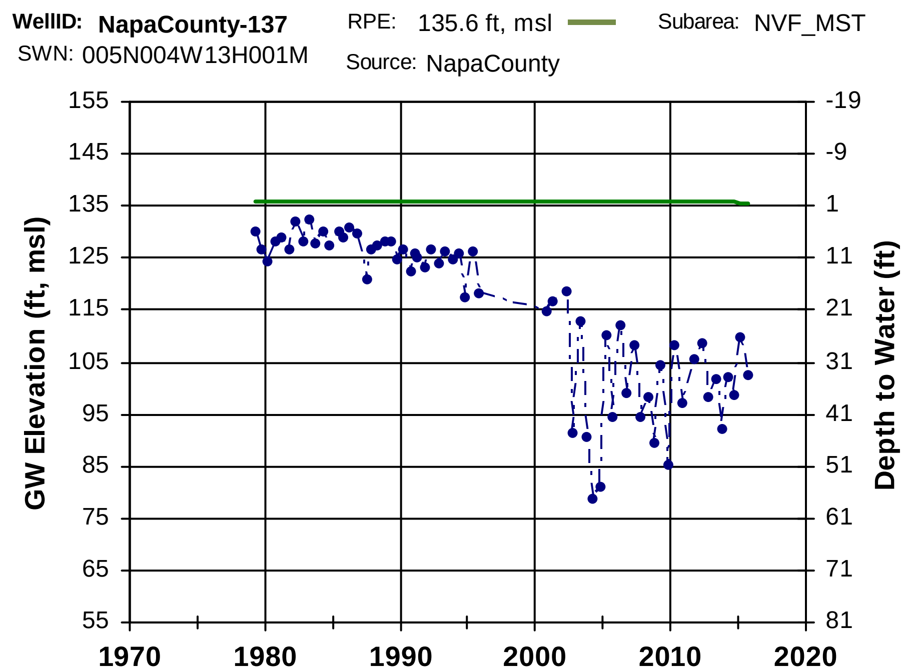
WellID: **NapaCounty-225** RPE: 311.75 ft, msl Subarea: NVF_Calis
SWN: Unknown Source: NapaCounty



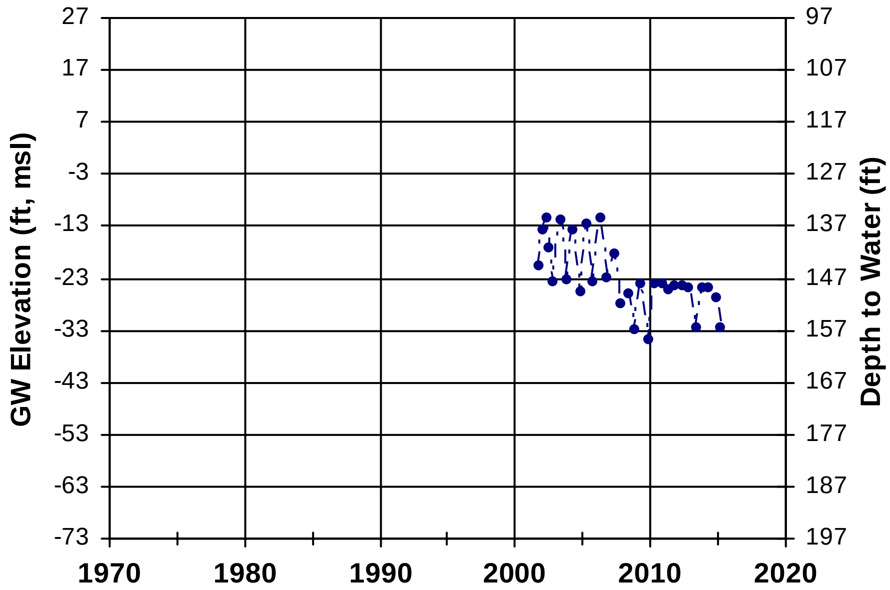

WellID: NapaCounty-10
RPE: 258.3 ft, msl
Subarea: NVF_MST
SWN: 005N003W05M001M
Source: NapaCounty
GW Elevation (ft, msl)
Depth to Water (ft)
224
174
124
74
24
-26
34
84
134
184
234
284
1970
1980
1990
2000
2010
2020


WellID: NapaCounty-118
RPE: 148.65 ft, msl
Subarea: NVF_MST
SWN: 005N003W07B00_My
Source: NapaCounty
GW Elevation (ft, msl)
Depth to Water (ft)
121
111
101
91
81
71
61
51
41
31
21
28
38
48
58
68
78
88
98
108
118
128
1970
1980
1990
2000
2010
2020

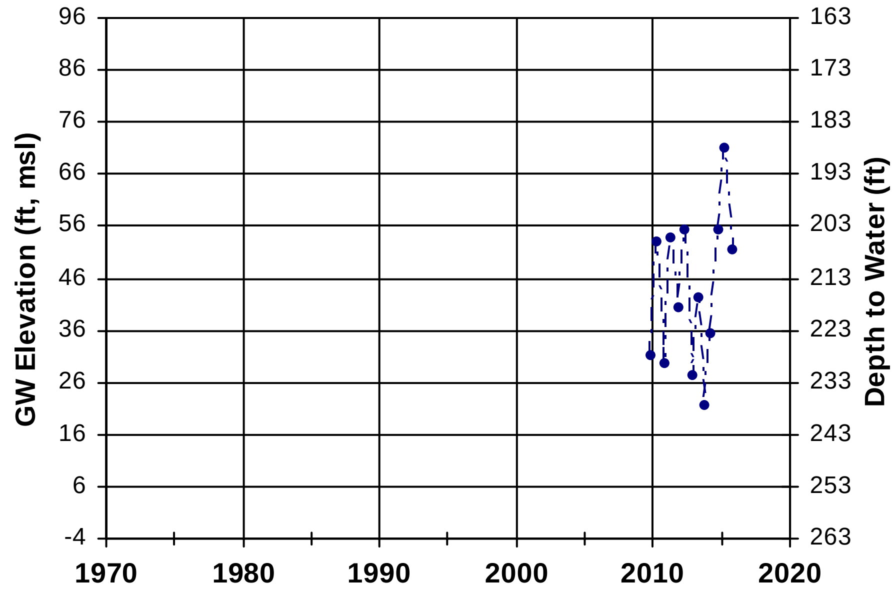

WellID: NapaCounty-122
RPE: 59.15 ft, msl
Subarea: NVF_MST
SWN: 006N004W26L00_M
Source: NapaCounty
GW Elevation (ft, msl)
Depth to Water (ft)
34
24
14
4
-6
-16
-26
-36
-46
-56
-66
25
35
45
55
65
75
85
95
105
115
125
1970
1980
1990
2000
2010
2020


WellID: NapaCounty-137
RPE: 135.6 ft, msl
Subarea: NVF_MST
SWN: 005N004W13H001M
Source: NapaCounty
GW Elevation (ft, msl)
Depth to Water (ft)
155
145
135
125
115
105
95
85
75
65
55
-19
-9
1
11
21
31
41
51
61
71
81
1970
1980
1990
2000
2010
2020

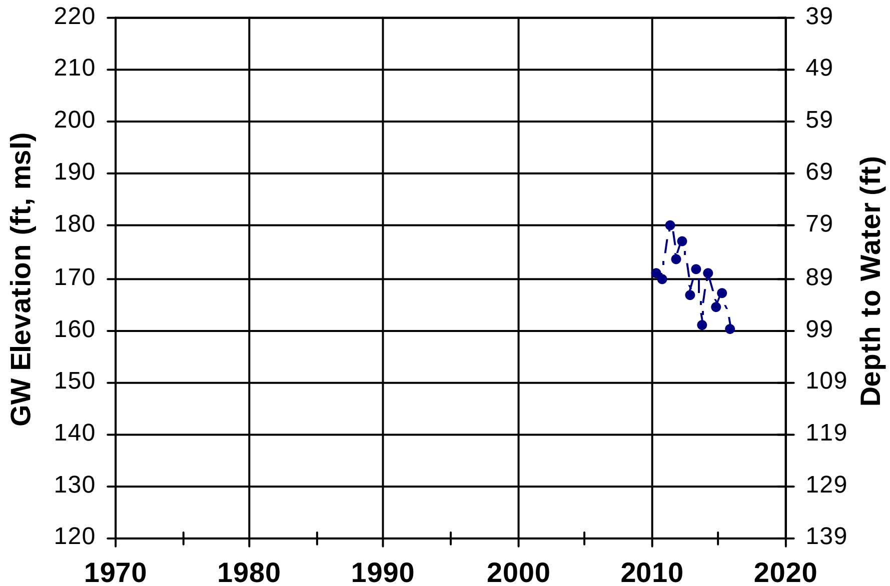
WellID: **NapaCounty-142** RPE: 124.2 ft, msl Subarea: NVF_MST
SWN: 006N004W25G00_M Source: NapaCounty



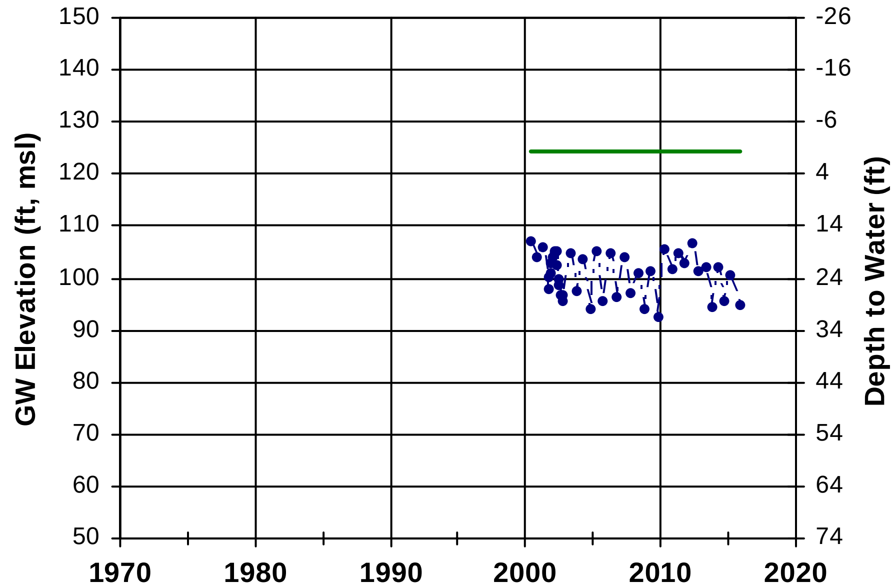
WellID: **NapaCounty-148** RPE: 258.6 ft, msl Subarea: NVF_MST
SWN: 005N003W05M00_M Source: NapaCounty



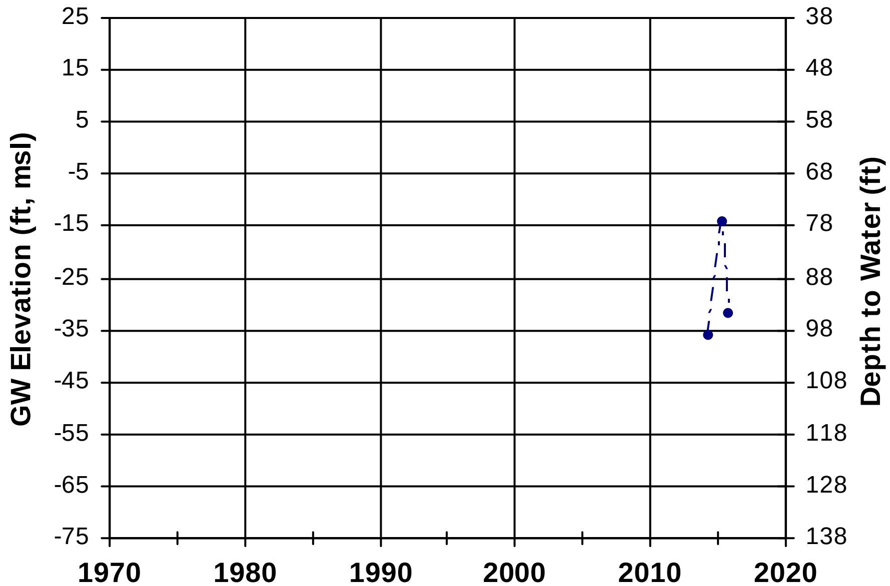
WellID: **NapaCounty-149** RPE: 258.9 ft, msl Subarea: NVF_MST
SWN: 005N003W08E00_M Source: NapaCounty



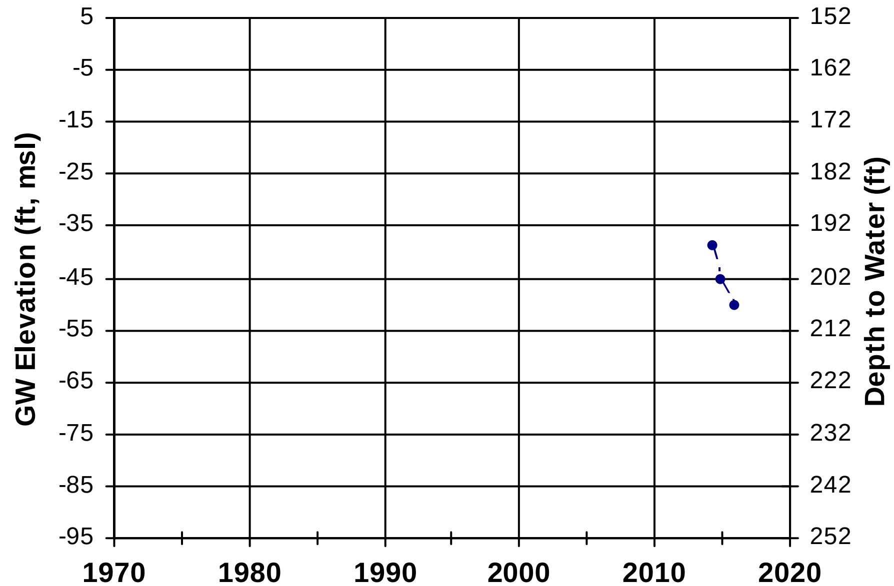
WellID: **NapaCounty-18** RPE: 124.3 ft, msl Subarea: NVF_MST
SWN: 005N004W13G004M Source: NapaCounty



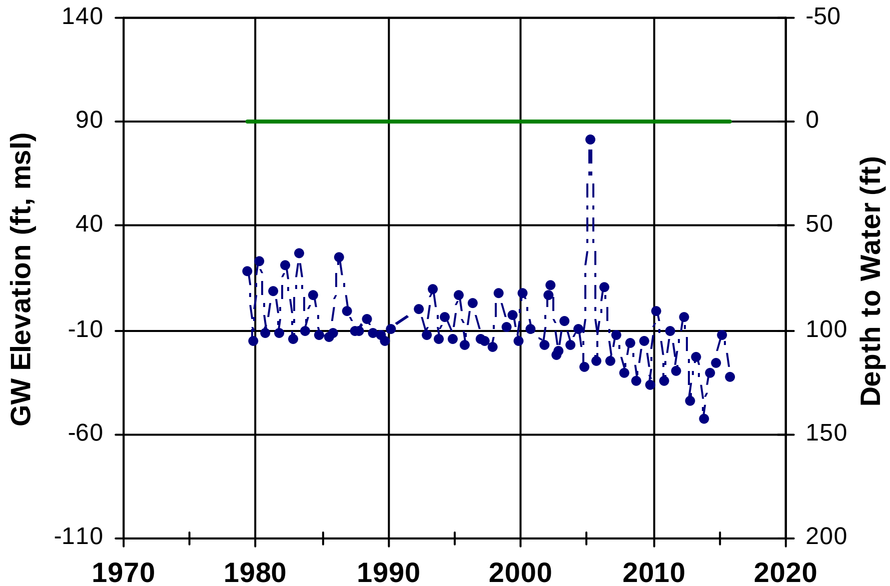
WellID: **NapaCounty-191** RPE: 63.1 ft, msl Subarea: NVF_MST
SWN: Unknown Source: NapaCounty



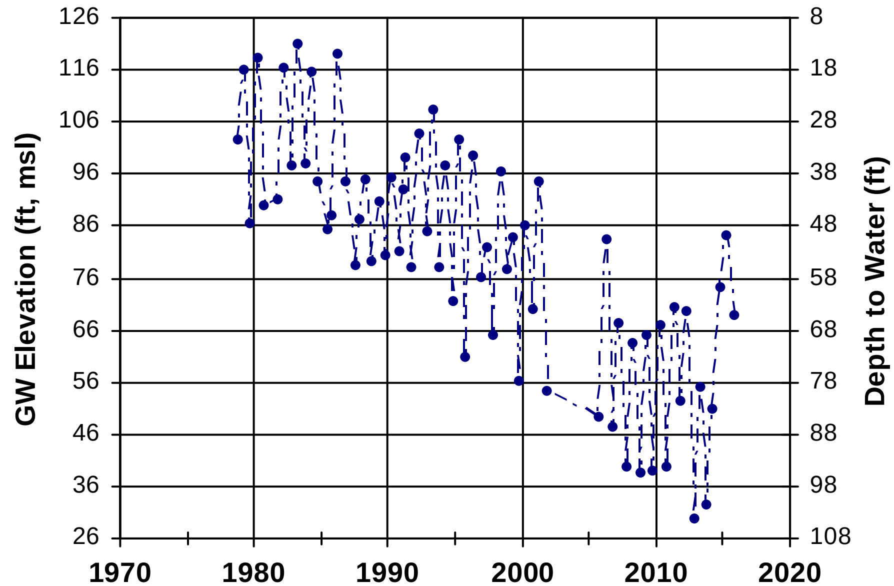
WellID: **NapaCounty-192** RPE: 156.8 ft, msl Subarea: NVF_MST
SWN: Unknown Source: NapaCounty



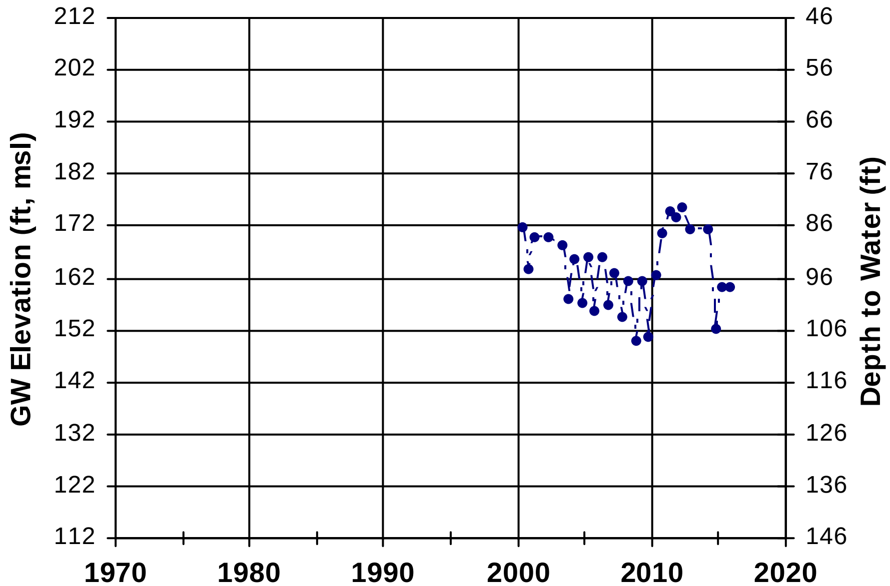
WellID: **NapaCounty-2** RPE: 90.5 ft, msl Subarea: NVF_MST
SWN: 006N004W23J001M Source: NapaCounty



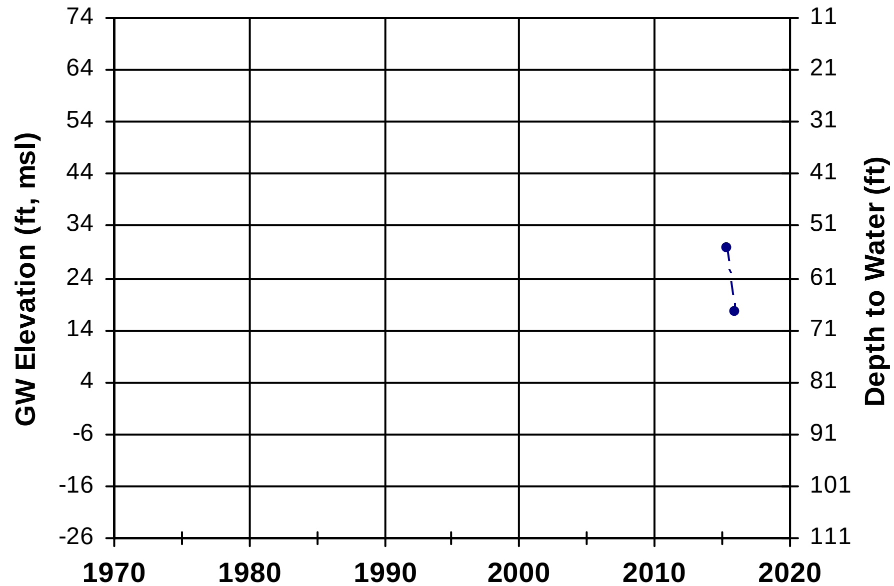
WellID: **NapaCounty-20** RPE: 134.5 ft, msl Subarea: NVF_MST
SWN: 005N003W07C003M Source: NapaCounty



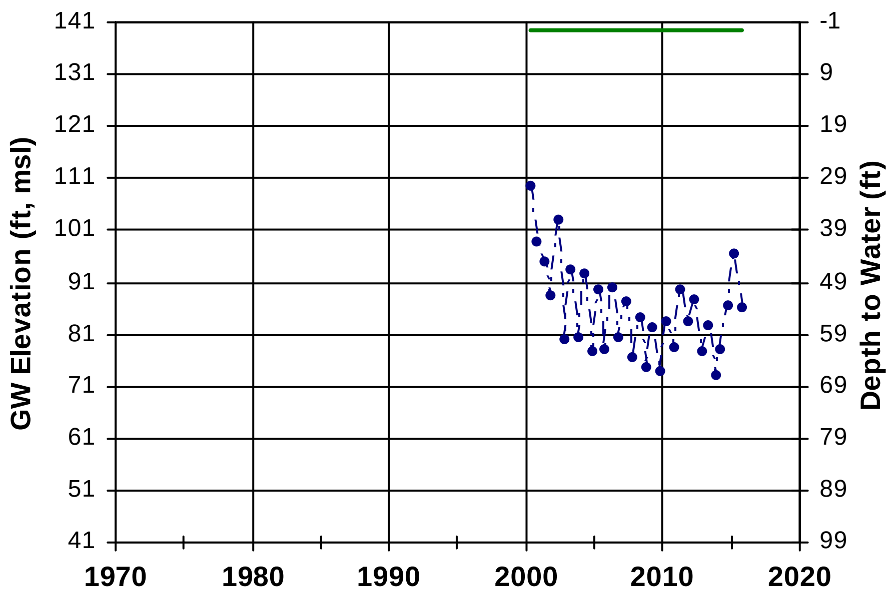
WellID: **NapaCounty-22** RPE: 257.7 ft, msl Subarea: NVF_MST
SWN: 005N003W08E001M Source: NapaCounty



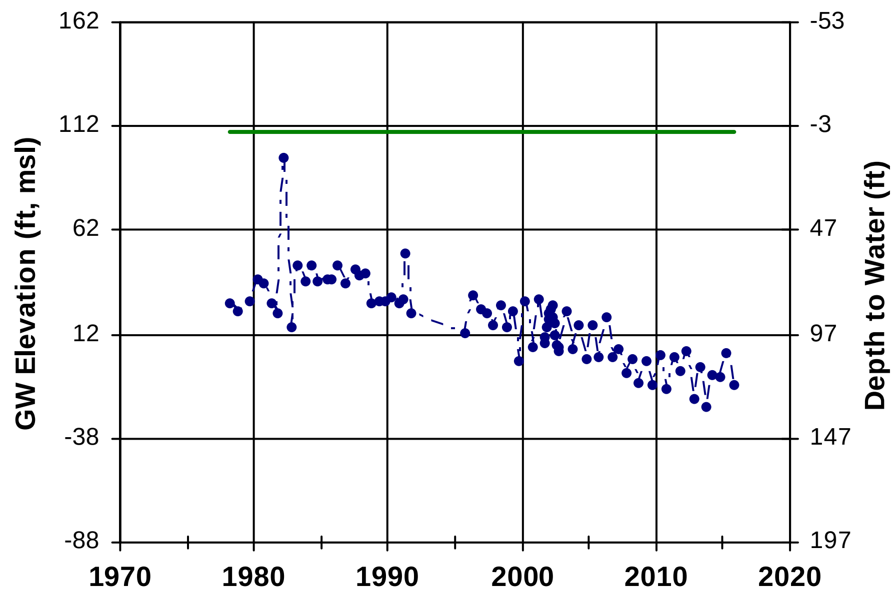
WellID: **NapaCounty-226** RPE: 84.9 ft, msl Subarea: NVF_MST
SWN: Unknown Source: NapaCounty



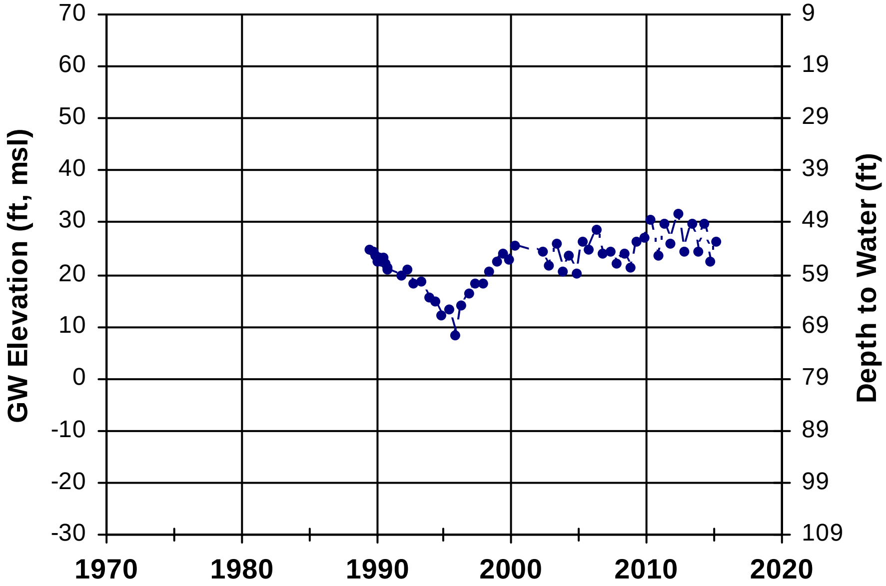
WellID: **NapaCounty-35** RPE: 139.6 ft, msl Subarea: NVF_MST
SWN: 005N003W18D001M Source: NapaCounty



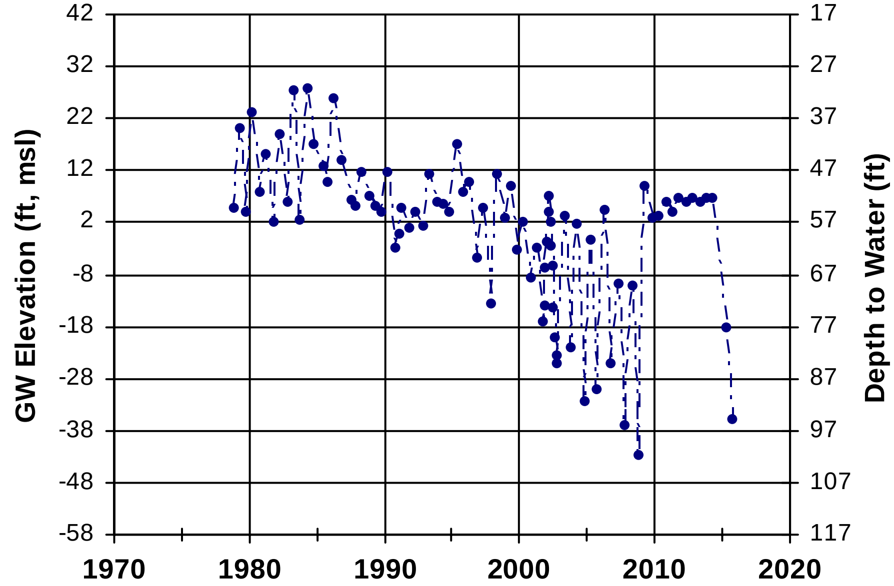
WellID: **NapaCounty-43** RPE: 109 ft, msl Subarea: NVF_MST
SWN: 006N004W23Q003M Source: NapaCounty



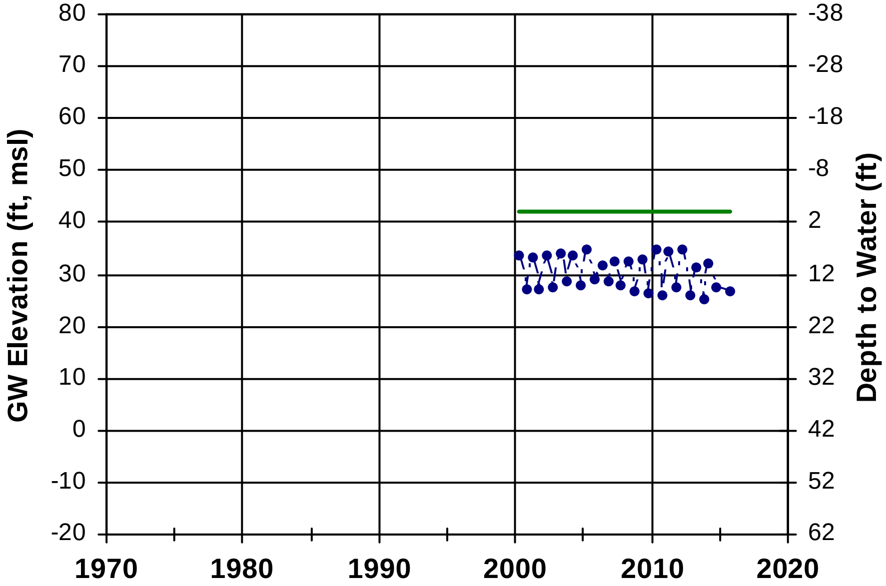
WellID: NapaCounty-49 RPE: 79.2 ft, msl Subarea: NVF_MST
SWN: 005N004W14J003M Source: NapaCounty



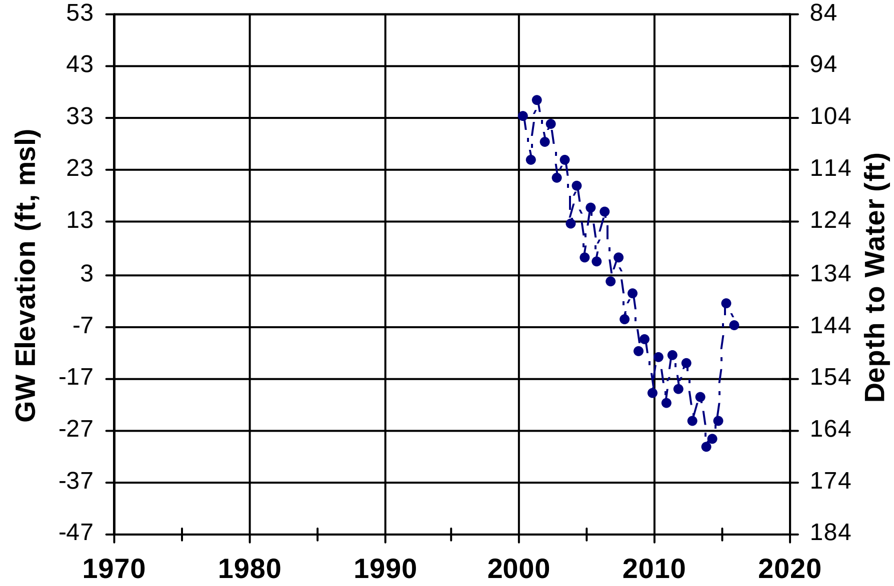
WellID: NapaCounty-56 RPE: 58.6 ft, msl Subarea: NVF_MST
SWN: 006N004W26G001M Source: NapaCounty



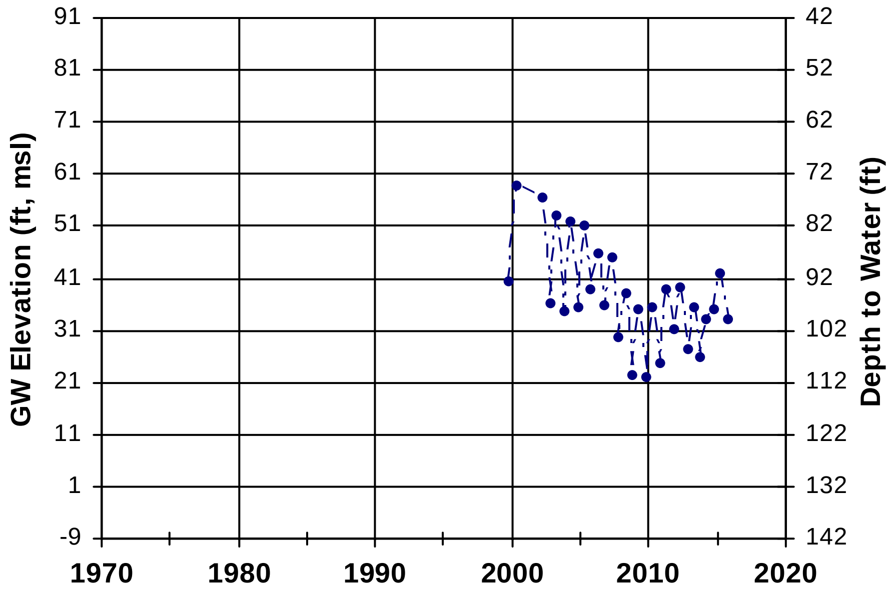
WellID: NapaCounty-69 RPE: 42.1 ft, msl Subarea: NVF_MST
SWN: 006N004W35G005M Source: NapaCounty



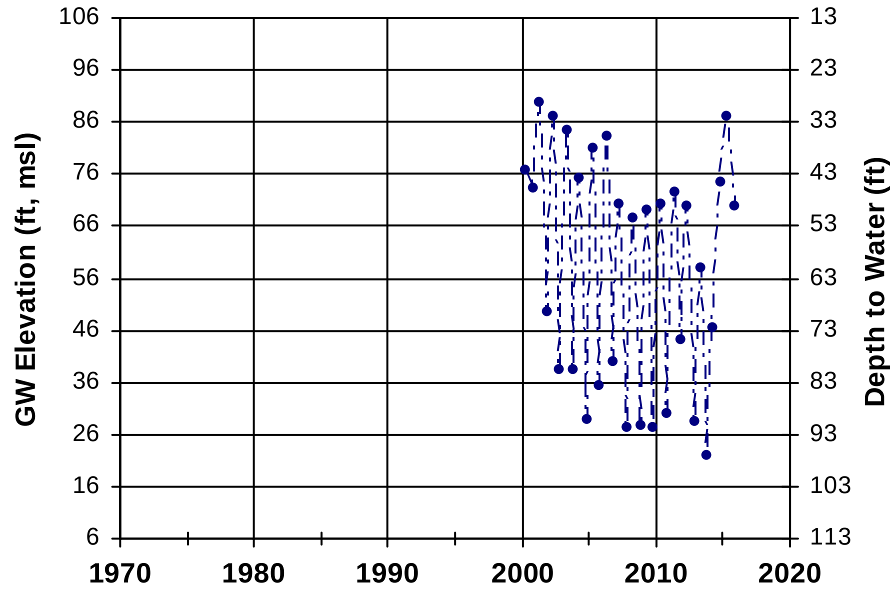
WellID: NapaCounty-72 RPE: 137.1 ft, msl Subarea: NVF_MST
SWN: 005N003W07D003M Source: NapaCounty



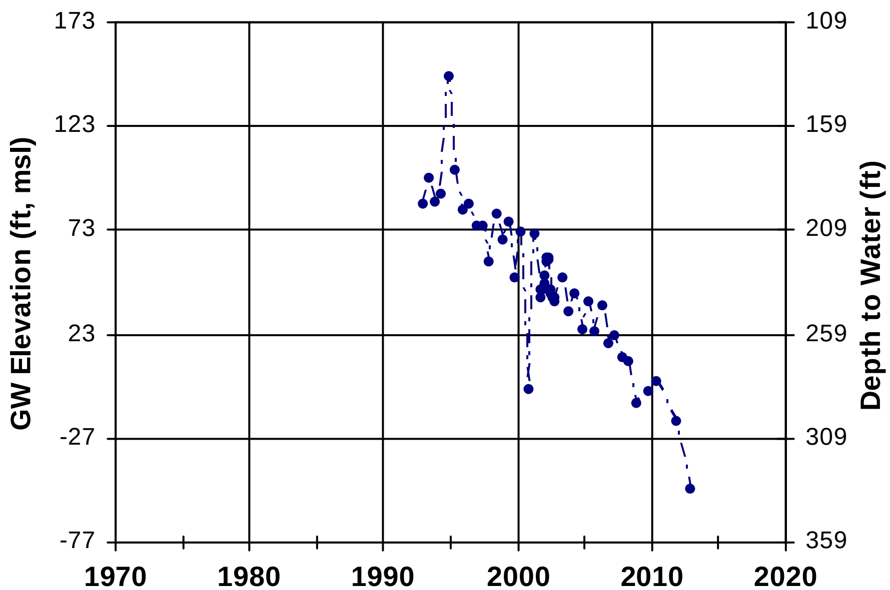
WellID: **NapaCounty-74** RPE: 133.3 ft, msl Subarea: NVF_MST
SWN: 005N003W06M001M Source: NapaCounty



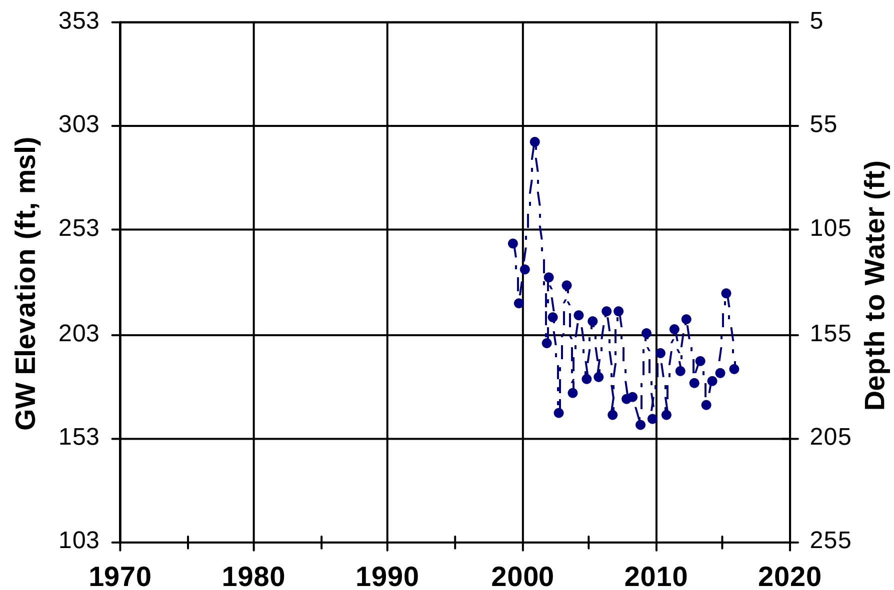
WellID: **NapaCounty-81** RPE: 118.6 ft, msl Subarea: NVF_MST
SWN: 005N003W07F003M Source: NapaCounty



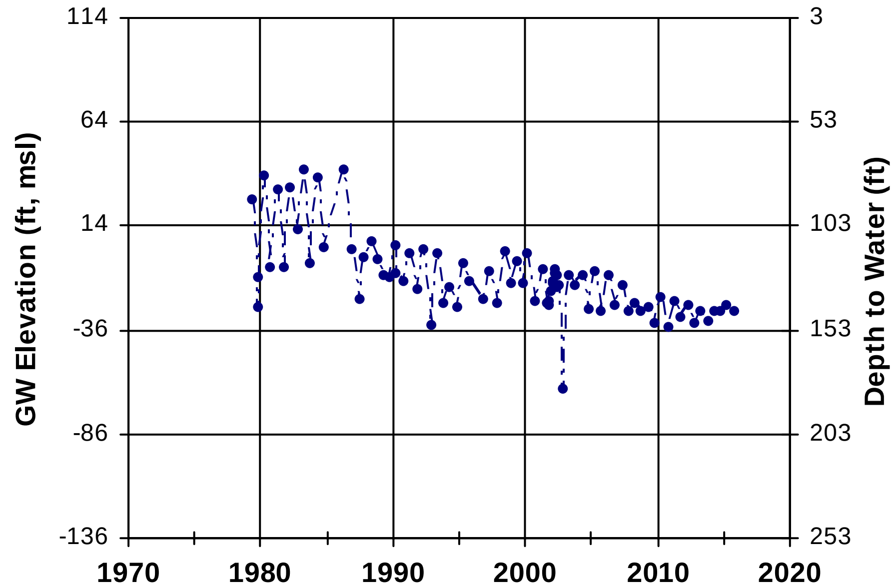
WellID: **NapaCounty-91** RPE: 281.9 ft, msl Subarea: NVF_MST
SWN: 005N003W06B002M Source: NapaCounty



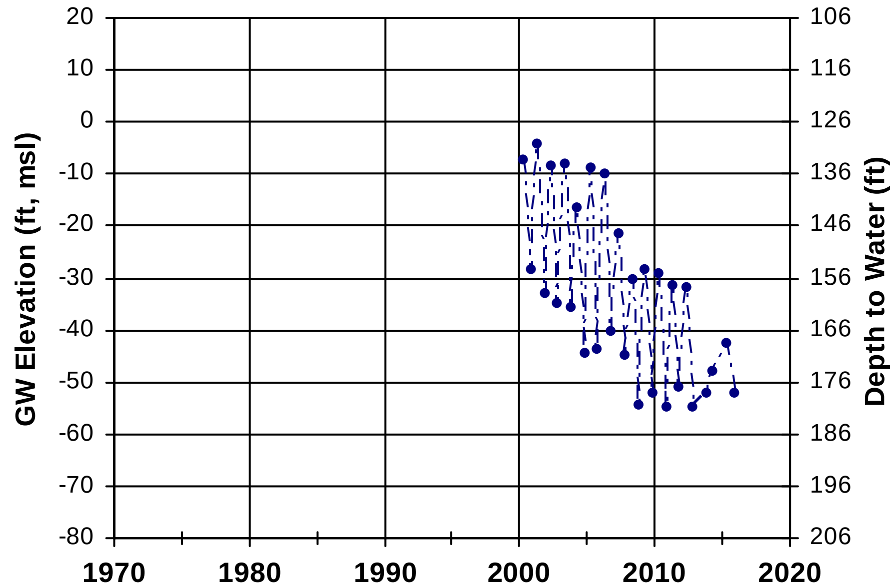
WellID: **NapaCounty-92** RPE: 358.2 ft, msl Subarea: NVF_MST
SWN: 005N003W06A001M Source: NapaCounty



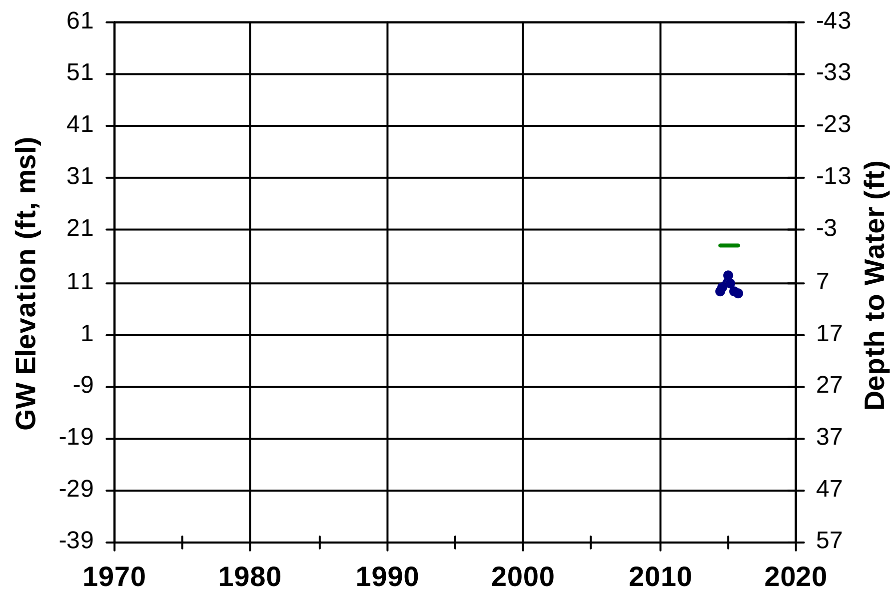
WellID: **NapaCounty-95** RPE: 116.9 ft, msl Subarea: NVF_MST
SWN: 006N004W36G001M Source: NapaCounty



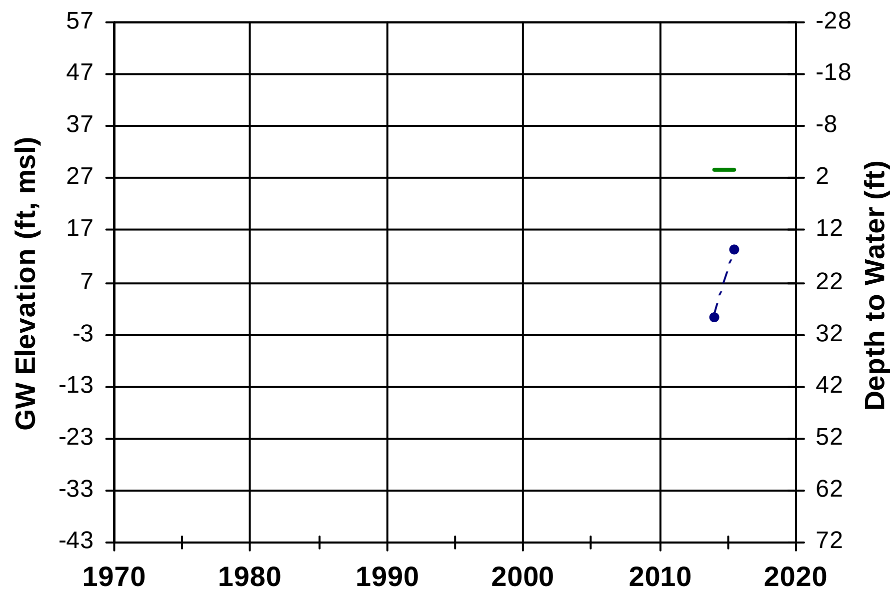
WellID: **NapaCounty-98** RPE: 125.7 ft, msl Subarea: NVF_MST
SWN: 006N004W36A001M Source: NapaCounty



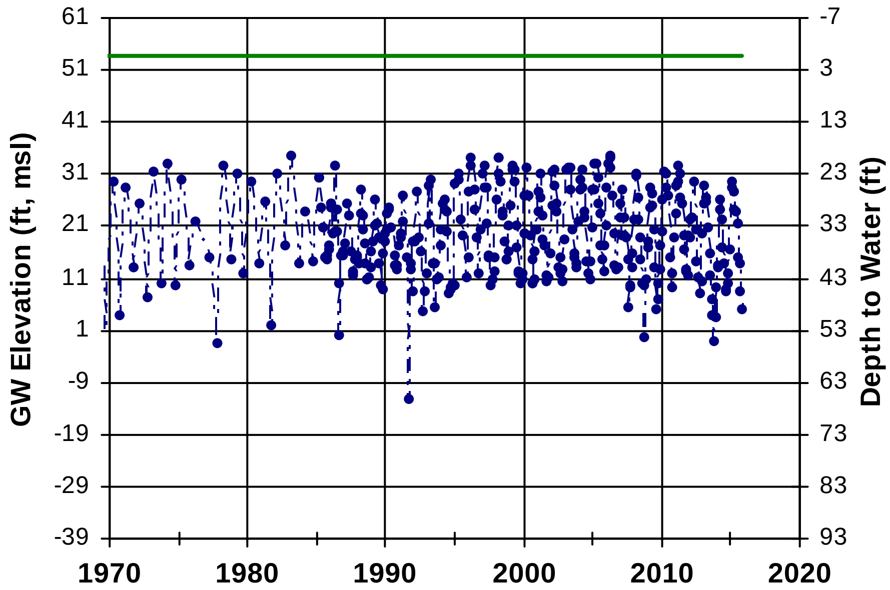
WellID: **T0605500200MW-1** RPE: 18.16 ft, msl Subarea: NVF_MST
SWN: Unknown Source: Geotracker



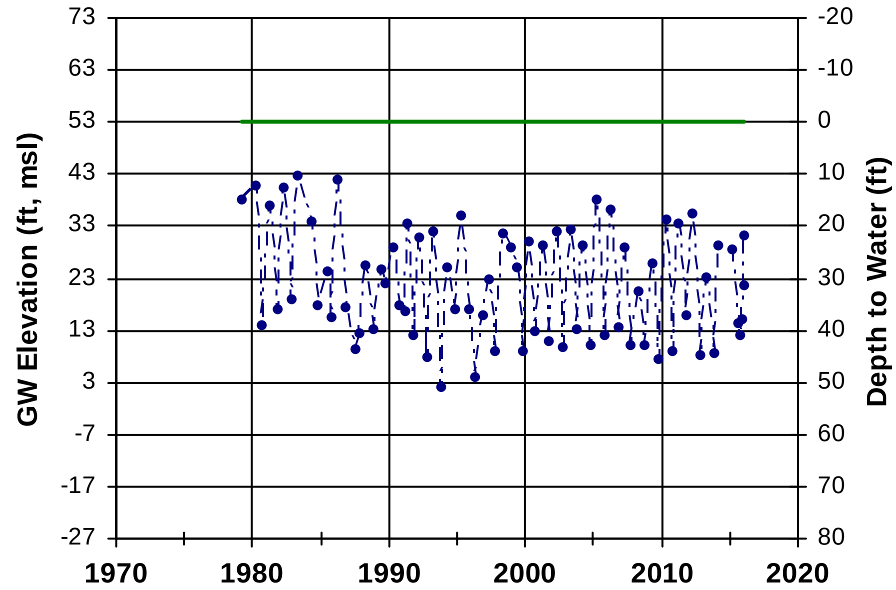
WellID: **T10000005248MW-** RPE: 28.81 ft, msl Subarea: NVF_MST
SWN: Unknown Source: Geotracker



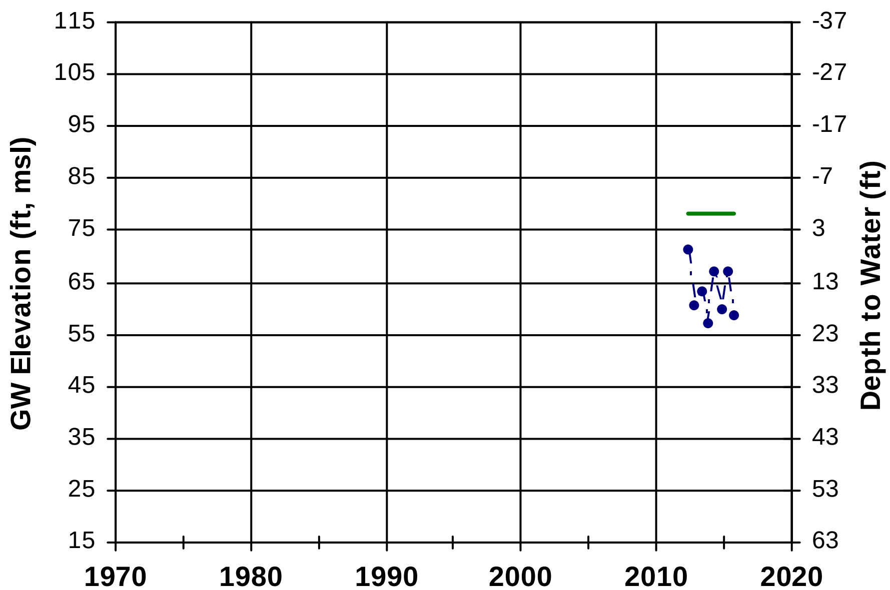
WellID: 06N04W27L002M RPE: 53.6 ft, msl Subarea: NVF_Napa
SWN: 006N004W27L002M Source: DWR



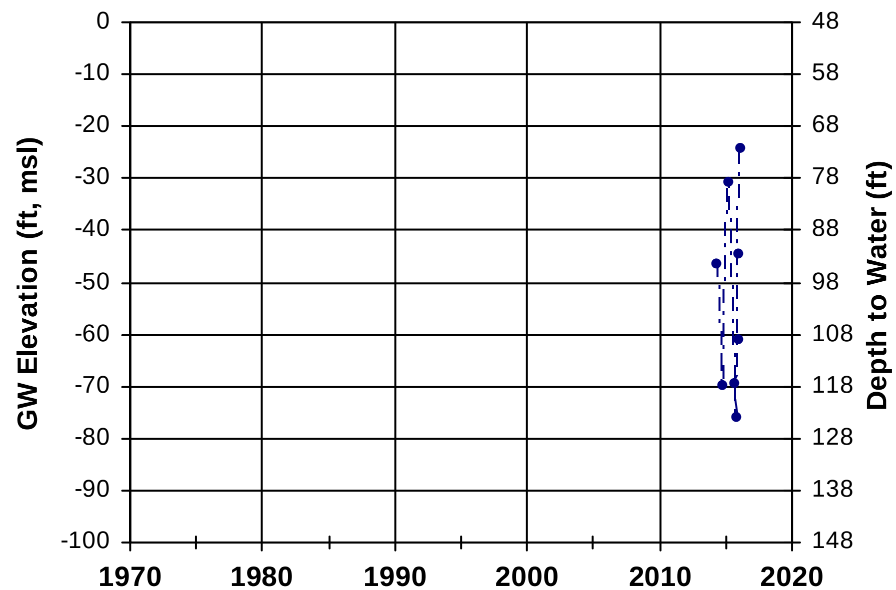
WellID: NapaCounty-136 RPE: 53.2 ft, msl Subarea: NVF_Napa
SWN: 006N004W27N001M Source: NapaCounty



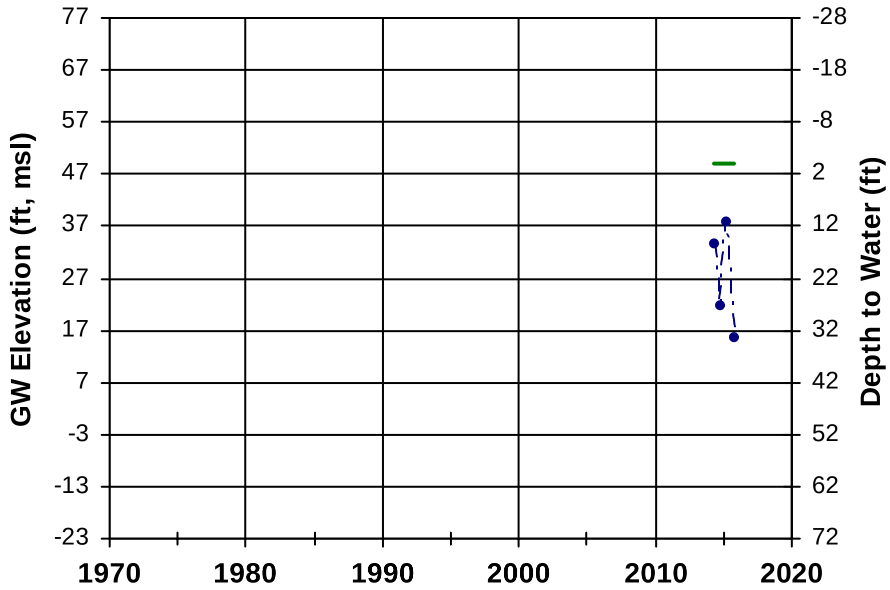
WellID: NapaCounty-152 RPE: 78.3 ft, msl Subarea: NVF_Napa
SWN: 006N004W28Mx Source: NapaCounty



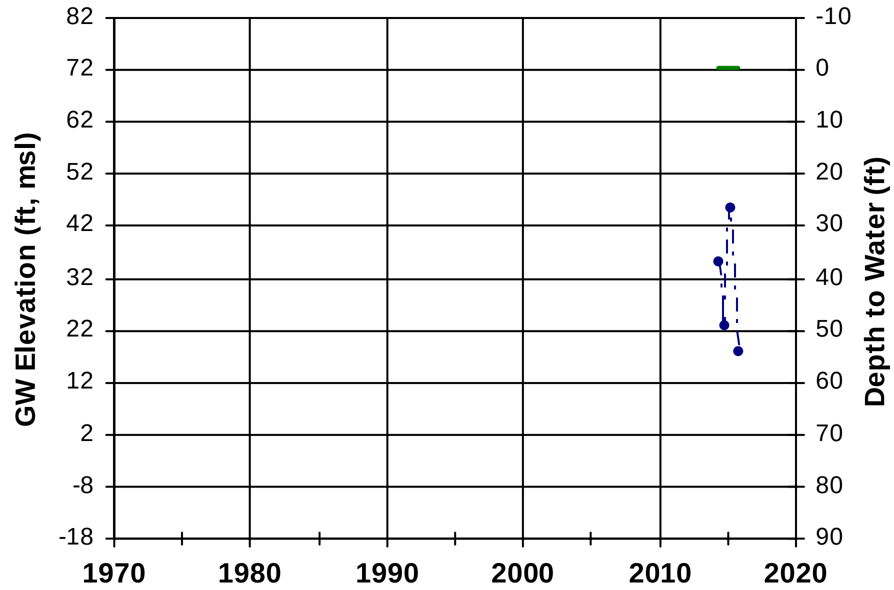
WellID: NapaCounty-182 RPE: 48.1 ft, msl Subarea: NVF_Napa
SWN: Unknown Source: NapaCounty



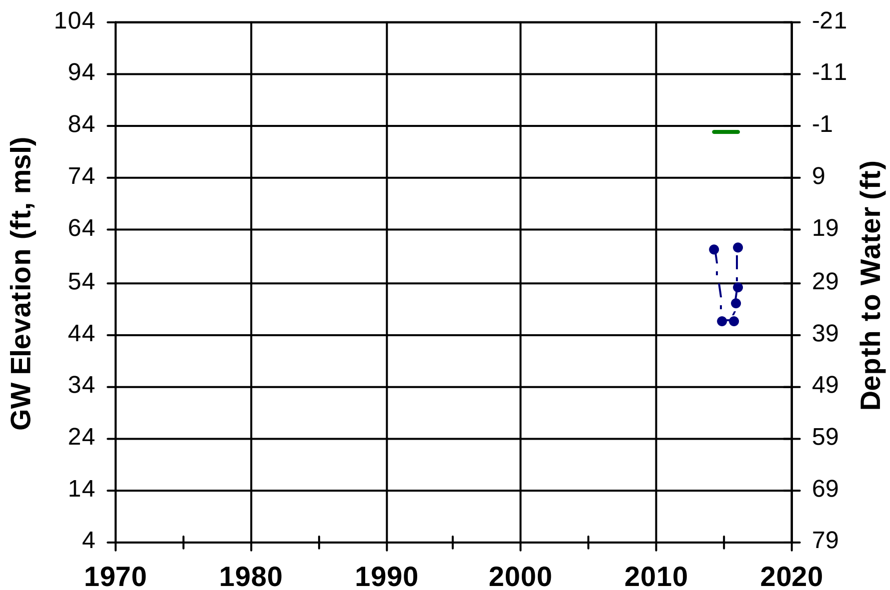
WellID: **NapaCounty-183** RPE: 48.9 ft, msl Subarea: NVF_Napa
SWN: Unknown Source: NapaCounty



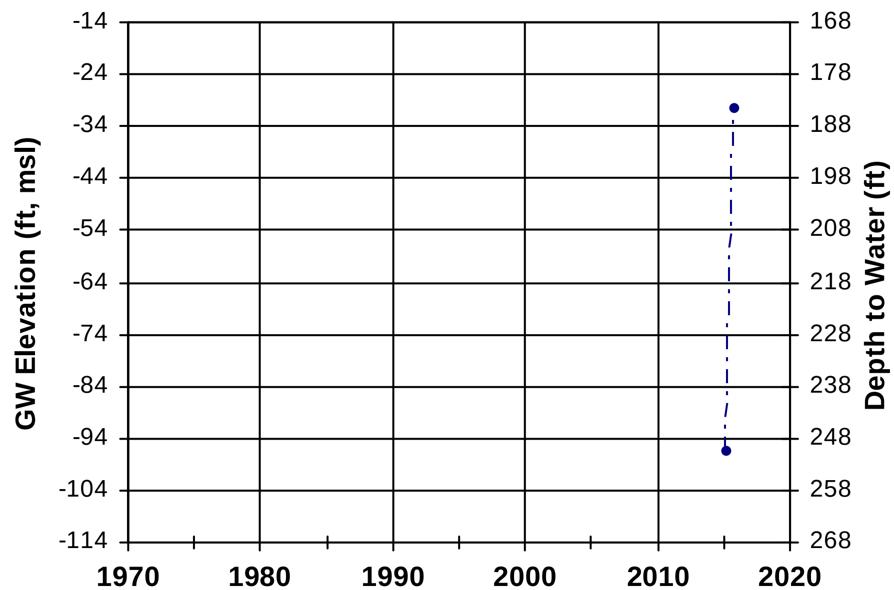
WellID: **NapaCounty-184** RPE: 72.5 ft, msl Subarea: NVF_Napa
SWN: Unknown Source: NapaCounty



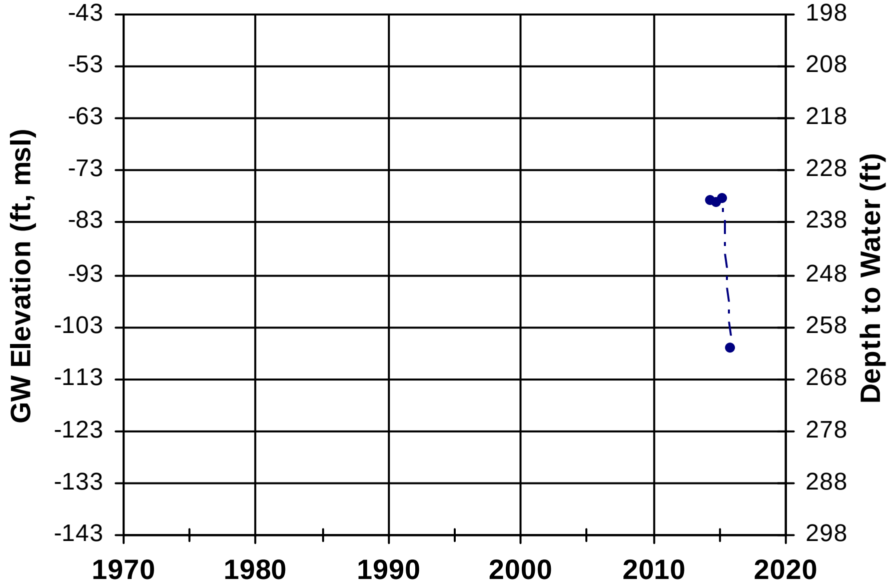
WellID: **NapaCounty-185** RPE: 83 ft, msl Subarea: NVF_Napa
SWN: Unknown Source: NapaCounty



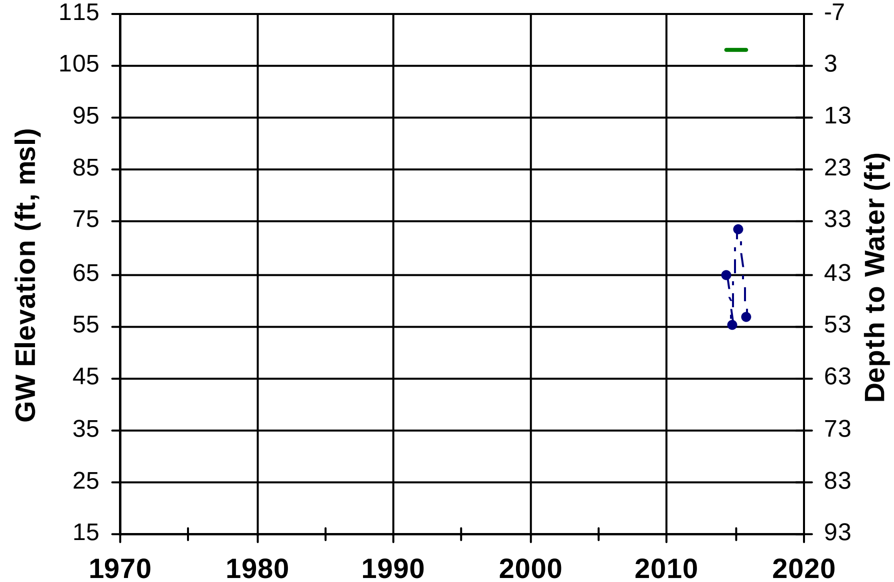
WellID: **NapaCounty-187** RPE: 153.5 ft, msl Subarea: NVF_Napa
SWN: Unknown Source: NapaCounty



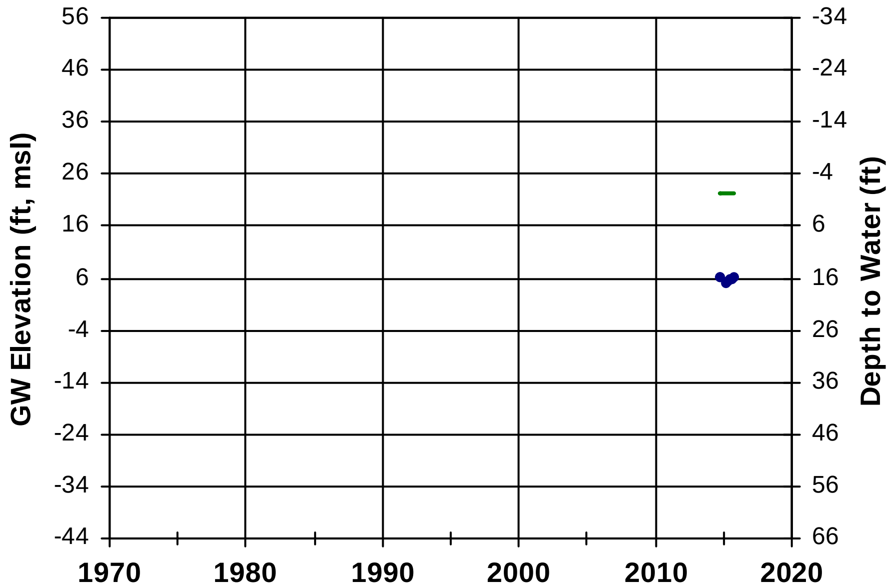
WellID: **NapaCounty-188** RPE: 154.6 ft, msl Subarea: NVF_Napa
SWN: Unknown Source: NapaCounty



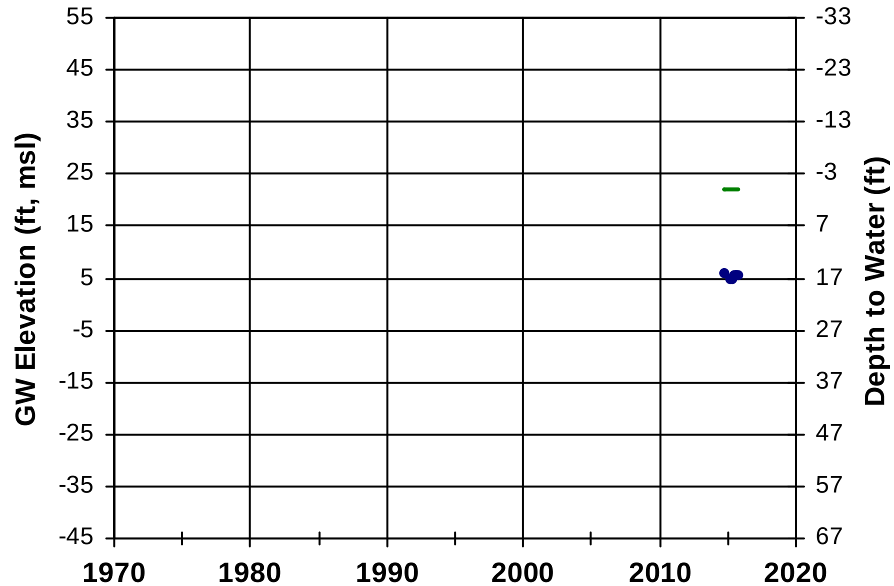
WellID: **NapaCounty-189** RPE: 108.25 ft, msl Subarea: NVF_Napa
SWN: Unknown Source: NapaCounty



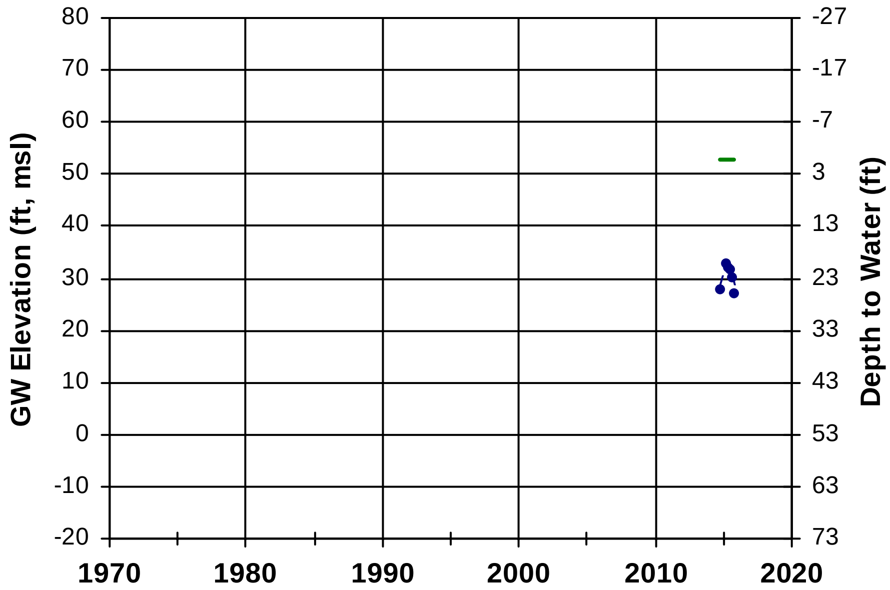
WellID: **NapaCounty-214s-s** RPE: 22.1 ft, msl Subarea: NVF_Napa
SWN: Unknown Source: NapaCounty



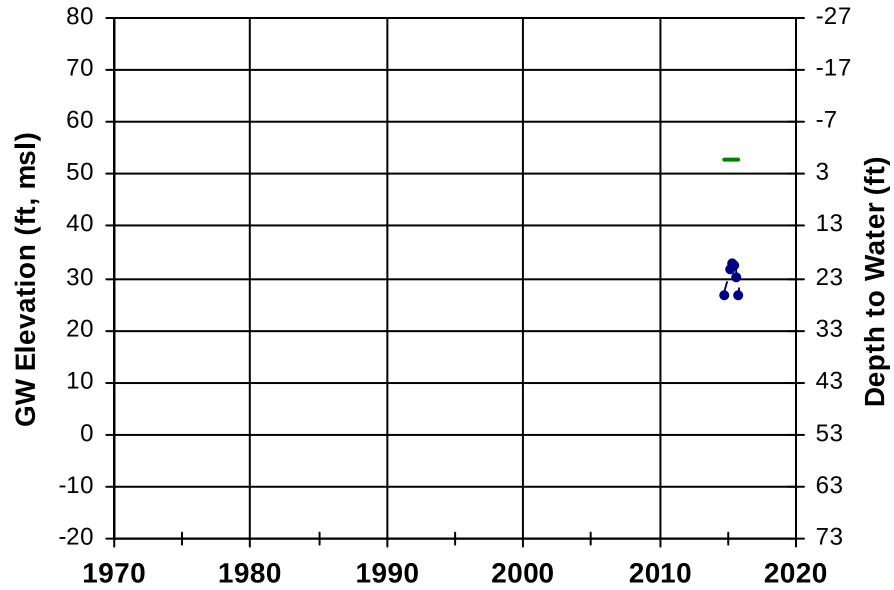
WellID: **NapaCounty-215d-s** RPE: 22.05 ft, msl Subarea: NVF_Napa
SWN: Unknown Source: NapaCounty



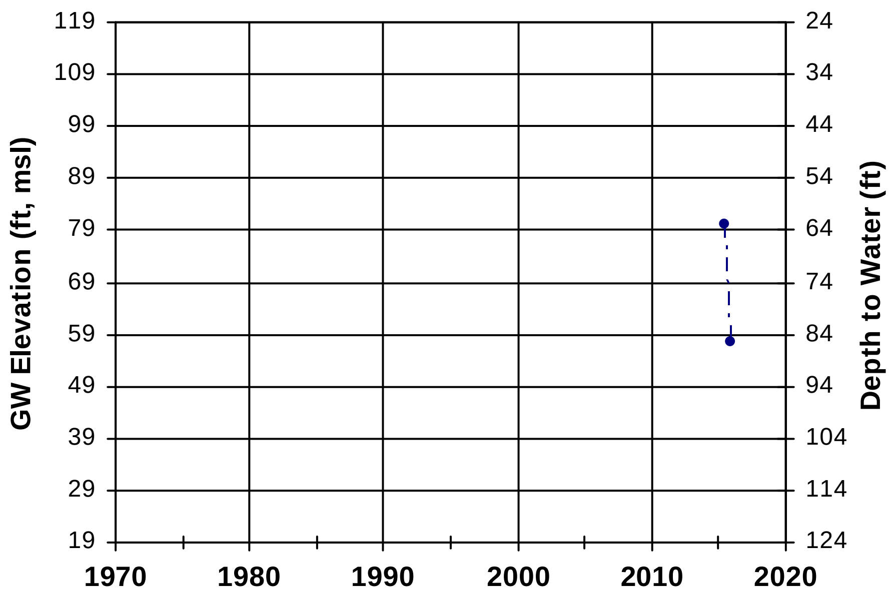
WellID: **NapaCounty-218s-s** RPE: 52.8 ft, msl Subarea: NVF_Napa
SWN: Unknown Source: NapaCounty



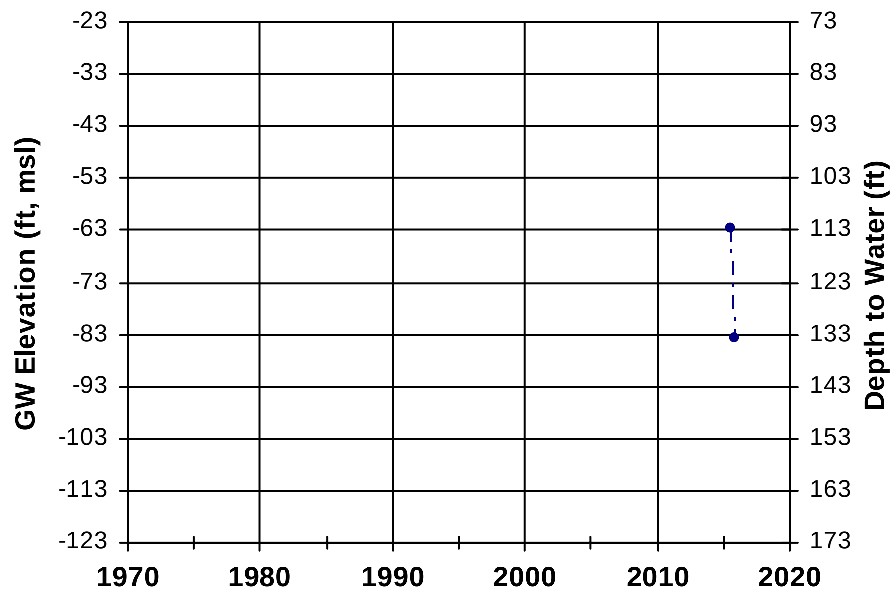
WellID: **NapaCounty-219d-s** RPE: 52.75 ft, msl Subarea: NVF_Napa
SWN: Unknown Source: NapaCounty



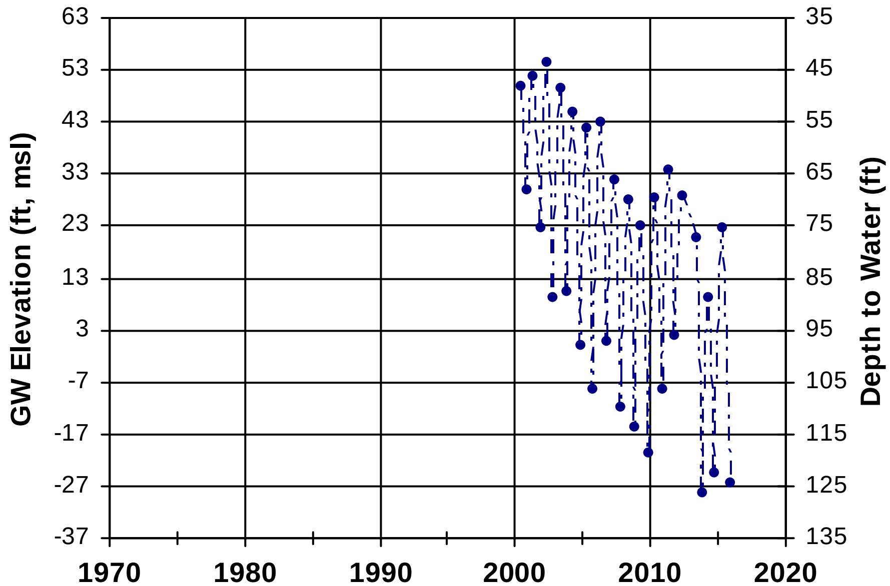
WellID: **NapaCounty-227** RPE: 143.3 ft, msl Subarea: NVF_Napa
SWN: Unknown Source: NapaCounty



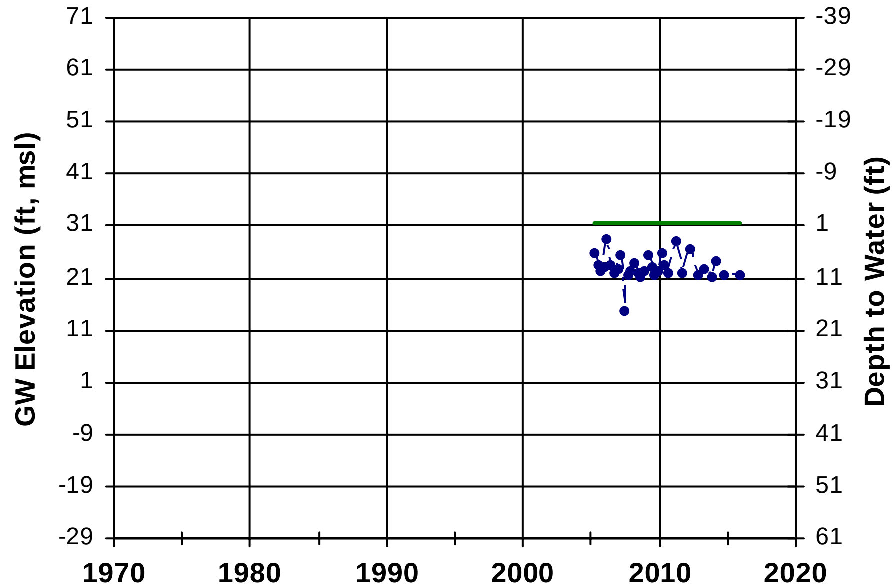
WellID: **NapaCounty-228** RPE: 50.2 ft, msl Subarea: NVF_Napa
SWN: Unknown Source: NapaCounty



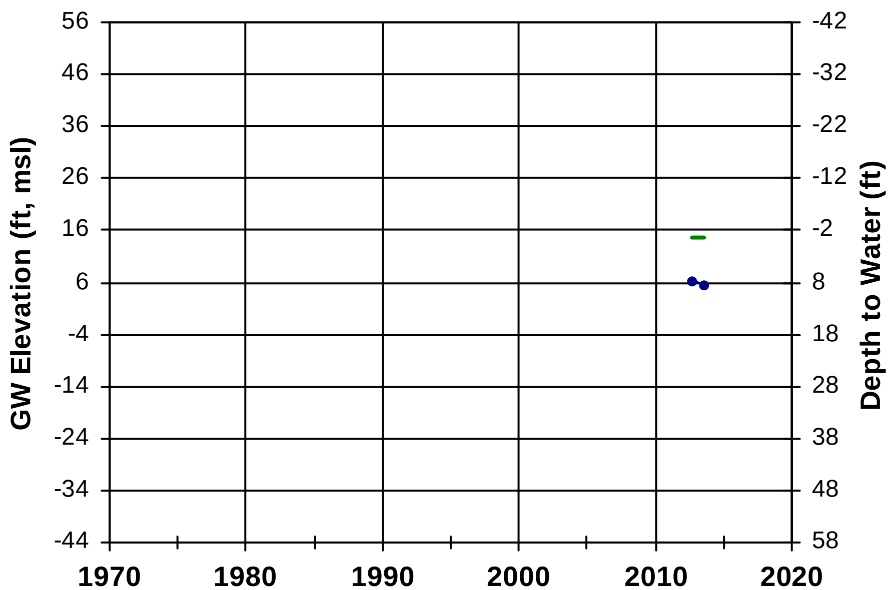
WellID: **NapaCounty-76** RPE: 97.7 ft, msl Subarea: NVF_Napa
SWN: 006N004W15R003M Source: NapaCounty



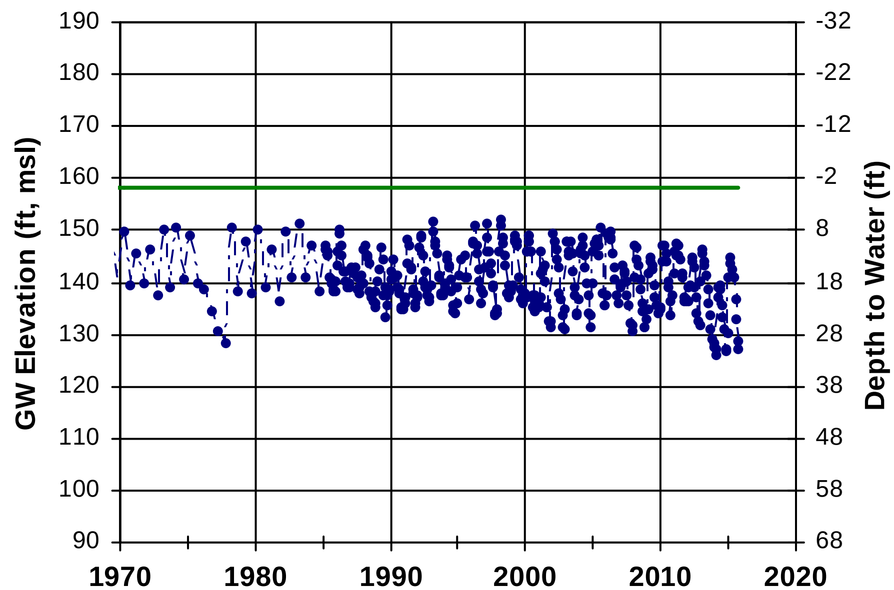
WellID: **SL0605536682MW-** RPE: 31.63 ft, msl Subarea: NVF_Napa
SWN: Unknown Source: Geotracker

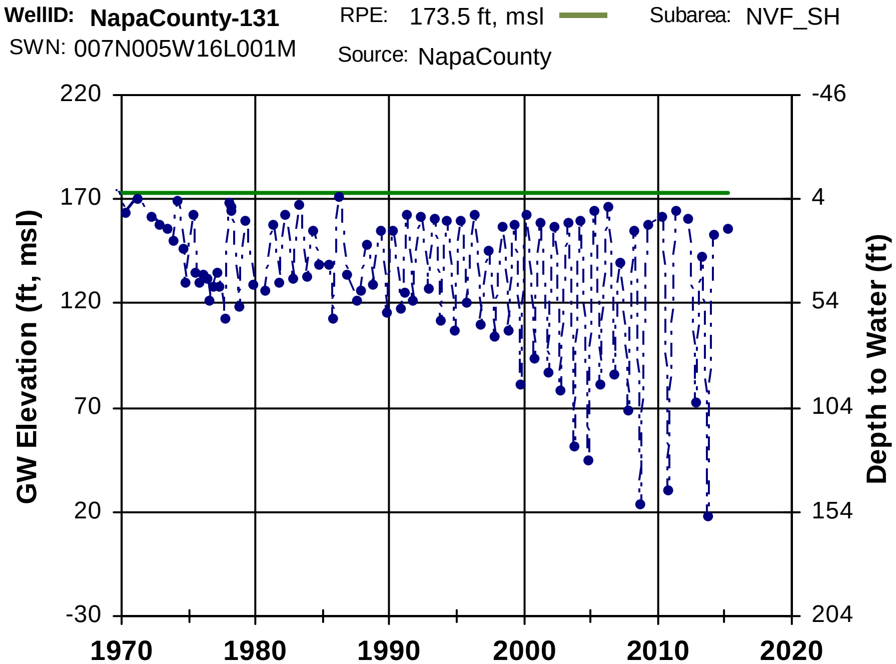


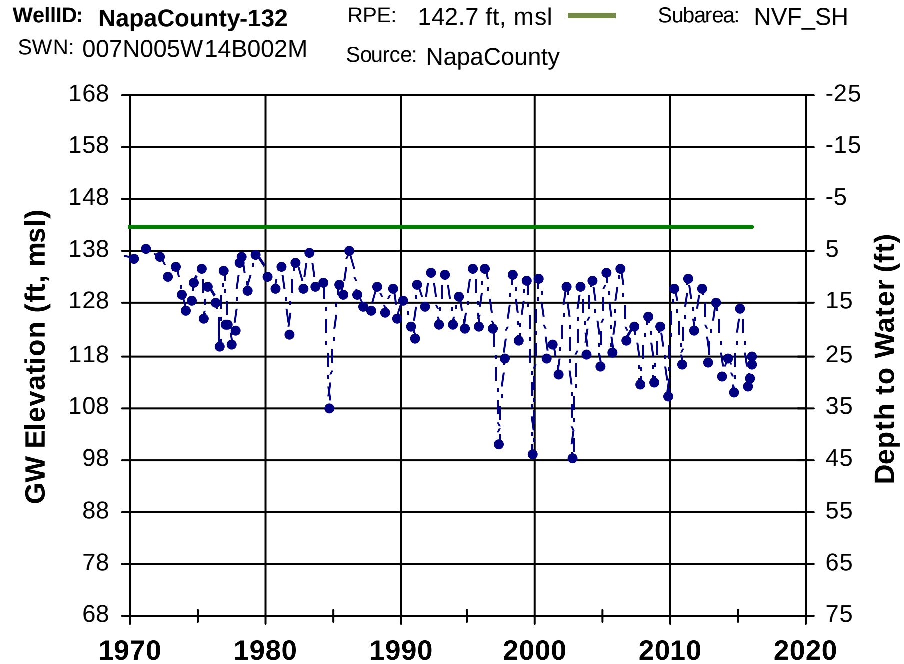
WellID: **T0605514064DPE1** RPE: 14.47 ft, msl Subarea: NVF_Napa
SWN: Unknown Source: Geotracker

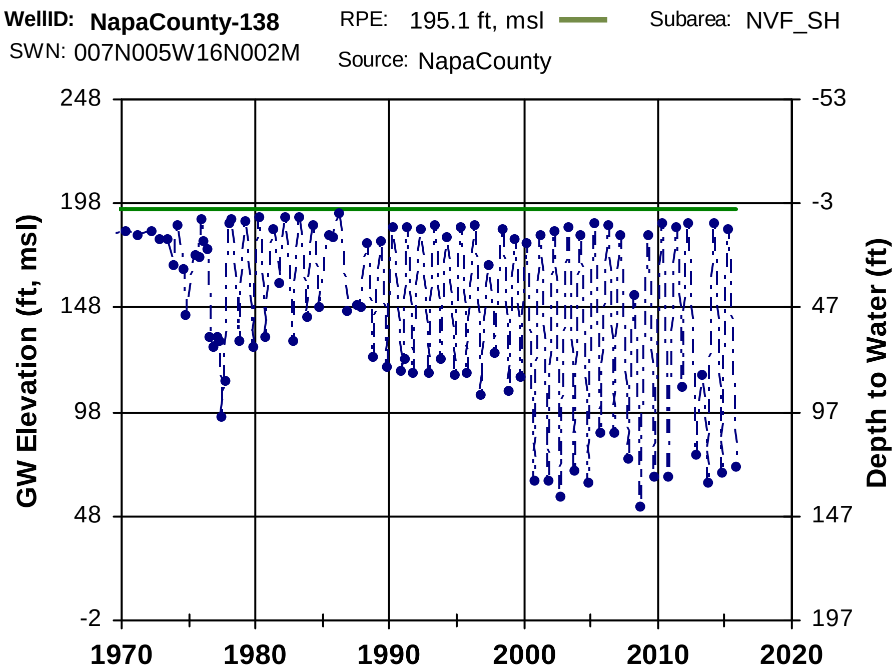


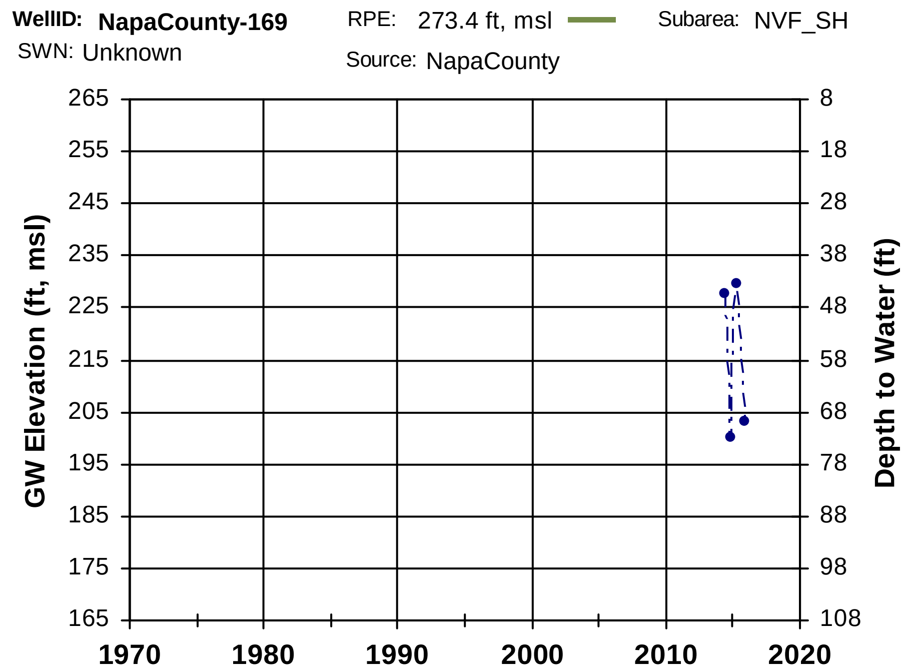
WellID: **07N05W09Q002M** RPE: 158.24 ft, msl Subarea: NVF_SH
SWN: 007N005W09Q002M Source: DWR



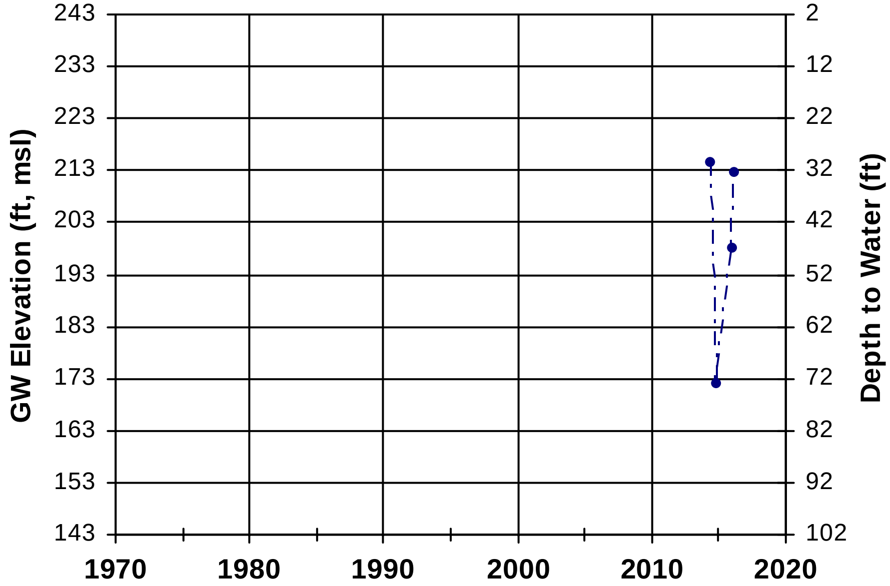

WellID: NapaCounty-131
SWN: 007N005W16L001M
RPE: 173.5 ft, msl
Source: NapaCounty
Subarea: NVF_SH
GW Elevation (ft, msl)
Depth to Water (ft)
220
170
120
70
20
-30
-46
4
54
104
154
204
1970
1980
1990
2000
2010
2020


WellID: NapaCounty-132
SWN: 007N005W14B002M
RPE: 142.7 ft, msl
Source: NapaCounty
Subarea: NVF_SH
GW Elevation (ft, msl)
Depth to Water (ft)
168
158
148
138
128
118
108
98
88
78
68
-25
-15
-5
5
15
25
35
45
55
65
75
1970
1980
1990
2000
2010
2020

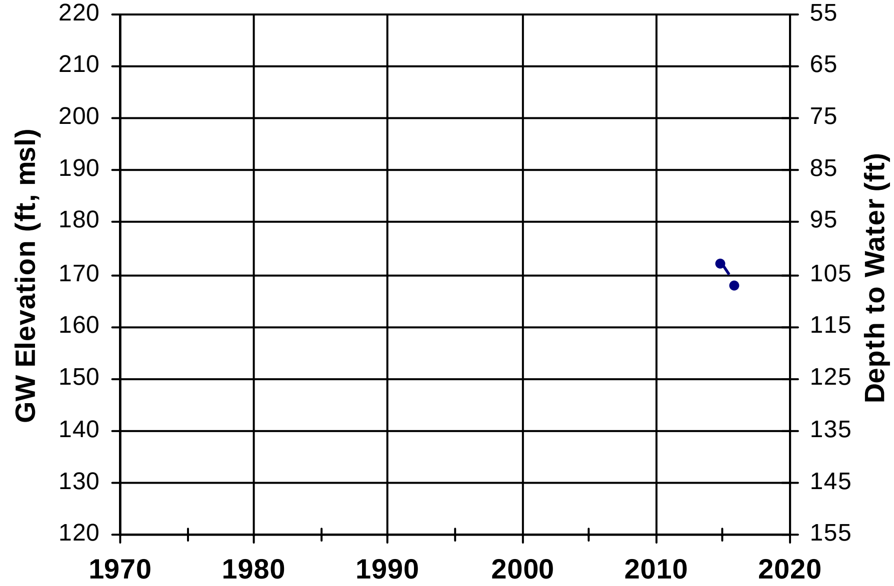

WellID: NapaCounty-138
SWN: 007N005W16N002M
RPE: 195.1 ft, msl
Source: NapaCounty
Subarea: NVF_SH
GW Elevation (ft, msl)
Depth to Water (ft)
248
198
148
98
48
-2
-53
-3
47
97
147
197
1970
1980
1990
2000
2010
2020


WellID: NapaCounty-169
SWN: Unknown
RPE: 273.4 ft, msl
Source: NapaCounty
Subarea: NVF_SH
GW Elevation (ft, msl)
Depth to Water (ft)
265
255
245
235
225
215
205
195
185
175
165
8
18
28
38
48
58
68
78
88
98
108
1970
1980
1990
2000
2010
2020

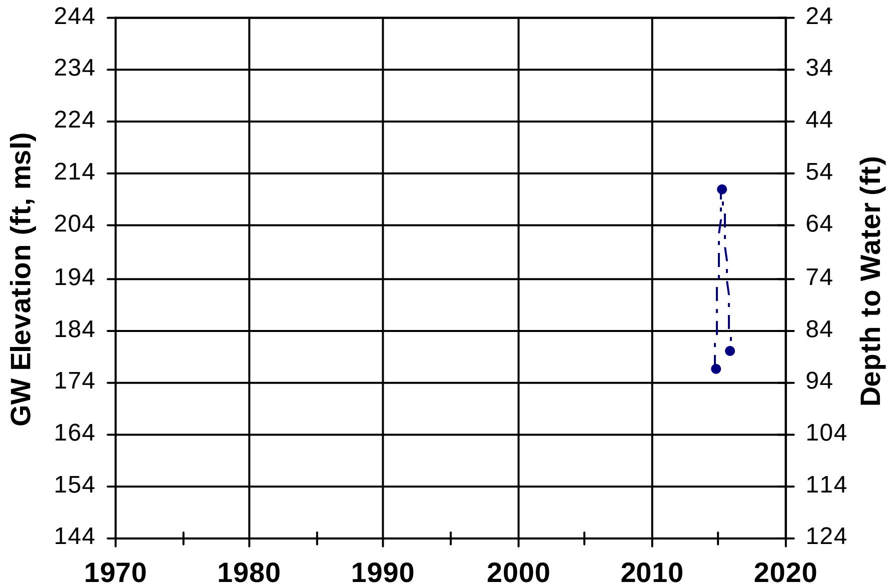
WellID: **NapaCounty-171** RPE: 245.1 ft, msl Subarea: NVF_SH
SWN: Unknown Source: NapaCounty



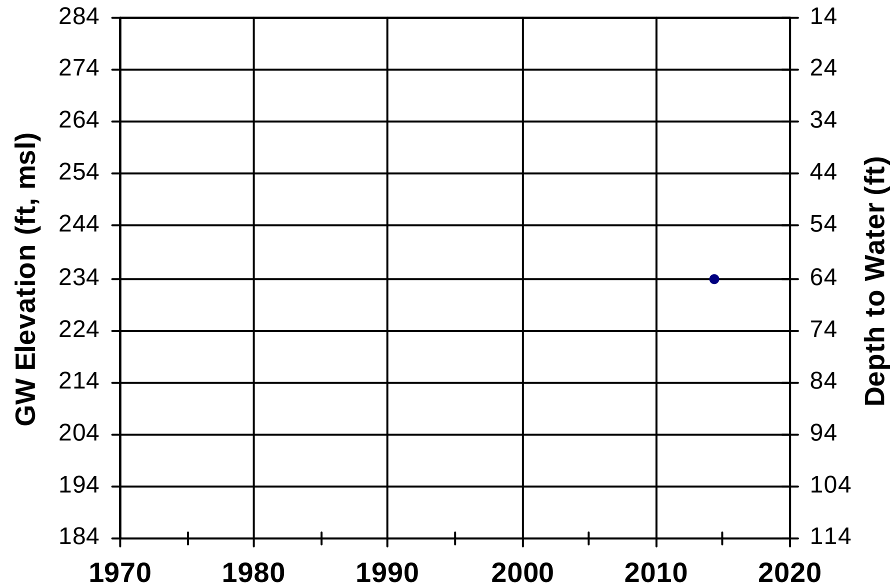
WellID: **NapaCounty-172** RPE: 275.2 ft, msl Subarea: NVF_SH
SWN: Unknown Source: NapaCounty



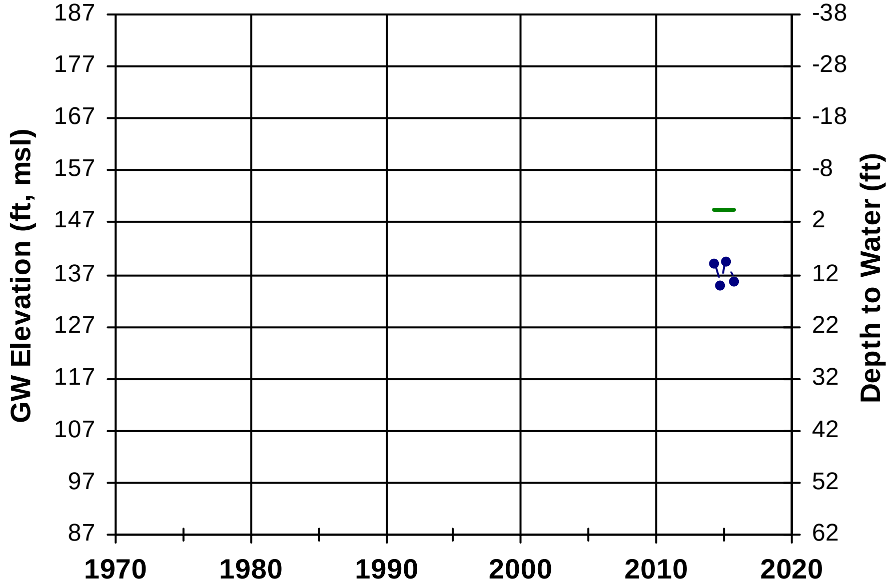
WellID: **NapaCounty-173** RPE: 268.3 ft, msl Subarea: NVF_SH
SWN: Unknown Source: NapaCounty



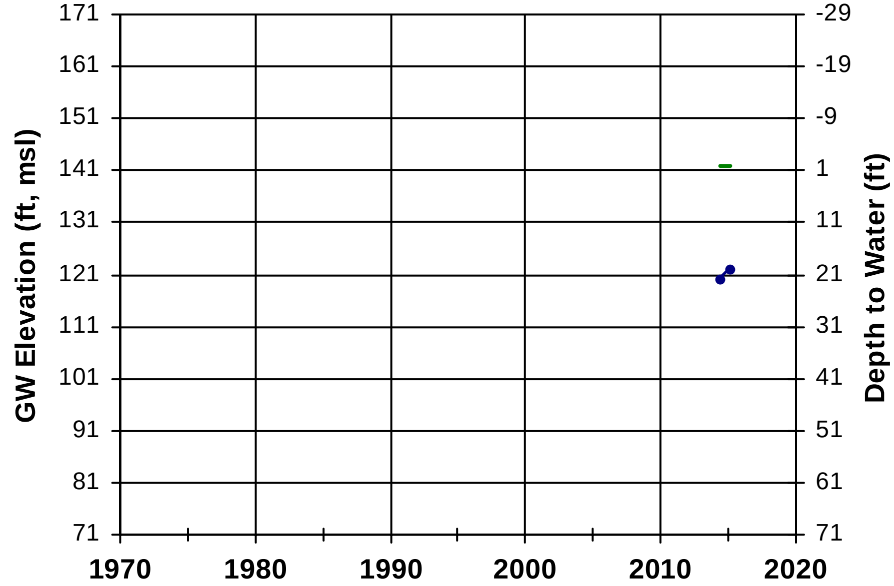
WellID: **NapaCounty-174** RPE: 298.2 ft, msl Subarea: NVF_SH
SWN: Unknown Source: NapaCounty



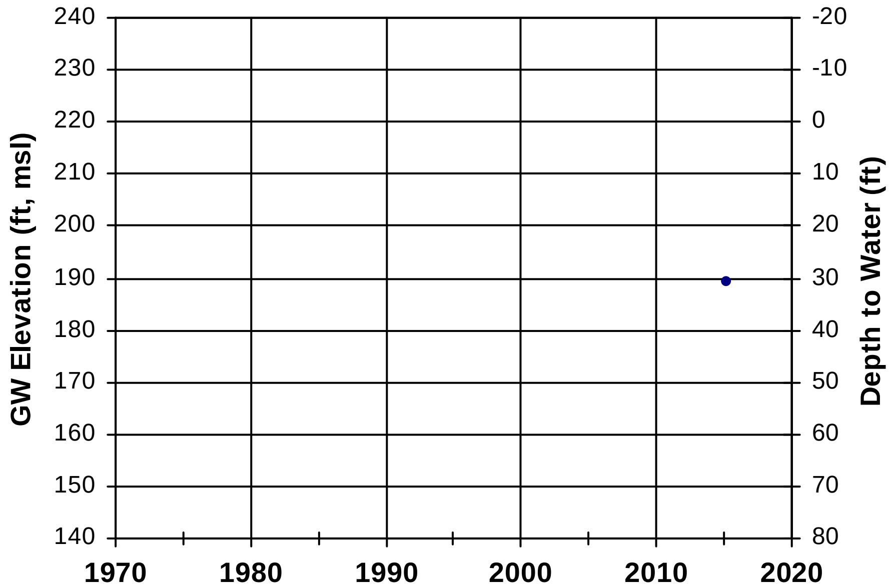
WellID: **NapaCounty-177** RPE: 149.3 ft, msl Subarea: NVF_SH
SWN: Unknown Source: NapaCounty



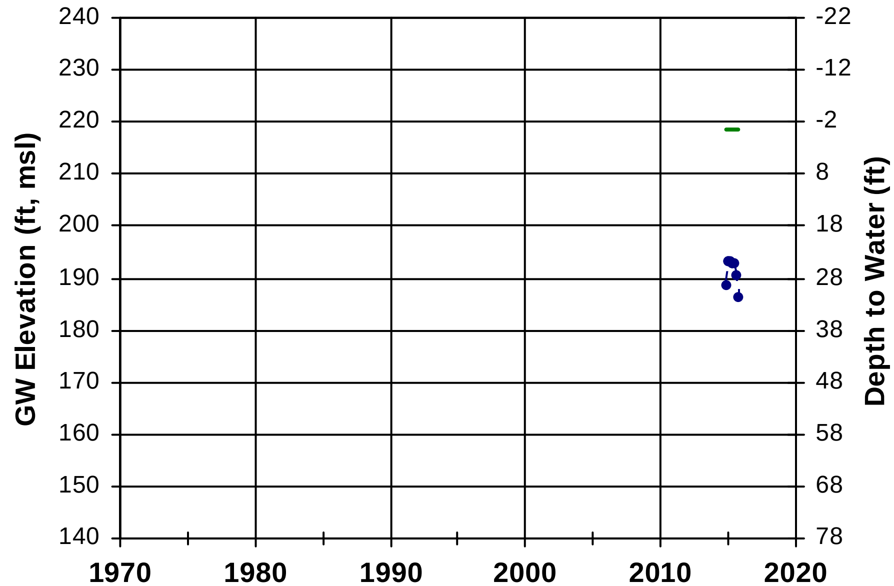
WellID: **NapaCounty-204** RPE: 141.7 ft, msl Subarea: NVF_SH
SWN: Unknown Source: NapaCounty



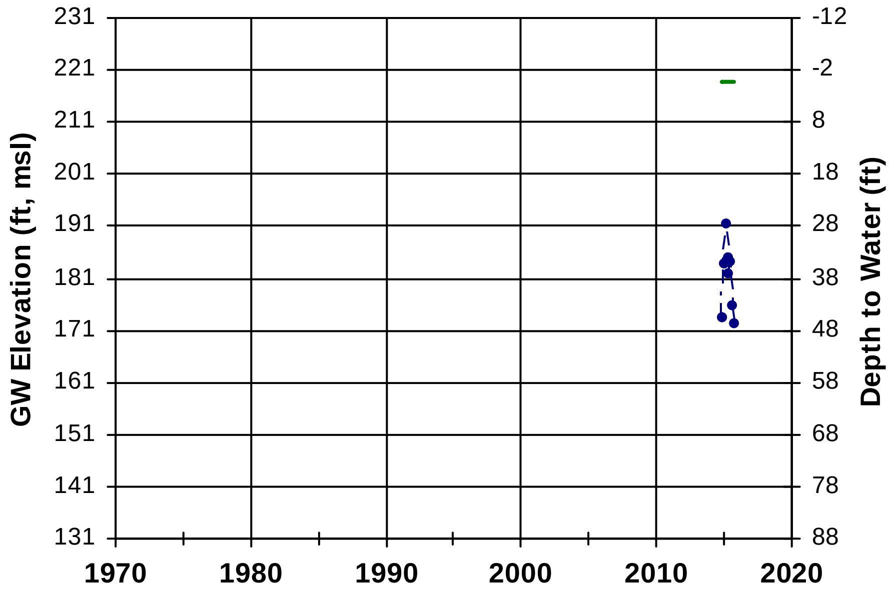
WellID: **NapaCounty-212** RPE: 220.5 ft, msl Subarea: NVF_SH
SWN: Unknown Source: NapaCounty



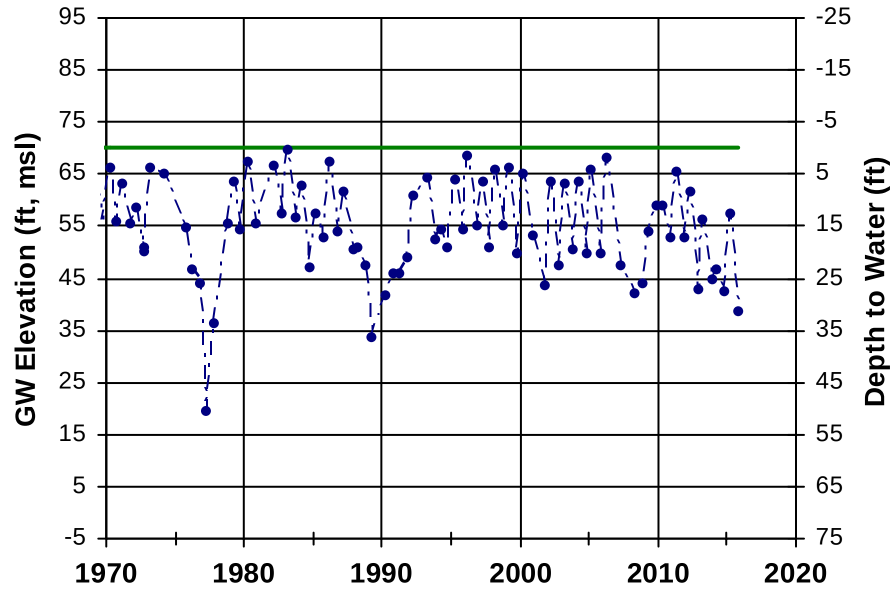
WellID: **NapaCounty-222s-s** RPE: 218.5 ft, msl Subarea: NVF_SH
SWN: Unknown Source: NapaCounty



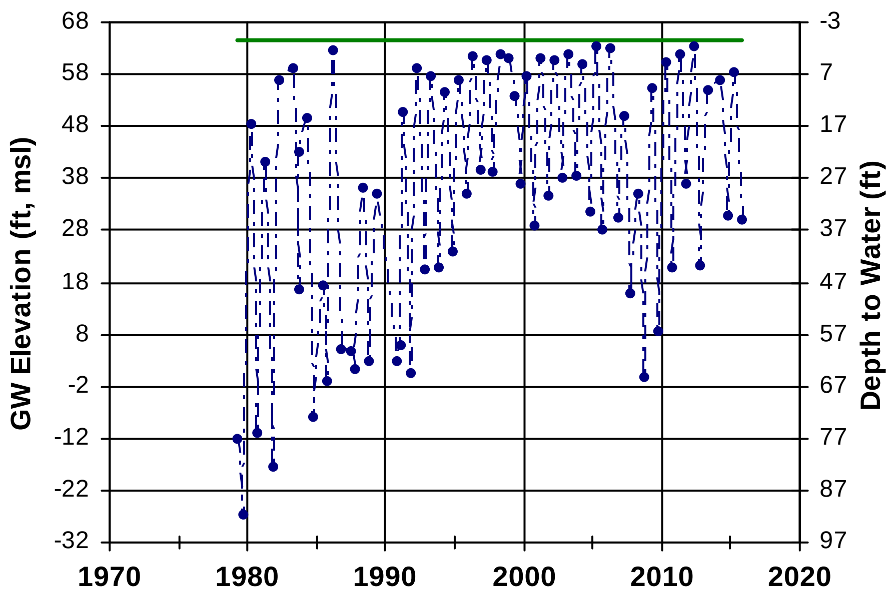
WellID: **NapaCounty-223d-s** RPE: 218.55 ft, msl Subarea: NVF_SH
SWN: Unknown Source: NapaCounty



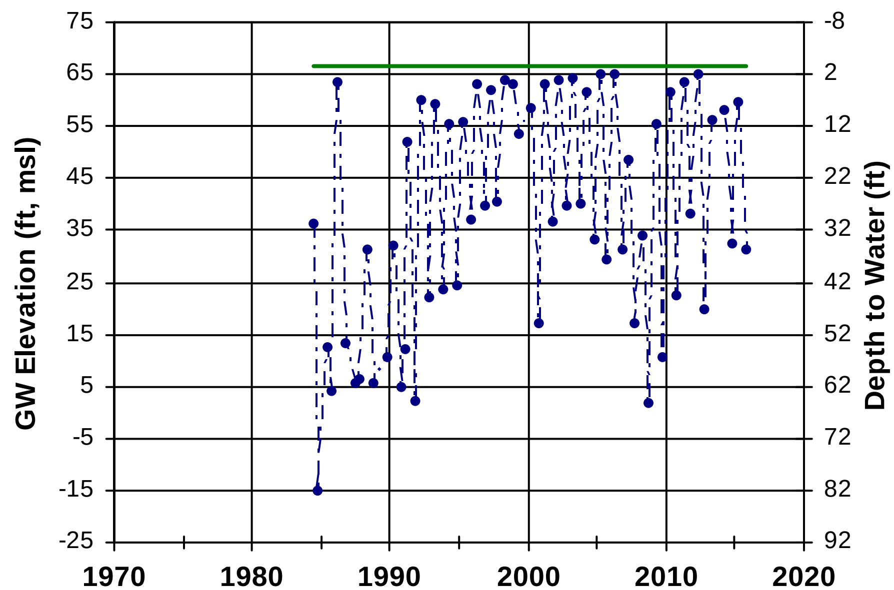
WellID: **06N04W17A001M** RPE: 70.26 ft, msl Subarea: NVF_Yount
SWN: 006N004W17A001M Source: DWR



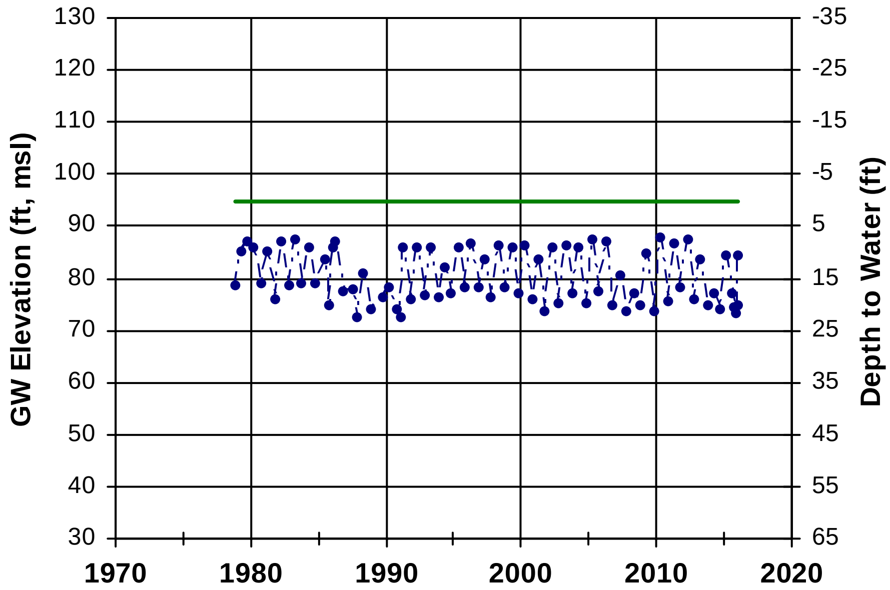
WellID: **NapaCounty-125** RPE: 64.6 ft, msl Subarea: NVF_Yount
SWN: 006N004W09Q001M Source: NapaCounty



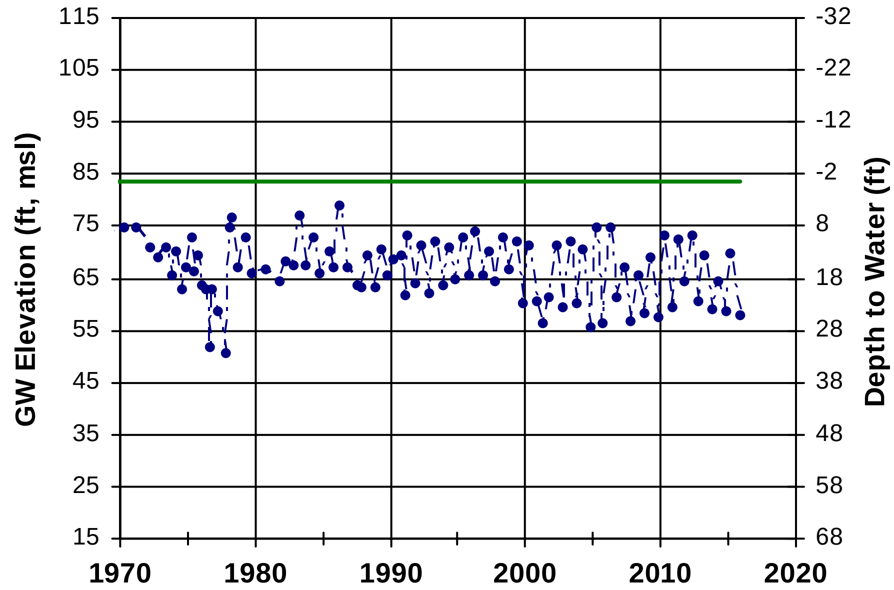
WellID: **NapaCounty-126** RPE: 66.7 ft, msl Subarea: NVF_Yount
SWN: 006N004W09Q002M Source: NapaCounty



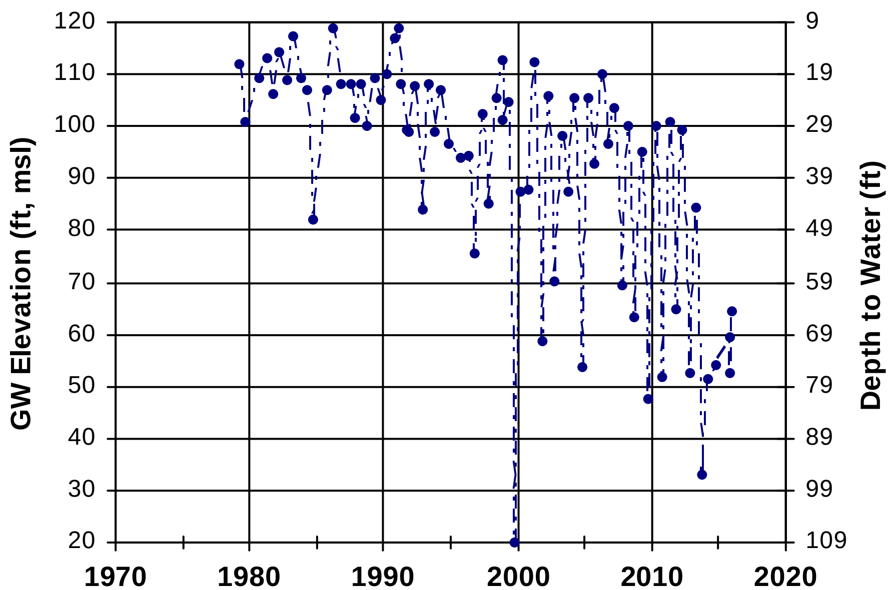
WellID: **NapaCounty-133** RPE: 94.7 ft, msl Subarea: NVF_Yount
SWN: 007N004W31M001M Source: NapaCounty



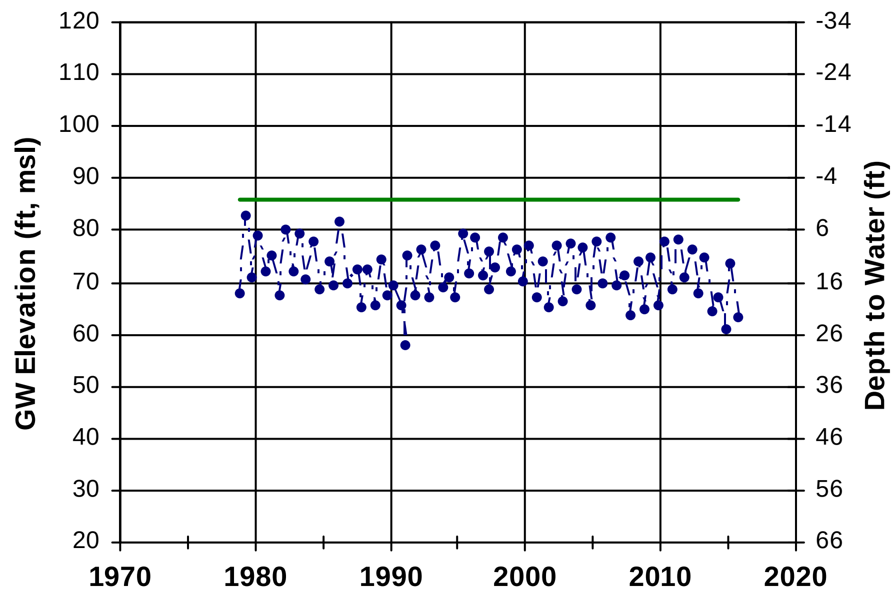
WellID: **NapaCounty-134** RPE: 83.4 ft, msl Subarea: NVF_Yount
SWN: 006N004W06L002M Source: NapaCounty



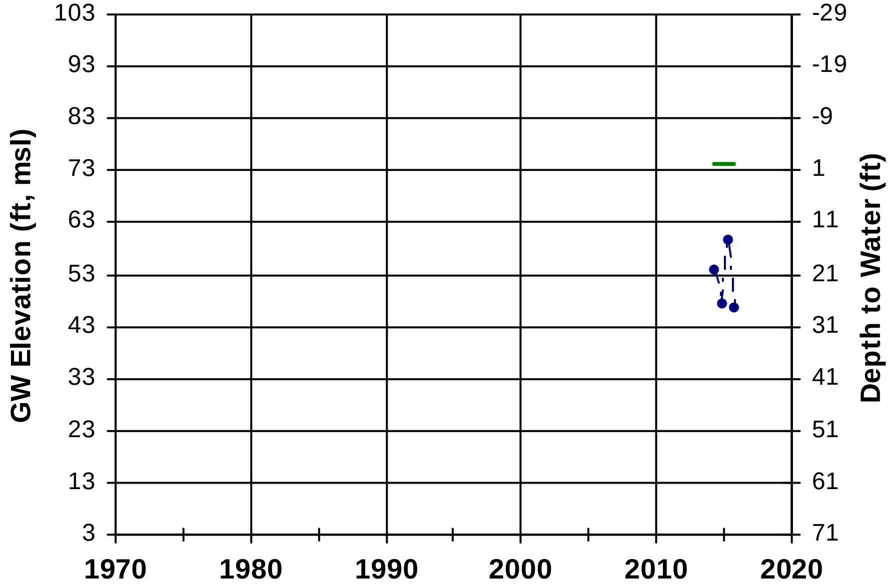
WellID: **NapaCounty-135** RPE: 129.2 ft, msl Subarea: NVF_Yount
SWN: 006N004W19B001M Source: NapaCounty



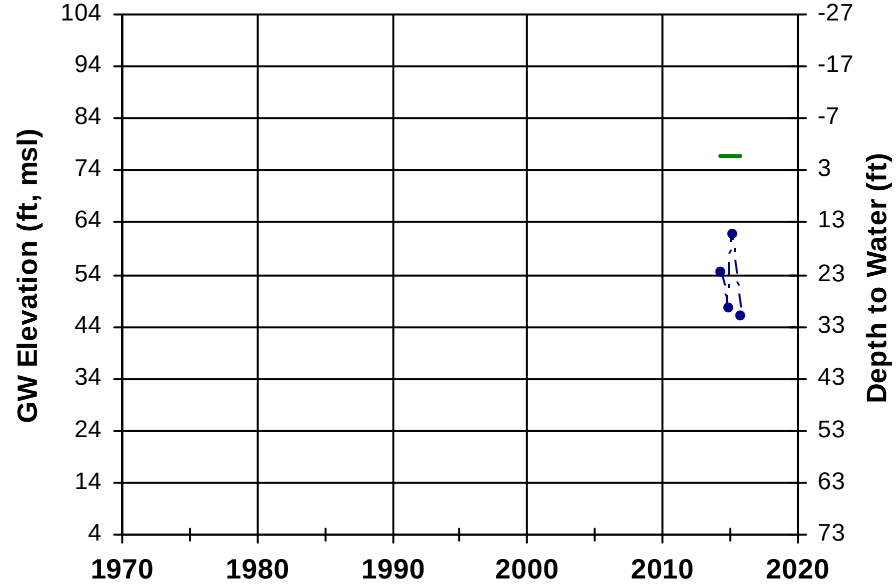
WellID: **NapaCounty-139** RPE: 85.8 ft, msl Subarea: NVF_Yount
SWN: 006N004W17R002M Source: NapaCounty



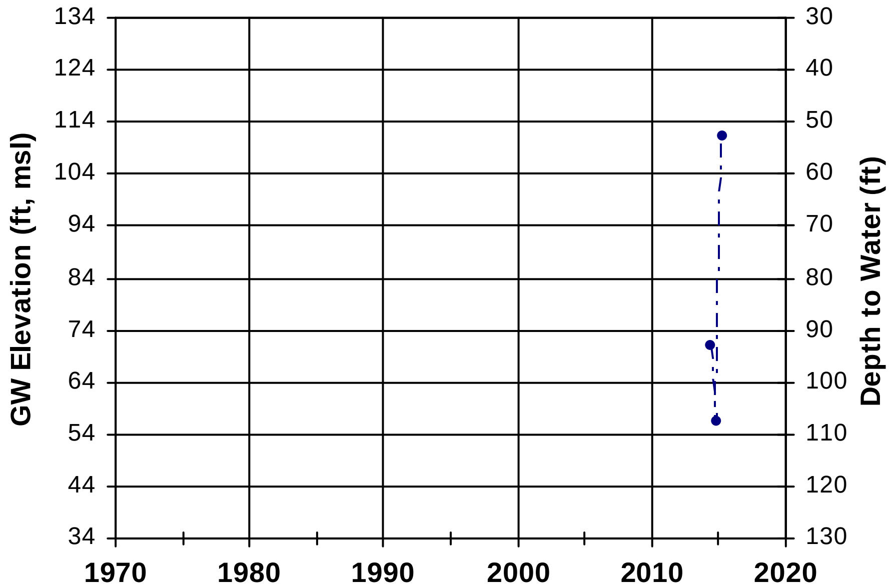
WellID: **NapaCounty-179** RPE: 74.3 ft, msl Subarea: NVF_Yount
SWN: Unknown Source: NapaCounty



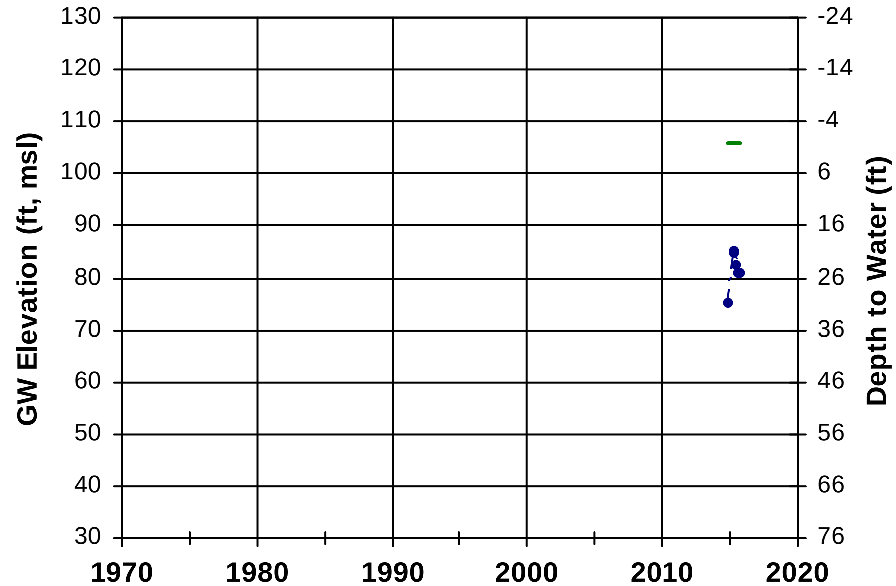
WellID: **NapaCounty-180** RPE: 76.9 ft, msl Subarea: NVF_Yount
SWN: Unknown Source: NapaCounty



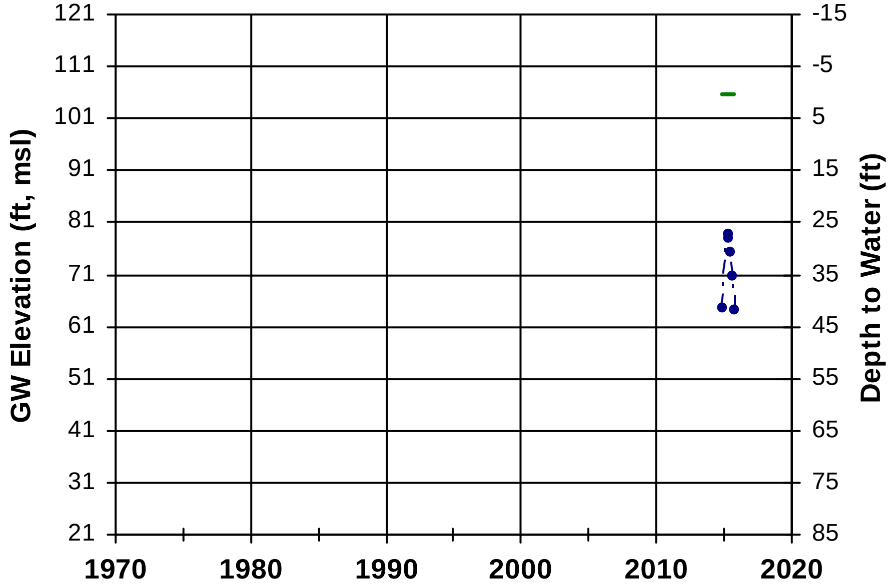
WellID: **NapaCounty-181** RPE: 163.6 ft, msl Subarea: NVF_Yount
SWN: Unknown Source: NapaCounty



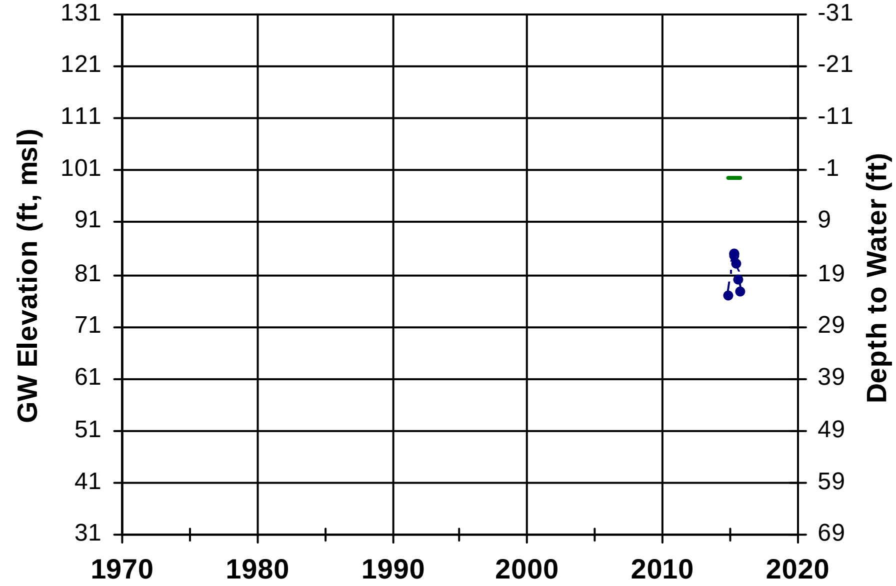
WellID: **NapaCounty-216s-s** RPE: 105.8 ft, msl Subarea: NVF_Yount
SWN: Unknown Source: NapaCounty



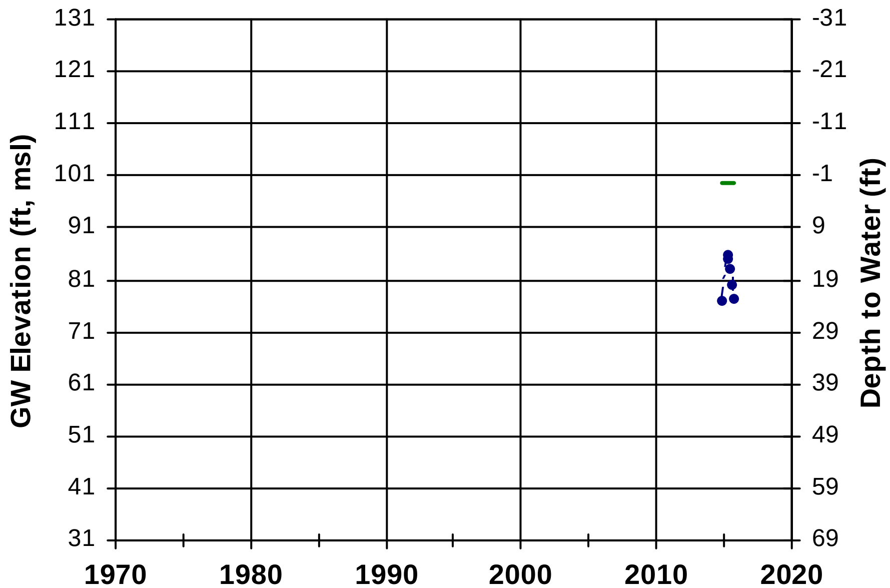
WellID: **NapaCounty-217d-s** RPE: 105.8 ft, msl Subarea: NVF_Yount
SWN: Unknown Source: NapaCounty



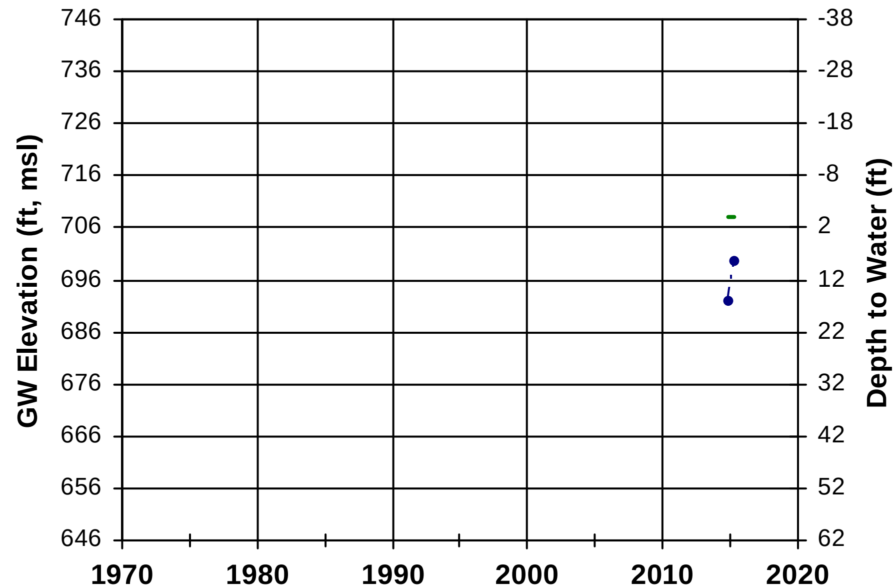
WellID: **NapaCounty-220s-s** RPE: 99.7 ft, msl Subarea: NVF_Yount
SWN: Unknown Source: NapaCounty

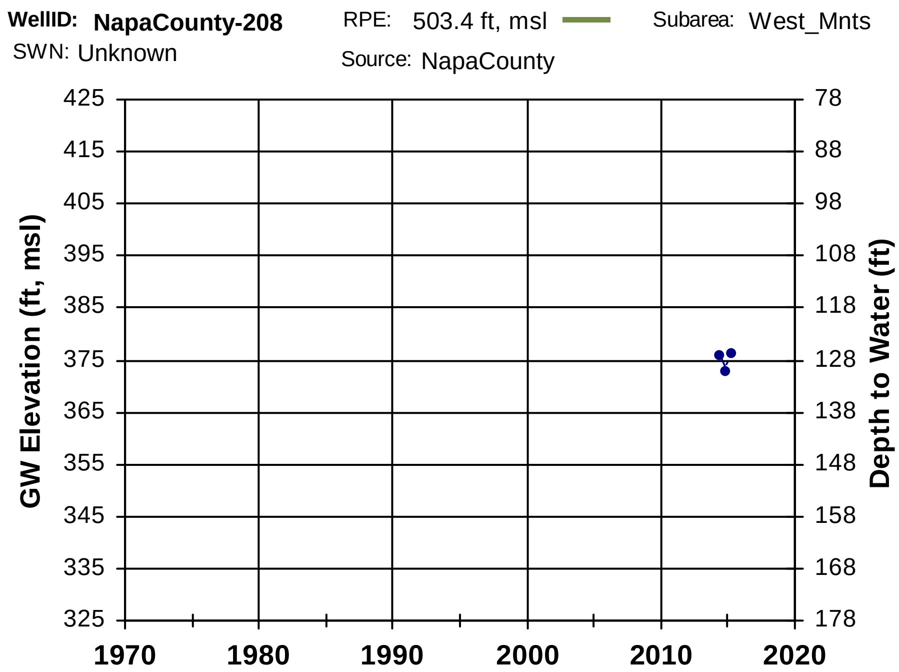


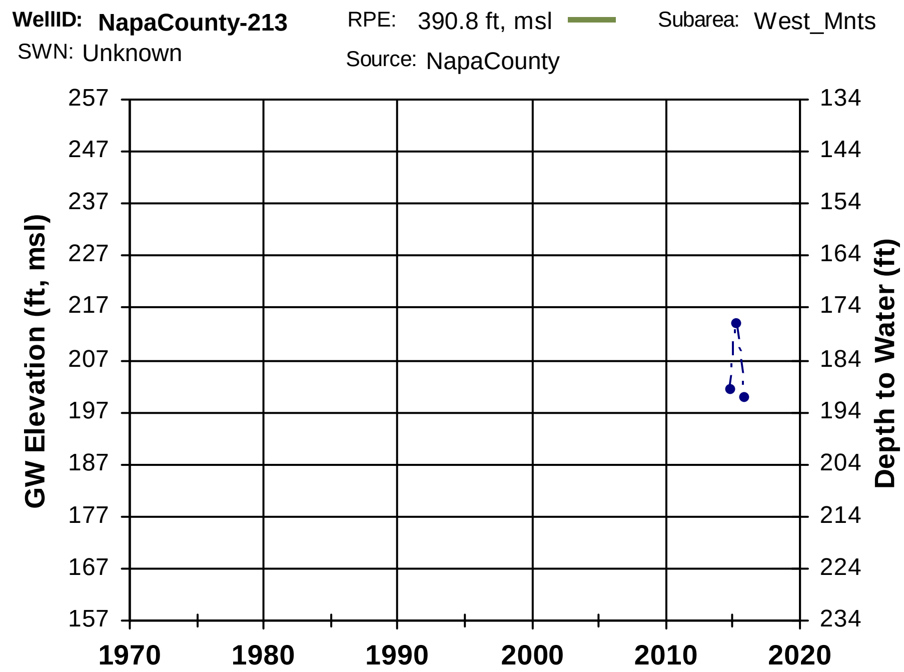
WellID: **NapaCounty-221d-s** RPE: 99.7 ft, msl Subarea: NVF_Yount
SWN: Unknown Source: NapaCounty



WellID: **NapaCounty-211** RPE: 708.2 ft, msl Subarea: PV
SWN: Unknown Source: NapaCounty




WellID: NapaCounty-208
SWN: Unknown
RPE: 503.4 ft, msl
Source: NapaCounty
Subarea: West_Mnts
GW Elevation (ft, msl)
Depth to Water (ft)
425
415
405
395
385
375
365
355
345
335
325
78
88
98
108
118
128
138
148
158
168
178
1970
1980
1990
2000
2010
2020


WellID: NapaCounty-213
SWN: Unknown
RPE: 390.8 ft, msl
Source: NapaCounty
Subarea: West_Mnts
GW Elevation (ft, msl)
Depth to Water (ft)
257
247
237
227
217
207
197
187
177
167
157
134
144
154
164
174
184
194
204
214
224
234
1970
1980
1990
2000
2010
2020

APPENDIX C

Napa County Procedure for Measuring Groundwater Levels

NAPA COUNTY PROCEDURE FOR MEASURING THE DEPTH TO WATER IN MONITORING AND PRODUCTION WELLS

Purpose

To obtain an accurate dated and timed measurement of the static depth to water in a well that can be converted into a water level elevation in reference to a commonly used reference datum (e.g., NAVD 1988). In this context, static means that the water level in the well is not influenced by pumping of the well. For comparability, measurements should be obtained according to an established schedule designed to capture times of both highest and lowest seasonal water level elevations. Also for comparability, measurements during a particular field campaign should be obtained consecutively and without delay within the shortest reasonable time.

Measurement Procedure

- If a well is being pumped, do not measure; return later, but not sooner than 60 minutes and preferably after 24 hours (see below "Special Circumstances" for additional instructions).
- Turn on water level indicator signaling device and check battery by hitting the test button.
- Remove access plug or well cap from the well cover and lower probe (electric sounder) into the well.
- When probe hits water a loud "beep" will sound and signal light will turn red.
- Retract slightly until the tone stops.
- Slowly lower the probe until the tone sounds.
- Note depth measurement at rim (i.e., the surveyed reference point for water level readings) of well to the nearest 0.01 foot and rewind probe completely out of well.
- Remove excess water and lower probe once again into well and measure again.
- If difference is within ±0.02 foot of first measurement, record measurement.
- If difference is greater repeat the same procedure until three consecutive measurements are recorded within ± 0.02 foot.
- Rewind and remove probe from well and replace the access plug or well cap in the well cover.
- Clean and dry the measuring device/probe and continue to next well.

Special Circumstances

Oil Encountered in Well

If oil is detected in the well structure, the depth to the air-oil interface is measured. To obtain such a measurement, the electric sounder is used similar to the way chalked steel tapes were traditionally used for depth-to-water measurements.

1. Lower the cleaned probe well below the air-oil interface (e.g., 1 foot). Read and record the depth at the reference point (since this depth is chosen somewhat arbitrarily by the field technician, an even number can be chosen, e.g., 37.00 feet). This measurement is the length of cable lowered into the well and corresponds to a line that the oil leaves on the probe or cable (i.e., the oil inundation line). Above this line, smudges of oil may appear on the cable. Below this line, the cable/probe is completely covered with oil. If the probe is lowered too far, completely penetrates the oil, and is far submerged in the water below the oil, parts of the probe/cable below the oil inundation line may also appear smudgy.
2. Retrieve probe, identify and record the oil inundation line on the cable (e.g., 2.72 feet). This measurement does not reflect the thickness of the oil. It reflects the length of the cable below the air-oil interface.
3. Compute the depth to oil by subtracting the length of line below the air-oil interface from the corresponding measurement at the reference point: Depth to oil = 37.00 feet – 2.72 feet = 34.28 feet.

Since oil has a slightly smaller density than water, a depth-to-oil measurement will always be smaller than a corresponding depth-to-water measurement in the same well if oil were not present. Depth-to-oil measurements yield a reasonable approximation to depth-to-water measurements unless the oil thickness is great. For each foot of oil in the well casing, the depth-to-oil measurement will be approximately 0.12 foot smaller than a corresponding depth-to-water measurement if oil were not present.

Pumping Water Level on Arrival

If well is being pumped, do not measure. Return later when the water level has stabilized. Using past field notes, the field technician will use his/her experience to determine the appropriate duration necessary for static measurements. Upon returning to the well site (at a location where pumping was previously noted on the same day), the technician will measure the water level. The technician will have available historical water level data to determine whether the measurement is consistent with past measurements. If the initial measurement appears anomalous, the technician will measure water levels every 10 minutes over a period of 30 minutes.[8] If measurements vary significantly from past measurements (taking into account seasonal variations), the technician will note the circumstances (i.e., the date and time when the well was first visited, total time it was pumping (if known), when it was shutoff, when the technician returned, and subsequent water level measurements [on the same day, or as the case may be based on experience, the day immediately following]). Subsequent consideration of pumping effects at a site-specific well location will be addressed as necessary.

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[8] During this period, if the groundwater level difference is greater [than +/- 0.02 feet], repeat the same procedure until three consecutive measurements are recorded within ± 0.02 foot.

Recordation

1. Name of field technician
2. Unique identification of well
3. Weather and site conditions (e.g., clear, sunny, strong north wind, intense dust blowing over wellhead from nearby plowed field; dry ground, easy access)
4. Condition of well structure (e.g., well cap cracked – replaced with new one; wasp hive between well casing and well housing; no action, discuss with project manager)
5. Time and date of depth-to-water reading
6. Any other pertinent comments (e.g., sounder hangs up at 33 feet, thus no measurement; or: fifth measurement of ~55.68 feet in a row…residual water in end cap?; or: oil in well…measurement is depth to oil; or: intense sulfur odor upon opening well cap; or: nearby (west ~100 feet) irrigation well pumping)

APPENDIX D

Surface Water-Groundwater Monitoring Sites Water Quality Sample Results

Site	Sample ID	Sample Date	Total Alkalinity mg/L as CaCO3 Std Method 2320 B [1]*	Dissolved Aluminum mg/L EPA 200.8 (D) [1]*	Dissolved Antimony mg/L EPA 200.8 (D) [1]*	Dissolved Arsenic mg/L EPA 200.8 (D) [1]*	Dissolved Barium mg/L EPA 200.8 (D) [1]*	Dissolved Beryllium mg/L EPA 200.8 (D) [1]*	Dissolved Bicarbonate (HCO3-) mg/L as CaCO3 Std Method 4500-CO2 D [1]*	Dissolved Boron mg/L EPA 200.7 (D) [1]*	Dissolved Bromide mg/L EPA 300.0 28d Hold [1]*	Dissolved Cadmium mg/L EPA 200.8 (D) [1]*	Dissolved Calcium mg/L EPA 200.7 (D) [1]*
Site 1	NapaCounty-214s	6/3/2015 8:09	117	<0.01	<0.001	<0.001	0.081	<0.001	117	0.2	0.07	<0.001	19
Site 1	NapaCounty-215d	6/3/2015 7:16	258	<0.01	<0.001	0.007	0.103	<0.001	258	1.4	0.63	<0.001	41
Site 1	NapaCounty-swgw_SW1	6/4/2015 13:39	145	0.02	<0.001	0.015	0.136	<0.001	144	1.4	15.9	<0.001	145
Site 2	NapaCounty-216s	6/3/2015 13:03	93	0.089	<0.001	<0.001	0.046	<0.001	93	<0.1	0.12	<0.001	22
Site 2	NapaCounty-217d	6/3/2015 12:23	116	0.432	<0.001	0.001	0.027	<0.001	116	<0.1	0.06	<0.001	15
Site 2	NapaCounty-swgw_SW2	6/3/2015 13:15	154	0.029	<0.001	<0.001	0.059	<0.001	153	0.1	0.02	<0.001	34
Site 3	NapaCounty-218s	6/3/2015 11:02	192	<0.01	<0.001	<0.001	0.091	<0.001	192	0.1	0.13	<0.001	47
Site 3	NapaCounty-219d	6/3/2015 10:04	225	<0.01	<0.001	0.046	0.088	<0.001	224	9.1	0.33	<0.001	17
Site 3	NapaCounty-swgw_SW3	6/4/2015 12:46	176	0.012	<0.001	0.003	0.073	<0.001	175	0.5	0.2	<0.001	36
Site 4	NapaCounty-220s	6/4/2015 8:19	199	<0.01	<0.001	0.003	0.078	<0.001	199	0.1	0.1	<0.001	32
Site 4	NapaCounty-221d	6/4/2015 7:52	124	<0.01	<0.001	0.004	0.05	<0.001	124	<0.1	0.03	<0.001	14
Site 4	NapaCounty-swgw_SW4	6/4/2015 8:50	98	<0.01	<0.001	0.001	0.042	<0.001	98	<0.1	0.08	<0.001	22
Site 5	NapaCounty-222s	6/4/2015 11:29	117	<0.01	<0.001	0.003	0.041	<0.001	117	0.6	0.12	<0.001	28
Site 5	NapaCounty-223d	6/4/2015 10:56	213	<0.01	<0.001	0.002	0.104,0.105**	<0.001	213	0.5	0.07	<0.001	16
Site 5	NapaCounty-swgw_SW5	6/4/2015 11:56	92,93**	<0.01	<0.001	0.004	0.039	<0.001	93	0.8	0.12	<0.001	21

Site	Sample ID	Sample Date	Dissolved Carbonate (CO3--) mg/L as CaCO3 Std Method 4500-CO2 D [1]*	Dissolved Chloride mg/L EPA 300.0 28d Hold [1]*	Dissolved Chromium mg/L EPA 200.8 (D) [1]*	Dissolved Cobalt mg/L EPA 200.8 (D) [1]*	Conductance (EC) µS/cm Std Method 2510-B [1]*	Dissolved Copper mg/L EPA 200.8 (D) [1]*	Dissolved Fluoride mg/L EPA 300.0 28d Hold [1]*	Dissolved Hardness mg/L as CaCO3 Std Method 2340 B [1]*	Dissolved Hydroxide (OH-) mg/L as CaCO3 Std Method 4500-CO2 D [1]*	Dissolved Iron mg/L EPA 200.8 (D) [1]*	Dissolved Lead mg/L EPA 200.8 (D) [1]*
Site 1	NapaCounty-214s	6/3/2015 8:09	<1	28	<0.001	<0.005	416	<0.001	0.2	144	<1	0.009	<0.001
Site 1	NapaCounty-215d	6/3/2015 7:16	1	177	<0.001	<0.005	1174	0.001	0.2	226	<1	0.042	<0.001
Site 1	NapaCounty-swgw_SW1	6/4/2015 13:39	1	4699	0.002	<0.005	14319	0.006	<0.1	1717	<1	0.025	<0.001
Site 2	NapaCounty-216s	6/3/2015 13:03	<1	15	0.001	<0.005	317	0.003	0.2	116	<1	0.066	<0.001
Site 2	NapaCounty-217d	6/3/2015 12:23	<1	5	0.001	<0.005	255	0.001	0.6	74	<1	0.331	<0.001
Site 2	NapaCounty-swgw_SW2	6/3/2015 13:15	1	12	0.005	<0.005	411	0.006	0.2	159	<1	0.091	<0.001
Site 3	NapaCounty-218s	6/3/2015 11:02	<1	19	0.001	<0.005	536	<0.001	<0.1	247	<1	0.008	<0.001
Site 3	NapaCounty-219d	6/3/2015 10:04	1	73	<0.001	<0.005	712	0.005	0.3	116	<1	0.021	<0.001
Site 3	NapaCounty-swgw_SW3	6/4/2015 12:46	1	27	<0.001	<0.005	515	0.001	0.2	215	<1	0.022	<0.001
Site 4	NapaCounty-220s	6/4/2015 8:19	<1	7	<0.001	<0.005	429	<0.001	0.2	190	<1	<0.005	<0.001
Site 4	NapaCounty-221d	6/4/2015 7:52	<1	6	<0.001	<0.005	263	<0.001	0.2	100	<1	0.009	<0.001
Site 4	NapaCounty-swgw_SW4	6/4/2015 8:50	<1	18	<0.001	<0.005	328	0.001	0.1	128	<1	0.046	<0.001
Site 5	NapaCounty-222s	6/4/2015 11:29	<1	32	<0.001	<0.005	372	<0.001	0.3	123	<1	0.014	<0.001
Site 5	NapaCounty-223d	6/4/2015 10:56	<1	16	0.001	<0.005	453	<0.001	0.3	113	<1	0.473,0.476**	<0.001
Site 5	NapaCounty-swgw_SW5	6/4/2015 11:56	<1	34	<0.001	<0.005	346	0.002	0.4	100	<1	0.019	<0.001

*Codes in brackets ([]) following the analyte name refer to the Method Comparability Code. For more information, please refer to http://www.water.ca.gov/waterdatalibrary/includes/mtc_code.cfm.
**More than one analysis was made for this sample

Site	Sample ID	Sample Date	Dissolved Lithium mg/L EPA 200.8 (D) [1]*	Dissolved Magnesium mg/L EPA 200.7 (D) [1]*	Dissolved Manganese mg/L EPA 200.8 (D) [1]*	Dissolved Mercury mg/L EPA 200.8 (Hg Dissolved) [1]*	Dissolved Molybdenum mg/L EPA 200.8 (D) [1]*	Dissolved Nickel mg/L EPA 200.8 (D) [1]*	Dissolved Nitrate mg/L as N EPA 300.0 28d Hold [1]*	Dissolved Nitrite mg/L as N Std Method 4500-NO2 B (48Hr) [1]*	Dissolved Potassium mg/L EPA 200.7 (D) [1]*	Dissolved Selenium mg/L EPA 200.8 (D) [1]*	Dissolved Silver mg/L EPA 200.8 (D) [1]*
Site 1	NapaCounty-214s	6/3/2015 8:09	0.011	23	2.53	<0.0002	<0.005	0.003	7.3	0.02	1.1	<0.001	<0.001
Site 1	NapaCounty-215d	6/3/2015 7:16	0.059	30	1.13	<0.0002	<0.005	0.002	<0.1	<0.01	4.5	0.002	<0.001
Site 1	NapaCounty-swgw_SW1	6/4/2015 13:39	0.067	329	0.076	<0.0002	<0.005	0.007	12.6	<0.01	106.5	0.046	<0.001
Site 2	NapaCounty-216s	6/3/2015 13:03	0.012	15	0.041	<0.0002	<0.005	0.002	5.4	0.01	0.9	<0.001	<0.001
Site 2	NapaCounty-217d	6/3/2015 12:23	0.014	9	0.643	<0.0002	0.005	0.002	<0.1	<0.01	1.3	<0.001	<0.001
Site 2	NapaCounty-swgw_SW2	6/3/2015 13:15	0.008	18	0.024	<0.0002	<0.005	0.013	0.5	<0.01	2.1	<0.001	<0.001
Site 3	NapaCounty-218s	6/3/2015 11:02	0.01	31	<0.005	<0.0002	<0.005	0.003	1.8	<0.01	0.7	<0.001	<0.001
Site 3	NapaCounty-219d	6/3/2015 10:04	0.037,0.038**	18	0.241,0.242**	<0.0002	0.013,0.014**	0.001	<0.1	<0.01	5.2	<0.001	<0.001
Site 3	NapaCounty-swgw_SW3	6/4/2015 12:46	0.046	30	0.038	<0.0002	<0.005	0.004	<0.1	<0.01	2.9	<0.001	<0.001
Site 4	NapaCounty-220s	6/4/2015 8:19	<0.005	26	0.568	<0.0002	<0.005	0.005	0.7	0.03	3.6	<0.001	<0.001
Site 4	NapaCounty-221d	6/4/2015 7:52	<0.005	16	0.728	<0.0002	<0.005	0.002	<0.1	<0.01	4.7	<0.001	<0.001
Site 4	NapaCounty-swgw_SW4	6/4/2015 8:50	<0.005	17	0.041	<0.0002	<0.005	0.003	<0.1	<0.01	1.7	<0.001	<0.001
Site 5	NapaCounty-222s	6/4/2015 11:29	0.063	13	0.641	<0.0002	<0.005	0.01	<0.1	<0.01	3.8	<0.001	<0.001
Site 5	NapaCounty-223d	6/4/2015 10:56	0.075,0.076**	18	0.219,0.223**	<0.0002	<0.005	0.002	0.3	<0.01	7.1	<0.001	<0.001
Site 5	NapaCounty-swgw_SW5	6/4/2015 11:56	0.095	11	0.048	<0.0002	<0.005	0.003	<0.1	<0.01	3.7	<0.001	<0.001

Site	Sample ID	Sample Date	Dissolved Sodium mg/L EPA 200.7 (D) [1]*	Total Dissolved Solids mg/L Std Method 2540 C [1]*	Dissolved Strontium mg/L EPA 200.8 (D) [1]*	Dissolved Sulfate mg/L EPA 300.0 28d Hold [1]*	Dissolved Thallium mg/L EPA 200.8 (D) [1]*	Turbidity N.T.U. EPA 180.1 [D-2]*	Dissolved Vanadium mg/L EPA 200.8 (D) [1]*	Dissolved Zinc mg/L EPA 200.8 (D) [1]*	pH pH Units Std Method 2320 B [1]*
Site 1	NapaCounty-214s	6/3/2015 8:09	31	268	0.144	45	<0.001	1.21	<0.005	<0.005	6.9
Site 1	NapaCounty-215d	6/3/2015 7:16	164	683	0.32	74	<0.001	2.75	<0.005	<0.005	7.3
Site 1	NapaCounty-swgw_SW1	6/4/2015 13:39	2590	8830	2.19	667	<0.001	20.6	0.018	0.012	7.8
Site 2	NapaCounty-216s	6/3/2015 13:03	22	208	0.169	38	<0.001	77.4	<0.005	<0.005	6.8
Site 2	NapaCounty-217d	6/3/2015 12:23	29	164	0.107	9	<0.001	7.29	<0.005	<0.005	7.4
Site 2	NapaCounty-swgw_SW2	6/3/2015 13:15	28	255	0.269	44	<0.001	1.37	<0.005	0.027	7.6
Site 3	NapaCounty-218s	6/3/2015 11:02	20	324	0.357	65	<0.001	5.06	<0.005	<0.005	6.7
Site 3	NapaCounty-219d	6/3/2015 10:04	108	452	0.125,0.126**	32	<0.001	1.16	<0.005	0.006	7.4
Site 3	NapaCounty-swgw_SW3	6/4/2015 12:46	27	313	0.248	54	<0.001	7.48	<0.005	<0.005	7.8
Site 4	NapaCounty-220s	6/4/2015 8:19	19	292	0.199	11	<0.001	3.29	<0.005	<0.005	6.7
Site 4	NapaCounty-221d	6/4/2015 7:52	16	204	0.079	6	<0.001	7.11	<0.005	<0.005	7.1
Site 4	NapaCounty-swgw_SW4	6/4/2015 8:50	17	250	0.131	39	<0.001	3.4	<0.005	<0.005	7.3
Site 5	NapaCounty-222s	6/4/2015 11:29	26	241	0.155	21	<0.001	1.33,1.48**	<0.005	<0.005	7.1
Site 5	NapaCounty-223d	6/4/2015 10:56	56	343	0.104,0.105**	6	<0.001	18.8	<0.005	<0.005	7.2
Site 5	NapaCounty-swgw_SW5	6/4/2015 11:56	30	220	0.111	25	<0.001	1.68	<0.005	0.006	7.4

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