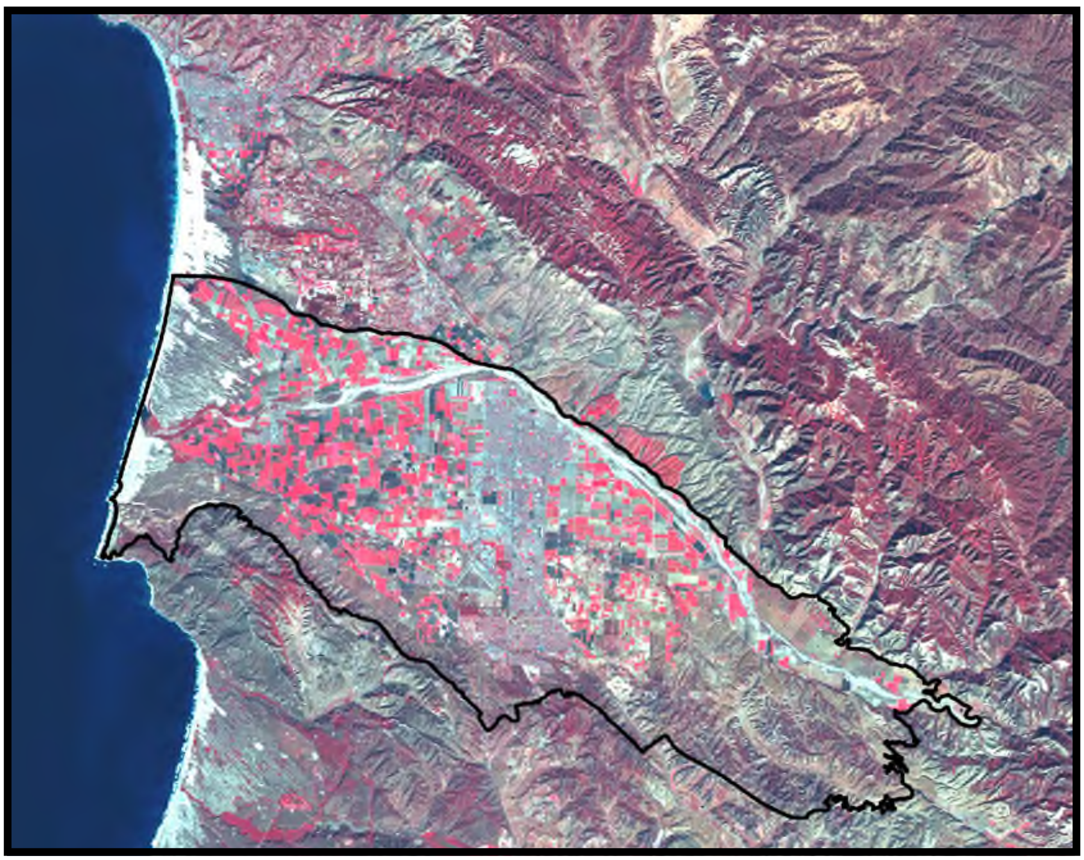
2015 Annual Report of Hydrogeologic Conditions, Water Requirements, Supplies and Disposition

Santa Maria Valley Management Area



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Consulting Engineers

April, 2016

2015 Annual Report of Hydrogeologic Conditions
Water Requirements, Supplies, and Disposition

Santa Maria Valley Management Area

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Acronyms and Abbreviations

af, afy, af/ac	acre-feet, acre-feet per year, acre-feet/acre
AW	applied water
CCAMP	Central Coast Ambient Monitoring Program
CCRWQCB	Central Coast Regional Water Quality Control Board
CCWA	Central Coast Water Authority
CIMIS	California Irrigation Management Information System
DU	Distribution Uniformity
DWR	California Department of Water Resources
ET	evapotranspiration
ET_{aw}, ET_c, ET_o	ET of applied water, ET of the crop, Reference ET
GIS	Geographic Information System
GPD	Gallons per day
GSWC	Golden State Water Company
K_c	crop coefficient
Laguna CSD	Laguna County Sanitation District
LSCE	Luhdorff & Scalmanini, Consulting Engineers
mg/l	milligrams per liter
MOU	Memorandum of Understanding
Nipomo CSD	Nipomo Community Services District
NMMA (TG)	Nipomo Mesa Management Area (Technical Group)
NO3-NO3	nitrate-as-nitrate
NOAA	National Oceanic and Atmospheric Administration
P_E	effective precipitation
SBCWA	Santa Barbara County Water Agency
SCWC	Southern California Water Company
SLODPW	San Luis Obispo County Department of Public Works
SMVMA	Santa Maria Valley Management Area
SMVWCD	Santa Maria Valley Water Conservation District
SWP	State Water Project
SWRCB	State Water Resources Control Board
TMA	Twitchell Management Authority
UCCE	University of California Cooperative Extension
USGS	United States Geological Survey
umho/cm	micromhos per centimeter
WIP	Waterline Intertie Project
WWTP	waste water treatment plant

1. Introduction

This annual report of conditions in the Santa Maria Valley Management Area, for calendar year 2015, has been prepared to meet the reporting conditions of the June 30, 2005, Stipulation entered by the Superior Court of the State of California, County of Santa Clara, in the Santa Maria Valley Groundwater Basin litigation. The Stipulation divided the overall Santa Maria Valley Groundwater Basin into three management areas, the largest of which overlies the main Santa Maria Valley (the Santa Maria Valley Management Area, or SMVMA) and is the subject of this report. The other two management areas, the Nipomo Mesa Management Area (NMMA) and the Northern Cities Management Area, are addressed in separate annual reports prepared by others.

The Stipulation, approved and implemented in 2008, specifies that monitoring shall be sufficient to determine groundwater conditions, land and water uses, sources of water supply, and the disposition of all water supplies in the Basin. Annual Reports for the SMVMA are to summarize the results of the monitoring and include an analysis of the relationship between projected water demand and supply. The Stipulation was preserved in the California Court of Appeal (Sixth Appellate District) Decision of November 21, 2012, and in the Superior Court of the State of California (County of Santa Clara) Final Judgment of April 23, 2014. Thus, the Physical Solution criteria for monitoring and managing groundwater in the basin remain.

In accordance with the Stipulation, this report on the SMVMA provides a description of the physical setting and briefly describes previous studies conducted in the groundwater basin, including the long-term monitoring program developed for the SMVMA. As reported herein, the Twitchell Management Authority (TMA) commissioned the preparation of a monitoring program for the SMVMA in 2008, and its complete implementation is expected to provide the data with which to fully assess future conditions. This report describes hydrogeologic conditions in the management area historically and through 2015, including groundwater conditions, Twitchell Reservoir operations, and hydrologic and climatic conditions. As with all previous annual reports (2008 through 2014), the water requirements and supplies for agricultural and municipal uses are accounted, as are the components of water disposition in the SMVMA. Conclusions drawn regarding water resource conditions are discussed, including any finding of severe water shortage, which is concluded to not be the case through 2015. Finally, recommendations are provided with regard to the intra-basin transfer of water from the SMVMA to the NMMA, possible enhancement of groundwater recharge, expanded assessment of water resource conditions, and continued implementation of the monitoring program for the SMVMA.

1.1 Physical Setting

The Santa Maria Valley Management Area (SMVMA) includes approximately 175 square miles of the Santa Maria Valley Groundwater Basin in northern Santa Barbara and southern San Luis Obispo Counties, as shown by the location map of the area (Figure 1.1-1). The SMVMA encompasses the contiguous area of the Santa Maria Valley, Sisquoc plain, and Orcutt upland, and is primarily comprised of agricultural land and areas of native vegetation, as well as the urban areas of Santa Maria, Guadalupe, Orcutt, Sisquoc, and several small developments.

Surrounding the SMVMA are the Casmalia and Solomon Hills to the south, the San Rafael Mountains to the southeast, the Sierra Madre Mountains to the east and northeast, the Nipomo Mesa to the north, and the Pacific Ocean to the west. The main stream is the Santa Maria River, which generally flanks the northern part of the Santa Maria Valley; other streams include portions of the Cuyama River, Sisquoc River and tributaries, and Orcutt Creek.

1.2 Previous Studies

The first overall study of hydrogeologic conditions in the Santa Maria Valley described the general geology, as well as groundwater levels and quality, agricultural water requirements, and groundwater and surface water supplies as of 1930 (Lippincott, J.B., 1931). A subsequent comprehensive study of the geology and hydrology of the Valley also provided estimates of annual groundwater pumpage and return flows for 1929 through 1944 (USGS, Worts, G.F., 1951). A followup study provided estimates of the change in groundwater storage during periods prior to 1959 (USGS, Miller, G.A., and Evenson, R.E., 1966).

Several additional studies have been conducted to describe the hydrogeology and groundwater quality of the Valley (USGS, Hughes, J.L., 1977; California CCRWQCB, 1995) and coastal portion of the basin (California DWR, 1970), as well as overall water resources of the Valley (Toups Corp., 1976; SBCWA, 1994 and 1996). Of note are numerous land use surveys (California DWR, 1959, 1968, 1977, 1985, and 1995) and investigations of crop water use (California DWR, 1933, and 1975: Univ. of California Cooperative Extension, 1994; Hanson, B., and Bendixen, W., 2004) that have been used in the estimation of agricultural water requirements in the Valley. Recent investigation of the Santa Maria groundwater basin provided an assessment of hydrogeologic conditions, water requirements, and water supplies through 1997 and an evaluation of basin yield (LSCE, 2000).

1.3 SMVMA Monitoring Program

In accordance with the Stipulation, a monitoring program was initially prepared in 2008 to provide the fundamental data for ongoing annual assessments of groundwater conditions, water requirements, water supplies, and water disposition in the SMVMA (LSCE, 2008). As a basis for designing the monitoring program, historical data on the geology and water resources of the SMVMA were compiled to define aquifer depth zones, specifically a shallow unconfined zone and a deep semi-confined to confined zone, into which a majority of monitored wells were classified based on well depth and completion information. Assessment of the spatial distribution of the wells throughout the SMVMA, as well as their vertical distribution within the aquifer system, provided the basis for designation of two well networks, one each for the shallow and deep aquifer zones. All network wells are to be monitored for groundwater levels, with a subset of those wells to be monitored for groundwater quality. Those wells with inconclusive depth and completion information were originally designated as unclassified wells; in 2009 and 2013, review of groundwater level and quality records allowed classification of some wells into the shallow or deep aquifer zones. Accordingly, the monitoring program was revised in 2009 and 2013 to reflect those minor changes to the well networks.

Also to be monitored are surface water conditions, specifically Twitchell Reservoir releases, stage, and storage, and stream discharge and quality, and climatic conditions, specifically precipitation and reference evapotranspiration data.

In addition to the hydrologic data described above, the monitoring program specifies those data to be compiled to describe agricultural and municipal water requirements and water supplies. These include land use surveys, to serve as a basis for the estimation of agricultural irrigation requirements, and municipal groundwater pumping and imported water records, including any transfers between purveyors.

Lastly, the monitoring program for the SMVMA specifies water disposition data be compiled, including treated water discharged at waste water treatment plants (WWTPs) and any water exported or transferred from the SMVMA. As part of this accounting, estimation is to be made of agricultural drainage from the SMVMA and return flows to the aquifer system. For reference, the SMVMA monitoring program is included in Appendix A.

In order to complete this annual assessment of groundwater conditions, water requirements, water supplies, and water disposition in the SMVMA, the following data for 2015 were acquired from the identified sources:

- groundwater level and quality data: the US Geological Survey (USGS), the Santa Maria Valley Water Conservation District (SMVWCD), the Technical Group for the adjacent NMMA (NMMA TG), the City of Santa Maria, and Golden State Water Company;

- Twitchell Reservoir stage, storage, and release data: the SMVWCD and Santa Barbara County Public Works Department;

- surface water discharge and quality data: the USGS and the Central Coast Regional Water Quality Control Board (CCRWQCB);

- precipitation data: the National Weather Service of the National Oceanic and Atmospheric Administration (NOAA), California Department of Water Resources (DWR), and SMVWCD;

- reference evapotranspiration and evaporation data: the California DWR, including California Irrigation Management Information System (CIMIS), and SMVWCD, respectively;

- agricultural land use data, aerial photography, and satellite imagery: Santa Barbara and San Luis Obispo County Agricultural Commissioner's Offices; US Department of Agriculture (USDA); and USGS;

- municipal groundwater pumping and imported water data: the City of Santa Maria, the City of Guadalupe, and the Golden State Water Company; and

- treated municipal waste water data: the City of Santa Maria, the City of Guadalupe, the Laguna Sanitation District, and the CCRWQCB.

1.4 Additional Monitoring and Reporting Programs

In 2014, the TMA was designated by the Calif. DWR as the Monitoring Entity for the SMVMA under DWR's California Statewide Groundwater Elevation Monitoring (CASGEM) Program. Compliance with the CASGEM Program requirements, which include at least semi-annual monitoring and reporting of groundwater levels in a subset of shallow and deep wells already within the SMVMA Monitoring Program, is fulfilled by the TMA.

Additionally, in 2016, groundwater resource planning and data reporting requirements under the Calif. DWR Sustainable Groundwater Management Program (SGMA) commenced. Since the SMVMA is part of an adjudicated basin, the Calif. DWR considers it already managed by the Court and, thus, SGMA groundwater resource planning requirements do not apply. The remaining SGMA requirements for reporting water resources data such as groundwater levels, groundwater pumping, and imported water amounts, were fulfilled by LSCE in its capacity as Management Area Engineer under the Stipulation.

1.5 Report Organization

To comply with items to be reported as delineated in the Stipulation, this annual report is organized into five chapters:

- this ***Introduction***;
- discussion of ***Hydrogeologic Conditions***, including groundwater, Twitchell Reservoir, surface streams, and climate;
- description and quantification of ***Water Requirements and Water Supplies*** for the two overall categories of agricultural and municipal land and water use in the SMVMA;
- description and quantification of ***Water Disposition*** in the SMVMA; and
- summary ***Conclusions and Recommendations*** related to findings regarding water resource conditions in the SMVMA, in 2015 as well as historically, and recommended actions related to water transfer, groundwater recharge, water resource assessment, and water resource monitoring.

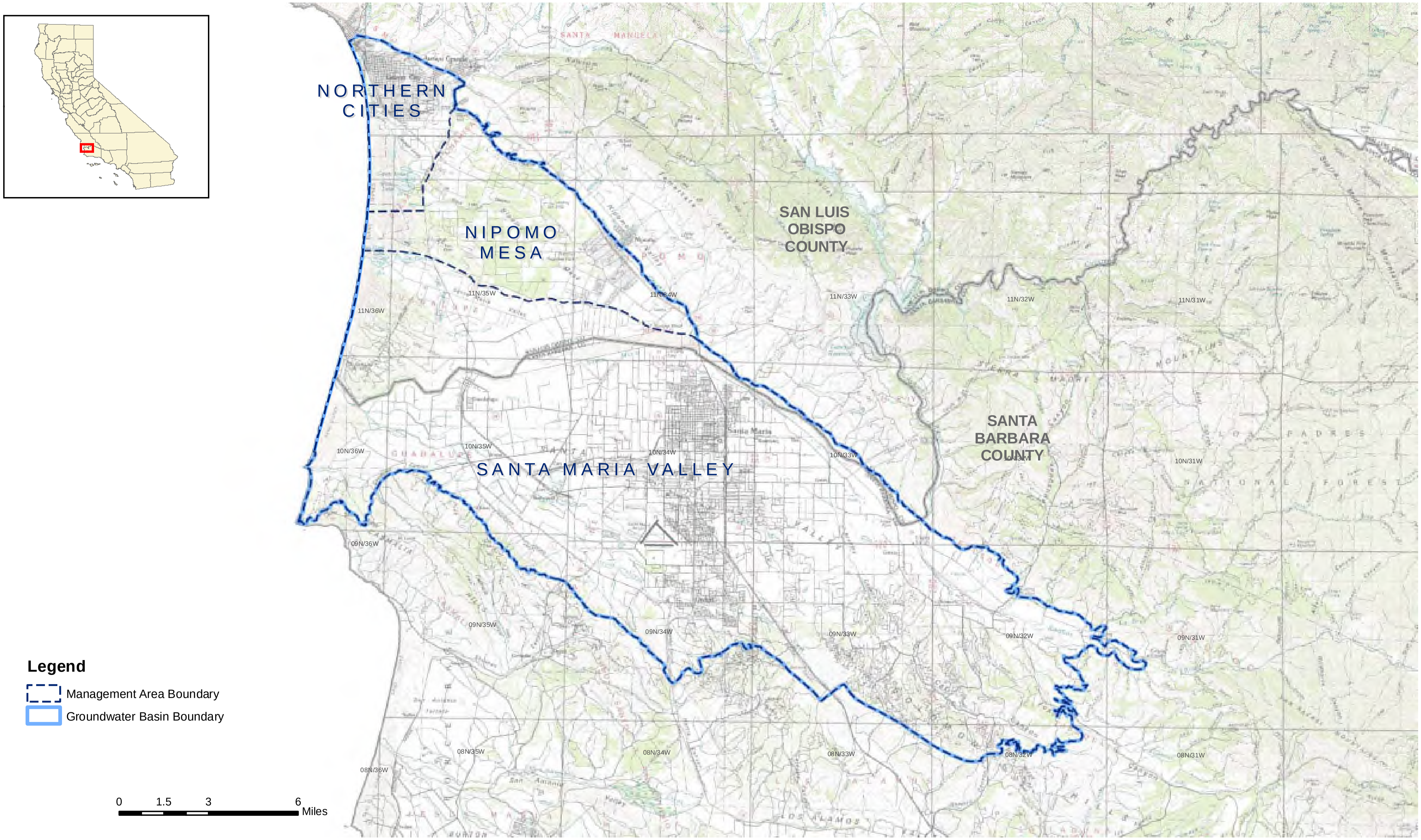

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Figure 1.1-1
Santa Maria Valley Groundwater Basin and Management Areas
Santa Maria Valley Management Area

2. Hydrogeologic Conditions

Current and historical hydrogeologic conditions in the SMVMA, including groundwater conditions, Twitchell Reservoir operations, and stream and climate conditions, are described in the following sections of this Chapter.

2.1 Groundwater Conditions

To provide a framework for discussion of groundwater conditions, the geology of the SMVMA, including geologic structure and the nature and extent of geologic formations comprising the aquifer system, is described in the following section. Current groundwater levels are then described in relation to historical trends in groundwater levels and flow directions in the SMVMA, as well as in context of Stipulation protocol for defining conditions of severe water shortage. Current and historical groundwater quality conditions are also discussed, including general groundwater quality characteristics as well as groundwater quality degradation, specifically due to elevated nitrate concentrations.

2.1.1 Geology and Aquifer System

The SMVMA is underlain by unconsolidated alluvial deposits that comprise the aquifer system, primarily gravel, sand, silt and clay that cumulatively range in thickness from about 200 to 2,800 feet. The alluvial deposits fill a natural trough, which is composed of older folded and consolidated sedimentary and metamorphic rocks with their deepest portions beneath the Orcutt area. The consolidated rocks also flank the Valley and comprise the surrounding hills and mountains; typically, the consolidated rocks do not yield significant amounts of groundwater to wells. The geologic formations comprising the alluvial deposits and the geologic structure within the study area are illustrated in a generalized geologic map (Figure 2.1-1a) and two geologic cross sections (Figures 2.1-1b and 2.1-1c).

The alluvial deposits are composed of the Careaga Sand and Paso Robles Formation (Fm.) at depth, and the Orcutt Fm., Quaternary Alluvium, and river channel, dune sand, and terrace deposits at the surface (USGS, Worts, G.F., 1951). The Careaga Sand, which ranges in thickness from about 650 feet to a feather edge, is identified as being the lowermost fresh water-bearing formation in the basin (DWR, 1970), resting on the above-mentioned consolidated rocks (specifically, the Tertiary-aged Foxen Mudstone, Sisquoc Fm., and Monterey Shale and the Jurassic/Cretaceous-aged Franciscan Fm., descriptions of which may be found in USGS, Worts, G.F., 1951). Overlying the Careaga Sand is the Paso Robles Fm., which comprises the greatest thickness of the alluvial deposits (from about 2,000 feet to a feather edge); the thickest portion of this formation is located beneath the Orcutt area. Both the Careaga Sand and Paso Robles Fm. underlie the great majority of the SMVMA (see Figures 2.1-1b and 2.1-1c). The Careaga Sand is mainly composed of white to yellowish-brown, loosely-consolidated, massive, fossiliferous, medium- to fine-grained sand with some silt and is reported to be predominantly of marine origin (USGS, Worts, G.F., 1951). The Paso Robles Fm. is highly variable in color and texture, generally composed of yellow, blue, brown, grey, or white lenticular beds of: boulders and coarse to fine gravel and clay; medium to fine sand and clay; gravel and sand; silt; and clay

(USGS, Worts, G.F., 1951). This formation is reported to be primarily fluvial (stream-laid) in origin and there is no areal correlation possible between the individual beds, with the exception of a coarse basal gravel of minor thickness in the Santa Maria Valley oil field, generally in the southeast part of the SMVMA.

Above the Paso Robles Fm. and comprising the Orcutt Upland is the Orcutt Fm., which is typically about 160 to 200 feet thick; in the remainder of the SMVMA, the Paso Robles Fm. is overlain by the Quaternary Alluvium, which comprises the majority of the Valley floor and is typically about 100 to 200 feet thick. Further north in the adjacent NMMA, the Paso Robles Fm. is overlain by the Older Dune Sand, which comprises the Nipomo Mesa and ranges in thickness from approximately 400 feet to a feather edge. Along the northeast edge of the Sisquoc plain, the Paso Robles Fm. is overlain by terrace deposits approximately 60 feet thick. The Orcutt Fm. is composed of conformable upper and lower units ("members"), both reported to be mainly of fluvial origin that become finer toward the coast. The upper member generally consists of reddish-brown, loosely-compacted, massive, medium-grained clean sand with some lenses of clay, and the lower member is primarily grey to white, loosely-compacted, coarse-grained gravel and sand (USGS, Worts, G.F., 1951).

The Quaternary Alluvium is also composed of upper and lower members that are reported to be mainly fluvial in origin. The composition of the upper member becomes progressively finer toward the coast, with boulders, gravel, and sand in the Sisquoc plain area; sand with gravel in the eastern/central Valley area; sand with silt from the City of Santa Maria to a point approximately halfway to Guadalupe; and clay and silt with minor lenses of sand and gravel from that area westward. The lower member is primarily coarse-grained boulders, gravel and sand with minor lenses of clay near the coast. The Older Dune Sand is composed of loosely- to slightly-compacted, massive, coarse- to fine-grained, well-rounded, cross-bedded quartz sand that is locally stained dark reddish-brown (California DWR, 1999). The terrace deposits, in general, are similar in composition to the coarse-grained parts of the Quaternary Alluvium.

The alluvial deposits comprising the aquifer system include thin, discontinuous clay lenses, without thick sections of clay, at depth; further, the deposits lack peat (organic) layers. Thus, the potential is remote for deep land subsidence to occur as the deposits dewater during periods of declining groundwater levels. There are no known reports of, nor the potential for, land subsidence in the SMVMA, as noted in a recent technical report on the occurrence of subsidence through California (California DWR, 2014).

Two geologic cross sections illustrate several points about the geologic structure and variable aquifer thickness throughout the SMVMA. Longitudinal geologic cross section A-A' (see Figure 2.1-1b) begins in the area near the mouth of the Santa Maria River, traverses the Orcutt Upland, and terminates in the Sisquoc plain area near Round Corral, immediately southeast of the SMVMA. It shows the relative thicknesses of the various geologic formations and their general "thinning" from the central valley area toward the Sisquoc plain. This cross section also shows the Quaternary Alluvium and Orcutt Fm., essentially adjacent to each other and comprising the uppermost aquifer in the SMVMA, divided into the above-described upper and lower members.

Transverse geologic cross section B-B' (see Figure 2.1-1c) begins in the Casmalia Hills, traverses the western portion of the Valley (near the City of Guadalupe) and the southern Nipomo Mesa, and terminates at Black Lake Canyon. It shows the prominent asymmetrical syncline (folding of the consolidated rocks and Paso Robles Fm.) within the SMVMA and adjacent NMMA, with the deepest portion of Paso Robles Fm. toward the southern edge of the SMVMA, gradually becoming thinner and more shallow toward the north where it extends beneath the NMMA. This cross section also shows that both the upper and lower members of the Quaternary Alluvium extend north to the Santa Maria River, but only the upper member extends beyond the River to the southern edge of the Nipomo Mesa, and neither member extends northward beneath the Mesa.

Several faults have been reported to be located in the SMVMA and adjacent portion of the NMMA. The Santa Maria and Bradley Canyon faults, located in the Valley in the area between the City of Santa Maria and Fugler Point (at the confluence of the Cuyama and Sisquoc Rivers to form the Santa Maria River), are concealed and they are reported to be northwest-trending, high-angle faults, that vertically offset the consolidated rocks, Careaga Sand, and Paso Robles Fm., but not the overlying Quaternary Alluvium or Orcutt Fm. (USGS, Worts, G.F., 1951). The Oceano and Santa Maria River faults are of a similar nature (the latter fault also has a significant strike-slip component of movement), but they are primarily located in the southern Nipomo Mesa. The maximum vertical offset on the Oceano fault is reported to be in the range of 300 to 400 feet within the Careaga Sand and Paso Robles Fm.; on the other faults, the vertical offset is reported to be much less, within the range of 80 to 150 feet (USGS, Worts, G.F., 1951; California DWR, 1999). However, these faults do not appear to affect groundwater flow within the SMVMA, based on the review of historical groundwater level contour maps (USGS, Worts, G.F., 1951; LSCE, 2000).

There is no known structural (e.g., faulting) or lithologic isolation of the alluvial deposits from the Pacific Ocean; i.e., the Quaternary Alluvium, Orcutt Fm., Careaga Sand, and Paso Robles Fm. aquifers continue beneath the Ocean. Thus, there is geologic continuity that permits groundwater discharge from the SMVMA to the Ocean, and the potential exists for salt water to intrude into the coastal (landward) portions of the aquifers if hydrologic conditions within them were to change.

The aquifer system in the SMVMA is comprised of the Paso Robles Fm., the Orcutt Fm., and the Quaternary Alluvium (USGS, Worts, G.F., 1951). The upper member of the Quaternary Alluvium is consistently finer-grained than the lower member throughout the Valley. Further, the upper member becomes finer grained toward the Ocean such that it confines groundwater in the lower member from the approximate area of the City of Santa Maria's waste water treatment plant westward (approximately eight miles inland from the coast). The result of this has been some artesian conditions in the western valley area (historically, flowing artesian wells were reported until the early 1940s in the westernmost portion of the Valley) (USGS, Worts, G.F., 1951). More recently, many wells belonging to local farmers in the western valley area, specifically in the Oso Flaco area, began flowing again in response to rising confined groundwater levels, such as during the winter of 1999.

Analysis of the geology, groundwater levels, and groundwater quality indicates that the aquifer system varies across the area and with depth, and this variation was the basis for the shallow and deep aquifer zone designations of the SMVMA monitoring program (LSCE, 2008). In the central and major portion of the SMVMA, there is a shallow unconfined zone comprised of the Quaternary Alluvium, Orcutt Fm., and uppermost Paso Robles Fm., and a deep semi-confined to confined zone comprised of the remaining Paso Robles Fm. and Careaga Sand. In the eastern portion of the SMVMA where these formations are much thinner and comprised of coarser materials, particularly in the Sisquoc Valley, the aquifer system is essentially uniform without distinct aquifer depth zones. In the coastal area where the surficial deposits (upper members of Quaternary Alluvium and Orcutt Fm.) are extremely fine-grained, the underlying formations (lower members of Quaternary Alluvium and Orcutt Fm., Paso Robles Fm., and Careaga Sand) comprise a deep confined aquifer zone.

2.1.2 Groundwater Levels

Groundwater levels within the SMVMA have fluctuated greatly since the 1920's, when historical water level measurements began, with marked seasonal and long-term trends, as shown by a collection of representative groundwater level hydrographs from various areas throughout the SMVMA (Figure 2.1-2). The areas are designated on Figure 2.1-2 for illustrative purposes only, and include the so-called Coastal, Oso Flaco, Central Agricultural, Municipal Wellfield, Twitchell Recharge, and Sisquoc Valley areas. The historical groundwater level hydrographs illustrate that widespread decline in groundwater levels, from historical high to historical low levels, occurred between 1945 and the late 1960's. The declines ranged from approximately 20 to 40 feet near the coast, to 70 feet near Orcutt, to as much as 100 feet further inland (in the area just east of downtown Santa Maria). Those declines were observed in both the shallow and deep aquifer zones, and are interpreted today to have been the combined result of progressively increasing agricultural (and to a lesser degree, municipal) demand and long-term drier than normal climatic conditions during that period.

Since the late 1960’s, the basin has alternately experienced significant recharge (recovery) and decline which, collectively, reflect a general long-term stability as groundwater levels in both aquifer zones have fluctuated between historical-low and near historical-high levels over alternating five- to 15-year periods. Groundwater levels throughout the SMVMA have shown this trend, but with different ranges of fluctuation (see Figure 2.1-2); and groundwater levels have repeatedly recovered to near or above previous historical-high levels, including as recently as 2002. Shallow groundwater levels in the Sisquoc Valley fluctuated somewhat differently in that they did not fully recover to historical high levels by 2002. In the primary areas of recharge along the Santa Maria River, groundwater level fluctuations are greater in the shallow aquifer zone than the deep (see Twitchell Recharge Area and Central Agricultural Area hydrographs). Conversely, in the Municipal Wellfield and Coastal Areas, groundwater level fluctuations are greater in the deep aquifer zone. Hydrographs from wells along the coastal portion of the SMVMA show that groundwater elevations have remained above sea level, with deep (confined) groundwater levels rising enough to result in flow at the ground surface, throughout the historical period of record. The periodic groundwater level fluctuation since the late 1960's (with a long-term stability) have apparently been due to intermittent wet and dry climatic conditions, with natural recharge during wet periods complemented by supplemental recharge along the Santa

Maria River from the Twitchell Reservoir project (since becoming fully operational in the late 1960's). Long-term stability would also appear to be partially attributable to a general "leveling-off" of agricultural land and water use in the basin since the early to mid-1970’s, as further described in Chapter 3.

Most recently, groundwater levels in both the shallow and deep zones have been in a gradually declining trend since 2002, and have declined more rapidly since 2012. Particularly in light of prevailing land use and water requirements, this overall groundwater level decline can be considered to be primarily due to the fact that Twitchell Reservoir releases, for in-stream supplemental groundwater recharge, and Sisquoc River discharge, have been well below the historical average in most years since 2000. More specifically, there were no Twitchell Reservoir releases in nine of the last 14 years, including in 2013, 2014, and 2015. Further, the Sisquoc River discharge was well below average in almost all years since 2002, as will be discussed in Section 2.2. The declining trend in shallow groundwater levels was slowed or reversed during years 2005-2006 and again in 2010-2011. During these short periods, releases from Twitchell Reservoir, as well as discharge in the Sisquoc River, were above average following above-average rainfall periods. However, with continuing dry conditions, and particularly the current severe drought that commenced in 2012, the declining trend in groundwater levels across the SMVMA resumed.

In 2015, groundwater levels in one deep well in the Twitchell Recharge Area, specifically well 10N/33W-30G1, declined to just below the historical low water level observed in this well in 1991 (see Figure 2.1-2). However, water levels in numerous shallow and deep wells in the area with long historical records (covering previous drought periods) did not decline below their respective historical low. Thus, it appears the 2015 water levels in well 30G1 reflect a localized lowering of water levels. In fact, shallow and deep groundwater levels across the great majority of the SMVMA remain above historical low levels in 2015. This includes along the coast where groundwater levels are well above sea level, indicating that the conditions conducive to sea water intrusion are absent. As such, the groundwater level conditions observed in 2015 in the SMVMA do not meet Stipulation provisions defining a condition of severe water shortage, as will be discussed in Section 5.1.

Groundwater beneath the SMVMA has historically flowed to the west-northwest from the Sisquoc area toward the Ocean, and this remained the case during 2015 as illustrated by contour maps of equal groundwater elevation for the shallow and deep aquifer zones (Figures 2.1-3a through 2.1-3f). As in most years of study in the basin, a notable feature in the contour maps in 2015 is the widening of groundwater level contours beneath the central-south and western portions of the SMVMA that indicates a reduced (flatter) groundwater gradient in this area. This likely reflects the fact that the majority of aquifer system recharge derives from streamflow in the Sisquoc and Santa Maria Rivers, specifically in the eastern portion of the SMVMA upstream of Bonita School Crossing Road, and to a certain extent from streamflow in creeks draining the Casmalia and Solomon Hills (such as Orcutt Creek) along the southern portion of the SMVMA. This is supported by the presence of a reduced groundwater gradient in this area since at least 1960 (USGS, Miller, G.A., and Evenson, R.E., 1966; USGS, Hughes, J.L., 1977; LSCE, 2000).

The reduced gradient likely also reflects ongoing groundwater pumping in and around the municipal wellfield near the Santa Maria Airport and Town of Orcutt where numerous deep municipal water supply wells of the City of Santa Maria and the Golden State Water Company (GSWC), and nearby agricultural wells, operate. This is supported by the observance that, in this area, the groundwater gradient in the deep aquifer zone is more reduced (flatter) than in the shallow zone. Further, groundwater elevations in the deep zone are markedly lower than those in the shallow zone in this area, with smaller differences in groundwater elevations between depth zones in other portions of the SMVMA. Importantly, while the reduced groundwater gradient near the municipal well field has had the effect of slowing the movement of groundwater through that portion of the SMVMA, it has not stopped or reversed the direction of groundwater flow.

Also notable from the contour maps is the overall seasonal difference in groundwater levels across the SMVMA between the spring and fall periods. A decline in water levels was observed between early March and late April (early and late spring contour maps, respectively), with additional decline through early October. The timing and magnitude of the decline presumably reflect that of the area-wide groundwater pumping associated with seasonal agricultural irrigation, as well as the fact that stream discharge in the Sisquoc River and the associated recharge to the aquifer system were essentially nil in 2015. Importantly, during 2015, a seaward gradient for offshore groundwater flow was maintained, and coastal groundwater elevations remained well above sea level (typically exceeding 15 feet, NAVD88), in both the shallow and deep aquifer zones. Across the coastal boundary of the SMVMA, the offshore flow of groundwater in the shallow aquifer zone appears to have been reduced by the fall, with a portion flowing to the northwest beneath the southern coastal Nipomo Mesa (see Figure 2.1-3c). Similarly, the offshore flow of groundwater in the deep zone appears to have been reduced, although by early spring (see Figure 2.1-3d). Regarding this groundwater flow from the SMVMA toward the southern coastal Nipomo Mesa, it appears to either meet groundwater pumping demands in the area or eventually flow offshore along the coastal boundary of the NMMA.

Additional information about the seasonal fluctuation of groundwater levels in and near the SMVMA, in particular along its northern boundary with the NMMA near Oso Flaco Valley, is derived from hourly groundwater level measurements made since late 2013 by transducers in two monitoring wells belonging to the San Luis Obispo County Department of Public Works (SLODPW) in that area. A groundwater level hydrograph for one well located in the northwestern edge of Santa Maria Valley (Figure 2.1-4a) illustrates how, in 2015, groundwater levels were highest but already gradually declining in early January, before reaching their lowest levels in September and October. In that area, the overall seasonal decline was about 12 feet. Importantly, it can be seen that groundwater levels did not recover fully in 2015; the year-end levels were seven feet lower than those observed at the beginning of the year.

A groundwater level hydrograph for the second well, located in the southern central edge of the Nipomo Mesa (Figure 2.1-4b) indicates very similar groundwater level fluctuations, with groundwater levels highest (but already declining) in early January before reaching their lowest levels in early October. An overall seasonal water level decline of about 20 feet was observed between January and October, with partial recovery by the end of the year. In fact, year-end water levels were three feet lower than those observed in the beginning of the year. Thus, the frequent groundwater level data from the transducers provide detailed information about the timing of spring high and fall low water levels in the SMVMA. While it is locally understood that spring high levels in the SMVMA typically occur in late February to early March, the transducer data indicate that the spring high level of 2015 in fact occurred in early January.

The transducer data also indicate that the period of spring high groundwater levels in the SMVMA 2015, following the recovery of groundwater levels over winter 2014-2015, was very brief. It is likely that seasonal agricultural irrigation commenced earlier than usual, perhaps due to ongoing severe drought and/or changing irrigation practices, which would have contributed to an early decline in groundwater levels. Further, aquifer recharge from Sisquoc River discharge, which typically occurs over the winter months, was essentially nil.

Given that a common objective of groundwater monitoring programs is to measure the spring high and fall low groundwater levels, for example to facilitate estimation of annual change in basin storage, the USGS came the closest of all agencies to meeting that objective in 2015 (with early March and mid-October measurements). The transducer data provide the magnitude of groundwater level decline that occurred in 2015 in this portion of the SMVMA between early March and late April, from 5 to 10 feet. This in turn illustrates the magnitude of inconsistency in spring groundwater level data collected in the SMVMA by the USGS (early March), the SMVWCD (early April), and the SLOPWD (late April). Alternatively, the transducer data indicate that groundwater levels declined to (and maintained) their fall low period during mid-September to mid-October 2015, thus illustrating the proper timing of fall measurements made in the SMVMA (all agencies in that period).

2.1.3 Groundwater Quality

Groundwater quality conditions in the SMVMA have fluctuated greatly since the 1930's, when historical water quality sampling began, with marked short- and long-term trends. Groundwater quality in the SMVMA historically reflects the various natural sources of recharge to the aquifer system, most notably streamflows of the Cuyama and Sisquoc Rivers that provide recharge along the Santa Maria River. The great majority of groundwater in the SMVMA, primarily in the eastern and central portions of the Santa Maria Valley and in the Sisquoc Valley, had historically been of a calcium magnesium sulfate type originating from the Cuyama and Sisquoc River streamflows. Further, groundwater was historically of better quality toward the Orcutt Upland, Nipomo Mesa, the City of Guadalupe, and coastal areas (Lippincott, J.B., 1931).

With development of the Valley and surrounding areas in the 1940's through 1970's, including expansion of the agricultural and urban areas and addition of the Twitchell Reservoir project, groundwater quality conditions changed within the SMVMA. The changes included improvement of the general groundwater quality in the eastern to central part of the Santa Maria Valley in and near the area of Twitchell Reservoir recharge, including the current-day municipal wellfield near the Town of Orcutt. Additionally, degradation of groundwater quality occurred further west and downgradient in the Valley, specifically with elevated general mineral and nitrate concentrations (USGS, Hughes, J.L., 1977).

Subsequently, from the 1970's through current day, general mineral concentrations in groundwater have remained essentially unchanged, including the occurrence of better quality water in the SMVMA's eastern, central, and southern portions and poorer quality water to the west. Further, groundwater quality is generally slightly better and with less fluctuation in the deep aquifer zone compared to the shallow, as shown by a map with representative historical groundwater quality graphs from areas throughout the SMVMA (Figure 2.1-5). Groundwater quality data from 2015 indicate that total dissolved solids (TDS) concentrations in the shallow aquifer zone generally ranged between 700 and 1,100 mg/l in the Twitchell Recharge and Municipal Wellfield Areas, and were about 650 to 1,000 mg/l in the Coastal Area. TDS values in the deep zone were slightly lower in the Twitchell Recharge Area (between 800 and 900 mg/l) and Municipal Wellfield Area (between 650 and 800 mg/l), but somewhat higher in the Coastal Area (between 700 and 1,400 mg/l). In portions of the deep coastal zone, TDS values also show a long-term gradual increase. TDS concentrations in the shallow aquifer zone of the Sisquoc Valley are unknown but, in the deep zone, were about 600 mg/l. Overall, TDS values in the SMVMA generally remain at or below the California Department of Public Health's secondary standard of 1,000 mg/l.

In contrast to the overall stability in general mineral (TDS) concentrations in groundwater observed during this recent period, nitrate concentrations in shallow groundwater have progressively increased. In 2015, nitrate-as-nitrate (nitrate-NO3) concentrations in shallow groundwater remained elevated, in many areas above the primary drinking water standard of 45 mg/l. In the Twitchell Recharge Area, nitrate concentrations were somewhat lower than those observed in recent years, ranging from 5 to 20 mg/l (although a well typically with high nitrate concentrations was not sampled in 2015). Nitrate concentrations in shallow groundwater in the Municipal Wellfield Area continue a slight increasing trend from just above 50 mg/l a decade ago to about 65 mg/l currently. However, in the Coastal Area, nitrate concentrations in shallow groundwater remained non-detect (less than 0.18 mg/l).

Compared to widespread elevated nitrate concentrations in shallow groundwater, deep groundwater concentrations remain markedly lower, generally less than 10 mg/l (nitrate-NO3). Extensive nitrate data from 2015 available from purveyor water supply wells (City of Santa Maria and GSWC), particularly for deep wells in the southern SMVMA, indicate nitrate-NO3 values remain less than 10 mg/l. Exceptions to this observation have been two deeper wells in the south-southeast part of the Valley (9N/33W-02A7 and 9N/34W-03F2), with nitrate concentrations between 25 and 35 mg/l, and some coastal deep monitoring wells with nitrate levels exceeding 90 mg/l, as discussed below.

Of particular importance to ongoing assessment of potential conditions of sea water intrusion are the groundwater quality data from two sets of coastal monitoring wells. During an investigation conducted in the late 1960's, for which the monitoring well sets were constructed, localized areas of degraded shallow groundwater were identified but concluded at the time to be due to environmental factors other than intrusion (California DWR, 1970). Review of the coastal monitoring results through 2015, in particular TDS values, provides an indication of whether sea water intrusion has occurred in the coastal SMVMA; review of coastal nitrate concentrations provides a measure of the extent and magnitude of water quality degradation from land use activities further inland. Historical water quality graphs for these wells are provided in Appendix B.

Since the commencement of coastal groundwater quality monitoring, coastal groundwater has continued to show elevated but largely unchanging specific conductance values. In 2015, shallow groundwater at the southerly monitoring well set (10N/36W-02Q, shallow well 02Q7, Figure 2.1-5) had a value of just under 1,000 mg/l; deep groundwater values (wells 02Q1, 02Q3, and 02Q4) have been lower, between 650 and 700 mg/l over the last 35 plus years. Groundwater at the more northerly monitoring well set (11N/36W-35J) shows more variation in TDS values with depth: the wells with depths of 615, 495, and 228 feet have values of 700 mg/l, 1,300 mg/l, and 1,400 mg/l, respectively. TDS values in the shallowest well (35J5, 136 feet deep), have gradually risen throughout the monitoring period from about 1,000 mg/l in 1977 to 1,400 mg/l in 2015.

Some coastal groundwater, specifically in portions of the deep aquifer zone near the northerly monitoring well set (11N/36W-35J), have shown gradually increasing degradation from nitrate, including through the present. Nitrate-NO3 concentrations have steadily risen from a range of 5 to 10 mg/l in the 1980’s to between 40 and 95 mg/l in 2015 (see Figure 2.1-5). In contrast, groundwater in all aquifer zones near the southerly monitoring well set (10N/36W-02Q) have consistently shown very low concentrations of nitrate through the present. Shallow groundwater continued to have non-detectable levels of nitrate (less than 0.18 mg/l) and deep groundwater concentrations remained near 3 mg/l through 2015. Nitrate concentrations in the deepest groundwater, specifically below a depth of 600 feet, along the coast (at both well sets) remain stable with values of around 3 mg/l or less.

2.2 Twitchell Reservoir Operations

In order to describe Twitchell Reservoir operations, monthly records of reservoir stage, storage, and releases were updated and recorded observations of reservoir conditions were noted. The historical stage, storage, and releases, including through 2015, are described in relation to observed climatic conditions in the SMVMA.

2.2.1 Reservoir Stage and Storage

Historical stage and storage in Twitchell Reservoir, for which reliable records begin in 1967, indicate a typical seasonal rise with winter and spring rain, followed by decline through subsequent spring and summer releases. Reservoir stage has risen to as high as about 640 feet msl, corresponding to storage of nearly 190,000 acre-feet, on several occasions during the winter and spring months of years during which rainfall amounts were substantially higher than average. Historical rises in stage have been rapid, occasionally over one or two months, with subsequent declines gradually spread over the subsequent year or multiple years. During those years when releases have essentially emptied the reservoir for purposeful supplemental groundwater recharge through the Santa Maria River channel, the dam operator recorded the associated minimum reservoir stage, which has risen over time from about 480 feet msl in 1968, to 525 feet MSL since 1986. This rise reflects the long-term filling of former dead pool storage (about 40,000 acre-feet below the reservoir outlet for release from conservation storage) with sediment that has naturally occurred with operation of the project (SMVWCD, 1968-2015). These seasonal fluctuations and long-term rise in minimum stage, shown in relation to the reservoir conservation, flood control, and surcharge pools, are illustrated in a graph of historical reservoir stage and storage (Figure 2.2.1a).

It is noteworthy that the sedimentation of the former dead pool storage below the conservation outlet in Twitchell Reservoir has not impeded the conservation of runoff for subsequent release for downstream groundwater recharge. Except for a few individual years over the life of the reservoir, accumulated storage in any year has been less than the designated active conservation pool of 109,000 af. In the infrequent wet years when greater storage could be conserved, e.g. 1969, 1978, 1983, 1995, and 1998, the SMVWCD has been permitted to temporarily utilize some of the dedicated flood control pool (89,000 af) to conserve those additional inflows and then release them soon thereafter for downstream recharge. Total storage has never exceeded the combined conservation pool and flood control pool storage volume (198,000 af) and has never invaded the uppermost surcharge pool (159,000 af above the conservation and flood control pools) in the overall reservoir.

Reservoir storage has historically risen to between 150,000 and nearly 190,000 acre-feet (af) during the winter and spring months of years during which rainfall was substantially higher than average, with storage commonly below 50,000 af during most other years. As can be seen on Figure 2.2-1a, reservoir storage has repeatedly dropped to essentially zero during periods of below-average rainfall, including those associated with drought conditions in 1976-77, 1987-90, and 2012-current year. Reservoir storage has also been essentially zero during most of 2000 through 2004, 2007 through 2009, as a result of the overall drier climatic period that began in 2002.

Briefly during this drier climatic period, such as in both 2005 and 2006 when rainfall was above average, about 50,000 af of storage were accrued, all of which was released for downstream groundwater recharge. In late 2010 into early 2011, again in response to above-average rainfall, storage accrued by April 2011 to almost 93,000 af (and the stage to 615 feet MSL) with releases commencing in February 2011 and continuing through March 2012. Since then, only a minor amount of water has been conserved that subsequently evaporated and/or was lost to seepage such that, during 2015, no releases were possible, reservoir stage remained at approximately 524 feet MSL, and storage remained less than 1,000 af.

2.2.2 Reservoir Releases

Twitchell Reservoir annual releases for in-stream groundwater recharge since 1967 have ranged from zero during low rainfall years and drought periods to a maximum of 243,660 af in 1998, as illustrated in a bar chart of annual reservoir releases (Figure 2.2-1b). In general, and most notably in the Twitchell Recharge Area, groundwater levels have tended to track Twitchell releases since the beginning of Reservoir operations (see Figure 2.1-2 and 2.2-1b). The long-term average annual release amount for the period 1967 through 2015 is 48,700 afy, with below-average releases during roughly two-thirds of those years. The five-year period from 1995 through 1999 is notable for continual releases in amounts well above the annual average, reflecting a wetter climatic period from 1993 through 1998. Also notable are multiple year

periods when releases dropped to zero, specifically from 1987 through 1990 and from 2002 through 2004, reflecting the drier climatic conditions during those periods of time. While releases in 2005 and 2006 amounted to about 106,000 and 80,000 af, respectively, drier climatic conditions persisted with no releases for in-stream groundwater recharge in 2009 or 2010. The release of nearly 90,000 af of water from Twitchell Reservoir was conducted from February through December 2011, with the highest amounts during the months of June through September. In 2012, the beginning of the current severe drought, releases were well below average, conducted only in January through March and amounting to only 9,100 af; since then, essentially no water has been available in storage and no releases have been made from the reservoir, including during 2015.
Importantly, the magnitude of the effect on reservoir releases of the current dry climatic period that commenced in 2002 can be seen in a comparison of the calculated average reservoir releases for the following selected periods of time:

Period of record 1967 – 2015 (48,700 afy);
Pre-current dry period 1967 – 2001 (59,300 afy); and
Current dry period 2002 – 2015 (22,100 afy).

The average amount of water released during the current dry period (2002 – 2015) is less than one-half the average for the overall period of record (1967 – 2015).

2.3 Streams

The surface water hydrology of the SMVMA is characterized in this section, specifically the current conditions in relation to historical trends in stream discharge and quality.

2.3.1 Discharge

The main streams entering the SMVMA are the Cuyama and Sisquoc Rivers; these rivers join on the Santa Maria Valley floor near Garey and become the Santa Maria River, which drains the Valley from that point westward (see Figure 1.1-1 and Appendix A, Figure 3). The headwaters of the Sisquoc River include a portion of the San Rafael Mountains and Solomon Hills, and the River's main tributaries within the SMVMA are Foxen, La Brea, and Tepusquet Creeks. Streamflow in the Sisquoc River and its tributary creeks have remained uncontrolled through the present. The Cuyama River drains a portion of the Sierra Madre Mountains, including the Cuyama Valley, and streamflow into the Santa Maria River has been controlled since construction of Twitchell Dam between 1957 and 1959. The Santa Maria River receives minor streamflows from two small tributaries, Suey and Nipomo Creeks, along its course toward the City of Guadalupe and the Pacific Ocean. In the southern portion of the SMVMA, Orcutt Creek drains a portion of the Solomon Hills (Solomon Canyon) and the Orcutt area, receives intermittent flow from Graciosa Canyon, before ending near Betteravia.

Stream discharge in the Cuyama River below the dam, recorded during the initial period of Twitchell project operations between 1959 and 1983, averaged 37,350 afy. As discussed above, Twitchell Reservoir releases have averaged 48,700 afy from 1967 through 2015. The historical variation in reservoir releases and Cuyama River streamflow is shown in a bar chart of annual surface water discharge for the River (Figure 2.3-1a). Cuyama River stream discharge, which comprises the largest source of SMVMA groundwater recharge, has ranged over the historical period of record from no streamflow during several drought years, including as recently as 2010, 2013, 2014, and 2015, to a high of almost 250,000 af during 1998.

Stream discharge in the Sisquoc River, recorded at gauges at the southeast end of the Sisquoc plain ("near Sisquoc") and further downstream at the opening to the SMVMA ("near Garey"), averages 34,300 (absent data from years 1999-2007) and 36,400 afy, respectively, over the historical period of record.[1] The downstream gauge ("near Garey") provides a measure of the stream discharge entering the SMVMA from the Sisquoc plain, and it reflects inflow from the headwaters of the Sisquoc River and its tributaries, as well as gains from and losses to the shallow aquifer in the Sisquoc plain. The historical variation in Sisquoc River streamflow is shown in a bar chart of annual surface water discharge for the River at both gauges (Figure 2.3-1b). Sisquoc River stream discharge to the SMVMA ("near Garey" gauge), which comprises a large source of SMVMA groundwater recharge, has ranged over the historical period of record from no streamflow during several drought years to over 300,000 af during 1998; the 2015 annual discharge (provisional/approved) into the SMVMA was well below average, only about 250 af. Of note is that the upstream gauge ("near Sisquoc") was non-operational, and thus no data are available, from 1999 through 2007. Further, discharge amounts in the tributaries Foxen, La Brea, and Tepusquet Creeks have not been recorded since the early 1970's (early 1980's for the latter creek), when gauge operations were discontinued. As a result, the net amount of groundwater recharge in the Sisquoc plain from the Sisquoc River currently cannot be quantified. Reestablishment and monitoring of these currently inactive gauges (Foxen, La Brea, and Tepusquet Creeks), as previously outlined in the SMVMA Monitoring Program and recommended in this annual report, would provide for better understanding of the magnitude and distribution of recharge from the Sisquoc River in the Sisquoc Valley.

Streamflow in the Santa Maria River has been recorded at two gauges during varying periods of time (see Appendix A, Figure 3). At the Guadalupe gauge, which was operational between 1941 and 1987, stream discharge ranged from no streamflow during numerous years to almost 185,000 af during 1941, and averaged 26,800 afy prior to the commencement of Twitchell project operations compared to 17,600 afy during the period of Twitchell project operations. The historical variation in Santa Maria River streamflow is shown in a bar chart of annual surface water discharge for the River (Figure 2.3-1c). The reduction in streamflow at Guadalupe is attributed to Twitchell project operations, which are intended to maximize recharge along the more permeable portion of the River streambed by managing reservoir releases to maintain a "wetline" (downstream extent of streamflow) only as far as the Bonita School Road Crossing.

Supplemental recharge to the Santa Maria Valley from Twitchell project operations has been estimated to be about 32,000 afy based on comparison of pre- and post-project net losses in streamflow between Garey and Guadalupe (LSCE, 2000). The estimation does not account for changes in climatic conditions between the pre-project (overall dry) and post-project (overall wet) periods or losses/gains along the Santa Maria River due to other processes, which could result in changes in the amount of water available for recharge over time. As a result of discontinued stream discharge measurements at Guadalupe since 1987, combined with the lack

[1] These values of mean annual discharge include provisional (October through December) 2015 discharge data.

of gauged data for Suey and Nipomo Creeks, the net amount of groundwater recharge in the Santa Maria Valley from the Santa Maria River currently cannot be updated. Reestablishment and monitoring of these currently inactive gauges (Suey Creek, Nipomo Creek, and Santa Maria River at Gaudalupe), as previously outlined in the SMVMA Monitoring Program and recommended in this annual report, would provide for better understanding of the magnitude and distribution of streamflow and recharge from the Santa Maria River.

Stream discharge in the Santa Maria River has also been recorded more recently at a gauge at Suey Crossing northeast of the City of Santa Maria. However, these data are reported only sporadically, as for years 1999 and 2006, or not at all, as in 2000 through 2005, and the discharge data for 2009 through 2015 remain problematic. However, future acquisitions of the discharge data from this gauge will also enhance an understanding of streamflow and recharge along the Santa Maria River.

Stream discharge in Orcutt Creek, recorded at Black Road crossing from 1983 through the present (absent data from years 1992 through 1994), averages about 1,570 afy, ranging from essentially no streamflow during several years to just over 10,000 af in 1995; in 2015, stream discharge was well below average, approximately 220 af. The historical variation in streamflow is shown in a bar chart of annual surface water discharge for the creek (Figure 2.3-1d). While essentially all streamflow recorded at the gauge ultimately provides groundwater recharge to the SMVMA, it is not known how much groundwater recharge or discharge occurs upstream from the gauge, specifically between the gauge and the point where Orcutt Creek enters the SMVMA, or downstream from the gauge toward Guadalupe.

2.3.2 Surface Water Quality

The majority of recharge to the SMVMA has historically derived from streamflow in the Santa Maria River originating from the Cuyama and Sisquoc Rivers. Thus, groundwater quality in much of the SMVMA has historically reflected the water quality of streamflow in the Cuyama and Sisquoc Rivers. Water quality in the rivers depends on the proportion and quality of the rainfall runoff and groundwater inflow contributing to streamflow in their respective watersheds above the Santa Maria Valley. The Cuyama River watershed includes the Cuyama Valley, which is reported to be underlain by geologic formations containing large amounts of gypsum; the Sisquoc River watershed is primarily steep terrain underlain by consolidated rocks (USGS, Worts, G.F., 1951).

The quality of the streamflow in both the Cuyama and Sisquoc Rivers has historically been of a calcium magnesium sulfate type, although the Sisquoc River contains less sulfate and more bicarbonate than the Cuyama River. The Cuyama River quality has improved at two points in time during the historical period, specifically the mid-1940's and the late 1960's (USGS, Hughes, J.L., 1977). The improvement observed in the mid-1940's is thought to be due to agricultural development of the Cuyama Valley that was supported by increased groundwater pumping in that Valley for irrigation. The increased pumping lowered groundwater levels in the Cuyama Valley, in turn reducing groundwater inflow to the Cuyama River, thereby reducing the contribution of dissolved salts (sulfate in particular) to the River.

The improvement observed in the late 1960's is thought to be due to implementation of Twitchell Reservoir project operations, which facilitated conservation of Cuyama River runoff and augmented recharge to the Santa Maria Valley groundwater basin. Specifically, the higher streamflow events in the Cuyama River that previously discharged to the ocean are of a better quality due to dilution by greater rainfall runoff. Releases from Twitchell Dam therefore contain lower concentrations of dissolved salts than the Cuyama River streamflows from the period preceding the project. The improvement in Cuyama River water quality from both of these developments may be seen in Table 2.3-1, which summarizes those earlier water quality results from the USGS (Hughes, J.L., 1977); more recent monitoring results from the USGS (1976 – 2015) and the Central Coast Ambient Monitoring Program (CCAMP) (2000 – 2015), are also shown (CCRWQCB, 2015).

Since operation of the Twitchell project began in the 1960s, Cuyama River water quality has remained fairly constant. Reported TDS values range from about 650 to 1,200 mg/l; sulfate and chloride concentrations range from 190 to 760 mg/l, and from 25 to 85 mg/l, respectively. Nitrate-NO3 concentrations have remained low, ranging from <1 to 20 mg/l.

Water quality in the Sisquoc River has remained relatively unchanged since 1906, with general mineral constituent concentrations typically below those observed in the Cuyama River. Since the Twitchell project began, reported TDS values have ranged from about 450 to 1,000 mg/l; sulfate and chloride concentrations have ranged from 270 to 380 mg/l, and from 13 to 16 mg/l, respectively. Nitrate-NO3 concentrations have remained very low, ranging from <1 to 3.2 mg/l. Sisquoc River historical water quality is shown in a graph (Figure 2.3-2a), which in particular illustrates TDS values maintaining a long-term stability with slight seasonal variation, presumably due to varying stream discharge. Overall, the historical water quality data for the Sisquoc River and tributary streams indicate the quality of streamflows entering the Sisquoc plain are slightly improved by tributary inflows.

As might be expected, water quality in the Santa Maria River northeast of Santa Maria (Bull Canyon) reflects the combined quality of streamflows in the Cuyama and Sisquoc Rivers. Reported TDS values have ranged from about 800 to 1,000 mg/l; sulfate concentrations have ranged from 370 to 540 mg/l (no chloride data are available), and nitrate-NO3 concentrations have remained low, ranging from <1 to 2.7 mg/l.

In contrast, water quality is degraded in streams in the western portion of the Santa Maria Valley, including the Santa Maria River and Oso Flaco Creek near Guadalupe. Reported TDS values have ranged from about 130 to 2,300 mg/l; sulfate concentrations have ranged from 440 to 1,000 mg/l (no chloride data are available), and nitrate-NO3 concentrations have reached 450 mg/l. Water draining in Green Canyon, a canal coursing from the central valley floor toward Guadalupe to join the Santa Maria River, is of a similar quality.

Water quality is also degraded in streams in the southern portion of the SMVMA, including Bradley Canyon and Orcutt Creek, both of which drain the Solomon Hills. Bradley Canyon drainage has TDS values that consistently fluctuate between about 180 and 1,300 mg/l, and nitrate concentrations to 150 mg/l (no sulfate or chloride data are available). Orcutt Creek (near Orcutt) historical water quality, shown in a graph (Figure 2.3-2b), has TDS values typically fluctuating between 500 and 3,000 mg/l, with values that exceeded 3,600 mg/l in 2005 and 2006. During the last decade, nitrate concentrations typically exceeded the health-based standard of 45 mg/l, in fact exceeding 125 mg/l in 2007 through 2009 before declining to a range between 40 and 70 mg/l since 2011. However, in 2015, the reported nitrate-NO3 concentration reached the highest observed for this portion of Orcutt Creek, 135 mg/l.

2.4 Climate

The climatic data reported for the SMVMA are characterized in this section, specifically the current conditions in relation to historical trends in precipitation and evapotranspiration data.

2.4.1 Precipitation

At least three precipitation gauges have historically been located in the SMVMA, at Guadalupe, Santa Maria (currently at the Airport and previously downtown), and Garey (see Appendix A, Figure 3). Additional gauges include two operated by the Santa Barbara County Public Works Department at Sisquoc Ranch and Orcutt. The average annual rainfall measured at the Santa Maria Airport gauge, the most centrally located of the three gauges, is 12.63 inches, as shown in a bar chart of historical precipitation (Figure 2.4-1). Historically, the majority of rainfall occurs during the months of November through April. In calendar year 2015, the total rainfall was well below average, at only 4.05 inches, with the greatest monthly amounts in December (1.12 inches), November (0.69 inches), and April (0.67 inches), as shown in Table 2.4-1.

Long-term rainfall characteristics for the SMVMA are reflected by the cumulative departure curve of historical annual precipitation (on Figure 2.4-1), which indicates that the SMVMA has generally experienced periods of wetter than normal conditions alternating with periods of drier than normal to drought conditions. Wet conditions prevailed from the 1930's through 1944, followed by drier conditions from 1945 through the late 1960's. Subsequently, there have been shorter periods of alternating wet and dry conditions, including the most recent cycle of a wet period in the early-1990's to 1998, followed by the current overall dry period from 2002 through 2015. Conditions have shown short-term variation with rainfall totals above the long-term average in 2010 and 2011 but well below the average since 2012. This pattern of fluctuations in climatic conditions closely corresponds to the long-term fluctuations in groundwater levels described in Section 2.1.2 above, including the substantial decline observed between 1945 and the late 1960's and the subsequent repeating cycle of decline and recovery between historical-low and historical-high groundwater levels. Most recently, groundwater levels rose substantially in much of the SMVMA through 2011 in response to large amounts of rainfall in late 2010 and early 2011 (and the associated recharge from prolonged Twitchell Reservoir releases and high Sisquoc River discharge). However, the overall decline in groundwater levels observed since 2002 and particularly since 2012 is primarily attributed to the continued below average rainfall, Twitchell releases, and Sisquoc River discharge.

Importantly, the magnitude of the effect on rainfall amounts of the current dry climatic period that commenced in 2002 can be seen in a comparison of the calculated average precipitation for the following selected periods of time. They include the entire period of record (1948 – 2015) as well as the same periods as those for historical Twitchell Reservoir releases described in Section 2.2.2 above):

Precipitation data period of record 1948 – 2015 (12.63 inches)
Twitchell period of record 1967 – 2015 (13.14 inches);
Twitchell pre-current dry period 1967 – 2001 (13.95 inches); and
Current dry period 2002 – 2015 (11.10 inches).
The average rainfall during the current dry period (11.10 inches for 2002 – 2015) is 84 percent of the average for the Twitchell period of record (13.14 inches for 1967 – 2015) and 88 percent of the average for the precipitation data period of record (12.63 inches for 1948 – 2015).

2.4.2 Evapotranspiration

Three CIMIS climate stations were initially operated within the SMVMA for varying periods of time, specifically at Santa Maria, Betteravia, and Guadalupe between 1983 and 1997 (see Appendix A, Figure 3). Subsequently, CIMIS stations began operating near Sisquoc and on the southern Nipomo Mesa, the latter located just outside of the SMVMA, with climate data available for full calendar years beginning in 2001 and 2007, respectively. Most recently, a CIMIS climate station located on the floor of the Santa Maria Valley ("Santa Maria II" near the Santa Maria airport, see Appendix A, Figure 3) was reestablished in April 2011. A full calendar year of data from Santa Maria II was available for the first time in 2012. These six stations have recorded daily reference evapotranspiration (ETo) and precipitation amounts, with annual ETo values typically ranging between 42 and 53 inches and averaging about 48 inches, as shown in a bar chart of the historical ETo values for the SMVMA (Figure 2.4-2).

Daily climate data for 2015 from the Santa Maria II, Nipomo, and Sisquoc stations are listed in Table 2.4-2, specifically daily, monthly, and annual ETo and precipitation amounts. Annual ETo values ranged from 43.49 inches (Nipomo) to 51.49 inches (Sisquoc). Annual precipitation amounts were reported as 5.61 inches at the Sisquoc station but had questionable recorded totals of 1.65 inches at the Santa Maria II station and 8.29 inches at the Nipomo station.

Several characteristics of the 2015 CIMIS station data are worthy of note. Evapotranspiration was highest during the months of March through September at all three stations, and the ETo values from the Santa Maria II station were typically intermediate to those from the other two stations. In addition, the 2015 total precipitation recorded at the Sisquoc CIMIS station was the most similar to the total amount observed at the Santa Maria Airport precipitation gauge. However, the monthly precipitation amounts reported at all three CIMIS stations do not track those of the airport gauge. Similar inconsistencies in precipitation data between CIMIS stations and the airport gauge have been observed since 2012. For this reason, and as described in the next chapter, the 2015 ETo data from the Santa Maria II CIMIS station and the 2015 precipitation data from the airport gauge were utilized in the estimation of agricultural water requirements for the SMVMA in 2015.

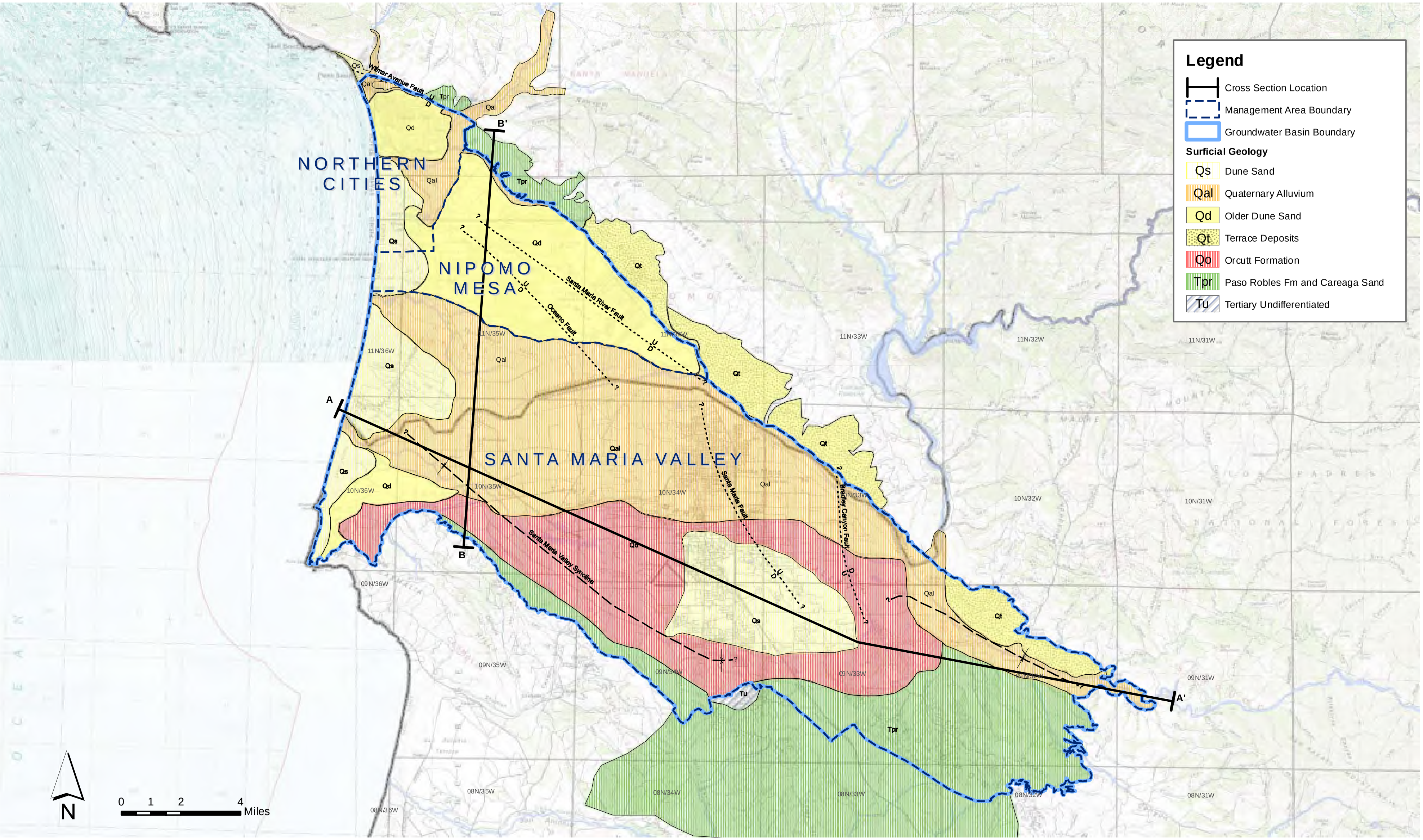

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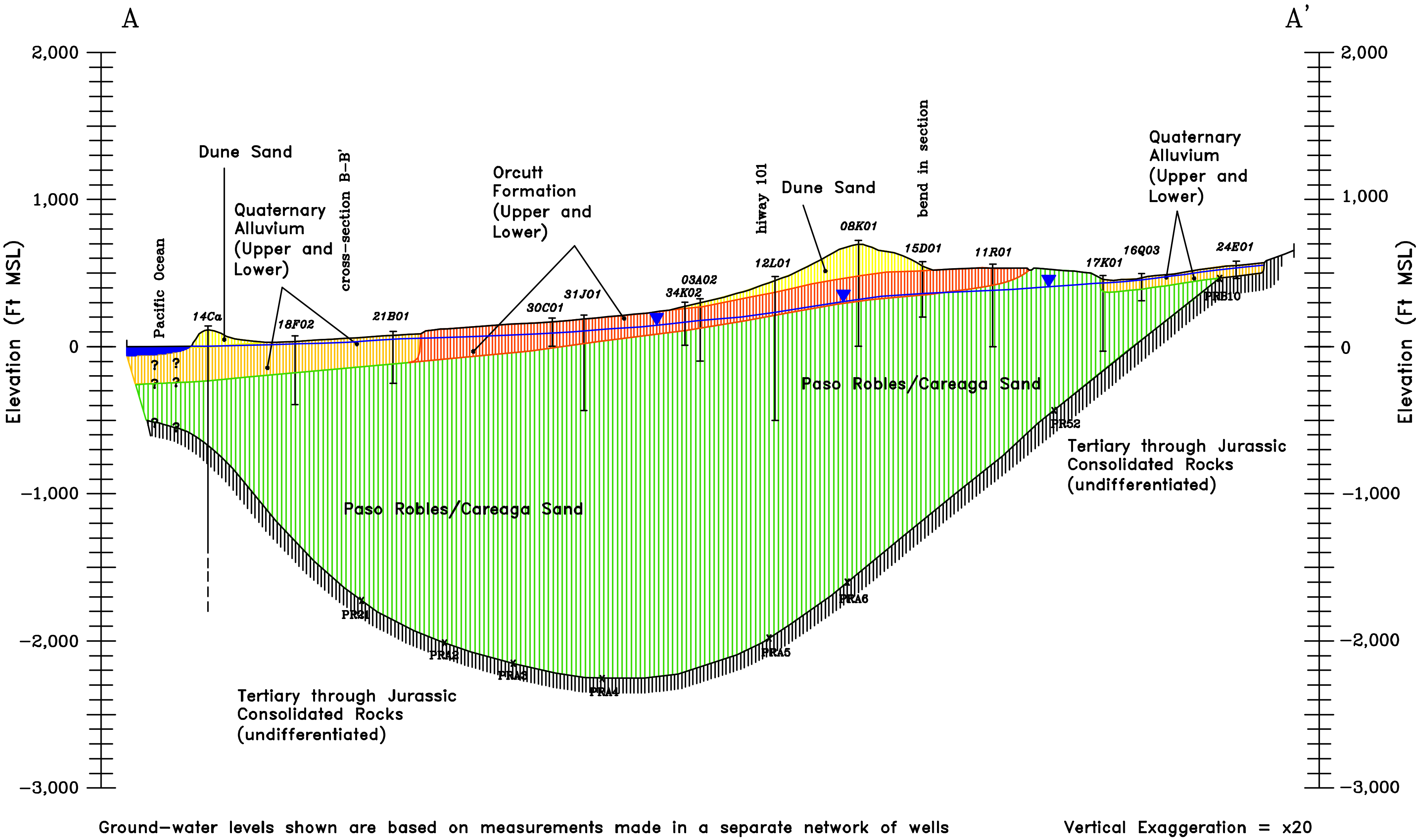
Figure 2.1-1a
Generalized Geologic Map with Cross Section Locations
Santa Maria Valley Management Area



C: \SantaMaria 2008\Annual Report 2008\Fig 2.1-1b XSec A-A' 2008.dwg

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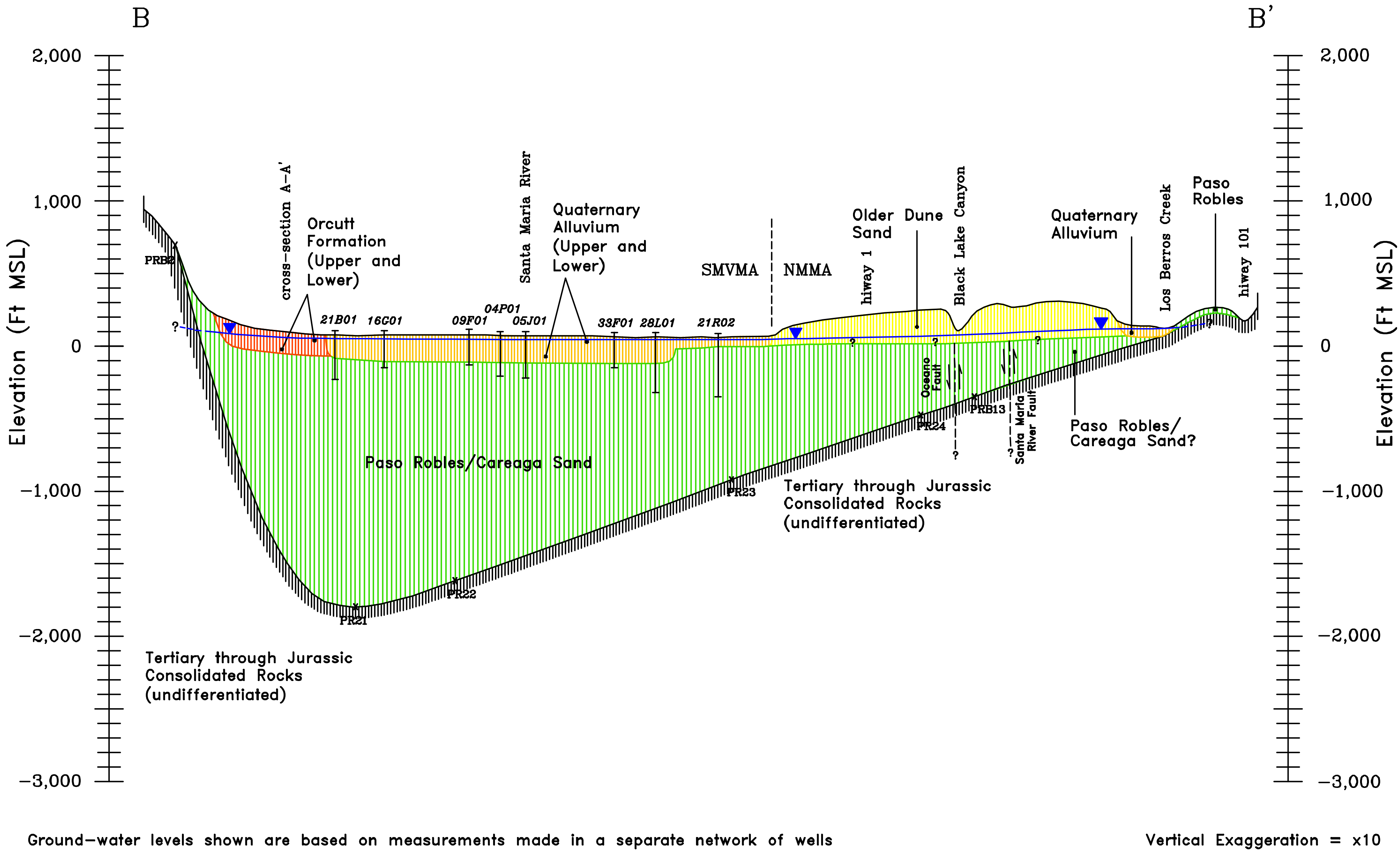
Figure 2.1-1b
Longitudinal Geologic Cross Section, A-A'
Santa Maria Valley Management Area



C:\Santa Maria 2008\Annual Report 2008\Fig 2.1-1c XSec B-B' 2009.dwg

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Figure 2.1-1c
Transverse Geologic Cross Section, B-B'
Santa Maria Valley Management Area

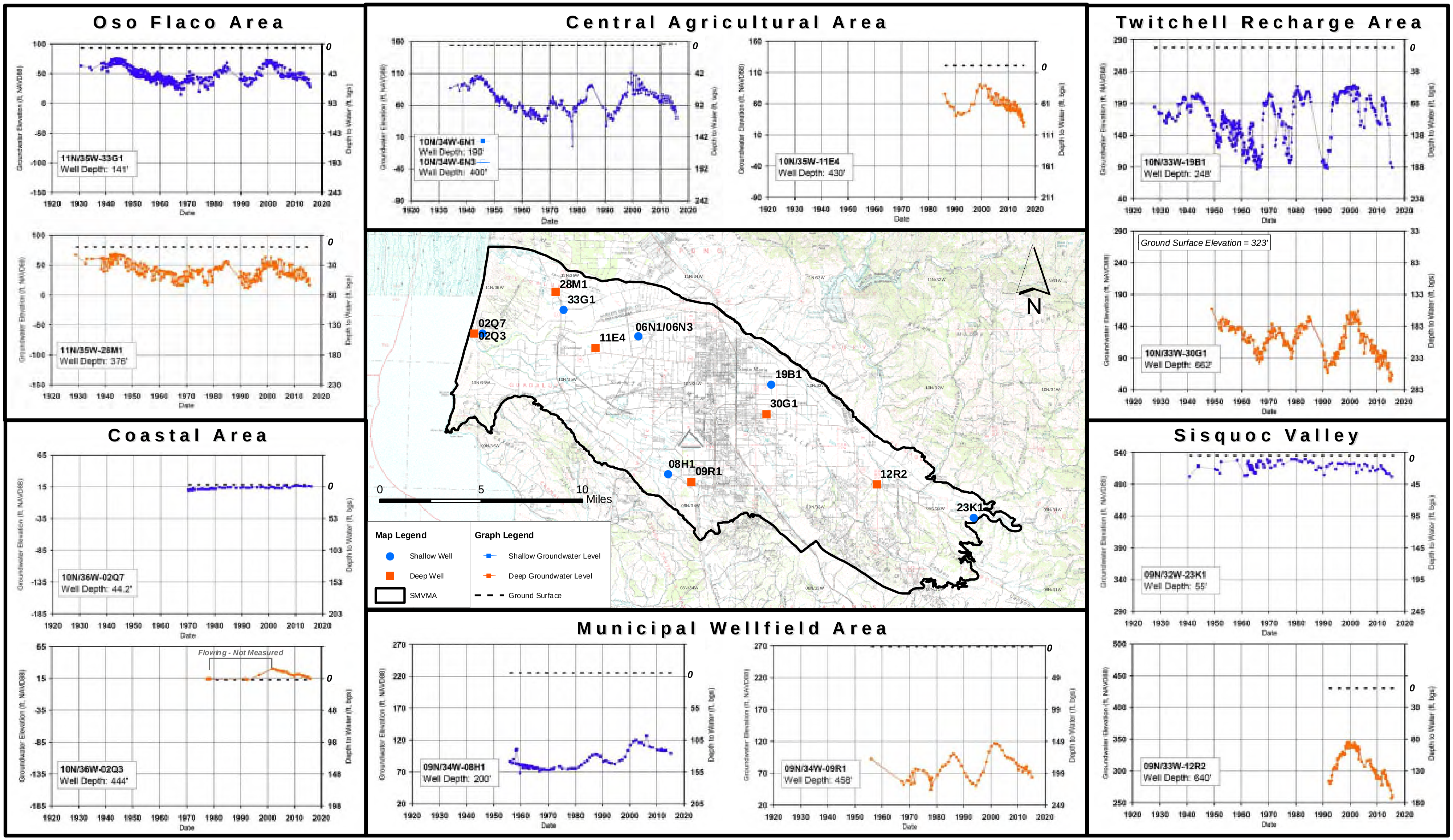

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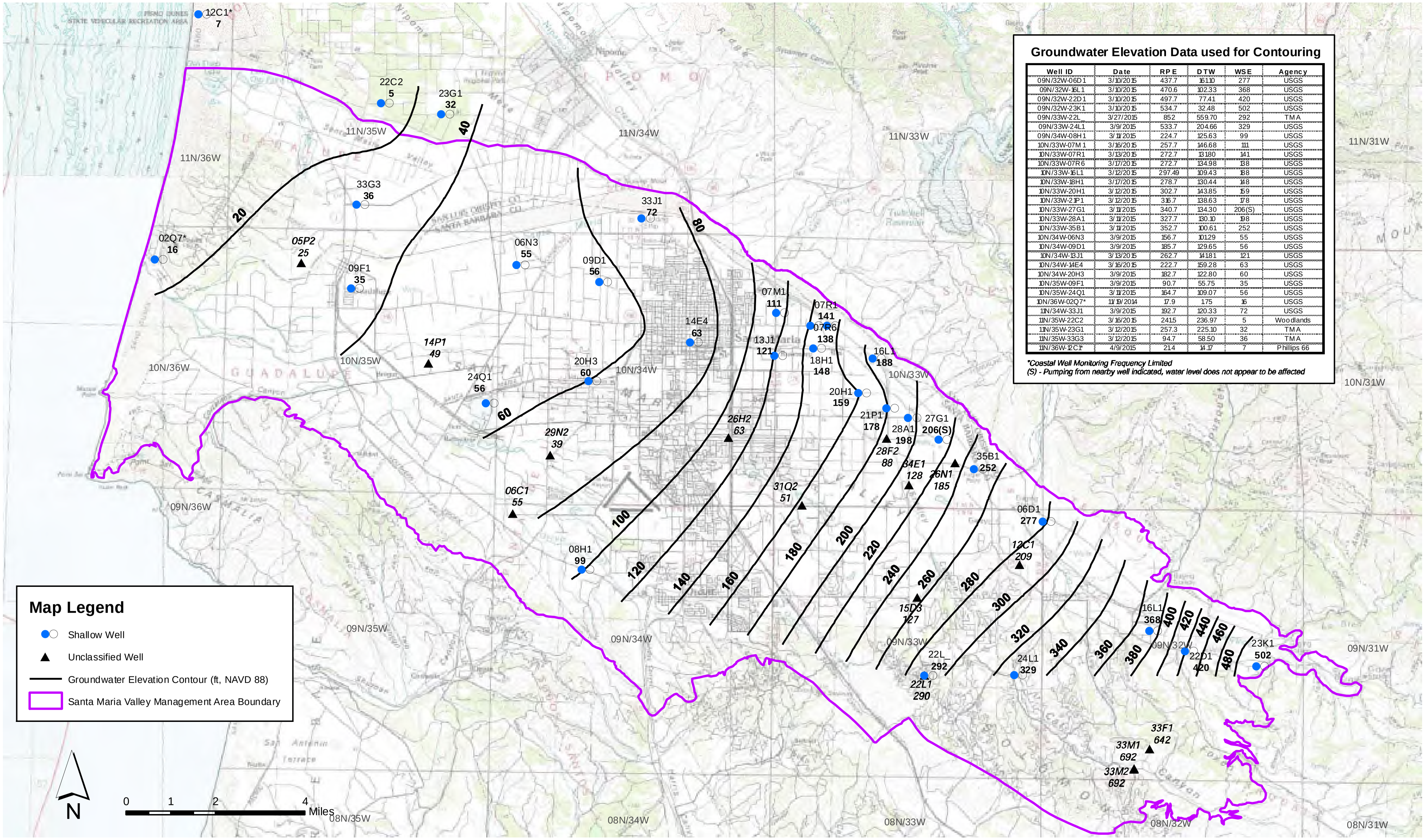
Figure 2.1-2
Historical Groundwater Levels
Santa Maria Valley Management Area



Groundwater Elevation Data used for Contouring

Well ID	Date	RPE	DTW	WSE	Agency
09N/32W-06D1	3/10/2015	437.7	161.10	277	USGS
09N/32W-16L1	3/10/2015	470.6	102.33	368	USGS
09N/32W-22D1	3/10/2015	497.7	77.41	420	USGS
09N/32W-23K1	3/10/2015	534.7	32.48	502	USGS
09N/33W-22L_	3/27/2015	852	559.70	292	TMA
09N/33W-24L1	3/9/2015	533.7	204.66	329	USGS
09N/34W-08H1	3/11/2015	224.7	125.63	99	USGS
10N/33W-07M1	3/16/2015	257.7	146.68	111	USGS
10N/33W-07R1	3/13/2015	272.7	131.80	141	USGS
10N/33W-07R6	3/17/2015	272.7	134.98	138	USGS
10N/33W-16L1	3/12/2015	297.49	109.43	188	USGS
10N/33W-18H1	3/17/2015	278.7	130.44	148	USGS
10N/33W-20H1	3/12/2015	302.7	143.85	159	USGS
10N/33W-21P1	3/12/2015	316.7	138.63	178	USGS
10N/33W-27G1	3/11/2015	340.7	134.30	206(S)	USGS
10N/33W-28A1	3/11/2015	327.7	130.10	198	USGS
10N/33W-35B1	3/11/2015	352.7	100.61	252	USGS
10N/34W-06N3	3/9/2015	156.7	101.29	55	USGS
10N/34W-09D1	3/9/2015	185.7	129.65	56	USGS
10N/34W-13J1	3/13/2015	262.7	141.81	121	USGS
10N/34W-14E4	3/16/2015	222.7	159.28	63	USGS
10N/34W-20H3	3/9/2015	182.7	122.80	60	USGS
10N/35W-09F1	3/9/2015	90.7	55.75	35	USGS
10N/35W-24Q1	3/11/2015	164.7	109.07	56	USGS
10N/36W-02Q7*	11/19/2014	17.9	1.75	16	USGS
11N/34W-33J1	3/9/2015	192.7	120.33	72	USGS
11N/35W-22C2	3/16/2015	241.5	236.97	5	Woodlands
11N/35W-23G1	3/12/2015	257.3	225.10	32	TMA
11N/35W-33G3	3/12/2015	94.7	58.50	36	TMA
11N/36W-12C1*	4/9/2015	21.4	14.17	7	Phillips 66

**Coastal Well Monitoring Frequency Limited*
(S) - Pumping from nearby well indicated, water level does not appear to be affected

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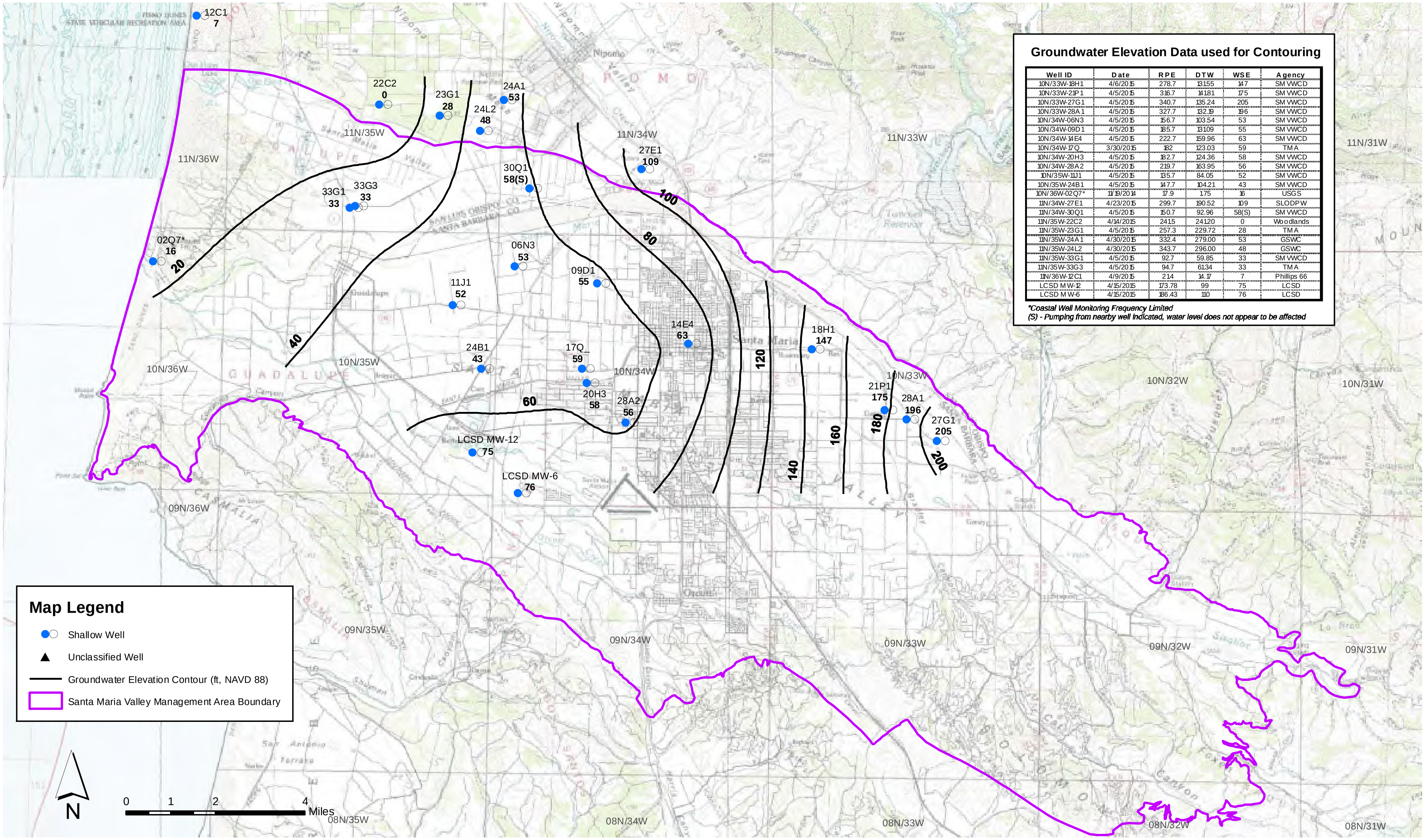
Figure 2.1-3a
Contours of Equal Groundwater Elevation, Shallow Zone, Early Spring (March 9 - March 27) 2015
Santa Maria Valley Management Area



Groundwater Elevation Data used for Contouring

Well ID	Date	RPE	DTW	WSE	Agency
10N/33W-18H1	4/6/2015	278.7	131.55	147	SMVWCD
10N/33W-21P1	4/5/2015	316.7	141.81	175	SMVWCD
10N/33W-27G1	4/5/2015	340.7	135.24	205	SMVWCD
10N/33W-28A1	4/5/2015	327.7	132.19	196	SMVWCD
10N/34W-06N3	4/5/2015	156.7	103.54	53	SMVWCD
10N/34W-09D1	4/5/2015	185.7	131.09	55	SMVWCD
10N/34W-14E4	4/5/2015	222.7	159.96	63	SMVWCD
10N/34W-17Q_	3/30/2015	182	123.03	59	TMA
10N/34W-20H3	4/5/2015	182.7	124.36	58	SMVWCD
10N/34W-28A2	4/5/2015	219.7	163.95	56	SMVWCD
10N/35W-11J1	4/5/2015	135.7	84.05	52	SMVWCD
10N/35W-24B1	4/5/2015	147.7	104.21	43	SMVWCD
10N/36W-02Q7*	11/19/2014	17.9	1.75	16	USGS
11N/34W-27E1	4/23/2015	299.7	190.52	109	SLODPW
11N/34W-30Q1	4/5/2015	150.7	92.96	58(S)	SMVWCD
11N/35W-22C2	4/14/2015	241.5	241.20	0	Woodlands
11N/35W-23G1	4/5/2015	257.3	229.72	28	TMA
11N/35W-24A1	4/30/2015	332.4	279.00	53	GSWC
11N/35W-24L2	4/30/2015	343.7	296.00	48	GSWC
11N/35W-33G1	4/5/2015	92.7	59.85	33	SMVWCD
11N/35W-33G3	4/5/2015	94.7	61.34	33	TMA
11N/36W-12C1	4/9/2015	21.4	14.17	7	Phillips 66
LCSD MW-12	4/15/2015	173.78	99	75	LCSD
LCSD MW-6	4/15/2015	186.43	110	76	LCSD

**Coastal Well Monitoring Frequency Limited*
(S) - Pumping from nearby well indicated, water level does not appear to be affected

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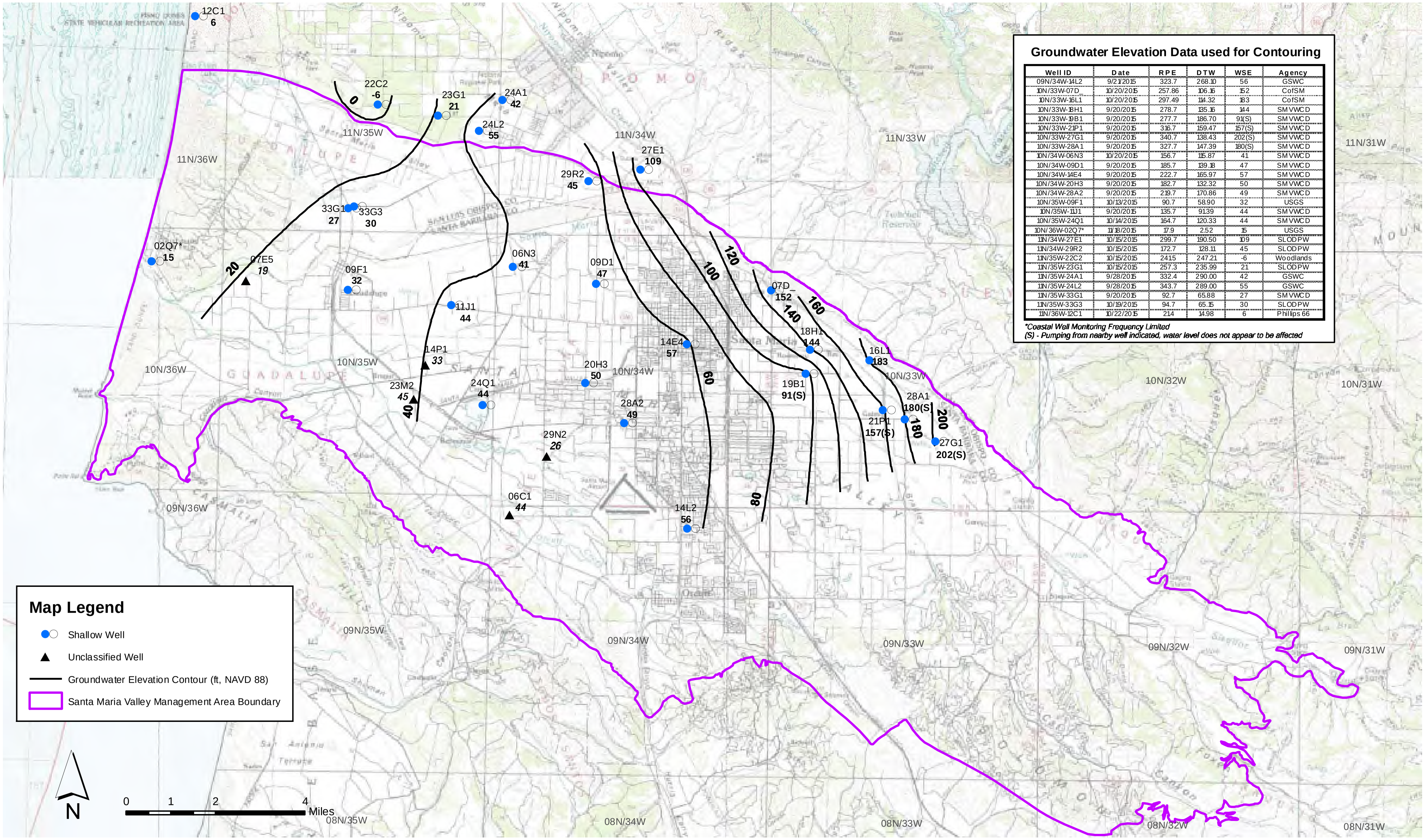
Figure 2.1-3b
Contours of Equal Groundwater Elevation, Shallow Zone, Late Spring (March 30 - April 30) 2015
Santa Maria Valley Management Area



Groundwater Elevation Data used for Contouring

Well ID	Date	RPE	DTW	WSE	Agency
09N/34W-14L2	9/21/2015	323.7	268.10	56	GSWC
10N/33W-07D_	10/20/2015	257.86	106.16	152	CofSM
10N/33W-16L1	10/20/2015	297.49	114.32	183	CofSM
10N/33W-18H1	9/20/2015	278.7	135.16	144	SMVWCD
10N/33W-19B1	9/20/2015	277.7	186.70	91(S)	SMVWCD
10N/33W-21P1	9/20/2015	316.7	159.47	157(S)	SMVWCD
10N/33W-27G1	9/20/2015	340.7	138.43	202(S)	SMVWCD
10N/33W-28A1	9/20/2015	327.7	147.39	180(S)	SMVWCD
10N/34W-06N3	10/20/2015	156.7	115.87	41	SMVWCD
10N/34W-09D1	9/20/2015	185.7	139.18	47	SMVWCD
10N/34W-14E4	9/20/2015	222.7	165.97	57	SMVWCD
10N/34W-20H3	9/20/2015	182.7	132.32	50	SMVWCD
10N/34W-28A2	9/20/2015	219.7	170.86	49	SMVWCD
10N/35W-09F1	10/13/2015	90.7	58.90	32	USGS
10N/35W-11J1	9/20/2015	135.7	91.39	44	SMVWCD
10N/35W-24Q1	10/14/2015	164.7	120.33	44	SMVWCD
10N/36W-02Q7*	11/18/2015	17.9	2.52	15	USGS
11N/34W-27E1	10/15/2015	299.7	190.50	109	SLODPW
11N/34W-29R2	10/15/2015	172.7	128.11	45	SLODPW
11N/35W-22C2	10/15/2015	241.5	247.21	-6	Woodlands
11N/35W-23G1	10/15/2015	257.3	235.99	21	SLODPW
11N/35W-24A1	9/28/2015	332.4	290.00	42	GSWC
11N/35W-24L2	9/28/2015	343.7	289.00	55	GSWC
11N/35W-33G1	9/20/2015	92.7	65.88	27	SMVWCD
11N/35W-33G3	10/19/2015	94.7	65.15	30	SLODPW
11N/36W-12C1	10/22/2015	214	14.98	6	Phillips 66

*Coastal Well Monitoring Frequency Limited
(S) - Pumping from nearby well indicated, water level does not appear to be affected

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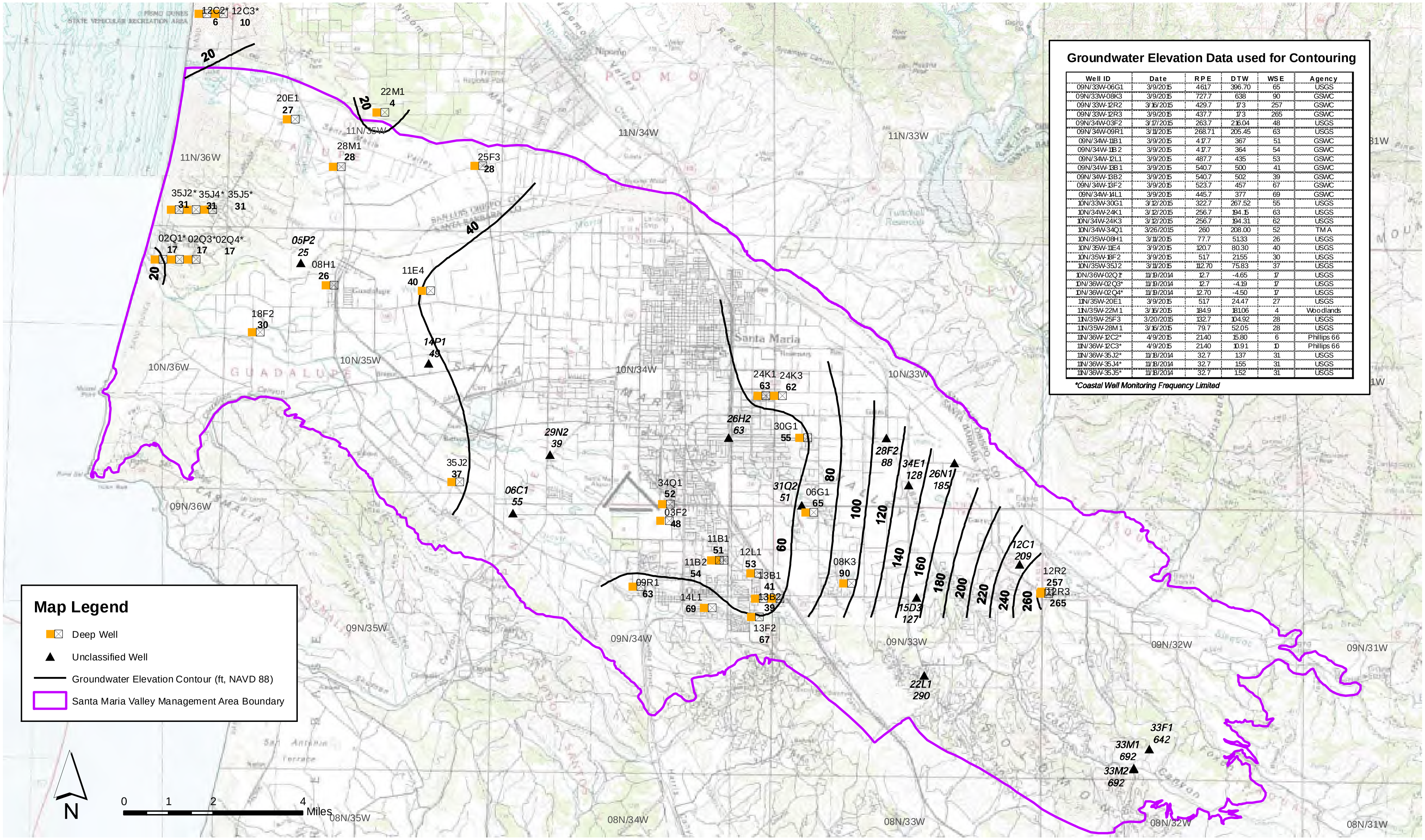
Figure 2.1-3c
Contours of Equal Groundwater Elevation, Shallow Zone, Fall (September 20 - October 22) 2015
Santa Maria Valley Management Area



Groundwater Elevation Data used for Contouring

Well ID	Date	RPE	DTW	WSE	Agency
09N/33W-06G1	3/9/2015	461.7	396.70	65	USGS
09N/33W-08K3	3/9/2015	727.7	638	90	GSWC
09N/33W-12R2	3/16/2015	429.7	173	257	GSWC
09N/33W-12R3	3/9/2015	437.7	173	265	GSWC
09N/34W-03F2	3/17/2015	263.7	216.04	48	USGS
09N/34W-09R1	3/11/2015	268.71	205.45	63	USGS
09N/34W-11B1	3/9/2015	417.7	367	51	GSWC
09N/34W-11B2	3/9/2015	417.7	364	54	GSWC
09N/34W-12L1	3/9/2015	487.7	435	53	GSWC
09N/34W-13B1	3/9/2015	540.7	500	41	GSWC
09N/34W-13B2	3/9/2015	540.7	502	39	GSWC
09N/34W-13F2	3/9/2015	523.7	457	67	GSWC
09N/34W-14L1	3/9/2015	445.7	377	69	GSWC
10N/33W-30G1	3/12/2015	322.7	267.52	55	USGS
10N/34W-24K1	3/12/2015	256.7	194.15	63	USGS
10N/34W-24K3	3/12/2015	256.7	194.31	62	USGS
10N/34W-34Q1	3/26/2015	260	208.00	52	TMA
10N/35W-08H1	3/11/2015	77.7	51.33	26	USGS
10N/35W-11E4	3/9/2015	120.7	80.30	40	USGS
10N/35W-18F2	3/9/2015	51.7	21.55	30	USGS
10N/35W-35J2	3/11/2015	112.70	75.83	37	USGS
10N/36W-02Q1*	11/19/2014	12.7	-4.65	17	USGS
10N/36W-02Q3*	11/19/2014	12.7	-4.19	17	USGS
10N/36W-02Q4*	11/19/2014	12.70	-4.50	17	USGS
11N/35W-20E1	3/9/2015	51.7	24.47	27	USGS
11N/35W-22M1	3/16/2015	184.9	181.06	4	Woodlands
11N/35W-25F3	3/20/2015	132.7	104.92	28	USGS
11N/35W-28M1	3/16/2015	79.7	52.05	28	USGS
11N/36W-12C2*	4/9/2015	21.40	15.80	6	Phillips 66
11N/36W-12C3*	4/9/2015	21.40	10.91	10	Phillips 66
11N/36W-35J2*	11/18/2014	32.7	1.37	31	USGS
11N/36W-35J4*	11/18/2014	32.7	1.55	31	USGS
11N/36W-35J5*	11/18/2014	32.7	1.52	31	USGS

**Coastal Well Monitoring Frequency Limited*

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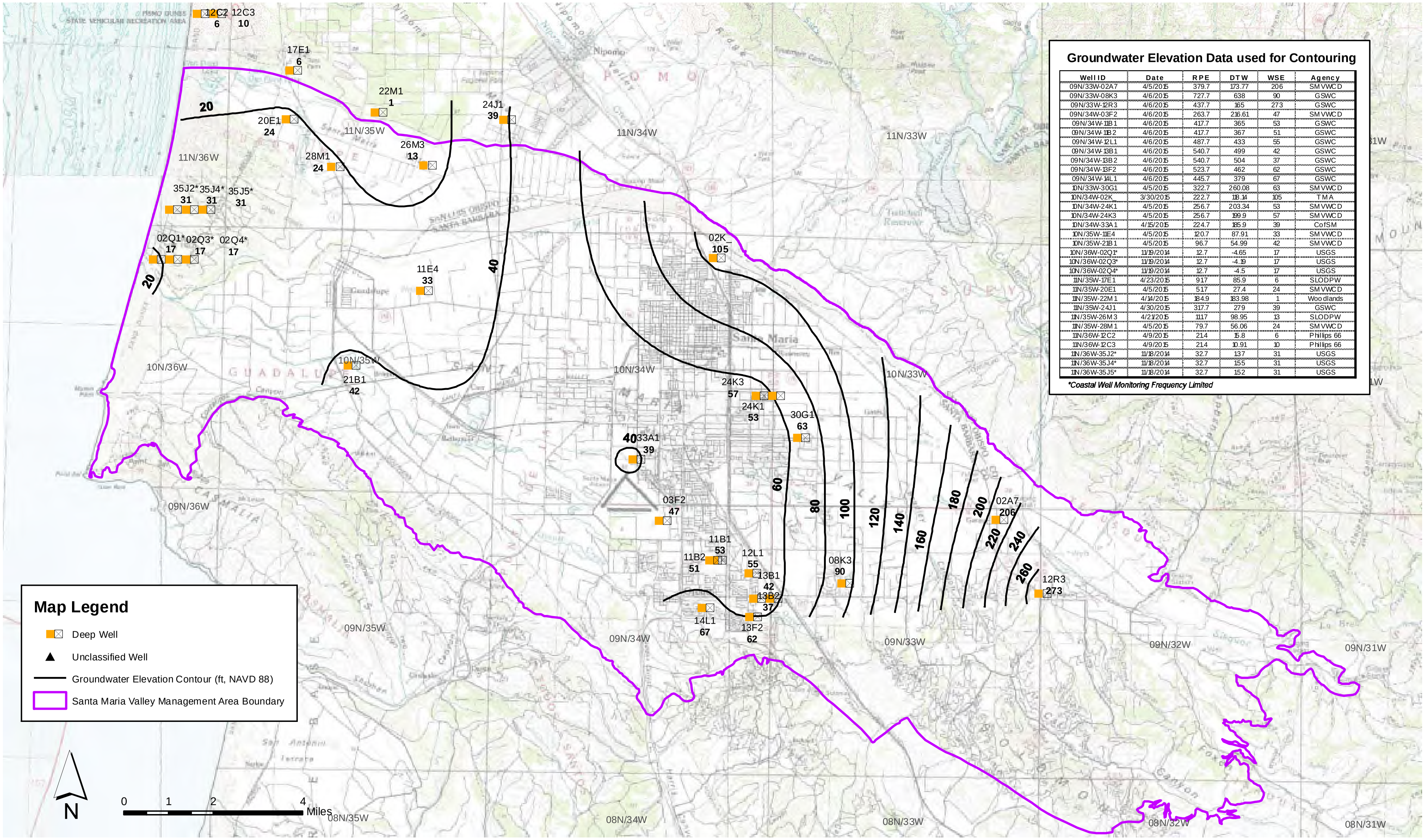
Figure 2.1-3d
Contours of Equal Groundwater Elevation, Deep Zone, Early Spring (March 9 - March 27) 2015
Santa Maria Valley Management Area



Groundwater Elevation Data used for Contouring

Well ID	Date	RPE	DTW	WSE	Agency
09N/33W-02A7	4/5/2015	379.7	173.77	206	SMVWCD
09N/33W-08K3	4/6/2015	727.7	638	90	GSWC
09N/33W-12R3	4/6/2015	437.7	165	273	GSWC
09N/34W-03F2	4/6/2015	263.7	216.61	47	SMVWCD
09N/34W-11B1	4/6/2015	417.7	365	53	GSWC
09N/34W-11B2	4/6/2015	417.7	367	51	GSWC
09N/34W-12L1	4/6/2015	487.7	433	55	GSWC
09N/34W-13B1	4/6/2015	540.7	499	42	GSWC
09N/34W-13B2	4/6/2015	540.7	504	37	GSWC
09N/34W-13F2	4/6/2015	523.7	462	62	GSWC
09N/34W-14L1	4/6/2015	445.7	379	67	GSWC
10N/33W-30G1	4/5/2015	322.7	260.08	63	SMVWCD
10N/34W-02K_	3/30/2015	222.7	118.14	105	TMA
10N/34W-24K1	4/5/2015	256.7	203.34	53	SMVWCD
10N/34W-24K3	4/5/2015	256.7	199.9	57	SMVWCD
10N/34W-33A1	4/15/2015	224.7	185.9	39	CofSM
10N/35W-11E4	4/5/2015	120.7	87.91	33	SMVWCD
10N/35W-21B1	4/5/2015	96.7	54.99	42	SMVWCD
10N/36W-02Q1*	11/19/2014	12.7	-4.65	17	USGS
10N/36W-02Q3*	11/19/2014	12.7	-4.19	17	USGS
10N/36W-02Q4*	11/19/2014	12.7	-4.5	17	USGS
11N/35W-17E1	4/23/2015	91.7	85.9	6	SLODPW
11N/35W-20E1	4/5/2015	51.7	27.4	24	SMVWCD
11N/35W-22M1	4/14/2015	184.9	183.98	1	Woodlands
11N/35W-24J1	4/30/2015	317.7	279	39	GSWC
11N/35W-26M3	4/21/2015	111.7	98.95	13	SLODPW
11N/35W-28M1	4/5/2015	79.7	56.06	24	SMVWCD
11N/36W-12C2	4/9/2015	21.4	15.8	6	Phillips 66
11N/36W-12C3	4/9/2015	21.4	10.91	10	Phillips 66
11N/36W-35J2*	11/18/2014	32.7	137	31	USGS
11N/36W-35J4*	11/18/2014	32.7	155	31	USGS
11N/36W-35J5*	11/18/2014	32.7	152	31	USGS

*Coastal Well Monitoring Frequency Limited

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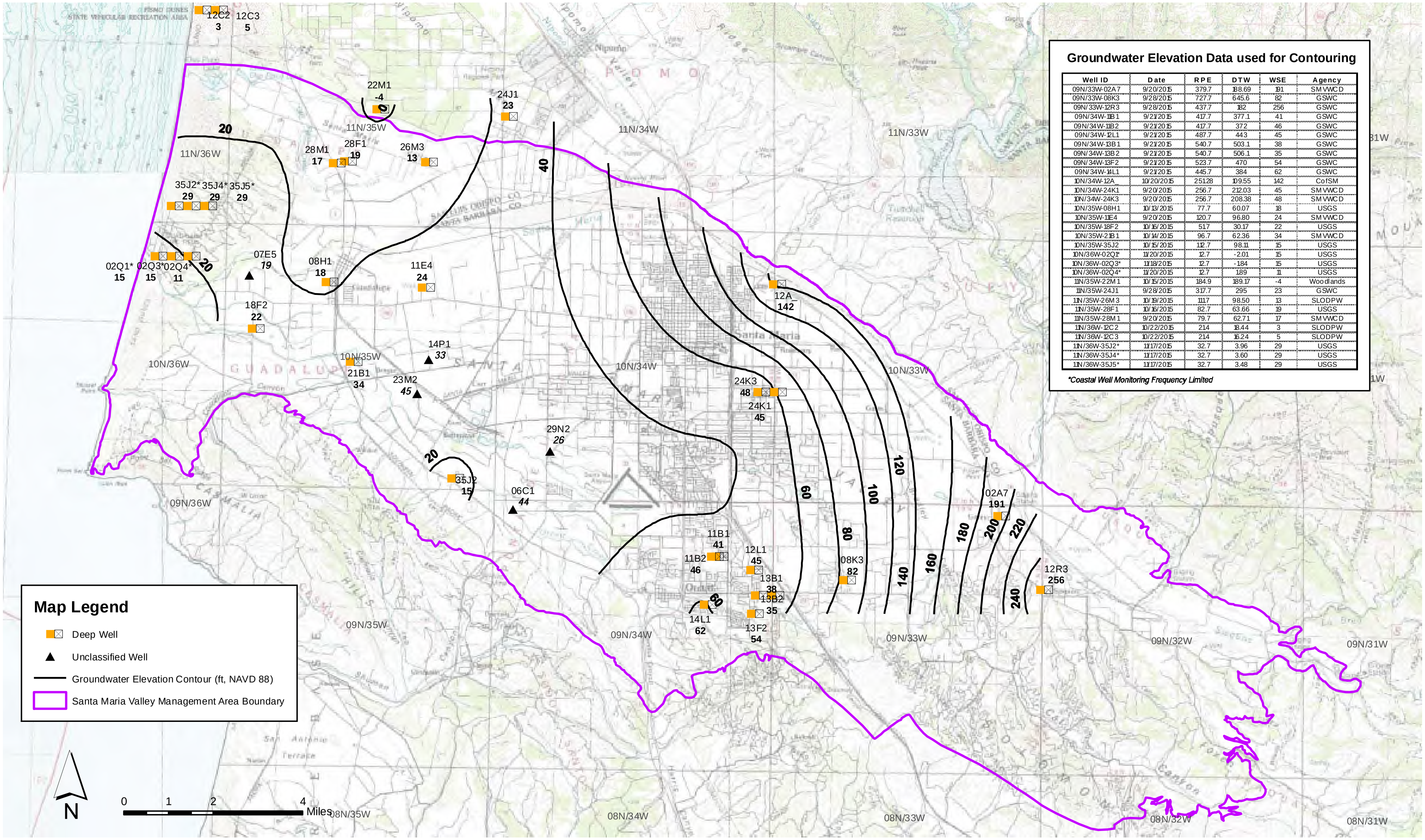
Figure 2.1-3e
Contours of Equal Groundwater Elevation, Deep Zone, Late Spring (March 30 - April 30) 2015
Santa Maria Valley Management Area



Groundwater Elevation Data used for Contouring

Well ID	Date	RPE	DTW	WSE	Agency
09N/33W-02A7	9/20/2015	379.7	188.69	191	SMVWCD
09N/33W-08K3	9/28/2015	727.7	645.6	82	GSWC
09N/33W-12R3	9/28/2015	437.7	182	256	GSWC
09N/34W-11B1	9/21/2015	417.7	377.1	41	GSWC
09N/34W-11B2	9/21/2015	417.7	372	46	GSWC
09N/34W-12L1	9/21/2015	487.7	443	45	GSWC
09N/34W-13B1	9/21/2015	540.7	503.1	38	GSWC
09N/34W-13B2	9/21/2015	540.7	506.1	35	GSWC
09N/34W-13F2	9/21/2015	523.7	470	54	GSWC
09N/34W-14L1	9/21/2015	445.7	384	62	GSWC
10N/34W-12A_	10/20/2015	251.28	109.55	142	CofSM
10N/34W-24K1	9/20/2015	256.7	212.03	45	SMVWCD
10N/34W-24K3	9/20/2015	256.7	208.38	48	SMVWCD
10N/35W-08H1	10/13/2015	77.7	60.07	18	USGS
10N/35W-11E4	9/20/2015	120.7	96.80	24	SMVWCD
10N/35W-18F2	10/16/2015	51.7	30.17	22	USGS
10N/35W-21B1	10/14/2015	96.7	62.36	34	SMVWCD
10N/35W-35J2	10/15/2015	112.7	98.11	15	USGS
10N/36W-02Q1*	11/20/2015	12.7	-2.01	15	USGS
10N/36W-02Q3*	11/18/2015	12.7	-1.84	15	USGS
10N/36W-02Q4*	11/20/2015	12.7	1.89	11	USGS
11N/35W-22M1	10/15/2015	184.9	189.17	-4	Woodlands
11N/35W-24J1	9/28/2015	317.7	295	23	GSWC
11N/35W-26M3	10/19/2015	111.7	98.50	13	SLODPW
11N/35W-28F1	10/16/2015	82.7	63.66	19	USGS
11N/35W-28M1	9/20/2015	79.7	62.71	17	SMVWCD
11N/36W-12C2	10/22/2015	21.4	18.44	3	SLODPW
11N/36W-12C3	10/22/2015	21.4	16.24	5	SLODPW
11N/36W-35J2*	11/17/2015	32.7	3.96	29	USGS
11N/36W-35J4*	11/17/2015	32.7	3.60	29	USGS
11N/36W-35J5*	11/17/2015	32.7	3.48	29	USGS

*Coastal Well Monitoring Frequency Limited

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Figure 2.1-3f
Contours of Equal Groundwater Elevation, Deep Zone, Fall (September 20 - October 22) 2015
Santa Maria Valley Management Area

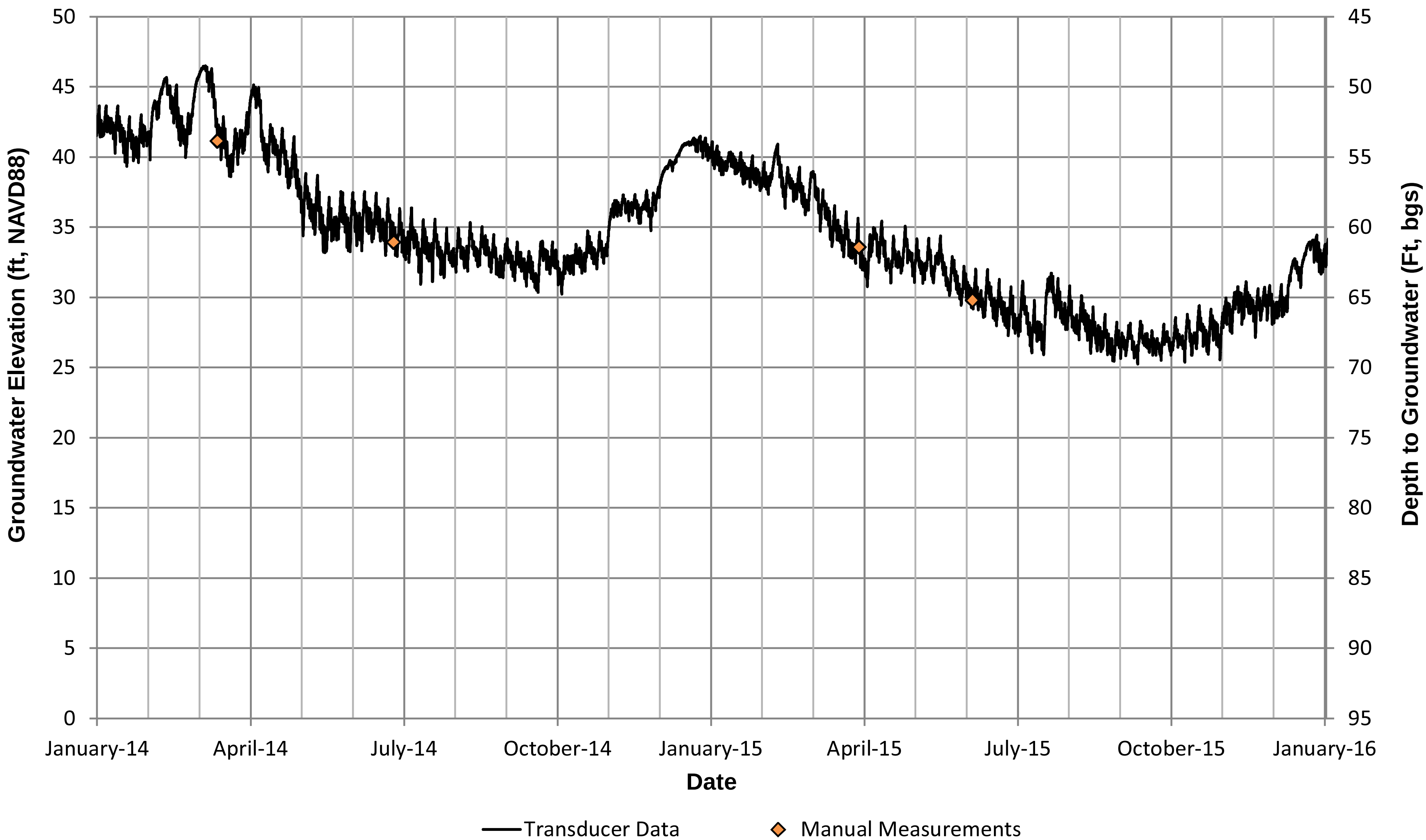

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Figure 2.1-4a
Seasonal Groundwater Level Fluctuations, Northern Santa Maria Valley
Santa Maria Valley Management Area

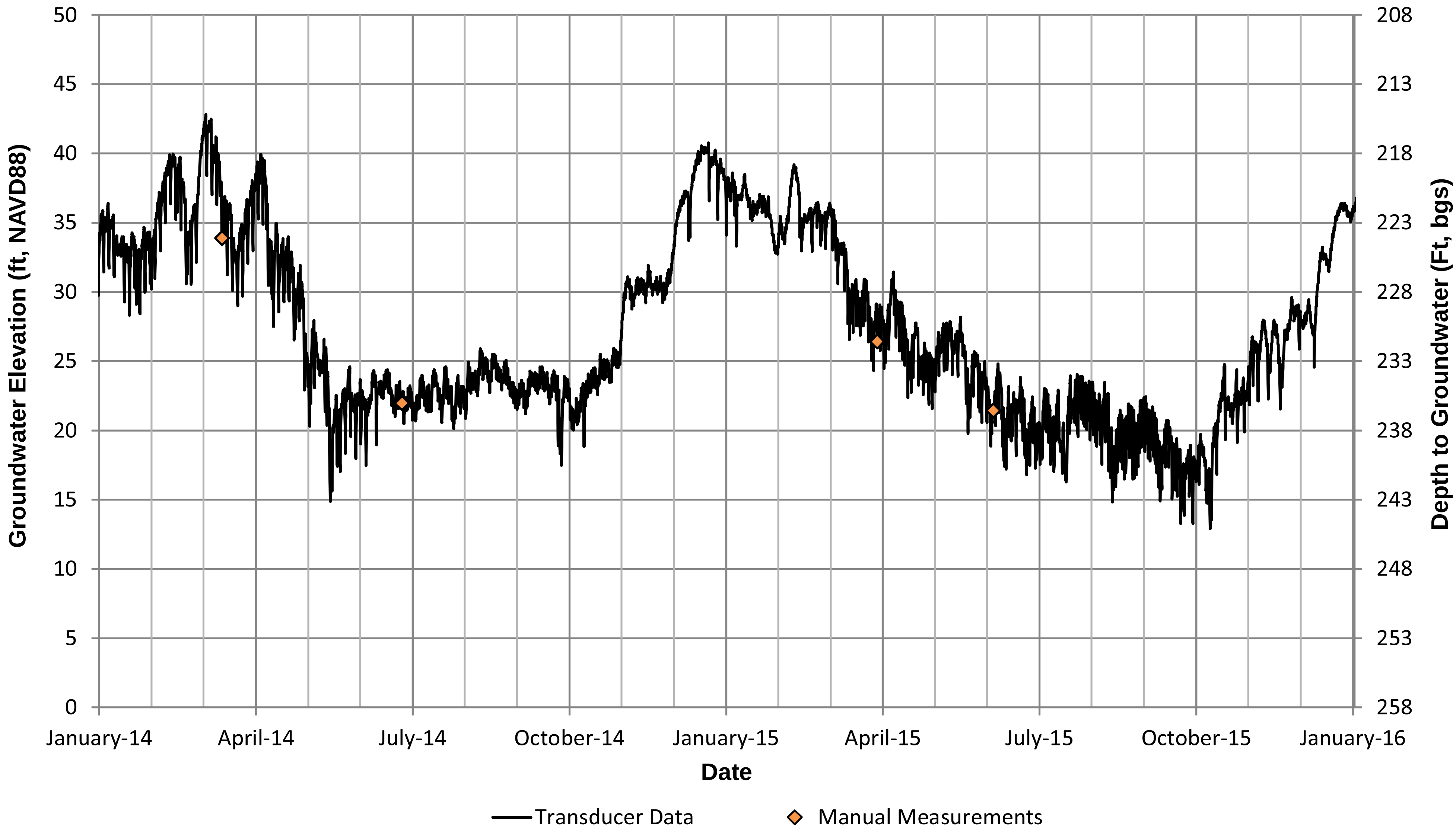

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Figure 2.1-4b
Seasonal Groundwater Level Fluctuations, Southern Nipomo Mesa
Santa Maria Valley Management Area

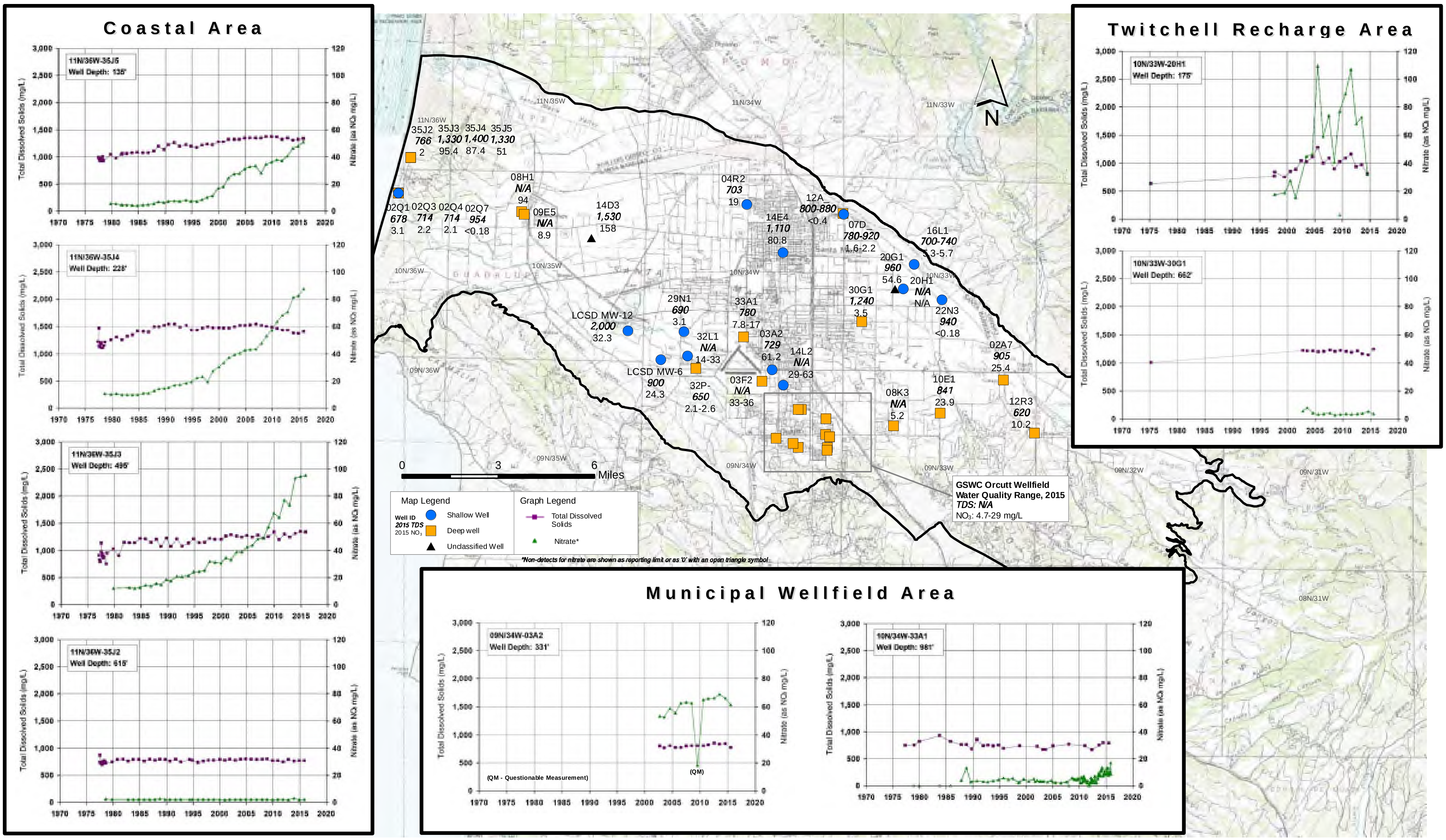

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Figure 2.1-5
Historical Groundwater Quality
Santa Maria Valley Management Area

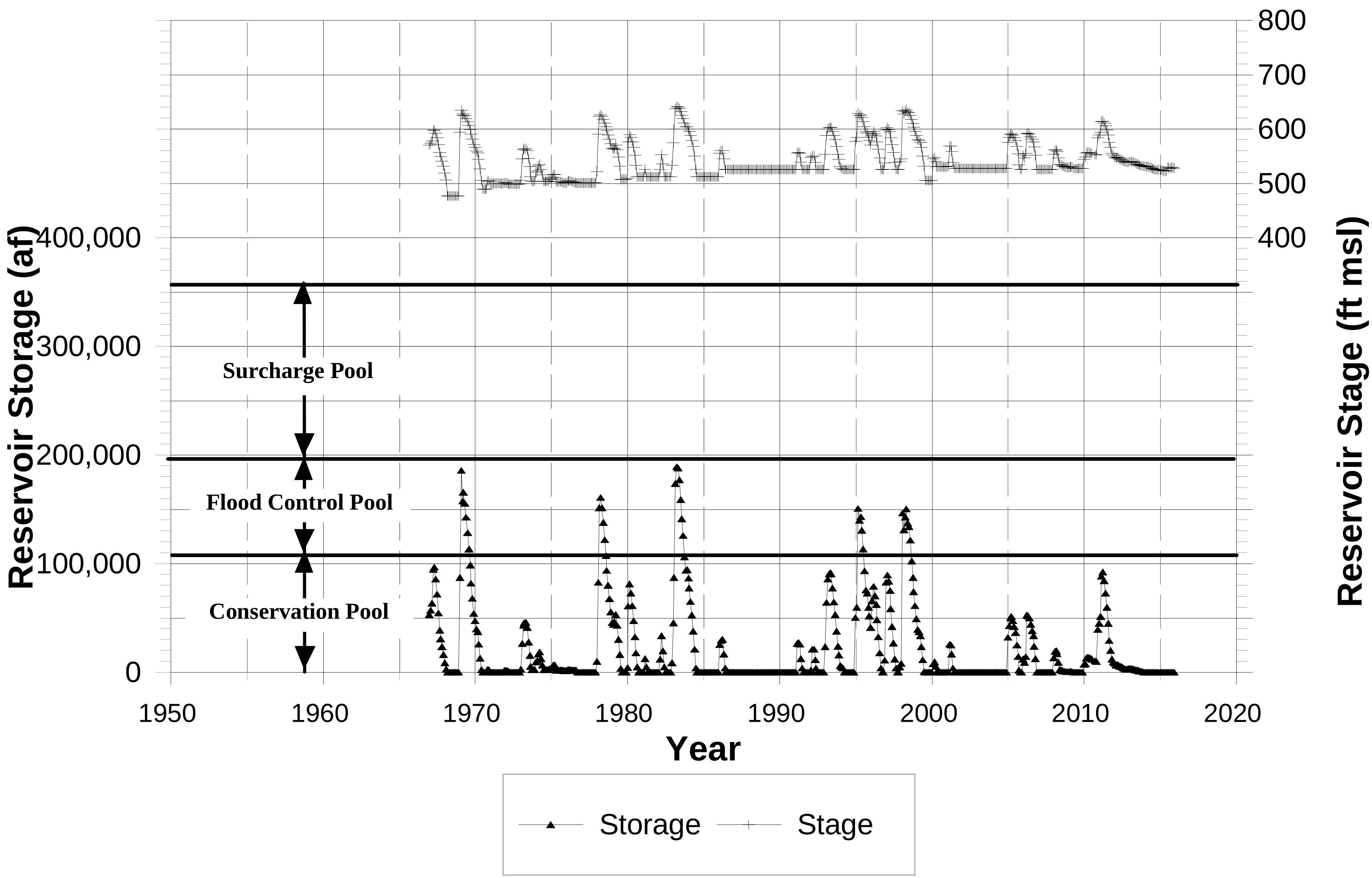

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Figure 2.2-1a
Historical Stage and Storage, Twitchell Reservoir
Santa Maria Valley Management Area

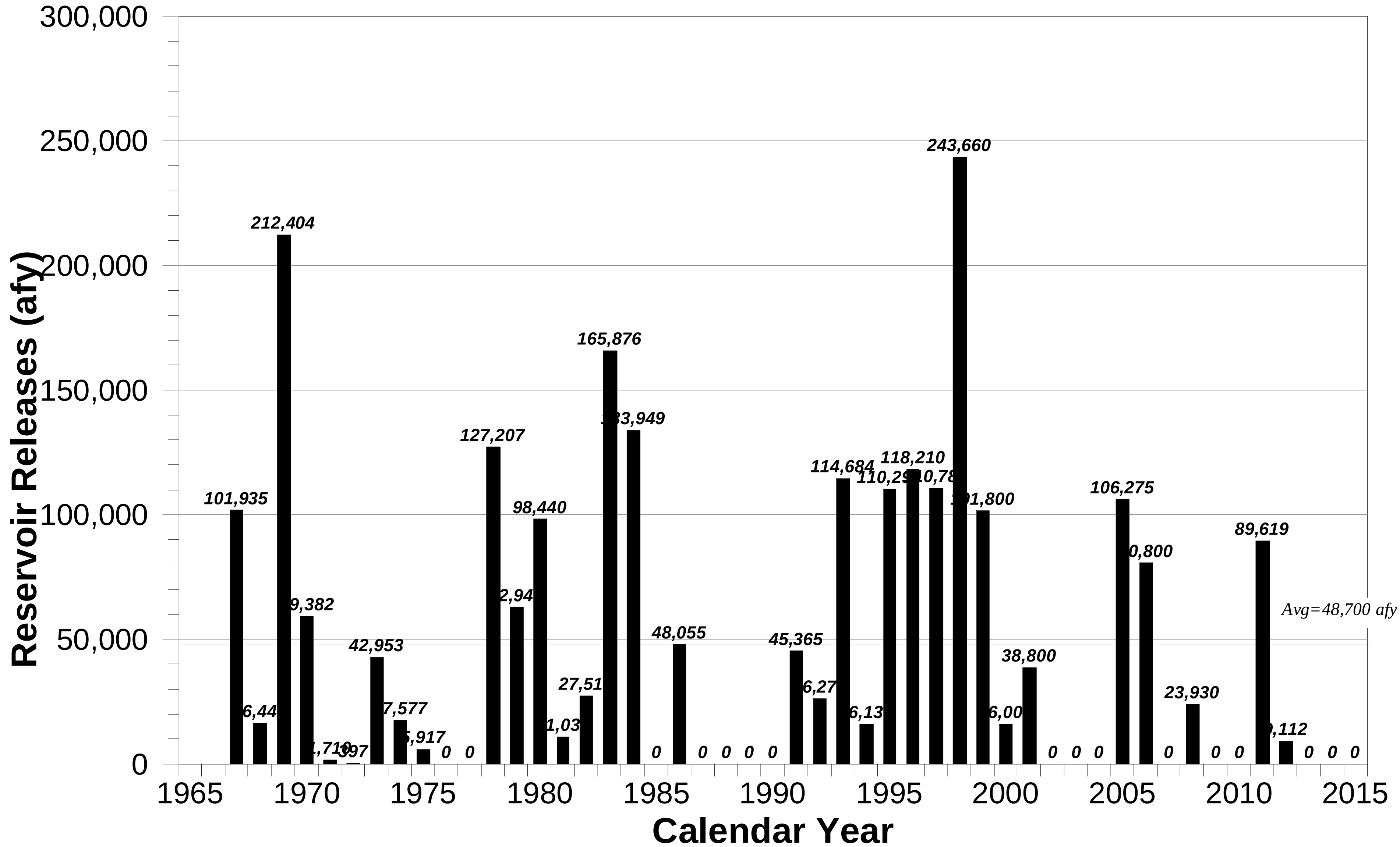

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Figure 2.2-1b
Historical Releases, Twitchell Reservoir
Santa Maria Valley Management Area

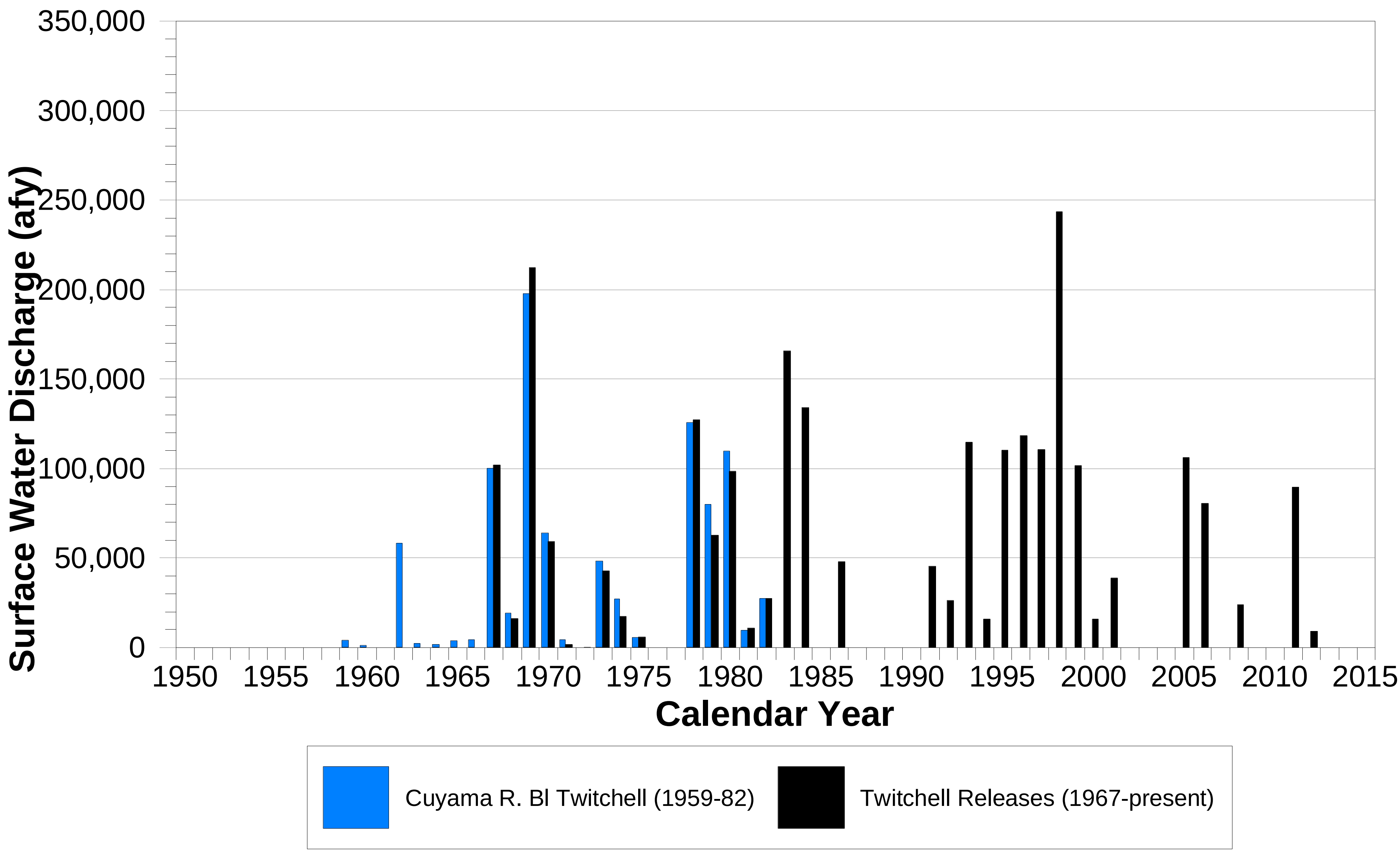

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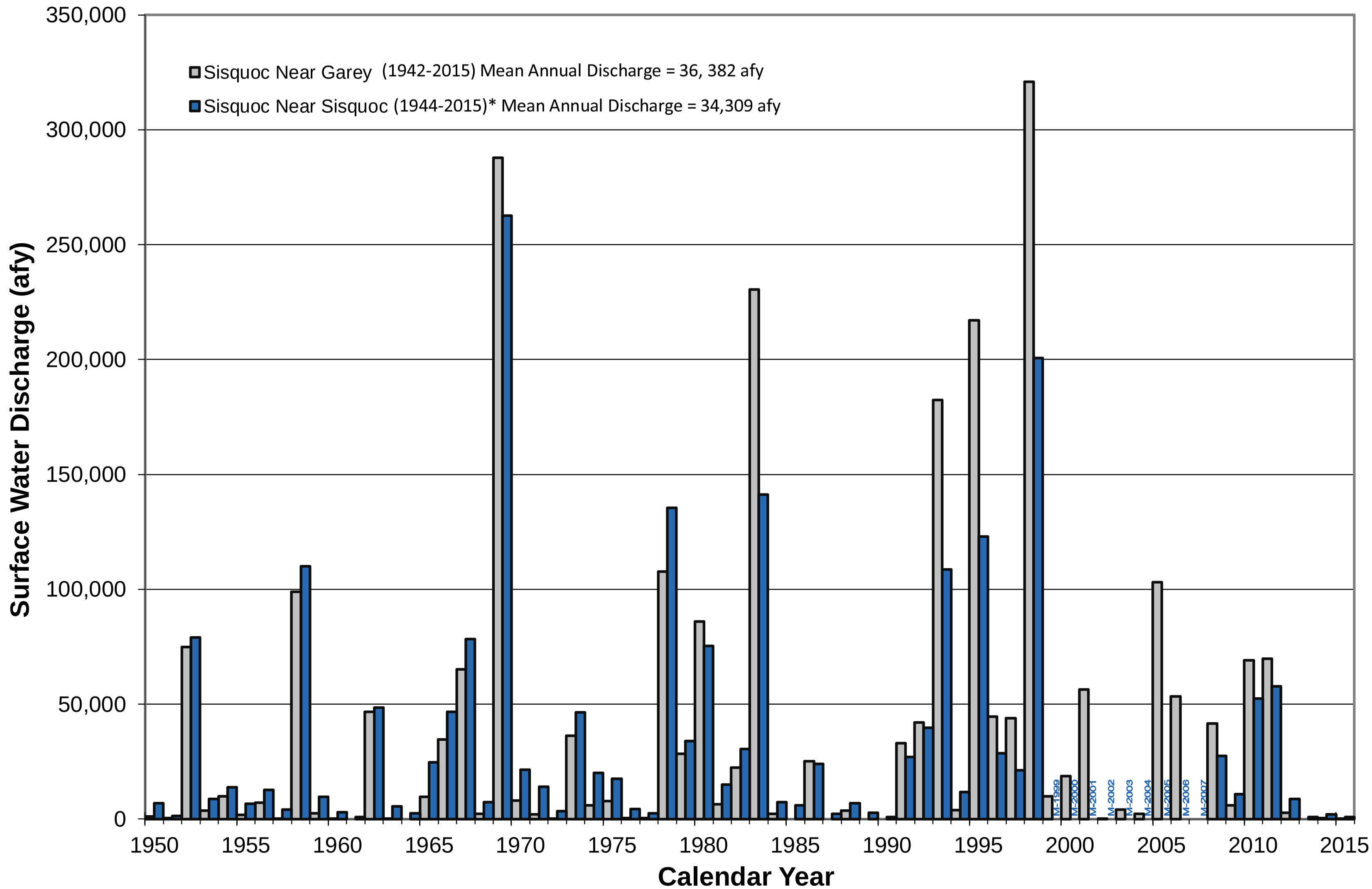
Figure 2.3-1a
Historical Discharge, Cuyama River, and Twitchell Reservoir Releases
Santa Maria Valley Management Area



Note:
The annual total discharge is comprised of average daily flow data for the respective 'Near Sisquoc' and 'Near Garey' Gauges. The 'Near Siquoc' and 'Near Garey' datasets have been approved by the USGS through September 2015 and are provisional through Dec 2015.

**Discharge data are unavailable for the 'Near Sisquoc' Gauge from 1999-2007; missing years are labeled with a 'M - yyyy' notation.*

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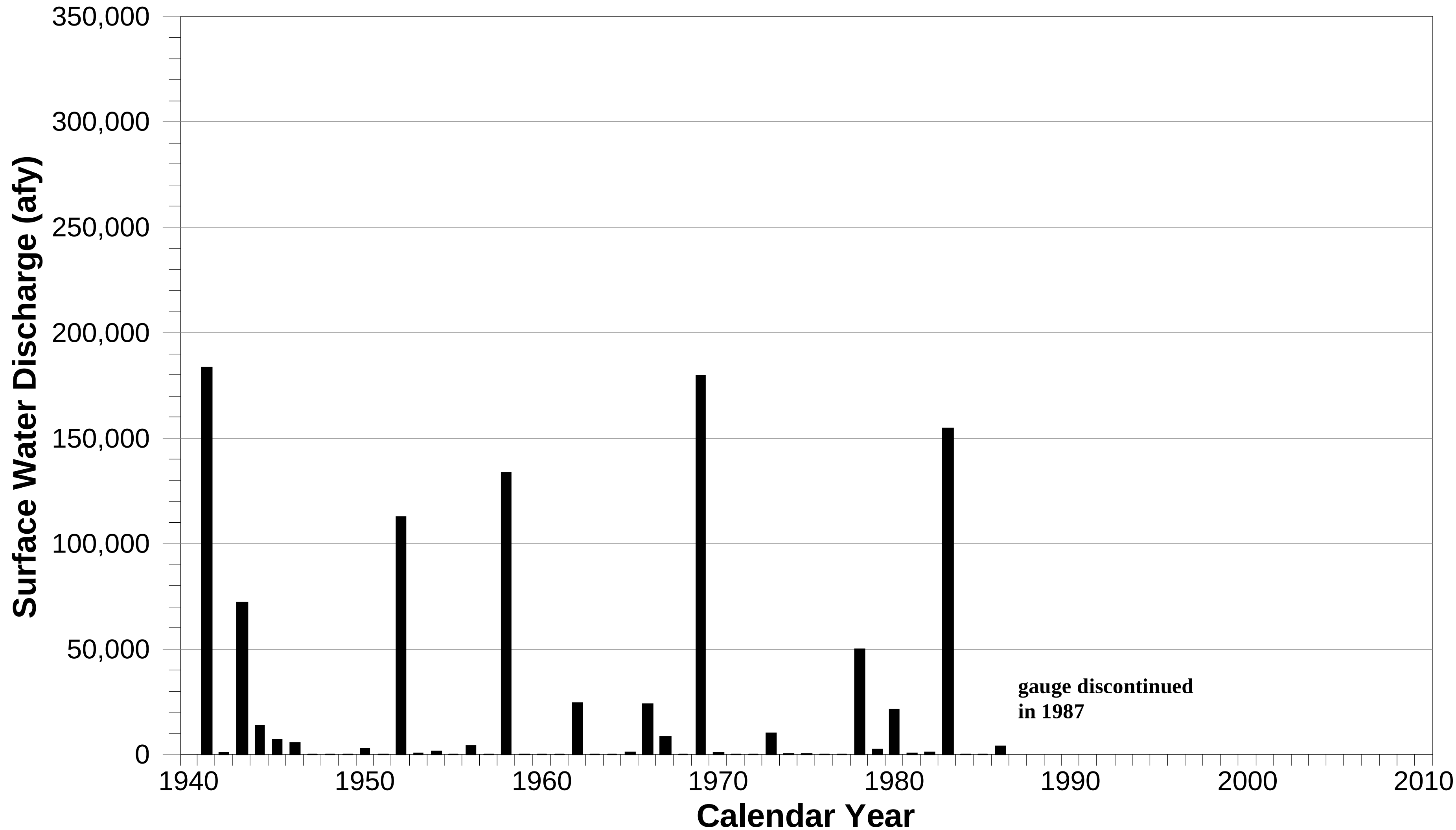
Figure 2.3-1b
Historical Stream Discharge, Sisquoc River
Santa Maria Valley Management Area



C:\Santa Maria 2008\Annual Report 2008\Fig 2.3-1c SMR Guad.dwg

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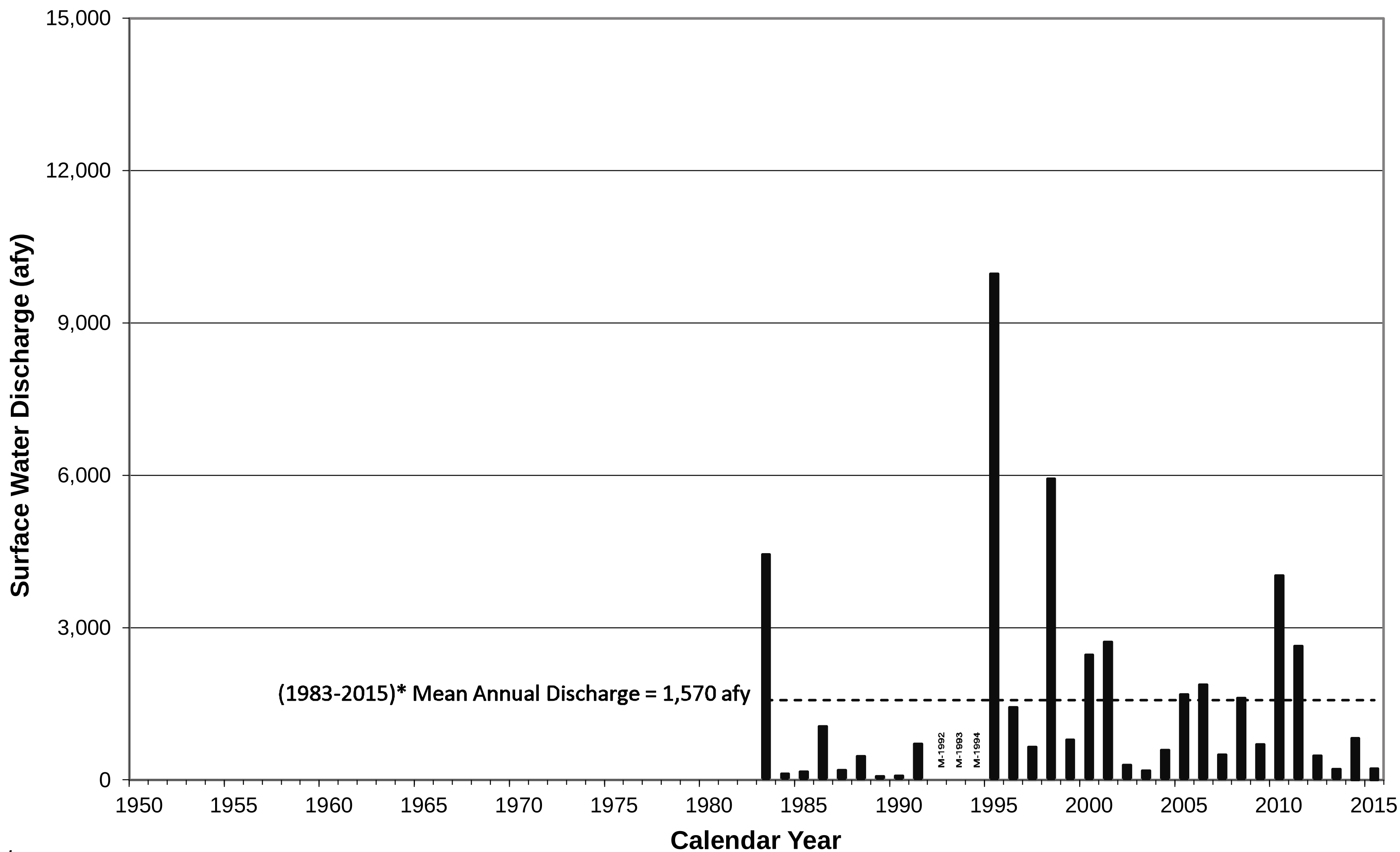
Figure 2.3-1c
Historical Surface Water Discharge, Santa Maria River at Guadalupe
Santa Maria Valley Management Area



Note:
The annual total discharge is comprised of average daily flow data; these daily data have been approved by the USGS through September 2015 and are provisional October through December 2015. Due to bridge construction near the guage location, the guage equipment was removed in May 2014 until construction was completed in January 2015. Over that period, 30 manual measurements of instantaneous discharge were made by the USGS at almost weekly intervals. Discharge on days without measurements was estimated using precipitation and the nearest manually measured values. These measured and estimated values are utilized as average daily flow rates in the calculation of total discharge over the missing period of record .
**Discharge data are unavailable for the 'Orcutt Creek' Gauge from 1992-1994; missing years are labeled with a 'M - yyyy' notation and are not included in the long-term mean calculation.*

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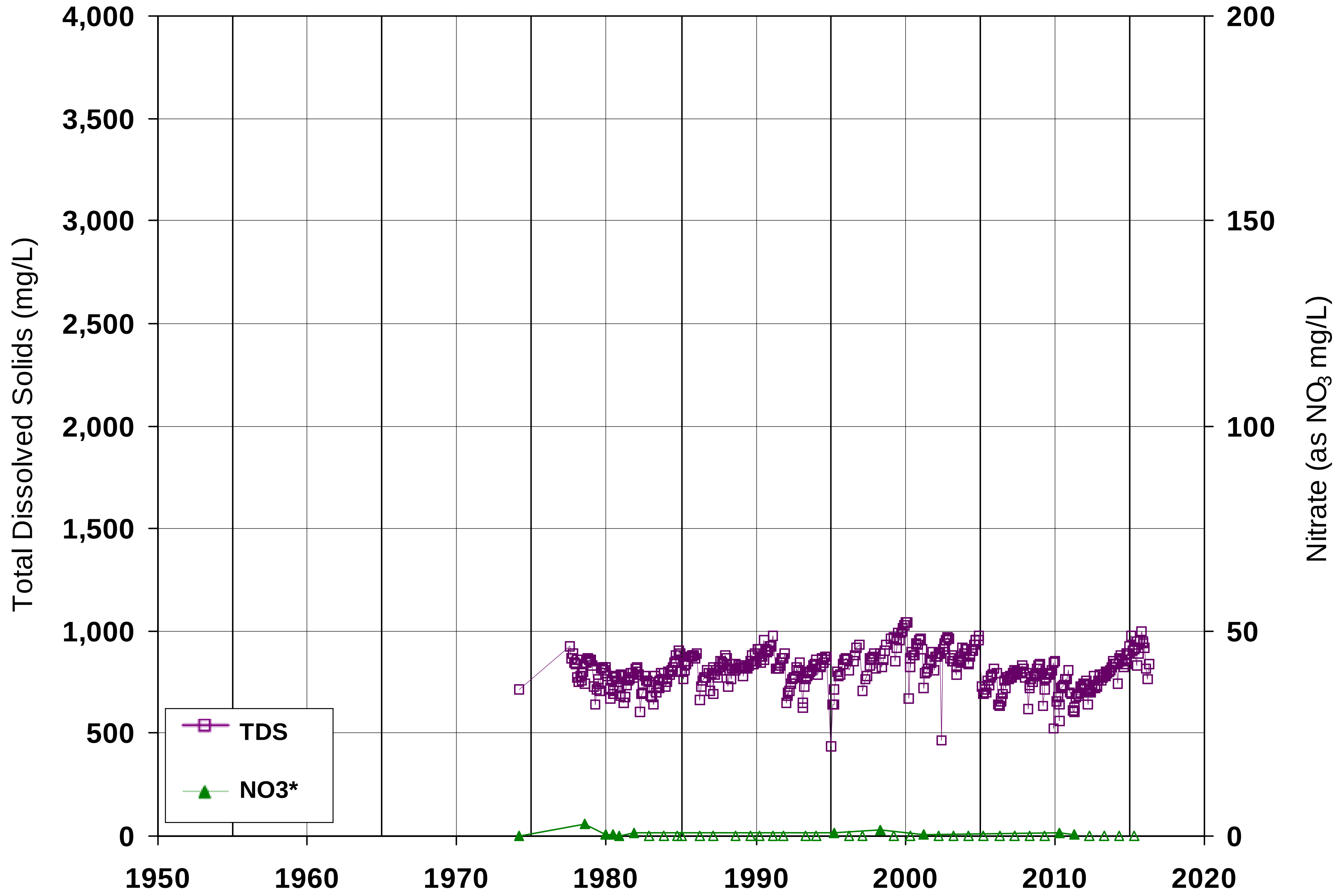
Figure 2.3-1d
Historical Stream Discharge, Orcutt Creek
Santa Maria Valley Management Area



*Non-detects for nitrate are shown as reporting limit or as '0' with an open triangle symbol

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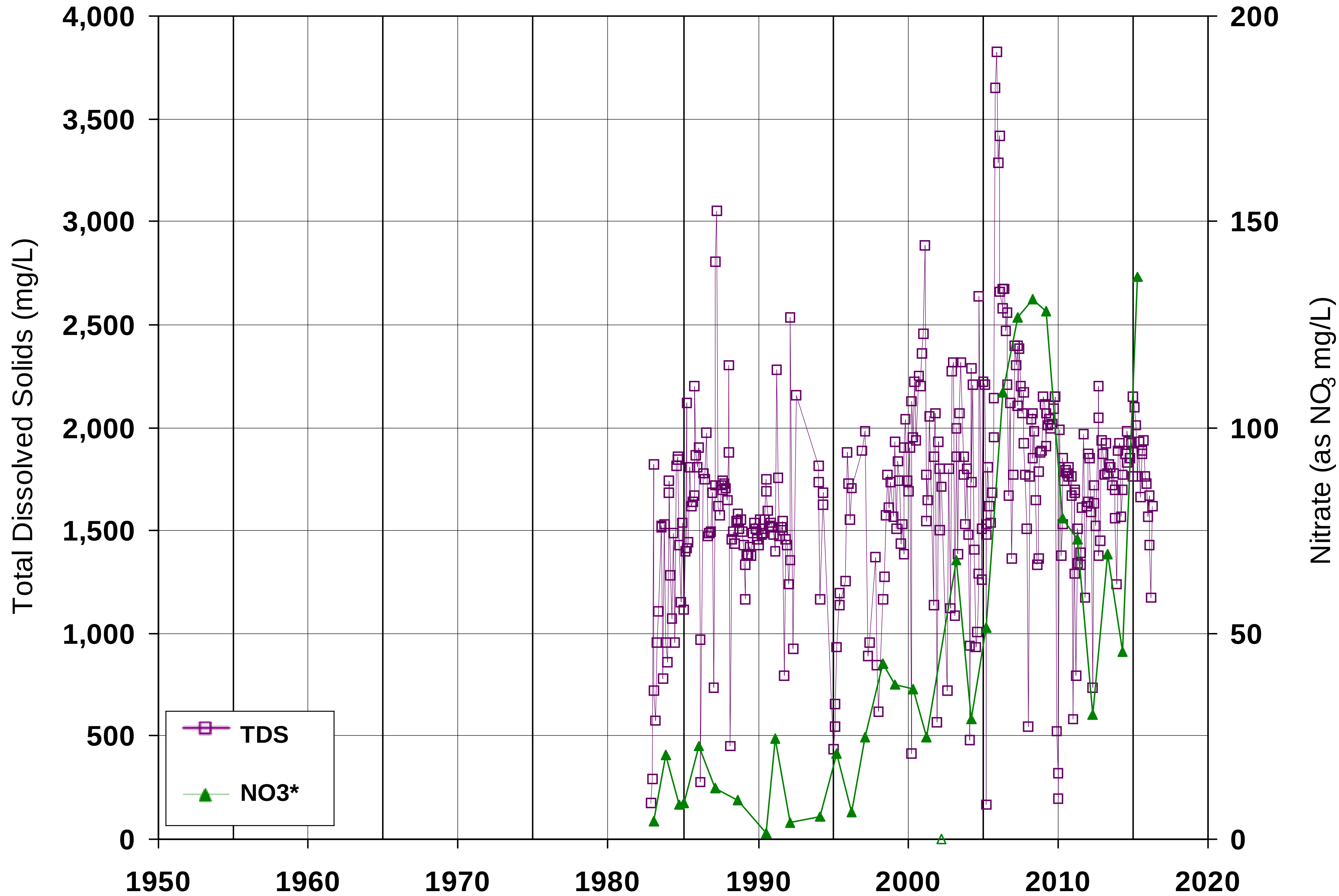
Figure 2.3-2a
Historical Surface Water Quality, Sisquoc River Near Sisquoc
Santa Maria Valley Management Area



*Non-detects for nitrate are shown as reporting limit or as '0' with an open triangle symbol

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Figure 2.3-2b
Historical Surface Water Quality, Orcutt Creek
Santa Maria Valley Management Area

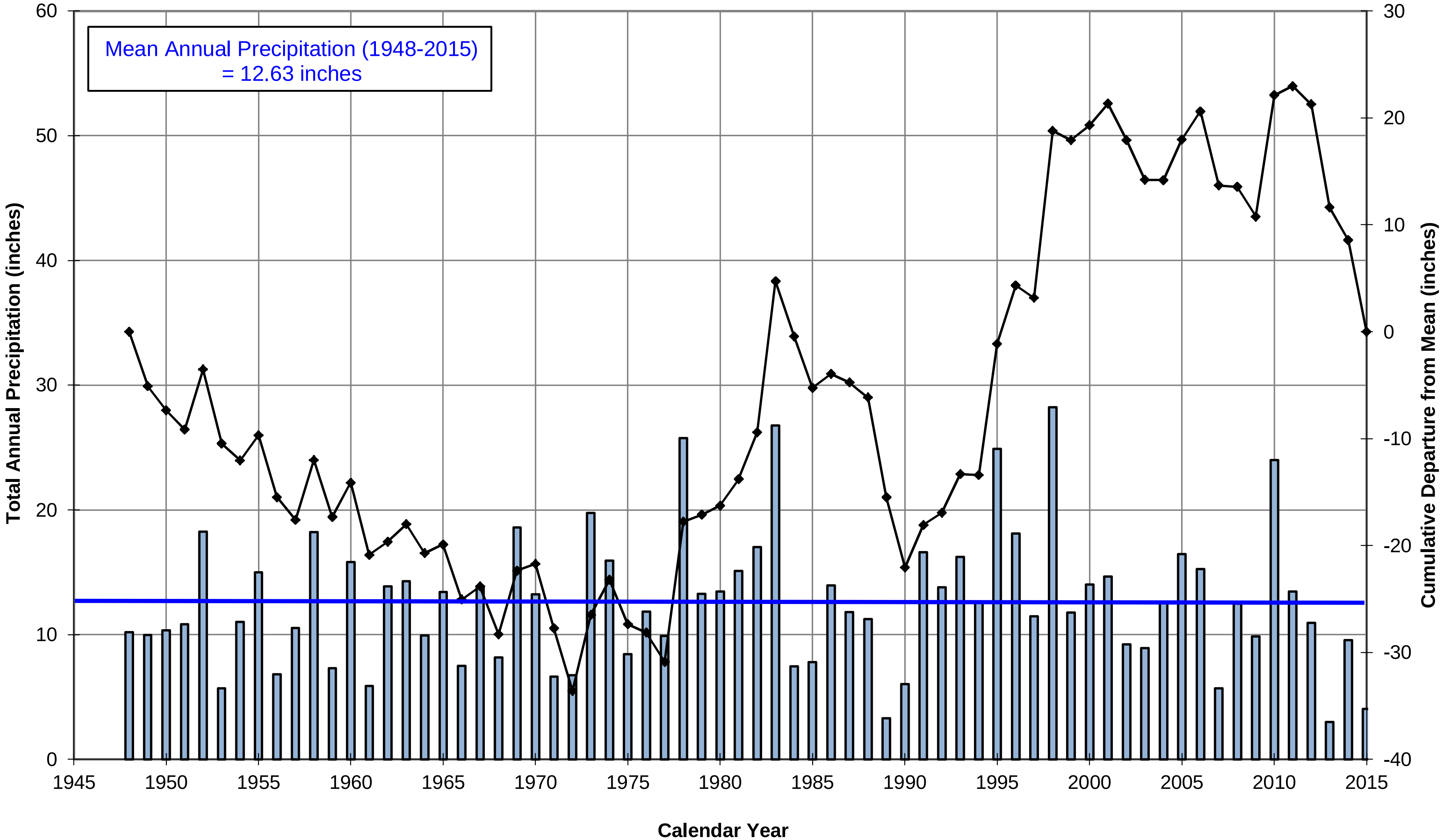

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Figure 2.4-1
Historical Precipitation, Santa Maria Airport
Santa Maria Valley Management Area

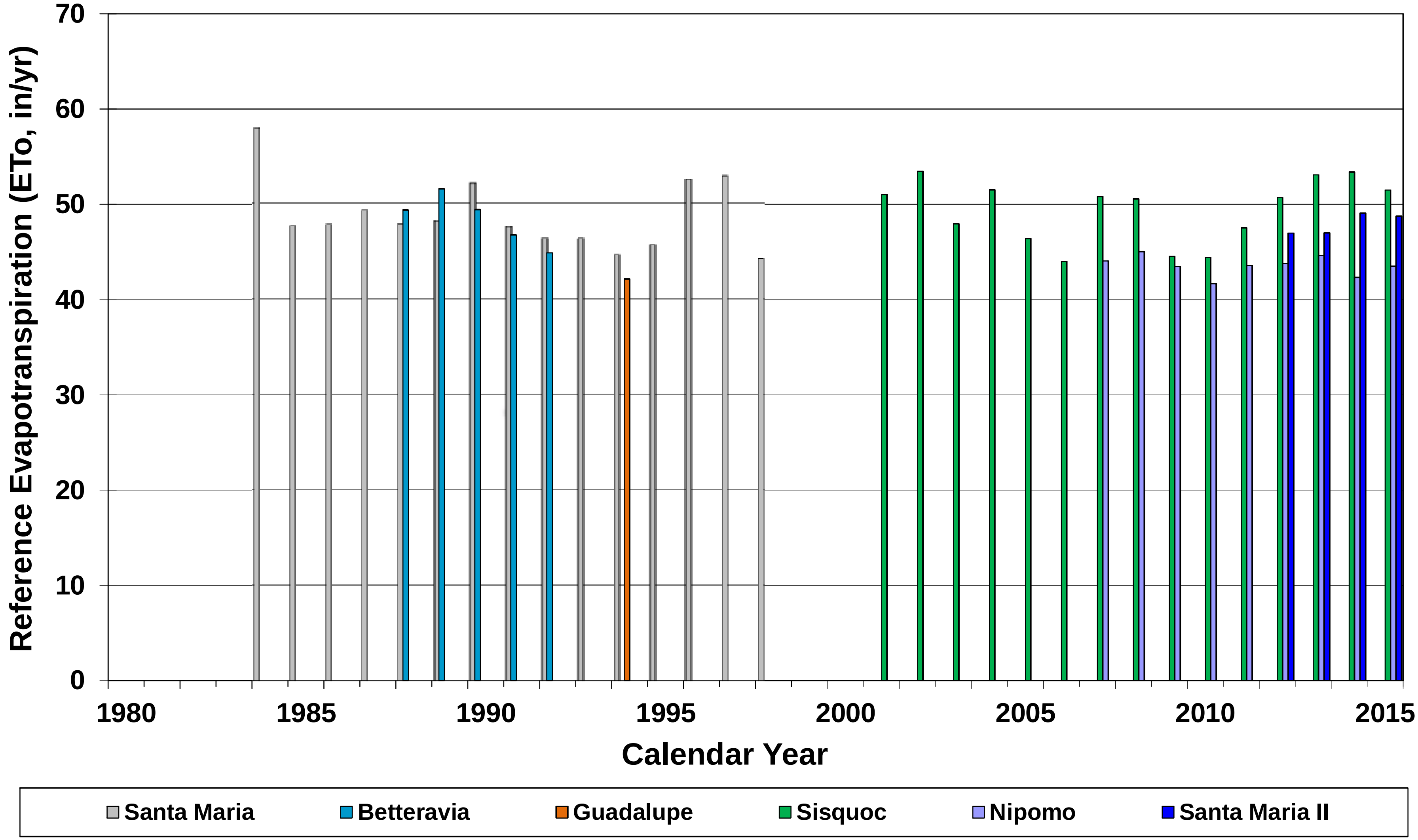

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Figure 2.4-2
Historical Reference Evapotranspiration, CIMIS Stations
Santa Maria Valley Management Area

Table 2.3-1
Selected General Mineral Constituent Concentrations
Santa Maria Valley Streams

Streams	Units	1906 - 1945		1946 - 1966		1967 - 1975		1976 - 1999		2000 - 2015	
		Concentration Range	Data Source	Concentration Range	Data Source	Concentration Range	Data Source	Concentration Range	Data Source	Concentration Range	Data Source
Cuyama River bl Twitchell Res											
Total Dissolved Solids	umho/cm	1,100 - 2,900	(1)	800 - 1,500	(1)	500 - 1,350	(1)	N/A	---	650 - 1,200	(3)
Sulfate	mg/l	700 - 1,700	(1)	450 - 700	(1)	190 - 550	(1)	N/A	---	700 - 760	(3)
Chloride	mg/l	90 - 140	(1)	50 - 100	(1)	25 - 85	(1)	N/A	---	N/A	---
Nitrate-NO3	mg/l	2.7 - 5.9	(1)	1.8 - 13.5	(1)	3.6 - 19.8	(1)	N/A	---	0.13 - 2.5	(3)
Sisquoc R nr Garey, nr Sisquoc											
Total Dissolved Solids	umho/cm	400 - 750	(1)	N/A	---	550 - 700	(1)	450 - 800	(2)	500 - 1,000	(2,3)
Sulfate	mg/l	150 - 340	(1)	N/A	---	270 - 340	(1)	N/A	---	380	(3)
Chloride	mg/l	9 - 16	(1)	N/A	---	13 - 16	(1)	N/A	---	N/A	---
Nitrate-NO3	mg/l	<1	(1)	N/A	---	<1 - 3.2	(1)	<2	(2)	<0.2	(2,3)
Santa Maria R (Bull Canyon)											
Total Dissolved Solids	umho/cm	N/A	---	N/A	---	N/A	---	N/A	---	800 - 1,000	(3)
Sulfate	mg/l	N/A	---	N/A	---	N/A	---	N/A	---	370 - 540	(3)
Chloride	mg/l	N/A	---	N/A	---	N/A	---	N/A	---	N/A	---
Nitrate-NO3	mg/l	N/A	---	N/A	---	N/A	---	N/A	---	ND - 2.7	(3)
Santa Maria R (Guadalupe)											
Total Dissolved Solids	umho/cm	1,500	(1)	N/A	---	450	(1)	N/A	---	130 - 2,300	(3)
Sulfate	mg/l	680	(1)	N/A	---	100	(1)	N/A	---	500 - 1,000	(3)
Chloride	mg/l	86	(1)	N/A	---	62	(1)	N/A	---	N/A	---
Nitrate-NO3	mg/l	N/A	---	N/A	---	29	(1)	N/A	---	ND - 430	(3)
Oso Flaco Ck (Guadalupe)											
Total Dissolved Solids	umho/cm	N/A	---	N/A	---	N/A	---	N/A	---	300 - 1,900	(3)
Sulfate	mg/l	N/A	---	N/A	---	N/A	---	N/A	---	440 - 950	(3)
Chloride	mg/l	N/A	---	N/A	---	N/A	---	N/A	---	N/A	---
Nitrate-NO3	mg/l	N/A	---	N/A	---	N/A	---	N/A	---	ND - 450	(3)
Orcutt Ck nr Orcutt											
Total Dissolved Solids	umho/cm	N/A	---	N/A	---	N/A	---	125 - 2,900	(2)	200 - 3,800	(2,3)
Sulfate	mg/l	N/A	---	N/A	---	N/A	---	N/A	---	180 - 440	(3)
Chloride	mg/l	N/A	---	N/A	---	N/A	---	N/A	---	N/A	---
Nitrate-NO3	mg/l	N/A	---	N/A	---	N/A	---	ND - 45	(2)	ND-135	(2,3)
Bradley Channel											
Total Dissolved Solids	umho/cm	N/A	---	N/A	---	N/A	---	N/A	---	180 - 1,300	(3)
Sulfate	mg/l	N/A	---	N/A	---	N/A	---	N/A	---	430	(3)
Chloride	mg/l	N/A	---	N/A	---	N/A	---	N/A	---	N/A	---
Nitrate-NO3	mg/l	N/A	---	N/A	---	N/A	---	N/A	---	1.4 - 150	(3)
Green Canyon											
Total Dissolved Solids	umho/cm	N/A	---	N/A	---	N/A	---	1,500	(2)	220 - 2,400	(3)
Sulfate	mg/l	N/A	---	N/A	---	N/A	---	N/A	---	N/A	---
Chloride	mg/l	N/A	---	N/A	---	N/A	---	N/A	---	N/A	---
Nitrate-NO3	mg/l	N/A	---	N/A	---	N/A	---	60 - 80	(2)	50 - 670	(3)

Time periods shown based on the period of record for the earliest historical water quality data for the Cuyama and Sisquoc Rivers (USGS, Hughes, J.L., 1977).

Data Sources are as follows: (1) Hughes, 1977; (2) USGS NWIS; (3) CCRWQCB CCAMP

N/A Data not available

Table 2.4-1
Precipitation Data, 2015, Santa Maria Airport
Santa Maria Valley Management Area
(all values in inches)

Day	January	February	March	April	May	June	July	August	September	October	November	December
1	0.00	0.00	0.04	0.00	0.00	0.00	T	0.00	0.00	0.03	0.00	0.00
2	0.00	0.00	0.26	0.00	0.00	0.00	T	0.00	0.00	0.00	0.24	0.00
3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	T	0.00	0.03
4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00
5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	0.00	T	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	0.00	0.31	0.00	0.60	T	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8	0.00	0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.00
9	T	T	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.00	0.12	0.00
10	0.19	0.00	0.00	0.00	0.00	0.00	0.00	T	0.00	0.00	0.01	0.01
11	0.10	0.00	T	0.00	0.00	0.00	0.00	T	0.00	0.00	0.00	0.15
12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.15
14	0.00	0.00	0.00	0.00	0.24	0.00	0.00	0.00	0.09	0.02	0.00	0.00
15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.19	0.00
16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
19	0.00	0.00	0.00	0.00	0.00	0.00	0.14	0.00	0.00	T	0.00	0.49
20	0.00	0.00	0.00	0.00	0.00	0.00	T	0.00	0.00	0.00	0.00	0.00
21	0.00	T	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.09
22	0.00	0.07	0.00	0.00	0.00	0.00	T	0.00	0.00	0.00	0.00	0.15
23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.03
25	0.00	0.00	0.00	0.07	T	0.00	0.00	0.00	0.00	0.00	0.05	0.00
26	T	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
27	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
28	0.00	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	T	0.00	0.02
29	0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
30	T		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
31	0.00		0.00		0.00		0.00	0.00		0.00		0.00
Total	**0.32**	**0.52**	**0.30**	**0.67**	**0.24**	**0.03**	**T**	**T**	**0.09**	**0.07**	**0.69**	**1.12**
	T = Trace amount									**Total Precipitation (in)**		**4.05**

Table 2.4-2
Reference Evapotranspiration and Precipitation Data, 2015
Santa Maria Valley Management Area CIMIS Stations

Reference Evapotranspiration (in inches)

Day	January Sisquoc	January Santa Maria II	January Nipomo	February Sisquoc	February Santa Maria II	February Nipomo	March Sisquoc	March Santa Maria II	March Nipomo	April Sisquoc	April Santa Maria II	April Nipomo	May Sisquoc	May Santa Maria II	May Nipomo	June Sisquoc	June Santa Maria II	June Nipomo
1	0.08	0.07	0.07	0.10	0.09	0.08	0.04	0.06	0.05	0.21	0.18	0.17	0.20	0.18	0.16	0.22	0.21	0.19
2	0.07	0.06	0.07	0.10	0.09	0.09	0.05	0.06	0.07	0.21	0.19	0.18	0.20	0.19	0.16	0.22	0.19	0.17
3	0.07	0.06	0.07	0.10	0.09	0.08	0.12	0.12	0.10	0.20	0.20	0.20	0.18	0.17	0.15	0.19	0.18	0.16
4	0.07	0.06	0.06	0.09	0.07	0.07	0.14	0.13	0.12	0.18	0.17	0.16	0.18	0.18	0.16	0.09	0.08	0.11
5	0.08	0.07	0.08	0.07	0.07	0.06	0.15	0.15	0.14	0.17	0.16	0.15	0.13	0.10	0.10	0.22	0.20	0.17
6	0.11	0.08	0.09	0.11	0.10	0.10	0.17	0.18	0.19	0.16	0.16	0.14	0.14	0.12	0.13	0.20	0.19	0.13
7	0.12	0.08	0.10	0.02	0.01	0.00	0.19	0.16	0.15	0.07	0.08	0.10	0.07	0.10	0.09	0.22	0.18	0.14
8	0.09	0.07	0.07	0.07	0.06	0.02	0.14	0.12	0.10	0.18	0.17	0.16	0.10	0.11	0.13	0.24	0.21	0.17
9	0.07	0.06	0.05	0.09	0.10	0.08	0.14	0.13	0.11	0.18	0.16	0.16	0.19	0.17	0.15	0.03	0.06	0.04
10	0.04	0.04	0.05	0.11	0.15	0.14	0.12	0.10	0.08	0.17	0.15	0.15	0.19	0.17	0.16	0.24	0.22	0.18
11	0.04	0.05	0.06	0.13	0.11	0.12	0.03	0.03	0.04	0.20	0.19	0.18	0.18	0.17	0.15	0.19	0.15	0.06
12	0.06	0.07	0.07	0.15	0.12	0.13	0.18	0.20	0.17	0.20	0.19	0.18	0.20	0.20	0.18	0.21	0.19	0.14
13	0.07	0.08	0.08	0.15	0.12	0.14	0.20	0.15	0.14	0.16	0.15	0.12	0.18	0.18	0.16	0.23	0.20	0.10
14	0.09	0.08	0.08	0.13	0.11	0.12	0.20	0.17	0.16	0.23	0.24	0.22	0.08	0.08	0.10	0.20	0.15	0.12
15	0.09	0.08	0.08	0.11	0.11	0.09	0.17	0.15	0.15	0.23	0.26	0.23	0.20	0.19	0.15	0.21	0.17	0.14
16	0.08	0.08	0.09	0.09	0.07	0.03	0.16	0.13	0.13	0.23	0.22	0.23	0.20	0.19	0.17	0.24	0.20	0.16
17	0.08	0.09	0.11	0.04	0.01	0.01	0.08	0.08	0.08	0.23	0.22	0.21	0.12	0.15	0.12	0.24	0.20	0.14
18	0.07	0.07	0.07	0.09	0.09	0.08	0.16	0.15	0.13	0.19	0.17	0.14	0.20	0.19	0.17	0.25	0.20	0.15
19	0.08	0.08	0.09	0.08	0.08	0.08	0.17	0.16	0.13	0.18	0.15	0.14	0.18	0.19	0.17	0.25	0.21	0.19
20	0.06	0.06	0.07	0.08	0.10	0.08	0.15	0.14	0.09	0.15	0.14	0.13	0.16	0.15	0.14	0.26	0.21	0.17
21	0.08	0.08	0.09	0.09	0.08	0.05	0.16	0.14	0.11	0.04	0.05	0.08	0.15	0.18	0.17	0.23	0.18	0.13
22	0.10	0.07	0.08	0.05	0.07	0.06	0.14	0.14	0.12	0.14	0.13	0.12	0.20	0.19	0.18	0.23	0.20	0.15
23	0.11	0.09	0.10	0.10	0.12	0.11	0.17	0.16	0.13	0.16	0.14	0.11	0.17	0.12	0.12	0.24	0.21	0.16
24	0.12	0.10	0.12	0.13	0.13	0.12	0.19	0.18	0.15	0.17	0.17	0.16	0.20	0.19	0.18	0.23	0.21	0.17
25	0.11	0.11	0.12	0.12	0.13	0.13	0.19	0.19	0.16	0.08	0.11	0.11	0.17	0.14	0.11	0.25	0.21	0.16
26	0.11	0.08	0.08	0.13	0.12	0.11	0.22	0.19	0.17	0.20	0.19	0.18	0.14	0.13	0.11	0.23	0.20	0.12
27	0.08	0.08	0.09	0.10	0.11	0.10	0.19	0.15	0.11	0.23	0.21	0.20	0.19	0.15	0.15	0.16	0.10	0.09
28	0.06	0.04	0.05	0.08	0.10	0.10	0.18	0.16	0.13	0.20	0.18	0.15	0.19	0.17	0.16	0.22	0.17	0.14
29	0.09	0.08	0.09				0.19	0.17	0.15	0.20	0.18	0.16	0.21	0.16	0.08	0.22	0.20	0.17
30	0.07	0.08	0.08				0.19	0.16	0.13	0.24	0.20	0.18	0.22	0.19	0.15	0.26	0.21	0.17
31	0.09	0.09	0.09				0.17	0.16	0.15				0.20	0.14	0.09			
Total	**2.54**	**2.29**	**2.50**	**2.71**	**2.61**	**2.38**	**4.75**	**4.37**	**3.84**	**5.39**	**5.11**	**4.80**	**5.32**	**4.94**	**4.40**	**6.42**	**5.49**	**4.29**

Reference Evapotranspiration (in inches)

Day	July Sisquoc	July Santa Maria II	July Nipomo	August Sisquoc	August Santa Maria II	August Nipomo	September Sisquoc	September Santa Maria II	September Nipomo	October Sisquoc	October Santa Maria II	October Nipomo	November Sisquoc	November Santa Maria II	November Nipomo	December Sisquoc	December Santa Maria II	December Nipomo
1	0.10	0.08	0.10	0.22	0.19	0.17	0.14	0.14	0.12	0.06	0.15	0.13	0.09	0.10	0.09	0.08	0.08	0.09
2	0.20	0.17	0.13	0.19	0.18	0.17	0.17	0.17	0.15	0.07	0.15	0.13	0.00	0.01	0.01	0.08	0.07	0.08
3	0.23	0.19	0.14	0.22	0.21	0.19	0.18	0.16	0.15	0.05	0.13	0.10	0.08	0.09	0.08	0.08	0.06	0.06
4	0.21	0.18	0.14	0.22	0.20	0.17	0.13	0.15	0.14	0.05	0.10	0.10	0.09	0.10	0.09	0.07	0.08	0.08
5	0.20	0.17	0.13	0.17	0.13	0.10	0.15	0.17	0.15	0.08	0.14	0.12	0.10	0.10	0.10	0.06	0.06	0.06
6	0.19	0.16	0.13	0.12	0.09	0.06	0.18	0.20	0.17	0.08	0.14	0.12	0.11	0.11	0.13	0.07	0.06	0.06
7	0.22	0.20	0.18	0.16	0.19	0.17	0.19	0.20	0.17	0.08	0.14	0.11	0.13	0.11	0.10	0.09	0.08	0.10
8	0.21	0.20	0.17	0.22	0.20	0.18	0.18	0.19	0.16	0.09	0.14	0.13	0.10	0.09	0.09	0.07	0.07	0.08
9	0.20	0.21	0.19	0.22	0.19	0.16	0.17	0.19	0.16	0.09	0.15	0.13	0.05	0.07	0.06	0.07	0.07	0.07
10	0.23	0.20	0.19	0.14	0.12	0.12	0.13	0.17	0.14	0.09	0.13	0.11	0.08	0.08	0.08	0.02	0.01	0.01
11	0.23	0.20	0.18	0.19	0.15	0.12	0.13	0.12	0.12	0.09	0.14	0.11	0.10	0.10	0.11	0.04	0.05	0.04
12	0.24	0.22	0.21	0.22	0.21	0.19	0.11	0.11	0.09	0.10	0.14	0.12	0.10	0.10	0.13	0.07	0.07	0.07
13	0.22	0.21	0.19	0.22	0.21	0.19	0.13	0.10	0.12	0.10	0.14	0.13	0.13	0.10	0.10	0.03	0.03	0.03
14	0.20	0.19	0.16	0.23	0.21	0.19	0.06	0.07	0.07	0.08	0.09	0.08	0.12	0.09	0.09	0.07	0.07	0.07
15	0.21	0.17	0.14	0.24	0.21	0.18	0.04	0.07	0.07	0.07	0.08	0.04	0.03	0.04	0.04	0.07	0.07	0.07
16	0.23	0.20	0.17	0.22	0.21	0.18	0.16	0.17	0.14	0.09	0.07	0.03	0.11	0.10	0.10	0.08	0.06	0.07
17	0.22	0.19	0.14	0.20	0.18	0.13	0.17	0.17	0.15	0.02	0.02	0.03	0.13	0.10	0.10	0.07	0.07	0.08
18	0.23	0.22	0.18	0.19	0.17	0.10	0.19	0.19	0.18	0.07	0.12	0.11	0.11	0.13	0.11	0.07	0.06	0.06
19	0.17	0.10	0.07	0.18	0.16	0.15	0.18	0.18	0.15	0.10	0.11	0.09	0.11	0.12	0.12	0.01	0.02	0.02
20	0.18	0.21	0.19	0.17	0.18	0.17	0.19	0.19	0.15	0.12	0.13	0.11	0.10	0.15	0.13	0.04	0.05	0.05
21	0.22	0.20	0.15	0.16	0.14	0.12	0.16	0.17	0.13	0.13	0.12	0.10	0.13	0.10	0.10	0.02	0.01	0.02
22	0.19	0.13	0.11	0.17	0.17	0.15	0.15	0.16	0.12	0.10	0.10	0.09	0.13	0.10	0.11	0.00	0.01	0.02
23	0.21	0.19	0.17	0.18	0.17	0.16	0.15	0.16	0.12	0.11	0.11	0.09	0.09	0.08	0.07	0.08	0.08	0.08
24	0.25	0.22	0.20	0.19	0.17	0.15	0.18	0.18	0.14	0.13	0.11	0.09	0.05	0.06	0.05	0.05	0.06	0.06
25	0.25	0.22	0.20	0.19	0.19	0.15	0.16	0.16	0.12	0.08	0.08	0.07	0.06	0.06	0.06	0.07	0.06	0.06
26	0.18	0.15	0.12	0.21	0.18	0.14	0.16	0.15	0.12	0.13	0.12	0.10	0.06	0.07	0.07	0.07	0.07	0.08
27	0.21	0.20	0.17	0.23	0.21	0.18	0.13	0.13	0.10	0.07	0.08	0.07	0.07	0.07	0.07	0.07	0.06	0.07
28	0.23	0.20	0.15	0.23	0.21	0.18	0.14	0.13	0.11	0.08	0.11	0.10	0.08	0.07	0.08	0.05	0.05	0.05
29	0.22	0.18	0.13	0.19	0.18	0.17	0.15	0.14	0.11	0.11	0.12	0.11	0.09	0.07	0.09	0.07	0.08	0.07
30	0.18	0.16	0.14	0.18	0.18	0.17	0.16	0.16	0.15	0.10	0.12	0.12	0.10	0.07	0.08	0.07	0.06	0.08
31	0.22	0.19	0.16	0.18	0.17	0.16				0.10	0.13	0.14				0.07	0.06	0.07
Total	**6.48**	**5.71**	**4.83**	**6.05**	**5.56**	**4.82**	**4.52**	**4.65**	**3.97**	**2.72**	**3.61**	**3.11**	**2.73**	**2.64**	**2.64**	**1.86**	**1.79**	**1.91**

Total Evapotranspiration (in) SMVMA CIMIS Stations	Station	Value
	Sisquoc	**51.49**
	Santa Maria II	**48.77**
	Nipomo	**43.49**

Table 2.4-2 (cont.)
Reference Evapotranspiration and Precipitation Data, 2015
Santa Maria Valley Management Area CIMIS Stations

Precipitation (in inches)

	January			February			March			April			May			June		
Day	Sisquoc	Santa Maria II	Nipomo	Sisquoc	Santa Maria II	Nipomo	Sisquoc	Santa Maria II	Nipomo	Sisquoc	Santa Maria II	Nipomo	Sisquoc	Santa Maria II	Nipomo	Sisquoc	Santa Maria II	Nipomo
1	0.00	0.00	0.00	0.00	0.00	0.00	0.19	0.74	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.02
2	0.00	0.00	0.00	0.00	0.00	0.07	0.14	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.02
3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.01
4	0.00	0.00	0.00	0.00	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.02	0.00	0.00	0.01
5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.02	0.00	0.00	0.02
6	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.02
7	0.00	0.00	0.00	0.32	0.30	0.01	0.00	0.00	0.00	0.22	0.00	0.24	0.15	0.00	0.05	0.00	0.00	0.02
8	0.00	0.00	0.02	0.18	0.08	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04
9	0.00	0.00	0.00	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.01	0.00	0.00	0.06
10	0.16	0.18	0.03	0.00	0.00	0.00	0.00	0.01	0.02	0.00	0.00	0.01	0.00	0.00	0.02	0.00	0.00	0.02
11	0.22	0.08	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.01	0.00	0.00	0.02
12	0.01	0.01	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.01	0.00	0.00	0.02
13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.04
14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.01	0.13	0.00	0.25	0.00	0.00	0.04
15	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.02
16	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.01	0.00	0.00	0.00
17	0.00	0.00	0.05	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.01	0.00	0.00	0.02	0.00	0.00	0.03
18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.02	0.00	0.00	0.01	0.00	0.00	0.02
19	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.01	0.00	0.00	0.01	0.00	0.00	0.02
20	0.00	0.00	0.07	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.01	0.00	0.00	0.02	0.00	0.00	0.02
21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.01	0.00	0.00	0.01	0.00	0.00	0.04
22	0.00	0.00	0.00	0.61	0.09	0.00	0.00	0.00	0.02	0.00	0.00	0.01	0.00	0.00	0.01	0.00	0.00	0.03
23	0.00	0.00	0.05	0.01	0.01	0.00	0.00	0.00	0.03	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.02
24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00
25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.15	0.00	0.00	0.01	0.00	0.00	0.01
26	0.02	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.02
27	0.07	0.04	0.02	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.01	0.00	0.00	0.01	0.00	0.00	0.01
28	0.00	0.00	0.00	0.02	0.04	0.00	0.00	0.00	0.03	0.00	0.00	0.02	0.00	0.00	0.02	0.00	0.00	0.02
29	0.00	0.00	0.00				0.00	0.00	0.02	0.00	0.00	0.02	0.00	0.00	0.01	0.00	0.00	0.01
30	0.00	0.00	0.04				0.00	0.00	0.01	0.00	0.00	0.02	0.00	0.00	0.02	0.00	0.00	0.01
31	0.00	0.00	0.02				0.00	0.00	0.01				0.00	0.00	0.01			
Total	**0.48**	**0.32**	**0.43**	**1.16**	**0.54**	**0.12**	**0.33**	**0.79**	**0.40**	**0.22**	**0.00**	**0.62**	**0.28**	**0.00**	**0.67**	**0.00**	**0.00**	**0.64**

Precipitation (in inches)

	July			August			September			October			November			December		
Day	Sisquoc	Santa Maria II	Nipomo	Sisquoc	Santa Maria II	Nipomo	Sisquoc	Santa Maria II	Nipomo	Sisquoc	Santa Maria II	Nipomo	Sisquoc	Santa Maria II	Nipomo	Sisquoc	Santa Maria II	Nipomo
1	0.00	0.00	0.02	0.00	0.00	0.01	0.00	0.00	0.03	0.00	0.00	0.01	0.00	0.00	0.01	0.00	0.00	0.00
2	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.01	0.28	0.00	0.26	0.00	0.00	0.00
3	0.00	0.00	0.02	0.00	0.00	0.02	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.06
4	0.00	0.00	0.02	0.00	0.00	0.02	0.00	0.00	0.02	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00
5	0.00	0.00	0.03	0.00	0.00	0.02	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	0.00	0.00	0.01	0.00	0.00	0.02	0.00	0.00	0.01	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00
7	0.00	0.00	0.02	0.00	0.00	0.02	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00
8	0.00	0.00	0.02	0.00	0.00	0.01	0.00	0.00	0.04	0.00	0.00	0.01	0.01	0.00	0.19	0.00	0.00	0.00
9	0.00	0.00	0.02	0.00	0.00	0.02	0.00	0.00	0.02	0.00	0.00	0.01	0.11	0.00	0.13	0.00	0.00	0.00
10	0.00	0.00	0.01	0.00	0.00	0.02	0.00	0.00	0.02	0.00	0.00	0.02	0.01	0.00	0.01	0.14	0.00	0.06
11	0.00	0.00	0.01	0.00	0.00	0.01	0.00	0.00	0.02	0.00	0.00	0.02	0.00	0.00	0.00	0.23	0.00	0.30
12	0.00	0.00	0.02	0.00	0.00	0.03	0.00	0.00	0.02	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00
13	0.00	0.00	0.02	0.00	0.00	0.02	0.00	0.00	0.02	0.00	0.00	0.01	0.00	0.00	0.00	0.17	0.00	0.09
14	0.00	0.00	0.01	0.00	0.00	0.01	0.00	0.00	0.06	0.00	0.00	0.07	0.00	0.00	0.00	0.00	0.00	0.00
15	0.00	0.00	0.02	0.00	0.00	0.02	0.00	0.00	0.01	0.00	0.00	0.06	0.29	0.00	0.19	0.00	0.00	0.00
16	0.00	0.00	0.01	0.00	0.00	0.02	0.00	0.00	0.01	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00
17	0.00	0.00	0.02	0.00	0.00	0.02	0.00	0.00	0.01	0.00	0.00	0.01	0.00	0.00	0.01	0.00	0.00	0.00
18	0.00	0.00	0.01	0.00	0.00	0.02	0.00	0.00	0.01	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00
19	0.26	0.00	1.06	0.00	0.00	0.02	0.00	0.00	0.01	0.00	0.00	0.01	0.00	0.00	0.00	0.38	0.00	0.49
20	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.01	0.00	0.00	0.00	0.30	0.00	0.09
22	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.01	0.01	0.00	0.01	0.00	0.00	0.00	0.83	0.00	0.28
23	0.00	0.00	0.04	0.00	0.00	0.02	0.00	0.00	0.02	0.00	0.00	0.02	0.00	0.00	0.02	0.00	0.00	0.00
24	0.01	0.00	0.01	0.00	0.00	0.01	0.00	0.00	0.01	0.00	0.00	0.02	0.06	0.00	0.03	0.02	0.00	0.06
25	0.00	0.00	0.03	0.00	0.00	0.02	0.00	0.00	0.02	0.00	0.00	0.01	0.02	0.00	0.07	0.00	0.00	0.00
26	0.00	0.00	0.02	0.00	0.00	0.02	0.00	0.00	0.01	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00
27	0.00	0.00	0.02	0.00	0.00	0.02	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
28	0.00	0.00	0.01	0.00	0.00	0.02	0.00	0.00	0.02	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.01
29	0.00	0.00	0.03	0.00	0.00	0.02	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
30	0.00	0.00	0.01	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
31	0.00	0.00	0.02	0.00	0.00	0.00				0.00	0.00	0.01				0.00	0.00	0.00
Total	**0.27**	**0.00**	**1.54**	**0.00**	**0.00**	**0.53**	**0.00**	**0.00**	**0.54**	**0.02**	**0.00**	**0.43**	**0.78**	**0.00**	**0.93**	**2.07**	**0.00**	**1.44**

Total Precipitation (in)	**Sisquoc**	**5.61**
SMVMA CIMIS Stations	**Santa Maria II**	**1.65**
	Nipomo[1]	**8.29**

1) Sisquoc and Nipomo stations precipitation data flagged by Calif. DWR for less than 10 days of the year

3. Water Requirements and Water Supplies

Current water requirements and water supplies in the SMVMA, including discussion of agricultural land use and crop water requirements, which were the basis for estimation of agricultural water requirements and groundwater supply in 2015, are described in the following sections of this Chapter. Municipal water requirements and the components of water supply to meet those requirements, including groundwater and imported water from the State Water Project (SWP), are also described in the following sections.

3.1 Agricultural Water Requirements and Supplies

All agricultural water requirements in the SMVMA are supplied by local groundwater pumping, essentially all of which is neither directly metered nor otherwise indirectly measured. Consequently, agricultural water requirements, which represent by far the largest part of overall water requirements in the SMVMA, need to be indirectly estimated. Historically, and for this annual report, agricultural water requirements are estimated by quantifying land use (crop types and acreages), computing applied water requirements for each crop type, and summing total water requirements for the aggregate of various crops throughout the SMVMA. Reflected in this annual report are previously reported estimates of historical agricultural land use and water requirements through 1995 (LSCE, 2000) and from 1998 through 2014 (LSCE, 2009 - 2015), as well as the current estimate of land use and water requirements for 2015 made as part of the overall preparation of this annual report.

3.1.1 Land Use

An assessment was made of crop acreages in 2015 from the review of Pesticide Use Report (PUR) databases, including mapped agricultural parcels permitted for pesticide application, maintained by the Santa Barbara and San Luis Obispo County Agricultural Commissioner's Offices. The mapped parcels were identified by the respective Counties under the following crop types: 1) Rotational Vegetable, 2) Strawberry, 3) Wine Grape, 4) Pasture, 5) Grain, 6) Nursery, and 7) Orchard (Citrus and Deciduous). Also in 2015, the acreage of hydroponic crops, primarily tomatoes, was accounted. Review of the PUR records indicated that "Rotational Vegetable" primarily consisted of lettuce, celery, broccoli, cauliflower, and spinach crops. Verification of agricultural cropland distribution in the SMVMA was conducted through review of 2015 satellite images, an inventory of which is provided in Appendix C of this report. The distribution of irrigated acreage for 2015, by crop type identified by the Counties as well as by crop category utilized by the California DWR in its periodic land use studies, is listed in Table 3.1-1a. The crop parcel locations in 2015 are shown in a map of agricultural land use throughout the SMVMA (Figure 3.1-1a) and the distribution of historical irrigated acreage, including DWR land use study years and LSCE assessment years through 2015, is listed in Table 3.1-1b (USGS, Worts, G.F., 1951; California DWR, 1959, 1968, 1977, 1985, and 1995; LSCE, 2000 and 2009 - 2015).

In 2015, about 52,300 acres in the Santa Maria Valley were irrigated cropland, with the great majority (87 percent) in truck crops, specifically Rotational Vegetables (34,640 acres), Strawberries (10,810 acres), and Hydroponic (135 acres). Vineyard comprised the next largest category (4,920 acres), with Pasture, Nursery, Grain, and Orchard in descending order of acreage (465, 215, 165, and 40 acres, respectively). Fallow cropland was estimated to be approximately 910 acres. Cropland occupies large portions of the Santa Maria Valley floor, Orcutt Upland, Oso Flaco area, and Sisquoc plain and terraces.

The total irrigated acreage of about 52,300 acres in 2015 is within and near the upper end of the reported historical range of roughly 34,000 acres in 1945 to 53,000 acres in 1995 (see Table 3.1-1b). The 2015 cropland locations maintain the historical trend of agricultural expansion onto portions of the Orcutt Upland, Sisquoc Valley, and, most recently, Graciosa Canyon, as urban land use expands into former cropland near the central portions of the Santa Maria Valley and Orcutt Upland. Further, the crop type distribution continues the historical trend of increased truck crop acreage and decline in pasture (including alfalfa), field, and orchard acreages, as illustrated by the bar chart of historical crop type distribution from DWR land use study years and for 2015 (Figure 3.1-1b). In order to provide consistency with the historical land use data, the crop acreages reported here are "land" acreages; i.e., the land area used for growing crops regardless of whether it is used for single or multiple cropping throughout any given year. Multiple cropping of land, and associated annual water requirements, is accommodated in the calculation of applied crop water requirements below.

3.1.2 Applied Crop Water Requirements

Applied crop water requirements were developed for the crop categories described above, and the approach used in their development depended on information available for each individual category. In the case of Rotational Vegetables (primarily lettuce, celery, broccoli, cauliflower, and spinach; and including cane and bush berries), Strawberries, and Pasture, values for their evapotranspiration of applied water (ETaw) were developed using a CIMIS-based approach where reference evapotranspiration data (ETo) were coupled with crop coefficients (Kc) to first estimate the evapotranspirative water requirements of the crops (ETc). Those requirements were then factored to consider any effective precipitation in 2015 that would have reduced the need for applied water to meet the respective evapotranspirative water requirements, which in turn provided the ETaw values for those three categories.

For the remaining crop categories (except hydroponic), for which information was insufficient to utilize a CIMIS-based approach, reported values of ETaw were used (California DWR, 1975). Specifically, these were values measured and developed for different rainfall zones in the central California coastal valleys, and a review of the reported values indicated that they accommodated multiple cropping. The values in turn had previously been used to develop a relationship between ETaw values and the annual rainfall amounts within the Santa Maria Valley groundwater basin by crop type (LSCE, 2000). With a rainfall total of about 4.0 inches in 2015 in the Valley, the previously developed ETaw values corresponding to that amount of precipitation were used for this assessment. For hydroponic tomatoes, an applied crop water duty was estimated from hydroponic crop research articles and notes (Selina, et. al., April 2002; Resh, 2005; and Jones, 2012).

For the three crop categories utilizing the CIMIS-based approach, the ETo data for 2015 from the Santa Maria II CIMIS station were used in conjunction with Kc values from the following sources to develop ETc values. The Rotational Vegetable value was based on reported values for lettuce derived from an agricultural leaflet for estimating ETc for vegetable crops (Univ. of California Cooperative Extension, 1994); the Strawberry values were derived from a paper reporting the results of a study on drip irrigation of strawberries in the Santa Maria Valley (Hanson, B., and Bendixen, W., 2004); and the Pasture values were directly based on ETo values measured on the reference surface (grass) at the Santa Maria II station. The resulting ETc values for the three crop categories are shown in Table 3.1-1c.

Effective precipitation (P_E) during 2015 was then subtracted from the ETc values to estimate crop ETaw values. The P_E amounts that contributed to meeting the ETc of the crops, and thus reduced applied water requirements, were based on review of the precipitation data for 2015, during which rain primarily occurred in December, with only minor amounts in November and in January through April. During the latter months, the ETc for the crops was only partially reduced by precipitation; it was assumed for the hydroponic crops that no component of precipitation was effective. The calculated ETaw values for Rotational Vegetables, Strawberries, and Pasture, as well as the developed values for the remaining crop categories (and the value for Nursery from NMMA TG), are shown in Table 3.1-1c.

Values of ETaw were then used to estimate applied crop water requirements (AW) by considering estimated irrigation system distribution uniformity (DU) values for each crop. For Strawberries grown in the Santa Maria Valley, DU values have been reported to range from 80 and 94 percent (Hanson, B., and Bendixen, W., 2004), and an intermediate DU value of 85 percent was selected for this assessment. For the remaining crops, DU values have not been specifically reported for the Santa Maria Valley; for this assessment, values of 80 percent (Rotational Vegetables, Truck, Grain, and Pasture), 85 percent (Citrus), and 95 percent (Vineyard and Nursery) were utilized. For the hydroponic tomato crops, all of which are grown in a controlled environment greenhouse, the DU value was assumed to be 100 percent. The resulting AW values for each of the crop categories are shown in Table 3.1-1c; they range from the highest applied water rate of 4.7 af/ac for pasture, to intermediate rates of 2.5 af/ac for rotational vegetables and 2.0 af/ac for hydroponic tomatoes, to the lowest rates of 1.6 af/ac for strawberries, 1.4 af/ac for vineyard, and less than one af/ac for grain. The AW values calculated for crops grown in the SMVMA are similar to those previously reported for crops grown in the NMMA (NMMA TG, 2009 through 2014). Between the two adjacent management areas, crops in common are Rotational Vegetables, Strawberries, Pasture, Citrus, Nursery, and Deciduous.

3.1.3 Total Agricultural Water Requirements

The AW values for each SMVMA crop category were coupled with their respective crop acreages from 2015 to produce estimates of the individual crop and total agricultural water requirements for 2015, as shown in Table 3.1-1c. The resultant estimated total water requirement was almost 115,750 af, with Rotational Vegetables comprising by far the greatest component, about 88,595 af, primarily because about 66 percent of the total acreage was dedicated to those crops. Strawberries comprised the next largest crop acreage and had an associated water requirement just under 17,100 af. Vineyard had a water requirement of about 6,730 af, and all remaining crop types had water requirements at or below 2,000 af.

In the context of historical estimates of total agricultural water requirements, the estimated 2015 agricultural water use is in the range of applied water requirements over the last four decades, as illustrated in a graph of historical irrigated acreage and agricultural groundwater pumping (the sole source of irrigation water in the Valley and, thus, equal to total agricultural water requirements) (Figure 3.1-1c). For reference, agricultural water requirements were previously estimated to be around 80,000 afy during the 1940's and 1950's, gradually increasing to over 100,000 afy by the 1970's; since then, agricultural water requirements have fluctuated from year to year, as a function of weather variability, but water requirements have generally remained within a broad but fairly constant range (LSCE, 2000, 2009 - 2015). Since the 1970's, maximum and minimum agricultural water requirements, respectively, were about 132,000 af in 1997 and about 77,000 af in 1998, with estimated agricultural water requirements in 2015 well within and near the upper end of that range.

3.1.4 Agricultural Groundwater Pumping

As noted above, the sole source of water for agricultural irrigation in the SMVMA is groundwater, so groundwater pumping for agricultural irrigation in 2015 is of course estimated to be the same as the total estimated agricultural water requirement of 115,750 af. This amount is within the historical range of estimated groundwater pumping for agricultural irrigation in the Valley over the last four decades. Proportions of groundwater pumping from the shallow and deep aquifer zones of the SMVMA are not known because a comprehensive investigation of individual agricultural water supply well depths and completion intervals has not been completed.

3.2 Municipal Water Requirements and Supplies

Prior to the late 1990’s, all municipal water requirements in the SMVMA were met by local groundwater pumping. Since the beginning of State Water Project (SWP) availability in 1997, deliveries of SWP water have replaced some of the local groundwater pumping for municipal supply. Beginning in 2015, water (for municipal supply) was transferred from the SMVMA to the NMMA by way of the newly constructed waterline intertie project, which is discussed further in Section 4.4. All municipal pumping, imported (SWP) water deliveries to the SMVMA, and intra-basin water transfers from the SMVMA to the NMMA are metered; consequently, the following summaries of municipal water requirement and supplies derive from those measured data.

3.2.1 Municipal Groundwater Pumping

Municipal purveyors in the SMVMA include the Cities of Santa Maria and Guadalupe and the Golden State Water Company (GSWC, formerly Southern California Water Company, or SCWC). The latter provides water to suburban areas in the southern portion of the SMVMA, specifically the towns of Orcutt and Sisquoc and the Lake Marie and Tanglewood developments. With the exception of small pumping in Guadalupe and Sisquoc, municipal pumping is from numerous water supply wells in individual wellfields located between the Santa Maria Airport and the town of Orcutt. The municipal water supply wells are completed in the shallow and/or deep aquifer zones with, in general, newer wells having been constructed to produce from deeper portions of the aquifer system with better water quality. The monthly and total annual groundwater pumping amounts for 2015 are tabulated by individual well, by purveyor, and for each water system in Table 3.2-1a.

In 2015, a total of 16,175 af of groundwater was pumped for municipal water supply in the SMVMA, which is a substantial decrease (approximately 21 percent) from the prior year (20,385 af) and on the order of groundwater pumping reported for as long ago as the mid-1980's. The City of Santa Maria pumped the greatest amount, about 9,080 af. GSWC pumped about 5,995 af, with the great majority of that for their Orcutt system (5,575 af) and the remaining 420 af for their other systems combined. The City of Guadalupe pumped about 1,100 af, almost identical to the amount pumped in the prior year (1,115 af). It should be noted that, of the total groundwater pumped in 2015 by the City of Santa Maria (9,080 af), about 215 af were transferred to the NMMA, so that the City's groundwater use in the SMVMA totaled 8,865 af.

Since the initial deliveries of supplemental imported SWP water commenced in 1997, groundwater pumped for municipal supply has declined substantially, as shown in a graph of historical municipal groundwater pumping for the SMVMA (Figure 3.2-1a). The City of Santa Maria has greatly reduced pumping since the importation of SWP water began, from 12,800 af in 1996 to an annual average of 3,400 af for subsequent years. In those years when pumping exceeds this annual average, it is typically due to limited SWP water availability. Such was the case in 2013 through 2015 when SWP water availability ranged from only 5 to 35 percent. The GSWC has also reduced groundwater pumping since the importation of SWP water began, from 9,960 af in 1996 to an annual average of 8,400 af for subsequent years. In recent years, in fact since 2009, GSWC has reduced pumping to or below this annual average. Additionally, the City of Guadalupe has reduced groundwater pumping since the importation of SWP water began, from 725 af in 1996 to an annual average of 650 af for subsequent years. Similar to the City of Santa Maria, Guadalupe's annual pumping in 2013 through 2015 exceeded the average amount due to the limited SWP water availability during those years.

3.2.2 Imported Water

The three municipal purveyors in the SMVMA have entitlements to imported water from the State Water Project (SWP) through the Central Coast Water Authority (CCWA). Each purveyor's total entitlement is comprised of their basic entitlement plus a "drought buffer" equal to 10 percent of their basic entitlement. By purveyor, their respective total entitlements are as follows: City of Santa Maria, 17,820 af (16,200 af basic entitlement plus 1,620 af drought buffer); GSWC (SCWC), 550 af (500 af plus 50 af drought buffer); and City of Guadalupe, 605 af (550 af basic plus 55 af drought buffer). The drought buffer is intended to provide a way to stabilize annual fluctuations in SWP water deliveries to the purveyors due to annual fluctuations in SWP water availability, in essence firming up the overall reliability of the purveyors' SWP entitlements. As such, during years when SWP water availability exceeds purveyor demand, unused entitlement allocations could be stored either directly into a groundwater basin or in an in-lieu manner (i.e. exchange with other SWP Contractors). Conversely, during years when SWP water availability is less than purveyor demand, stored entitlement water or returned exchange water is meant to be available to augment SWP deliveries (personal communication, S. Springer, City of Santa Maria, April 26, 2016).

The total entitlements listed in Exhibit F to the Stipulation are as follows: Santa Maria, 17,800 af; GSWC (SCWC), 550 af; and Guadalupe, 610 af;. The amounts listed for Santa Maria and Guadalupe appear to be the actual entitlements described above but "rounded off." Such as the Stipulation also specifies certain minimum importation of SWP water, as a function of its availability in any given year and also as a function of individual purveyor entitlement, the following assessment of imported water use in 2015 is related to those total entitlements.

In 2015, total deliveries of SWP water to the SMVMA were 3,450 af, increased from those of the previous year (about 1,770 af). The majority of those deliveries, 3,435 af, were to the City of Santa Maria. A small portion of the Santa Maria deliveries, 16 af, was transferred to GSWC, and 100 af were transferred to the NMMA, so the City's SWP water use in the SMVMA totaled about 3,320 af. GSWC also took delivery of 13 af of its own entitlement, for a total of about 30 af, and the City of Guadalupe took no SWP water in 2015. The monthly and total annual deliveries of SWP water to the SMVMA in 2015 are summarized in Table 3.2-1b.

Historically, municipal deliveries commenced in 1997 with approximately 4,500 af going to the City of Santa Maria. The following year, the City's delivery more than doubled to nearly 10,700 af and GSWC took about 80 af (the City of Guadalupe delivery records prior to 2004 are unavailable). Over the entire period since SWP water deliveries began, the average total annual amount delivered is 10,250 afy, and the average SWP water availability is 64 percent. California's highly variable climatic conditions can be seen from review of the historical SWP water deliveries (and percent SWP water availabilities) for the SMVMA: delivery amounts have ranged from 13,780 af in 2006 (SWP availability of 100 percent) to 1,770 af in 2014 (SWP availability of 5 percent). The effect of the current severe drought can also be seen: the average annual SWP availability during this period (2011 – 2015) is only 41 percent, compared to the average for the preceding years, 73 percent, as can be seen in a graph of historical SWP water deliveries to the SMVMA (Figure 3.2-1b).

As mentioned above, the Stipulation designates minimum amounts of SWP water to be imported and used in the SMVMA in any year as a function of individual entitlement and SWP availability. Santa Maria is to import and use not less than 10,000 afy of available SWP water, or the full amount of available SWP water when it is less than 10,000 af. GSWC is to import and use all its available SWP water. Guadalupe is to import and use a minimum of 75 percent of its available SWP water. In 2015, overall SWP water availability was 20 percent of entitlements. So, for municipal purveyors in the SMVMA, that availability converts to the following individual availability of SWP water: Santa Maria, 3,560 af; GSWC, 110 af; and Guadalupe, 120 af (75 percent of which, or 90 af, as a minimum was to be imported). Actual imports of SWP water by all three municipal purveyors, including the transfers from Santa Maria to GSWC (within the SMVMA) and to the NMMA (intra-basin), were as follows: Santa Maria, 3,320 af; GSWC, 30 af; and Guadalupe, none (see Table 3.2-1b). Comparison of these figures indicates the City of Santa Maria imported slightly less than the minimum amount specified in the Stipulation for import and use in the SMVMA (roughly 93 percent). However, in late 2015, the City had been on track to meet its minimum annual SWP deliveries, but was prevented from doing so due to SWP operational complications (personal communication, S. Springer, City of Santa Maria, April 26, 2016). Specifically, a longer than normal shutdown by California DWR occurred and SWP water taste and odor issues arose in December, forcing an unanticipated decrease in 2015 SWP deliveries to the City. Importantly, the undelivered portion of SWP water from 2015 is stored in San Luis Reservoir and is available for delivery to the City of Santa Maria in 2016. The GSWC imported less than 30 percent, and the City of Guadalupe imported none, of their respective minimum amounts specified in the Stipulation. Summarizing purveyor SWP imports in 2015: a total of 3,350 af was imported for use in the SMVMA compared to a total of 3,760 af specified for import and use (approximately 89 percent of the Stipulation amount).

3.2.3 Total Municipal Water Requirements

Total municipal water requirements in 2015 were about 19,620 af, including the approximate 315 af of water transferred by Santa Maria to the NMMA; the total water utilized within the SMVMA was then 19,305 af. These totals are substantially less (approximately 13 percent) than in 2014 (about 22,150 af) and are on par with the requirements in 1998 and, in fact, as far back in time as the mid-1980's. The 2015 total reflects an overall stability in municipal water use since 1989, prior to which a steep increasing trend was observed (particularly 1970 – 1989). The overall history of municipal water use in the SMVMA is detailed in Table 3.2-1c and illustrated in a graph of annual municipal requirements (Figure 3.2-1c).

3.3 Total Water Requirements and Supplies

The total water requirement (combined agricultural and municipal) in 2015 for the SMVMA, including the water provided by intra-basin transfer from the SMVMA to the NMMA, was approximately 135,370 af, as seen in Table 3.3-1a.

In 2015, the total demand was met almost entirely by groundwater pumping, about 131,920 af. This amount is only slightly less than the total groundwater pumping for the previous year 2014 (about 133,065 af). The balance of the total demand was roughly 3,450 af met by delivery of imported water from the State Water Project. This amount exceeds the total imported water to the SMVMA for the previous year 2014 (1,765 af) but is substantially lower than the long-term average delivery from 1997 through 2015 (10,250 afy).

Groundwater pumping in 2015 met 100 percent of the agricultural water requirement (115,750 af), 82 percent of the municipal water requirements (19,620 af), and about 97 percent of the total water requirements in the SMVMA (135,370 af).

Historical total water requirements in the SMVMA have increased from about 80,000 af in 1950 to about 150,000 af by 1990, and have fluctuated in a broad but relatively constant range between about 100,000 and 150,000 afy, as shown in a graph of historical total water requirements (Figure 3.3-1). Total water requirements in 2015 remained within that range.

Historical water supplies in the SMVMA were solely derived from groundwater pumping until 1997, when the City of Santa Maria commenced importation of SWP water. While groundwater has always met 100 percent of agricultural water requirements, since 1997 groundwater has met a wide range of municipal water requirements, from 35 to 92 percent. Further, groundwater has comprised a consistently large portion of the total water requirements in the SMVMA (from 87 to 99 percent), as shown in Table 3.3-1b.

Over the period since SWP water deliveries began in the SMVMA, the average total annual amount delivered is 10,250 afy, and the average SWP water availability is 64 percent. In contrast, during the current severe drought (2011 – 2015), the average annual SWP delivery amount is 7,670 af with an average SWP availability of only 41 percent. Historical SWP water deliveries (and percent SWP water availabilities) range from 13,780 af in 2006 (SWP availability of 100 percent) to 1,770 af in 2014 (SWP availability of 5 percent).

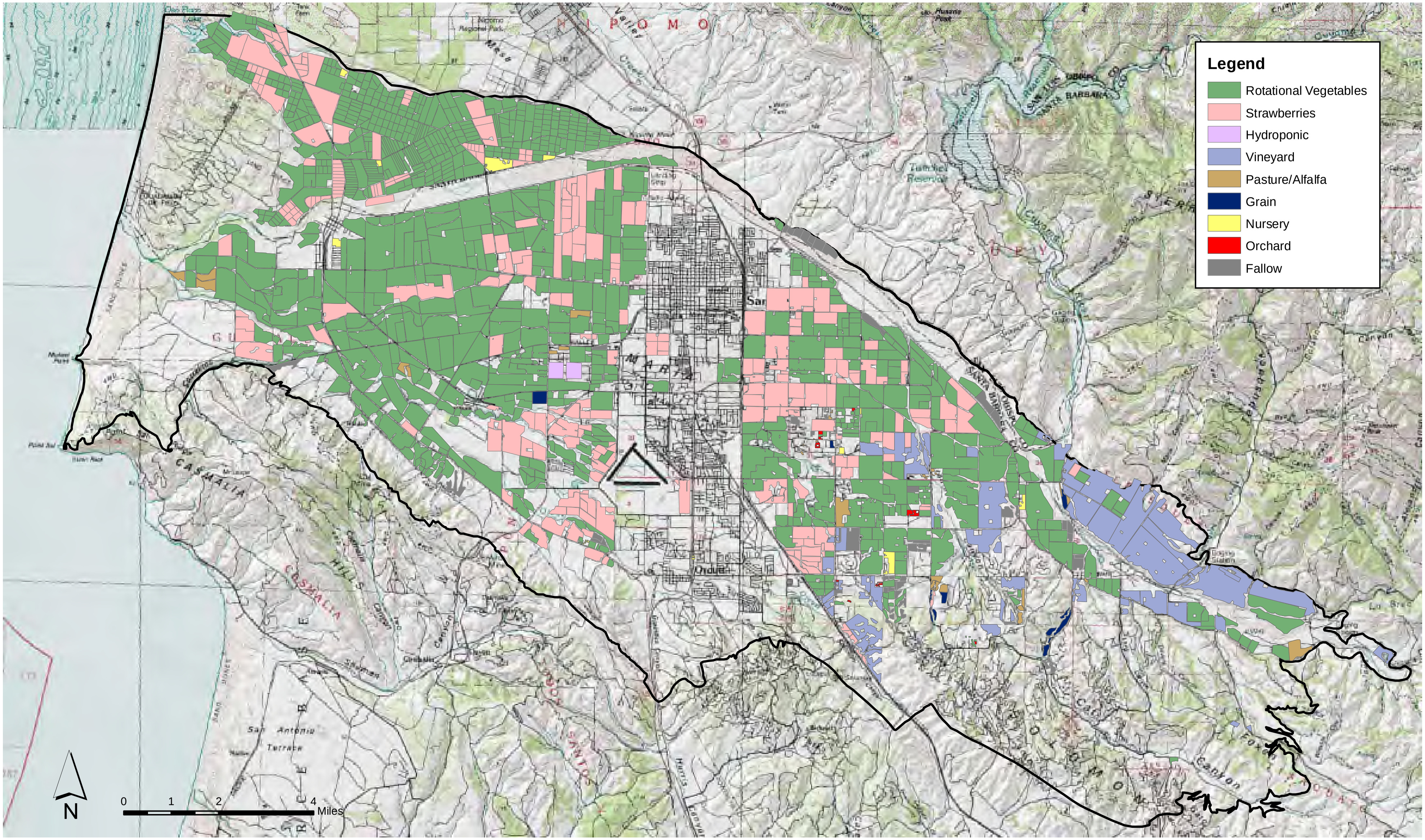

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Figure 3.1-1a
Agricultural Land Use, 2015
Santa Maria Valley Management Area

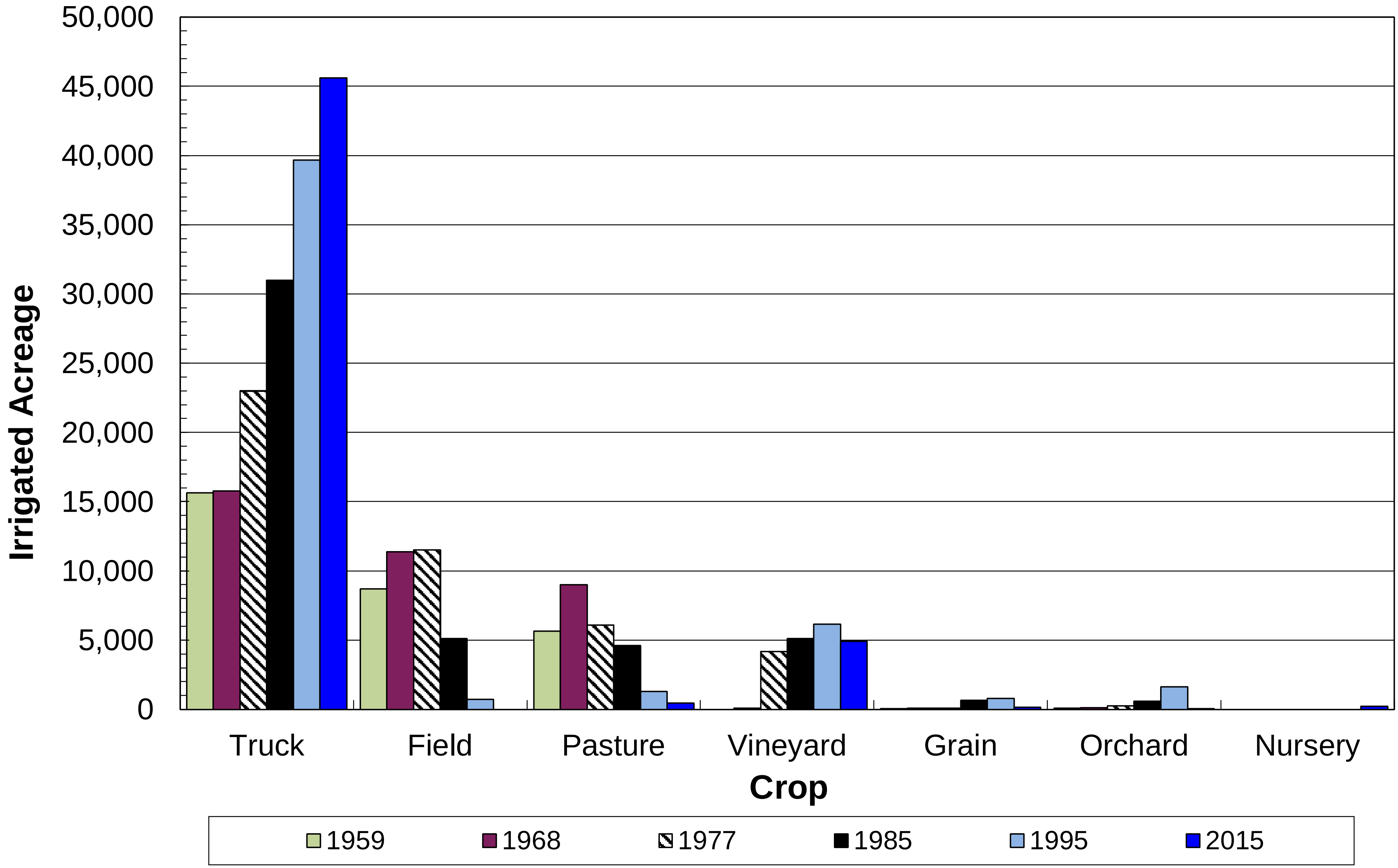

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Figure 3.1-1b
Historical Distribution of Irrigated Acreage by Crop Category
Santa Maria Valley Management Area

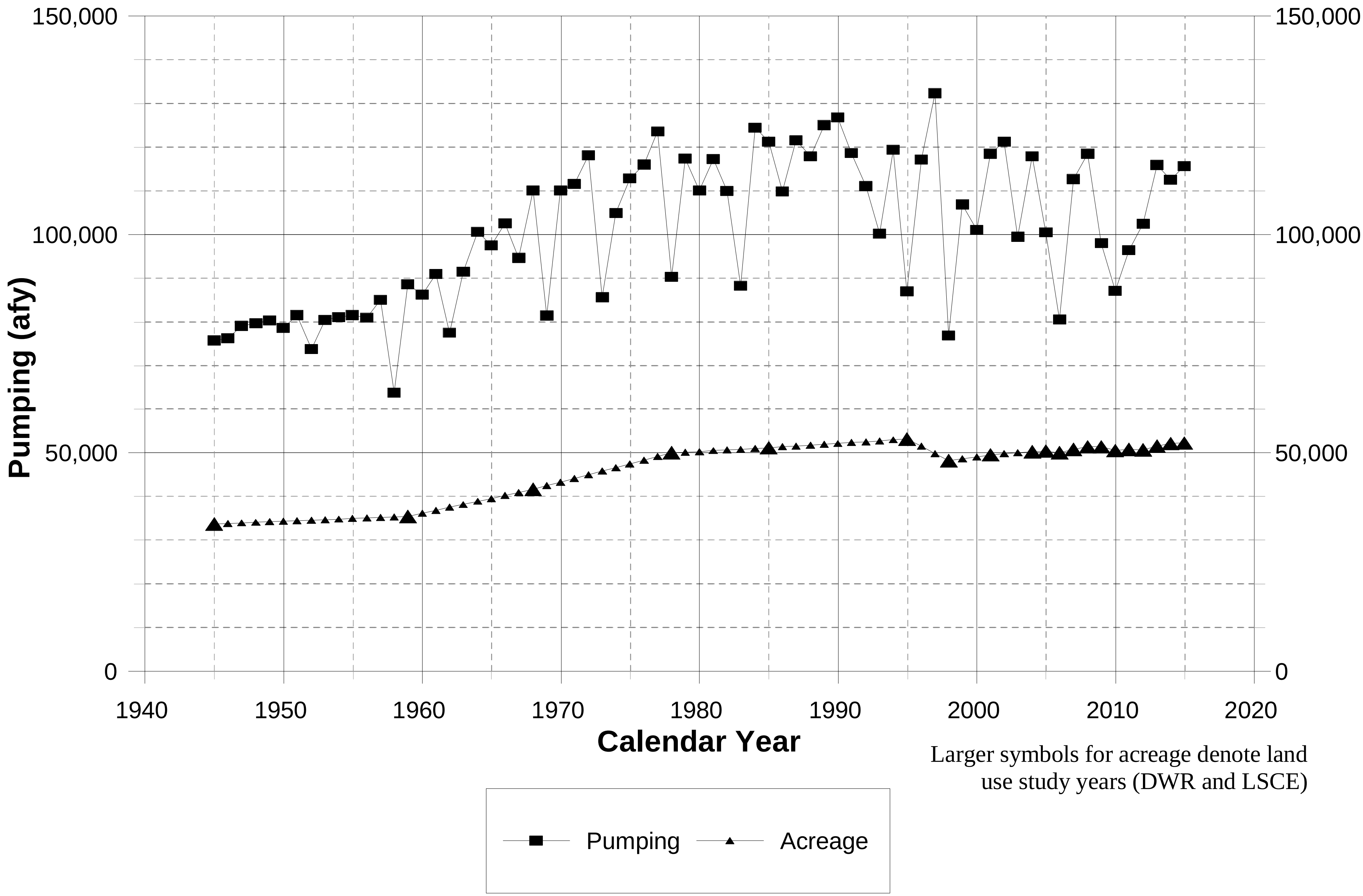

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Figure 3.1-1c
Historical Agricultural Acreage and Groundwater Pumping
Santa Maria Valley Management Area

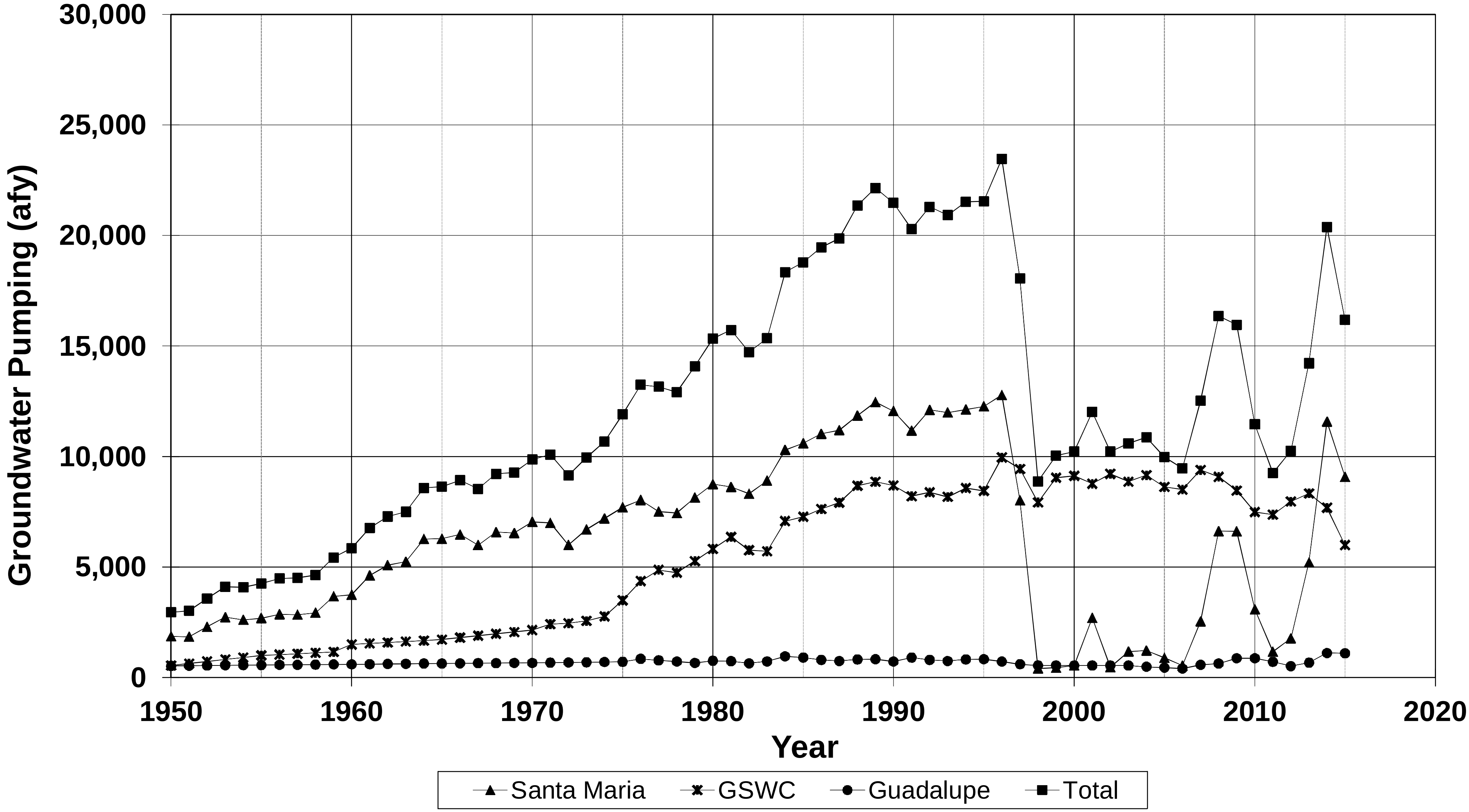

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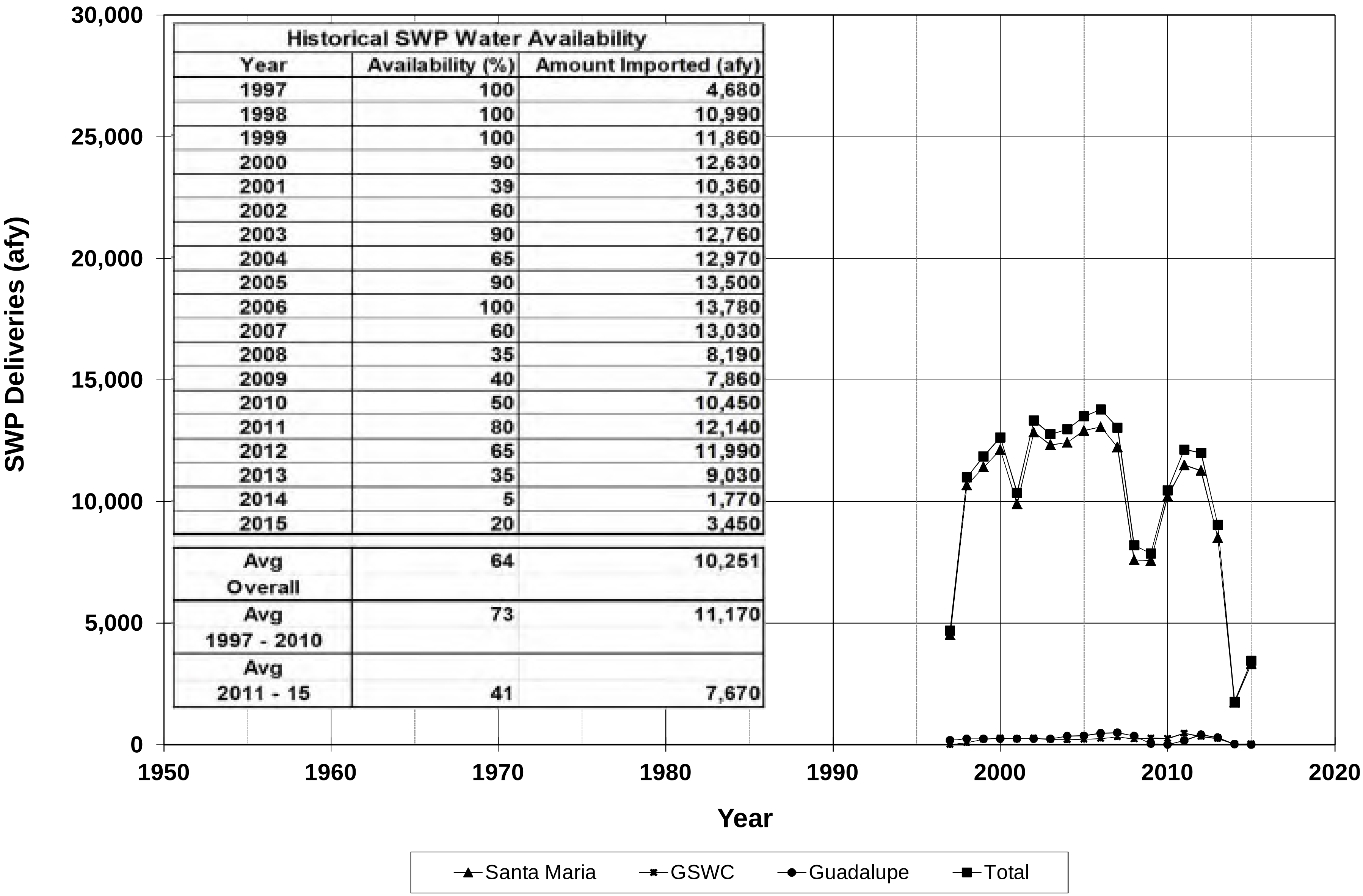
Figure 3.2-1a
Historical Municipal Groundwater Pumping
Santa Maria Valley Management Area



Historical SWP Water Availability		
Year	Availability (%)	Amount Imported (afy)
1997	100	4,680
1998	100	10,990
1999	100	11,860
2000	90	12,630
2001	39	10,360
2002	60	13,330
2003	90	12,760
2004	65	12,970
2005	90	13,500
2006	100	13,780
2007	60	13,030
2008	35	8,190
2009	40	7,860
2010	50	10,450
2011	80	12,140
2012	65	11,990
2013	35	9,030
2014	5	1,770
2015	20	3,450
Avg Overall	64	10,251
Avg 1997 - 2010	73	11,170
Avg 2011 - 15	41	7,670

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Figure 3.2-1b
Historical State Water Project Deliveries
Santa Maria Valley Management Area

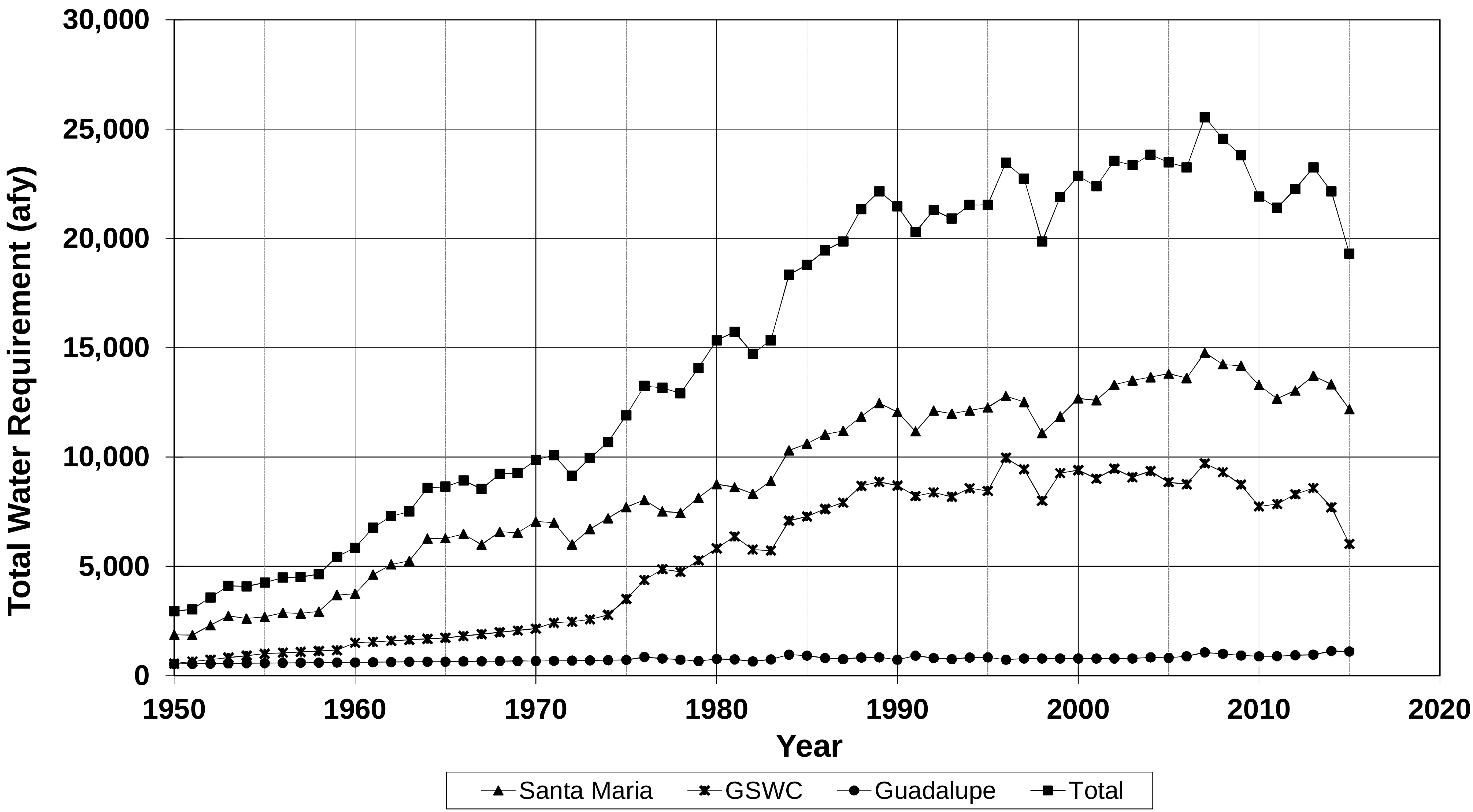

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Figure 3.2-1c
Historical Municipal Water Requirements
Santa Maria Valley Management Area

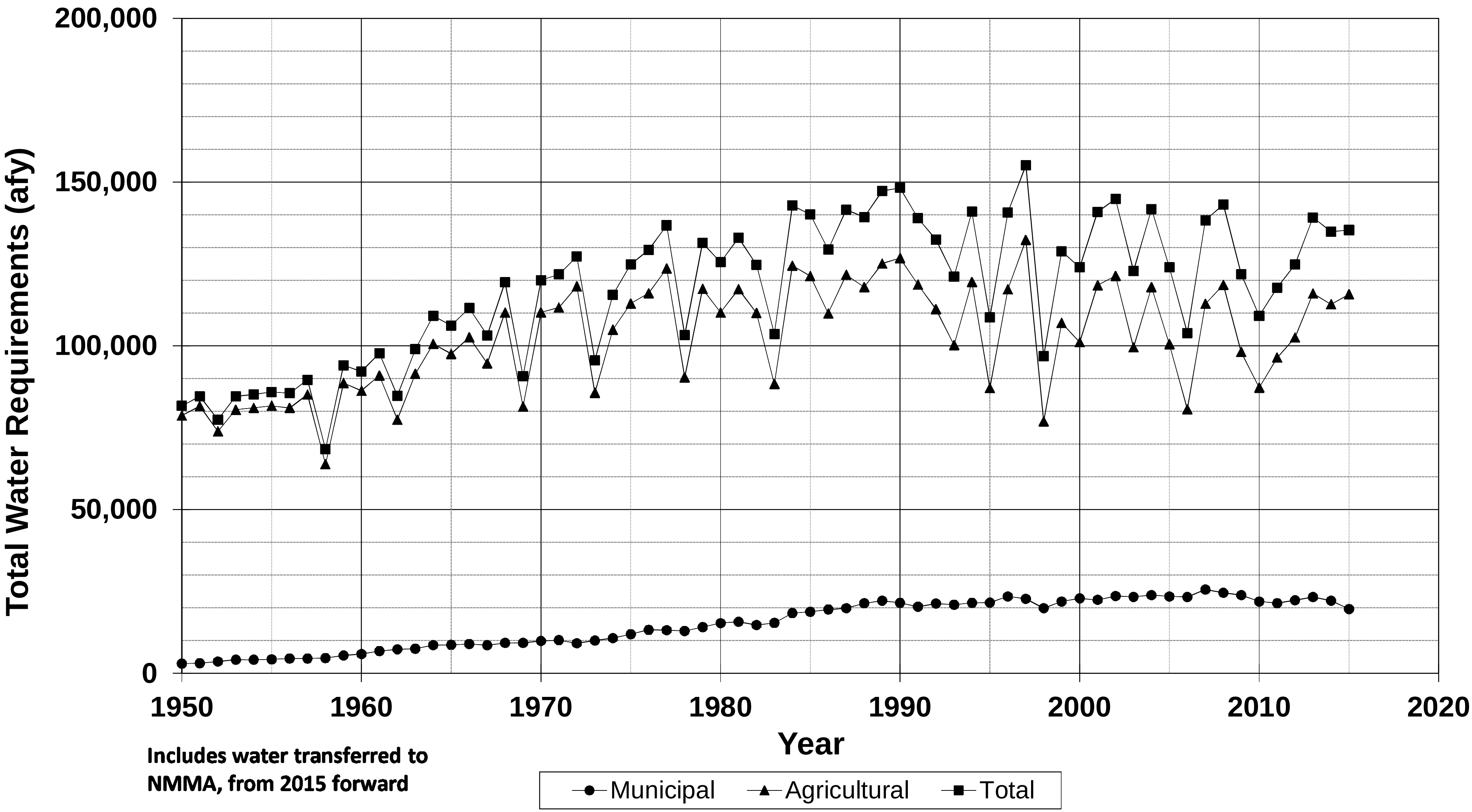

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Figure 3.3-1
Historical Total Water Requirements
Santa Maria Valley Management Area

Table 3.1-1a
Distribution of Irrigated Acreage, 2015
Santa Maria Valley Management Area

Crop Category	Acreages	
	Individual	Total
Truck Crops		
Rotational Vegetables[1]	34,638	
Strawberries	10,810	
Hydroponic[2]	135	45,583
Vineyard		
Wine Grapes	4,919	4,919
Pasture		
Pasture, Alfalfa	465	465
Grain		
Barley, Oat, "Grain"	165	165
Nursery		
Nursery, Outdoor Container and Transplants	215	215
Orchard		
Deciduous	13	
Citrus, Avocado	26	39
Fallow		
Fallow	909	909
Total		**52,295**

1) Rotational Vegetables include lettuce, broccoli, cauliflower, celery, spinach, cut flowers, peas, squash, beans, tomatillos, and others; cane and bush berry acreages are included due to similar crop water requirements.

2) Hydroponic includes primarily tomatoes with minor cucumber, peppers, and other vegetables (Windset Farms facility)

Table 3.1-1b
Historical Distribution of Irrigated Acreage
Land Use Study Years (DWR and LSCE)
Santa Maria Valley Management Area

	Year																			
Crop Categories	**1945**	**1959**	**1968**	**1977**	**1985**	**1995**	**1998**	**2001**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**
Rotational Vegetables	-----	-----	-----	-----	-----	-----	37,264	38,329	37,645	38,097	36,189	37,015	35,132	33,737	33,850	34,243	34,920	33,796	33,574	34,638
Strawberries	-----	-----	-----	-----	-----	-----	3,516	2,731	5,968	5,958	7,553	7,388	9,139	10,375	10,010	9,938	9,323	11,464	11,912	10,810
Hydroponic	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	135	135	135
Total Truck	20,000	15,640	15,770	23,000	31,000	39,665	40,780	41,060	43,613	44,055	43,742	44,403	44,271	44,112	43,860	44,181	44,243	45,395	45,621	45,583
Vineyard	0	0	95	4,200	5,100	6,148	5,180	5,241	4,311	4,219	4,400	4,492	4,968	4,765	4,675	4,561	4,573	4,788	4,992	4,919
Alfalfa	2,200	2,820	5,660	1,500	1,400	0	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Pasture	1,000	2,830	3,330	4,600	3,200	1,295	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Total Pasture	3,200	5,650	8,990	6,100	4,600	1,295	629	911	457	516	447	322	368	441	321	320	362	446	457	465
Field	5,000	8,710	11,390	11,500	5,100	734	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Grain	1,200	40	80	100	640	789	546	947	760	877	837	420	382	580	993	1,028	588	158	280	165
Nursery	0	0	0	0	0	0	203	215	235	238	219	222	243	239	215	229	201	227	212	215
Deciduous	50	70	20	50	50	66	-----	-----	-----	15	13	13	13	13	10	10	10	10	13	13
Citrus	0	0	110	200	550	1,561	-----	-----	-----	18	18	23	23	23	24	24	20	20	26	26
Total Orchard	50	70	130	250	600	1,627	108	21	24	33	31	36	36	36	34	34	30	30	39	39
Fallow	4,400	5,430	5,220	4,900	4,200	2,973	790	1,211	932	507	408	900	1,136	1,244	557	528	711	519	637	909
Total Acreage	**33,850**	**35,540**	**41,675**	**50,050**	**51,240**	**53,231**	**48,236**	**49,606**	**50,332**	**50,445**	**50,084**	**50,795**	**51,404**	**51,417**	**50,655**	**50,881**	**50,708**	**51,563**	**52,238**	**52,295**

Table 3.1-1c
Applied Crop Water Requirements and Total Agricultural Water Requirements, 2015
Santa Maria Valley Management Area

Crop Category	Evapotranspiration of Crop ETc (in)	Effective Precipitation P_E (in)	Evapotranspiration of Applied Water ETaw (in)	Evapotranspiration of Applied Water ETaw (af/ac)	Distribution Uniformity DU (%)	Applied Water AW (af/ac)	Crop Acreage	Estimated Water Requirements (af)
Rotational Vegetables[1]	25.69	1.14	24.55	2.05	80	2.56	34,638	88,596
Strawberries[1]	18.18	2.05	16.13	1.34	85	1.58	10,810	17,096
Hydroponic[2]	---	---	---	---	---	2.0	135	270
Vineyard[3]	---	---	15.6	1.3	95	1.4	4,919	6,731
Pasture[1]	48.77	3.86	44.91	3.74	80	4.68	465	2,175
Grain[3]	---	---	8.4	0.7	80	0.9	165	144
Nursery[4]	---	---	---	---	---	2.0	215	430
Deciduous[3]	---	---	32.4	2.7	85	3.2	13	41
Avocado[3]	---	---	32.4	2.7	85	3.2	26	83
Fallow	---	---	2.4	0.2	---	0.2	909	182
Total							**52,295**	**115,749**

1) CIMIS-based applied crop water duties

2) Research-based applied crop water duty

3) Reported ETaw-based applied crop water duties

4) NMMA applied crop water duty; DU assumed as 80%

Table 3.2-1a
Municipal Groundwater Pumpage in 2015
Santa Maria Valley Management Area
(in acre-feet)

City of Santa Maria

Well	January	February	March	April	May	June	July	August	September	October	November	December	Total
6S	9.7	8.2	8.5	29.8	30.8	21.9	30.0	2.4	0.1	3.3	11.5	2.5	159
9S	0.0	0.0	1.0	0.7	21.7	1.5	3.3	6.8	11.3	1.8	6.7	10.9	66
10S	115.3	105.0	223.6	268.3	161.4	165.1	144.5	178.8	156.1	45.4	56.6	0.0	1,620
11S	19.9	38.4	119.6	149.4	54.3	84.9	112.3	95.4	121.7	66.5	100.1	50.1	1,013
12S	108.6	175.9	297.1	146.9	160.9	141.5	177.8	153.7	143.8	124.0	227.2	97.6	1,955
13S	183.6	199.6	254.1	220.2	185.5	189.3	193.5	189.3	189.9	142.2	195.6	177.5	2,320
14S	315.3	157.4	42.0	163.9	107.0	126.2	126.1	109.0	82.9	187.8	294.5	234.6	1,947
Well Total	752.5	684.4	945.8	979.3	721.7	730.4	787.4	735.5	705.9	571.1	892.3	573.2	9,080
WIP Transfers to NCSD*	0.0	0.0	0.0	0.0	0.0	0.0	33.0	32.2	32.1	27.3	53.0	36.6	214
Purveyor Total	**752.5**	**684.4**	**945.8**	**979.3**	**721.7**	**730.4**	**754.3**	**703.3**	**673.8**	**543.8**	**839.3**	**536.6**	**8,866**

Golden State Water Company
Orcutt System

Well	January	February	March	April	May	June	July	August	September	October	November	December	Total
Crescent #1	88.8	76.7	89.6	75.9	78.8	82.3	84.0	78.7	81.9	82.6	76.1	74.3	970
Kenneth #1	134.8	121.6	123.6	90.5	98.3	104.3	98.8	94.5	91.9	70.8	46.1	20.5	1,096
Mira Flores #1	24.0	22.7	0.1	3.2	24.2	25.3	18.1	14.7	12.2	13.8	21.7	21.7	202
Mira Flores #2	14.1	0.9	24.1	16.3	0.0	0.0	0.0	0.0	3.2	67.3	40.3	12.6	179
Mira Flores #4	12.4	1.3	8.8	6.2	5.4	14.3	68.2	34.5	47.2	15.2	7.7	2.5	224
Mira Flores #5	24.5	14.1	29.2	6.8	20.3	17.5	2.6	3.1	12.9	4.0	2.2	0.2	137
Mira Flores #6	42.6	48.9	37.8	57.0	52.2	41.8	47.4	43.2	24.0	18.7	2.2	9.2	425
Mira Flores #7	50.7	59.7	49.0	71.4	68.1	66.6	45.2	51.3	55.0	35.4	53.0	71.5	677
Oak	2.6	5.1	17.6	24.9	23.2	13.8	13.2	13.4	13.8	12.8	6.1	5.2	152
Orcutt	20.0	18.4	29.6	41.4	40.6	38.7	35.3	38.1	35.7	33.5	18.1	12.1	362
Woodmere #1	15.3	20.2	90.2	6.3	2.8	2.1	17.1	1.7	4.0	13.5	62.8	106.4	342
Woodmere #2	0.1	1.0	15.9	120.0	114.6	101.9	80.1	115.0	112.7	117.0	30.5	0.0	809
System Total	429.8	390.6	515.5	519.8	528.4	508.6	509.9	488.3	494.4	484.7	366.8	336.3	5,573

Lake Marie System

Well	January	February	March	April	May	June	July	August	September	October	November	December	Total
Lake Marie #4	12.1	11.7	22.3	18.3	13.6	17.1	19.0	21.1	18.9	22.0	10.0	5.8	192
Vineyard #5	0.3	0.1	0.0	0.0	0.0	0.2	0.1	0.1	0.0	0.0	0.0	0.0	1
Vineyard #6	0.7	3.4	5.6	1.9	6.3	3.9	2.7	1.1	3.2	0.9	1.9	4.1	36
System Total	13.1	15.2	27.8	20.2	20.0	21.3	21.8	22.3	22.2	22.9	12.0	9.9	229

Tanglewood System

Well	January	February	March	April	May	June	July	August	September	October	November	December	Total
Tanglewood #1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
Tanglewood #3	11.3	10.0	14.0	13.7	14.8	14.7	14.0	14.9	14.0	13.3	11.2	11.5	157
System Total	11.3	10.0	14.0	13.7	14.8	14.7	14.0	14.9	14.0	13.3	11.2	11.5	158

Sisquoc System

Well	January	February	March	April	May	June	July	August	September	October	November	December	Total
Foxen Cyn #4	0.1	0.3	0.1	0.9	0.5	0.4	0.3	0.3	0.2	0.2	0.1	0.1	4
Foxen Cyn #5	2.1	1.4	2.9	4.0	2.8	2.7	3.4	3.7	2.8	2.4	1.3	1.1	31
System Total	2.2	1.7	3.1	4.9	3.4	3.1	3.7	4.0	3.0	2.6	1.4	1.3	34
Purveyor Total	**456.4**	**417.5**	**560.4**	**558.7**	**566.5**	**547.6**	**549.4**	**529.6**	**533.5**	**523.5**	**391.4**	**359.0**	**5,993**

City of Guadalupe

Well	January	February	March	April	May	June	July	August	September	October	November	December	Total
Obispo	68.6	59.3	65.8	67.0	74.7	69.9	67.2	70.6	79.8	65.5	54.4	47.5	790
Tognazzini	18.1	20.3	26.6	27.7	22.8	24.6	29.1	25.3	21.0	29.4	30.4	35.4	311
Purveyor Total	**86.6**	**79.6**	**92.4**	**94.7**	**97.5**	**94.5**	**96.3**	**96.0**	**100.8**	**94.9**	**84.8**	**82.8**	**1,101**

Nipomo Community Services District

	January	February	March	April	May	June	July	August	September	October	November	December	Total
WIP Transfers from Santa Maria*	0.0	0.0	0.0	0.0	0.0	0.0	33.0	32.2	32.1	27.3	53.0	36.6	214
Purveyor Total	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**33.0**	**32.2**	**32.1**	**27.3**	**53.0**	**36.6**	**214**

Total Municipal Pumpage 16,174

*Water transfers from Santa Maria to NCSD by Waterline Intertie Project (WIP) commenced in July 2015; 214 af of groundwater part of a total of 314 af of water transferred (68% groundwater and 32% SWP water)

Table 3.2-1b
Municipal State Water Project Deliveries in 2015
Santa Maria Valley Management Area
(in acre-feet)

City of Santa Maria

	January	February	March	April	May	June	July	August	September	October	November	December	Total
SWP Deliveries	140.4	129.8	142.9	151.4	379.6	377.9	382.9	476.0	459.6	537.4	0.0	257.3	3,435
Transfers to GSWC	0.3	0.3	1.0	1.1	2.2	4.7	2.4	1.4	1.2	0.2	0.0	0.8	16
WIP Transfers to NCSD*	0.0	0.0	0.0	0.0	0.0	0.0	16.0	20.8	20.9	25.7	0.0	16.4	100
Purveyor Total	**140.1**	**129.5**	**141.9**	**150.3**	**377.4**	**373.2**	**364.5**	**453.8**	**437.5**	**511.5**	**0.0**	**240.1**	**3,319**

Golden State Water Company

	January	February	March	April	May	June	July	August	September	October	November	December	Total
Orcutt System													
Transfers from Santa Maria	0.3	0.3	1.0	1.1	2.2	4.7	2.4	1.4	1.2	0.2	0.0	0.8	16
System Total	0.3	0.3	1.0	1.1	2.2	4.7	2.4	1.4	1.2	0.2	0.0	0.8	16
Tanglewood System													
SWP Deliveries	0.9	0.9	1.0	1.1	1.1	1.1	1.2	1.2	1.2	1.2	1.0	1.0	13
System Total	0.9	0.9	1.0	1.1	1.1	1.1	1.2	1.2	1.2	1.2	1.0	1.0	13
Purveyor Total	**1.3**	**1.3**	**2.0**	**2.2**	**3.3**	**5.8**	**3.7**	**2.6**	**2.4**	**1.4**	**1.0**	**1.9**	**29**

City of Guadalupe

	January	February	March	April	May	June	July	August	September	October	November	December	Total
SWP Deliveries	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
Purveyor Total	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0**

Nipomo Community Services District

	January	February	March	April	May	June	July	August	September	October	November	December	Total
WIP Transfers from Santa Maria*	0.0	0.0	0.0	0.0	0.0	0.0	16.0	20.8	20.9	25.7	0.0	16.4	100
Purveyor Total	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**16.0**	**20.8**	**20.9**	**25.7**	**0.0**	**16.4**	**100**

Total Municipal Deliveries	**3,448**

*Water transfers from Santa Maria to NCSD by Waterline Intertie Project (WIP) commenced in July 2015; 100 af of SWP water part of a total of 314 af transferred (32% SWP water and 68% groundwater)

Table 3.2-1c
Historical Municipal Water Requirements and Supplies
Santa Maria Valley Management Area

	Groundwater Pumping (afy)							State Water Project Deliveries (afy)										Total Municipal Water Supplies (afy)								
	City of Santa Maria					NCSD	Total	City of Santa Maria				Golden State Water Company				NCSD	Total	Water Use In SMVMA						WIP Transfers to NCSD		
Year	City of Santa Maria	WIP Transfers to NCSD	Net Total	GSWC	City of Guadalupe	WIP Transfers from Santa Maria	Groundwater pumped from SMVMA	Deliveries to City of Santa Maria	Transfers to GSWC	WIP Transfers to NCSD	Net Total	Deliveries to GSWC	Transfers from Santa Maria	Net Total	City of Guadalupe	WIP Transfers from Santa Maria	SWP Water Delivered to SMVMA	City of Santa Maria	Golden State Water Company	City of Guadalupe	Groundwater Supply	SWP Supply	Total Supply	Groundwater Supply	SWP Supply	Total Supply
1950	1,866	-----	1,866	550	533	-----	2,949	-----	-----	-----	0	-----	-----	0	0	0	0	1,866	550	533	2,949	0	2,949	0	0	0
1951	1,847	-----	1,847	640	540	-----	3,027	-----	-----	-----	0	-----	-----	0	0	0	0	1,847	640	540	3,027	0	3,027	0	0	0
1952	2,298	-----	2,298	730	548	-----	3,576	-----	-----	-----	0	-----	-----	0	0	0	0	2,298	730	548	3,576	0	3,576	0	0	0
1953	2,732	-----	2,732	820	556	-----	4,108	-----	-----	-----	0	-----	-----	0	0	0	0	2,732	820	556	4,108	0	4,108	0	0	0
1954	2,610	-----	2,610	910	563	-----	4,083	-----	-----	-----	0	-----	-----	0	0	0	0	2,610	910	563	4,083	0	4,083	0	0	0
1955	2,688	-----	2,688	1,000	566	-----	4,254	-----	-----	-----	0	-----	-----	0	0	0	0	2,688	1,000	566	4,254	0	4,254	0	0	0
1956	2,866	-----	2,866	1,040	574	-----	4,480	-----	-----	-----	0	-----	-----	0	0	0	0	2,866	1,040	574	4,480	0	4,480	0	0	0
1957	2,845	-----	2,845	1,080	582	-----	4,507	-----	-----	-----	0	-----	-----	0	0	0	0	2,845	1,080	582	4,507	0	4,507	0	0	0
1958	2,930	-----	2,930	1,120	590	-----	4,640	-----	-----	-----	0	-----	-----	0	0	0	0	2,930	1,120	590	4,640	0	4,640	0	0	0
1959	3,676	-----	3,676	1,160	598	-----	5,434	-----	-----	-----	0	-----	-----	0	0	0	0	3,676	1,160	598	5,434	0	5,434	0	0	0
1960	3,749	-----	3,749	1,500	600	-----	5,849	-----	-----	-----	0	-----	-----	0	0	0	0	3,749	1,500	600	5,849	0	5,849	0	0	0
1961	4,618	-----	4,618	1,544	608	-----	6,771	-----	-----	-----	0	-----	-----	0	0	0	0	4,618	1,544	608	6,771	0	6,771	0	0	0
1962	5,083	-----	5,083	1,588	617	-----	7,288	-----	-----	-----	0	-----	-----	0	0	0	0	5,083	1,588	617	7,288	0	7,288	0	0	0
1963	5,245	-----	5,245	1,633	626	-----	7,503	-----	-----	-----	0	-----	-----	0	0	0	0	5,245	1,633	626	7,503	0	7,503	0	0	0
1964	6,267	-----	6,267	1,677	634	-----	8,578	-----	-----	-----	0	-----	-----	0	0	0	0	6,267	1,677	634	8,578	0	8,578	0	0	0
1965	6,282	-----	6,282	1,725	633	-----	8,640	-----	-----	-----	0	-----	-----	0	0	0	0	6,282	1,725	633	8,640	0	8,640	0	0	0
1966	6,476	-----	6,476	1,810	642	-----	8,927	-----	-----	-----	0	-----	-----	0	0	0	0	6,476	1,810	642	8,927	0	8,927	0	0	0
1967	5,993	-----	5,993	1,894	651	-----	8,538	-----	-----	-----	0	-----	-----	0	0	0	0	5,993	1,894	651	8,538	0	8,538	0	0	0
1968	6,580	-----	6,580	1,979	660	-----	9,219	-----	-----	-----	0	-----	-----	0	0	0	0	6,580	1,979	660	9,219	0	9,219	0	0	0
1969	6,538	-----	6,538	2,064	669	-----	9,271	-----	-----	-----	0	-----	-----	0	0	0	0	6,538	2,064	669	9,271	0	9,271	0	0	0
1970	7,047	-----	7,047	2,150	666	-----	9,863	-----	-----	-----	0	-----	-----	0	0	0	0	7,047	2,150	666	9,863	0	9,863	0	0	0
1971	7,000	-----	7,000	2,415	675	-----	10,090	-----	-----	-----	0	-----	-----	0	0	0	0	7,000	2,415	675	10,090	0	10,090	0	0	0
1972	6,000	-----	6,000	2,460	685	-----	9,145	-----	-----	-----	0	-----	-----	0	0	0	0	6,000	2,460	685	9,145	0	9,145	0	0	0
1973	6,700	-----	6,700	2,565	694	-----	9,959	-----	-----	-----	0	-----	-----	0	0	0	0	6,700	2,565	694	9,959	0	9,959	0	0	0
1974	7,200	-----	7,200	2,770	704	-----	10,674	-----	-----	-----	0	-----	-----	0	0	0	0	7,200	2,770	704	10,674	0	10,674	0	0	0
1975	7,700	-----	7,700	3,500	714	-----	11,914	-----	-----	-----	0	-----	-----	0	0	0	0	7,700	3,500	714	11,914	0	11,914	0	0	0
1976	8,033	-----	8,033	4,367	845	-----	13,245	-----	-----	-----	0	-----	-----	0	0	0	0	8,033	4,367	845	13,245	0	13,245	0	0	0
1977	7,509	-----	7,509	4,868	781	-----	13,158	-----	-----	-----	0	-----	-----	0	0	0	0	7,509	4,868	781	13,158	0	13,158	0	0	0
1978	7,446	-----	7,446	4,743	722	-----	12,911	-----	-----	-----	0	-----	-----	0	0	0	0	7,446	4,743	722	12,911	0	12,911	0	0	0
1979	8,142	-----	8,142	5,274	666	-----	14,082	-----	-----	-----	0	-----	-----	0	0	0	0	8,142	5,274	666	14,082	0	14,082	0	0	0
1980	8,754	-----	8,754	5,820	762	-----	15,336	-----	-----	-----	0	-----	-----	0	0	0	0	8,754	5,820	762	15,336	0	15,336	0	0	0
1981	8,621	-----	8,621	6,366	738	-----	15,725	-----	-----	-----	0	-----	-----	0	0	0	0	8,621	6,366	738	15,725	0	15,725	0	0	0
1982	8,313	-----	8,313	5,765	648	-----	14,726	-----	-----	-----	0	-----	-----	0	0	0	0	8,313	5,765	648	14,726	0	14,726	0	0	0
1983	8,903	-----	8,903	5,714	733	-----	15,350	-----	-----	-----	0	-----	-----	0	0	0	0	8,903	5,714	733	15,350	0	15,350	0	0	0
1984	10,299	-----	10,299	7,079	961	-----	18,339	-----	-----	-----	0	-----	-----	0	0	0	0	10,299	7,079	961	18,339	0	18,339	0	0	0
1985	10,605	-----	10,605	7,276	908	-----	18,789	-----	-----	-----	0	-----	-----	0	0	0	0	10,605	7,276	908	18,789	0	18,789	0	0	0
1986	11,033	-----	11,033	7,625	798	-----	19,456	-----	-----	-----	0	-----	-----	0	0	0	0	11,033	7,625	798	19,456	0	19,456	0	0	0
1987	11,191	-----	11,191	7,916	757	-----	19,864	-----	-----	-----	0	-----	-----	0	0	0	0	11,191	7,916	757	19,864	0	19,864	0	0	0
1988	11,849	-----	11,849	8,678	823	-----	21,350	-----	-----	-----	0	-----	-----	0	0	0	0	11,849	8,678	823	21,350	0	21,350	0	0	0
1989	12,464	-----	12,464	8,860	828	-----	22,152	-----	-----	-----	0	-----	-----	0	0	0	0	12,464	8,860	828	22,152	0	22,152	0	0	0
1990	12,052	-----	12,052	8,691	724	-----	21,467	-----	-----	-----	0	-----	-----	0	0	0	0	12,052	8,691	724	21,467	0	21,467	0	0	0
1991	11,170	-----	11,170	8,210	908	-----	20,288	-----	-----	-----	0	-----	-----	0	0	0	0	11,170	8,210	908	20,288	0	20,288	0	0	0
1992	12,116	-----	12,116	8,381	798	-----	21,295	-----	-----	-----	0	-----	-----	0	0	0	0	12,116	8,381	798	21,295	0	21,295	0	0	0
1993	11,984	-----	11,984	8,174	757	-----	20,915	-----	-----	-----	0	-----	-----	0	0	0	0	11,984	8,174	757	20,915	0	20,915	0	0	0
1994	12,129	-----	12,129	8,571	823	-----	21,523	-----	-----	-----	0	-----	-----	0	0	0	0	12,129	8,571	823	21,523	0	21,523	0	0	0
1995	12,267	-----	12,267	8,447	828	-----	21,542	-----	-----	-----	0	-----	-----	0	0	0	0	12,267	8,447	828	21,542	0	21,542	0	0	0
1996	12,780	-----	12,780	9,960	724	-----	23,464	-----	-----	-----	0	-----	-----	0	0	0	0	12,780	9,960	724	23,464	0	23,464	0	0	0
1997	8,016	-----	8,016	9,441	603	-----	18,060	4,506	0	-----	4,506	0	0	0	175	0	4,681	12,522	9,441	778	18,060	4,681	22,741	0	0	0
1998	411	-----	411	7,922	545	-----	8,878	10,674	0	-----	10,674	79	0	79	233	0	10,986	11,085	8,001	778	8,878	10,986	19,865	0	0	0
1999	454	-----	454	9,044	545	-----	10,043	11,405	0	-----	11,405	219	0	219	233	0	11,857	11,859	9,263	778	10,043	11,857	21,900	0	0	0
2000	548	-----	548	9,131	545	-----	10,224	12,174	42	-----	12,132	226	42	268	233	0	12,633	12,679	9,399	778	10,224	12,633	22,856	0	0	0
2001	2,699	-----	2,699	8,772	545	-----	12,016	9,914	20	-----	9,894	217	20	237	233	0	10,364	12,594	9,009	778	12,016	10,364	22,380	0	0	0
2002	468	-----	468	9,211	545	-----	10,224	12,879	35	-----	12,844	220	35	255	233	0	13,332	13,312	9,466	778	10,224	13,332	23,556	0	0	0
2003	1,178	-----	1,178	8,866	545	-----	10,589	12,325	4	-----	12,321	201	4	205	233	0	12,759	13,499	9,071	778	10,589	12,759	23,349	0	0	0
2004	1,223	-----	1,223	9,159	487	-----	10,869	12,427	0	-----	12,427	197	0	197	345	0	12,969	13,650	9,356	832	10,869	12,969	23,838	0	0	0
2005	897	-----	897	8,626	452	-----	9,975	12,960	43	-----	12,917	177	43	220	362	0	13,499	13,814	8,846	814	9,975	13,499	23,474	0	0	0
2006	543	-----	543	8,511	412	-----	9,466	13,128	61	-----	13,067	182	61	243	471	0	13,781	13,610	8,754	883	9,466	13,781	23,247	0	0	0
2007	2,550	-----	2,550	9,393	580	-----	12,523	12,352	120	-----	12,232	197	120	317	483	0	13,032	14,782	9,710	1,063	12,523	13,032	25,555	0	0	0
2008	6,631	-----	6,631	9,083	636	-----	16,350	7,652	48	-----	7,604	180	48	228	361	0	8,193	14,235	9,311	997	16,350	8,193	24,543	0	0	0
2009	6,615	-----	6,615	8,463	879	-----	15,957	7,641	84	-----	7,557	182	84	266	38	0	7,861	14,172	8,729	917	15,957	7,861	23,818	0	0	0
2010	3,087	-----	3,087	7,487	880	-----	11,454	10,279	72	-----	10,207	176	72	248	0	0	10,455	13,294	7,735	880	11,454	10,455	21,909	0	0	0
2011	1,170	-----	1,170	7,375	713	-----	9,258	11,785	290	-----	11,495	179	290	469	172	0	12,136	12,665	7,844	885	9,258	12,136	21,394	0	0	0
2012	1,775	-----	1,775	7,966	521	-----	10,262	11,407	144	-----	11,263	185	144	330	404	0	11,996	13,038	8,296	924	10,262	11,996	22,258	0	0	0
2013	5,215	-----	5,215	8,333	672	-----	14,220	8,591	87	-----	8,504	156	87	243	284	0	9,031	13,719	8,576	956	14,220	9,031	23,251	0	0	0
2014	11,586	-----	11,586	7,681	1,115	-----	20,382	1,747	11	-----	1,735	11	11	22	8	0	1,766	13,321	7,703	1,123	20,382	1,766	22,148	0	0	0
2015	9,080	214	8,866	5,993	1,101	214	16,174	3,435	16	100	3,319	13	16	29	0	100	3,448	12,185	6,022	1,101	15,960	3,348	19,308	214	100	314

estimated

Table 3.3-1a
Total Water Requirements and Supplies 2015
Santa Maria Valley Management Area
(acre-feet)

Water Use Category	Water Requirements	Water Supplies						
		Groundwater	Groundwater transfer[1]	Net Groundwater	SWP imported	SWP transfer[2]	SWP transfer[3]	Net SWP
Agricultural								
Total	**115,749**	**115,749**	**--**	**115,749**	**--**	**--**	**--**	**--**
Municipal								
City of Santa Maria	12,185	9,080	-214	8,866	3,435	-16	-100	3,319
Golden State Water Company	6,022	5,993	--	5,993	13	16	--	29
City of Guadalupe	1,101	1,101	--	1,101	0	--	--	0
Total SMVMA	19,308	16,174	-214	15,960	3,448	0	-100	3,348
Transfer to NMMA	314	--	214	214	--	--	100	100
Total	**19,622**	--	--	**16,174**	**--**	**--**	**--**	**3,448**
SMVMA Total	**135,057**			**131,709**				**3,348**
SMVMA Total including transfer to NMMA	**135,371**			**131,923**				**3,448**

[1]Transfer of Groundwater from SMVMA to NMMA, by Santa Maria to Nipomo Community Services District
[2]Transfer within SMVMA, from Santa Maria to Golden State Water Company
[3]Transfer of SWP Water from SMVMA to NMMA, by Santa Maria to Nipomo Community Services District

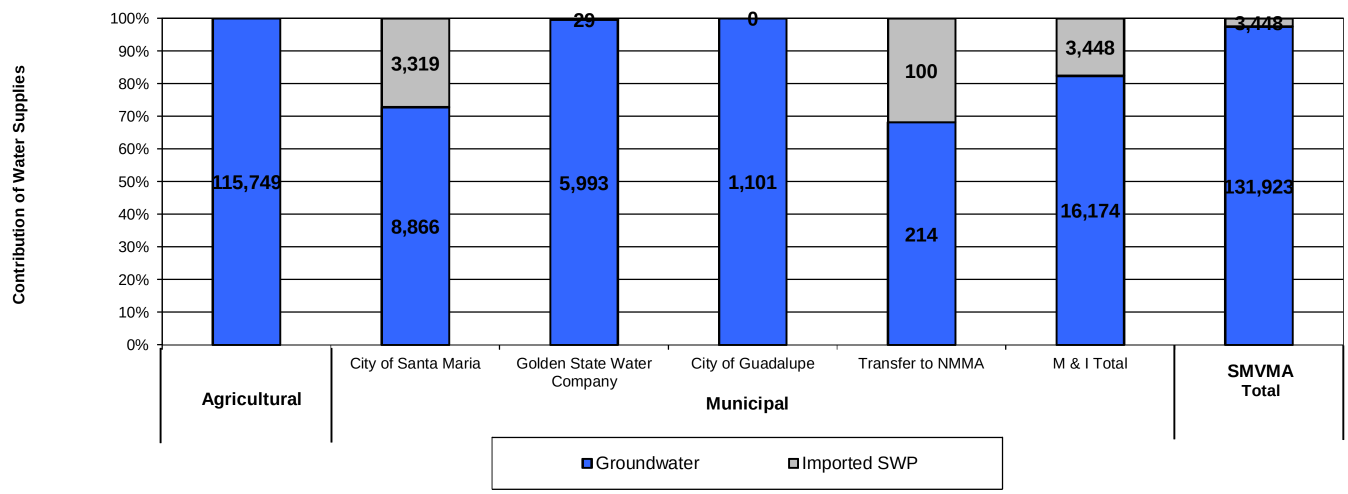
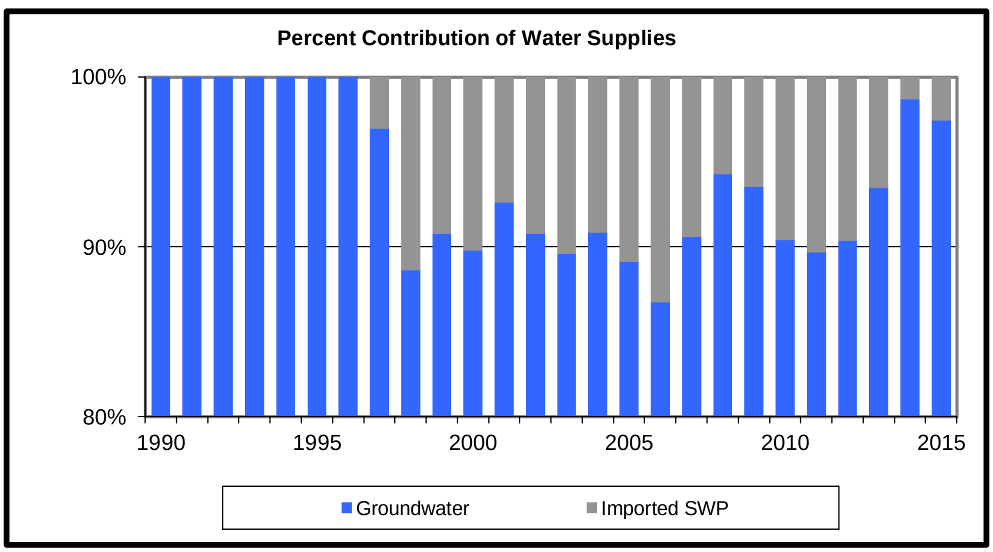


Table 3.3-1b
Recent Historical Total Water Supplies
Santa Maria Valley Management Area
(Acre-feet)

Year	*Total Groundwater*	*Total Imported SWP Water*	**Total Water Supply**
1990	148,254	0	**148,254**
1991	138,963	0	**138,963**
1992	132,461	0	**132,461**
1993	121,124	0	**121,124**
1994	140,956	0	**140,956**
1995	108,640	0	**108,640**
1996	140,691	0	**140,691**
1997	150,451	4,681	**155,132**
1998	85,778	10,986	**96,765**
1999	117,013	11,857	**128,870**
2000	111,306	12,633	**123,938**
2001	130,532	10,364	**140,896**
2002	131,557	13,332	**144,889**
2003	110,099	12,759	**122,859**
2004	128,799	12,969	**141,768**
2005	110,469	13,499	**123,968**
2006	90,130	13,781	**103,911**
2007	125,318	13,032	**138,350**
2008	134,962	8,193	**143,155**
2009	114,042	7,861	**121,903**
2010	98,668	10,455	**109,123**
2011	105,645	12,136	**117,781**
2012	112,779	11,996	**124,775**
2013	130,192	9,031	**139,223**
2014	133,062	1,766	**134,828**
2015	131,923	3,448	**135,371**



4. Water Disposition

The Stipulation directs that there be an annual accounting of the disposition of water supplies in the SMVMA. The primary uses of water in the SMVMA are for agricultural irrigation and for domestic and related municipal uses, as detailed in Chapter 3, where most of the water is consumptively used. The balance of water supply primarily flows, or is disposed, back to the groundwater basin via the following pathways: 1) deep percolation of applied irrigation that exceeds agricultural crop water requirements, 2) deep percolation of landscape or other non-agricultural irrigation, 3) purposeful infiltration of treated municipal waste water, and 4) in the Sisquoc Valley, deep percolation of a minor amount of treated water from septic systems.

Other disposition of water in the SMVMA includes purposeful consumptive use of treated municipal waste water via spray irrigation for disposal (evapotranspiration), injection of brine derived from reverse osmosis treatment, and industrial use, as well as Sisquoc Valley septic system discharge. Additional disposition of water is agricultural drainage in localized areas, specifically those of low soil and aquifer permeability and shallow groundwater levels. Lastly, discussion is provided of the commencement in 2015 of water export from the SMVMA to the NMMA, comprising an intra-basin transfer, per provisions of the Stipulation. Included in this discussion are those Stipulation provisions, the amount and source of water transferred in 2015, and technical concerns regarding potential impacts to SMVMA water resources from the water transfers.

4.1 Agricultural Return Flows

The largest component of overall return flows in the SMVMA originates as applied water for agricultural irrigation. Except for local areas near the Santa Maria River toward the western end of the SMVMA where subsurface drainage removes shallow groundwater beneath irrigated lands, applied irrigation in excess of crop water requirements is considered to deep-percolate beyond crop rooting depths and result in return flows to groundwater. The estimation of agricultural water requirements and associated groundwater pumping, as described in Section 3.1, is based on crop areas, respective crop water requirements, and estimated performance of various irrigation systems. For the range of crops and irrigation systems in the SMVMA, most crops are considered to consumptively use about 80 to 85 percent of the water applied to them, resulting in an estimated 20 to 15 percent, respectively, of applied water exceeding crop consumption and deep percolating as return flow to the underlying aquifer system. Exceptions to the preceding ranges are wine grapes and hydroponic tomatoes, where 95% and 100% of applied water are estimated to be consumptively used, respectively (resulting in return flow from only the vineyards, specifically 5% of applied water).

For the full range of crop categories in the SMVMA, return flow rates in 2015 are estimated to range from less than 0.1 af/ac for Vineyard, to about 0.5 af/ac for the predominant Rotational Vegetables and Orchard in the Valley to a maximum of about 0.9 af/ac for Pasture. The respective estimated agricultural return flow rates are detailed in Table 4.1-1. When combined with their respective individual crop acreages, it is estimated that about 21,200 af of applied agricultural irrigation deep percolated to groundwater as return flows in the SMVMA in 2015.

4.2 Treated Municipal Waste Water Discharge

There are three municipal waste water treatment plants in the SMVMA: the City of Santa Maria plant located west of the City; the Laguna Sanitation District plant west of the Santa Maria Airport; and the City of Guadalupe plant west of Guadalupe (see Appendix A, Figure 2a). At the City of Santa Maria WWTP, influent volumes are metered and recorded, and all treated water is discharged to percolation ponds near Green Canyon adjacent to the plant facilities. At the Laguna Sanitation District (Laguna CSD) WWTP, influent volumes are metered and recorded, and in 2015, the large majority of treated water (93%) was discharged to permanent spray fields north and west of the plant facilities and to Santa Maria airport lands for irrigation. Of the remaining Laguna SD effluent, a small amount (5%) was brine derived from reverse osmosis treatment of part of the total waste water flow; that brine is discharged to a deep injection well (a converted oil well, completed below the base of fresh groundwater). The balance of effluent (2%) was conveyed to an oil lease within the SMVMA for industrial use. At the City of Guadalupe WWTP, influent volumes are recorded and all treated water is discharged to permanent spray fields north of the plant facilities, across the Santa Maria River (with storage pond north of the facility).

The monthly total influent data from 2015 are shown by facility and method of disposal in Table 4.2-1. For all three plants, effluent volumes are estimated to be 90 percent of the metered influent, with the remainder assumed to be lost (consumed) during treatment. In 2015, a total estimated 10,600 af of treated municipal waste water were discharged in the SMVMA. About 77 percent (8,200 af) of that total was discharged to the percolation ponds of the City of Santa Maria WWTP. Approximately 21 percent (2,280 af) of the total treated water was discharged by Laguna CSD to spray irrigation of the WWTP permanent pasture and Santa Maria airport lands and by the City of Guadalupe to spray irrigation. About one percent (80 af of brine) of the total treated water was discharged by deep well injection and the remaining approximate one percent (34 af) was utilized for industrial purposes on an oil lease near Orcutt.

The Stipulation has provisions for each of the municipal water purveyors in the SMVMA to have rights to recover return flows that derive from their respective importations of water from the SWP. Those rights are to specific fractions of SWP water use in the preceding year; they are limited in time to recovery in the following year, and thus do not carry over or otherwise accumulate in the basin. The respective fractions for the three municipal purveyors are 65 percent for Santa Maria and 45 percent each for GSWC (formerly Southern California Water Company) and for Guadalupe. The Stipulation is silent as to the basis for the respective fractions; logically, however, they would have some basis in the fate of imported SWP water, i.e. what fraction ends up being “disposed” as a “return flow” to the groundwater basin.

Since the SMVMA water supply is a commingled combination of groundwater and SWP water, the “return flow” fraction attributable to SWP water would be the same as that for the commingled supply. An accounting of waste stream volumes from the different sources as influent to the three WWTPs and the calculated return flows generated from the WWTP discharge for years 1997 through 2015 are provided in Table 4.2-2. Return flows derived from landscape irrigation within the SMVMA urban areas (water applied beyond the consumptive use of landscape plantings) are also included in Table 4.2-2. The supporting calculations of return flows from WWTP discharge (for 1997 through 2015) and landscape irrigation (2008 through 2015) are provided in Appendices D and E, respectively. Included in Appendix E for 2015 are return flows generated from septic systems in the GSWC Sisquoc water service area.

While the volume of influent is recorded at each of the three WWTPs, the amount of water toward landscape irrigation is necessarily estimated. The monthly base indoor water usage is assumed to approximately equal the reported water supply for the winter months, with water use in excess of that base amount for all other months calculated as landscape irrigation. The balance of water supplies (i.e., not conveyed to WWTPs or utilized for landscape irrigation) is assumed to have been consumptively used or lost during conveyance in water service areas. The results of these calculations provide an indication of the fate of water used by the cities of Santa Maria and Guadalupe and by the GSWC. Specifically, the fate and average percentage of each purveyor's respective water supplies (for 2008 – 2015, see Appendix E) are as follows:

- WWTP total influent/water supply: Santa Maria, 66%; GSWC, 33%; Guadalupe, 72%
- Landscape irrigation/water supply: Santa Maria, 32%; GSWC, 43%; Guadalupe, 22%
- Residential consumption and conveyance loss/water supply: Santa Maria, 2%; GSWC, 24%; Guadalupe, 6%

Interpretation of the Santa Maria municipal water supply and waste water processes, as well as the estimated return flows from WWTPs and landscape irrigation, indicates the average fraction of return flows to water supply for the period from 1997 through 2015 is 66 percent. Thus, the 65 percent "return flow" fraction specified in the Stipulation for Santa Maria is representative of the amount of Santa Maria water supply providing return flow to the SMVMA. This is primarily the case because the great majority of waste water generated in Santa Maria is conveyed to the City's WWTP (with some small amount conveyed to the Laguna CSD WWTP) where effluent discharge is to percolation ponds for purposeful infiltration (and generation of return flows) to the groundwater basin (see Table 4.2-2).

Interpretation of the GSWC/Laguna CSD and Guadalupe water supplies and waste water processes, as well as the estimated return flows from WWTPs and landscape irrigation, indicates their average fractions of return flows to water supplies for the 1997 through 2015 period are 18 and 16 percent, respectively. Thus, it appears the 45 percent "return flow" fraction specified in the Stipulation for GSWC and Guadalupe is not representative of the amount of their respective water supplies providing return flow to the SMVMA. This is likely the case because the great majority of waste water generated in the GSWC service areas is conveyed to the Laguna CSD WWTP (with some small amount conveyed to the Santa Maria WWTP), and the waste water generated in Guadalupe is conveyed to their WWTP. At both plants, effluent discharge is primarily to permanent spray fields for evapotranspiration, with only minor generation of return flows to the groundwater basin.

In summary, as long as the existing waste water treatment and disposal processes remain in place at the Laguna CSD and City of Guadalupe WWTPs, the results of these analyses support the 65 percent fraction for the City of Santa Maria but not the 45 percent fraction for GSWC and the City of Guadalupe. Instead, the results suggest that the GSWC and Guadalupe fractions are roughly one half of the 45 percent fraction specified in the Stipulation for recovering return flows from their respective use of SWP water. Any “recovery” of those amounts of water by groundwater pumping would actually be comprised of about one-half SWP “return flow” with the balance being groundwater unrelated to imported SWP water use by either entity.

4.3 Agricultural Drainage

In areas of low soil and aquifer permeability and shallow groundwater levels, such as the Oso Flaco Valley, agricultural irrigation water in excess of crop water requirements percolates past the crop root zone to provide return flows to the aquifer or to be intercepted by area drains before reaching the aquifer. Further, the return flows to the aquifer increase water in storage in the aquifer and raise shallow groundwater levels; in certain cases, this rise in groundwater levels can be sufficiently high for area drains to capture and drain groundwater from the aquifer.

While no known measurements exist of the agricultural drainage that occurred in the SMVMA during 2015, a recent study produced information about the timing and amounts of drainage in several portions of Oso Flaco Creek during 2010, 2011, and early 2012 (Althouse and Meade, Inc., October 2012). From this information, specifically the reported monthly mean discharge (in cfs) at a portion of the Creek immediately upstream from Oso Flaco Lake, an estimate was made of the total annual agricultural drainage in 2010 and 2011. Discharge at this point was considered to represent the total drainage of the area, including the agricultural drainage and the surface water runoff associated with rain events. The discharge measured during the dry months of each year, specifically May through October, was considered to be comprised solely of agricultural drainage with no contribution of surface water runoff from rain. During 2010, the monthly mean discharge rates for May through October were similar and averaged 6.5833 cfs, and during 2011, the monthly mean discharge rates for May through October were also similar and averaged 5.8750 cfs. These rates were assumed to represent the agricultural drainage that occurred during all months of each year and were utilized to estimate annual agricultural drainage, approximately 4,800 af in 2010 and 4,300 af in 2011, or an average of about 4,500 afy.

In the SMVMA 2014 annual report (LSCE, April 2015), in order to estimate agricultural drainage in the area during 2014, consideration was made of the depth to groundwater and the period of seasonal agricultural irrigation during 2010, 2011, and 2014. While area groundwater levels were slightly lower in 2014 than in 2010/2011 (and thus would be expected to contribute less groundwater to drainage ditches and Oso Flaco Creek), it appears that the irrigation season began earlier and was longer in 2014 than in 2010/2011 (and thus would be expected to contribute more intercepted water to drainage ditches and the Creek). Each of these factors was assumed to offset each other and, for that reason, the average discharge of 4,500 afy was used as an estimate of the agricultural drainage in 2014.

Review of Oso Flaco area groundwater depths and agricultural irrigation in 2015 indicates that, compared to 2014, groundwater levels are lower but it appears the irrigation season began earlier and was longer. Again, each of these factors was assumed to offset each other and, for that reason, the average discharge of 4,500 afy was used as an estimate of the agricultural drainage in 2015.

4.4 Exported Water (Intra-Basin Transfer)

The Stipulation includes provisions specific to the NMMA for implementation of a Memorandum of Understanding (MOU) between the City of Santa Maria and the Nipomo CSD that would provide for the sale of a minimum of 2,500 af of "supplemental water" per year by the City to Nipomo CSD. That sale for delivery of water constitutes an export of water from the SMVMA to the NMMA, as well as an intra-basin transfer of water within the Santa Maria Groundwater Basin.

In support of the sale, an agreement was approved between the City and Nipomo CSD that serves as a successor to the MOU (Wholesale Water Supply Agreement or "Agreement") and facilities were completed with the capacity to convey 500 to 1,000 afy of water from the SMVMA to the NMMA ("Phase I" Waterline Intertie Project or WIP). The Agreement and WIP accommodate future project expansion such that water deliveries are planned as follows: 645 af in year one; 800 afy in years 2 through 5; 1,000 afy in years 6 through 10, and 2,500 afy in years 11 through the term of the agreement (2085). A provision in the Agreement specifies that the Nipomo CSD may request delivery of an additional 3,200 afy in excess of these quantities (potential total delivery of 5,700 afy).

The intra-basin transfer of water from the SMVMA to the NMMA commenced in July 2015, with the delivery of about 50 af of water in each month from July through December. Thus, in the latter half of 2015, a total of 314 af of water was transferred. Delivery of an additional 300 af of water is planned for the first half of 2016 to complete year 1 of the Agreement. The 314 af of water transferred in 2015 was comprised of about 215 af of groundwater pumped from City water supply wells and 100 af of SWP water delivered to the City.

While the water transfer in 2015 reduced the amount of groundwater pumping of the NCSD, as is one intent of the Stipulation provision regarding the sale of water for transfer, it necessitated a corresponding increase in groundwater pumping in the SMVMA. With the planned phased increase in water transfers per the provisions of the Agreement, two technical concerns remain about the potential impacts to SMVMA water resources, in particular groundwater levels, from the ongoing transfer of water to the NMMA. Those concerns, expressed in the previous annual reports for the SMVMA, are discussed herein.

<u>1) Identification of Surplus Water in the SMVMA</u>

Analysis needs to be conducted to identify the existence of surplus water in the SMVMA to meet the additional water requirements of the planned water transfer to the NMMA. The City of Santa Maria has previously listed a combination of water supplies by type and quantity that exceed its existing and currently projected water requirements. The list includes appropriative rights to groundwater in the SMVMA; a portion of the yield from Twitchell Reservoir operations; imported SWP supplies; and return flows from SWP water use by the City. However, analysis is needed to identify whether there are sufficient water supplies reliably available to the City whereby a "surplus" exists to support the transfer of water to the NMMA according to the Agreement without causing a shortage in the SMVMA. An example of such analysis is development of water budget scenarios to evaluate potential change in storage in the SMVMA under current and potential future water supply conditions.

Through its Utilities Department, the City has previously maintained the intent to analyze this issue as part of a larger effort that will include securing additional SWP allocation on a schedule that coincides with requests from Nipomo CSD for water deliveries from the City (personal communication, R. Sweet, City of Santa Maria, May 15, 2013). Regardless of the timing of such requests, the City continues its pursuit of additional SWP allocation in order to support the transfer of water under the Agreement as well as offset projected reductions in the overall reliability of SWP water deliveries (personal communication, S. Springer, City of Santa Maria, April 18, 2016).

2) Analysis of the Distribution of Increased Groundwater Pumping

The Agreement specifies water delivered to Nipomo CSD by the City be of the same quality delivered to City customers (a mix of groundwater and SWP water). Meeting this specification would require the City to increase groundwater pumping beyond its own demand in most years, given the City's current SWP entitlement and the current average SWP water availability. However, analysis needs to be conducted to evaluate potential impacts to groundwater levels in the SMVMA from the associated increase in groundwater pumping. An example of such analysis is estimation of groundwater levels under a range of additional pumping amounts, as well as diverse pumping locations and well depths, to provide information about how to distribute groundwater pumping to minimize groundwater level impacts.

For reference in the following discussion, Table 4.3-1 is a summary examination of the respective amounts of SWP water and SMVMA groundwater that would supply the City alone ("without Agreement" case) compared to the respective amounts that would supply both the City and Nipomo CSD ("with Agreement" case). The examination in Table 4.3-1 accommodates the range in SWP delivery amounts with varying SWP availability. Two scenarios have been constructed for the case comparisons: Scenario 1, which reflects "current" conditions (2015 City water demand and 315 af of water transferred to the Nipomo CSD) and Scenario 2, which reflects one set of possible "projected" conditions (2015 City water demand and 2,500 afy of water transferred).

Scenario 1 examines the case of implementing the Agreement under current conditions, i.e., 2015 City water demand for the SMVMA, a SWP availability of 20 percent (with the corresponding SWP deliveries), and the transfer of 315 af of water to the NMMA. This would produce fractions of 28 percent SWP water and 72 percent groundwater to a combination of City and Nipomo CSD customers. However, compared to the water supply in the "without Agreement" case, SWP water use in the SMVMA would have decreased from the full availability of 3,560 af to 3,470 af; and the total groundwater pumping by the City would have increased from 8,625 af to about 8,940 af. This additional groundwater pumping amount of 315 af equates to the amount of water that would have been transferred to the NMMA under the Agreement comprised of 90 af SWP water and 225 af groundwater in order to provide water of equivalent quality.

Review of the City's actual water supply within the SMVMA and the Nipomo CSD's transferred water in 2015 indicates the blended fractions of water are very similar to those of Scenario 1, with 27 percent SWP water and 73 percent local groundwater. In order to provide the 315 af of water for transfer, the City decreased its SWP water use in the SMVMA by 100 af (from 3,435 to 3,335 af) and increased its groundwater pumping by 315 af (from 8,550 to 8,865 af), of which 215 af was transferred.

Scenario 2 examines the case of implementing the Agreement under one set of possible projected conditions, i.e., as in Scenario 1 regarding City water demand for the SMVMA and SWP availability and deliveries, but with an increase in water transferred to the NMMA to 2,500 af. This would produce fractions of 24 percent SWP water and 76 percent groundwater to a combination of City and Nipomo CSD customers. However, compared to the water supply in the "without Agreement" case,, SWP water use in the SMVMA would decrease from the full availability of 3,560 af to about 2,955 af; and the total groundwater pumping by the City would increase from 8,625 af to 11,125 af. This additional groundwater pumping amount of 2,500 af equates to the amount of water that would be transferred to the NMMA under the Agreement comprised of 605 af SWP water and 1,895 af groundwater in order to provide water of equivalent quality.

Regarding the potential impacts to groundwater levels in the SMVMA associated with increased groundwater pumping, the City's Utilities Department has previously maintained its intent to conduct an analysis. Such analysis would again be part of a larger effort that includes acquiring additional SWP allocation on a schedule that coincides with requests from Nipomo CSD for water deliveries from the City.

Implicit in discussion of these two technical concerns is that the City's water demand for the SMVMA (excluding the additional demand to meet intra-basin transfers) is currently projected to increase from about 12,200 af in 2015 to about 14,500 af in 2030, and then to about 16,200 af by 2040 (City of Santa Maria, April 2016). Importantly, the current projection of water demand is lower than previous projections due to the fact recent conservation efforts of the City and its customers have resulted in substantially lower per capita water use. Specifically, per capita water use has decreased from over 200 gallons per day (GPD) before 1990 to less than 110 GPD in 2015. This can be seen in the City's 2015 water demand, which is about 10 percent lower than the previous year and essentially at the amount of the late 1980's. As such, at least in 2015, water conservation, not the acquisition of additional SWP allocation, met (and in fact exceeded) the City's additional demand specific to intra-basin water transfer.

In addition to the technical concerns above, resolution is needed about the potential conflict between the Stipulation and the Agreement regarding the importation and use of SWP water in the SMVMA. The Stipulation specifies the City import and use within the SMVMA at least 10,000 afy of SWP water unless limited SWP availability precludes importation of the 10,000 af; in those years, the City is to import and use its full available SWP supply in the SMVMA. However, if the City transfers water in accordance with the Agreement in years when its SWP supply is less than 10,000 af (i.e., in years when SWP availability is less than about 60 percent), the City would be out of compliance with the Stipulation by not utilizing its full available SWP supply within the SMVMA. Further, the City would need to pump more groundwater than envisioned by the Stipulation to replace the transferred SWP water and meet the balance of additional water requirements of the Agreement.

The preceding discussion is intended to illustrate the potential conflict between the Stipulation and the Agreement. With the Agreement calling for the transfer of 315 af of water in the latter part of 2015, and given the City's current SWP entitlement (17,800 af), the current average SWP water availability for the SMVMA (64 percent), and the SWP availability as it was in 2015 (20%), the City technically could not fully satisfy both the Agreement and the Stipulation. The SWP water available to the City in 2015 was 3,560 af, but the Agreement called for the transfer of 90 af of that SWP water to the NMMA, with a balance of only 3,470 af of SWP water available for use in the SMVMA, less than the minimum specified in the Stipulation. Without access to additional SWP water, the City would be required by the Stipulation to dedicate the full 3,560 af of SWP allocation to the SMVMA with no delivery of SWP water as part of the transfer to the NMMA. To at least fulfill the intra-basin transfer of a volume of 315 af of water (Scenario 1) or 2,500 af of water (Scenario 2), the water transferred would then necessarily be comprised solely of groundwater, with a different water quality than delivered to City customers, thus not fully satisfying the Agreement.

In summary regarding the intra-basin transfer of water from the SMVMA to the NMMA, the City recognizes the preceding concerns and continues work on their resolution. Primarily, the City is maintaining efforts to increase its long-term water supply, in particular working toward securing approximately 12,000 afy or more of additional SWP allocation. Possible sources include some combination of suspended SWP Table A allocation in Santa Barbara County and unused SWP Table A allocation in San Luis Obispo County. These efforts are certainly toward satisfying the provisions of the Stipulation and Agreement, namely the transfer of water from the SMVMA to the NMMA, as well as offsetting projected reductions in SWP water supply reliability.

Table 4.1-1

Applied Crop Water Requirements, Total Agricultural Water Requirements and Return Flows, 2015

Santa Maria Valley Management Area

Crop Category	Evapotranspiration of Crop ETc (in)	Effective Precipitation P_E (in)	Evapotranspiration of Applied Water ETaw (in)	Evapotranspiration of Applied Water ETaw (af/ac)	Distribution Uniformity DU (%)	Applied Water AW (af/ac)	Crop Acreage	Estimated Water Requirements (af)	Applied Water above ETaw AW-ETaw (ft)	Agricultural Return Flow (af)
Rotational Vegetables[1]	25.69	1.14	24.55	2.05	80	2.56	34,638	88,596	0.51	17,719
Strawberries[1]	18.18	2.05	16.13	1.34	85	1.58	10,810	17,096	0.24	2,564
Hydroponic[2]	---	---	---	---	---	2.00	135	270		
Vineyard[3]	---	---	15.6	1.3	95	1.4	4,919	6,731	0.07	337
Pasture[1]	48.77	3.86	44.91	3.74	80	4.68	465	2,175	0.94	435
Grain[3]	---	---	8.4	0.7	80	0.9	165	144	0.18	29
Nursery[4]	---	---	---	---	---	2.0	215	430	0.40	86
Deciduous[3]	---	---	32.4	2.7	85	3.2	13	41	0.48	6
Avocado[3]	---	---	32.4	2.7	85	3.2	26	83	0.48	12
Fallow	---	---	2.4	0.2	---	0.2	909	182	0.00	0
Total							**52,295**	**115,749**		**21,189**

1) CIMIS-based applied crop water duties

2) Research-based applied crop water duty

3) Reported ETaw-based applied crop water duties

4) NMMA applied crop water duty; DU assumed as 80%

Table 4.2-1
Treated Municipal Waste Water Discharge in 2015
Santa Maria Valley Management Area
(all amounts in acre-feet)

	City of Santa Maria[1]		Laguna Sanitation District WWTP[2]					City of Guadalupe[3]		Total Municipal Waste Water Discharge					
	Metered Influent	Estimated Effluent	Metered Influent	Estimated Effluent				Metered Influent	Estimated Effluent	Influent	Effluent				
Month	Total	Total	Total	irrigation[4]	injection	industrial use[5]	Total	Total	Total	Total	ponds	irrigation	injection	industrial use	Total
January	706	636	172	142	6.9	5.7	155	69	62	948	636	205	6.9	5.7	853
February	671	604	155	128	6.2	5.3	139	63	56	888	604	184	6.2	5.3	799
March	752	677	171	143	6.8	4.7	154	67	60	990	677	203	6.8	4.7	891
April	816	735	159	134	6.6	3.3	143	69	62	1,044	735	195	6.6	3.3	940
May	744	670	122	100	6.8	3.3	110	68	62	935	670	161	6.8	3.3	841
June	719	647	146	121	6.7	3.1	131	66	60	931	647	181	6.7	3.1	838
July	804	724	138	114	6.9	3.3	124	68	62	1,011	724	176	6.9	3.3	910
August	785	707	151	126	6.9	3.4	136	69	62	1,005	707	188	6.9	3.4	905
September	762	686	152	128	6.4	1.9	137	75	67	989	686	196	6.4	1.9	890
October	892	803	158	136	6.2	0.2	142	76	68	1,126	803	204	6.2	0.2	1,013
November	755	679	156	133	6.9	0.0	140	64	57	974	679	190	6.9	0.0	876
December	706	636	162	139	6.4	0.2	146	65	58	933	636	197	6.4	0.2	840
Annual Totals	**9,113**	**8,202**	**1,842**	1,544	80	34	**1,658**	**818**	**736**	**11,773**	8,202	2,280	80	34	**10,596**

1) Total effluent estimated as 90% of metered influent (assumed loss of 10% during treatment); all effluent discharged to ponds.
2) Total effluent estimated as 90% of metered influent; brine discharged to deep injection well and treated water for industrial use is metered, with the balance of discharge for irrigation.
3) Total effluent estimated as 90% of metered influent; all effluent discharged to spray fields.
4) Includes spray irrigation on Laguna San fields and irrigation on Santa Maria airport lands.
5) For industrial use on oil lease in SMVMA.

Table 4.2-2
Estimated Recent Historical Return Flows from WWTPs and Landscape Irrigation
Santa Maria Valley Management Area
(all units in afy unless otherwise noted)

	Total Water Use				Effluent Available for Return Flows					Estimated Landscape Irrigation			Return Flows													
					Santa Maria		GSWC		Guadalupe				Santa Maria					Golden State Water Company					Guadalupe			
Year	SM	GSWC	GSWC[1]	Guad	from SM WWTP	from LSD WWTP	from SM WWTP	from LSD WWTP	from Guad WWTP	Santa Maria[2]	GSWC[3]	Guadalupe[4]	from SM WWTP[5]	from LSD WWTP[6]	from landscape irrigation[7]	Total	% of Water Use	from SM WWTP[5]	from LSD WWTP[6]	from landscape irrigation[7]	Total	% of Water Use	from Guad WWTP[6]	from landscape irrigation[7]	Total	% of Water Use
1997	12,522	9,441	9,387	778	7,279	83	296	2,269	420	4,383	4,626	163	7,279	17	877	8,172	65	296	454	925	1,675	17.8	84	33	117	15
1998	11,085	8,001	7,960	778	6,434	82	302	1,874	420	3,880	3,921	163	6,434	16	776	7,226	65	302	375	784	1,461	18.4	84	33	117	15
1999	11,859	9,263	9,193	778	6,899	82	298	2,215	420	4,151	4,539	163	6,899	16	830	7,745	65	298	443	908	1,649	17.9	84	33	117	15
2000	12,679	9,399	9,342	778	7,223	83	309	2,459	420	4,438	4,606	163	7,223	17	888	8,127	64	309	492	921	1,722	18.4	84	33	117	15
2001	12,594	9,009	8,950	778	7,538	83	323	2,500	420	4,408	4,414	163	7,538	17	882	8,436	67	323	500	883	1,706	19.1	84	33	117	15
2002	13,312	9,466	9,409	778	7,661	83	320	2,287	420	4,659	4,638	163	7,661	17	932	8,610	65	320	457	928	1,705	18.1	84	33	117	15
2003	13,499	9,071	9,023	778	7,766	83	431	2,281	420	4,725	4,445	163	7,766	17	945	8,728	65	431	456	889	1,776	19.7	84	33	117	15
2004	13,650	9,356	9,302	832	8,201	83	399	2,240	449	4,778	4,585	175	8,201	17	956	9,173	67	399	448	917	1,764	19.0	90	35	125	15
2005	13,814	8,846	8,802	814	8,374	82	317	1,990	439	4,835	4,334	171	8,374	16	967	9,358	68	317	398	867	1,582	18.0	88	34	122	15
2006	13,610	8,754	8,700	883	8,251	81	288	1,724	477	4,764	4,289	185	8,251	16	953	9,220	68	288	345	858	1,491	17.1	95	37	132	15
2007	14,782	9,710	9,652	1,063	8,074	81	368	1,854	574	5,174	4,758	223	8,074	16	1,035	9,125	62	368	371	952	1,690	17.5	115	45	159	15
2008	14,235	9,311	9,255	997	8,123	81	444	1,963	570	4,952	4,282	211	8,123	16	990	9,130	64	444	393	856	1,693	18.3	114	42	156	16
2009	14,172	8,729	8,668	917	8,057	81	467	1,932	598	5,392	4,228	216	8,057	16	1,078	9,152	65	467	386	846	1,699	19.6	120	43	163	18
2010	13,294	7,735	7,681	880	7,360	80	489	1,888	598	4,176	4,052	201	7,360	16	835	8,211	62	489	378	810	1,677	21.8	120	40	160	18
2011	12,665	7,844	7,794	885	7,598	81	506	1,933	589	3,377	3,005	124	7,598	16	675	8,290	65	506	387	601	1,494	19.2	118	25	143	16
2012	13,038	8,296	8,241	924	8,028	84	490	1,861	613	4,247	3,710	180	8,028	17	849	8,895	68	490	372	742	1,604	19.5	123	36	159	17
2013	13,719	8,576	8,526	956	8,094	84	376	1,819	614	4,639	3,598	235	8,094	17	928	9,038	66	376	364	720	1,460	17.1	123	47	170	18
2014	13,321	7,703	7,651	1,123	7,850	84	250	1,849	712	4,372	3,493	317	7,850	17	874	8,741	66	250	370	699	1,319	17.2	142	63	206	18
2015	12,185	6,022	5,988	1,101	7,956	84	246	1,460	736	2,865	1,673	145	7,956	17	573	8,546	70	246	292	335	872	14.6	147	29	176	16
																avg %	66				avg %	18			avg %	16

Estimated

SM City of Santa Maria
GSWC Golden State Water Company
Guad City of Guadalupe
LSD Laguna Sanitation District

1) Excludes Sisquoc System water use (for effluent return flow calculations).
2) Percent range of SM total water supply used for landscape irrigation estimated from monthly water use data since 2008 = 24-38%.
3) Percent range of GSWC total water supply used for landscape irrigation estimated from monthly water use data since 2008 = 28-53%.
4) Percent range of Guad total water supply used for landscape irrigation estimated from monthly water use data since 2008 = 13-28%.
5) All effluent from Santa Maria WWTP percolation ponds assumed as return flows.
6) 20 percent of effluent from Laguna San and Guadalupe WWTP spray irrigation assumed as return flows.
7) 20 percent of landscape irrigation assumed as return flows.

Table 4.3-1
Water Requirements, Supplies, and Amounts Delivered under Current and Projected Conditions
Wholesale Water Supply Agreement, May 7, 2013
Santa Maria Valley Management Area
(State Water Project water availability in 2015, 20 percent)

Scenario 1: Current Conditions with Intra-Basin Transfer from SMVMA to NMMA in 2015, Partial Year 1 of the Agreement (315 af transferred)

SWP		**City Water Requirements**			**City Water Supply**					**City Water Delivered****					
		In 2015	=	12,185						SMVMA			NCSD		
Allocation (%)	**Supply to City** (af)	City (af)	NCSD (af)	Total (af)	SWP (af)	(%)*	Groundwater (af)	(%)*	Total (af)	SWP (af)	Groundwater (af)	Total (af)	SWP (af)	Groundwater (af)	Total (af)
100	17,800	12,185	315	12,500	12,500	100	0	0	12,500	12,185	0	12,185	315	0	315
90	16,020	12,185	315	12,500	12,500	100	0	0	12,500	12,185	0	12,185	315	0	315
80	14,240	12,185	315	12,500	12,500	100	0	0	12,500	12,185	0	12,185	315	0	315
75	13,350	12,185	315	12,500	12,500	100	0	0	12,500	12,185	0	12,185	315	0	315
70	12,460	12,185	315	12,500	12,460	100	40	0	12,500	12,146	39	12,185	314	1	315
65	11,570	12,185	315	12,500	11,570	93	930	7	12,500	11,278	907	12,185	292	23	315
60	10,680	12,185	315	12,500	10,680	85	1,820	15	12,500	10,411	1,774	12,185	269	46	315
50	8,900	12,185	315	12,500	8,900	71	3,600	29	12,500	8,676	3,509	12,185	224	91	315
40	7,120	12,185	315	12,500	7,120	57	5,380	43	12,500	6,941	5,244	12,185	179	136	315
30	5,340	12,185	315	12,500	5,340	43	7,160	57	12,500	5,205	6,980	12,185	135	180	315
20	**3,560**	**12,185**	**315**	**12,500**	**3,560**	**28**	**8,940**	**72**	**12,500**	**3,470**	**8,715**	**12,185**	**90**	**225**	**315**
10	1,780	12,185	315	12,500	1,780	14	10,720	86	12,500	1,735	10,450	12,185	45	270	315
5	890	12,185	315	12,500	890	7	11,610	93	12,500	868	11,317	12,185	22	293	315

Given:

City Table A (af) = 17,800
City Water Req (af) = 12,185
NCSD Water Req (af) = 315

* % of total water requirements by source
** provides for water delivered to be of equal quality

Scenario 2: Projected Conditions with Intra-Basin Transfer from SMVMA to NMMA, From Agreement Year 11 Forward (2,500 afy transfer)

SWP		**City Water Requirements**			**City Water Supply**					**City Water Delivered****					
		In 2015	=	12,185						SMVMA			NCSD		
Allocation (%)	**Supply to City** (af)	City (af)	NCSD (af)	Total (af)	SWP (af)	(%)*	Groundwater (af)	(%)*	Total (af)	SWP (af)	Groundwater (af)	Total (af)	SWP (af)	Groundwater (af)	Total (af)
100	17,800	12,185	2,500	14,685	14,685	100	0	0	14,685	12,185	0	12,185	2,500	0	2,500
90	16,020	12,185	2,500	14,685	14,685	100	0	0	14,685	12,185	0	12,185	2,500	0	2,500
80	14,240	12,185	2,500	14,685	14,240	97	445	3	14,685	11,816	369	12,185	2,424	76	2,500
75	13,350	12,185	2,500	14,685	13,350	91	1,335	9	14,685	11,077	1,108	12,185	2,273	227	2,500
70	12,460	12,185	2,500	14,685	12,460	85	2,225	15	14,685	10,339	1,846	12,185	2,121	379	2,500
65	11,570	12,185	2,500	14,685	11,570	79	3,115	21	14,685	9,600	2,585	12,185	1,970	530	2,500
60	10,680	12,185	2,500	14,685	10,680	73	4,005	27	14,685	8,862	3,323	12,185	1,818	682	2,500
50	8,900	12,185	2,500	14,685	8,900	61	5,785	39	14,685	7,385	4,800	12,185	1,515	985	2,500
40	7,120	12,185	2,500	14,685	7,120	48	7,565	52	14,685	5,908	6,277	12,185	1,212	1,288	2,500
30	5,340	12,185	2,500	14,685	5,340	36	9,345	64	14,685	4,431	7,754	12,185	909	1,591	2,500
20	**3,560**	**12,185**	**2,500**	**14,685**	**3,560**	**24**	**11,125**	**76**	**14,685**	**2,954**	**9,231**	**12,185**	**606**	**1,894**	**2,500**
10	1,780	12,185	2,500	14,685	1,780	12	12,905	88	14,685	1,477	10,708	12,185	303	2,197	2,500
5	890	12,185	2,500	14,685	890	6	13,795	94	14,685	738	11,447	12,185	152	2,348	2,500

Given:

City Table A (af) = 17,800
City Water Req (af) = 12,185
NCSD Water Req (af) = 2,500

* % of total water requirements by source
** provides for water delivered to be of equal quality

5. Conclusions and Recommendations

Conclusions drawn from assessment of the hydrogeologic conditions and the water requirements, supplies, and disposition in the SMVMA in 2015 are discussed in the following section, which is in turn followed by recommendations for ongoing data collection, water resource management, and future technical analyses.

5.1 Conclusions

5.1.1 Hydrogeologic Conditions

Assessment of hydrogeologic conditions in 2015 showed that groundwater levels slightly declined from 2014, but the water levels and general mineral quality in the shallow and deep aquifer zones remain within historical ranges for the SMVMA. As has historically been the case for several decades, the prevailing gradients for groundwater flow in both zones was reduced (flattened) in the vicinity of local pumping near the Santa Maria Airport, but groundwater flow continued through the area toward the coast where groundwater levels remained above sea level. Concentrations of nitrate in groundwater remained near or below detection limits in the deep aquifer zone, but continued to increase in the shallow zone near Orcutt. Nitrate concentrations also continued to gradually increase in portions of the aquifer along the coast.

Operation of Twitchell Reservoir has, overall, continued to provide conservation of runoff for subsequent release for groundwater recharge in the SMVMA, despite sedimentation that has now filled the former dead pool storage below the conservation pool of the Reservoir. However, with precipitation well below average the last four years, Twitchell Reservoir storage was essentially nil and, in 2015, no releases were made from the reservoir and stream discharge in the Sisquoc River was well below average. The decline in groundwater levels observed across the SMVMA in 2015 was at least partially due to the lack of Twitchell releases and greatly reduced Sisquoc River discharge.

General mineral and nitrate concentrations remain higher in streams in the western and southern portion of the SMVMA, including the Santa Maria River, Oso Flaco Creek, and Green Canyon near Guadalupe, as well as Orcutt Creek and Bradley Canyon on the Orcutt Upland. In particular, the streams are degraded with elevated concentrations of dissolved salts, measured as specific conductance, and nitrate. In comparison, the Cuyama, Sisquoc, and Santa Maria Rivers in or flowing into the eastern portion of the SMVMA have only slightly elevated salt levels and very low levels of nitrate. In the case of all the main streams, the reported constituent concentrations in 2015 were within their respective historical ranges.

5.1.2 Water Requirements, Supplies, and Disposition

Total water requirements for the SMVMA in 2015 slightly exceeded those of the previous year (135,370 and 134,830 af, respectively). In fact, the water requirements for agricultural irrigation increased by about 3,000 af while those for municipal use decreased by almost equal magnitude. Regarding total water supplies in 2015 compared to the previous year, imported SWP water deliveries were increased (3,450 and 1,765 af, respectively) as was the SWP availability (20 and 5 percent, respectively), while total groundwater pumping decreased (131,920 and 133,060 af, respectively). Regarding the disposition of the total water used in 2015 compared to the previous year, the consumptive use of water was stable (104,260 and 103,965 af, respectively), as were return flows (30,800 and 30,865 af, respectively). The initial water transfer in 2015 to the NMMA (about 315 af) can be considered as additional consumptive use of water in the SMVMA, as this water would not have generated return flows to the SMVMA (although it would to the NMMA and, thus, the basin). Water requirements, supplies, and disposition in the SMVMA during 2015 are summarized in Table 5.1-1.

Regarding agricultural land and water use in 2015, the total irrigated acreage and crop distribution were very similar to the previous year (52,295 and 52,240 acres, respectively) with plantings devoted primarily to truck crops. The associated applied water requirement was higher than in the previous year (115,750 and 112,680 af, respectively), but 2015 crop acreage and water requirements are consistent with the generally constant trend in agricultural land and water use in the SMVMA over the last 20 years. Specifically, total irrigated cropland has been stable between 48,000 and 53,000 acres, with increased truck crop acreage and a decline in pasture, field, and citrus acreages. The associated applied water requirements have also been stable, although in the broad range of 80,000 to 120,000 afy that is largely driven by year-to-year weather conditions. The sole source of water supply for agricultural irrigation continues to be groundwater, and thus groundwater pumping for agricultural purposes in 2015 equaled the agricultural water requirement of 115,750 af. Disposition of the agricultural irrigation was to evapotranspiration by crops (90,060 af), return flow to the groundwater basin (21,190 af), and drainage captured in the Oso Flaco Valley area, specifically in drainage ditches and Oso Flaco Creek (4,500 af).

Regarding municipal water requirements and supplies in 2015, the total water requirement was reduced compared to the previous year (19,620 and 22,148 af, respectively) and consistent with the long-term trend for the SMVMA. Specifically, municipal water demand over the last 30 years has been fairly stable within a broad range of 19,000 to almost 26,000 afy. The total municipal water requirement in 2015 (19,620 af) was met by about 16,170 af groundwater and 3,450 af imported SWP water, or approximately 82 and 18 percent, respectively, of the total requirement. The groundwater pumping was approximately 21 percent lower than in the previous year (16,170 and 20,385 af, respectively), in fact on par with groundwater pumping reported for as long ago as the mid-1980's. The SWP water delivery was higher than in the previous year (3,450 and 1,765 af, respectively) but reduced compared to the long-range average delivery (10,250 af over the period 1997 – 2015). SWP water availability was higher than in the previous year (20 and 5 percent, respectively) but still reduced compared to the long range average availability (64 percent over 1997 – 2015). Importantly, in 2015, SWP water deliveries were somewhat lower than the minimum annual amounts specified in the Stipulation for all three municipal purveyors in the SMVMA (approximately 89 percent of the Stipulation total amount), primarily due to SWP operational complications.

Disposition of municipal water supply in 2015 was very similar to the last 10 to 15 years. A large portion of the total municipal water supply, 7,535 af, was utilized in municipal service areas, either consumptively used or generating return flow from landscape irrigation (in the

Sisquoc water service area, consumptive use and return flows also derive from septic systems). Most of the remaining municipal supply, about 11,775 af, was processed at WWTPs, with a portion of the plant influent consumed during treatment. The resulting balance of treated water generated return flows (primarily from surface spreading in infiltration basins and a minor amount through spray irrigation) or was consumed through spray irrigation evaporative loss and, in minor amounts, brine injection, and industrial use. The remainder of municipal supply, about 315 af, was transferred from the SMVMA to the NMMA to augment Nipomo CSD water supply.

5.1.3 Stipulation

The November 21, 2012, California Court of Appeal decision preserved the Stipulation provisions for each of the municipal purveyors in the SMVMA awarding rights to return flows derived from purveyors' respective importations of SWP water. At that time, appellants did not challenge the respective return flow percentages and, accordingly, the decision does not address their accuracy. However, current technical analysis, as described in this and previous annual reports, indicates the existing systems for waste water treatment and disposal are such that only the City of Santa Maria discharges in a manner that supports the 65 percent return flow fraction specified in the Stipulation for the City. Waste water treatment and disposal of waters supplied by GSWC and the City of Guadalupe are estimated to be roughly one-half the 45 percent return flow fraction specified in the Stipulation for them. Until there is some substantial change in their respective treatment and disposal schemes, or some provision of technical support for the 45 percent, the Stipulation provision that entitles recovery of 45 percent of SWP water to both purveyors should be decreased according to the current technical analysis.

Finally, the Stipulation delineates four specific criteria that, when all are met in any given year, define a condition of severe water shortage in the SMVMA; those four criteria are:

- chronic decline in groundwater levels (over period of not less than 5 years);
- groundwater level decline not caused by drought;
- material increase in groundwater use during the five year period; and
- groundwater levels below lowest recorded levels.

While groundwater levels in the SMVMA have gradually declined overall since about 2002 (with substantial recovery in 2011 temporarily interrupting the decline), they remain in 2015 above the lowest recorded levels in the great majority of the SMVMA. An exception to this was seen in the historical water level record for one deep well in the Twitchell Recharge Area, with 2015 water levels reflecting a localized lowering of water levels below its historical low. Drier conditions have prevailed through the period from 2002 through 2015, notably resulting in no releases from Twitchell Reservoir in 2002 through 2004, 2007, 2009, 2010, and 2013 through 2015, with only limited releases in most intervening years. Also of note during this dry period are the greatly reduced streamflows in the Sisquoc River. Thus, the recent gradual decline in groundwater levels is most likely attributable to this extended dry period and current drought conditions.

The total groundwater use in 2015, at 131,920 af, was comparable to use during the last 15 years, which has ranged between 90,000 and 135,000 afy. In summary, conditions in the SMVMA do not satisfy the criteria delineated in the Stipulation to define a severe water shortage; as a result, it is concluded that there is no severe water shortage in the SMVMA as of 2015.

5.2 Recommendations

There are several points that have the potential to affect hydrogeologic conditions and water supply in the SMVMA, including: 1) the intra-basin transfer of water from the SMVMA to the NMMA, 2) drought conditions and the associated groundwater level decline in the SMVMA extending into 2016, and 3) existing ground and surface water quality degradation in numerous portions of the SMVMA. An additional point regards the ongoing assessment of hydrogeologic and water supply conditions, specifically the expansion of water resource assessment to include evaluation of basin safe yield, and expansion of the monitoring program for the SMVMA to provide additional needed data. To address these points, several recommendations are made herein.

Intra-Basin Water Transfer

With the commencement of water transfer from the SMVMA to the NMMA by the City of Santa Maria according to the Stipulation and Agreement provisions, and as long as City SWP entitlement and the average SWP availability remain at current levels, it is then recommended the City proceed with its analysis of the following:

- Identifying surplus water in the SMVMA, logically from the acquisition of additional SWP entitlement, that could meet the additional water requirements typically needed for intra-basin water transfer; and

- Evaluating the potential impacts to groundwater in the SMVMA that may derive from such water transfer, specifically those from any associated increase in groundwater pumping.

Completion of these analyses would be protective of SMVMA water resources and water supplies and would facilitate compliance with Stipulation provisions regarding the importation and use of SWP water in the SMVMA, as well as with terms of the Agreement regarding the phasing and quality of water transferred.

Certainly related to this point is the City's continuing efforts to secure additional SWP entitlement to increase its long-term water supply, in particular working toward ultimately securing about 12,000 afy or more of additional SWP allocation.

Water Conservation and Groundwater Recharge

The amount of groundwater pumped in 2015 for municipal water supply in the SMVMA was substantially lower (21 percent) than the previous year, very likely due to conservation efforts. While it is unknown to what extent water conservation in the agricultural industry has reduced groundwater pumping over time, the continued conservation of water on the part of both municipal and agricultural interests would clearly benefit SMVMA groundwater resources.

Additionally, with the current drought extending into 2016, the augmentation of groundwater recharge projects could alleviate, to a certain extent, groundwater level declines in the SMVMA in the short and long term. Further, with the existing ground and surface water quality degradation in the SMVMA, the implementation or expansion of certain water resource management approaches could reduce the contribution of salts, nutrients, and other constituents of concern to ground and surface water. Thus, it is recommended that those activities that enhance groundwater recharge, including its quality, be developed further. Toward this goal, are the following examples:

- The City of Santa Maria is in the process of implementing long-term management options that would augment existing groundwater recharge and reduce contributions of constituents (e.g., salt and nutrients) to groundwater in the SMVMA;

- The Laguna CSD already provides a small amount of treated water for industrial use, effectively recycling water that, in turn, reduces groundwater pumping in the SMVMA by that amount. Expansion of this type of recycling would further benefit groundwater resources in the SMVMA; and

- The Irrigated Lands Program (CCRWQCB) has been implemented, with landowners and operators of irrigated lands conducting surface and groundwater monitoring with the goal of modifying management approaches to reduce contributions of constituents (e.g., fertilizers and pesticides) to ground and surface water.

Expansion of Water Resources Assessment

The current annual assessment of water resources in the SMVMA, conducted per provisions in the Stipulation, includes ground and surface water conditions, Twitchell Reservoir operations, and an accounting of water used in the SMVMA, specifically water requirements, supplies, and disposition. With the current period of declining groundwater levels, the existing ground and surface water quality degradation, and projected reductions in water supply, it is recommended that an expanded assessment of water resources be conducted. Specifically, a more detailed assessment needs to be made of water resources in the Santa Maria Groundwater Basin, such as by water budget analysis that accounts the components of inflow, outflow, and the associated change in storage in the basin. This level of accounting would facilitate a better understanding of the basin and management area water resources and their optimal management.

Expansion of SMVMA Monitoring Program

Implementation of the SMVMA monitoring program has proceeded in phases, and it is recommended that such efforts continue in order to fully implement the program. Examples of continued or expanded monitoring, in order of importance, include:

- measurement of groundwater levels on a semi-annual basis in designated wells (specifically, with the addition of fall measurements in wells typically measured only in the spring by the USGS, made under some formal long-term arrangement);

- activation of stream gauges, in order of priority: 1) Cuyama River (below Twitchell) and Santa Maria River (below Bonita School Road), 2) Sisquoc River tributaries (Foxen, La Brea, and Tepusquet Creeks), and 3) Santa Maria River tributaries (Nipomo and Suey Creeks);

- groundwater quality monitoring, general minerals and nitrate, on a biennial basis in designated water quality wells (beyond those monitored annually by the USGS);

- installation of pressure transducers in at least one well near the boundary between the SMVMA and the NMMA (beyond the two existing SLODPW monitoring wells already utilized);

- installation of at least one deep monitoring well north of the City of Santa Maria for inclusion in the monitoring program well networks; and

- surface water quality monitoring, for general minerals and nitrate, from Twitchell Reservoir and streams on a biennial basis.

Table 5.1-1
Summary of 2015 Total Water Requirements, Water Supplies, and Disposition
Santa Maria Valley Management Area
(in acre-feet)

Water Requirements			Water Supplies		
Agricultural	Municipal	Total	Groundwater	Imported SWP Water	Total
115,749	19,622	135,371	131,923	3,448	135,371

Water Disposition

Agricultural			
Consumption	Drainage	Return Flows	Total
90,060	4,500	21,189	115,749

Municipal										
Service Area Use			Waste Water Influent				Transfer to NMMA	Total		
7,535			11,773				314	19,622		
Consumption		Return Flows	Consumption/Disposal			Return Flows		Consumption	Return Flows	Transfer
In-Home	Irrigation/ Septic	Irrigation/ Septic	Treatment	Spray Irrigation	Injection/ Industial Use	Pond/Spray Field				
2,821	3,764	949	1,177	1,824	114	8,658		9,700	9,607	314

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Appendix A

SMVMA Monitoring Program

Monitoring Program for the Santa Maria Valley Management Area

prepared for

Superior Court of California, County of Santa Clara
and
Twitchell Management Authority

Luhdorff and Scalmanini
Consulting Engineers

October 2008
(revised April 2011 and 2013)

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I. INTRODUCTION

The terms and conditions of a Stipulation in the Santa Maria Valley Groundwater Basin Litigation passed down by the Superior Court of the State of California, County of Santa Clara, on June 30, 2005, are intended to "impose a physical solution establishing a legal and practical means for ensuring the Basin's long-term sustainability." Under the Stipulation, the groundwater, imported and developed water, and storage space of the Basin are to be managed in three management areas, including one for the Santa Maria Valley (SMVMA) (Figure 1). The management area is approximately 175 square miles in size encompassing the Santa Maria and Sisquoc Valleys, extending north to the Nipomo Mesa, east to the cliffs above the Santa Maria River and terraces along the Sisquoc River, south to the Casmalia and Solomon Hills, and west to the coast.

According to the Stipulation, a monitoring program is to be established for each of the three management areas to collect and analyze data regarding water supply and demand such that the following objectives are met:

1) assessment of groundwater conditions, both levels and quality;
2) determination of land use, water requirements, and water supply; and
3) accounting of amounts and methods of disposition of water utilized.

This monitoring program has been prepared to meet these objectives in the SMVMA. Also in accordance with the Stipulation, it is expected that the monitoring results will be utilized for preparation of annual reports on the SMVMA, including an assessment of whether conditions of severe water shortage are present. The monitoring program for the SMVMA, with minor revisions from October 2008, is described by individual element in the following section.

Among other components, the monitoring program includes networks of historically monitored wells, stream gauges, and climatic stations. These monitoring points were selected based on publicly available information about their locations, characteristics, and historical data records with the intent of continuing those records as much as possible. It is recognized that, as implementation of the program proceeds, the inclusion of some network wells may be determined to be impractical or impossible due to problems of access or abandonment. Further, the reestablishment of inactive (or installation of new) wells, stream gauges and climatic stations will depend on interagency coordination, permitting procedures, and budgetary constraints. Thus, it is anticipated that the overall monitoring program will be incrementally implemented as practicalities like those mentioned above dictate. Similarly, it is expected that, with time, the program will undergo modification in response to various factors (e.g. replacing network wells abandoned in the future, revising well classifications by aquifer depth zone), while maintaining the overall goal of facilitating interpretation and reporting on water requirements, water supplies, and the state of groundwater conditions in the SMVMA.

II. MONITORING PROGRAM

As a basis for designing the monitoring program, all pertinent historical data on the geology and water resources of the SMVMA were updated and compiled into a Geographic Information System (GIS). The data include the following:

- well location, reference point elevation (RPE), depth, and construction information;
- surface water gauge locations and characteristics;
- precipitation gauge and climate station locations and characteristics;
- groundwater levels and quality;
- Twitchell Reservoir releases, stream discharge and quality;
- precipitation and reference evapotranspiration (ETo) records;
- topographic, cultural, soils, and land use maps;
- geologic map and geologic structure contours;
- water purveyor wellfield areas;
- wastewater treatment plant (WWTP) locations.

The GIS was first utilized to define aquifer depth zones for groundwater monitoring purposes. In the central and major portion of the SMVMA, there is a shallow zone comprised of the Quaternary Alluvium, Orcutt formation, and uppermost Paso Robles formation and a deep zone comprised of the remaining Paso Robles formation and Careaga Sand. In the eastern portion of the SMVMA where these formations are much thinner and comprised of coarser materials, particularly in the Sisquoc Valley, the aquifer system is essentially uniform without distinct aquifer depth zones. In the coastal area where the surficial deposits (upper members of Quaternary Alluvium and Orcutt formation) are extremely fine-grained, the underlying formations (lower members of Quaternary Alluvium and Orcutt formation, Paso Robles formation, and Careaga Sand) comprise a confined aquifer.

The GIS was then used to classify a majority of wells into the shallow or deep aquifer zones based on well depth and completion information, although a number of wells could not be classified because this information is either unavailable or indicates completion across both the shallow and deep zones. An evaluation was made of the distribution of wells across the SMVMA completed in each depth zone. Wells actively or historically monitored for water levels and quality by the U.S. Geological Survey (USGS) and its cooperating local agencies[1] (Agencies) were identified, and an evaluation was made of the adequacy of coverage of the SMVMA to meet the objective in the Stipulation of assessing groundwater conditions.

It was determined that the wells actively monitored by the Agencies for groundwater levels provide extensive but somewhat incomplete coverage of the SMVMA, with areas

[1] Cooperating local agencies include Santa Barbara County, San Luis Obispo County, and the Santa Maria Valley Water Conservation District (SMVWCD).

left unmonitored in both aquifer zones. Based on this assessment, the groundwater monitoring program for the SMVMA was designed to first incorporate all of the actively monitored wells (denoted herein as "active wells"). Thus, those wells will continue to be monitored for water levels by the Agencies with the resulting data used toward assessing groundwater conditions in the SMVMA.

Secondly, in order to fill the gaps in coverage around the active wells, the groundwater monitoring program includes a number of additional wells historically monitored by the Agencies that are no longer monitored (denoted herein as "inactive wells", but intended to be actively monitored as part of this program). Thus, water level monitoring in these wells will need to be restarted in collaboration with the Agencies. This will provide the additional benefit of bringing forward the historical water level records of the inactive wells, some of which begin in the 1920s.

Regarding the active and inactive wells, those that could not be classified by aquifer depth zone (noted as "unclassified wells") are nonetheless included in the monitoring program because they contribute to completing well coverage of the SMVMA. The main revision to the October 2008 monitoring program is classification of previously unclassified wells based on additional well information, water level, and water quality data collected since the monitoring program was implemented.

Third, the groundwater monitoring program includes new monitoring wells to be installed in both the shallow and deep aquifer zones in an area north of downtown Santa Maria to fill a gap in coverage by existing wells. Arrangements will need to be made for the well installations, and monitoring will need to be implemented in collaboration with the Agencies.

This groundwater monitoring program designates a subset of wells for the purpose of monitoring groundwater quality, with well selection based on evaluation of well depths, completion information, and historical water level and quality data. It was determined that, of those wells actively monitored for groundwater levels, very few are actively monitored for groundwater quality. The subset of groundwater quality wells under this monitoring program incorporates the few active water quality wells, which will continue to be monitored by the Agencies. In addition, the subset includes wells historically (but no longer) monitored for water quality and wells historically monitored for water levels (but never for water quality) by the Agencies. Thus, water quality monitoring in these wells will need to be restarted or implemented in collaboration with the Agencies. Lastly, in order to fill a gap in coverage by existing wells, the new monitoring well to be installed in the deep aquifer zone north of downtown Santa Maria is included in the subset of groundwater quality wells.

Thus, the groundwater monitoring program designates two well networks, one each for the shallow and deep aquifer zones, primarily comprised of wells that are actively monitored. The networks include additional wells that are currently inactive (monitoring to be restarted) and some new wells (installation and monitoring to be implemented). All network wells are to be monitored for groundwater levels, with a subset of those wells to be monitored for groundwater quality, as described in detail in the subsection below.

Another use of the GIS was for the evaluation of actively and historically monitored surface water and climatic gauges by their location and period of record, specifically for Twitchell Reservoir releases, stream discharge, precipitation, and reference evapotranspiration (ETo) data, in order to assess adequacy of coverage in the SMVMA to meet monitoring objectives in the Stipulation. In this case, it was determined that the actively monitored gauges provide a substantial but incomplete accounting of surface water resources in the SMVMA, with several streams no longer monitored and the Valley floor without any climatic gauges. The SMVMA monitoring program was designed to incorporate the active gauges and reestablish inactive gauges to provide a comprehensive record of surface water and climatic data. A revision to the October 2008 monitoring program is the addition of a surface water sampling point on Green Canyon drainage, currently monitored for flow and quality.

A description of the groundwater, surface water, and climatic monitoring included in the SMVMA monitoring program is provided in the following subsection. Three monitoring program elements designate the data collection to be conducted across the area including 1) hydrologic data with which groundwater conditions, surface water conditions, and agricultural water requirements may be assessed, 2) water requirements and supply data for agricultural irrigation and municipal use; and 3) water disposition data for agricultural and municipal land uses.

2.1 Hydrologic Data

Hydrologic data include groundwater levels and quality from two well networks, one each for the shallow and deep aquifer zones. Also to be collected are data on Twitchell Reservoir releases and stream stage, discharge, and quality, from a designated set of surface water monitoring locations. The data also include precipitation and ETo data, which will be used to estimate agricultural water use in the SMVMA.

2.1.1 Groundwater Levels and Quality

Well Networks

Evaluation of historical groundwater level and quality data from the SMVMA indicates that groundwater conditions differ across the area and with depth; accordingly and as described above, the groundwater monitoring program designates both shallow and deep well networks. The monitoring networks include along the coast three sets of existing grouped monitoring wells that are completed at varying depths for the purpose of detecting conditions of saltwater intrusion. However, the networks lack coverage inland in an area north of downtown Santa Maria adjacent to the Santa Maria River, necessitating the installation of at least one shallow and one deep well.

The monitoring networks are primarily comprised of wells actively monitored by the USGS and cooperating agencies (Agencies). The networks include additional wells that are currently inactive (monitoring to be restarted) and some new wells (installation and monitoring to be implemented). The shallow well network consists of 68 wells for groundwater level monitoring with a subset of 37 wells for water quality monitoring (Table 1a and Figure 2a), including one new well to be installed north of Santa Maria and monitored for shallow groundwater levels. The deep well network consists of 52 wells for water level monitoring with a subset of 38 water quality wells (Table 1b and Figure 2b), including one new well to be monitored for groundwater levels and quality in the deep zone. In addition, 29 unclassified wells are included for groundwater level monitoring with a subset of 4 water quality wells (Table 1c); they are shown on both the shallow and deep well network maps (see Figures 2a/2b) to illustrate the areal distribution of network wells across the SMVMA.

To augment the monitoring program results, data from water supply well monitoring conducted by the Cities of Santa Maria and Guadalupe and by the Golden State Water Company to meet California Dept. of Health Services requirements will be compiled. Likewise, data from sanitation facility well monitoring conducted under their respective permit conditions will augment the monitoring program results. Finally, data collected from wells in the Nipomo Mesa Management Area (NMMA) monitoring program (not part of the SMVMA well networks) will be compiled in order to assess groundwater conditions in the area along the northern boundary of the SMVMA.

Overall, the groundwater monitoring networks for the SMVMA include:

- 149 wells for water levels (68 shallow, 52 deep, 29 unclassified), of which:

- 91 of the 149 wells are active (42 shallow, 28 deep, 21 unclassified) and will continue to be monitored for water levels by the Agencies,
- 56 wells are inactive (25 shallow, 23 deep, 8 unclassified) and will need to have water level monitoring restarted in collaboration with the Agencies,
- 2 wells are new (1 shallow and 1 deep) and will need to have arrangements made for their installation and water level monitoring implemented in collaboration with the Agencies, and

- 79 of the 149 wells are also for water quality (37 shallow, 38 deep, 4 unclassified), of which:
- 14 wells are active (4 shallow, 9 deep, 1 unclassified), and will continue to be monitored for water quality by the Agencies,
- 34 wells are inactive (17 shallow, 14 deep, 3 unclassified), and will need to have water quality monitoring restarted in collaboration with the Agencies,
- 30 wells not monitored (16 shallow, 14 deep), and will need to have water quality monitoring implemented in collaboration with the Agencies,
- 1 well is new (deep) and will need to have water quality monitoring implemented in collaboration with the Agencies.

The areal coverage of wells for groundwater levels and quality is comparable to previous groundwater resources investigations periodically conducted by the USGS. The groundwater monitoring networks are comprehensive and conservative in that they provide areal coverage of the SMVMA in two depth zones, including focused monitoring for potential saltwater intrusion along the coast. Upon implementation of the groundwater monitoring program and analysis of the initial groundwater level and quality results, an assessment will be made of whether the well network requires modification, e.g., more or less wells, while ensuring the monitoring objectives of the Stipulation are met.

Monitoring Specifications

Under the monitoring program, groundwater level measurements in each network well will be made from an established wellhead reference point to an accuracy of 0.01 foot. Groundwater quality monitoring will include general mineral constituents to facilitate description of the general groundwater chemistry throughout the SMVMA. In addition, specific inorganic constituents are included to assess effects of historical and current land uses and groundwater quality relative to potential saltwater intrusion along the coast. The initial monitoring constituents for both the shallow and deep well networks are:

General Minerals *(including Total Dissolved Solids (TDS), Electrical Conductivity (EC), pH, sodium (Na), calcium (Ca), magnesium (Mg), potassium (K), chloride (Cl), sulfate (SO4), and bicarbonate (HCO3)*
Nitrate as Nitrate *(NO3-NO3)*
Bromide *(Br)*

All sample collection, preservation, and transport will be according to accepted EPA protocol. Sample analyses are to be conducted by laboratories certified by the State of California utilizing standard EPA methodologies. Analyses for NO3-NO3 and Br are to achieve minimum reporting limits of 0.10 mg/l.

The great majority of existing wells in the SMVMA have reported reference point elevations (RPEs) that appear to have been derived from USGS 7-1/2' topographic quadrangles, with variable levels of accuracy. Therefore, a wellhead survey will need to be conducted establishing the RPE for each network well to an accuracy of less than one foot, preferably to 0.01 foot, in order to allow accurate assessment of groundwater conditions throughout the SMVMA. The wellhead survey would most easily be completed using survey-grade global positioning system (GPS) equipment. Upon evaluation of the initial monitoring results, an assessment will be made regarding the need to verify RPEs or modify the set of water quality constituents and/or reporting limits.

Monitoring Frequency

Historical groundwater level data from the SMVMA indicate that water levels typically peak between January and April and decline to the seasonal low between July and October. Accordingly, the initial frequency of groundwater level monitoring is semiannually during the spring and fall, as has typically been the practice of the USGS and some cooperating agencies.

Review of historical groundwater quality data indicates that some quality constituents, such as sulfate, nitrate, and associated TDS and EC values, can change substantially over two to three years. As a result, the initial frequency of groundwater quality sampling is every two years, and preferably during the summer to allow any necessary followup sampling. Coastal monitoring wells will be sampled twice annually, during spring and fall, to evaluate seasonal water quality changes with the seasonal fluctuation in Valley groundwater levels.

The annual groundwater level and quality monitoring results from purveyors and sanitation facility wells will be compiled with the results from the SMVMA monitoring program, at which time an assessment will be made regarding the need for additional monitoring of selected purveyor/facility wells. Regarding the SMVMA well network, following evaluation of the initial groundwater level and quality results, an assessment will be made whether monitoring frequencies need to be modified.

Data Sources, Agency Coordination, and Plan Implementation

Implementation of the groundwater monitoring program will necessitate completing several tasks augmenting the groundwater monitoring currently conducted by the Agencies. It is recommended that program implementation proceed through the following tasks in order:

1) Coordination with the Agencies (primarily the USGS) and landowners to assess site conditions at each designated program well, including field determinations of well and wellhead conditions and access (as needed), with the objective of establishing final well networks (shallow and deep) for the ongoing measurement of water levels and collection of water quality samples;

2) Installation of monitoring wells in those areas lacking coverage by the established networks;

3) Coordination with the Agencies and landowners to make arrangements for conducting groundwater level and quality monitoring, per the monitoring program, on an ongoing basis; and

4) Completion of a wellhead survey to record the reference point elevation and ground surface elevation at each network well.

On an annual basis, the designated groundwater monitoring activities for the SMVMA will need to be coordinated with the USGS and cooperating agencies to confirm their continued monitoring of network wells. During each year, groundwater level and quality data from the Agencies will be compiled with the SMVMA dataset, and an assessment will be made of the remaining data needs to fulfill the groundwater monitoring program. The annual agency coordination, planning of monitoring activities, data collection, and data compilation will be jointly conducted by LSCE and the TMA.

2.1.2 Surface Water Storage, Discharge, Stage, and Quality

Monitoring Locations

Twitchell Reservoir stage, storage, and surface water releases are recorded on a daily basis. Also, four stream gauges in the SMVMA currently provide average daily discharge data, specifically two on the Sisquoc River ("near Sisquoc" and "near Garey"), one on the Santa Maria River ("at Suey Crossing near Santa Maria"), and one on Orcutt Creek ("near Orcutt"). Together, the reservoir release data and current stream gauge measurements account for the primary components of streamflow into the Santa Maria Valley (Figure 3).

Additional data are needed for the main streams associated with the Santa Maria Valley for the purpose of assessing surface water resources and stream/aquifer interactions in the SMVMA. The main component of streamflow into the Santa Maria Valley is not measured, specifically from the Cuyama River (inactive gauge), and streamflow from the Santa Maria Valley cannot be accounted because the gauge located on the Santa Maria River at Guadalupe is inactive. Further, for all streams in the SMVMA, stage measurements are not reported and water quality monitoring is limited to the Sisquoc River ("near Sisquoc") and Orcutt Creek ("near Orcutt"). A sampling point on Green Canyon provides information on the flow and quality of drainage in the western Valley.

Accordingly, the surface water monitoring program specifies that reservoir stage, storage, and releases from the Twitchell Project continue to be recorded on a daily basis. The program also designates a set of stream gauges on the Sisquoc, Cuyama, and Santa Maria Rivers and Orcutt Creek for the determination of average daily stage and discharge (see Figure 3). Gauge locations will serve as water quality sampling points. Additional water quality sampling points (without gauge) are the current Green Canyon point and a new one to be located on Oso Flaco Creek.

The main surface water monitoring locations for the SMVMA include:

- Twitchell Project, which will continue to be monitored for reservoir stage, storage, and releases (with water quality monitoring to be implemented) by the SMVWCD;

- 6 stream gauges, of which:
  2 gauges will continue to be monitored for stream discharge and quality
  by the USGS:

“Sisquoc River near Sisquoc”
“Orcutt Creek near Orcutt”
2 gauges will continue to be monitored for stream discharge by the USGS (with water quality monitoring to be implemented in collaboration with the USGS):
“Sisquoc River near Garey”
“Santa Maria River at Suey Crossing near Santa Maria”
2 gauges for which stream discharge and water quality monitoring will need to be reestablished in collaboration with the USGS:
“Cuyama River below Twitchell”
“Santa Maria River at Guadalupe”; and

- Green Canyon, for which flow and quality monitoring will continue, and Oso Flaco Creek, for which water quality monitoring will need to be implemented in collaboration with the USGS.

The inactive gauges on the Cuyama River (“below Twitchell) and Santa Maria River (“at Guadalupe”) need to be reestablished, and rating curves relating stage measurements to discharge need to be redeveloped. If possible, it would be preferable to establish an alternate location for the Cuyama River gauge closer to its confluence with the Sisquoc River. At the present time, streamflow entering the Santa Maria Valley from the Cuyama River can be estimated from Twitchell Project release data (streamflow losses occur on the Cuyama River between Twitchell Dam and its confluence with the Sisquoc River). Streamflow data from the former Cuyama River gauge facilitated better estimation of streamflow entering the Valley but did not preclude estimation errors.

Operation of the Santa Maria River gauge at Suey Crossing, located in the primary recharge area of the River, will need evaluation. Currently, stream discharge data are reported only sporadically; it appears that stage data have been collected but not yet converted to discharge pending development by the USGS of appropriate rating curves. However, data collection may be being compromised by technical problems with the gauge, in which case timely resolution of the problems or consideration of an alternate gauge location in this reach of the River would be necessary.

It should be noted that, in order to provide for the most complete assessment of surface water resources of the SMVMA, data would also be needed for its tributary streams. Streamflows into the Sisquoc Valley from La Brea Ck, Tepusquet Ck, and Foxen Canyon cannot be accounted because their respective gauges are inactive. Also, streamflows into the Santa Maria Valley from Nipomo and Suey Creeks have not been monitored (see Figure 3). Thus, stream gauges for the determination of average daily stage and discharge would need to be reestablished for La Brea, Tepusquet, and Foxen Canyon Creeks and installed on Nipomo and Suey Creeks in collaboration with the USGS.

To augment the surface water monitoring program results, water quality data from stream studies periodically conducted by the Central Coast Regional Water Quality Control Board and from sanitation facility monitoring will be compiled.

Monitoring Specifications

For the Twitchell Project, reservoir stage will need to be related to storage volume. For all stream gauges, stage measurements will need to be reported relative to some known elevation datum. Under the monitoring program, initial surface water quality analyses to be performed are for the same general mineral and specific inorganic constituents as for groundwater. Reservoir and stream sample collection will be according to accepted protocol; sample preservation, transport, analyses, and reporting limits will be according to groundwater quality monitoring specifications.

Monitoring Frequency

For the Twitchell Project, daily releases and reservoir stage are to be recorded. For all streams, gauge operations will provide average daily stream stage and discharge data. Water quality monitoring will be conducted on a semi-annual basis during the period of maximum winter/spring runoff and minimum summer flows to evaluate changes in surface water quality with fluctuations in stream discharge.

Data Sources, Agency Coordination, and Plan Implementation

Implementation of the surface water monitoring program will necessitate completing several tasks augmenting the stream monitoring currently conducted by the USGS. It is recommended that program implementation proceed through the following tasks in order:

1) Coordination with the USGS to assess site suitability for stream gauges on the Cuyama River ("below Twitchell") and Santa Maria River ("at Guadalupe"), with the objective of establishing the locations and specifications for gauge installation to conduct ongoing measurement of stream stage, discharge, and quality;

2) Coordination with the USGS to install stream gauges and develop rating curves for the Cuyama River ("below Twitchell") and Santa Maria River ("at Guadalupe") locations;

3) Coordination with the Agencies to make arrangements for conducting surface water monitoring, per the monitoring program, on an ongoing basis on the designated streams (USGS) and Twitchell Reservoir (SMVWCD);

4) Coordination with the USGS to assess site suitability for stream gauges on the tributaries La Brea, Tepusquet, Foxen Canyon, Suey, and Nipomo Creeks, with the objective of establishing the locations and specifications for gauge installation to conduct ongoing measurement of stream stage, discharge, and quality;

5) Coordination with the USGS to install stream gauges and develop rating curves for the La Brea, Tepusquet, Foxen Canyon, Suey, and Nipomo Creeks locations; and

6) Coordination with the Agencies to make arrangements for conducting surface water monitoring, per the monitoring program, on an ongoing basis on the designated streams and tributaries (USGS) and Twitchell Reservoir (SMVWCD).

On an annual basis, the designated surface water monitoring activities for the SMVMA will need to be coordinated with the USGS to confirm their continued operation of each monitoring program gauge. During each year, Twitchell Project data from the SMVWCD will be compiled with stream stage, discharge, and water quality data from the USGS. Annual agency coordination, planning of monitoring activities, data collection, and data compilation will be jointly conducted by LSCE and the TMA.

2.1.3 Precipitation and Reference Evapotranspiration (ETo)

Monitoring Locations

There currently are three active NCDC[2] precipitation gauges in the SMVMA providing long-term daily precipitation data through the present, specifically at Guadalupe, the Santa Maria airport (formerly downtown), and Garey. In addition, daily precipitation is recorded at four locations around the SMVMA, at the Twitchell Dam (by the SMVWCD) and three active CIMIS[3] climate stations on the Santa Maria Valley floor, near Sisquoc, and on the southern Nipomo Mesa. Daily ETo data are also currently recorded by these three CIMIS climate stations (see Figure 3).

Accordingly, the monitoring program designates the set of four active precipitation gauges (NCDC and Twitchell) and three active CIMIS climate stations for the determination of daily precipitation and ETo (see Figure 3).

The climatic monitoring stations include:

- Four precipitation gauges, which will continue to be monitored by current operators:
  Twitchell Dam (SMVWCD)
  Guadalupe (NCDC)
  Santa Maria Airport (NCDC)
  Garey (NCDC)

- Three climate stations for precipitation and ETo, which will continue to be monitored by California DWR:
  'Santa Maria II'
  'Sisquoc'
  'Nipomo'

[2] NCDC: National Climatic Data Center, administered by the National Oceanic and Atmospheric Administration (NOAA).
[3] CIMIS: California Irrigation Management Information System, administered by California Department of Water Resources (California DWR).

Monitoring Specifications and Frequency

Precipitation gauges will continue to collect total daily precipitation data, and climate stations will report daily ETo values. Operation of the climate stations will be according to CIMIS standards to collect all data utilized in the calculation of ETo values (e.g., air temperature, relative humidity, air speed).

Data Sources, Agency Coordination, and Plan Implementation

On an annual basis, the designated climatic monitoring activities for the SMVMA will need to be coordinated with the NCDC, California DWR, and SMVWCD to confirm their continued operation of each gauge/station. The annual coordination with these agencies and data compilation will be jointly conducted by LSCE and the TMA.

2.2 Water Requirements and Supply Data

These data include agricultural land use derived from land use surveys as input to the estimation of applied agricultural water requirements and, thus, groundwater pumping (sole supply) in the SMVMA. Data also include municipal and private purveyor records of water supplies, which include groundwater and imported water that in total equal the municipal water requirements in the SMVMA.

2.2.1 Agricultural Land Use and Water Requirements

Under the monitoring program, land use surveys of the SMVMA will be conducted on an annual basis from analysis and field verification of aerial photography. In the event that aerial photographs of the SMVMA are unavailable from existing agricultural service companies, arrangements for the aerial photography work will need to be made.

Survey results will be utilized to determine crop distribution and acreages, which in turn will be used in conjunction with standard crop coefficient values, ETo and precipitation data, and Valley-specific irrigation efficiency values to estimate annual applied agricultural water requirements. With groundwater serving as the sole source of water supply for agricultural irrigation in the SMVMA, the estimated applied agricultural water requirements will be considered equal to the agricultural groundwater pumping in the SMVMA.

Aerial photography arrangements and analysis, field verification, determination of crop distribution and acreages, and estimation of agricultural water requirements will be jointly conducted by LSCE and the TMA.

2.2.2 Municipal Water Requirements

As part of the monitoring program, records will be compiled of groundwater pumping and imported water deliveries from the State Water Project, Central Coast Authority (SWP), to municipal and private water purveyors, including the Cities of Santa Maria and Guadalupe, and the Golden State Water Company. All data will be recorded by subsystem on a monthly basis; groundwater pumping will be by individual water supply well; and all water transfers within the SMVMA between purveyors are to be noted. Also included are data on the number of service connections, any estimates of water usage on a per capita or per connection basis, and historical and current projections of water demand.

During the first year, purveyors will also provide current service area boundaries and all available water supply well location, depth, and completion information. With groundwater pumping and imported water deliveries as the two sources of water supply for municipal water use in the SMVMA, their total will be considered equal to the municipal water requirements in the SMVMA.

During each year, water supply data from the purveyors will be compiled into the SMVMA dataset. Annual coordination with purveyors will be jointly conducted by LSCE and the TMA.

2.2.3 Groundwater Pumping

The estimated groundwater pumping for agricultural irrigation will be summed with the reported pumping for municipal use in order to calculate total annual groundwater pumping in the SMVMA.

2.2.4 Imported Water

Imported water data will be obtained to summarize SWP deliveries to municipal and private water purveyors, specifically the Cities of Santa Maria and Guadalupe and the Golden State Water Company. Those data will be summed to calculate total annual imported water supplies in the SMVMA.

2.3 Water Disposition Data

In order to provide an accounting of amounts and methods of disposition of water utilized in the SMVMA, several data are to be reported. These include treated water volumes processed and disposed at wastewater treatment plants (WWTPs); records of any water exported from the SMVMA; and estimates of agricultural drainage disposed outside the SMVMA. “Disposition” of applied irrigation not consumptively used by crops, e.g., return flows to the aquifer system, will also be accounted.

2.3.1 Treated Water Discharge

Under the monitoring program, records of influent and treated effluent volumes will be compiled for WWTPs, including the Cities of Santa Maria, Guadalupe, and Laguna Sanitation District. All data will initially be recorded on a monthly basis to assess seasonal variation in the disposition of water (e.g., percentage of water utilized that becomes WWTP influent; losses during treatment). Effluent volumes will be recorded by disposal method and location, including any reuse of recycled water.

These data will be utilized to provide an accounting of municipal water disposed in the SMVMA. During each year, water disposal data from the WWTPs will be compiled into the SMVMA dataset. Annual coordination with the WWTPs will be jointly conducted by LSCE and the TMA.

2.3.2 Exported Water

As part of the monitoring program, records will be compiled of any groundwater or imported (SWP) water that is exported from the SMVMA. All data will be recorded by subsystem on a monthly basis and the receiving entities are to be noted. During each year, the data acquisition and compilation into the SMVMA dataset will be jointly conducted by LSCE and the TMA.

2.3.3 Agricultural Drainage and Return Flows

Under the monitoring program, estimation will be made of water drained from agricultural fields (e.g., by tile drains) for disposal outside of the SMVMA. Finally, while not formally "monitored," the disposition of applied irrigation will include estimates of the fate of that fraction of water not consumptively used by crops, primarily as return flow to the aquifer system.

III. SUMMARY

The monitoring program for the SMVMA includes the collection of hydrologic data, including: groundwater levels and quality; surface water storage, stream stage, discharge, and quality; and precipitation and ETo. The program provides designated shallow and deep well networks (Tables 1a/b/c and Figures 2a/b) and a surface water and climatic monitoring network (Figure 3) for collection of these data. Also specified are water requirements and supply data to be compiled for agricultural irrigation and municipal use, the disposal data for municipal water use, data on water exported from the SMVMA, and estimates of agricultural drainage and return flows.

The monitoring program components and frequencies are summarized as follows:

- groundwater levels: 149 wells (68 shallow, 52 deep, 29 unclassified), of which:
  91 wells are actively monitored (with monitoring to continue),
  56 wells are inactive (with monitoring to be reactivated), and
  2 wells are new (with monitoring to be implemented);
  semiannual frequency.

- groundwater quality: subset of 79 wells (37 shallow, 38 deep, 4 unclassified); of which:
  14 wells are actively monitored (with monitoring to continue),
  34 wells are inactive (with monitoring to be reactivated),
  30 wells are unmonitored and
  1 well is new (with monitoring to be implemented;
  analyzed for General Minerals (incl. NO3-NO3) and Bromide;
  biennial frequency.

- Twitchell Reservoir: stage, storage, and releases, which are actively monitored (with monitoring to continue), and
  quality, which is unmonitored (with monitoring to be implemented);
  stage, storage, and releases monitored daily;
  quality analyzed for General Minerals (incl. NO3-NO3) and Bromide on a biennial frequency.

- streams: 6 designated gauges for discharge, stage, and quality, of which:
  2 gauges are actively monitored for discharge and quality (to be continued),
  2 gauges are actively monitored for discharge (to be continued) but not monitored for water quality (to be implemented), and
  2 gauges are inactive (discharge and water quality monitoring to be reestablished);
  discharge and stage monitored daily;
  quality analyzed for General Minerals (incl. NO3-NO3) and Bromide on a biennial frequency.

- stream tributaries: 5 potential gauges for daily discharge and stage, that are inactive and would need to be reestablished.

- precipitation: 4 active gauges (to be continued);
  daily frequency.

- ETo: 3 active stations (to be continued);
  daily frequency.

- land use; annually.

- municipal water requirements, supplies (groundwater pumping and SWP imported water), disposal, and exportation; monthly.

- agricultural drainage and return flow; annually.

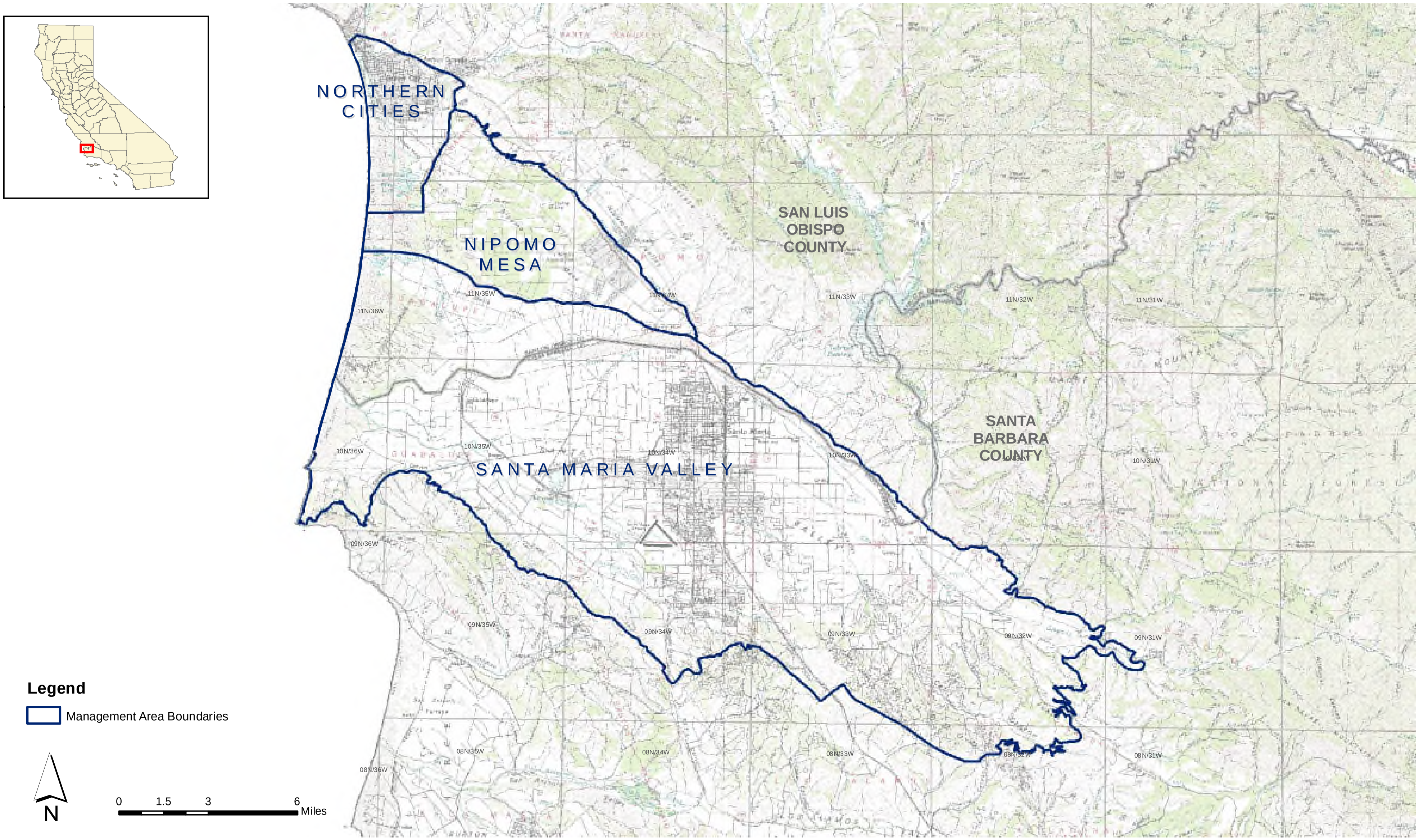

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Figure 1
Santa Maria Valley Groundwater Basin and Management Areas

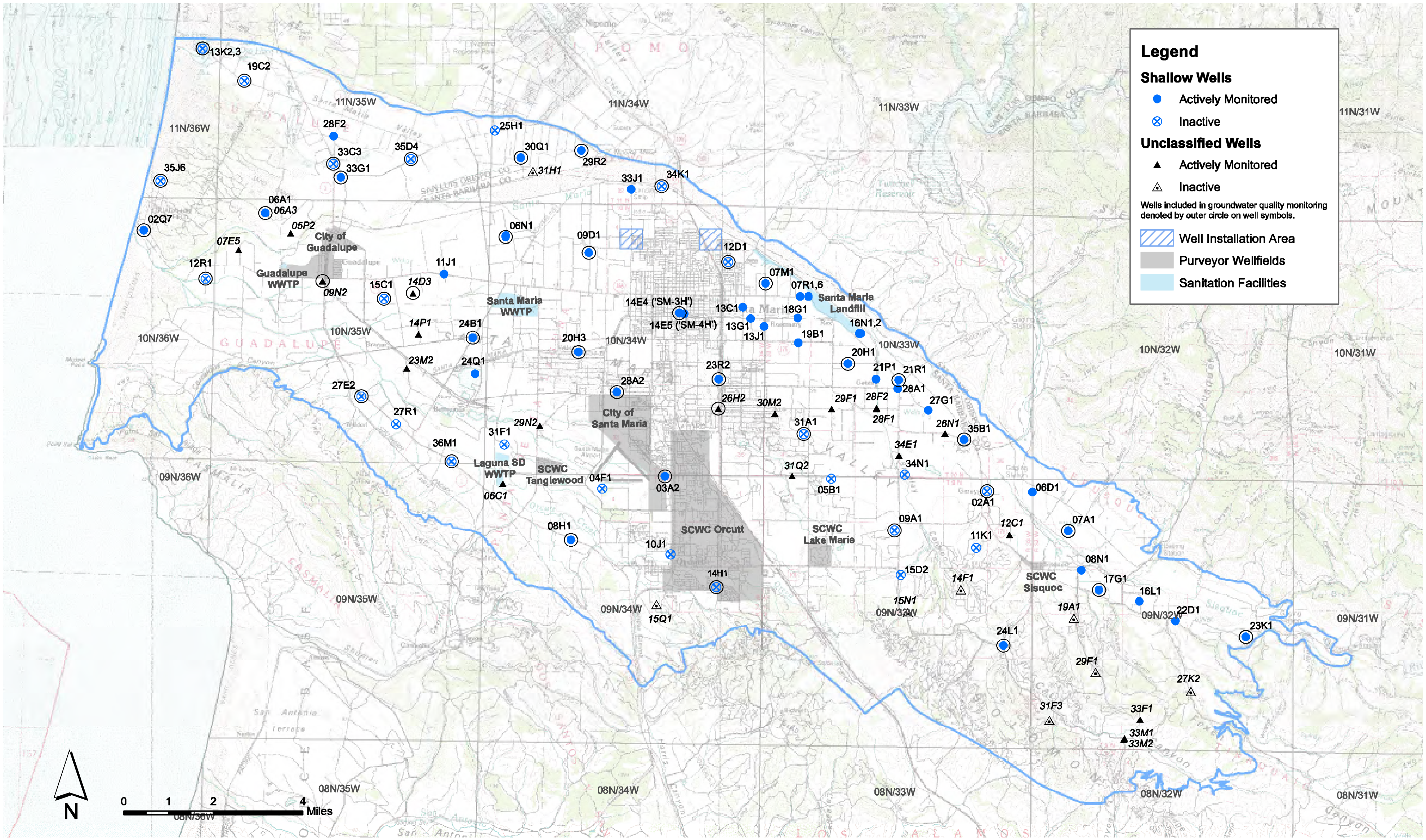

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Figure 2a
Well Network for Monitoring Shallow Groundwater
Santa Maria Valley Management Area

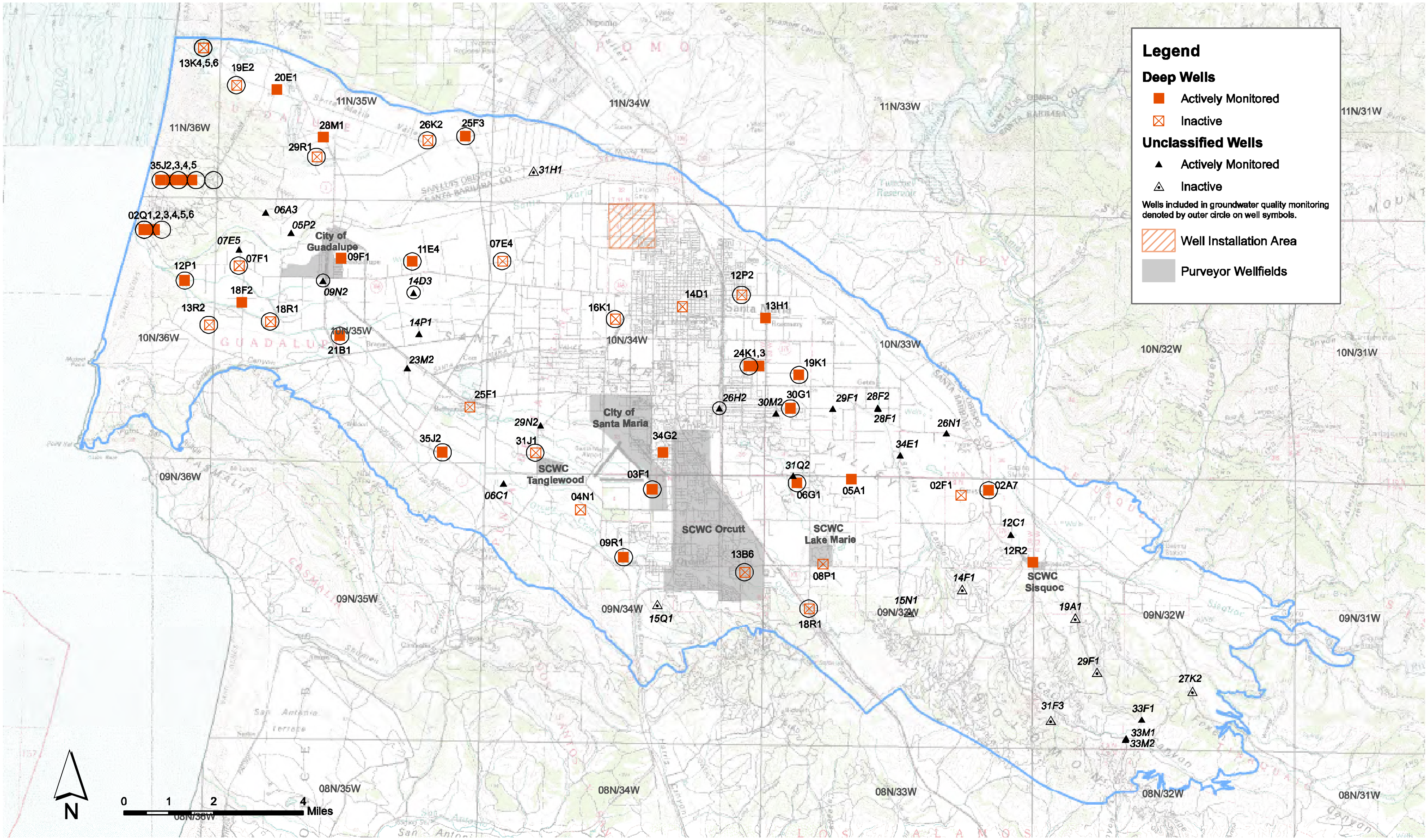

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Figure 2b
Well Network for Monitoring Deep Groundwater
Santa Maria Valley Management Area

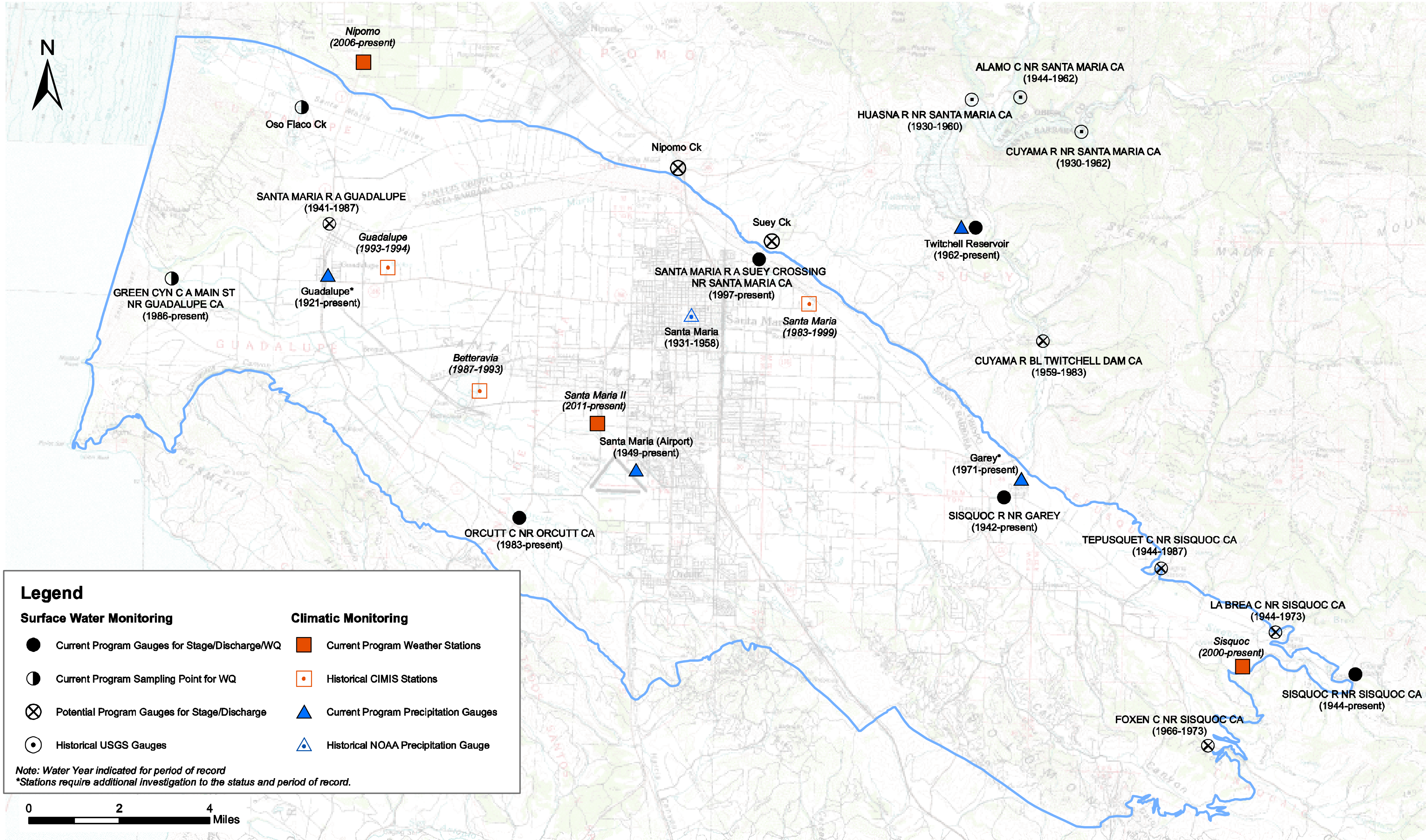

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Figure 3
Surface Water and Climatic Monitoring Network
Santa Maria Valley Management Area

Table 1a
Well Network for Monitoring Shallow Groundwater
Santa Maria Valley Management Area
(corresponds to Figure 2a)

Township/ Range	State Well Number	Well Map ID	Monitoring Agency	Actively Monitored for Water Levels	Actively Monitored for Water Quality	To Be Sampled for Water Quality
SHALLOW WELLS						
9N/32W	009N032W06D001S	06D1	USGS	A/S		
	009N032W07A001S	07A1	USGS	A/S		B
	009N032W08N001S	08N1	USGS	A/S		
	009N032W16L001S	16L1	USGS	A/S		
	009N032W17G001S	17G1	USGS	A/S		B
	009N032W22D001S	22D1	USGS	A/S		
	009N032W23K001S	23K1	USGS	A/S		B
9N/33W	009N033W02A001S	02A1	TBD			B
	009N033W05B001S	05B1	TBD			
	009N033W09A001S	09A1	TBD			B
	009N033W11K001S	11K1	TBD			
	009N033W15D002S	15D2	TBD			
	009N033W24L001S	24L1	USGS	A/S		B
9N/34W	009N034W03A002S	03A2	USGS	A/S	A	B
	009N034W04F001S	04F1	TBD			
	009N034W08H001S	08H1	USGS	A/S		B
	009N034W10J001S	10J1	TBD			
	009N034W14H001S	14H1	TBD			B
10N/33W	010N033W07M001S	07M1	USGS	A/S		B
	010N033W07R001S	07R1	USGS	A/S		
	010N033W07R006S	07R6	USGS	A/S		
	010N033W16N001S	16N1	USGS	A/S		
	010N033W16N002S	16N2	USGS	A/S		
	010N033W18G001S	18G1	SMVWCD & USGS	Qtr & S		
	010N033W19B001S	19B1	SMVWCD & USGS	Qtr & S		
	010N033W20H001S	20H1	USGS	A/S	A	B
	010N033W21P001S	21P1	SMVWCD & USGS	Qtr & S		
	010N033W21R001S	21R1	USGS	A/S		B
	010N033W27G001S	27G1	SMVWCD & USGS	Qtr & S		
	010N033W28A001S	28A1	SMVWCD & USGS	Qtr & S		
	010N033W31A001S	31A1	TBD			B
	010N033W34N001S	34N1	TBD			
	010N033W35B001S	35B1	USGS	A/S		B
10N/34W	010N034W06N001S	06N1	SMVWCD & USGS	Qtr & S		B
	010N034W09D001S	09D1	SMVWCD & USGS	Qtr & S		B
	010N034W12D001S	12D1	TBD			B
	010N034W13C001S	13C1	USGS	A/S		
	010N034W13G001S	13G1	USGS	A/S		
	010N034W13J001S	13J1	USGS	A/S		
	010N034W14E004S	14E4	SMVWCD & USGS	Qtr & S	A	B
	010N034W14E005S	14E5	USGS	A/S		
	010N034W20H003S	20H3	SMVWCD & USGS	Qtr & S		B
	010N034W23R002S	23R2	USGS	A/S		B
	010N034W28A002S	28A2	SMVWCD & USGS	Qtr & S		B
	010N034W31F001S	31F1	TBD			
10N/35W	010N035W06A001S	06A1	USGS	A/S		B
	010N035W11J001S	11J1	SMVWCD & USGS	Qtr & S		
	010N035W15C001S	15C1	TBD			B
	010N035W24B001S	24B1	SMVWCD & USGS	Qtr & S		B
	010N035W24Q001S	24Q1	USGS	A/S		
	010N035W27E002S	27E2	TBD			B
	010N035W27R001S	27R1	TBD			
	010N035W36M001S	36M1	TBD			B

Frequency Abbreviation: A/S - Annual/Semiannual; Qtr & S - Quarter & Semiannual; A - Annual; B - Biennial
Agency Abbreviation: SMVWCD - Santa Maria Valley Water Conservation District; SLODPW - San Luis Obispo Department of Public Works; USGS - United States Geological Survey; TBD - To Be Determined

Table 1a (continued)
Well Network for Monitoring Shallow Groundwater
Santa Maria Valley Management Area
(corresponds to Figure 2a)

Township/ Range	State Well Number	Well Map ID	Monitoring Agency	Actively Monitored for Water Levels	Actively Monitored for Water Quality	To Be Sampled for Water Quality
SHALLOW WELLS						
10N/36W	010N036W02Q007S	02Q7	USGS	A/S	A	B
	010N036W12R001S	12R1	TBD			B
11N/34W	011N034W29R002S	29R2	SLODPW & USGS	A/S		B
	011N034W30Q001S	30Q1	SMVWCD & USGS	Qtr & S		B
	011N034W33J001S	33J1	SMVWCD & USGS	Qtr & S		
	011N034W34K001S	34K1	TBD			B
11N/35W	011N035W19C002S	19C2	TBD			B
	011N035W25H001S	25H1	TBD			
	011N035W28F002S	28F2	SLODPW & USGS	A/S		
	011N035W33C003S	33C3	TBD			B
	011N035W33G001S	33G1	SMVWCD & USGS	Qtr & S		B
	011N035W35D004S	35D4	TBD			B
11N/36W	011N036W13K002S	13K2	TBD			B
	011N036W13K003S	13K3	TBD			B
	011N036W35J006S	35J6	TBD			B

Frequency Abbreviation: A/S - Annual/Semiannual; Qtr & S - Quarter & Semiannual; A - Annual; B - Biennial
Agency Abbreviation: SMVWCD - Santa Maria Valley Water Conservation District; SLODPW - San Luis Obispo Department of Public Works; USGS - United States Geological Survey; TBD - To Be Determined

Notes on Network Modification
09N/32W-6D1 previously unclassified; now included as shallow well (depth unknown; water levels similar to those from shallow wells with known depths and dissimilar to those from deep wells with known depths)
09N/33W-12R2 removed; classified as deep well
10N/33W-18G1 previously unclassified; now included as shallow well (depth = 422'; water levels similar to those from shallow wells with known depths and dissimilar to those from deep wells with known depths)
10N/35W-11J1 previously unclassified; now included as shallow well (depth=215'; water levels similar to those from shallow wells with known depths and dissimilar to those from deep wells with known depths)
11N/34W-33J1 previously not included in monitoring network; now included as shallow well (depth = 149'; water level data recently made available by the USGS)
11N/35W-28F2 previously not included in monitoring network; now included as shallow well (depth = 48'; water level data recently made available by NMMA)
11N/36W-35J5 removed; classified as deep well
11N/35W-33G1 previously unclassified; now included as shallow well

Table 1b
Well Network for Monitoring Deep Groundwater
Santa Maria Valley Management Area
(corresponds to Figure 2b)

Township/ Range	State Well Number	Well Map ID	Monitoring Agency	Actively Monitored for Water Levels	Actively Monitored for Water Quality	To Be Sampled for Water Quality
DEEP WELLS						
9N/33W	009N033W02A007S	02A7	SMVWCD & USGS	Qtr & S	A	B
	009N033W02F001S	02F1	TBD			
	009N033W05A001S	05A1	USGS	A/S		
	009N033W06G001S	06G1	USGS	A/S		B
	009N033W08P001S	08P1	TBD			
	009N033W12R002S	12R2	SMVWCD & USGS	Qtr & S		
	009N033W18R001S	18R1	TBD			B
9N/34W	009N034W03F001S	03F1	USGS	A/S		B
	009N034W04N001S	04N1	TBD			
	009N034W09R001S	09R1	USGS	A/S		B
	009N034W13B006S	13B6	TBD			B
10N/33W	010N033W19K001S	19K1	USGS	A/S		B
	010N033W30G001S	30G1	SMVWCD & USGS	Qtr & S	A	B
10N/34W	010N034W07E004S	07E4	TBD			B
	010N034W12P002S	12P2	TBD			B
	010N034W13H001S	13H1	USGS	A/S		
	010N034W14D001S	14D1	TBD			
	010N034W16K001S	16K1	TBD			B
	010N034W24K001S	24K1	SMVWCD & USGS	Qtr & S		
	010N034W24K003S	24K3	SMVWCD & USGS	Qtr & S		B
	010N034W31J001S	31J1	TBD			B
	010N034W34G002S	34G2	SMVWCD & USGS	Qtr & S		
10N/35W	010N035W07F001S	07F1	TBD			B
	010N035W09F001S	09F1	USGS	A/S		
	010N035W11E004S	11E4	SMVWCD & USGS	Qtr & S		B
	010N035W18F002S	18F2	USGS	A/S		
	010N035W18R001S	18R1	TBD			B
	010N035W21B001S	21B1	SMVWCD & USGS	Qtr & S		B
	010N035W25F001S	25F1	TBD			
	010N035W35J002S	35J2	USGS	A/S		B
10N/36W	010N036W02Q001S	02Q1	USGS	A/S	A	B
	010N036W02Q002S	02Q2	TBD			B
	010N036W02Q003S	02Q3	USGS	A/S	A	B
	010N036W02Q004S	02Q4	USGS	A/S	A	B
	010N036W02Q005S	02Q5	TBD			B
	010N036W02Q006S	02Q6	TBD			B
	010N036W12P001S	12P1	USGS	A/S		B
	010N036W13R002S	13R2	TBD			B
11N/35W	011N035W19E002S	19E2	TBD			B
	011N035W20E001S	20E1	SMVWCD & USGS	Qtr & S		
	011N035W25F003S	25F3	SMVWCD & USGS	Qtr & S		B
	011N035W26K002S	26K2	TBD			B
	011N035W28M001S	28M1	SMVWCD & USGS	Qtr & S		
	011N035W29R001S	29R1	TBD			B
11N/36W	011N036W13K004S	13K4	TBD			B
	011N036W13K005S	13K5	TBD			B
	011N036W13K006S	13K6	TBD			B
	011N036W35J002S	35J2	USGS	A/S	A	B
	011N036W35J003S	35J3	USGS	A/S	A	B
	011N036W35J004S	35J4	USGS	A/S	A	B
	011N036W35J005S	35J5	USGS	A/S	A	B

Frequency Abbreviation: A/S - Annual/Semiannual; Qtr & S - Quarter & Semiannual; A - Annual; B - Biennial
Agency Abbreviation: SMVWCD - Santa Maria Valley Water Conservation District; SLODPW - San Luis Obispo Department of Public Works; USGS - United States Geological Survey; TBD - To Be Determined

Notes on Network Modification
09N/33W-2A7 previously not included in monitoring network; now included as deep well (depth = 512'; water level data recently made available by the USGS)
09N/33W-12R2 previously thought to be shallow well; now classified as deep well (depth = 640'; water levels similar to those from deep wells with known depths and dissimilar to those from shallow wells with known depths)
10N/35W-9F1 previously unclassified; now included as deep well (depth = 240'; water levels similar to those from deep wells with known depths and dissimilar to those from shallow wells with known depths)
10N/35W-18F2 previously unclassified; now included as deep well (depth = 251'; water levels similar to those from deep wells with known depths and dissimilar to those from shallow wells with known depths)
10N/35W-21B1 previously unclassified; now included as deep well (depth = 300'; water levels similar to those from deep wells with known depths and dissimilar to those from shallow wells with known depths)
11N/35W-20E1 previously unclassified; now included as deep well (depth = 444'; water levels similar to those from deep wells with known depths and dissimilar to those from shallow wells with known depths)
11N/35W-25F3 previously unclassified; now included as deep well (depth unknown; water levels similar to those from deep wells with known depths and dissimilar to those from shallow wells with known depths)
11N/35W-28M1 previously unclassified; now included as deep well (depth = 376'; water levels similar to those from deep wells with known depths and dissimilar to those from shallow wells with known depths)
11N/36W-35J5 previously thought to be shallow well; now classified as deep well (depth = 135'; water levels and quality similar to other deep coastal network wells)

Table 1c
Unclassified Wells for Groundwater Monitoring
Santa Maria Valley Management Area
(shown on Figures 2a and 2b)

Township/ Range	State Well Number	Well Map ID	Monitoring Agency	Actively Monitored for Water Levels	Actively Monitored for Water Quality	To Be Sampled for Water Quality
UNCLASSIFIED WELLS						
9N/32W	009N032W19A001S	19A1	TBD			
	009N032W27K002S	27K2	TBD			
	009N032W29F001S	29F1	TBD			
	009N032W31F003S	31F3	TBD			
	009N032W33F001S	33F1	USGS	A/S		
	009N032W33M001S	33M1	USGS	A/S		
	009N032W33M002S	33M2	USGS	A/S		
9N/33W	009N033W12C001S	12C1	USGS	A/S		
	009N033W14F001S	14F1	TBD			
	009N033W15N001S	15N1	TBD			
9N/34W	009N034W06C001S	06C1	USGS	A/S		
	009N034W15Q001S	15Q1	TBD			
10N/33W	010N033W26N001S	26N1	USGS	A/S		
	010N033W28F001S	28F1	USGS	A/S		
	010N033W28F002S	28F2	USGS	A/S		
	010N033W29F001S	29F1	USGS	A/S		
	010N033W30M002S	30M2	USGS	A/S		
	010N033W31Q002S	31Q2	USGS	A/S		
	010N033W34E001S	34E1	USGS	A/S		
10N/34W	010N034W26H002S	26H2	USGS	A/S		B
	010N034W29N002S	29N2	USGS	A/S		
10N/35W	010N035W05P002S	05P2	USGS	A/S		
	010N035W06A003S	06A3	USGS	A/S		
	010N035W07E005S	07E5	USGS	A/S		
	010N035W09N002S	09N2	USGS	A/S		B
	010N035W14P001S	14P1 (D3)[1]	USGS	A/S	(A)	(A)
	010N035W23M002S	23M2	USGS	A/S		
11N/34W	011N034W31H001S	31H1	TBD			

[1]14P1 actively monitored for levels but not quality. 14D3 actively monitored for quality but not levels.

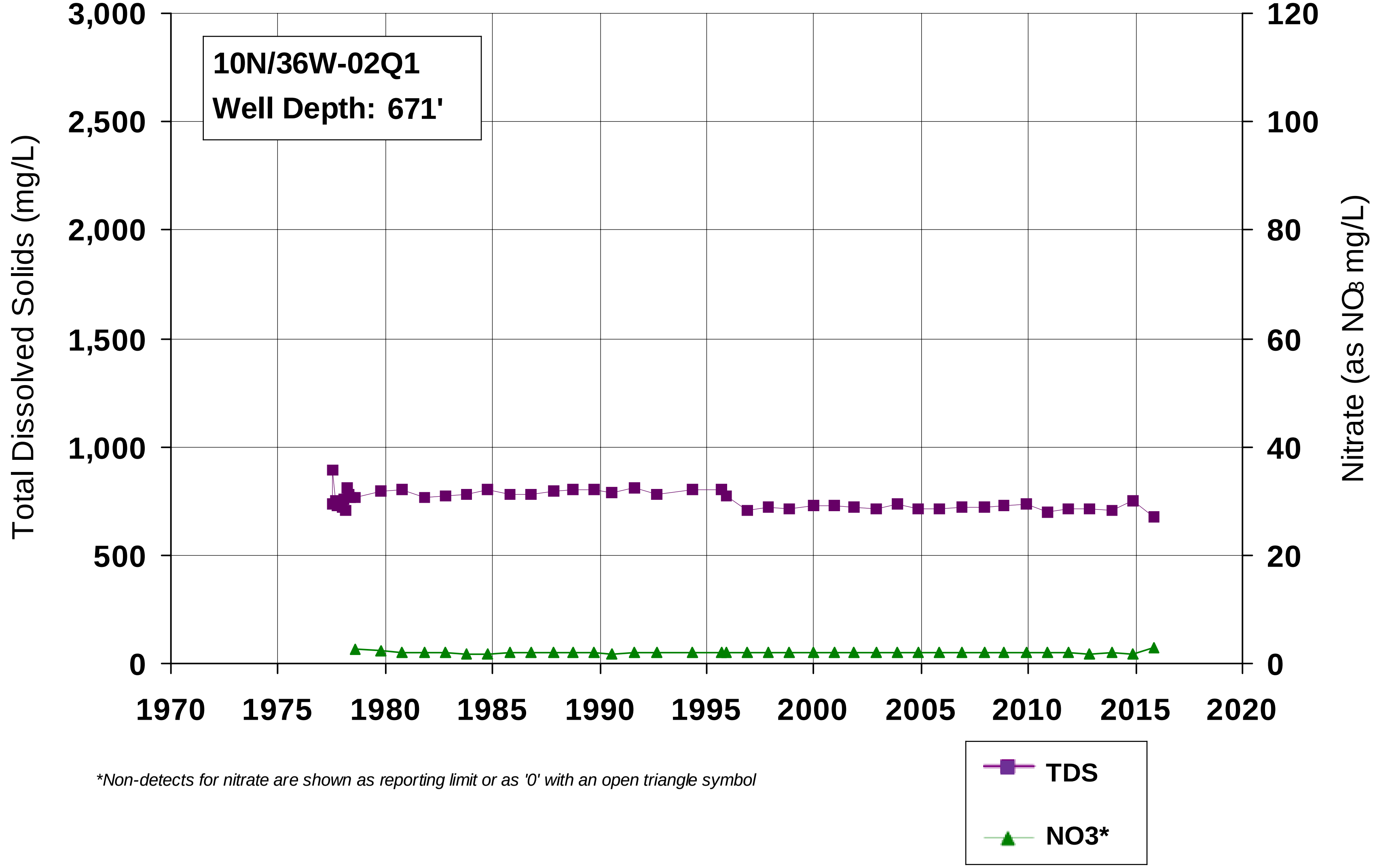
Frequency Abbreviation: A/S - Annual/Semiannual; Qtr & S - Quarter & Semiannual; A - Annual; B - Biennial

Agency Abbreviation: SMVWCD - Santa Maria Valley Water Conservation District; USGS - United States Geological Survey; TBD - To Be Determined

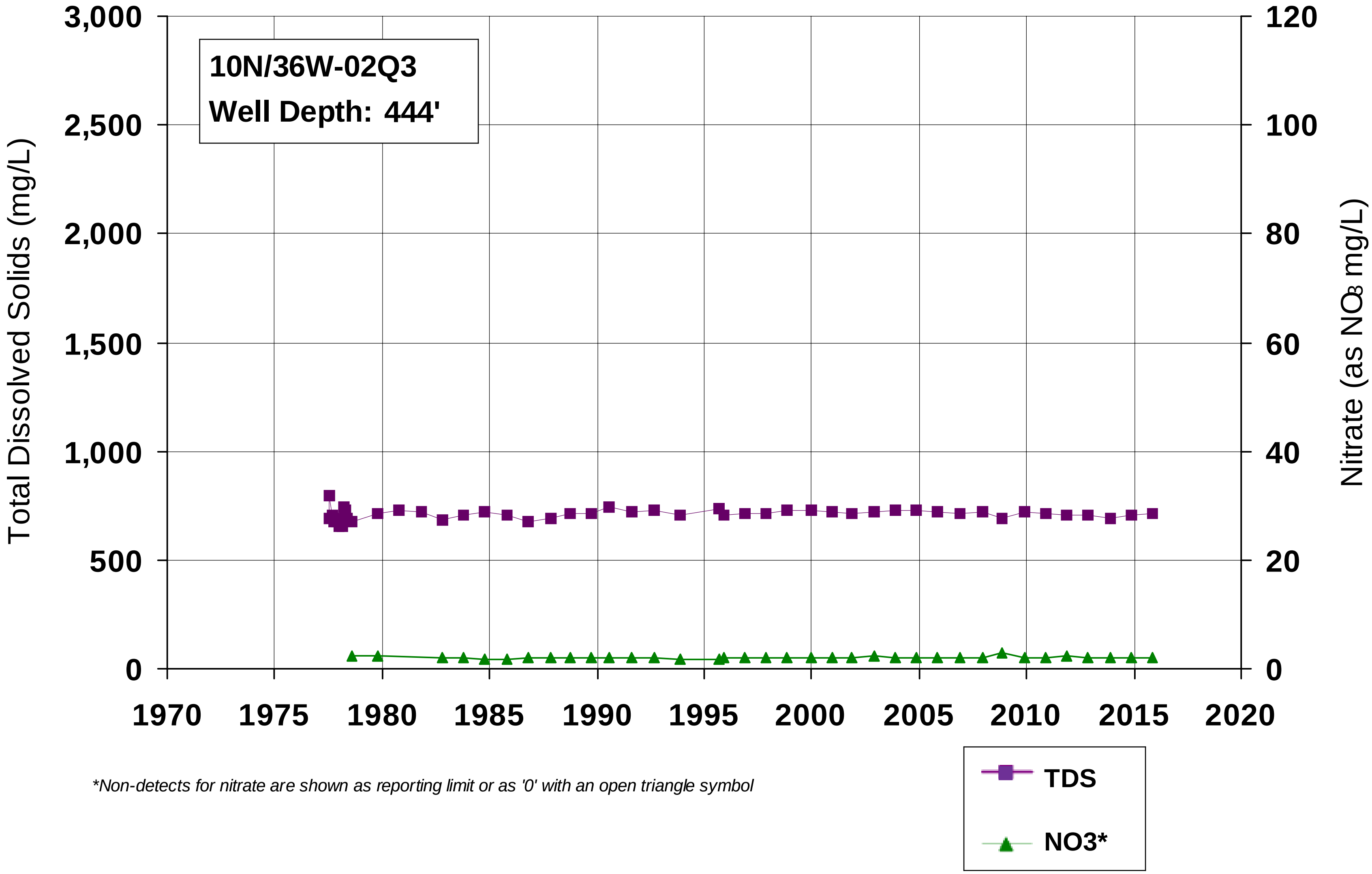
Notes on Network Modification
09N/32W-6D1 removed; classified as shallow well
10N/33W-18G1 removed; classified as shallow well
10N/35W-9F1 removed; classified as deep well
10N/35W-11J1 removed; classified as shallow well
10N/35W-18F2 removed; classified as deep well
10N/35W-21B1 removed; classified as deep well
11N/35W-20E1 removed; classified as deep well
11N/35W-25F3 removed; classified as deep well
11N/35W-28M1 removed; classified as deep well
11N/35W-33G1 removed; classified as shallow well

Appendix B

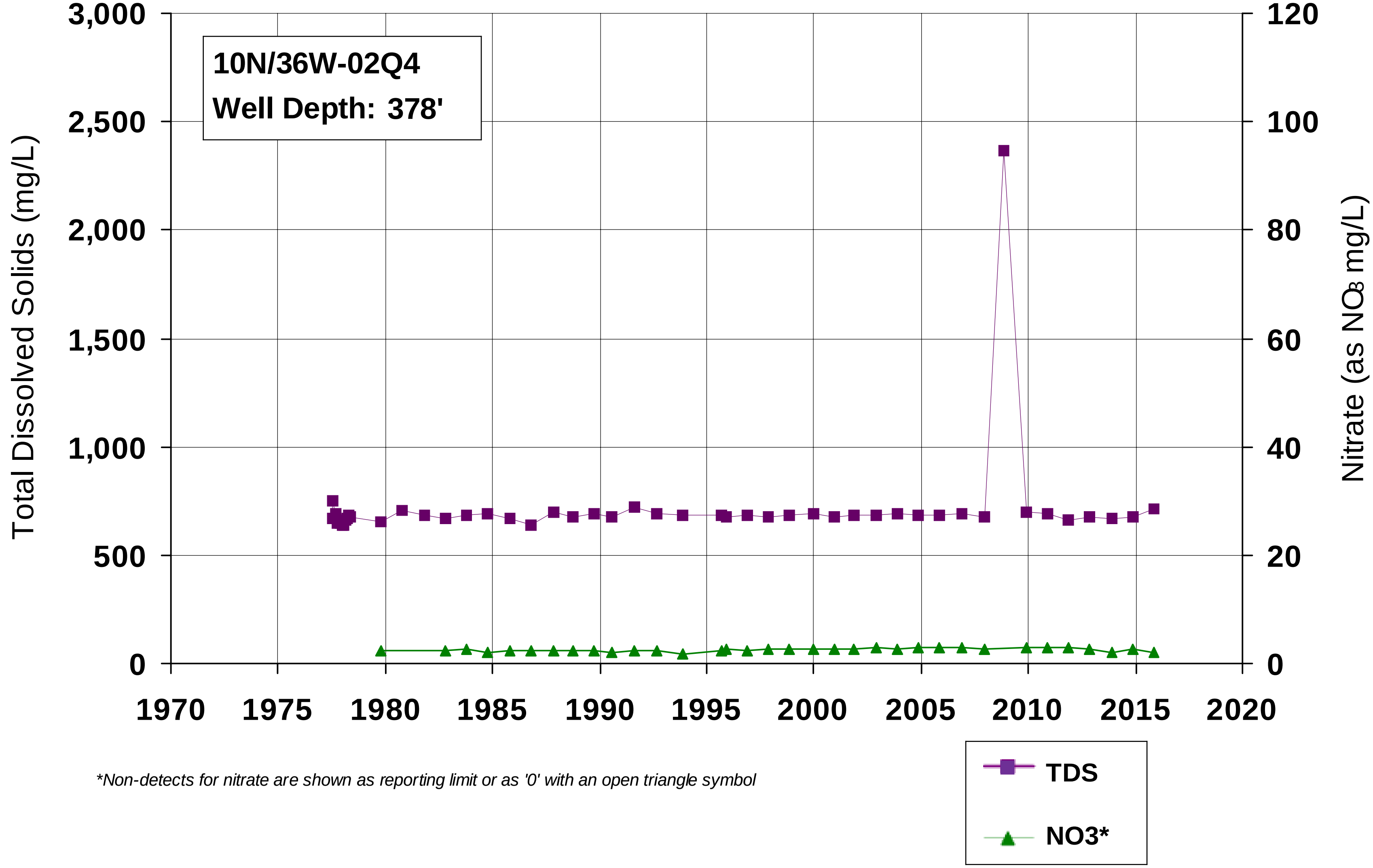
Historical Groundwater Quality Coastal Monitoring Wells



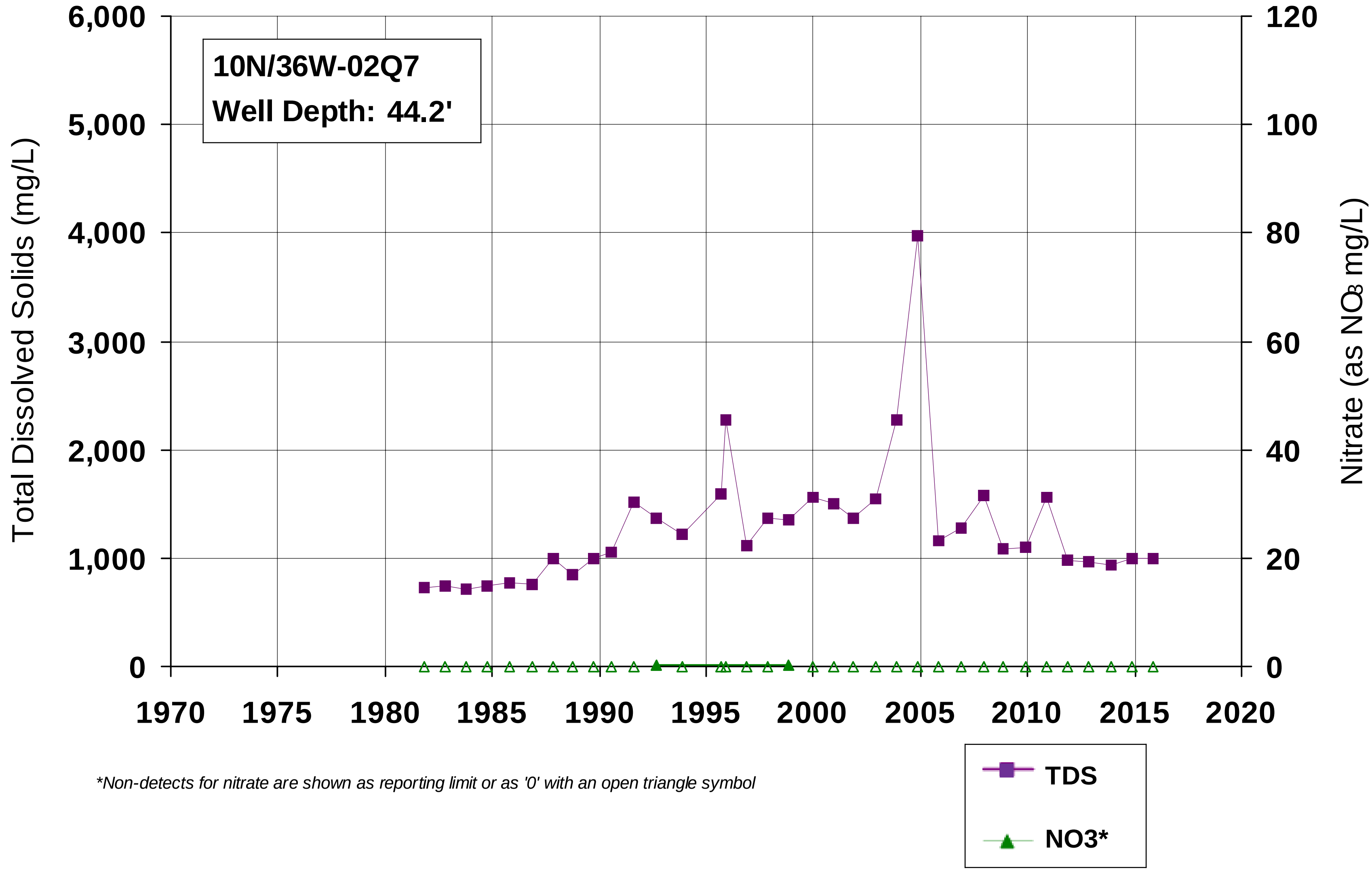
*Non-detects for nitrate are shown as reporting limit or as '0' with an open triangle symbol



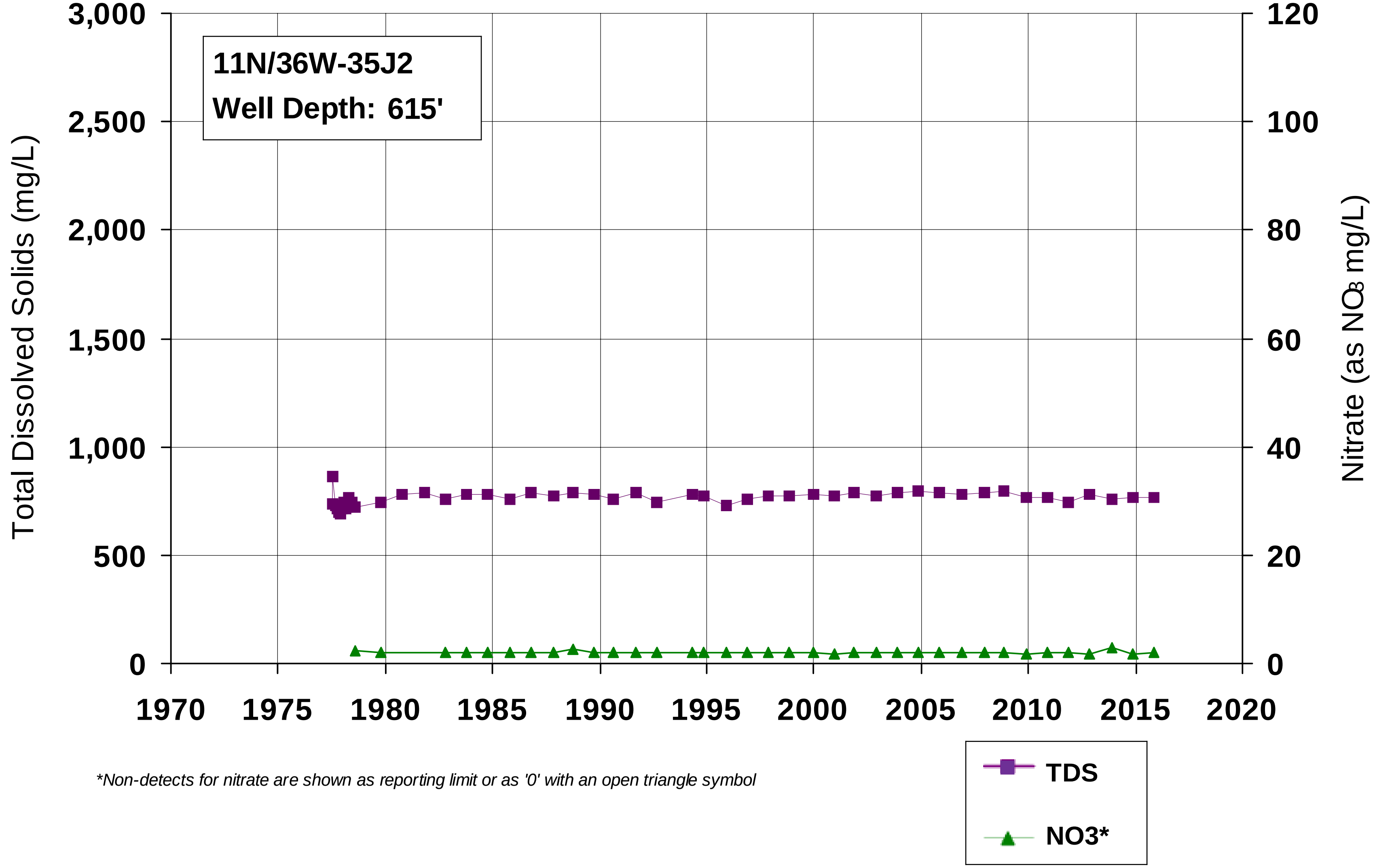
*Non-detects for nitrate are shown as reporting limit or as '0' with an open triangle symbol



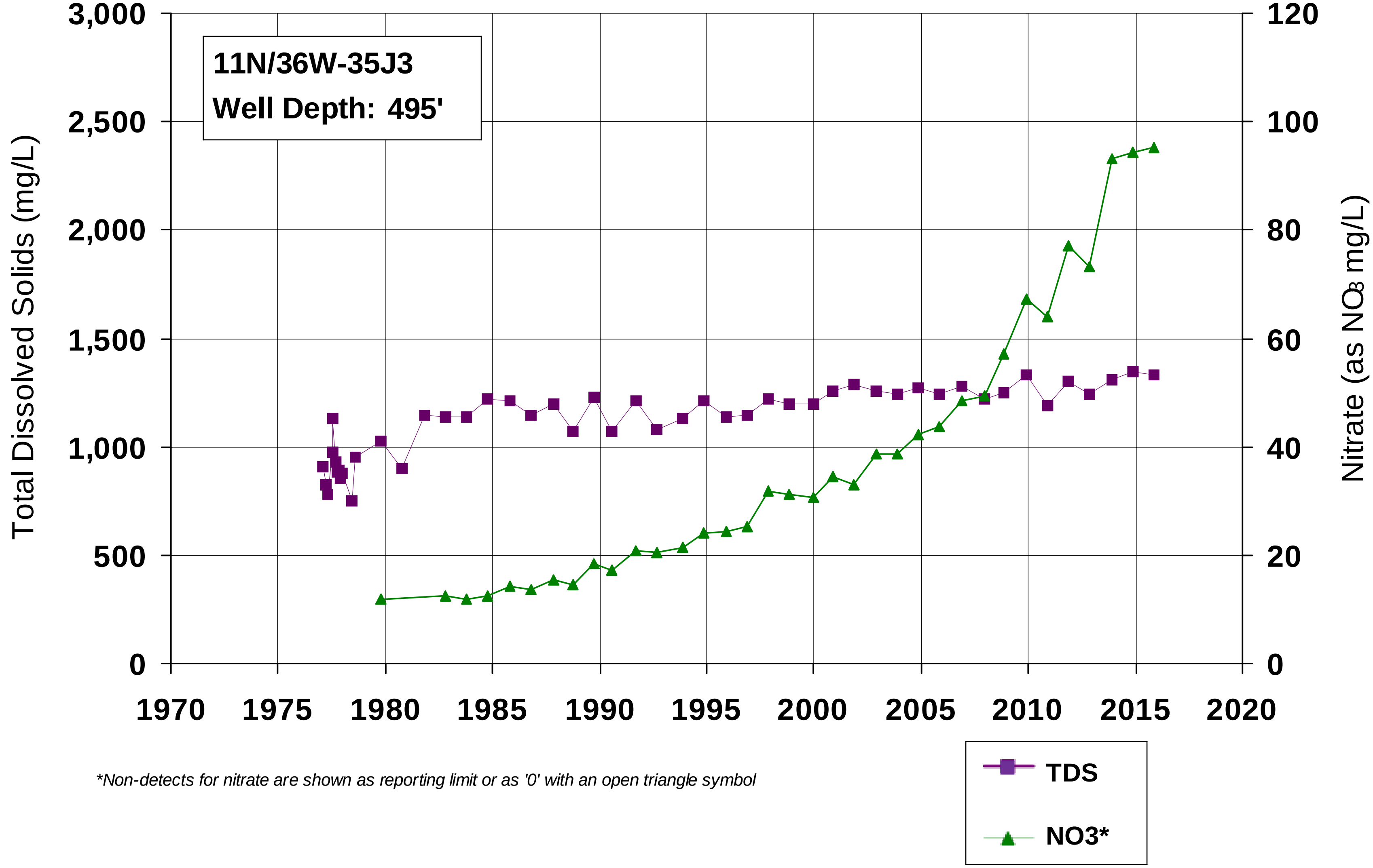
*Non-detects for nitrate are shown as reporting limit or as '0' with an open triangle symbol



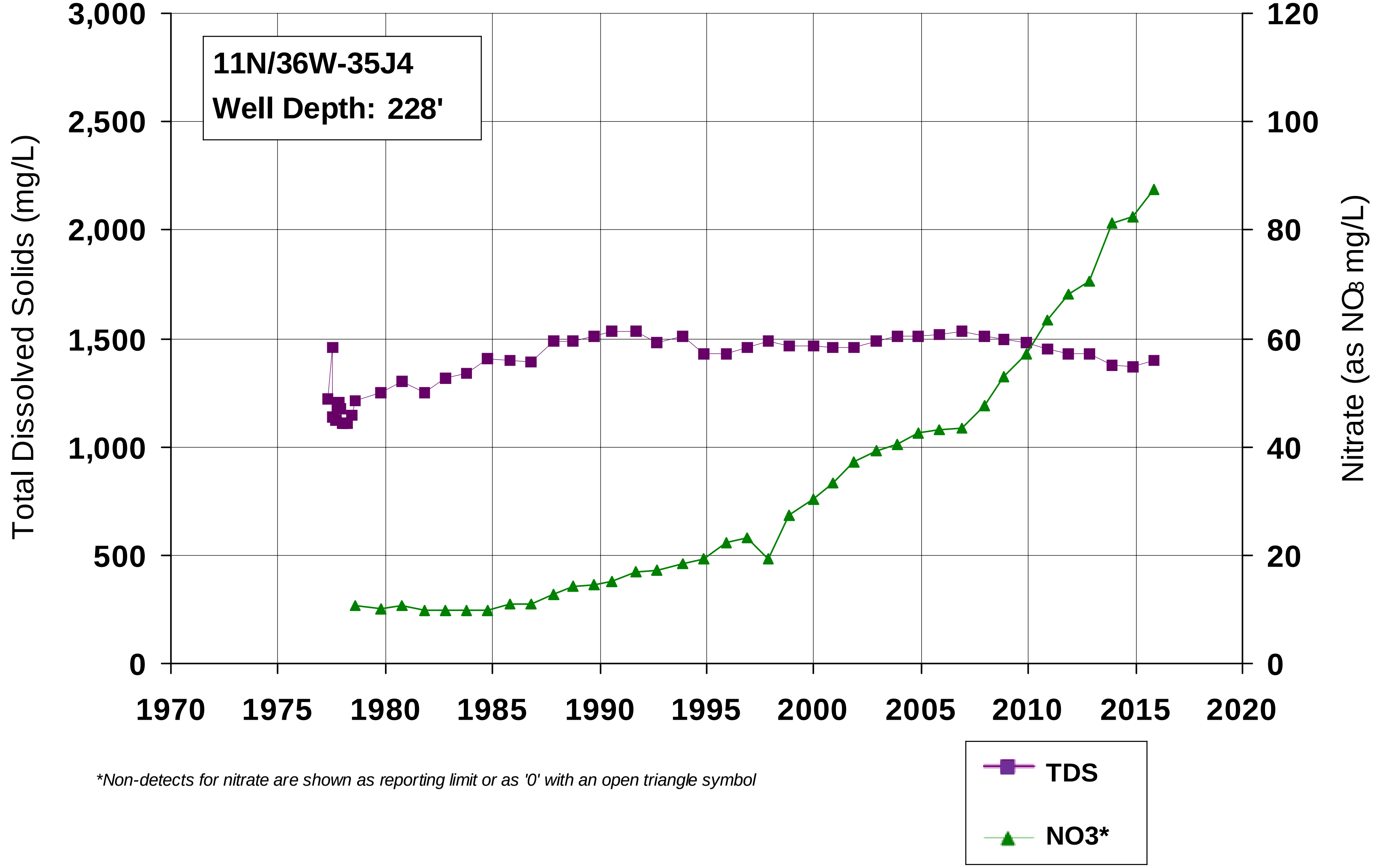
*Non-detects for nitrate are shown as reporting limit or as '0' with an open triangle symbol



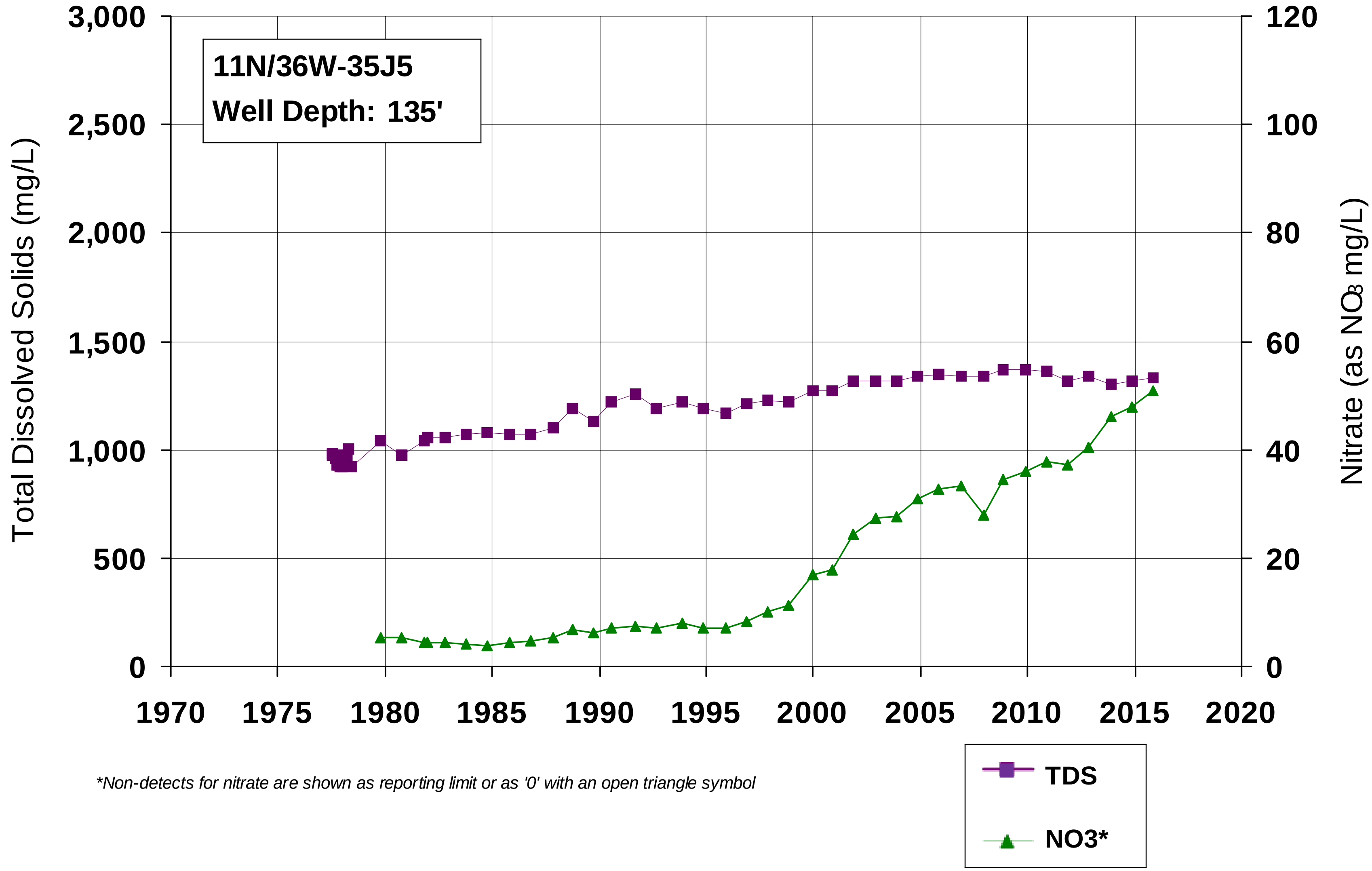
*Non-detects for nitrate are shown as reporting limit or as '0' with an open triangle symbol



*Non-detects for nitrate are shown as reporting limit or as '0' with an open triangle symbol



*Non-detects for nitrate are shown as reporting limit or as '0' with an open triangle symbol



*Non-detects for nitrate are shown as reporting limit or as '0' with an open triangle symbol

Appendix C

2015 Land Use Interpretation Data and Image Inventory

Appendix C

2015 Land Use Interpretation

Data and Image Inventory

Santa Maria Valley Management Area

Year	Dataset	Data Type and Resolution	Coverage Area	Date	Source
2015	NDVI	L8 Multi-band Raster 30m	PR 42/36	January 2, 2015	USGS
	NDVI	L8 Multi-band Raster 30m	PR 42/36	January 18, 2015	USGS
	NDVI	L8 Multi-band Raster 30m	PR 42/36	February 3, 2015	USGS
	NDVI	L8 Multi-band Raster 30m	PR 42/36	March 7, 2015	USGS
	NDVI	L8 Multi-band Raster 30m	PR 42/36	March 23, 2015	USGS
	NDVI	L8 Multi-band Raster 30m	PR 42/36	April 8, 2015	USGS
	NDVI	L8 Multi-band Raster 30m	PR 42/36	April 24, 2015	USGS
	NDVI	L8 Multi-band Raster 30m	PR 42/36	May 10, 2015	USGS
	NDVI	L8 Multi-band Raster 30m	PR 42/36	June 27, 2015	USGS
	NDVI	L8 Multi-band Raster 30m	PR 42/36	July 13, 2015	USGS
	NDVI	L8 Multi-band Raster 30m	PR 42/36	July 29, 2015	USGS
	NDVI	L8 Multi-band Raster 30m	PR 42/36	August 30, 2015	USGS
	NDVI	L8 Multi-band Raster 30m	PR 42/36	October 1, 2015	USGS
	NDVI	L8 Multi-band Raster 30m	PR 42/36	November 18, 2015	USGS
	NAIP Digital Ortho Mosaic	Color aerial photo 1m	SLO and SB Cty	June/Sept 2014	USDA/FSA/APFO
	SB Cty Pesticide Crop Report	Crop Polygon shp	SB Cty	2015	SB Cty Ag Co
	SLO Cty Pesticide Permitted Crop	Crop Polygon shp	SLO Cty	2015	SLO Cty Ag Co

L8 - Landsat 8; NAIP - National Ag Imagery Program; NDVI - Normalized Difference Vegetation Index; PR - Path/Row; SB Cty - Santa Barbara County; SB Cty Ag Co - Santa Barbara Agricultural Commission; shp - Shapefile; SLO Cty - San Luis Obispo County; SLO Cty Ag Co - San Luis Obispo County Agriculture Commission; USDA/FSA/APFO - United States Department of Agriculture/Farm Service Agency/Aerial Photography Field Office; USGS - United States Geological Survey

Appendix D

Estimated Historical Return Flows
Waste Water Treatment Plants

Appendix D
Estimated Historical Return Flows from Waste Water Treatment Plants
Santa Maria Valley Management Area
(all units in afy unless otherwise noted)

Year	Total Water Use: SM[1]	Total Water Use: GSWC	Total Water Use: GSWC[1]	Total Water Use: Guad	Total WWTP Influent: SM	Total WWTP Influent: LSD	Total WWTP Influent: Guad
1997	12,522	9,441	9,387	778	8,436	2,723	467
1998	11,085	8,001	7,960	778	7,501	2,267	467
1999	11,859	9,263	9,193	778	7,996	2,660	467
2000	12,679	9,399	9,342	778	8,369	2,825	467
2001	12,594	9,009	8,950	778	8,734	2,870	467
2002	13,312	9,466	9,409	778	8,868	2,632	467
2003	13,499	9,071	9,023	778	9,108	2,626	467
2004	13,650	9,356	9,302	832	9,555	2,580	499
2005	13,814	8,846	8,802	814	9,657	2,302	488
2006	13,610	8,754	8,700	883	9,487	2,006	530
2007	14,782	9,710	9,652	1,063	9,380	2,150	638
2008	14,235	9,311	9,255	997	9,520	2,271	633
2009	14,172	8,729	8,668	917	9,471	2,237	664
2010	13,294	7,735	7,681	880	8,721	2,336	664
2011	12,665	7,844	7,794	885	9,005	2,361	654
2012	13,038	8,296	8,241	924	9,465	2,311	681
2013	13,719	8,576	8,526	956	9,411	2,267	682
2014	13,321	7,703	7,651	1,123	9,000	2,295	791
2015	12,185	6,022	5,988	1,101	9,113	1,842	818

Year	Total WWTP Influent by Purveyor — from Santa Maria: Influent to SM WWTP	Influent to LSD WWTP[2]	Total Influent to SM and LSD WWTPs	% Water Use[3]	from Golden State Water Company: Influent to LSD WWTP	Influent to SM WWTP	Total Influent to SM and LSD WWTPs	% Water Use[4]	Guadalupe: Influent to Guad WWTP	% Water Use[5]
1997	8,107	95	8,202	65.5	2,628	329	2,957	31.5	467	60
1998	7,166	95	7,261	65.5	2,172	336	2,507	31.5	467	60
1999	7,665	95	7,760	65.4	2,565	331	2,896	31.5	467	60
2000	8,025	95	8,120	64.0	2,730	344	3,073	32.9	467	60
2001	8,375	95	8,470	67.3	2,775	359	3,133	35.0	467	60
2002	8,512	95	8,607	64.7	2,537	355	2,893	30.7	467	60
2003	8,629	95	8,724	64.6	2,531	479	3,010	33.4	467	60
2004	9,112	95	9,207	67.4	2,485	443	2,929	31.5	499	60
2005	9,305	95	9,400	68.0	2,207	352	2,559	29.1	488	60
2006	9,168	95	9,263	68.1	1,911	320	2,231	25.6	530	60
2007	8,971	95	9,066	61.3	2,055	409	2,463	25.5	638	60
2008	9,026	95	9,121	64.1	2,176	494	2,670	28.8	633	63
2009	8,952	95	9,047	63.8	2,142	519	2,661	30.7	664	72
2010	8,177	95	8,272	62.2	2,241	544	2,785	36.3	664	75
2011	8,442	95	8,537	67.4	2,266	563	2,828	36.3	654	74
2012	8,920	100	9,020	69.2	2,211	545	2,755	33.4	681	74
2013	8,993	100	9,093	66.3	2,167	418	2,585	30.3	682	71
2014	8,722	100	8,822	66.2	2,195	278	2,473	32.3	791	70
2015	8,840	100	8,940	73.4	1,742	273	2,015	33.7	818	74

Year	Total WWTP Effluent — SM Total	LSD: Brine Injection[6]	LSD: Industrial Use	LSD: Irrigation	LSD: Total	Guad Total
1997	7,592	0	0	2,451	2,451	420
1998	6,751	0	0	2,040	2,040	420
1999	7,196	0	0	2,394	2,394	420
2000	7,532	0	0	2,542	2,542	420
2001	7,860	0	0	2,583	2,583	420
2002	7,981	0	0	2,369	2,369	420
2003	8,197	0	0	2,363	2,363	420
2004	8,600	0	0	2,322	2,322	449
2005	8,691	0	0	2,072	2,072	440
2006	8,539	0	4	1,802	1,806	477
2007	8,442	0	16	1,919	1,935	574
2008	8,568	89	12	1,943	2,044	570
2009	8,524	73	28	1,912	2,013	598
2010	7,849	79	55	1,968	2,102	598
2011	8,104	72	40	2,014	2,125	589
2012	8,519	86	49	1,945	2,080	613
2013	8,470	78	58	1,903	2,040	614
2014	8,100	60	72	1,934	2,065	712
2015	8,202	80	34	1,544	1,658	736

Year	Effluent Available for Return Flows — Santa Maria: Effluent from SM WWTP	Santa Maria: Effluent from LSD WWTP	Golden State Water Company: Effluent from SM WWTP	Golden State Water Company: Effluent from LSD WWTP[7]	Guadalupe: Effluent from Guad WWTP	Return Flows — Santa Maria: from SM WWTP	Santa Maria: from LSD WWTP	Santa Maria: Total	Santa Maria: % Water Use	Golden State Water Company: from SM WWTP	Golden State Water Company: from LSD WWTP[8]	Golden State Water Company: Total[8]	Golden State Water Company: % Water Use[8]	Guadalupe: from Guadalupe WWTP	Guadalupe: % Water Use	Total
1997	7,296	86	296	2,365	420	7,296	17	7,313	58	296	473	769	8.2	84	11	8,166
1998	6,449	86	302	1,955	420	6,449	17	6,466	58	302	391	693	8.7	84	11	7,243
1999	6,899	86	298	2,308	420	6,899	17	6,916	58	298	462	759	8.3	84	11	7,759
2000	7,223	86	309	2,457	420	7,223	17	7,240	57	309	491	801	8.6	84	11	8,125
2001	7,538	86	323	2,497	420	7,538	17	7,555	60	323	499	822	9.2	84	11	8,461
2002	7,661	86	320	2,284	420	7,661	17	7,678	58	320	457	777	8.3	84	11	8,539
2003	7,766	86	431	2,278	420	7,766	17	7,783	58	431	456	887	9.8	84	11	8,754
2004	8,201	86	399	2,237	449	8,201	17	8,218	60	399	447	846	9.1	90	11	9,154
2005	8,374	86	317	1,987	440	8,374	17	8,391	61	317	397	714	8.1	88	11	9,193
2006	8,251	85	288	1,717	477	8,251	17	8,268	61	288	343	631	7.3	95	11	8,994
2007	8,074	85	368	1,834	574	8,074	17	8,091	55	368	367	734	7.6	115	11	8,940
2008	8,123	81	444	1,861	570	8,123	16	8,140	57	444	372	817	8.8	114	11	9,070
2009	8,057	81	467	1,830	598	8,057	16	8,073	57	467	366	833	9.6	120	13	9,026
2010	7,360	80	489	1,888	598	7,360	16	7,376	55	489	378	867	11.3	120	14	8,362
2011	7,598	81	506	1,933	589	7,598	16	7,614	60	506	387	893	11.5	118	13	8,625
2012	8,028	84	490	1,861	613	8,028	17	8,045	62	490	372	862	10.5	123	13	9,030
2013	8,094	84	376	1,819	614	8,094	17	8,110	59	376	364	740	8.7	123	13	8,973
2014	7,850	84	250	1,849	712	7,850	17	7,867	59	250	370	620	8.1	142	13	8,629
2015	7,956	84	246	1,460	736	7,956	17	7,973	65	246	292	538	9.0	147	13	8,658

Estimated

SM	City of Santa Maria
GSWC	Golden State Water Company
Guad	City of Guadalupe
LSD	Laguna Sanitation District

1) For Santa Maria, starting 2015, excludes water transferred to NMMA; for GSWC, all years, excludes Sisquoc system water use (typically 40 - 70 afy) for effluent return flow calculations.
2) For 1997 - 2011, influent amount of 95 afy from Santa Maria to LSD WWTP estimated (LSD staff, April 2009); for subsequent years, reported influent amount of 100 afy (LSD staff, April 2012 and April 2016).
3) For 1997 - 1998, percentage of SM total water use as total influent to WWTPs estimated as 65.5% (SM staff, April 2009).
4) For 1997 - 1999, percentage of GSWC water use (excluding Sisquoc System) as total influent to WWTPs estimated as 31.5%.
5) For 1997 - 2007, percentage of Guadalupe total water use as influent to WWTP estimated as 60% (Guad staff, April 2009).
6) For 1997 - 2007, average brine amount to injection well (afy) estimated as 80 afy; reported amounts for 2008 to present.
7) For 1997 - 2011, effluent volumes available for generating return flows from GSWC-derived wastewater at LSD WWTP adjusted (from previous annual reports) to reflect zero return flows from brine injection and oil lease industrial use.
8) GSWC return flow amounts from LSD WWTP, total return flow amounts, and % water use reflect effluent volume adjustments described in footnote 7.

Santa Maria	Avg Percentage, Influent/Water Use =	66.0 %
GSWC	Avg Percentage, Influent/Water Use =	31.6 %
Guadalupe	Avg Percentage, Influent/Water Use =	65.6 %

Appendix E

Calculation of Landscape Irrigation Return Flows Annually from 2008

Appendix E

Disposition of Municipal Waters, Annually from 2008
Estimated Percentages of Municipal Water Supply
Santa Maria Valley Management Area
(all units in acre-feet unless otherwise noted)

Santa Maria

*Excludes NMMA water transfer

Water supply	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
2008	775	774	1,105	1,197	1,314	1,473	1,521	1,502	1,361	1,335	1,017	859	14,235
2009	971	732	959	1,229	1,395	1,362	1,528	1,496	1,324	1,174	1,095	908	14,172
2010	1,108	899	910	959	1,228	1,353	1,428	1,379	1,331	1,062	877	760	13,294
2011	819	778	774	992	1,249	1,207	1,377	1,344	1,217	1,141	900	868	12,665
2012	922	867	925	867	1,210	1,349	1,370	1,403	1,239	1,192	961	733	13,038
2013	761	757	982	1,114	1,307	1,366	1,437	1,381	1,329	1,265	1,045	974	13,719
2014	1,013	746	898	1,040	1,382	1,372	1,421	1,317	1,228	1,263	888	753	13,321
2015*	893	814	1,088	1,130	1,099	1,104	1,119	1,157	1,111	1,055	839	777	12,185
Avg	908	796	955	1,066	1,273	1,323	1,400	1,372	1,268	1,186	953	829	13,329
Min		732											
Max		899											

Landscape Irrig	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
2008	2	0	332	423	540	699	747	729	588	561	244	86	4,952
2009	239	0	228	497	663	631	796	764	592	442	363	176	5,392
2010	348	139	150	199	468	593	668	619	571	302	118	0	4,176
2011	45	4	0	218	475	433	603	570	443	367	126	94	3,377
2012	190	134	193	135	478	617	638	670	507	460	228	0	4,247
2013	5	0	225	357	551	609	681	625	572	509	288	218	4,639
2014	267	0	152	294	636	626	675	572	483	518	142	7	4,372
2015*	116	37	311	353	322	327	342	380	335	279	63	0	2,865

Santa Maria Annual Summation of Water Disposition*

Year	Water supply	Influent to WWTPs	Influent % of WS	Water Used in Service Area	Applied Landscape Irrig	Irrig % of WS	Septic Flow to Systems	Septic % of WS	Customer Consumption	Consump % of WS	Irrigation Consumption	Irrigation Return Flows	Septic Consumption	Septic Return Flows
2008	14,235	9,121	64	5,114	4,952	35	NA	NA	162	1	3,961	990	NA	NA
2009	14,172	9,047	64	5,125	5,392	38	NA	NA	-267	-2	4,314	1,078	NA	NA
2010	13,294	8,272	62	5,022	4,176	31	NA	NA	846	6	3,340	835	NA	NA
2011	12,665	8,537	67	4,128	3,377	27	NA	NA	751	6	2,702	675	NA	NA
2012	13,038	9,020	69	4,018	4,247	33	NA	NA	-229	-2	3,398	849	NA	NA
2013	13,719	9,093	66	4,626	4,639	34	NA	NA	-13	0	3,711	928	NA	NA
2014	13,321	8,822	66	4,499	4,372	33	NA	NA	127	1	3,498	874	NA	NA
2015*	12,185	8,940	73	3,245	2,865	24	NA	NA	380	3	2,292	573	NA	NA
		avg	67		avg	32	NA	NA	avg	2				

*Excludes water transferred by WIP to NMMA, from 2015 forward

GSWC

**Includes Sisquoc water supply

Water supply	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
2008	434	414	672	803	951	1,021	1,072	1,037	919	852	634	445	9,255
2009	548	370	539	749	889	882	987	959	901	710	686	448	8,668
2010	410	302	502	544	787	915	931	933	874	621	480	383	7,682
2011	445	412	399	616	814	773	907	878	807	712	498	533	7,793
2012	557	503	543	517	803	890	919	928	837	786	581	378	8,241
2013	411	433	593	734	874	882	935	886	836	768	611	564	8,526
2014	629	424	497	574	819	809	833	788	720	715	497	347	7,652
2015**	458	419	562	561	570	553	553	532	536	525	392	361	6,022
Avg	486	410	538	637	813	841	892	868	804	711	547	432	7,980
Min		302											
Max		503											

Landscape Irrig	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
2008	20	0	257	389	536	607	658	623	505	438	219	30	4,282
2009	178	0	169	379	519	512	617	589	531	340	316	78	4,228
2010	108	0	200	242	485	613	628	631	571	318	177	80	4,052
2011	46	13	0	217	415	374	508	479	408	313	99	134	3,005
2012	179	126	165	140	426	512	542	550	459	409	203	0	3,710
2013	0	22	182	324	463	471	524	475	425	357	200	153	3,598
2014	282	78	151	227	472	463	486	441	374	368	151	0	3,493
2015**	97	58	202	200	209	193	192	171	175	164	32	0	1,692

GSWC Annual Summation of Water Disposition**

Year	Water supply	Influent to WWTPs	Influent % of WS	Water Used in Service Area	Applied Landscape Irrig	Irrig % of WS	Septic Flow to Systems	Septic % of WS	Customer Consumption	Consump % of WS	Irrigation Consumption	Irrigation Return Flows	Septic Consumption	Septic Return Flows
2008	9,255	2,670	28.9	6,585	4,282	46.3	---	---	2,303	24.9	3,426	856	---	---
2009	8,668	2,661	30.7	6,007	4,228	48.8	---	---	1,779	20.5	3,383	846	---	---
2010	7,682	2,785	36.3	4,897	4,052	52.8	---	---	845	11.0	3,242	810	---	---
2011	7,793	2,828	36.3	4,965	3,005	38.6	---	---	1,961	25.2	2,404	601	---	---
2012	8,241	2,755	33.4	5,486	3,710	45.0	---	---	1,776	21.6	2,968	742	---	---
2013	8,526	2,585	30.3	5,941	3,598	42.2	---	---	2,343	27.5	2,878	720	---	---
2014	7,652	2,473	32.3	5,179	3,493	45.7	---	---	1,685	22.0	2,795	699	---	---
2015**	6,022	2,015	33.5	4,007	1,692	28.1	11	0.2	2,304	38.3	1,354	338	2	9
		avg	32.7		avg	43.4	avg	0.2	avg	23.9				

**Includes Sisquoc area water supply, from 2015 forward

Guadalupe

Water supply	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
2008	76	30	80	90	96	100	98	96	94	92	77	70	997
2009	69	58	65	81	83	83	87	88	82	78	72	70	917
2010	67	57	68	67	80	85	85	85	85	75	64	63	880
2011	65	59	64	71	78	78	85	86	81	80	68	72	886
2012	75	68	74	71	88	88	88	87	78	77	67	62	924
2013	63	60	74	77	88	87	91	93	82	86	77	78	956
2014	81	67	77	95	117	105	108	104	99	102	87	80	1,123
2015	87	80	92	95	98	94	96	96	101	95	85	83	1,101
Avg	73	60	74	81	91	90	92	92	88	86	75	72	973
Min		30											
Max		68											

Landscape Irrig	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
2008	7	0	11	21	27	31	29	28	25	23	8	1	211
2009	11	0	7	22	25	25	29	30	24	20	13	11	216
2010	10	0	11	11	24	28	28	28	28	19	8	6	201
2011	0	0	0	12	14	13	20	22	16	15	4	8	124
2012	13	6	12	9	26	26	26	25	16	15	5	0	180
2013	3	0	14	17	28	27	31	33	22	26	17	18	235
2014	14	0	10	28	49	38	41	37	32	35	20	13	317
2015	7	0	13	15	18	15	17	16	21	15	5	3	145

Guadalupe Annual Summation of Water Disposition

Year	Water supply	Influent to WWTPs	Influent % of WS	Water Used in Service Area	Applied Landscape Irrig	Irrig % of WS	Septic Flow to Systems	Septic % of WS	Customer Consumption	Consump % of WS	Irrigation Consumption	Irrigation Return Flows	Septic Consumption	Septic Return Flows
2008	997	633	63	364	211	21	NA	NA	154	15	168	42	NA	NA
2009	917	664	72	253	216	24	NA	NA	37	4	173	43	NA	NA
2010	880	664	75	216	201	23	NA	NA	15	2	161	40	NA	NA
2011	886	654	74	232	124	14	NA	NA	108	12	99	25	NA	NA
2012	924	681	74	243	180	20	NA	NA	63	7	144	36	NA	NA
2013	956	682	71	274	235	25	NA	NA	38	4	188	47	NA	NA
2014	1,123	791	70	332	317	28	NA	NA	15	1	254	63	NA	NA
2015	1,101	818	74	283	145	13	NA	NA	138	13	116	29	NA	NA
		avg	72		avg	21	NA	NA	avg	7				

Note: for 2008, Guadalupe, typical avg % Feb/Jan and avg % Feb/March were utilized to estimate Feb 2008 (69), which was used in place of the recorded 30.

Annual Summation of Total Water Disposition for the SMVMA

Year	Total Water Supply	Total Influent to WWTPs	Total Water Used in Service Area	Total Applied Landscape Irrig	Total Septic Flow to Systems	Total Customer Consumption	Total Irrigation Consumption	Total Irrigation Return Flows	Total Septic Consumption	Total Septic Return Flows
2008	24,487	12,424	12,063	9,444	---	2,618	7,556	1,889	---	---
2009	23,756	12,372	11,384	9,836	---	1,548	7,869	1,967	---	---
2010	21,856	11,721	10,135	8,429	---	1,706	6,743	1,686	---	---
2011	21,344	12,019	9,325	6,506	---	2,819	5,205	1,301	---	---
2012	22,204	12,456	9,748	8,138	---	1,610	6,510	1,628	---	---
2013	23,201	12,360	10,841	8,473	---	2,368	6,778	1,695	---	---
2014	22,095	12,086	10,009	8,182	---	1,827	6,546	1,636	---	---
2015	19,308	11,773	7,535	4,702	11	2,821	3,762	940	2	9