# Nipomo Mesa Management Area

## 2nd Annual Report

## Calendar Year 2009

**Prepared by**

**NMMA Technical Group**

**Submitted June 2010**

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**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). Coastal water quality and water levels continue to be better than thresholds for Water Shortage Conditions (i.e., chloride concentrations are less than threshold concentrations and groundwater elevations are higher than threshold elevations). Potentially Severe Water Shortage Conditions trigger 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 smaller than last year (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 have completed the purveyor Well Management Plan (see Section 1.1.6 Well Management Plan).

7. 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).

8. 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).

9. 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).

10. 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** |

11. 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).

12. Contour maps prepared using spring and fall 2009 groundwater elevations suggests 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).

13. 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).

14. There is no evidence of any water quality issues including seawater intrusion 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).

15. 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).

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 a new 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 ES-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 |

Note: It is anticipated that these two technical tasks would be accomplished cooperatively by TG members without the need for contracting outside services.

- **Well Management Plan –** It is recommended that for calendar year 2010, purveyors compile and present to the TG a Well Management Plan status update.

- **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).

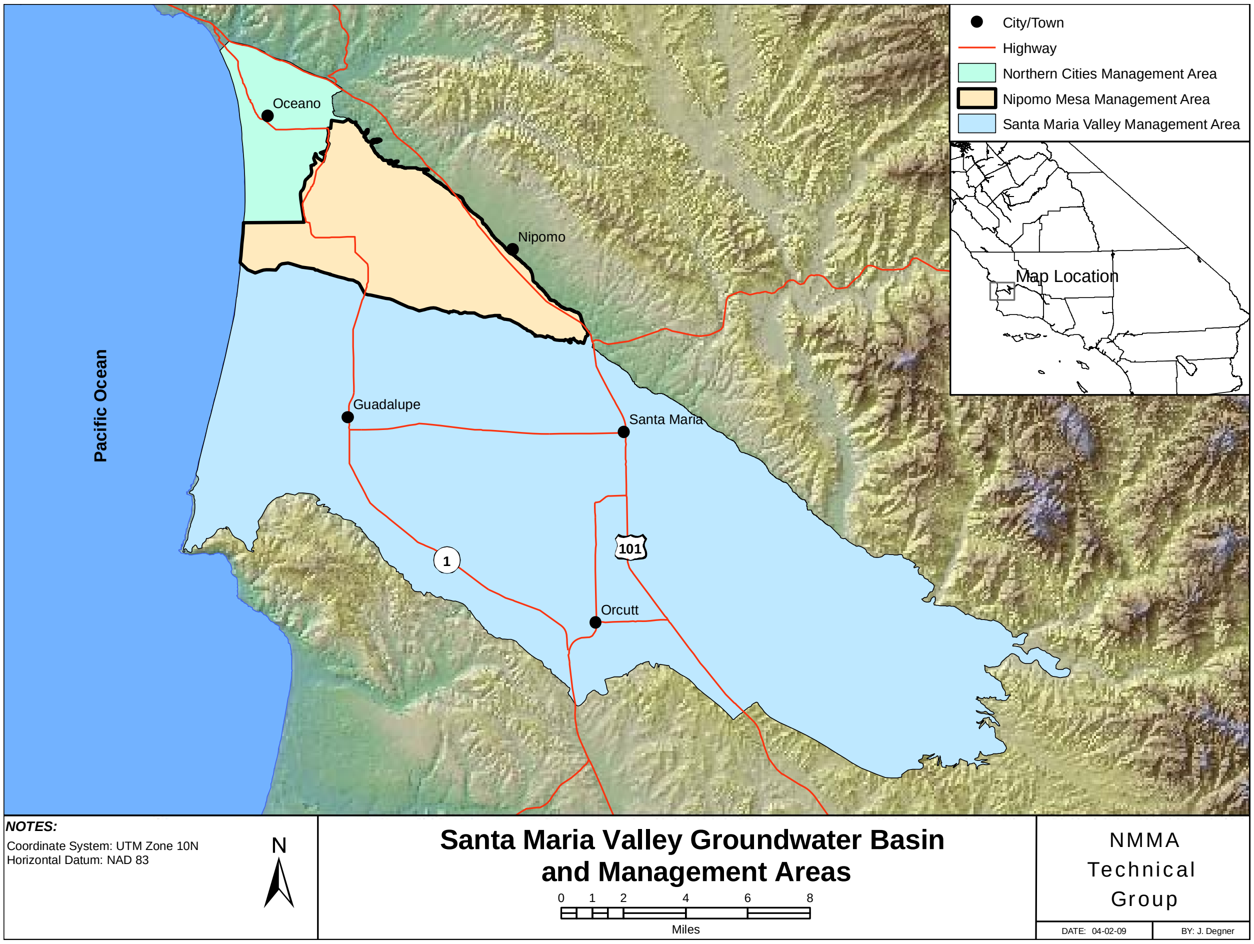


**Figure 1-1. Santa Maria Valley Groundwater Basin and Management Areas**

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.
[2] Jacqueline Frederick replaced Carl Holloway as the Stipulating Party representing Agriculture.

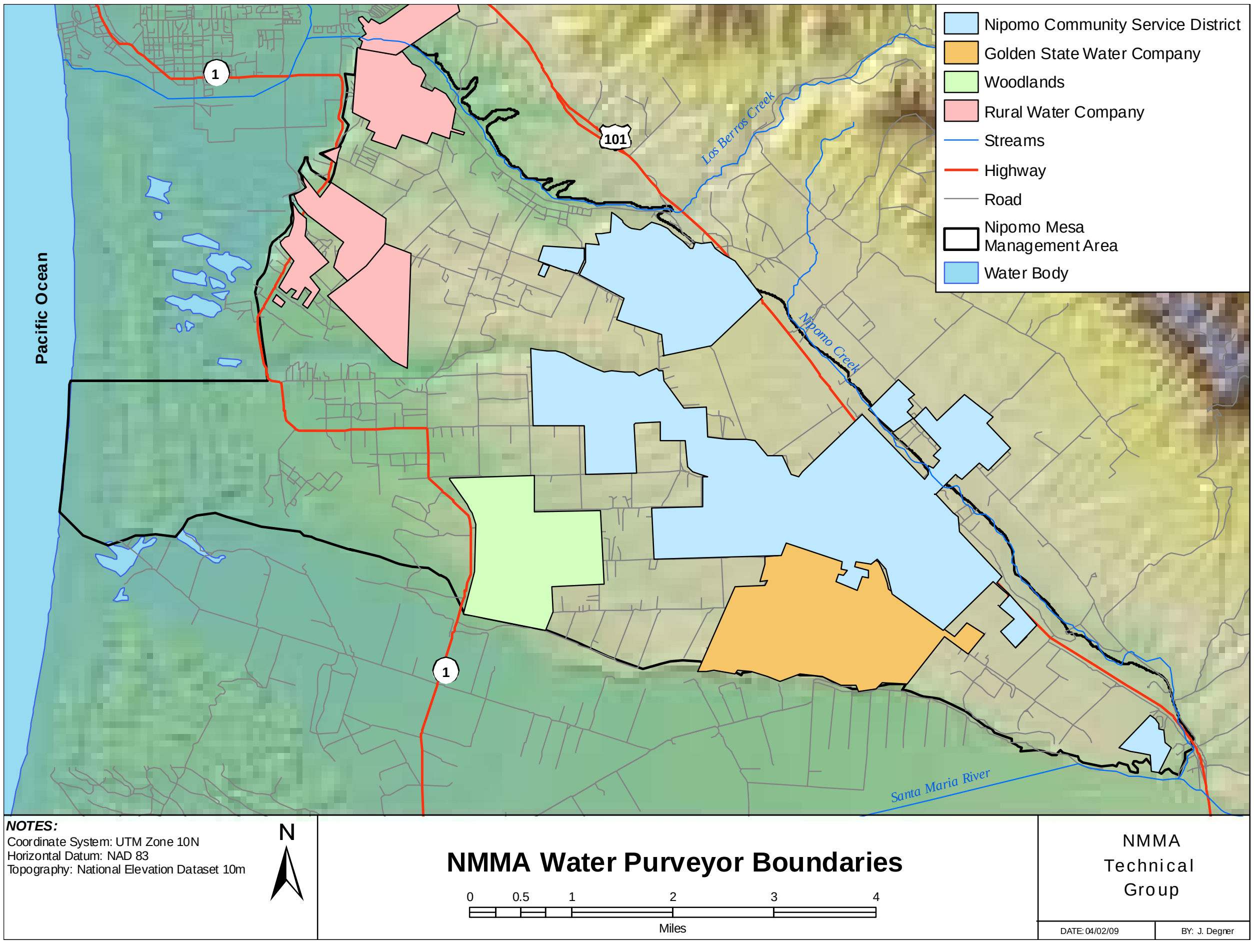


**Figure 1-2. NMMA Water Purveyor Boundaries**

### 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.

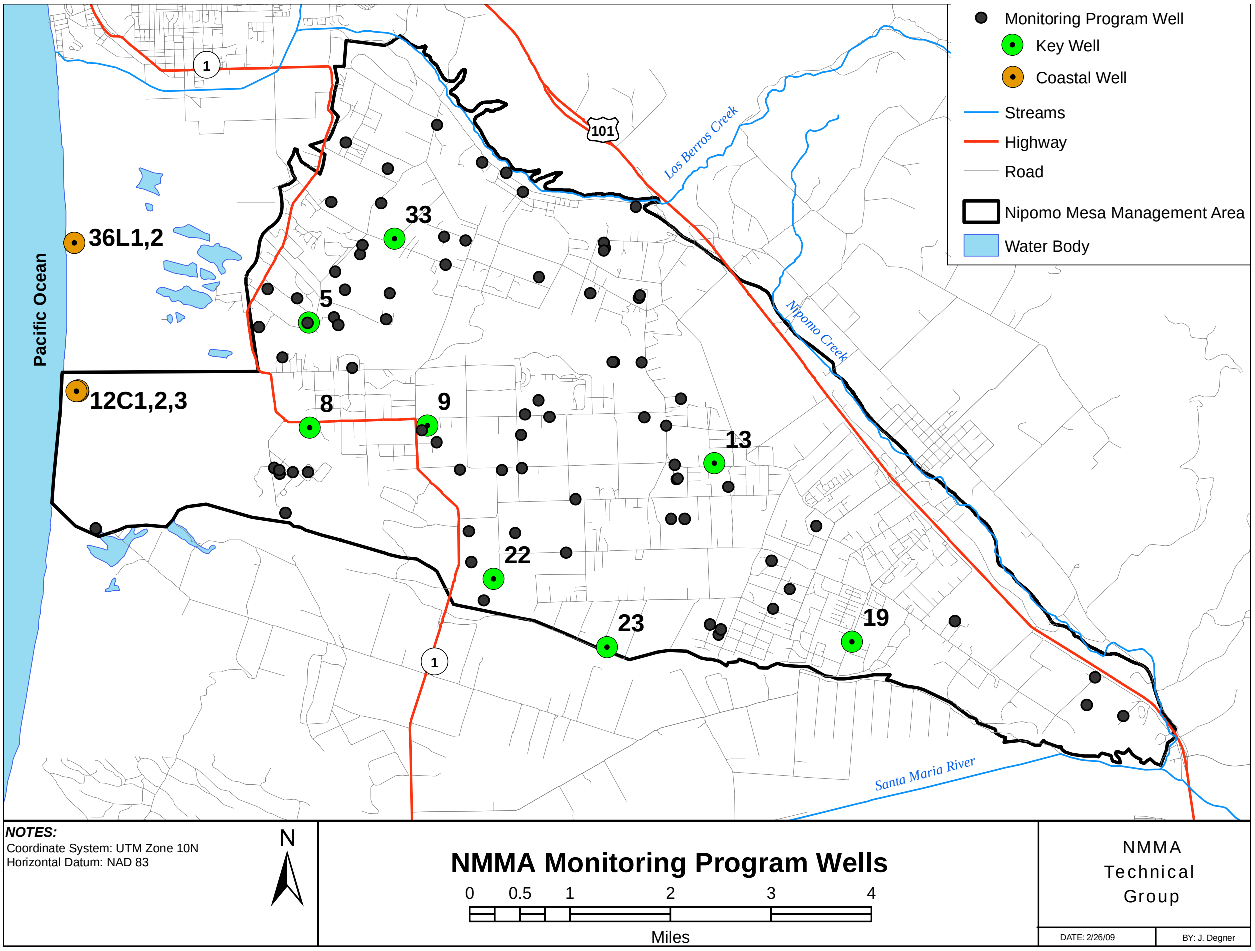


**Figure 1-3. NMMA Monitoring Program Wells**

### 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[3] 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 provisions in the Stipulation regarding Supplemental Water provide 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 final Judgment entered on January 24, 2008, states: "The court approves the Stipulation, orders the Stipulating Parties only to comply with each and every term thereof, and incorporates the same

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

herein as though set forth in full." Thus, the terms of the Stipulation as herein stated must be complied with in accordance with the order of the Court.

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 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**

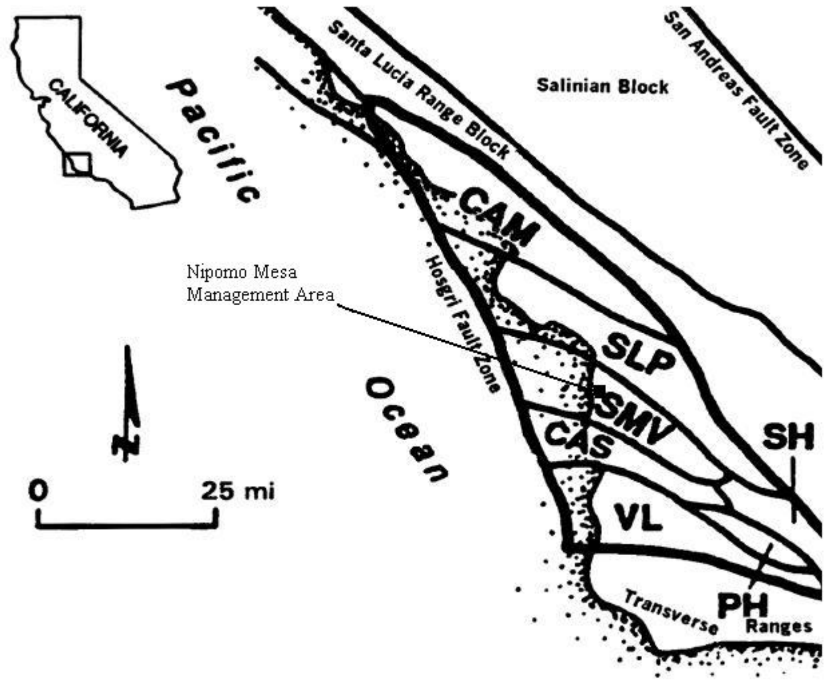


Figure simplified from Lettis, et al., 1994. Abbreviations are: CAM = Cambria block, SLP = San Luis/Pismo block, SMV = Santa Maria Valley block, CAS = Casmalia block, VL = Vandenberg/Lompoc block, PH = Purisima Hills block, SH = Solomon Hills block.

**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).

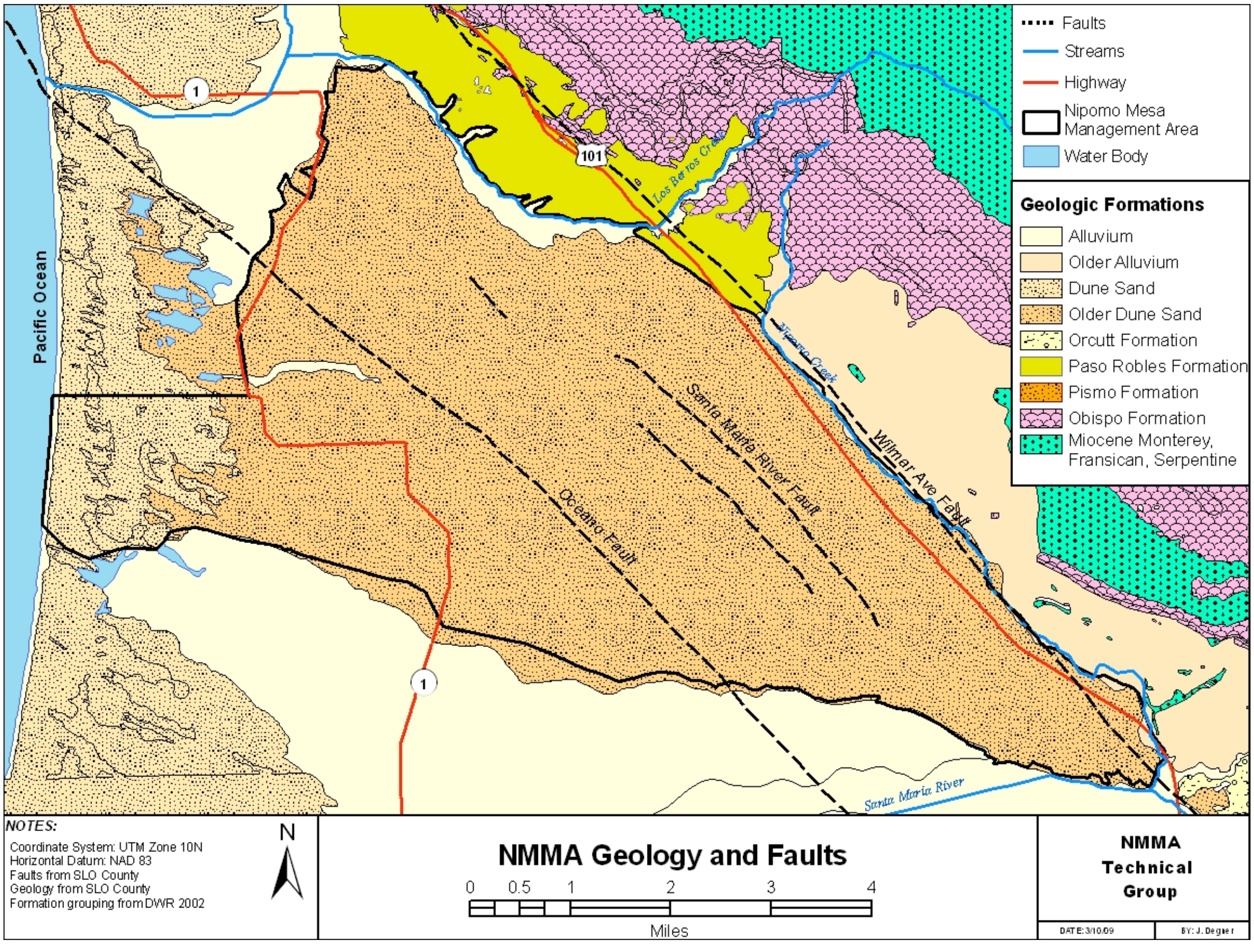


**Figure 2-2. NMMA Geology and Faults.**

### *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 x $10^{-4}$ 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).

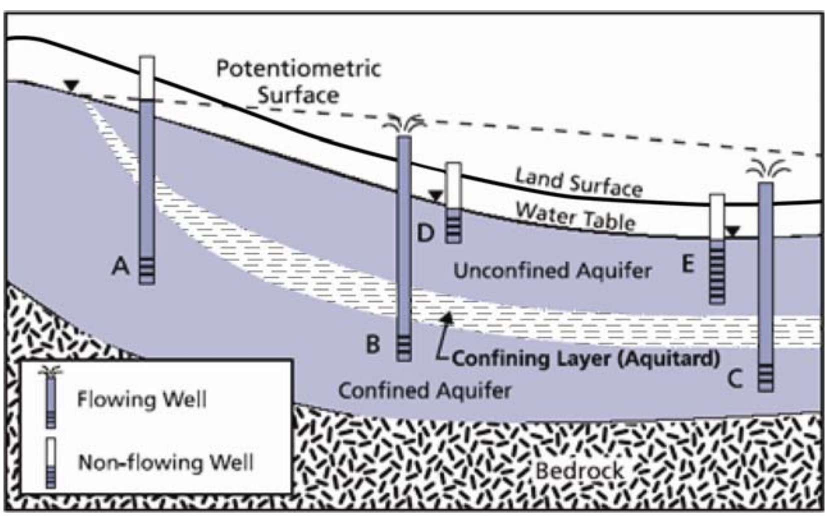


**Figure 2-3. Schematic of Confining Layer and Confined Aquifer (Bachman et al, 2005).**

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.

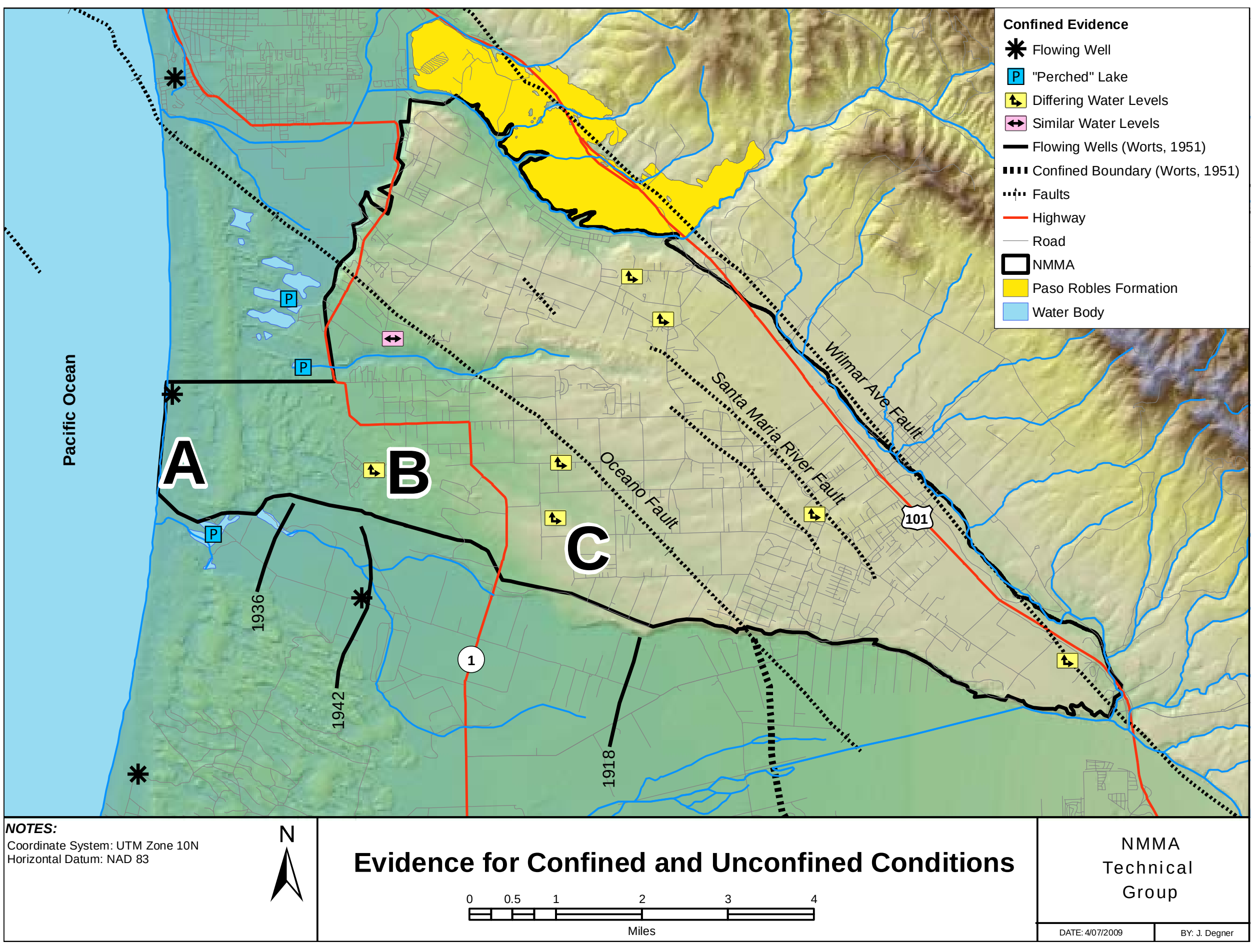


**Figure 2-4. Locations of potential evidence for confined or unconfined conditions within the Deep Aquifer.** *Flowing Well: historical artesian flow above ground surface; "Perched" Lake: lakes separated from Deep Aquifer by confining layer; Differing Water Levels: nearby wells in Shallow and Deep aquifers 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 Valley, 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 do 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 could 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).

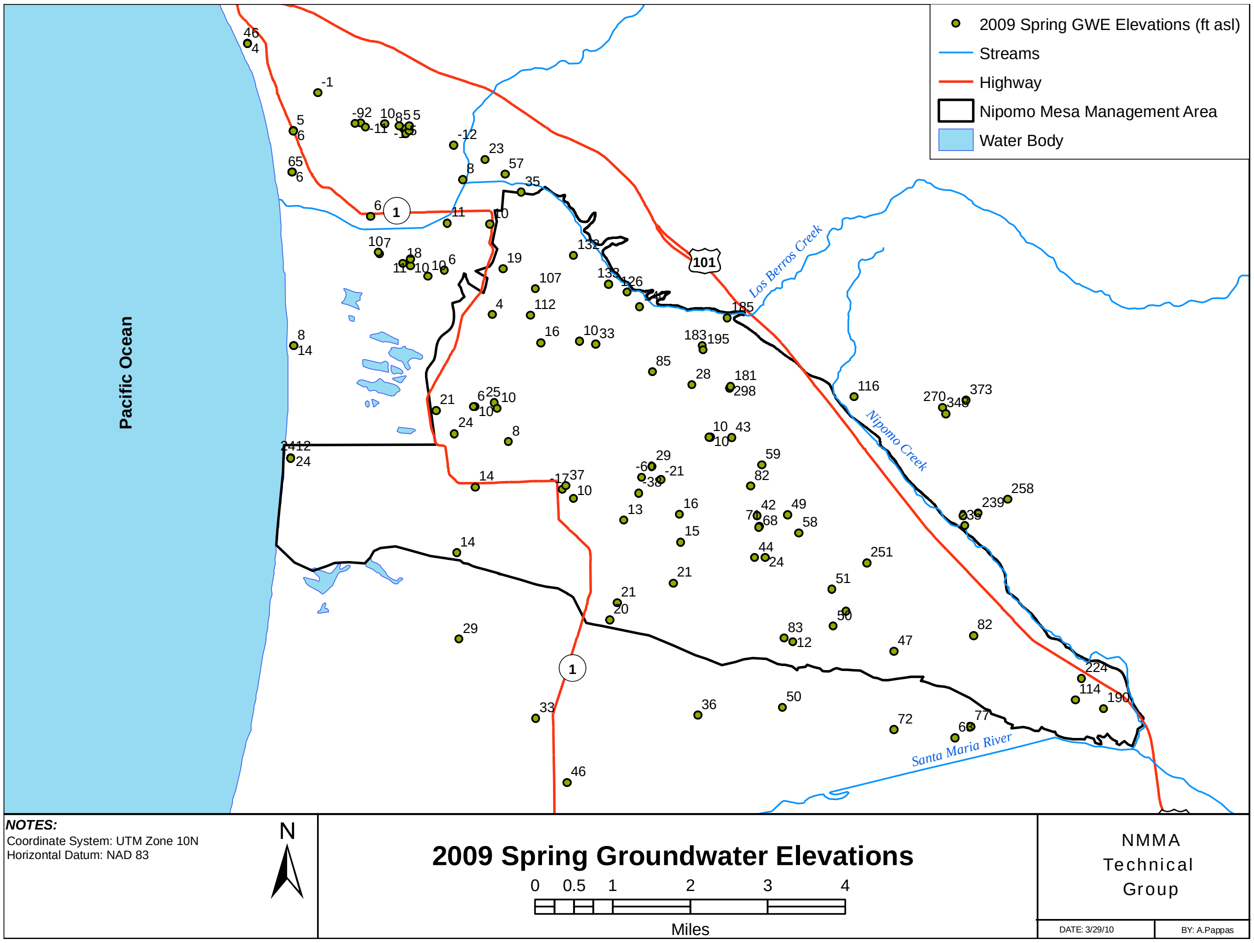


**Figure 3-1. 2009 Spring Groundwater Elevations**

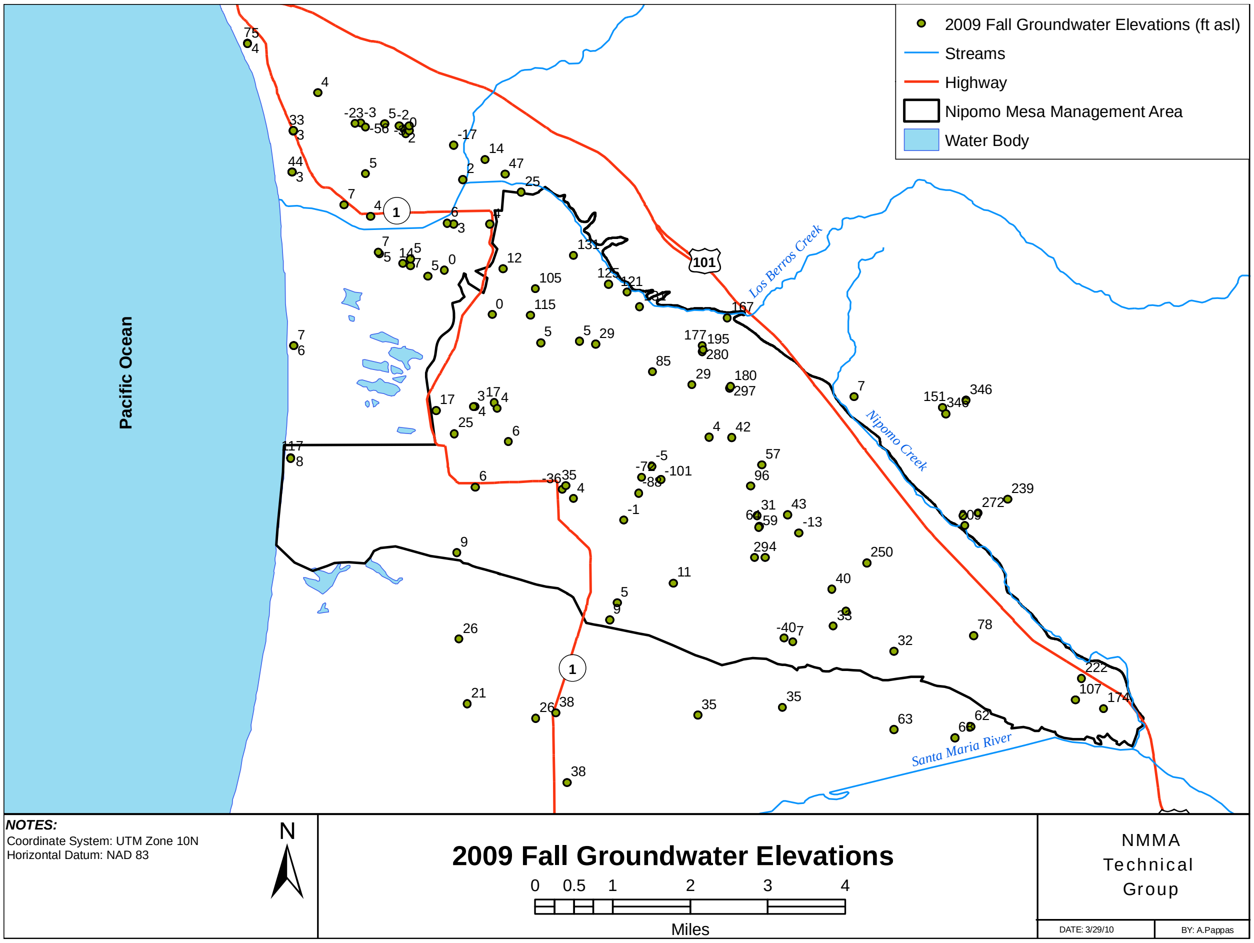


**Figure 3-2. 2009 Fall Groundwater Elevations**

### 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.

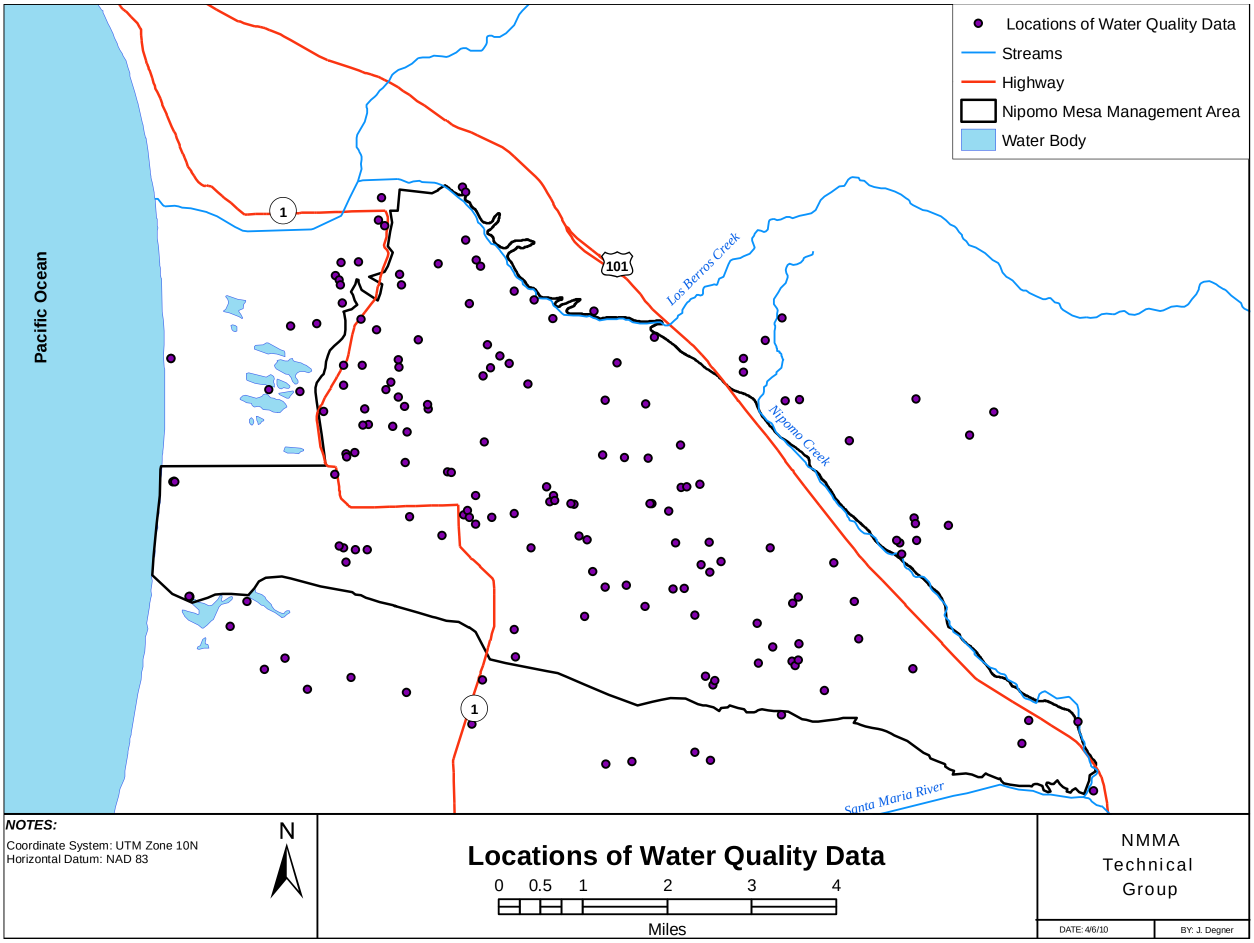


**Figure 3-3. Locations of Water Quality Data**

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.

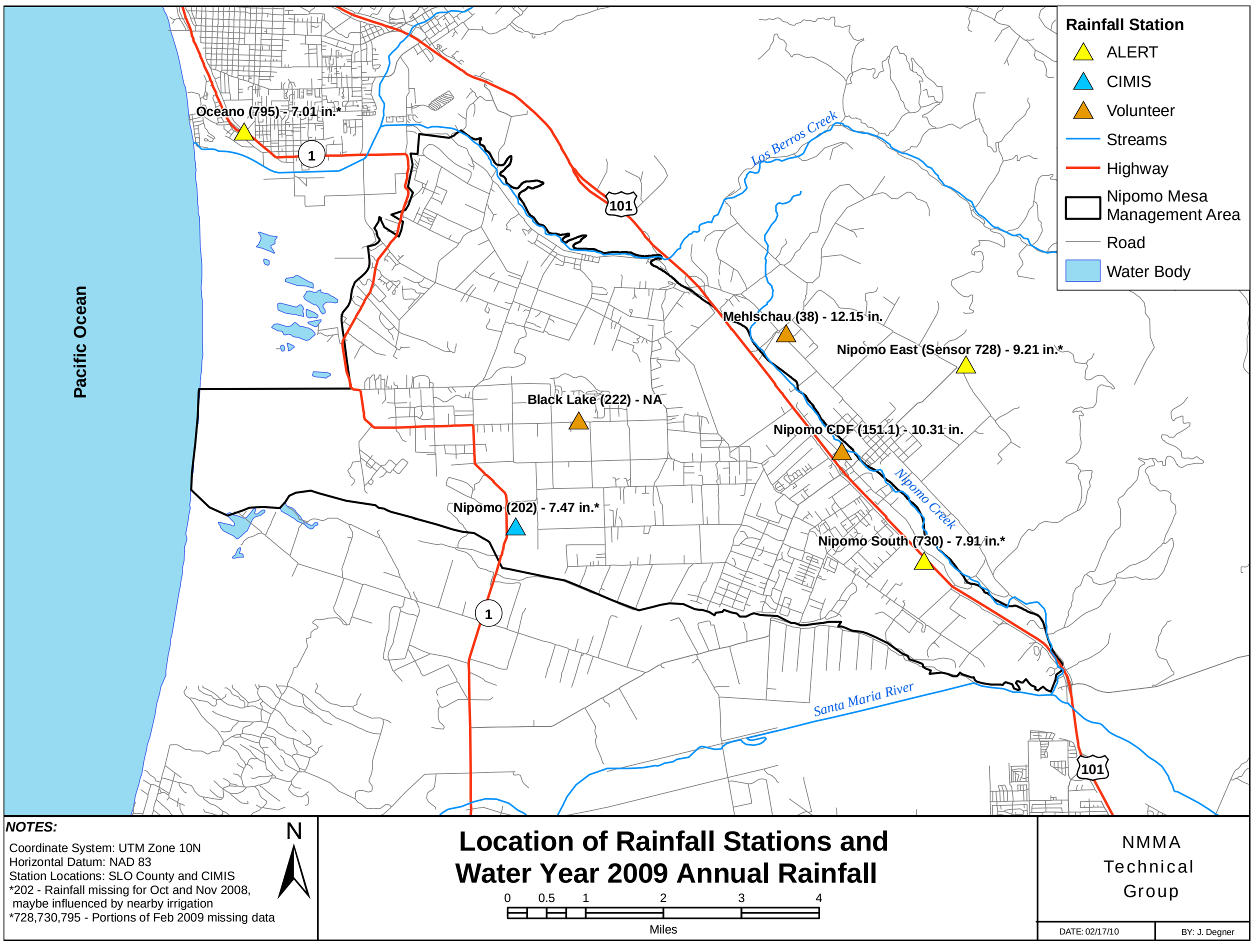


**Figure 3-4. Rainfall Station Location and Water Year 2009 Annual Rainfall**

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.

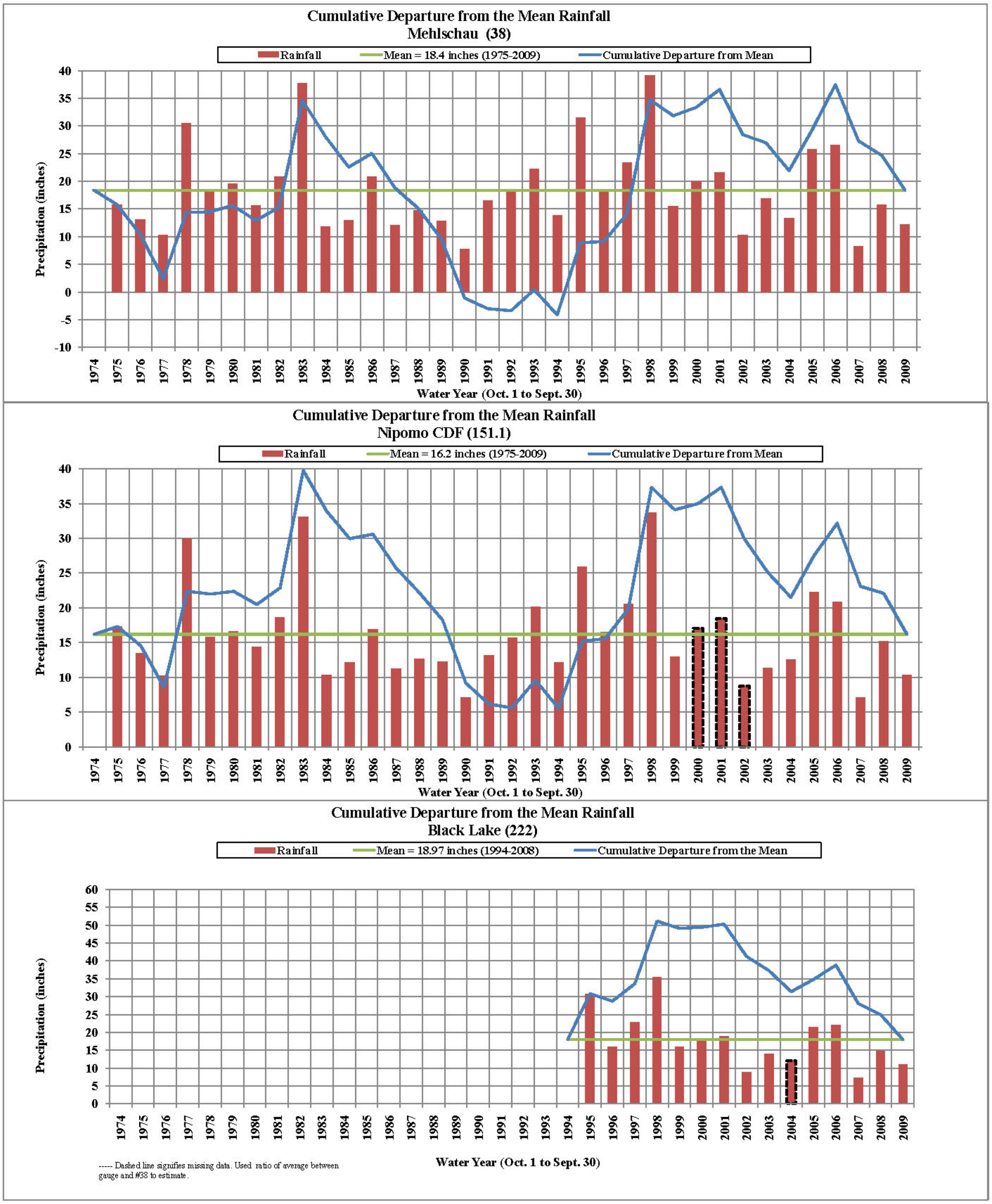


**Figure 3-5. Cumulative Departure from the Mean for the following rain gauges: Mehlschau (38), Nipomo CDF (151.1), and Black Lake (222)**

### 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.

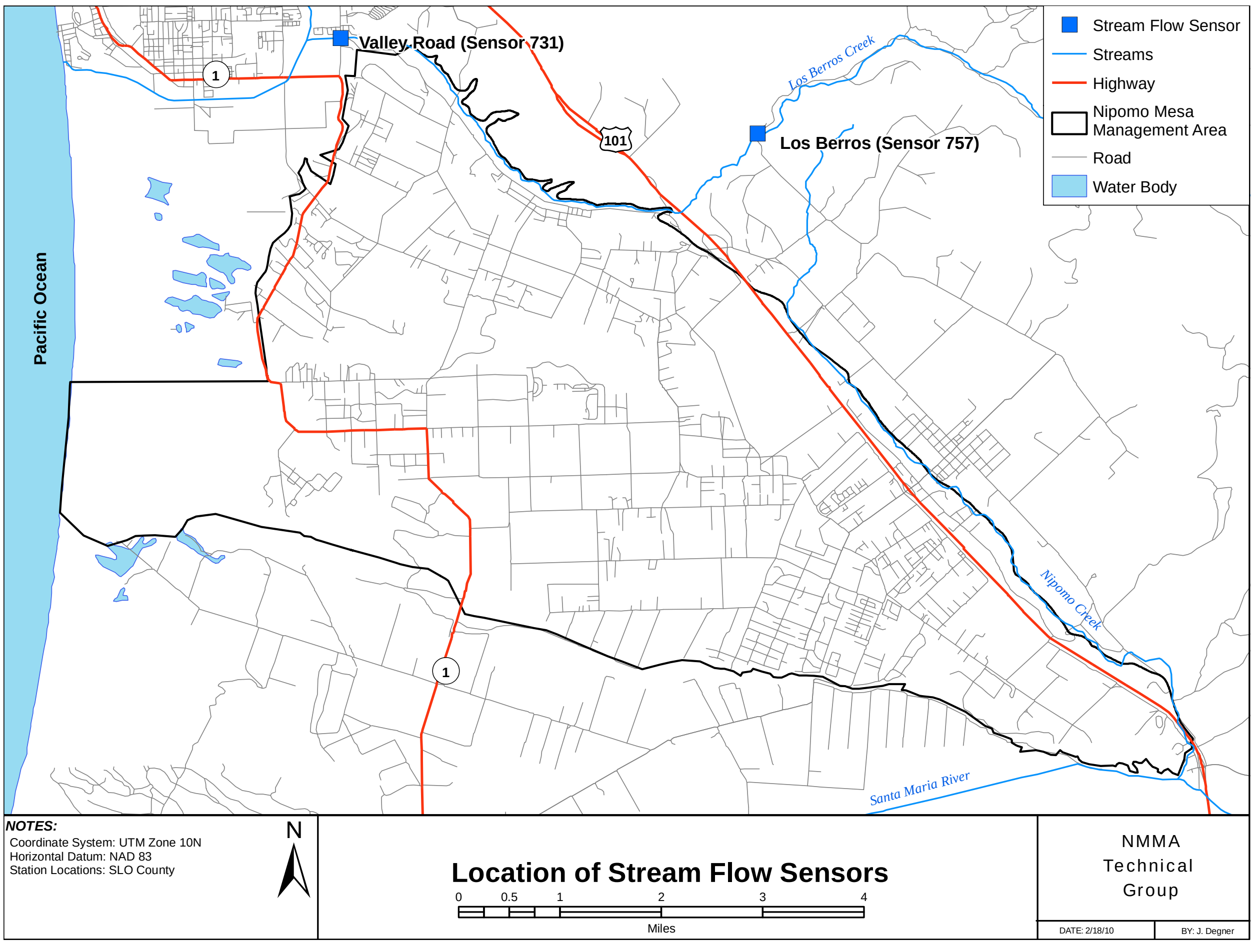


**Figure 3-6. Location of Stream Flow Sensors**

### 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 E.

**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**[4] |

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

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**[5] |

*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).

**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

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

(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**[6] | |

*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 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.

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

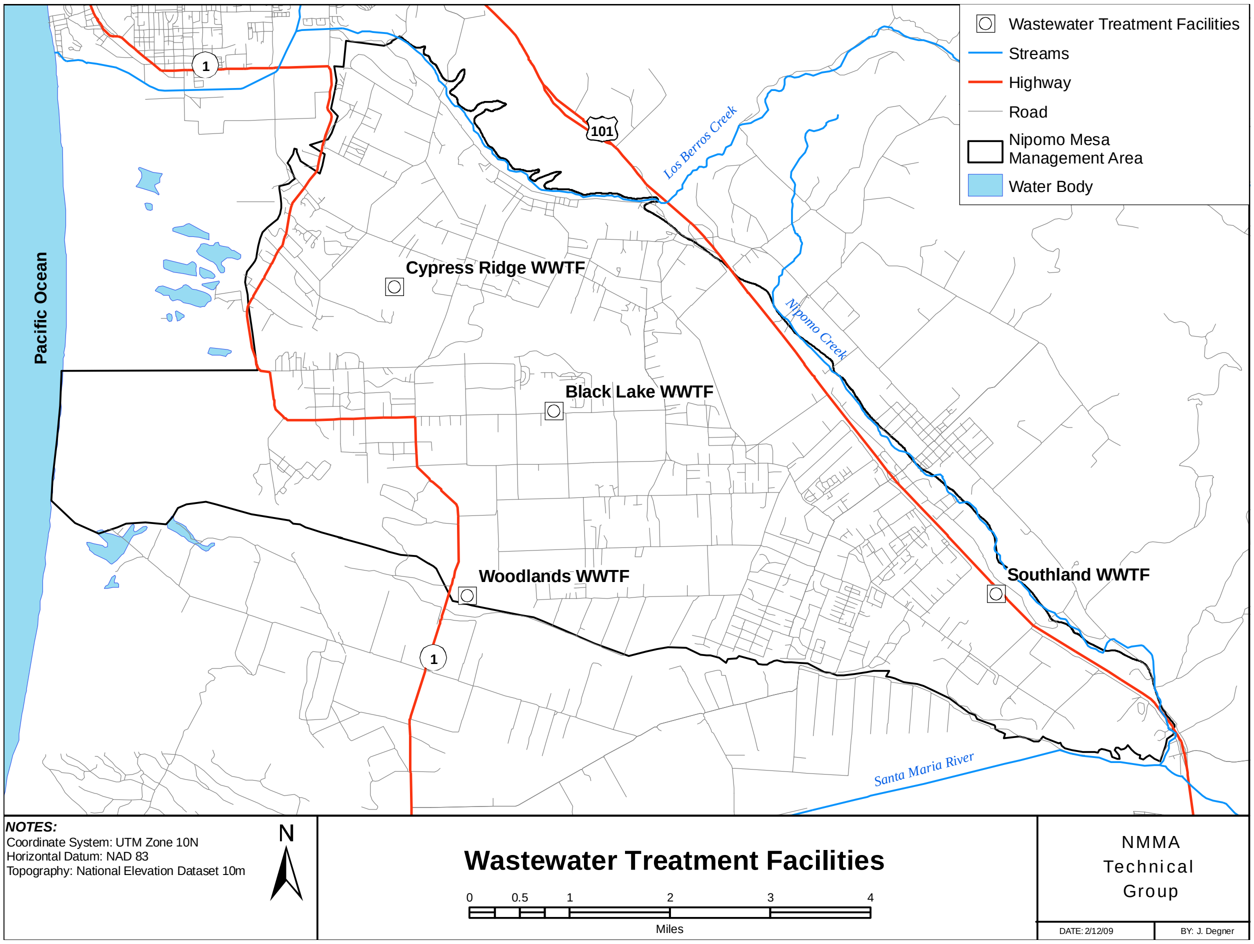


**Figure 3-7. Wastewater Treatment Facilities**

## 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 Recommendations).

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 (see Section 4.2.2 Current Production). 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 Section 6.2 Groundwater Quality). 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).

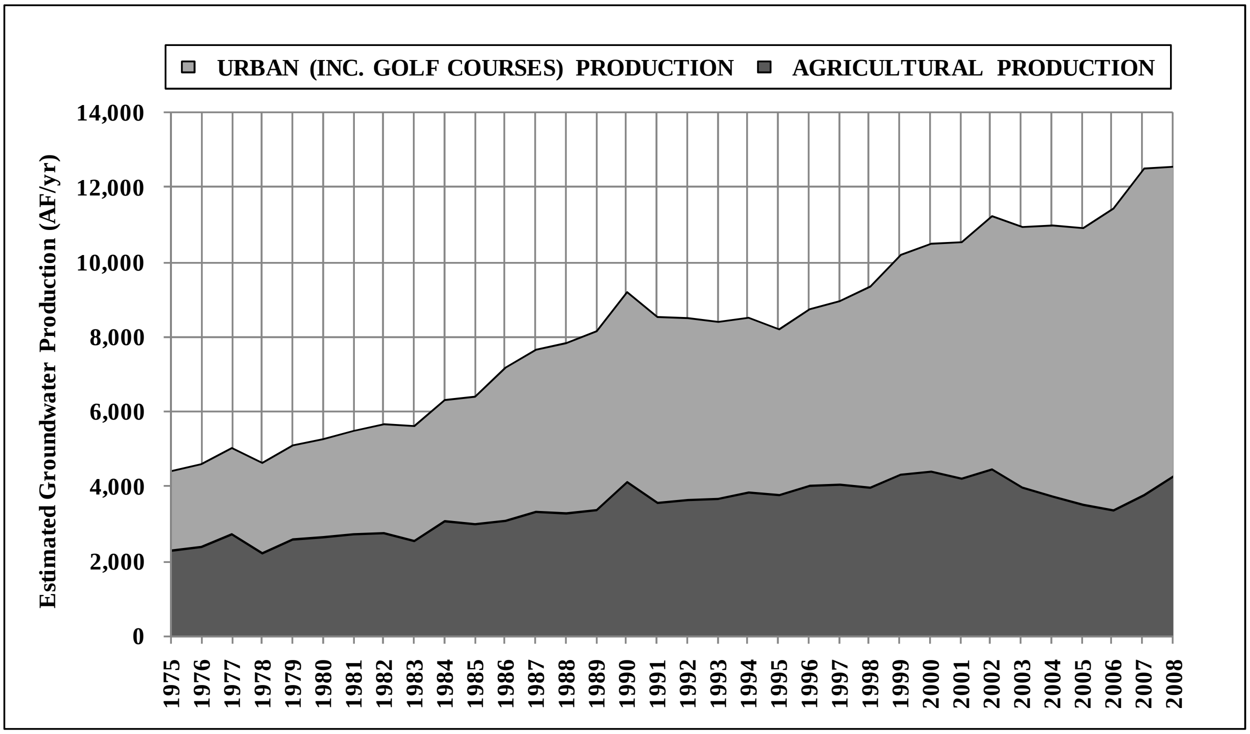


**Figure 4-1. Historical NMMA Groundwater Production**

### 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 Rainfall) 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 considered 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 (see Section 3.1.8 Land Use). 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 (Demand)

The projected future demand for NCSD is an increase from 2,560 AF/yr in 2009 to between 4,960 AF/yr to 7,340 AF/yr under different land use scenarios in 2030 (NCSD, 2006 – Table 27). NCSD expects future demand to be 5,170 AF assuming a growth rate of 2.3 percent. 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. Future production from the Groundwater Basin is restricted by San Luis Obispo County Ordinance 3090 (adopted May 2006) which provides that Land Divisions authorized by the current South County Area Plan (Inland) pay a supplemental water charge Not-to-Exceed $13,200 for each dwelling unit equivalent and further provides that future general plan amendments will not be approved unless supplemental water to off-set the proposed development's estimated increase in non-agricultural demand has been specifically allocated for exclusive use of the development resulting from the general plan amendment and is available for delivery to the Nipomo Mesa Water Conservation Area.

# 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 ($\Delta S$) = Inflow – Outflow;

$\Delta S$= 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).

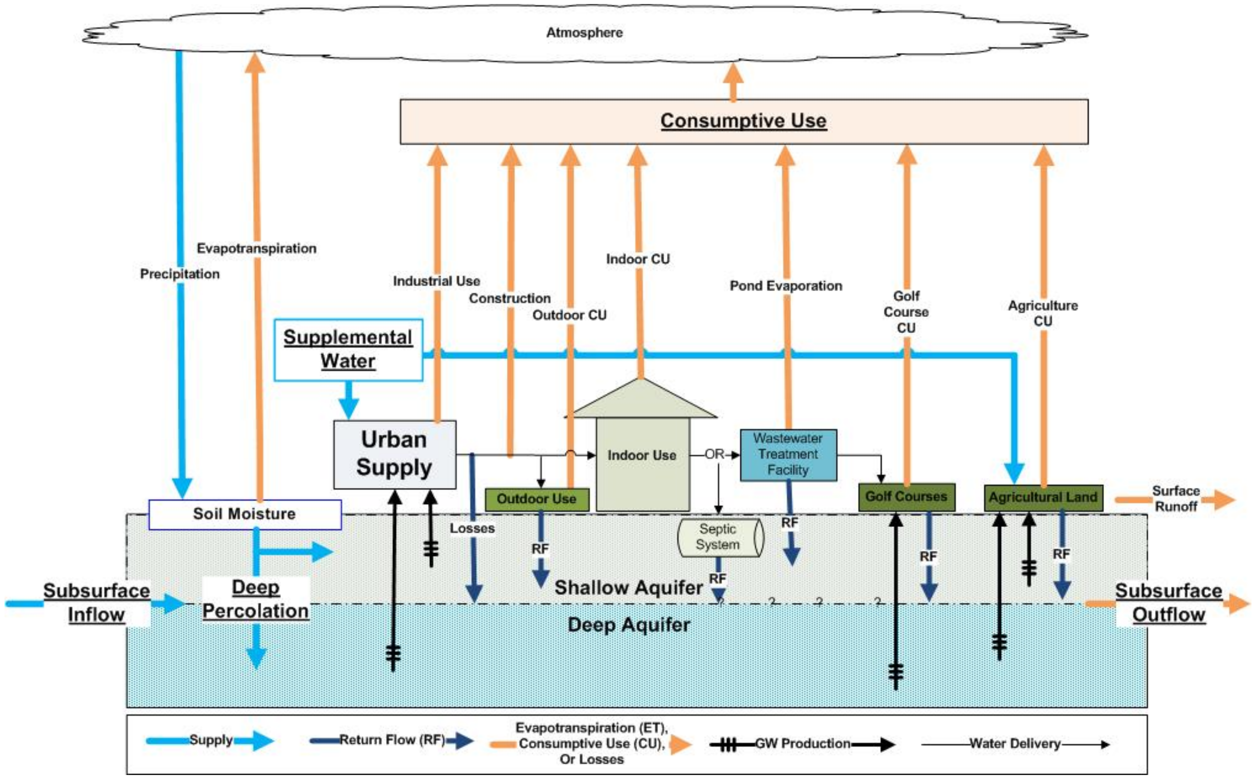


**Figure 5-1. Schematic of the Hydrologic Inventory**

## 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 Recommendations).

## 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.

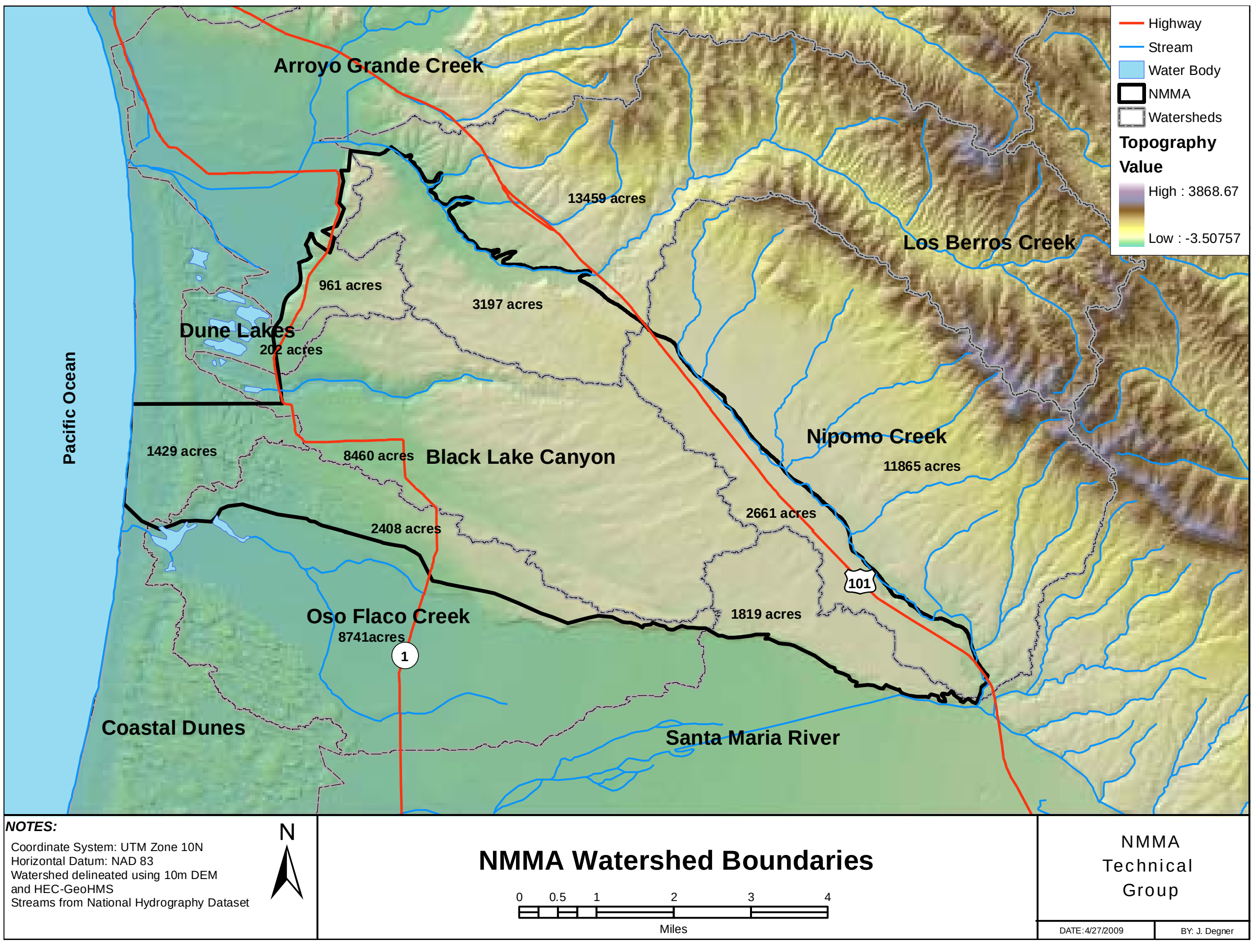


**Figure 5-2. NMMA Watershed Boundaries**

## 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 Historical Production), and the estimated 2009 groundwater production is approximately 12,200 AF/yr (see Section 4.2.2 Current Production), 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 (see Section 6.1.5 Groundwater Gradients) 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.

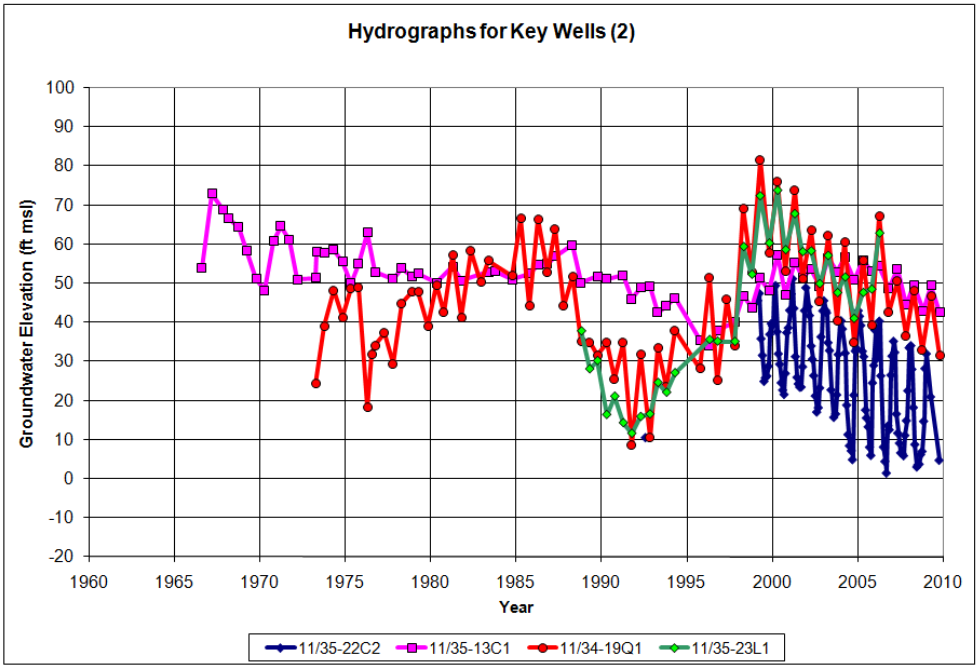


**Figure 6-1. Key Wells Hydrographs, Western Portion of NMMA**

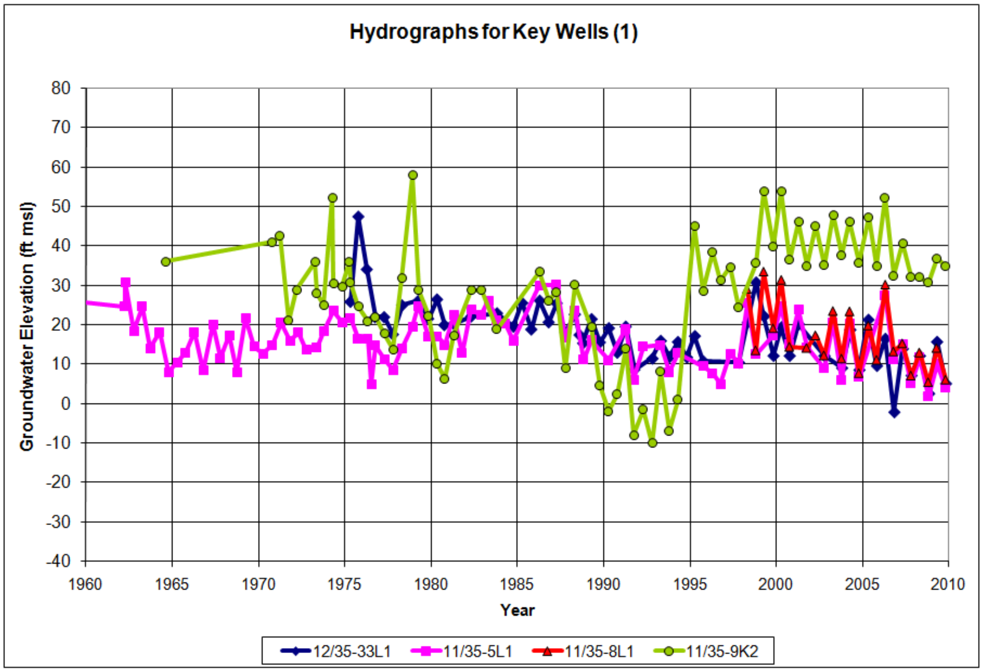


**Figure 6-2. Key Wells Hydrographs, Eastern Portion of NMMA.**

### 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.

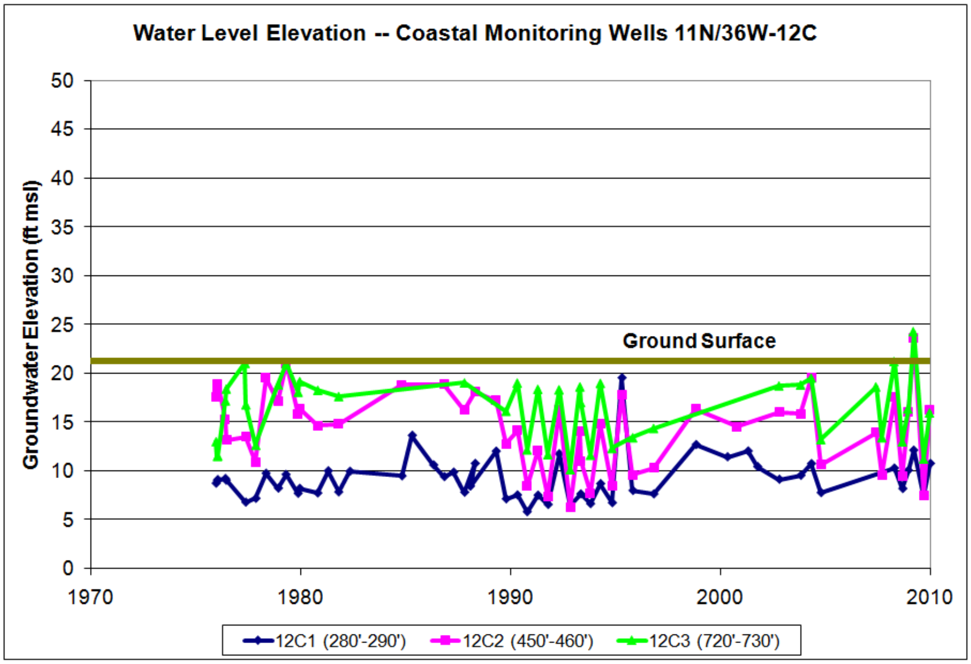


**Figure 6-3. Hydrograph for Coastal Monitoring Well Clusters 11N/36W-12C.**

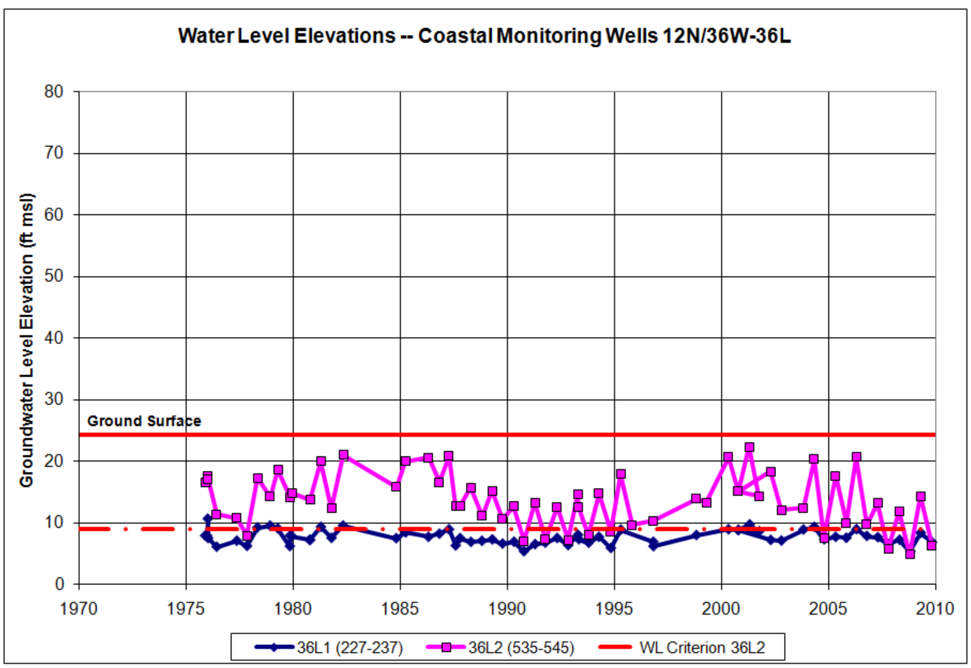


**Figure 6-4. Hydrograph for Coastal Monitoring Well Clusters 12N/36W-36L.**

### 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.

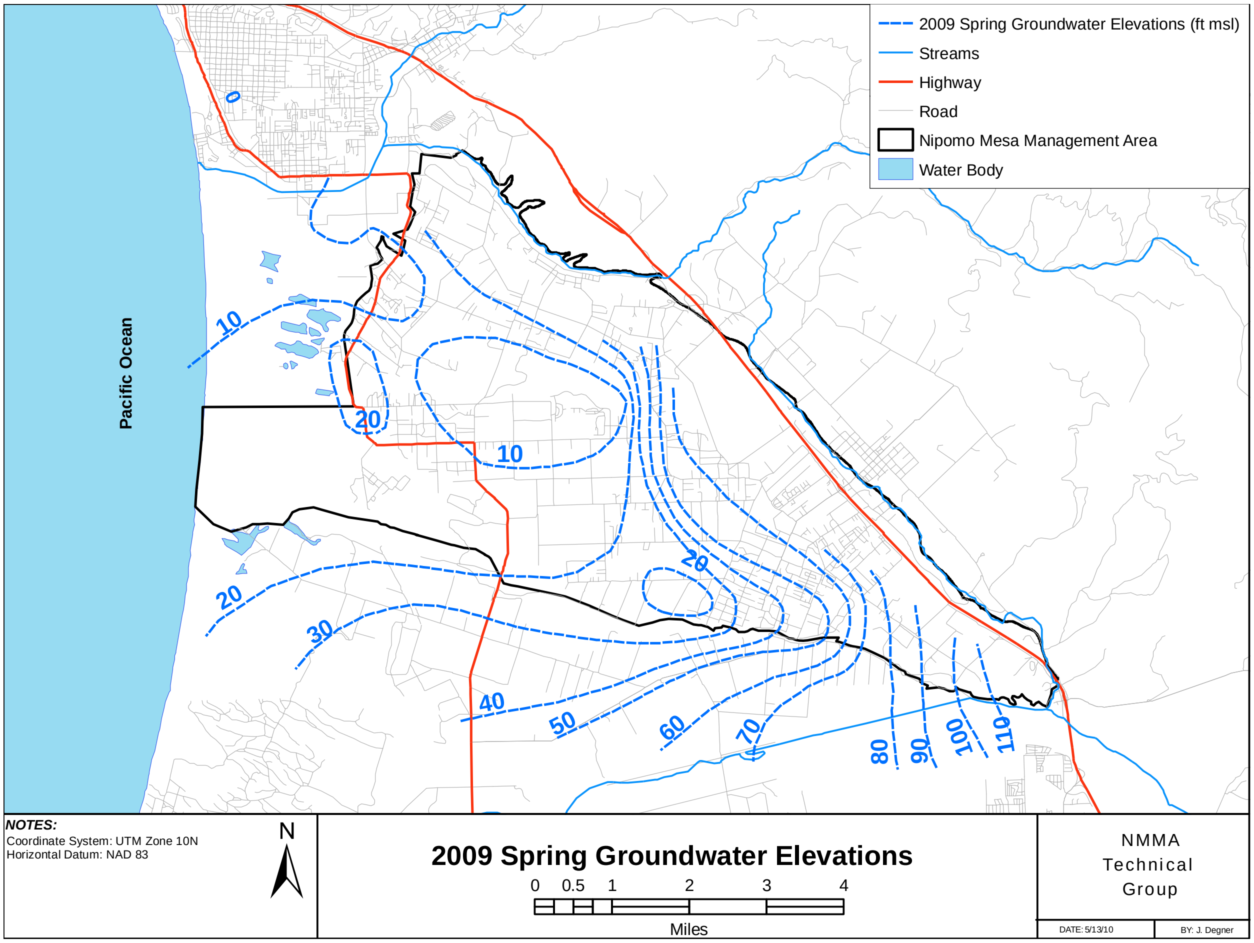


**Figure 6-5. 2009 Spring Groundwater Elevations.**

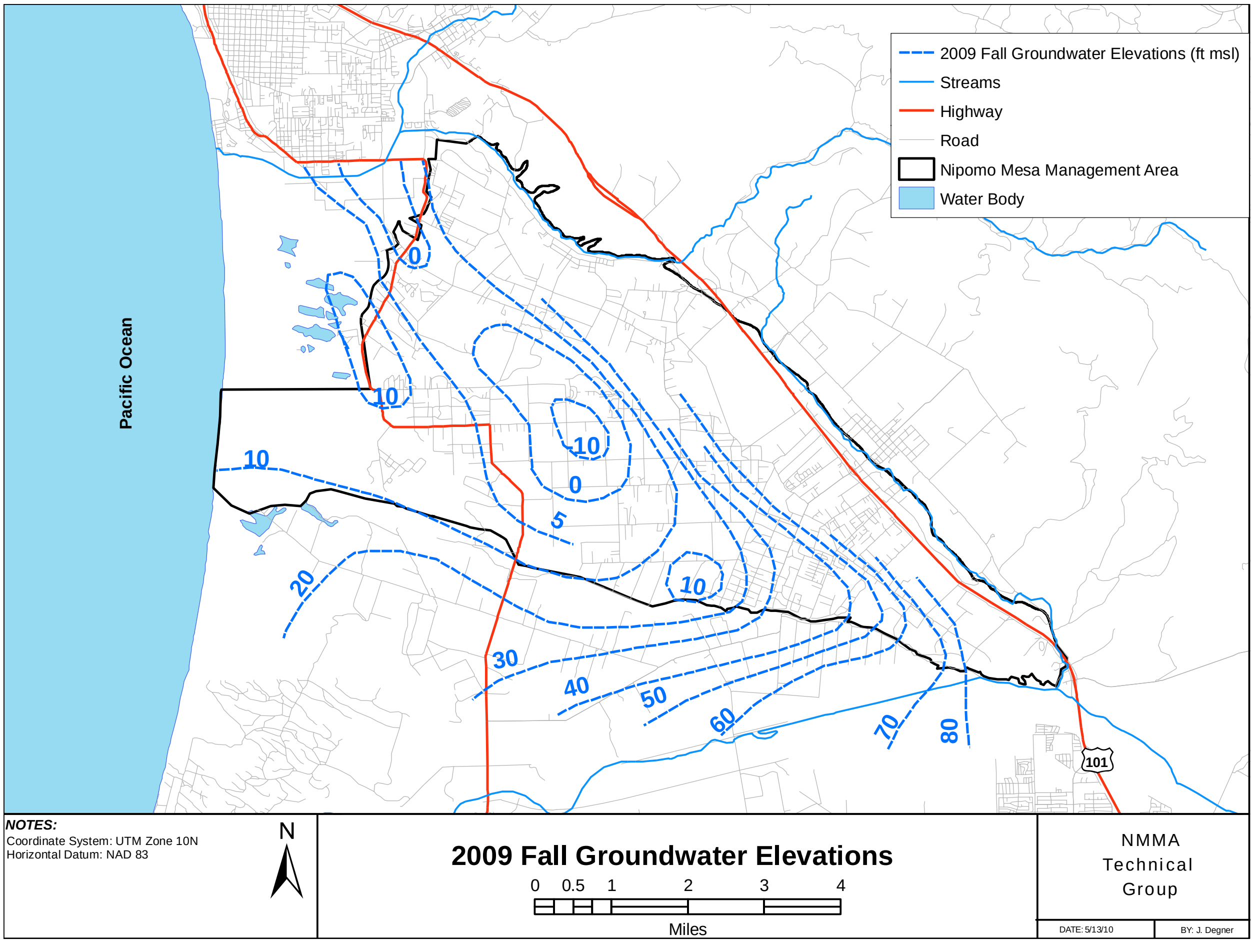


**Figure 6-6. 2009 Fall Groundwater Elevations.**

## 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 Current Supply).

**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.

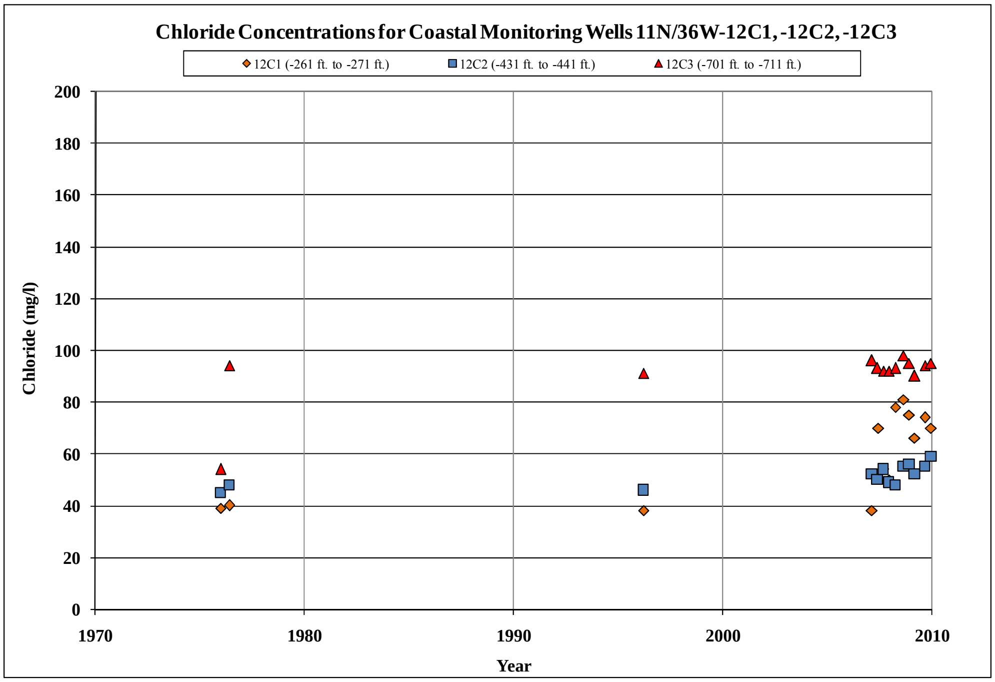


**Figure 6-7. Chloride in Coastal Well 11N/36W-12C.**

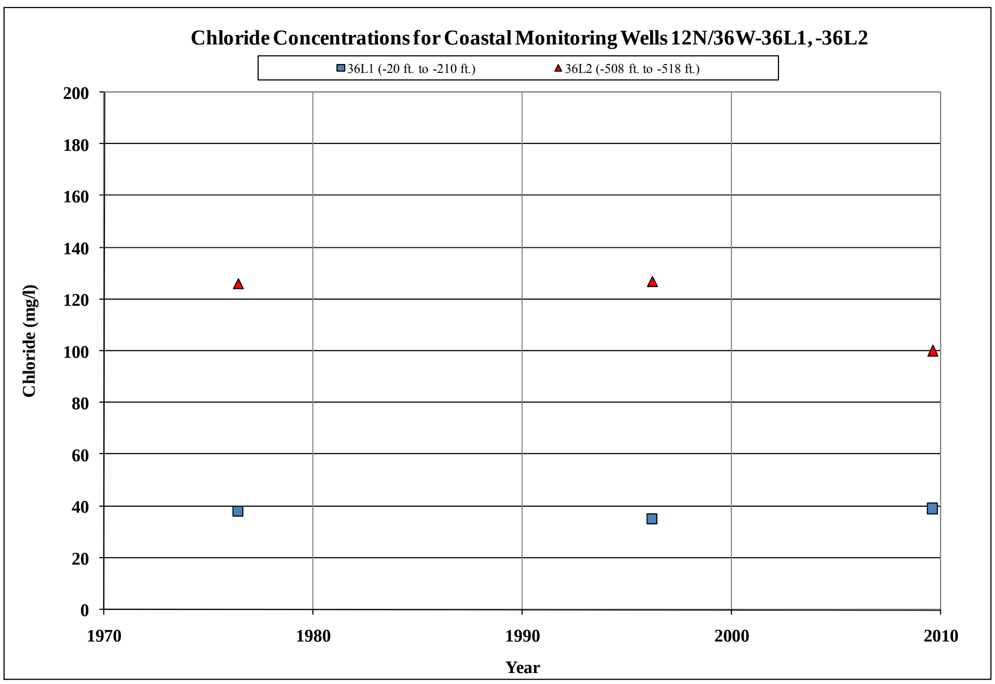


**Figure 6-8. Chloride in Coastal Well 12N/36W-36L.**

### 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 E: 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 E: 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 E: 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 E: 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 E: 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 E: 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 nitrate.

# 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).

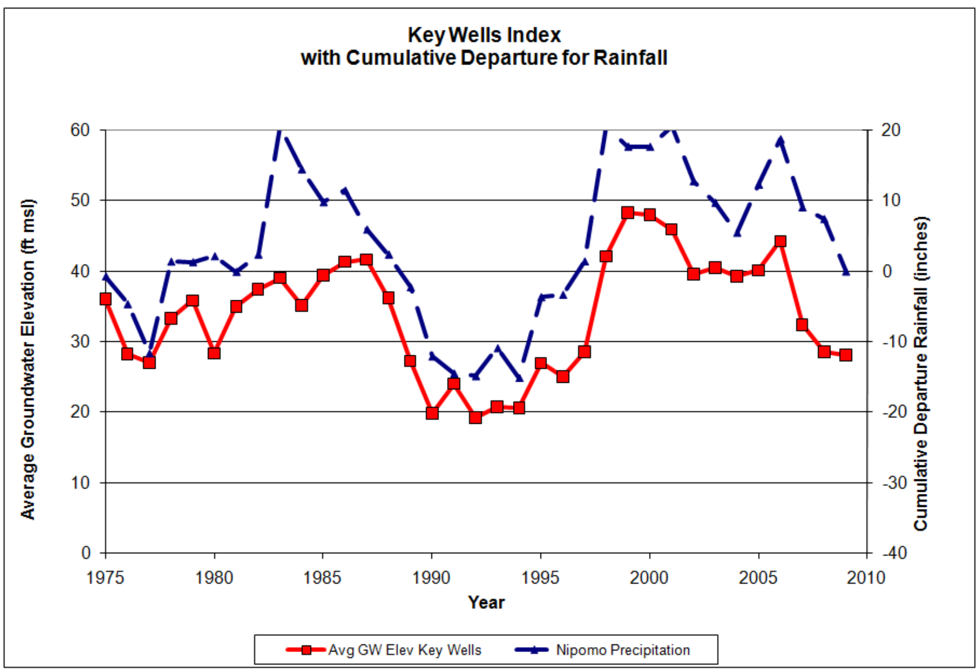


**Figure 7-1. Key Wells Index with cumulative departure for rainfall (using average rainfall from the combination of gauges at Nipomo CDF #151.1 and Mehlschau #38).** *The two graphs are plotted*

*together to indicate that the general trends of rainfall and groundwater elevations are similar within the NMMA.*

**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 be used directly to calculate the potential imbalance in supply and demand for calendar year 2009, 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 portion 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** |

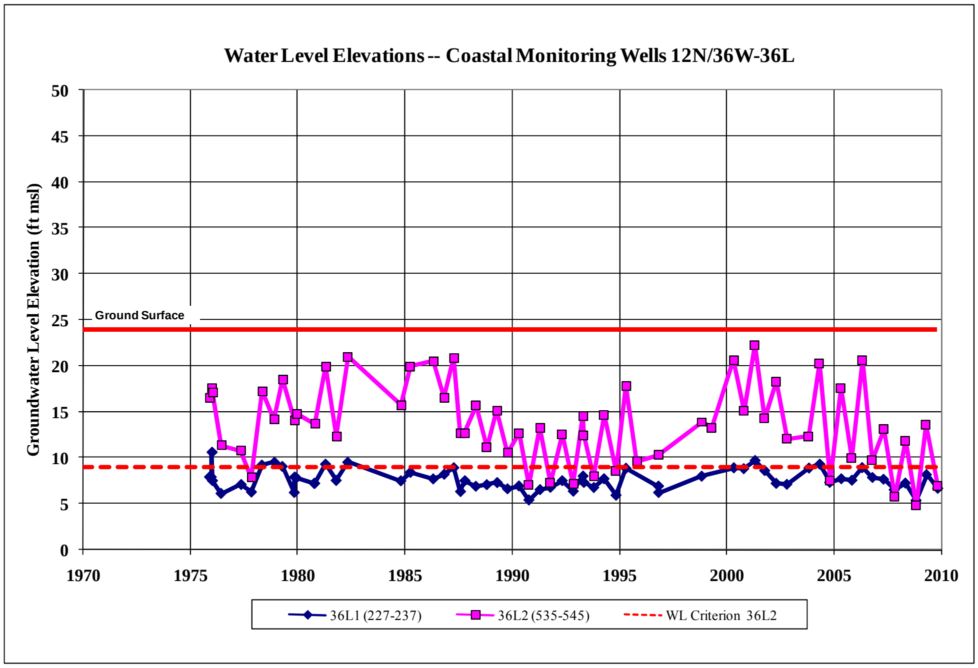


**Figure 7-2. Coastal monitoring well cluster 36L.** *The criterion for Potentially Severe Water Shortage Conditions for well 36L2 indicated by dashed line.*

### 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).

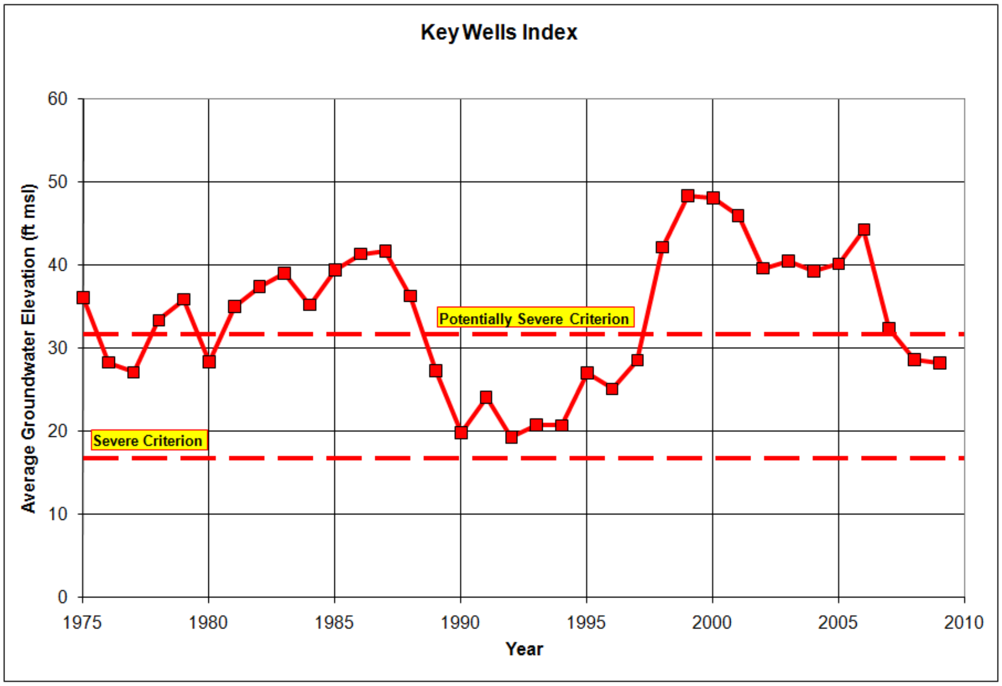


**Figure 7-3. Key Wells Index.** *The upper dashed line is the criterion for Potentially Severe Water Shortage Conditions and the lower dashed line is the criterion for Severe Conditions.*

### 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 2010 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 Well Management Plan)
- Continued progress in 2009 on a supplemental water project (see Section 1.1.7 Supplemental Water)

*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 April 2010 for the Nipomo Mesa area is approximately 110 percent to 132 percent of average.

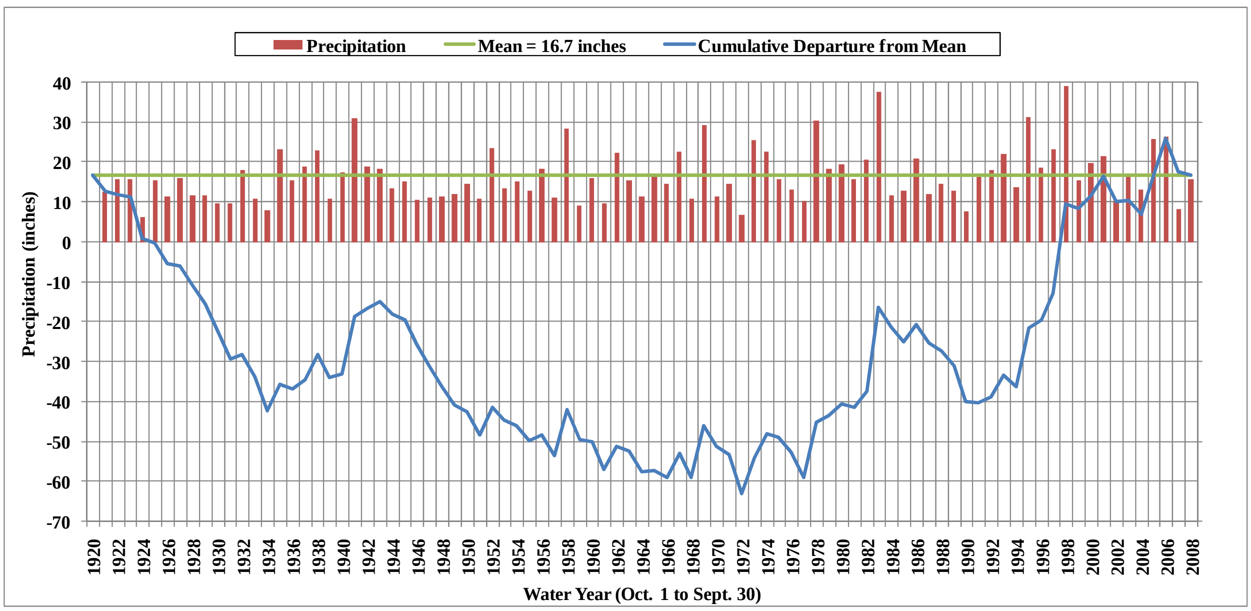


**Figure 7-4. Rainfall: Cumulative Departure from the Mean – Rainfall Gauge Mehlschau (38)**

## 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 Land Use). 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 |

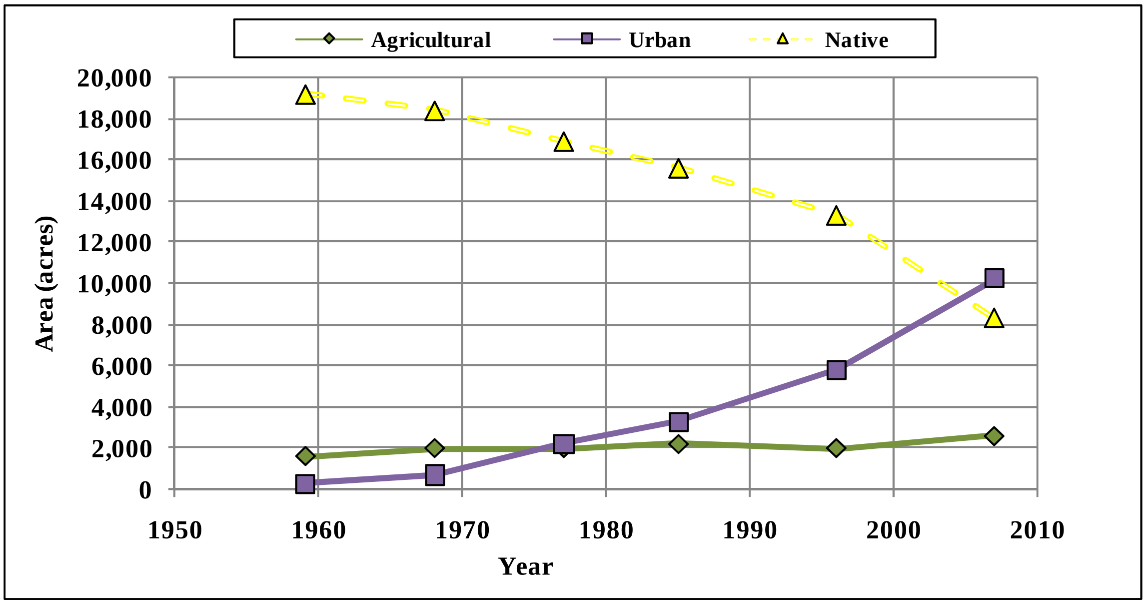


**Figure 7-5. NMMA Land Use – 1959 to 2007**

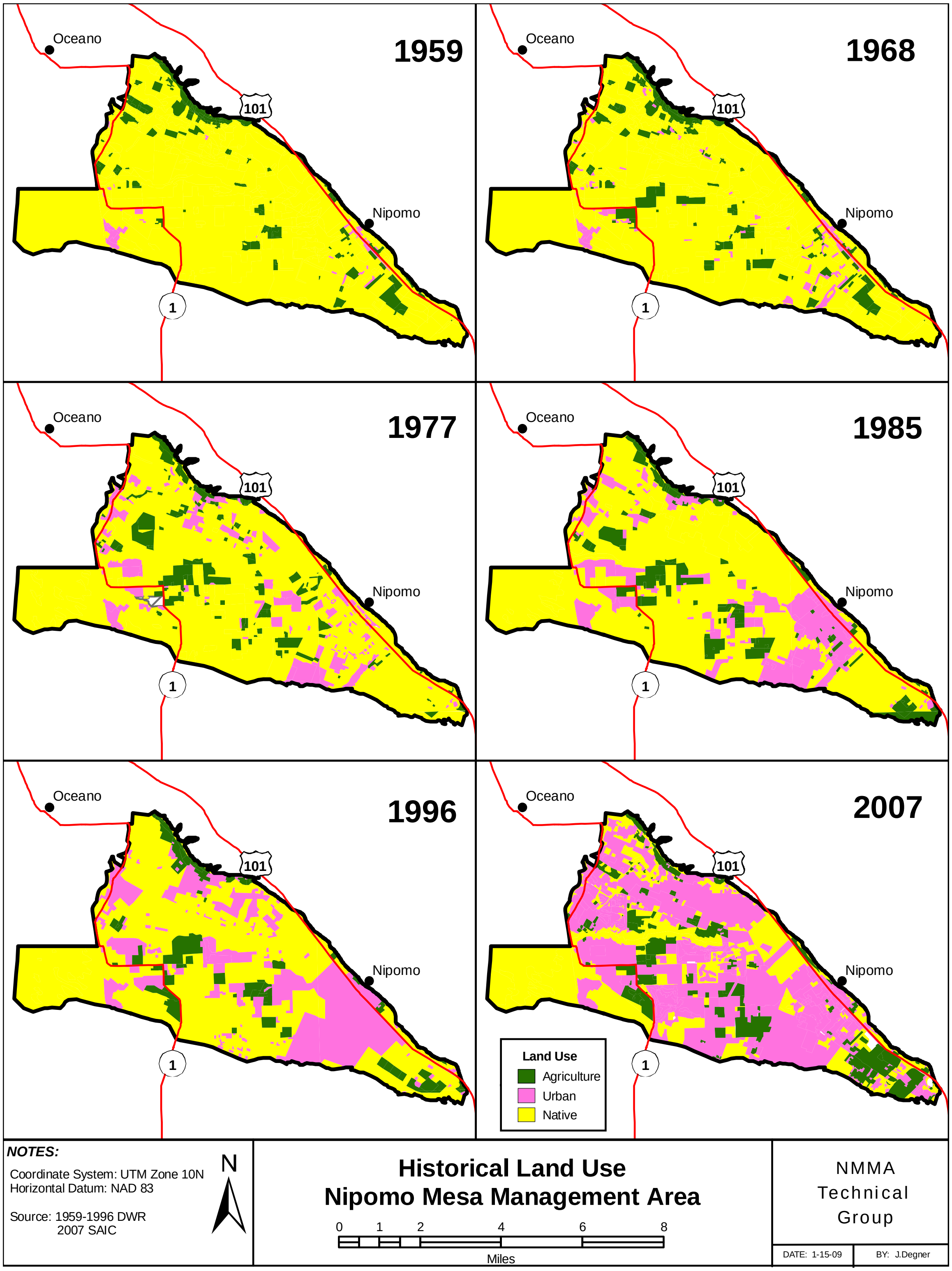


**Figure 7-6. Historical Land Use in the NMMA**

### 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 2010 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 |

Note: It is anticipated that these two technical tasks would be accomplished cooperatively by TG members without the need for contracting outside services.

- **Well Management Plan –** It is recommended that for calendar year 2010, purveyors compile and present to the TG a Well Management Plan status update.

- **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