Nipomo Mesa Management Area

2nd Annual Report

Calendar Year 2009

Prepared by

NMMA Technical Group

Submitted April 2010

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Table of Contents

List of Figures

List of Tables

Acronyms

AF	-	acre-feet
AF/yr	-	acre-feet per year
ALERT	-	Automated Local Evaluation in Real Time
C.E.G.	-	Certified Engineering Geologist
C.H.G	-	Certified Hydrogeologist
CCAMP	-	Central Coast Ambient Monitoring Program
CDF	-	California Department of Forestry
CIMIS	-	California Irrigation Management Information System
CPUC	-	California Public Utilities Commission
CU	-	consumptive use
d	-	day
DPH	-	California Department of Public Health
DWR	-	California Department of Water Resources
ES	-	Executive Summary
ft	-	feet
ft^2	-	square feet
ft msl	-	feet above mean sea level
gpd	-	gallons per day
GSWC	-	Golden State Water Company
K	-	hydraulic conductivity
mg/L	-	milligrams per Liter
msl	-	mean sea level
NCSD	-	Nipomo Community Services District
NMMA	-	Nipomo Mesa Management Area
TG	-	Nipomo Mesa Management Area Technical Group
P.E.	-	Professional Engineer
P.G.	-	Professional Geologist
RF	-	return flow
RP	-	reference point
RWC	-	Rural Water Company
SCWC		Southern California Water Company (now named Golden State Water Company)
SLO	-	San Luis Obispo County
SLO DPW	-	San Luis Obispo County Department of Public Works
SWP	-	State Water Project
TDS	-	Total Dissolved Solids
U.S.	-	United States
WWTF	-	wastewater treatment facility
WY	-	Water Year
yr	-	year

Abbreviations

Black Lake WWTF	-	Black Lake Reclamation Facility
Cypress Ridge WWTF	-	Rural Water Company's Cypress Ridge Wastewater Facility
Judgment	-	Judgment After Trial dated January 25, 2008
Phase III	-	Santa Maria Groundwater Litigation Phase III
Program	-	Nipomo Mesa Management Area Monitoring Program
Santa Maria Groundwater Litigation	-	*Santa Maria Valley Water Conservation District vs. City of Santa Maria, et al.* Case No. 770214
Southland WWTF	-	Southland Wastewater Works
Stipulation	-	Stipulated Judgment dated June 30. 2005
Temp	-	Temperature
Woodlands	-	Woodlands Mutual Water Company
Woodlands WWTF	-	Woodlands Mutual Water Company Wastewater Reclamation Facility Plant

Executive Summary

This 2nd Annual Report, covering calendar year 2009, for the Nipomo Mesa Management Area (NMMA), is prepared in accordance with the Stipulation and Judgment for the Santa Maria Groundwater Litigation (Lead Case No. 1-97-CV-770214). This and each annual report to follow provides an assessment of hydrologic conditions for the NMMA based on an analysis of the data accruing each calendar year. Each report will be submitted to the court annually in accordance with the Stipulation in the year following that which is assessed in the report. This Executive Summary contains three sections: ES-1 Background; ES-2 Findings; and ES-3 Recommendations.

ES-1 Background

The NMMA Technical Group (TG) is one of three management areas committees established by the Court and charged with developing the technical bases for sustainable management of the surface and groundwater supplies available to each of the management areas. The TG is responsible for the NMMA. The Northern Cities Management Area lies to the north of the NMMA and the Santa Maria Valley Management Area lies to the south. The goal of each management area is to promote monitoring and management practices so that present and future water demands are satisfied without causing long-term damage to the underlying groundwater resource.

The TG, a committee formed to administer the relevant provisions of the Stipulation regarding the NMMA, prepared this Annual Report for 2009. ConocoPhillips, Golden State Water Company, Nipomo Community Services District, and Woodlands Mutual Water Company are responsible for appointing the members of the committee, and along with an agricultural overlying landowner who is also a Stipulating Party, are responsible for the preparation of this annual report.

The TG collected and compiled data and reports from numerous sources including the NMMA Monitoring Parties, Counties of San Luis Obispo and Santa Barbara, California Department of Water Resources and Department of Public Health, the U. S. Geologic Survey and the Management Area Engineers for the Northern Cities and Santa Maria Valley Management Areas. The TG developed an electronic database to aid in the evaluation of the long-term sustainability of the NMMA portion of the Santa Maria Valley Groundwater Basin. The TG reviewed these data and reports and concluded that additional data and evaluations were required to understand the hydrogeologic conditions of the NMMA in sufficient detail to make comprehensive recommendations for the long-term management of the NMMA.

The TG evaluated the available compiled data to reach the findings presented in the following section of this Executive Summary. The TG recognizes that the data used in the evaluations are not equally reliable but represent what is currently available. In some cases, additional analysis will be required for an adequate characterization of the physical setting within NMMA to develop an appropriately detailed model of the stratigraphy, defining the location and thickness of production aquifers and confining layers. Refinements in the understanding of the physical setting will improve upon estimates of groundwater in storage available for pumping to meet water demands. Such work is an important goal for the TG, and mirrors the TG's desire to characterize groundwater storage in the NMMA. The TG has developed specific recommendations to address these issues for the next annual report.

ES-2 Findings

Presented in this section of the Executive Summary are brief descriptions of the findings by the TG for calendar year 2009. Presented in the body of this report are the details and bases for these findings.

1. The TG recommends that the Nipomo Supplemental Water project be implemented as soon as possible (see Section 9.3 Technical Recommendations).

2. Potentially Severe Water Shortage Conditions continue to exist in the NMMA as indicated by the Key Wells Index (see Section 7.2.3 Status of Water Shortage Conditions). All other indicators are above threshold values to designate Potentially Severe Water Shortages Conditions. This water shortage condition triggers a voluntary response plan as presented in the Water Shortage Conditions and Response Plan (see Section 7.2.3 Status of Water Shortage Conditions).

3. Spring groundwater elevations underlying the NMMA, indicated by the Key Wells Index of eight (8) wells, declined from 2006 levels for the third consecutive year (through the spring of 2009), although the decline in this year is relatively small (see Section 7.1.1 Groundwater Conditions).

4. There are a number of direct measurements that indicate that demand exceeds the ability of the supply to replace the water pumped from the aquifers (see Section 7.1.2 Water Supply and Demand).

5. The final environmental documentation for the Nipomo Supplemental Water Project is completed and NCSD has informed the TG that construction could begin in 16 months (see Section 1.1.7 Supplemental Water).

6. Nipomo Community Services District, Golden State Water Company, and Woodlands has completed the purveyor Well Management Plan (see Section 1.1.6 Well Management Plan).

7. The 2009 Annual Report prepared by the Northern Cities Management Area addresses the evidence for seawater intrusion that was gathered in 2009 (see Section 8.2 Threats to Groundwater Supply).

8. Total rainfall for Water Year 2009 (October 1, 2008 through September 30, 2009) is approximately 70 percent of the long-term average (see Section 3.1.3 Rainfall).

9. For the partial water year 2010 through April 2010, precipitation ranges from 110 to 132 percent of the long-term average total rainfall through April at the Nipomo South, Nipomo East, Oceano and CIMIS Nipomo rainfall stations (see Section 3.1.3 Rainfall).

10. The period of analysis (1975-2009) used by the TG is roughly 11 percent "wetter" on average than the long-term record (1920-2009) indicating there is a slight bias toward overstating the amount of local water supply resulting from percolation of rainfall (see Section 7.3.1 Climatological Trends).

11. The total estimated groundwater production is 12,200 acre-feet (AF). The breakdown by user and type of use is shown in the following table (see Section 3.1.9 Groundwater Production (Reported and Estimated)).

Agriculture	3,800 AF
Urban/Industrial	7,400 AF
Total Production	**12,200 AF**

12. The total Waste Water Treatment Facility effluent discharged in the NMMA was 690 AF for Calendar Year 2009 (see Section 3.1.10 Wastewater Discharge and Reuse).

13. Contour maps prepared using spring and fall 2009 groundwater elevations show subsurface flow is generally from east to west (toward the ocean). They also show a nearly flat gradient in a localized area near the coast (see Section 6.1.4 Groundwater Contours and Pumping Depressions).

14. The acreage for land use classification of Urban is 10,246 acres; of Agriculture is 2,587 acres; and, of Native is 8,314 acres (see Section 3.1.8 Land Use).

15. There is no evidence of any water quality issues that significantly restrict current use of groundwater to meet the current water demands, but localized areas of the NMMA have reported nitrate concentrations as high as 90 percent of the Maximum Contaminant Level and rising nitrate concentrations in groundwater (see Section 6.2.3 Results of Inland Water Quality Monitoring).

16. There is a lack of understanding of the contribution of Los Berros and Nipomo Creeks to the NMMA water supplies (see Section 3.1.5 Streamflow).

17. There is a lack of understanding about confined and unconfined aquifer conditions in the NMMA, except near the coast and locally adjacent areas where the Deep Aquifer is known to be confined (see Section 2.3.3 Hydrogeology).

18. There is a lack of understanding of the flow path of rainfall, applied water, and treated wastewater to specific aquifers underlying the NMMA (see Section 3.1.10 Wastewater Discharge and Reuse).

ES-3 Recommendations

This section of the Executive Summary presents the three categories of recommendations from the TG. They are: (1) Funding Recommendations, that support the recommended actions and further activities of the TG, (2) Achievement from the 2008 NMMA Annual Report Recommendations, and (3) Technical Recommendations, that deal primarily with the need to implement the Monitoring Program to generate data that will make future Annual Reports more complete.

ES-3.1 Funding Recommendations

A six year capital and operating expenditure program has been prepared by the TG as summarized in Table 9-1 below. The yearly budget totals in this proposed plan currently exceeds the $75,000 per year funding cap outlined in the stipulation.

NMMA 6-Year Cost Analysis

Task Description	Total Cost	Targeted Completion Year	Projected 6-year Cash Flow					
			2010	2011	2012	2013	2014	2015
Yearly Tasks								
Annual report preparation			$50,000	$50,000	$50,000	$50,000	$50,000	$50,000
Grant funding efforts			$10,000	$10,000	$10,000	$10,000	$10,000	$10,000
Confining layer definition			$10,000	$10,000	$10,000	$10,000	$10,000	$10,000
Well head surveying			$3,000	$3,000	$3,000	$3,000	$3,000	$3,000
Analytical testing			$5,000	$5,000	$5,000	$5,000	$5,000	$5,000
Long Term Studies								
Groundwater model (NMMA share)	$250,000	2015	--	$33,300	$33,300	$33,300	$75,000	$75,000
Capital Projects								
Oso Flaco monitoring well	$130,000	2013	--	$43,300	$43,300	$43,300	--	--
Automatic monitoring equipment	$25,000	2015	--	--	--	--	$12,500	$12,500
Total Projected Annual Cost			$78,000	$154,600	$154,600	$154,600	$165,500	$165,500

ES-3.2 Achievements from 2008 NMMA Annual Report Recommendations

The TG worked diligently to address several of the recommendations outlined in the 2008 Annual Report. Major accomplishments and/or progress were accomplished during 2009 on the following:

- Evaluation of an Oso Flaco monitoring well cluster;
- Development of a Data Acquisition Protocols for Groundwater Level Measurements for the NMMA (Appendix D);
- Development of a purveyor Well Management Plan by the Purveyors and adopted by the TG(Appendix C);
- Evaluation of stream gauge placement;
- Evaluation of hydrological conditions – refinement of areal extent of the confined aquifer was undertaken (ongoing).

ES-3.3 Technical Recommendations

The following technical recommendations are not organized in their order of priority because the monitoring parties, considering their own particular funding constraints and authorities, will determine the implementation strategies and priorities. However, the TG has suggested a priority for some of the technical recommendations.

- **Supplemental Water Supply** – An alternative water supply that would allow reduced pumping within the NMMA is likely to be the most effective method of reducing the stress on the aquifer and allow groundwater elevations to recover. The Nipomo Supplemental Water project (see

Section 1.1.7-Supplemental Water) is likely to be the fastest method of obtaining alternative water supplies. Given the Potentially Severe Water Shortage Conditions within the NMMA and the other risk factors discussed in this Report, the TG recommends that this project be implemented as soon as possible.

- **2010 Work Plan** – To advance important technical characterization of the NMMA groundwater resources, the TG has developed a work plan for two intermediate work products in 2010, including milestone dates as follows:

Table 0-1: 2010 Work Plan

Task Description	Milestone Date	Use of Work Product
1. Technical memo establishing methodology and quantifying volume of water percolating beyond the root zone.	August 13, 2010	Available for immediate use by TG members, and incorporated into 2010 Annual Report
2. Technical memo establishing methodology and quantifying consumptive water demand within the NMMA	September 17, 2010	Available for immediate use by TG members, and incorporated into 2010 Annual Report

- **Changes to Monitoring Points or Methods** – The coastal monitoring wells are of great importance in the Monitoring Program. The inability to locate the monitoring well cluster under the sand dunes proximally north of Oso Flaco Lake renders the southwestern coastal portion of the NMMA without adequate coastal monitoring. During 2009, the NMMA Technical Group reviewed options for replacing this lost groundwater monitoring site. The TG was given written support of the concept from the State Parks Department to allow replacement of the well, and the TG has also had discussions with San Luis Obispo County, which may be able to provide some financial assistance for the project. The NMMA Technical Group has incorporated replacement of this monitoring well in its long-term capital project planning and will investigate possible State or Federal grants for financial assistance with the construction of this multi-completion monitoring well.

- **Installation of Groundwater Monitoring Equipment** – When a groundwater level is measured in a well, both the length of time since the measured well is shut off and the effect of nearby pumping wells modify the static water level in the well being measured. For the Key Wells, the installation of transducers and data loggers will largely solve this problem. Installation of transducers is also recommended for purveyors' wells that pump much of the time.

- **Well Reference Point Elevations** – It is recommended that all the wells used for monitoring have an accurate RP established over time. This could be accomplished by surveying a few wells every year or by working with the other Management Areas and the two counties in the Santa Maria Basin to obtain LIDAR data for the region; the accuracy of the LIDAR method allows one-foot contours to be constructed and/or spot elevations to be determined to similar accuracy.

- **Groundwater Production** – Estimates of total groundwater production are based on a combination of measurements provided freely from some of the parties, and estimates based on land use. The TG recommends developing a method to collect groundwater production data from all stipulating parties. The TG recommends updating the land use classification on an interval commensurate with growth and as is practical with the intention that the interval is more frequent than DWR's 10 year cycle of land use classification.

- **Stream Flow Analysis** – For the 2009 Annual Report, stream flow measured at Arroyo Grande Creek and Los Berros Creek at County stream gages is presented. Because of the location of the stream gages as well as unique runoff characteristics of the Nipomo Mesa, the annual amount of surface runoff from the NMMA is difficult to estimate. The TG will determine whether stream flow and surface runoff volume is a significant component of the hydrologic inventory, determine the methodology to calculate it and present the estimates in the 2010 Annual Report.

- **CIMIS Station #202** – The TG will evaluate the Nipomo CIMIS station #202 to ensure better annual data quality.

- **Increased Collaboration with Agricultural Producers** – To better estimate agricultural groundwater production where data is incomplete, it is recommended that the TG work with a subset of agricultural entities to measure groundwater production. This measured production can then be used to calibrate models and verify estimates of agricultural groundwater production where data are not available.

- **Hydrogeologic Characteristics of NMMA** – Further defining the continuity of confining conditions within the NMMA remains a topic of investigation by the TG. The locations of unconfined conditions is important – they control to a significant degree both the NMMA groundwater budget as to the quantity of recharge from overlying sources and any calculation of changes in groundwater storage.

- **Modifications of Water Shortage Conditions Criteria** – The Water Shortage Conditions and Response Plan was finalized in 2008. The TG will review the plan on a regular basis.

- **Groundwater Modeling** - The TG continues to recommend the advancement of a groundwater model as presented in the NMMA 6-yr Cost Analysis.

1. Introduction

The rights to extract water from the Santa Maria Valley Groundwater Basin have been in litigation since the late 1990s. By stipulation and Court action three separate management areas were established, the Northern Cities Management Area, the Nipomo Mesa Management Area (NMMA) and the Santa Maria Valley Management Area. Each management area was directed to form a group of technical experts (TG) to continue to study and evaluate the characteristics and conditions of each management area and present their findings to the Court in the form of an annual report.

This 2009 Annual Report is a joint effort of the TG. The requirement contained in the Judgment for the production of an Annual Report is as follows:

> "Within one hundred and twenty days after each Year, the Management Area Engineers will file an Annual Report with the Court. The Annual Report will summarize the results of the Monitoring Program, changes in groundwater supplies, and any threats to Groundwater supplies. The Annual Report shall also include a tabulation of Management Area water use, including Imported Water availability and use, Return Flow entitlement and use, other Developed Water availability and use, and Groundwater use. Any Stipulating Party may object to the Monitoring Program, the reported results, or the Annual Report by motion."

The report is organized into ten sections as follows: Section 1 – Introduction which presents the general background of the litigation and some of the requirements imposed by the Court; Section 2 – Basin Description; Section 3 – Data Collection; Section 4 –Water Supply and Demand; Section 5 – Hydrologic Inventory; Section 6 - Groundwater Conditions; Section 7 – Analysis of Groundwater Conditions; Section 8 – Other Considerations; Section 9 – Recommendations; and Section 10 - References.

Five appendices are also included: Appendix A – NMMA Monitoring Program, Appendix B – NMMA Water Shortage Conditions and Response Plan, Appendix C – Well Management Plan, Appendix D – Data Acquisition Protocols for Groundwater Level Measurements for the NMMA, and Appendix E – Additional Data and Maps.

1.1. *Background*

Presented in this subsection is the history of the litigation process and general discussions of activities underway to manage the water resources of the NMMA.

1.1.1. History of the Litigation Process

The Santa Maria Valley Groundwater Basin has been the subject of ongoing litigation since July 1997. Collectively called the Santa Maria Groundwater Litigation (*Santa Maria Valley Water Conservation District vs. City of Santa Maria, et al.* Case No. 770214), over 1,000 parties were involved with competing claims to pump groundwater from within the boundary of the Santa Maria Valley Groundwater Basin (Figure 1-1).

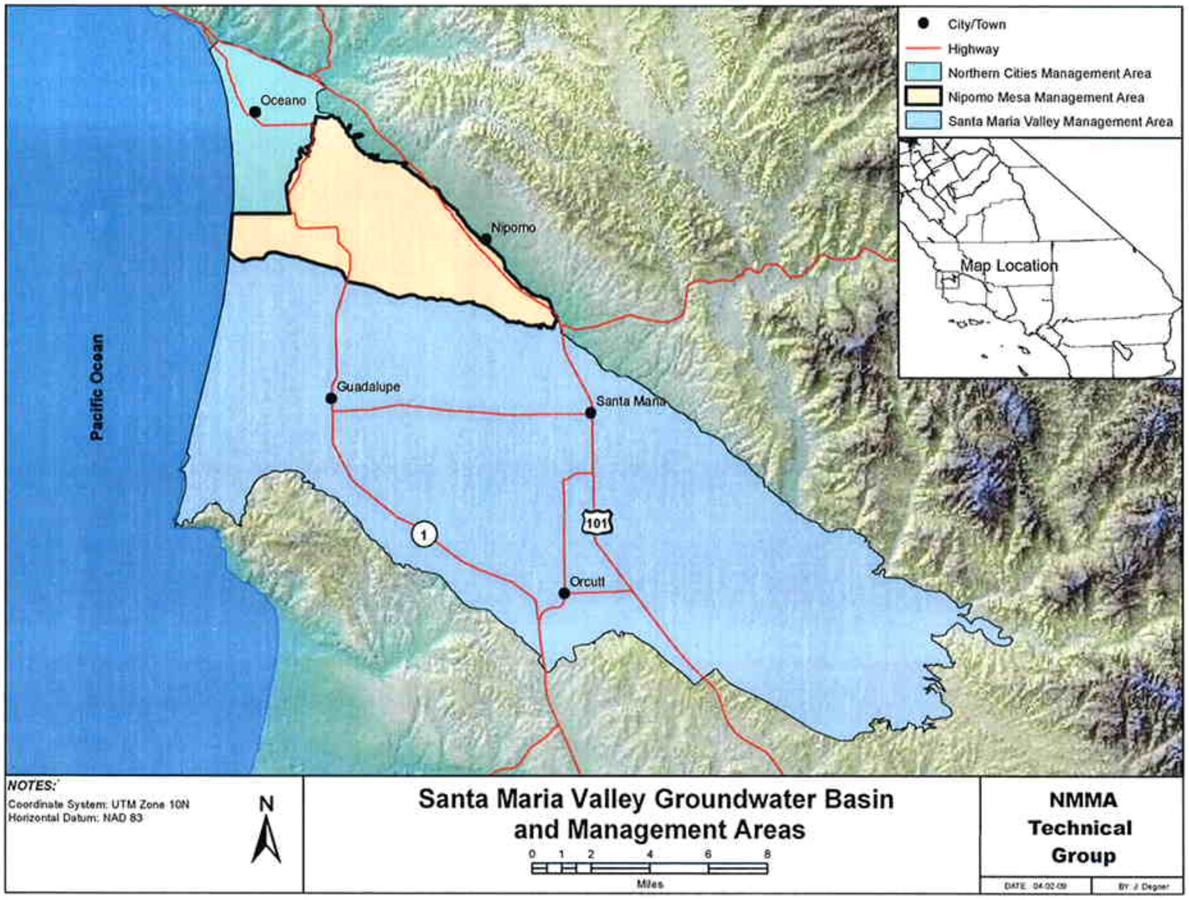

Figure 1-1. Santa Maria Valley Groundwater Basin and Management Areas

The Santa Maria Valley Water Conservation District was originally concerned that banking of State Water Project (SWP) water in the groundwater basin by the City of Santa Maria would give the City priority rights to the groundwater. The lawsuit was broadened to address groundwater management of the entire Santa Maria Valley Groundwater Basin.

On June 30, 2005, the Court entered a Stipulated Judgment ("Stipulation") in the case. The Stipulation divides the Santa Maria Valley Groundwater Basin into three separate management sub-areas (the Northern Cities Management Area, the Nipomo Mesa Management Area (NMMA), and the Santa Maria Valley Management Area). The Stipulation contains specific provisions with regard to rights to use groundwater, development of groundwater monitoring programs, and development of plans and programs to respond to Potentially Severe and Severe Water Shortage Conditions.

The TG was formed pursuant to a requirement contained in the Stipulation. Sections IV D (All Management Areas) and Section VI (C) (Nipomo Mesa Management Area) contained in the Stipulation were independently adopted by the Court in the Judgment After Trial (herein "Judgment"). The Judgment is dated January 25, 2008 and was entered and served on all parties on February 7, 2008.

It is noted that pursuant to paragraph 5 of the Judgment, the TG retains the right to seek a Court Order requiring non-stipulating parties to monitor their well production, maintain records thereof, and make the data available to the Court or the Court's designee. The compilation and evaluation of existing, and the aggregation of additional data are ongoing processes. Given its limited budget and resources, the TG has focused its efforts on the evaluation of readily accessible data. The TG does intend to slowly integrate into its assessment, new data that may be collected from stipulating parties and other sources that were not previously compiled as part of the existing database.

1.1.2. Description of the Nipomo Mesa Management Area Technical Group

The TG is composed of representatives from the Nipomo Community Services District (NCSD), Golden State Water Company (GSWC)[1] (named changed from Southern California Water Company in 2005), ConocoPhillips, Woodlands Mutual Water Company (Woodlands), and an agricultural user that is also a stipulating party. Rural Water Company (RWC) is responsible for funding a portion of the TG's efforts, but does not appoint a representative to the TG. The TG is responsible for conducting and funding the Monitoring Program. In-lieu contributions through engineering services may be provided, subject to agreement by those parties. The budget of the TG shall not exceed $75,000 per year without prior approval of the Court. The TG is responsible for preparing the Monitoring Program, conducting the Monitoring Program, and preparing the annual reports. The TG attempts to develop consensus on all material issues. If the TG is unable to reach a consensus, the matter may be taken to the court for resolution.

The TG may hire individuals or consulting firms to assist in the preparation of the Monitoring Program and Annual Reports (the Judgment describes these individuals or consulting firms as the "Management Area Engineer"). The representatives to the TG as a group function as the Management Area Engineer (Table 1-1). The TG Monitoring Parties have the sole discretion to select, retain, and replace the Management Area Engineer.

Table 1-1. NMMA Technical Group

Monitoring Parties	Management Area Engineers
ConocoPhillips	Steve Bachman, Ph.D., P.G.
ConocoPhillips	Norm Brown, Ph.D., P.G.
Woodlands	Tim Cleath, P.G., C.H.G., C.E.G.
Agricultural Representative	Jacqueline Fredericks (2)
Woodlands	Rob Miller, P.E.
Golden State Water Company	Toby Moore, Ph.D., P.G., C.H.G.
Nipomo Community Services District	Brad Newton, Ph.D., P.G.

A large areal extent within the NMMA receives water service from the major water purveyors (Figure 1-2). The majority of the lands within the NMMA obtain water by means other than from a purveyor. A fraction of these property owners are Stipulating Parties. All of the larger purveyors are also Stipulating Parties. All Stipulating Parties are obligated to make available relevant information regarding groundwater elevations and water quality data necessary to implement the NMMA Monitoring Program.

[1] Southern California Water Company changed its name to Golden State Water Company in 2005.

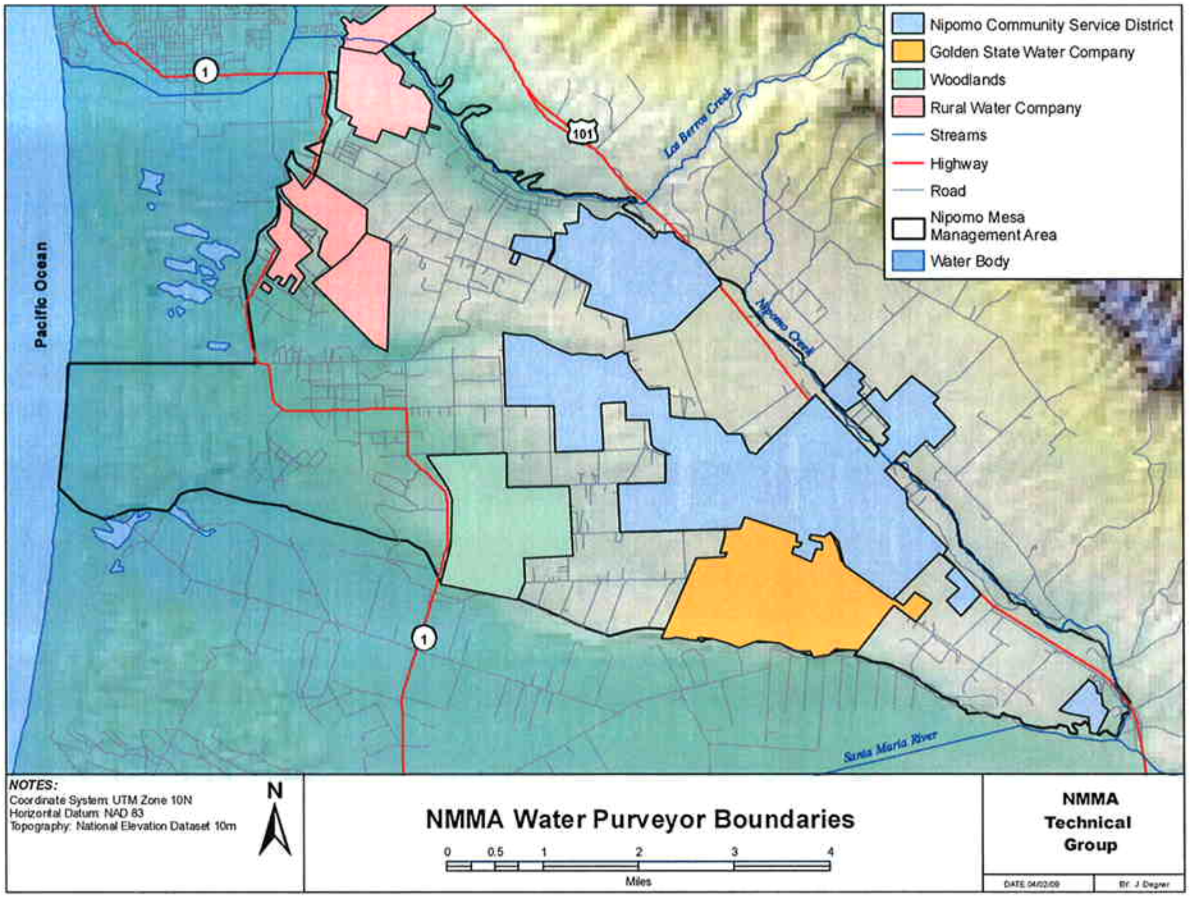

Figure 1-2. NMMA Water Purveyor Boundaries

1.1.3. Coordination with Northern Cities and Santa Maria Management Areas

The NMMA is bounded on the north by the Northern Cities Management Area and on the south by the Santa Maria Valley Management Area (Figure 1-1). All three management areas will monitor subsurface flows by comparing groundwater elevation data on each side of the management area boundary to determine the gradient and direction of flow. Each management area will collect groundwater elevation data within their boundaries and share it with the others to allow estimates of the quantity and direction of flow. The TG has incorporated this concept in its monitoring program submitted to the court and described in the next section. It is understood that the neighboring subareas will do the same.

One of the sources of uncertainty is the subsurface quantity that crosses the NMMA boundaries. The TG recognizes that collaborative technical efforts with the Northern Cities and Santa Maria technical groups will be critical to the appropriate management of the basin. Examples of current collaborative efforts include:

- Sharing of technical data throughout the year, and during the preparation of annual reports

- Opportunities for review and comment on technical work products
- Sharing of protocols and standards for data collection and analysis
- Consideration of jointly-pursued projects and grant opportunities

As the conditions of the existing basin underlying the NMMA are described in subsequent sections, periodic reference will be made to the 2009 Annual Reports produced by neighboring technical groups. The aerial extent of groundwater contours has also been limited to the immediate vicinity of the NMMA.

1.1.4. Development of Monitoring Program

The TG developed and the Court has approved the NMMA Monitoring Program ("Monitoring Program"), attached as Appendix A, to ensure systematic monitoring of important information in the basin. This Monitoring Program includes information such as groundwater elevations, groundwater quality, and pumping amounts. The Monitoring Program also identifies a number of wells in the NMMA to be monitored (Figure 1-3) and discusses the methods of analysis of the data.

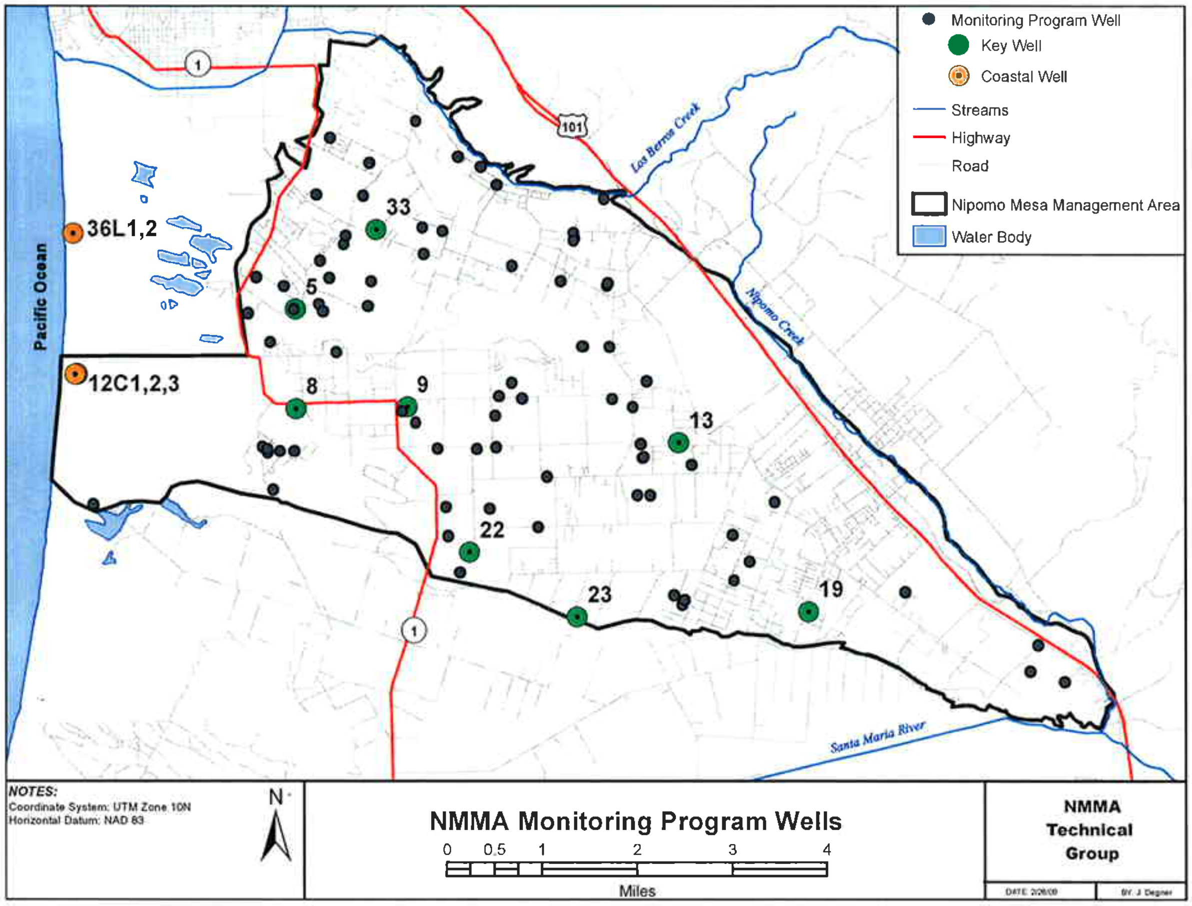

Figure 1-3. NMMA Monitoring Program Wells

1.1.5. Development of Water Shortage Conditions and Response Plan

Pursuant to the Stipulation, the Water Shortage Conditions and Response Plan was developed based upon and as part of the Monitoring Program. The Water Shortage Conditions were characterized by criteria developed over an extensive series of meetings during 2008 and 2009. There are two different criteria – those for Potentially Severe Water Shortage Conditions and those for Severe Water Shortage Conditions – that include both coastal and inland areas. The Response Plan for these conditions includes voluntary and mandatory actions by the parties to the Stipulation. The Court approved the Water Shortage Conditions and Response Plan on April 22, 2009, and the document is attached as Appendix B to this report.

1.1.6. Well Management Plan

The Stipulation requires the preparation of a Well Management Plan when Potentially Severe Water Shortage Conditions or Severe Water Shortage Conditions exist prior to the completion of the Nipomo Supplemental Water Project. The Well Management Plan provides for steps to be taken by the NCSD, GSWC, Woodlands and RWC under these water shortage conditions. The Well Management Plan has no applicability to either ConocoPhillips or Overlying Owners as defined in the Stipulation. The

Well Management Plan[2] was adopted by the TG in January 2010 and is attached as Appendix C to this report.

NCSD, GSWC and the Woodlands have interconnected their pipeline conveyance systems via two emergency connections. The NCSD-Woodlands Intertie is by means of an 8 inch double check valve located at the West end of Camino Caballo. The NCSD-GSWC Intertie is through a 6 inch meter on Division West of Orchard Road.

NCSD is capable of delivering water to either purveyor subject to the hydraulic limitations of the respective interties and the NCSD production capability. NCSD has performed hydraulic modeling (using Water Gems software) to document that its gravity system can deliver water at pressures ranging from 95 psi to 140 psi. The Water Gems model also indicates that the NCSD water system is capable of wheeling new water from the proposed Waterline Intertie Project to either of the two interties and to new sites located along the NCSD major distribution mains. An evaluation of the capability of either GSWC or the Woodlands ability to convey water through their respective interties to NCSD has not yet been conducted.

There is no interconnection currently between RWC and the other two purveyors. NCSD is closer to RWC than the others with the nearest water main to RWC located in Pomeroy Road just north of Willow Road, a distance of approximately 1.5 miles.

1.1.7. Supplemental Water

The requirement in the Stipulation for the Supplemental Water provides in relevant part:

"The NCSD agrees to purchase and transmit to the NMMA a minimum of 2,500 acre-feet of Nipomo Supplemental Water each Year. However, the NMMA Technical Group may require NCSD in any given Year to purchase and transmit to the NMMA an amount in excess of 2,500 acre-feet and up to the maximum amount of Nipomo Supplemental Water which the NCSD is entitled to receive under the MOU if the Technical Group concludes that such an amount is necessary to protect or sustain Groundwater supplies in the NMMA. The NMMA Technical Group also may periodically reduce the required amount of Nipomo Supplemental Water used in the NMMA so long as it finds that groundwater supplies in the NMMA are not endangered in any way or to any degree whatsoever by such a reduction".

"Once the Nipomo Supplemental Water is capable of being delivered, those certain Stipulating Parties listed below shall purchase the following portions of the Nipomo Supplemental Water Yearly:

NCSD - 66.68%
Woodlands Mutual Water Company - 16.66%
SCWC - 8.33%
RWC - 8.33%"

The NCSD is developing the Waterline Intertie Project to bring supplemental water to the above referenced Stipulating Parties within the NMMA. The Waterline Intertie Project involves the

[2] RWC did not participate in the preparation of the Well Management Plan

construction of approximately five miles of new water main to transport up to 3,000 AF of new water from the City of Santa Maria. The Waterline Intertie Project is nearing 90% design completion. In the first year of operation, the District expects to purchase 2,000 AF of water from the City and to increase deliveries to 2,500 AF by 2016. The final EIR has been certified by the District as lead agency and the City of Santa Maria as a responsible agency. The final Supplemental Water Agreement has been approved by the District and the City of Santa Maria. The current cost estimate for construction of the project is $23,600,000. The District, Woodlands, GWC and RWC are exploring with the County of San Luis Obispo the formation of an assessment district to finance the $23,600,000 capital costs of the Waterline Intertie Project. Assuming the assessment district is approved, GSWC and RWC must also obtain California Public Utilities Commission (CPUC) approval to participate in this project to account for the cost of the supplemental water.

2. Basin Description

The Santa Maria Valley Groundwater Basin, covering a surface area of approximately 256 square miles, is bounded on the north by the San Luis and Santa Lucia mountain ranges, on the south by the Casmalia-Solomon Hills, on the east by the San Rafael Mountains, and on the west by the Pacific Ocean. The basin receives water from rainfall directly and runoff from several major watersheds drained by the Cuyama River, Sisquoc River, Arroyo Grande Creek, and Pismo Creek, as well as many minor tributary watersheds. Sediment eroded from these nearby mountains and deposited in the Santa Maria Valley formed beds of unconsolidated alluvium, averaging 1,000 feet in depth, with maximum depths up to 2,800 feet and comprise the principle production aquifers from which water is produced to supply the regional demand. Three management areas were defined to recognize that the development and use of groundwater, State Water Project water, surface water storage, and treatment and distribution facilities have historically been financed and managed separately, yet they are all underlain by or contribute to the supplies within the same groundwater basin.

2.1. *Physical Setting*

The Nipomo Mesa Management Area has physical characteristics which are distinct from the other two management areas. It is largely a mesa area that is north of the Santa Maria River, west of the San Luis Range and south of the Arroyo Grande Creek, with a lower lying coastal environment to the west. The Mesa was formed when the Santa Maria River and Arroyo Grande Creek eroded the surrounding area. The current coastal environment developed subsequently, is composed of beach dunes and lakes, and is currently a recreational area with sensitive species habitat. Locally, hummocky topography on the mesa area reflects the older dune deposits. Black Lake Canyon is an erosional feature north-central in the NMMA and where the dune deposit thickness is exposed.

2.1.1. Area

The NMMA covers approximately 33 square miles or 21,100 acres, which accounts for approximately 13 percent of the overall Santa Maria Valley Groundwater Basin (164,000 acres). Approximately 13,000 acres on the NMMA, or 60 percent, is developed land requiring water pumped from the underground aquifers to sustain the agricultural and urban development.

2.1.2. General Land Use

Land uses include agricultural, urban (residential/commercial), and native or undeveloped areas. There are also three golf courses and one oil-processing facility. The crop types grown in 2009 in the order of largest acreage are strawberries, nursery, avocado, and rotational vegetables (broccoli, lettuce, etc.).

2.2. *Climate*

A Mediterranean-like climate persists throughout the area with cool moist winters and warm dry summers. During the summer months, the warm air inland rises and draws in the relatively cooler marine layer near the coastline keeping summer cooler and providing moisture for plant growth, while in the winter months the relatively warmer ocean temperature keeps the winter warmer. The average annual maximum temperature is 69 degrees Fahrenheit, and the average annual minimum temperature is 46 degrees Fahrenheit. Precipitation normally occurs as rainfall between November and April when cyclonic storms originating in the Pacific Ocean move onto the continent. The long-term (1959 to 2008) average annual rainfall reported at CDF Nipomo rain Gage #151.1 is 15.5 inches and is representative of the larger area of the NMMA. Rainfall variability exists across the NMMA and rainfall increases in the foothills and mountains due to the orographic (elevation) effect. The coastal environment is dominated by on-shore westerly winds flowing from the Ocean onto the land. The average annual potential to evaporate water is 52 inches due to ample sunlight and the large amount of air mass advection. It is important to note that the average annual reference evaporation (Potential Evapotranspiration) is more than three times the average annual rainfall (Table 2-1).

Table 2-1. Climate in the Nipomo Mesa Area

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Average Max Temp (Fahrenheit)[1]	63.1	64.3	64.7	66.9	68.2	70.5	72.8	73.2	74.3	73.4	69.1	64.4	68.7
Average Min Temp (Fahrenheit)[1]	38.9	40.9	42.1	43.4	46.8	50.0	53.0	53.6	52.1	47.9	42.5	38.6	45.8
Average Rainfall (inches)[2]	3.31	3.35	2.75	1.09	0.24	0.03	0.02	0.04	0.21	0.66	1.56	2.26	15.52
Monthly Average Potential Evapotranspiration (inches)[3]	2.21	2.50	3.80	5.08	5.70	6.19	6.43	6.09	4.87	4.09	2.89	2.28	52.13

Notes:

1. Data from Santa Maria Airport - Nearest long-term temperature record to the NMMA in the Western Regional Climate Center is from the Santa Maria Airport, station #47946. The average is from 1948 through 2005. Source: http://www.wrcc.dri.edu/climsum.html2.
2. Data from CDF Nipomo Rain Gage 151.1 (1959 to 2008).
3. Data from California Irrigation Management Information System (CIMIS) - Records at Nipomo (202) are less than 5 years; therefore CIMIS reports the regional average for Central Coast Valleys for Station #202. Source: http://www.cimis.water.ca.gov/cimis/data.jsp

2.3. *Geology*

The Nipomo Mesa Management Area overlies part of the northwest portion of and is contiguous with the Santa Maria Valley Groundwater Basin (Figure 1-1). The Santa Maria Valley Groundwater

Basin is the upper, relatively recent and water-bearing portion of the Santa Maria Geologic Depositional Basin, which includes older Tertiary age consolidated rocks. The aquifer system in the basin consists of unconsolidated alluvial deposits including gravel, sand, silt and clay with total thickness ranging from 200 to nearly 2,800 feet. The underlying consolidated rocks typically yield relatively insignificant quantities of water to wells.

A mantle of late Pleistocene eolian (wind-blown) dune sands overlies the elevated area, known as Nipomo Mesa. The dune deposits were once much more extensive, but most were eroded away during the last ice age by the ancestral Arroyo Grande Creek, Los Berros Creek, Nipomo Creek, and Santa Maria River (Papadopulos, 2004). Today the Nipomo Mesa older dune sands area is a triangular lobe extending four (4) miles along the coast and extending 12 miles inland to the Hwy 101 Bridge over the Santa Maria River.

Lithologic logs recorded during the drilling of wells indicate that the Nipomo Mesa dune sands are 150 to 300 feet thick. The Nipomo Mesa dune sands are highly porous and permeable. DWR (2002) reported that minor surface runoff occurs from the bluffs at the margins of NMMA, but that increased development has resulted in some increase in surface runoff from the NMMA to the adjacent Arroyo Grande Plain and Santa Maria River Valley.

2.3.1. Stratigraphy

The unconsolidated alluvial deposits comprising the aquifers underlying the NMMA include the Careaga Sand, the Paso Robles Formation, Quaternary Alluvium, and wind-blown dune sands at or near the surface. The following paragraphs, based on DWR (2002), describe the unconsolidated deposits.

Careaga Formation

The late Pliocene shallow-water marine Careaga Formation of the Santa Maria Valley Groundwater Basin is typically described on the lithologic logs as unconsolidated to well consolidated, coarse- to fine-grained, blue to bluish-gray, white, gray, green, yellow, or brown to yellowish-brown sand, gravel, silty sand, silt, and clay. Sea shells or shell fragments in clays, and sometimes in sands or gravels, are locally common, but the distinctive sand dollar fossils (Dendraste, sp.), reported in outcrops of the formation south of the study area were not identified on the lithologic logs. Occasional mention was made of Monterey shale chips. Within the study area, the Careaga Formation occurs only at depth. The formation is about 150 feet thick proximal to the Santa Maria River fault under the NMMA and progressively thickens to about 300 feet toward the southwest part of the NMMA.

Paso Robles Formation

The Pliocene-Pleistocene Paso Robles Formation was deposited under a variety of conditions, ranging from fluvial and estuarine-lagoonal in inland areas to near-shore marine at the coast. Consequently, the formation exhibits a wide range of lithologic character and texture. As described on the lithologic logs of well completion reports, the formation typically consists of unconsolidated to poorly consolidated to sometimes cemented beds or lenses of gray, brown, tan, white, blue, green, or yellow, coarse- to fine-grained gravel and clay, sand and clay, shale gravel, silt, clay, silty clay, and sandy clay, with some lenses of gravel and sand. The near-shore marine deposits can contain fossils near the base of the formation.

The Paso Robles Formation lies conformably upon the Careaga Formation. Where the Careaga Formation is absent, the formation lies unconformably upon undifferentiated Tertiary rocks or basement complex. Where the Paso Robles Formation overlies the Careaga Formation the contact is often difficult to distinguish on the basis of borehole lithologic log descriptions. Woodring and Bramlette (1950) identified the base of the Paso Robles Formation by the occurrence of characteristic, but discontinuous, 50- to 100-foot beds of clay and freshwater limestone; where these were absent, they used conglomerate as the base, but considered the base not well controlled; and, where there was neither clay nor conglomerate, they considered the base doubtful and arbitrary.

The formation is about 150 feet thick near Nipomo Creek in the eastern boundary of the NMMA and progressively thickens to about 500 feet near the southwestern boundary of the NMMA. Individual beds in the Paso Robles Formation are laterally discontinuous and difficult to correlate between wells. Worts (1951, p. 32) commented that "The logs show that, there is no correlation possible between beds from place to place in the formation, and that the deposits are lenticular.". The abrupt lateral discontinuity of the beds within the formation is typical of sediments deposited in a coastal environment under conditions of rising and falling sea levels.

Pleistocene Dune Sand

The dune deposits are from 150 to 300 feet thick and unconformably overlie the Paso Robles Formation. The triangular lobe of older Pleistocene dune sands underlies the majority of the NMMA. These older dunes hardly resemble dunes near the coast, but are a disorganized assemblage of rounded hillocks and hollows. The dune sands consist of coarse- to fine-grained, well-rounded, massive sand with some silt and clay.

The sands are largely quartz and are loosely to slightly compacted. The older dune sands are anchored by vegetation and have a well-developed soil mantle. Also, iron oxides may locally cement the dune surface into a crust and stain the sand dark reddish-brown. Lithologic logs indicate that the dune sands may contain clay layers that locally retard downward percolation of water. The older dunes have a maximum thickness of about 300 feet near the southern edge of NMMA.

Quaternary Alluvium

The only quaternary alluvium found in NMMA is in Black Lake Canyon, where it is about 30 feet thick. There is also alluvium near the NMMA, east of the NMMA in the floor of Nipomo Valley, north of the NMMA in the Los Berros Creek floodplain, and northwest of the NMMA in the Arroyo Grande Plain.

Holocene Dune Sand

Holocene dune sands occur along the coast in the southwestern portion of the NMMA west of Highway 1 and may reach about 100 feet thick.

2.3.2. Structure

The dominant west northwest – east southeast trending structural features in the region are the Santa Maria Valley syncline, the Pismo syncline, and the Huasna syncline, neotectonic San Luis Pismo and Santa Maria Valley structural blocks, and a series of faults. The following sections present discussions of the structural elements pertaining only to the NMMA.

Synclines

The Santa Maria Valley syncline is an asymmetrical fold that developed within the northern part of the Santa Maria Valley Groundwater Basin. The syncline is evident only from subsurface data. The axial trace of the syncline lies about six miles south of the county line, north of the middle of Santa Maria

Valley. The Santa Maria syncline and its margins are cut by numerous faults of middle and late Cenozoic age.

Structural Blocks

The most significant structural features in the region are the San Luis Pismo and Santa Maria Valley structural blocks (Figure 2-1). The San Luis Pismo block consists of the San Luis Range, including the Pismo syncline, and is northeast of the NMMA. The block is undergoing uplift as a relatively rigid crustal block with little or no internal deformation. The block is bordered on the southwest by a diffuse zone of late Quaternary west northwest – east southeast trending, northeast-dipping reverse faults (Wilmar Avenue and Oceano faults) and monoclines that separate it from the subsiding Santa Maria Valley structural block.

The Santa Maria Valley structural block consists of Quaternary sediments and is bounded on the northeast by the San Luis Pismo block. On the west, the block is truncated by the Hosgri fault zone and on the south the block is bounded by the Casmalia and Solomon Hills blocks (Figure 2-1).

Map of Structural Blocks in the South Central California Coast Region

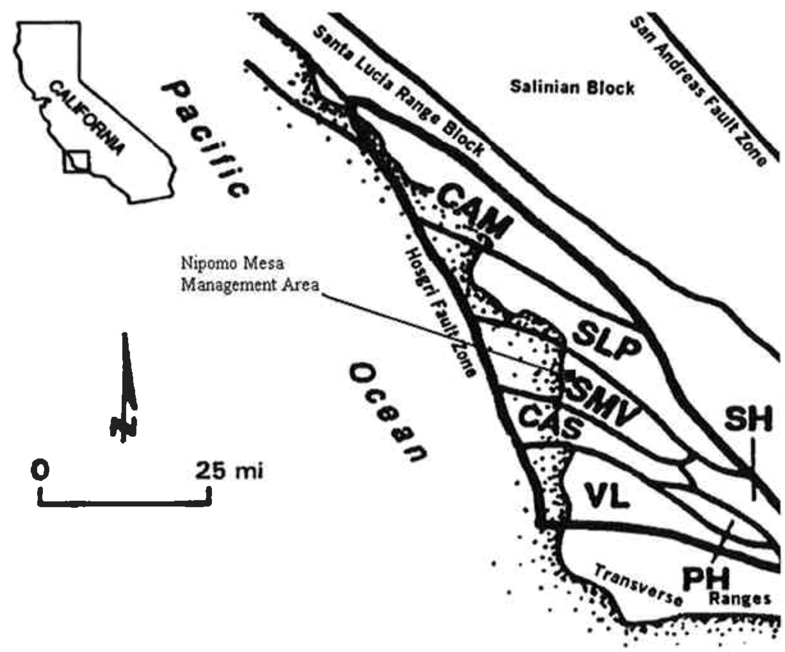

Figure simplified from Lettis, et al., 1994. Abbreviations are: CAM = Cambria block, SLP = San Luis/Pismo block, SMV = Santa Maria Valley block, CAS = Casmalia block, VL = Vandenberg/Lompoc block, PH = Purisima Hills block, SH = Solomon Hills block.

Figure 2-1. Map of Structural Blocks in the South Central California Coast Region (DWR, 2002)

Faulting within the boundaries of the NMMA may affect the direction and quantity of groundwater flow. The Santa Maria River, Wilmar Avenue and the Oceano faults are the three main faults within the NMMA (Figure 2-2).

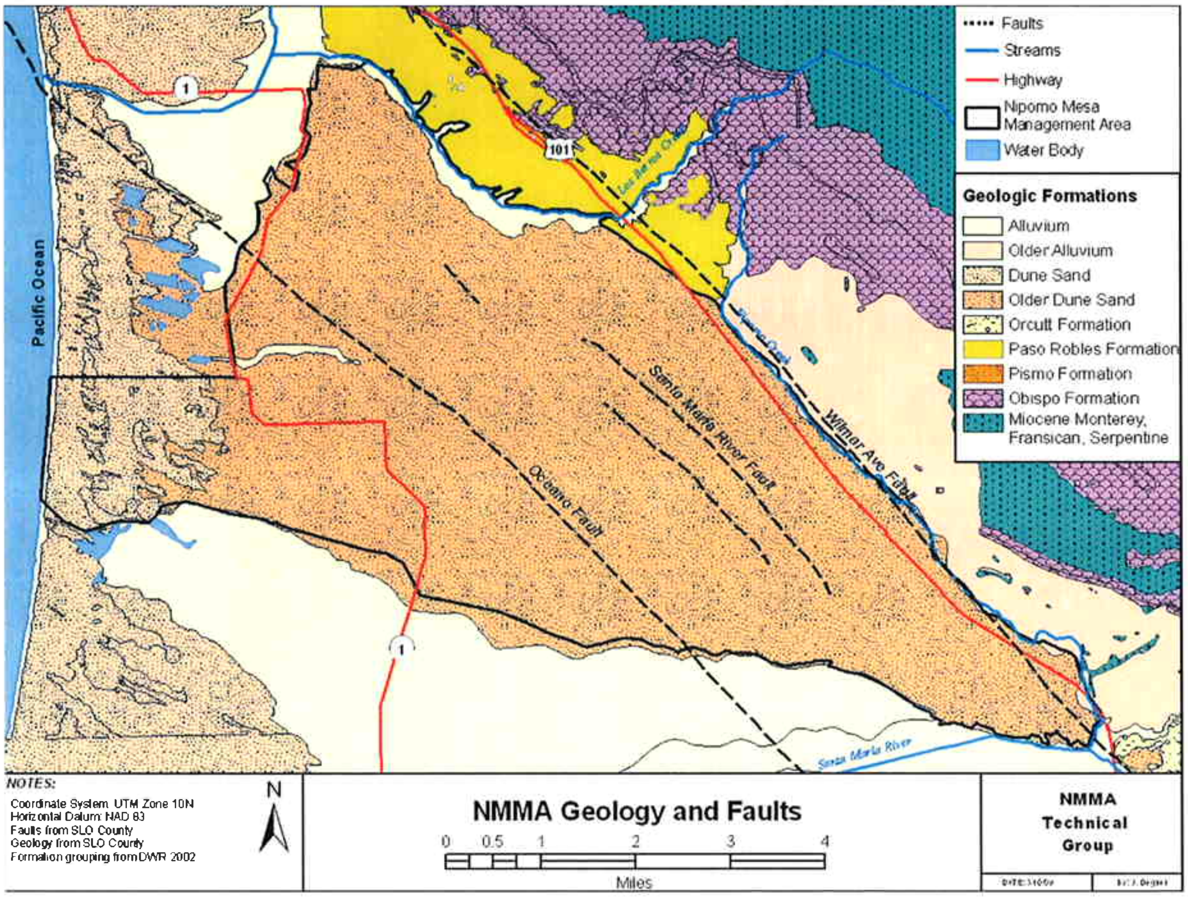

Figure 2-2. NMMA Geology and Faults.

Santa Maria River Fault

The Santa Maria River fault trends northwest to southeast inside the NMMA. To the southeast, from near the head of Black Lake Canyon to near Division Street, the fault has been postulated to be a zone of subsurface steps or warps in the top of the bedrock, rather than a single fault. The fault is identified by significant lithologic differences on opposite sides of the fault (DWR, 2002). The interpretation of the location of the fault by the County of San Luis Obispo as presented in this report differs from the DWR location (Figure 2-2).

Wilmar Avenue Fault

The range front Wilmar Avenue fault is a northwest-southeast striking, northeast-dipping late Quaternary reverse fault. The fault is exposed only at a sea cliff in Pismo Beach and extends at least to Arroyo Grande. The range front fault is characterized by two distinct structural segments: a western segment that exhibits block uplift with minor tilting or folding and an eastern segment that forms a monoclinal fold in the upper Pliocene strata. The fault extends offshore, veering slightly to the west for at least three miles. The fault may extend south of Arroyo Grande along the front of the San Luis Range and the northeast margin of NMMA to the northern part of Santa Maria Valley, where it may truncate against the Santa Maria River fault. Along this segment, the fault is inferred by the alignment of subtle geomorphic and geologic features, including a straight segment of Nipomo Creek (DWR, 2002).

Oceano Fault

The northwest-southeast trending, northeast-dipping late Quaternary Oceano fault underlies Nipomo Mesa and extends offshore south of Oceano. Stratigraphic offsets recognized in boreholes indicate vertical separation of units across the fault, with an overall down-to-the-coast relative sense of separation. Within the onshore segment, the fault is not geomorphically expressed because of the relatively thick alluvial and eolian cover. The fault was first recognized by the DWR in a 1970 cross-section (A-A') along the coast, and later by Pacific Gas and Electric Company based on interpretation of onshore and offshore seismic reflection and oil well data. It displaces Franciscan Complex basement and overlying Tertiary strata. A southeasterly decrease in vertical separation suggests that the fault may terminate out in the northern Santa Maria Valley near the Santa Maria River (DWR, 2002).

2.3.3. Hydrogeology

The potentially water-bearing basin-fill sediments of the NMMA are underlain by bedrock. The base of the main groundwater basin is approximately 1,500 feet below msl under the Santa Maria River and about 200 feet above msl under the northeastern edge of Nipomo Mesa (DWR, 2002).

Aquifers

Holocene alluvium through upper Pliocene sediments constitute the principal groundwater reservoir of the basin. With the exception of the dune sands, the basin-fill sediments were deposited by water in a range of depositional environments, including fluvial, marginal marine and shallow water environments (DWR, 2002). Stratigraphy of the principal deep aquifer can be generally described as interbedded units of differing clay to sand grain size, with more continuous packages of units near the coast than elsewhere in the NMMA, likely due to differences in depositional environment in the inland areas.

Water-bearing units of the Santa Maria Groundwater Basin includes the Careaga Sand, Pismo Formation, Paso Robles Formation, Orcutt Formation, terrace deposits, Quaternary Alluvium, river channel deposits, and dune sand. The most productive and developed aquifers are in the alluvium and Paso Robles Formation – this report will focus on these aquifers. Some wells in the groundwater basin produce from either the alluvium or the Paso Robles Formation only, and others produce from both deposits.

The Paso Robles Formation is the thickest and most extensive aquifer in the basin and is referred to as the Deep Aquifer. Hydraulic conductivity (K) values for the Paso Robles Formation were estimated by Luhdorff and Scalmanini (2000) for 20 locations throughout the groundwater basin. In the Sisquoc plain, Orcutt Upland, and central Santa Maria River Valley, K ranges from 100 to 400 gpd/ft^2 (13 to 52 ft/d). Values are lower in the western portion of the Santa Maria River Valley and beneath Nipomo Mesa where the reported values range from 15 to 110 gpd/ft^2 (2 to 15 ft/d). The wells on Nipomo Mesa are typically screened over hundreds of feet of the Paso Robles Formation, so these values represent bulk averages for the formation. Specific yield values in the range of 8 to 13 percent, and storativity of 1×10^{-4} were assigned by Luhdorff & Scalmanini (2000) for groundwater flow modeling.

The Quaternary Alluvium is the most permeable aquifer, although few testing data are available to estimate hydraulic conductivity. Luhdorff & Scalmanini (2000) show seven locations with estimates of alluvium hydraulic conductivity, indicating decreasing conductivity toward the west. Hydraulic conductivity of 4,500 gpd/ft^2 (600 ft/d) is typical in the Sisquoc plain, whereas 2,000 gpd/ft^2 (265 ft/d) is typical for the lower portion of the alluvium near Guadalupe. Typical thickness for the Quaternary Alluvium in the Santa Maria River Valley is 100 to 200 feet. Near Guadalupe the upper portion of the alluvium is fine-grained and acts as a confining layer on top of the lower alluvium and Paso Robles Formation below (Worts, 1951).

A mantle of late Pleistocene eolian (wind-blown) dune sands underlies the Nipomo Mesa. The dune deposits were once much more extensive, but most were eroded away during the last ice age by the ancestral Arroyo Grande Creek, Los Berros Creek, Nipomo Creek, and Santa Maria River (Papadopulos, 2004). Today the Nipomo Mesa older dune sand is a triangular lobe that extends 4 miles along the coast and inland more than 12 miles to the basin margin east of Hwy 101. Lithologic logs of water wells indicate that the Nipomo Mesa dune sands are 150 to 300 feet thick. The Nipomo Mesa dune sands are very porous and permeable, and negligent amounts of surface runoff are generated on these dune sands.

Confining Layers

In general, the difference between an unconfined aquifer and a confined aquifer is illustrated by the schematic in Figure 2-3. An unconfined aquifer is saturated with water and the surface of the water is at atmospheric pressure. The groundwater level in a well completed in an unconfined aquifer will be the same as the water table (wells D and E in Figure 2-3). The groundwater in a confined aquifer is under pressure. When a well penetrates a relatively impermeable layer (aquitard) that confines the aquifer, the water will rise in the well to the potentiometric surface of the confined aquifer (wells A, B and C in Figure 2-3).

Confining layers within and above the Paso Robles Formation in the NMMA are most likely formed from individual or packages of predominantly clay units. When confining layers are present, there may be both an unconfined and confined aquifer, respectively above and below the confining aquitard materials. The Shallow Aquifer within the NMMA is considered to be an unconfined aquifer. There may also be perched aquifers above local clay beds (perched aquifers are unconfined aquifers where the aquifer material below the clay bed is unsaturated). Unconfined aquifers intercept downward percolating water. Where the Deep Aquifer is present beneath a confining layer, then the Deep Aquifer is considered to be confined. A characteristic of the Deep Aquifer when it is confined is water levels measured in wells that are above the top of the aquifer (perhaps even flowing freely to the surface as illustrated in wells B and C in Figure 2-3).

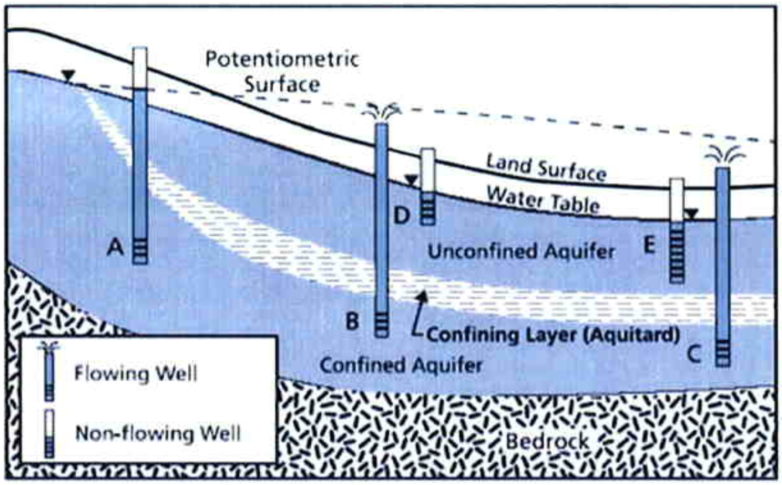

Figure 2-3. Schematic of Confining Layer and Confined Aquifer (Bachman et al, 2005).

In the Santa Maria Groundwater Basin, Worts (1951) demarcated a large area, extending inland for about 6 miles beneath the Oso Flaco District and Santa Maria Valley, as containing water confined by fine-grained sediments in the upper part of the alluvium ("confined boundary" of Figure 2-4). Worts used as evidence the occurrence of historical flowing artesian wells (historical landward extent of flowing wells for different years shown as "flowing wells" lines in Figure 2-4), surface water at Oso Flaco Lake (southernmost of dune lakes shown in Figure 2-4), and a demarcation in groundwater gradients. However, he also stated that the continuity of the clay beds across the west end is not conclusive. Worts did not extend the confined zone beneath the NMMA because of a lack of data within the NMMA at the time. Instead, he noted uncertainty to the northern extent of the main Santa Maria Valley confined area on his maps. A subsequent study of the area (Toups Corp., 1976) erroneously transformed Worts' uncertainties of the northern extent of the confined zone to an actual edge of the confined area, not transferring the "question marks" from Worts' map. Chipping (1994) investigated the Black Lake Canyon area and concluded that the development of the canyon may have occurred on top of the confining layer as shallow water flowing laterally emerged and eroded loose sediments initiating the channel head. Channel head evolution continued up-gradient on top of the confining layer to form a canyon at the present location.

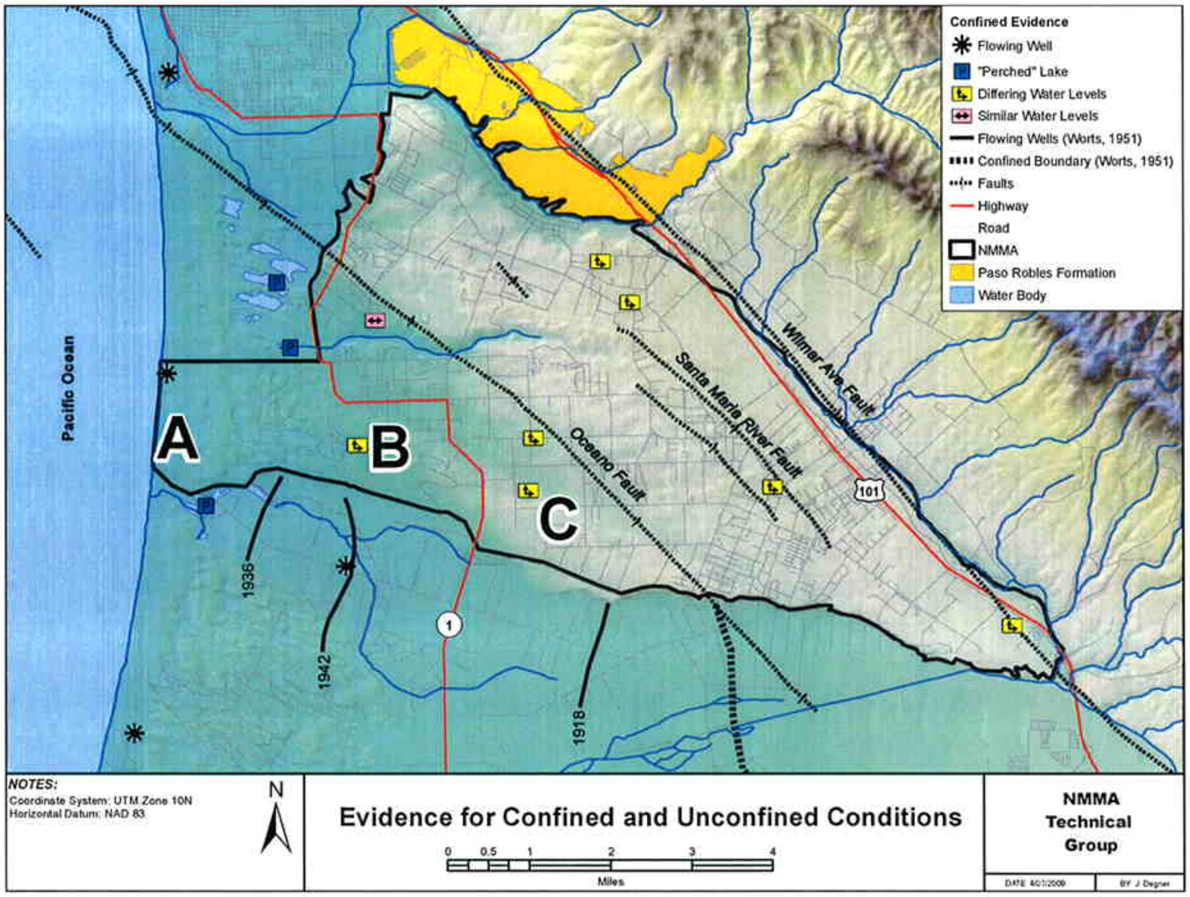

Figure 2-4. Locations of potential evidence for confined or unconfined conditions within the Deep Aquifer. *Flowing Well: historical artesian flow above ground surface; "Perched" Lake: lakes separated from Deep Aquifer by confining layer; Differing Water Levels: nearby wells in Shallow and Deep aquifers have significant difference in groundwater levels; Similar Water Levels: nearby wells in Shallow and Deep aquifers have similar groundwater levels; Flowing Wells (Worts, 1951): historical lines demarking farthest landward location of flowing wells; Confining Boundary (Worts, 1951): proposed boundary between unconfined (landward) and confined (seaward) conditions in Deep Aquifer; Paso Robles Outcrop: shown to indicate unconfined outcrop area (partially unsaturated). Areas of Deep Aquifer confinement based on detailed borehole and related analysis indicated by regions labeled A, B and C (see text for discussion).*

Evidence for confined aquifer conditions is derived from a range of conditions, including: 1) differences in groundwater elevations between the Shallow and Deep aquifers, 2) historical flowing artesian wells, 3) dune lakes, 4) extent of Twitchell releases down the Santa Maria River, and 5) the occurrence of Black Lake Canyon (Figure 2-4). There are several hydrogeologic possibilities to explain these features. On the eastern side of the NMMA, differences in groundwater elevation between Shallow and Deep aquifers may reflect either a shallow perched zone overlying a confined or unconfined Deep aquifer, or a Shallow unconfined aquifer overlying a confined Deep aquifer. If the Deep Aquifer is confined, the primary confining layers are likely to be fine-grained sediments in the upper portion of the Paso Robles Formation beneath dune sands (Morro Group, 1996). In addition, the dune sands locally contain clay layers on which groundwater is perched. Evidence to confirm whether the Deep Aquifer is confined in these areas would include historical groundwater elevations in a well that are higher than potential confining layers.

A principal feature of the NMMA stratigraphy is the general discontinuity of individual beds and packages of sedimentary units in the Paso Robles Formation. Previous work concludes that the Paso Robles is associated with a range of shallow water and fluvial depositional environments, giving rise to a range of interbedded and commonly discontinuous sedimentary layers. Paso Robles Formation stratigraphy can be generally described as interbedded units of differing clay to sand grainsize, with more continuous packages of units near the coast than elsewhere in the NMMA, likely due to differences in depositional environment in the inland areas. This architecture of units creates local discontinuity of aquifer units, increasing the likelihood of discontinuous confining conditions in inland portions of the NMMA (as compared with coastal portions), as well as the possibility of significant vertical transmissivity in inland areas between young sand and alluvium and the underlying, principal producing aquifers.

Lateral discontinuity of some water-bearing units is likely also created at the unconformity at the top of the Paso Robles Formation and base of the dune sands, producing local truncations of individual units and juxtapositions of units with different conductivity.

On the northeastern side of the NMMA, the Paso Robles outcrop is unconfined and partially unsaturated (Figure 2-4). To the southwest of the outcrop, sediments overlying the Paso Robles are thin and the aquifer is likely unconfined for some distance from the outcrop. In the western portion of Black Lake Canyon, the Shallow and Deep aquifers have similar groundwater elevations ("similar water levels" in Figure 2-4) suggesting connectivity between unconfined aquifers. Black Lake Canyon itself may have formed by the erosional effects of perched groundwater flowing over an exposed edge of the confining clay layer and down-cutting into the Paso Robles Aquifer (Chipping, 1994).

In the western portion of the NMMA, historical artesian flow in wells and dune lakes (Figure 2-4) indicate confined conditions in the Deep Aquifer. The boundary between confined and unconfined conditions is likely to be east of Worts' 1918 line (Figure 2-4) within the southern portion of the NMMA, extending north towards Black Lake Canyon.

To help demarcate areas of Deep Aquifer confinement, detailed analysis of wellbore lithologic and electric logs was also conducted, together with stratigraphic evaluation, additional water level analysis and water quality analysis, principally for the portion of the NMMA from the coast to the approximate location of the Oceano Fault, and south of Black Lake canyon. The analysis utilized several methods intended to complement previous work on the subject of aquifer confinement in the NMMA. Much of the information is derived from wells and the data collected from them. Approximately 100 wells are regularly monitored for water levels in the NMMA, and a large number of these wells have both well construction information (notably perforated intervals) as well as lithologic data logged during well construction. Sixty-five wells also have electric logs of the borehole, providing additional information about subsurface stratigraphy and the location of potentially confining layers within or above the deep aquifer packages.

Additional work has also been conducted to examine other well pairs or closely spaced groups of wells where the adjacent wells have different perforated intervals corresponding with the Shallow and Deep Aquifers. In these cases, different water levels or water quality between the Shallow and Deep Aquifers can provide important information about potential hydraulic separation and confinement between the aquifers.

The focus of this additional work has been on the area west of the Oceano fault because geological structure can greatly influence groundwater flow and basin confinement, and the analysis has been conservative about extending observed confined or unconfined conditions across NMMA faults without definitive evidence of hydrologic conditions on both sides of such structures.

Previous work in the NMMA concludes that vertical offset of the Careaga and Paso Robles Formations (down-to-the-coast relative motion) exists across the Oceano and Santa Maria River fault zones, with vertical separations up to several hundred feet. Well logs confirm this general geometry, which is most pronounced for the top-of-bedrock surface. However, well logs, perforated intervals and groundwater data are, to date, inconclusive with regard to how any confining layers and confined aquifer conditions might extend across these faults (the Oceano fault in particular). Well logs also strongly suggest that the Oceano fault zone, and by analogy likely also the Santa Maria River fault zone, are complex structures with segmented overlapping and anastomosing slip surfaces. Combined with the discontinuous nature of the Paso Robles formation strata in the inland portion of the NMMA, these features complicate interpretation of fault disruption of the stratigraphy and the producing aquifers. Despite the observed separation of stratigraphy across the faults, the sense of shear across these faults is not known, and attempts to identify possible piercing points in the NMMA are hampered by the discontinuous nature of the stratigraphy. The detailed analysis of the area from the coast to the approximate location of the Oceano Fault, and south of Black Lake canyon shows that the Deep Aquifer in much of this region is confined:

- Coastal Region. Along the coastal portion of the NMMA, detailed well logs, including electric logs, show considerable lateral north-south continuity of principal producing aquifers as well as fine-grained potentially confining layers; DWR (2002) provides a detailed cross section of the stratigraphy along the coast. In addition, historical observations of flowing wells in the Santa Maria Valley management area have led to a general understanding that the principal producing aquifers are confined west of a line roughly defined by the Bonita School Road crossing of the Santa Maria River (SMVMA, 2009). The stratigraphic continuity combined with groundwater levels in the Paso Robles aquifer that were measured above sea level at coastal monitoring well 12C confirm that the Deep Aquifer in the coastal region is confined in the NMMA (the general area indicated by "A" in Figure 2-4). These confining layers and conditions likely extend for a distance to the north and south along the coast, though these regions have not been the subject of NMMA TG detailed study). This finding of Deep Aquifer confinement is consistent with historical evidence of flowing wells near the coast in the adjacent Santa Maria River valley.

- Near-Coastal Region. In near-coastal areas of the NMMA, roughly delineated by the portion of the NMMA that is transected by the railway, and extending east to Highway 1, evidence from closely adjacent wells with known perforations in only the deep and shallow aquifers shows water levels in these aquifers are distinct from one another. This finding is most reasonably explained by the existence of confined conditions in the principal producing Paso Robles aquifer (general area "B" in Figure 2-4). Here also, stratigraphic correlation with coastal units is possible on a gross level, with modest continuity recognized in packages of sedimentary strata.

- South-Central Region. In the southern portion of the NMMA, east of Highway 1 to the Oceano fault, water level comparisons and some stratigraphic correlations with coastal confining units indicate that the Deep Aquifer in this portion of the NMMA is also generally confined however continuity of confining strata to the coast is not well understood (general area "C" in Figure 2-4).

One effect of confining beds above much of the Paso Robles Aquifer within the NMMA is that percolating water from rainfall and return flows does not directly recharge these portions of the Paso Robles Aquifer. Instead, some of the percolating water is diverted laterally on top the low-permeability layers and may emerge as surface water as in Black Lake Canyon and support flow in Black Lake and the other systems of coastal drainages and lakes west of Nipomo Mesa including the creek in Cienega Valley, Celery Lakes, White Lake, Little Oso Flaco Lake and the creek along the southwest margin of Nipomo Mesa (Papadopulos, 2004). Some remainder of the shallow groundwater that is diverted laterally may percolate downward where these low-permeable layers are discontinuous, and percolate to greater depths and thereby contribute to water in the underlying Paso Robles Aquifer.

The continuity of confining conditions within the NMMA is not completely understood and remains a topic of investigation by the TG. The locations of unconfined conditions is important – they control to a significant degree both the NMMA groundwater budget as to the quantity of recharge from overlying sources and any calculation of changes in groundwater storage. The TG will study these issues in 2010. There is much uncertainty as to the location of this boundary within the NMMA – uncertainty that may be resolved in future Annual Reports.

Groundwater Flow Regime

Before development of groundwater in coastal basins, groundwater gradients were generally seaward, with groundwater flowing from areas of recharge inland to areas of discharge seaward. Groundwater discharge to the ocean was greater a century ago along the coastal portions of the Santa Maria basin, and has decreased in concert with historical groundwater production in the basin (Worts, 1951; Miller and Evenson, 1966). Artesian flow conditions were prevalent near the coastline and the landward extent of artesian conditions (dated boundary lines of artesian conditions in Figure 2-4), correlates with long-term climatic variability (see Section 7.3.1 Climatological Trends). The implication of maps of historical groundwater elevations where there is a relatively smooth westward-oriented gradient (Luhdorff & Scalmanini, 2000) is that there was a significant component of recharge from the hills directly to the east of the NMMA.

Following development and the drilling of groundwater wells, groundwater elevations began to drop within the NMMA in some areas. Groundwater elevation contour maps prepared by DWR (2002) indicate an increasing groundwater depression in the central portion of the NMMA from 1975 to 1995, although offshore flow of groundwater at the coast was maintained. The groundwater depression has expanded to include most of the central area of the NMMA today (see Section 6.1 Groundwater Elevations). The depression caused by pumping, superimposed on the regional and historic groundwater gradient, results in an apparent groundwater divide between the pumping depression and the ocean.

Faulting can affect groundwater flow, as evidenced locally by changes in groundwater elevations from wells on one side of a fault to those on the other side. DWR (2002) postulated that within the NMMA southeast of Black Lake Canyon, the Santa Maria River fault is an impediment to groundwater flow, whereas other faults in the basin are not. Currently, groundwater elevation data do not support the theory that the Santa Maria River fault is an impediment to flow in the deeper aquifer (see Section 6.1 Groundwater Elevations).

Groundwater flow directions can also be used to support the origin of recharge to the basin. In the NMMA, groundwater contours near the eastern contact with bedrock generally indicate that groundwater migrates through the subsurface from the elevated bedrock groundwater regimes into the NMMA sedimentary aquifers, with some additional recharge from stream discharges originating in bedrock portions of the watershed. Another source of recharge (or discharge) is along the boundaries with the Santa Maria Valley and Northern Cities Management Areas. The DWR (2002) maps indicate historically that there has been negligible flow across the boundary with the Santa Maria Basin, but there has been a component of flow (discharge) from the NMMA to the Northern Cities area. DWR's (2002) water budget presented for the base period of 1984-1995 reports 2,300 AFY of subsurface inflow across the boundary with Santa Maria Basin, and 1,300 AFY of outflow across the boundary with the Northern Cities area (DWR, 2002. Page 136, Table 26), estimates of historical flow across these subsurface boundaries does not distinguish between shallow and deep aquifers and contains large year-to-year differences in the amount of such flow. Current data indicate that this flow has changed and the TG will establish a investigatory program for developing its own estimate of the subsurface inflow and outflow to NMMA (see Section 6.1 Groundwater Elevations).

Aquifer Interface at the Coastal Zone

Knowing the location of any aquifer interface with seawater is important because that location would be the likely origin of seawater intrusion, if it was to occur. Elsewhere along the California coast, seawater intrusion is most prevalent where geologic processes created a condition offshore that exposes the aquifer to seawater close to shore along the walls of a submarine canyon (e.g., Oxnard Plain, Salinas Valley), through a buried channel complex (e.g., Orange County), or by near-shore uplifting and erosional truncation at the sea floor. Offshore of Nipomo Mesa in contrast, the ocean bottom slopes gently seaward with no significant bathymetry expressing a near shore outcrop of the Paso Robles Formation. The slope is so gentle that at approximately 20 miles offshore, the ocean depth is only 1,100 to 1,400 feet, with no indications of submarine canyons or of seaward extensions of present stream valleys. Such relatively flat offshore extensions of alluvial formations have a potential for storing large quantities of fresh water (DWR, 1970). Thus, any physical interface of the aquifers with the ocean would have to either occur far offshore or be caused by some structural or stratigraphic feature(s) that expose the aquifer at the sea floor (a condition that is not currently observed, though based on limited available data).

It is not known where the freshwater - seawater interface might occur in the offshore equivalent of the Paso Robles Formation (Deep Aquifer) – projections of the dip of the aquifers beneath the seabed until there is an intersection with the sea floor (Papadopulos, 2004) are problematic and it is unlikely that any geologic formations in coastal California are at a constant dip for long distances because of the extensive faulting and folding. This deformation could cause the aquifer to be exposed either close to shore or at a long distance from shore. Similar uncertainties arise from poor knowledge of how the sedimentary geology of the Deep Aquifer changes as these units extend offshore. Changes in the type of sediment and associated permeability can have a strong impact on the nature of offshore groundwater migration and the potential paths by which seawater might encroach landward. Moreover, it is not known whether historic conditions caused any advancement of the seawater – freshwater interface landward. Not knowing where a seawater interface occurs requires a conservative approach to groundwater management. Seawater was observed in the Northern Cities MA coastal monitoring array during 2009 (NCMA, 2010). The assumption must be that seawater advancement <u>could</u> occur if groundwater gradients allow landward migration of groundwater from offshore areas. Thus, coastal groundwater gradients are an important element in evaluation of water supply conditions.

3. Data Collection

The TG is monitoring and analyzing water conditions in the NMMA in accordance with the requirements of the Stipulation and Judgment. The Stipulating Parties are required to provide monitoring and other production data at no charge, to the extent that such data are readily available. The TG is developing protocols concerning measuring devices in order to obtain consistency with the Monitoring Programs of other Management Areas. Discussions of these subjects are presented in the following sub sections of this 2009 Annual Report.

3.1. ***Data Collected***

The data presented in this section of the annual report was measured during the calendar year 2009 and is the subject of this Annual Report. Groundwater elevations, water quality, rainfall, surface water, landuse, groundwater production and waste water discharge data were compiled and are presented in the following sections.

3.1.1. Groundwater Elevations in Wells

Groundwater elevation is determined by measuring the depth to water in a well from a reference point at the top of the well casing. The reference point and depth to water data are collected from each agency and input into a TG database that includes groundwater elevation determinations. The date, depth to water, measuring agency, pumping condition, and additional comments are recorded. When the database is updated with new data, an entry is posted in the database log describing the changes that have been made to the database. The groundwater elevation measurements are subjected to Quality Assurance/Quality Control procedures adopted by the TG in part by reviewing historical hydrographs to determine if the measurements are within the historical range for the given well.

The accuracy of the groundwater elevations depends on measurement protocols, the reference point and local drawdown effects at that well. The TG surveyed the elevation for all the reference points at each Key Well in February of 2009. Additional elevation surveys for all monitoring program wells are scheduled for the continued improvement of groundwater elevations accuracy. Furthermore, protocol standards were developed by the TG regarding the length of time for well shut down before a groundwater elevation measurement is taken, and a notation of whether nearby wells are known to be concurrently pumping.

Depth-to-water measurements were collected in the April and October of 2009 by the County of San Luis Obispo. In addition Nipomo Community Services District, ConocoPhillips, Woodlands, Golden State Water Company, Cypress Ridge Golf Course, and the USGS collected depth-to-water measurements in 2009 (Figure 3-1, Figure 3-2).

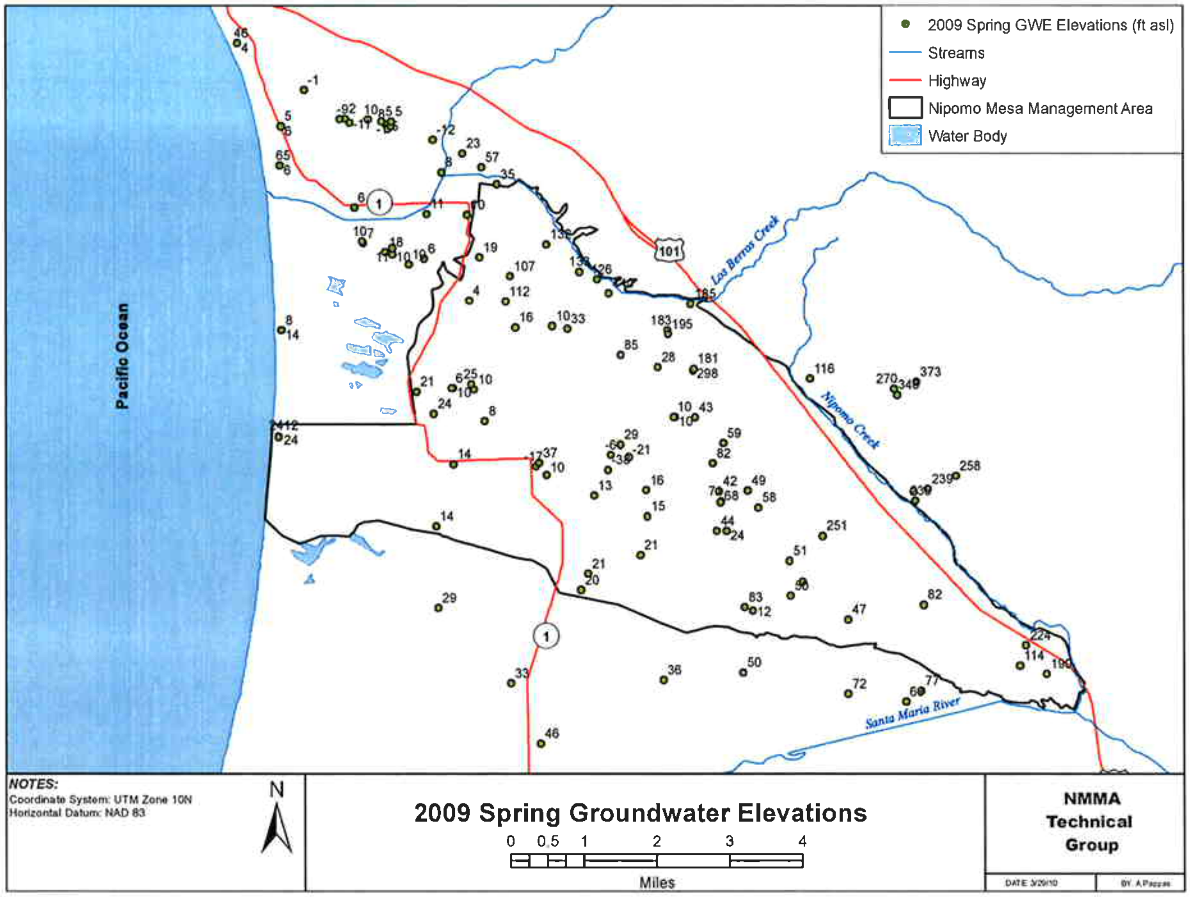

Figure 3-1. 2009 Spring Groundwater Elevations

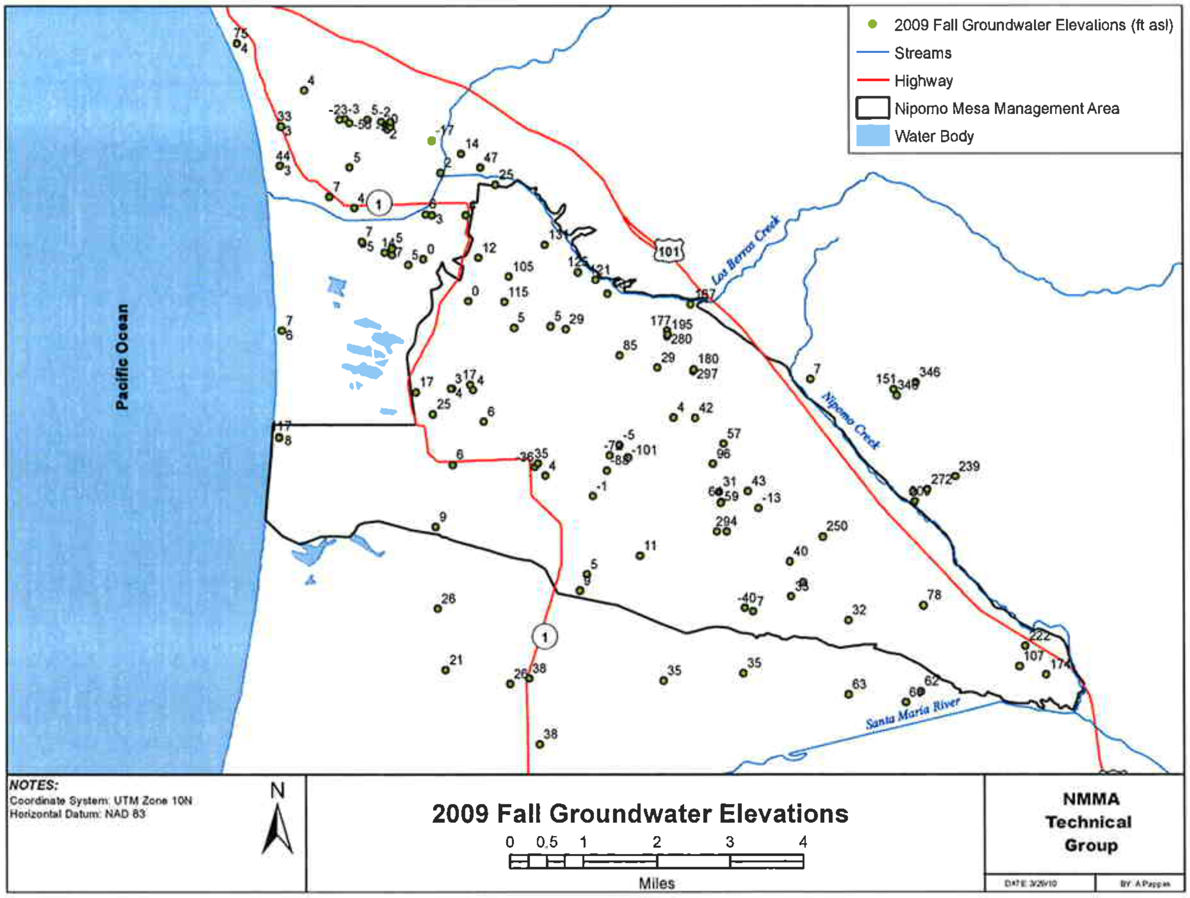

Figure 3-2. 2009 Fall Groundwater Elevations

3.1.2. Water Quality in Wells

Public water purveyors within the NMMA have historically gathered and reported groundwater quality data (filed with the California Department of Public Health) as an element of compliance with their drinking water reporting responsibilities. In addition, the U.S. Geological Survey, the California Department of Water Resources, and SLO County have also gathered some water quality data within the NMMA. The TG maintains these data in a digital database. In the NMMA, data from approximately 200 wells can be used to map groundwater quality conditions in both the Shallow and Deep aquifers (Figure 3-3). In some cases, water quality records consist of only one or two sampling events from a well, and with only a few water quality parameters, such as total dissolved solids or chloride. In other cases such as wells within the potable water systems, regular groundwater quality testing for a wide range of constituents is conducted.

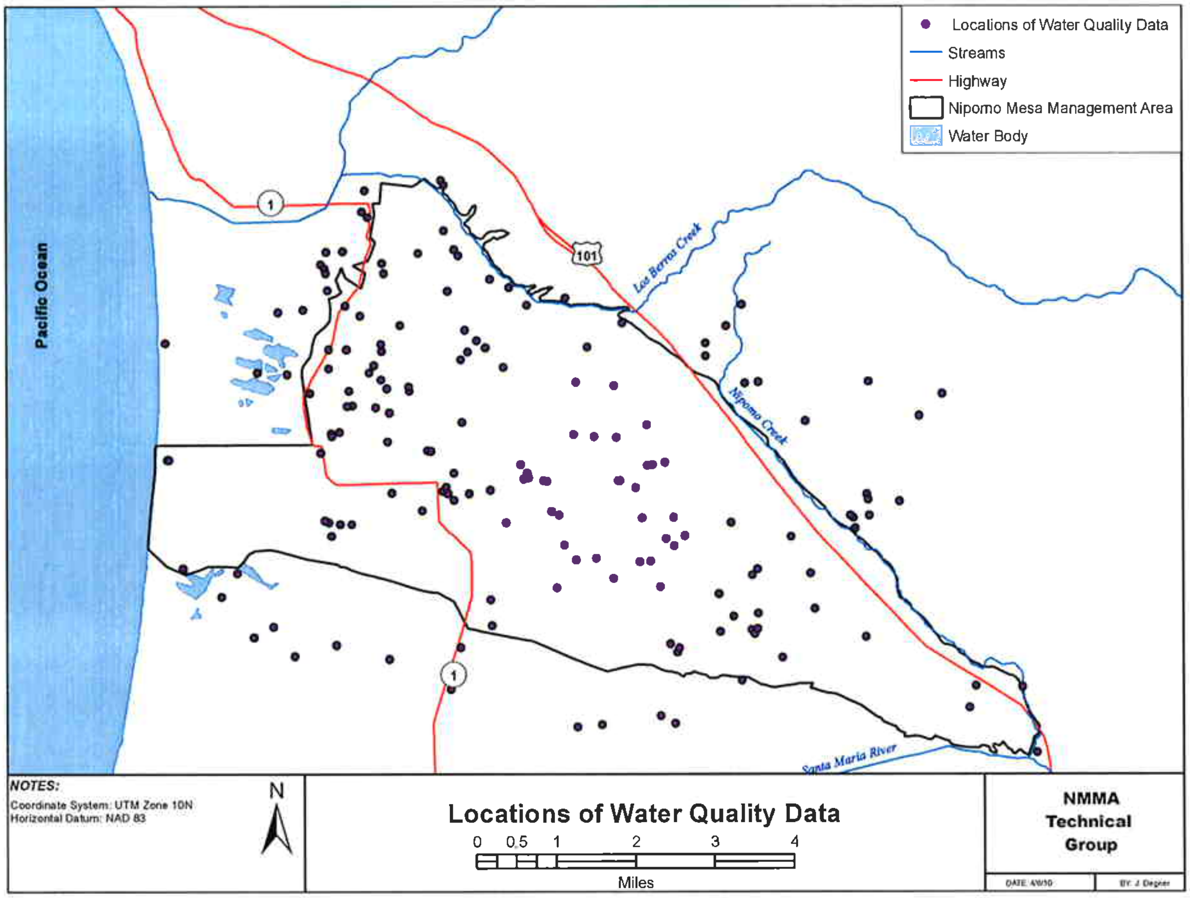

Figure 3-3. Locations of Water Quality Data

Groundwater quality in wells near the ocean is of considerable importance because this is the most likely site where any intrusion of seawater would first be detected. Coastal nested monitoring well site 11N/36W-12C (west of the ConocoPhillips refinery) is now monitored under agreement with SLO County and provides quarterly water quality sampling. Samples are collected for chloride, sulfate, and sodium lab analyses and pH, EC, and temperature are measured in the field. Coastal nested monitoring well site 12C will be evaluated to determine whether current quarterly sampling can be reduced in frequency (or field testing substituted for laboratory analysis), thus allowing funding for water quality monitoring of additional nested sites for instance the 36L1-L2 nested site in the coastal dunes west of Black Lake Canyon. Additionally, the TG is considering replacing the currently unavailable coastal nested site 13K2-K6 near Oso Flaco Lake.

The TG will arrange to receive water quality monitoring results from purveyors within the NMMA, either directly from the purveyors or annually from the Department of Public Health. Each well used for monitoring of groundwater elevations will be tested once for general minerals (if such testing is not already conducted) as budgeting allows. This testing will help further define groundwater characteristics of the principal aquifers.

At present no municipal or agricultural wells are known to require treatment because of point-source contamination from facilities such as industrial, wastewater treatment or legacy contaminated sites.

3.1.3. Rainfall

There are seven active rainfall gauges available to estimate the NMMA rainfall (Figure 3-4). Three stations are part of the ALERT Storm Watch System, Nipomo East (728), Nipomo South (730), and Oceano (795). One station is a California Irrigation Management Information System (CIMIS station), CIMIS (202). The other three stations are active volunteer gauges and include Black Lake (222), Mehlschau (38), and Nipomo CDF (151.1). The data are collected by the County of San Luis Obispo Department of Public Works (SLO DPW) and CIMIS. The TG obtains these data by filing a data request with County Public Works at the beginning of the calendar year for the rainfall data from the preceding year. SLO DPW staff collects volunteer gauge data once each year in the month of July for the previous year, July through June. Rainfall data are often compiled on a water year basis. A water year typically begins October 1st and ends September 30th of the following year, and the year referenced is that of September (i.e., WY2003 is defined as October 1, 2002 through September 30, 2003). For the volunteer gages data collected from July 2009 to December 2010 is unavailable until July 2010, when County collects and compiles the rainfall data.

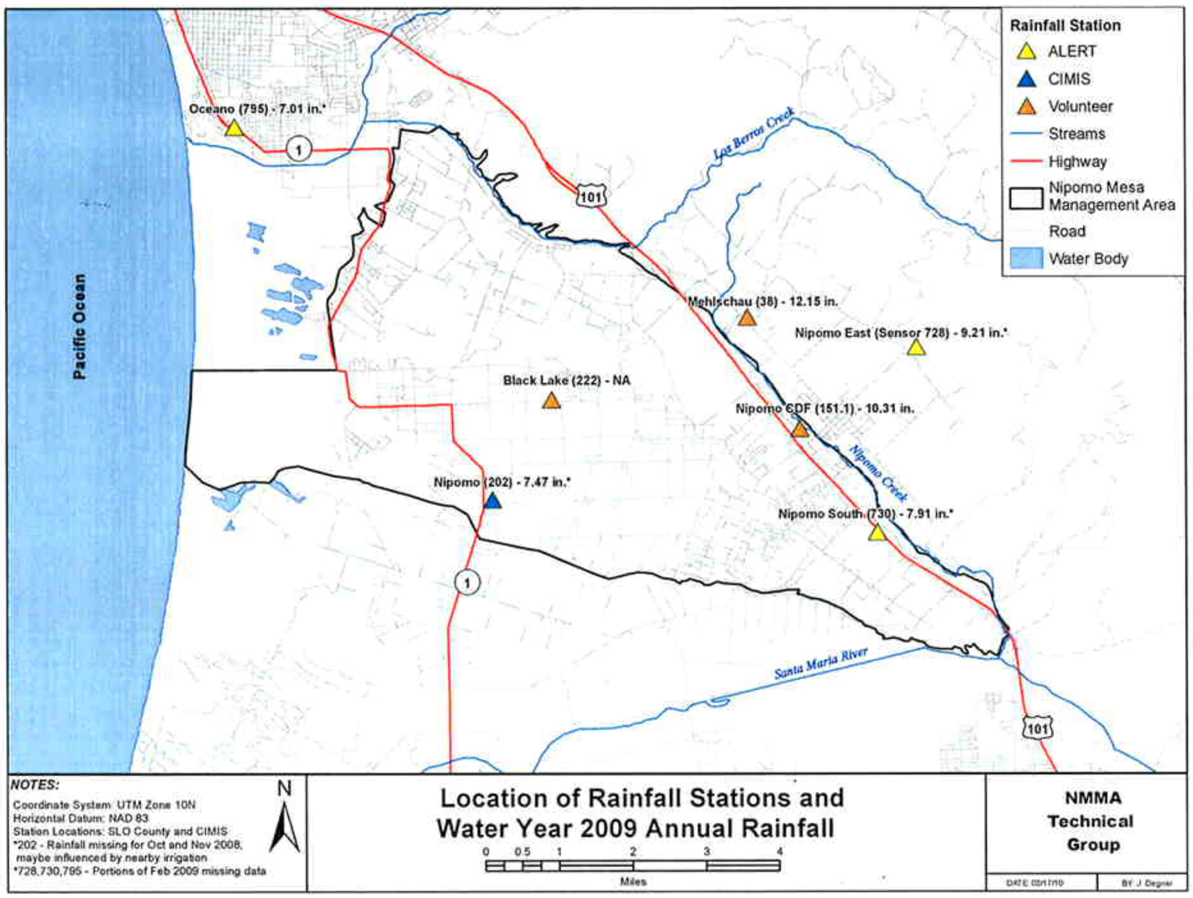

Figure 3-4. Rainfall Station Location and Water Year 2009 Annual Rainfall

The WY2009 rainfall totals are approximately 70 percent of the long-term average (Table 3-1). The current water year ending September 30th, 2010 will be more than 110 percent of the long-term average. Potential evapotranspiration for calendar year 2009 is 43.5 inches, as compared to 45 inches in calendar year 2008.

Table 3-1. Rainfall Gauges and 2009 Rainfall Totals

Rainfall Station	Period of Record	Period of Record Mean	Water Year 2009[1]	Calendar Year 2009	Water Year 2010 thru April 2010	Percent of Normal[2]
Nipomo East (728)	2005-2009	14.37	9.21*	9.92*	20.32	132%
Nipomo South (730)	2005-2009	13.98	7.91*	7.68*	17.05	110%
Oceano (795)	2005-2009	11.75	7.01*	8.03*	17.40	113%
CIMIS Nipomo (202)	2006-2009	9.75	7.47*	8.67*	17.22	112%
Nipomo CDF (151.1)	1958-2009	15.43	10.31	NA	NA	NA
Black Lake (222)	1994-2008	18.97	NA	NA	NA	NA
Mehlschau (38)	1920-2009	16.64	12.15	NA	NA	NA

Notes:
NA - Data not available for July 2009 and after.
1. Water Year is defined as Oct. 1 of previous year through Sept. 30 of the current year.
2. Percent of Normal, calculated using the period of record annual averages for the #151.1.
*202 - No rainfall recorded in Oct and Nov 2008 when rainfall was recorded in other gauges. Rainfall data collected at CIMIS 202 maybe influenced by nearby irrigation.
*728,730, and 795 - Rainfall data missing for parts of Feb 2009.

3.1.4. Rainfall Variability

Quantifying the temporal and spatial variability is critical where rainfall is a large portion of the water supply. Spatial variability in the volume of rainfall across the NMMA is apparent when comparing the WY2009 rainfall totals from these gauges. The WY2009 total rainfall ranges from 7.01 inches (Oceano #795) to 12.15 inches (Mehlschau #38).

Climatic trends and interannual variability also impact the water supply to the NMMA. The cumulative departure from the mean was prepared for three rain gauge stations Mehlschau (38), CDF Nipomo (151.1), and Black Lake (222) over the period from water year 1975 to water year 2009 (Figure 3-5). Periods of wetter than average and drier than average conditions are coincident at all three gauges. The most pronounced drying period occurred from 1983 to 1994, followed by a wetter than average period from 1994 to 1998. Water years 2007, 2008, and 2009 have been drier than average.

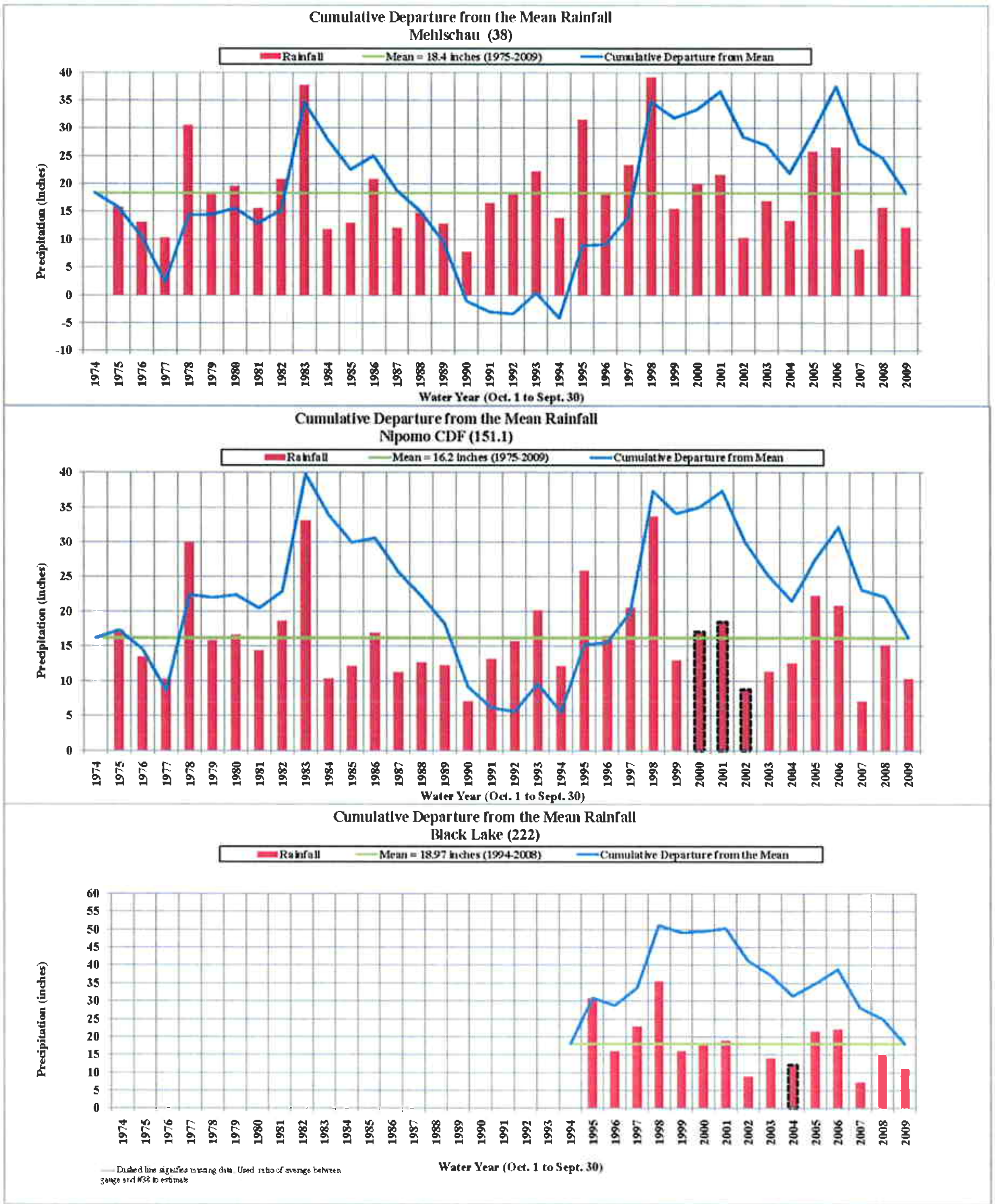

Figure 3-5. Cumulative Departure from the Mean for the following rain gauges: Mehlschau (38), Nipomo CDF (151.1), and Black Lake (222)

3.1.5. Streamflow

Currently, there are some records of streamflow within the NMMA. On Los Berros Creek, the Los Berros 757 streamflow sensor is located 0.8 miles downstream from Adobe Creek and 3.7 miles north of Nipomo on Los Berros Road and the Valley Road (Sensor 731) is located on at the Valley Road bridge over Los Berros Creek (Figure 3-6). The data at the Los Berros gauge are compiled by San Luis County Department of Public Works. Nipomo Creek streamflow is not currently gauged.

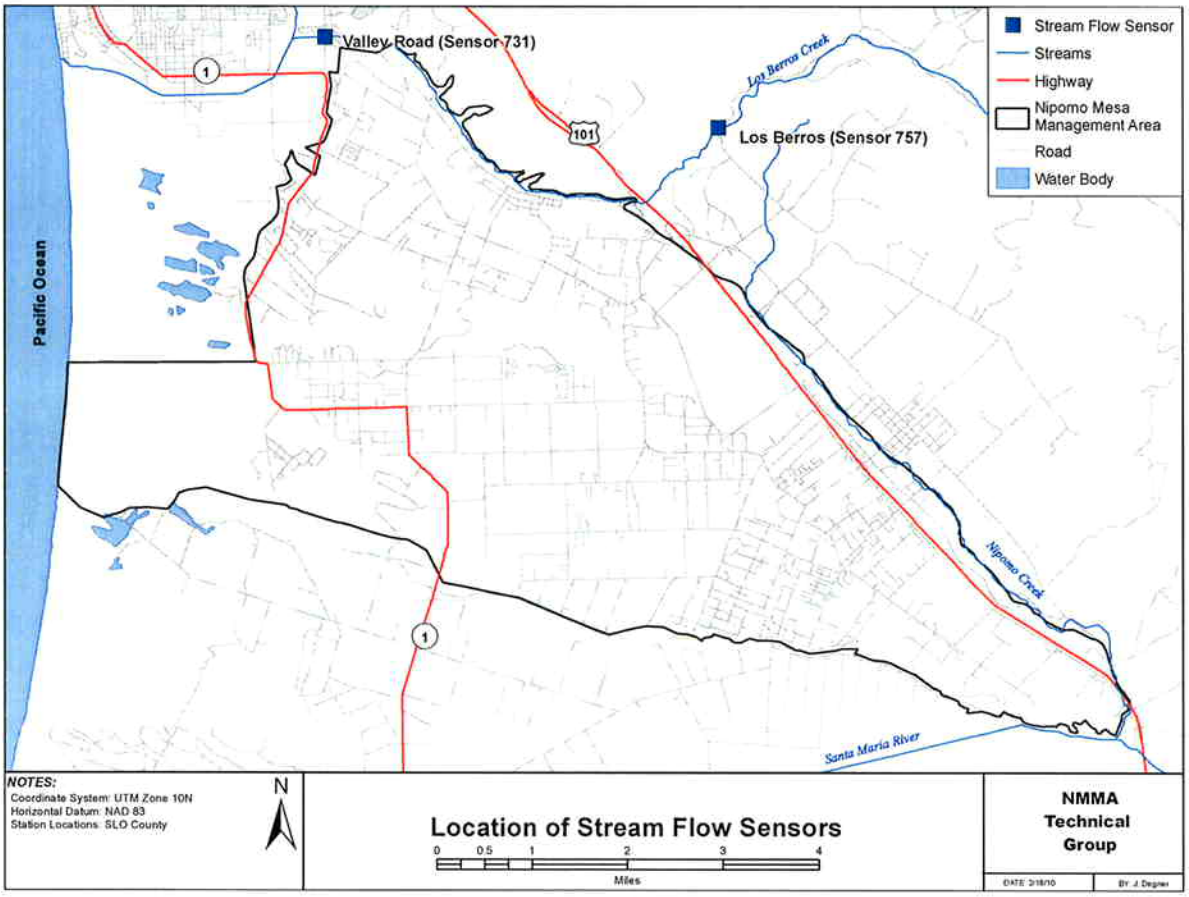

Figure 3-6. Location of Stream Flow Sensors

3.1.6. Surface Water Usage

There are no known diversions of surface water within the NMMA.

3.1.7. Surface Water Quality

Surface water quality samples were taken in Nipomo Creek in 2001 and 2002 and in Los Berros Creek in 2002 and 2003 for the Central Coast Ambient Monitoring Program (www.ccamp.org). Nipomo Creek was listed as an impaired water body because of fecal coliform counts in exceedance of the basin plan standard. There are no known surface water quality samples taken since the CCAMP sampling.

3.1.8. Land Use

Land use data historically has been collected for the NMMA by the DWR at approximately ten year intervals since 1959. DWR periodically performs land use surveys of the Southern Central Coast area (which includes the NMMA). The TG will decide when the next land use survey should be completed. Ideally, DWR will update the land use for the South Central Coast area (which includes the NMMA) in the future for the next land use survey. The status of the DWR land use program for the Southern District can be accessed at (http://www.dpla.water.ca.gov/sd/land_use/landuse_surveys.html).

The most recent DWR Land Use survey that covers the NMMA was in 1996. The 2007 NMMA land use was classified by applying the DWR methodology to a June 2007 one-foot resolution aerial photograph. Land use was classified into four main categories based on the methodology used by DWR in 1996; agriculture, urban, golf course and native vegetation (undeveloped lands).

Agricultural lands for 2009 were further subdivided using the San Luis Obispo County Agriculture Commissioner survey of the 2009 crop types and acreage for San Luis Obispo County. The major crops grown on in the NMMA are strawberries, vegetable rotational, avocados, and nursery plants.

Urban lands were classified following the DWR methodology with additional sub categories based on San Luis Obispo County land use categories from land use zoning maps. The categories for urban include (1) Commercial-Industrial; (2) Commercial-office, (3) Residential Multi-family; (4) Residential-Single Family; (5) Residential-Suburban; (6) Residential-Rural; (7) Recreational grass; (8) Vacant. Golf courses were classified separately from Agricultural or Urban Lands.

Native vegetation lands were classified following the 1996 DWR methodology. In the DWR methodology, all undeveloped land was classified as native vegetation and includes groves of non-native eucalyptus and fields of non-native grasses. The lands classified as native vegetation were further broken down into two categories: grasses; and trees and shrubs; to better estimate deep percolation of rainfall required for the hydrologic inventory (see Section 5 Hydrologic Inventory).

The land use acreage for Urban is 10,246 acres; for Agriculture is 2,587 acres; and for Native is 8,314 acres. Sub categorical land use acreage is also defined and will subsequently be utilized to compute the groundwater productions and consumptive use of water for each subcategory (Table 3-2).

Table 3-2. 2009 Land Use Summary

Land Use Category	Year of Data	Acreage
Urban		
Commercial - Industrial	2007	472
Commercial - Office	2007	118
Golf Course	2007	549
Residential Multi-family	2007	24
Residential Single Family	2007	821
Residential Suburban	2007	3,597
Residential Rural	2007	4,629
Recreational grass	2007	36
Urban Total	**2007**	**10,246**
Agriculture		
Deciduous	2009	2
Pasture	2009	2
Vegetable rotational	2009	225
Avocado and Lemons	2009	277
Strawberries	2009	1,393
Nursery	2009	332
Non-irrigated farmland	2007	356
Agriculture Total	**2007**	**2,587**
Native Vegetation		
Fallow Ag Land	2007	234
Native Trees and Shrubs	2007	2,657
Native Grasses	2007	4,579
Urban Vacant	2007	765
Water Surface	2007	9
Unclassified	2007	70
Native Total	**2007**	**8,314**
Total Land Use	**21,147**	

3.1.9. Groundwater Production (Reported and Estimated)

The groundwater production data presented in this section of the annual report were collected for calendar year 2009. Where groundwater production records were unavailable, the groundwater production was estimated for calendar year 2009.

Reported Groundwater Production

Individual landowners, public water purveyors, and industry all rely on groundwater pumping from the aquifers underlying the NMMA. Data were requested by the TG from the public water purveyors and individual pumpers and incorporated in this 2009 Annual Report. Stipulating Parties to the Judgment are required to provide monitoring and other production data at no charge, to the extent that such data have been generated and are readily available.

Stipulating parties provided production records that report a total of 6,740 AF (AF) of groundwater produced in calendar year 2009 (Table 3-3) , an increase of 140 AF from last year. Woodlands increase in production is consistent with the planned build-out of the development; however the magnitude is offset by reductions occurring from other parties. NCSD and GSWC production is lower this year as compared to last year. Two facts likely influence these reductions, climatic demand and conservation. Reduced climatic demands likely account for the lesser portion and conservation the larger portion of the total reduction.

Table 3-3. Calendar Year 2009 Reported Production

Stipulating Parties	Production (AF/yr)
NCSD	2,560
GSWC	1,290
Woodlands	810
ConocoPhillips	1,200
RWC	880
Subtotal	**6,740**

Estimated Production

The estimated production for agricultural crops in the NMMA is 3,800 AF computed by multiplying the crop area and the crop specific unit production for 2009 (Table 3-4). A detailed explanation of the methodology used for this estimate is provided in Appendix C.

Table 3-4. 2009 Estimated Production for Agricultural

Crop Type	2009 Area	2009 Unit Production	2009 Production
	Acres	AF/acre	AF/yr
Deciduous	2	3.1	10
Pasture	2	3.5	10
Vegetable rotational	225	2.5	570
Avocado and Lemon	277	2.4	660
Strawberries	1,393	1.3	1,880
Nursery	332	2.0	660
Un-irrigated Ag Land	355	0.0	0
Total	**2,587**		**3, 800**[3]

Production for urban use was estimated for rural landowners not served by a purveyor which reported groundwater production to the TG. The total estimated production for the rural landowners is 1,700 AF for 2009 (Table 3-5).

Table 3-5. Estimated Groundwater Production for Rural Landowners

Land Use Type	Area (acres)	Unit Production (AF/acre)[1]	Production (AF/yr)
Commercial - Retail	0	1.42	0
Residential Single Family	48	2.10	100
Residential Suburban	979	0.98	960
Residential Rural	3,281	0.20	660
Urban Vacant	149	0.00	0
Total	**4,456**		**1,700**[4]
Note: 1. Unit production values from NCSD 2007, Water and Sewer Master Plan Update			

Combining the estimates of groundwater production for Stipulating Parties (Table 3-3), for Agriculture (Table 3-4) and Rural Landowners (Table 3-5) results in an estimated total groundwater production of 12,200 AF for 2009 (Table 3-6).

[3] This number has been rounded to reflect accuracy in estimation.

[4] This number has been rounded to reflect accuracy in estimation.

Table 3-6. 2009 Measured and Estimated Groundwater Production (AF/yr)

Measured	
NCSD	2,560
GSWC	1,290
Woodlands	810
ConocoPhillips	1,200
RWC	880
Subtotal	6,740
Estimated	
Rural Landowners	1,700
Agriculture	3,800
Total NMMA Production	**12,200**

3.1.10. Wastewater Discharge and Reuse

Four wastewater treatment facilities (WWTF) discharge treated effluent within the NMMA: The facilities include the Southland Wastewater Works (Southland WWTF), the Black Lake Reclamation Facility (Black Lake WWTF), Rural Water Company's Cypress Ridge Wastewater Facility (Cypress Ridge WWTF), and the Woodlands Mutual Water Company Wastewater Reclamation Facility (Woodlands WWTF) (Figure 3-7). The total WWTF effluent in the NMMA was 690 AF for 2009 (Table 3-7). The portion of treated effluent that percolates to the underlying groundwater system and contributes to the water supplies of the NMMA will be the subject of future investigations by the TG.

Table 3-7. 2009 Wastewater Volumes

WWTF	Influent (AF/yr)	Estimated Effluent (AF/yr)	Re-use
Southland	629	551 (1)	Infiltration
Black Lake	71	60 (1)	Irrigation
Cypress Ridge	Not Reported	49	Irrigation
Woodlands	Not Reported	28	Irrigation
Total		**690**[5]	

Notes:
1. Effluent was estimated as the Influent - Evaporation from Aeration Ponds - 10% of Influent to account for biosolid removal. For the Nipomo Mesa, the 2009 annual evapotranspiration is approximately 43.5 inches (CIMIS, 2010) and the 2009 rainfall is at CIMIS is approximately 8.66 inches year (CIMIS 202). This results in a net evaporation from a pond of 29.6 inches per year. Evaporation from holding or infiltration ponds has not been included.

[5] This number has been rounded to reflect accuracy in estimation.

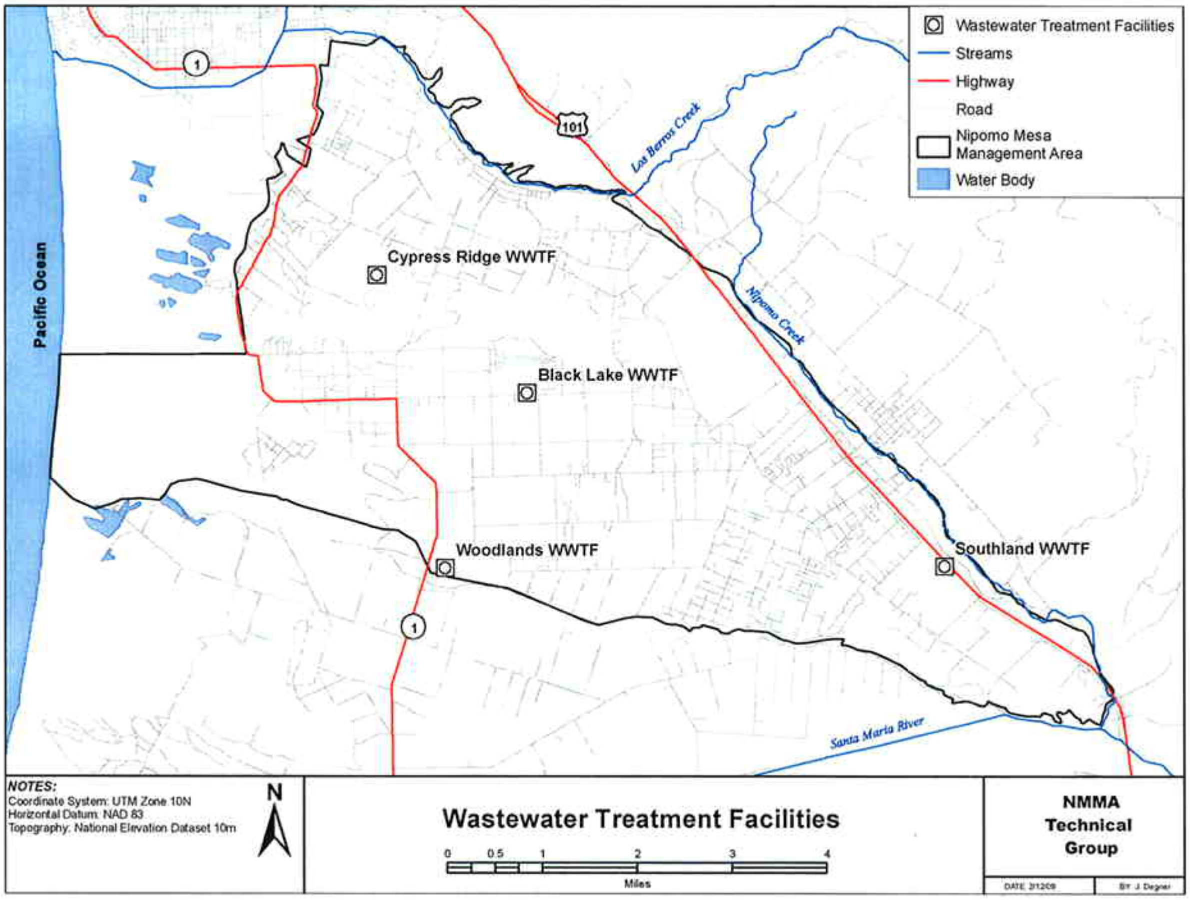

Figure 3-7. Wastewater Treatment Facilities

3.2. *Database Management*

The database of monitoring data is an entirely digital database and is maintained in Microsoft Excel. The database is broken into five datasets: Groundwater Elevation dataset, groundwater quality dataset, rainfall dataset, groundwater production dataset, and land use dataset.

NCSD, through their consultant SAIC, is designated as the database steward and is responsible for maintaining and updating the digital files and for distributing any updated files to other members of the TG. A "change log" is maintained for each database. The date and nature of the change, along with any special features, considerations or implications for linked or related data are recorded in the change log.

3.3. *Data and Estimation Uncertainties*

Uncertainties exist in data, and therefore uncertainties exist in derivatives of data including interpretations and estimations made from direct measurements. Uncertainties arise from errors in measurements, missing measurements, and inaccurate methodologies and generalizing assumptions. For example, rainfall is measured at a few locations across the NMMA. However, it is well known that the spatial and temporal variability in rainfall deposition in a storm is much greater than that which the density of rainfall gages can represent. Ground surface elevation across the NMMA is known to be in error at places and may be reported incorrectly by amounts as large as 20 feet. This affects the accuracy of groundwater elevations and contours. There exists missing data from both groundwater elevations and rainfall records. Estimations are made to fill in these data gaps with the understanding that the accuracy of these estimates is reduced. Derivatives from these data therefore contain inaccuracies. Additionally, precision issues arise when interpretations are made from data, in that individuals make decisions during the process of interpreting data that are subjective and therefore not documentable. For example, aerial image classification is a subjective process as well as is the preparation of groundwater elevation contours. Estimations are made for parameters that are not measurable or very difficult to measure. The methodologies used to make estimates represent a simplified numerical representation of the environment and are based on assumptions defining these simplifications. Estimates in their very nature contain uncertainty.

Quantifying the uncertainty in data or data derivatives is a rigorous process. Currently, the NMMA TG has not accomplished this task. However, hypothetical ranges in uncertainty may be used to quantify the impact of an uncertainty on the understanding of the physical condition being described. In the following sections, uncertainty may be presented as a hypothetical range based on reasonable amounts or professional judgment, for example two times greater or one half less than the value presented. Comparing the extreme case of uncertainty in both positive and negative directions can qualify the understanding of the physical condition being described.

4. Water Supply & Demand

Presented in this section are discussions of the various components of historical, current and projected values of water supplies and demands for the NMMA.

4.1. *Water Supply*

The water supplies supporting the activities within the NMMA are met entirely from groundwater production. No surface water diversions exist. Nor is there currently any imported water. Nipomo Supplemental Water, as defined by the Stipulation, is being developed and delivery is expected within the next few years. A brief description of the historical supply, current supply, groundwater production and quality, recycled water, supplemental water, and surface water diversion is presented in the following sections.

Rainfall that percolates to the underlying groundwater aquifers has historically been assumed to represent the main source of supply for water users in the NMMA. As noted in Section 2.3.3, the presence of dense or confining layers in the subsurface could inhibit rainfall percolating to the deeper aquifers in some areas of the NMMA. The location of these dense or confining layers is not well understood, but is an area of on-going focus for the technical group. Other areas of uncertainty include:

- Santa Maria River subsurface flow
- Subsurface flow from the eastern and northern boundaries of the management area
- Components of water supply as recharge to various aquifers, shallow and deep

While progress has been made in a number of the above areas, the TG has elected to limit quantitative estimates of various components of the water balance. This approach reflects a change from the information presented in the 2008 Annual Report. A structured program to refine and report on components of the water balance is included in the Technical Recommendations in Section 9.

4.1.1. Historical Supply

DWR (2002) estimated the Dependable Yield (DWR, 2002. Page ES21) for their study area to be between 4,800 and 6,000 AF/yr. Their study area is approximately equivalent to the boundary of the Nipomo Mesa Management Area. The TG has established a structured program for developing its own estimate of the available recharge and supply as indicated in Section 9.

4.1.2. Current Supply

Rainfall measured at the stations described in Section 3 range from 7.0 to 12.2 inches for water year 2009, and is approximately 70% of the long-term annual average. This rainfall flows on hardscape surfaces or in local depressions, recharges shallow aquifers and the deep aquifers where confining layers are absent, or is retained in the soil profile until it is evaporated or transpired by overlying vegetation. Prior to the 2010 Annual Report, the TG expects to develop an estimate of the quantity of rainfall that percolated downward during WY2009 and available to shallow or deep aquifers (see Section 9).

Another component of the groundwater supply underlying the NMMA is the net of subsurface inflow and outflow. Currently, the TG does not have a sufficient understanding of stratigraphy to quantify the subsurface inflow and outflow for the shallow and deep aquifers adequately. The TG anticipates that each year the implementation of the Monitoring Program will improve upon data availability and reliability. Additionally, the TG currently is evaluating the hydrogeology under the NMMA and defining aquifer characteristics, location of confining layers, and developing the understanding necessary to contour the groundwater elevation (or potentiometric surface) in specific aquifers from which groundwater is produced.

4.1.3. Groundwater Production and Quality

Currently, groundwater pumping is not differentiated between various strata, shallow or deep aquifers. In some places, particularly for purveyor wells, the screened intervals are known, however the screened intervals of private wells, a number of wells on the order of ten times the purveyor wells, are not known. In the future, it is expected that the natural supply of water will be supplemented with the construction of the Waterline Intertie Project and delivery of Nipomo Supplemental Water, and possibly better utilization of recycled water.

Shallow Aquifer

Domestic production by rural landowners was estimated to be about 1,700 AF/yr (see Section 4.2.2 Current Production). The majority of this production may be from the Shallow Aquifer. A portion of the estimated 3,800 AF/yr agricultural pumping may also be from the Shallow Aquifer. Of the water quality data reported in the Department of Public Health electronic database (DPH, 2009), none is known to be from wells that the NMMA TG has identified as being completed or perforated exclusively in the Shallow Aquifer.

Deep Aquifers

All production from wells used for public drinking water and industrial water is likely pumped from the Deep Aquifers (primarily the Paso Robles Aquifer). This pumping is estimated to be about 6,740 AF/yr (Section 4.2.2). In addition, a portion of the estimated 3,800 AF/yr of agricultural pumping may also be produced from the Deep Aquifer.

Of all production wells reporting to the DPH in the NMMA, all met drinking water quality standards in 2009. Groundwater samples from two wells in the south-central portion of the NMMA contained total dissolved solids at or above the 1,000 mg/l California recommended secondary limit for TDS. Groundwater samples from these two wells had 1,000 and 1,100 mg/l TDS; these values are still below the California short-term maximum recommended secondary standard for TDS (1,500 mg/l). The NMMA TG will continue to monitor the water quality of these wells.

In addition, a TDS concentration of 1,000 mg/l was recorded for one of the Deep Aquifer sampling horizons at the coastal monitoring well 12C, but this portion of the aquifer has produced TDS at least as high at different times since 1976. High TDS concentrations are known for all three monitored intervals of this well (nearly all results are above 800 mg/l TDS for all three monitored intervals of this well).

Groundwater samples from several wells contain nitrate concentrations that have increased over the last decade (see **Error! Reference source not found.**). Specifically, one well screened in the Deep Aquifer contained groundwater with nitrate concentration measured at 39 mg/l (see Section 6.2.1-Constituents of Concern to Beneficial Uses). The potential sources of nitrate in groundwater are agricultural fertilizers, septic systems, concentrated animals (such as cows and horses), and percolation of treated water from wastewater treatment plants. Because these are all sources at the ground surface, it is most common to find higher nitrate concentrations in shallower aquifers, closer to their source. Thus, nitrate in the Deep Aquifer may indicate that nitrate has already percolated through the shallow aquifer within a portion of the NMMA. Regular groundwater quality sampling within the NMMA is largely conducted by the water purveyors whose wells are in the Deep Aquifer, so the presence and extent of nitrate in the shallow aquifer is unknown.

4.1.4. Recycled Water

Wastewater effluent from the golf course developments at Black Lake, Cypress Ridge, and Woodlands is recycled and utilized for golf course irrigation. The amount of recycled water used in 2009 for irrigation at Black Lake, Cypress Ridge and Woodlands are 60 AF, 49 AF, and 28 AF, respectively (see Section 3.1.10 Wastewater Discharge and Reuse).

4.1.5. Supplemental Water

There was no Nipomo Supplemental Water delivered to the NMMA in 2009.

4.1.6. Surface Water Diversions

There are no known surface water diversions within the NMMA.

4.2. *Water Demand*

The water demands in the NMMA include urban (residential, commercial, industrial), golf course, and agricultural demands. The TG used a variety of methods to estimate the water demands of the respective categories. These methods are discussed in Section 3.1.8 Land Use.

4.2.1. Historical Production

The historical demand estimated for urban (including golf course and industrial) and agricultural land uses has been steadily increasing since 1975 with urban accounting for the largest increase in total volume and percentage (Figure 4-1).

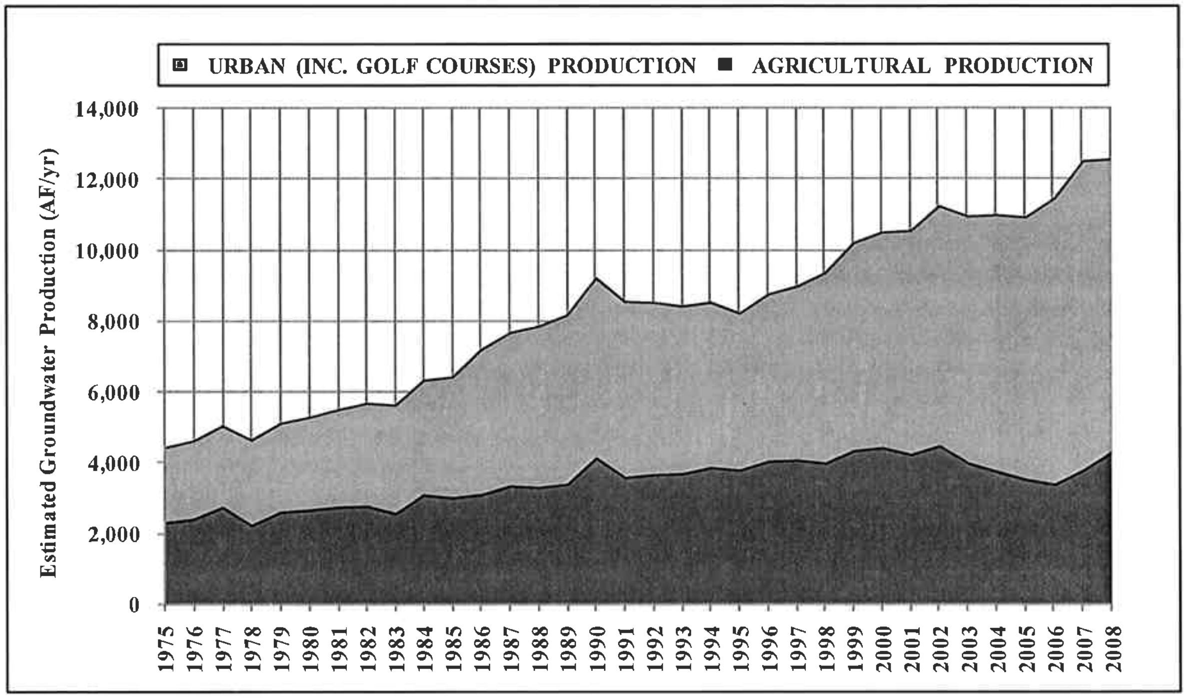

Figure 4-1. Historical NMMA Groundwater Production

4.2.2. Current Production

The estimated groundwater production is 12,200 AF for Calendar Year 2009, based on annual groundwater production records provided by the water purveyors on the Nipomo Mesa and based on an estimated groundwater production by land use area (see Section 3.1.9-Groundwater Production (Reported and Estimated). This amount of groundwater production represents a decrease of 400 AF from the previous year, as reported in the 1st Annual Report Calendar Year 2008, which is consistent with the current year lesser potential evapotranspiration also known as climatic demand (see section 3.1.3) and conservation measures taken by purveyors during Potentially Severe Water Shortage Conditions.

4.2.3. Precision/Reliability

The measured groundwater production values are reliable and are consider precise to the tens place for NCSD, GSWC, and Woodlands, RWC and the hundreds place for ConocoPhillips. The estimated production values are less reliable and precise. For the rural landowner production, the unit production factors used to estimate the production were developed for the NCSD Water and Sewer Master Plan (Section 3.1.8). When these unit production factors are applied to GSWC land use as a check for precision, the estimated production is approximately 5 percent higher than the measured production.

For the estimated agricultural production, there is no measured data available in the NMMA to verify the precision or reliability of the agricultural production.

4.2.4. Potential Future Production

The projected future production for NCSD is an increase from 2,560 AF/yr in 2009 to between 6,300 AF/yr to 7,900 AF/yr under different land use scenarios in 2030 (NCSD, 2007). The ConocoPhillips refinery now pumps approximately 1,200 AF/yr and plans to increase its groundwater production to 1,400 AF/yr, which will be less than its historical peak pumping. The projected water demands for Woodlands project at build-out according to the Woodlands Specific Plan EIR is 1,600 AF/yr (SLO, 1998). The projected water demand for the GSWC at full build out of current service area is estimated to potentially increase to approximately 1,940 AF/yr in 2030 (GSWC, 2008). Currently, no estimate of potential future production for agriculture has been developed.

5. Hydrologic Inventory

A typical hydrologic inventory accounts for the volume of water that increase and decrease the amount of water in storage in the aquifers. The difference in these two amounts is termed the change in storage. A conceptual schematic of the inflows and outflows to the aquifers underlying the NMMA is illustrated in Figure 5-1. The hydrologic inventory can be formalized in the following equation:

Change in Storage (ΔS) = Inflow – Outflow;

ΔS= Subsurface Inflow – Subsurface Outflow + Net Components of Other Recharge and Discharge (including precipitation and runoff, imported water, return flows and other parameters indicated in Figure 5-1).

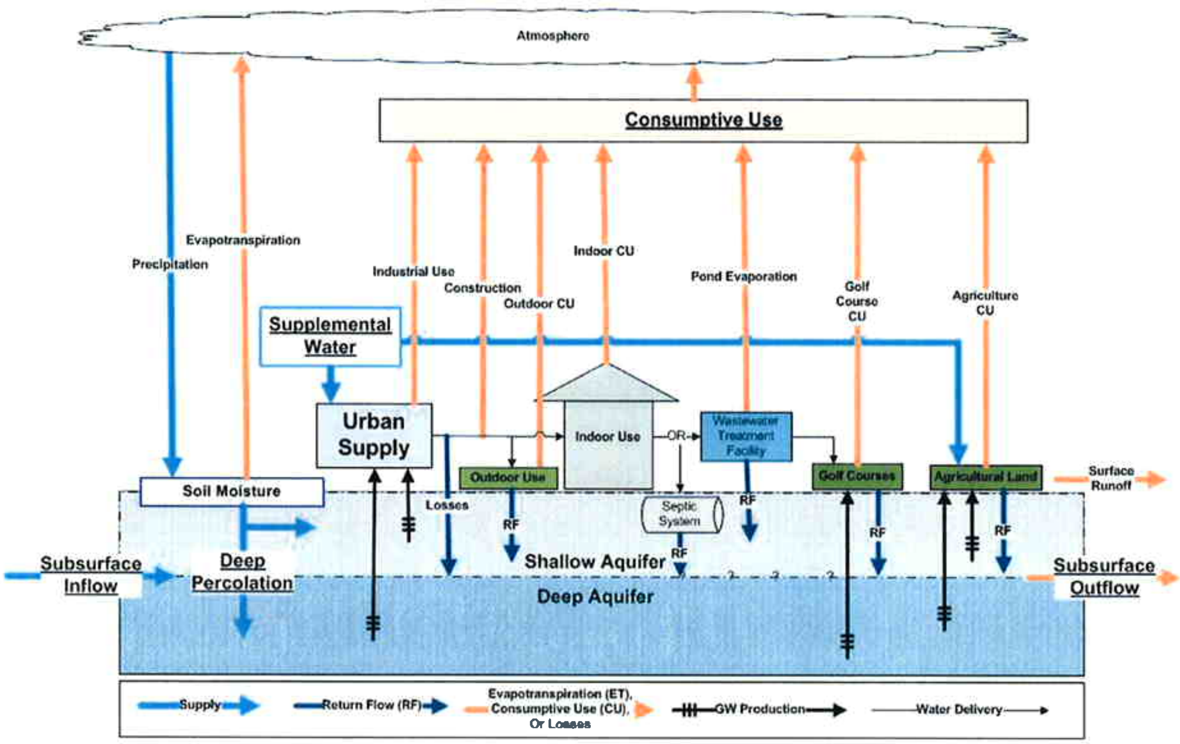

Figure 5-1. Schematic of the Hydrologic Inventory

5.1. *Rainfall and Deep Percolation*

A portion of the rainfall that falls on the NMMA is evapotranspirated, infiltrates the soil, or becomes surface runoff. Deep percolation is the volume of rainfall that percolates past the root zone and may provide recharge to the Shallow and or Deep Aquifers beneath the NMMA. The TG has not yet prepared an estimate of the portion of rainfall that percolates downward recharging the shallow aquifer in a specific place, or the deep aquifer because of the uncertainty in the geometry of confined and unconfined aquifers, as well as the uncertainty in the amount of subsurface flow that emerges down-slope to fill coastal dune lakes and Black Lake Canyon creek. Prior to the 2010 Annual Report, the TG expects to develop an estimate of the consumptive water demand met by rainfall for native vegetation, urban areas, golf courses, and agricultural areas during WY2009 (see Section 9).

5.2. *Streamflow and Surface Runoff*

At this time, an estimate of streamflow and surface runoff will not be presented in this 2009 Annual Report. Streamflow and surface runoff are the volumes of water that flow into or out of the NMMA through surface water channels or as overland flow. The current understanding suggests that surface runoff does occur during major rainfall events and could occur in locations where local conditions near the NMMA boundary are sufficient to promote overland flow out of the area, and where shallow subsurface flow contributes to streamflow that is conveyed out of the NMMA, or to coastal dune lakes where it evaporates. This may occur in the following areas (Figure 5-2):

- Los Berros Creek Watershed in NMMA,
- Steep bluffs between the top and toe of the NMMA adjacent to Arroyo Grande Valley,
- Black Lake Canyon in NMMA,
- Steep bluffs between the top and toe of the NMMA adjacent to Santa Maria River Valley,
- Nipomo Creek Watershed in NMMA,
- Dune Lakes.

The volume of this water which leaves the NMMA is not well understood. Increased understanding of these processes may alter the assumptions used in the hydrologic inventory. The TG continues to analyze where it might be appropriate to install temporary or permanent stream gauging sites to determine the volume of water that percolates beneath streams in the NMMA.

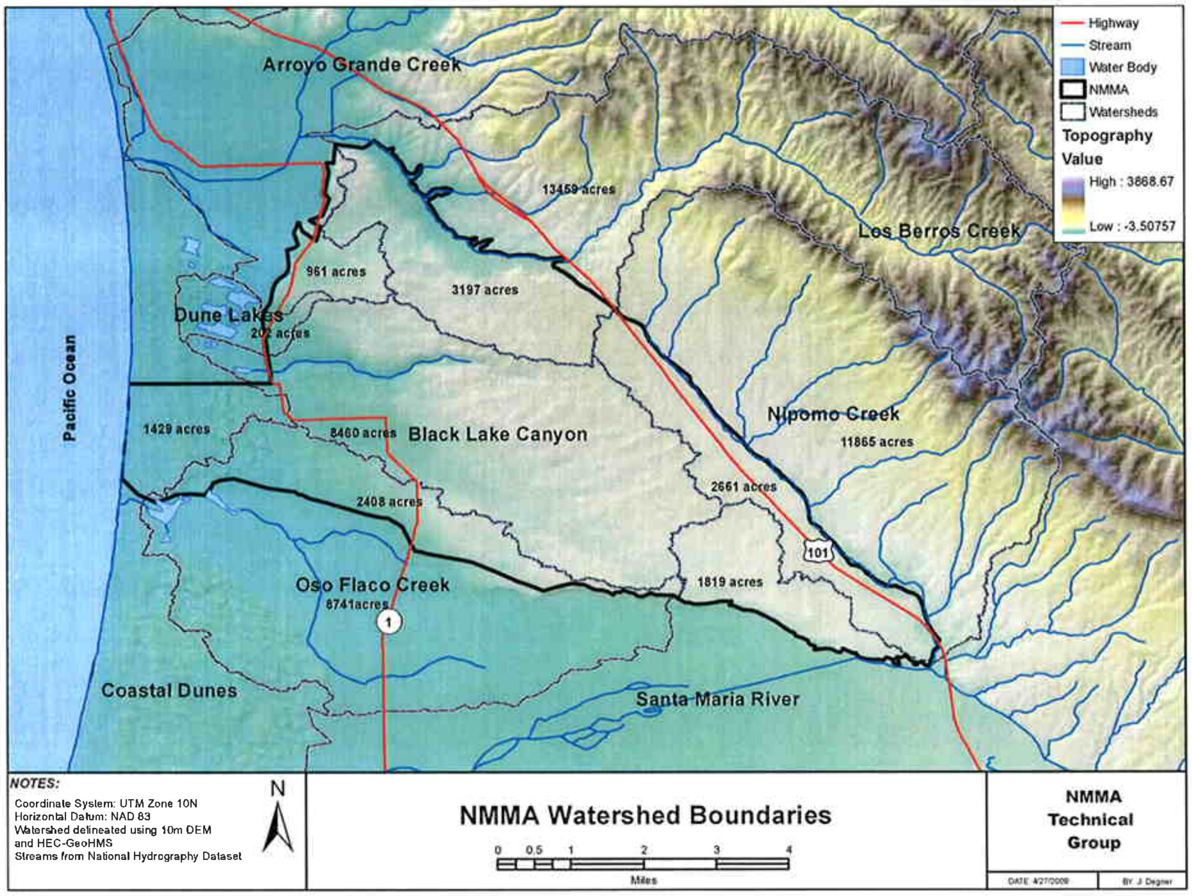

Figure 5-2. NMMA Watershed Boundaries

5.3. *Groundwater Production*

The groundwater production component of the Hydrologic Inventory is calculated using metered production records where available and estimated from land use data where measurements are unavailable. The groundwater production has steadily increased from 4,400 AF/yr in 1975 to 10,500

AF/yr in 2000 (see Section 4.2.1), and the estimated 2009 groundwater production is approximately 12,200 AF/yr (see Section 4.2.2), 400 AF less than the estimate for calendar year 2008.

5.4. *Groundwater Subsurface Flow*

The groundwater subsurface flow is the volume of water that flows into and out of the NMMA groundwater system. Typical methods used to estimate subsurface flow is Darcy's equation (using hydraulic conductivity, groundwater gradient, and aquifer thickness) or flow equations that are part of a regional groundwater model. In the NMMA, the three areas with the most potential for subsurface flow are at the northwestern boundary with the Northern Cities MA, the southern boundary with the Santa Maria Valley MA, and the seaward edge of the basin. Contours of groundwater elevations in this report (section 6.1.5) suggest that there is net inflow from the Santa Maria Valley, net outflow at the coast (required to prevent seawater intrusion), and something approaching no subsurface flow into or out of the Northern Cities MA. The amount of inflow across the eastern boundary is not well understood.

The nature and extent of the confining layer(s) beneath the NMMA and the extent that faults in the NMMA may act as barriers to subsurface flow are not well understood. Therefore, to the TG has not yet quantified the contribution of subsurface flows. As indicated previously, future technical collaboration with the other management groups will be critical for overall basin evaluation.

5.5. *Supplemental Water*

Supplemental water is the volume of water produced outside the NMMA and delivered to the NMMA. There was no supplemental water delivered to the NMMA in 2009. Future deliveries of supplemental water will be measured and subsequent annual reports will present the volume and disposition of the supplemental water delivered to the NMMA.

5.6. *Wastewater Discharge*

Wastewater discharges are the volumes of wastewater effluent discharged by the four wastewater treatment facilities located within the NMMA, and individual septic tanks where centralized sewer service is not provided. The WWTFs include the Southland Wastewater Works (Southland WWTF), the Black Lake Reclamation Facility (Black Lake WWTF), Rural Water Company's Cypress Ridge Wastewater Facility (Cypress Ridge WWTF), and the Woodlands Mutual Water Company Wastewater Reclamation Facility (Woodlands WWTF). The Southland WWTF discharges treated wastewater into infiltration basins (see Section 3.1.10 Wastewater Discharge and Reuse). A portion of the water percolates and returns to the groundwater system and the remaining portion evaporates. The treated effluent from Black Lake WWTF, Cypress Ridge WWTF, and Woodlands WWTF is used to irrigate golf course landscaping, reducing the demand for groundwater production. The total WWTF effluent in the NMMA was 690 AF for 2009 (Table 3-7). The wastewater discharged in the septic systems that do not overlie confining layers percolates downward and may recharge the Deep Aquifer.

5.7. *Return Flow of Applied Water and Consumptive Use*

Return flow is defined as the amount of recharge to the aquifer resulting from water applied for beneficial use; it is the amount of remaining water that percolates to recharge the aquifer(s) after portions of the applied water have been used for evaporation, transpiration, and additions to soil storage. This functional definition differs somewhat from that used in the Stipulation to apportion the right to use water that was imported to the basin. However, the physical process of recharge by return flow of applied water is the same regardless of where the water originated.

Because of the uncertainty in the geometry of confined and unconfined aquifers, the TG has not yet prepared an estimate of return flow to the producing aquifers.

5.8. *Change in Groundwater Storage*

The change in groundwater storage from the hydrologic inventory over a period of time is a method of determining whether an imbalance exists between supply and demand. Typically, this change in storage is compared to a change in storage computed from groundwater contours, cross-checking the results of each. Storage changes from groundwater contours are typically calculated by measuring change in groundwater elevation and multiplying that change by a storage factor. As discussed in section 2.3.3, there is significant uncertainty in the extent of confined and unconfined portions of the aquifers. Storage factors differ by orders of magnitude between confined and unconfined aquifers. Therefore, the portion of confined and unconfined areas is critical to the calculation of change in storage from groundwater contours.

The TG's current understanding of confining conditions within the NMMA precludes calculating change in groundwater storage from groundwater contours at this time for the management area.

6. Groundwater Conditions

6.1. *Groundwater Elevations*

For this report, groundwater elevations are analyzed using several methods. Hydrographs (graphs of groundwater elevation through time) were constructed for a number of wells, particularly all the Key Wells. The Key Wells Index was calculated to determine the groundwater conditions in inland areas. In coastal monitoring wells, groundwater elevations were graphed for each well completion within a nested site to compare to sea level. Finally, the aggregate of groundwater elevation measurements was used to construct groundwater contour maps for the spring and fall of 2009.

6.1.1. Summary of Hydrographs

Hydrographs for wells within and adjacent to the NMMA were updated through calendar year 2009. The hydrographs are separated into two sections – inland and coastal.

6.1.2. Results from Inland Key Wells

Hydrographs were prepared for the Key Wells (Figure 6-1, Figure 6-2). Groundwater elevations in 2009 were above sea level in all cases for the Key Wells. Groundwater elevations are trending somewhat downward, as would be expected in the drier conditions that occurred through 2009. The difference between spring and fall measurements in these wells ranged from a little less than 5 feet to as much as 30 feet. Groundwater elevations are within their historical fluctuation in all wells except 22C2, where groundwater elevations are continuing to drop within the NMMA groundwater depression.

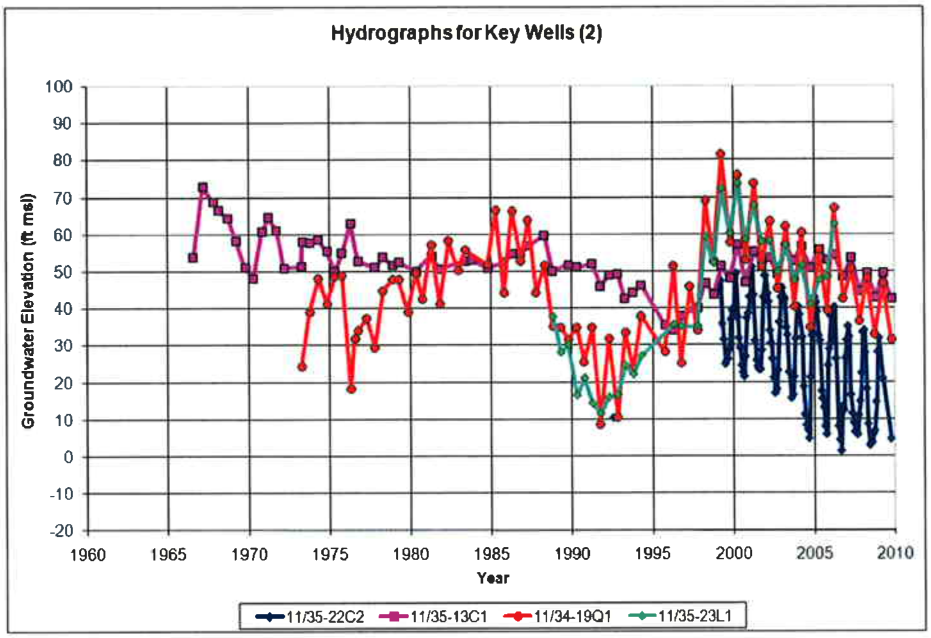

Figure 6-1. Key Wells Hydrographs, Western Portion of NMMA

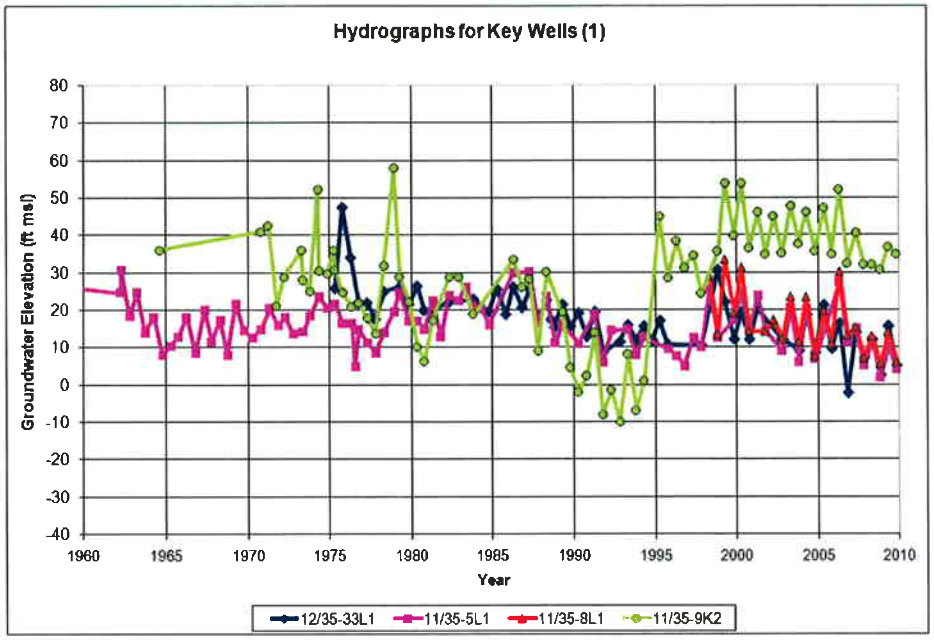

Figure 6-2. Key Wells Hydrographs, Eastern Portion of NMMA.

6.1.3. Results from Coastal Monitoring Wells

The elevation of groundwater in the coastal monitoring wells is very important because it indicates whether there is an onshore or offshore gradient to the ocean. In both coastal monitoring sites adjacent to the NMMA, groundwater elevations are above sea level and high enough to counteract the higher head caused by the more-dense seawater (Figure 6-3, Figure 6-4). In spring 2009, the deeper well at site 12C had heads that were above ground surface (flowing artesian conditions). At site 36L groundwater elevations that had dropped several years through 2008 instead rose slightly in 2009.

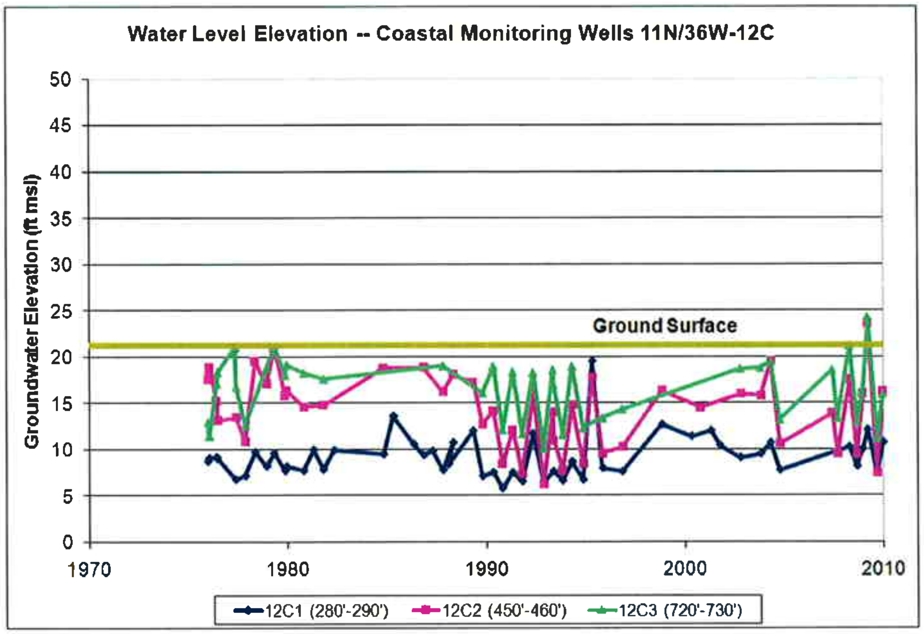

Figure 6-3. Hydrograph for Coastal Monitoring Well Clusters 11N/36W-12C.

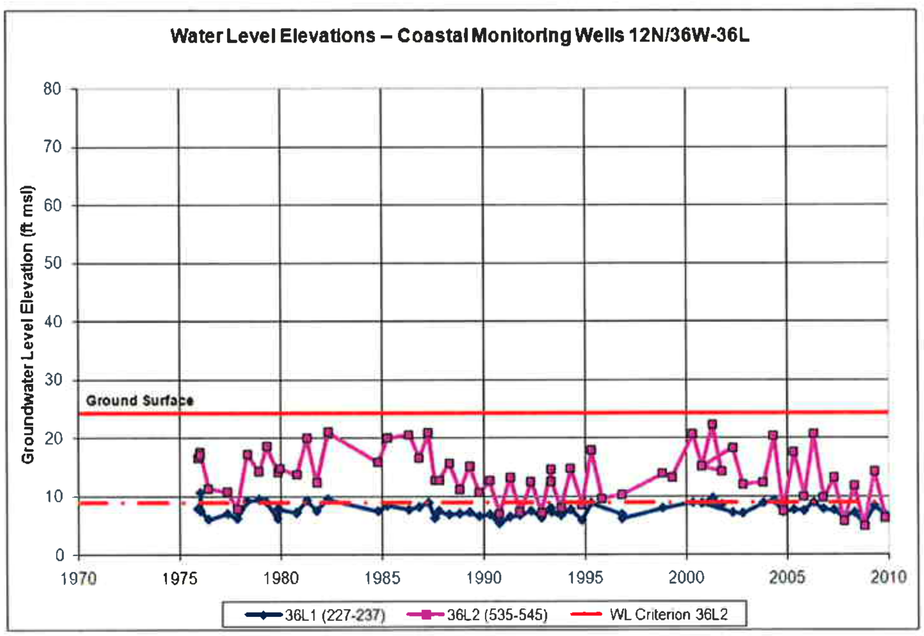

Figure 6-4. Hydrograph for Coastal Monitoring Well Clusters 12N/36W-36L.

6.1.4. Groundwater Contours and Pumping Depressions

Groundwater elevation data for the Deep Aquifer were plotted on two separate maps for spring and fall of 2009 and hand-contoured. Groundwater elevation contours were constructed for both spring and fall of 2009 so that high and low groundwater conditions could be analyzed (Figure 6-5, Figure 6-6). Maps that depict both the measured groundwater elevation data and the subsequent contouring of the data are included in Appendix E.

The most obvious feature in the contour maps is the pumping depression that has existed for decades within the north-central portion of the basin. The low point in the depression was just above sea level in spring 2009 and lower than 10 feet below sea level in fall 2009. The pumping depression trends in a northwest-southeast direction, parallel to the Santa Maria River and Oceano faults. DWR (2002) suggested that the Santa Maria River fault affected flow in the Deep Aquifer, with groundwater elevation contours offset by several tens of feet. However, the more-extensive groundwater elevation data set used in this Annual Report could not support this conclusion – the data are too variable from well to well in the eastern portion of the NMMA to detect offset of groundwater contours in the range of tens of feet.

Of interest is the area along the northwesterly boundary of the NMMA, adjacent to the Northern Cities Management Area. Groundwater elevation data from private wells in the Cypress Ridge area appear to define the location of a "saddle" between the NMMA and the Northern Cities Management Area to the north. These groundwater data were not measured at the same time as the measurements used in drawing the water level contours, so the data weren't used to contour the maps. However, the location of the "saddle" is well defined in the Cypress Ridge area and is used in constructing the 2009 contour maps. During future water level monitoring events, concurrent information in this area should be collected, and this continued monitoring of the Cypress Ridge wells will indicate how this "saddle" might change with time. The conditions along this boundary provide a salient example of the need for collaboration and cooperation between the technical groups.

Near the coastline, groundwater elevations within the NMMA are above sea level. As in 2008, there is a ridge of higher pressure in the aquifer (groundwater elevations 10 to 20 ft above sea level) just inland from the coastal dunes that provide a buffer between inland areas and the coast. South of this ridge to near Oso Flaco Lake, gradients are relatively flat from the coast to inland area.

The groundwater gradient is relatively steep along the eastern edge of the basin. The contours are sub-parallel to the eastern edge of the basin (with groundwater flow paths perpendicular to the basin edge), suggesting that significant recharge may occur in this area. Besides the possibility of recharge from rainfall and seepage from adjacent older sediments along and to the east of the edge of the NMMA, Los Berros Creek flows across the outcropping Paso Robles Aquifer in the northeastern portion of the NMMA. The steep groundwater gradient adjacent to this outcrop area suggests that this is an important area of recharge, although the amount of recharge to the shallow or deep aquifer has not been measured.

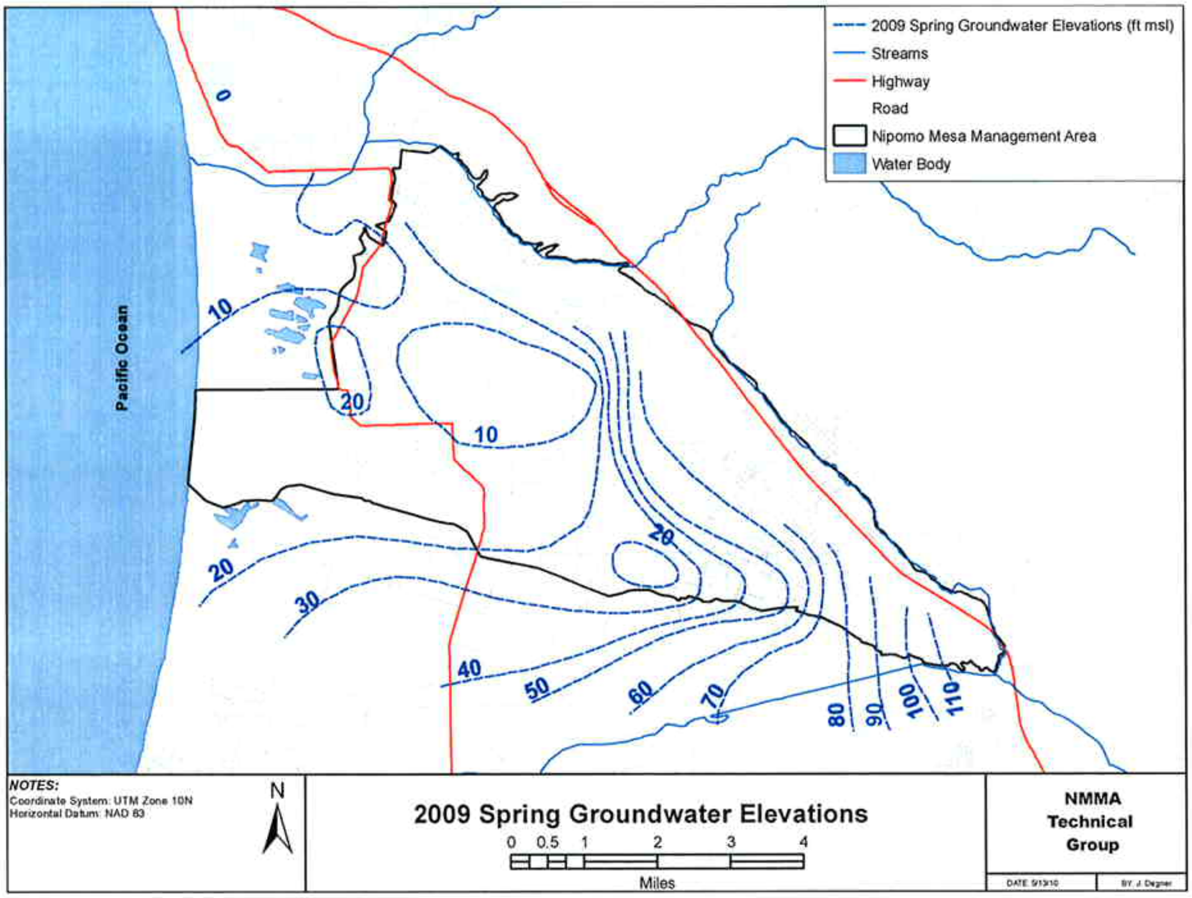

Figure 6-5. 2009 Spring Groundwater Elevations.

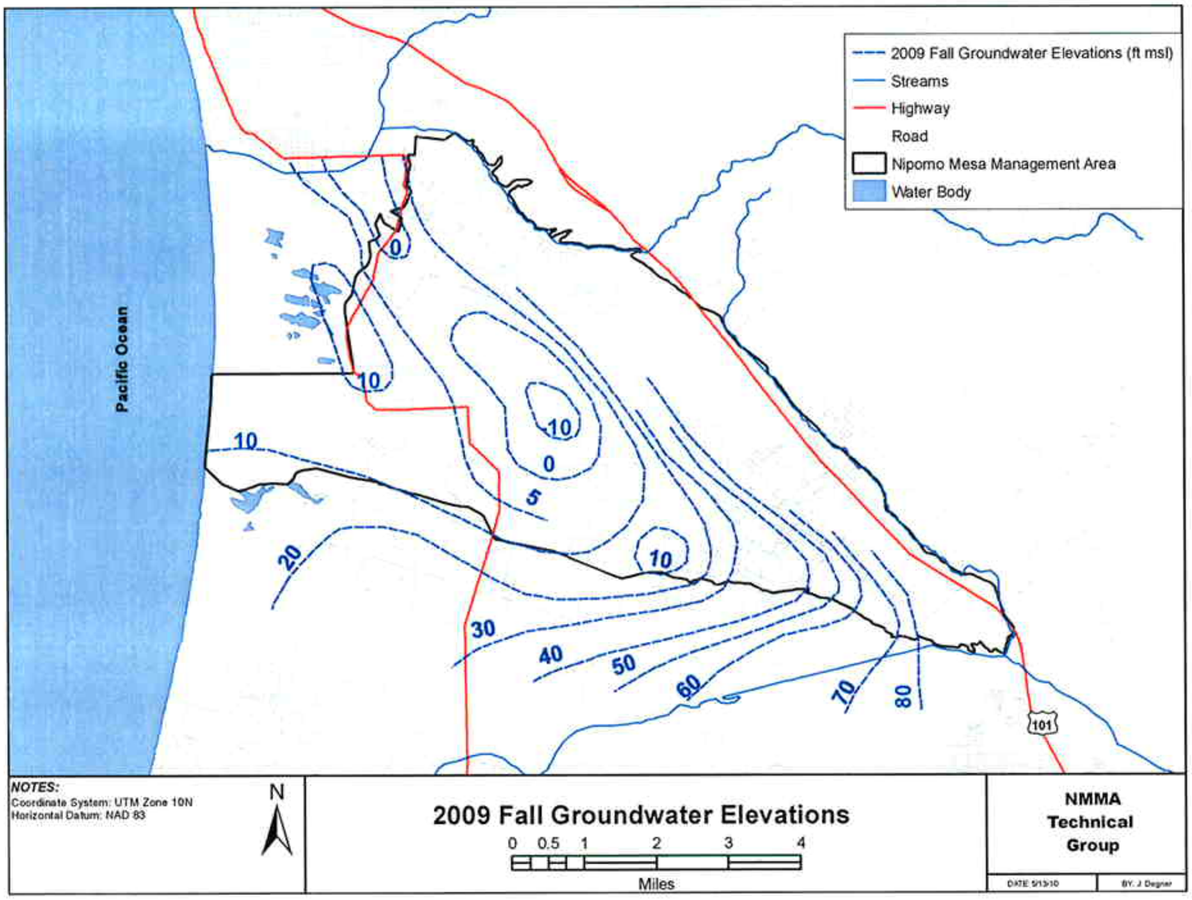

Figure 6-6. 2009 Fall Groundwater Elevations.

6.1.5. Groundwater Gradients

Groundwater gradients can be calculated directly from the groundwater elevation contour maps (Figure 6-5, Figure 6-6). The discussion of gradients is separated into coastal gradients that could affect potential seawater intrusion and gradients to/from adjacent management areas.

Coastal Gradients

In the coastal portions of the NMMA, there was an offshore gradient in both spring and fall of 2009 in most areas of the NMMA. However, the offshore gradient only extends under the coastal dunes. East of the dunes, the gradient reverses to a landward gradient. In the coastal area near Black Lake, the coastal gradient is parallel to the coastline in the spring, but reverts to an offshore gradient in the fall. There is a transient groundwater divide under the dunes that is the result of the expanding groundwater pumping depression. If this condition continues, the transient divide will be eliminated and there will be a landward gradient from the coastal monitoring wells all the way to the inland groundwater depression. Just to the north of Oso Flaco Lake, the transient divide is largely missing in the fall, with groundwater elevations relatively flat from the coast to the edge of the pumping depression (i.e., along the 10-foot contour of Figure 6-6).

Gradients to/from Adjacent Management Areas

As discussed earlier in this section, the groundwater gradient between the NMMA and the Northern Cities Management Area consists of a saddle or divide in the groundwater elevations that separate the two management areas. The groundwater elevations along the divide are in the range of five to ten feet higher than adjacent areas. Thus, it appears that there is currently no flow to or from the Northern Cities Management Area. In the future, combined modeling efforts may be one effective tool to jointly manage this boundary

The northwest groundwater gradient along the southern boundary of the NMMA creates flow into the NMMA along much of the length of the Santa Maria River in that area (Figure 6-5, Figure 6-6). This northwest gradient is limited to the area between the river and the NMMA boundary – it does not extend into the Santa Maria Valley on the south side of the river. Thus, the groundwater elevation beneath the river forms an effective boundary where groundwater flows toward the NMMA north of the river and into the main Santa Maria basin south of the river. This pattern of gradients suggests that the Santa Maria River is a source of supply to both management areas. If the Deep Aquifer is considered to be confined in the area between the river and the NMMA boundary, then recharge from the river to the aquifer must be largely occurring up-gradient in places where no confining conditions exist.

6.2. *Groundwater Quality*

6.2.1. Constituents of Concern to Beneficial Uses

Water quality is a concern for all groundwater producers, although the specific concerns vary by water use. Water quality is somewhat different in different portions of the NMMA because:

- the source of recharge varies for different portions of the aquifer system,
- groundwater can develop different mineral signatures from the rock it flows through, and
- percolation of surface water mobilize constituents of concern and carry these to aquifers.

In the Nipomo Mesa Management Area, there is no evidence that water quality issues significantly restrict current use of groundwater to meet water demands. Specific water quality constituents are discussed below.

Chloride: The primary concern for both drinking water and irrigation use is potential high chloride concentrations from seawater. Depending upon the crop, chloride concentrations well below the drinking water standard of 500 mg/L can cause leaf burn and plant stunting, with plant death occurring at higher concentrations. Elevated chloride concentrations can also occur in groundwater from the recharge by return flows of water applied to overlying land uses, tidal waters, and shallow lakes, especially in unconfined aquifers.

The irrigation ditches and dune lakes within the NMMA generally have somewhat elevated concentrations of chloride (range of 120 to 680 mg/L; DWR, 1970). Shallow water within the NMMA ranges in chloride concentration from approximately 30 to 580 mg/L, with chloride generally higher towards the coast. Deeper water has the best water quality, with chloride concentrations ranging from approximately 30 to 80 mg/L (DWR, 1970).

In 2009, chloride concentrations were largely unchanged from the previous year, with 100 mg/l chloride or less for all groundwater samples obtained from the Deep Aquifer in the NMMA.

Total Dissolved Solids (TDS): The trend in TDS is very much like that for chloride. Concentrations of TDS in irrigation ditches and dune lakes range from 540 to 2,400 mg/L (DWR, 1970). Historically, shallow water contained TDS concentrations as high as approximately 1,500 mg/L, with concentrations generally higher towards the coast. The underlying Paso Robles and older aquifers range in historical TDS concentrations from 200 to 2,400 mg/L.

In 2009, TDS concentrations were also similar to 2008 results, with most all Deep Aquifer production wells below 800 mg/l, except for two with approximately 1,000 mg/l concentrations in the south-central portion of the NMMA (see section 4.1.2).

Nitrate: Elevated nitrate concentrations in groundwater can be a natural phenomenon, but is generally caused in groundwater from the recharge by return flows of water applied to fertilized areas or septic/waste water plant discharges. Nitrate is largely a drinking water concern, with a primary drinking water standard of 45 mg/L (nitrate as NO_3, which is used throughout this report).

Natural flows in surface waters within and adjacent to the NMMA are generally low in nitrate (<10 mg/L), although irrigation ditches may contain nitrate in excess of the drinking water standard (up to 88 mg/L tested by DWR during 1961-1967). Return flows from water applied to overlying land uses and nitrate concentrations are quite variable, ranging from near the detection level to as high as 200 mg/L. Because shallow groundwater is used for some domestic well production, the locally high concentrations of nitrate make it a problematic source of safe drinking water in some areas.

Nitrate loading from overlying land uses is the primary cause of nitrate impacts to groundwater. The Paso Robles and underlying aquifers generally have concentrations of nitrate below the drinking water standard but have significant concentrations up to approximately 30 mg/l throughout a wide portion of the NMMA. Groundwater with nitrate concentrations as high as 160 mg/L have historically occurred where the Paso Robles aquifer exists near-ground surface (DWR, 1970).

In 2009, the highest Deep Aquifer nitrate concentration recorded was below 39 mg/l. This value is below the 45 mg/l MCL, but there are wells in the NMMA with persistently high, and in some cases rising nitrate concentrations over the last several years.

6.2.2. Results of Coastal Water Quality Monitoring

Quarterly coastal water quality monitoring within the NMMA boundary is currently limited to a single group of monitoring intervals at well 11N/36W-12C1, 2, 3 (Figure 6-7). Limited historical water quality data are also available for coastal monitoring wells to the north and south of this (11N/36W-13K not reported, and 12N/36W-36L see Figure 6-4).

Most chloride concentrations in the coastal wells are between 40 and 60 mg/L, and do not show evidence of significant change over time. Two monitoring intervals that include the uppermost strata (up to -20' elevation) have historical chloride concentrations between 80 and 180 mg/L. Measurements of related constituents such as TDS, EC and major ions are consistent with the chloride values and trends.

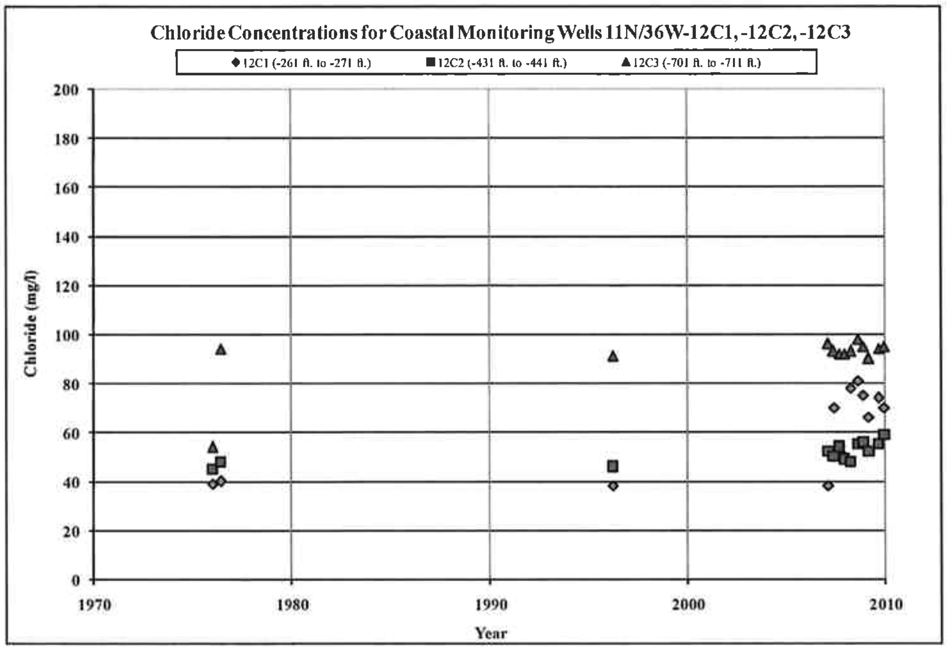

Figure 6-7. Chloride in Coastal Well 11N/36W-12C.

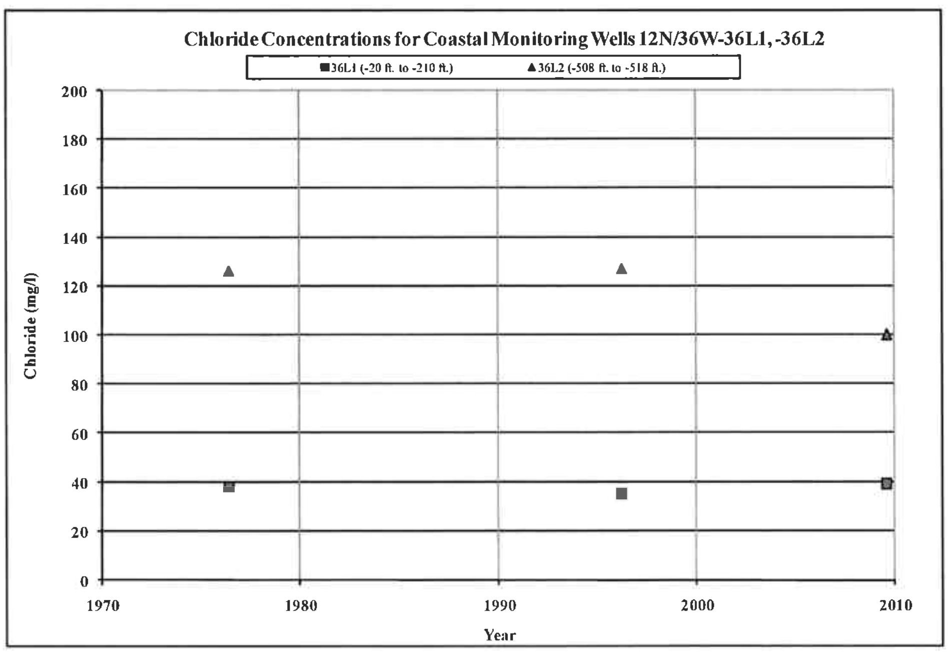

Figure 6-8. Chloride in Coastal Well 12N/36W-36L.

6.2.3. Results of Inland Water Quality Monitoring

Water quality from inland wells is more variable, both between wells (with similar groundwater elevations) and over time within a single well. Neither chloride nor total dissolved solids concentrations display large temporal changes in hydrographs (see Appendix C: Additional Data and Maps, Water Quality Figures). Nitrate data do not indicate broad changes, but since 1993 there was one detection within the NMMA and several within the Northern Cities management Area of nitrate concentrations above the drinking water standard of 45 mg/L in localized areas (see Appendix C: Additional Data and Maps).

Chloride: In the easternmost portion of the NMMA, groundwater from a single well 11N/34E-34 has tested as high as 280 mg/L chloride during the last 15 years; this concentration is above the secondary water quality standard of 250 mg/L and above the concentration suitable for many salt-sensitive crops, but is well below the drinking water standard of 500 mg/L and has decreased substantially from 2002 to 2006. All other parts of the NMMA have exhibited chloride concentrations of 150 mg/L or less (see Section Appendix C: Additional Data and Maps, Water Quality Figure A).

Total Dissolved Solids: Since 1993, TDS has been less than 1,100 mg/L for all wells tested within the NMMA (see Section Appendix C: Additional Data and Maps, Water Quality Figure B).

Nitrate: For the period 1993-2009, two wells in the NMMA have tested for nitrate in excess of the 45 mg/L drinking water standard (see Section Appendix C: Additional Data and Maps, Water Quality Figure C). Both wells were below the drinking water standard for the most recent water quality analyses but have exhibited spikes in concentrations typical of wells affected by nitrates.

In the northwestern portion of the NMMA (see Section Appendix C: Additional Data and Maps, Water Quality Figure C), the high nitrate well had several analyses of nitrate concentrations above the drinking water standard from 1998 to 2007. Besides this well, other wells in the area have nitrate concentrations between 25 and 45 mg/L.

The other high-nitrate well, located in the eastern portion of the NMMA, exceeded the drinking water standard in one analysis. In addition, another well nearby has experienced a two-decade upward trend in nitrate concentration from 1 to 34 mg/L. This well is approximately 1.5 miles west of the Southland WWTF percolation ponds (Figure 3 7), where shallow groundwater chemistry is now dominated by effluent from the Southland WWTF percolation ponds (Fugro, 2007). However, other surrounding wells show stable or declining concentrations of NO_3.

7. Analyses of Water Conditions

Current groundwater conditions, water shortage conditions, and long-term trends are presented in the following sections, with emphasis on the primary areas of concern.

7.1. *Analyses of Current Conditions*

7.1.1. Groundwater Conditions

The primary areas of concern in evaluating the conditions of groundwater within the NMMA are: 1) groundwater elevations and water chemistry of coastal monitoring wells, 2) the coastal groundwater gradient, 3) the overall groundwater elevations within the NMMA as measured by the Key Wells Index, and 4) the extent of the pumping depression.

Coastal Monitoring Wells – Both groundwater elevations and chloride concentrations in the coastal well cluster within the NMMA have been stable for some years and are not a concern. However, groundwater elevations in the coastal well cluster 36L have declined the last decade (Figure 6-4).

Coastal Groundwater Gradient – As discussed in Section 6.1.5, there is currently a westward component of flow toward the ocean beneath the coastal dunes, separated from the inland groundwater depression by a transient groundwater divide. If the inland groundwater depression continues to expand, a landward gradient from the coastal monitoring wells to the inland groundwater depression may develop. In spring 2009, the coastal gradient near Black Lake was parallel to the coastline (rather than towards the offshore), although an offshore gradient was evident in fall 2009.

Along the coast, coastal monitoring well groundwater elevations decline from the south to the north. This suggests that there is a northward component of flow along the coast.

Key Wells – The Key Wells, as represented by the Key Wells Index, indicate trends in groundwater elevations within inland areas of the NMMA. Over the period 1975 to 2009, the Key Wells Index has tracked rainfall cumulative departure trends fairly closely (Figure 7-1). This correlation suggests that rainfall affects groundwater elevations by recharging the aquifer and by reductions in groundwater pumping. As well, the converse is suggested, that drier conditions induce greater demand for groundwater production.

The downward trend in the Key Wells Index from 2007 through 2009 is expected following three drier than average years. In 2009 the Index was below the threshold criterion for Potentially Severe conditions (see Section 7.2.2 Inland Criteria).

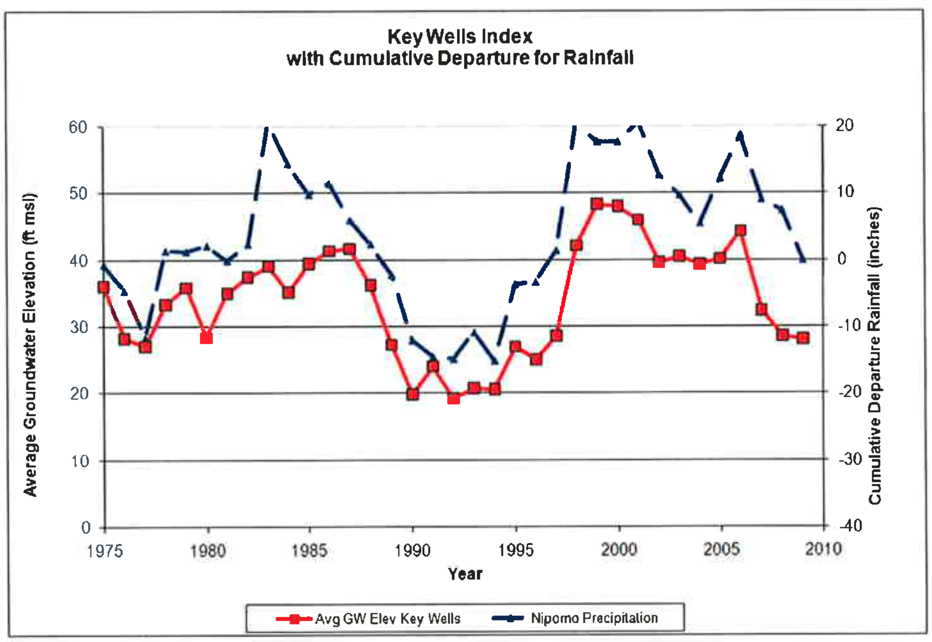

Figure 7-1. Key Wells Index with cumulative departure for rainfall (using average rainfall from the combination of gauges at Nipomo CDF #151.1 and Mehlschau #38).

Pumping Depression – The groundwater depression within the inland portion of the NMMA was evident in both spring and fall 2009 groundwater elevation contours (Figure 6-5, Figure 6-6). This depression creates a transient groundwater divide between both coastal areas and the Northern Cities Management Area. If this groundwater depression widens to the west or lengthens to the north, the groundwater divide may be breached, allowing groundwater flow from coastal areas to the groundwater depression. This potential reversal of groundwater gradients could create conditions for seawater intrusion. Thus, the TG will carefully research it for future reports in cooperation with the Northern Cities TG

The other effect of the groundwater depression could be compaction and dewatering of fine-grained sediments within and adjacent to the aquifers of the NMMA, with subsequent land subsidence. There is currently no evidence of land subsidence within the NMMA, although small amounts of subsidence might go undetected. During dewatering and compaction, it is typically the finer grained sediments that are most impacted rather than the main water-producing horizons.

7.1.2. Water Supply and Demand

Although the hydrologic inventory cannot currently be used directly to calculate the potential imbalance in supply and demand, there are a number of direct measurements that indicate that demand exceeds the ability of the supply to replace this water pumped from the aquifers. These indicators include: 1) continuing deepening of the pumping depression in the NMMA, a potion of which is below sea level; 2) declining groundwater elevations as indicated by the Key Well Index and groundwater contours; 3) a limited component of seaward flow at the coast; 4) a flattening of the groundwater ridge between coastal and inland wells that protects inland areas from potential seawater intrusion; and 5) a threat on the north by the occurrence of seawater intrusion in the Deep Aquifer there.

7.2. *Water Shortage Conditions*

The Stipulation requires the determination of the water shortage condition as part of the Annual Report. Water shortage conditions are characterized by criteria designed to reflect that groundwater levels beneath the NMMA as a whole are at a point at which a response would be triggered to avoid further declines in groundwater levels (Potentially Severe), and to declare that the lowest historic groundwater levels beneath the NMMA as a whole have been reached or that conditions constituting seawater intrusion have been reached (Severe). Potentially Severe Water Shortage Conditions exist in 2009.

Potentially Severe Water Shortage Conditions

The Stipulation, page 25, defines Potentially Severe Water Conditions as follows:

Caution trigger point (Potentially Severe Water Shortage Conditions)

(a) Characteristics. The NMMA Technical Group shall develop criteria for declaring the existence of Potentially Severe Water Shortage Conditions. These criteria shall be approved by the Court and entered as a modification to this Stipulation or the judgment to be entered based upon this Stipulation. Such criteria shall be designed to reflect that water levels beneath the NMMA as a whole are at a point at which voluntary conservation measures, augmentation of supply, or other steps may be desirable or necessary to avoid further declines in water levels.

Severe Water Shortage Conditions

The Stipulation, page 25, defines Severe Water Conditions as follows:

Mandatory action trigger point (Severe Water Shortage Conditions)

(a) Characteristics. The NMMA Technical Group shall develop the criteria for declaring that the lowest historic water levels beneath the NMMA as a whole have been reached or that conditions constituting seawater intrusion have been reached. These criteria shall be approved by the Court and entered as a modification to this Stipulation or the judgment to be entered based upon this Stipulation.

7.2.1. Coastal Criteria

All coastal groundwater elevation and water quality criteria for Water Shortage Conditions are at acceptable levels (Table 7-1). However, coastal well 36L2 (Figure 7-2), perforated between 535 feet and 545 feet below ground surface, had a fall 2009 groundwater elevation of 6.3 feet mean sea level ("ft msl"). It is the spring 2009 measurement on which the Water Shortage Conditions are based; the spring 2009 measurement was 14.3 ft msl, above the Potentially Severe criterion of 9 ft msl. The fall groundwater elevations in the 36L2 well were previously below 9 ft msl during the droughts of the late 1970s and the early 1990s.

Table 7-1: Criteria for Potentially Severe Water Shortage Conditions

Well	Perforations Elevations (ft msl)	Aquifer	Spring 2009 Elevations (ft msl)	Elevation Criteria (ft msl)	2009 Highest Chloride (mg/L	Chloride Concentration Criteria (mg/L)
11N/36W-12C1	-261 to -271	Paso Robles	9.3	**5.0**	74	**250**
11N/36W-12C2	-431 to -441	Pismo	23.6	**5.5**	59	**250**
11N/36W-12C3	-701 to -711	Pismo	24.1	**9.0**	95	**250**
12N/36W-36L1	-200 to -210	Paso Robles	8.15	**3.5**	39	**250**
12N/36W-36L2	-508 to -518	Pismo	13.65	**9.0**	100	**250**

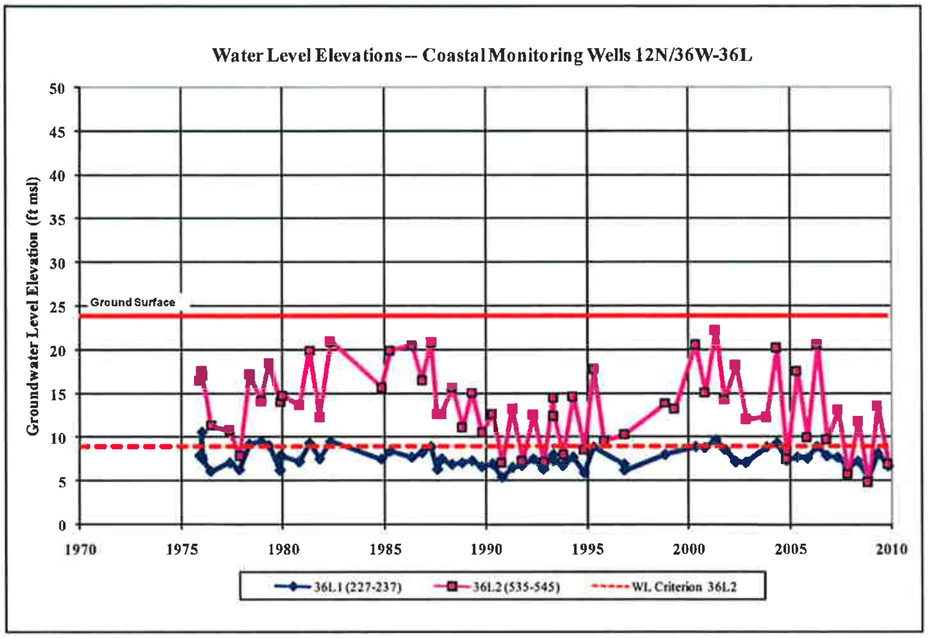

Figure 7-2. Coastal monitoring well cluster 36L with criterion for Potentially Severe Water Shortage Conditions for well 36L2 indicated by dashed line.

7.2.2. Inland Criteria

The inland criteria for Water Shortage Conditions use the Key Wells Index as a basis. The spring 2009 Key Well Index was 28.1 ft msl, at a lower elevation than the criterion for Potentially Severe Water Shortage Conditions of 31.5 ft msl, and fractionally less than the key well index for 2008 (Figure 7-3).

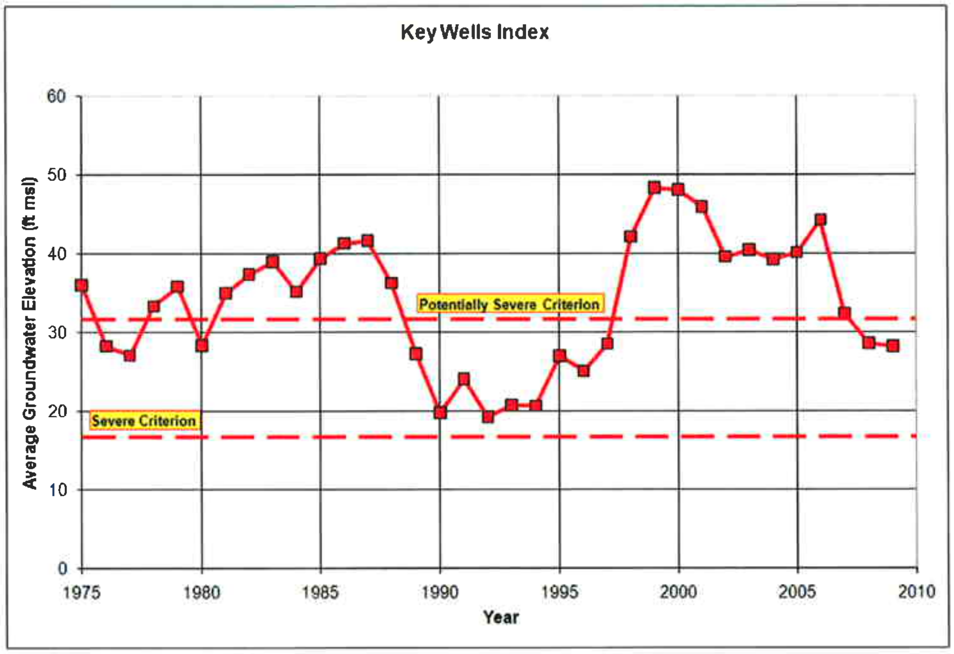

Figure 7-3. Key Wells Index. *The upper dashed line is the criterion for Potentially Severe Water Shortage Conditions and the lower dashed line is the criterion for Severe Conditions.*

7.2.3. Status of Water Shortage Conditions

The Key Wells Index went below the elevation criterion for Potentially Severe Water Shortage Conditions with the Spring 2008 water level measurements, and has remained so in 2009. Exiting the Potentially Severe Water Shortage Conditions requires two consecutive years where the Key Well Index is above the level of Potentially Severe Water Shortage Condition.

The responses required by the Stipulation are set forth as follows:

VI(D)(1b) Responses [Potentially Severe]. *If the NMMA Technical Group determines that Potentially Severe Water Shortage Conditions have been reached, the Stipulating Parties shall coordinate their efforts to implement voluntary conservation measures, adopt programs to increase the supply of Nipomo Supplemental Water if available, use within the NMMA other sources of Developed Water or New Developed Water, or implement other measures to reduce Groundwater use.*

VI(A)(5). ...In the event that Potentially Severe Water Shortage Conditions or Severe Water Shortage Conditions are triggered as referenced in Paragraph VI(D) before Nipomo Supplemental Water is used in the NMMA, NCSD, [GSWC], Woodlands and RWC agree to develop a well management plan that is acceptable to the NMMA Technical Group, and which may include such steps as imposing conservation measures, seeking sources of supplemental water to serve new customers, and declaring or obtaining approval to declare a moratorium on the granting of further intent to serve or will serve letters.

Nipomo Mesa groundwater management options to address water shortage conditions include responses required under the Stipulation as well as other possible groundwater management actions to address a range of resource concerns associated with the current

Potentially Severe Water Shortage Condition. TG concerns directly relating to groundwater conditions include:

- Depressed groundwater elevations, both as measured by the key wells and in specific portions of the management area;
- Very limited offshore gradient for a large area of the coastal and central portions of the NMMA;
- Very limited gradient separating the management area with the coastal area of seawater intrusion to the north.

Potential actions to address the above concerns include a range of projects and activities already in place, in progress, or contemplated for future consideration. Many of these possibilities have been reviewed previously in water supply evaluations (SAIC, 2006; Kennedy-Jenks, 2001; Bookman-Edmonston, 1994).

Existing Actions in the NMMA reviewed by the TG include

- Adoption in 2009 of a purveyor Well Management Plan, which includes conservation, public outreach, and facilities upgrades to allow greater distribution of pumping stresses away from areas of concern (see section 1.1.6)
- Continued progress in 2009 on a supplemental water project (see section 1.1.7)

Potential actions to be reviewed by the TG include

- Increased development of reclaimed water for certain NMMA water supply needs in lieu of pumping from the Deep Aquifer

Different management options have different potential capacity to reduce demand or increase supply, and each has its own technical considerations. By way of example and assuming regulatory agency approval and the establishment of an appropriate cost benefit that meets the requirements of Prop 218 or the PUC, wastewater effluent that is not already reclaimed may be discharged in locations where wastewater effluent would have a beneficial effect on the deep aquifer and in areas closer to the coast.

Areas of special concern with regard to potential shortage conditions have special significance if they experience beneficial results from projects to manage groundwater demands and overall supply. For example, the coastal portion of the NMMA has a limited component of seaward flow, and is threatened on the north by the occurrence of seawater intrusion in the Deep Aquifer there. Actions that maintain a healthy oceanward component of flow protect the basin from potential seawater intrusion. Similarly, the pumping depression in the central portion of the NMMA has transient groundwater levels below sea level and is a pronounced feature of the main producing aquifer in the NMMA (see Figures 6-5 and 6-6). Allowing water levels to rebound in this area would also help to maintain protective groundwater gradients.

7.3. ***Long-term Trends***

7.3.1. Climatological Trends

Climatological trends have been identified through the use of cumulative departure from mean analyses. A cumulative departure from the mean represents the accumulation, since the beginning of the period of record, of the differences (departures) in annual total rainfall volume from the mean value for the period of record. Each year's departure is added to or subtracted from the previous year' cumulative total, depending on whether that year's departure was above or below the mean annual rainfall depth. When the slope of the cumulative departure from the mean is negative (i.e. downward), the sequence of years is drier than the mean, and conversely when the slope of the cumulative departure from the mean is positive (i.e. upward), the sequence of years is wetter than the mean. The cumulative departures from the mean were computed for the rainfall station Mehlschau (38), the longest rainfall record for the NMMA (Figure 7-4).

Historical rainfall records for the Nipomo Mesa begin in 1920 (Figure 7-4). There are three significant long-term dry periods in the record, from 1921 to 1934, from 1944 to 1951, and from 1984 to 1991. Long-term dry periods have occurred in the last 90 years that are longer in duration than the 1987 to 1992 drought (Figure 7-4). Between each large dry period, three wetting periods have occurred. These wetting periods are from 1935 to 1943, from 1977 to 1983, and from 1994 to 2001.

The period of analyses (1975-2009) used by the TG is roughly 11 percent "wetter" on average than the long-term record (1920-2009) indicating a slight bias toward overestimating the amount of local water supply resulting from percolation of rainfall. The past three years (Water Years 2007, 2008, and 2009) have had less than average rainfall. Water year 2007 was approximately 45 percent to 50 percent of average rain fall, Water Year 2008 was approximately 94 percent to 97 percent of average rain fall, and Water Year 2009 was approximately 67 percent to 73 percent of average rain fall For Water Year 2010, (Table 3-1), rainfall through March 2010 for the Nipomo Mesa area is approximately 101 percent to 127 percent of average.

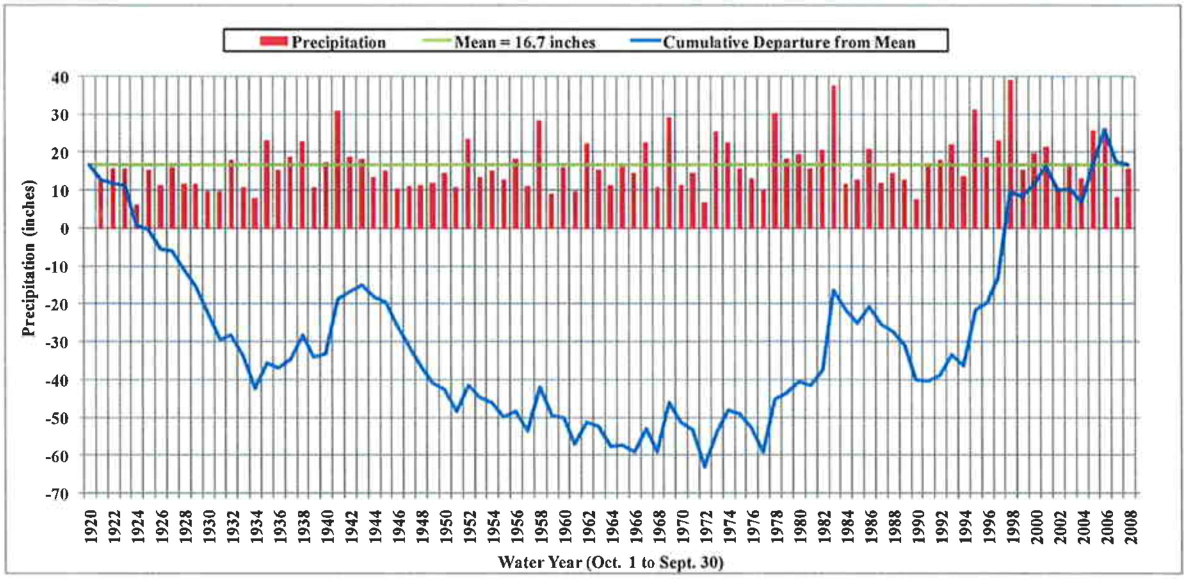

Figure 7-4. Rainfall: Cumulative Departure from the Mean – Rainfall Gauge Mehlschau (38)

7.3.2. Land Use Trends

The DWR periodically has performed land use surveys of the South Central Coast, which includes the NMMA, in 1958, 1969, 1977, 1985, and 1996. A land use survey for only the NMMA was performed in 2007 based on 2007 aerial photography (see Section 3.1.8). Based on these surveys, land use in the NMMA has changed dramatically over the past half-century (Table 7-2, Figure 7-5, Figure 7-6). Urban development has replaced native vegetation at an increasing rate, especially over the past 10 years. Agriculture land use has remained relatively constant (see Section 3.1.8 Land Use).

Table 7-2. NMMA Land Use – 1959 to 2007 (Values in acres)

	1959	1968	1977	1985	1996	2007
Agricultural	1,600	2,000	2,000	2,200	2,000	2,600
Urban	300	700	2,200	3,300	5,800	10,200
Native	19,200	18,400	16,900	15,600	13,300	8,300
Total	21,100	21,100	21,100	21,100	21,100	21,100

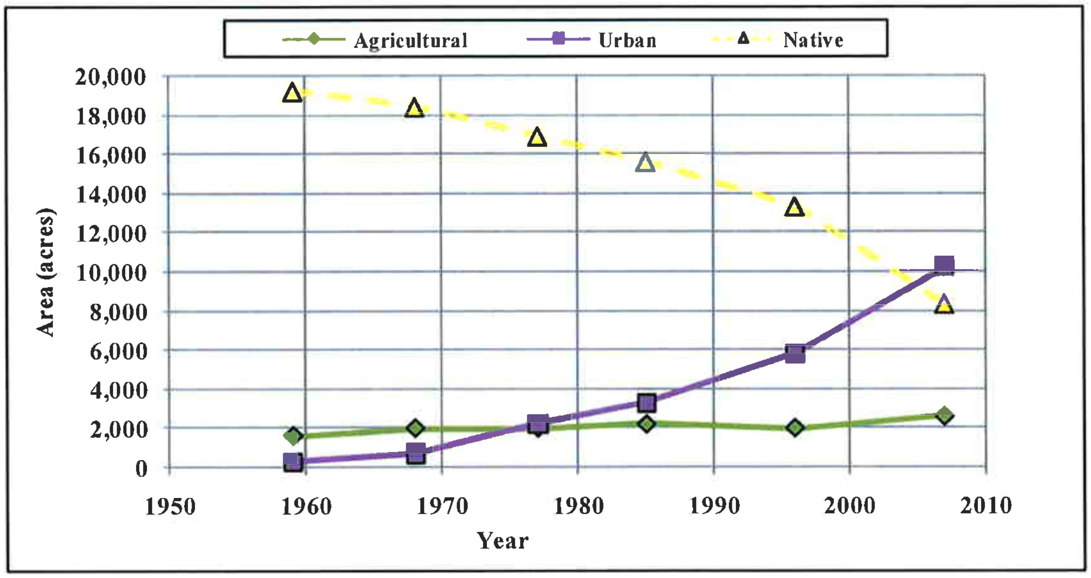

Figure 7-5. NMMA Land Use – 1959 to 2007

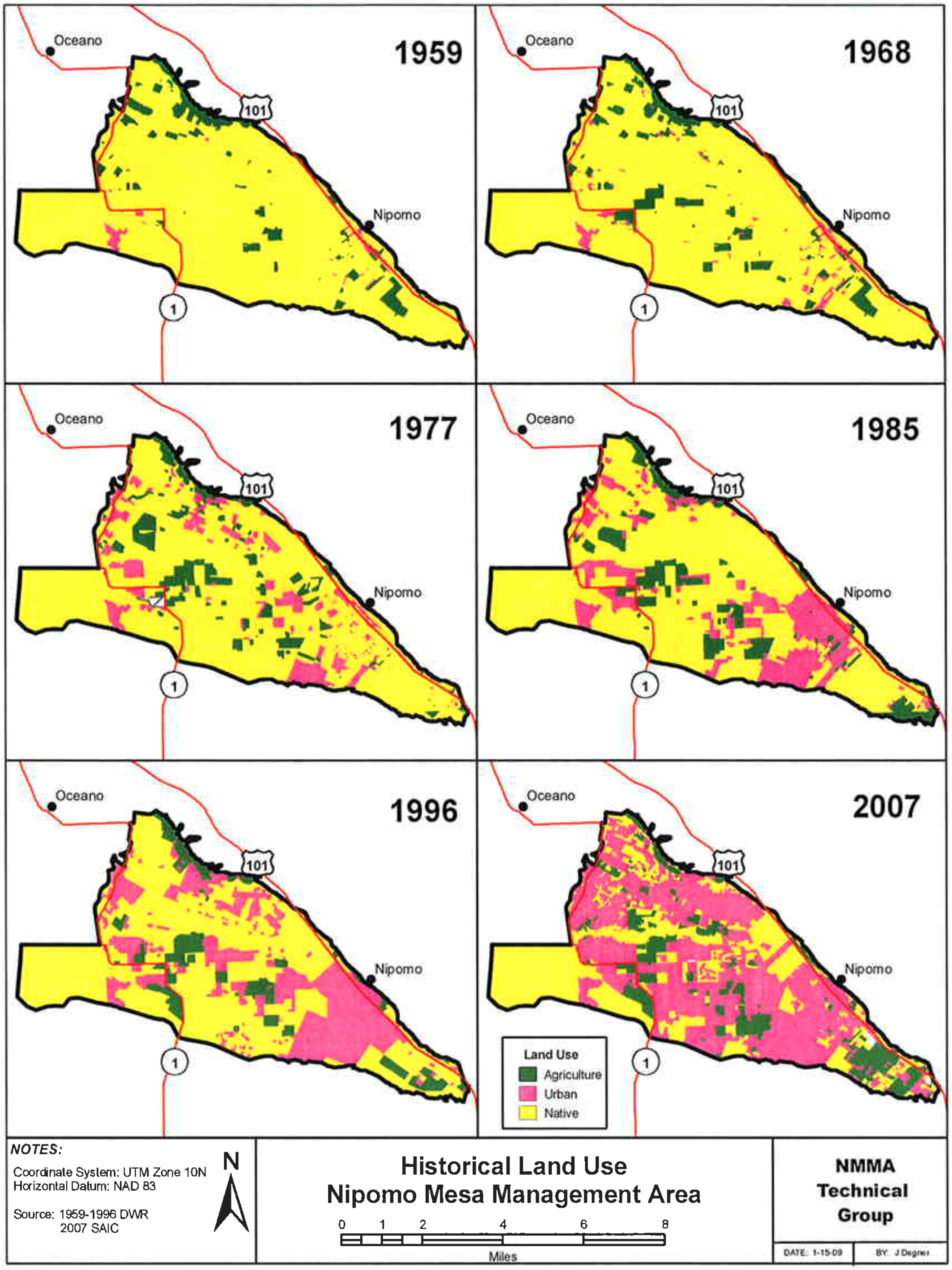

Figure 7-6. Historical Land Use in the NMMA

7.3.3. Water Use and Trends in Basin Inflow and Outflow

The estimated groundwater production is 12,200 AF for calendar year 2009; nearly three times the groundwater production in 1975 (see Figure 4-1). The estimated consumptive use of water for urban, agriculture and golf courses, and industrial is currently being analyzed by the TG, with a projected completion milestone in 2010 as indicated in Section 9. A documented estimate of the rainfall in excess of evapotransipration and soil storage is also scheduled for completion in 2010. Contours of groundwater elevations in this report (see Section 6.1.5) suggest that there is likely inflow from the Santa Maria Valley, outflow at the coast (required to prevent seawater intrusion), and something approaching no subsurface flow into or out of the Northern Cities MA. The net subsurface flow to the NMMA is therefore likely to be positive. The nature and extent of the confining layer(s) beneath the NMMA and the extent that faults in the NMMA may act as barriers to subsurface flow are not well understood (see Section 2.3.3 Confining Layers). Therefore, the TG has not yet quantified the amount of subsurface water flowing across the NMMA boundaries in specific aquifers or strata.

8. Other Considerations

8.1. *Institutional or Regulatory Challenges to Water Supply*

Several types of entities and individual landowners extract water from aquifers underlying the NMMA to meet water demands and no single entity is responsible for the delivery and management of available water supplies. Each entity must act in accordance with the powers and authorities granted under California law.

The powers and authorities the Woodlands Mutual Water Company and Nipomo Community Services District are set forth in the California Water Code. The CPUC regulates Golden State Water Company's and Rural Water Company. This diversity of the public water purveyor's powers and the locations of their respective service areas (Figure 1-1) must be taken into account in attempting to develop consistent water management strategies that can be coupled with enforceable measures to ensure timely compliance with recommendations made by the TG, or mandatory Court orders. This is particularly true when there are legal requirements relating to the timing of instigating changes in water rates, implementation of mandatory water conservation practices or forcing a change in pumping patterns which may require one entity to deliver water to a location outside its service area.

A cooperative effort among the purveyors and other parties is the only expedient means to meet these institutional and regulatory challenges relating to the water supply and overall management of the NMMA. The purveyors developed a Well Management Plan in 2009 which outlines steps to take in "potentially severe water shortage conditions" as well as in "severe water shortage conditions"[7]. The WMP identifies a list of recommended water use restrictions to limit prohibited, nonessential and unauthorized water uses. For each condition, the WMP also identifies both voluntary and mandatory actions such as conservation goals, shifts in pumping patterns, and potential additional use and pumping restrictions. NCSD is developing the engineering design of the Waterline Intertie Project which will provide for the delivery of Supplemental Water within the NMMA.

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[7] See Appendix B- "NMMA Water Shortage Conditions and Response Plan" which defines these conditions.

8.2. *Threats to Groundwater Supply*

The 2009 Annual Report prepared by the NCMA addresses the evidence for seawater intrusion that was gathered in 2009. Within the NMMA, there are currently no known threats to groundwater, other than the Potentially Severe Water Shortage Conditions discussed elsewhere in this report. The unconfined Shallow Aquifer is potentially threatened locally by contaminants from overlying land uses. Sources of contamination from point sources (leaking tanks, spills, etc.) were identified using the State Water Resources Control Board's GeoTracker online program. The Central Coast Regional Water Quality Control Board is responsible for overseeing the remediation and monitoring at these sites. Active sites within the NMMA include:

Table 8-1. State Water Resources Control Board GeoTracker Active Sites

Site Name	Address	Notes
Chevron Station 9-5867	460 West Tefft St	Leaking underground tank site. In 1998, a release of gasoline was discovered impacting soil. Current status – remediation and monitoring;
Gibbs Int'l Truck Center	375 N. Frontage Road	Leaking underground tank site. In 2006, a hydrocarbon release was discovered. Impacted media not reported. Current status – verification monitoring.
Nipomo Creek Pipeline	671 Oakglen Ave	Leak discovery in 2003 of Conoco's (Union Oil at time of release) crude oil pipeline. Heavy chain hydrocarbon impacts to soil. Current status – ongoing groundwater monitoring and evaluation of a corrective action plan.
Conoco Phillips Refinery, Santa Maria Facility	2555 Willow Rd	Case opened in 1999 to investigate soil and groundwater impacts from a Coke pile area. Hydrocarbon impacts to shallow groundwater. Current Status – remediation and groundwater monitoring activities.
Source: http://geotracker.swrcb.ca.gov		

9. Recommendations

A list of recommendations were developed and published in the 2008 NMMA Annual Report. The TG will address past and newly developed recommendations along with the implementation schedule based on future budgets, feasibility, and priority. The recommendations are subdivided into four categories: (1) Draft capital and operation expenditure plan, (2) Achievements from the 2008 NMMA annual report recommendations; and (3) Technical Recommendations – to address the needs of the TG for data collection and compilation.

9.1. *Funding of Capital and Operating Expenditure Program*

A six year capital and operating expenditure program has been prepared by the TG as summarized in Table 9-1 below. The yearly budget totals in this proposed plan currently exceeds the $75,000 per year funding cap outlined in the stipulation.

Table 9-1. NMMA 6-Year Cost Analysis

Task Description	Total Cost	Targeted Completion Year	Projected 6-year Cash Flow					
			2010	2011	2012	2013	2014	2015
Yearly Tasks								
Annual report preparation			$50,000	$50,000	$50,000	$50,000	$50,000	$50,000
Grant funding efforts			$10,000	$10,000	$10,000	$10,000	$10,000	$10,000
Confining layer definition			$10,000	$10,000	$10,000	$10,000	$10,000	$10,000
Well head surveying			$3,000	$3,000	$3,000	$3,000	$3,000	$3,000
Analytical testing			$5,000	$5,000	$5,000	$5,000	$5,000	$5,000
Long Term Studies								
Groundwater model (NMMA share)	$250,000	2015	--	$33,300	$33,300	$33,300	$75,000	$75,000
Capital Projects								
Oso Flaco monitoring well	$130,000	2013	--	$43,300	$43,300	$43,300	--	--
Automatic monitoring equipment	$25,000	2015	--	--	--	--	$12,500	$12,500
Total Projected Annual Cost			$78,000	$154,600	$154,600	$154,600	$165,500	$165,500

9.2. *Achievements from 2008 NMMA Annual Report Recommendations*

The TG worked diligently to address several of the recommendations outlined in the 2008 Annual Report. Major accomplishments and/or progress was accomplished during 2009 on the following:

- Evaluation of an Oso Flaco monitoring well cluster;
- Development of a Data Acquisition Protocols for Groundwater Level Measurements for the NMMA (Appendix D);
- Development of a purveyor Well Management Plan by the Purveyors and adopted by the TG (Appendix C);
- Evaluation of stream gauge placement;
- Evaluation of hydrological conditions – refinement of areal extent of the confined aquifer was undertaken (ongoing).

9.3. *Technical Recommendations*

The following technical recommendations are not organized in their order of priority because the monitoring parties, considering their own particular funding constraints and authorities, will determine the implementation strategies and priorities. However, the TG has suggested a priority for some of the technical recommendations.

- **Supplemental Water Supply** – An alternative water supply that would allow reduced pumping within the NMMA is likely to be the most effective method of reducing the stress on the aquifer and allow groundwater elevations to recover. The Nipomo Supplemental Water project (see

Section 1.1.7-Supplemental Water) is likely to be the fastest method of obtaining alternative water supplies. Given the Potentially Severe Water Shortage Conditions within the NMMA and the other risk factors discussed in this Report, the TG recommends that this project be implemented as soon as possible.

- **2010 Work Plan** - To advance important technical characterization of the NMMA groundwater resources, the TG has developed a work plan for two intermediate work products in 2010, including milestone dates as follows:

Table 9-2: 2010 Work Plan

Task Description	Milestone Date	Use of Work Product
1. Technical memo establishing methodology and quantifying volume of water percolating beyond the root zone.	August 13, 2010	Available for immediate use by TG members, and incorporated into 2010 Annual Report
2. Technical memo establishing methodology and quantifying consumptive water demand within the NMMA	September 17, 2010	Available for immediate use by TG members, and incorporated into 2010 Annual Report

- **Changes to Monitoring Points or Methods** – The coastal monitoring wells are of great importance in the Monitoring Program. The inability to locate the monitoring well cluster under the sand dunes proximally north of Oso Flaco Lake renders the southwestern coastal portion of the NMMA without adequate coastal monitoring. During 2009, the NMMA Technical Group reviewed options for replacing this lost groundwater monitoring site. The TG was given written support of the concept from the State Parks Department to allow replacement of the well, and the TG has also had discussions with San Luis Obispo County, which may be able to provide some financial assistance for the project. The NMMA Technical Group has incorporated replacement of this monitoring well in its long-term capital project planning and will investigate possible State or Federal grants for financial assistance with the construction of this multi-completion monitoring well.

- **Installation of Groundwater Monitoring Equipment** – When a groundwater level is measured in a well, both the length of time since the measured well is shut off and the effect of nearby pumping wells modify the static water level in the well being measured. For the Key Wells, the installation of transducers and data loggers will largely solve this problem. Installation of transducers is also recommended for purveyors' wells that pump much of the time.

- **Well Reference Point Elevations** – It is recommended that all the wells used for monitoring have an accurate RP established over time. This could be accomplished by surveying a few wells every year or by working with the other Management Areas and the two counties in the Santa Maria Basin to obtain LIDAR data for the region; the accuracy of the LIDAR method allows one-foot contours to be constructed and/or spot elevations to be determined to similar accuracy.

- **Groundwater Production** – Estimates of total groundwater production are based on a combination of measurements provided freely from some of the parties, and estimates based on land use. The TG recommends developing a method to collect groundwater production data from all stipulating parties. The TG recommends updating the land use classification on an interval commensurate with growth and as is practical with the intention that the interval is more frequent than DWR's 10 year cycle of land use classification.

- **Stream Flow Analysis** – For the 2009 Annual Report, stream flow measured at Arroyo Grande Creek and Los Berros Creek at County stream gages is presented. Because of the location of the stream gages as well as unique runoff characteristics of the Nipomo Mesa, the annual amount of surface runoff from the NMMA is difficult to estimate. The TG will determine whether stream flow and surface runoff volume is a significant component of the hydrologic inventory, determine the methodology to calculate it and present the estimates in the 2010 Annual Report.

- **CIMIS Station #202** – The TG will evaluate the Nipomo CIMIS station #202 to ensure better annual data quality.

- **Increased Collaboration with Agricultural Producers** – To better estimate agricultural groundwater production where data is incomplete, it is recommended that the TG work with a subset of farmers to measure groundwater production. This measured groundwater production can then be used to calibrate models and verify estimates of agricultural groundwater production where data are not available.

- **Hydrogeologic Characteristics of NMMA** - Further defining the continuity of confining conditions within the NMMA remains a topic of investigation by the TG. The locations of unconfined conditions is important – they control to a significant degree both the NMMA groundwater budget as to the quantity of recharge from overlying sources and any calculation of changes in groundwater storage.

- **Modifications of Water Shortage Conditions Criteria** - The Water Shortage Conditions and Response Plan was finalized in 2008. The TG will review the plan on a regular basis.

- **Groundwater Modeling** - The TG continues to recommend the advancement of a groundwater model as presented in the NMMA 6-yr Cost Analysis.

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Appendices

Appendix A: Monitoring Program

Nipomo Mesa Monitoring Program

Prepared by

Nipomo Mesa Management Area Technical Group

August 2008

Table of Contents

1 INTRODUCTION

1.1 Background

This Monitoring Program is a joint effort of the Nipomo Mesa Management Area ("NMMA") Technical Group ("Technical Group"). The Technical Group was formed pursuant to a requirement contained in the 2005 Stipulation ("Stipulation") for the Santa Maria Basin Adjudication. Sections IV D (All Management Areas) and Section VI (C) (Nipomo Mesa Management Area) contained in the Stipulation were independently adopted by the Court in the Judgment After Trial[1] (herein "Judgment"). The Monitoring Program is a key component of the portions of the Judgment that involve the NMMA and forms the basis for subsequent analyses of the basin to be included in Annual Reports for the NMMA.

This Monitoring Program includes a discussion of the various parameters to be monitored within the NMMA, and a discussion of data analysis methods and water shortage triggers. The Monitoring Program provides a permanent foundation for the type of information to be regularly monitored and collected. However, the Technical Group is expected periodically to evaluate and update the Monitoring Program to ensure it provides comprehensive information sufficient to assess the integrity of water resources within the NMMA. For example, the Technical Group may change or expand monitoring points or types of data to be collected and otherwise periodically amend the Monitoring Program. Material amendments will be submitted for court approval.

1.2 Judgment

As a component of the physical solution for the Santa Maria groundwater basin, the Judgment requires the development and implementation of comprehensive monitoring and reporting in each of three Management Areas in the basin – Northern Cities Management Area, Nipomo Mesa Management Area, and Santa Maria Valley Management Area (Figure 1). For each of these Management Areas the Judgment specifies:

"A Monitoring Program shall be established in each of the three Management Areas to collect and analyze data regarding water supply and demand conditions. Data collection and monitoring shall be sufficient to determine land and water uses in the Basin, sources of supply to meet those uses, groundwater conditions including groundwater levels and quality, the amount and dispositions of Developed Water supplies, and the amount and disposition of any sources of water supply in the Basin.

[1] The Judgment is dated January 25, 2008 and was entered and served on all parties on February 7, 2008. This Monitoring Program is to be submitted for court approval on or before August 6, 2008.

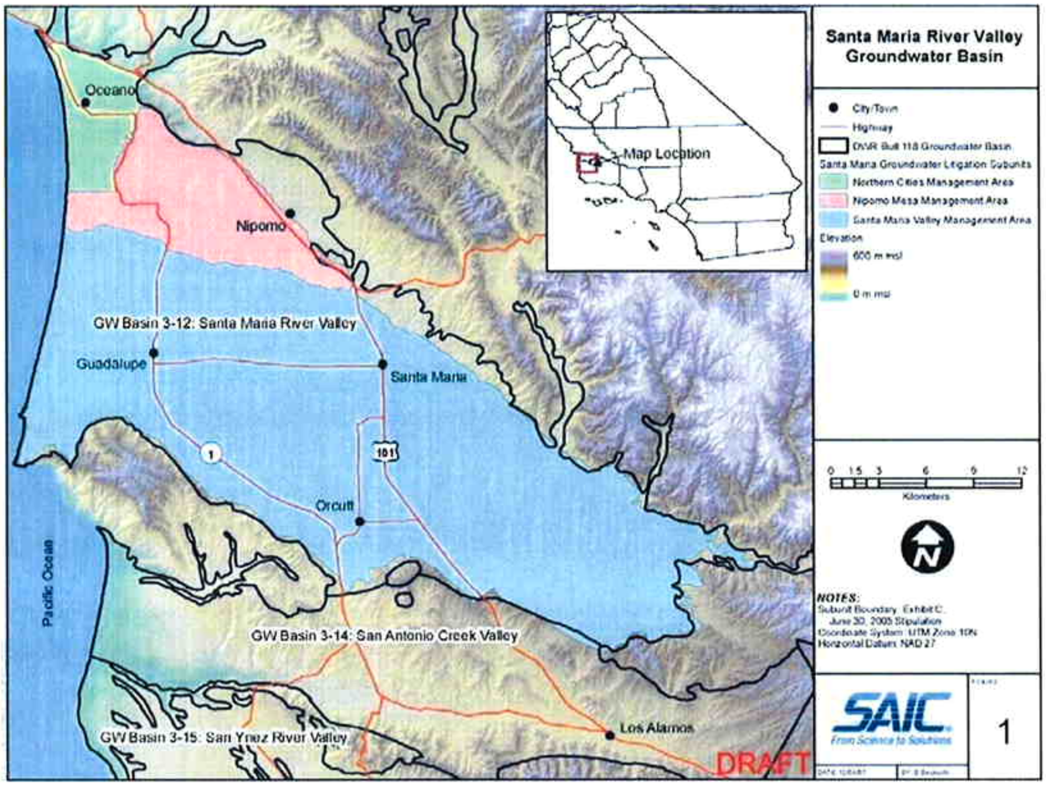

Figure 1. Santa Maria groundwater basin location map.

Within one hundred and eighty days after entry of judgment, representatives of the Monitoring Parties from each Management Area will present to the Court for its approval their proposed Monitoring Program."

The Judgment also requires the NMMA and the Santa Maria Valley management area technical committees to submit for court approval the criteria that trigger responses to "potentially severe and severe shortage conditions" that are specified in the Judgment.

An additional requirement of the Judgment is an Annual Report:

"Within one hundred and twenty days after each Year, the Management Area Engineers will file an Annual Report with the Court. The Annual Report will summarize the results of the Monitoring Program, changes in groundwater supplies, and any threats to Groundwater supplies. The Annual Report shall also include a tabulation of Management Area water use, including Imported Water availability and use, Return Flow entitlement and use, other Developed Water availability and use, and Groundwater use. Any Stipulating Party may object to the Monitoring Program, the reported results, or the Annual Report by motion."

Each Management Area Monitoring Plan will provide the basis for the preparation of the annual reports and the data to support the evaluations for the potentially severe and severe water shortage conditions relevant to the NMMA and the Santa Maria Valley management area.

1.3 Technical Group

The NMMA Technical Group is designated as the Monitoring Party for the NMMA.

Membership

The NMMA Technical Group is designated in the Judgment as including representatives appointed by Nipomo Community Services District, Southern California Water Company (now known as Golden State Water Company), ConocoPhillips, Woodlands Mutual Water Company, and an agricultural overlying owner who is also a Party to the Stipulation. The service areas of purveyors in the Technical Group are indicated in Figure 2.

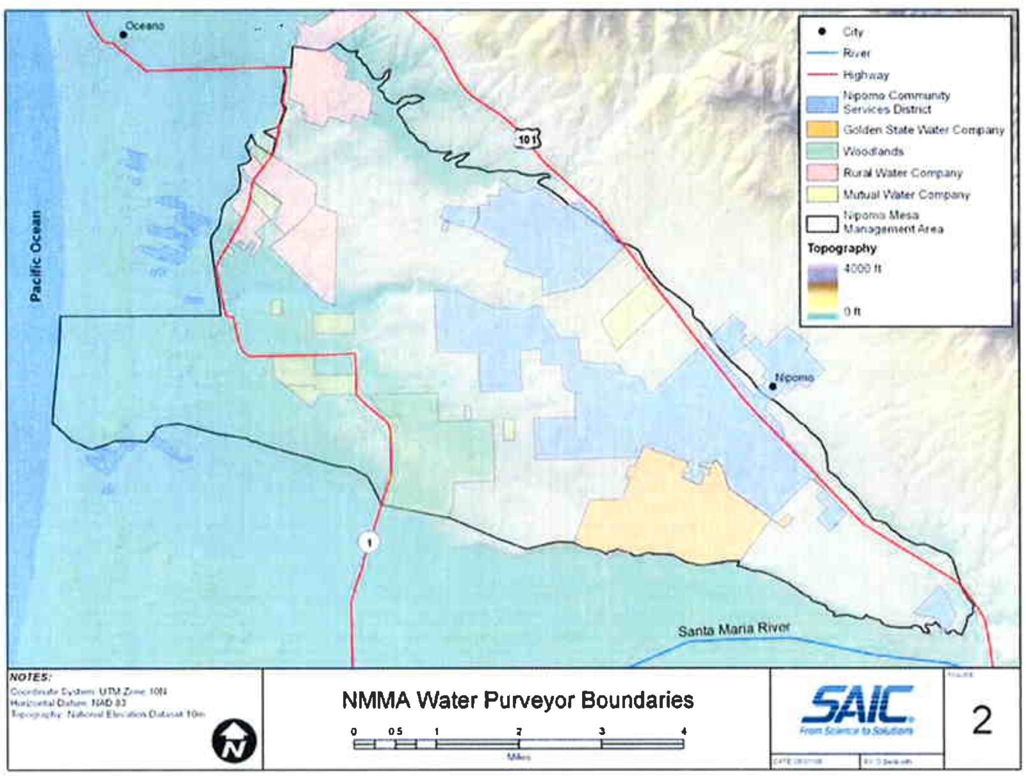

Figure 2. Water purveyors within the NMMA.

Role

The Technical Group is responsible for preparing the Monitoring Program, conducting the Monitoring Program, and preparing the Annual Reports. The Technical Group may hire individuals or consulting firms to assist in the preparation of the Monitoring Program and Annual Reports (the Judgment describes these individuals or consulting firms as the "Management Area Engineer"). The Technical Group has the sole discretion to select, retain, and replace the Management Area Engineer.

To assist the Technical Group in monitoring and analyzing water conditions in the NMMA, Stipulating Parties are required to provide monitoring and other production data at no charge, to the extent that such data have been generated and are readily available. The Technical Group is required to adopt rules and regulations concerning measuring devices that are consistent with the Monitoring Programs of other Management Areas when feasible.

If the Technical Group is unable to agree on any aspect of the Monitoring Program, the matter may be taken to the Court for resolution.

Cost Sharing

The Technical Group functions are to be funded by contribution levels negotiated by Nipomo Community Services District, Golden State Water Company, Rural Water Company, ConocoPhillips, and Woodlands Mutual Water Company. In-lieu contributions through engineering services may be provided, subject to agreement by those parties. The budget of the Technical Group shall not exceed $75,000 per year without prior approval of the Court.

1.4 Objectives Of Monitoring Program

The objectives of the Monitoring Program are to establish appropriate data collection criteria and analytical techniques to be used within the NMMA so that groundwater conditions, changes in groundwater supplies, threats to groundwater supplies, water use, and sources of water can be documented and reported on an annual basis. In addition, data developed through the Monitoring Program will be relied upon to provide the criteria for potentially severe and severe water shortage conditions.

1.5 Reporting Requirements

The Monitoring Program shall be presented for Court approval consistent with the Judgment. The Annual Report shall be submitted to the Court by April 30 of each year (April 29 on leap years).

2 MONITORING PARAMETERS

To satisfy the objectives of the Monitoring Program (section 1.4), data need to be collected from a variety of sources. The data to be collected include:

- Groundwater elevations measured in wells
- Water quality measured in wells
- Precipitation
- Streamflow
- Surface water usage
- Surface water quality
- Land use to the extent differential uses impact the NMMA water budget
- Groundwater pumping (measured)
- Groundwater pumping (estimated)
- Wastewater discharge and reuse amounts and locations

2.1 Groundwater Elevations

The San Luis Obispo County Department of Public Works, the U.S. Geological Survey, the California Department of Water Resources, and some groundwater users within the NMMA periodically gather groundwater elevation data on a large number of wells within the NMMA. Various members of the NMMA Technical Group already maintain these data in digital databases.

Current monitoring of groundwater elevations is conducted primarily by the County of San Luis Obispo, and additionally by Nipomo Community Services District, ConocoPhillips, Woodlands, Golden State Water Company, and Rural Water Company. The Monitoring Program will include compilation of groundwater elevations for a large number (93 initially) of groundwater wells located throughout the NMMA. Typically, groundwater elevations are measured during the fall and spring of each year. The initial list of the wells to be included in the Monitoring Program are shown in the Appendix.

The extensive current monitoring of groundwater elevations within the NMMA is sufficient to provide initial information on groundwater trends. However, there are four additional issues that the Technical Group will consider for further monitoring or analysis over the first years of implementation of the Monitoring Program:

- Additional existing coastal nested monitoring wells will be considered for inclusion in the groundwater elevation monitoring program. These include the 13K2-K6 nested site near Oso Flaco Lake (currently not being monitored) and the 36L1-L2 nested site in the coastal dunes west of Black Lake Canyon (outside the NMMA, currently monitored for groundwater elevations by SLO County).

- The wells used in the Monitoring Program will be investigated as necessary to ensure that the aquifer penetrated by the wells is verified.

- Additional wells may be added as necessary to the Monitoring Program in a phased approach to fill in data gaps recognized during preparation of the Annual Reports.

- The Technical Group may recommend that additional dedicated monitoring well(s) need to be installed at critical locations where no other information is available.

2.2 Groundwater Quality

As an element of compliance with their drinking water reporting responsibilities, public water purveyors within the NMMA have historically gathered and reported groundwater quality data (filed with the California Department of Public Health). In addition, the U.S. Geological Survey, the California Department of Water Resources, and SLO County have also gathered some water quality data within the NMMA. Members of the NMMA Technical Group maintain these data in digital databases.

Of considerable importance is groundwater quality in wells near the ocean, the most likely site where any intrusion of seawater would first be detected. Because there was no current monitoring of groundwater quality in any of the coastal nested monitoring wells, the Monitoring Program will include the following:

- Coastal nested monitoring well site 11N/36W-12C (west of the ConocoPhillips refinery) is now monitored under agreement with SLO County and provides quarterly water quality sampling. Samples are collected for chloride, sulfate, and sodium lab analyses and pH, EC, and temperature are measured in the field.

Regular sampling and analyses of groundwater quality is an important component of the Monitoring Program, because of the potential threat of seawater intrusion at the coastline and potential water quality changes caused by pumping stress in other portions of the NMMA and the basin as a whole. Water quality does not change as rapidly as groundwater elevations, so quality monitoring does not have to be as frequent. With the addition of the coastal nested monitoring data, current water quality monitoring appears to be adequate. However, four aspects of the Monitoring Program will be further evaluated to ensure the ongoing adequacy of the Monitoring Program:

- The Technical Group will arrange to receive water quality monitoring results from purveyors within the NMMA, either directly from the purveyors or annually from the Department of Public Health.

- Coastal nested monitoring well site 12C will be evaluated to determine whether current quarterly sampling can be reduced in frequency (or field testing substituted for laboratory analysis), thus allowing funding for water quality monitoring of additional nested site 13K2-K6 near Oso Flaco Lake (not sampled for three decades) and the 36L1-L2 nested site in the coastal dunes west of Black Lake Canyon (last sampled 12 years ago).

- Each well used for monitoring of groundwater elevations will be tested once for general minerals (if such testing is not already conducted) as budgeting allows. This testing will help further define particular aquifer characteristics.

- A water quality monitoring contingency plan will be developed in the event that there are indications of seawater intrusion in coastal monitoring wells. This contingency plan will consider triggers for increased sampling, both in frequency and in added analytes (e.g., iodide, strontium, boron, oxygen/hydrogen isotopes).

2.3 Precipitation

There is a wide choice of existing precipitation stations that can be used to estimate rainfall within the NMMA. Two gauges are part of the ALERT Storm Watch System, Nipomo East (728) and Nipomo South (730). Other gauges include Simas (201.1), Black Lake (222), Runels Ranch (42.1), Oceano Wastewater Plant (194), Nipomo Mesa (152.1), Peny Ranch (175.1), Mehlschau (38), NCSD Shop (223), Nipomo CDF (151.1), and CIMIS Nipomo #202 Station. As part of the analysis for the Annual Reports, data from an appropriate subset of these gauges will be used to estimate precipitation each year.

2.4 Streamflow

Streamflow can be important both as an input and an output of the water balance for an area. Currently, streamflow within the NMMA is partially gauged. The Los Berros Creek gauge (Sensor 757) is located 0.8 miles downstream from Adobe Creek and 3.7 miles north of Nipomo on Los Berros Road. This station is located approximately where Los Berros Creek conveys water out of the NMMA.

Nipomo Creek is not currently being monitored and is observed to convey water out of the NMMA during some of the year. The Technical Group will consider whether monitoring of Nipomo Creek or any other surface water monitoring is necessary or appropriate.

2.5 Surface Water Quality and Usage

There has been limited surface water monitoring of the dune lake complex and in Black Lake Canyon by the San Luis Obispo Land Conservancy and others. The

Technical Group will evalute whether this monitoring is sufficient and will obtain this and any additional related data as necessary and appropriate.

It is not known whether there are surface water diversions within the NMMA. The Technical Group will investigate this issue and determine whether additional monitoring is necessary and appropriate.

2.6 Land and Water Uses Impacting NMMA Water Balance

Land uses within the NMMA include agricultural, residential/commercial, and undeveloped areas. Land use surveys can be useful both in developing an overall water balance assessment and as an aide to estimate water use when such use is not directly measured. The most common method of conducting a land use survey is to obtain current digital aerial photography, classify the land uses, and create GIS mapping of the various land use classifications. In some cases, field checking is also required to confirm information obtained from aerial photography.

Where necessary, water use may be established based on the various types of land use within the NMMA. Information may be obtained from both published data (including San Luis Obispo County WPA-6) and any information compiled from existing stations installed in and around the NMMA that monitor climate data (CIMIS). This is described in greater detail in Section 2.8.

2.7 Groundwater Pumping (Measured)

Individual landowners, public water purveyors, and industry all rely on groundwater pumping from the NMMA. To the extent users measure their volume of use, these data will be reported to the Technical Group on an annual basis. Stipulating Parties to the Judgment are required to provide monitoring and other production data at no charge, to the extent that such data have been generated and are readily available.

Pursuant to paragraph 5 of the Judgment, the Technical Group retains the right to seek a Court Order requiring non-stipulating parties to monitor their well production, maintain records thereof, and make the data available to the Court or the Court's designee.

2.8 Groundwater Pumping (Estimated)

Some groundwater users do not measure the volume of their groundwater production, and thus, this increment of groundwater pumping will have to be estimated each year. There are several methods of estimating groundwater pumping when totalizing meters are not installed. For cooperating pumpers, electrical records for pumping can be used, with the most accuracy obtained when the wells are tested regularly for pump efficiency.

Another method of estimating agricultural pumping is through self-reporting or surveys of crop type and irrigated acreage. For agriculture, water use can then be estimated using calculations that include crop water demand, effective precipitation, evapotranspiration, irrigation efficiency, and leaching requirements. An active California Irrigation Management Information System (CIMIS) station is located in the southern portion of the Woodlands within the NMMA and provides a useful reference for Nipomo Mesa evapotranspiration. A second active station is located adjacent to the Sisquoc River, above Tepusquet Creek.

For municipal or mixed rural lands, estimates will be based on acreage and development type. In some urban lands, a "unit water use" can be derived from average water consumption recorded from comparable or historical conditions.

To develop a complete picture of groundwater withdrawals for Nipomo Mesa, the Technical Group will develop methods for estimating unmetered groundwater pumping that will likely include some combination of those discussed above.

2.9 Wastewater Discharge and Reuse

Four wastewater treatment facilities discharge treated effluent within the NMMA and include the following: NCSD's Southland Wastewater Treatment Facility in the eastern portion of Nipomo Mesa, NCSD's wastewater treatment plant at Blacklake Village, Cypress Ridge's wastewater treatment facility, and the Woodland's wastewater treatment facilities. The Monitoring Program will include an annual compilation of wastewater treatment plant discharges, any reuse of the treated water (quantities and locations), and available water quality parameters.

3 DATA ANALYSIS & WATER SHORTAGE TRIGGERS

The primary purpose of the Monitoring Program is to detect changes in groundwater conditions that indicate current and future water supply problems within the NMMA. Although the determination of methods of data analysis and subsequent triggers that can indicate negative water supply conditions are not elements of the Monitoring Program, initial assessment of these issues are the responsibility of the Technical Group. A short discussion of potential methodologies follows.

3.1 Data Analysis

The focus of data analysis is to help detect and predict whether any conditions exist that could harm the aquifer, either by excessive drawdown or by degrading water quality. In evaluating the Monitoring Program data, the Technical Group will establish methodologies to use monitoring data to define the "health" of the basin. Among the methodologies that the Technical Group will evaluate in developing potentially severe and severe water shortage triggers are:

- **Coastal monitoring wells** – trends in water quality and groundwater elevations. Establish criteria to recognize both the potential for seawater intrusion and evidence of actual seawater intrusion.

- **Coastal groundwater gradient** – the direction and magnitude of groundwater flow either towards the ocean or in a landward direction. Establish criteria to recognize conditions that could cause seawater intrusion.

- **NMMA-wide groundwater elevation contouring** – establish groundwater flow directions, detect areas of increased drawdown, determine how pumping patterns are affecting the basin and the effects of any changes in the location of pumping that may serve to mitigate negative impacts.

- **Key wells** – indicator wells in key areas that track changes in groundwater elevations and water quality. Establish criteria to determine whether monitored changes could potentially be harmful to the aquifers.

- **Groundwater in storage** – calculation of changes of groundwater in storage and consideration of changes of groundwater storage over time can be used to analyze trends in the basin hydrologic balance.

3.2 Water Shortage Triggers

The Stipulation requires that water level and water quality criteria are to be established that will trigger responses to potential water shortages (the potentially severe and severe water shortage conditions). The Technical Group will rely on the Monitoring Program data and protocol in establishing the proposed criteria for these triggers. The triggers points will be presented for court approval, as required in the Stipulation, prior to or concurrent with the filing of the first Annual Report in 2009. Annual Reports will include an assessment of basin conditions relative to the proposed trigger points.

APPENDIX – MONITORING POINTS

The monitoring points shown on Figure A-1 and in Table A-1 are the 93 initial wells that the NMMA Technical Group determined would provide information to evaluate the health of the Nipomo Mesa portion of the Santa Maria basin. Many of the wells indicated are currently being monitored (see Table A-1), with the remainder planned to be monitored prior to preparation of the first Annual Report.

As discussed in the main text of this Monitoring Program, wells will be added and/or dropped in subsequent years as the basin is evaluated annually. The addition and/or subtraction of monitoring wells will be based on data gaps, areas of special concern that require more monitoring, and data redundancy. Information from some of the wells listed in Table A-1 that are monitored by the County of San Luis Obispo may not be available because of privacy concerns – this issue will be addressed prior to preparation of the first Annual Report.

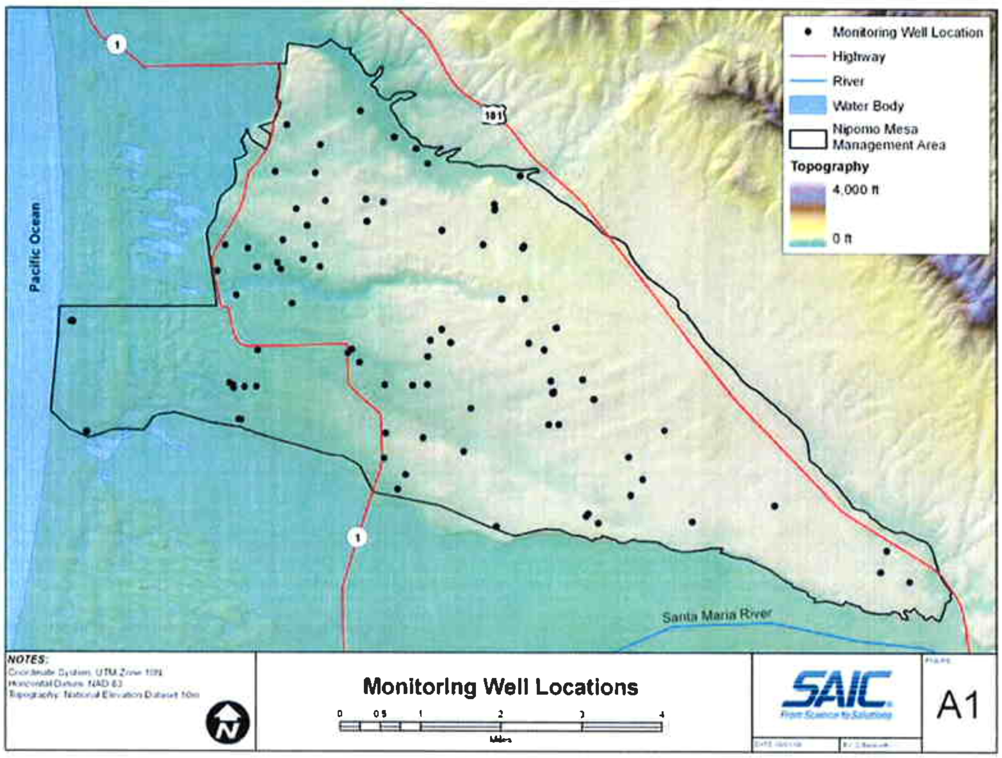

Figure A-1. Locations of monitoring points listed in Table A-1.

Appendix B: Water Shortage Conditions and Response Plan

FINAL 4/13/09

Nipomo Mesa Management Area

Water Shortage Conditions and Response Plan

Nipomo Mesa Management Area
Technical Group

April 2009

The Santa Maria basin was divided into three management areas as a result of the adjudication of the Santa Maria groundwater basin. The June 30, 2005 Stipulation ("Stipulation"), the terms of which are incorporated into the Court's Judgment dated January 25, 2008 ("Judgment"), established the boundaries of the Nipomo Mesa Management Area ("NMMA"), and provided for a technical group (NMMA Technical Group) to oversee management of the NMMA. As part of the Stipulation, the Technical Group was tasked to develop a Monitoring Program that shall include the setting of well elevations and groundwater quality criteria that trigger the responses set forth in Paragraph VI(D) of the Stipulation.

The NMMA Technical Group prepared a Monitoring Program dated August 5, 2008 that was submitted to the Court in accordance with the Judgment. This Water Shortage Conditions and Response Plan is an addendum to the Monitoring Program and completes the Monitoring Program requirements as defined in the Stipulation.

This document is divided into three sections:

I. Water Shortage Conditions Nipomo Mesa Management Area,
II. Response Plan for Potentially Severe and Severe Water Shortage Conditions, and
III. Discussion of Criteria for Potentially Severe and Severe Water Shortage Conditions.

I. Water Shortage Conditions Nipomo Mesa Management Area

Water shortage conditions are characterized by criteria designed to reflect that groundwater levels beneath the NMMA as a whole are at a point at which a response would be triggered to avoid further declines in groundwater levels (Potentially Severe), and to declare that the lowest historic groundwater levels beneath the NMMA as a whole have been reached or that conditions constituting seawater intrusion have been reached (Severe).

Groundwater levels beneath the NMMA as a whole impact the cost of pumping, the quality of groundwater pumped, and the overall flow of fresh water to the ocean that balances potential seawater intrusion. Lowering of groundwater levels below certain thresholds is to be curtailed by importing supplemental water, increasing conservation, and decreasing consumptive use of groundwater produced.

The NMMA Technical Group has developed criteria for declaring the existence of Potentially Severe and Severe Water Shortage Conditions. These criteria represent the conditions in both coastal and inland wells, and depend upon measurements of groundwater elevation and groundwater quality.

While this Response Plan relies on quantitative measurements of groundwater levels, the Technical Group acknowledges these measurements are subject to many variables so that any given measurement may only be accurate within a percentage range; no given measurement is exact or precise. For example, water level measurements obtained from groundwater production wells may be influenced by a range of factors, including but not limited to temperature, the method, protocol, and equipment used to obtain the measurement, the condition of the well, the time allowed for water levels in a previously producing well to equilibrate, and any nearby wells that remain pumping while the measurements are taken. As well, the historic data used as the basis to set action levels for Severe and Potentially Severe Water Shortage Conditions may be influenced by these and other factors. Finally, while there is sufficient historical data to reliably set Severe and Potentially Severe Water Shortage Conditions criteria, as more data is gathered pursuant to the NMMA Monitoring Plan, the Technical Group expects its understanding of NMMA characteristics will become increasingly more sophisticated and accurate. As a result of these considerations, the Technical Group acknowledges and expects that it will recommend modifications to the Severe and Potentially Severe Water Shortage Conditions criteria as more data are obtained on a consistent basis and as the Technical Group's understanding of the NMMA characteristics improves over time.

Seawater intrusion is a condition that could permanently impair the use of the principal producing aquifer to meet water demands of the NMMA. For coastal areas, the criteria described here are set either to indicate conditions that, if allowed to persist, may lead to seawater intrusion or increasing chloride concentrations, or that actual seawater intrusion has occurred.

Monitoring Wells

As with the NMMA Monitoring Plan, primary data for this Water Shortage Conditions and Response Plan is derived from a select group of wells located within the NMMA. Identification of these wells and the selection criteria are as follows.

Coastal sentinel wells, installed by the Department of Water Resources in the 1960s, are monitored to characterize any condition for the advancement of seawater into the freshwater aquifer. Specifically, the groundwater elevation and concentration of indicator constituents are evaluated to determine the threat or presence of seawater intrusion to the fresh water aquifer. These coastal monitoring wells are as follows:

Coastal Well	Perforation Elevation (ft msl)	Aquifer
11N/36W-12C1	-261 to -271	Paso Robles
11N/36W-12C2	-431 to -441	Pismo
11N/36W-12C3	-701 to -711	Pismo
12N/36W-36L1	-200 to -210	Paso Robles
12N/36W-36L2	-508 to -518	Pismo

For inland areas, criteria for water shortage conditions are based on annual Spring groundwater elevation measurements made in key wells located inland from the coast (the "Key Wells Index"). The inland Key Wells are as follows:

Key Wells
11N/34W-19
11N/35W-5
11N/35W-8
11N/35W-9
11N/35W-13
11N/35W-22
11N/35W-23
12N/35W-33

Potentially Severe Water Shortage Conditions

The Stipulation, page 25, defines Potentially Severe Water Conditions as follows:

Caution trigger point (Potentially Severe Water Shortage Conditions)[1]

(a) Characteristics. The NMMA Technical Group shall develop criteria for declaring the existence of Potentially Severe Water Shortage Conditions. These criteria shall be approved by the Court and entered as a modification to this Stipulation or the judgment to be entered based upon this Stipulation. Such criteria shall be designed to reflect that water levels beneath the NMMA as a whole are at a point at

[1] The multiple citations to and partial restatements of the Stipulation are intended to provide context to this Water Shortage Conditions and Response Plan. However, neither the restatement of a portion of the Stipulation herein, nor the omission of a portion of a quotation from the Stipulation, is intended to override or alter the mutual obligations and requirements set forth in the Stipulation.

which voluntary conservation measures, augmentation of supply, or other steps may be desirable or necessary to avoid further declines in water levels.

Inland Areas: The NMMA Technical Group set the criteria for a Potentially Severe Water Shortage Condition to the elevation of groundwater as determined by the Key Wells Index. If the Spring groundwater elevations indicate that the Key Wells Index is less than 15 feet above the Severe Water Shortage criterion (equal to **31.5 ft msl**[2]), the Technical Group will notify the Monitoring Parties of the current data, and evaluate the probable causes of this low level as described below. If the Key Wells Index continues to be lower than **31.5 ft msl** in the following Spring, the Technical Group will report to the Court in the Annual Report that Potentially Severe Water Shortage Conditions are present and provide its recommendations regarding the appropriate response measures. During the period a Potentially Severe Water Shortage Condition persists, the NMMA Technical Group shall include in each Annual Report an assessment of the hydrologic conditions and any additional recommended response measures. A discussion of how the groundwater elevations criteria were determined is presented in discussion Section III. Potentially Severe Water Shortage Conditions will no longer be considered to exist when: 1) the Key Well Index is above the Potentially Severe criterion of 31.5 ft msl for two successive Spring measurements, or 2) the Key Well Index is 5 ft or higher above the Potentially Severe criterion (which calculates to 36.5 ft msl) in any Spring measurement. Alternatively, the NMMA Technical Group may determine that the Potentially Severe Water Shortage Condition no longer exists when the Key Well Index is above the Potentially Severe criterion of 31.5 ft msl and conditions warrant this conclusion.

The Key Well Index criteria for Potentially Severe Water Shortage Conditions may be modified in the future by the Technical Group as more data are developed on the accuracy of measured data and Key Well construction or condition.

Coastal Areas: The NMMA Technical Group set the coastal criteria for a Potentially Severe Water Shortage Condition using both groundwater surface elevation and groundwater quality measured in the coastal monitoring wells, as presented in the table below. The groundwater elevation criteria are discussed in Section III. The groundwater quality portion of the coastal criteria is set at **250 mg/L** chloride. There is no water quality criterion for the shallow alluvium. Potentially Severe Water Shortage Conditions are determined if either the Spring groundwater elevation drops below the criteria elevation, or chloride concentration exceeds the criteria concentration, in any of the coastal monitoring wells subject to the Response Plan data analysis and verification described below.

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[2] The decimal point does not imply the accuracy of the historical low calculation.

The NMMA Technical Group will report to the Court in the Annual Report that Potentially Severe Water Shortage Conditions are present and provide its recommendations regarding the appropriate response measures. During the period a Potentially Severe Water Shortage Condition persists, the Technical Group shall include in each Annual Report an assessment of the hydrologic conditions and any additional recommended response measures.

When Spring groundwater elevations or groundwater quality subsequently improves so that the criteria threshold for two successive measurements are no longer exceeded, Potentially Severe Water Shortage Conditions will no longer be considered to exist. Alternatively, the Technical Group may determine that the Potentially Severe Water Shortage Condition no longer exists when the Spring groundwater elevation or groundwater quality criteria threshold are no longer exceeded in a single measurement and conditions warrant this conclusion.

The coastal threshold criteria for Potentially Severe Water Shortage Conditions may be modified in the future by the Technical Group as more data are developed on the accuracy and extent of the coastal data, including the potential for inclusion of additional coastal monitoring wells into the Monitoring Plan.

Criteria for Potentially Severe Water Shortage Conditions, Coastal Area

Well	Perforation Elevation (ft msl)	Aquifer	Elevation Criteria (ft msl)	Chloride Concentration Criteria (mg/L)
11N/36W-12C1	-261 to -271	Paso Robles	**5.0**	**250**
11N/36W-12C2	-431 to -441	Pismo	**5.5**	**250**
11N/36W-12C3	-701 to -711	Pismo	**9.0**	**250**
12N/36W-36L1	-200 to -210	Paso Robles	**3.5**	**250**
12N/36W-36L2	-508 to -518	Pismo	**9.0**	**250**

Severe Water Shortage Conditions

The Stipulation, page 25, defines Potentially Severe Water Conditions as follows:

Mandatory action trigger point (Severe Water Shortage Conditions)

(a) Characteristics. The NMMA Technical Group shall develop the criteria for declaring that the lowest historic water levels beneath the NMMA as a whole

have been reached or that conditions constituting seawater intrusion have been reached. These criteria shall be approved by the Court and entered as a modification to this Stipulation or the judgment to be entered based upon this Stipulation.

Inland Areas: A Severe Water Shortage Condition exists when the Key Wells Index is less than **16.5 feet msl**, using Spring groundwater elevation measurements. The Mandatory Response Plan will remain in effect until groundwater elevations as indicated by the Key Wells Index are 10 ft above the Severe criterion (which calculates to **26.5 feet msl**). Alternatively, the NMMA Technical Group may determine that the Severe Water Shortage Condition no longer exists when the Key Well Index is above the Severe criterion of 16.5 ft msl and conditions warrant this conclusion.

The criteria for Severe Water Shortage Conditions may be modified in the future by the Technical Group as more data are developed on the accuracy of measured data and Key Well construction or condition.

Coastal Areas: The NMMA Technical Group set the coastal criteria for Severe Water Shortage Condition to the occurrence of the chloride concentration in groundwater greater than the drinking water standard in any coastal monitoring well. Thus, the coastal criterion for a Severe Water Shortage Condition is the chloride concentration exceeding **500 mg/L** in any of the coastal monitoring wells. If the criterion is exceeded, an additional sample will be collected and analyzed from that well as soon as practicable to verify the result. The response triggered by the measurement will not be in effect until the laboratory analysis has been verified. If the chloride concentration subsequently improves above the criterion threshold for two successive Spring measurements, Severe Water Shortage Conditions will no longer be considered to exist. Alternatively, the Technical Group may determine that the Severe Water Shortage Condition no longer exists when groundwater quality criteria threshold are no longer exceeded in a single measurement and conditions warrant this conclusion.

The coastal threshold criteria for Severe Water Shortage Conditions may be modified in the future by the Technical Group as more data are developed on the accuracy and extent of the coastal data, including the potential for inclusion of additional coastal monitoring wells into the Monitoring Plan.

II. Response Plan for Potentially Severe and Severe Water Shortage Conditions

("Response Plan")

Introduction

This Response Plan is triggered by criteria designed to reflect either Potentially Severe Water Shortage Conditions or Severe Water Shortage Conditions. Nothing in this Response Plan is intended to, nor shall operate so as to reduce, limit or change the rights, duties, and responsibilities of the parties to this Response Plan as those rights, duties, and responsibilities are stated in the Stipulation and the Judgment.

1. Potentially Severe Water Shortage Conditions

The responses required by the Stipulation are set forth as follows:

VI(D)(1b) Responses [Potentially Severe]. *If the NMMA Technical Group determines that Potentially Severe Water Shortage Conditions have been reached, the Stipulating Parties shall coordinate their efforts to implement voluntary conservation measures, adopt programs to increase the supply of Nipomo Supplemental Water*[3] *if available, use within the NMMA other sources of Developed Water or New Developed Water, or implement other measures to reduce Groundwater use.*[4]

VI(A)(5). ...In the event that Potentially Severe Water Shortage Conditions or Severe Water Shortage Conditions are triggered as referenced in Paragraph VI(D) before Nipomo Supplemental Water is used in the NMMA, NCSD, [GSWC[5]*], Woodlands and RWC agree to develop a well management plan that is acceptable to the NMMA Technical Group, and which may include such steps as imposing conservation measures, seeking sources of supplemental water to serve new customers, and declaring or obtaining approval to declare a moratorium on the granting of further intent to serve or will serve letters.*[6]

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[3] A defined term in the parties' Stipulation. The following terms, when used in this Response Plan, are terms whose definitions are found in the Stipulation and that definition is specifically incorporated herein and adopted as the meaning of these terms: "Developed Water," "Groundwater," "Native Groundwater," "New Developed Water," "Nipomo Supplemental Water," "Nipomo Supplemental Water Project," "Stipulating Parties" and "Year."

[4] Ibid at p.25.

[5] Name changed from Southern California Water Company (SCWC) in 2005.

[6] Ibid at p.22.

The Response Plan shall be implemented when the Potentially Severe Water Shortage Conditions occur within the NMMA. The Response Plan is a combination of technical studies to better determine the nature of the threat, water supply and demand actions to mitigate overall conditions in the NMMA, and compliance with the Stipulation and the Judgment. The Response Plan includes, where applicable, the following:

1. Coastal Groundwater Elevation and/or Groundwater Quality Conditions:
   a. Verify that the measurement is not an anomaly by retesting at the site(s) of exceedence as soon as practicable and again in the following month.
   b. Characterize the extent of either low groundwater elevation(s) or increased chloride concentration(s) near the coast, which might include adding and/or installing additional monitoring points.
   c. Identify, to the extent practical, factors that contributed to the low groundwater elevations in coastal monitoring wells.
   d. Investigate whether increased chloride concentration(s) indicate intrusion of seawater or other causes through chemistry/geochemistry studies.

2. Inland Groundwater Elevation Condition:
   a. Verify that the measurement is not an anomaly by retesting at the site(s) of exceedence as soon as practicable and again in the following month.
   b. Characterize the extent of the area where groundwater elevation(s) have decreased sufficiently to lower the Key Wells Index.
   c. Identify factors that contributed to the low groundwater elevation(s) in coastal monitoring wells.

3. Implement sections VI(D)1(b) and VI(A)(5) of the Stipulation, as reproduced above.

4. When either the groundwater quality or groundwater elevation conditions are confirmed, the following provisions apply to the Response Plan for Potentially Severe Water Shortage Conditions:

   a. ConocoPhillips shall have the right to the reasonable and beneficial use of Groundwater on the property it owns as of the date of the Stipulation located in the NMMA without limitation.[7]

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[7] Ibid at p. 23.

b. Overlying Owners that are Stipulating Parties that own land located in the NMMA as of the date of the Stipulation shall have the right to the reasonable and beneficial use of Groundwater on their property within the NMMA without limitation.[8]

c. Woodlands shall not be subject to restriction in its reasonable and beneficial use of Groundwater, provided it is concurrently using or has made arrangements for other NMMA parties to use within the NMMA, the Nipomo Supplemental Water allocated to Woodlands. Otherwise, Woodlands shall be subject to reductions equivalent to those imposed on NCSD, GSWC, and RWC.[9]

2. Severe Water Shortage Conditions

The responses required by the Stipulation are set forth following:

VI(D)(1b) Responses [Severe]. *As a first response, subparagraphs (i) through (iii) shall be imposed concurrently upon order of the Court. The Court may also order the Stipulating Parties to implement all or some portion of the additional responses provided in subparagraph (iv) below.*

(i) For Overlying Owners other than Woodlands Mutual Water Company and ConocoPhillips, a reduction in the use of Groundwater to no more than 110% of the highest pooled amount previously collectively used by those Stipulating Parties in a Year, prorated for any partial Year in which implementation shall occur, unless one or more of those Stipulating Parties agrees to forego production for consideration received. Such forbearance shall cause an equivalent reduction in the pooled allowance. The base Year from which the calculation of any reduction is to be made may include any prior single Year up to the Year in which the Nipomo Supplemental Water is transmitted. The method of reducing pooled production to 110% is to be prescribed by the NMMA Technical Group and approved by the Court. The quantification of the pooled amount pursuant to this subsection shall be determined at the time the mandatory action trigger point (Severe Water Shortage Conditions) described in Paragraph VI(D)(2) is reached. The NMMA Technical Group shall determine a technically responsible and consistent method to determine the pooled amount and any individual's contribution to the pooled amount. If the NMMA Technical Group cannot agree upon a technically responsible and consistent method to determine the pooled amount, the matter may be determined by the Court pursuant to a noticed motion.

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[8] Ibid.

[9] Ibid at p. 23.

(ii) ConocoPhillips shall reduce its Yearly Groundwater use to no more than 110% of the highest amount it previously used in a single Year, unless it agrees in writing to use less Groundwater for consideration received. The base Year from which the calculation of any reduction is to be made may include any prior single Year up to the Year in which the Nipomo Supplemental Water is transmitted. ConocoPhillips shall have discretion in determining how reduction of its Groundwater use is achieved.

(iii) NCSD, RWC, SCWC, and Woodlands (if applicable as provided in Paragraph VI(B)(3) above) shall implement those mandatory conservation measures prescribed by the NMMA Technical Group and approved by the Court.

(iv) If the Court finds that Management Area conditions have deteriorated since it first found Severe Water Shortage Conditions, the Court may impose further mandatory limitations on Groundwater use by NCSD, SCWC, RWC and the Woodlands. Mandatory measures designed to reduce water consumption, such as water reductions, water restrictions, and rate increases for the purveyors, shall be considered.

(v) During Severe Water Shortage Conditions, the Stipulating Parties may make agreements for temporary transfer of rights to pump Native Groundwater, voluntary fallowing, or the implementation of extraordinary conservation measures. Transfer of Native Groundwater must benefit the Management Area and be approved by the Court.[10]

The following Response Plan for Severe Water Shortage Conditions is premised on the assumption that the Nipomo Supplemental Water Project within the NMMA is fully implemented and yet Severe Water Shortage Conditions exist.

If either the coastal or inland criteria occur for Severe Water Shortage Conditions within the NMMA, a Response Plan shall be implemented. The Response Plan is a combination of technical studies to better determine the nature of the threat, water supply and demand actions to mitigate overall conditions in the NMMA that triggered a Response Plan, and compliance with the terms of the Stipulation and the Judgment. It includes, where applicable, the following NMMA Technical Group actions:

1. Groundwater Quality Condition:
   a. Verify data.

[10] Ibid at pp. 25-27.

b. Investigate whether increased chloride concentration(s) indicate intrusion of seawater or result from other causes through chemistry/geochemistry studies.

c. Characterize the extent of the increase in chloride concentration(s), which may include adding additional monitoring points and/or installing new monitoring points.

d. Given information from sections (a) and (b) above, identify the factors that may have caused the groundwater quality degradation.

2. Groundwater Elevation Condition:

a. Verify that the measurement is not an anomaly by retesting at the site(s) of exceedence as soon as practicable and again in the following month.

b. Characterize the extent of the area where groundwater elevation(s) have decreased sufficiently to lower the Key Wells Index.

c. Identify the factors that contributed to the low groundwater elevation(s) in key wells.

3. As a first response, the NMMA Technical Group shall request the Court to order concurrently sections VI(D)(1b)(i) through (iii) of the Stipulation, as reproduced above.

4. Prepare a semi-annual report on the trend in chloride concentration for the Court. If chloride concentration(s) continue to increase at the coastline, request the Court to implement section VI(D)(1b)(iv) of the Stipulation, as reproduced above.

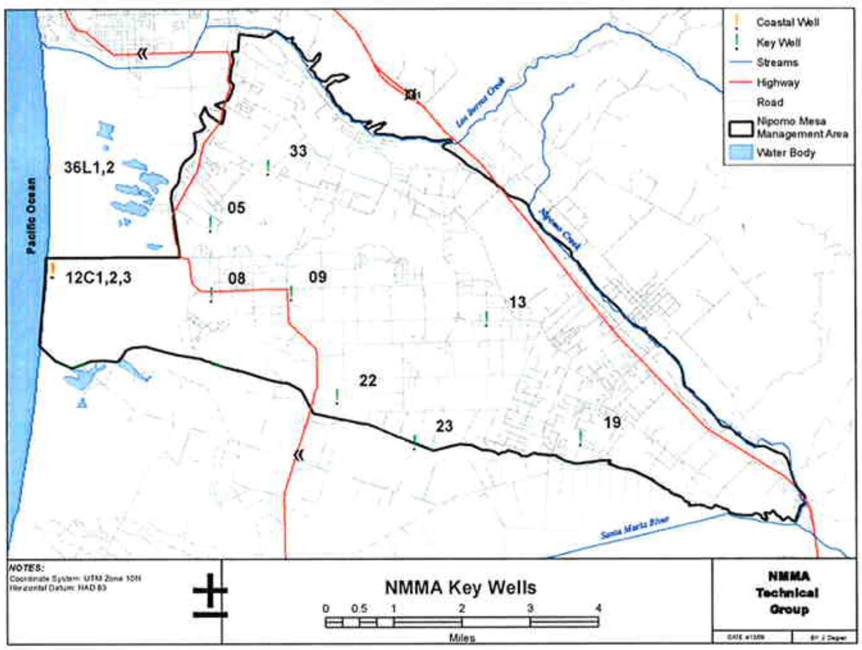
5. During Severe Water Shortage Conditions, the Stipulating Parties may make agreements for temporary transfer of groundwater pumping rights in accordance with section VI(D)(1b)(v) of the Stipulation, as reproduced above.

III. Discussion of Criteria for Potentially Severe and Severe Water Shortage Conditions

1. Water Shortage Conditions as a Whole

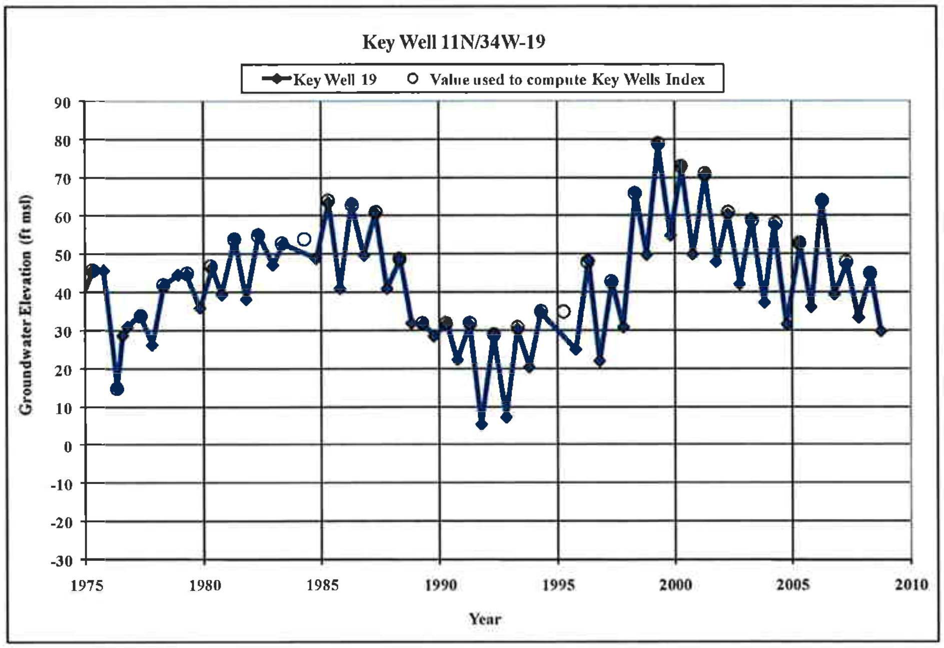
The Stipulation established that the Severe Water Shortage Conditions is characterized by the lowest historic groundwater levels beneath the NMMA as a whole. The NMMA Technical Group selected the data from eight inland key wells to represent the whole of the NMMA. These wells are listed in the following tabulation and are shown on the figure entitled "NMMA Key Wells". The average Spring groundwater elevation of these key wells is used to calculate the Key Wells Index ("Index").

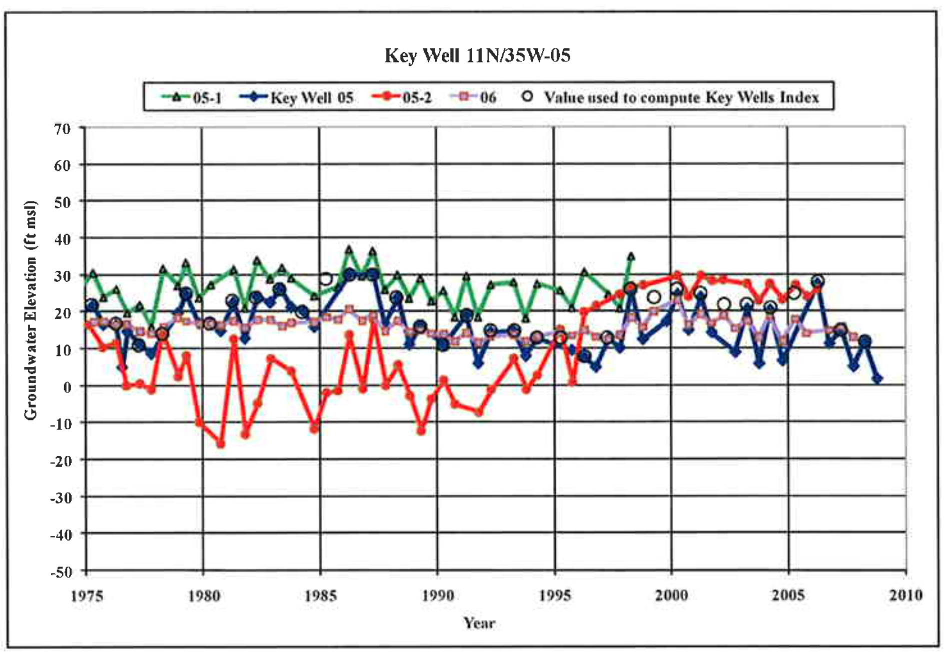
Key Wells For Inland Criterion
11N/34W-19
11N/35W-5
11N/35W-8
11N/35W-9
11N/35W-13
11N/35W-22
11N/35W-23
12N/35W-33

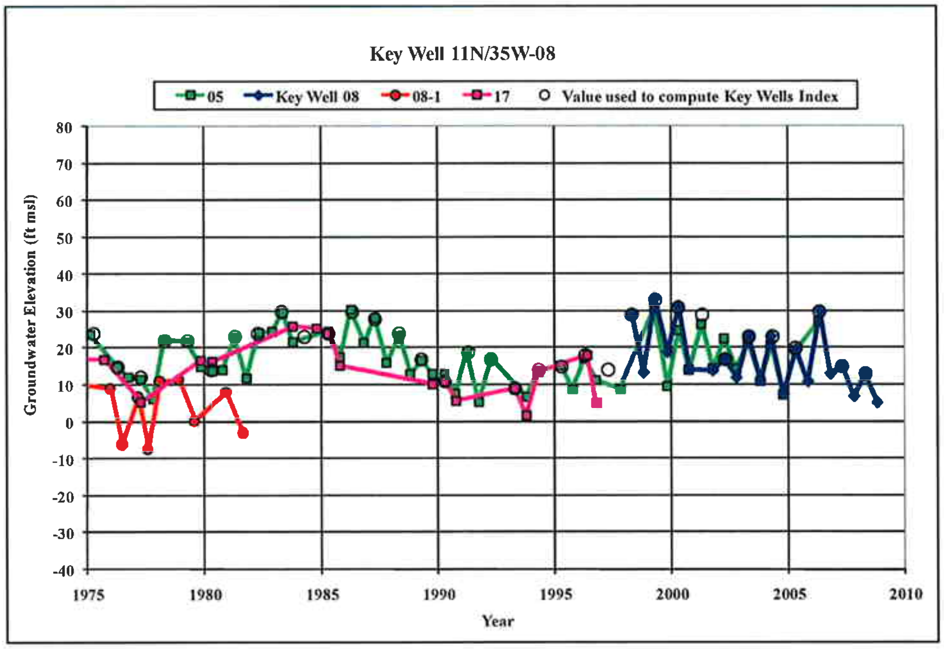


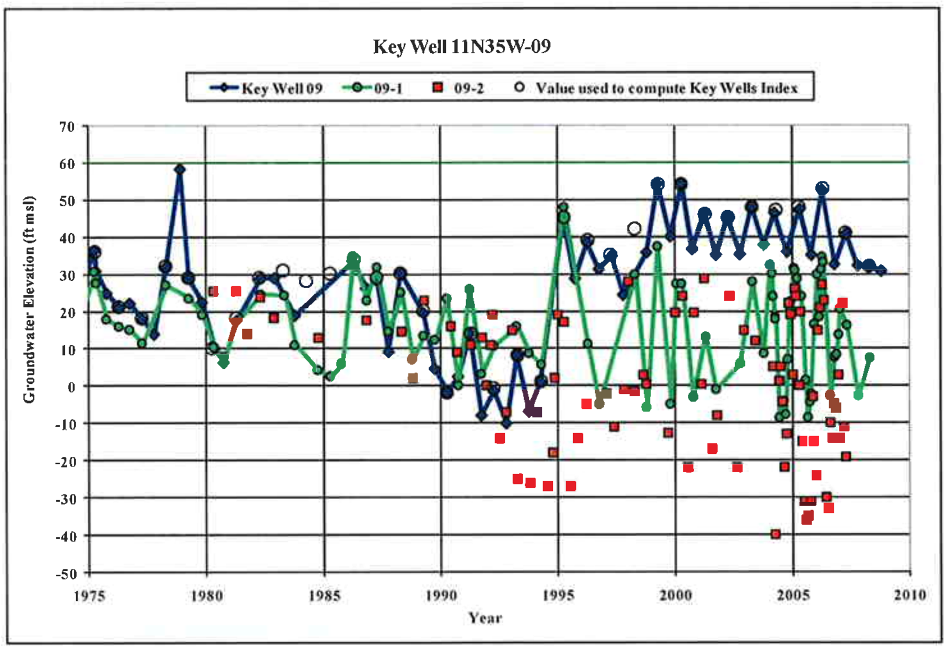
The Index was calculated annually using Spring groundwater elevation measurements from 1975 to 2008. The Key Wells were selected to represent various portions of the groundwater basin within the NMMA. The following charts display the hydrographs for each Key Well and surrounding wells. The open circles represent the actual Spring value for that year or a correlation of that value for each year that was used to compute the Index.

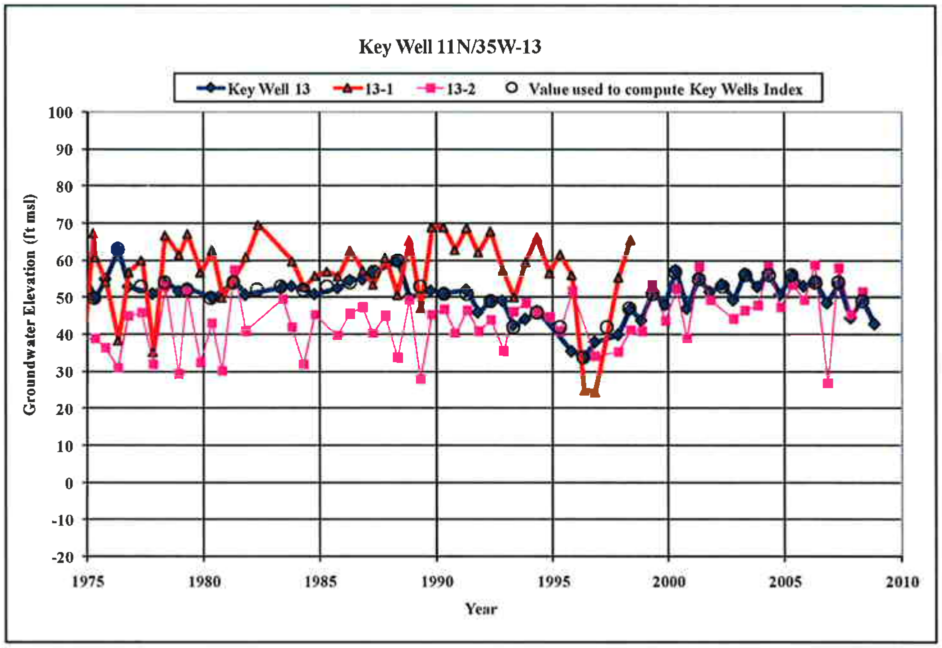
When there was no Spring groundwater elevation measurement for a particular year, the value was determined by either 1) interpolating between Spring measurements in adjacent years or 2) computing the Spring elevation by taking the Fall measurements in adjacent years and increasing the value by the typical increase in groundwater elevations between Spring and Fall measurements in that well. If there is a significant data gap in the record for a particular well (e.g., 22 well below), a nearby well was used to fill the gap.



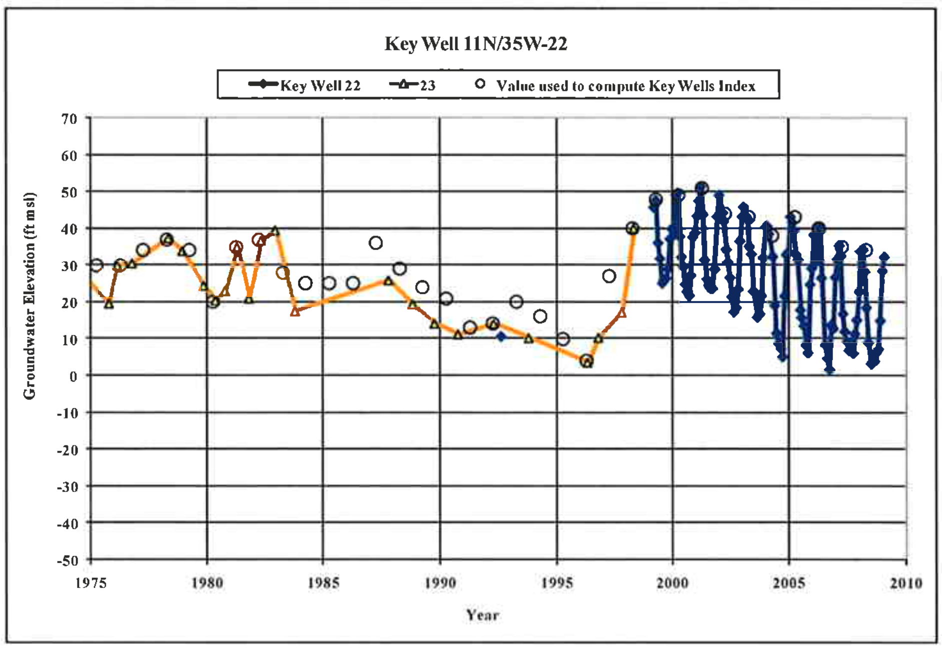



Key Well 11N/35W-08
05
Key Well 08
08-1
17
Value used to compute Key Wells Index
Groundwater Elevation (ft msl)
80
70
60
50
40
30
20
10
0
-10
-20
-30
-40
1975
1980
1985
1990
1995
2000
2005
2010
Year

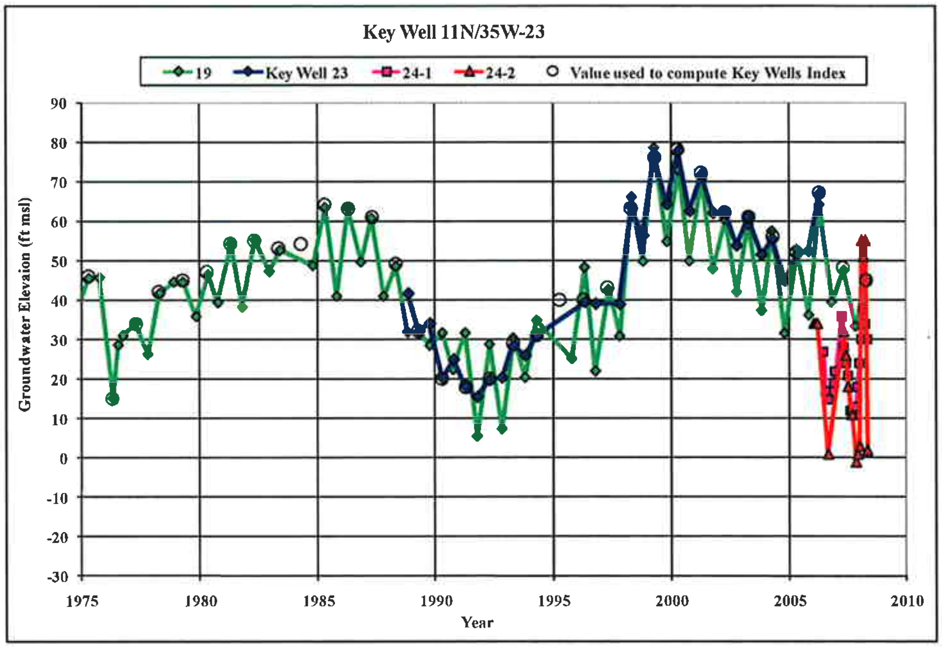

Key Well 11N35W-09
Key Well 09
09-1
09-2
Value used to compute Key Wells Index
Groundwater Elevation (ft msl)
70
60
50
40
30
20
10
0
-10
-20
-30
-40
-50
1975
1980
1985
1990
1995
2000
2005
2010
Year

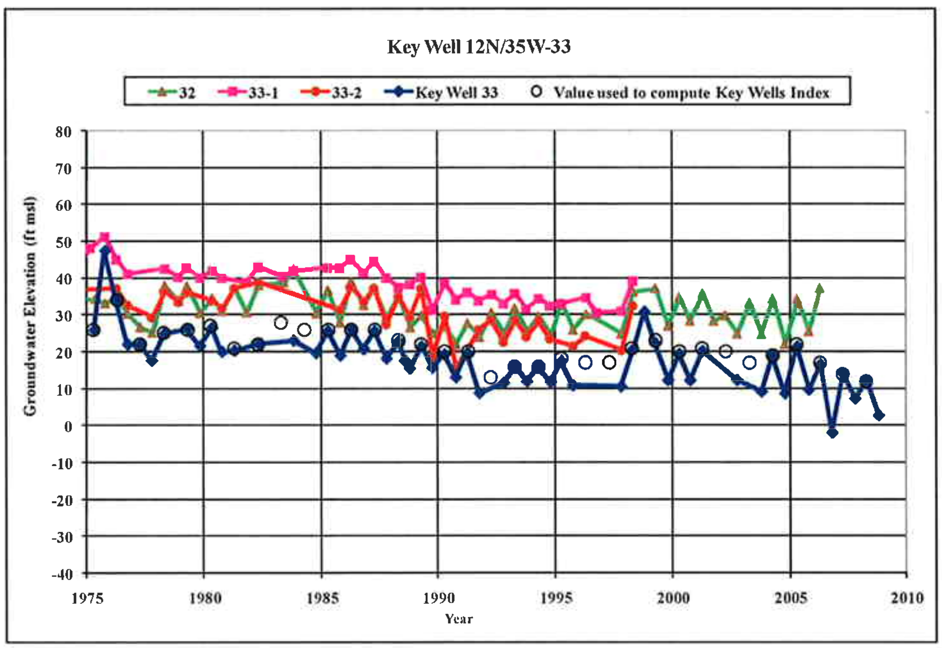


Key Well 11N/35W-13
Key Well 13
13-1
13-2
Value used to compute Key Wells Index
Groundwater Elevation (ft msl)
100
90
80
70
60
50
40
30
20
10
0
-10
-20
1975
1980
1985
1990
1995
2000
2005
2010
Year



Key Well 11N/35W-22
Key Well 22
23
Value used to compute Key Wells Index
Groundwater Elevation (ft msl)
70
60
50
40
30
20
10
0
-10
-20
-30
-40
-50
1975
1980
1985
1990
1995
2000
2005
2010
Year





In selecting the eight key wells, the following criteria were applied so that the wells generally represent the NMMA as a whole:

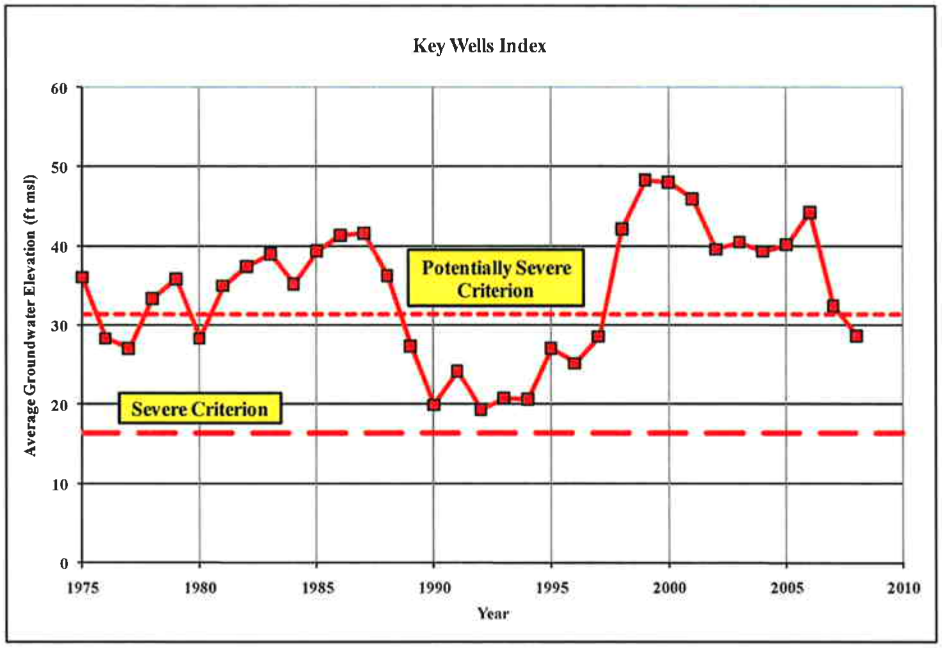
(1) The wells are geographically distributed.

(2) No single well overly influences the Index.

The first criterion was met in the selection of the wells. To meet the second criterion, groundwater elevations from each well were normalized so that any well where elevations were on the average higher or lower than the other wells did not overly influence the overall Index. This normalization was accomplished by dividing each Spring groundwater elevation measurement by the sum of all the Spring groundwater elevation data for that well.

The Index was defined for each year as the average of the normalized Spring groundwater data from each well. The lowest value of the Index could be considered the "historical low" within the NMMA. The sensitivity of that "historical low" was tested by examining the effect of eliminating a well from the Key Wells Index. Eight separate calculations of the Index from 1975 to 2008 were made by excluding the data from one of the eight wells, and computing the average value for each year from the remaining wells' normalized Spring groundwater data.

The criterion for a Potentially Severe Water Shortage Conditions should provide for enough time before the Severe criterion occurs to allow pumpers time to implement voluntary measures to mitigate a falling Key Wells Index. Based on the assumption that two years is adequate for this early warning, then the historical Index can be used to determine the potential rate of fall of the Index. The maximum drop in the historical Index over a two-year period was about 15 feet, during the last two years of the 1986-1991 drought. Thus, the criterion for Potentially Severe Water Shortage Conditions is set at 15 feet above the Severe Water Shortage Condition criterion, which calculates to **31.5 ft msl**. The Key Wells Index for all eight wells, which will be computed each year in the future, will be compared to the Potentially Severe and Severe criteria discussed above. The Index through 2008 is shown below.



Key Wells Index for the period 1975 to 2008. Upper dashed line is criterion for Potentially Severe Water Shortage Conditions and lower dashed line is criterion for Severe Conditions.

The Index generally tracks wet and dry climatic cycles, indicating the importance of natural recharge in the NMMA. Significant deviations from this climatic tracking could occur if supplemental water deliveries reduced pumping, if overlying land use changed the return flows to the aquifer, or if there was a large change in groundwater extractions in addition to those resulting from the introduction of the Supplemental Water.

A. Seawater Intrusion Criteria for Potentially Severe Water Shortage Conditions

The criteria for potentially severe conditions in coastal areas are either gradient conditions that could pull seawater into the principal aquifer, or threshold chloride concentrations detected in coastal monitoring wells. Whereas chloride is the principal indicator for the groundwater quality portion of this criteria, other groundwater quality constituents may be considered for future refinement of this criteria.

To avoid seawater contamination, groundwater elevations in the coastal monitoring wells must be sufficiently high to balance higher-density seawater (about 2.5 of extra head is required for every 100 ft of ocean depth of an offshore outcrop of the aquifer). Thus, if an aquifer is penetrated at 100 ft below sea level in a coastal well, it is assumed that groundwater elevations in that aquifer must be at least 2.5 ft above sea level to counteract the higher density of seawater. Although offshore outcrop areas are not currently defined, it is assumed that some hydraulic connection between the onshore aquifers and seawater at the sea floor is possible or even probable.

Historical groundwater elevation data from these coastal wells indicate that groundwater elevations have not always been higher than the theoretical elevations of fresh water to balance sea water, described in the preceding paragraph. It is not known to what extent (if any) that seawater has advanced toward the land during the periodic depression of groundwater elevation, nor has any groundwater quality data supported the indication that seawater has contaminated the fresh water aquifer at the coastal monitoring well locations. Thus, coastal groundwater elevation criteria must take into account the periodic depression of groundwater elevations. To accommodate these fluctuations and until further understanding is developed, the coastal criteria are presented in the table below, based on the lower of 1) historical low groundwater elevations in the coastal monitoring wells or 2) a calculation of 2.5 ft of elevation for every 100 ft of aquifer depth in the well. If the historical low elevation is used, the value is reduced by one foot and rounded to the nearest half-foot. Similarly, if a calculated value is the lower option, it is rounded to the nearest half-foot. The results of these criteria are indicated in the following table.

Criteria for Potentially Severe Water Shortage Conditions

Well	Perforations Elevation (ft msl)	Aquifer	Historic Low (ft msl)	2.5' per 100' Depth (ft msl)	Elevation Criteria (ft msl)	Highest Chloride (mg/L)	Chloride Concentration Criteria (mg/L)
11N/36W-12C1	-261 to -271	Paso Robles	5.8	6.5	**5.0**	81	**250**
11N/36W-12C2	-431 to -441	Pismo	6.3	10.8	**5.5**	55	**250**
11N/36W-12C3	-701 to -711	Pismo	10.1	17.5	**9.0**	98	**250**
12N/36W-36L1	-200 to -210	Paso Robles	4.3	5.7	**3.5**	38	**250**
12N/36W-36L2	-508 to -518	Pismo	10.1	13.4	**9.0**	127	**250**

The groundwater quality portion of the criteria is set at 250 mg/L chloride. There is no groundwater quality criterion for the shallow alluvium. Although there is no assumption that seawater intrusion has occurred at this concentration, the cause of the rise in chloride concentration must be investigated and appropriate mitigation measures taken. Thus, Potentially Severe Water Shortage Conditions are established if either the groundwater elevation or groundwater quality criteria are met.

B. Seawater Intrusion Criteria for Severe Water Shortage Conditions

One criterion for Severe Water Shortage Conditions is the occurrence of conditions that result in chloride concentration(s) in groundwater greater than the drinking water standard in any of the coastal monitoring wells.

A principal threat for such occurrence is from seawater intrusion. The first evidence of seawater intrusion can occur very quickly or may involve a slower and more subtle change. Because the rate of change for chloride concentrations during seawater intrusion is difficult to predict for the NMMA, the criterion is set to the Maximum Contaminant Level for chloride in drinking water.

The Nipomo Mesa Technical Group set the coastal criterion for Severe Water Shortage Conditions at a chloride concentration at or above **500 mg/L** in any of the coastal monitoring wells. If the criterion is exceeded, an additional sample will be collected and analyzed from that well as soon as practically possible to verify the result. The Severe Water Shortage Condition will not be in effect until the laboratory analysis has been verified.

Appendix C: Well Management Plan

NMMA PURVEYOR

NMMA WELL MANAGEMENT PLAN[1]

Adopted January 21, 2010

Stage 1: Potentially Severe Water Shortage Conditions

- Potentially Severe Water Shortage Conditions Triggered[2];
- Voluntary measures urged by Water Purveyors (NCSD, GSWC, Woodlands, and RWC). See list of "Recommended Water Use Restrictions;"
- Voluntary evaluation of sources of new supplemental water;
- Voluntary purveyor conservation goal of 15% (Baseline to be suggested by the NMMA TG);
- Voluntary/Recommended public information program;
- Voluntary evaluation and implementation of shifting pumping to reduce GW depressions and/or protect the seaward gradient. This includes the analysis and establishment of a potential network of purveyor system interties to facilitate the exchange of water;

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[1] This Well Management Plan is required by the terms of the Stipulation (page 22). The Well Management Plan provides for steps to be taken by the NCSD, GSWC, Woodlands and RWC under a factual scenario where Nipomo Supplemental Water (a defined term in the Stipulation) has not been "used" in the NMMA (page 22). The Well Management Plan, therefore, has no applicability to either ConocoPhillips or Overlying Owners as defined in the Stipulation (page 22).

[2] Water shortage conditions are characterized by criteria designed to reflect that groundwater levels beneath the NMMA as a whole are at a point at which a response would be triggered to avoid further declines in the groundwater levels (potentially severe), and to declare that the lowest historic groundwater levels beneath the NMMA as a whole have been reached or that conditions constituting seawater intrusion have been reached (severe). See current version of Water Shortage Conditions and Response Plan – appendix to Annual Report.

Stage 2: Severe Water Shortage Conditions

- Severe Water Shortage Conditions Triggered and Nipomo Supplemental Water has been used in the NMMA (see footnote 1)[3];

- Overlying landowners other than Woodlands and ConocoPhillips shall reduce groundwater use to no more than 110% of the highest pooled base year prior to the transmittal of Nipomo supplemental water. The NMMA TG will determine a technically responsible and consistent method to determine the pooled amount and an individual's contribution (To be determined when trigger occurs). The method of reducing pooled production to 110% is to be prescribed by the TG and approved by the court. Landowners may consider using less water for consideration received;

- ConocoPhillips shall reduce its yearly groundwater use to no more than 110% of the highest amount it used in a single year prior to the transmittal of Nipomo supplemental water. ConocoPhillips may consider using less water for consideration received and has discretion to determine how its groundwater reduction is achieved;

- Water Purveyors (NCSD, GSWC, Woodlands, and RWC) shall implement mandatory conservation measures. Where possible, institute mandatory restrictions with penalties;

- The mandatory conservation goals will be determined by the NMMA TG when the Severe water shortage trigger is reached. Annually, should conditions worsen; the NMMA TG will re-evaluate the mandatory conservation goal;

- Measures may include water reductions, additional water restrictions, and rate increases. GSWC and RWC shall aggressively file and implement[4] a schedule 14.1 mandatory rationing plan with the CPUC consistent with the mandatory goals;

- Penalties, rates, and methods of allocation under the rationing program shall be at the discretion of each entity and its regulating body;

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[3] [see comment at footnote #1] Water shortage conditions are characterized by criteria designed to reflect that groundwater levels beneath the NMMA as a whole are at a point at which a response would be triggered to avoid further declines in the groundwater levels (potentially severe), and to declare that the lowest historic groundwater levels beneath the NMMA as a whole have been reached or that conditions constituting seawater intrusion have been reached (severe). See current version of Water Shortage Conditions and Response Plan (appendix to Annual Report).

[4] CPUC has the authority to set rates and allow mandatory conservation actions. As CPUC regulated entities, GSWC and RWC cannot implement such programs without CPUC approval.

- Aggressive voluntary public information program which includes discussions with high use water users such as school districts, parks, and golf courses to seek voluntary reductions in potable water irrigation;

List of Recommended Water Use Restrictions

The following provisions are examples of what may be considered prohibited, nonessential, and/or unauthorized water use:

1) Prohibit nonessential and unauthorized water use, including but not limited to:
   a) Use of potable water for more than minimal landscaping, as defined in the landscaping regulated of the jurisdiction or as described in Article 10.8 of the California Government Code in connection with new construction;
   b) Use through any meter when the company has notified the customer in writing to repair a broken or defective plumbing, sprinkler, watering or irrigation system and the customer has failed to effect such repairs within five business days;
   c) Use of potable water which results in flooding or runoff in gutters or streets;
   d) Individual private washing of cars with a hose except with the use of a positive action shut-off nozzle. Use of potable water for washing commercial aircraft, cars, buses, boats, trailers, or other commercial vehicles at any time, except at commercial or fleet vehicle or boat washing facilities operated at a fixed location where equipment using water is properly maintained to avoid wasteful use;
   e) Use of potable water washing buildings, structures, , driveways, patios, parking lots, tennis courts, or other hard-surfaced areas, except in the cases where health and safety are at risk;
   f) Use of potable water to irrigate turf, lawns, gardens, or ornamental landscaping by means other than drip irrigation, or hand watering without quick acting positive action shut-off nozzles, on a specific schedule, for example: 1) before 9:00 a.m. and after 5:00 p.m.; 2) every other day; or 3) selected days of the week;
   g) Use of potable water for watering streets with trucks, except for initial wash-down for construction purposes (if street sweeping is not feasible), or to protect the health and safety of the public;
   h) Use of potable water for construction purposes, such as consolidation of backfill, dust control, or other uses unless no other source of water or other method can be used.

i) Use of potable water for construction purposes unless no other source of water or other method can be used;

j) Use of potable water for street cleaning;

k) Operation of commercial car washes without recycling at least 50% of the potable water used per cycle;

l) Use of potable water for watering outside plants, lawn, landscape and turf areas during the hours of 9:00 am to 5:00 pm;

m) Use of potable water for decorative fountains or the filling or topping off of decorative lakes or ponds. Exceptions are made for those decorative fountains, lakes, or ponds which utilize recycled water;

n) Use of potable water for the filling or refilling of swimming pools.

o) Service of water by any restaurant except upon the request of a patron; and

p) Use of potable water to flush hydrants, except where required for public health or safety.

Appendix D: Data Acquisition Protocol for Groundwater Level Measurement for the Nipomo Mesa Management Area

Data Acquisition Protocol for Groundwater Level Measurement for the Nipomo Mesa Management Area

Introduction

The purpose of this memorandum is to establish a protocol for measuring and recording groundwater levels for Nipomo Mesa Management Area (NMMA) wells, and to describe various methods used for collecting meaningful groundwater data. Static groundwater levels obtained for the NMMA monitoring program are determined by measuring the distance to water in a non-pumping well from a measuring point that has been referenced to sea level. Subtracting the distance to water from the elevation of the measuring point determines groundwater surface elevations above or below sea level. This is represented by the following equation:

$$E_{GW} = E_{MP} - D$$

Where:

E_{GW} = Elevation of groundwater above mean sea level (feet)
E_{MP} = Elevation above sea level at measuring point (feet)
D = Depth to water (feet)

Groundwater elevation data can be used to construct groundwater contour maps, determine groundwater flow direction and hydraulic gradients, show locations of groundwater recharge, determine amount of water in storage, show changes in groundwater storage over time, and identify other aquifer characteristics. Miss-representation of aquifer conditions result from errors introduced during water level measurements, from a changed measuring point, during data recording, from equipment problems, or from using inappropriate measuring equipment or techniques for a particular well.

In an effort to minimize such errors and to standardize the collection of groundwater data, the U.S. Geological Survey (U.S.G.S.) has conducted extensive investigations into methods for measuring groundwater levels. In conjunction with several other federal agencies, the U.S.G.S. published the "National Handbook of Recommended Methods for Water-Data Acquisition" (1977); "Introduction to Field Methods for Hydrologic and Environmental Studies, (2001); and several Stand-alone Procedure Documents (GWPD, 1997). Excerpts from these publications relating to water-level measurements are attached. The following protocol for obtaining and reporting accurate data, including a discussion of potential errors associated with several measurement techniques, are based on these U.S.G.S. documents.

Well Information

To give the most meaningful value to the data obtained in the NMMA monitoring program, each well file should include as much information as is available. Table 1 below lists important well information to be maintained in a well file or in a field notebook. Additional information that should be available to the person collecting water-level data should include a description of access to the property and the well, the presence and depth of cascading water, or downhole obstructions that could interfere with a sounding cable. San Luis Obispo County Department of Public Works maintains well cards on the wells in the County monitoring network.

Table 1
Well File Information

Well Completion Report	Hydrologic Information	Additional Information to be Recorded
Well name	Map showing basin boundaries and wells	Township, Range, and ¼ ¼ Section
Well Owner	Name of groundwater basin	Latitude and Longitude (Decimal degrees)
Drilling Company	Description of aquifer	Assessor's Parcel Number
Location map or sketch	Confined, unconfined, or mixed aquifers	Description of well head and sounding access
Total depth	Pumping test data	Measuring point & reference point elevations
Perforation interval	Hydrographs	Well use and pumping schedule if known
Casing diameter	Water quality data	Date monitoring began
Date of well completion		Land use

Types of Wells

The monitoring program is likely to include several types of wells with various means of access and pumping schedules. It is important to understand the characteristics of each well type and its downhole conditions to best determine monitoring schedules and appropriate measuring technique. Below is a brief summary of well types and their pumping characteristics. A more detailed description of these well types is included in the attached "National Handbook of Recommended Methods for Water-Data Acquisition".

Existing Wells

These include abandoned wells, irrigation wells, public supply wells, and domestic wells. Existing wells provide convenient and inexpensive measuring sites; however, they should be carefully evaluated to show that they can provide accurate data under static conditions with reliable access.

Abandoned wells are often in poor condition and may have partially collapsed casing or accumulated sediments. Damaged casing may also result in cascading water. An undamaged well with the pump removed, however, can provide easy access and reliable water-level data.

Irrigation wells are generally pumped on a regular schedule, allowing static water-level measurements to be taken during known non-pumping periods. Seasonal changes in the pumping schedules should also be noted when planning monitoring events.

Public supply wells may be part of a monitoring program if sufficient information regarding their operations is available. Hydrographs showing periods or pumping and recovery should be obtained to determine the best time to measure static water levels.

Domestic wells are generally pumped frequently and for short durations, making it difficult to monitor during static conditions. Determining when the lowest domestic water use occurs during the day can facilitate monitoring schedules.

Observation Wells
These wells are designed for specific sites and depths in known hydrogeologic conditions to supply desired information. Typically, there is no permanent pump, making measurements relatively easy.

Piezometers
A piezometer is a small diameter observation well designed to measure the hydraulic head within a small zone. It should have a very short screen and filter pack interval so it can represent the hydraulic head at a single point within the aquifer.

Access to Supply Wells

Access into a well to obtain a water level measurement depends on pump types and wellhead construction. For turbine-pump wells, there is typically an opening between the pump column and the casing either through a port or between the base plate and the casing. The filter-pack fill tube should not be confused with a casing vent or sounding access pipe. In some wells, there is no access for a downhole measuring tape; however, the well may be equipped with an air-line measuring system.

Access to submersible wells is generally through a small diameter plug located in the plate on top of the casing. In wells where there is no sounding tube, caution should be used during water level measurements to minimize the chance of the sounding tape becoming entangled with the power cable. Additional information and wellhead diagrams regarding supply well access is found in the attached "National Handbook of Recommended Methods for Water-Data Acquisition".

Measuring Points and Reference Points

Measuring point (MP) elevations are the basis for determining groundwater elevations relative to sea level. The MP is generally that point on the well head that is the most convenient place to measure the water level in a well. In selecting an MP, an additional consideration is the ease of surveying either by Global Positioning System (GPS) or by leveling.

The MP must be clearly defined, well marked, and easily located. If permissible, the point should be labeled with the letters MP and an arrow. A description, sketch, and photograph of the point should be included in the well file.

The Reference Point (RP) is a surveyed point established near the wellhead on a permanent object. It serves as a benchmark by which the MP can be checked or re-surveyed if the MP is changed. The RP should be marked, sketched, photographed, and described in the well file.

All MPs and RPs for the NMMA monitored wells should be surveyed using the same horizontal and vertical datum by a California licensed surveyor to the nearest tenth of one foot vertically, and the nearest one foot horizontally. The surveyor's report should be maintained in the project file.

In addition to the MP and RP survey, the elevation of the ground surface adjacent to the well should also be surveyed and recorded in the well file. Because the ground surface adjacent to a well is rarely uniform, the average surface level should be estimated. This average ground surface elevation is referred to in the U.S.G.S. Procedural Document (GWPD-1, 1997) as the Land Surface Datum (LSD).

Water-Level Data Collection

Prior to beginning the field work, the field technician should review each well file to determine which well owners require notification of the upcoming site visit, or which well pumps need to be turned off to allow for water level recovery. Because groundwater elevations are used to construct groundwater contour maps and to determine flow direction, all water level measurements should be collected within a 24-hour period or within as short a period as possible. Weather and groundwater conditions are least likely to change significantly during a short period for data collection. For an individual well, the same measuring method and the same sounder should be used during each sampling event where practical.

Prior to taking a measurement, the length of time since a pump has been operating should be determined. If possible, a domestic well should be allowed to recover at least one half hour prior to measuring, whereas an irrigation or public well should recover a minimum of eight hours prior to measuring. If the well is capped but not vented, remove the cap and wait several minutes before measurement to allow water levels to equilibrate to atmospheric pressure.

When there is doubt about whether water levels in a well are continuing to recover, repeated measurements should be made. Or, if an electric sounder is being used, it is possible to hold the sounder level at one point just above the known water level and wait for a signal that would indicate rising water. For each well, the general schedule of pump operation should be determined and noted.

When lowering a graduated steel tape (chalked tape) or electric tape in a well without a sounding tube in an equipped well, the tape should be played out slowly by hand to minimize the chance of the tape end becoming caught in a downhole obstruction. The tape should be held in such a way that any change in tension will be felt. When withdrawing a sounding tape, it should also be brought up slowly so that if an obstruction is encountered, tension can be relaxed so that the tape can be lowered again before attempting to withdraw it around the obstruction.

All water level measurements should be made to an accuracy of 0.1 feet. The field technician should make at least two measurements. If measurements of static levels do not agree within 0.1 feet , the technician should continue measurements until the reason for the disparity is determined, or the measurements are within 0.1 feet.

Where groundwater levels are found to be above ground surface, a sensitive pressure gage can be used to determine the height above the measuring point or a sealed well could have a manometer tube that would show the height above ground surface. A manometer tube may not be high enough to measure the water level if the groundwater is under more than 5 feet of pressure.

Record Keeping in the Field

The information recorded in the field is often the only remaining evidence of the conditions at the time of the monitoring event. It is important that the field book be protected carefully and that it contains the name of the field technician and appropriate contact information. Because the field book contains original tables of multiple monitoring events, copies of the tables should be made following each monitoring event. The data can be further protected by entering the data electronically as soon as practicable.

All field notes must be recorded during the time the work is being done in the field. Accurate documentation of field conditions cannot be made after the field technician has returned to the office. Because much of the data will be reviewed by office staff, and because more than one field technician may participate in the monitoring program, it is essential that notes be intelligible to anyone without requiring a verbal explanation. As a means to support field information, sketches or digital photos attached to field notes should be encouraged.

All field notes should be made with a sharp pencil with lead appropriate for the conditions. Erasures should not be made when recording data. A single line should be drawn through an error without obscuring its legibility, and the correct value or information should be written adjacent to it or in a new row below it.

During each monitoring event it is important to record any conditions at a well site and its vicinity that may affect groundwater levels, or the field technician's ability to obtain groundwater levels. Table 2 lists important information to record, however, additional information should be included when appropriate. Table 3, The Water Level Measurement Form, is a suggested format for recording field data.

Table 2
Information Recorded at Each Well Site

Well name	Property access conditions	Downhole obstructions
Name and organization of field technician	Changes in land use	Presence of oil in well
Date & time (time in 24-hour notation)	Changes in MP	Cascading water
Measurement method used	Nearby wells in use	Equipment problems
Sounder used	Weather conditions	Physical changes in wellhead
Most recent sounder calibration	Recent rainfall events	Comments

Measurement Techniques

Four standard methods of obtaining water levels are discussed below. The chosen method depends on site and downhole conditions, and the equipment limitations. In all monitoring situations, the procedures and equipment used should be documented in the field notes and in final reporting. Additional detail on manual methods of water level measurement is included in the attached U.S.G.S. Stand-Alone Procedure Documents and the "National Handbook of Recommended Methods for Water-Data Acquisition". The attached "Introduction to Field Methods for Hydrologic and Environmental Studies" includes a discussion of pressure transducers.

Graduated Steel Tape

This method uses a graduated steel tape with a brass or stainless steel weight attached to its end. The tape is graduated in feet. The approximate depth to water should be known prior to measurement.

- Chalk the lower few feet of the tape by applying blue carpenter's chalk.
- Lower the tape to just below the estimated depth to water so that a few feet of the chalked portion of the tape is submerged. Be careful not to lower the tape beyond its chalked length.
- Hold the tape at the MP and record the tape position (this is the "hold" position and should be at an even foot);
- Withdraw the tape rapidly to the surface;
- Record the length of the wetted chalk mark;
- Subtract the wetted chalk number from the "hold" position number and record this number in the "Depth to Water below MP" column;
- Perform a check by repeating the measurement using a different MP hold value;
- All data should be recorded to the nearest 0.01 foot;
- Disinfect the tape by pouring a small amount of chlorine bleach on a clean cloth and wiping down the portion of the tape that was submerged below the water surface.

The graduated steel tape is generally considered to be the most accurate method for measuring static water levels. Measuring water levels in wells with cascading water or with condensing water on the well casing causes potential errors, or can be impossible. The tape should be calibrated against another steel tape that is maintained in the office and is used only for calibration.

Electric Tape

An electric tape operates on the principle that an electric circuit is completed when two electrodes are submerged in water. Most electric tapes are mounted on a hand-cranked reel equipped with batteries and an ammeter, buzzer or light to indicate when the circuit is closed. Tapes are graduated in either one-foot intervals or in hundredths of feet depending on the manufacturer. Like graduated steel tapes, electric tapes are attached with brass or stainless steel weights.

- Check the circuitry of the tape before lowering the probe into the well by dipping the probe into water and observe if the ammeter needle or buzzer/light signals that the circuit is closed;
- Lower the probe slowly and carefully into the well until the signal indicates that the water surface has been reached;

- Place a finger or thumb on the tape at the MP when the water surface is reached;
- If the tape is graduated in one-foot intervals, partially withdraw the tape and measure the distance from the MP mark to the nearest one-foot mark to obtain the depth to water below the MP. If the tape is graduated in hundredths of a foot, simply record the depth at the MP mark as the depth to water below the MP;
- Make all readings using the same needle deflection point on the ammeter scale (if equipped) so that water levels will be consistent between measurements;
- Make check measurements until agreement shows the results to be reliable;
- All data should be recorded to the nearest 0.01 foot;
- Disinfect the tape by pouring a small amount of chlorine bleach on a clean cloth and wiping down the submerged portion of the tape;
- Periodically check the tape for breaks in the insulation. Breaks can allow water to enter into the insulation creating electrical shorts that could result in false depth readings.

<u>The electric tape may give slightly less accurate results than the graduated steel tape.</u> Errors can result from signal "noise" in cascading water, breaks in the tape insulation, or tape stretch. Electric tape products graduated in hundredths of a foot generally give more accurate results than electric tapes graduated in one-foot intervals. This accuracy difference is due to less stretch and ease of measurement in the tapes graduated in hundredths of a foot. All electric tapes should be calibrated periodically against a steel tape that is maintained in the office and used only for calibration.

<u>Air Line</u>

The air line method is usually used only in wells equipped with pumps. This method typically uses a 1/8 or 1/4-inch diameter, seamless copper tubing, brass tubing, or galvanized pipe with a suitable pipe tee for connecting an altitude or pressure gage. Plastic tubing may also be used, but is considered less desirable. An air line must extend far enough below the water level that the lower end remains submerged during pumping of the well. The air line is connected to an altitude gage that reads directly in feet of water, or to a pressure gage that reads pressure in pounds per square inch (psi). The gage reading indicates the length of the submerged air line.

The formula for determining the depth to water below the MP is: $\mathbf{d = k - h}$ where d = depth to water; k = constant; and h = height of the water displaced from the air line. In wells where a pressure gage is used, h is equal to 2.31 ft/psi multiplied by the gage reading. The constant value for k is approximately equivalent to the length of the air line.

- Calibrate the air line by measuring an initial depth to water (d) below the MP with a graduated steel tape. Use a tire pump, air tank, or air compressor to pump compressed air into the air line until all the water is expelled from the line. When all the water is displaced from the line, record the stabilized gage reading (h). Add d to h to determine the constant value for k.
- To measure subsequent depths to water with the air line, expel all the water from the air line, subtract the gage reading (h) from the constant k, and record the result as depth to water (d) below the MP.

The air line method is not as accurate as a graduated steel tape or electric tape. Measurements with an altitude gage are typically accurate to approximately 0.1 foot, and measurements using a pressure gage are accurate to the nearest one foot at best. Errors can occur with leaky air lines, or when tubing becomes clogged with mineral deposits or bacterial growth.

Submersible Pressure Transducers

Electrical pressure transducers make it possible to collect frequent and long-term water-level or pressure data from wells. These pressure-sensing devices, installed at a fixed depth in a well, sense the change in pressure against a membrane. The pressure changes occur in response to changes in the height of the water column in the well above the transducer. To compensate for atmospheric changes, transducers may have vented cables or they can be used in conjunction with a barometric transducer that is installed in the same well or a nearby observation well above the water level.

Transducers are selected on the basis of expected water-level fluctuation. The smallest range in water levels provides the greatest measurement resolution. Accuracy is generally 0.01 to 0.1 percent of the full scale range.

Retrieving data in the field is typically accomplished by downloading data through a USB connection to a portable "lap-top" computer. A site visit to retrieve data should involve several steps designed to safeguard the data and the continued useful operation of the transducer:

- Inspect the wellhead and check that the transducer cable has not moved or slipped;
- Ensure that the instrument is operating properly;
- Measure and record the depth to water with a graduated steel or electric tape;
- Document the site visit, including all measurements and any problems;
- Retrieve the data and document the process;
- Review the retrieved data by viewing the file or plotting the original data;
- Recheck the operation of the transducer prior to disconnecting from the computer.

A field notebook with a checklist of steps and measurements should be used to record all field observations and the current data from the transducer. It provides an historical record of field activities. In the office, maintain a binder with field information similar to that recorded on the field notebook so that a general historical record is available there and can be referred to before and after a field trip.

Summary and Recommendations

Static groundwater levels obtained for the NMMA monitoring program are determined by measuring the distance to water from wellhead MPs that have been surveyed using an accepted sea level-based datum. Subtracting the distance to water from the elevation of an MP determines groundwater surface elevations above or below sea level. The following items should be considered important to creating and maintaining a successful monitoring program:

- All wells should be surveyed by a licensed surveyor;

- Three survey points should be set for each well: the MP on the wellhead, the RP on a nearby permanent object, and the adjacent ground surface;
- The points should be surveyed to the nearest tenth of one foot vertically, and the nearest one foot horizontally;
- A one-inch diameter water-level sounding tube should be installed in each NMMA monitoring program well;
- Static water levels should always be measured to the nearest 0.01 feet from the same measuring point, using the same measuring techniques for each well;
- Measurement techniques using graduated steel tapes, electric tapes graduated in hundredths of feet, or pressure transducers should be considered appropriate for the monitoring program;
- Because of its lower accuracy and higher potential for errors than other methods, the air-line method should not be used in the program;
- Thorough and accurate field documentation and complete project files are essential to a successful monitoring program.

Appendix E: Additional Data and Maps

Addendum to Section 3.11 - Estimated Groundwater Production for Agriculture

To estimate groundwater production for agriculture by crop acreage, a crop specific unit production value is multiplied the acreage of the crop. The unit production is estimated by the following formula. The formula is broken down into 8 steps below:

*Unit Production = (Crop Coefficient*Potential Evapotranspiration - Rainfall)/Irrigation Efficiency*

Step 1: Obtain Potential Evapotranspiration data

Reference potential evapotranspiration (ETo) approximates the evapotranspiration from a field of 4 to 6 inch tall, cool-season grass that is not water stressed. Obtain the monthly data for ETo for the area of interest tabulated in inches per month. In the example, the ETo data was obtained from the active California Irrigation Management Information System (CIMIS) Nipomo (#202) Station for for Calendar Year 2009. http://wwwcimis.water.ca.gov/cimis.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total (in)	Total (ft)
ETo (in)	2.64	2.25	3.76	4.66	4.39	4.61	5.02	4.57	3.88	3.63	2.47	1.61	**43.5**	**3.6**

Step 2: Obtain Crop Coefficient Estimates

To use this ETo to calculate water use for a crop type (example avocados) you must multiply the ETo by a crop coefficient (Kc) that accounts for the ET difference between the crop (avocado) and the cool-season grass. Obtain the crop coefficient estimates from scientific studies. Below are the crop coefficients for avocado based on research done in Corona, Ca (1988-92) and Covey Lane, North San Diego County, Ca (1992-97). http://ucavo.ucr.edu/avocadowebsite%20folder/avocadowebsite/Irrigation/CropCoefficients.html

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Kc (%)	0.4	0.5	0.55	0.55	0.6	0.65	0.65	0.65	0.6	0.55	0.55	0.5

Step 3: Estimate Specific Crop Evapotranspiration (ETc) *ETc = Kc*ETo*

Multiply the ETo by the monthly crop coefficients to estimate the seasonal crop evapotranspiration (ETc). Below is the Etc for avocado trees in the Nipomo area.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total (in)	Total (ft)
ETc (in)	1.1	1.1	2.1	2.6	2.6	3.0	3.3	3.0	2.3	2.0	1.4	0.8	**25.2**	**2.1**

Step 4: Rainfall Data

Obtain the rainfall from the real time rainfall stations and review data for inconsistencies. For the Nipomo Mesa the real-time stations are CIMIS Nipomo #202, and ALERT stations 728 and 730. For Calendar Year 2008, Nipomo #202 did not record rainfall data for events in October 2008 and November 2008. Due to the missing data, data recorded by ALERT Station #730 Nipomo South was used to represent the precipitation on the Nipomo Mesa.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total (in)	Total (ft)
Rainfall (in)	0.2	1.7	0.6	0.5	0.1	0.0	0.0	0.0	0.1	1.6	0.0	2.8	**7.7**	**0.6**

Step 5: Estimate Evapotranspiration of Applied Water (ETaw) *ETaw= ETc - Precip*

Subtract the monthly rainfall from the crop evapotranspiration (ETc), to estimate the portion of ETc estimated to be met by applied water (ETaw). Set all negative values equal to zero.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total (in)	Total (ft)
ETaw	0.9	0.0	1.4	2.1	2.5	3.0	3.3	3.0	2.2	0.4	1.4	0.0	**20.1**	**1.7**

Step 6: Obtain Estimates of Irrigation Efficiency

Irrigation efficiency is the estimated portion of applied water that is evapotranspired by the crop. The water not used by the crop return flows to the groundwater. The San Luis Obispo County (SLO) Master Water Plan Update assigned irrigation efficiency averages for the following crop groups on the Nipomo Mesa: Nursery (60-70%); Permanent (60-70%); Vegetable (65-75%); and Vineyard (65-75%). For this calculation, the high-end of the range was used for all crops since the SLO report indicates a projected average increase in irrigation efficiency of 5 percent. Therefore for avocado, a permanent crop group, the irrigation efficiency is set at 70%.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Irrigation Efficiency %	70%	70%	70%	70%	70%	70%	70%	70%	70%	70%	70%	70%

Step 7: Estimate the Unit Production per acre *Unit Production = ETaw/Irrigation Efficiency*

Divide the evapotranspiration of applied water (ETaw) by the irrigation efficiency to estimate the unit groundwater production.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total (in)	Total (ft)
Unit Production	1.2	0.0	2.1	3.0	3.6	4.3	4.7	4.2	3.2	0.5	1.9	0.0	**28.7**	**2.40**

Step 8: Estimate the Production by Crop Category for the NMMA *Production = Unit Production*Area*

Multiply the acreage of the crop type (avocado and lemons) in the NMMA by the unit production to estimate the overall groundwater production for avocados and lemons in the NMMA. There is a small orchard of lemons in the NMMA (31 acres) which were included in the avocado category because they are also a subtropical fruit with similar water use requirements.

Crop Type	2009 Area	2009 Unit Production	2009 Production
	Acres	ft	acre-feet
Avocados (and Lemons)	277.3	2.40	**660**

Agricultural Crop Coefficient and Irrigation Efficiency Assumptions: Addendum to Section 3.1-11

Year	Month	ETo	Precipitation	Deciduous		Pasture		Truck Mult-Crop (Vegetable rotational)		Citrus and Subtropical (Avocado)		Strawberries		Nursery	
				Kc	Eff%	Kc	Eff%	Kc	Eff%	Kc	Eff%	Kc	Eff%	Kc	Eff%
		in	in		%		%		%		%		%		%
2009	Jan	2.64	0.20	0.00	70%	0.00	75%	0.00	75%	0.40	70%	0.18	75%	0.50	70%
2009	Feb	2.25	1.73	0.00	70%	0.00	75%	1.00	75%	0.50	70%	0.36	75%	0.50	70%
2009	Mar	3.76	0.63	0.58	70%	1.00	75%	1.00	75%	0.55	70%	0.56	75%	0.50	70%
2009	Apr	4.66	0.47	0.72	70%	1.00	75%	1.00	75%	0.55	70%	0.65	75%	0.50	70%
2009	May	4.39	0.12	0.83	70%	1.00	75%	0.51	75%	0.60	70%	0.68	75%	0.50	70%
2009	Jun	4.61	0.00	0.90	70%	1.00	75%	0.00	75%	0.65	70%	0.69	75%	0.50	70%
2009	Jul	5.02	0.00	0.96	70%	1.00	75%	0.49	75%	0.65	70%	0.35	75%	0.50	70%
2009	Aug	4.57	0.00	0.96	70%	1.00	75%	1.00	75%	0.65	70%	0.00	75%	0.50	70%
2009	Sep	3.88	0.08	0.92	70%	1.00	75%	1.00	75%	0.60	70%	0.00	75%	0.50	70%
2009	Oct	3.63	1.61	0.81	70%	1.00	75%	1.00	75%	0.55	70%	0.00	75%	0.50	70%
2009	Nov	2.47	0.00	0.00	70%	0.00	75%	0.00	75%	0.55	70%	0.00	75%	0.50	70%
2009	Dec	1.61	2.83	0.00	70%	0.00	75%	0.00	75%	0.50	70%	0.00	75%	0.50	70%
Source:		CIMIS Nipomo 202	Nipmo South Sensor 730	DWR 1975		DWR 1975		DWR 1975 - spring lettuce/early cauliflower		UCANR http://ucavo.ucr.edu		Hanson and Bendixen 2004, Fig. 1B - single crop		SLO 1998, UCCE 1991 for Santa Barbara County Cut Flowers	

Irrigation Efficiency:

San Cuis Obispo County. 1998. Water Master Plan: Estimated Current Agricultural Irrigation Water Requirements.

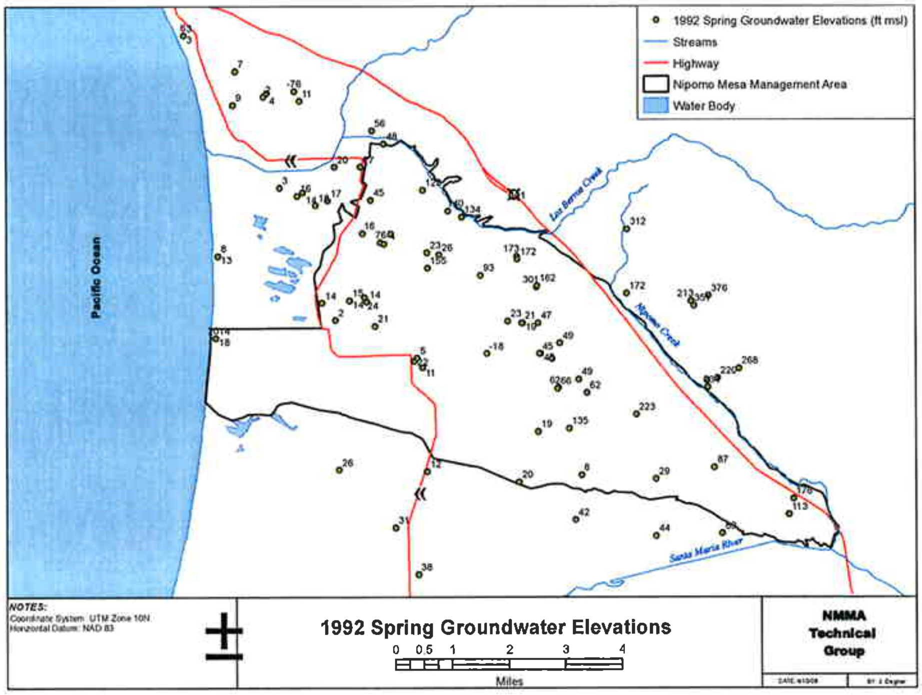
Crop Coefficent References:

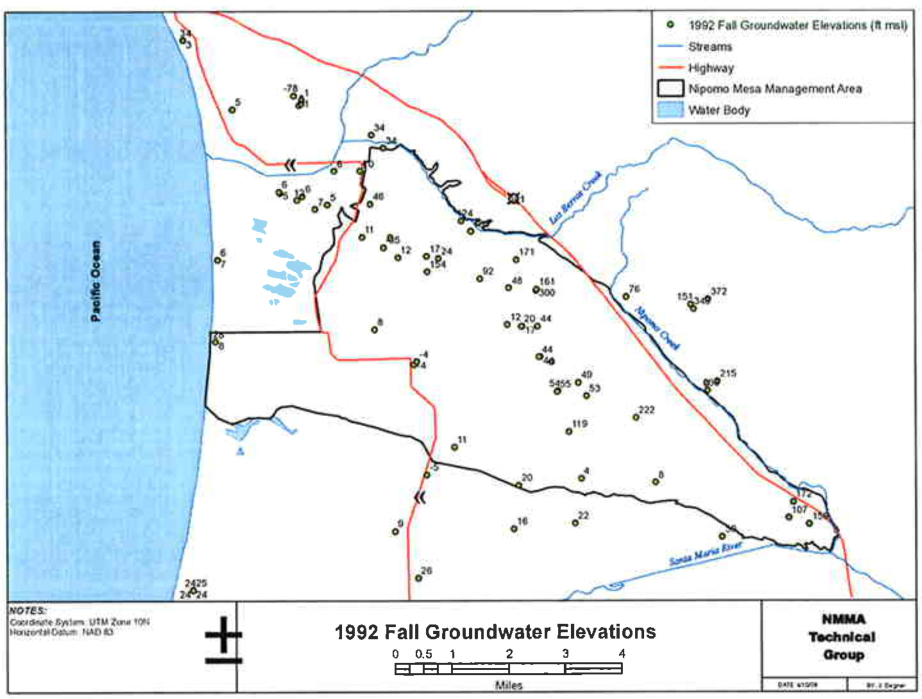
DWR 1975. Vegetative Use in California 1974

Hansen, Blaine and Bendixen, Warren. 2004. Drip irrigation evaluated in Santa Maria Valley strawberries. California Agriculture 58:1 pg. 48-53

UCANR (University of California, Agricultural and Natural Resources) 2009. Crop Coefficients for Avocado.

SLO (San Cuis Obispo County). 1998. Water Master Plan: Estimated Current Agricultural Irrigation Water Requirements.


1992 Spring Groundwater Elevations (ft msl)
Streams
Highway
Nipomo Mesa Management Area
Water Body
Pacific Ocean
Los Berros Creek
Nipomo Creek
Santa Maria River
NOTES:
Coordinate System: UTM Zone 10N
Horizontal Datum: NAD 83
1992 Spring Groundwater Elevations
0 0.5 1 2 3 4
Miles
NMMA
Technical
Group


1992 Fall Groundwater Elevations (ft msl)
Streams
Highway
Nipomo Mesa Management Area
Water Body
Pacific Ocean
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Nipomo Creek
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NOTES:
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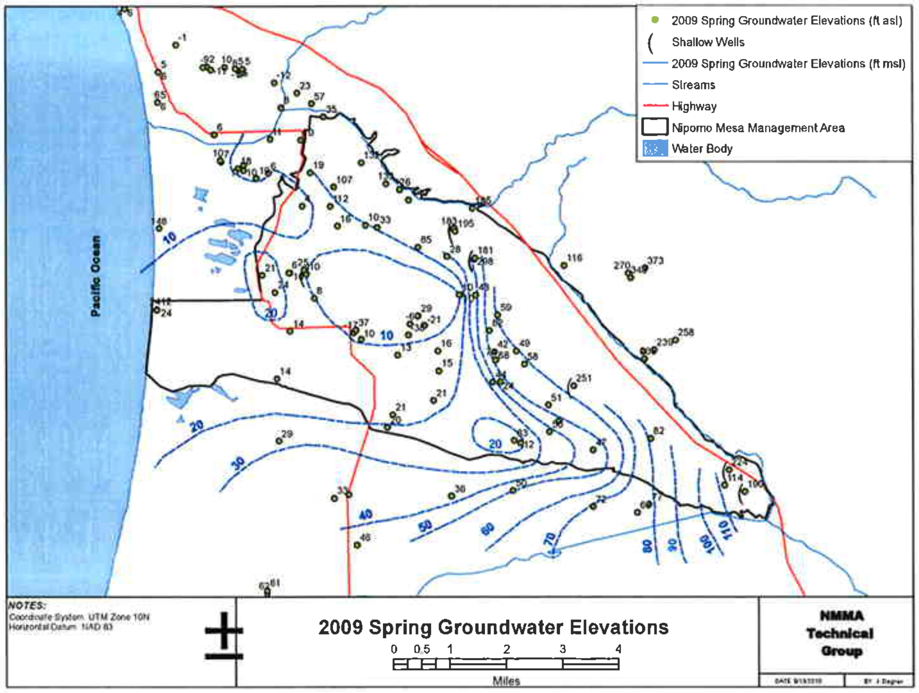
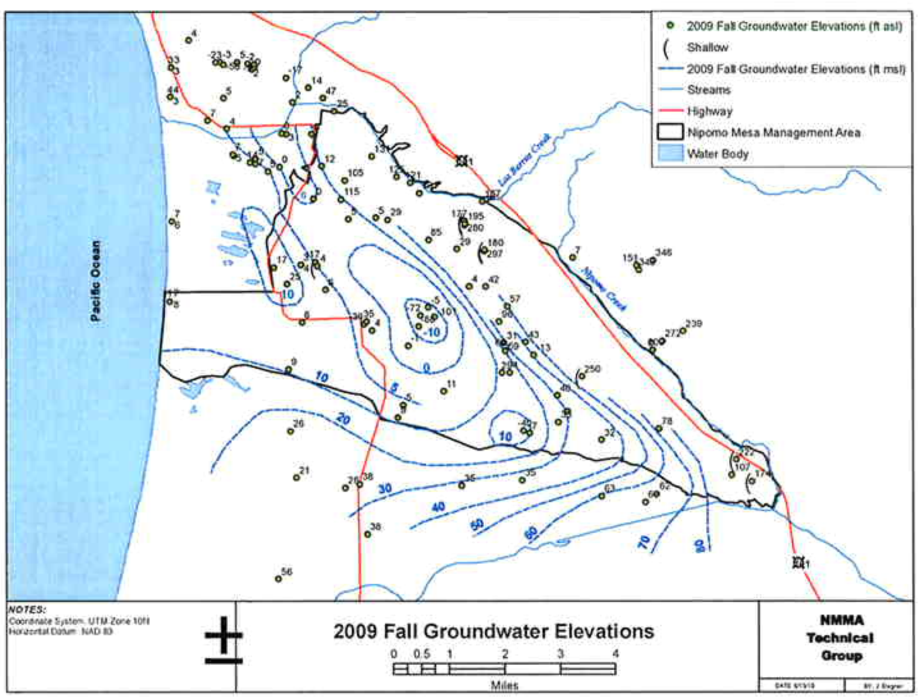
Horizontal Datum: NAD 83
1992 Fall Groundwater Elevations
0 0.5 1 2 3 4
Miles
NMMA
Technical
Group



2009 Spring Groundwater Elevations (ft asl)
Shallow Wells
2009 Spring Groundwater Elevations (ft msl)
Streams
Highway
Nipomo Mesa Management Area
Water Body
Pacific Ocean
NOTES:
Coordinate System: UTM Zone 10N
Horizontal Datum: NAD 83
2009 Spring Groundwater Elevations
0 0.5 1 2 3 4
Miles
NMMA Technical Group



2009 Fall Groundwater Elevations (ft asl)
Shallow
2009 Fall Groundwater Elevations (ft msl)
Streams
Highway
Nipomo Mesa Management Area
Water Body
Pacific Ocean
Los Berros Creek
Nipomo Creek
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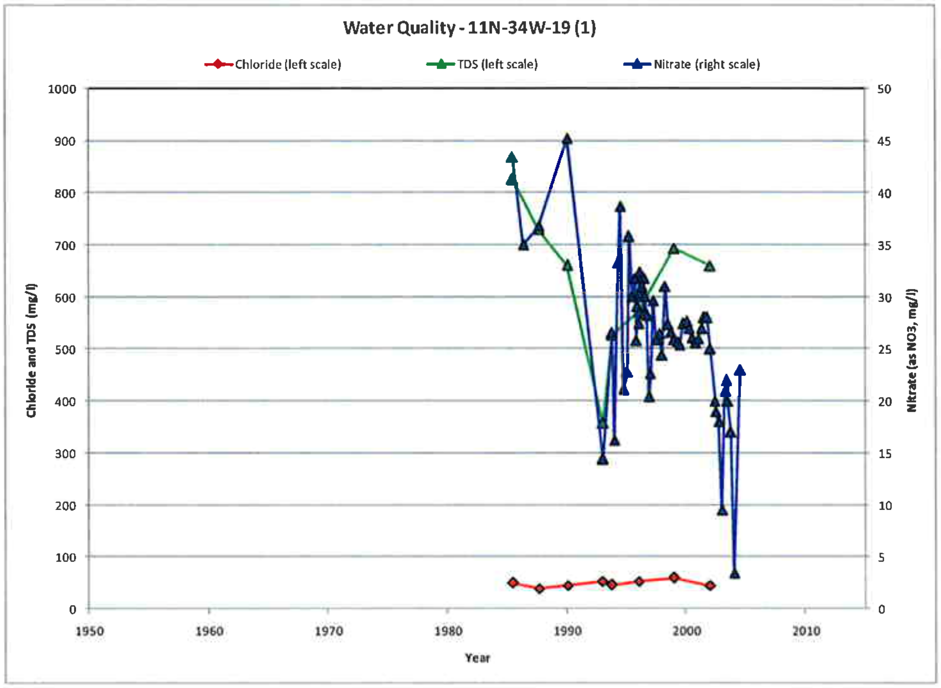
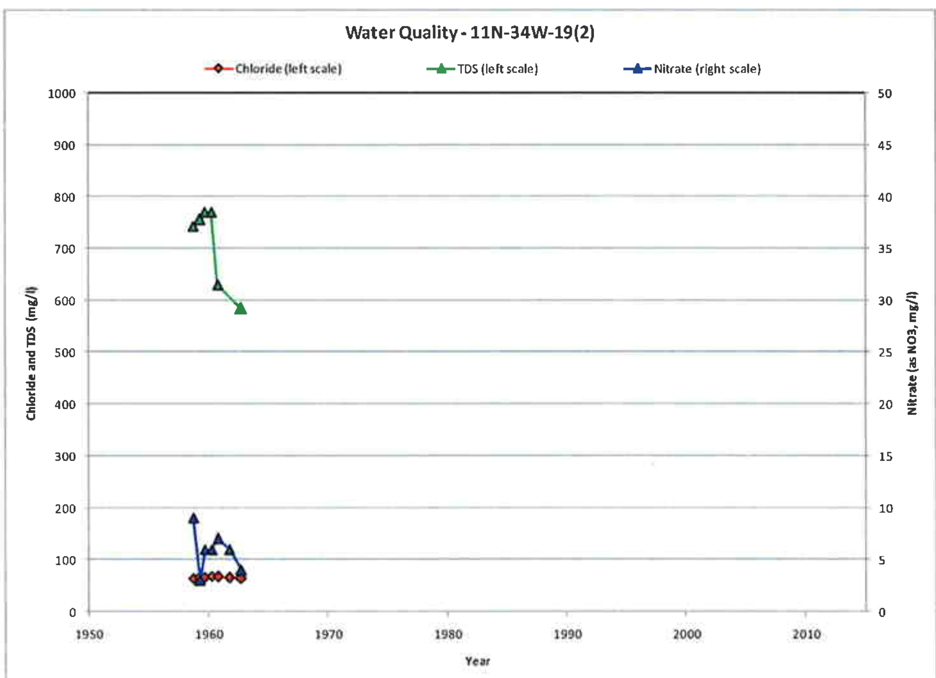
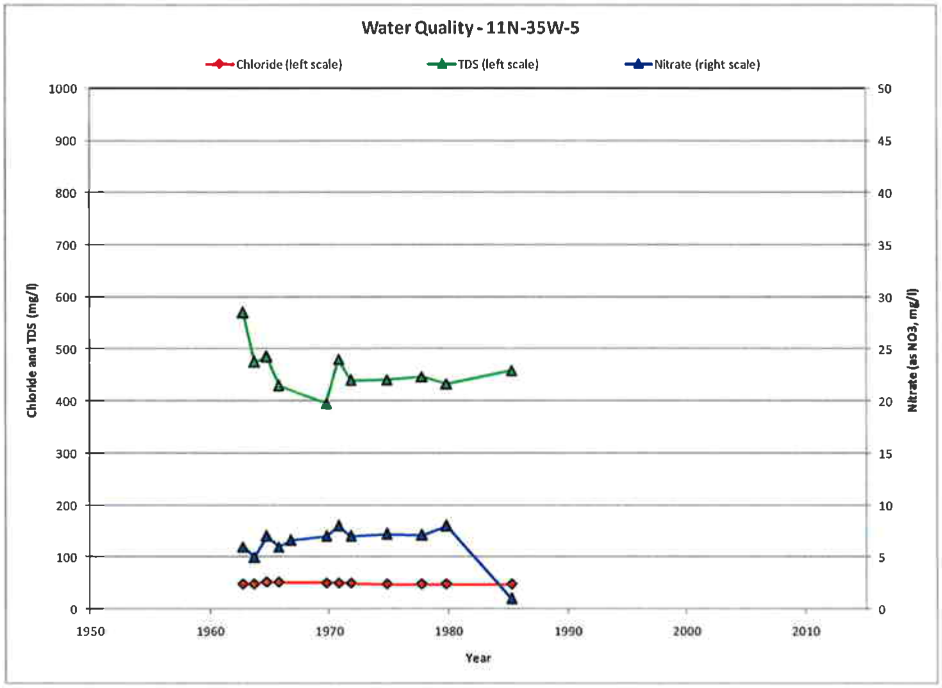
Coordinate System: UTM Zone 10N
Horizontal Datum: NAD 83
2009 Fall Groundwater Elevations
0 0.5 1 2 3 4
Miles
NMMA Technical Group

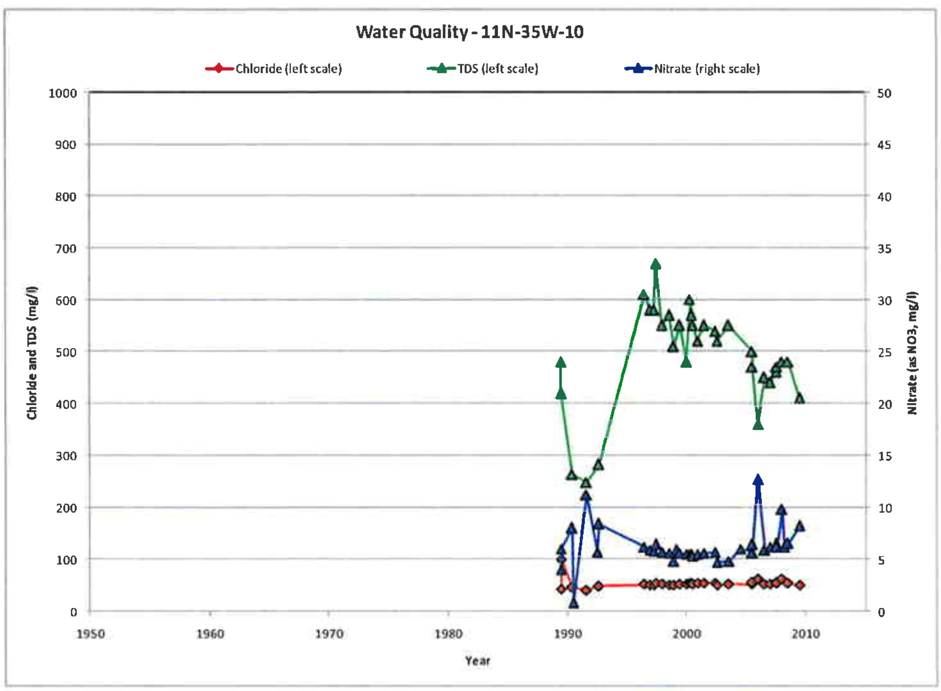
WQ Figures – Chloride, Nitrate and TDS concentrations for selected wells



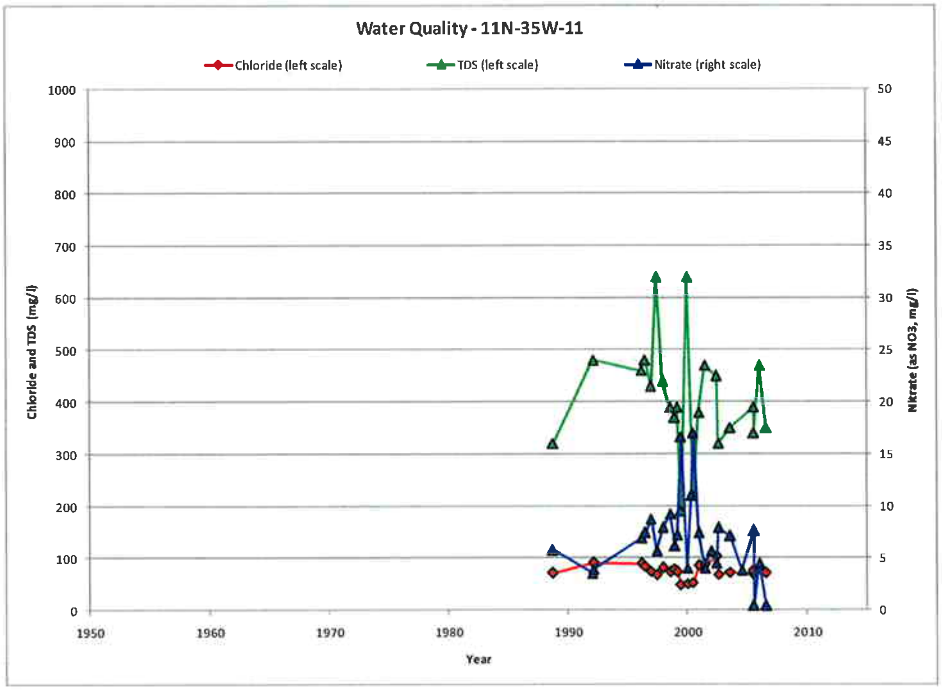


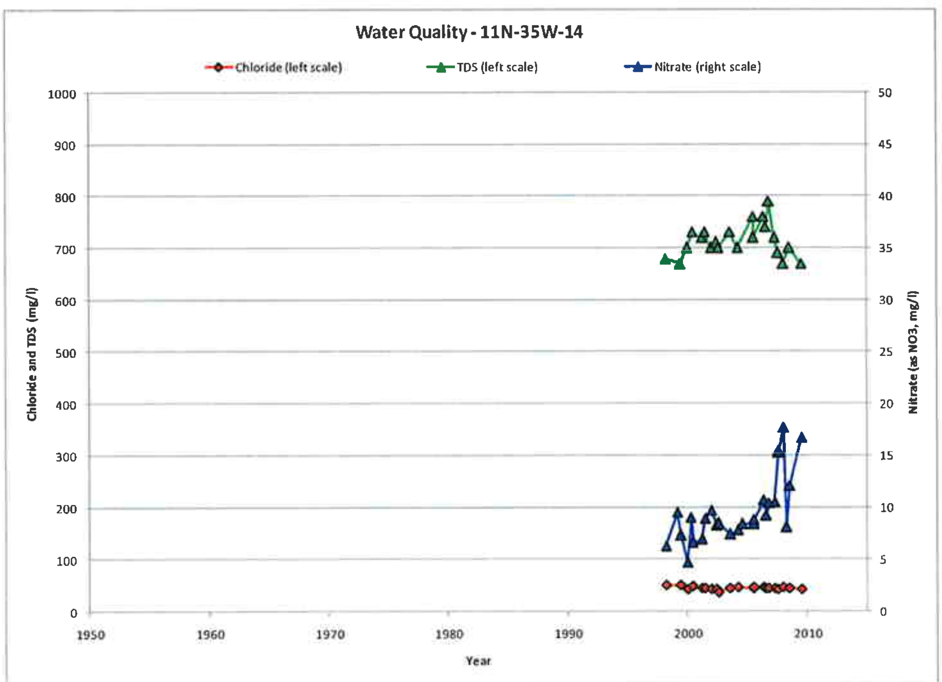


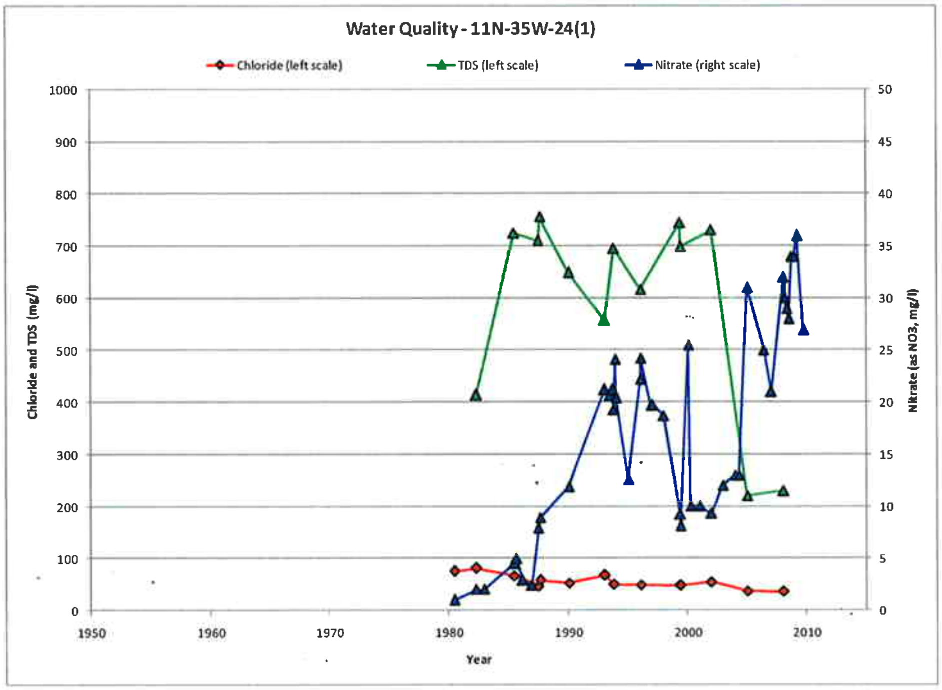
Water Quality - 11N-35W-5
Chloride (left scale)
TDS (left scale)
Nitrate (right scale)
Chloride and TDS (mg/l)
Nitrate (as NO3, mg/l)
Year

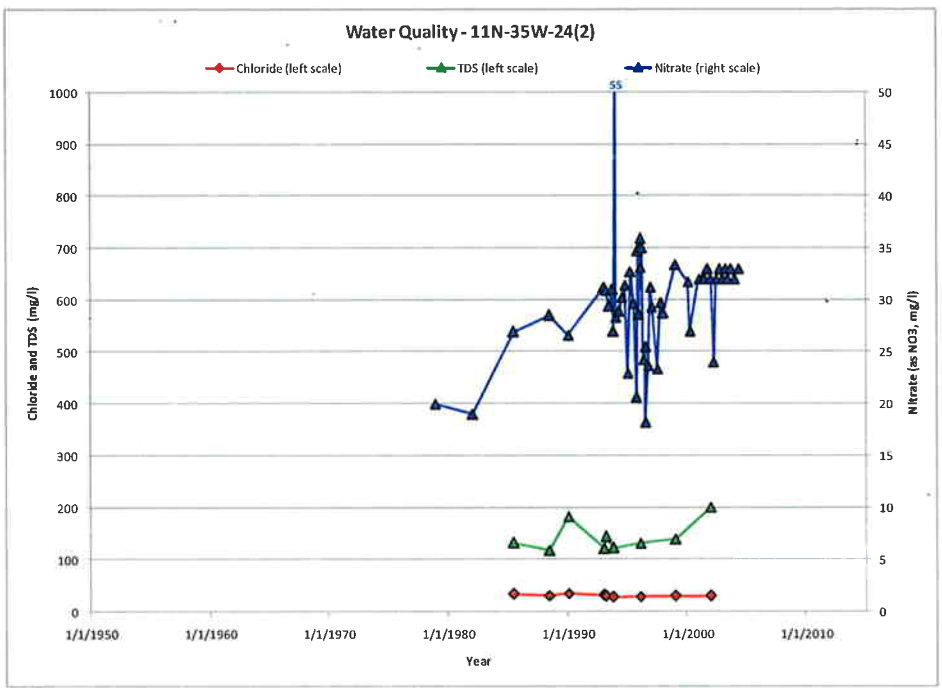


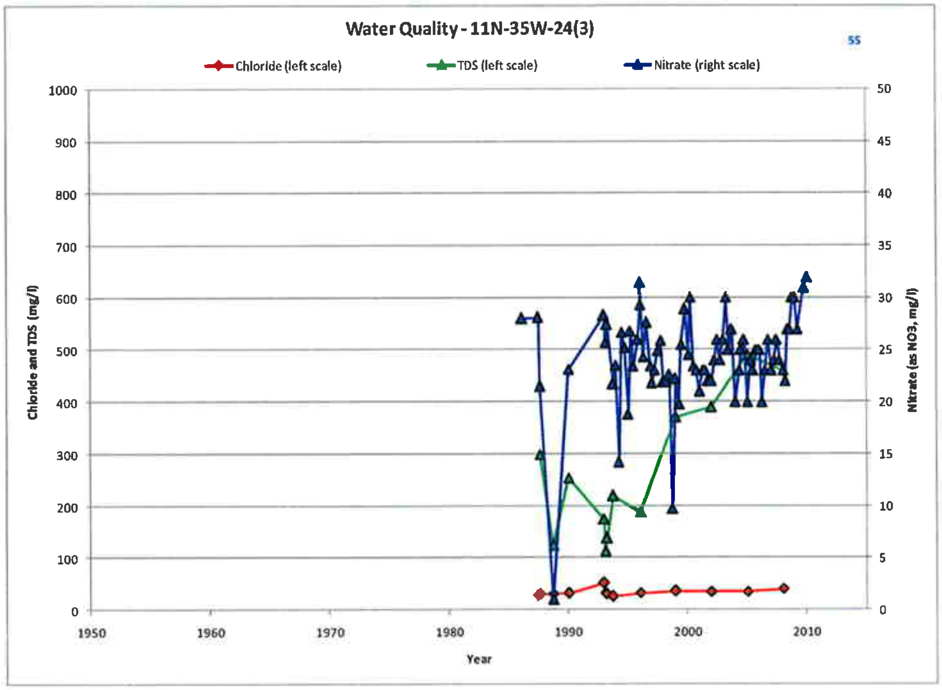
Water Quality - 11N-35W-10
Chloride (left scale)
TDS (left scale)
Nitrate (right scale)
Chloride and TDS (mg/l)
Nitrate (as NO3, mg/l)
Year


Water Quality - 11N-35W-11
Chloride (left scale)
TDS (left scale)
Nitrate (right scale)
Chloride and TDS (mg/l)
Nitrate (as NO3, mg/l)
Year
0
100
200
300
400
500
600
700
800
900
1000
0
5
10
15
20
25
30
35
40
45
50
1950
1960
1970
1980
1990
2000
2010


Water Quality - 11N-35W-14
Chloride (left scale)
TDS (left scale)
Nitrate (right scale)
Chloride and TDS (mg/l)
Nitrate (as NO3, mg/l)
Year
0
100
200
300
400
500
600
700
800
900
1000
0
5
10
15
20
25
30
35
40
45
50
1950
1960
1970
1980
1990
2000
2010


Water Quality - 11N-35W-24(1)
Chloride (left scale)
TDS (left scale)
Nitrate (right scale)
Chloride and TDS (mg/l)
Nitrate (as NO3, mg/l)
Year
1000
900
800
700
600
500
400
300
200
100
0
50
45
40
35
30
25
20
15
10
5
0
1950
1960
1970
1980
1990
2000
2010

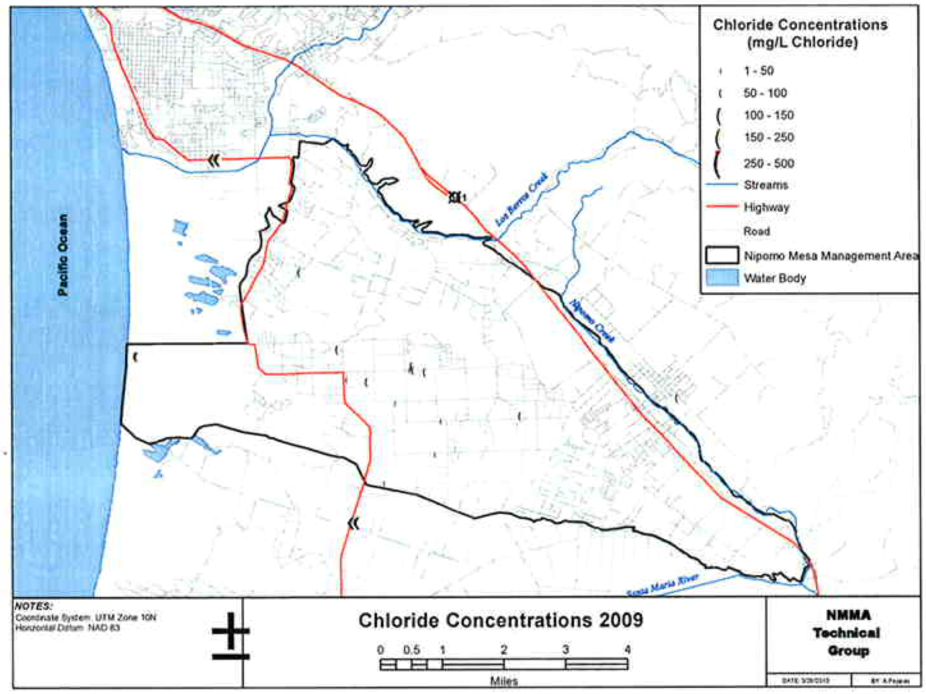

Water Quality - 11N-35W-24(2)
Chloride (left scale)
TDS (left scale)
Nitrate (right scale)
55
Chloride and TDS (mg/l)
Nitrate (as NO3, mg/l)
Year
1000
900
800
700
600
500
400
300
200
100
0
50
45
40
35
30
25
20
15
10
5
0
1/1/1950
1/1/1960
1/1/1970
1/1/1980
1/1/1990
1/1/2000
1/1/2010



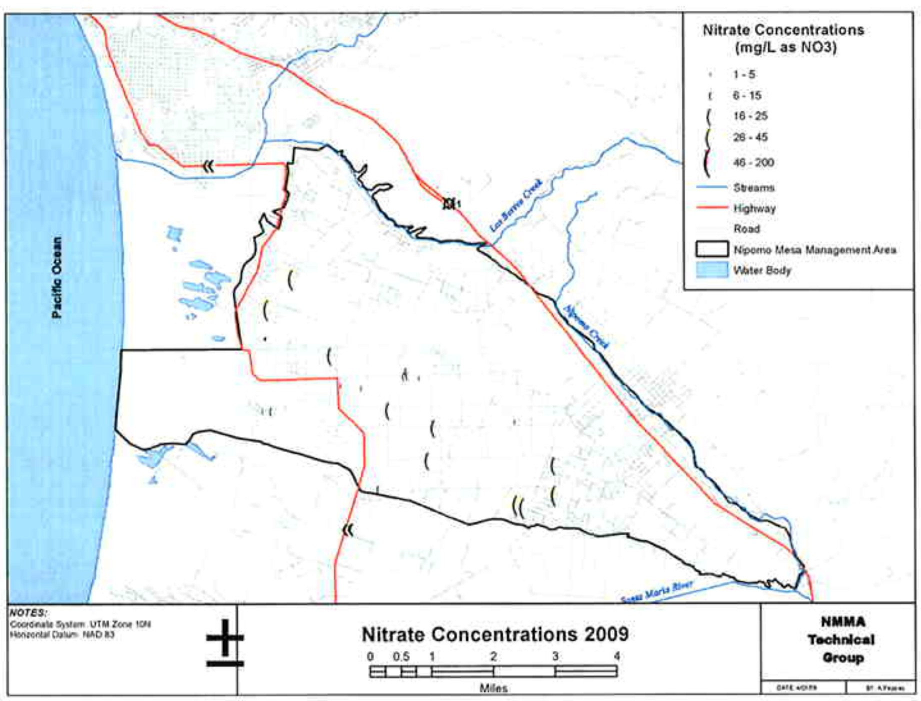
Water Quality - 11N-35W-24(3)
55
Chloride (left scale)
TDS (left scale)
Nitrate (right scale)
Chloride and TDS (mg/l)
Nitrate (as NO3, mg/l)
Year
1000
900
800
700
600
500
400
300
200
100
0
50
45
40
35
30
25
20
15
10
5
0
1950
1960
1970
1980
1990
2000
2010

NMMA groundwater quality sampling data in 2009. (A) Chloride; (B) Nitrate; (C) Total Dissolved Solids. See report text for discussion.

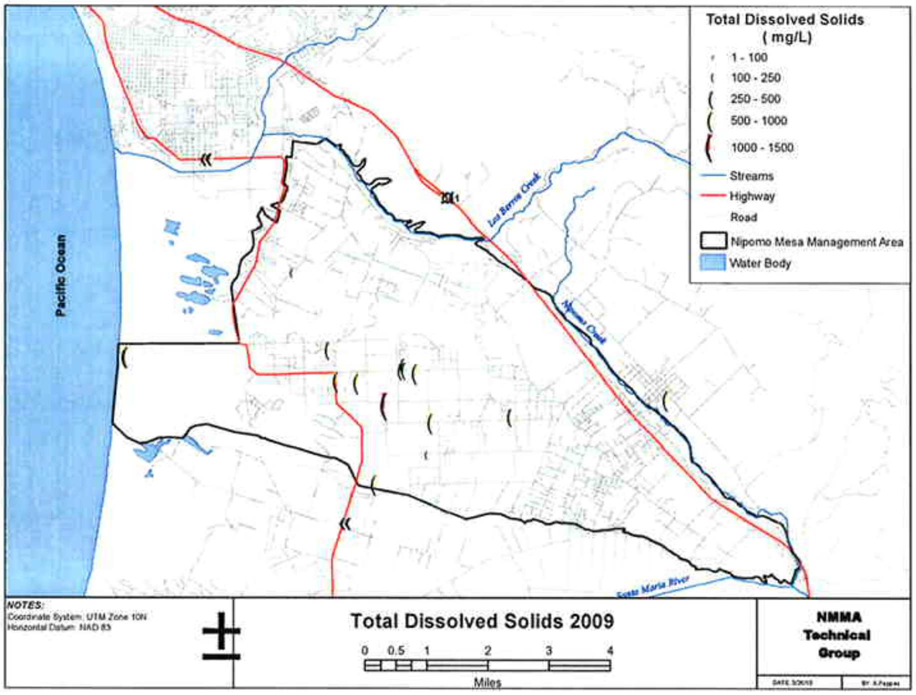
(A) Chloride



(B) Nitrate



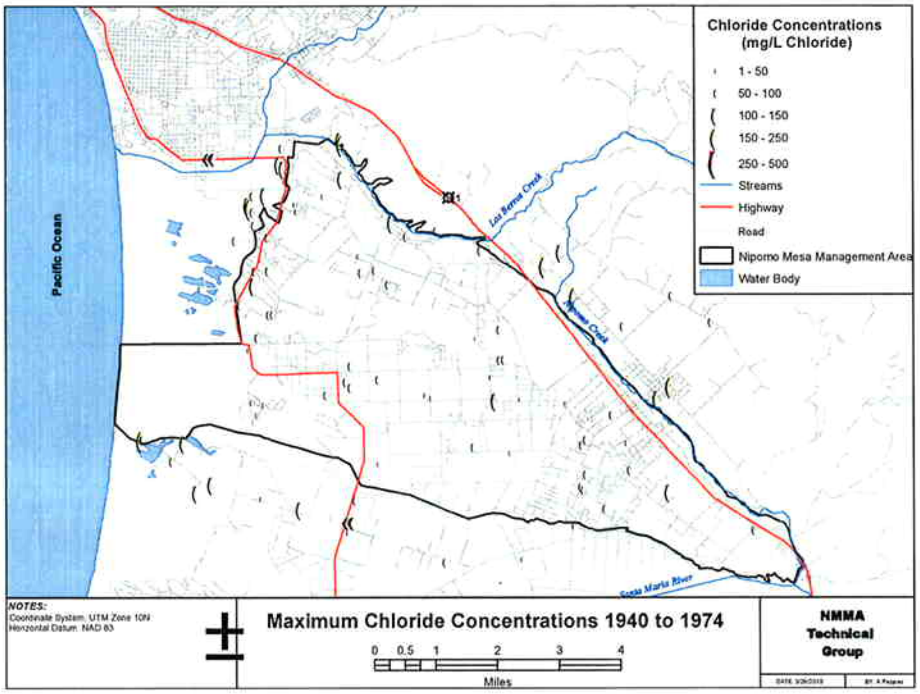
(C) TDS



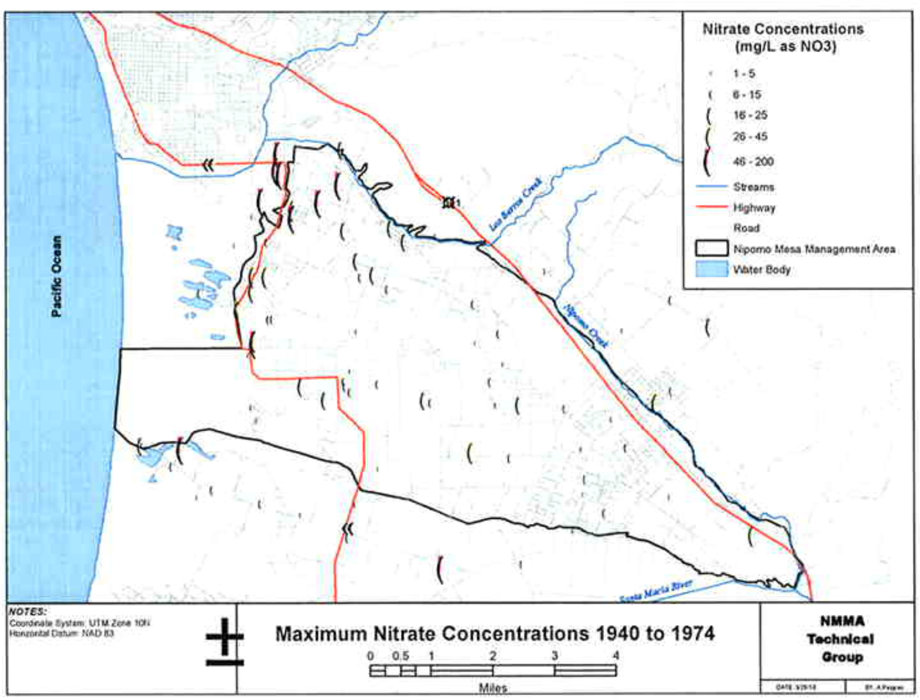
Total Dissolved Solids
(mg/L)
1 - 100
100 - 250
250 - 500
500 - 1000
1000 - 1500
Streams
Highway
Road
Nipomo Mesa Management Area
Water Body
Pacific Ocean
Los Berros Creek
Nipomo Creek
Santa Maria River
NOTES:
Coordinate System: UTM Zone 10N
Horizontal Datum: NAD 83
Total Dissolved Solids 2009
0 0.5 1 2 3 4
Miles
NMMA
Technical
Group

NMMA groundwater quality for the period 1940-1974. This period includes the earliest available groundwater quality data and is characterized by generally drier than average precipitation conditions. (A) Chloride; (B) Nitrate; (C) Total Dissolved Solids.

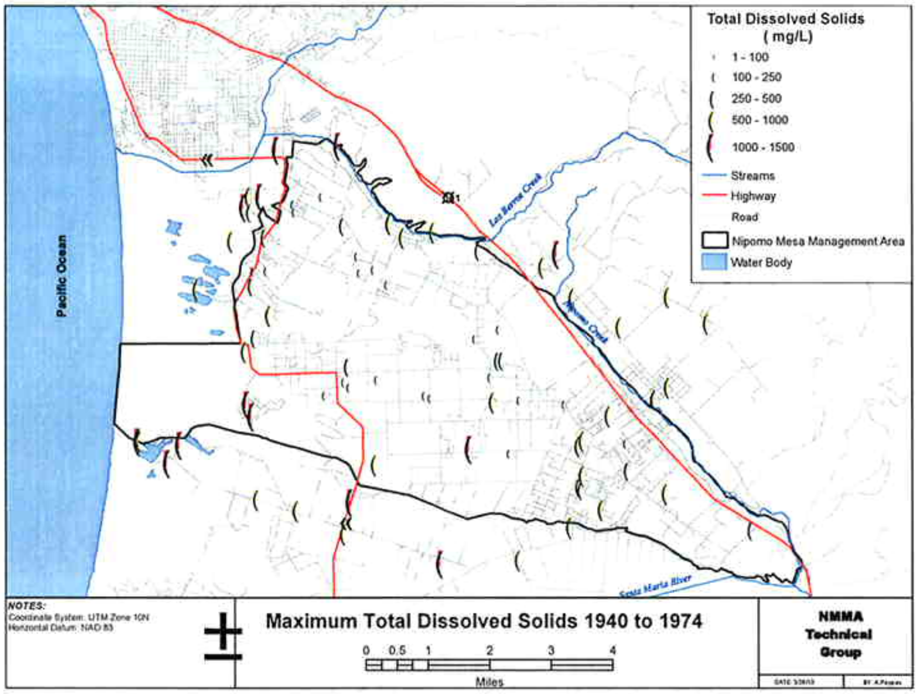
(A) Chloride



(B) Nitrate

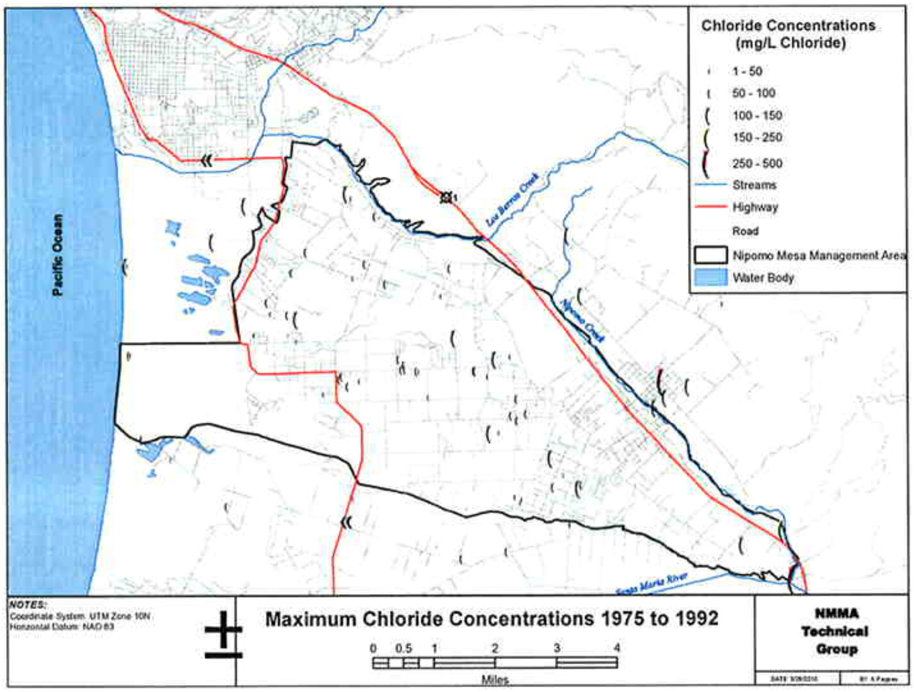


(C) TDS

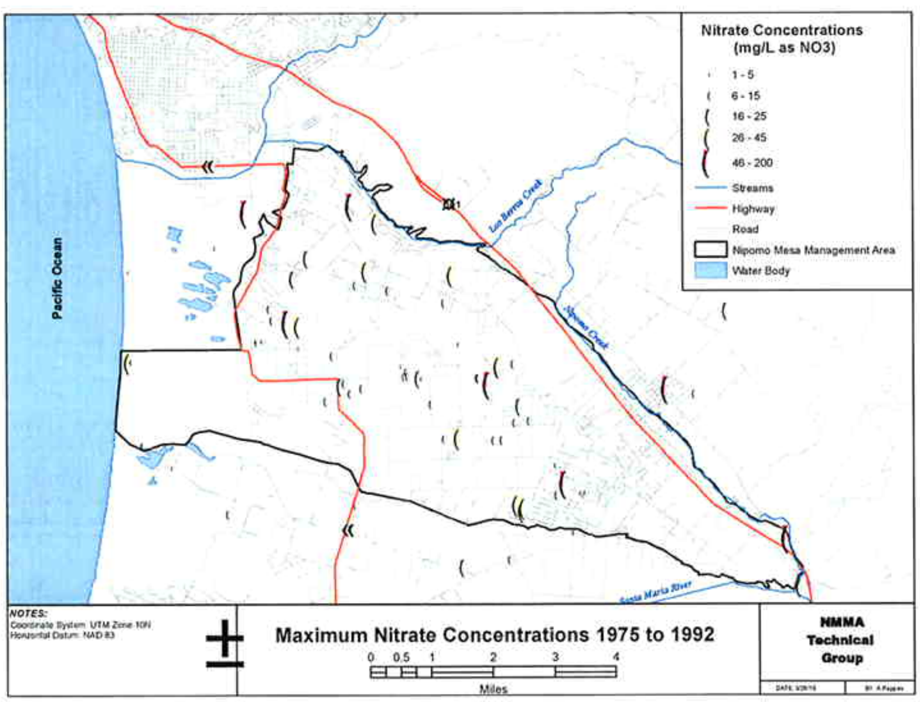

Total Dissolved Solids
(mg/L)
1 - 100
100 - 250
250 - 500
500 - 1000
1000 - 1500
Streams
Highway
Road
Nipomo Mesa Management Area
Water Body
Pacific Ocean
Los Berros Creek
Nipomo Creek
Santa Maria River
NOTES:
Coordinate System: UTM Zone 10N
Horizontal Datum: NAD 83
Maximum Total Dissolved Solids 1940 to 1974
0 0.5 1 2 3 4
Miles
NMMA
Technical
Group

NMMA groundwater quality for the period 1975-1992. This period includes both relatively wet and dry precipitation conditions. (A) Chloride; (B) Nitrate; (C) Total Dissolved Solids.

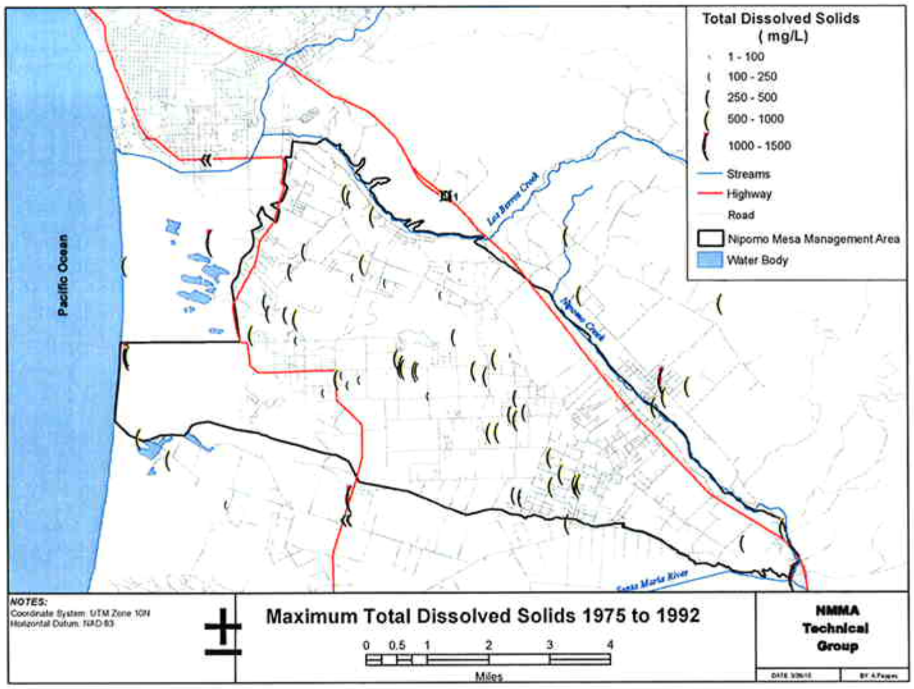
(A) Chloride



(B) Nitrate



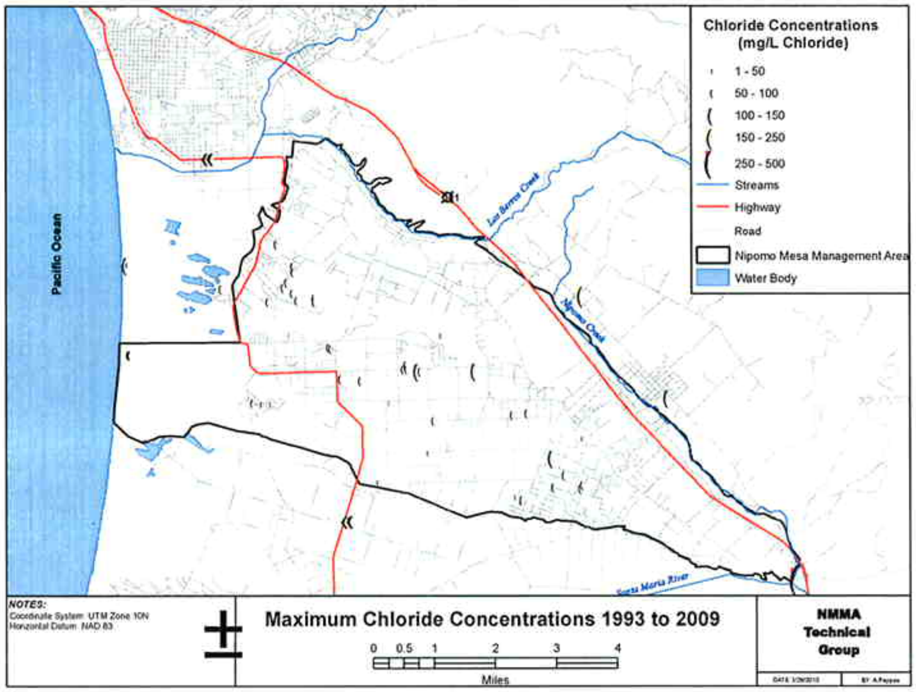
(C) TDS



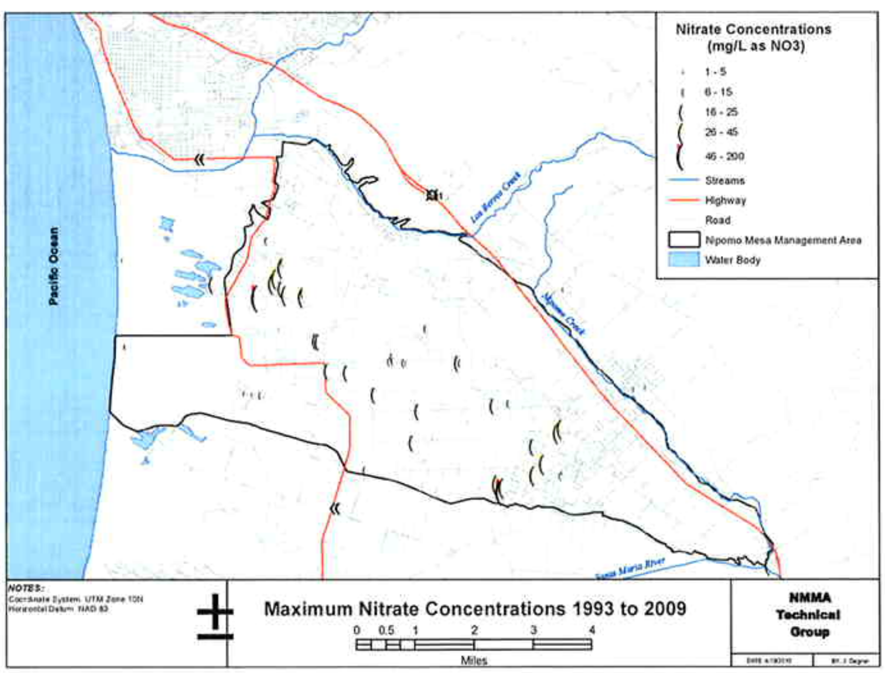
Total Dissolved Solids
(mg/L)
1 - 100
100 - 250
250 - 500
500 - 1000
1000 - 1500
Streams
Highway
Road
Nipomo Mesa Management Area
Water Body
Pacific Ocean
Los Berros Creek
Nipomo Creek
Santa Maria River
NOTES:
Coordinate System: UTM Zone 10N
Horizontal Datum: NAD 83
Maximum Total Dissolved Solids 1975 to 1992
0 0.5 1 2 3 4
Miles
NMMA
Technical
Group

NMMA groundwater quality for the period 1993-2009. This period includes the most recent available groundwater quality data and has had somewhat wetter than average precipitation conditions overall. (A) Chloride; (B) Nitrate; (C) Total Dissolved Solids.

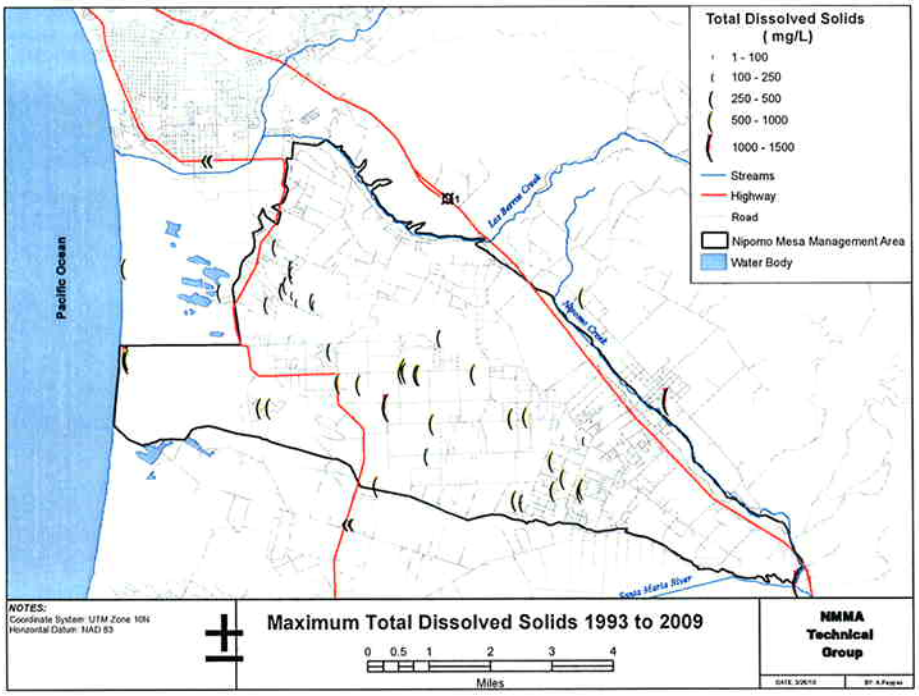
(A) Chloride



(B) Nitrate



(C) TDS


Total Dissolved Solids
(mg/L)
1 - 100
100 - 250
250 - 500
500 - 1000
1000 - 1500
Streams
Highway
Road
Nipomo Mesa Management Area
Water Body
Pacific Ocean
Los Berros Creek
Nipomo Creek
Santa Maria River
NOTES:
Coordinate System: UTM Zone 10N
Horizontal Datum: NAD 83
Maximum Total Dissolved Solids 1993 to 2009
0 0.5 1 2 3 4
Miles
NMMA
Technical
Group