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City of Oxnard

Public Works Integrated Master Plan

RECYCLED WATER

PROJECT MEMORANDUM 4.7
SALT AND NUTRIENT MANAGEMENT PLAN SUMMARY

REVISED FINAL DRAFT
September 2017

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PREFACE

The analysis and evaluations contained in these Project Memorandum (PM) are based on data and information available at the time of the original date of publication, December 2015. After development of the December 2015 Final Draft PMs, the City continued to move forward on two concurrent aspects: 1) advancing the facilities planning for the water, wastewater, recycled water, and stormwater facilities; and 2) developing Updated Cost of Service (COS) Studies (Carollo, 2017) for the wastewater/collection system and the water/distribution system. The updated 2017 COS studies contain the most recent near-term Capital Improvement Projects (CIP). **The complete updated CIP based on the near-term and long-term projects is contained in the Brief History and Overview of the City of Oxnard Public Works Department's Integrated Planning Efforts: May 2014 – August 2017 section.**

At the time of this Revised PWIMP, minor edits were also incorporated into the PMs. Minor edits included items such as table title changes and updating reports that were completed after the December 2015 original publication date.

City of Oxnard

Public Works Integrated Master Plan

RECYCLED WATER

PROJECT MEMORANDUM 4.7
SALT AND NUTRIENT MANAGEMENT PLAN SUMMARY

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SALT AND NUTRIENT MANAGEMENT PLAN

1.0 INTRODUCTION

The City of Oxnard (City) developed a Preliminary Draft Salt and Nutrient Management Plan (SNMP) (Carollo, 2016) to meet the regulatory requirements per the State Water Resources Control Board (SWRCB) Recycled Water Policy (2008). The City is leading the Oxnard Plain and Pleasant Valley SNMP which includes analysis of the Oxnard Forebay, Oxnard Plain, and Pleasant Valley Basins.

1.1 Project Memorandums (PMs) Used for Reference

Other Project Memoranda (PMs) that relate to the SNMP effort include:

- PM 1.1 - Overall - Master Planning Process Overview.
- PM 2.1 - Water System - Background Summary.
- PM 3.1 - Wastewater System - Background Summary.
- PM 4.2 - Recycled Water System - Background Summary.
- PM 5.1 - Stormwater System - Background Summary.

2.0 SUMMARY OF SNMP WORK TO BE COMPLETED

In July 2016, the City completed the Preliminary Draft SNMP and provided it to the LARWQCB. The work plan included identification of SNMP participants, study area, parameters, data period, and major steps necessary to develop the SNMP. Technical work including characterizing basin hydrogeology, summarizing monitoring programs and data, evaluating existing groundwater and surface water quality, and assessing assimilative capacity was also conducted. Future possible tasks include developing salt and nutrient balances, evaluating proposed projects, conducting an antidegradation analysis, CEQA evaluation, and developing a basin plan amendment or implementation plan. The outcome of the SNMP will be key basin management goals and objectives for each basin that will inform the selection of management efforts as they relate to salt and nutrient loading.

In August 2016, the LARWQCB responded to the Preliminary Draft SNMP with their comments. In September 2016 the City responded to the LARWQCB comments with a 4-page letter responding to each of the Regional Board’s main points. Basically, the City requested the RWQCB accept this document as a draft and that obtaining recycled water permits for their proposed projects not be impacted or delayed in any way. The City requested the Final Oxnard SNMP be delayed to be coincident with the development of the Groundwater Sustainability Plan (GSP).

The Preliminary Draft SNMP includes stakeholder involvement through a Technical Advisory Group (TAG) as well as the larger stakeholder community. Facility meetings, discussions, and consensus building was used to inform and solicit input on the development of the SNMP.

The completed Preliminary Draft SNMP dated July 2016 and the Oxnard SNMP Response letter dated September 16, 2016 are included as Appendix A.

APPENDIX A - SALT AND NUTRIENT MANAGEMENT PLAN (PRELIMINARY DRAFT) JULY 2016

CITY OF OXNARD CALIFORNIA

PRELIMINARY DRAFT • JULY 2016

PUBLIC WORKS
Integrated Master Plan
Salt and Nutrient Management Plan (SNMP) for the Oxnard Plain and Pleasant Valley Basins

HydroMetrics WRI

carollo

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CITY OF OXNARD

PUBLIC WORKS INTEGRATED MASTER PLAN

SALT AND NUTRIENT MANAGEMENT PLAN (SNMP) FOR THE OXNARD PLAIN AND PLEASANT VALLEY BASINS

PRELIMINARY DRAFT
July 2016

CITY OF OXNARD

PUBLIC WORKS INTEGRATED MASTER PLAN

SALT AND NUTRIENT MANAGEMENT PLAN (SNMP) FOR THE OXNARD PLAIN AND PLEASANT VALLEY BASINS

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ABBREVIATIONS AND ACRONYMS

ASR	Aquifer Storage and Recovery
AWPF	Advanced Water Purification Facility
BPTC	Best Practicable Treatment or Control
CFR	Code of Federal Regulations
CSUCI	California State University Channel Islands
DDW	Division of Drinking Water
FCGMA	Fox Canyon Groundwater Management Agency
GIS	Geographic Information System
GSA	Groundwater Sustainability Agencies
GSP	Groundwater Sustainability Plan
LARWQCB	Los Angeles Regional Water Quality Control Board
LAS	Lower Aquifer System
LSCR	Lower Santa Clara River
mg/L	milligrams per liter
PVCWD	Pleasant Valley County Water District
RO	Reverse Osmosis
RWQCB	Regional Water Quality Control Board (or Regional Board)
SGMA	Sustainable Groundwater Management Act
SNMP	Salt and Nutrient Management Plan
SWRCB	State Water Resources Control Board
TAG	Technical Advisory Group
TDS	Total Dissolved Solids
TMDL	Total Maximum Daily Load
UAS	Upper Aquifer System
UWCD	United Water Conservation District
VCAILG	Ventura County Agricultural Irrigated Lands Group
WRF	Water Reclamation Facility
WRP	Water Recycling Plant
WWTP	Wastewater Treatment Plant

SALT AND NUTRIENT MANAGEMENT PLAN (SNMP) FOR THE OXNARD PLAIN AND PLEASANT VALLEY BASINS

1.0 INTRODUCTION

The City of Oxnard has developed a preliminary draft Salt and Nutrient Management Plan (SNMP) for the Oxnard Plain (inclusive of the Oxnard Forebay) and Pleasant Valley groundwater basins. The purpose of this document is to provide a preliminary draft document for stakeholder review and comment.

1.1 Regulatory Background

1.1.1 Recycled Water Policy

In November 2008, the State Water Resources Control Board (SWRCB) adopted the Statewide Recycled Water Policy, which requires regional or sub-regional salt and nutrient management plans for groundwater basins in California by 2014. The Recycled Water Policy was revised in January 2013. The purpose of the Recycled Water Policy is to increase the use of recycled water from municipal wastewater sources consistent with state and federal water quality laws. Since recycled water contains salts and nutrients that may cause or contribute to exceedances of water quality objectives, management of these constituents in recycled water projects is important. However, the Recycled Water Policy recognizes that recycled water projects are not the only source of salts and nutrients to groundwater basins. As a result, the Recycled Water Policy states:

> "It is the intent of this Policy that salts and nutrients from all sources be managed on a basin-wide or watershed-wide basis in a manner that ensures attainment of water quality objectives and protection of beneficial uses. The State Water Board finds that the appropriate way to address salt and nutrient issues is through the development of regional or sub-regional salt and nutrient management plans rather than through imposing requirements solely on individual recycled water projects."

The Policy defines a process for development and approval of the SNMPs:

- A locally driven and funded process open to all stakeholders and including Regional Water Quality Control Board (Regional Board) staff will be used to develop the SNMPs.
- After completion, the plans will be submitted for consideration to the Regional Board.
- Within one year of receipt of the SNMP, Regional Board will adopt revised implementation plans based on the SNMP for groundwater basins where water quality objectives for salts or nutrients are being, or are threatening to be, exceeded.

- The adoption of revised implementation plans will be proposed as Basin Plan Amendments and will be included in the Basin Plan once adopted.

In addition to the Recycled Water Policy, the Los Angeles Regional Water Quality Control Board (LARWQCB) developed a guidance document, *Regional Water Board Assistance in Guiding Salt and Nutrient Management Plan Development in the Los Angeles Region* (LARWQCB Guidance Document). The LARWQCB SNMP Guidance Document includes a number of technical elements that go beyond the requirements of the Recycled Water Policy. These elements are based on recommended elements for inclusion in the SNMPs that was prepared by the SWRCB.

1.1.2 Sustainable Groundwater Management Act 2014

The Sustainable Groundwater Management Act (SGMA) was passed in 2014. The intent of this act is for groundwater to be managed sustainably in California's groundwater basins by local public agencies and newly-formed groundwater sustainability agencies (GSAs).

The Fox Canyon Groundwater Management Agency (FCGMA) has been established as the GSA for the basins included in this SNMP planning area. Development of the Groundwater Sustainability Plan (GSP) is underway, and is expected to be completed in 2016. While the GSP is currently being developed and refined, there are some general goals that overlap with the goals of the SNMP, including:

- Limiting further progression of saline zones.
- Limiting any further degradation of water quality without mitigation.

In addition, to assess and evaluate sustainable management of groundwater basins, the GSP will include a comprehensive monitoring plan for groundwater level, as well as groundwater quality.

The GSP is broader in scope and stakeholder involvement than the SNMP, and the overlapping goals, objectives, and planning elements are recognized. Relative to the GSP, this SNMP is intended to inform the GSP process and allows the GSP to be the primary planning process for certain issues, including limiting further progression of the saline intrusion zone, and development of a comprehensive monitoring program.

1.2 Stakeholders

The City of Oxnard is the lead agency in the development of the SNMP. A two-tiered stakeholder process was implemented. The tiers include a Technical Advisory Group (TAG) and the larger stakeholder community. The City of Oxnard has conducted two TAG meetings, one stakeholder meeting, and one separate meeting with the LARWQCB (See Appendix A).

1.2.1 Technical Advisory Group

A TAG consists of the funding agency and stakeholders responsible for management of salts and nutrients in the watershed. The list of TAG members includes:

- City of Oxnard.
- LARWQCB.
- City of Camarillo.
- Camrosa Water District.
- Pleasant Valley Community Water District.
- Representative(s) from the Calleguas Creek Watershed Group.
- Ventura County.
- United Water Conservation District.
- FCGMA.
- Ventura County Farm Bureau and Ventura County Agricultural Irrigated Lands Group (VCAILG).

The TAG has provided review of technical work and will participate in decisions related to the SNMP development. Appendix A includes TAG workshop materials and a list of attendees.

1.2.2 Stakeholder Community

Stakeholder outreach was facilitated through established stakeholder groups. The Calleguas Creek Watershed mailing list was used as the initial basis for establishing the stakeholder group and additional names were added to ensure all key stakeholders are included. Stakeholder input was considered in developing the SNMP content and in the decision making process. Appendix A includes stakeholder workshop materials and a list of attendees.

1.3 Goals and Objectives

The State Recycled Water Policy (2008) was developed to streamline recycled water permits without compromise to groundwater quality and beneficial uses. SNMP goals and objectives were developed from existing related reports/documents and stakeholder input. The following goals were identified:

- Increase recycled water use in the region.
- Protect existing groundwater resources and beneficial uses.
- Increase groundwater recharge and infiltration.

- Improve water quality.
- Provide benefits to the local economy.
- Collecting, treating, and infiltrating stormwater runoff in new and redevelopment.

The stakeholders have also developed specific recycled water program objectives. The City of Oxnard, City of Camarillo, City of Camrosa, and Pleasant Valley County Water District (PVCWD), are all planning to implement recycled water in the study area. Planned recycled water projects are evaluated in this SNMP.

2.0 BASIN SETTING

2.1 Groundwater Basins

The proposed planning area includes the Oxnard Forebay, Oxnard Plain, and Pleasant Valley groundwater basins. Figure 1 shows the groundwater basins within the study area.

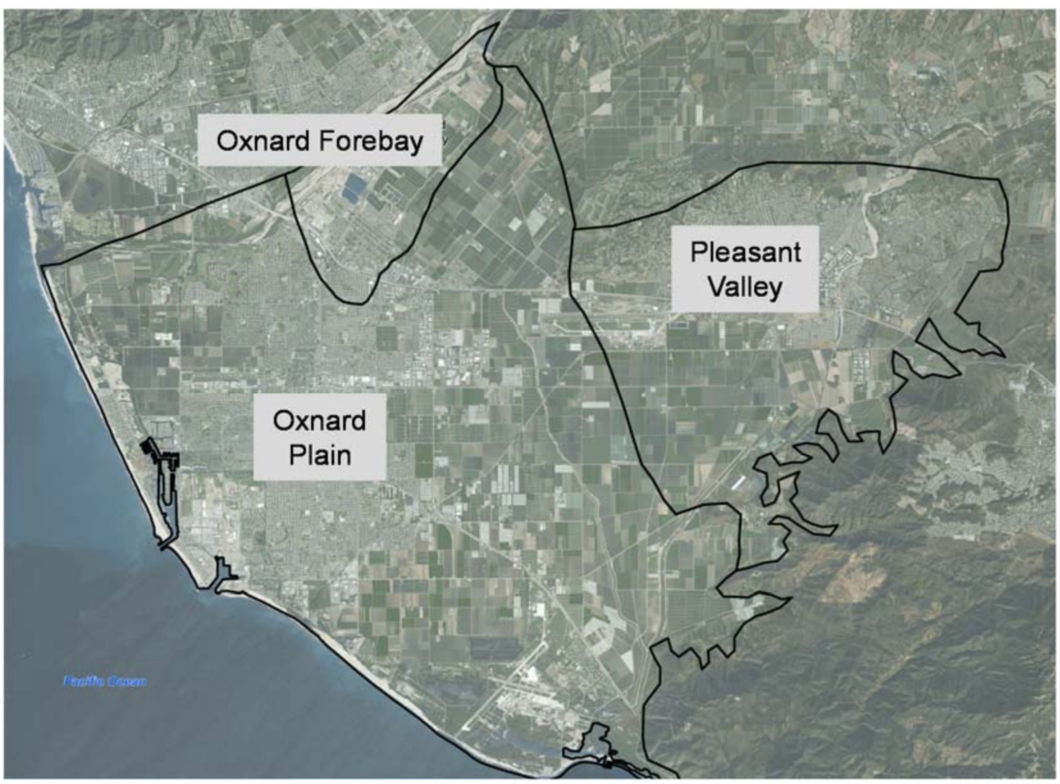


Figure 1 Study Area and Basin Boundaries

The City of Oxnard recognizes that groundwater basins along the planning area boundaries may require close coordination with other efforts. The Calleguas Creek Watershed Group has previously identified an SNMP planning area based on the Calleguas Creek Watershed that includes the Pleasant Valley groundwater basin. In addition, the Lower Santa Clara River (LSCR) SNMP includes the Oxnard Forebay. This SNMP will rely upon the analysis of the Oxnard Forebay that was conducted for the LSCR SNMP.

2.2 Groundwater Basin Boundaries

There are several agencies that have delineated the groundwater basins in the study area including the California Department of Water Resources, Ventura County, Fox Canyon Groundwater Management Agency (FCGMA), and United Water Conservation District (UWCD). The UWCD and the FCGMA groundwater basin boundaries are very similar. The most significant differences among the different boundaries include the delineation of the Oxnard Forebay, and the boundary between the Oxnard Plain and Pleasant Valley basins.

In an attempt to align the Oxnard SNMP with the basin boundaries used for other planning studies, the boundaries developed by Department of Water Resources (DWR) (Bulletin 118) are used. However, the GSA has requested a change to DWR Bulletin 118 groundwater basins that would impact both the Oxnard Plain and Pleasant Valley Basin boundaries with the Los Posas Basin boundaries. The formal approval of the modified boundaries is not expected until 2017. Therefore, for this purpose of this SNMP, the existing Bulletin 118 basin boundaries are used. The delineation of the Oxnard Forebay was added to the bulletin 118 boundaries, as was done for the LSCR SNMP.

2.3 Groundwater Basin Characterization

The groundwater basin geology and hydrogeology of the basins have been characterized. This information in provide in a separate technical memorandum, and is included in Appendix B.

3.0 GROUNDWATER BASIN QUALITY

3.1 Data Period

The data period for the Oxnard SNMP is the 5 previous years, from 2010 through 2014. However, to assess groundwater concentration trends, the data period was extended to years earlier than 2009 to increase the number of data points. The data period for the LSCR SNMP was 1996 through 2012, and captured both wet and dry hydrologic conditions. Data from 1996 through 2014 were used for this analysis when a longer period of record was warranted.

3.2 Constituents

The Basin Plan for the Coastal Watersheds of Los Angeles and Ventura Counties (1994) (Basin Plan) includes water quality objectives for many constituents in the groundwater basins in the planning area. The parameters for the SNMP are TDS, chloride, and nitrate as N. These parameters are appropriate constituents to represent salts and nutrients for planning purposes.

3.3 Data Sources

The constituents that are evaluated in this SNMP are TDS, chloride, and nitrate as N. The data period is 1996 through 2014, which captures several wet and dry periods. The use of the full data period and the most recent five years of data are described in subsequent sections. Groundwater and surface water data were compiled for the SNMP. Appendix C includes a summary of existing monitoring programs. The following sources of data were used:

- UWCD provided geographic information system (GIS) shapefiles for their monitoring wells, production wells, and surface water sampling sites. Well depth characterization, upper aquifer system (UAS) or lower aquifer system (LAS), was included in the UWCD GIS files for UWCD monitoring wells and production wells.
- Ventura County provided GIS shapefiles for their monitoring wells, and wells registered with the County.
- UWCD provided groundwater data (1996 to 2014) collected by UWCD as well as other entities, including Ventura County and data submitted to State Water Resources Control Board Division of Drinking Water (DDW) by municipal/community water purveyors.
- UWCD provided surface water quality data associated with their sampling locations.
- Surface water quality data were compiled from the Ventura Countywide Stormwater Quality Management Program website.

The groundwater and surface water quality data included nitrate, TDS, and chloride. Since the data was compiled from a variety of sources, there were some issues to resolve related to the analytical methods and reporting of the results, including:

- TDS data – Environmental Protection Agency (EPA) Method 1601 and Standard Methods 2540C are included as approved 40 Code of Federal Regulations (CFR) 136 methods for TDS (or total filterable residue). The majority of the TDS data was determined by one of these methods. However, some TDS values were determined by summation. These values are included in the database, but not in the analysis or presentation of results since a 40 CFR-approved method was not used.
- Nitrate data – Most of the nitrate data was reported as nitrate as N values. However, some data was only reported as nitrate. In this analysis the calculated nitrate as N values were used, except in cases where the calculated values differed from the reported values. For these exceptions, the reported nitrate as N values were used.

3.4 Existing Groundwater Quality

The evaluation of existing water quality is primarily based on data from the most recent five years (2010 through 2014). Median concentrations were calculated for each well over the 5-year period. The longer dataset, (1996 through 2014) was used to identify and evaluate groundwater quality trends and to provide additional information for delineating groundwater quality zones.

The distribution of perched, UAS, and LAS wells with data over the last five years are shown for chloride and TDS in Figure 2, and for nitrate as N in Figure 3. The distribution of groundwater quality data is reasonable for the UAS and LAS. However, there are only seven wells with perched groundwater data, all of which are in the Oxnard Plain basin. Therefore, even though there are water quality objectives set for the perched aquifer in the Oxnard Plain, analysis of existing water quality and the basin's assimilative capacity in the perched aquifer is not possible due to the limited data available.

3.4.1 Estimation of Existing Groundwater Quality Methodology

The procedure for estimating the existing groundwater quality for each basin involved first delineating water quality zones (zones) of similar groundwater qualities for each aquifer. This is achieved by plotting the wells and their 2010 through 2014 median concentrations on separate maps for the UAS and LAS, and hand delineating zones to include wells with similar concentrations. This approach is taken, instead of contouring, because of the variability of concentrations over small distances that makes contouring impractical. Additional wells with median concentrations from 1996 through 2014 are also plotted on the maps to provide an indication of relative concentrations in areas where the well distribution is poorer. Those data are not used in the existing groundwater quality estimations, only for aiding in water quality zone delineation if 2010 through 2014 median data are not available. The UAS chloride, TDS, and nitrate as N concentrations are presented in Figures 4, 5 and 6, respectively. The LAS chloride, TDS, and nitrate as N concentrations are presented in Figures 7, 8 and 9, respectively.

A concentration for each water quality zone is calculated by averaging the median concentrations of all the wells falling within the zone. A single value for existing groundwater quality for each basin is estimated by calculating the volume weighted average concentration from all the water quality zones within the basin. The volume of groundwater within each zone is estimated from UCWD's groundwater model layer geometry. The volume weighted average concentrations are regarded as the existing groundwater quality for the basin.

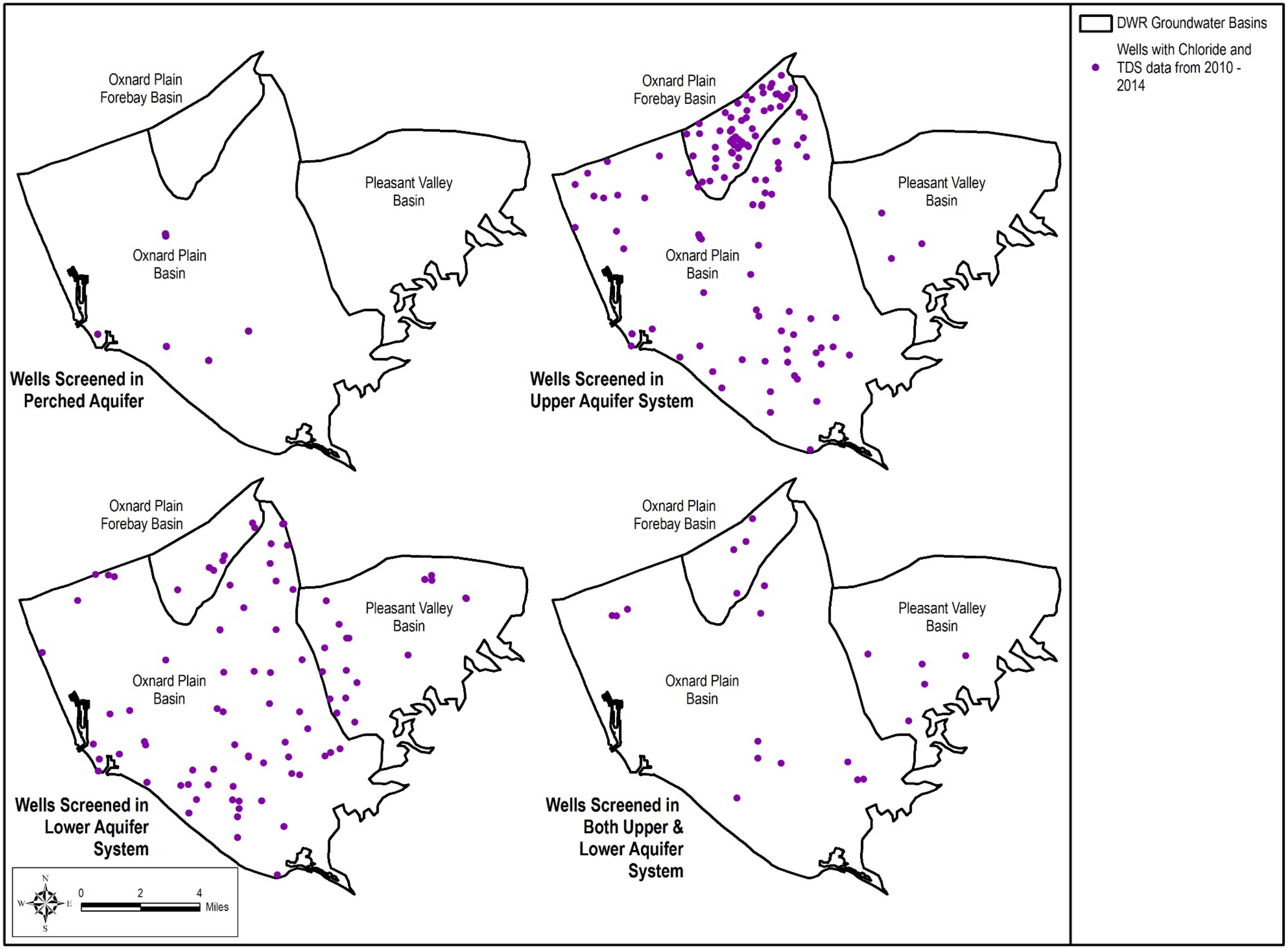


Figure 2 Distribution of Wells with Chloride and TDS Data (2010 – 2014)

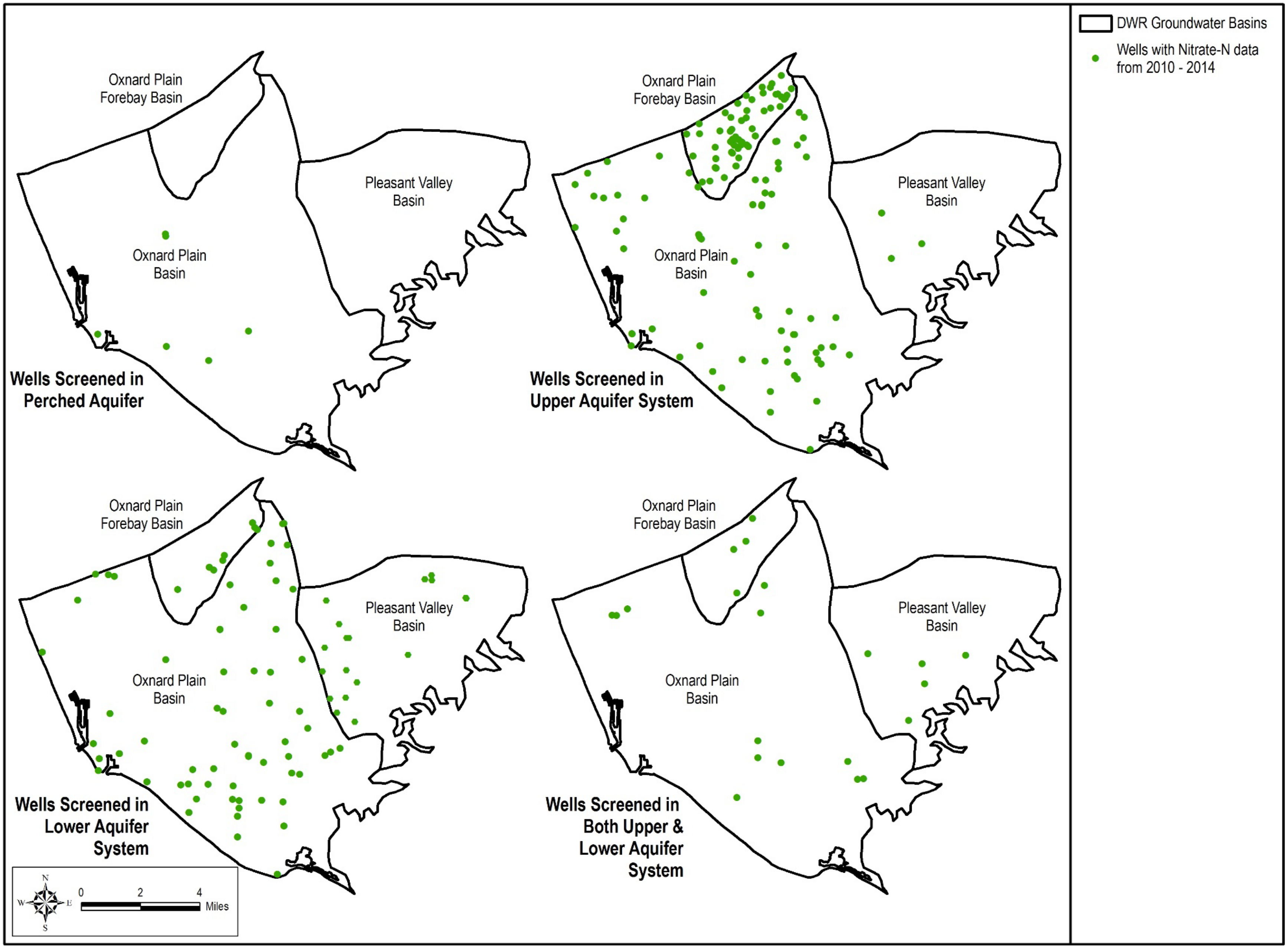
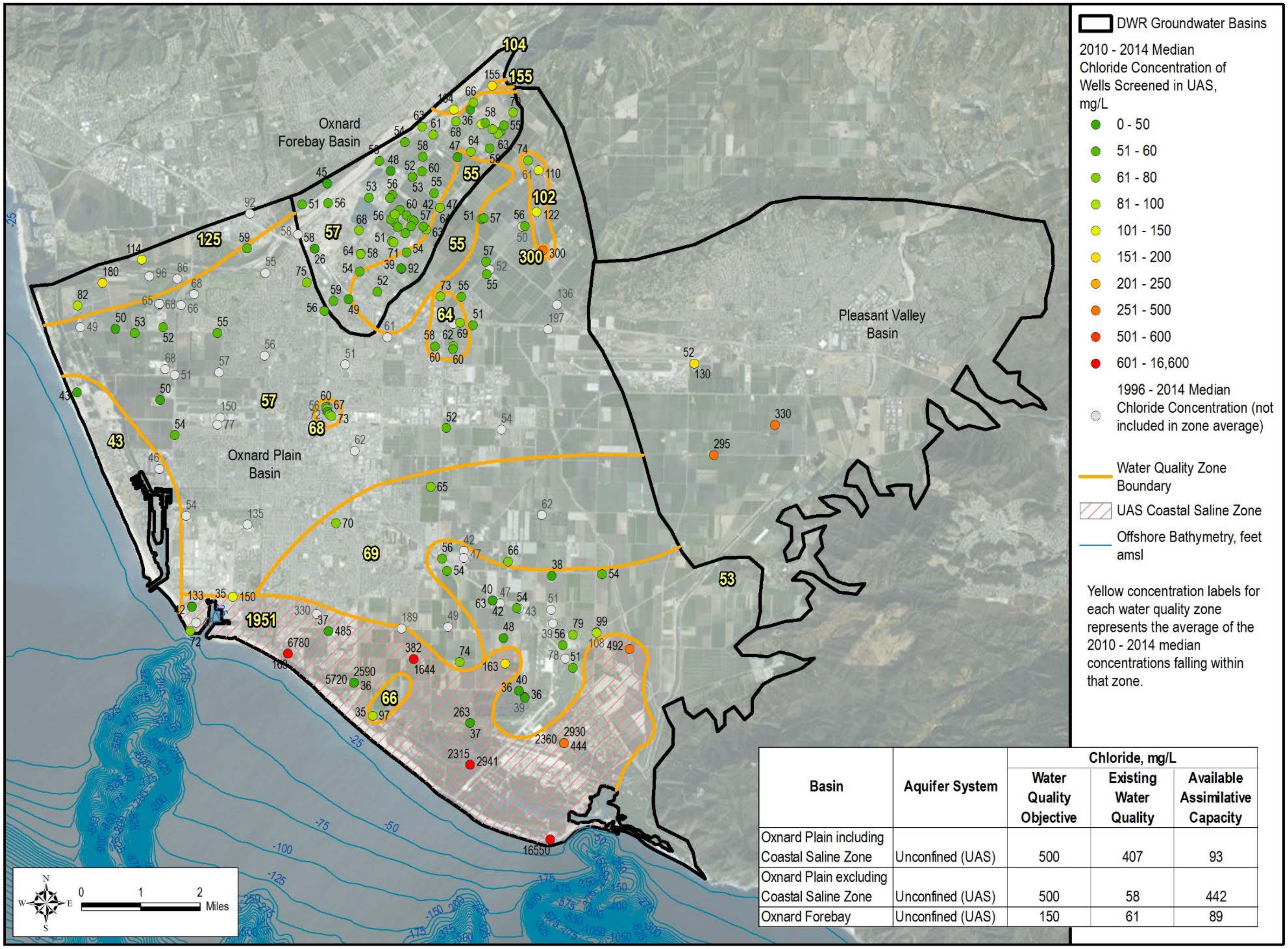
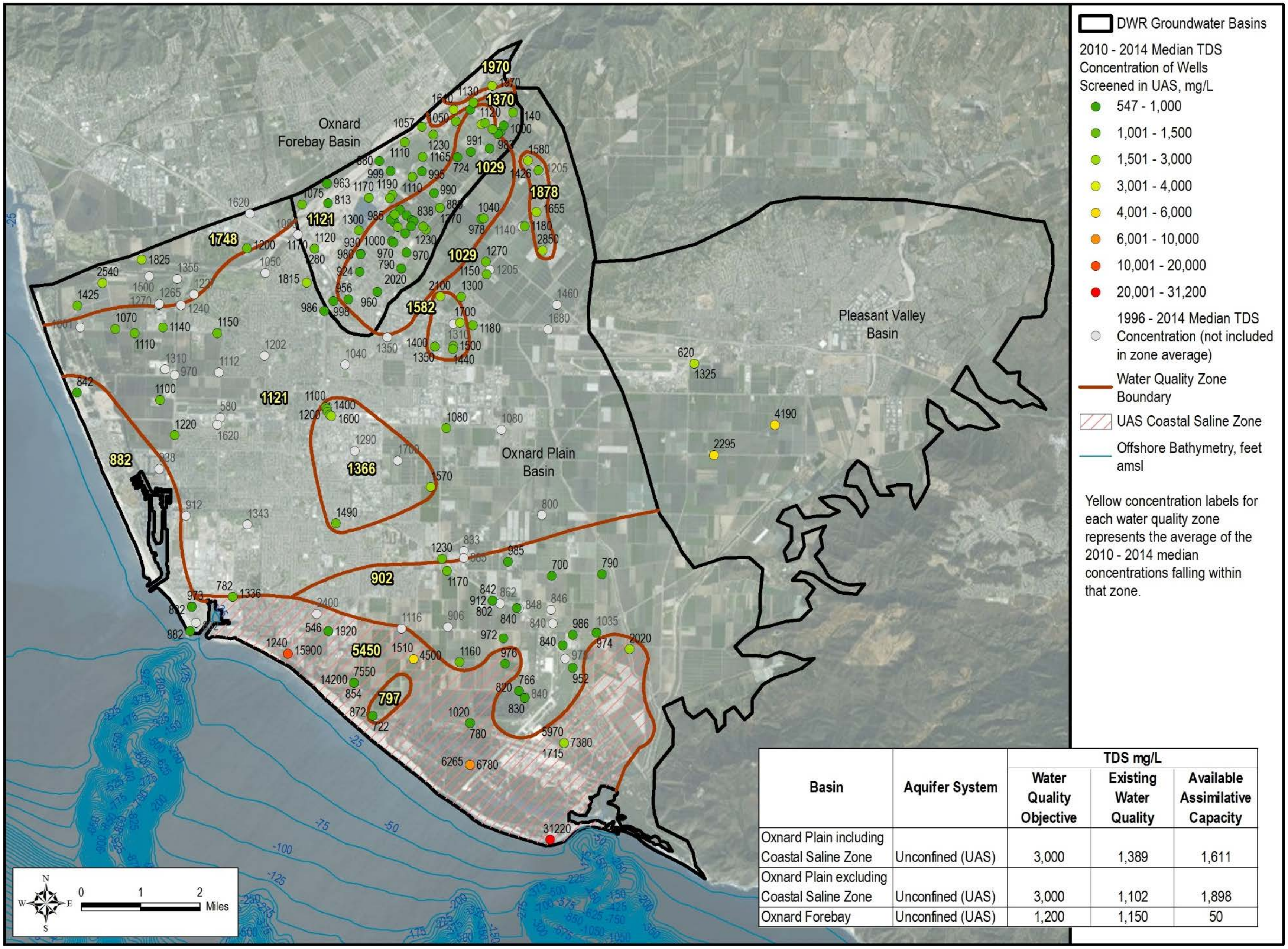


Figure 3 Distribution of Wells with Nitrate as N Data (2010 – 2014)



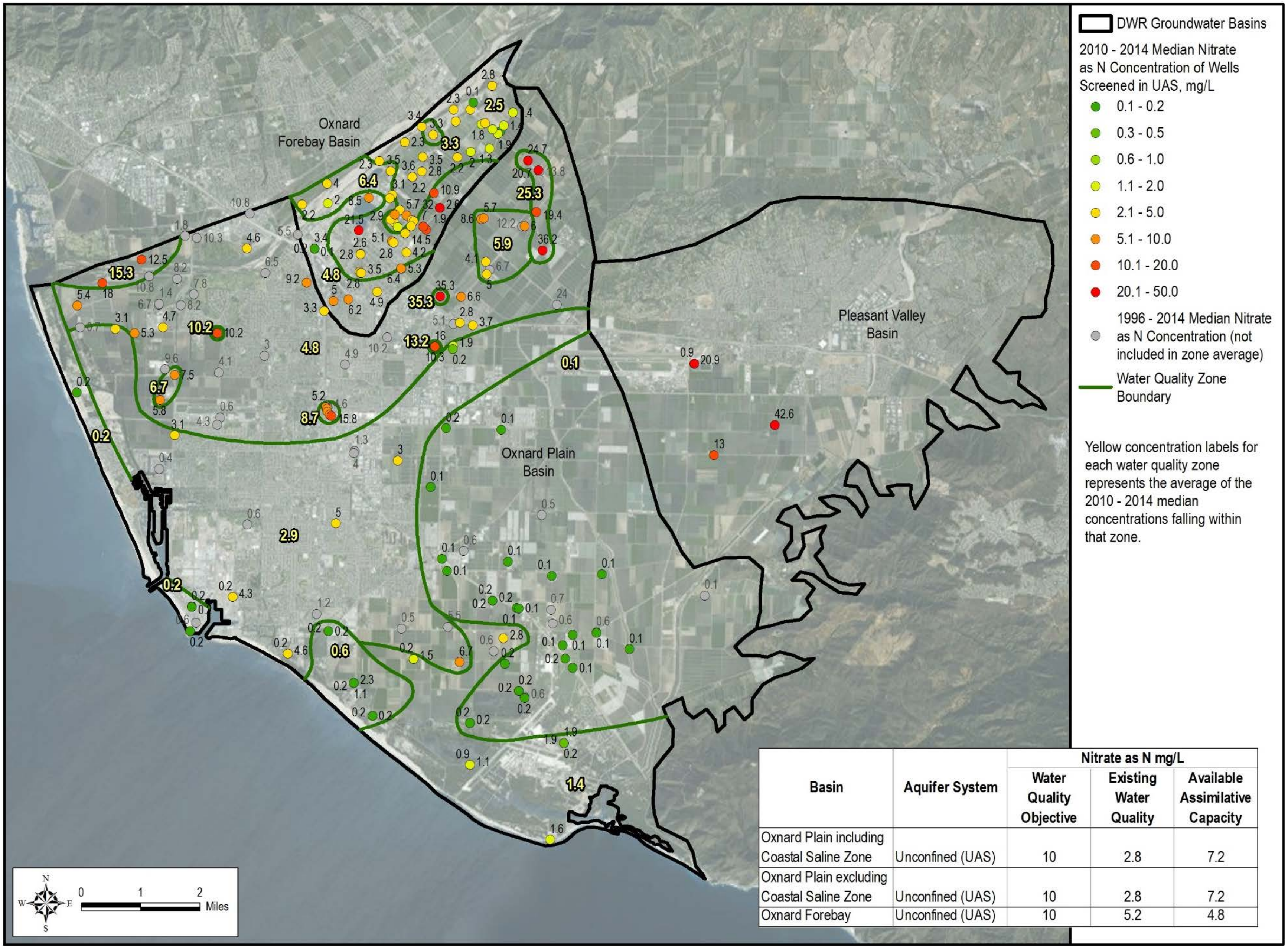
Basin	Aquifer System	Chloride, mg/L Water Quality Objective	Chloride, mg/L Existing Water Quality	Chloride, mg/L Available Assimilative Capacity
Oxnard Plain including Coastal Saline Zone	Unconfined (UAS)	500	407	93
Oxnard Plain excluding Coastal Saline Zone	Unconfined (UAS)	500	58	442
Oxnard Forebay	Unconfined (UAS)	150	61	89

Figure 4 Upper Aquifer System Chloride Groundwater Quality



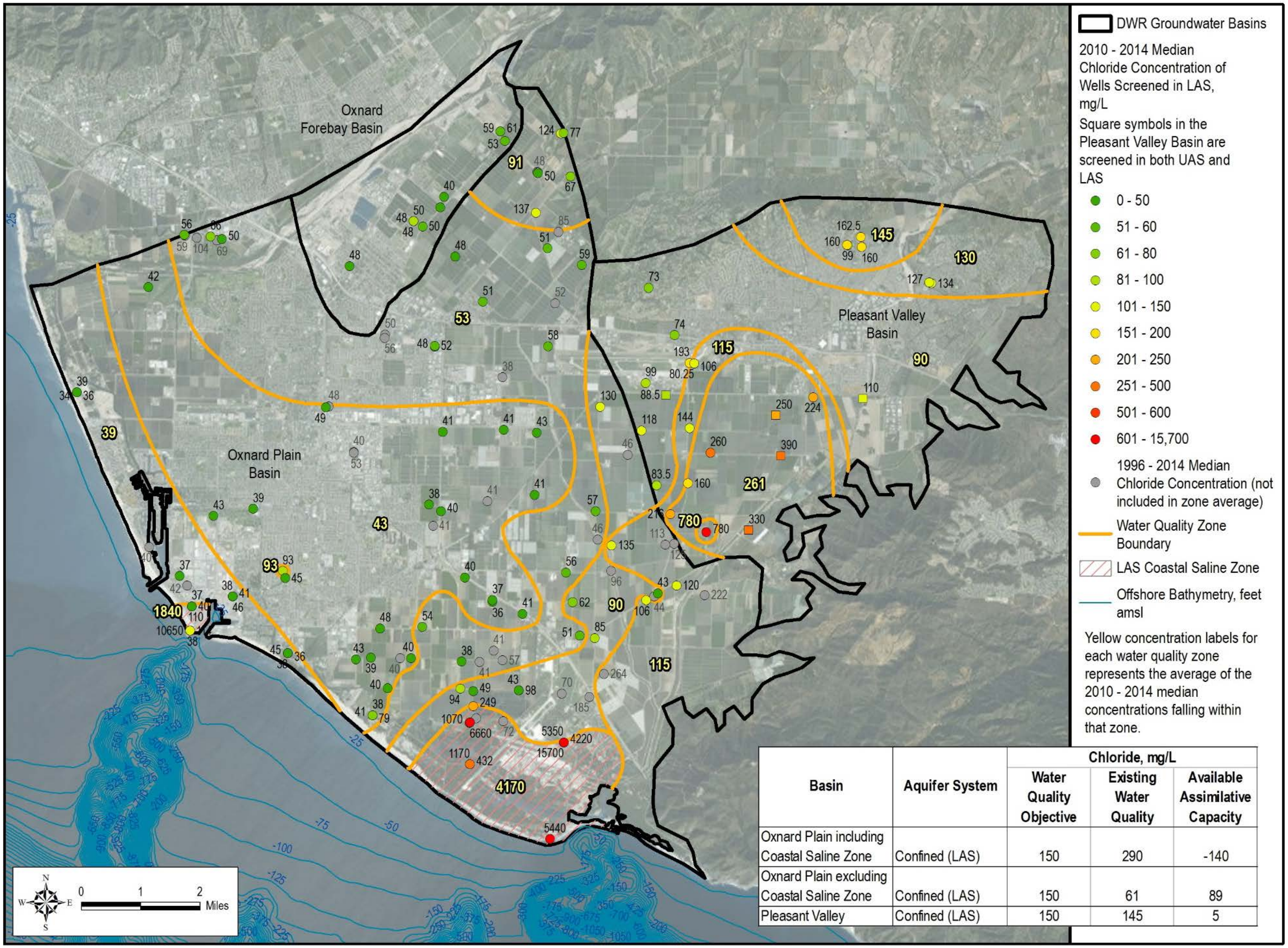
Basin	Aquifer System	TDS mg/L Water Quality Objective	TDS mg/L Existing Water Quality	TDS mg/L Available Assimilative Capacity
Oxnard Plain including Coastal Saline Zone	Unconfined (UAS)	3,000	1,389	1,611
Oxnard Plain excluding Coastal Saline Zone	Unconfined (UAS)	3,000	1,102	1,898
Oxnard Forebay	Unconfined (UAS)	1,200	1,150	50

Figure 5 Upper Aquifer System TDS Groundwater Quality



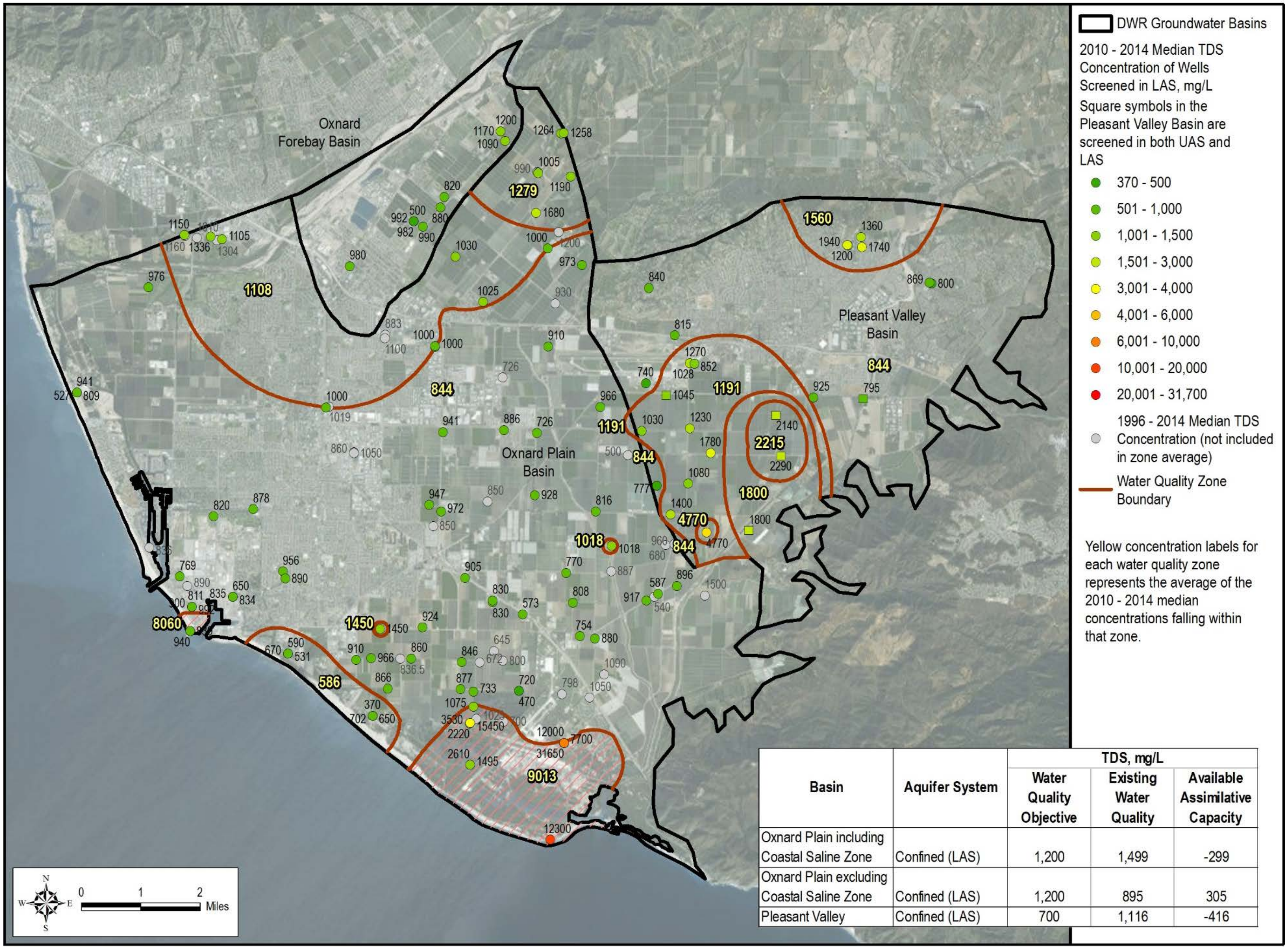
Basin	Aquifer System	Nitrate as N mg/L Water Quality Objective	Existing Water Quality	Available Assimilative Capacity
Oxnard Plain including Coastal Saline Zone	Unconfined (UAS)	10	2.8	7.2
Oxnard Plain excluding Coastal Saline Zone	Unconfined (UAS)	10	2.8	7.2
Oxnard Forebay	Unconfined (UAS)	10	5.2	4.8

Figure 6 Upper Aquifer System Nitrate as N Groundwater Quality



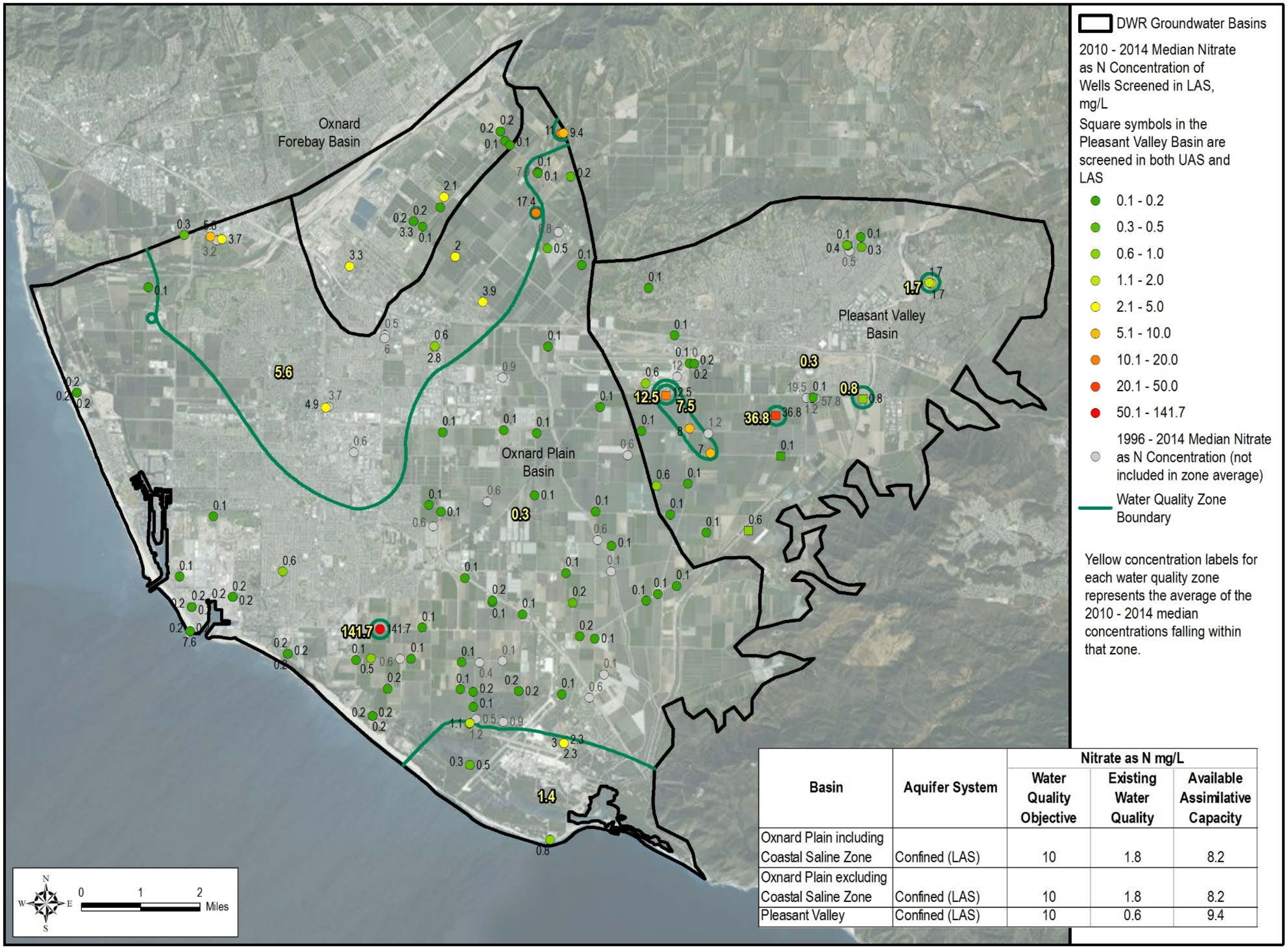
Basin	Aquifer System	Chloride, mg/L: Water Quality Objective	Existing Water Quality	Available Assimilative Capacity
Oxnard Plain including Coastal Saline Zone	Confined (LAS)	150	290	-140
Oxnard Plain excluding Coastal Saline Zone	Confined (LAS)	150	61	89
Pleasant Valley	Confined (LAS)	150	145	5

Figure 7 Lower Aquifer System Chloride Groundwater Quality



Basin	Aquifer System	TDS, mg/L		
		Water Quality Objective	Existing Water Quality	Available Assimilative Capacity
Oxnard Plain including Coastal Saline Zone	Confined (LAS)	1,200	1,499	-299
Oxnard Plain excluding Coastal Saline Zone	Confined (LAS)	1,200	895	305
Pleasant Valley	Confined (LAS)	700	1,116	-416

Figure 8 Lower Aquifer System TDS Groundwater Quality



Basin	Aquifer System	Nitrate as N mg/L		
		Water Quality Objective	Existing Water Quality	Available Assimilative Capacity
Oxnard Plain including Coastal Saline Zone	Confined (LAS)	10	1.8	8.2
Oxnard Plain excluding Coastal Saline Zone	Confined (LAS)	10	1.8	8.2
Pleasant Valley	Confined (LAS)	10	0.6	9.4

Figure 9 Lower Aquifer System Nitrate as N Groundwater Quality

3.4.2 Historic Trend Methodology

To evaluate whether there are localized or regional groundwater quality trends, chloride, TDS, and nitrate as N concentrations for wells with more than 10 data records over the 1996-2014 period were assessed. These data were assessed by considering both a visual interpretation of plotted time-series data and the results of the Mann-Kendall statistical test.

The Mann-Kendall test is a statistical technique used to identify the presence of trends in time-series data. The test looks for monotonic trends (values that always increase or always decrease) that occur over time, reporting how close the data are to monotonic but not how rapidly or gradually the data may change. The Mann-Kendall test calculates two statistics that were used to determine the presence or absence of trends: the tau statistic which indicates the strength of the trend, and the p-value which reports the statistical significant of the result. A dataset is considered to lack a detectable trend if either the absolute value of tau is less than 0.3 or the p-value is greater than or equal to 0.05.

Of the several variations of the Mann-Kendall test this investigation uses the simplest nonparametric Mann-Kendall test with no adjustments made for exogenous variables, such as variations in groundwater level that may drive variability in measured groundwater quality. For this reason, the Mann-Kendall test is not the only piece of evidence used to determine the presence or lack of a trend in groundwater quality data.

Visual inspection of the groundwater quality time-series plots is undertaken to overcome some of the shortcomings of the Mann-Kendall test. Each plot is inspected for characteristics that would render the Mann-Kendall results invalid, such as obvious groundwater level driven variations, two or more distinct periods with opposite trends, or the presence of several readings below a detection limit which changed over the 1996-2014 period. For these data sets the results of the Mann-Kendall test were ignored and the determination of the presence or lack of a trend was based entirely upon visual interpretation of the time-series plot.

Each dataset is classified as having either no trend, a decreasing trend, an increasing trend, or groundwater quality that is strongly driven by changes in groundwater elevations. In addition, datasets which exhibit trends but have little to no data since 2010 were classified separately. Figures 10 through Figure 12 summarize the number of wells assigned each classification for each basin and water quality constituent. Figures 13 through Figure 21 display on maps the trend classification of each well to help reveal any spatial trend patterns.

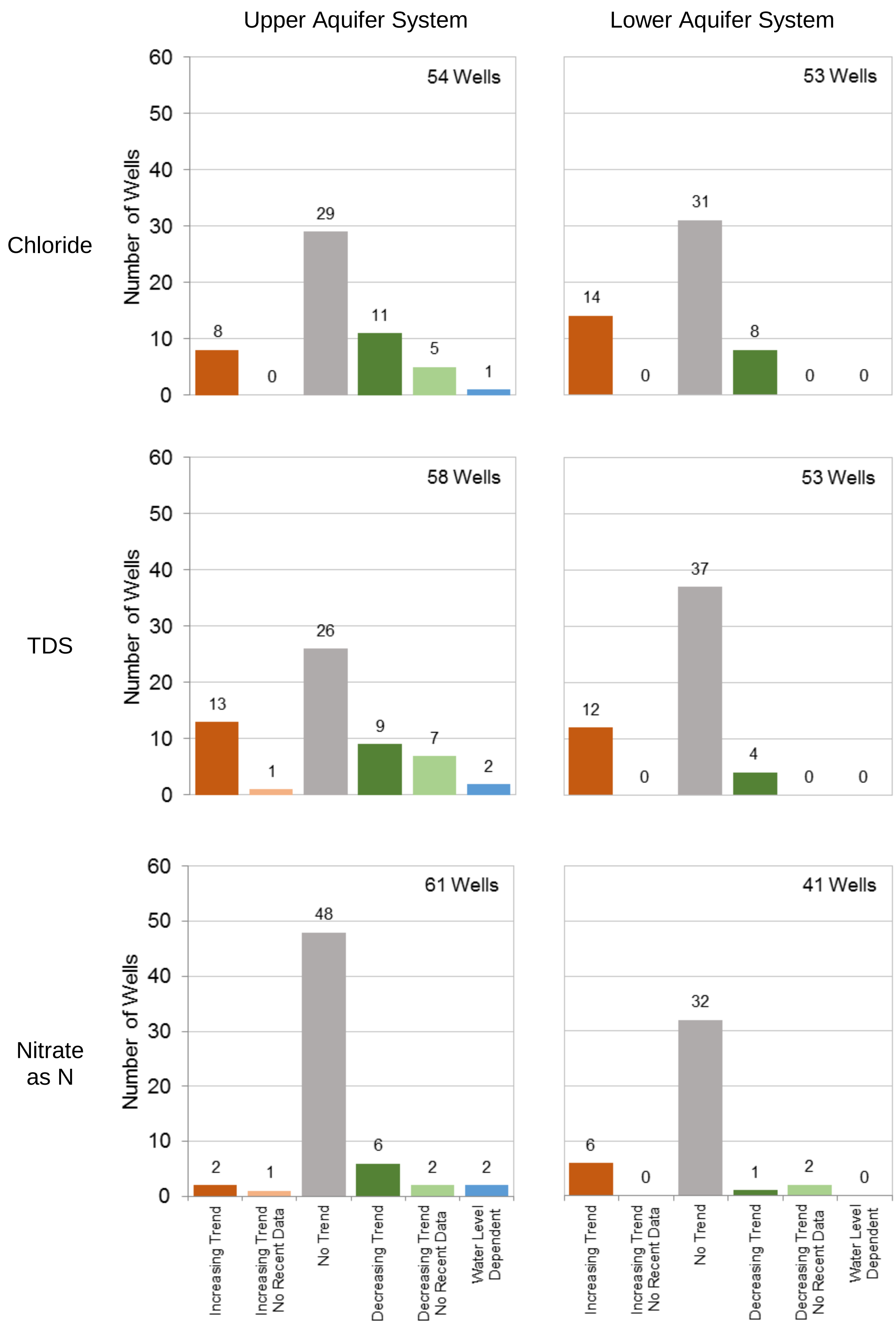


Figure 10 Trends Observed in Wells in the Oxnard Plain Basin

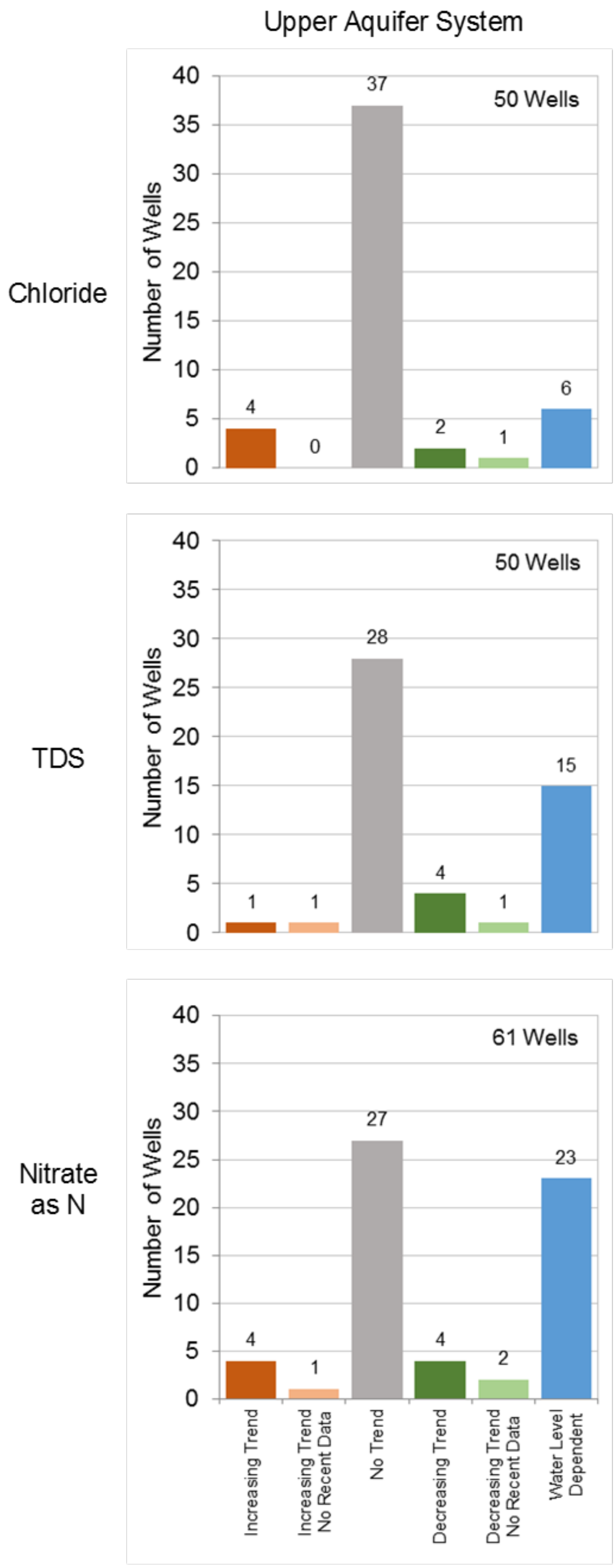


Figure 11 Trends Observed in UAS Wells in the Oxnard Forebay Basin

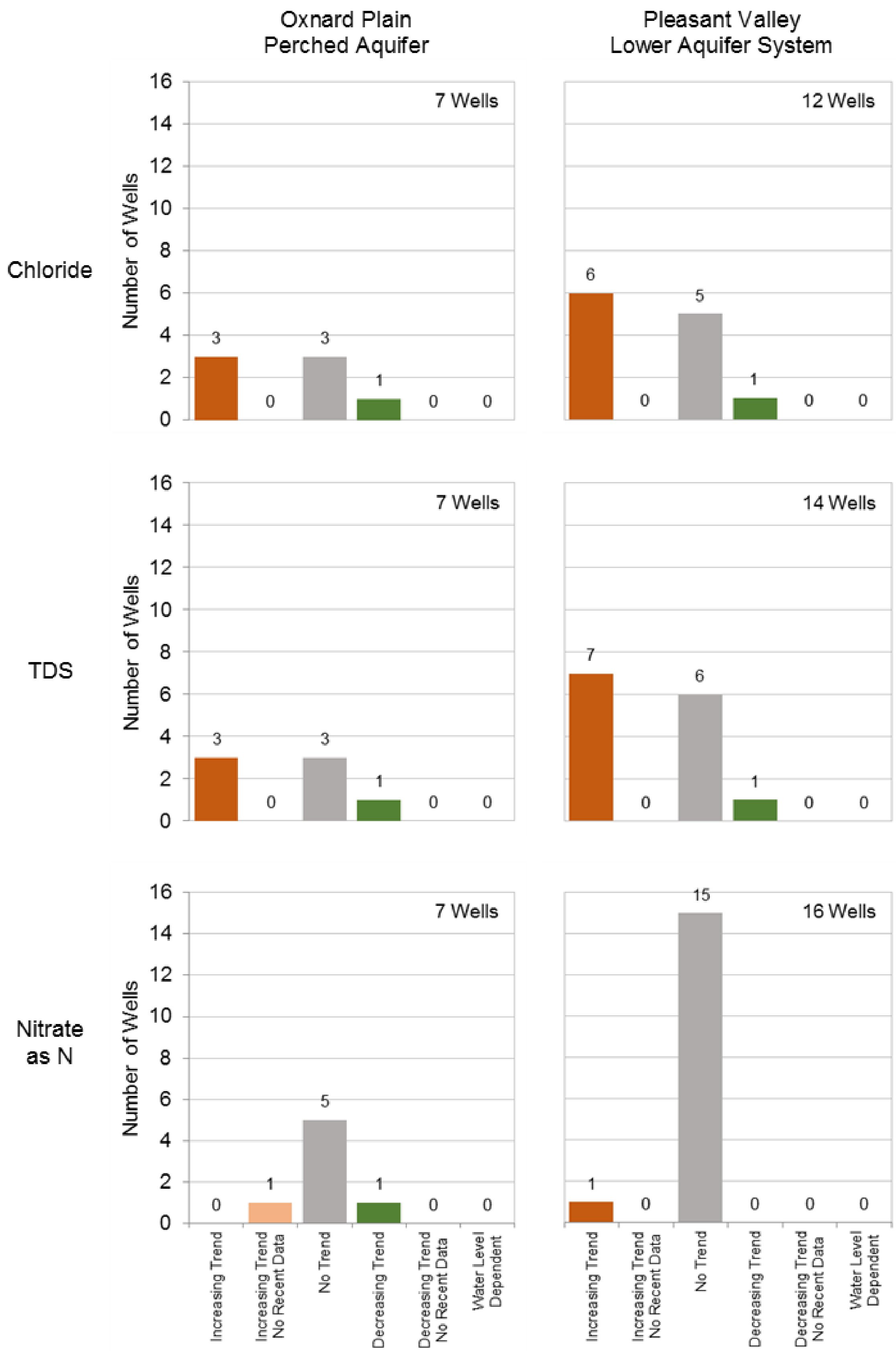


Figure 12 Trends Observed in Wells in the Oxnard Plain Basin Perched Aquifer and LAS Pleasant Valley Basin

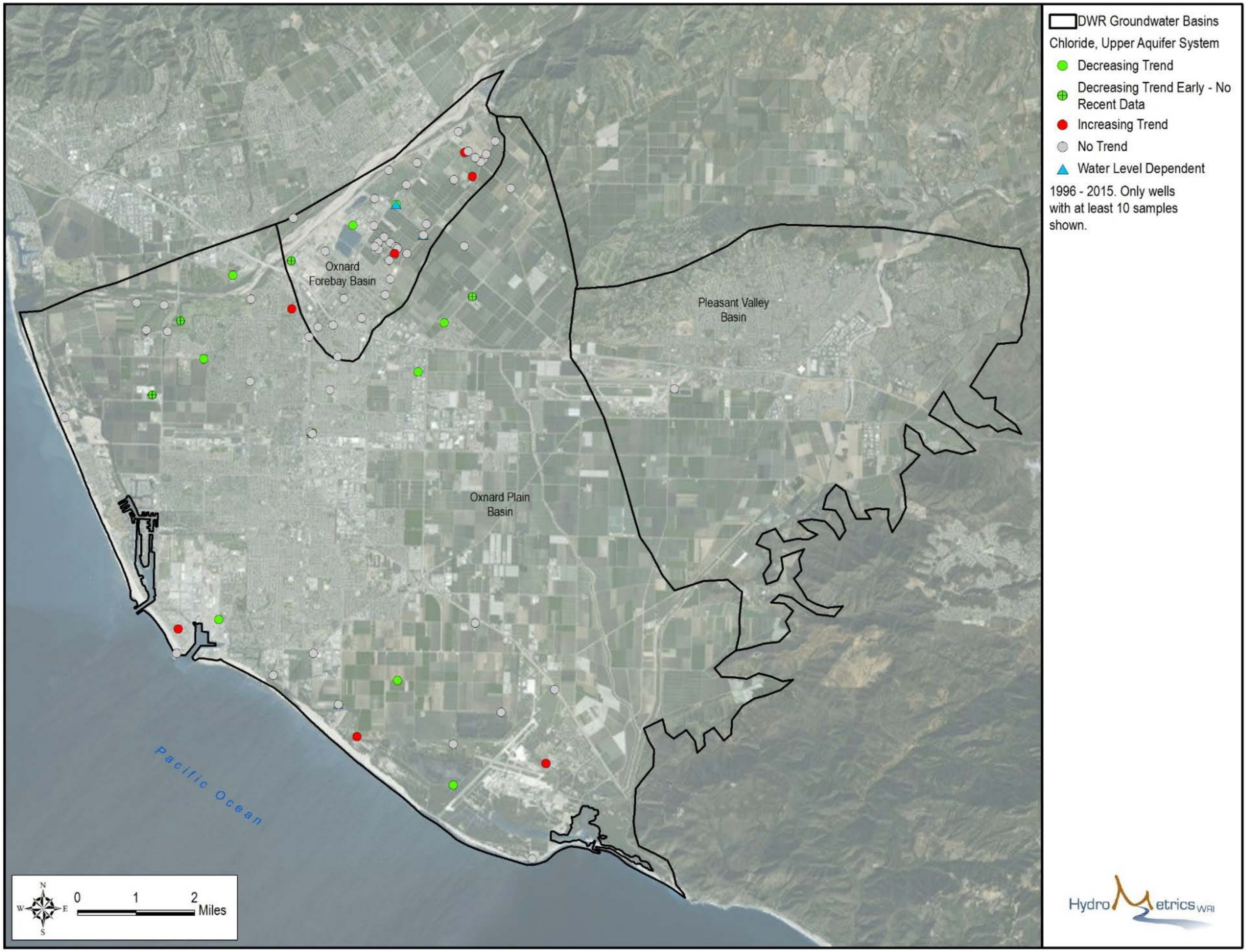


Figure 13 Upper Aquifer System Chloride Trend Distribution

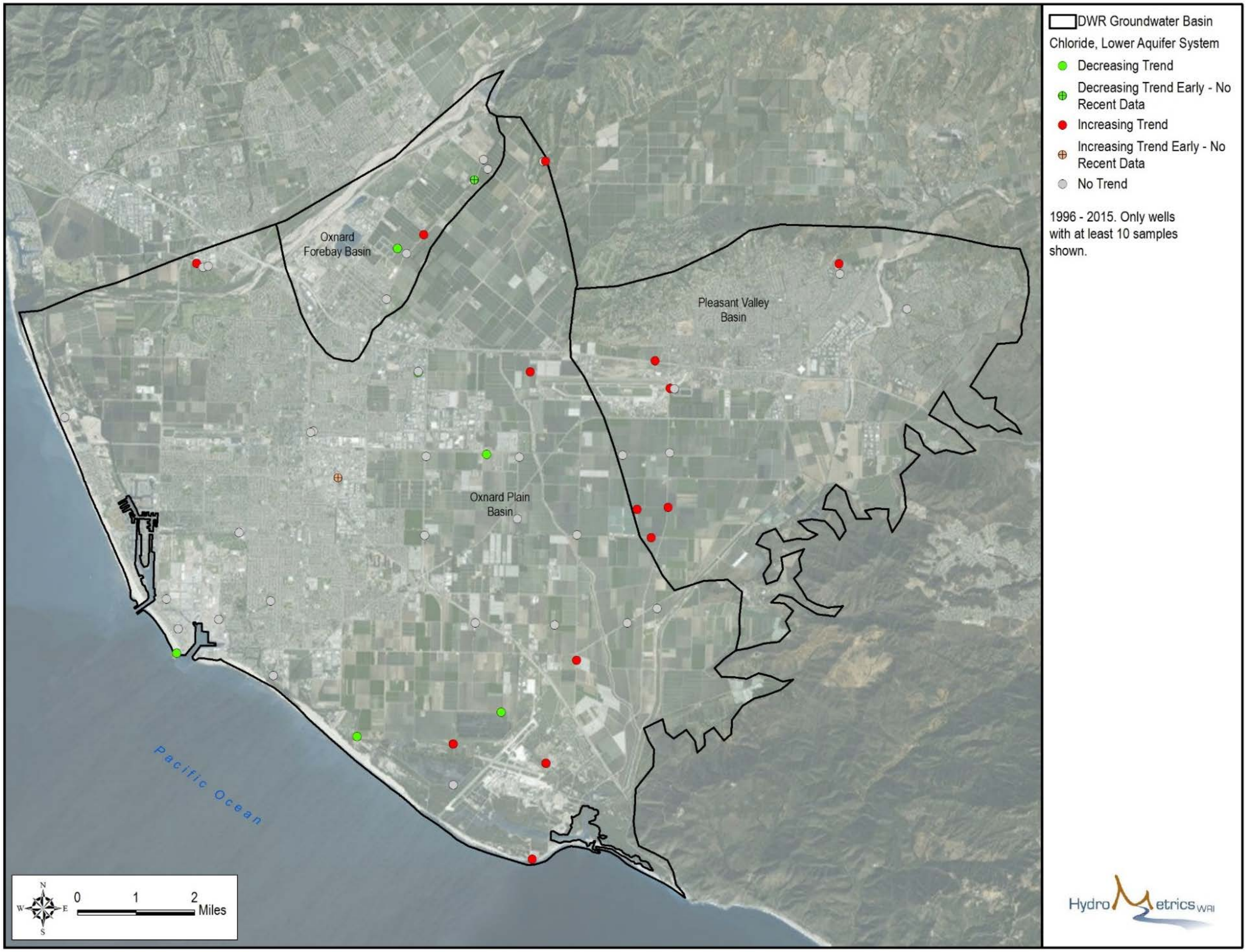


Figure 14 Lower Aquifer System Chloride Trend Distribution

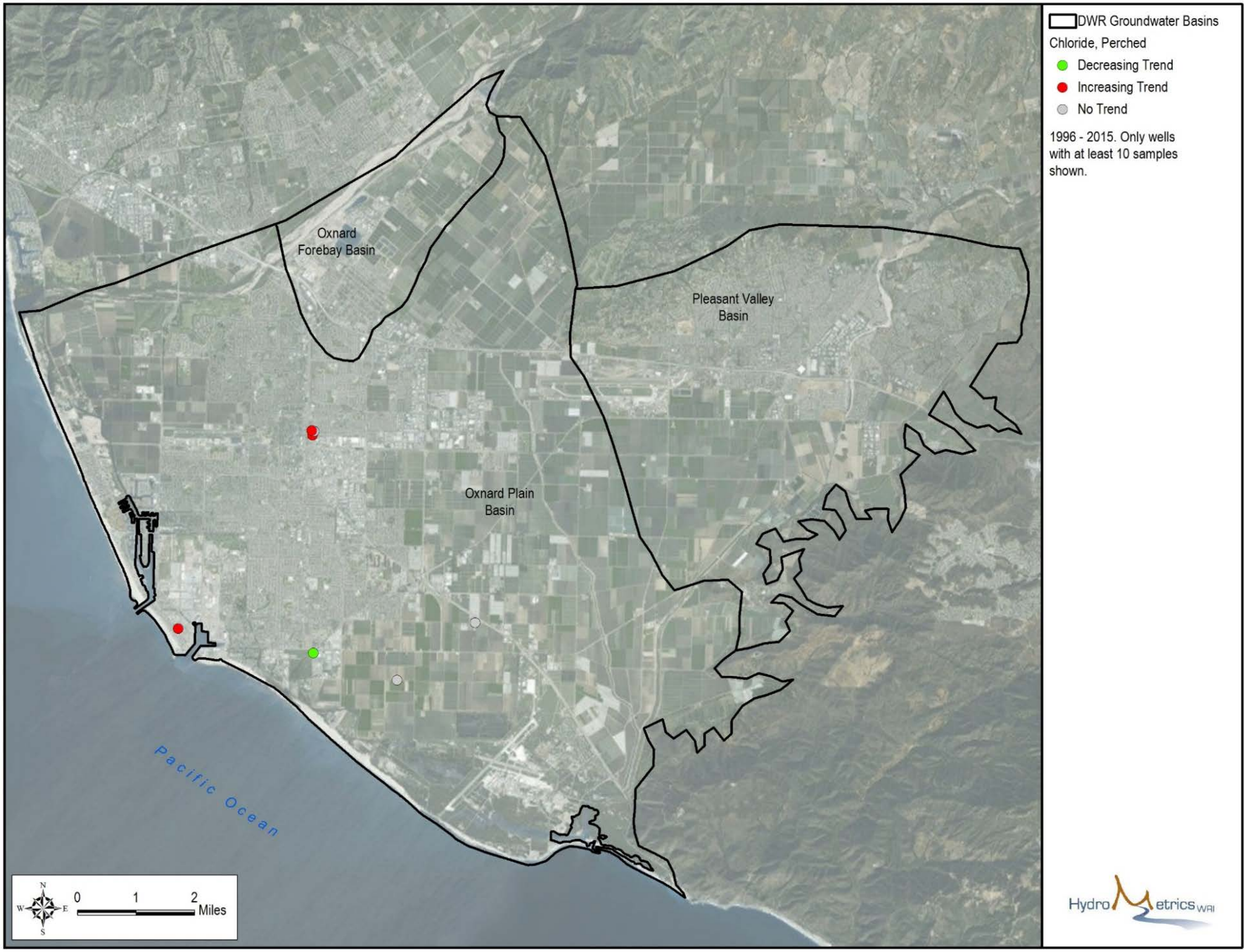


Figure 15 Perched Aquifer Chloride Trend Distribution

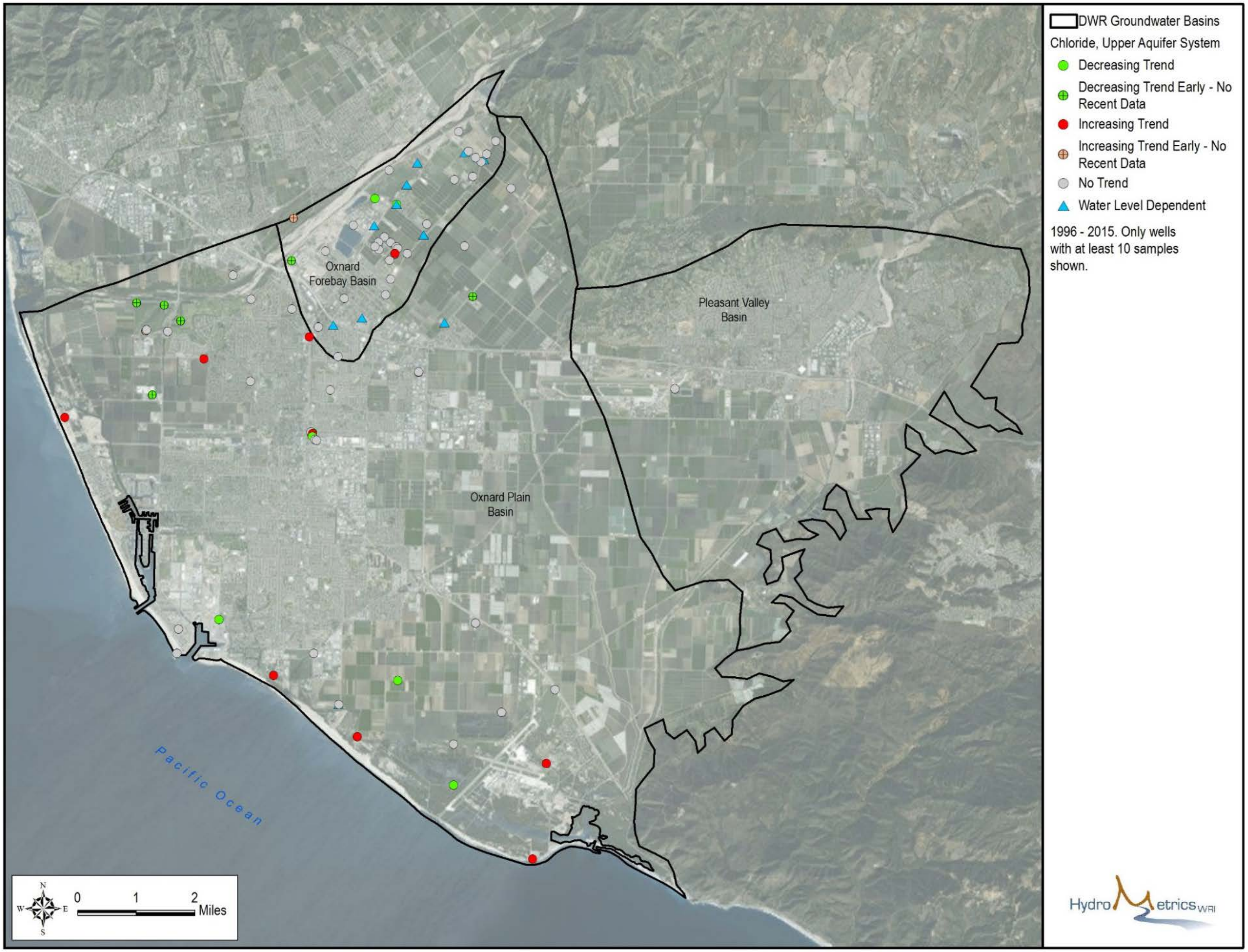


Figure 16 Upper Aquifer System TDS Trend Distribution

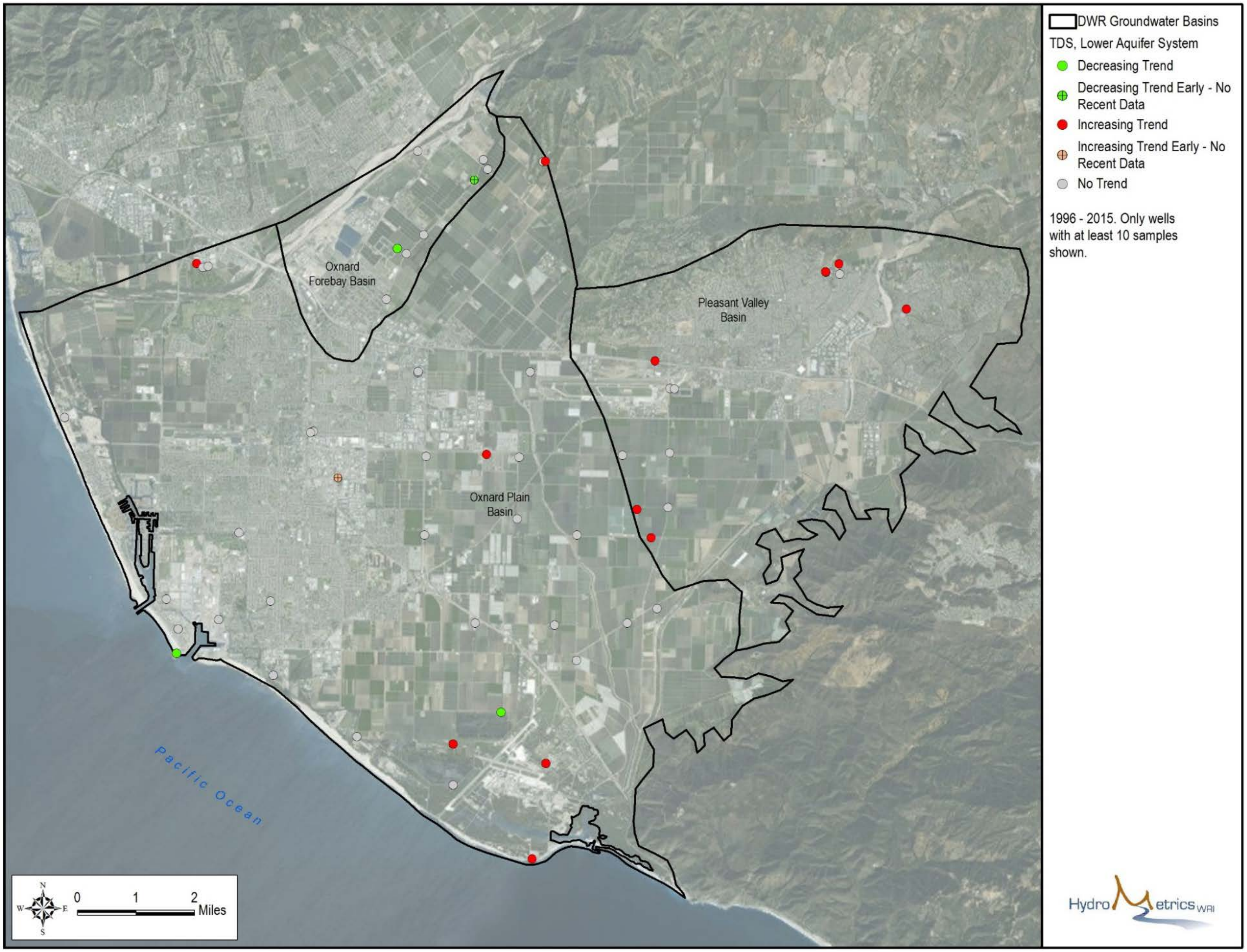


Figure 17 Lower Aquifer System TDS Trend Distribution

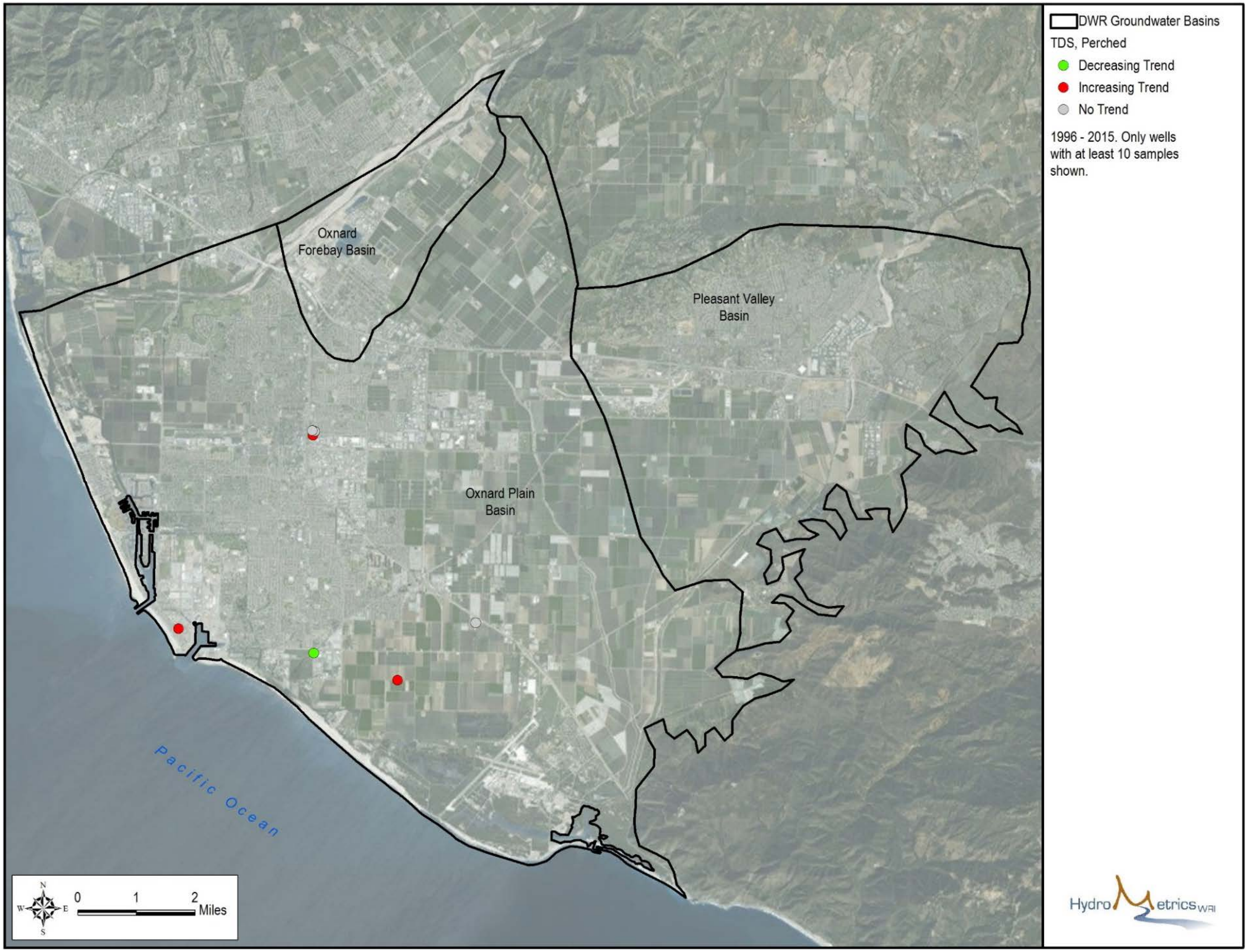


Figure 18 Perched Aquifer TDS Trend Distribution

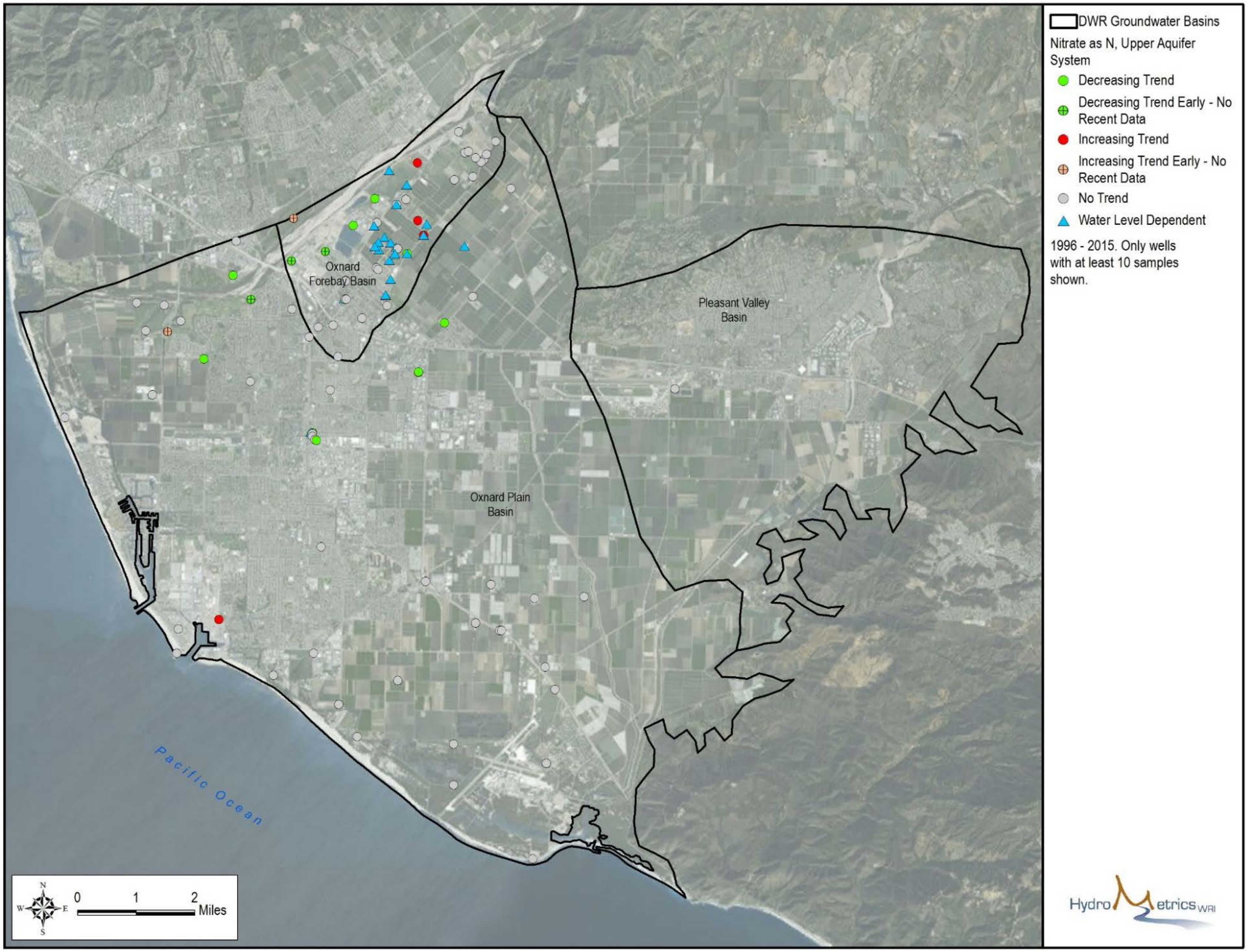


Figure 19 Upper Aquifer System Nitrate as N Trend Distribution

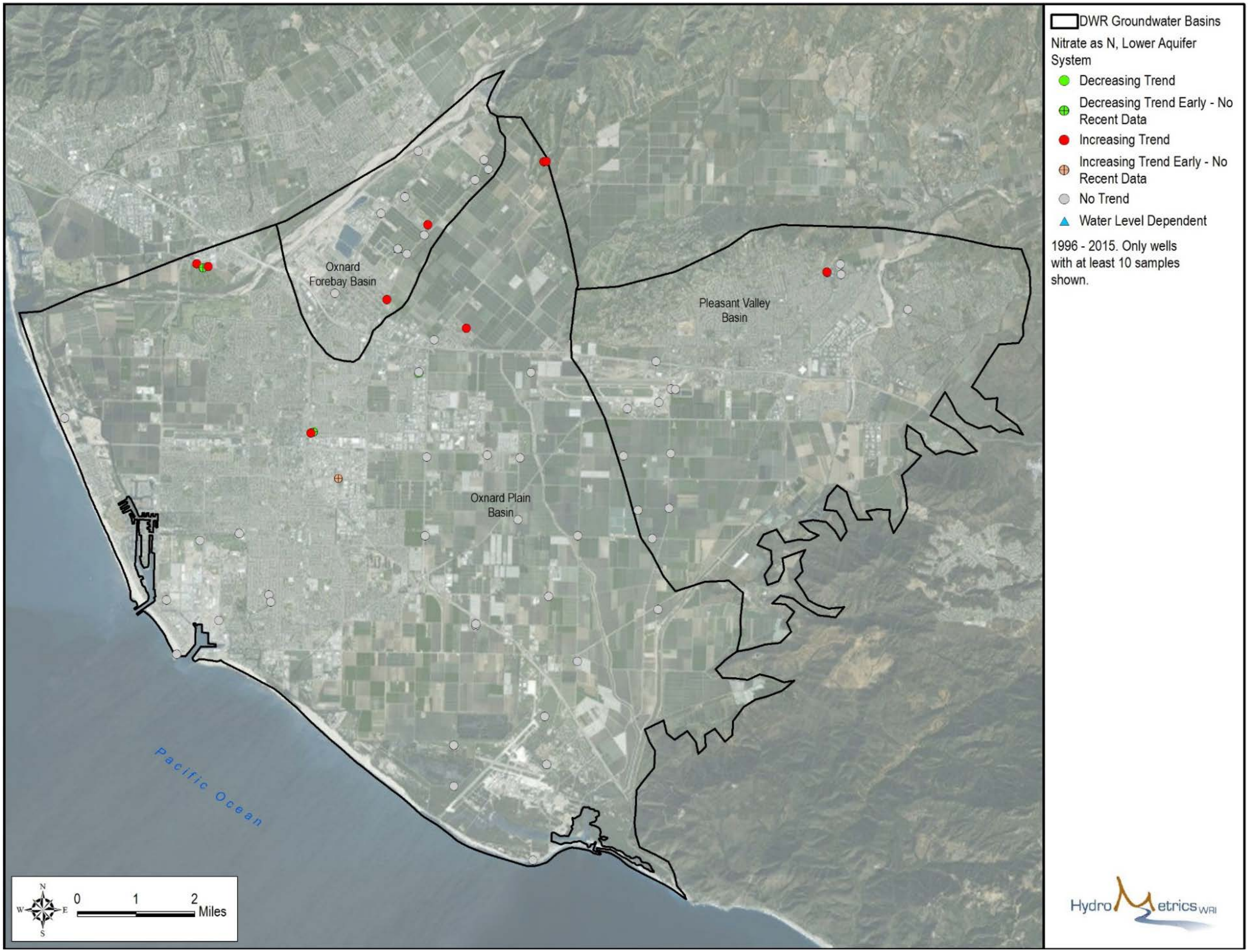


Figure 20 Lower Aquifer System Nitrate as N Trend Distribution

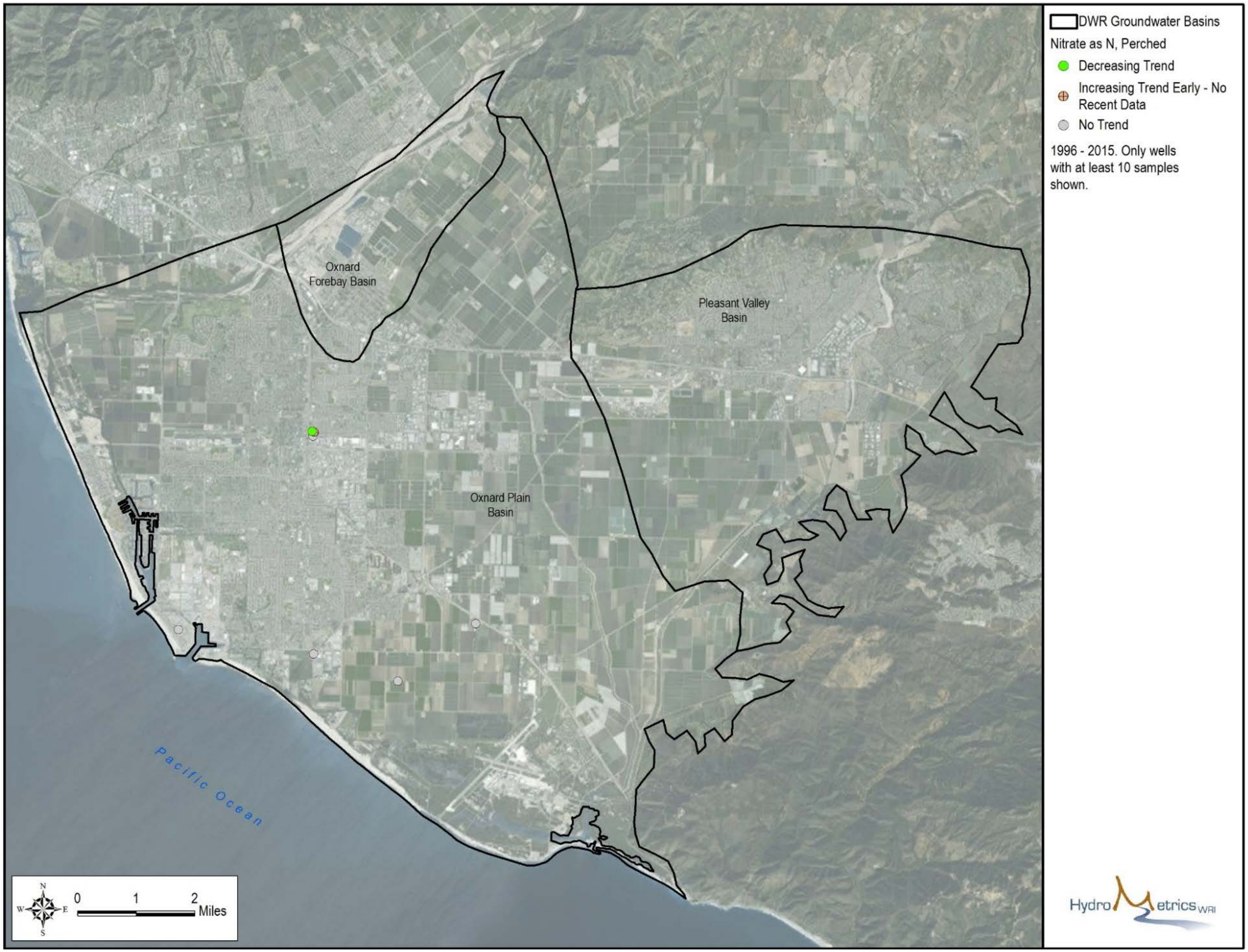


Figure 21 Perched Aquifer Nitrate as N Trend Distribution

3.4.3 Oxnard Plain Basin

The following sections describe the existing water quality and analysis of trends in the Oxnard Plain Basin. In addition, the following section describes the presence of a coastal saline zone in the Oxnard Plain basin and the implications on the assimilative capacity evaluation of the Oxnard Plain basin. Additional information on the coastal saline zone is included in Appendix D.

3.4.3.1 Coastal Saline Zone

The Oxnard Plain basin has experienced impaired groundwater quality with high chloride concentrations since at least the early 1930s. Highly saline waters are present in the confined UAS and LAS as well as in the shallow unconfined aquifer typically referred to as the ‘perched aquifer’. Regions of high salinity are focused in two arms which extend landward from below Port Hueneme and Mugu Lagoon. Wells in these areas show chloride concentrations of 150 milligrams per liter (mg/L) to 17,000 mg/L, which greatly exceed those in the aquifer to the north and west where concentrations tend to be between 40 and 70 mg/L. The boundaries of these zones have changed with different basin management activities such as shifting the location of pumping, in-lieu recharge, and managed aquifer recharge in the Oxnard Forebay basin.

Various studies have attempted to measure the extent of the saline groundwater and identify possible chloride sources. Seawater intrusion, where seawater migrates inland in response to pumping induced drawdown in coastal aquifers, has long been known to occur. The regions of high salinity extending from below Port Hueneme and Mugu Lagoon appear to result from seawater intrusion from outcrops of the aquifer systems are exposed to the ocean in submarine canyons. The LAS does not crop out in the Mugu submarine canyon and the salinity in the LAS near Mugu Lagoon is thought to originate from other sources. A series of studies by the United States Geological Survey (USGS) and others (USGS, 1996) in the 1990s identified additional sources of chloride to the aquifer systems, suggesting that seawater intrusion may not be as widely spread as previously thought. The additional sources of high salinity water are: lagoonal deposits in the UAS near Point Mugu and marine and volcanic rock surrounding and underlying the LAS. Importantly, the chloride in the UAS and LAS is thought to come primarily from natural sources which migrate into the aquifer in response to groundwater level drawdown. The introduction of chloride through fertilizer application has not been identified as a major source.

For purposes of estimating assimilative capacity, the Oxnard Plain basin is divided into two zones, a Coastal Saline Zone and the remainder of the basin, based on chloride concentrations[1]. The Coastal Saline Zone currently has chloride concentrations greatly above water quality objectives. The remainder of the basin has low salinity that can accept

[1] The spatial distribution of TDS concentrations in wells follows the same general pattern as chloride, and therefore the impaired zone for chloride is suitable for use with TDS in both the UAS and LAS.

additional loading with recycled water without exceeding the water quality objectives for the aquifer systems. If the Oxnard Plain basin is treated as a single pool of water with a single assimilative capacity, the high concentrations of the impaired zone strongly bias the estimate of existing groundwater quality and there will be no assimilative capacity. This biased result would limit recycled water use in the basin.

The Coastal Saline Zone is delineated using groundwater quality data from 2010 through 2014 in wells screened in both aquifer systems, and a geophysical survey that used a measure of electrical conductivity of the aquifer systems to delineate saline zones (UWCD, 2010). The saline zone was delineated to include wells where median chloride concentrations are generally above 150 mg/L and to follow, where possible, the shape of the saline and brackish zones identified in the geophysical survey. A chloride concentration of 150 mg/L was used as the zone extent as it represents the basin's LAS groundwater quality objective.

As discussed, the GSP includes planning goals that are relevant to water quality issues in the coastal saline zone, including controlling saline intrusion front at its current position. At this time, specific measures for controlling saline intrusion have not been identified through the GSP. However, based on these planning goals, it is assumed that measures will be implemented to minimize further progression of the saline zone and improve overall basin sustainability. The delineated Coastal Saline Zone is therefore suitable as a zone that can be separated from the rest of the basin. In the future, if the saline zone shrinks, the existing groundwater quality and assimilative capacity should be re-estimated.

Existing groundwater quality and available assimilative capacity for each aquifer system are estimated for the Oxnard Plain basin with the Coastal Saline Zone both included and excluded. However, the analysis will be based on the assimilative capacity results with exclusion of the Coastal Saline Zone.

3.4.3.2 Oxnard Plain Basin Existing Groundwater Quality

Maps showing the delineation of groundwater quality zones in the UAS of the Oxnard Plain basin are shown on Figure 4 through Figure 6 for chloride, TDS, and nitrate as N, respectively. Figure 7 through Figure 9 show the delineation of groundwater quality zones in the LAS for chloride, TDS, and nitrate as N, respectively.

3.4.3.2.1 Chloride

Chloride concentrations in the UAS of the Oxnard Plain basin are generally less than 70 mg/L (Figure 4). Areas that have higher concentrations than this are along the basin's northern boundary with the Mound basin, east of the Oxnard Forebay basin, and along the basins' southern boundary with the Pacific Ocean which is delineated as the Coastal Saline Zone (hatched area on Figure 4). Based on the calculation of the volume weighted concentration for the UAS, the existing groundwater quality for chloride in the UAS is 407 mg/L if the Coastal Saline Zone is included, and 58 mg/L if the Coastal Saline Zone is excluded (Figure 4).

Chloride concentrations in the LAS have fewer localized highs than the UAS, however overall concentrations are higher throughout the basin compared to the UAS (Figure 7). In general, chloride concentrations are somewhat elevated in the more eastern areas of the basin, with the exception of the Coastal Saline Zone which has the highest concentration of chloride within the LAS. The Coastal Saline Zone in the UAS has a much smaller footprint than in the UAS (hatched area on Figure 7). In the LAS, the existing groundwater quality for chloride is 209 mg/L if the Coastal Saline Zone is included, and 61 mg/L if the Coastal Saline Zone is excluded (Figure 7).

3.4.3.2.2 __Total Dissolved Solids__

The groundwater quality zones in the UAS of the Oxnard Plain basin vary from 880 mg/L to 1,878 mg/L, excluding the Coastal Saline Zone which has a volume weighted average concentration of 5,450 mg/L (Figure 5). There are several areas with higher concentrations than the majority of the basin. These are: along the basin’s northern boundary with the Mound basin, in the northern portion of the basin where there are two areas east of the Oxnard Forebay basin, and in an area near downtown Oxnard. Based on the calculation of volume weighted concentration for the UAS, the existing groundwater quality for TDS in the UAS is 1,389 mg/L if the Coastal Saline Zone is included, and 1,102 mg/L if the Coastal Saline Zone is excluded (Figure 5).

TDS concentrations in the LAS (Figure 8) are more uniform than in the UAS (Figure 5). As with chloride, TDS concentration tend to be elevated in some areas in the more eastern portion of the basin, with the exception of the Coastal Saline Zone which has a volume weighted average concentration of 9,013 mg/L. In the LAS, the existing groundwater quality for TDS is 1,499 mg/L if the Coastal Saline Zone is included, and 895 mg/L if the Coastal Saline Zone is excluded (Figure 8).

3.4.3.2.3 __Nitrate as N__

Higher nitrate concentrations in the UAS are expected in agricultural areas such as those overlying the Oxnard Plain basin. This is the case in the northern portion of the basin but not in the southern half of the basin where nitrate as N is commonly only 0.1 mg/L (Figure 6 and Figure 9). Elevated nitrates in the northern portion of the Oxnard Plain basin are likely because this area is hydraulically downgradient of the Oxnard Forebay basin, which has similar concentrations.

There are also several localized high concentration areas within the UAS, particularly in the northern part of the basin (Figure 6). It is beyond the scope of this study to determine what causes water at a single well location to have abnormally high concentrations. However, as shown on the maps, the very high concentrations were included in the estimation of existing groundwater quality by delineating a small water quality zone around the impacted wells.

In general, the nitrate concentrations in the LAS are lower than the UAS. However, there is one well in the LAS, in an agricultural area east of Port Hueneme, that has a nitrate as N concentration of 141.7 mg/L which is the highest concentration in the dataset (Figure 9). The concentrations observed in the water from this well are likely due to vertical migration of localized high nitrate water from the overlying perched aquifer through an existing well.

The Point Mugu area has higher than background nitrate as N concentrations in both the UAS and LAS (1.4 mg/L). The cause of this is uncertain at this time.

The existing groundwater quality of nitrate as N in the Oxnard Plain UAS is 2.8 mg/L, and 1.8 mg/L in the LAS (Figure 6 and Figure 9).

3.4.3.3 Oxnard Plain Basin Groundwater Quality Historic Trends

The Oxnard Plain basin is characterized by a large central area where few trends in groundwater quality are observed, and regions to the north and south where regional trends occur (Figure 13 through Figure 21). The UAS has a greater proportion of wells with either increasing or decreasing trends, with decreasing trends being observed more than increasing trends. Chloride and TDS have more defined trends than nitrate as N. The water quality data for nearly half of the wells in the perched aquifer show trends but there are too few data to infer whether regional trends are taking place.

The most significant regional trends in the Oxnard Plain Basin are observed along the southern coast and southern portion of the basin where the Coastal Saline Zone has been delineated. There are a few wells east and west of the Oxnard Forebay basin that tap groundwater with localized increasing trends. Overall, the groundwater from many wells in the UAS show decreasing trends in chloride, TDS, and nitrate as N, while the groundwater from several wells in the LAS show increasing trends of nitrate as N. Along the southern coast there are notable increases in chloride and TDS in both aquifer systems over time.

3.4.4 Oxnard Forebay Basin

The main aquifer in the Oxnard Forebay basin is the unconfined UAS. Although the LAS does exist in the basin, it is truncated and contains significant clays. Because of this, the Basin Plan does not have water quality objectives for the LAS. Where data are available for the LAS in the Oxnard Forebay basin, they have been have included on the water quality maps for completeness.

3.4.4.1 Oxnard Forebay Basin Existing Groundwater Quality

3.4.4.1.1 Chloride

Higher chloride concentrations above 100 mg/L occur in the northern portion of the Oxnard Forebay basin's UAS, where it is likely marine sediments underlying the aquifers are shallower than in the southern portion of the basin. With the marine sediments occurring at a shallower depth, wells in this area may extract more saline groundwater that originates from those sediments. The groundwater in the majority of the basin has chloride concentrations of 40 – 70 mg/L. The volume weighted average chloride concentration for the UAS of the Oxnard Forebay basin is 61 mg/L (Figure 4).

3.4.4.1.2 __Total Dissolved Solids__

The distribution of TDS in the UAS of the Oxnard Forebay basin is similar to the distribution of chloride in the basin. The very northern part of the basin has the highest concentrations (maximum of 1,970 mg/L) likely due the shallow occurrence of the underlying marine sediments in this area. The remainder of the basin has concentrations that range from 800 to 1,300 mg/L. The volume weighted average TDS concentration for the UAS of the Oxnard Forebay basin is 1,150 mg/L (Figure 5).

3.4.4.1.3 __Nitrate as N__

Nitrate concentrations in the Oxnard Forebay basin are overall higher and fluctuate more than the other groundwater basins. UWCD has found that highest nitrate concentrations are commonly measured during and following drought periods, and lower nitrate concentrations are measured during wet periods (UWCD, 1998). This is because operations in UWCD's El Rio recharge basins recharge groundwater with low-nitrate water diverted from the Santa Clara River. The recharge of the lower nitrate water effectively dilutes the groundwater causing concentrations to drop. In years, where little to no managed aquifer recharge takes place, nitrate concentrations in the basin increase. Nitrate sources in the basin are related to agricultural fertilizers and septic systems (UWCD, 2014).

The volume weighted average nitrate as N concentration for the UAS of the Oxnard Forebay basin is 5.2 mg/L (Figure 6).

3.4.4.2 Oxnard Forebay Basin Groundwater Quality Historic Trends

The Oxnard Forebay basin has a high density of wells with data sufficient to conduct an analysis of groundwater quality trends (chloride in Figure 12, TDS in Figure 16, and nitrate as N in Figure 19). Only a small proportion of these wells display clear increasing or decreasing trends over time. Of those that do have trends there are more wells with decreasing trends in all constituents in the western portion of the basin, and to a lesser extent more increasing trends in the eastern portion of the basin.

The majority of wells in the Oxnard Forebay basin have either no groundwater quality trends or quality which appears to be greatly influenced by groundwater elevations. The most significant pattern observed in Oxnard Forebay basin water quality is the large variations in nitrate as N concentrations in the UAS which appear to be closely correlated to groundwater elevations. As discussed, these fluctuations in quality are influenced by the operation of UWCD's recharge basins.

3.4.5 Pleasant Valley Basin

The main aquifer in the Pleasant Valley basin is the confined LAS. Although the UAS does occur in the basin, it not considered a productive aquifer and as a result has very few production wells. Because of this, the Basin Plan does not have water quality objectives for the UAS. Where data are available for the UAS in the Pleasant Valley basin, they have been have included on the water quality maps for completeness.

3.4.5.1 Pleasant Valley Basin Existing Groundwater Quality

3.4.5.1.1 Chloride

The highest concentration of chloride in the Pleasant Valley basin occurs in the southern portion of the basin where concentrations have reached, in one well, 780 mg/L, but are generally between 120 and 400 mg/L (Figure 4). The source of these high chlorides may be due to wells being drilled too deep and they are extracting water from underlying formations, or they are extracting brines that have penetrated freshwater aquifers from the adjacent and underlying sediments because of altered hydraulic pressures due to pumping (UWCD, 2014).

The northern Pleasant Valley basin also has elevated chloride concentrations of around 145 mg/L (Figure 4). An evaluation of trends in the area revealed one well having experienced an increase in chloride of at least 100 mg/L since 1997. The mechanism for the increased concentrations is mobilization of salts in the unsaturated zone. Increased flows in the Arroyo Las Posas due to discharges of treated wastewater have increased groundwater levels by over 250 feet in the past 20 years through streambed percolation. The rewetting of the previously unsaturated zone has mobilized salts that are now contributing to salinity in the area. The City of Camarillo is working towards construction of a desalter known as the North Pleasant Valley Groundwater Treatment Facility to extract and treat this saline groundwater. A final environmental impact report was published in May 2015 (Padre Associates, Inc., 2015).

The remainder of the basin has chloride concentrations that typically range from 70 through 120 mg/L. The volume weighted average chloride concentration for the LAS of the Pleasant Valley basin is 145 mg/L (Figure 4).

3.4.5.1.2 Total Dissolved Solids

TDS follows a similar distribution to chloride in the LAS of the Pleasant Valley basin. The two areas with elevated concentrations are: in the south and in the north (Figure 8). The southern portion of the basin has concentrations as high as 4,770 mg/L but typically concentrations in this part of the basin range from 1,000 to 2,300 mg/L. The northern Pleasant Valley basin area has TDS concentrations averaging 1,560 mg/L. The likely causes of these elevated concentrations are the same as those described previously for chloride.

The remainder of the basin has TDS concentration of around 840 mg/L. There are no wells in the basin with a concentration less than 740 mg/L. The volume weighted average TDS concentration for the LAS of the Pleasant Valley basin is 1,116 mg/L (Figure 8).

3.4.5.1.3 Nitrate as N

Figure 9 shows that most of the wells with concentration data assigned to the UAS have more than 10 mg/L nitrate as N. Generally, nitrate as N concentrations in the LAS average 0.3 mg/L. There are some localized highs that appear to correspond in location to the UAS wells. Because the LAS is a confined layer, it should be somewhat protected from vertical migration of poorer water quality from perched and shallower groundwater. It is likely that the localized highs have been caused by vertical migration of poorer water quality via poorly constructed wells and/or improperly abandoned wells. All the high concentrations were included in estimate of existing groundwater quality.

The volume weighted average nitrate as N concentration for the LAS of the Pleasant Valley basin is 0.6 mg/L.

3.4.5.2 Pleasant Valley Basin Groundwater Quality Historic Trends

The Pleasant Valley basin has only a sparse distribution of wells with sufficient data to conduct an analysis of groundwater quality trends (chloride in Figure 14, TDS in Figure 17, and nitrate as N in Figure 20). Those wells that were analyzed are grouped along the western and northern sides of the basin. Over half of these wells have increasing trends of both chloride and TDS concentrations, with almost all of the remaining wells having no trend. The most notable areas of increased concentrations are in the southwest and northern portions of the basin. Groups of wells in these areas show increasing trends in both chloride and TDS. These areas coincide with the areas described in the existing water quality section that have elevated chloride and TDS concentrations due to higher saline water being extracted from the underlying marine sediments (in the south) and due to remobilization of salts in the northern area where groundwater levels have risen. There are no notable nitrate trends in the basin.

4.0 ASSIMILATIVE CAPACITY ANALYSIS

The available assimilative capacity for each basin is the difference between its groundwater quality objective and the volume weighted average concentration (existing groundwater quality). A summary of each basin's assimilative capacity estimates is provided in Table 1. In the table, the Oxnard Plain basin has two sets of available assimilative capacity estimates: 1) including the Coastal Saline Zone and 2) excluding the Coastal Saline Zone. Summary statistics for the median concentrations at each well, used to calculate the existing water quality (volume weighted averages of the well medians), are shown in Table 2 through Table 4.

Table 1 Available Assimilative Capacity
Public Works Integrated Master Plan
City of Oxnard

Basin	Aquifer	Chloride, mg/L			TDS, mg/L			Nitrate as N, mg/L		
		Water Quality Objective	Existing Water Quality	Available Assimilative Capacity	Water Quality Objective	Existing Water Quality	Available Assimilative Capacity	Water Quality Objective	Existing Water Quality	Available Assimilative Capacity
Oxnard Plain Including Coastal Saline Zone[1]	Perched	500	not enough data	-	3,000	not enough data	-	10	not enough data	-
	Unconfined (UAS)	500	407	93	3,000	1,389	1,611	10	2.8	7.2
	Confined (LAS)	150	290	-140	1,200	1,499	-299	10	1.8	8.2
Oxnard Plain Excluding Coastal Saline Zone	Perched	500	not enough data	-	3,000	not enough data	-	-[2]	-[2]	-[2]
	Unconfined (UAS)	500	58	442	3,000	1,102	1,898	-[2]	-[2]	-[2]
	Confined (LAS)	150	61	89	1,200	895	305	-[2]	-[2]	-[2]
Oxnard Forebay	Unconfined (UAS)	150	61	89	1,200	1,150	50	10	5.2	4.8
Pleasant Valley	Confined (LAS)	150	145	5	700	1,116	-416	10	0.6	9.4

Notes:
(1) Cells shaded in grey present the assimilative capacity analysis results including the Coastal Saline Zone.
(2) Nitrate as N is not a constituent that is influenced by the Coastal Saline Zone and therefore the zone is not excluded in the estimates.

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Table 2 Assimilative Capacity Summary Statistics for Chloride
Public Works Integrated Master Plan
City of Oxnard

Basin	Aquifer	Chloride, mg/L					
		25th Percentile	50th Percentile	75th Percentile	Interquartile Range[1]	Existing Water Quality	Average Absolute Deviation[2]
Oxnard Plain Including Coastal Saline Zone[3]	Unconfined (UAS)	41	49	93	52	290	759
	Confined (LAS)	50	60	113	62	407	699
Oxnard Plain Excluding Coastal Saline Zone	Unconfined (UAS)	41	47	60	19	61	21
	Confined (LAS)	50	56	72	22	58	21
Oxnard Forebay	Unconfined (UAS)	53	56	63	10	61	9
Pleasant Valley	Confined (LAS)	99	144	216	117	145	84

Notes:
(1) Interquartile range calculated based on well medians in basin with no volumetric weighting.
(2) Average absolute deviation is based on deviation of well medians from volume-weighted existing water quality.
(3) Cells shaded in grey present the assimilative capacity analysis results including the Coastal Saline Zone.

Table 3 Assimilative Capacity Summary Statistics for TDS
Public Works Integrated Master Plan
City of Oxnard

Basin	Aquifer	TDS, mg/L					
		25th Percentile	50th Percentile	75th Percentile	Interquartile Range(1)	Existing Water Quality	Average Absolute Deviation(2)
Oxnard Plain Including Coastal Saline Zone(3)	Unconfined (UAS)	830	927	1,005	175	1,499	1,513
	Confined (LAS)	929	1,125	1,498	568	1,389	1,523
Oxnard Plain Excluding Coastal Saline Zone	Unconfined (UAS)	815	903	977	162	895	137
	Confined (LAS)	913	1,070	1,300	388	1,103	269
Oxnard Forebay	Unconfined (UAS)	963	1,000	1,140	177	1,149	166
Pleasant Valley	Confined (LAS)	852	1,080	1,740	889	1,116	498

Notes:
(1) Interquartile range calculated based on well medians in basin with no volumetric weighting.
(2) Average absolute deviation is based on deviation of well medians from volume-weighted existing water quality.
(3) Cells shaded in grey present the assimilative capacity analysis results including the Coastal Saline Zone.

Table 4	**Assimilative Capacity Summary Statistics for Nitrate as N** **Public Works Integrated Master Plan** **City of Oxnard**						
		Nitrate as N, mg/L					
Basin	**Aquifer**	**25th Percentile**	**50th Percentile**	**75th Percentile**	**Interquartile Range[1]**	**Existing Water Quality**	**Average Absolute Deviation[2]**
Oxnard Plain[3]	Unconfined (UAS)	0.1	0.2	0.6	0.5	1.8	3.3
	Confined (LAS)	0.2	1.1	5.1	4.9	2.8	4.0
Oxnard Forebay	Unconfined (UAS)	2.1	2.8	3.9	1.8	5.2	2.8
Pleasant Valley	Confined (LAS)	0.1	0.2	0.8	0.7	0.6	2.8

Notes:
(1) Interquartile range calculated based on well medians in basin with no volumetric weighting.
(2) Average absolute deviation is based on deviation of well medians from volume-weighted existing water quality.
(3) Nitrate as N is not a constituent that is influenced by the Coastal Saline Zone and therefore the zone is not excluded in the estimates.

With the Coastal Saline Zone included in the estimate of existing water quality, the LAS of the Oxnard Plain basin does not have any chloride or TDS assimilative capacity. If the Coastal Saline Zone is excluded, there is 89 mg/L and 305 mg/L chloride and TDS available assimilative capacity, respectively, outside of the Coastal Saline Zone.

The Pleasant Valley basin does not have TDS assimilative capacity in the LAS. However, on examining the current TDS concentrations of wells in the basin, there are no wells with a TDS concentration less than 740 mg/L. Therefore all the wells have TDS concentrations that exceed the Basin Plan's water quality objective of 700 mg/L. Review of the document used to update the water quality objectives in 1993, shows that the TDS objective for the Pleasant Valley basin was suggested to be changed from 1,200 to 900 mg/L (Foster, 1993). It is not included in the report why this reduction was suggested or why the objective was finally reduced to 700 mg/L. For the eleven wells within the basin at the time that were used to revise the water quality objectives, the average TDS concentration was 366 mg/L with a maximum of 1,025 mg/L. Compared to current concentrations in the basin, there has been a considerable increase in TDS over the past 22 years.

Comparison of the chloride concentrations and the water quality objectives in the Pleasant Valley basin shows that while there is assimilative capacity for chloride in the LAS, it is limited to 5 mg/L of assimilative capacity.

All basins have relatively low nitrate as N concentrations relative to the water quality objective. Therefore, there is available nitrate as N assimilative capacity in all basins.

5.0 SOURCE IDENTIFICATION

Various sources contribute salts and nutrients to the basins. Both natural and anthropogenic sources of salts and nutrients are present in the study area. The analysis in this SNMP focuses on the anthropogenic sources of salt and nutrients, and transport of the loads to groundwater. The following section describes the major anthropogenic sources in the study area.

These sources are quantified using existing data on flows and quality. Infiltration of applied water is complex, where water can be lost to evaporative processes. However, for this analysis, it is assumed that all salt (chloride and TDS included) load is conserved from application to infiltration. This is a conservative assumption as there may be processes that would remove salt and reduce the load to groundwater. For nitrates applied via fertilizer application or in irrigation water, losses are accounted for, as described in the following sections.

5.1 Anthropogenic Sources

Anthropogenic sources of nutrients include:

- Irrigation.
- Fertilizer Application.
- Septic Systems.
- Wastewater Treatment Discharges.

5.1.1 Irrigation

Irrigation contributes salts and nutrients in agricultural and urban areas in the following ways:

- Urban landscape irrigation with potable or recycled water - Infiltration contributes to transport to groundwater. Runoff is collected in stormwater collection systems, and discharged to surface waters that may recharge groundwater basins.
- Agricultural irrigation with groundwater, surface water, or recycled water - Infiltration contributes to transport to groundwater. Runoff is conveyed to surface water discharges or to shallow groundwater.

Agricultural and urban landscape irrigation volumes were estimated based on agricultural and production well data. Estimates developed for the FCGMA Groundwater Sustainability Plan were used. Estimates for agricultural and urban irrigation with recycled water were based on existing wastewater reclamation facility permits.

The Ventura County Agricultural Commission 2015 Crop Layer was used to estimated crop type and acreages. Some crops were aggregated into more general categories for the purpose of applying irrigation and fertilization rates.

Ventura County General Plan Land Use data were used to estimate urban area boundaries. DWR (2001) Land Use data were used to estimate acreages of cemeteries and golf courses. The acreages of these uses were assumed to be the same as in 2001.

Salt loads applied from irrigation water are assumed to be transported to groundwater. Nitrate loads applied are reduced by plant uptake and other processes, per the description in the following section.

5.1.2 Fertilizer Application

Fertilizer application on urban, residential, and agricultural areas contributes nitrate loads (after transformations and losses) in the following ways:

- Fertilization in urban areas - Load from fertilizers is transported with water from irrigation or precipitation.

- Fertilization in agricultural areas - Load from fertilizers is transported with water from irrigation or precipitation.

Fertilizer application was assumed for crops and landscaped areas. Fertilizer was assumed to only contribute nitrate to the groundwater. Application rates, as well as losses to harvest and atmosphere were estimated using the rates in UC Davis (2012).

The calculation for the load of nitrate to groundwater in UC Davis (2012):

NGW = NDEPOSIT + NIRRIG + NAPPLIED - NHARVEST - NLOSS - NRUNOFF

N GW = N loading to groundwater

Assumptions:

NDEPOSIT = Atmospheric deposition

NRUNOFF = Runoff from fields

N IRRIG = N in irrigation water

N APPLIED = N applied

N HARVEST = Amount taken up by crop and removed in harvest

N LOSS = Losses to atmosphere, gaseous emission

5.1.3 Septic Systems

The outflows from septic tanks and leakage from "leaky" septic tanks transport salt and nutrient loads into groundwater. Estimates of septic system flows developed for the FCGMA GSP were used. Wastewater reclamation facility effluent concentrations were assumed for the concentrations of septic systems.

5.1.4 Wastewater Treatment Plant Discharges

Wastewater treatment plants (WWTPs) in the study area produce recycled wastewater, discharge to surface waters, or discharge to the Pacific Ocean. For the purpose of loading calculations, the salt and nutrient loads from groundwater recharge or irrigation with surface water, capture contribution of salts and nutrients from WWTP discharges. Loads attributed to irrigation with recycled water account for the volume and quality of existing recycled water projects.

5.2 Loading Estimates

The anthropogenic loads under existing conditions were calculated for this analysis using estimates of volumes/flows and concentrations. The loads for TDS, chloride, and nitrate for each basin are summarized in Tables 5 through 7, respectively.

Table 5 TDS, Chloride and Nitrate Loads in the Oxnard Plain
Public Works Integrated Master Plan
City of Oxnard

Component	TDS Load (lbs/day)	Chloride Load (lbs/day)	Nitrate Load (lbs/day)
Agricultural Irrigation with Surface Water	93,900	5,400	200
Agricultural Irrigation with Groundwater	482,600	27,600	1000
Agricultural Irrigation with Recycled Water	-	-	-
Agricultural Fertilization	-	-	6,600
Urban Irrigation with Municipal Water	64,100	7,400	200
Urban Irrigation with Recycled Water	3,400	1,000	10
Urban Fertilization	-	-	100
Septic Systems	4,900	700	40
Total Load	**649,000**	**42,000**	**8,000**

Table 6 TDS, Chloride and Nitrate Loads in the Oxnard Forebay
Public Works Integrated Master Plan
City of Oxnard

Component	TDS Load (lbs/day)	Chloride Load (lbs/day)	Nitrate Load (lbs/day)
Agricultural Irrigation with Surface Water	-		
Agricultural Irrigation with Groundwater	41,300	2,000	100
Agricultural Irrigation with Recycled Water	-		
Agricultural Fertilization	-	-	600
Urban Irrigation with Municipal Water	1,500	800	-
Urban Irrigation with Recycled Water	-		
Urban Fertilization	-	-	10
Septic Systems	200	10	10
Total Load	**43,000**	**3,000**	**1,000**

Table 7	TDS, Chloride and Nitrate Loads in the Pleasant Valley Basin Public Works Integrated Master Plan City of Oxnard		
Component	**TDS Load (lbs/day)**	**Chloride Load (lbs/day)**	**Nitrate Load (lbs/day)**
Agricultural Irrigation with Surface Water	36,263	2,093	64
Agricultural Irrigation with Groundwater	122,160	6,429	233
Agricultural Irrigation with Recycled Water	17,120	3,656	182
Agricultural Fertilization	-	-	-
Urban Irrigation with Municipal Water	28,390	4,635	28
Urban Irrigation with Recycled Water	5,761	1,334	62
Urban Fertilization	-	-	-
Septic Systems	3,093	412	26
Total Load	**213,000**	**19,000**	**1,000**

6.0 FATE AND TRANSPORT ANALYSIS

6.1 Conceptual Fate and Transport Model

The recycled water policy indicates that a SNMP should include fate and transport analysis, but does not define the specific requirements on level of detail, complexity or methodology. A conceptual fate and transport analysis was developed for this SNMP. Figures 22 and 23 present the conceptual natural and anthropogenic transport/movement of water in the study area. These two figures include adjacent basins (grey boxes) that interact with the basins in the study area but are not included in the analysis of this SNMP. The anthropogenic loads described in the previous section are transported within and between groundwater basins. All of the loads are applied to the surface (irrigation) or near surface (septic tanks) and subsequently transported via natural or man-made transfers within and between the basins. Appendix B includes a description of the study area hydrogeology.

The fate and transport of anthropogenic loads applied to the basins are described as follows:

- Oxnard Plain - Loads applied to the surface/near surface of the Oxnard Plain would likely be present in the semi-perched zone. As noted in Appendix B, Vertical hydraulic gradients commonly occur between aquifers on the Oxnard Plain, causing some degree of movement between most of the major aquifers, both upwards and downwards (UWCD, 2014). For example, when groundwater levels in the shallow confined Oxnard aquifer are lowered (either regionally by drought conditions or locally by pumping), the movement of poor-quality water in the semi-perched aquifer downwards into the Oxnard aquifer (part of the UAS) has been reported (UWCD, 2014). Therefore, there is possibility of salts and nutrients to be transported from the semi-perched zone to the UAS. There may be some migration to the LAS, and transport out of the basin to the Pleasant Valley Basin, the West Las Posas Basin, and possibly to the Oxnard Forebay and Mound Basins. The assimilative capacity for salts and nutrients in the UAS and LAS of the Oxnard Plain will be considered in the analysis.

- Oxnard Forebay - Loads applied to the surface/near surface Oxnard Forebay would likely be present in the UAS. In contrast to the Oxnard Plain, a confined semi-perched zone is not present in the Oxnard Forebay. The Oxnard Forebay is in direct hydraulic connection with the UAS and LAS (confined aquifer) of the Oxnard Plain. Therefore, loads in the UAS of the Oxnard Forebay can be transported to the UAS and LAS of the Oxnard Plain. In addition, as the Oxnard Forebay basin is also a source of recharge to adjacent basins, salts and nutrients could be transported to the Mound, West Las Posas, and Pleasant Valley basins.
- Pleasant Valley Basin - Loads applied to the surface/near surface of the Pleasant Valley Basin, would likely be present in the UAS. In the Pleasant Valley Basin, the UAS is mostly fine grained alluvium, which limits recharge to the LAS. Salt and nutrients in the UAS are therefore not likely to be transported to the LAS. However, the LAS in the Pleasant Valley Basin is subject to a natural source of chloride. In the Pleasant Valley basin, the LAS is surrounded and underlain by partly consolidated marine deposits and volcanic rocks, which both contain high chloride water.

Future conditions may differ from existing conditions independent of new projects that add or reduce salt and nutrient loadings. In general, reduction in anthropogenic loads can be reduced through a reduction in volume (e.g., conservation measures) or change in water quality (via treatment or a different source), or both. The largest land-use based loading of salts is irrigation and therefore changes in irrigation water use (conservation) and/or changes in the source of irrigation water may influence groundwater concentrations. The largest land-use based loading of nutrients is fertilizer addition. Therefore, changes in agricultural practices/fertilizer application rates may potentially change nitrate concentrations in groundwater.

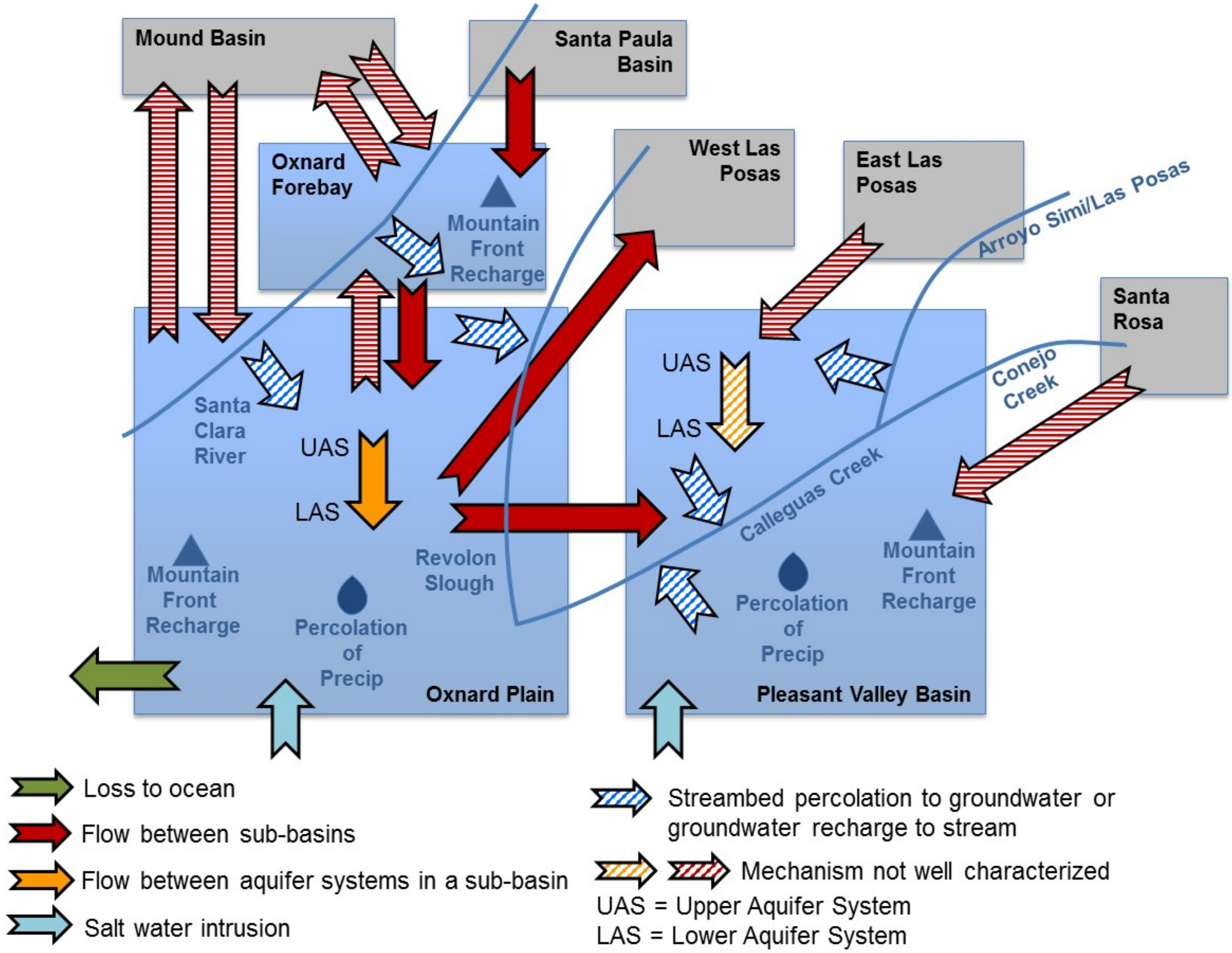


Figure 22 Natural Transport of Groundwater in the Study Area

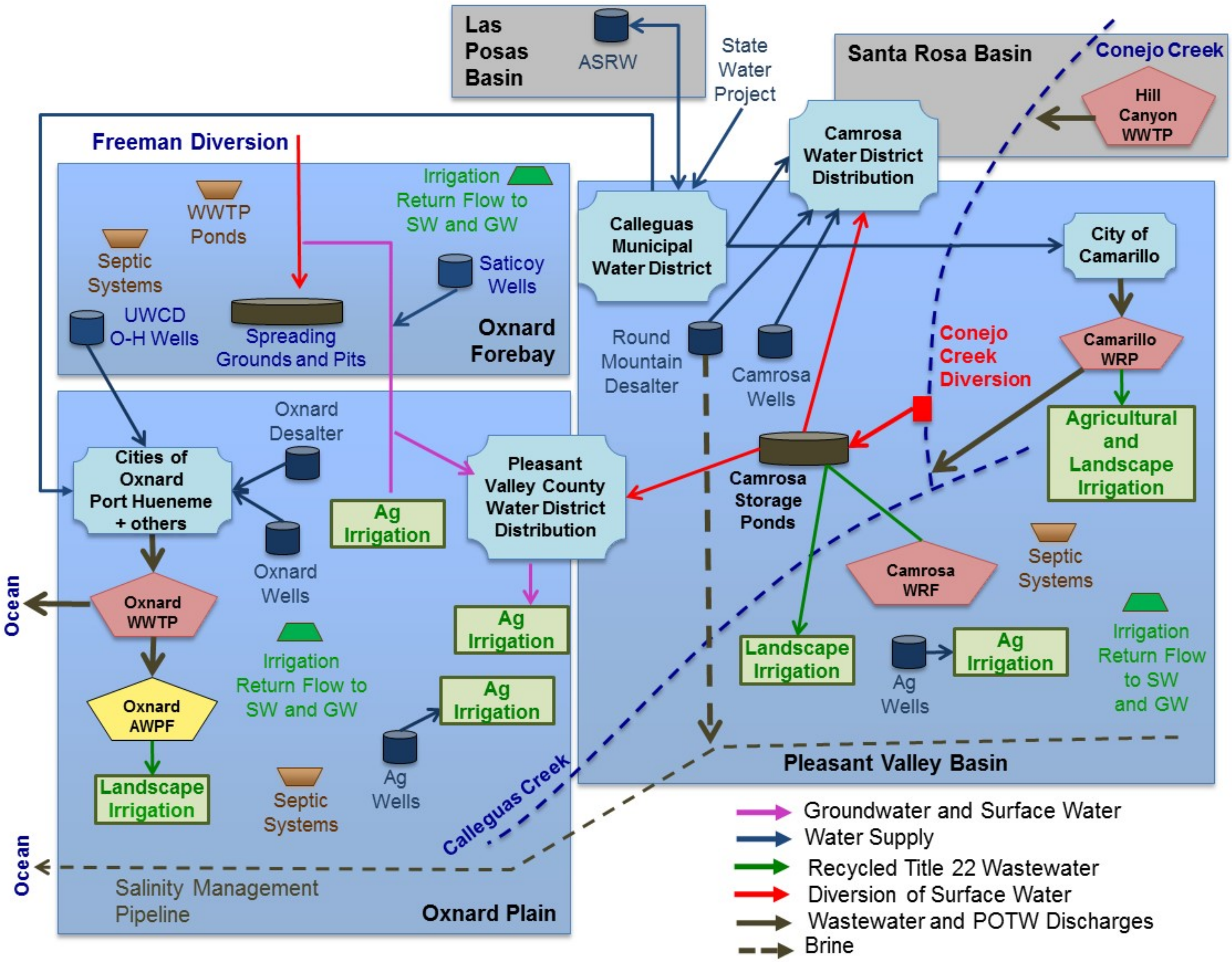


Figure 23 Anthropogenic Transport of Groundwater in the Study Area

6.2 Assimilative Capacity Discussion

The conceptual fate and transport analysis provides an understanding of the loads to the basins and an understanding of how assimilative capacity can be affected in the future. The nature of the proposed projects does not require that a quantified value for the available assimilative capacity be estimated. Assimilative capacity is summarized conceptually in Table 8.

Table 8 Assimilative Capacity Summary Table
Public Works Integrated Master Plan
City of Oxnard

Basin	Aquifer	Chloride	TDS	Nitrate
Oxnard Plain Including Coastal Saline Zone[1]	UAS	Yes	Yes	Yes
	LAS	No	No	Yes
Oxnard Plain Excluding Coastal Saline Zone	UAS	Yes	Yes	-[2]
	LAS	Yes	Yes	-[2]
Oxnard Forebay	UAS	Yes	Yes	Yes
Pleasant Valley	LAS	Yes - Limited	No	Yes

Notes:
(1) Cells shaded in grey present the assimilative capacity analysis results including the Coastal Saline Zone.
(2) Nitrate as N is not a constituent that is influenced by the Coastal Saline Zone and therefore the zone is not excluded in the estimates.

The importance of understanding the fate and transport of salts is elevated in the basins/aquifers that do not have assimilative capacity, specifically the Pleasant Valley basin for TDS. The types or proposed actions/projects, including recycled water projects or other management measures will require evaluation of fate and transport, and effect on groundwater quality.

7.0 PROJECT SCENARIOS

The types of recycled water projects and proposed locations of these projects provided context for developing the approach to analyzing the effects of loadings from future recycled water projects. Table 9 presents a summary of potential future recycled water projects, and Figure 24 provides approximate locations for recycled water projects.

The water quality of the recycled water is dependent on the source of recycled water associated with the proposed projects. Table 10 presents the water quality objectives for the Oxnard Plain and Pleasant Valley Basins and the estimated water quality of the recycled water that may be used within these basins in the future. Note that the Oxnard Forebay is not included, as recycled water projects are not proposed within the Oxnard Forebay boundaries.

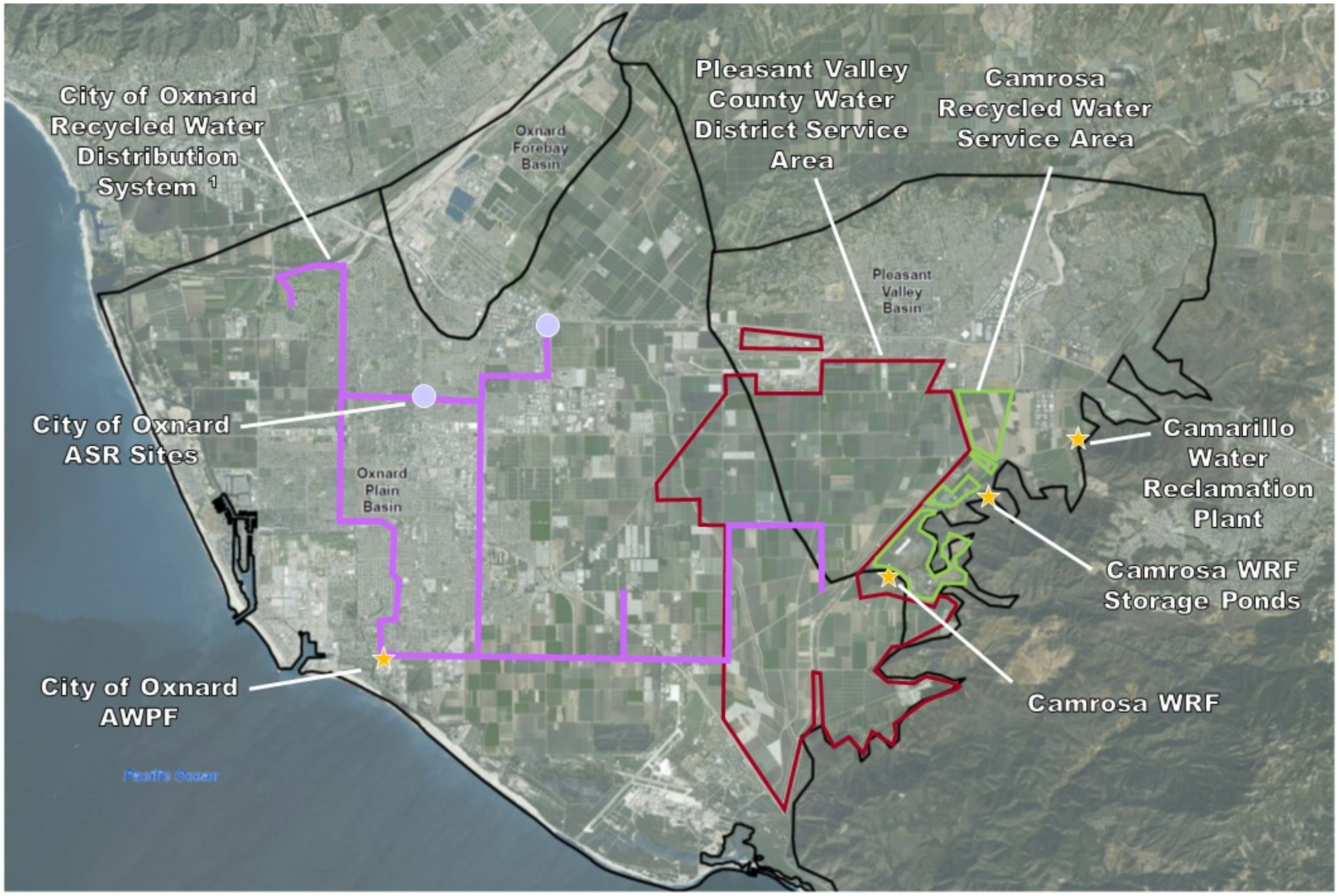
Table 9 Future Recycled Water Projects in the Study Area
Public Works Integrated Master Plan
City of Oxnard

Agency/ Project	Future Recycled Water Delivery Volume	Recycled Water Source	Recycled Water Level of Treatment	Location of Recycled Water Use	Groundwater Basin	Reference/Source
City of Oxnard						
Ag Irrigation East of the City	Up to 5,200 AFY	City of Oxnard AWPF	Advanced treatment including RO	Users between the AWPF and the PVCWD service area.	Oxnard Plain	City of Oxnard Public Works Integrated Master Plan - Draft (2015).
Aquifer Storage and Recovery (ASR)	Up to 15,800 AFY	City of Oxnard AWPF	Advanced treatment including RO	Multiple locations within the City of Oxnard.	Oxnard Plain	City of Oxnard Public Works Integrated Master Plan - Draft (2015).
Camrosa Water District						
Landscape and Agricultural Irrigation	Up to 2,044 AFY	Camrosa WRF	Tertiary treatment	Camrosa recycled water distribution system - CSUCI and local agricultural areas.	Pleasant Valley Basin	Camrosa Water District Facilities Master Plan (2011).
Landscape and Agricultural Irrigation	Up to 2,124 AFY	Camarillo WRP delivered to Camrosa WRF	Tertiary treatment	Camrosa recycled water distribution system - CSUCI and local agricultural areas.	Pleasant Valley Basin	Camrosa Water District Facilities Master Plan (2011).
PVCWD						
	500 AFY	Camrosa WRF Distribution System	Tertiary treatment	Agricultural Users within PVCWD service area.	Oxnard Plain and Pleasant Valley Basins	Personal Communication - PVCWD.
Ag Irrigation	Up to 5,200 AFY	City of Oxnard AWPF	Advanced treatment including RO.	Users within the PVCWD service area.	Oxnard Plain and Pleasant Valley Basins	City of Oxnard Public Works Integrated Master Plan - Draft (2015).

Table 10 Comparison of Reclaimed Water Quality to Objectives and Historical Data
Public Works Integrated Master Plan
City of Oxnard

Basin		Chloride (mg/L)					TDS (mg/L)					Nitrate as N (mg/L)				
		Water Quality Objective	Existing Water Quality(3)	Oxnard AWPF	Camrosa WRF(1)	Camarillo WRP(2)	Water Quality Objective	Existing Water Quality(3)	Oxnard AWPF	Camrosa WRF(1)	Camarillo WRP(2)	Water Quality Objective	Existing Water Quality(3)	Oxnard AWPF	Camrosa WRF	Camarillo WRP
Oxnard Plain	Perched	500	Not enough data	30	244	244	3,000	Not enough data	160	947	947	10	Not enough data	0.2	10	10
	UAS	500	58				3,000	1,102				10	2.8			
	LAS	150	61				1,200	895				10	1.8			
Pleasant Valley	UAS	NA	52-330(4)				NA	620-4190(4)				NA	0.9-42.9(4)			
	LAS	150	145				700	1,116				10	0.6			

Notes:
(1) Based on the Camrosa WRF recycled water permit.
(2) Because recycled water from Camarillo WRP will be routed to the Camrosa recycled water ponds, it is conservatively assumed that Camarillo WRP will need to meet the salt and nutrient concentration limits in the Camrosa WRF Recycled Water Permit.
(3) Existing water quality is from values presented in Section 3, except where noted.
(4) Range of median values presented in Figures 3 through 5.



[1] Recycled water distribution system shown in figure includes existing and future pipelines.

Figure 24 Approximate Locations of Proposed Recycled Water Projects

7.1 City of Oxnard

7.1.1 Future Recycled Water Projects

The City of Oxnard's proposed recycled water projects include Aquifer Storage and Recovery (ASR) for the purpose of potable reuse, urban irrigation, commercial uses, and agricultural irrigation. The City of Oxnard's Advanced Water Purification Facility (AWPF) produces water that meets potable water standards. Currently, a portion of the AWPF water is used for landscape irrigation and the remainder is discharged to the Pacific Ocean. Table 7 summarizes the proposed projects, estimated project capacity, and the general location (basin) for the recycled water projects.

The City of Oxnard is planning to implement ASR in the Oxnard Plain. The purpose of the proposed ASR projects is to provide potable water supply. It is conservatively assumed that the proposed ASR project(s) would not necessarily lead to a reduction in groundwater pumping (via offsetting use of existing wells) or use of imported water, both of which would have potential groundwater quality benefits. The intent of the ASR project is to inject recycled water into a groundwater aquifer, allow it to remain within the aquifer for a specified retention time, and then extract the water for potable use.

Agricultural irrigation with recycled water from the AWPF may be delivered directly to agricultural areas east of the City of Oxnard and/or delivered to PVCWD. Use of recycled water would likely offset existing water supplies for agricultural irrigation (groundwater or other). Recycled water delivered directly to agricultural areas east of the City of Oxnard would recharge the Oxnard Plain. If recycled water is sold to PVCWD, then it would be comingled with PVCWD existing water supplies and delivered for agricultural irrigation within the PVCWD service area. Recycled water delivered to PVCWD would recharge the Oxnard Plain and the Pleasant Valley Basin.

7.1.2 Recycled Water Quality Analysis

The AWPF treatment facility will produce purified recycled water and includes microfiltration, reverse osmosis (RO), and advanced oxidation. It is anticipated lime will be added to restore the alkalinity and calcium to the water to minimize the corrosivity of the recycled water. TDS and chloride of the reverse osmosis permeate was projected as 201 mg/L and 70 mg/L, respectively (Jensen Design and Survey 2015). Approximately 30 m/L of additional TDS was attributed to lime addition. Therefore, the predicted TDS, chloride and nitrate concentrations were 230 mg/L, 70 mg/L, and 0.7 mg/L as N, respectively. More recent estimates for the AWPF reverse osmosis permeate water are in the Draft Potable Water Reuse Engineering Report (2015). Preliminary estimates of the reverse osmosis permeate are 51 mg/L TDS, 14 mg/L chloride, and 0.11 mg/L as N of nitrate. Accounting for the additional TDS of lime addition, and adding in conservatism (factor of 2) to the estimates, it is assumed for this analysis that the recycled water from the AWPF has 160 mg/L TDS, 30 mg/L chloride, and 0.2 mg/L nitrate as N. The predicted water AWPF recycled water quality is well below the objectives and existing water quality in all systems of all basins within the study area.

7.2 Camrosa Water District

7.2.1 Future Recycled Water Project

Proposed recycled water projects for the Camrosa Water District include expanding upon the existing recycled program that currently serves landscape irrigation at California State University Channel Islands (CSUCI) and nearby agricultural areas. Table 7 summarizes the proposed projects, estimated project capacity, and the general location (basin) for the recycled water projects.

Construction of a connection between the Camarillo Water Reclamation Plant and the Camrosa Water Reclamation Facility (WRF) is in progress and is expected to be completed in 2017. This connection will allow recycled water to be delivered from the Camarillo WRP to the Camrosa WRF recycled water ponds. An expanded recycled water program would serve customers in the same general region as currently served, all within the Pleasant Valley Basin. As described in the previous section, agricultural or landscape irrigation would result in recharge to the UAS, where water quality objectives have not been established.

7.2.2 Camrosa WRF Recycled Water Quality

The Camrosa WRF was issued waste discharge requirements and Title 22 Water Reclamation Requirements that went into effect in February 2015 (R4-2015-0030). The permit indicates that recycled water is applied to ponds (and then used for irrigation) that overly the unconfined and semi-perched portions of the Pleasant Valley Basin for which there are no groundwater quality objectives. In addition, the permit references a baseline groundwater study entitled 1998 Annual Groundwater Monitoring Report Final Findings from 2-year Baseline Study. The results of this study indicate that the effluent quality from the Camrosa WRF contains less TDS and chloride than the groundwater in the Pleasant Valley Groundwater Basin. The TDS concentrations up-gradient of the unlined ponds storing the treated effluent ranged from 1904 to 2002 mg/L, and the concentrations of chloride up-gradient of the storage ponds ranged from 312 to 370 mg/L. There was no indication from the study that the local beneficial uses of the groundwater were being impaired by the storage or the agricultural use of the treated wastewater from the Camrosa WRF.

Therefore, best professional judgment was used to develop performance-based final effluent limitations in the permit, which are intended to protect the MUN beneficial use of the underlying groundwater basins, to prevent future degradation of the groundwater basin, and to help restore the water quality of the impacted aquifer (R4-2015-0030). Permit limits for TDS, chloride and nitrate concentrations are 947 mg/L, 244 mg/L, and 10 mg/L as N, respectively. These permit limits were based on performance data for the Camrosa WRF from 2009 to 2014, with effluent chloride concentrations between 144 mg/L and 246 mg/L;

and TDS concentrations between 682 mg/L and 992 mg/L. The permit limits are assumed to conservatively represent the Camrosa WRF recycled water quality.

The Camarillo WRP is under a time schedule order (TSO) to comply with final effluent limits for TDS and chloride of 850 mg/L and 150 mg/L by December 31, 2017. However, it is unknown at this time, whether recycled water delivered to Camrosa WRF will be required to meet the Camarillo WRF final effluent limits or the less stringent Camrosa WRF effluent limits. For this analysis, it is conservatively assumed that compliance with the Camrosa WRF effluent limits will be required and that the Camarillo WRF recycled water will contain TDS and chloride concentrations equal to the permit limits of 947 mg/L and 244 mg/L, respectively.

7.3 PVCWD

7.3.1 PVCWD Recycled Water Projects

Potential PVCWD recycled water projects include purchase of recycled water from the Camrosa Water District and/or purchase of recycled water from the City of Oxnard. Table 9 summarizes the proposed projects, estimated project capacity, and the general location (basin) for the recycled water projects.

If recycled water, from either source, is sold to PVCWD, then the recycled water would be comingled with PVCWD existing water supplies and delivered for agricultural irrigation within the PVCWD service area. It is estimated that PCVWD delivers approximately half of the water within the Oxnard Plain and half of the water in the Pleasant Valley Basin.

The two potential sources of recycled water include the Oxnard AWPF and the Camrosa WRF recycled water ponds. The quality of these two sources is discussed in the previous sections.

8.0 MANAGEMENT MEASURES

8.1 Existing and Future Management Measures

The primary goal of the SNMP is to protect water quality. Recycled water projects can augment water supplies and improve supply reliability. However, implementation of recycled water projects needs to consider and manage any potential adverse impacts on groundwater quality. This section outlines existing management measures that are currently in place in the study area that will be maintained under any future scenario and outlines a process for evaluating recycled water projects and determining whether additional management measures are needed. Potential future management measures are identified that can be selected if needed to implement a planned project.

The objective of SNMP implementation measures is to manage salt and nutrient loadings on a sustainable basis in order to maintain long term supply for multiple beneficial uses. Per the, LARWQCB SNMP Guidance Manual, these strategies should be tailored to basin specific characteristics and conditions, but should be geared toward:

- Pollution prevention.
- Source load reductions to groundwater basins.
- Treatment and management of areas of impaired water quality.
- Boosting or stabilizing declining water levels where water quality is not affected.
- Increasing groundwater recharge by stormwater.
- Increasing recycled water use.

There is a long history of salt and nutrient management within the study area. A portion of the study area, (the Pleasant Valley Basin and a portion of the Oxnard Plain) is within the Calleguas Creek Watershed. In December 2008, the Calleguas Creek Watershed Salts total maximum daily load (TMDL) went into effect. The TMDL implementation plan establishes requirements for percent reductions in the salt imbalance in the watershed over a 10-year period. The Calleguas Creek Watershed Stakeholders have been implementing management measures to achieve compliance with the TMDL.

The Calleguas Creek Watershed Stakeholders have prepared a Draft Implementation Plan Summary (Larry Walker Associates, 2016), which outlines existing and planned management measures in the watershed. The efforts to date have been recognized in the context of salt and nutrient management planning and recycled water permit requirements for permittees in the watershed. Table 11 summarizes existing management measures associated with the Calleguas Creek Salts TMDL as well as other management measures that have been implemented in the study area. The table of management measures was developed from existing documents and through communication with stakeholders.

The management measures are categorized by source and pathway for reducing salt and nutrient contributions to the groundwater. For example, some management measures prevent loads from entering the basin (e.g., water conservation or water softener bans), others offset loads from another source (e.g., changing the source water for an irrigation project), and others remove loading from the basin (e.g., groundwater treatment). The categories used to describe the management measures are:

- Improve wastewater and reclaimed water quality.
- Improve municipal water quality.
- Reduce septic system leachate and improve quality.
- Manage urban stormwater runoff to support basin water quality.
- Improve non-stormwater discharge control and quality.
- Improve agricultural runoff control and quality.

- Increase recycled water use.
- Increase aquifer recharge with lower concentration water source.
- Improve urban and agricultural water efficiency/conservation.
- Reduce saltwater intrusion and protect groundwater quality.
- Manage groundwater pumping and water levels.

The existing management measures that have been implemented in the study area include a range of source control and treatment activities. The measures include some of the more extreme and costly approaches including a salinity management pipeline, desalters and advanced wastewater treatment. The implementation of relatively aggressive measures for salt and nutrient management is indicative of the effort and resources that have been dedicated to reducing salt and nutrient discharges in the study area.

Tables 12 and 13 summarize the planned, and other potential future management measures, respectively. The table of planned measures was developed from existing documents and through communication with stakeholders. The planned measures also include aggressive salt and nutrient management measures, including, additional desalters, and potable reuse.

The other potential future management measures listed in Table 13 include measures that were identified as potential measures in planning studies, as well as other measures tailored to the site specific conditions in the study area. The other potential future management measures represent a menu of potential management measures that could be implemented if needed to manage salts and nutrients on a sustainable basis. The list is intended to represent a wide-range of potential options that could be considered and do not represent management measures that will be implemented.

8.2 Evaluation of Proposed Recycled Water Projects

Assimilative capacity is available in all subareas except for TDS in the UAS of the Pleasant Valley Basin. The overall approach to evaluating projects is based on evaluating the amount of assimilative capacity that would be used by a project or group of projects and determining whether the amount of assimilative capacity used would result in degradation of the basin as outlined in the anti-degradation analysis. If a project would result in degradation of the basin, management measures can be selected from the list of potential future management measures to offset the additional loading. Alternatively, a full anti-degradation analysis could be conducted for the project to determine if the degradation is offset by important social and economic benefits to the people of the state. This section outlines the process for evaluating projects and determining if additional management measures are needed or if a full anti-degradation analysis is needed.

Table 11 Existing Management Measures in the SNMP Study Area
Public Works Integrated Master Plan
City of Oxnard

Category	Specific Measure	Agency/Action	Description	Effect
Wastewater and reclaimed water quality	Source control - salts.	City of Camarillo	Water softener rebate program.	Fewer self-regenerating water softeners (or other treatment devices that produce a high mineral waste) will reduce the salt load in residential wastewater.
Wastewater and reclaimed water quality	Source control - salts.	City of Camarillo	Numeric limits on TDS and chloride concentrations.	Provides an upper limit on the concentration of salts in industrial contributions to wastewater.
Wastewater and reclaimed water quality	Source control - salts	City of Camrosa	Numeric limits on TDS and chloride concentrations.	Provides an upper limit on the concentration of salts in industrial contributions to wastewater.
Wastewater and reclaimed water quality	Source control.	UWCD	Identifies sources of nitrate in the Santa Clara Watershed.	Allows identification of new pollutant sources and trends in water quality.
Municipal, Wastewater and reclaimed water quality	Source control through providing brine discharge pipeline.	CMWD	Salinity management pipeline provides a mechanism to convey salts from desalters, reclaimed wastewaters, or industrial wastes to the Ocean and out of the SNMP Study area.	Allows an alternative to the sewer for industrial wastes, facilitates desalting projects (water supply desalting, or wastewater reclamation) because it provides an ocean discharge connection point.
Municipal, Wastewater and reclaimed water quality	Source control through desalting.	Camrosa Water District	Pump and treat unconfined aquifers in the Pleasant Valley Basin that currently contain water with high salts concentrations and discharge brine to the SMP.	Provides a desalted water supply and removes salts from the basin through brine discharge to the SMP.
Stormwater runoff management	Increase stormwater recharge through LID and improve quality through BMPs.	Ventura County - Municipal Separate Storm Sewer System (MS4) permit.	Requires specified New Development and Redevelopment projects to control pollutants, pollutant loads, and runoff volume emanating from impervious surfaces through infiltration, storage for reuse, evapotranspiration, or bioretention/ biofiltration by reducing the percentage of Effective Impervious Area (EIA) to 5% or less of the total project area.	Promotes infiltration of rainwater (low in salt and nutrients) into the groundwater. Through treatment, reduces pollutant loads to groundwater and surface waters (that may recharge groundwater basins).

Table 11 Existing Management Measures in the SNMP Study Area
Public Works Integrated Master Plan
City of Oxnard

Category	Specific Measure	Agency/Action	Description	Effect
Non-stormwater discharge control and quality	Source control of non-stormwater discharges.	Ventura County - Municipal Separate Storm Sewer System (MS4) permit.	Requires discharges of debrominated/dechlorinated swimming pool water to meet water quality standards for salts.	Provides an upper limit on the concentration of salts in non-stormwater contributions to stormwater.
Agricultural runoff control and quality	Source control through fertilizer BMPs.	VCAILG - Conditional Waiver of Waste Discharge Requirements for Discharges from Irrigated. Lands within the Los Angeles Region.	Fertilizers are applied in multiple smaller applications, as opposed to one large application. Fertilizer applications are adjusted to account for other nutrient sources, such as: irrigation water, cover crops, and residuals from previous fertilizations. Fertilization rates are adjusted based on the results of soil fertility measurements.	Reduces the load of nitrogen that is transported by runoff to surface waters and by infiltration to groundwater.
Agricultural runoff control and quality	Source control through salinity/ leaching BMPs.	VCAILG - Conditional Waiver of Waste Discharge Requirements for Discharges from Irrigated Lands within the Los Angeles Region.	Leaching is performed only when necessary, as determined by measuring soil solution electrical conductivity (EC). Saline or high selenium wells are decommissioned and other sources of water are used. Fertilizers and amendments with low salt index are used.	Reduces the load of salts to the groundwater from leaching activities.
Municipal Water Conservation	Conservation through water use management.	City of Camarillo	City is providing funds to the Metropolitan Water District (MWD) conservation rebate program for changing out fixtures and turf removal. The City is planning to for dew development projects to include a water conservation fee to refund an existing customer rebate program to incentivize water conservation.	Through conservation, reduces the load of salt associated with outdoor water use (irrigation water) that is ultimately conveyed in irrigation runoff or in percolation. Through conservation, groundwater pumping (drawdown of aquifer levels) is reduced.

Table 11 Existing Management Measures in the SNMP Study Area
Public Works Integrated Master Plan
City of Oxnard

Category	Specific Measure	Agency/Action	Description	Effect
Agricultural Water Conservation	Conservation through efficiency criteria.	FCGMA Agricultural Pumpers Use Irrigation Efficiency Criteria.	Agricultural users may use "Efficiency Criteria" in place of historical groundwater allocations. Must have 20% or less of applied water going to leaching, deep percolation or runoff.	Through conservation, reduces the load of salt associated with irrigation water that is ultimately conveyed in irrigation runoff or in percolation.
Agricultural Water Conservation	Conservation through irrigation management practices.	VCAILG - Conditional Waiver of Waste Discharge Requirements for Discharges from Irrigated Lands within the Los Angeles Region.	Irrigation is varied to accommodate plant growth stage and weather. Irrigation conducted by personnel who understand and practice irrigation practices related to runoff management. Irrigation is halted if significant runoff occurs.	Through conservation, reduces the load of salt associated with irrigation water that is ultimately conveyed in irrigation runoff or in percolation.
Wastewater Reuse	Offset supply with reclaimed wastewater.	City of Oxnard	Urban irrigation of golf courses and landscaping with desalted reclaimed water.	Limits the salts and nutrient concentrations in the applied irrigation water. Reduces imported water use and groundwater pumping.
Recycled Water Projects	Recycled water use for landscape and agricultural irrigation.	City of Camrosa	Recycled water for irrigation of the CSUCI campus and surrounding area.	Reduces imported water use and groundwater pumping.

Table 12	**Planned Management Measures Public Works Integrated Master Plan City of Oxnard**			
Category	**Specific Measure**	**Agency/Action**	**Description**	**Effect**
Wastewater and reclaimed water quality	Source control - salts and nutrients.	City of Oxnard - Industrial Discharge Ordinance.	Under evaluation. Potential local limits for chloride for current and future industries, and TDS for future. Evaluating nitrogen limits as well.	Provides an upper limit on the concentration of salts and nitrogen in industrial contributions to wastewater.
Municipal, Wastewater and reclaimed water quality	Replace or augment potable water supply.	City of Camarillo	Construction of a desalter in northern portion of the Pleasant Valley Basin, with discharge of brine to the SMP.	Offsets imported water use and transports salt out of basin.
Wastewater and reclaimed water quality	Source Control.	City of Camarillo	Water softener rebate program.	Fewer self-regenerating water softeners will reduce the salt load in residential wastewater.
Wastewater Reuse	Expand recycled water use.	Camarillo Sanitary District	Construction of an intertie to the Camrosa WRF recycled water ponds for irrigation or industrial reuse (cooling tower).	Reduces imported water use and groundwater pumping.
Wastewater Reuse	Replace or augment potable water supply.	City of Oxnard	The City of Oxnard is augmenting their potable water supply with purified wastewater that will be desalted via a reverse osmosis process.	The salt and nutrient concentrations in the potable reuse supply will be lower than existing potable water supply.
Wastewater Reuse	Expand agricultural irrigation with recycled water.	City of Oxnard	Delivery of recycled water from the AWPF to agricultural areas in the Oxnard Plain and Pleasant Valley Basins. The reclaimed wastewater will be desalted via a reverse osmosis process.	The salt and nutrient concentrations in the reclaimed wastewater will be lower than the concentrations in the groundwater supplies currently used by growers. This will reduce salt and nutrient loads in percolating groundwater.

Table 13 Other Potential Future Management Measures
Public Works Integrated Master Plan
City of Oxnard

Category	Specific Measure	Agency/Action	Description	Effect
Septic system leachate	Provide connections to sewer systems.	Ventura County and Municipalities	Consideration of a septic system conversion program to reduce the number of septic systems in the basins.	Reduces the volume of septic system leachate that percolates into shallow groundwater. Tie-in to a treatment plant ultimately leads to a treated waste stream with a lower nutrient load.
Non-stormwater discharge control and quality	Source control of non-stormwater discharges.	Ventura County – Municipal Separate Storm Sewer System (MS4) permit.	Ordinance banning installation and discharges of debrominated/dechlorinated swimming pool water.	Reduce primary source of salts in non-stormwater discharges.
Municipal Water Quality	Softening of groundwater supplies.	Water Purveyors	Consideration of water softening to reduce hardness.	Reduces need for the self-regenerating residential water softeners. Fewer self-regenerating water softeners will reduce the salt load in residential wastewater.
Municipal Water Quality	Advanced treatment of compromised groundwater supplies.	Water Purveyors	Consideration of RO treatment to remove salts from groundwater supplies, with likely participation in development of a regional brine line.	Through treatment, reduces salt load in potable water that is pass through to wastewater. Reduces need for residential water softeners.
Municipal Water Quality	Desalination	Water Purveyors	Consideration of desalination to replace existing groundwater supplies.	Through use of an alternative supply, reduces salt load in potable water that is pass through to wastewater. Reduces need for residential water softeners.
Agricultural Supply	Improve agricultural irrigation water quality.	Ventura County	Consideration of drilling deeper wells to access water with lower salt concentrations.	Improves irrigation water quality through use of an alternative supply. Reduces the load of salt and nutrients attributed to irrigation water.
Stormwater Recharge	Additional groundwater recharge with stormwater.	Ventura County and Municipalities	Consideration of capture and recharge of stormwater.	Provides dilution of groundwater through recharge of water with potentially low salt and low nutrient concentrations.
Wastewater Reuse	Recharge of treated wastewater.	UWCD	Recharge of recycled water in surface spreading basins and/or direct use for agricultural irrigation. Treatment will include RO.	Recharge and/or irrigation with reclaimed wastewater with low salt and nutrient concentrations.

It is important to remember that the implementation of recycled water projects in the study area is in and of itself a management measure for sustainable management of the groundwater basins. Recycled water projects provide a mechanism to offset groundwater use, and therefore contribute to reducing groundwater pumping. The LSCR SNMP includes a procedure for evaluating projects, as shown in Figure 25. This figure is used as a point of reference for the analysis that follows. The proposed recycled water projects are discussed in the context of each basin, as there are projects from different agencies that may be implemented in different combinations within a basin. This approach allows the projects, and associated loads, to be considered in combination.

8.2.1 <u>Oxnard Plain</u>

8.2.1.1 City of Oxnard ASR (Potable Reuse)

As discussed, the City of Oxnard's proposed recycled water projects include potable reuse via ASR. The AWPF produces high quality purified water, with salt and nutrient concentrations that are below water quality objectives and below existing groundwater concentrations (see Table 8). The evaluation of the City of Oxnard's proposed recycled water projects is summarized as follows.

In an ASR configuration, the recycled water is injected into an aquifer and extracted for use after some specified residence time. The purpose of the ASR projects is to provide water to meet increasing demands, and it is conservatively assumed that the water from the ASR project(s) will not offset existing groundwater pumping.

Relative to the time scales that are important in groundwater fate and transport, the residence time in an ASR configuration is relatively short. ASR effectively provides a relatively small and temporary additional load to the basin. There may be localized mixing of the injected water (desalted) and the groundwater aquifer during the residence time in the aquifer. However, any mixing that would occur would provide a diluting effect on existing groundwater, due to the superior quality of the AWPF recycled water as compared to existing groundwater quality. Therefore, if there is any effect of the temporary injection of AWPF water into aquifers in the Oxnard Plain, then it would be a beneficial effect of dilution. From a salt and nutrient loading perspective, ASR generates a no-net change to the existing system and can be conceptually thought of as a closed loop within the larger City of Oxnard water supply system. The purified water is injected into the ground, extracted for potable water supply use, routed to the AWPF where salts and nutrients are removed and discharged to the ocean, or recharges the aquifer as percolating high quality groundwater, and finally the treated water is injected into the aquifer again. Since ASR will effectively provide no change to groundwater quality or a potential benefit to groundwater quality, then it is reasonable to conclude that the proposed ASR project(s) are allowable under the SNMP framework and should proceed, provided that other regulatory requirements are met.

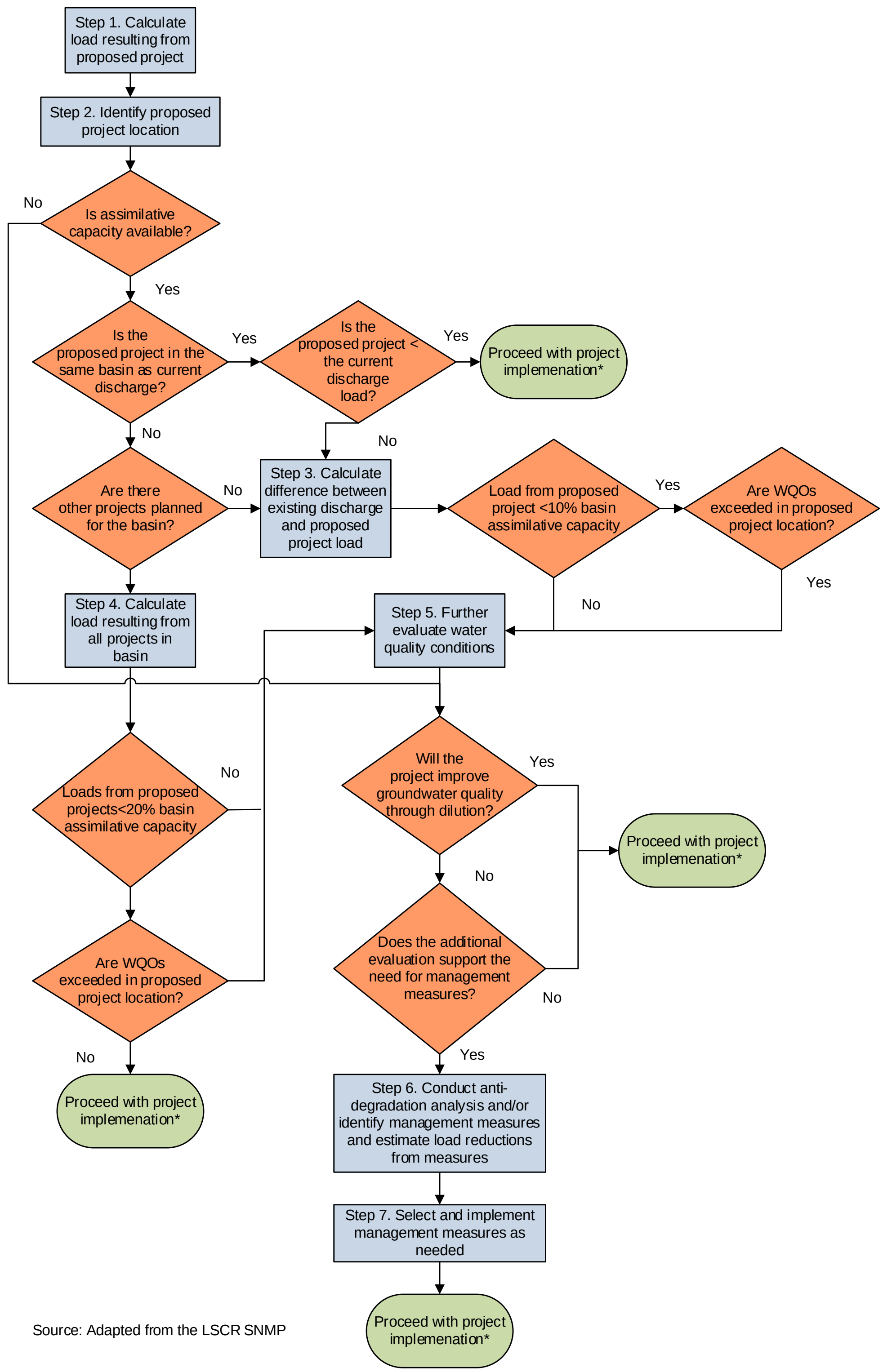


Figure 25 Process for Evaluating Proposed Recycled Water Projects

8.2.1.2 Agricultural Irrigation

Agricultural irrigation with recycled water will potentially be implemented through multiple scenarios:

- Scenario 1 - The PVCWD may purchase 500 acre feet per year (AFY) of recycled water from Camrosa Water District and distribute it for agricultural irrigation. The PVCWD may also purchase up to all of the City of Oxnard's AWPF water (5,200 AFY) that is planned for agricultural irrigation, and distribute it for agricultural irrigation. Approximately half of each of these supplies would be delivered in the Oxnard Plain and half in the Pleasant Valley Basin (i.e., 250 AFY of the water from Camrosa and or 2,600 AFY of the water from the AWPF).

- Scenario 2 - The PVCWD may purchase 500 AFY recycled water from Camrosa Water District and distribute it for agricultural irrigation (with 250 AFY within the Oxnard Plain). City of Oxnard may deliver all of the AWPF water, 5,200 AFY, that is planned for agricultural irrigation directly to agricultural areas within the Oxnard Plain. In this case, the 5,200 AFY of water would be delivered within the Oxnard Plain.

Within the PVCWD service area, the use of recycled water, from Camrosa Water District or from the AWPF, would offset use of PVCWDs existing groundwater supplies. Water delivered directly from the AWPF to agricultural areas would offset existing groundwater pumping. The AWPF water is far superior in quality to existing groundwater supplies and the recycled water that PVCWD would receive from Camrosa Water District. Since the AWPF water will reduce loads through offsetting existing supplies of lower quality, the most conservative alternative with respect to loading to the Oxnard Plain, is if all of the AWPF water designated for agricultural reuse is provided to PVCWD (scenario 1 above). In this case, there is less opportunity to offset loads to the Oxnard Plain Basin because the PVCWD distribution system delivers water to both the Oxnard Plain and the Pleasant Valley Basin, at an approximately 50/50 split. Agricultural irrigation with recycled water in the Oxnard Plain will result in recharge to perched aquifer and then potential transport to the UAS and LAS.

Table 14 presents a summary of the change in loads with the implementation of recycled water for agricultural irrigation, as described above in in the first scenario. The results in Table 14 simply consider the volume of water that is planned to be replaced with recycled water. The total volume of existing irrigation water that will be replaced is 2,850 AFY, with 2,600 AFY of water from the AWPF and 250 AFY of water from the Camrosa WRF Recycled Water Ponds. Comparison of the constituent load results for the existing condition and the future conditions with recycled water suggests that each constituent load will decrease with the implementation of recycled water. The weighted average TDS, chloride and nitrate concentration of the recycled water delivered by PVCWD is 230 mg/L, 48 mg/L, and 1.1 mg/L, respectively. These concentrations are less than existing groundwater in the

UAS and LAS of the Oxnard Plain (see Table 10), potentially providing a diluting effect on existing groundwater concentrations.

Table 14 Scenario 1 - Loading Summary for Agricultural Irrigation with Recycled Water
Public Works Integrated Master Plan
City of Oxnard

Component	Quantity	Chloride	TDS	Nitrate
Existing Condition				
PVCWD Water Supply	250 AFY	110 mg/L(1)	990 mg/L(2)	3 mg-N/L
Oxnard Plain Groundwater	2600 AFY	58 mg/L	895 mg/L	1.8 mg-N/L
Weighted Average Concentration		63 mg/L	900 mg/L	1.9 mg-N/L
Constituent Load		1,300 lb/day	19,200 lb/day	40 lb/day
With Recycled Water (Scenario 1)				
Recycled Water from Camrosa WRF Ponds	250 AFY	244 mg/L	947 mg/L	10 mg-N/L
Recycled Water AWPF	2600 AFY	30 mg/L	160 mg/L	0.2 mg-N/L
Weighted Average Concentration		48 mg/L	230 mg/L	1.1 mg-N/L
Constituent Load		1,000 lb/day	4,800 lb/day	20 lb/day

Notes:
(1) The measured range is approximately 40 to 180 mg/L chloride. The high end of the range represents more typical values. An average value is used to conservatively estimate the change in load resulting from recycled water use.
(2) The measured range is approximately 810 to 1170 mg/L TDS. The high end of the range represents more typical values. An average value is used to conservatively estimate the change in load resulting from recycled water use.

Note that this analysis is based on the average of two data points from PVCWD's existing water supply, one representing low concentrations and one that represents the more typical, much greater, concentrations. If the more typical concentrations were used in the calculations the estimated load reductions from implementing recycled water would be greater and the weighted average concentrations of the recycled water would show more potential for providing dilution of existing groundwater.

If all of the AWPF recycled water that is planned for agricultural irrigation is used directly in agricultural areas in the Oxnard Plain (scenario 2 above), then approximately 5450 AFY of existing agricultural irrigation water would be replaced by 5200 AFY of recycled water from the AWPF and 250 AFY of recycled water from the Camrosa WRF ponds. In comparison to scenario 1, the overall load reduction would be even greater. The weighted average TDS, chloride and nitrate concentration of the recycled water delivered to the Oxnard Plain would be 200 mg/L, 40 mg/L and 0.6 mg/L as N, respectively. These concentrations are less than existing groundwater in the UAS and LAS of the Oxnard Plain (see Table 10), potentially providing a diluting effect on existing groundwater concentrations.

Under both of these scenarios existing loads from agricultural irrigation would be reduced, and the irrigation water would have the potential to provide a diluting effect on existing groundwater. From an SNMP perspective, even if there is not assimilative capacity in a basin, a project that dilutes existing water quality can proceed with implementation, provided that all other regulatory requirements are met (see Figure 25).

8.2.2 Pleasant Valley Basin

Proposed projects in the Pleasant Valley Basin include:

- Camrosa Water District expanded delivery of recycled water to CSUCI for irrigation of landscape and local agricultural areas.
- PVCWD purchase recycled water from Camrosa Water District and from UWCD, for delivery for agricultural irrigation within the PVCWD service area.

8.2.2.1 Landscape and Agricultural Irrigation

The source of recycled water for the Camrosa Water District is the Camrosa WRF, and once the interconnection is completed, the Camarillo WRP. Recycled water from both sources will be combined in the Camrosa WRF recycled water ponds and then delivered for agricultural and landscape irrigation.

The source of recycled water for the PVCWD is the Camrosa WRF recycled water ponds and some portion of the AWPF water that is planned for agricultural irrigation. Recycled water delivered to PVCWD will be comingled with existing PVCWD water supplies, and delivered, via the PCVWD distribution, equally between the Oxnard Plain and the Pleasant Valley Basin.

The existing Camrosa WRF Recycled Water Permit includes performance based standards for chloride and TDS, based on best professional judgment of the RWQCB permit writers. The rationale for this approach included that there are no water quality objectives for the UAS in the Pleasant Valley Basin and that there are hydrogeologic studies that suggest very limited interaction between the UAS and the LAS, where water quality objectives have been established. Per the Camrosa WRF recycled water permit, the TDS and chloride limits were intended to protect the MUN beneficial use of the underlying groundwater basins, to prevent future degradation of the groundwater basin, and to help restore the water quality of the impacted aquifer.

In addition, while the water quality data set for the Pleasant Valley Basin UAS is very limited, comparison of the Camrosa WRF recycled water quality relative to existing groundwater quality suggest that the recycled water is within the range of existing groundwater concentrations and could potentially have a diluting effect on UAS groundwater concentrations. Recycled water from the AWPF is superior in quality relative to the existing quality of groundwater in the UAS, and therefore there is potential for dilution of existing groundwater concentrations.

From a SNMP perspective, the lack of water quality objectives for the UAS limits the ability to determine assimilative capacity and to assess the amount of assimilative capacity that will be used by the proposed projects. The limited productivity of the UAS limits the beneficial uses and the need for water quality objectives. Water quality objectives are not being proposed for the UAS of the Pleasant Valley Basin. It is therefore reasonable to conclude that an expansion of the Camrosa WRF recycled water program and delivery of recycled water by PVCWD, would be allowable under the SNMP analysis provided that other regulatory requirements are met. A key regulatory requirement is obtaining a recycled water permit for the expanded recycled water program. The permitting approach should follow the same rationale, with respect to recognizing that the UAS does not have water quality objectives and that therefore it is appropriate to develop performance based standards.

8.3 Management Measures and Groundwater Sustainability

It is important to recognize the linkage between the SNMP and the GSP planning process with respect to recycled water project and other management measures. While the primary focus of the GSP process will be groundwater quantity based, the GSP goals include limiting further degradation of areas with poor groundwater quality. As discussed, the southern Pleasant Valley Basin and region of the Oxnard Plain near the Pleasant Valley/Oxnard Plain boundary is area of depressed groundwater levels, and this adversely impacts long term sustainability and groundwater quality.

Groundwater is an important component of municipal and agricultural water supply. Implementation of recycled water projects contributes to sustainable management of the groundwater basins through offsetting groundwater extractions. The basins in the SNMP study area have been identified as priority basins for the GSP process. The benefit to groundwater sustainability by implementing recycled water projects that offset groundwater extractions should be recognized and considered in the evaluation of recycled water projects in this SNMP.

In addition, it is important to also recognize the past, present and future efforts of the Calleguas Creek Stakeholders. There is a long history of salt management in the study area basins, and through the TMDL implementation, there are planned measures that will continue to contribute to improving the salt balance in the Calleguas Creek Watershed.

9.0 ANTI-DEGRADATION ANALYSIS

9.1 Overview

An overview of the anti-degradation policy and analysis is provided as follows in Sections 9.1 and 9.2. Section 9.3 includes an assessment of impacts from the planned recycled water projects.

The Recycled Water Policy requires recycled water projects included within SNMPs to satisfy the requirements of State Water Board Resolution No. 68-16, the State anti-degradation policy adopted in 1968 to protect and maintain existing water quality in California.

The State's Resolution No. 68-16 is interpreted to incorporate the federal anti-degradation policy and satisfies the federal regulation requiring states to adopt their own anti-degradation policies. Resolution No. 68-16 states, in part:

- Whenever the existing quality of water is better than the quality established in policies as of the date on which such policies become effective, such existing high quality will be maintained until it has been demonstrated to the State that any change will be consistent with maximum benefit to the people of the State, will not unreasonably affect present and anticipated beneficial uses of such water and will not result in water quality less than that prescribed in the policies.

- Any activity which produces or may produce a waste or increased volume or concentration of waste and which discharges or proposes to discharge to existing high quality water will be required to meet waste discharge requirements which will result in the best practicable treatment or control of the discharge necessary to assure that (a) a pollution or nuisance will not occur and (b) the highest water quality consistent with maximum benefit to the people of the State will be maintained.

Entities that carry out actions that involve the disposal of wastes that could impact high quality waters are subject to the State's anti-degradation policy and required to implement best practicable treatment or control (BPTC) of the discharge to avoid producing a pollution source or nuisance and maintain the highest water quality consistent with maximum benefit to the people of the State. The Recycled Water Policy (Policy) finds that use of recycled water in accordance with the Policy is presumed to have a beneficial impact. The Policy requires that SNMPs be tailored to address the discharge of salts, nutrients, and other constituents that could impact water quality in a groundwater basin/subbasin. SNMPs are required to address and implement provisions, as appropriate, to control sources of salts and/or nutrients to groundwater basins, including those associated with recycled water irrigation projects and groundwater recharge reuse projects.

With regard to Resolution No. 68-16 and the potential degradation of groundwater quality through the implementation of a recycled water project that involves groundwater recharge and/or landscape irrigation, the Recycled Water Policy finds the following.

Groundwater recharge with recycled water for later extraction and use in accordance with this Policy and state and federal water quality law is to the benefit of the people of the state of California. Nonetheless, the State Water Board finds that groundwater recharge projects using recycled water have the potential to lower water quality in a basin. The proponent of a groundwater recharge project must demonstrate compliance with Resolution No. 68-16. Until such time as a salt/nutrient management plan is in effect, such compliance may be demonstrated as follows:

- A project that utilizes less than 10 percent of the available assimilative capacity in a basin/sub-basin (or multiple projects utilizing less than 20 percent of the available assimilative capacity in a basin/sub-basin) need only conduct an anti-degradation analysis verifying the use of the assimilative capacity. For those basins/sub-basins where the Regional Water Boards have not determined the baseline assimilative capacity, the baseline assimilative capacity shall be calculated by the initial project proponent, with review and approval by the Regional Water Board, until such time as the salt/nutrient plan is approved by the Regional Water Board as is in effect. For compliance with this sub-paragraph, the available assimilative capacity shall be calculated by comparing the mineral water quality objective with the average concentration of the basin/sub-basin, either over the most recent five years of data available or using a data set approved by the Regional Water Board Executive Officer. In determining whether the available assimilative capacity will be exceeded by the project or projects, the Regional Water Board shall calculate the impacts of the project or projects over at least a ten year time frame.

- In the event a project or multiple projects utilize more than the fraction of the assimilative capacity designated in subparagraph (1) [above], then a Regional Water Board-deemed acceptable anti-degradation analysis shall be performed to comply with Resolution No. 68-16. The project proponent shall provide sufficient information for the Regional Water Board to make this determination. An example of an approved method is the method used by the State Water Board in connection with Resolution No. 2004-0060 and the Regional Water Board in connection with Resolution No. R8-2004-00041. An integrated approach (using surface water, groundwater, recycled water, stormwater, pollution prevention, water conservation, etc.) to the implementation of Resolution No. 68-16 is encouraged.

Therefore, to complete an anti-degradation analysis (ADA) it is necessary to assess the impacts of the recycled water projects and associated management actions on the basins. The anti-degradation analysis approach is then based on the amount of assimilative capacity that would be utilized by the project or the project in combination with management measures. Following is a description of the potential approaches that could be utilized to conduct the anti-degradation analysis depending on the results of the assessment of project impacts.

9.1.1 Demonstration of Compliance in Accordance with Recycled Water Policy (Simple ADA)

The Recycled Water Policy has set forth thresholds of potential degradation to groundwater basins that are considered to be consistent with the anti-degradation policy. If the projects or the projects combined with management measures can be demonstrated to meet these thresholds, then the anti-degradation analysis is complete. The thresholds outlined in the Recycled Water Policy are no more than 10 percent of the available assimilative capacity for a single project or no more than 20 percent of the available assimilative capacity for multiple projects. To conduct this analysis, the following procedure would be used:

- Assess the assimilative capacity of each subbasin.
- Calculate the allowable loading to the basin that will not result in degradation based on the thresholds in the Recycled Water Policy (use of less than 10 percent of the assimilative capacity for one project or less than 20 percent of the assimilative capacity for multiple projects).
- Based on the allowable loading, assess whether the proposed projects or combination of projects and management measures are less than the allowable loading thresholds.

When comparing to these thresholds, the net loading that will result from the recycled water project will be utilized. Net loading calculations may take into account management measures that may be used to reduce or offset new loading stemming from the recycled water use. Therefore, it is possible to develop projects and associated management measures that will ensure these thresholds are met and avoid the need to do additional anti-degradation analysis. Projects with loadings that fall below the thresholds are considered to be meeting the anti-degradation policy. If the use of assimilative capacity by the projects or the combination of projects and management measures do not fall below those thresholds, either a complete anti-degradation analysis will be required.

9.1.2 Complete Anti-degradation Analysis (Complete Analysis)

If the projects or combination of projects and management measures will use more assimilative capacity than the thresholds outlined in the Recycled Water Policy or there is no assimilative capacity available in a project area, a complete anti-degradation analysis may need to be performed. If a complete analysis is required, the amount of analysis will be determined by the project and the level of information necessary to demonstrate that implementation of the proposed projects are consistent with maximum benefit to the people of the State and will not unreasonably affect existing or potential beneficial uses. Following is a summary of the factors that would be considered in determining whether a project is necessary to accommodate important economic or social development and is consistent with maximum public benefit.

- Past, present and probable beneficial uses.
- Economic costs to maintain water quality compared to the benefits.
- Environmental aspects of the proposed discharge.
- Consideration of feasible alternative control measures which might reduce, eliminate, or compensate for negative impacts of the project.

The results of the analysis will determine if a finding of compliance with the anti-degradation policy can be made or if additional management measures are needed to reduce the degradation of the groundwater basins to be in compliance with the policy.

9.2 Applicability of ADA Approach to the Oxnard SNMP

As determined in Section 8.2, the proposed projects will improve groundwater quality in the Oxnard Plain and will not use any assimilative capacity for chloride, TDS, or nitrate. The proposed projects in the Pleasant Valley Basin will recharge the UAS, where there are no water quality objectives and therefore assessment of assimilative capacity is not applicable. Therefore, the proposed projects can be implemented without the quantified evaluation of assimilative capacity. The simple or complete anti-degradation analyses described in this section are not applicable for the proposed projects. Implementation of the proposed projects will be consistent with the Anti-degradation Policy and the goals of the Recycled Water Policy.

10.0 MONITORING PLAN

The Recycled Water Policy requires the development of a monitoring program with the primary objectives to characterize the basin and to provide targeted monitoring:

- Basin-Wide Characterization (Recycled Water Policy Section 6.b.(3)(a)) “A basin/sub-basin wide monitoring plan that includes an appropriate network of monitoring locations.”
- Targeted Monitoring (Recycled Water Policy Section 6.b.(3)(a)(i)) “…focus on basin water quality near water supply wells and areas proximate to large water recycling projects, particularly groundwater recharge projects… where appropriate target groundwater and surface waters where groundwater has connectivity with adjacent surface waters.”

This SNMP is unique in the sense that both the SNMP and the GSP are being developed in overlapping timeframes. An important component of the GSP is a comprehensive monitoring program. Among other types of data groundwater level monitoring will be conducted. It is expected that the GSP monitoring program will also include water quality data, and thereby streamline some of the data collection efforts that are currently being conducted by various agencies. Ultimately, SNMP related monitoring activities should be incorporated into the GSP monitoring program and database to simplify data records and use resources efficiently. Therefore, the monitoring plan for this SNMP consists of guideline and recommendations for monitoring rather than a plan for specific monitoring activities.

It is important to recognize that this SNMP does not include long term projection of assimilative capacity and a quantified prediction of future groundwater quality with implementation of proposed projects and management measures. Consequently, it is critical that SNMP related monitoring is incorporated into recycled water permits and in the comprehensive monitoring program that is expected to be developed as part of the GSP.

10.1 Existing Monitoring Programs

Existing groundwater monitoring programs have been implemented to meet regulatory requirements such as drinking water regulations and waste discharge requirements, and overall characterization of groundwater quality. Key sources of existing data are from water purveyors, dischargers, the Ventura County (County) Groundwater Monitoring Program and UWCD's Water Quality Monitoring Program.

10.2 Water Quality Constituents

The Recycled Water Policy requires monitoring of salts, nutrients, and consideration of monitoring for constituents other than salt and nutrients that adversely affect groundwater quality. For projects that involve groundwater recharge with recycled water, the recycled water policy refers requirements for Contaminants of Emerging Concern (CEC) monitoring. The following sections provide a brief overview of basin-wide and targeted monitoring program constituents:

- Basin-wide monitoring: Basin wide monitoring should include parameters with water quality objectives, as identified in the Basin Plan. These parameters include TDS, chloride, nitrate, sulfate, and boron.
- Targeted Monitoring: The parameters for targeted monitoring should include all the constituents in the basin-wide monitoring program. In addition, other parameters may be added to address the specific objectives of the targeted monitoring activities. Potable reuse via ASR is a project type that warrants additional monitoring. It is anticipated that the recycled water permits for ASR will require groundwater monitoring for primary and secondary drinking water standards, total nitrogen and nitrite, and other contaminants. Monitoring requirements for CECs are likely to include the health based, performance based, and surrogate parameters identified in the Recycled Water Policy. However, the specific requirements for groundwater monitoring associated with the ASR projects will be identified in the permitting and approval process.

10.3 Basin-Wide Monitoring Locations and Frequency

Because the GSP is currently under development, there is opportunity for the basin-wide monitoring for the SNMP to be aligned with the GSP monitoring program. Within the study area, the spatial and vertical distribution of monitoring wells are both important considerations. In addition, there are areas within the basins that have exhibited trends. The GSP planning objective of not allowing areas of poor water quality to further degrade without mitigation, requires that there is sufficient data to assess trends in areas of poor water quality.

Combined evaluation of the historical groundwater quality and trends, suggests that there are some regions that should be considered for water quality monitoring. The intent of highlighting these regions is to inform the development of the GSP monitoring program rather than developing a specific monitoring program for this SNMP. In identifying the suggested areas for monitoring, the TDS, chloride, and nitrate median concentrations, and trends in these parameters were all considered. In some cases, a region was selected based on a single parameter (i.e., nitrate concentrations and trends are often not similar to TDS or chloride). Since it is recommended that these three parameters, as well as sulfate and boron, are sampled together, a single parameter could be the rationale for selecting the region. To provide a basis for comparison with water quality objectives, it is suggested that monitoring in each of the regions occurs within the following aquifers/systems:

- Oxnard Plain - Perched, UAS, and LAS.
- Oxnard Forebay - UAS.
- Pleasant Valley Basin - LAS.

Figure 26 provides an overview for the selected regions for monitoring.

10.4 Targeted Monitoring Locations and Frequency

Targeted monitoring will be associated with recycled water projects, both groundwater recharge projects and landscape/urban irrigation projects. Through the recycled water permitting process, which requires an engineer's report and a report of waste discharge, monitoring requirements will be developed for recycled water projects. The permitting process is project and site specific, and therefore will be developed to collect data specific to the recycled water projects once fully developed and define. Therefore, no specific targeted monitoring is identified in this SNMP.

10.5 Analytical Methods and QA/QC

The monitoring plan for the GSP will include detailed information on analytical methods and Quality Assurance/Quality Control (QA/QC) (for sample collection and laboratory analysis). It is recommended the GSP evaluate existing monitoring programs and identify methods and procedures that are consistent with existing monitoring programs, including monitoring for waste discharge requirements and recycled water permits. One key consideration is the analytical method for TDS. The historical data set includes TDS by summation and as measured as total filterable residual. It is recommended that the more common analysis for total filterable residual is implemented for future monitoring.

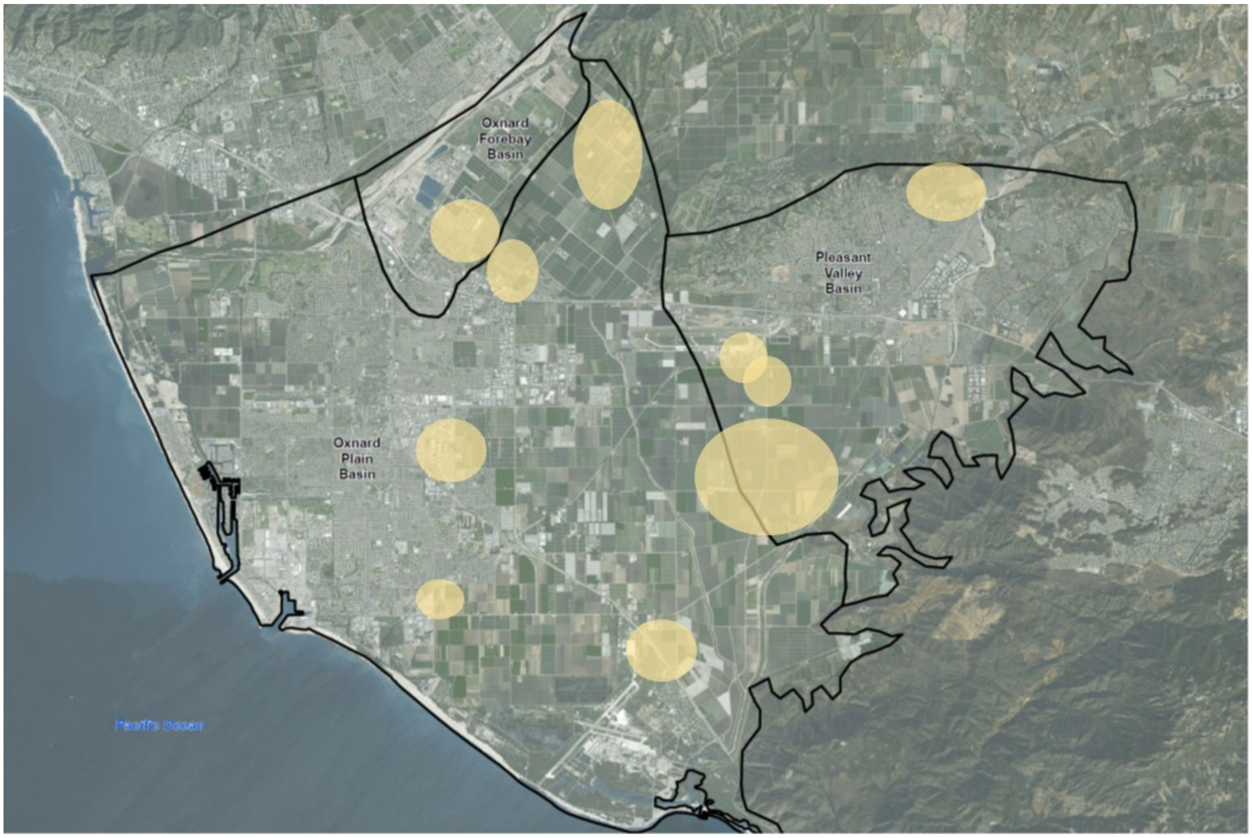


Figure 26 Approximate Regions for Monitoring

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APPENDIX A - SNMP WORKSHOP MATERIALS

Oxnard Salt and Nutrient Management Plan

Technical Advisory Group Meeting

June 1, 2015

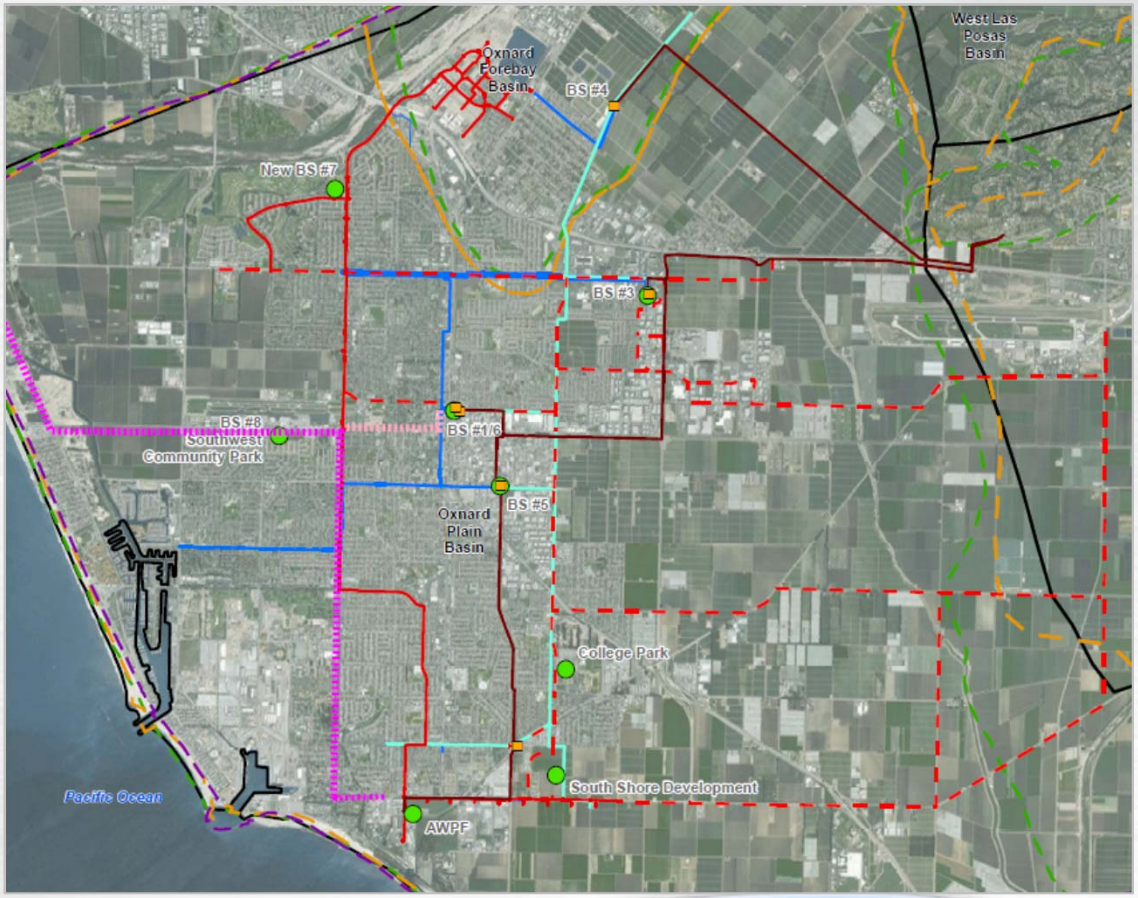
Workshop Agenda

- SNMP Introduction
- Project Team and TAG Introductions
- Meeting Objectives
- Overview of Phased Approach
- Project Schedule and TAG Involvement
- Draft SNMP Workplan – Key Issues
- Discussion
- Next Steps

SNMP INTRODUCTION

City is aggressively implementing recycled water on a large scale

- Landscape Irrigation
- Groundwater Recharge
- Industrial Reuse
- Agricultural Irrigation

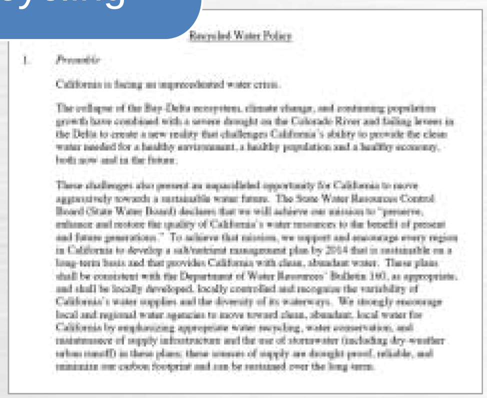


SNMP is foundational to the recycled water permits

- Information developed by the SNMP will be critical to the overall permit process
- Provides opportunity to quantify the predicted benefit of proposed recycled water projects
- Schedule for completing SNMP and obtaining recycled water permits is important to meeting GREAT Program objectives

SNMP and Recycled Water Permit Relationship

SWRCB Adopted Recycled Water Policy to encourage water recycling



Recycled Water Policy

1. *Preamble*

California is facing an unprecedented water crisis.

The collapse of the Bay-Delta ecosystem, climate change, and continuing population growth have combined with a severe drought on the Colorado River and failing levees in the Delta to create a new reality that challenges California's ability to provide the clean water needed for a healthy environment, a healthy population and a healthy economy, both now and in the future.

These challenges also present an unparalleled opportunity for California to move aggressively towards a sustainable water future. The State Water Resources Control Board (State Water Board) declares that we will achieve our mission to "preserve, enhance and restore the quality of California's water resources to the benefit of present and future generations." To achieve that mission, we support and encourage every region in California to develop a salt/nutrient management plan by 2014 that is sustainable on a long-term basis and that provides California with clean, abundant water. These plans shall be consistent with the Department of Water Resources' Bulletin 160, as appropriate, and shall be locally developed, locally controlled and recognize the variability of California's water supplies and the diversity of its waterways. We strongly encourage local and regional water agencies to move toward clean, abundant, local water for California by emphasizing appropriate water recycling, water conservation, and maintenance of supply infrastructure and the use of stormwater (including dry-weather urban runoff) in these plans; these sources of supply are drought proof, reliable, and minimize our carbon footprint and can be sustained over the long term.

Requires Stakeholders Develop Salt and Nutrient Management Plan (SNMP)

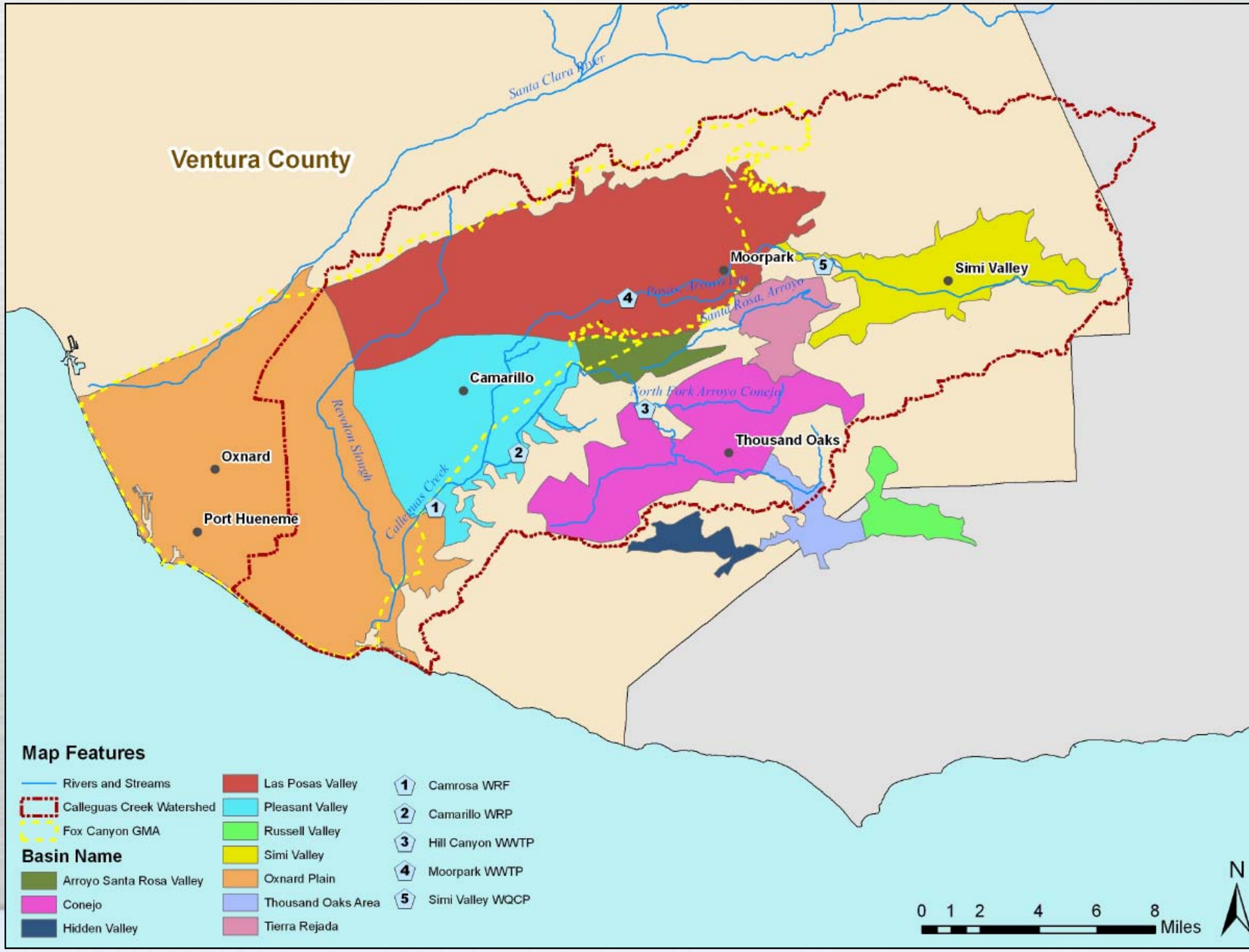
SNMPs consider all sources and define management measures

Management Measures incorporated into Basin Plan or Implementation Plan

Recycling Water Permits Based on SNMP and Basin Plan or Implementation Plan

Spring 2016 Completed SNMP

City recognizes need to coordinate with other SNMP efforts in the region



PROJECT TEAM AND TAG

SNMP project team and TAG

PROJECT TEAM

City of Oxnard

Carollo Engineers
Larry Walker Associates
Hydrometrics

REGULATORY GUIDANCE

Regional Water Quality Control Board

TECHNICAL AND STRATEGIC GUIDANCE

Technical Advisory Group

REVIEW AND INPUT

Stakeholders

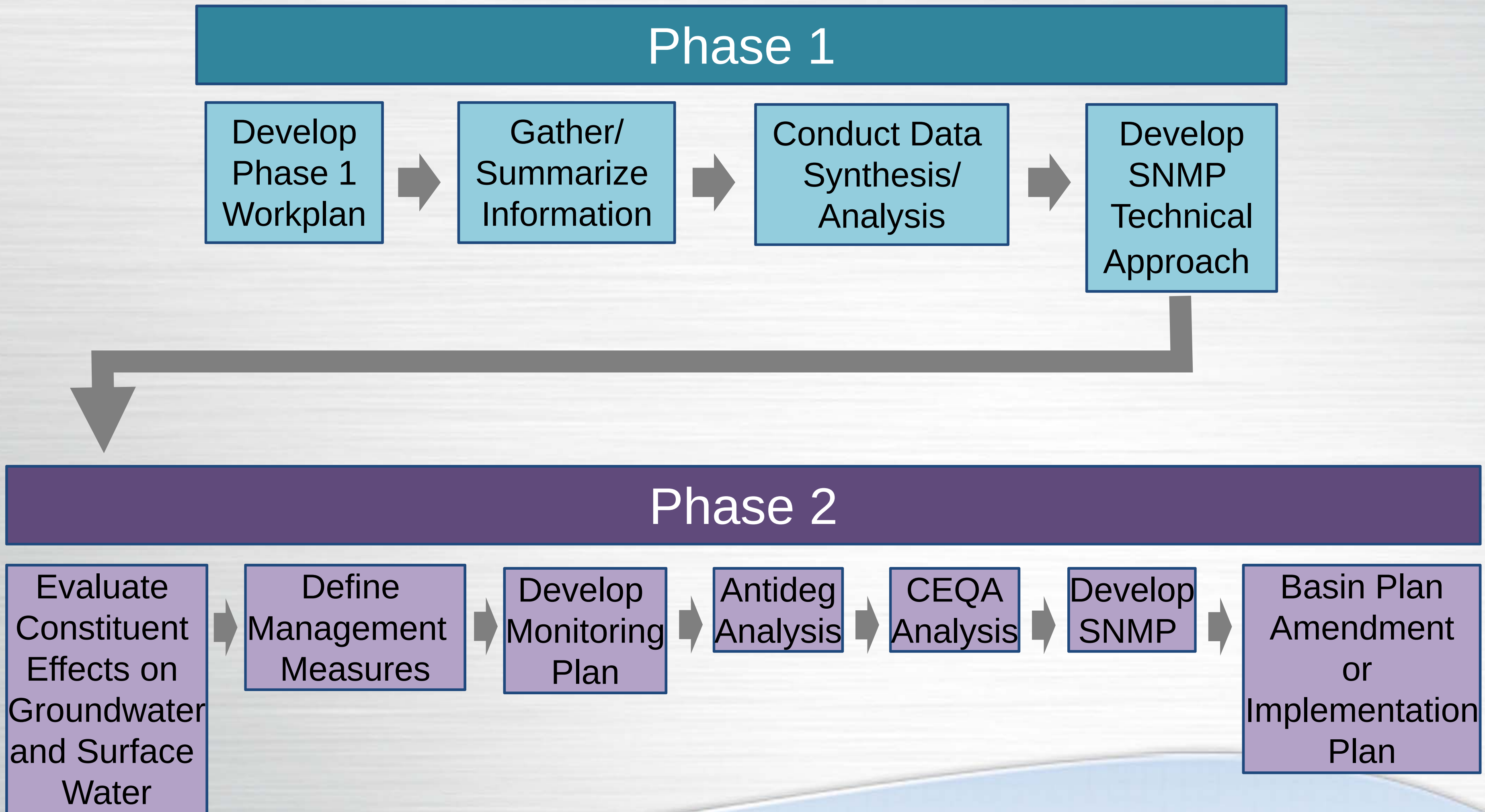
MEETING OBJECTIVES

Why are we here today?

- Introduce the Draft SNMP Workplan
- Solicit feedback on key issues
- Present next steps

PHASED SNMP DEVELOPMENT

SNMP Phase 1 and 2

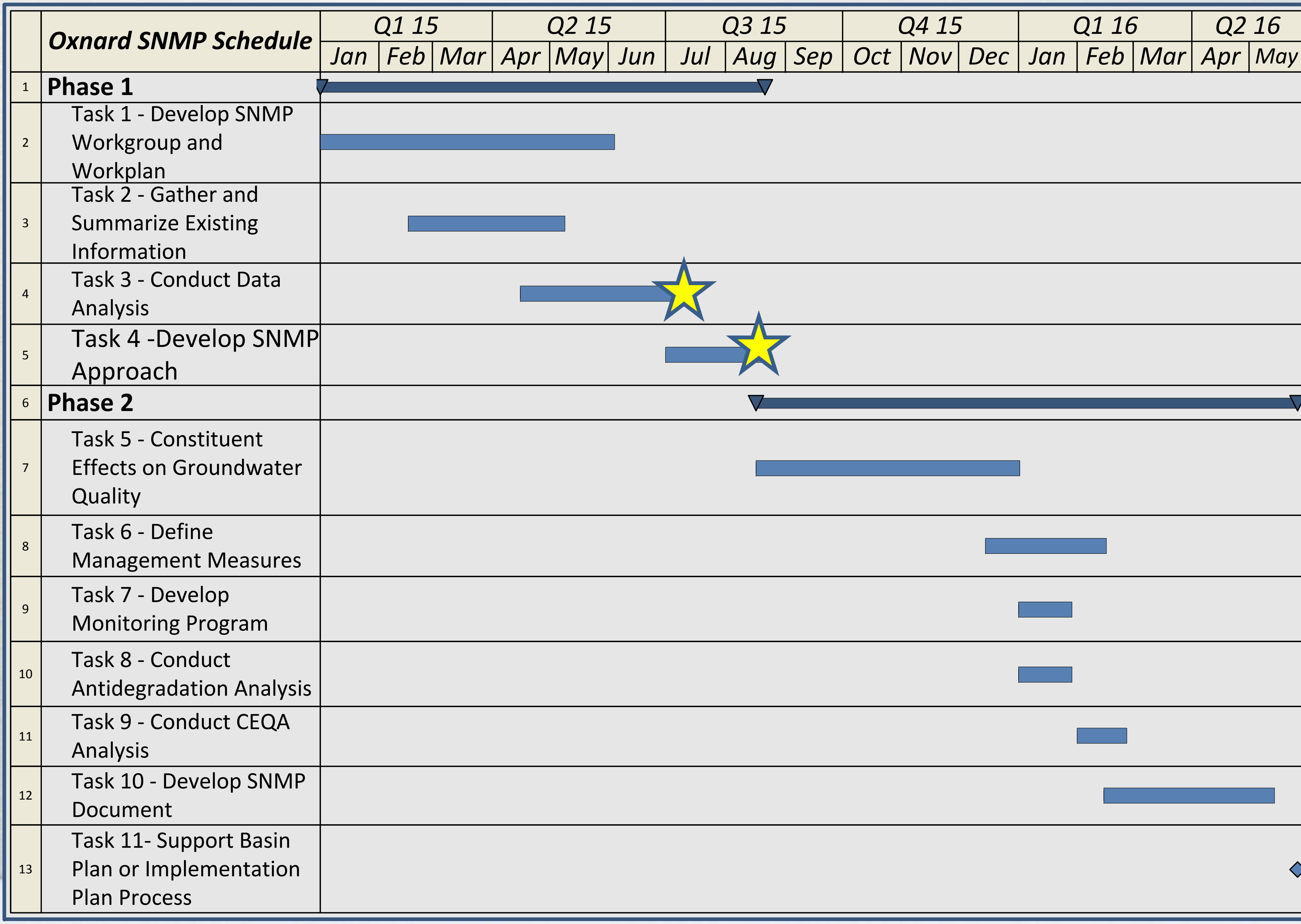


Phase SNMP Development – what is the point?

- Phase 1 to Phase 2
  - SNMP Approach Document
    - Establishes refined scope for Phase 2
    - RWQCB approval will streamline the Phase 2 technical work
  - Opportunity for merging/aligning efforts with regional efforts
  - Continuous work Phase 1 into Phase 2
    - Currently funded for Phase 1
    - Will be funded for Phase 2

PROJECT SCHEDULE AND TAG INVOLVEMENT

Project Schedule



TAG Involvement

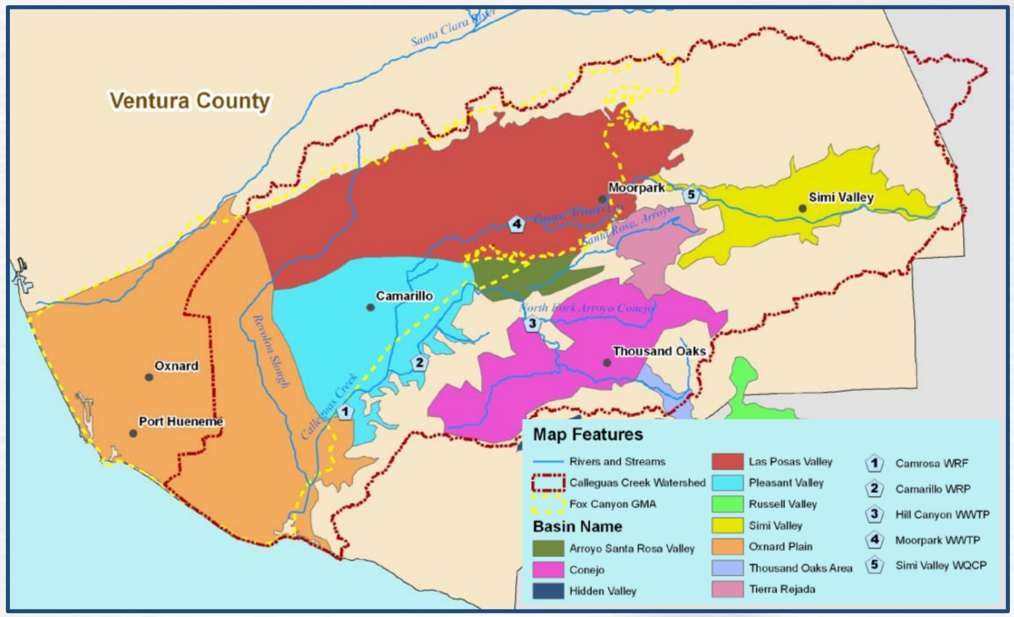
	PHASE 1				PHASE 2						
TASKS	Develop Workplan	Gather and Summarize Existing Information	Conduct Data Analysis	Develop SNMP Technical Approach	Evaluate Constituent Effects on Groundwater and Surface Water	Define Management Measures	Develop Monitoring Program	Anti-degradation Analysis	CEQA Analysis	Develop SNMP	Basin Plan Amendment or Implementation Plan
STAKEHOLDER AND TAG MEETINGS	T	S	T	T, S	T, S	T	T, S		T	T, S	T
LARWQCB MEETINGS	B			B	B		B		B	B	B

Notes: T= TAG Meeting, S = Stakeholder Meeting, and B= LARWQCB Meeting

DRAFT WORKPLAN – KEY ISSUES

Study Area – Oxnard Plain and Forebay, Pleasant Valley Basins

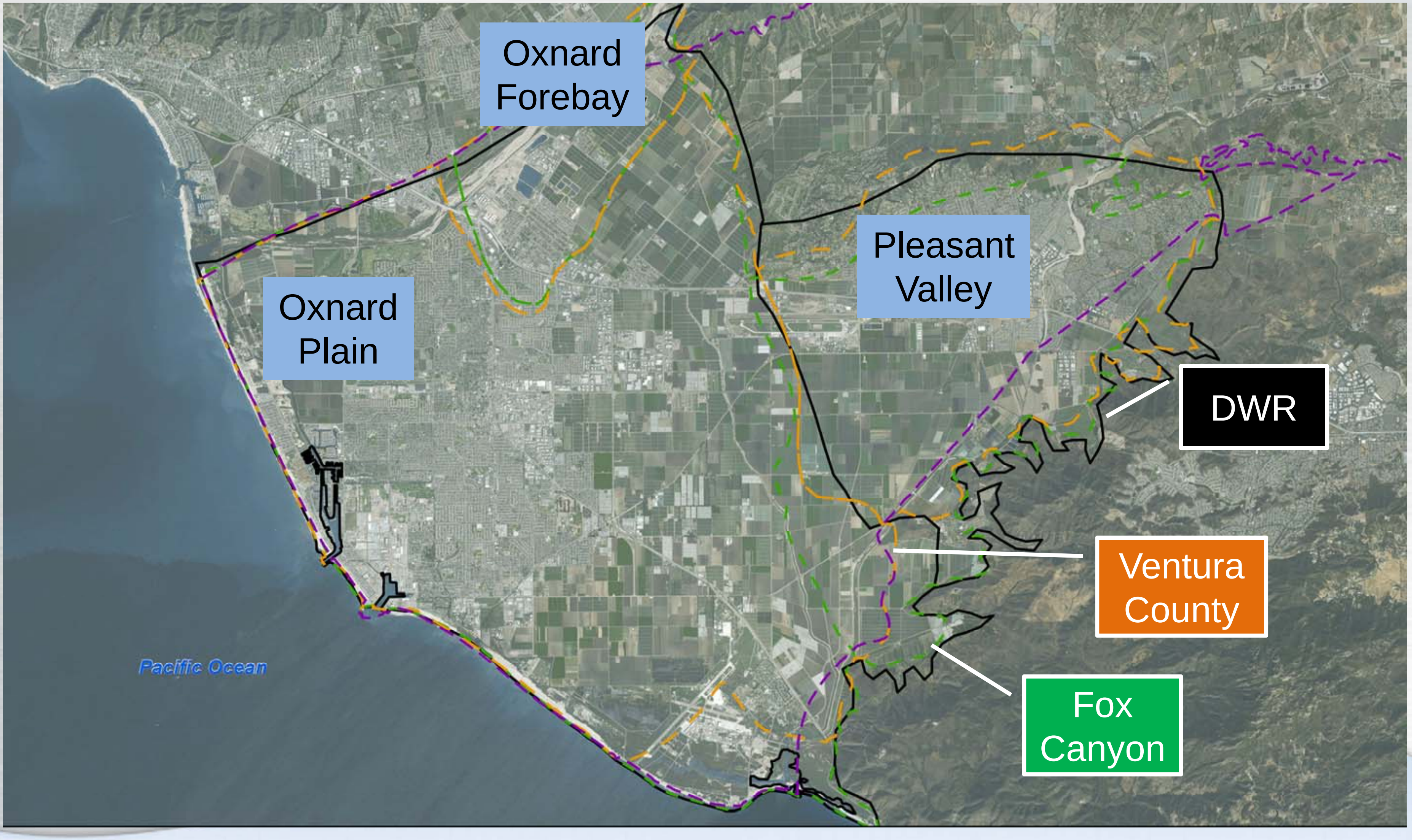
- Recycled water projects are within these basins
- Potential merging with basins in Calleguas Creek Watershed Group SNMP
- Opportunity to use information and boundary conditions for adjacent planning areas



Questions/Discussion – Study Area

- Are there comments on proposed study area?

Groundwater Basin Boundaries



Groundwater Basin Boundaries

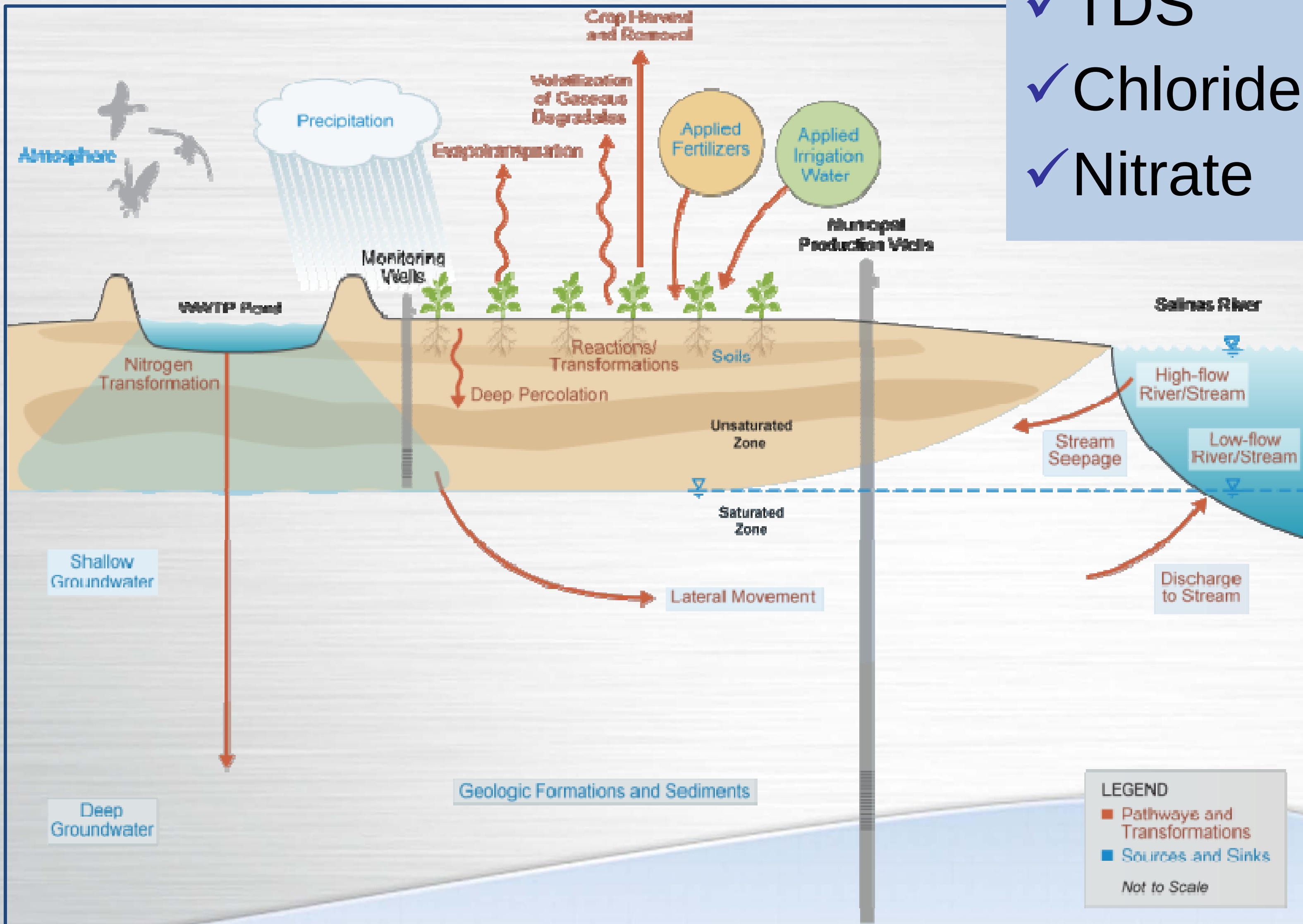
- DWR boundaries are accepted unless other boundaries are proposed
- DWR Boundaries
  - Do not delineate Forebay, however, LARWQCB accepted delineation in the LSCR SNMP
  - DWR boundaries extend beyond other boundaries in some areas
- SGMA includes process for basin boundary revisions

Questions/Discussion – Groundwater Basin Boundaries

- Comments on whether revised boundaries will be proposed?
- Should the SNMP boundaries be consistent with revised boundaries?

Constituents

- ✓TDS
- ✓Chloride
- ✓Nitrate

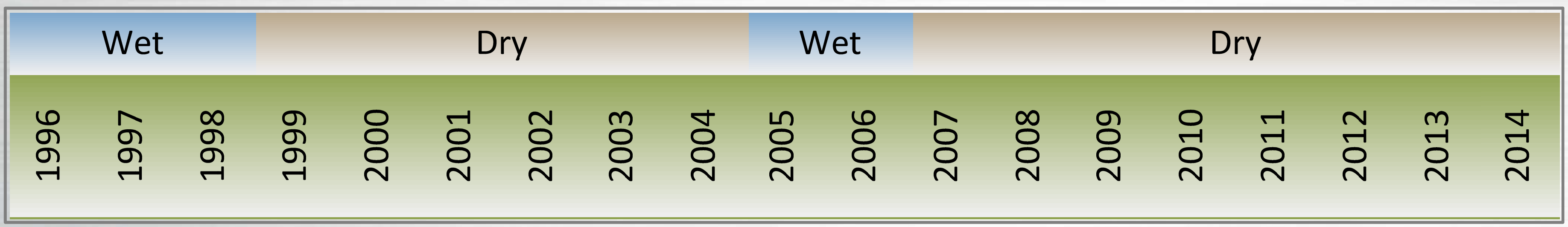


Questions/Discussion –Constituents

- Comments on using TDS, chloride and nitrate?
- Are there other parameters that should be included?

Data Period

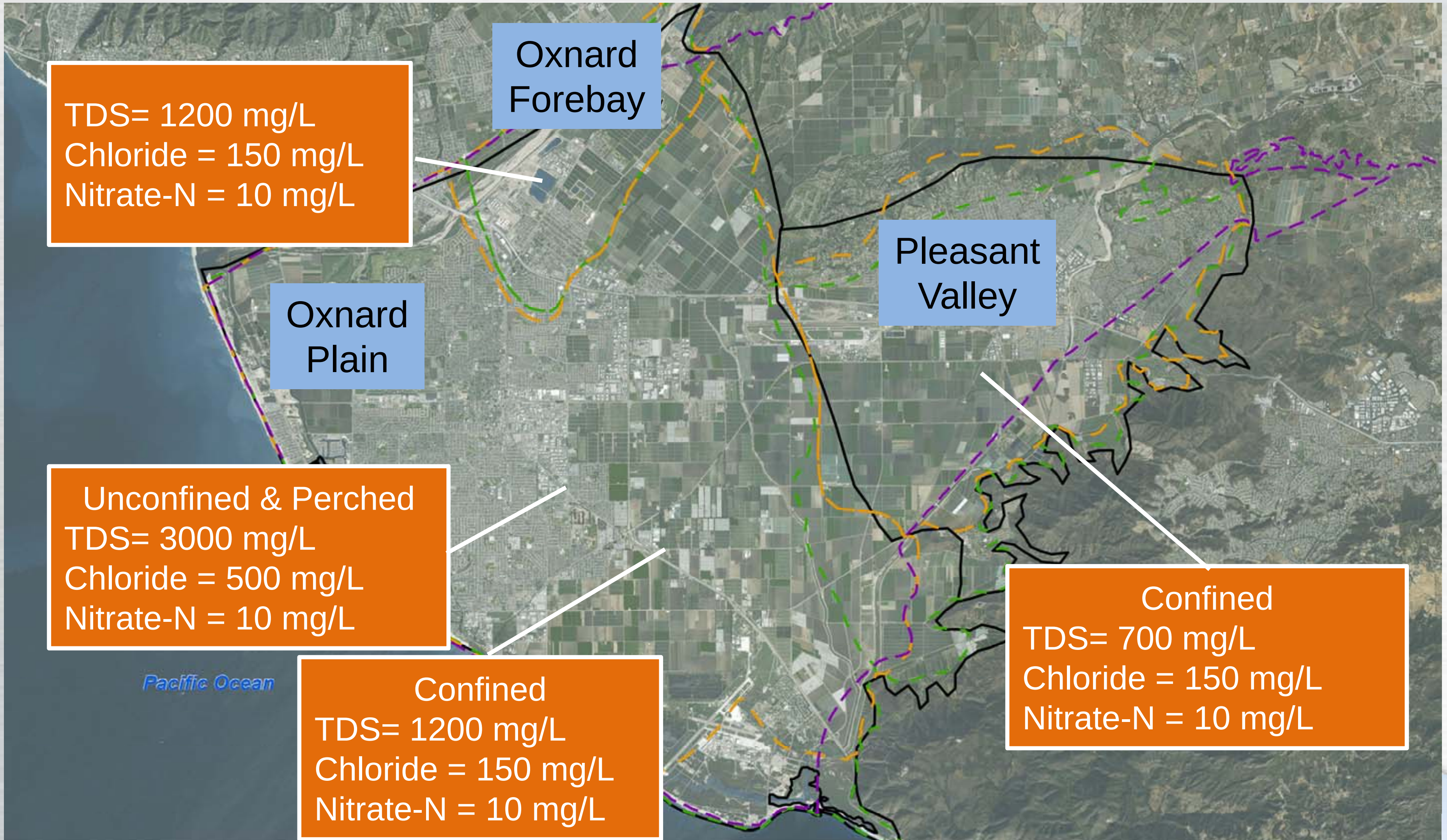
- Minimum is 5 years
- Trend analysis requires > 5 years
- Capture wet and dry periods
- Consistency with LSCR SNMP
- Proposed period 1996-2014



Questions/Discussion – Data Period

- Comments on the 1996-2014 data period?

Preliminary Assessment and Management Measures Approach



Preliminary Assessment and Management Measures Approach

- Areas within basins with compromised groundwater quality
- SNMP Management Measures
  - Maintain water quality
  - Contribute to improvements in water quality
  - Not a comprehensive plan to remediate all areas with compromised groundwater quality

Questions/Discussion - Preliminary Assessment and Management Measures Approach

- Comments on the intent of the SNMP management measures?

NEXT STEPS

Next Steps

- Prepare draft deliverables
  - Goals and objectives table
  - Recycled water projects and existing management measures
  - Existing monitoring program summary
  - Summary of basin characteristics
  - Preliminary data assessment
- TAG Meeting - July 2015
- Stakeholder Meeting July 2015
- Prepare Draft SNMP Approach
- TAG Meeting – August 2015

Oxnard Plain and Pleasant Valley Salt and Nutrient Management Plan

LARWQCB Meeting

July 17, 2015

Meeting Agenda

- Project Team
- Meeting Objectives
- SNMP Introduction
- SNMP Schedule
- Key Issues
- Next Steps

PROJECT TEAM

SNMP project team

PROJECT TEAM

City of Oxnard

Carollo Engineers
Larry Walker Associates
Hydrometrics

REGULATORY GUIDANCE

Regional Water Quality Control Board

TECHNICAL AND STRATEGIC GUIDANCE

Technical Advisory Group

REVIEW AND INPUT

Stakeholders

MEETING OBJECTIVES

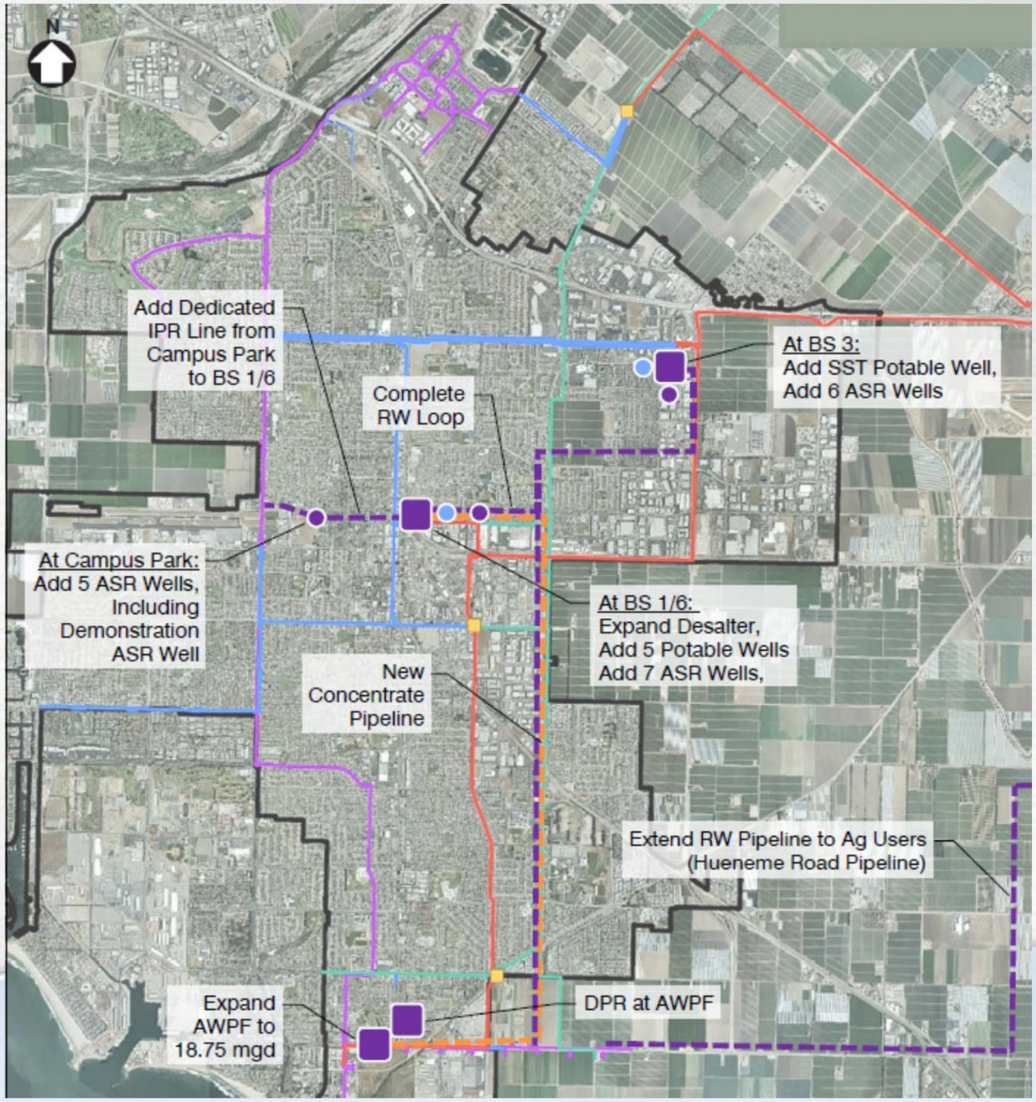
Why are we here today?

- Introduce the proposed Oxnard Plain and Pleasant Valley SNMP
- Provide LARWQCB with the Draft SNMP Workplan
- Solicit initial feedback and guidance
- Present next steps and schedule

SNMP INTRODUCTION

City is aggressively pursuing implementation of recycled water projects

- Landscape Irrigation
- Groundwater Recharge
- Industrial Reuse
- Agricultural Irrigation

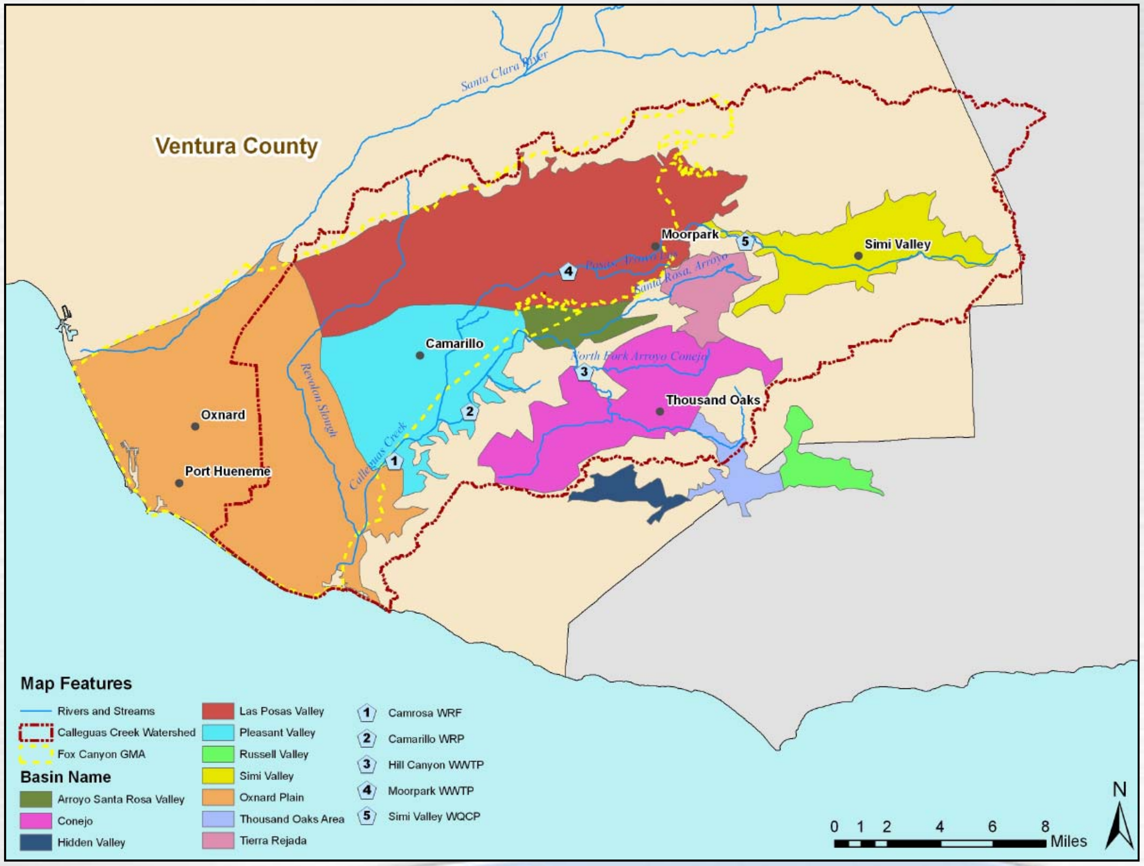


SNMP is foundational to the recycled water permits

- Information developed by the SNMP will be critical to the overall permit process
- Provides opportunity to quantify the predicted benefit of proposed recycled water projects
- Schedule for completing SNMP and obtaining recycled water permits is important to meeting GREAT Program objectives

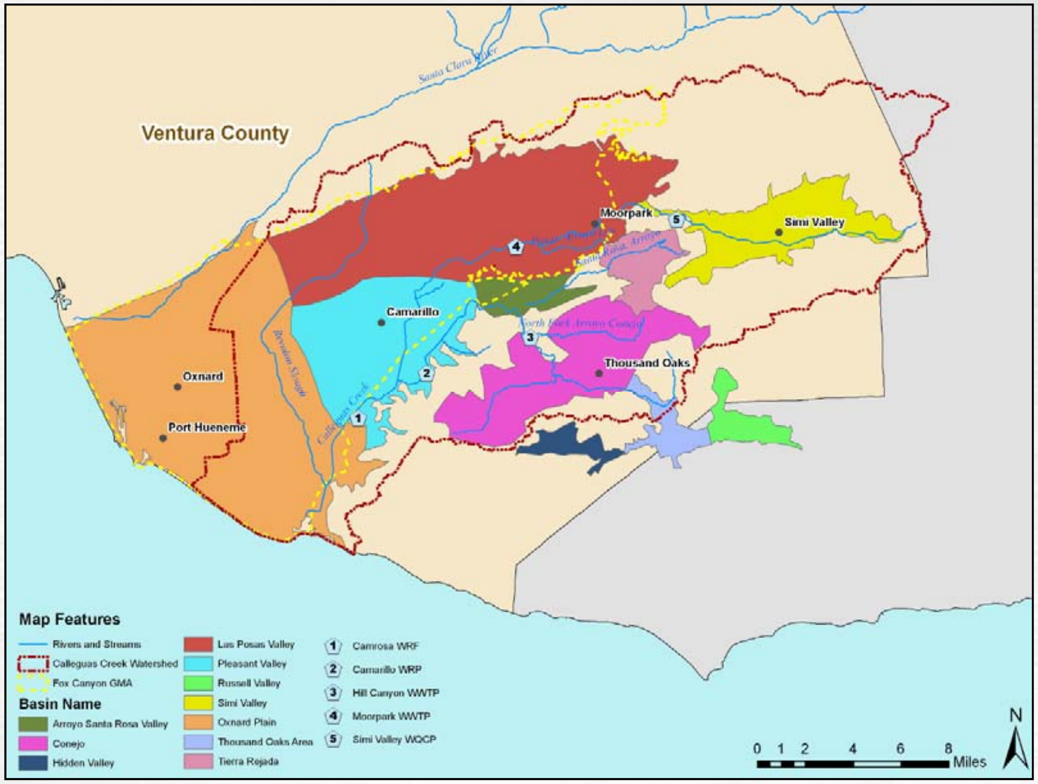
Oxnard Plain and Pleasant Valley Basins were selected because…

- Geographic scope of recycled water projects
- Allows alignment of SNMP completion and recycled water permit application process



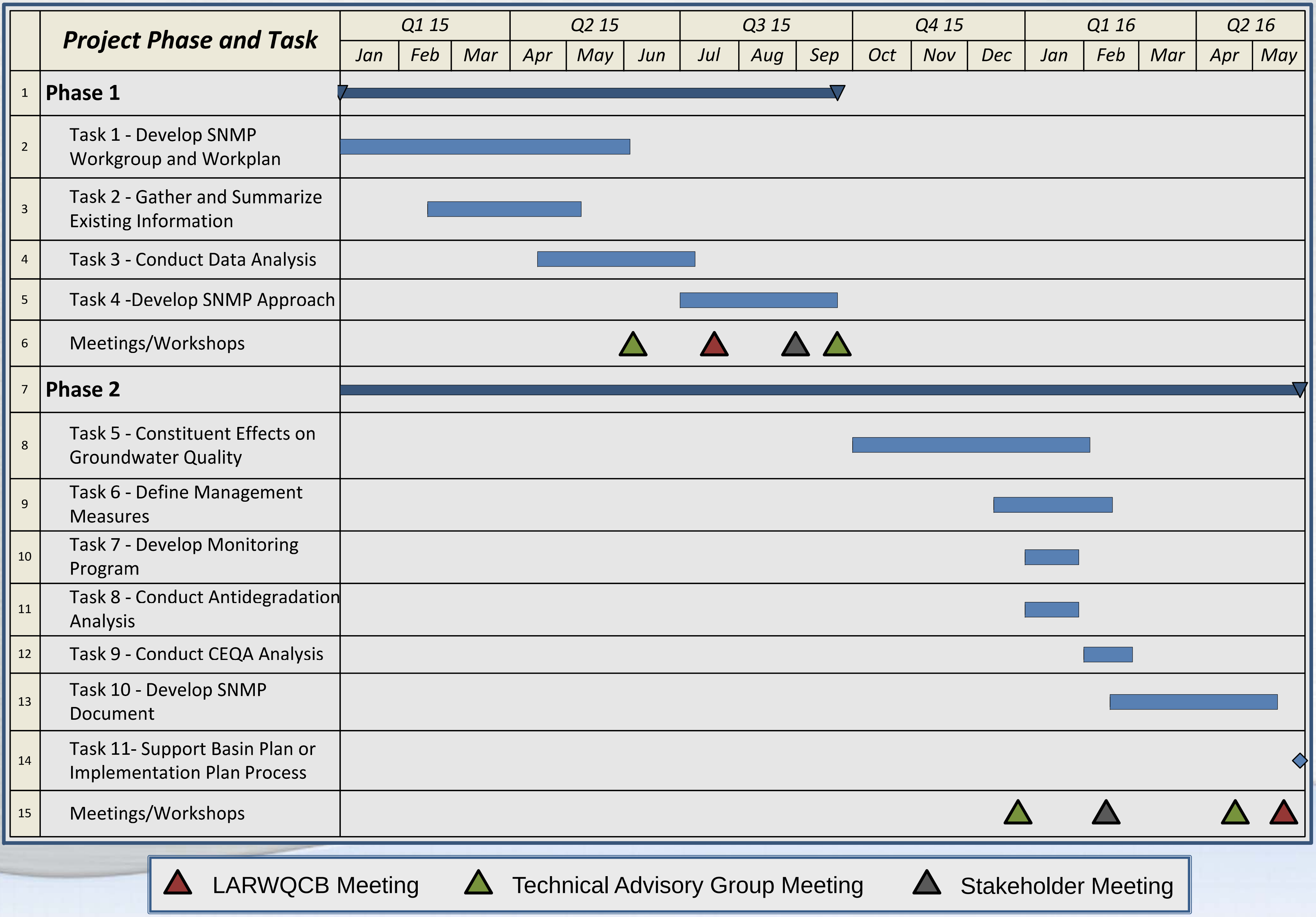
Calleguas Watershed Group will proceed in parallel with SNMP

- Efforts will be coordinated
- Boundary conditions for adjacent planning areas will be and identified
- Process for using/sharing boundary condition data will be developed



SNMP SCHEDULE

Project Schedule



SNMP Phase 1 and 2

Phase 1

1. Develop Phase 1 Workplan
2. Gather/ Summarize Information
3. Conduct Data Synthesis/ Analysis
4. Develop SNMP Technical Approach

Phase 2

1. Evaluate Constituent Effects on Groundwater and Surface Water
2. Define Management Measures
3. Develop Monitoring Plan
4. Antideg Analysis
5. CEQA Analysis
6. Develop SNMP
7. Basin Plan Amendment or Implementation Plan

Phased SNMP Development

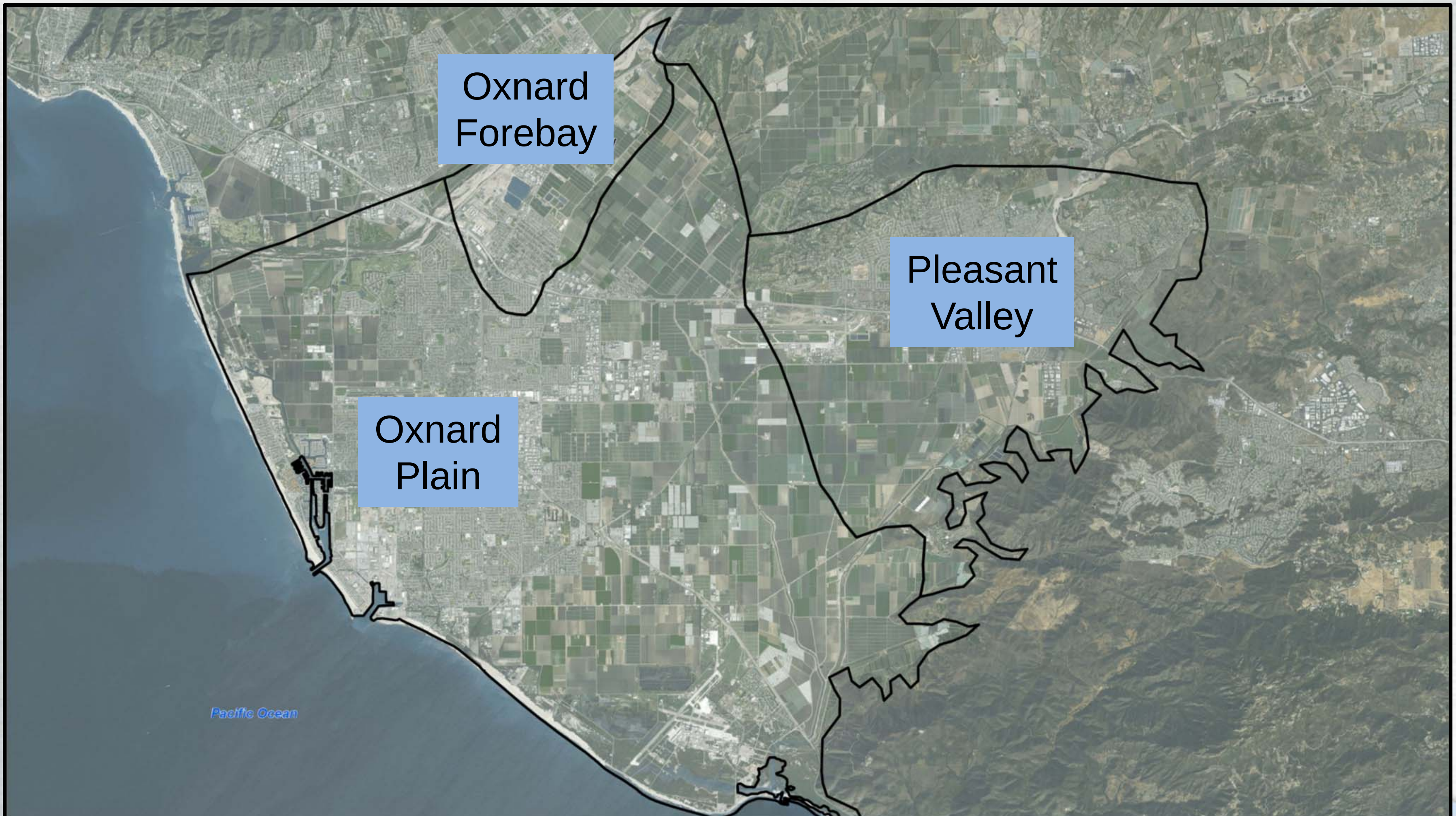
- SNMP Approach Document
  - Establishes refined scope for Phase 2
  - Opportunity for RWQCB feedback on the technical and regulatory tasks in Phase 2
- Opportunity for merging/aligning efforts with Calleguas Watershed Group

KEY ISSUES

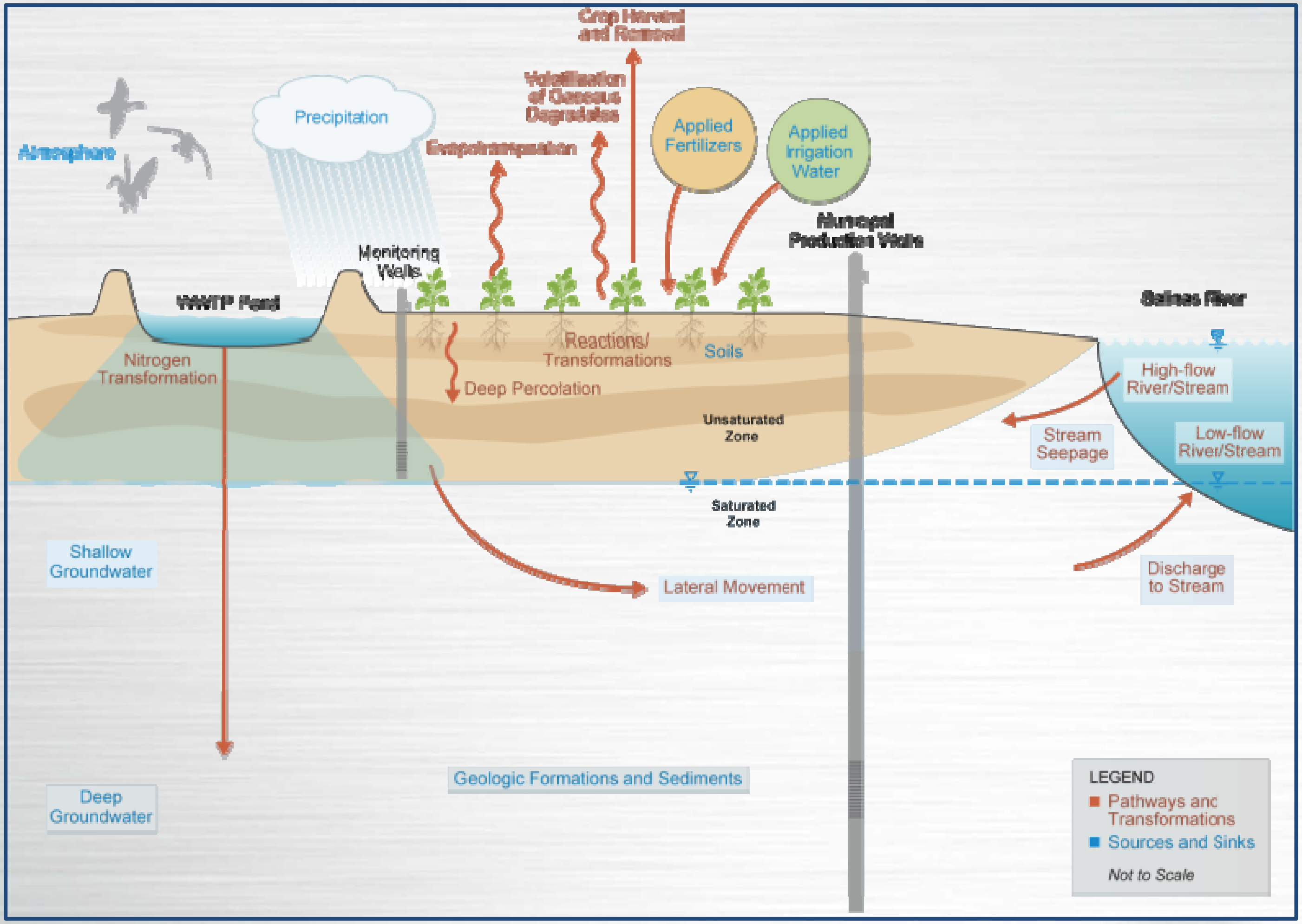
TAG provided input on key issues

- Basin Boundaries
- Constituents
- Data Period
- Management Measures Approach

DWR Groundwater Basin Boundaries



Constituents



✓ Focused analysis on TDS, chloride and nitrate

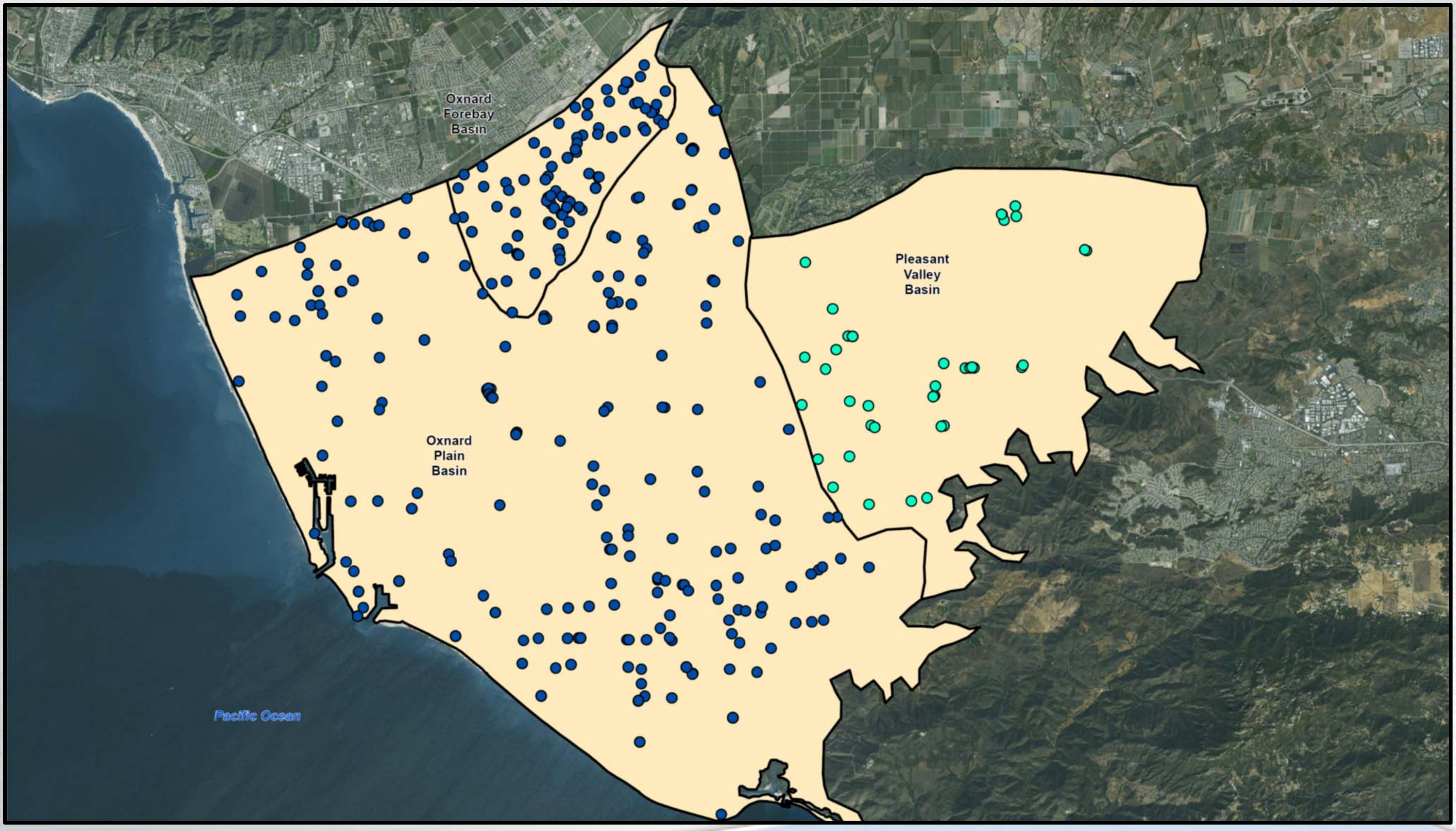
✓ Data compilation for boron and sulfate

Data Period

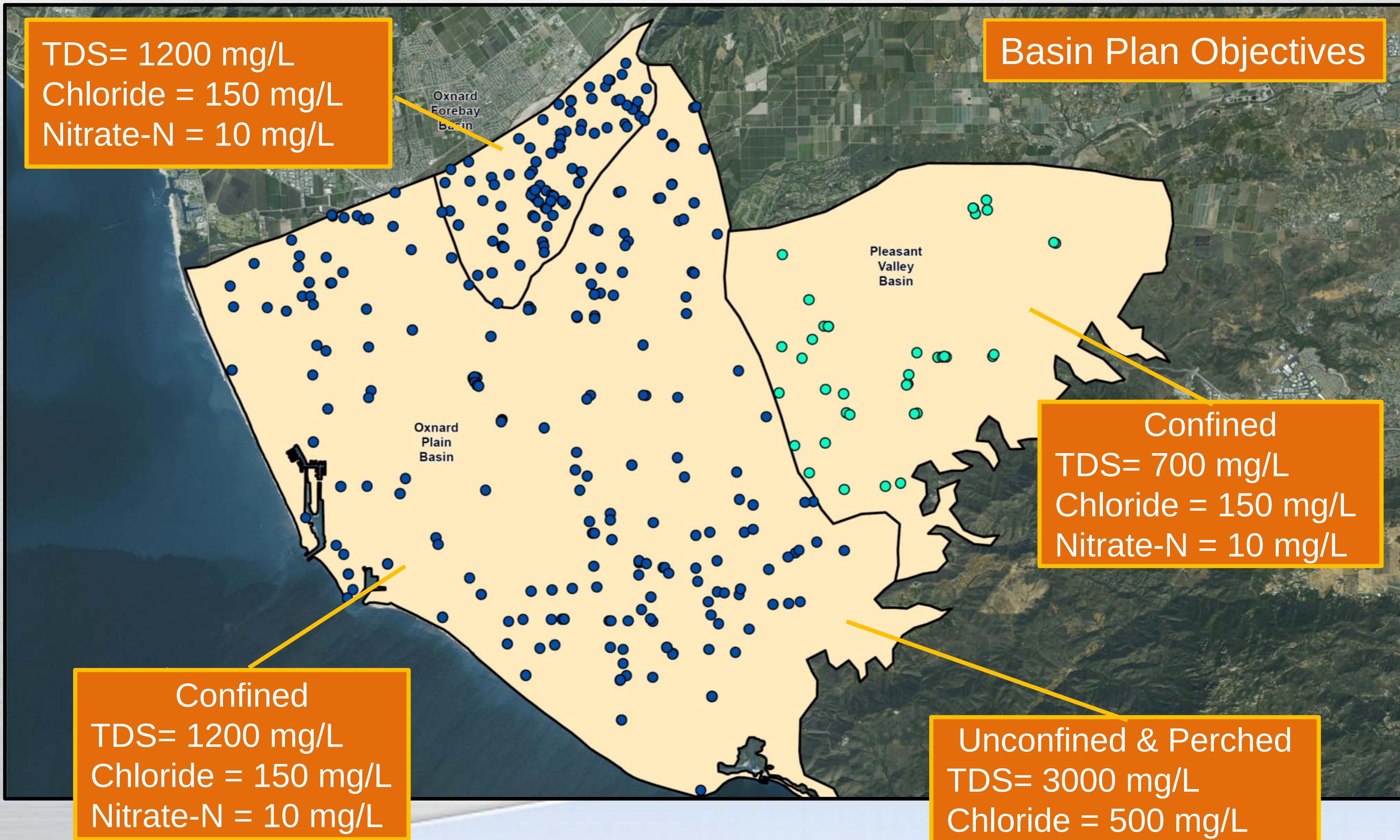
- Minimum is 5 years
- Capture wet and dry periods
- Consistency with LSCR SNMP
- Proposed period 1996-2014

Wet			Dry						Wet		Dry							
1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014

Data Period - Wells with data between 1996 and 2014



Preliminary Assessment and Management Measures Approach



Preliminary Assessment and Management Measures Approach

- Areas within basins with compromised groundwater quality
- SNMP Management Measures
  - Maintain water quality
  - Contribute to improvements in water quality
  - Not a comprehensive plan to remediate all areas with compromised groundwater quality

DISCUSSION

NEXT STEPS

Next Steps

- Continue Analysis
- Develop SNMP Approach
- Stakeholder Meeting – August 2015
- TAG Meeting and LARWQCB – September 2015

City of Oxnard
Public Works Integrated Master Plans
Salt and Nutrient Management Plan Stakeholder Meeting

SIGN IN SHEET

Purpose: Salt and Nutrient Management Plan Meeting
Time: 10:00 am – Noon

Date: Sept. 9, 2015
Location: AWPF Conference Room

NAME	AFFILIATION	EMAIL ADDRESS
MARTA Golding BROWN	Ventura County Coastal Assoc. of Realtors	mgbrown@vcrealtors.com
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Dave White	Grower	dwhite@plazadevelopment.net
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Ashli Desai	LWA	Ashlid@lwa.com
IAN PRICHARD • Mike Phelps	Calwosa	IANP@calwosa.com
JOHN MATTHEWS	Perceos	JMATTHEWS@ATOZLAW.COM
Curtis Hopkins	HGC	chop4@earthlink.net
Tracy Clinton	Carollo Engrs	TClinton@Carollo.com
ERIC KELLER	VCWWD	eric.keller@ventura.org
Jason Weiner	Wishtoyo/Vck	jweiner.venturacoastkeeper@wishtoyo.org
Jeanette Lombardo	CWA/CFAA	CAFOODANDAGRADVOCATES@aol.com
Elisa Garvey	Carollo Engrs	
Tom West	" "	
Mary Vorissis	City of Oxnard	mary.vorissis@gmail.com mary.vorissis@ci.oxnard.ca.us

Oxnard Plain and Pleasant Valley Salt and Nutrient Management Plan

Stakeholder Meeting

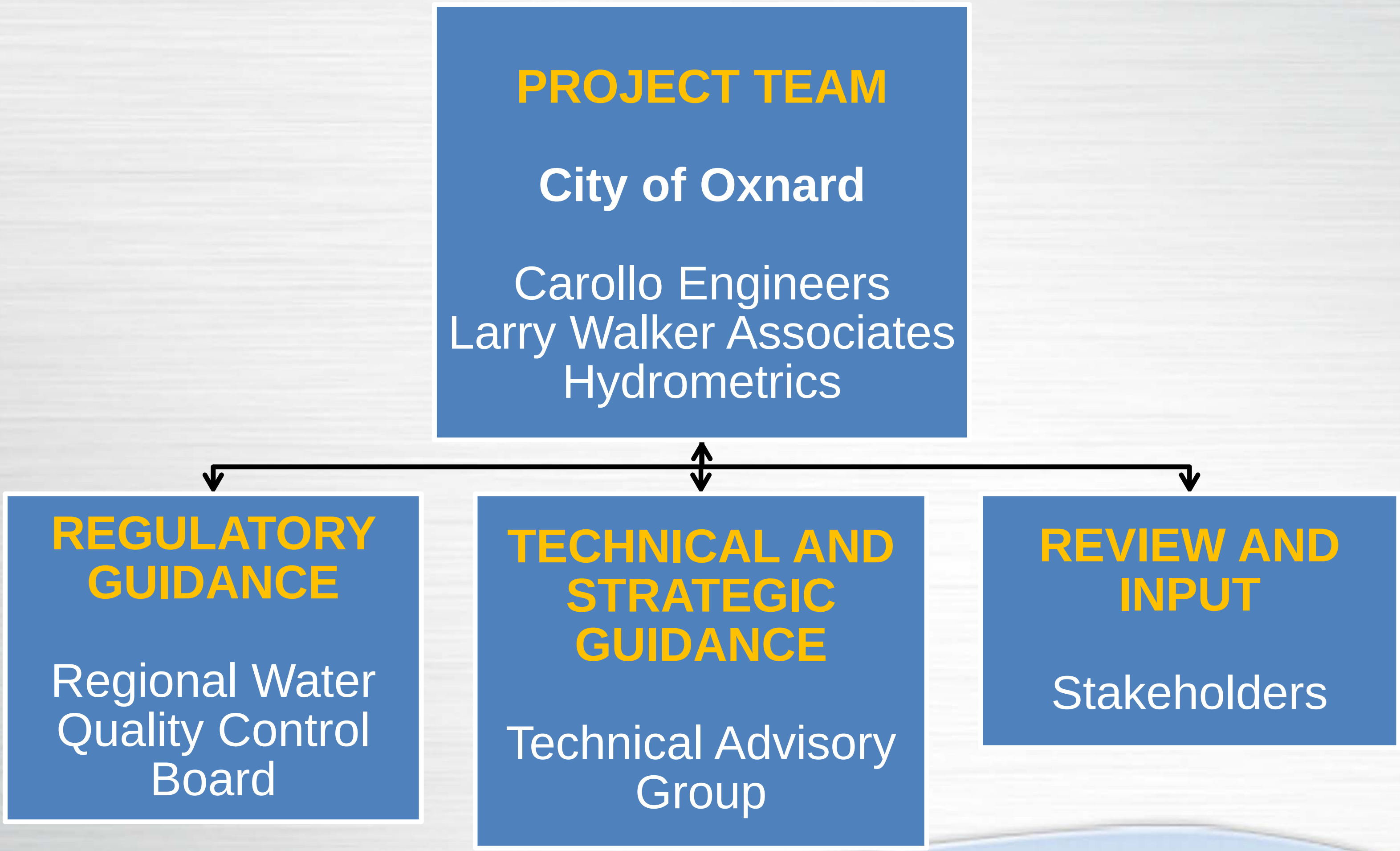
September 9, 2015

Meeting Agenda

- SNMP Introduction
- Project Team
- Meeting Objectives
- SNMP Overview
- Goals and Objectives
- Key Issues
- Discussion
- Next Steps

PROJECT TEAM

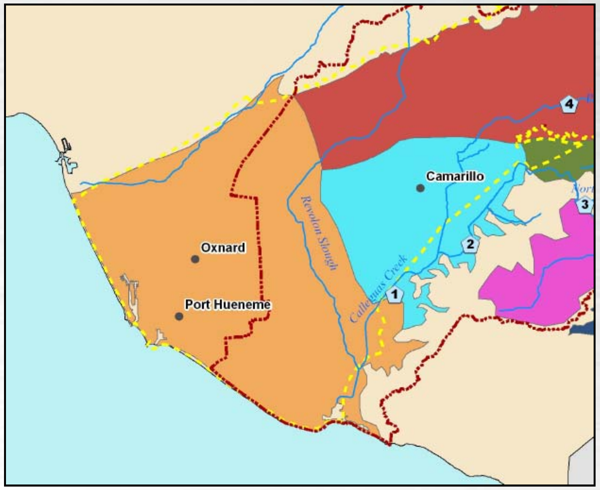
SNMP project team



MEETING OBJECTIVES

Why are we here today?

- Introduce the Oxnard Plain and Pleasant Valley SNMP
- Present work completed
- Present next steps



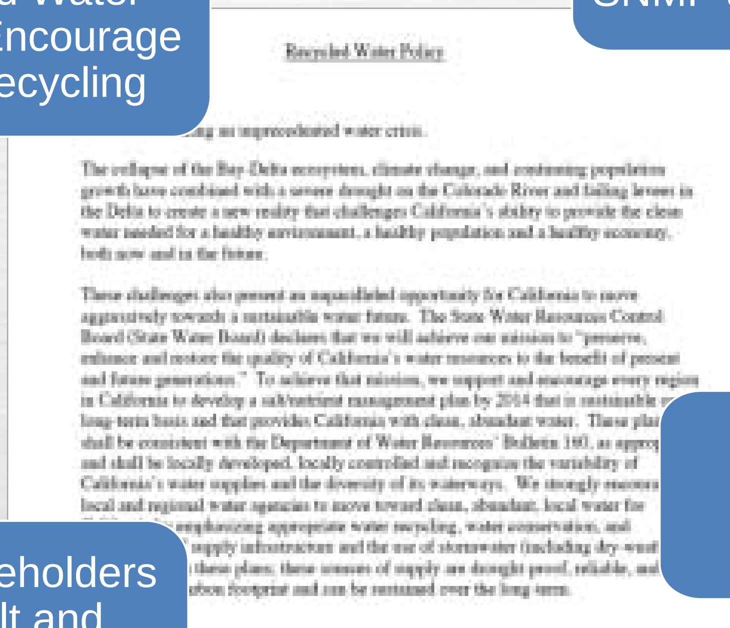
What is your role today?

- Listen
- Solicit initial feedback and guidance

SNMP OVERVIEW

SNMP Background and Purpose

SWRCB Adopted Recycled Water Policy to Encourage Water Recycling



Recycled Water Policy

…ing an unprecedented water crisis.

The collapse of the Bay-Delta ecosystem, climate change, and continuing population growth have combined with a severe drought on the Colorado River and failing levees in the Delta to create a new reality that challenges California's ability to provide the clean water needed for a healthy environment, a healthy population and a healthy economy, both now and in the future.

These challenges also present an unparalleled opportunity for California to move aggressively towards a sustainable water future. The State Water Resources Control Board (State Water Board) declares that we will achieve our mission to "preserve, enhance and restore the quality of California's water resources to the benefit of present and future generations." To achieve that mission, we support and encourage every region in California to develop a salt/nutrient management plan by 2014 that is sustainable … long-term basis and that provides California with clean, abundant water. These pla… shall be consistent with the Department of Water Resources' Bulletin 160, as approp… and shall be locally developed, locally controlled and recognize the variability of California's water supplies and the diversity of its waterways. We strongly encoura… local and regional water agencies to move toward clean, abundant, local water for … emphasizing appropriate water recycling, water conservation, and … supply infrastructure and the use of stormwater (including dry-weat… these plans; these sources of supply are drought proof, reliable, and … carbon footprint and can be sustained over the long term.

Recycling Water Permits Based on SNMP and Basin Plan

Management Measures Incorporated into Basin Plan

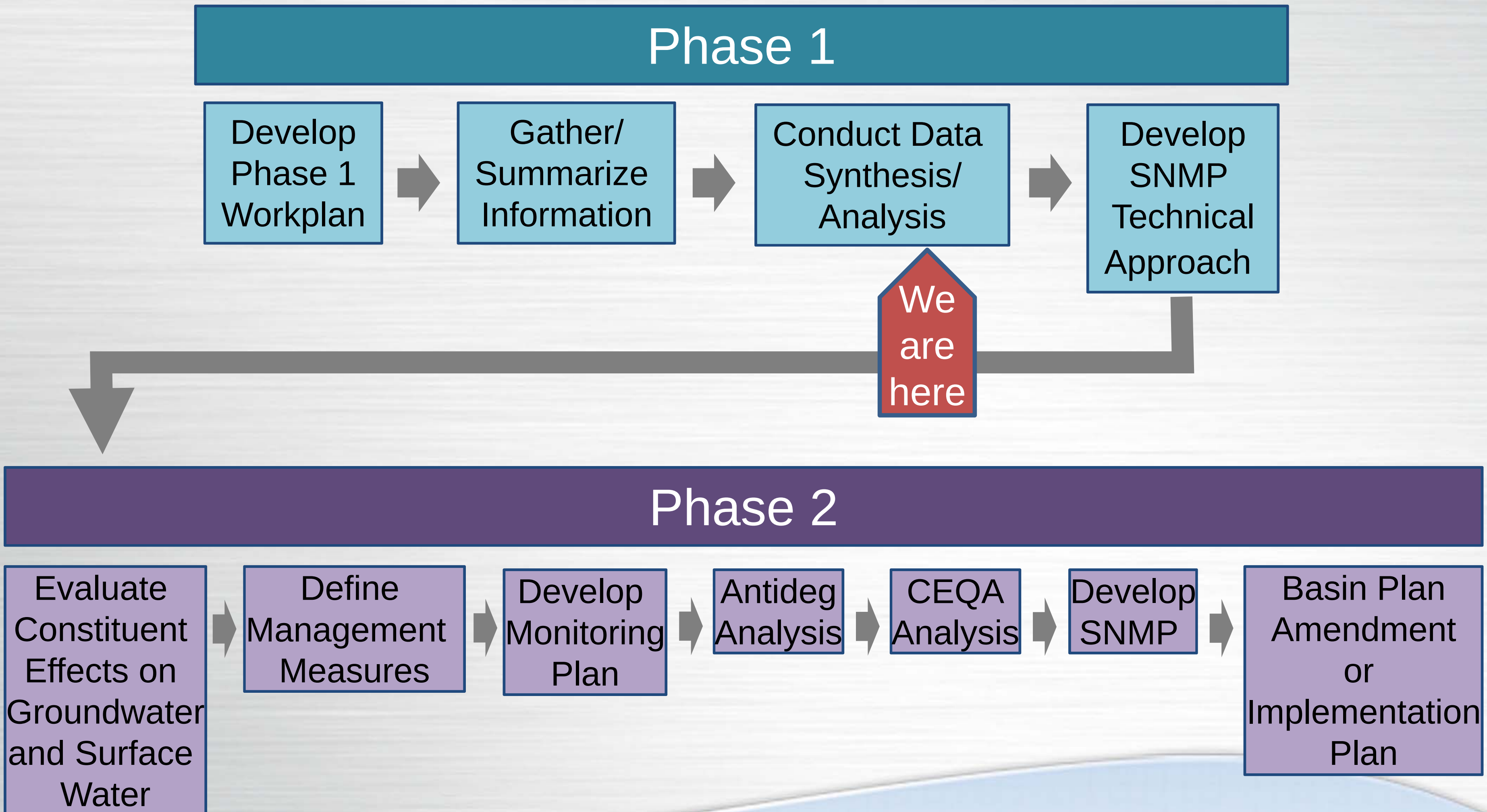
Requires Stakeholders Develop Salt and Nutrient Management Plan (SNMP)

SNMPs consider all sources and define management measures

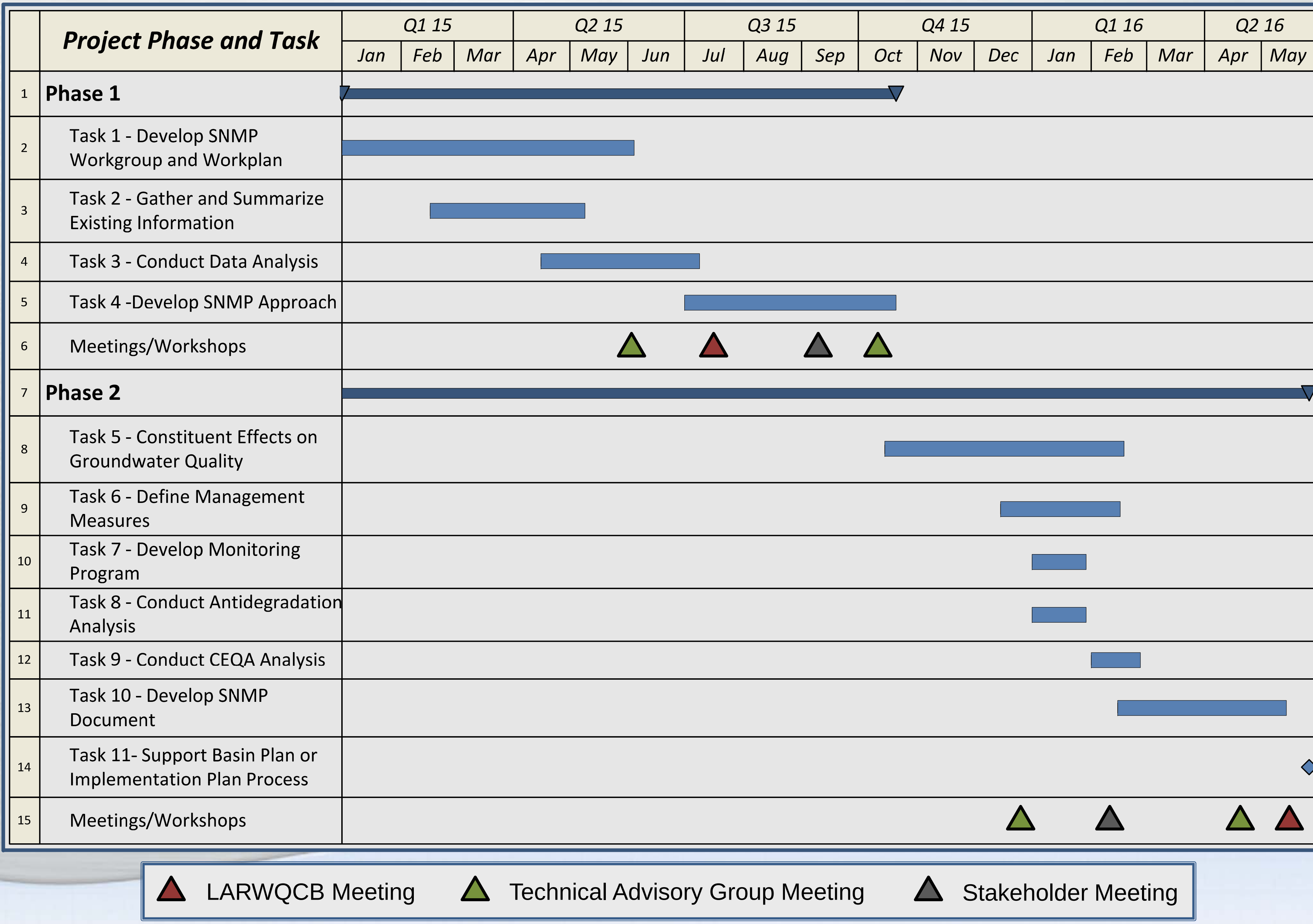
SNMP is foundational to recycled water permits

- Information developed by the SNMP will be critical to the overall permit process
- Provides opportunity to quantify the predicted benefit of proposed recycled water projects
- Schedule for completing SNMP and obtaining recycled water permits is important to meeting GREAT Program objectives

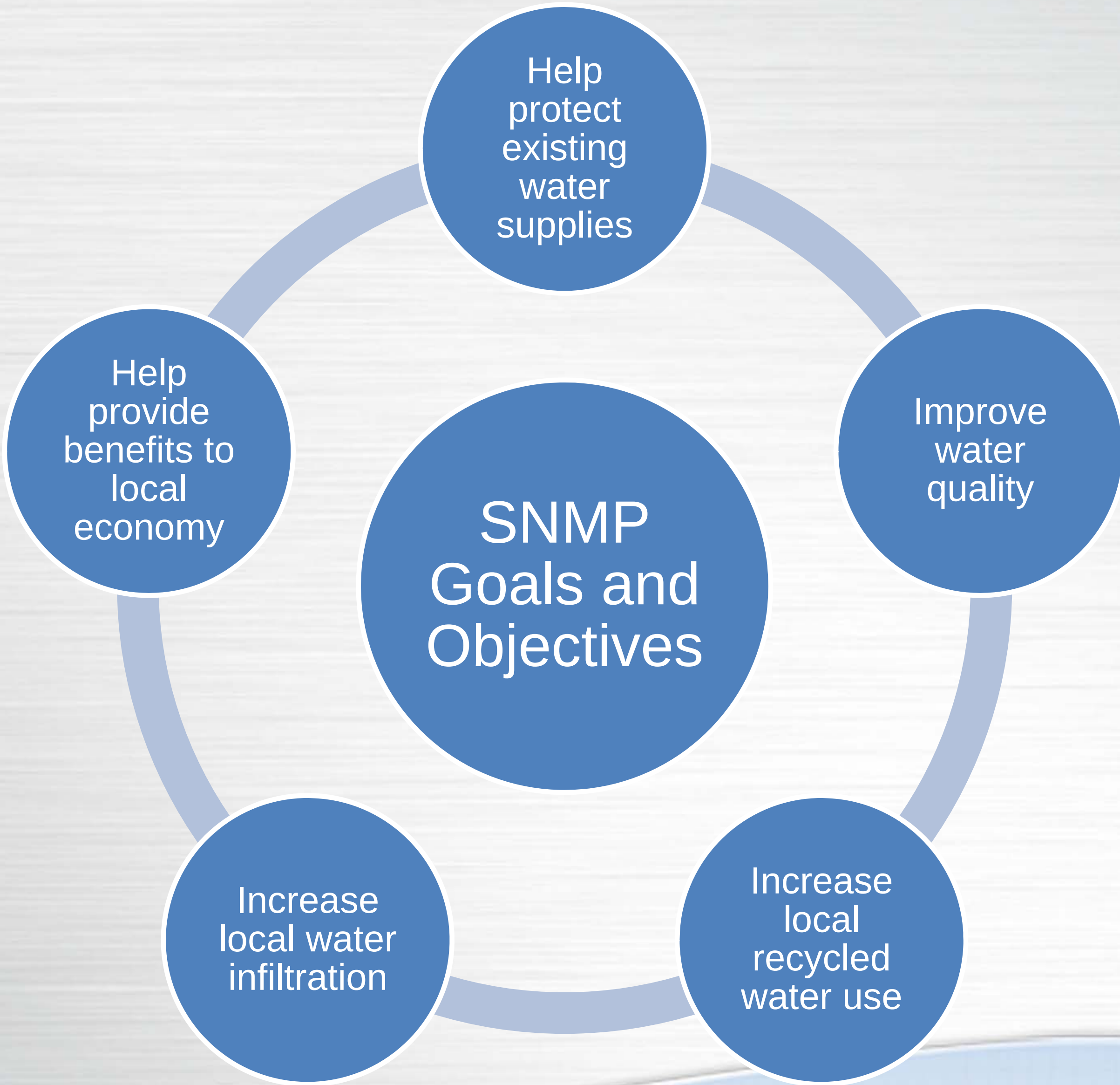
SNMP Development



Project Schedule

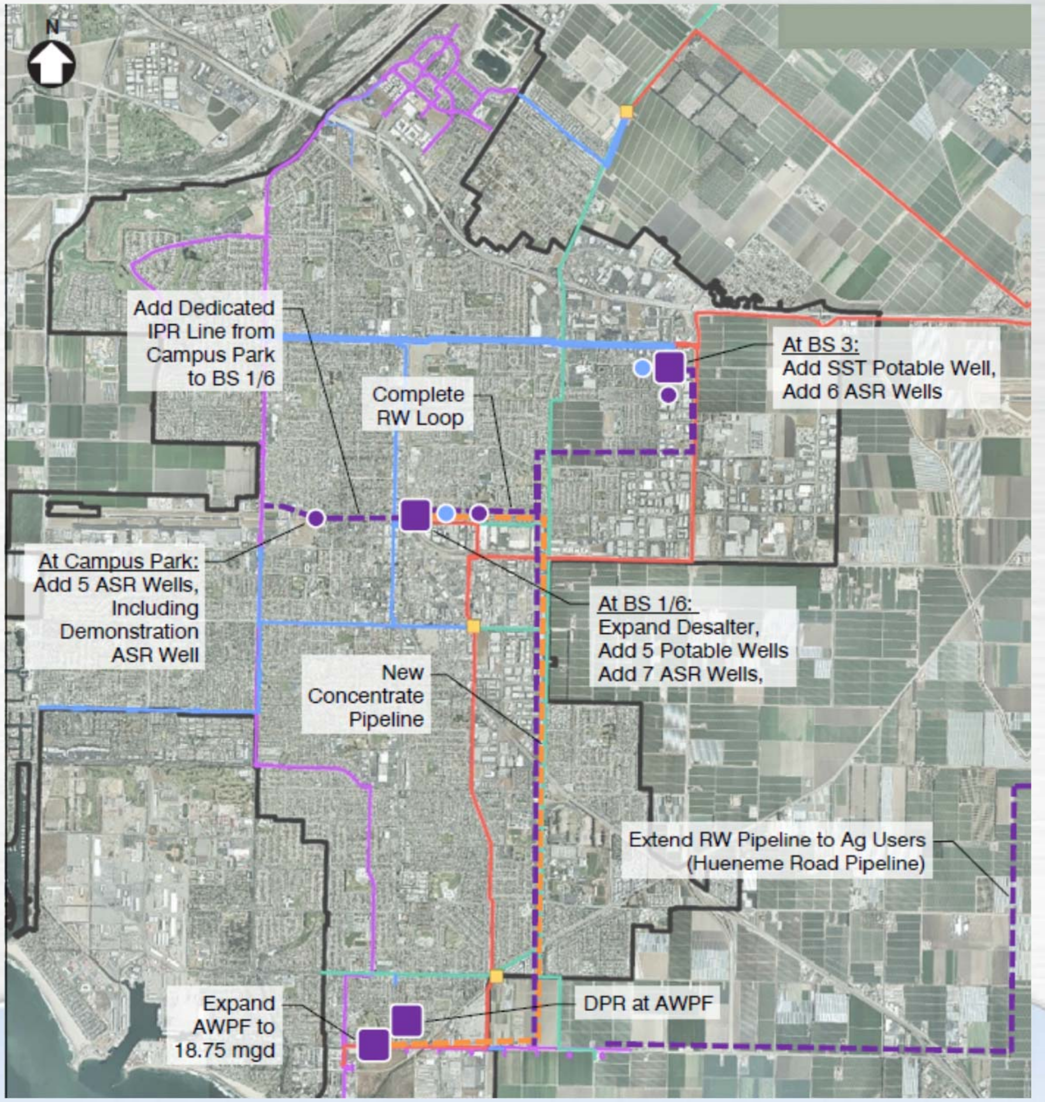


SNMP GOALS AND OBJECTIVES


SNMP Goals and Objectives
Help protect existing water supplies
Improve water quality
Increase local recycled water use
Increase local water infiltration
Help provide benefits to local economy

Recycled Water Goals and Objectives

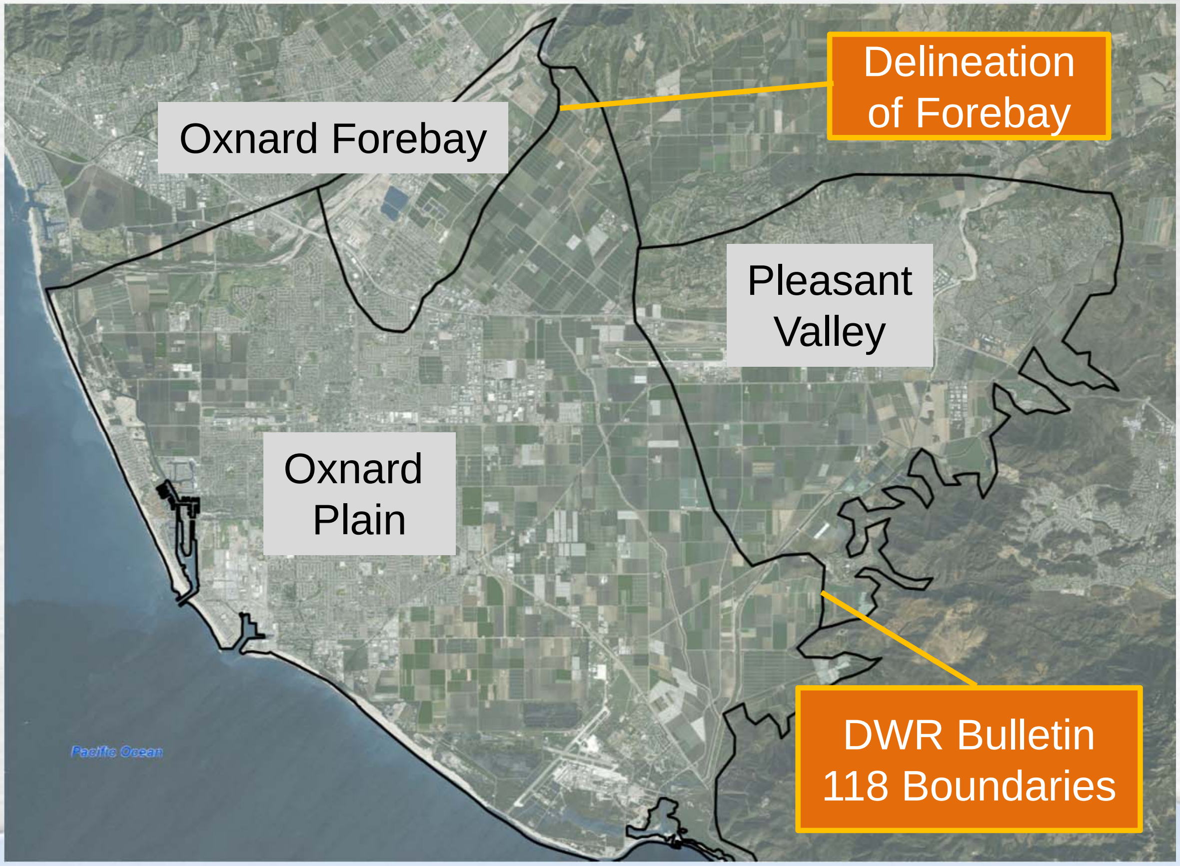
- City of Oxnard
  - Existing ~3000 AFY
  - Future
    - 7,000 AFY
    - 14,000 AFY
    - 21,000 AFY
  - Landscape and Ag Irrigation
  - Groundwater Recharge
  - Industrial Reuse
- Camrosa Water District
  - Existing ~6,000 AFY
  - Future ~7,000 AFY



STUDY AREA

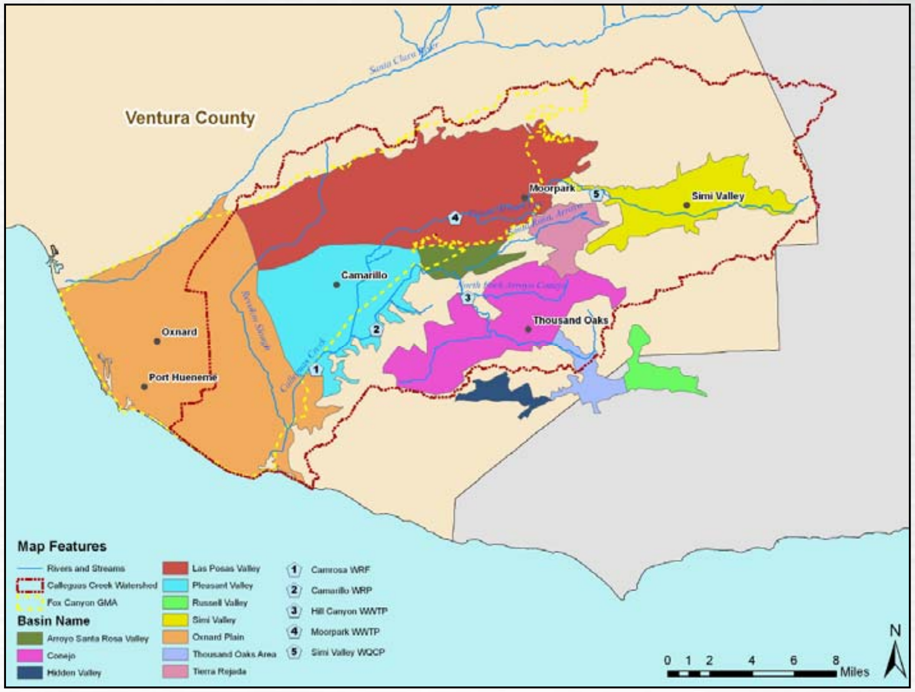
SNMP Study Area - Oxnard Plain and Pleasant Valley Basins

- Geographic scope of recycled water projects
- Allows alignment of SNMP completion and recycled water permit application process
- DWR basin boundaries



Coordination with the Calleguas Watershed Group SNMP

- Boundary conditions for adjacent planning areas will be identified
- Process for using/sharing boundary condition data will be developed
- Key Issue - Camarillo and Camrosa recycled water goals, analysis, and management measures



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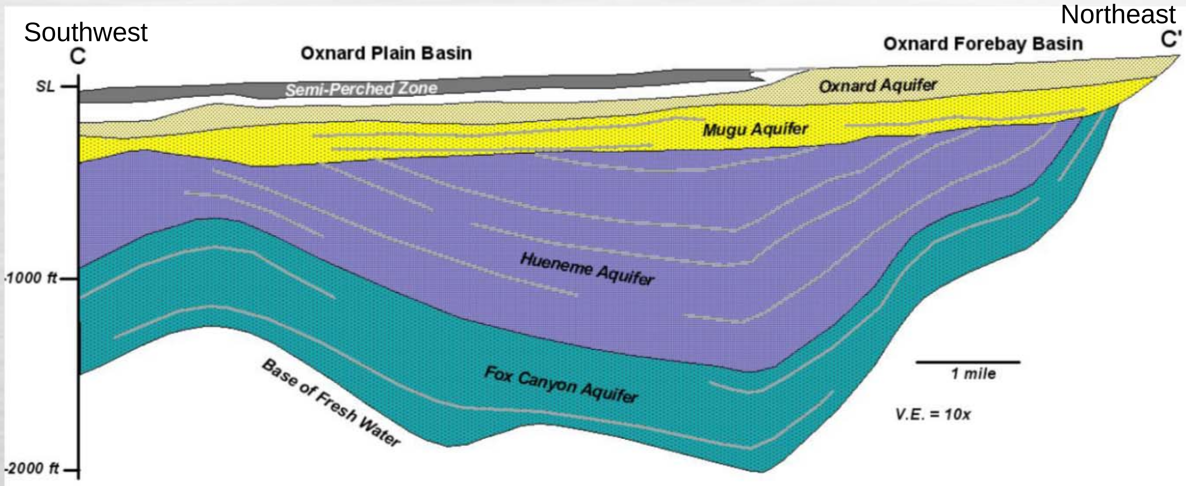
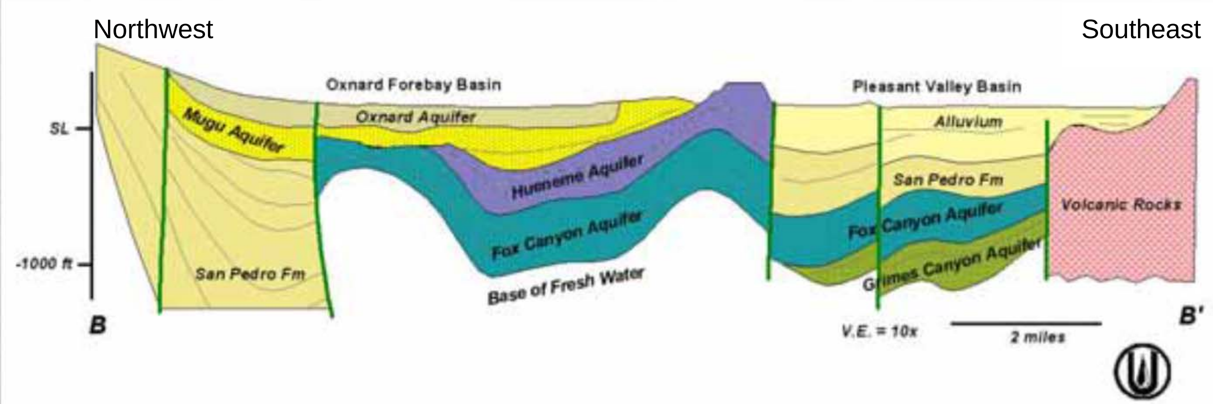
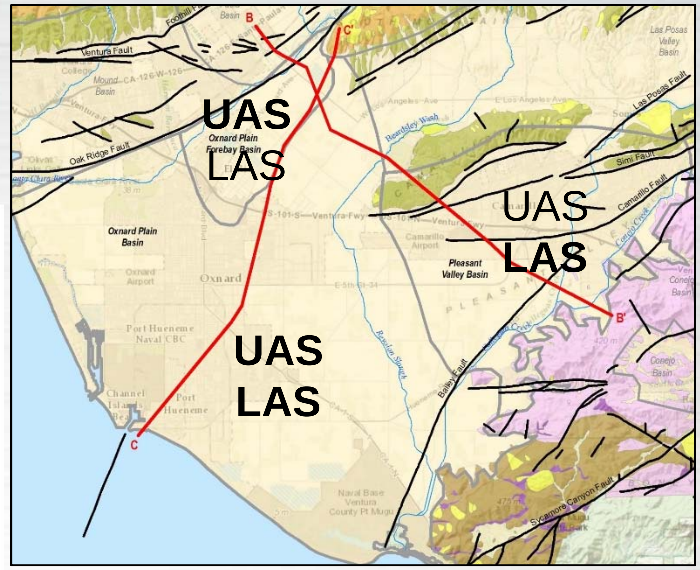
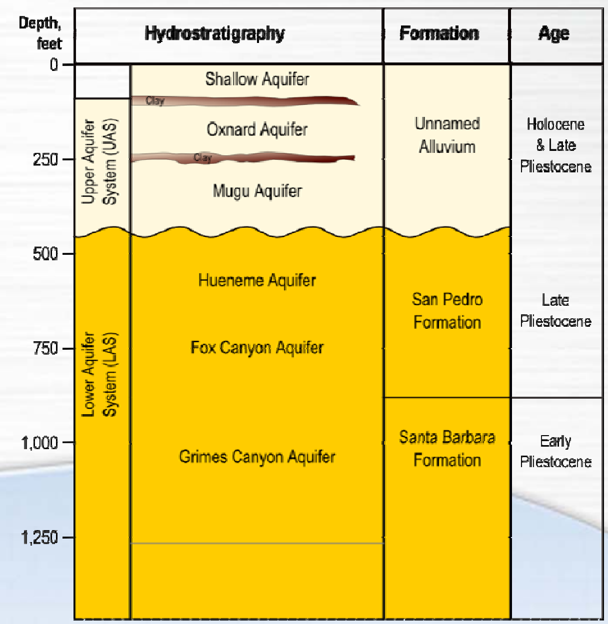
HYDROGEOLOGY

Hydrogeology



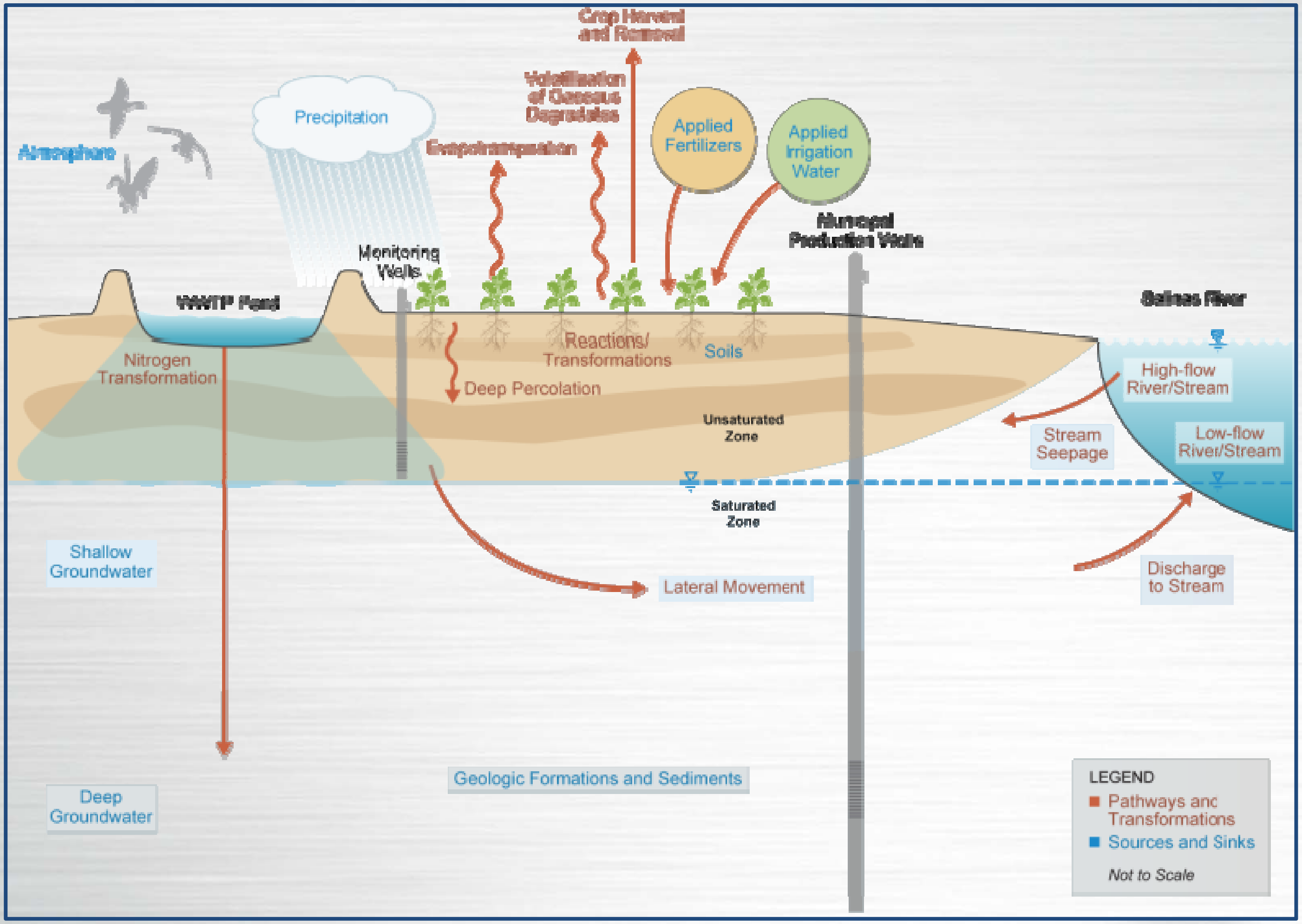






SNMP CONSTITUENTS AND DATA PERIOD

Constituent Selection



- ✓ Focused analysis on TDS, chloride and nitrate
- ✓ Data compilation for boron and sulfate

Data Period

- Existing Conditions and Assimilative Capacity
  - Recent 5 years (2010 – 2014)
  - May extend the 5 year period if a data gap is identified
- Model Development and Trend Analysis
  - Capture wet and dry periods
  - Proposed period 1996-2014

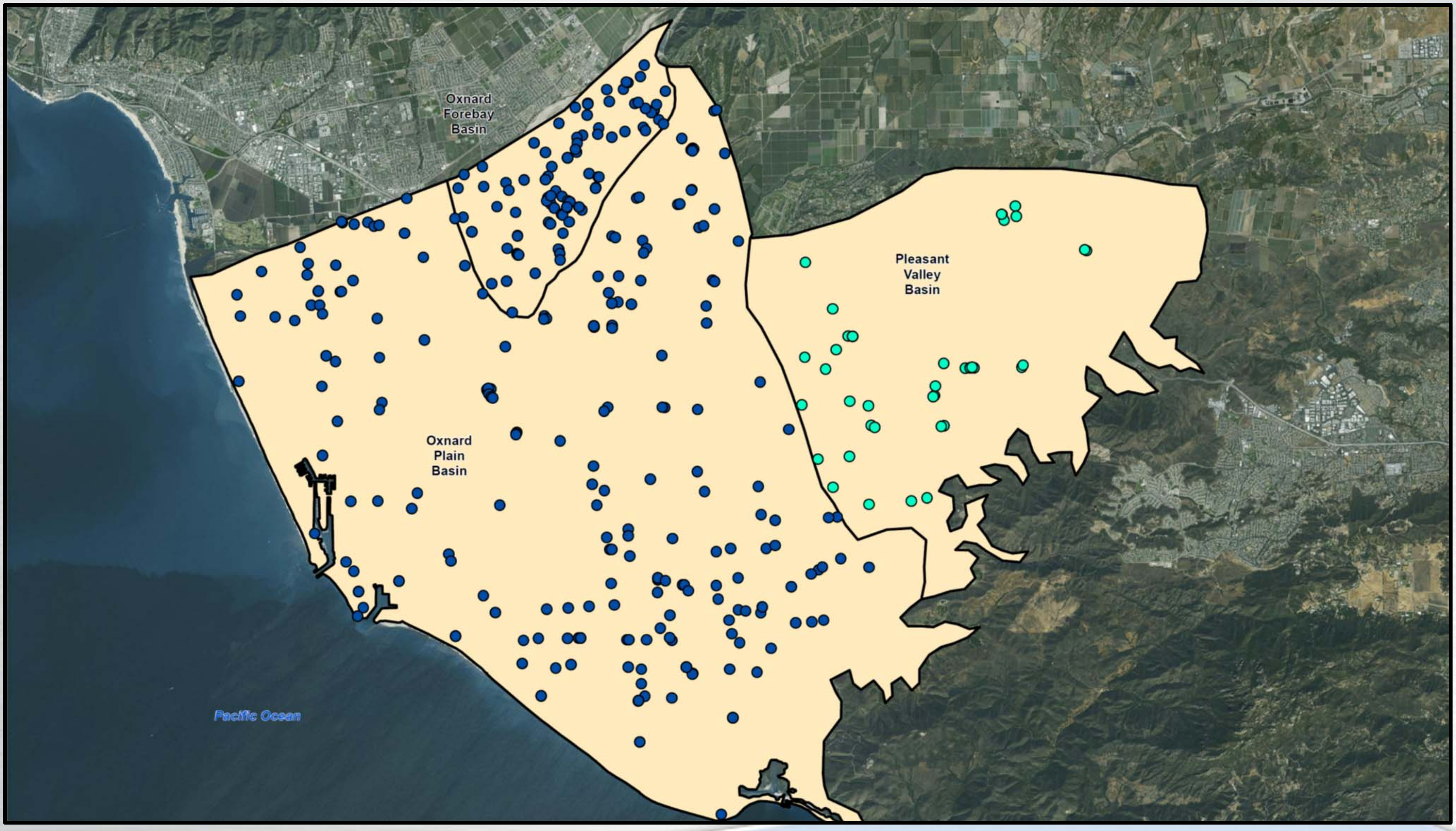
Wet			Dry						Wet		Dry							
1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014

DATA SOURCES

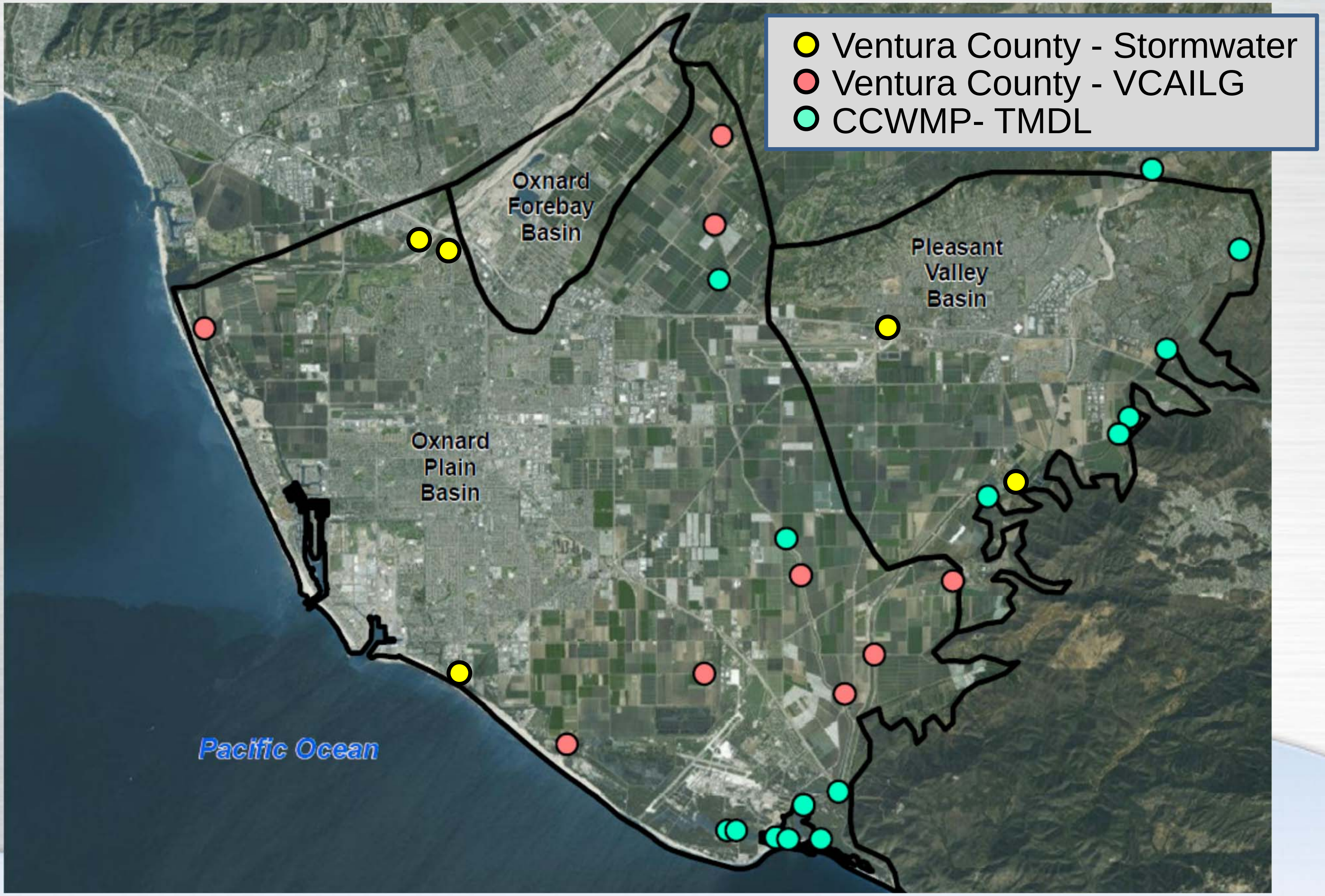
Existing Monitoring Programs

Groundwater		Surface Water	
Agency	**Program**	**Agency**	**Program**
Ventura County	Groundwater Monitoring Program	VCAILG	Irrigated Lands Program
UWCD	Water Quality Monitoring Program	CCWMP	Calleguas Creek Watershed TMDL Monitoring
City of Ventura	DDW Compliance Monitoring	Ventura County	Stormwater Quality Management Program
City of Oxnard	DDW Compliance Monitoring		
Other Water Purveyors	DDW Compliance Monitoring		
Montalvo Municipal Improvement District	WDR Monitoring Requirements		
Saticoy Sanitary District	WDR Monitoring Requirements		
Camrosa Water District	WDR Monitoring Requirements		

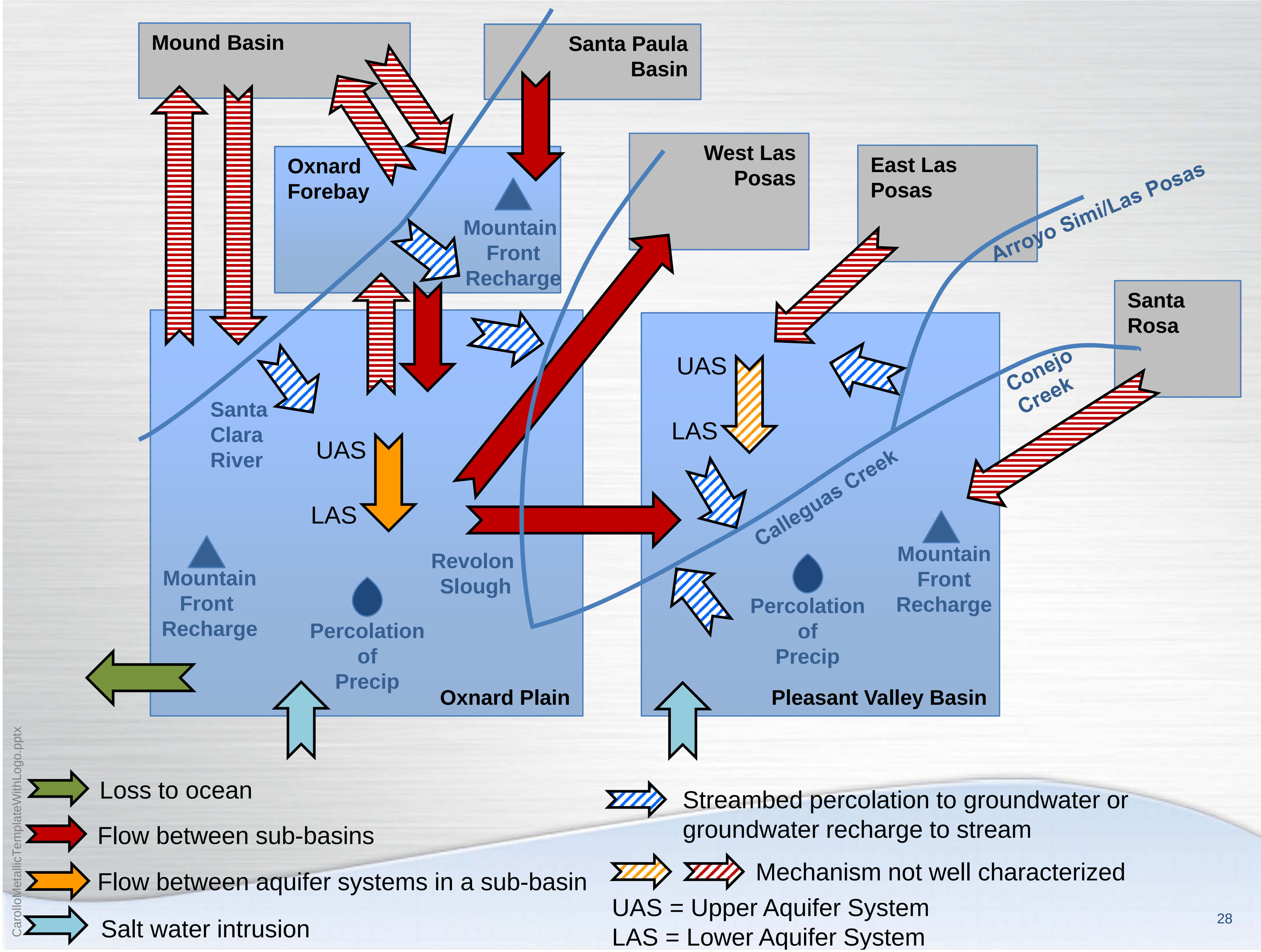
Data Period - Wells with data between 1996 and 2014



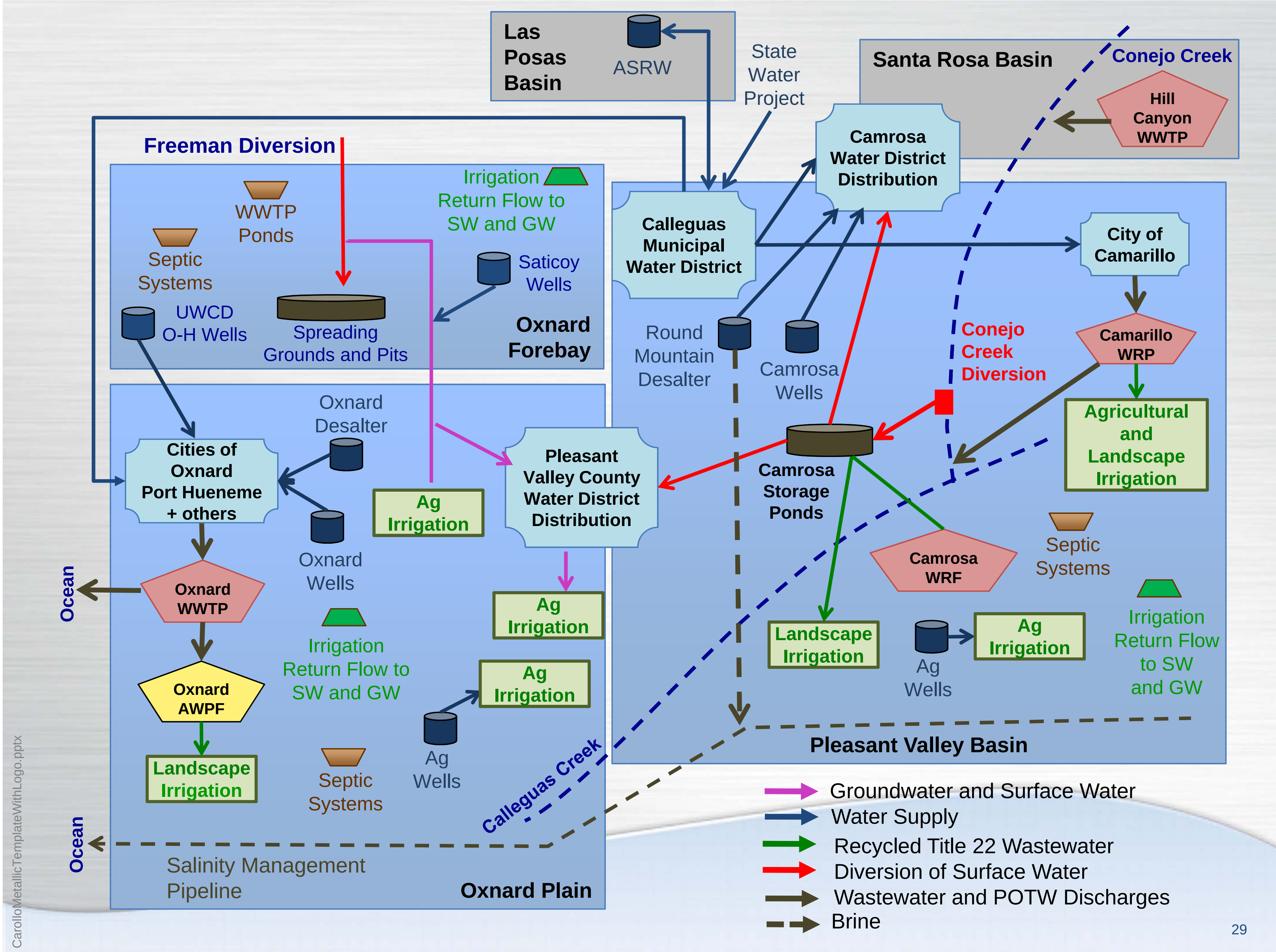
Surface Water Sampling Locations



CONCEPTUAL MODEL



Mound Basin
Santa Paula Basin
Oxnard Forebay
Mountain Front Recharge
West Las Posas
East Las Posas
Arroyo Simi/Las Posas
Santa Rosa
Conejo Creek
UAS
LAS
Santa Clara River
UAS
LAS
Calleguas Creek
Mountain Front Recharge
Revolon Slough
Percolation of Precip
Mountain Front Recharge
Percolation of Precip
Oxnard Plain
Pleasant Valley Basin
Loss to ocean
Flow between sub-basins
Flow between aquifer systems in a sub-basin
Salt water intrusion
Streambed percolation to groundwater or groundwater recharge to stream
Mechanism not well characterized
UAS = Upper Aquifer System
LAS = Lower Aquifer System



Las Posas Basin
ASRW
State Water Project
Santa Rosa Basin
Conejo Creek
Hill Canyon WWTP
Freeman Diversion
Irrigation Return Flow to SW and GW
WWTP Ponds
Septic Systems
Saticoy Wells
UWCD O-H Wells
Spreading Grounds and Pits
Oxnard Forebay
Calleguas Municipal Water District
Camrosa Water District Distribution
City of Camarillo
Round Mountain Desalter
Camrosa Wells
Conejo Creek Diversion
Camarillo WRP
Agricultural and Landscape Irrigation
Oxnard Desalter
Cities of Oxnard Port Hueneme + others
Ag Irrigation
Pleasant Valley County Water District Distribution
Camrosa Storage Ponds
Oxnard Wells
Camrosa WRF
Septic Systems
Ocean
Oxnard WWTP
Ag Irrigation
Irrigation Return Flow to SW and GW
Oxnard AWPF
Ag Irrigation
Landscape Irrigation
Ag Wells
Ag Irrigation
Irrigation Return Flow to SW and GW
Ag Wells
Landscape Irrigation
Septic Systems
Calleguas Creek
Pleasant Valley Basin
Ocean
Salinity Management Pipeline
Oxnard Plain
Groundwater and Surface Water
Water Supply
Recycled Title 22 Wastewater
Diversion of Surface Water
Wastewater and POTW Discharges
Brine
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Conceptual Model Summary

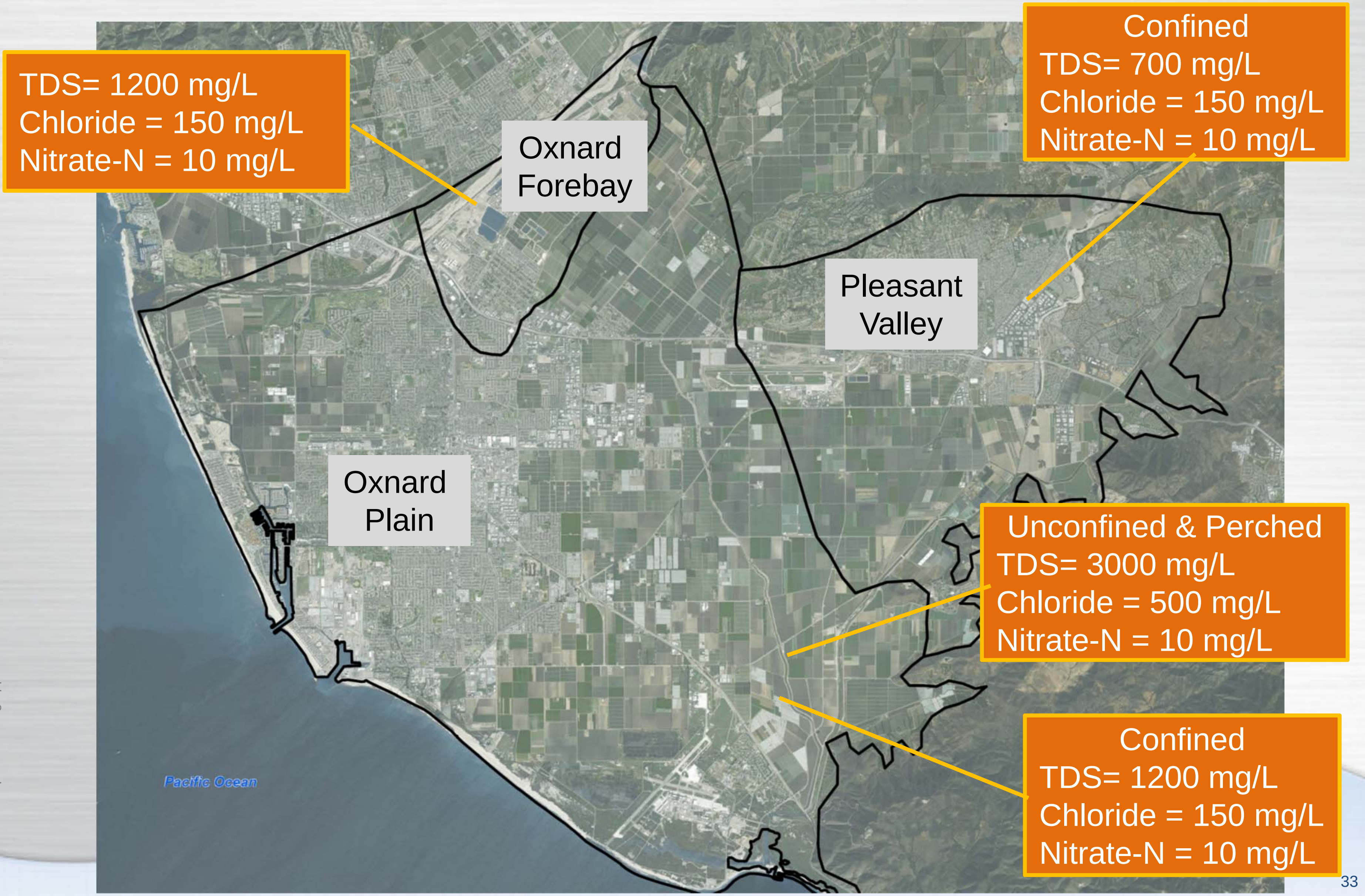
Recharge Component	Oxnard Plain	Pleasant Valley	Oxnard Forebay
SCR Streambed percolation	X		X
Arroyo Simi/Los Posas Streambed Percolation		X	
Conejo Creek Streambed Percolation		X	
Calleguas Creek Streambed Percolation		X	
Groundwater Underflow from	Forebay, Mound?	Las Posas Santa Rosa Oxnard Plain	Santa Paula
Irrigation Return Flow			
Groundwater	X	X	X
Surface Water	X	X	X
Recycled Water	X	X	
Direct Percolation of Precipitation	X	X	X
Mountain Front Recharge	X	X	X
Managed Aquifer Recharge			
Surface Water			Saticoy, Noble, El Rio
WWTP Percolation Ponds			X
Septic Systems	X	X	X

Conceptual Model Summary

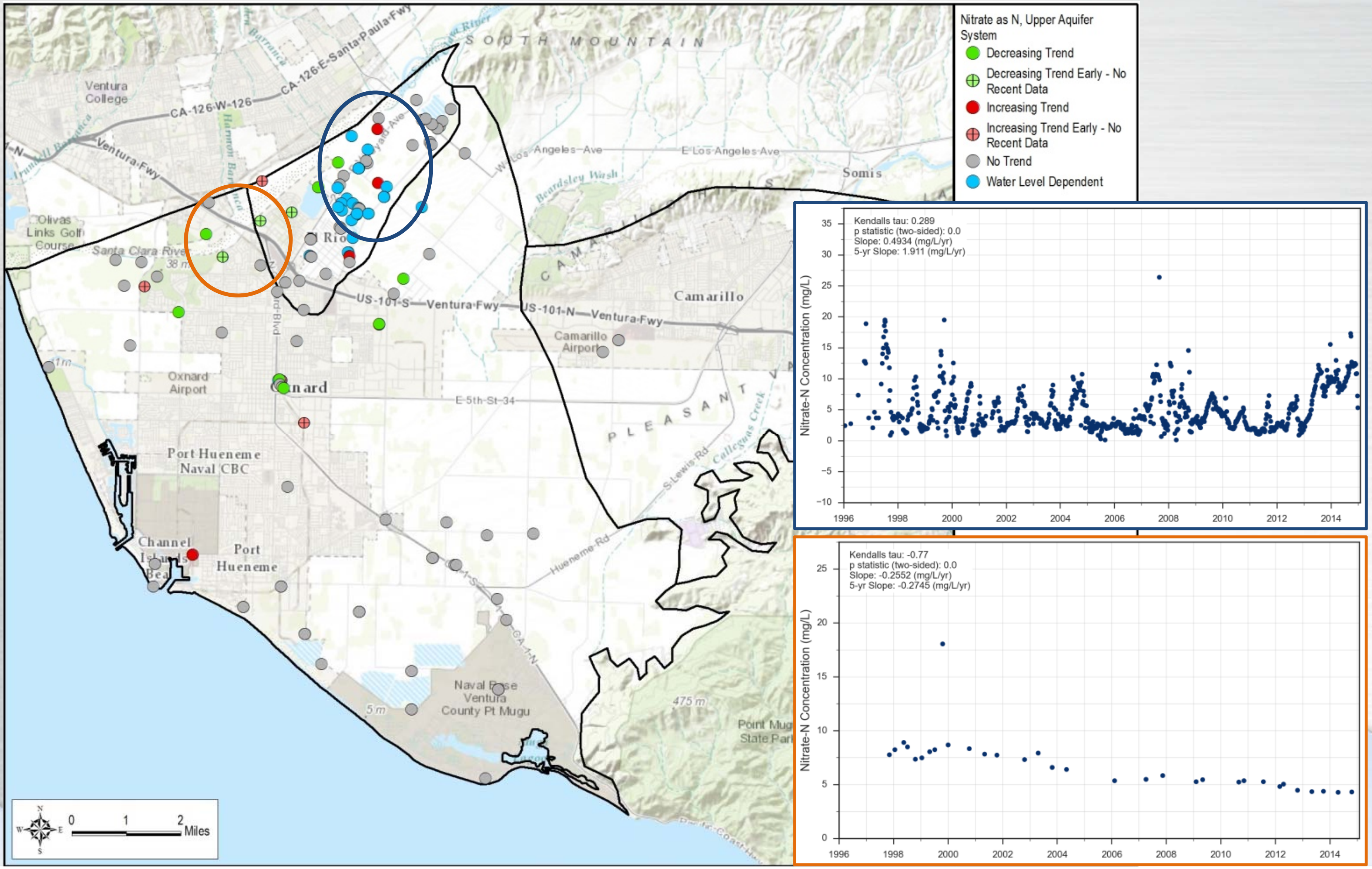
Discharge Component	Oxnard Plain	Pleasant Valley	Oxnard Forebay
Groundwater Pumping	X	X	X
Groundwater Underflow to	Mound ?, Pleasant Valley, Las Posas, Ocean	?	Oxnard Plain, Mound?

PRELIMINARY GROUNDWATER QUALITY ANALYSIS

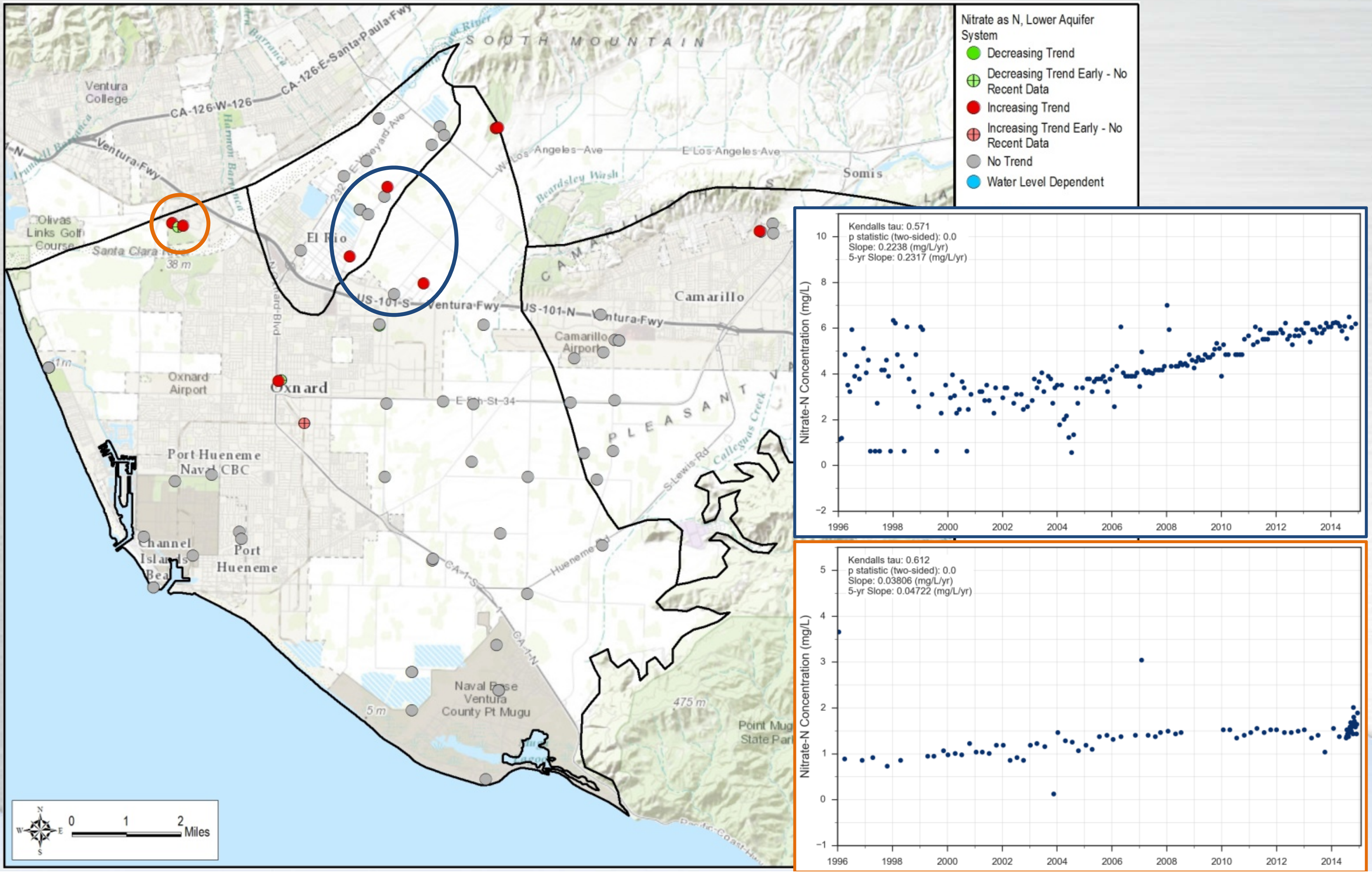
Basin Plan Objectives



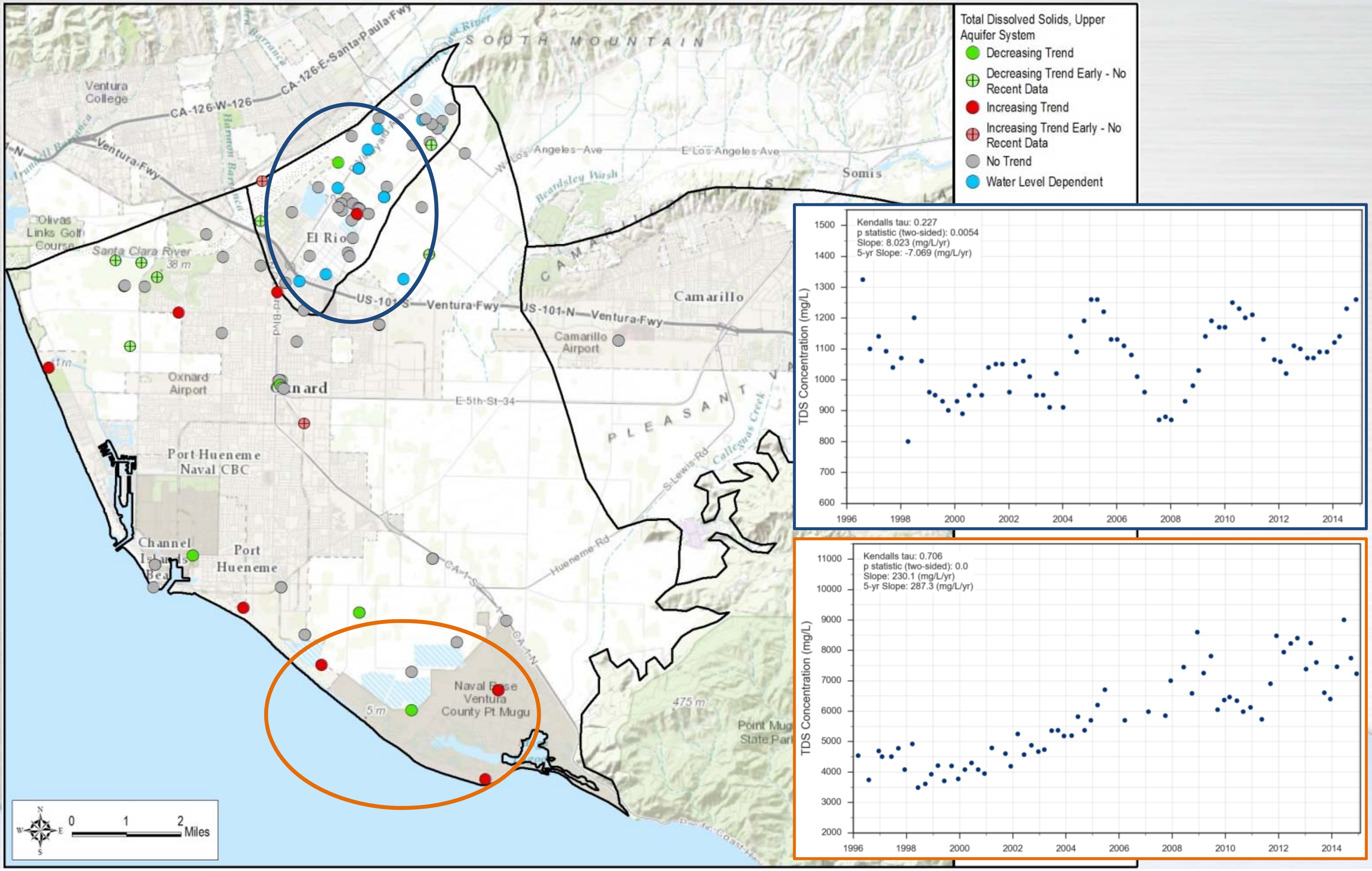
Groundwater Quality Trends:
Nitrate as N – Upper Aquifer System (UAS)



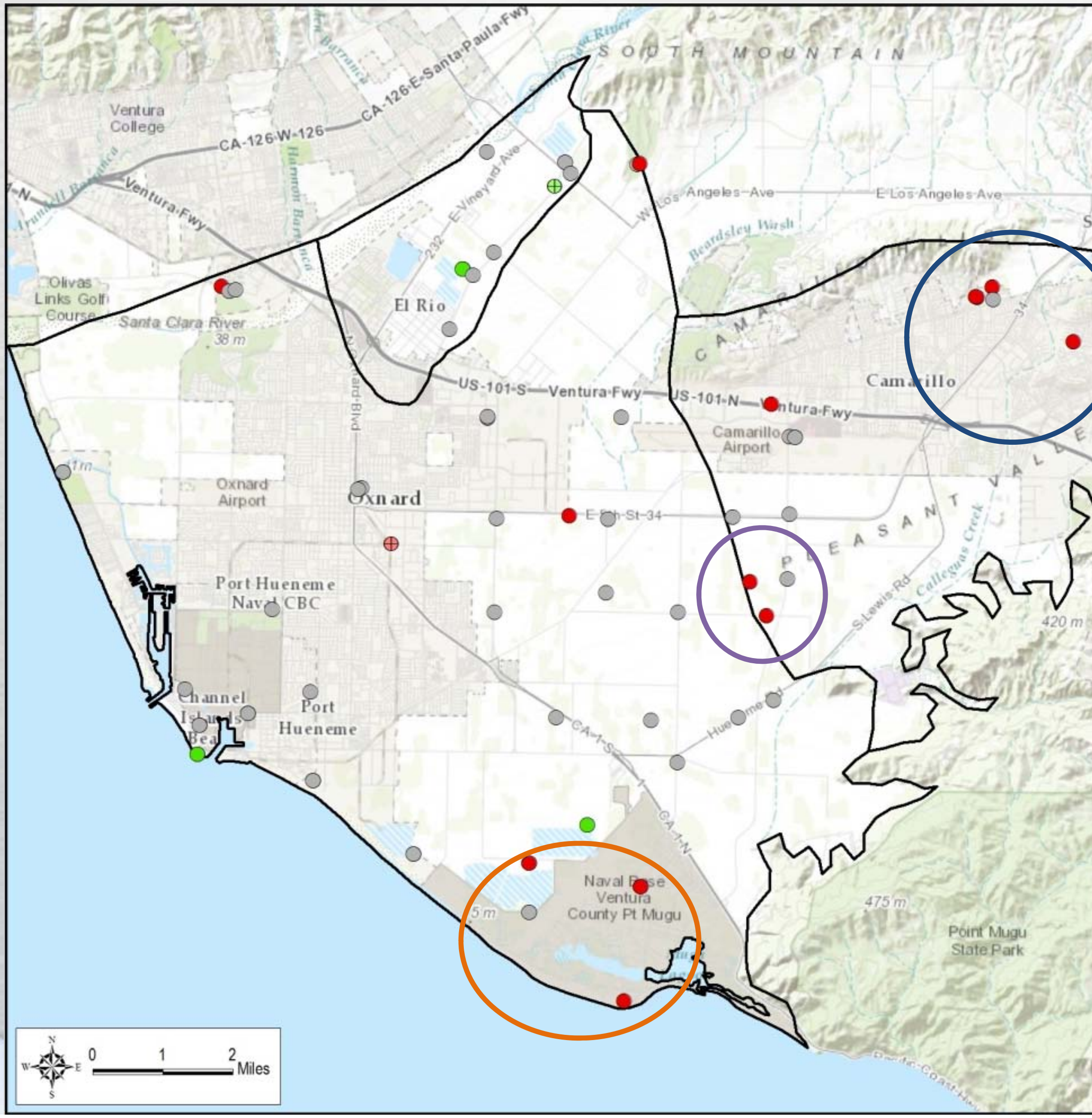
Groundwater Quality Trends:
Nitrate as N – Lower Aquifer System (LAS)

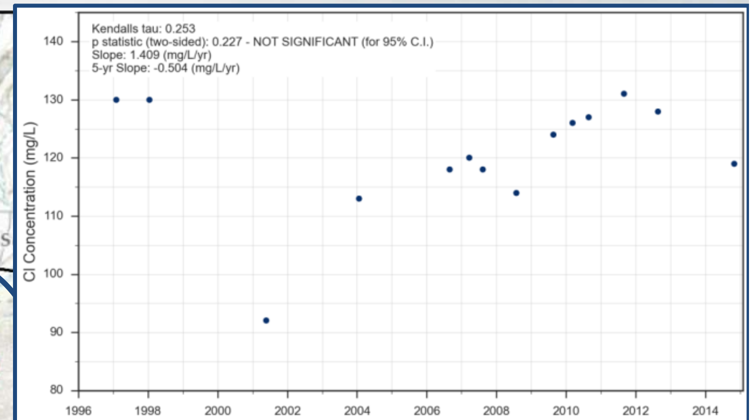


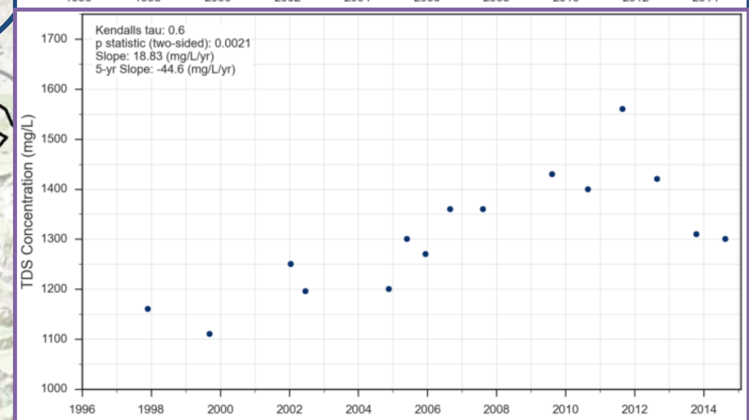
Groundwater Quality Trends: Total Dissolved Solids – UAS

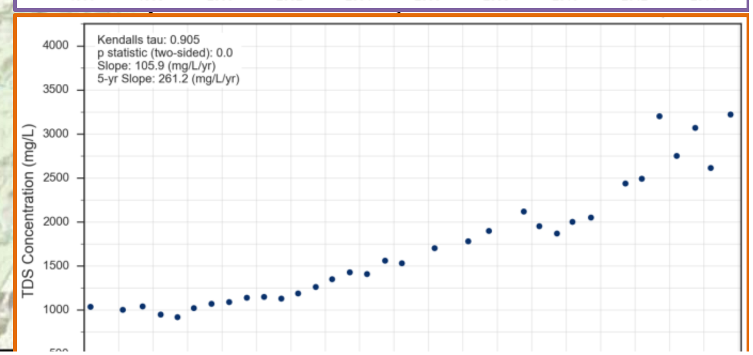


Groundwater Quality Trends:
Total Dissolved Solids - LAS

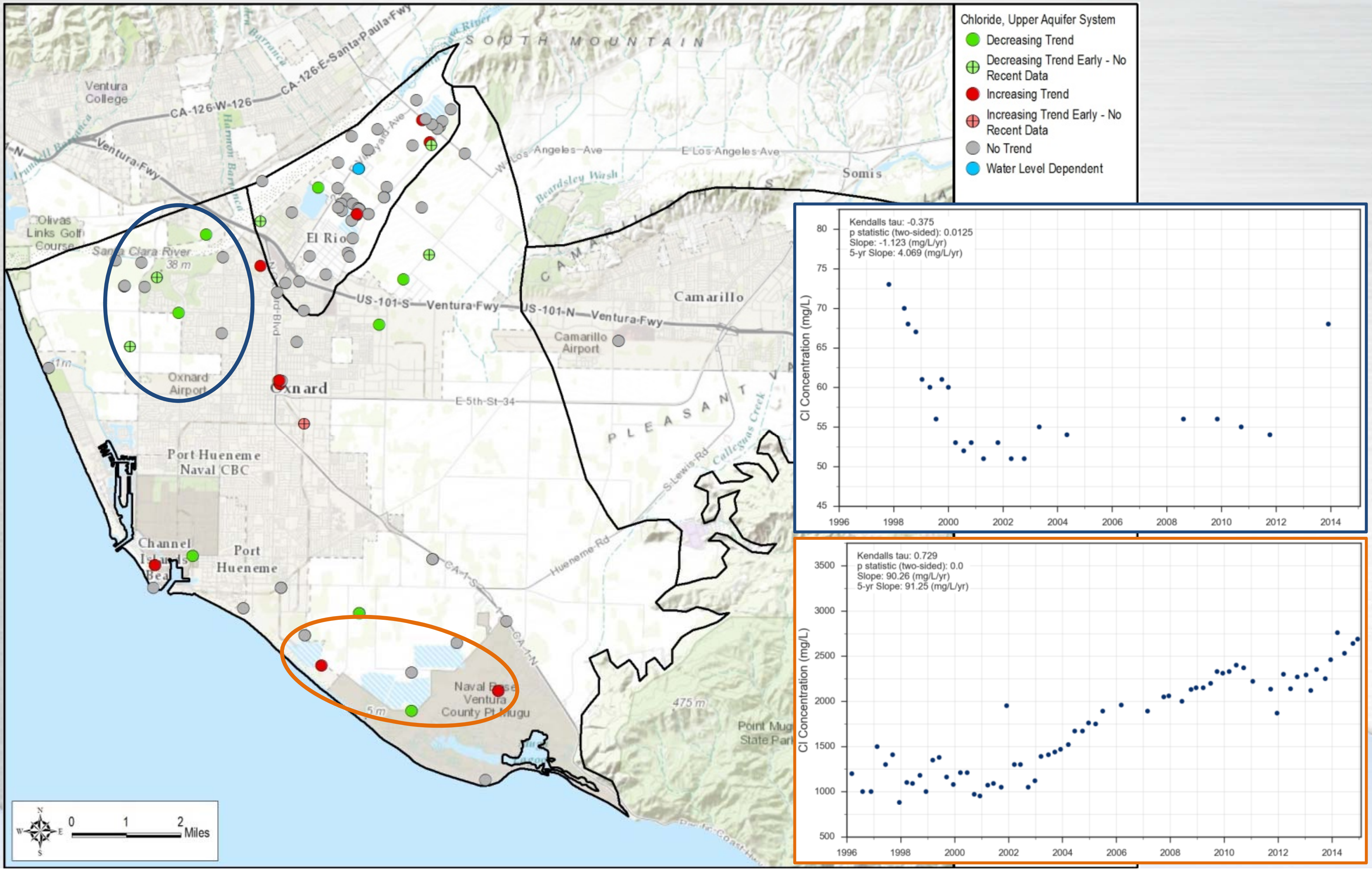




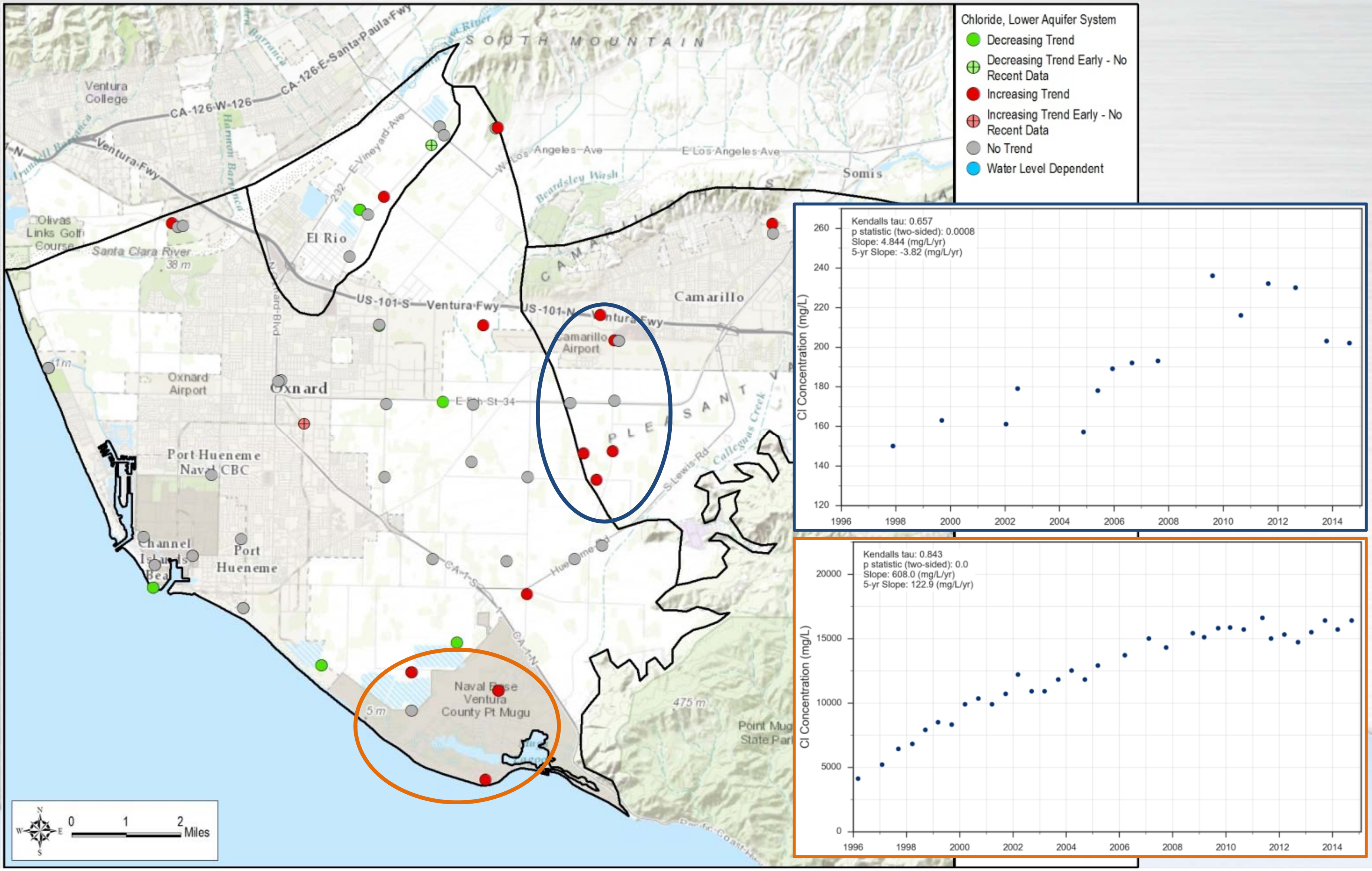




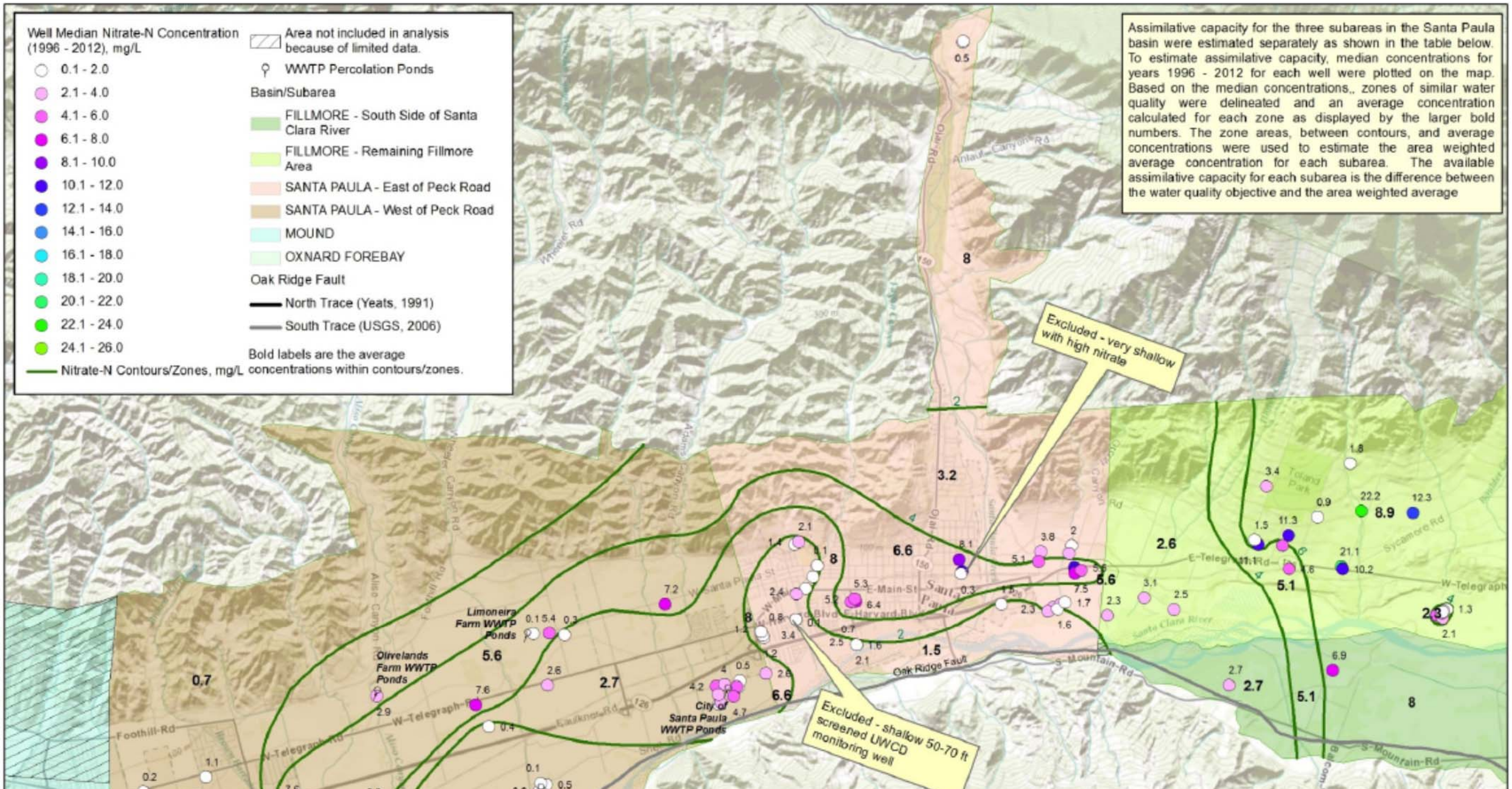
Groundwater Quality Trends: Chloride - UAS



Groundwater Quality Trends: Chloride - LAS



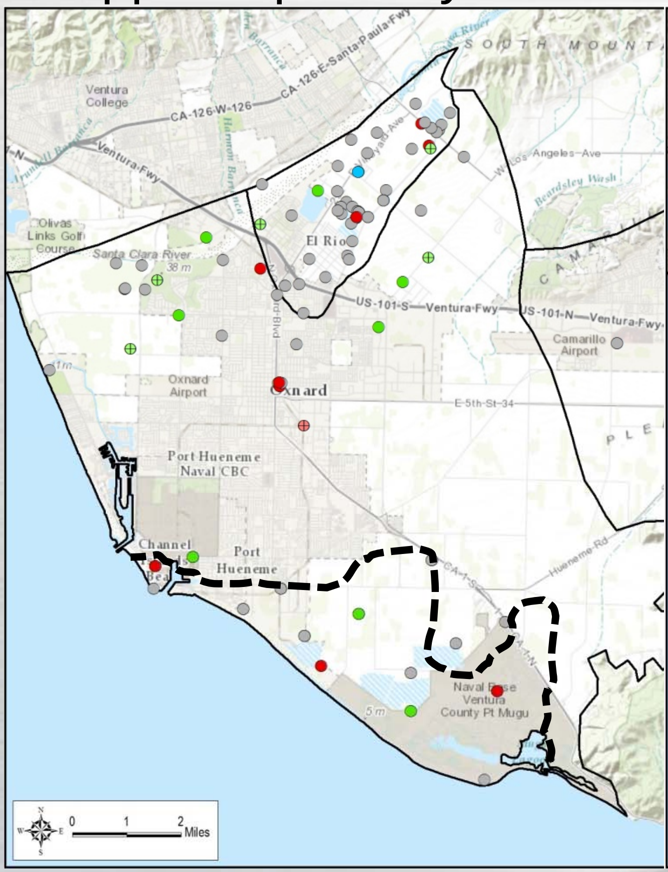
Example – Assimilative Capacity Analysis



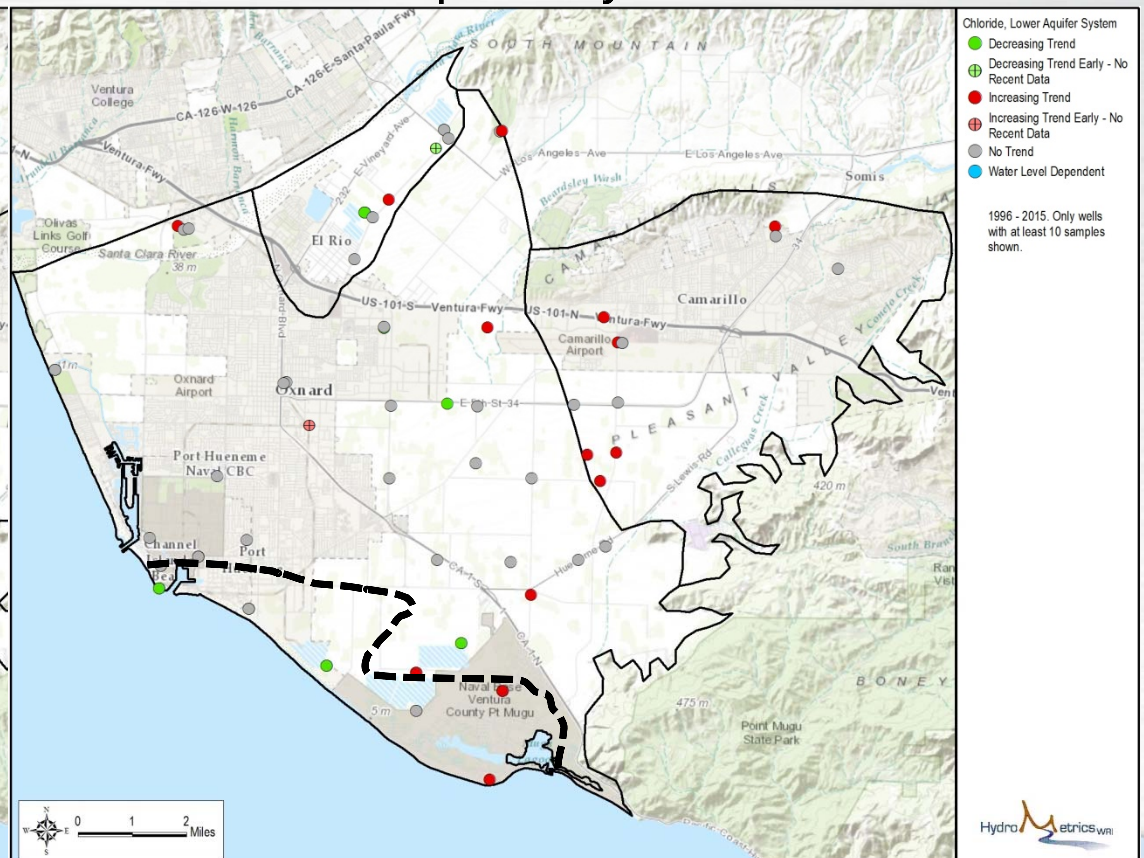
Basin	Subarea	Nitrate-N. mg/L Water Quality Objective	Existing Quality	Available Assimilative Capacity
Santa	East of Peck Road	10	5.0	5.0
Paula	West of Peck Road	10	2.0	8.0

Groundwater Quality: Seawater Intrusion

Upper Aquifer System



Lower Aquifer System



MANAGEMENT MEASURES APPROACH

Management Measures Approach

- Areas within basins with compromised groundwater quality
- SNMP Management Measures
  – Maintain water quality
  – Contribute to improvements in water quality
  – Not a comprehensive plan to remediate all areas with compromised groundwater quality
- Seawater intrusion zone
  – Describe existing management measures
  – Describe potential and/or planned measures

DISCUSSION

Stakeholder Input on Key Issues

- Study Area
  - Camrosa and Camarillo recycled water projects
- Data
  - Constituents, sources of data, time period
- Groundwater Quality Analysis
  - Trends
  - Seawater intrusion zone boundary
- Conceptual Model

NEXT STEPS

Next Steps

- Continue analysis
  – Assimilative capacity evaluation
- Coordinate with TAG
  – Seawater intrusion zone
  – Assimilative capacity analysis
- Develop SNMP Approach

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530-550-1039 (office)

925-989-2436 (cell)

carollo

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BY ______	DATE 10/14/15	SUBJECT TAG MTG OXNARD SNMP	SHEET NO. ___ OF ___
CHKD. BY ______	DATE ______		JOB NO. ______

SIGN-IN SHEET

Name	Organization
Tom West	Carollo
Elisa Garvey	"
Georgina King	Hydrometrics
Cameron Tana-Phelle	"
Barbara Wulf	City of OXNARD
Linda Poksay	Oxnard
Kevin Watson	Oxnard
Dan Detmer	United WCD
Ginachi Amah	Los Angeles Regional Water Quality Control Board
Mary Vorissis	City of Oxnard
Nancy Broschart	Farm Bureau of VC
RICK VIERGUTZ	COUNTY VENTURA WPD
JOHN MATHEWS	PLEASANT VALLEY COUNTY W.D.

Oxnard Plain and Pleasant Valley Salt and Nutrient Management Plan

TAG Meeting #2

October 14, 2015

Meeting Agenda

- Meeting Objectives
- Existing Groundwater Quality
- Assimilative Capacity Approach
  - Oxnard Forebay and Pleasant Valley Basin
  - Oxnard Plain Basin
- Management Measures Approach
- Modeling Approach
- Next Steps

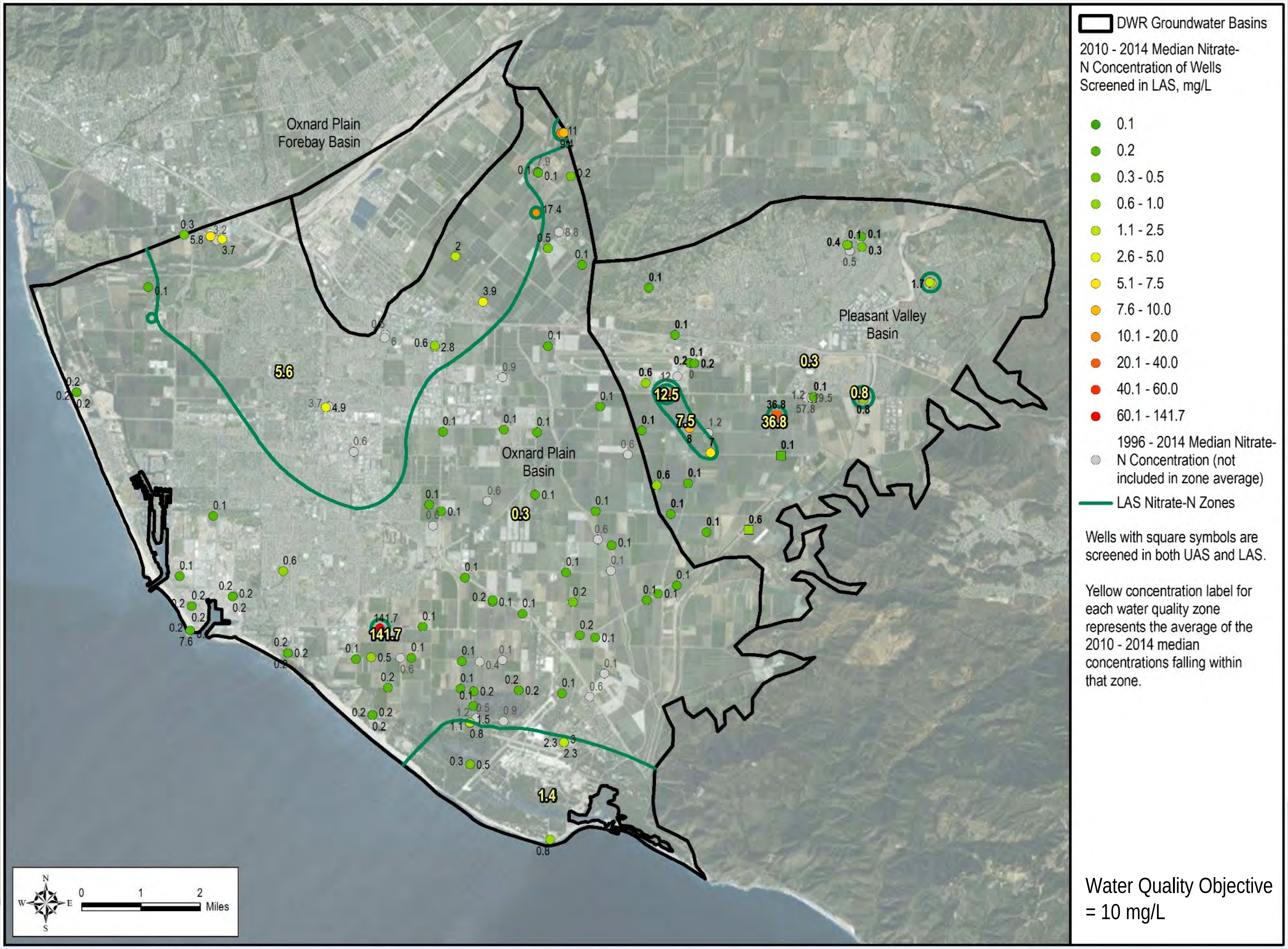
MEETING OBJECTIVES

Meeting Objective – Obtain consensus on:

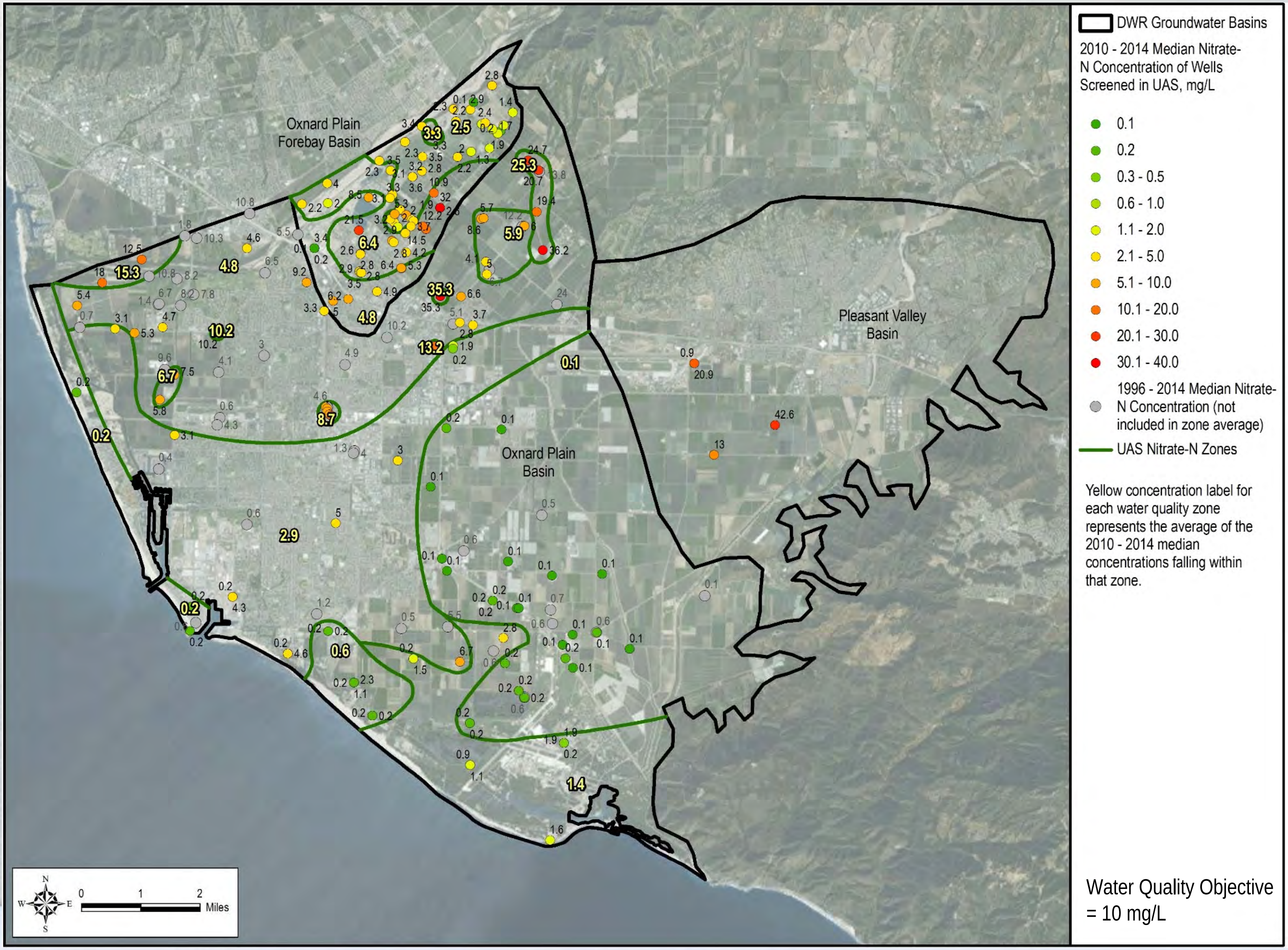
- Assimilative capacity analysis
- Assimilative capacity analysis for Oxnard Plain
- Management measures for seawater intrusion
  - GSP
  - SNMP
- Modeling approach

EXISTING GROUNDWATER QUALITY

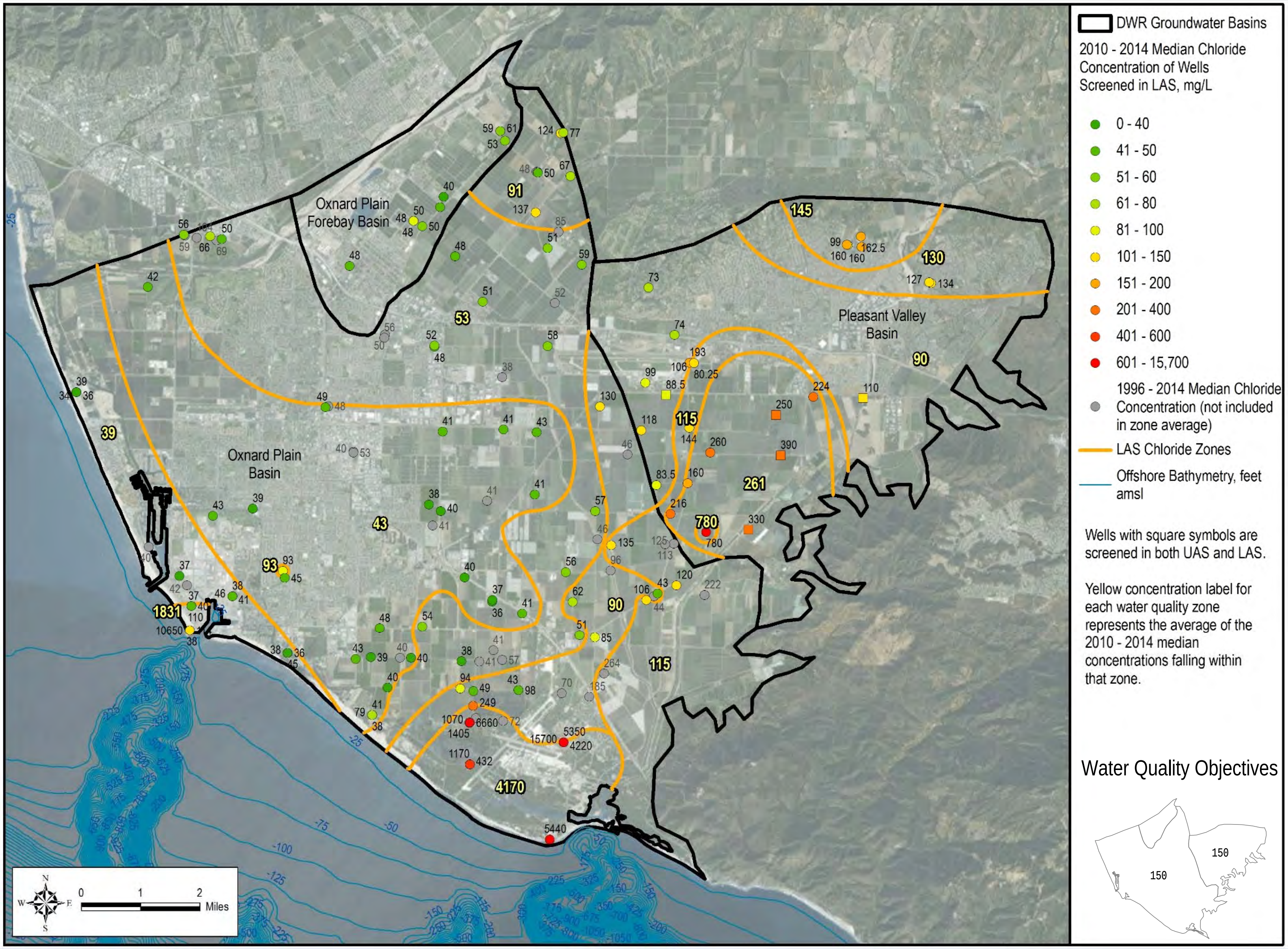
Nitrate-N: LAS



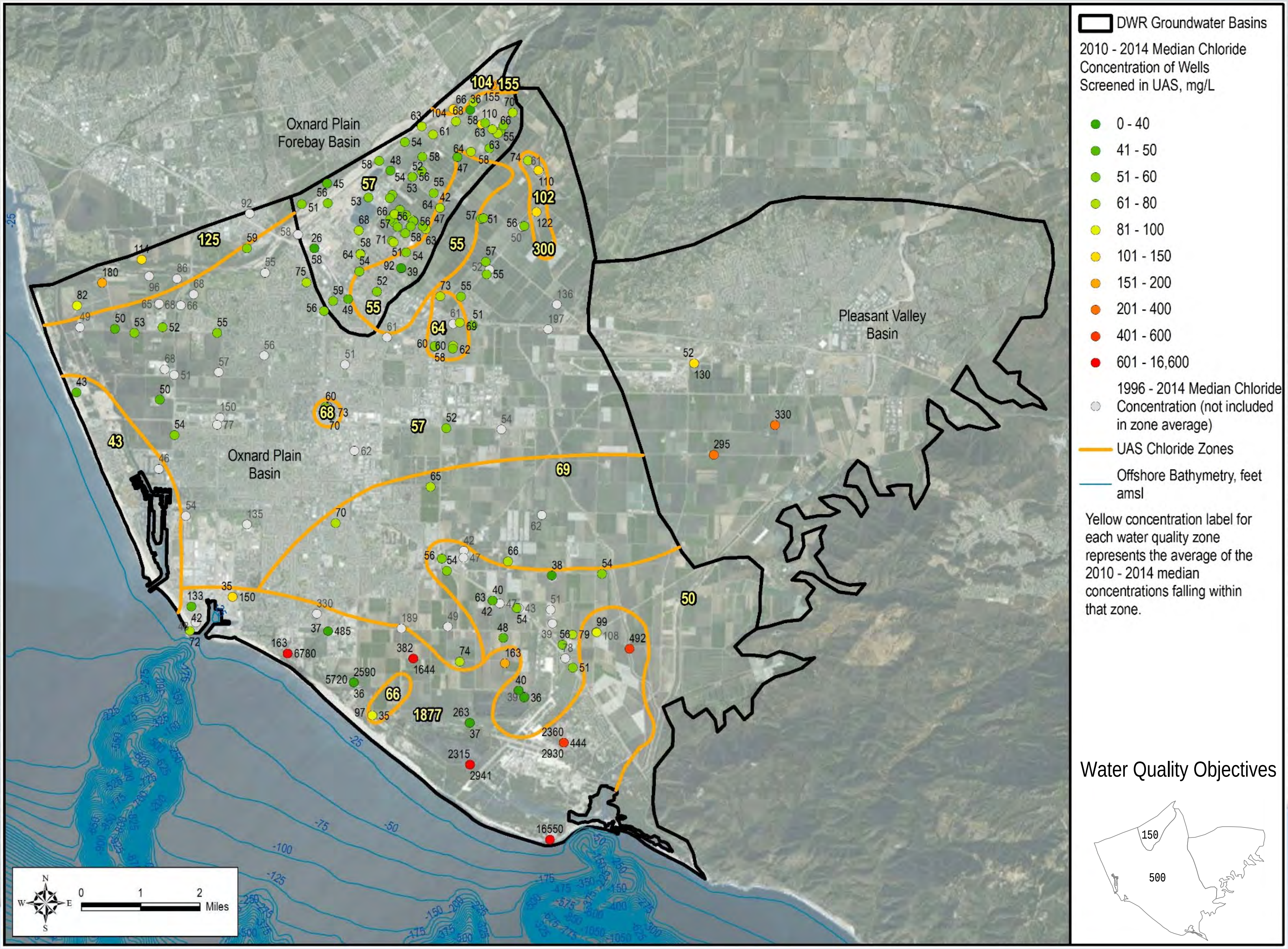
Nitrate-N: UAS



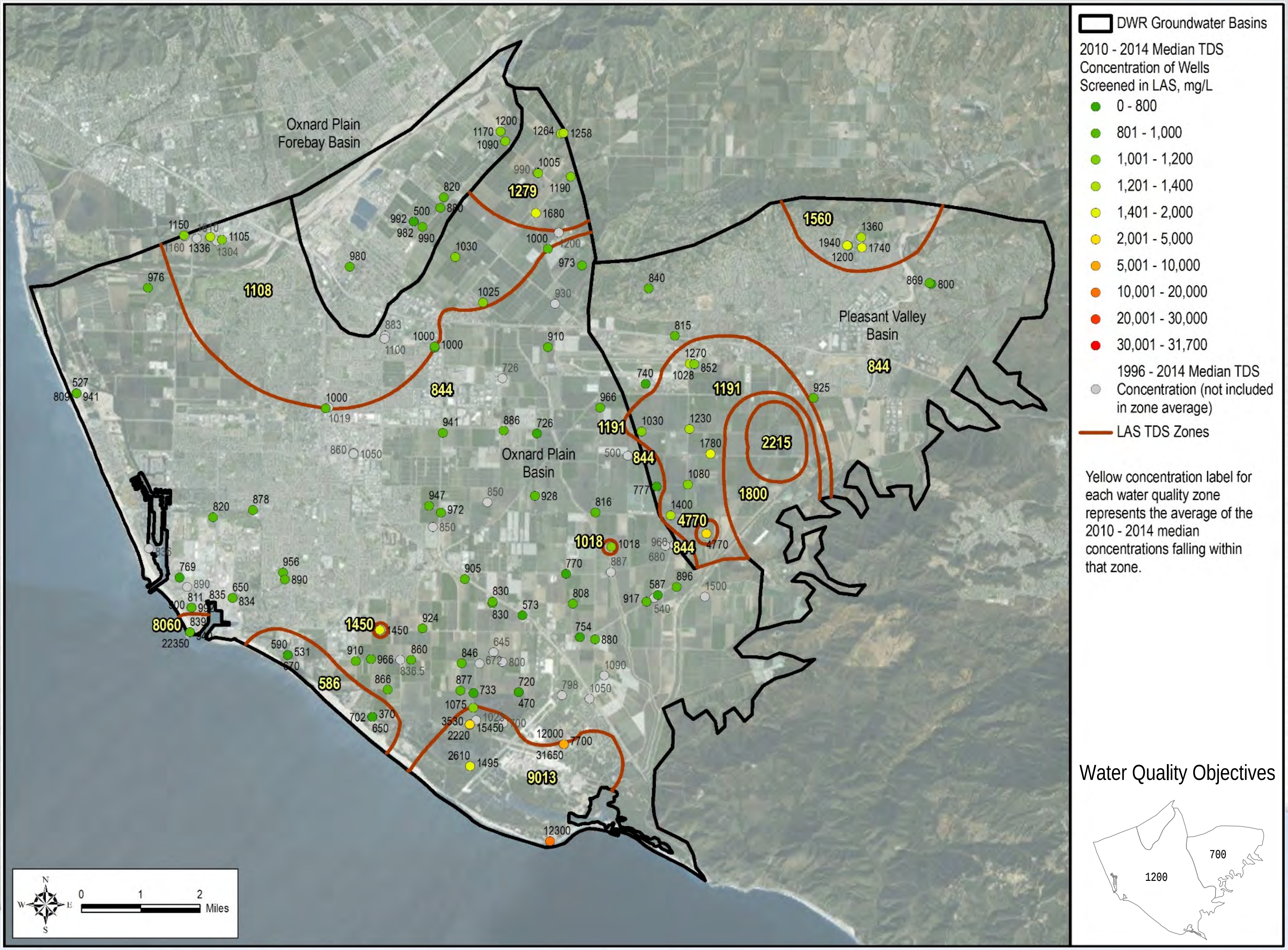
Chloride: LAS



Chloride: UAS

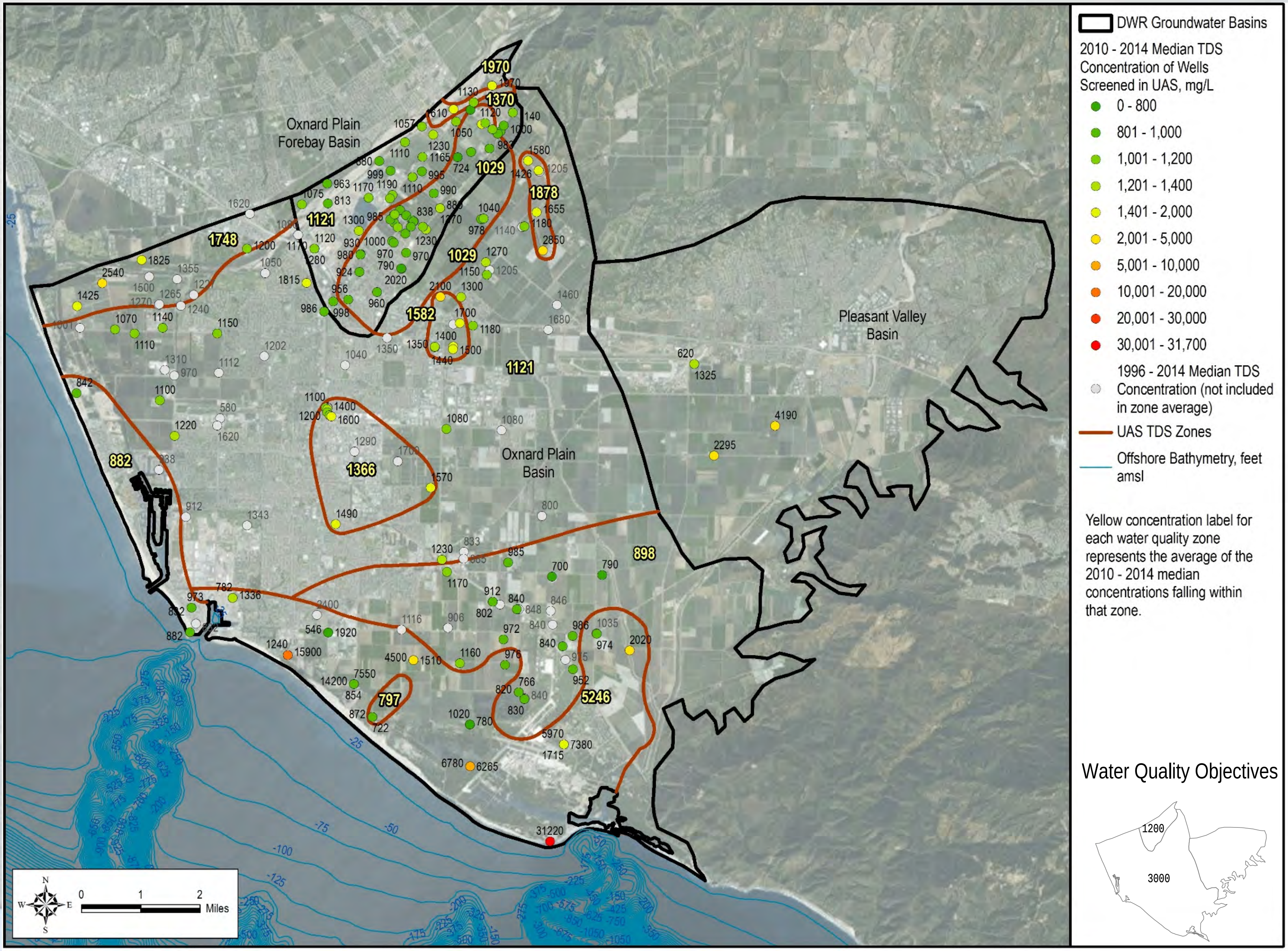


TDS: LAS



DWR Groundwater Basins
2010 - 2014 Median TDS Concentration of Wells Screened in LAS, mg/L
0 - 800
801 - 1,000
1,001 - 1,200
1,201 - 1,400
1,401 - 2,000
2,001 - 5,000
5,001 - 10,000
10,001 - 20,000
20,001 - 30,000
30,001 - 31,700
1996 - 2014 Median TDS Concentration (not included in zone average)
LAS TDS Zones
Yellow concentration label for each water quality zone represents the average of the 2010 - 2014 median concentrations falling within that zone.
Water Quality Objectives
700
1200
Oxnard Plain Forebay Basin
Oxnard Plain Basin
Pleasant Valley Basin
1108
1279
844
1560
1191
2215
1800
4770
1018
8060
1450
586
9013
0 1 2 Miles

TDS: UAS

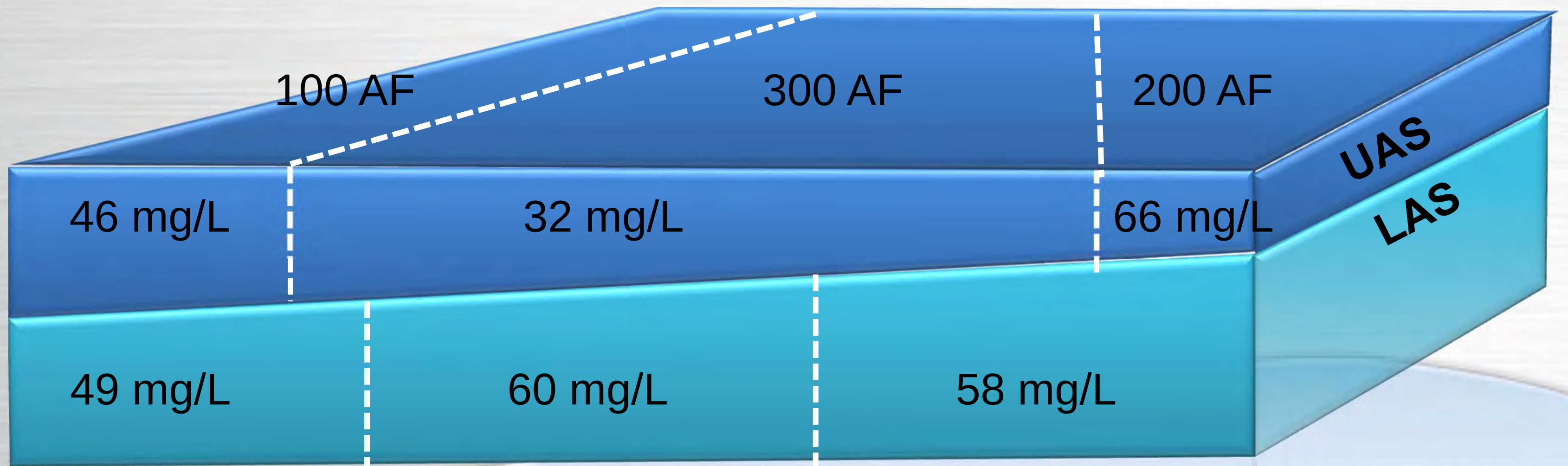

DWR Groundwater Basins
2010 - 2014 Median TDS Concentration of Wells Screened in UAS, mg/L
0 - 800
801 - 1,000
1,001 - 1,200
1,201 - 1,400
1,401 - 2,000
2,001 - 5,000
5,001 - 10,000
10,001 - 20,000
20,001 - 30,000
30,001 - 31,700
1996 - 2014 Median TDS Concentration (not included in zone average)
UAS TDS Zones
Offshore Bathymetry, feet amsl
Yellow concentration label for each water quality zone represents the average of the 2010 - 2014 median concentrations falling within that zone.
Water Quality Objectives
1200
3000
Oxnard Plain Forebay Basin
Oxnard Plain Basin
Pleasant Valley Basin
1970
1370
1029
1878
1121
1748
1029
1582
1121
1366
882
898
797
5246
0
1
2
Miles
N
S
E
W

ASSIMILATIVE CAPACITY ANALYSIS

Assimilative Capacity Methodology

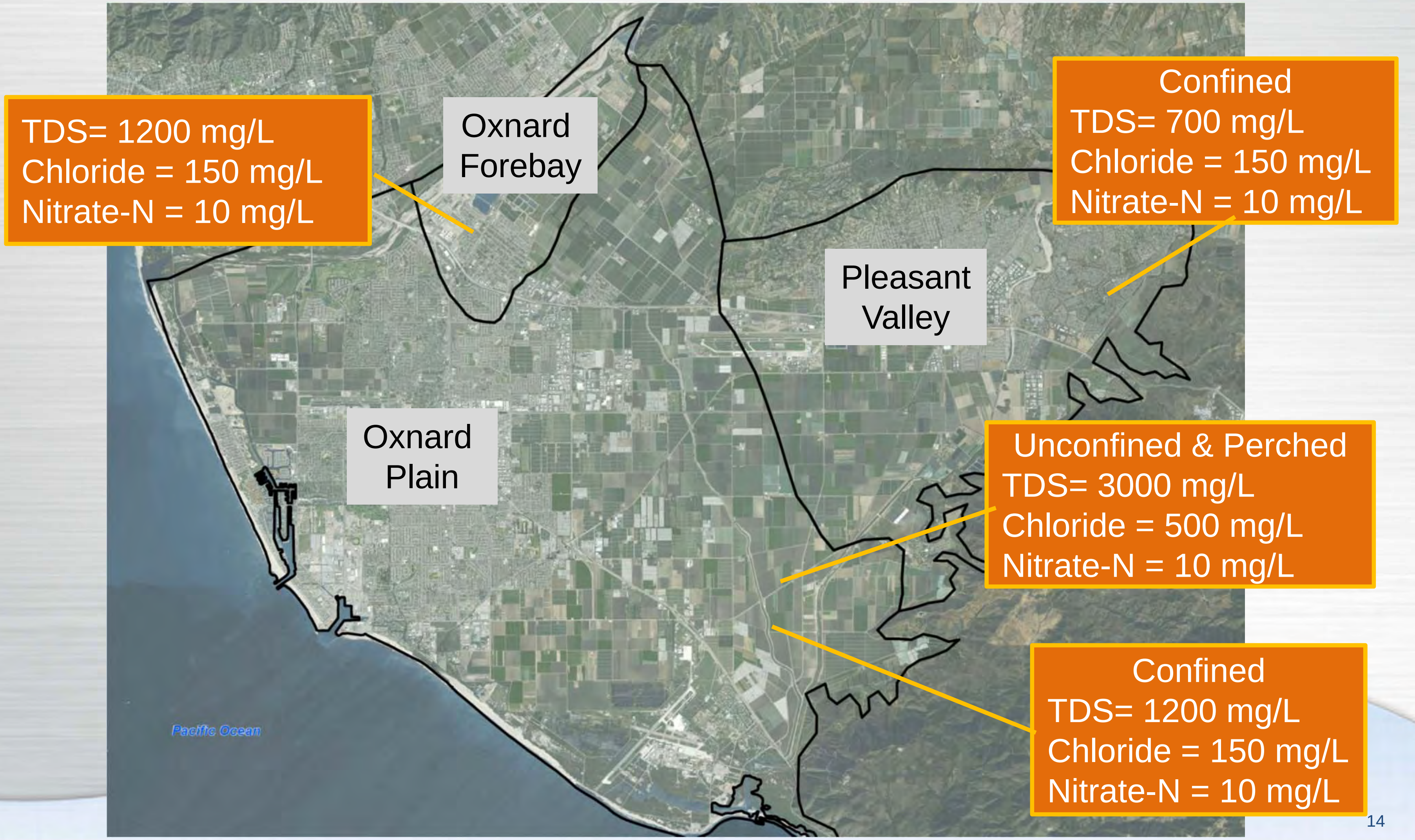
- Existing water quality for the basin by aquifer = average volume weighted concentrations for each water quality zone

UAS example: $\frac{40x100}{600} + \frac{32x300}{600} + \frac{66x200}{600} = 44.7\ mg/L$



Assimilative Capacity

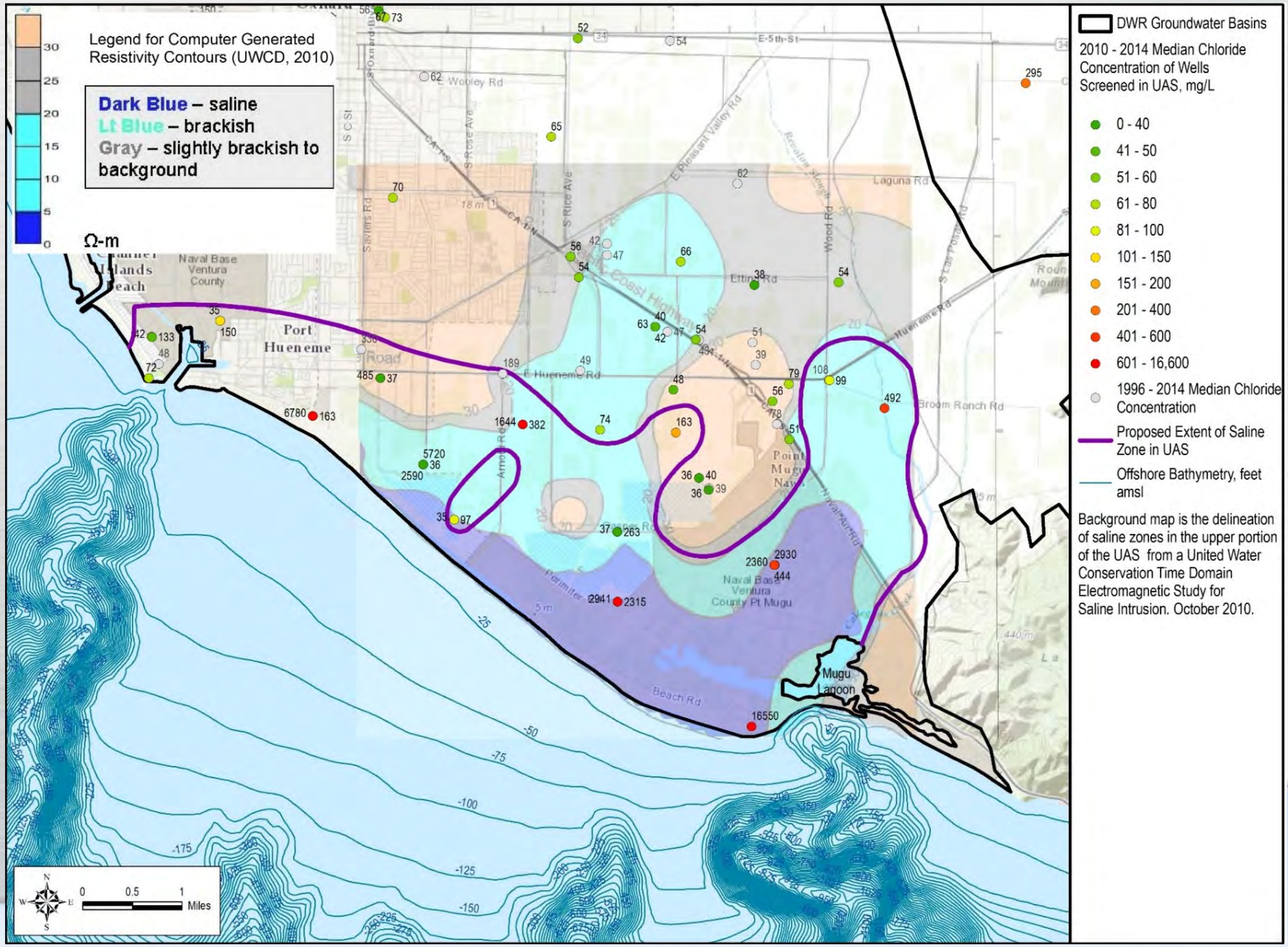
$$Water\ Quality\ Objective\ -Exisiting\ Water\ Quality$$



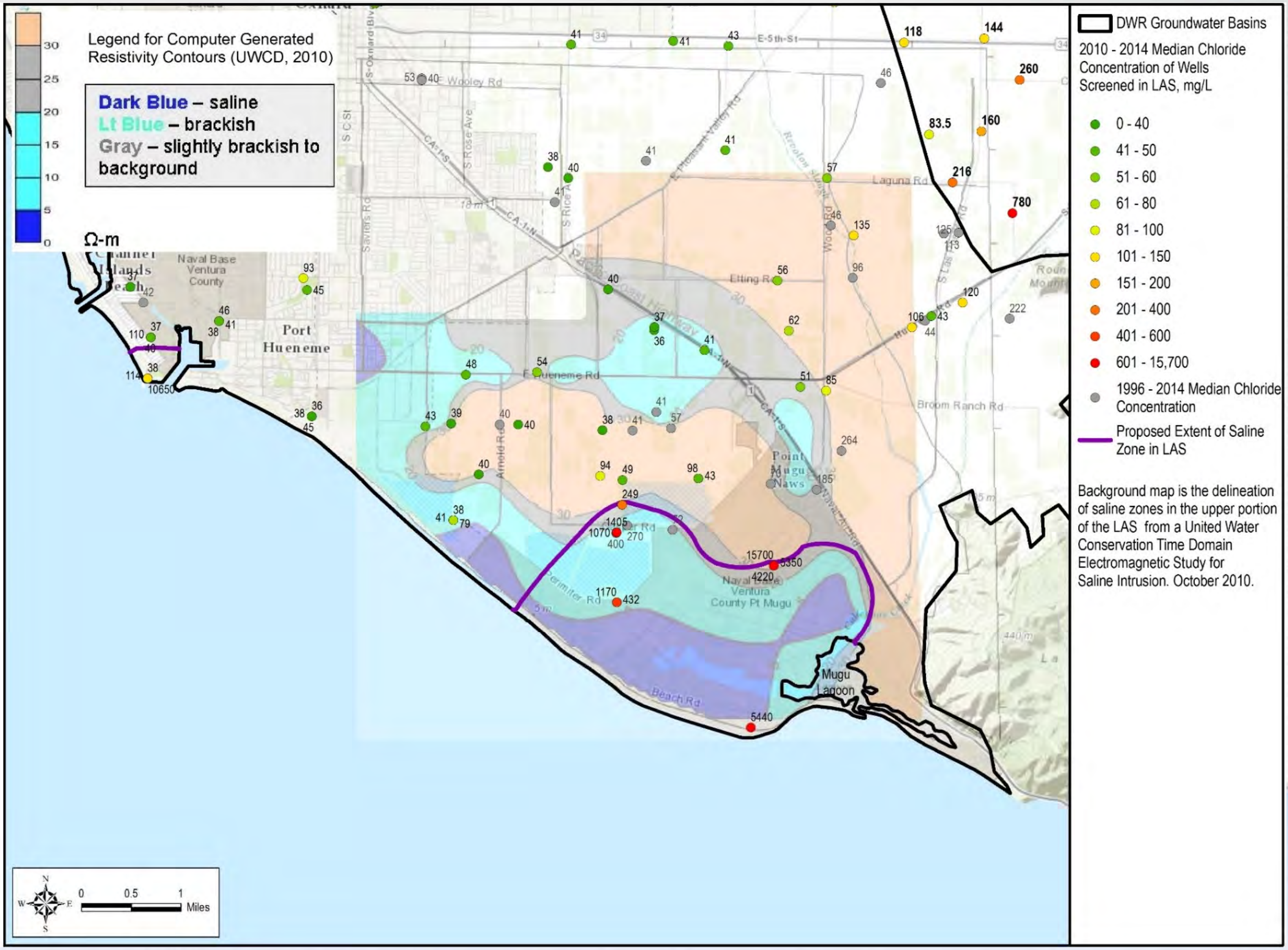
Oxnard Plain Assimilative Capacity Issues

- Coastal zone has much higher chloride and TDS concentrations than the rest of the basin
- Sources are seawater intrusion and natural salinity in underlying marine sediment
- Used last five years' water quality data and 2010 geophysical survey that used a measure of electrical conductivity to delineate saline zones

Proposed Coastal Saline Zone - UAS



Proposed Coastal Saline Zone - LAS



Proposed Assimilative Capacity Approach in the Oxnard Plain Basin

- Estimate existing groundwater quality for the UAS and LAS for both:
  - Entire basin
  - Exclude saline zone

- Compare against WQOs

MANAGEMENT MEASURES APPROACH

SNMP Management Measures

- Manage salt and nutrient loadings on a sustainable basis in order to maintain long term supply for multiple beneficial uses.
  - Pollution prevention
  - Source load reductions
  - Treatment/management of impaired water quality
  - Improving/stabilizing declining water levels where water quality is not affected
  - Increasing groundwater recharge by stormwater
  - Increasing recycled water use

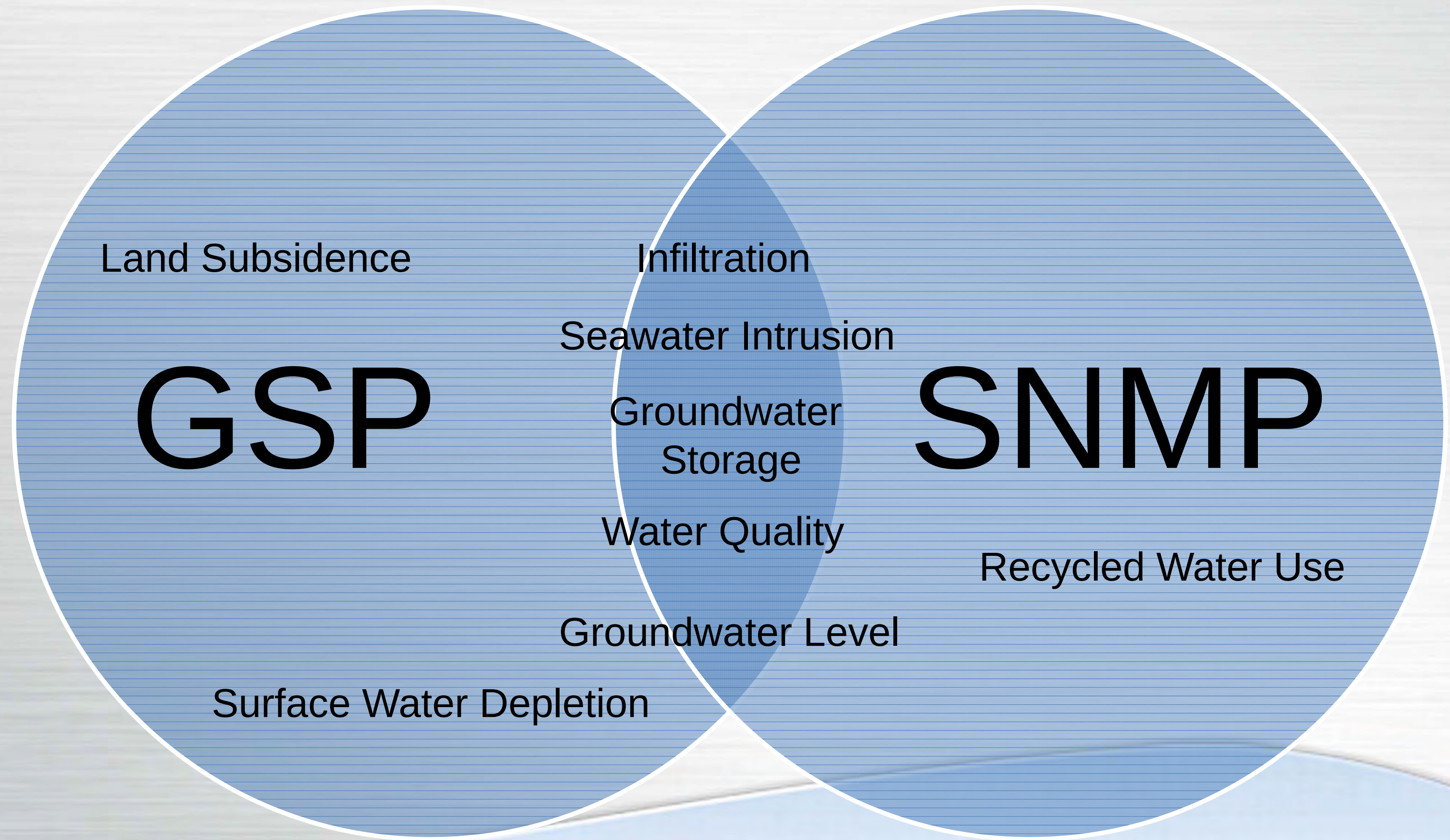
Sustainable Groundwater Management Act (SGMA)

- Groundwater Sustainable Agency (GSA)
  - Fox Canyon
- Groundwater Sustainability Plan (GSP)
  - Soon to be under contract with consultant team
  - Development in parallel with SNMP
- GSP Implementation - 20 years

Sustainable Groundwater Management

- The management and use of groundwater without causing undesirable results
  - Chronic lowering of groundwater levels
  - Reductions in groundwater storage
  - Seawater intrusion
  - Degradation of water quality
  - Land subsidence
  - Surface water depletions that impact beneficial uses

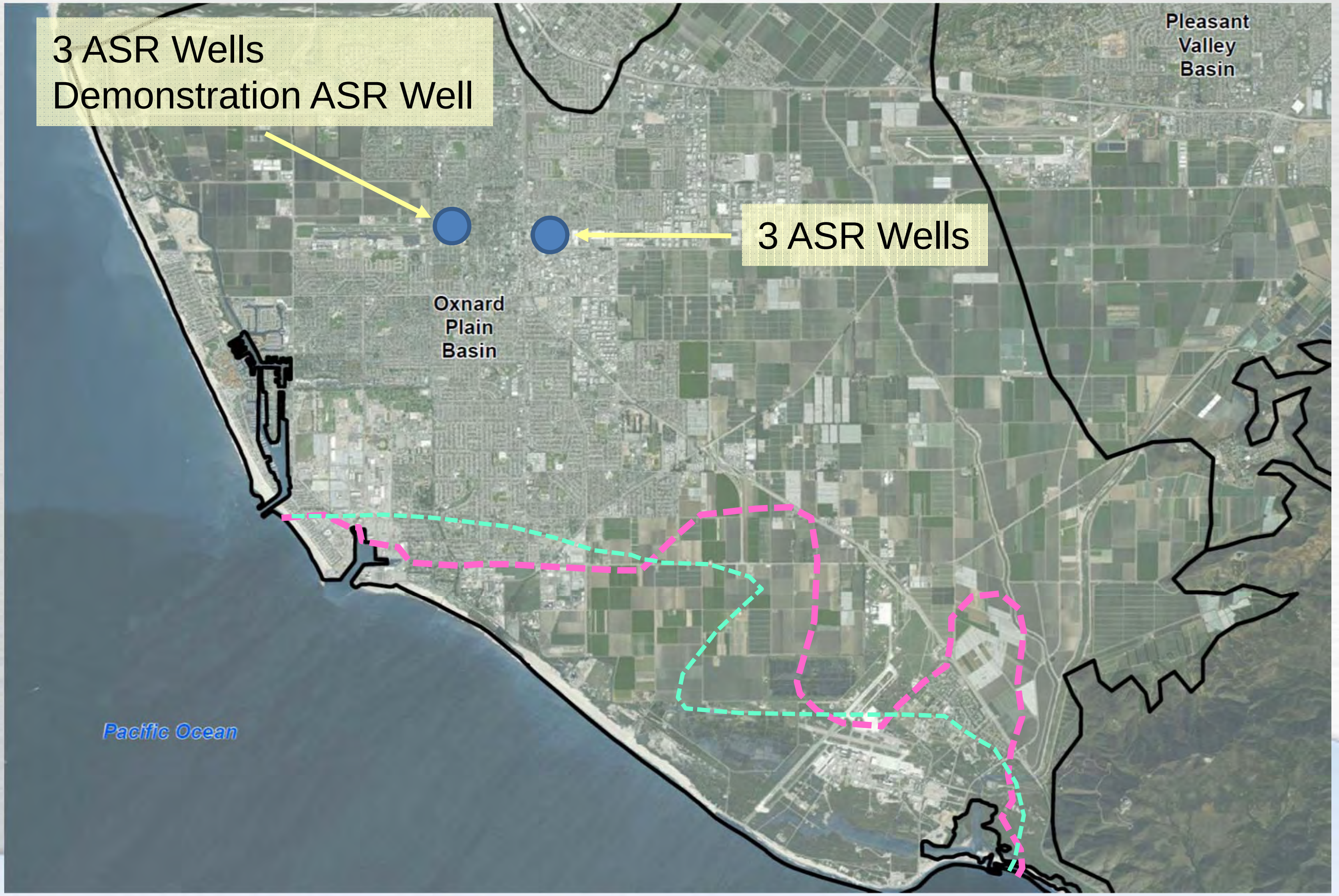
Overlapping objectives of planning processes



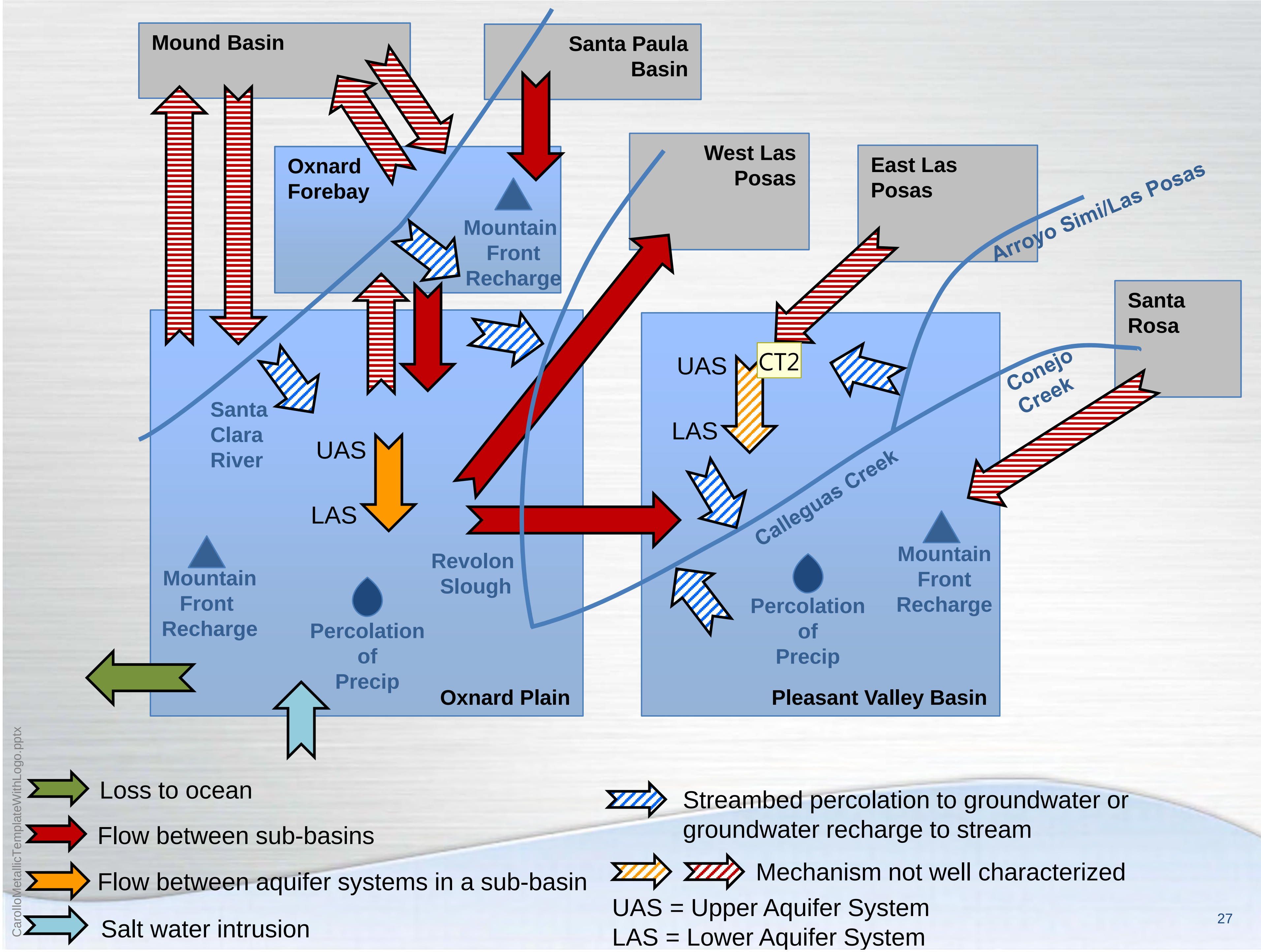
Proposed Management Measures Approach for Coastal Impaired Zone

- GSA/GSP to goal is that seawater intrusion will not progress further
  - Broader stakeholder/agency process
  - DWR involvement
- SNMP
  - Short Term
    - Characterize current management measures that will help protect groundwater that City recharges (ASR Wells)
  - Long Term
    - Recognize overlap with GSP process
    - Characterize seawater intrusion management measures identified in GSP (as feasible given difference in schedules)
    - Identify City role in GSP process and development of future seawater intrusion management measures

Proposed locations for ASR



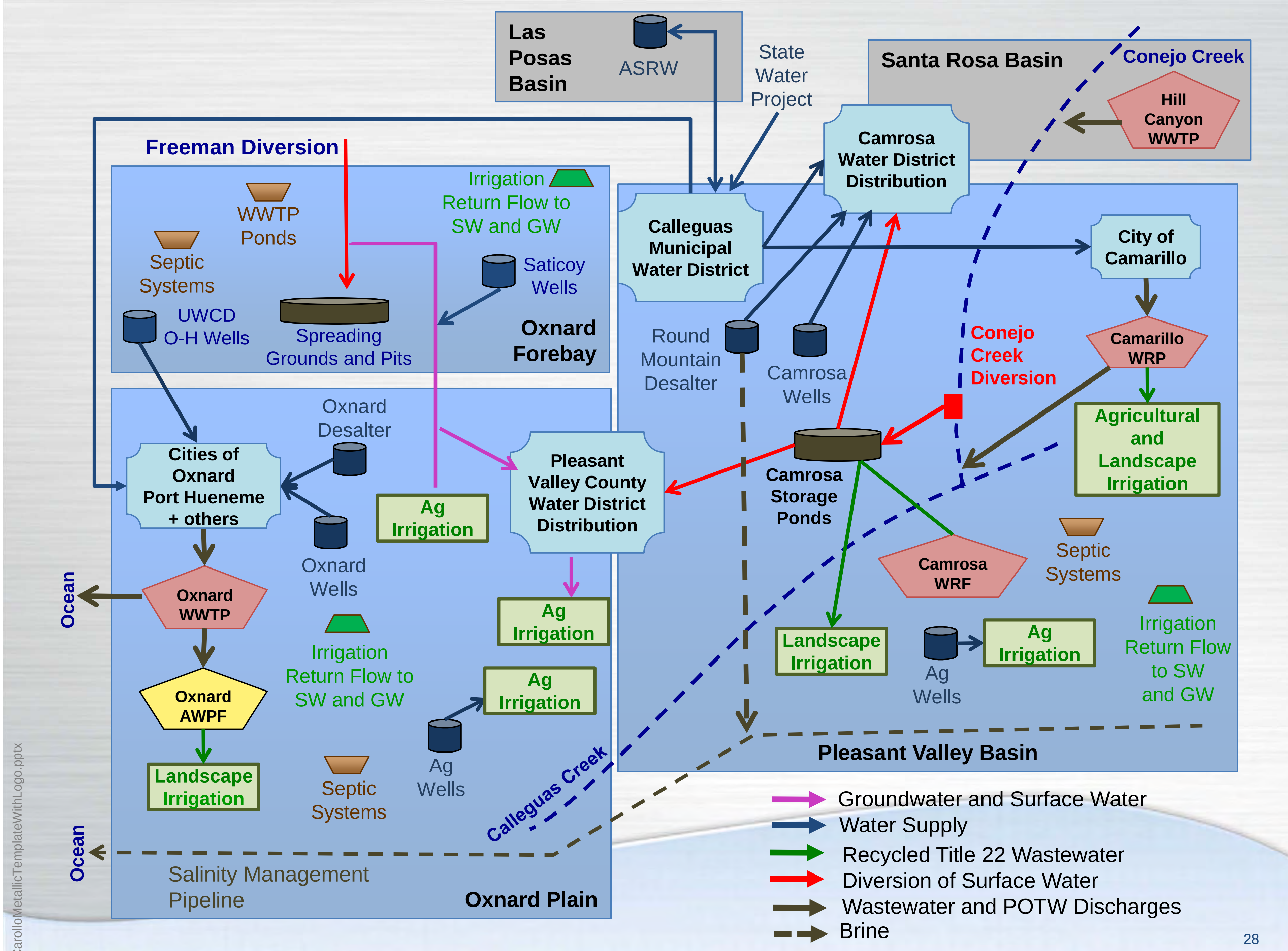
SNMP MODELING APPROACH



Mound Basin
Santa Paula Basin
Oxnard Forebay
Mountain Front Recharge
West Las Posas
East Las Posas
Arroyo Simi/Las Posas
Santa Rosa
Conejo Creek
UAS
CT2
LAS
Santa Clara River
UAS
LAS
Calleguas Creek
Revolon Slough
Mountain Front Recharge
Percolation of Precip
Mountain Front Recharge
Percolation of Precip
Oxnard Plain
Pleasant Valley Basin
Loss to ocean
Flow between sub-basins
Flow between aquifer systems in a sub-basin
Salt water intrusion
Streambed percolation to groundwater or groundwater recharge to stream
Mechanism not well characterized
UAS = Upper Aquifer System
LAS = Lower Aquifer System

CT2 UAS in Pleasant Valley? I view it as stream percolation directly to LAS

Cameron Tana, 10/9/2015



Las Posas Basin
ASRW
State Water Project
Santa Rosa Basin
Conejo Creek
Hill Canyon WWTP
Freeman Diversion
Irrigation Return Flow to SW and GW
WWTP Ponds
Septic Systems
Saticoy Wells
UWCD O-H Wells
Spreading Grounds and Pits
Oxnard Forebay
Calleguas Municipal Water District
Camrosa Water District Distribution
City of Camarillo
Round Mountain Desalter
Camrosa Wells
Conejo Creek Diversion
Camarillo WRP
Agricultural and Landscape Irrigation
Oxnard Desalter
Cities of Oxnard Port Hueneme + others
Pleasant Valley County Water District Distribution
Ag Irrigation
Camrosa Storage Ponds
Camrosa WRF
Septic Systems
Oxnard Wells
Ocean
Oxnard WWTP
Ag Irrigation
Irrigation Return Flow to SW and GW
Landscape Irrigation
Ag Wells
Ag Irrigation
Irrigation Return Flow to SW and GW
Oxnard AWPF
Ag Irrigation
Landscape Irrigation
Septic Systems
Ag Wells
Calleguas Creek
Pleasant Valley Basin
Ocean
Salinity Management Pipeline
Oxnard Plain
Groundwater and Surface Water
Water Supply
Recycled Title 22 Wastewater
Diversion of Surface Water
Wastewater and POTW Discharges
Brine

Discharge Components

Component	Water Balance	Salt & Nutrient Balance
Groundwater Extractions	We have metered well records from FCGMA	We have WQ data
Groundwater Underflow to other Basins & Ocean	Use annual contour maps from UWCD	We have WQ data

Recharge Components non-land use based

Component	Water Balance	Salt & Nutrient Balance
Direct Percolation of Precipitation	% of Precipitation	WQ based on regional and statewide estimates
Streambed Percolation	UWCD estimates for LSCR. All gaged flow on ALP percolates	We have WQ data
Mountain Front Recharge	Use data from USGS model	Same WQ as precipitation
Managed Aquifer Recharge to both ponds and streams	UWCD and WTPs	We have WQ data
Groundwater Flow between UAS and LAS	Use annual contour maps from UWCD	Existing groundwater quality & calculated by model
Groundwater Underflow from other Basins & Ocean	If possible, use annual contour maps from UWCD and others to determine hydraulic gradients and Darcy flow	Need to get data for West Las Posas and Santa Rosa basins **Seawater intrusion

Additional Components not flow related

Component	Salt & Nutrient Balance
Salt loading from saline marine sediments	Result of groundwater level changes within a basin
Mobilization of salts of previously unsaturated zone	

Recharge Components land use based

Component	Water Balance	Salt & Nutrient Balance
Irrigation Return Flow: groundwater, surface water, recycled water	% of Applied water	We have WQ data, adjusted for % of Applied water
Septic Systems	% of Municipal use in areas with septic systems	Use same as LSCR SNMP

General Model Assumptions

- Use annual data where possible
- Model will be a box model with no storage changes, i.e., each year inflow = outflow
- Transient concentrations in groundwater are calculated for each year based on flows for that year
- Water balance and loading will vary over time. Future simulations will need to include drought years.

NEXT STEPS

Next Steps

- SNMP Approach Document
  – Draft to TAG– Beginning November, 2015
  – Final Draft to LARWQCB – November 2015
- Coordination with Calleguas

Coordination with the Calleguas Watershed Group SNMP - Proposed Approach

- Oxnard conduct analysis for
  - Forebay
  - Oxnard Plain
  - Pleasant Valley Basin
- Calleguas group provide information on recycled water projects and management measures in Pleasant Valley Basin
- Calleguas group provide analysis of all other basins in Calleguas Creek Watershed

APPENDIX B - DRAFT BASIN CHARACTERIZATION

DRAFT

City of Oxnard
Salt & Nutrient Management Plan
Groundwater Basin Characterization

Prepared for:
Carollo Engineers

June 2016

Prepared by:

HydroMetrics WRI

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TABLE OF CONTENTS

LIST OF FIGURES

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ABBREVIATIONS

AFY..acre-feet per year
AP..airport
DWR......................................California Department of Water Resources
FCGMA.................................Fox Canyon Groundwater Management Agency
LAS..Lower Aquifer System
MSL.......................................mean sea level
SNMP....................................Salt and Nutrient Management Plan
UAS.......................................Upper Aquifer System
USGS.....................................United States Geological Survey
UWCD ....United Water Conservation District

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SECTION 1
GROUNDWATER BASIN OVERVIEW

The groundwater basins included in the Salt and Nutrient Plan (SNMP) planning area are the Oxnard Plain, Oxnard Plain Forebay, and Pleasant Valley groundwater basins. The geographic scope of City of Oxnard recycled water projects was a consideration in determining the planning area as described in other sections of the SNMP.

California Department of Water Resources (DWR) Bulletin 118 groundwater basin boundaries used in this SNMP are slightly different to the groundwater basins delineated by Ventura County (Figure 1) and by the Fox Canyon Groundwater Management Agency (FCGMA). The groundwater basins from Bulletin 118 are defined by the extent of quaternary geology, with the Oxnard Plain Forebay basin not separated from the Oxnard Plain basin. The County delineated basins are based on a study by Turner (1975) where basins were defined based on the occurrence of mapped aquifer zones. The Oxnard Plain Forebay basin as delineated by United Water Conservation District (UWCD) is included as a separate basin from Bulletin 118's Oxnard Plain basin because it is specifically called out in the Regional Water Quality Control Board's Basin Plan water quality objectives.

1.1 OXNARD PLAIN BASIN

The Oxnard Plain is a relative flat agricultural-rich alluvial area that forms part of a wide delta complex at the terminus of the ancestral Santa Clara River (FCGMA, 2007). Underlying the majority of the Oxnard Plain is the Oxnard Plain basin, which at 82.3 square miles is the largest of the three basins included in this SNMP. The Oxnard Plain basin is bound in the north by the Oak Ridge Fault zone and extends southward to where alluvium contacts non water-bearing rocks of the Santa Monica Mountains. The Mound and Oxnard Plain Forebay basins are located adjacent to its northern boundary. Although some of the aquifers underlying the basin extend offshore and are in direct contact with seawater (Hanson et al., 2003), the coastline is assigned as a basin boundary. The Santa Clara River runs through the very northern portion of the basin, providing a source of groundwater recharge through streambed percolation.

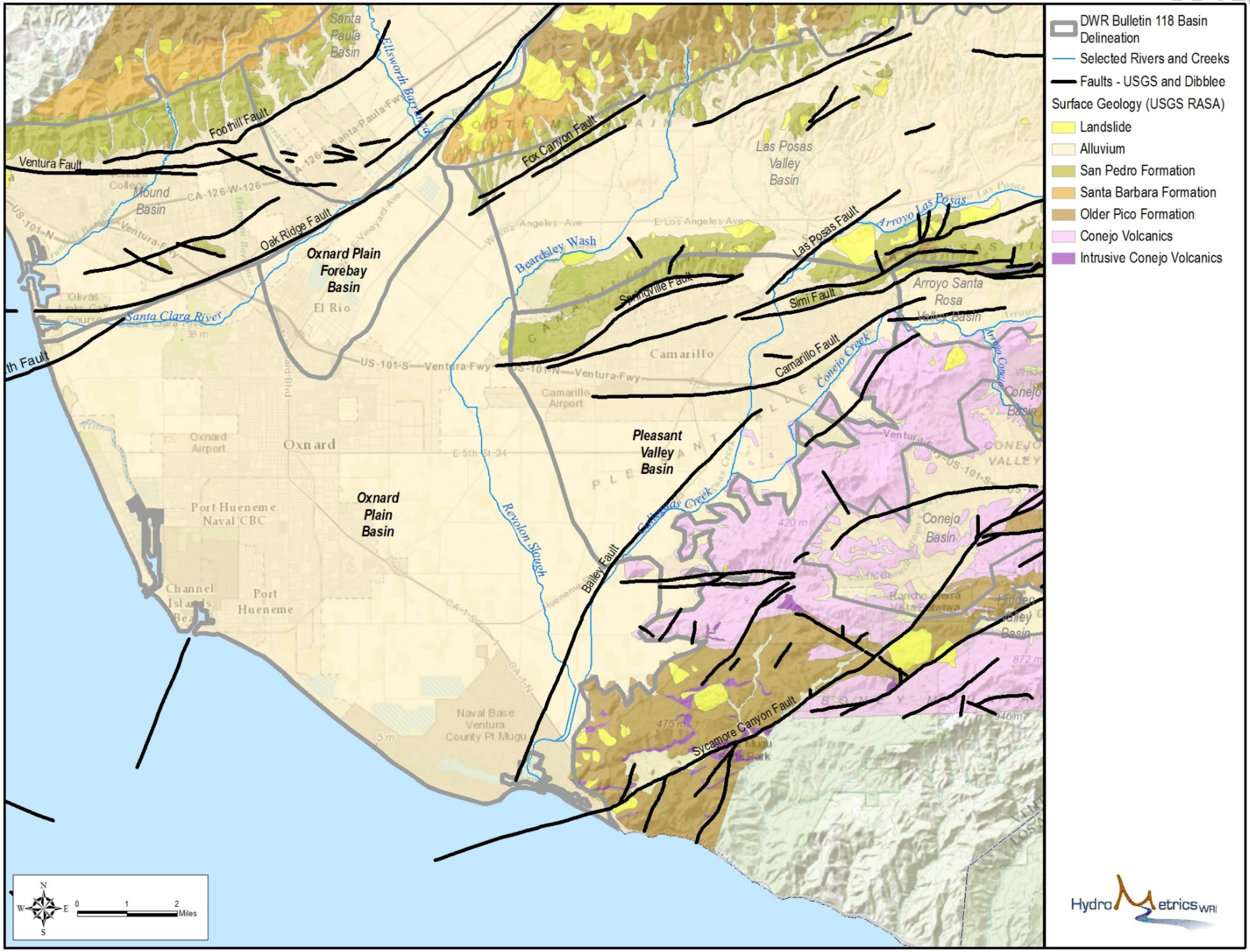

Figure 1: Groundwater Basins

1.2 Oxnard Plain Forebay Basin

A portion of the Oxnard Plain basin defined by Bulletin 118 is separated from the main basin based on the absence of a confining clay layer and is locally called the Oxnard Plain Forebay basin (Turner, 1975). Its northern boundary coincides with the McGrath Fault, which is a branch of the Oak Ridge Fault zone; and its remaining boundaries are delineated based on where the confining clay of the Oxnard Plain basin occurs (Turner, 1975). The Oxnard Plain Forebay basin is approximately 8.4 square miles in area, and is located south of both the Santa Paula and Mound groundwater basins.

1.3 Pleasant Valley Basin

The Pleasant Valley basin is differentiated from the Oxnard Plain basin by the absence of the Upper Aquifer System (Oxnard and Mugu Aquifers). Faults and folds separate it from the Las Posas and Arroyo Santa Rosa basins, to the north and east, respectively. It covers an area of 33.7 square miles, ranging in elevation from 20 feet to over 800 feet in the Camarillo Hills.

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SECTION 2
CLIMATE

The planning area experiences a Mediterranean climate, with mild wet winters and hot dry summers. Seventy-three percent of the annual precipitation falls from December through March (Figure 2). Rainfall generally increases with elevation as shown on Figure 3. Within the planning area, precipitation ranges from 10 inches per year at the coast to over 18 inches per year at the highest elevation in the northern portion of the Oxnard Plain Forebay basin.

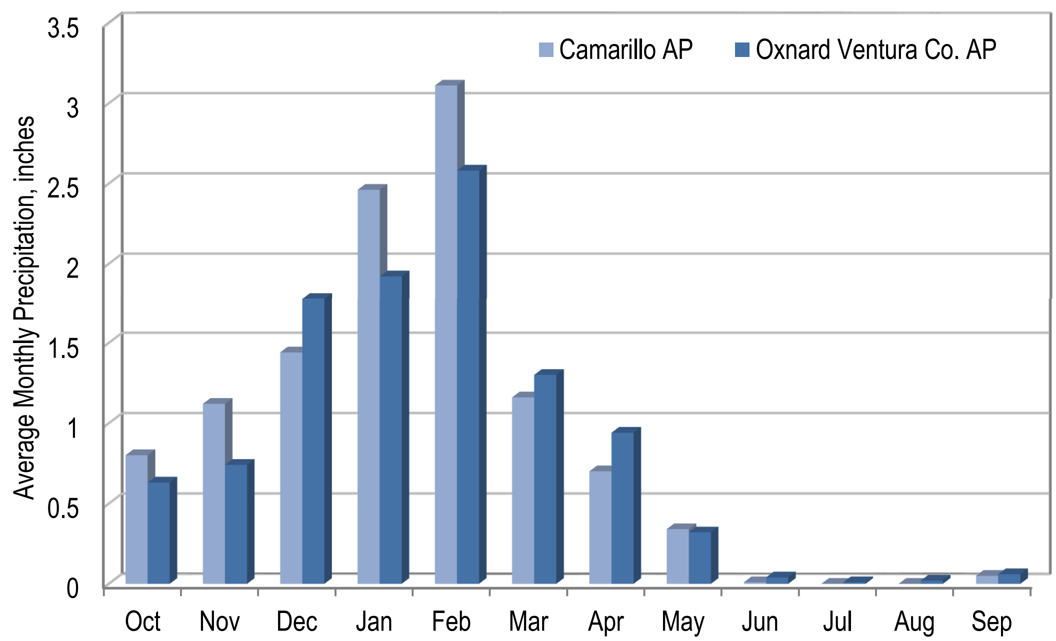

Figure 2: Average Monthly Precipitation at Camarillo AP (12/1/1952 – 3/31/2015) and Oxnard Ventura County AP (3/1/1998 – 3/31/2015)

Within the basin's watersheds, higher precipitation occurs in the highlands surrounding the groundwater basins. Table 1 summarizes the precipitation stations included on Figure 3. The climate pattern is typically cyclic, with years of above average rainfall followed by years of drought. California is currently experiencing drought conditions, with 2013 being one of the driest years on record. Since 2012, the annual precipitation in the planning area has been almost a third of the long-term average precipitation.

Table 1: Summary of Active Precipitation Stations

Ventura County Watershed Protection District Station Name and Number	Elevation (feet above MSL)	Period of Record	Mean Water Year Precipitation Over Period of Record
Channel Islands Harbor # 215	5	09/30/1963 - 09/30/2014	13.7
Point Mugu-USN #223A	12	10/01/1976 - 10/01/2013	13.8
Oxnard Ventura Co. AP	52	03/01/1998 - 10/01/2014	10.3
Camarillo AP	75	12/01/1952 - 03/31/2015	11.2
El Rio-UWCD Spreading Grounds #239	105	09/30/1972 - 02/26/2015	15.4
Camarillo-Leisure Village CIMIS 152	115	01/01/2000 - 10/01/2014	11.1

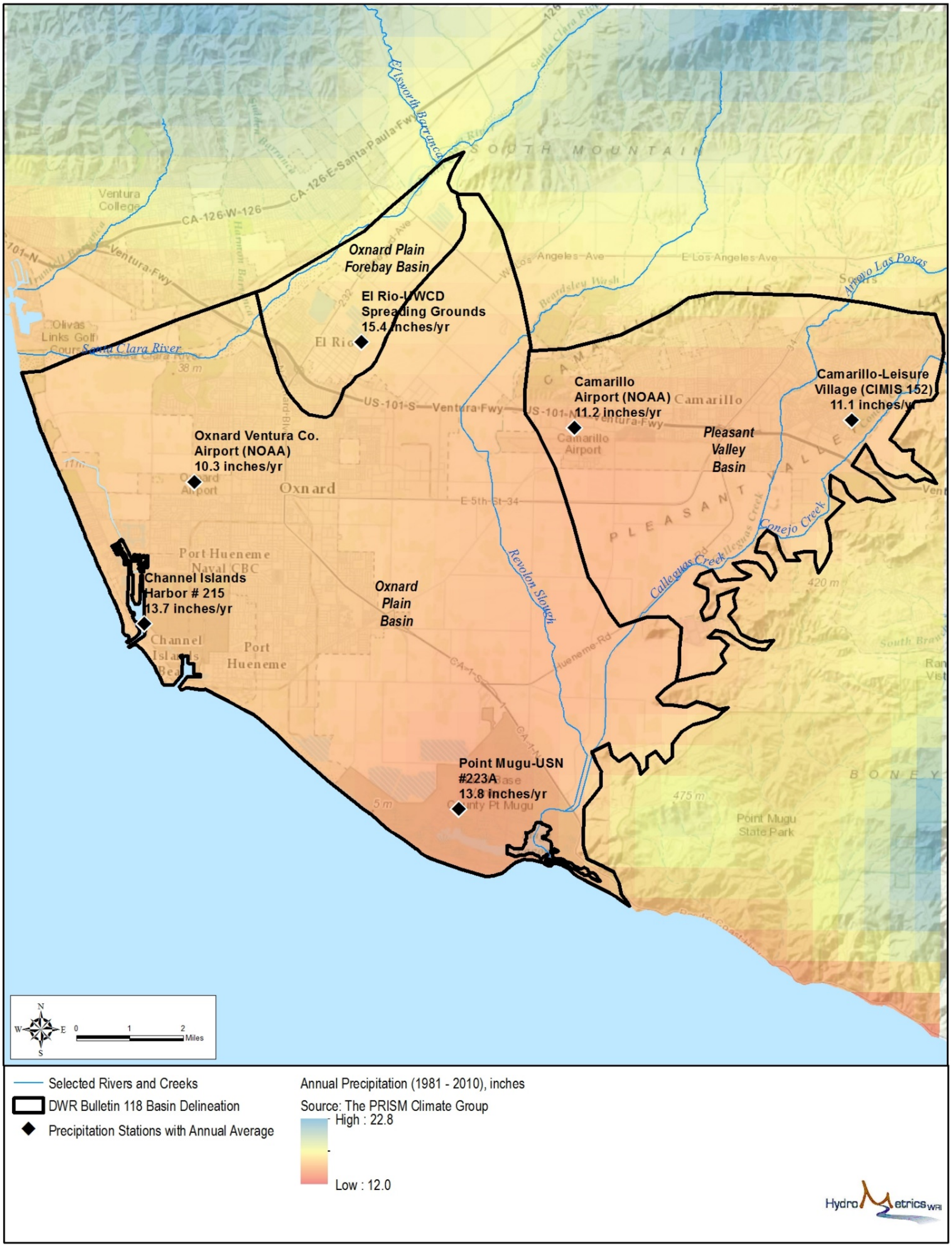

Figure 3: Precipitation Distribution

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SECTION 3
SURFACE HYDROLOGY

There are two regional watersheds that intersect the planning area. The Calleguas Creek watershed underlies more than half of the planning area: the Pleasant Valley basin falls entirely with the watershed and roughly half of the Oxnard Plain basin falls within the watershed; the Santa Clara River watershed underlies the majority of the Oxnard Plain Forebay basin and the western portion of the Oxnard Plain basin (Figure 4).

3.1 SANTA CLARA RIVER WATERSHED

The Santa Clara River watershed covers an area of 1,654 square miles of which only 43 square miles underlies the western portion of the planning area (Figure 4). The Santa Clara River extends 84 miles from its headwaters in Los Angeles County's San Gabriel Mountains to the Pacific Ocean. Major tributaries of the Santa Clara River include the Piru, Sespe, and Santa Paula Creeks (Figure 4). Climatic and basin characteristics of the Santa Clara River watershed result in an intermittent flow regime, however, flows can increase rapidly in response to high intensity rainfall with the potential for severe flooding (Figure 5). During winter months, the Santa Clara River may have continuous surface flow to the Pacific Ocean generated from storm flows. Controlled releases of water from Lake Piru supplement surface flows downstream of Piru Creek in the Santa Clara River.

Major surface water bodies tributary to the Santa Clara River that are used for water storage with regulated releases are Lake Piru and Pyramid Lake. Both these water bodies are located on Piru Creek, with Pyramid Lake located approximately 13 miles upstream of Lake Piru. The Santa Clara River, through its permeable bed, recharges aquifers in the northwestern of the planning area by direct infiltration (FCGMA, 2014). The United Water Conservation District (UWCD) diverts Santa Clara River flows that comprise State Water Project water and natural runoff, at the Freeman Diversion located just upstream of the Oxnard Plain Forebay, to recharge basins located within the Oxnard Plain Forebay basin (Figure 4). The lower portion of the Santa Clara River has become a perennial river due to near constant flows from wastewater treatment plants, urban runoff, and periodic releases from UWCD's Lake Piru as shown in the streamflow hydrograph of a USGS gage located on the Santa Clara River at Montalvo (Figure 5). Data collection from the gage was discontinued in 2004.

The western portion of the Oxnard Plain is also part of the Santa Clara River watershed but due to its flat topography and developed nature, its drainage is by the Cities of Oxnard and Port Hueneme stormwater systems, whose receiving waters are Beardsley Wash and Revolon Slough.

3.2 CALLEGUAS CREEK WATERSHED

The Calleguas Creek watershed is 343 square miles and extends 33 miles from Mugu Lagoon to its headwaters in the Santa Susanna Mountains just within Los Angeles County. The northern boundary is formed by the Santa Susana Mountains, South Mountain, and Oak Ridge Mountains. The Simi Hills and Santa Monica Mountains form its southern boundary.

The watershed comprises three sub-watersheds: the Calleguas Creek, Conejo Creek, and Beardsley Wash/Revolon Slough (Figure 4). The only long-term active stream gage in the Calleguas Creek watershed is USGS Gage No. 11106550 (Callegaus Creek near Camarillo). There are no major surface water bodies used for water storage in the Camarillo watershed. A diversion is operated by Camrosa Water District on the Conejo Creek near Highway 101 (Figure 4) to supplement agricultural groundwater extractions in the Pleasant Valley basin and the neighboring Santa Rosa Valley basin. The majority of water diverted is treated water discharged into the creek by the City of Thousand Oaks at the Hill Canyon Wastewater Treatment plant, 6.9 miles upstream of the diversion structure. Flow in the Calleguas Creek is near perennial due to upstream wastewater treatment plants in Simi Valley, Moorpark, Thousand Oaks, and Camarillo. Irrigation return flows and urban runoff contribute the remainder of the flows. A hydrograph of daily mean streamflow on the Callegaus Creek is included on Figure 5.

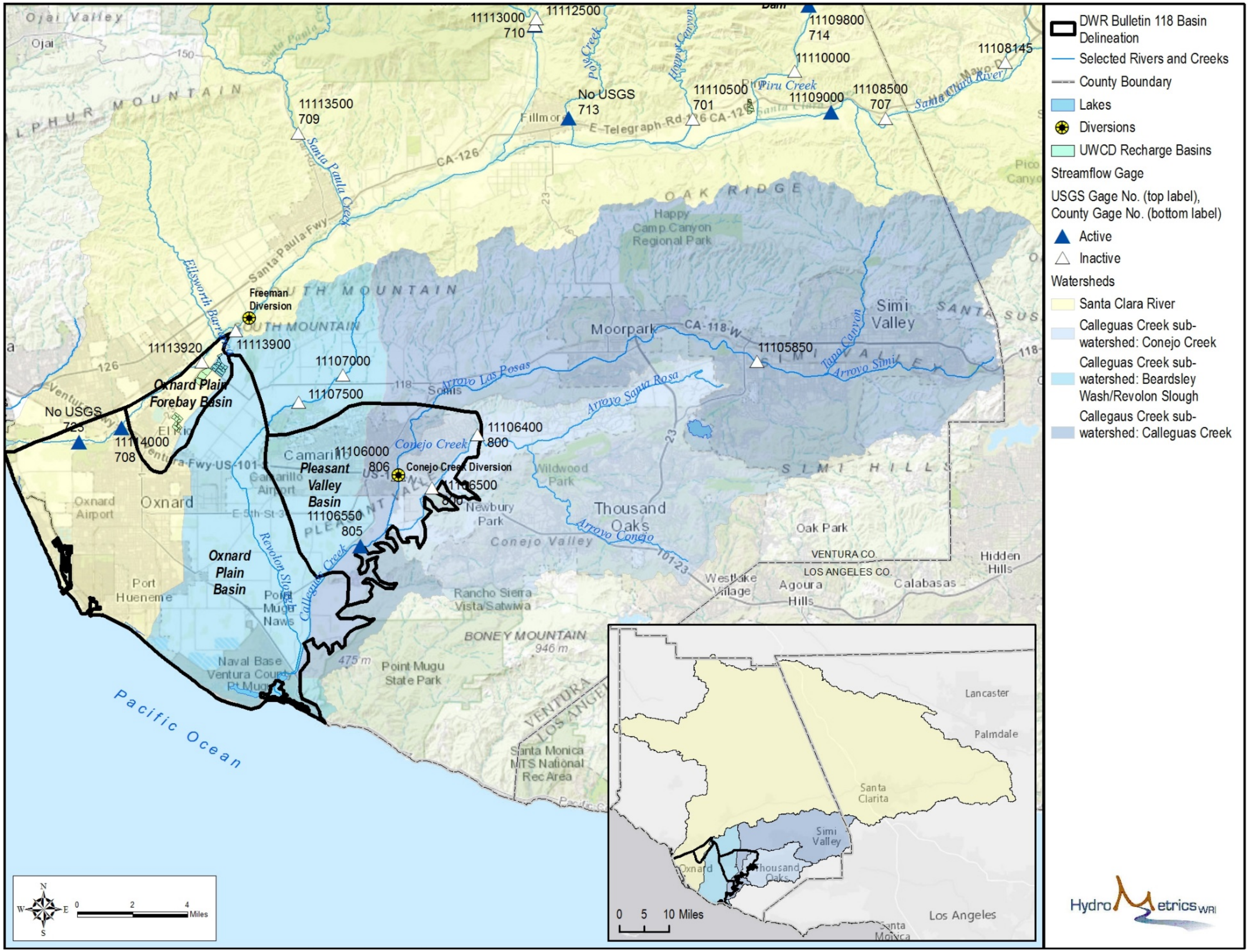

Figure 4: Planning Area Watersheds

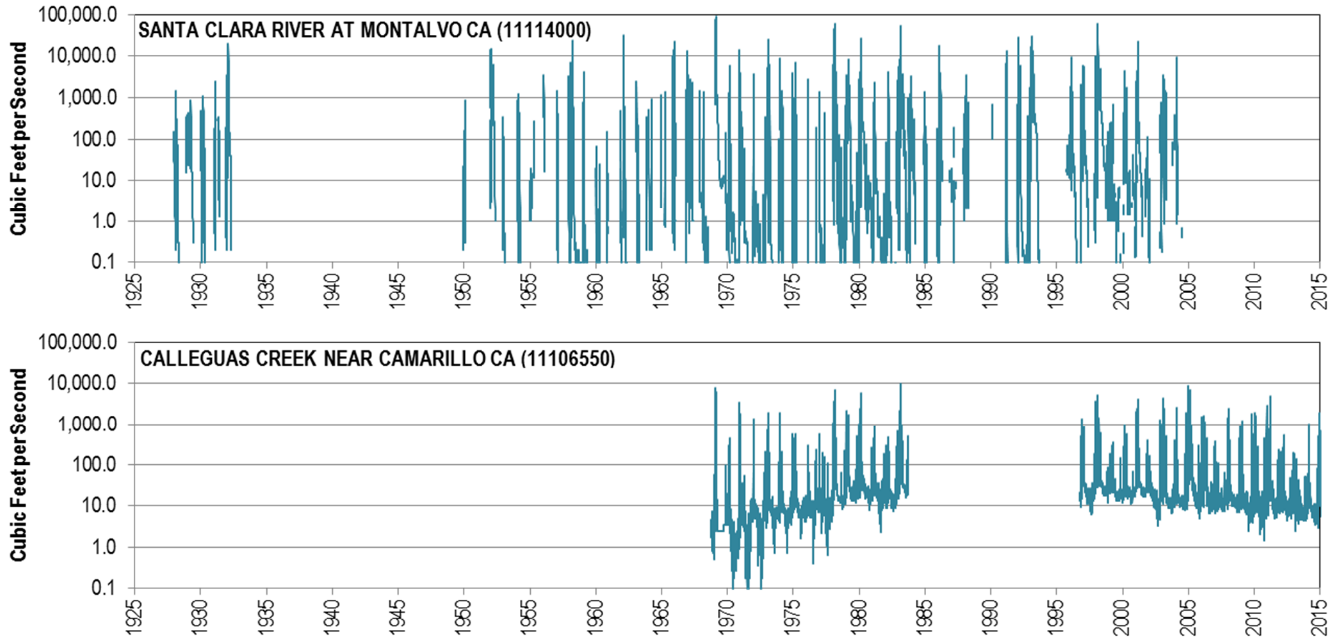

Figure 5: Daily Mean Streamflow for the Lower Santa Clara River and Callegaus Creek

SECTION 4
LAND USE AND LAND COVER

The Ventura County General Plan (County of Ventura, 2011) is used to describe the land use overlying the SNMP planning area. Figure 6 shows the distribution of land use types for each groundwater basin.

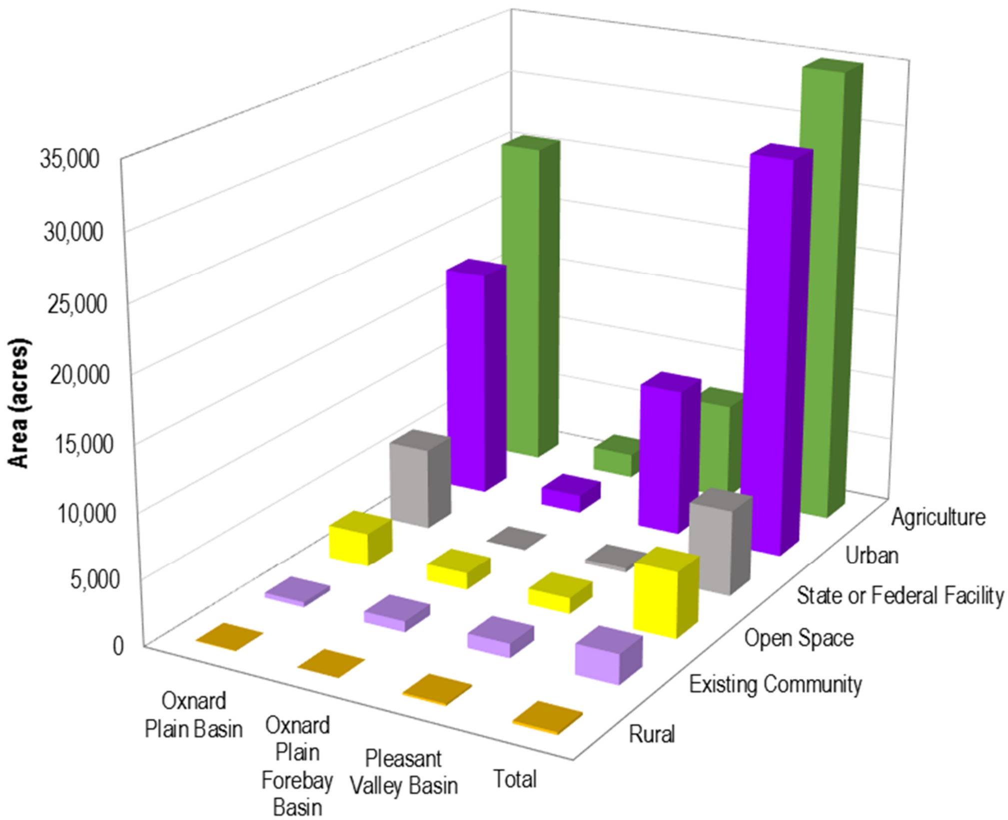

Figure 6: Land Use Type by Area

Agriculture is the predominant land use in the Oxnard Plain basin, followed by urban and state or federal facilities. Some open space does exist but for the most part, the basin is developed. The Pleasant Valley basin has predominantly urban land uses, with agriculture covering approximately 37% of the basin (Table 2). The Oxnard Plain Forebay basin has a similar distribution of agriculture, urban, and open space land uses (31%, 29%, and 27% respectively). Much of the open space in the Oxnard Plain Forebay basin is used for managed aquifer recharge by UCWD.

Overall in the planning area, the urban landscape predominates (comprising urban, existing communities, and state or federal facilities). Agriculture is the next predominant land use, with open space and rural covering much less of the planning area compared to the other land uses (Table 2). The amount of urban development has increased at the expense of agricultural land due to the region's approximately 4% annual population growth.

Table 2: Distribution of Land Use by Basin

Land Use	Percent Acreage in Groundwater Basin			Planning Area
	Oxnard Plain	Pleasant Valley	Oxnard Plain Forebay	
Agricultural	48.7%	34.6%	34.5%	43.9%
Urban	33.6%	25.7%	52.6%	38.2%
State & Federal Facility	11.9%	0.0%	1.5%	8.3%
Existing Community	0.7%	15.5%	5.1%	2.9%
Open Space	4.9%	24.2%	5.6%	6.4%
Rural	0.1%	0.0%	0.7%	0.3%

Source of data: Ventura County General Plan (2011)
Note: the urban reserve classification is applied to all unincorporated land within a city's adopted Sphere of Influence.

Table 3 summarizes the distribution of crops for each groundwater basin, and for the planning area as a whole. The predominant crops grown overall are row crops and strawberries.

Table 3: Distribution of Agricultural Activities by Basin (December 2014)

Crop/Agricultural Type	Percent of Agricultural Land Use			
	Oxnard Plain	Pleasant Valley	Oxnard Plain Forebay	Planning area
Apple	-	<0.1%	-	<0.1%
Artichoke	0.4%	-	-	0.3%
Avocado	1.3%	5.0%	5.1%	3.4%
Bean	0.6%	-	-	0.4%
Berries	0.1%	-	-	<0.1%
Blackberry	<0.1%	-	-	<0.1%
Blueberry	0.4%	1.0%	-	0.5%
Cabbage	1.0%	6.7%	-	2.2%
Celery	10.5%	8.5%	-	9.2%
Cherimoya	-	0.6%	-	0.1%
Cilantro	<0.1%	1.0%	-	0.2%
Citrus	-	<0.1%	-	<0.1%
Corn	<0.1%	-	-	<0.1%
Cucumber	<0.1%	-	-	<0.1%
Cut Flowers	2.1%	0.8%	0.7%	1.7%
Fallow	<0.1%	-	-	<0.1%
Grain	0.5%	-	-	0.4%
Grape	-	<0.1%	-	<0.1%
Greenhouse	<0.1%	-	-	<0.1%
Greens	0.1%	-	-	0.1%
Herbs	-	0.4%	-	<0.1%
Kale	<0.1%	-	-	<0.1%
Lemon	2.6%	8.9%	17.7%	4.8%
Lemon & Avocado	-	-	-	<0.1%
Lettuce	-	0.3%	-	<0.1%
Macadamia	-	<0.1%	-	<0.1%
Nursery	0.3%	0.2%	5.2%	0.6%
Orange	-	<0.1%	-	<0.1%
Parsley	-	0.4%	-	<0.1%
Pasture	-	-	-	<0.1%
Pepper	3.7%	2.0%	-	3.0%
Persimmon	-	<0.1%	-	<0.1%
Raspberry	11.4%	11.6%	0.4%	10.8%
Row Crops	23.6%	38.2%	5.5%	25.8%
Sapote	-	<0.1%	-	<0.1%
Sod	3.7%	1.1%	-	2.8%

Crop/Agricultural Type	Percent of Agricultural Land Use			
	Oxnard Plain	Pleasant Valley	Oxnard Plain Forebay	Planning area
Spinach	0.3%	-	-	0.2%
Squash	0.1%	<0.1%	-	<0.1%
Strawberry	36.6%	12.0%	65.3%	32.1%
Tangerine	-	<0.1%	-	<0.1%
Tomato	0.5%	0.1%	-	0.3%
Unknown	<0.1%	0.9%	<0.1%	0.2%
Vegetable Seed	<0.1%	-	-	<0.1%
Agricultural Area of Basin (acres)	**21,800**	**7,000**	**1,400**	**30,200**

Source of data: Ventura County Office of the Agricultural Commissioner (December 2014)

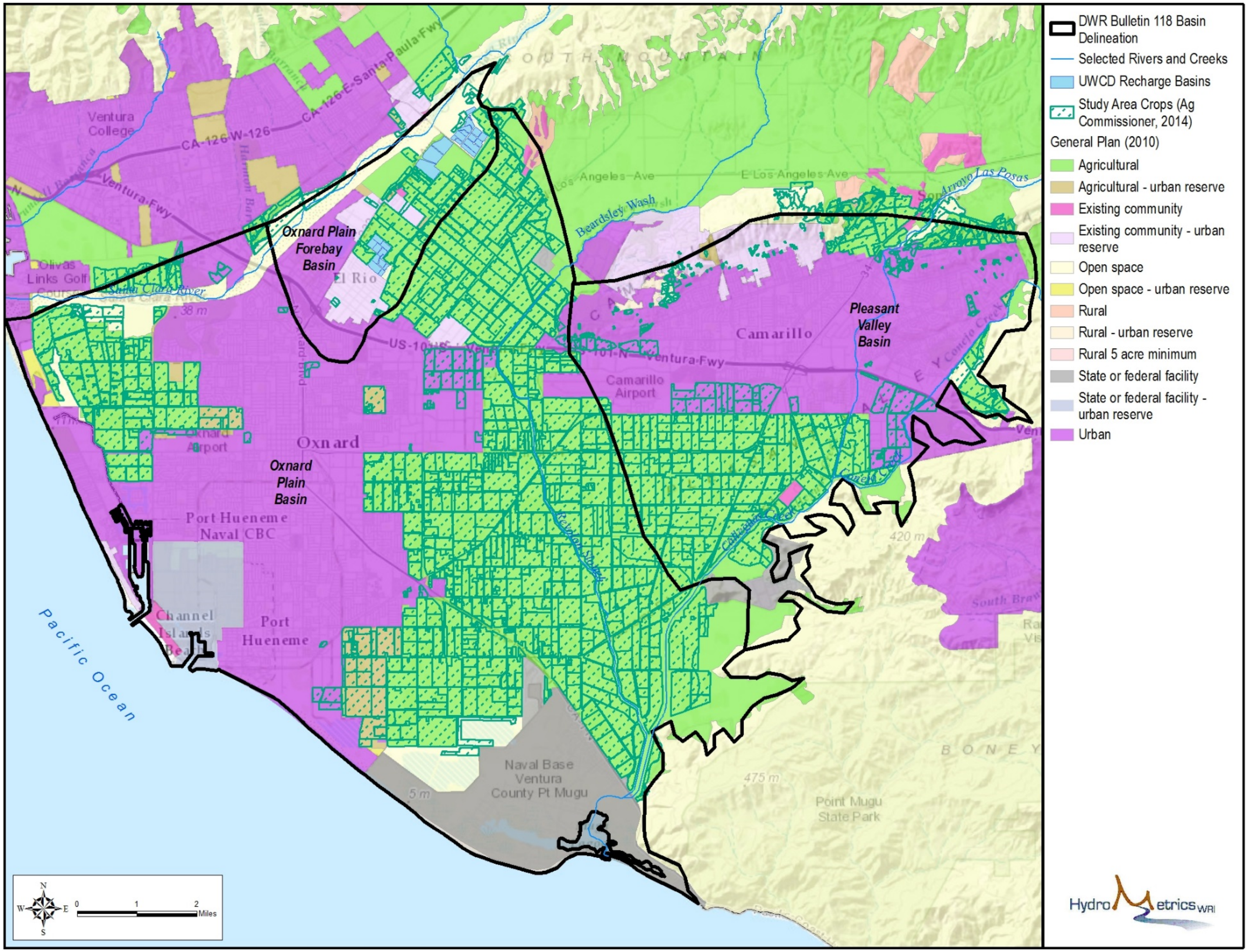

Figure 7: Land Use and Crop Cover

SECTION 5
BASIN GEOLOGY AND HYDROGEOLOGY

5.1 GEOLOGY

The groundwater basins of the SNMP planning area are part of the Transverse Ranges geologic province. The province's mountain ranges and basins are orientated east-west, instead of the northeast-southwest trend that occurs in much of California and the western United States. The Santa Clara valley is bordered by active thrust and reverse faults, which have caused uplift of the adjacent mountains relative to the Santa Clara River valley (UWCD, 2012b). The valleys have experienced both terrestrial and marine Tertiary and Quaternary sedimentation. The surface geology on Figure 8 illustrates the vast majority of the planning area comprises alluvium, with outcrop of San Pedro Formation only occurring the Camarillo Hills, along the northern boundary of the Pleasant Valley basin.

5.2 GENERAL HYDROGEOLOGY

The groundwater basins of the SNMP planning area generally contain two major aquifer systems: Upper Aquifer System (UAS) and Lower Aquifer System (LAS) (Turner, 1975; Mukae and Turner, 1975). Figure 9 illustrates the hydrostratigraphic and geologic relationship of the UAS and LAS with the regional geology. Each system has its own locally named aquifers. These include the Oxnard and Mugu aquifers of the UAS, and the Hueneme, Fox Canyon, and Grimes Canyon aquifers of the LAS. The Oxnard Plain and Pleasant Valley basins have a "semi-perched" zone that locally may contain poor quality water (FCGMA, 2007). The aquifers of the UAS and LAS comprise coarse-grained sediments that were either deposited along the ancestral Santa Clara River, within alluvial fans emanating from mountain valleys, or in a coastal plain/delta complex and the terminus of the Santa Clara River and Calleguas Creek. The coastal plain was heavily influenced by alternating episodes of advancing or retreating shallow seas that varied with world-wide sea level changes over many millions of years (FCGMA, 2007).

This section relies heavily on previous hydrogeological studies by UCWD over the years to characterize the groundwater basins.

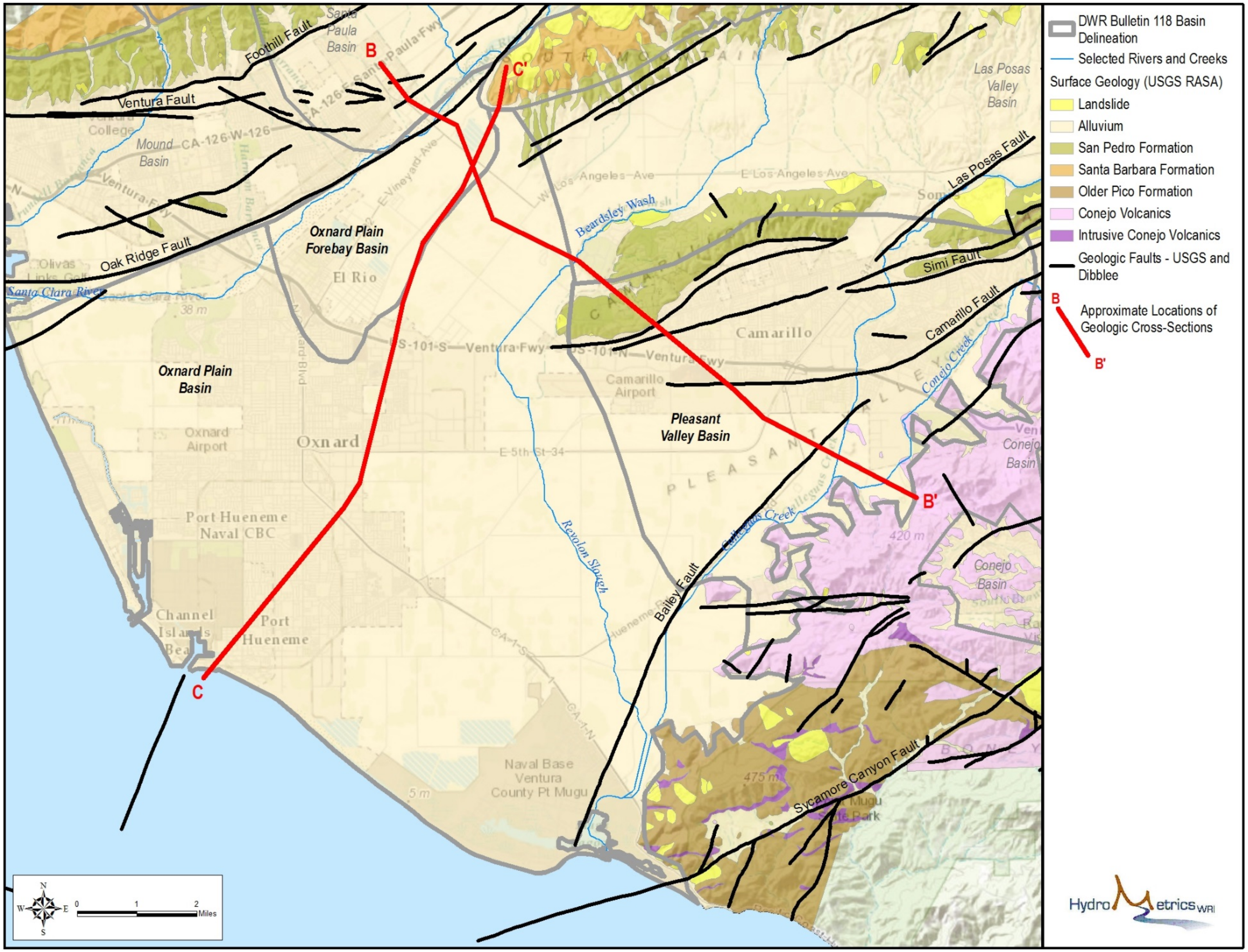

Figure 8: Surface Geology

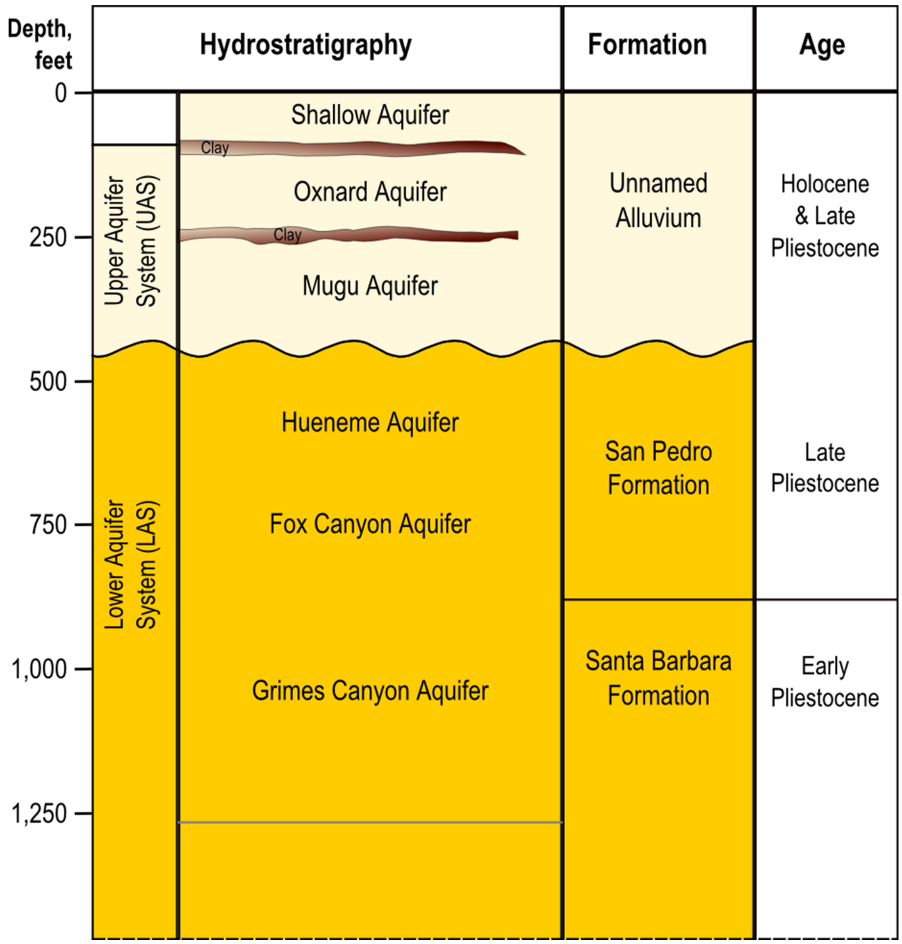

Figure 9: Planning Area Aquifer Systems (UWCD, 2012b)

5.2.1 Perched/Semi-Perched

On the Oxnard Plain, a perched/semi-perched zone overlies in the uppermost silt and clays of the Oxnard aquifer. This sandy zone generally contains poor-quality water and is rarely used for water supply.

5.2.2 Upper Aquifer System (UAS)

Upper Aquifer System (UAS) aquifers comprise the Mugu (deepest) and Oxnard (shallowest) aquifers of Late Pleistocene and Holocene age (Figure 9). An unconformity separates the UAS from the LAS, indicated by a basal conglomerate in many areas (Hanson et al., 2003) which is regarded as the Mugu aquifer. The Oxnard Plain is entirely underlain by the Oxnard aquifer at a depth of between 100 – 220 feet below ground surface. The Oxnard aquifer is the primary source of irrigation and water supply for the Oxnard Plain.

5.2.3 Lower Aquifer System (LAS)

The aquifers making up the LAS, from deepest to shallowest are the Grimes Canyon, Fox Canyon, and Hueneme aquifers (Figure 9). The aquifers are commonly separated from one another vertically by low permeability silts and clays, and horizontally by regional faults. Because of active tectonics in the area, the LAS is folded and tilted in many areas, with an unconformity between the LAS and UAS.

The LAS is part of the Santa Barbara, San Pedro, and Saugus formations of Pleistocene age (Hanson et al., 2003). The Grimes Canyon aquifer only occurs in the East Las Posas and Pleasant Valley basins. The Fox Canyon aquifer is the only aquifer that underlies all three basins of the SNMP planning area. The Hueneme aquifer underlies most of the coastal area of the southern Oxnard Plain (Hanson et al., 2003).

5.3 Oxnard Plain Basin Hydrogeology

5.3.1 Basin Aquifers

The Oxnard Plain basin is distinguished from the Oxnard Plain Forebay basin by the presence of a confining clay layer above which a semi-perched zone exists (Figure 10). The Oxnard Plain basin contains both the UAS and LAS. The UAS sediments are relatively flat lying across the upper 400 feet of the Oxnard Plain. Although the LAS is present, its lowermost aquifer, the Grimes Canyon aquifer is not.

Vertical hydraulic gradients commonly occur between aquifers on the Oxnard Plain, causing some degree of movement between most of the major aquifers, both upwards and downwards (UWCD, 2014). For example, when groundwater levels in the shallow confined Oxnard aquifer are lowered (either regionally by drought conditions or locally by pumping), the movement of poor-quality water in the semi-perched aquifer downwards into the Oxnard aquifer has been reported (UWCD, 2014). This downward vertical gradient together with abandoned and improperly destroyed wells acting as conduits (Izbicki, 1992; Stamos et al., 1992) are partly responsible for degrading water quality in the major aquifers.

The Oxnard Plain basin extends several miles offshore beneath the marine shelf, where the outer edges of its aquifers are in direct contact with seawater. Furthermore, the aquifers are in direct contact with seawater only a short distance offshore where submarine canyons near Port Hueneme and Point Mugu extend almost to the coastline (FCGMA, 2007).

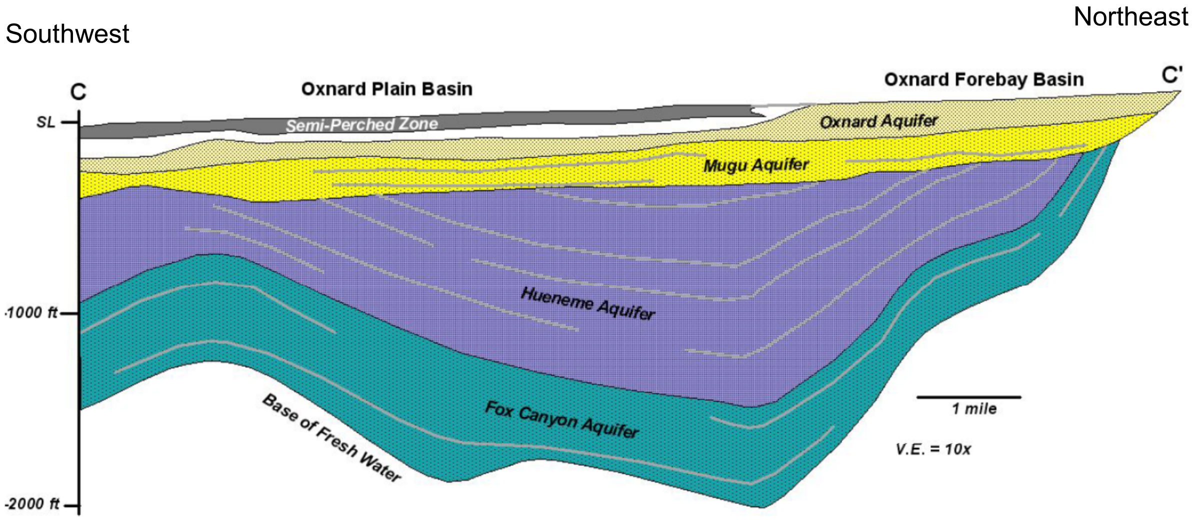

Figure 10: Geologic Cross-Section across the Oxnard Plain and Oxnard Plain Forebay Basins (simplified from Mukae and Turner, 1975)
See Figure 8 for Cross-Section Location

5.3.2 Groundwater Levels and Movement

Figure 11 and Figure 12 show groundwater elevations for the UAS and LAS, respectively, for average, wet, and dry years. The contours were provided by UWCD. In general, Figure 11 shows that UAS groundwater flows from the Oxnard Plain Forebay basin southwards into the Oxnard Plain basin and then southeasterly along the coast towards Point Mugu. The contours indicate that there is some flow across the basin's northern boundary into the Mound basin.

Groundwater levels in the Oxnard and Mugu aquifer, in the northern portions of the Oxnard Plain, are similar. However, in the south around the Mugu Lagoon, Mugu aquifer groundwater levels are deeper. The LAS sediments are generally finer-grained and have been deformed by folding and faulting in many areas. Because of the uneven distribution of pumping and structural and stratigraphic differences within the LAS, the deep wells in the basin have quite varied heads that can be challenging to contour.

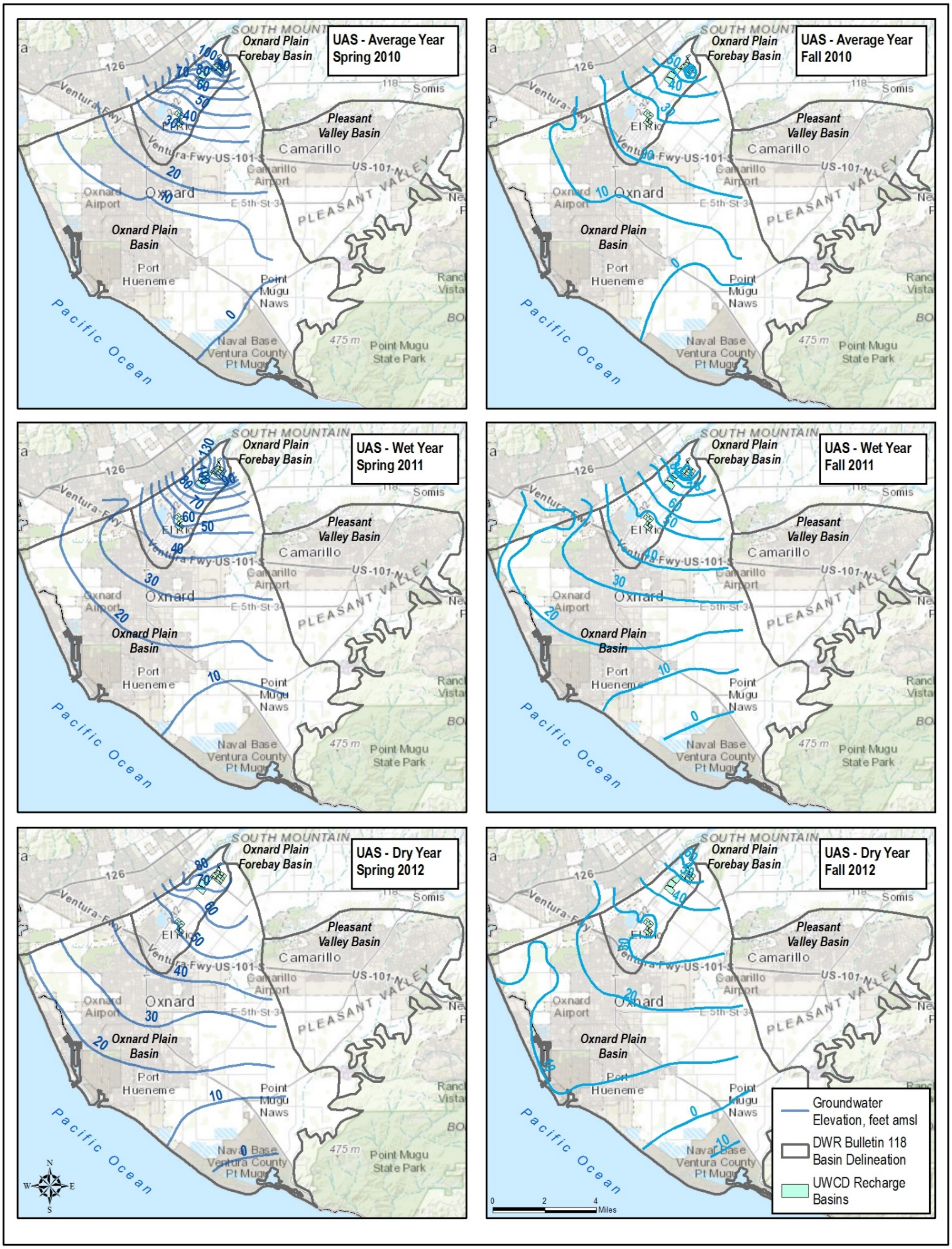

Figure 11: SNMP Planning Area Upper Aquifer System Groundwater Elevations

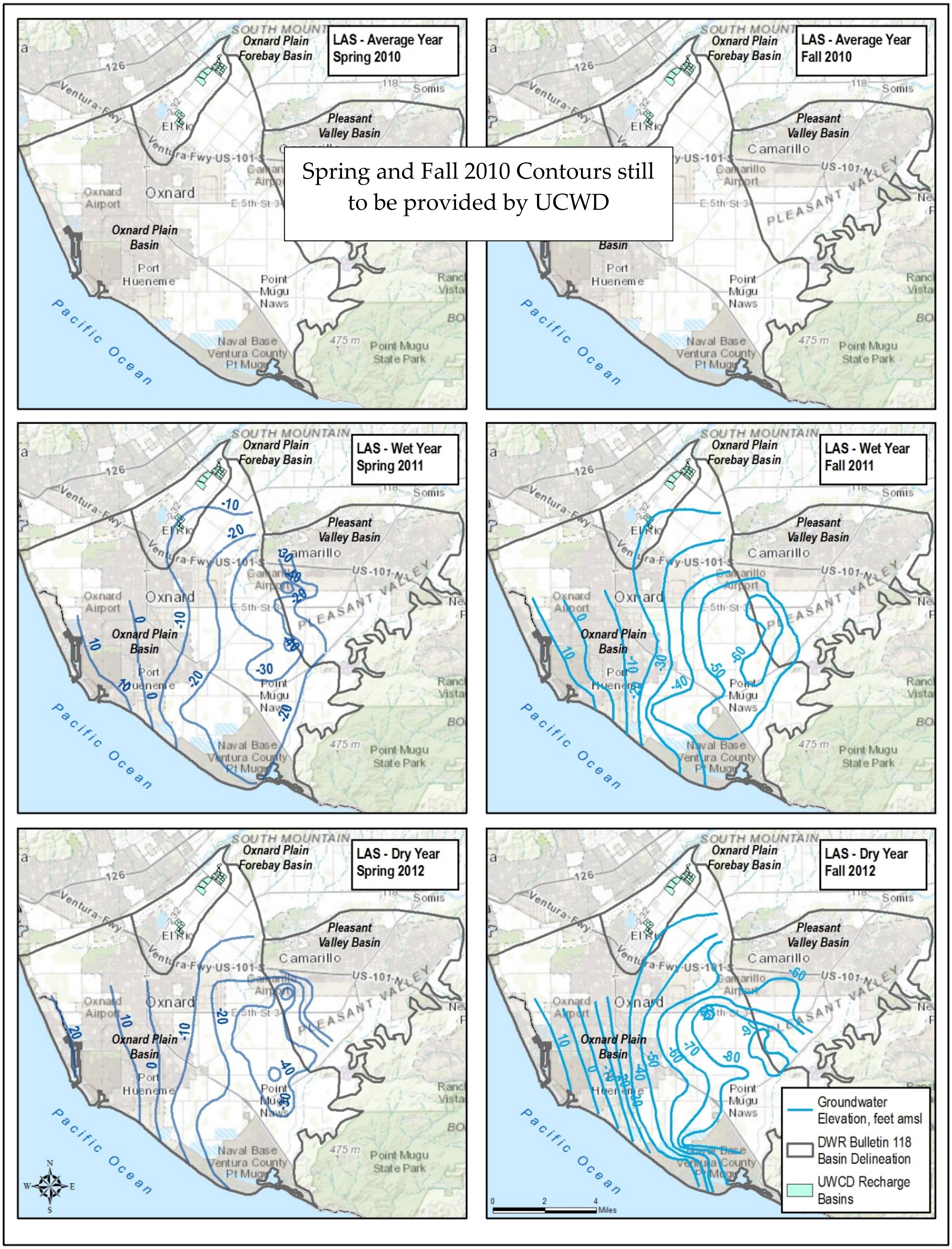

Figure 12: SNMP Planning Area Lower Aquifer System Groundwater Elevations

Figure 12 shows that a well-defined pumping depression occurs near the Oxnard Plain basin and Pleasant Valley basin boundary which is below mean sea level. In the drier years, the depression is more pronounced and extends deeper than 90 feet below mean sea level. A groundwater divide (0 feet above mean sea level contour) occurs south of the Oxnard Plain Forebay basin, with groundwater to the east of the divide flowing inland towards the Pleasant Valley basin, and groundwater to the west of the divide flowing towards the Pacific Ocean.

5.3.3 Recharge and Discharge

Recharge to the Oxnard Plain basin is primarily by underflow from the hydraulically upgradient Oxnard Plain Forebay basin. Other sources of recharge include streambed percolation from the Santa Clara River, deep percolation of rainfall, and agricultural and municipal irrigation return flows.

Where coastal groundwater elevations are greater than sea level groundwater discharges into the ocean. Other discharges occur through outflow to adjacent basins, and by groundwater extractions. Groundwater extractions have increased over the past 19 years as shown in Figure 13. Drought conditions in the state have resulted in the greatest demand being placed on the basin's aquifers over the past two years. Production in 2014 was almost 66,000 acre-feet. Approximately two-thirds of groundwater extracted is used for agriculture, and only one-third for domestic, municipal, and industrial uses.

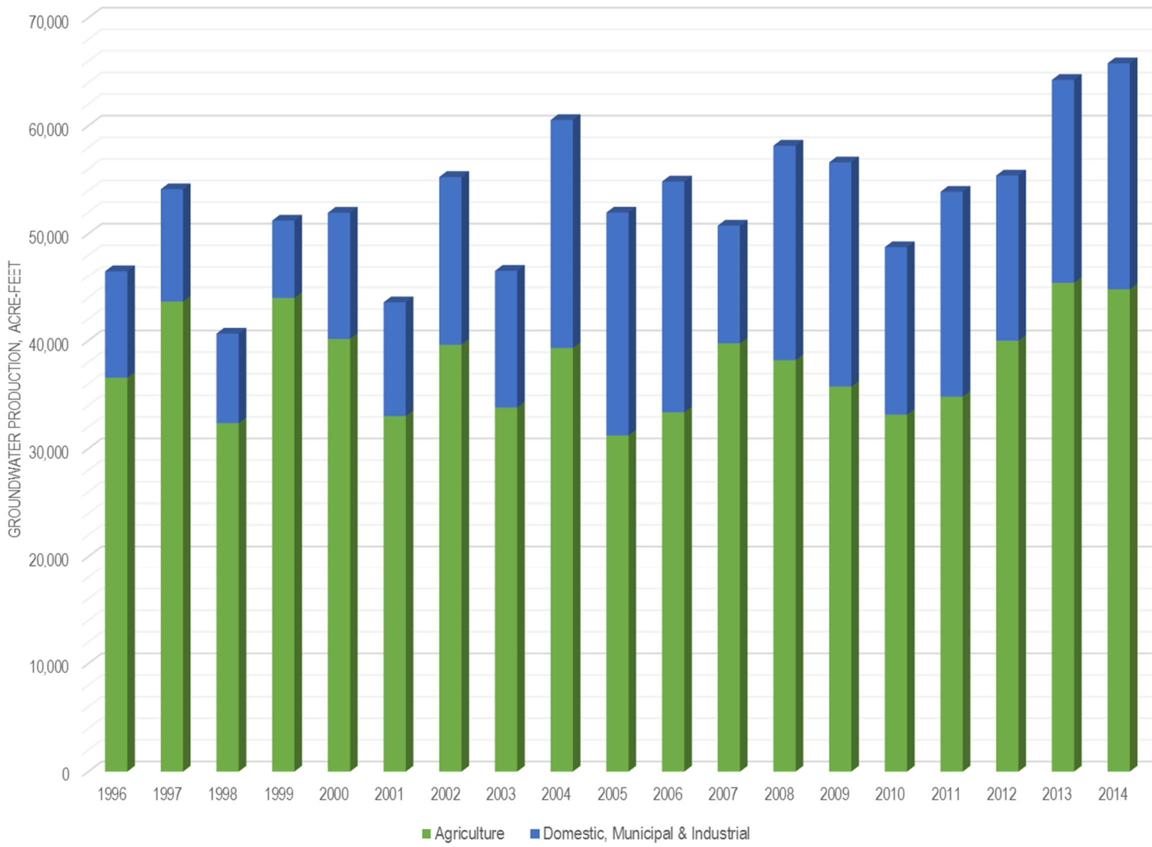

Figure 13: Oxnard Plain Basin Historical Groundwater Production

5.4 OXNARD PLAIN FOREBAY BASIN HYDROGEOLOGY

5.4.1 BASIN AQUIFERS

The Oxnard Plain Forebay basin is delineated as the unconfined portion of the Oxnard Plain basin, and contains both the UAS and LAS (Figure 20). As the Oxnard Plain Forebay basin aquifers are in direct hydraulic connection with the confined aquifer of the Oxnard Plain basin and has no confining layers, it is the primary source of recharge to the Oxnard Plain basin (Figure 10). The Oxnard Forebay basin is also a source of recharge to adjacent basins: Mound, West Las Posas, and Pleasant Valley, but the majority of its groundwater underflow is downgradient to the Oxnard Plain basin (UWCD, 2012b).

The UAS (Oxnard and Mugu aquifers) in the Oxnard Forebay basin consists primarily of coarse-grained alluvium deposited by the ancestral Santa Clara River and is laterally extensive over the entire basin. A geophysical investigation in the basin has shown the Oxnard aquifer to range in thickness from roughly 200 to 280 feet (UWCD, 2013c). The UAS lies unconformably over the LAS. Due to the Montalvo anticline, the LAS in the area between the El Rio and Saticoy spreading grounds has been uplifted and truncated along its contact with the UAS (UWCD, 2013c). In some areas, significant clays are present in the LAS.

5.4.2 Groundwater Levels and Movement

UAS groundwater elevations in the Oxnard Plain Forebay basin are shown on Figure 11 for an average year (2010), wet year (2011), and dry year (2012). In general, groundwater flows from UWCD's recharge basins in the northeast to the southwest and into the Oxnard Plain basin. Groundwater elevations in the Oxnard Plain Forebay basin north of the basin in wet years can be in excess of 120 feet above mean sea level (amsl) and fall to 60 feet amsl in dry years. Groundwater levels in the basin are strongly influenced by how much water is diverted from the Santa Clara River and recharge in UWCD's managed aquifer recharge facilities located. In the southern portion of the basin, UAS groundwater levels can fall as low as 20 feet amsl and rise up to 40 feet amsl. The steepest hydraulic gradients are generally observed in the northern half of the basin.

5.4.3 Recharge and Discharge

It has been estimated that approximately 20% of recharge in the Oxnard Plain Forebay basin reaches the LAS, with the remainder recharging the UAS (Hanson, 1998). Other sources of recharge include streambed percolation from Santa Clara River flows, UWCD's managed aquifer recharge at Saticoy, Noble, and El Rio spreading grounds, agricultural and municipal irrigation return flows, deep percolation of rainfall, and lesser amounts of underflow from adjacent basins. Managed aquifer recharge by UWCD maintains high groundwater elevations in the Oxnard Plain Forebay basin thereby increasing hydraulic pressures in the confined aquifers of the Oxnard Plain basin, raising groundwater levels throughout the Oxnard Plain and reestablishing natural offshore flow in coastal areas.

Discharge from the basin occurs mainly through underflow to neighboring basins, but also from groundwater extractions. Figure 14 shows that current groundwater production is approximately 20,000 AFY. Note that the vertical scale of the chart is the same as the Oxnard Plain basin production chart (Figure 13) to illustrate relative differences. The chart shows that over time, agricultural use has remained more constant than domestic, municipal, and industrial use. Non-agricultural usage is greater than agricultural usage, but has decreased since 2007, possibly due to water conservation efforts.

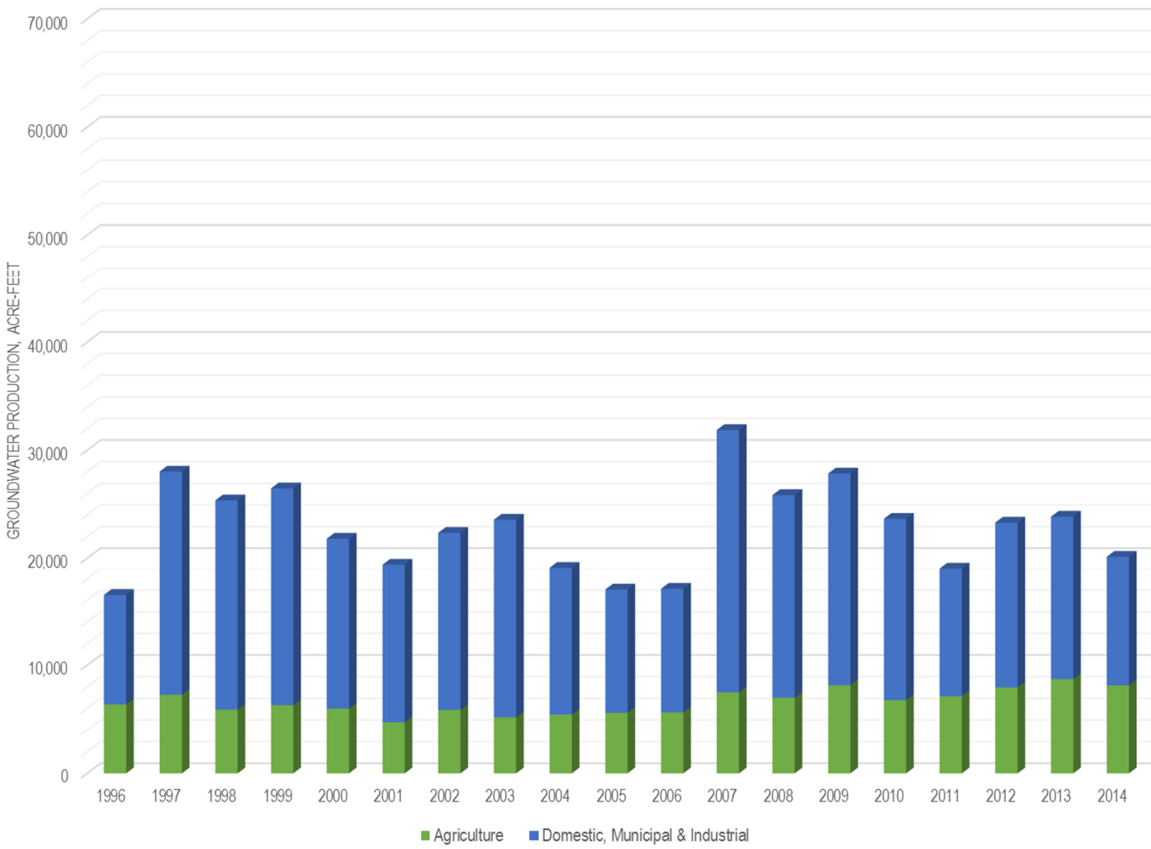

Figure 14: Oxnard Plain Forebay Basin Historical Groundwater Production

5.5 Pleasant Valley Basin Hydrogeology

5.5.1 Basin Aquifers

The Pleasant Valley basin is differentiated from the Oxnard Plain basin by a general lack of productive UAS units (Turner, 1975). Where UAS alluvial sediments occur they are approximately 400 feet thick, similar to the Oxnard Plain basin. The UAS is mostly fine-grained alluvial sediments deposited by the Callegaus Creek, which is much lower energy system compared to the Santa Clara River. Because of the fine-grained nature of these sediments, there are very few wells extracting groundwater from them.

LAS aquifers occur across the basin, extending to a depth of approximately 1,400 feet (Figure 15). The Hueneme aquifer comprises alternating sand and finer-grained deposits. The Fox Canyon and Grimes Canyon aquifers comprise thick sequences of relatively uniform marine sands, with the Fox Canyon aquifer being the main water-bearing unit in the basin. The lowest water-bearing unit of the Pleasant Valley basin is the Grimes Canyon aquifer. Pleasant Valley basin LAS is hydraulically connected to the Oxnard Plain basin's LAS.

In the Pleasant Valley basin, the LAS is surrounded and underlain by partly consolidated marine deposits and volcanic rocks. Outcrops of the San Pedro formation marine deposits occur in the Camarillo Hills along the basin's northern boundary and at the basin's western edge next to the Santa Monica Mountains near the coast. Because of faulting and uplift of the marine deposits near Mugu Lagoon, the LAS is not hydraulically connected to the ocean (Izbicki, 1996a; Hanson et al., 2003). The underlying marine deposits and volcanic rocks both contain high-chloride water.

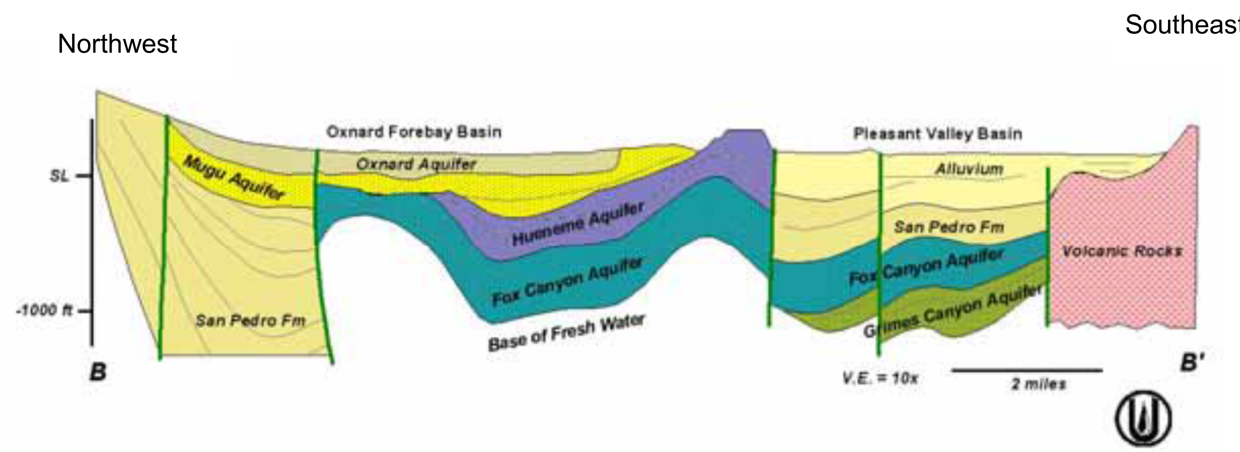

Figure 15: Geologic Cross-Section across Pleasant Valley and Oxnard Plain Forebay Basins (simplified from Mukae and Turner, 1975)
See Figure 8 for Cross-Section Location

5.5.2 Groundwater Levels and Movement

Pre-development natural groundwater movement in the Pleasant Valley basin was likely from the east of the basin to the southwest into the Oxnard Plain basin, however groundwater demands within the Pleasant Valley basin have reversed that flow direction. Important to note is that the northern portion of the basin has shown a groundwater level recovery over the past two decades of approximately 280 feet due to the re-establishment of surface flows in Arroyo Las Posas that has recharged the underlying LAS through streambed percolation.

Figure 12 show groundwater elevations for the LAS for average, wet, and dry years. Generally, groundwater in the LAS of the Pleasant Valley basin flows from east to west. This flow direction, is likely the same as the natural flow direction pre- groundwater development, however, a defined pumping depression near the basin's boundary with the Oxnard Plain basin intercepts groundwater flow that would otherwise have passed across the basin's boundary and traveled towards the ocean.

Most wells in the Pleasant Valley basin are screened in the LAS. UCWD reports that some wells are screened in coarse basal units of the UAS, but pumping and groundwater level measurements from UAS wells are uncommon, as the UAS in this area is predominantly fine-grained, and UCWD does not attempt to contour these levels (UCWD, 2003).

5.5.3 Recharge and Discharge

The LAS in Pleasant Valley appears to be fairly isolated from sources of recharge, with age dating of the water indicating ages ranging from 3,000 to more than 6,000 years before present (Izbicki, 1996b). The northern Pleasant Valley basin where groundwater level recovery has been observed from streambed percolation, as described in Section 5.5.2, is now recognized as a source of recharge to the basin. How much this recharge area influences recharge to the central portion of the basin is not well understood (UWCD, 2014). The City of Camarillo is planning construction of a desalter to pump, treat, and utilize this water, which is more mineralized than the surrounding native groundwater.

Limited surface source recharge to the basin, because of the fine-grained alluvium, occurs through streambed percolation from Calleguas Creek, deep percolation of rainfall, and agricultural and municipal irrigation return flows. It is not well understood if recharge occurs from underflow of groundwater from the Arroyo Santa Rosa and East Las Posas basins.

Groundwater discharge from the Pleasant Valley basin occurs primarily by groundwater pumping (between 10,000 – 20,000 acre-feet per year, Figure 16). Agricultural production exceeds domestic, municipal, and industrial production.

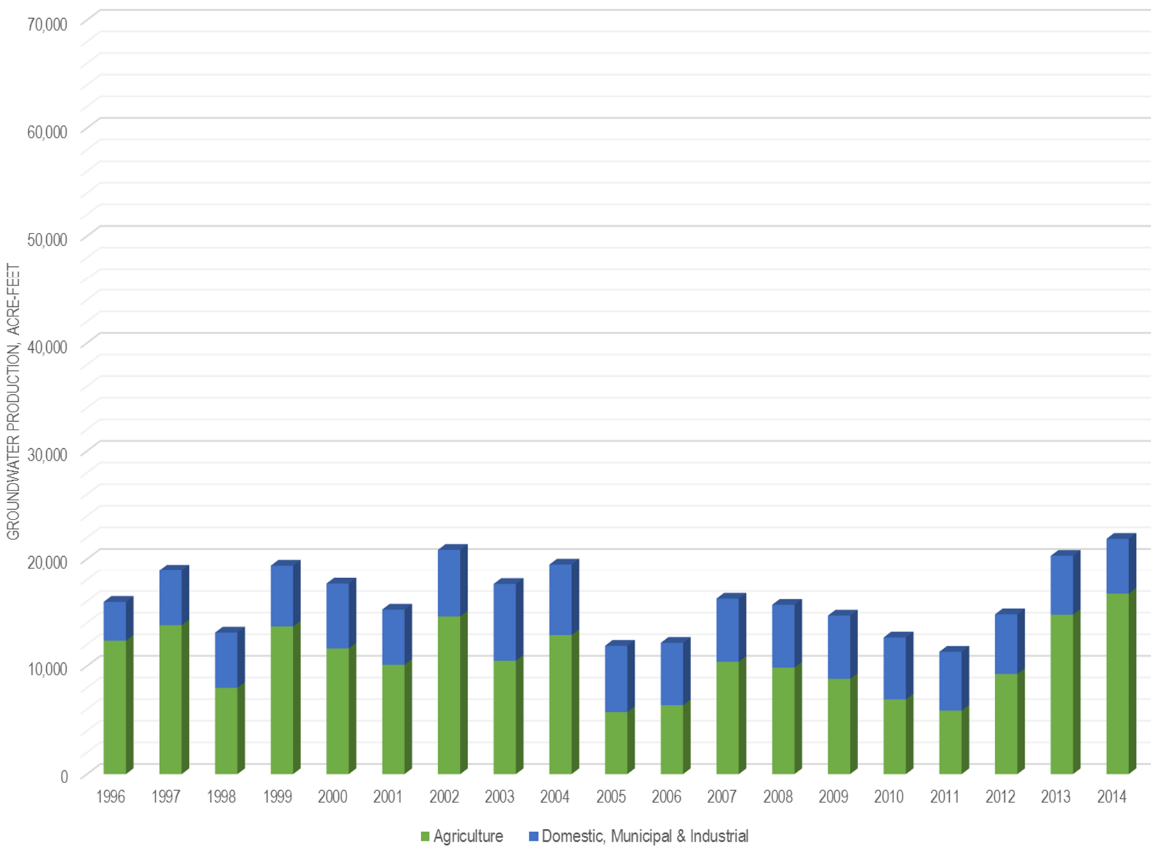

Figure 16: Pleasant Valley Basin Historical Groundwater Production

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SECTION 6
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APPENDIX C - SNMP MONITORING SUMMARY

Summary of Monitoring Programs in the Oxnard SNMP Study Area

Data Type	Agency	Frequency	Parameter: EC	TDS	Salinity	Chloride	Sulfate	Boron	Total Nitrogen	Organic Nitrogen	TKN	Ammonia	Nitrate	Nitrite	Nitrate + Nitrite	CECs	No. of Locations	Program	Description	Figure	Source
Groundwater	Ventura County	Annually	■	■	■	■	■						■				Varies by year	Ventura County Groundwater Monitoring Program	This program includes annual monitoring of groundwater wells for the purposes of groundwater resource assessment and management. The number of wells varies annually. For example in 2012 and 2013 there were 168 and 173 wells sampled throughout the County, respectively.		Ventura County - Groundwater Section Annual Reports
Groundwater	UWCD	Quarterly	■	■		■	■	■*					■				61	UWCD Water Quality Monitoring Program	UWCD conducts water quality monitoring of production wells and dedicated monitoring wells. In addition, UWCD uses groundwater monitoring data collected by Ventura County and water purveyors (data submitted to CPDH) to characterize groundwater quality within the District. *For the quarterly sampling events, an abbreviated suite of general minerals are analyzed twice per year. For the semi-annual sampling events, an abbreviated suite of general minerals are analyzed once per year. The abbreviated suite of general minerals does not include boron.		UWCD Groundwater and Surface Water Conditions Reports, Personal communication with Dan Detmer
		Semi-Annually	■	■		■	■	■*					■				33				
Groundwater	Ventura County Water Works	Quarterly		■		■	■	■		■		■	■	■			4	WWTP WDR Monitoring requirements	The County conducts sampling from wells upgradient and downgradient of percolation ponds.		MRP No. CI 5714
Groundwater	Saticoy Sanitary District	Quarterly		■		■	■	■	■	■		■	■	■			2	WWTP WDR Monitoring requirements	Prior to August 2013 there were 2 monitoring wells installed around the WWTP and the percolation/evaporation ponds. A cease and desist order was implemented in June 2013.		MRP Order R4-2013-0092
		Annually														■	2				
Groundwater	Montalvo Municipal Improvement District	Semi-Annually		■		■	■	■					■	■	■		3	WWTP WDR Monitoring requirements	Upstream and downstream of WWTP		MRP No. CI-5068
Groundwater	Camrosa Water District	Semi-Annually		■		■	■	■					■	■			2	WWTP WDR Monitoring requirements	Upstream and downstream of WWTP		MPR Order R4-2015-0030
Groundwater	City of Ventura	Annually											■				6	DDW Monitoring Requirements	The City conducts water quality monitoring of raw groundwater from their potable water supply wells.		DDW - Section 6 (Santa Barbara) Drinking Water Monitoring Schedule
		Other - Every 3 Years	■	■		■	■							■							
Groundwater	City of Oxnard	Annually											■				10	DDW Monitoring Requirements	The City conducts water quality monitoring of raw groundwater from their potable water supply wells.		DDW - Section 6 (Santa Barbara) Drinking Water Monitoring Schedule
		Other - Every 3 Years	■	■		■	■							■							
Groundwater	Other Small Water Purveyors	Annually											■				34	DDW Monitoring Requirements	The water purveyors conduct water quality monitoring of raw groundwater from their potable water supply wells. Such water purveyors include Camarillo Water District, Camrosa Water District, Naval Base Ventura County Point Mugu, Naval Base Ventura County Port Hueneme, Pleasant Valley Mutual Water Company, Port Hueneme Water Company , Saticoy Country Club, Ventura CWWD - Somis, and Ventural Water Department.		DDW - Section 6 (Santa Barbara) Drinking Water Monitoring Schedule
		Other - Every 3 Years	■	■		■	■							■							
Groundwater	USGS	Infrequently (most recent 2007)	■*	■*		■*	■*	■*				■*					18	California's GAMA Program	The Groundwater Ambient Monitoring and Assessment Program (GAMA) collects data by comprehensively sampling public and private groundwater sources. The GAMA Program was created by the State Water Board in 2000. * Parameter sampling depends on the well.		http://www.waterboards.ca.gov/gama/

Data Type	Agency	Frequency	Parameter														No. of Locations	Program	Description	Figure	Source
			EC	TDS	Salinity	Chloride	Sulfate	Boron	Total Nitrogen	Organic Nitrogen	TKN	Ammonia	Nitrate	Nitrite	Nitrate + Nitrite	CECs					
Groundwater	EPA	Annually		■		■	■					■	■	■				Halaco Superfund Site Monitoring Program	In 2009,2010, and 2013, 17 monitoring wells located in the perched shallow aquifer and deeper Oxnard aquifer were tested. Depth of screening depends on the well.		Supplemental Groundwater Sampling and Analysis Results - Halaco Superfund Site (June 2014)
Surface Water	UWCD	Quarterly	■	■		■	■	■*					■				5	UWCD Water Quality Monitoring Program	UWCD conducts water quality monitoring of the Santa Clara River and tributaries. *For the quarterly sampling events, an abbreviated suite of general minerals are analyzed twice per year. The abbreviated suite of general minerals does not include boron. ** At two locations monitoring is conducted more frequently than quarterly. At Newhall Crossing, the general minerals suite (includes boron) is measured quarterly, and an abbreviated suite of minerals is measured on a monthly basis. At Freeman diversion, the general minerals suite (includes boron) is measured quarterly, and an abbreviated suite of minerals does not include boron) is measured twice per month.		UWCD Groundwater and Surface Water Conditions Reports, Personal communication with Dan Detmer
		Quarterly	■	■		■	■	■					■				7				
		Other	■	■		■	■	■**					■				2				
Surface Water	City of Ventura	Weekly			■												5	WWTP NPDES Permit Monitoring Requirements	Upstream and downstream of WWTP discharge		MRP Order R4-2008-011
		Monthly								■	■	■	■	■			5				
Surface Water	Camarillo Sanitary District	Monthly		■		■	■	■	■		■	■	■	■			2	WWTP NPDES Permit Monitoring Requirements	Upstream and downstream of WWTP discharge		MRP Order R4-2014-0062
Surface Water	VCAILG	Other - 1 to 2 dry events, and 1-2 wet events per year	■	■		■	■					■	■				7-8	Conditional Waiver of Waste Discharge Requirements for discharges from Irrigated Lands within the Los Angeles Region	The VCAILG conducts monitoring per the requirements of the conditional waiver. Monitoring locations include several tributaries to the Santa Clara River, on agricultural drainage ditch and one background site.		Conditional Waiver Order No. R4-2010-0186, VCLAIG 2010 Annual Monitoring Report
Surface Water	Ventura County	Annually	■		■	■		■			■	■			■		4	SCCWRP Bioassessment Study	This 5-year bioassessment study is complete. The monitoring program for this study included water quality analyses at the monitoring locations. The 4 monitoring locations varied over the 5 year monitoring program. It is unknown if additional monitoring will be conducted in the future .		Personal Communication with Ventura County
Surface Water/ Stormwater	Ventura County	Other - 4 dry events, and 2 wet events per year	■	■		■	■	■		■	■	■	■	■	■		27	Calleguas Creek Watershed TMDL Compliance Monitoring Program	The TMDL Compliance Monitoring Program addresses the monitoring requirements of the six TMDLs in the Calleguas Creek Watershed. The program monitors the receiving water, as well as agricultural and urban discharges. Samples are collected for 4 dry events and 2 wet events per year.		Calleguas Creek Watershed TMDL Compliance Monitoring Program - Sixth Year Annual Monitoring Reports (2014)
Surface Water/ Stormwater	Ventura County	Other	■	■	■			■			■	■			■		5	Ventura County Stormwater Quality Management Program	This program includes monitoring of mass emissions stations and major outfalls. Within the project study area there is one mass emission stations, Calleguas Creek, and 4 major outfall stations. The mass emission and major outfall stations are monitored 4 times per year, 3 wet events and 1 dry event.		Ventura County Stormwater Quality Management Program annual Report - Attachment E, Personal Communication Zoe Carlson

APPENDIX D - TECHNICAL MEMORANDUM - COASTAL OXNARD PLAIN BASIN SALINE GROUNDWATER

1814 Franklin St, Suite 501
Oakland, CA 94612

TECHNICAL MEMORANDUM

To: Elisa Garvey, Carollo Engineers

From: Stephen Hundt and Georgina King

Date: October 9, 2015

Subject: Coastal Oxnard Plain Basin Saline Groundwater

This technical memorandum presents an alternative approach for estimating assimilative capacity in the Oxnard Plain basin where there is a coastal saline zone. An estimate of assimilative capacity based on established water quality objectives is part of the Oxnard Plain and Pleasant Valley Salt and Nutrient Plan (SNMP) currently being developed. It is hoped that by obtaining guidance from the SNMP Technical Advisory Group (TAG) using the content of this technical memorandum we will use this approach for estimating assimilative capacity in the Oxnard Plain basin.

The Oxnard Plain basin has experienced impaired groundwater quality with high chloride concentrations since at least the early 1930's. Highly saline waters are present in the confined Upper Aquifer System (UAS) and Lower Aquifer System (LAS) as well as in the shallow unconfined aquifer typically referred to as the 'perched aquifer'. Regions of high salinity are focused in two arms which extend landward from below Port Hueneme and Mugu Lagoon. Wells in these areas show chloride concentrations of 100 mg/L to 17,000 mg/L which greatly exceed those in the aquifer to the north and west where concentrations tend to fall between 40 and 70 mg/L. The boundaries of these zones have changed with different management activities such as shifting the location of pumping, in-lieu recharge, and managed aquifer recharge in the Oxnard Forebay basin.

Various studies have attempted to measure the extent of the saline groundwater and identify possible chloride sources. Seawater intrusion, where seawater migrates inland in response to pumping induced drawdown in coastal aquifers, has long been known to occur. The regions of high salinity extending from below

Port Hueneme and Mugu Lagoon appear to result from seawater intrusion from outcrops of the aquifer systems are exposed to the ocean in submarine canyons. The LAS does not crop out in the Mugu submarine canyon and the salinity in the LAS near Mugu Lagoon is thought to originate from other sources. A series of studies by the USGS and others (USGS, 1996) in the 1990's identified additional sources of chloride to the aquifer systems, suggesting that seawater intrusion may not be as widely spread as previously thought. The additional sources of high salinity water are: lagoonal deposits in the UAS near Point Mugu and marine and volcanic rock surrounding and underlying the LAS. Importantly, the chloride in the UAS and LAS is thought to come primarily from natural sources which migrate into the aquifer in response to drawdown. The introduction of chloride through human activities such as fertilizer application has not been identified as a major source.

We recommend for purposes of the Oxnard Plain and Pleasant Valley SNMP that the Oxnard Plain basin be divided into two zones, an impaired coastal zone and the remainder of the basin, based on chloride concentrations[1]. The unimpaired zone has low salinity that can accept additional loading with recycled water without exceeding the water quality objectives for the aquifer systems. The impaired coastal zone currently has chloride concentrations greatly above water quality objectives. However, the introduction of desalted recycled water could also potentially benefit the impaired coastal zone by diluting the high levels of chloride or by raising groundwater levels to mitigate the drawdown-induced migration of naturally occurring saline waters into the aquifer. If the Oxnard Plain basin is treated as a single pool of water with a single assimilative capacity the high concentrations of the impaired zone strongly bias the estimate of existing groundwater quality and there will be no assimilative capacity. This would limit recycled water use in the basin.

Figures 1 and 2 below contain our proposed boundaries for both the UAS and LAS. The boundaries were drawn by combining two sources of information: groundwater quality sampling data from 2010 – 2014 in wells screened in both aquifer systems and a geophysical survey that used a measure of electrical conductivity of the aquifer systems to delineate saline zones (UWCD, 2010). The

[1] The spatial distribution of TDS concentrations in wells follows the same general pattern as chloride, and therefore the impaired zone for chloride is suitable for use with TDS in both the UAS and LAS.

impaired zone was drawn to include wells where median chloride concentrations are generally above 100 mg/L and to honor the shape of the saline and brackish zones identified in the geophysical survey. The concentration of 100 mg was chosen as it is a salinity level that is harmful to local salt-sensitive crops.

The Fox Canyon Groundwater Management Agency (FCGMA) is responsible for the management of groundwater in the groundwater basins covered by this SNMP. Currently, FCGMA is in the process of developing planning goals that guide their management planning according to the Sustainable Groundwater Management Act (SGMA). Two draft goals are relevant to the water quality issues in the impaired zone. These are:

1) Seawater intrusion: stabilize the seawater intrusion front at the current position; and

2) Migration and intrusion of poor quality water: abate and/or do not allow groundwater quality to degrade beyond basin plan objectives without mitigation.

We will make the assumption that, based on these goals, we do not expect the impaired zone to increase, but rather to decrease over time with the implementation of activities to improve basin sustainability.

We are proposing the estimate the existing groundwater quality for chloride and TDS and therefore their respective assimilative capacities separately for the impaired zone and the remainder of the Oxnard Plain basin.

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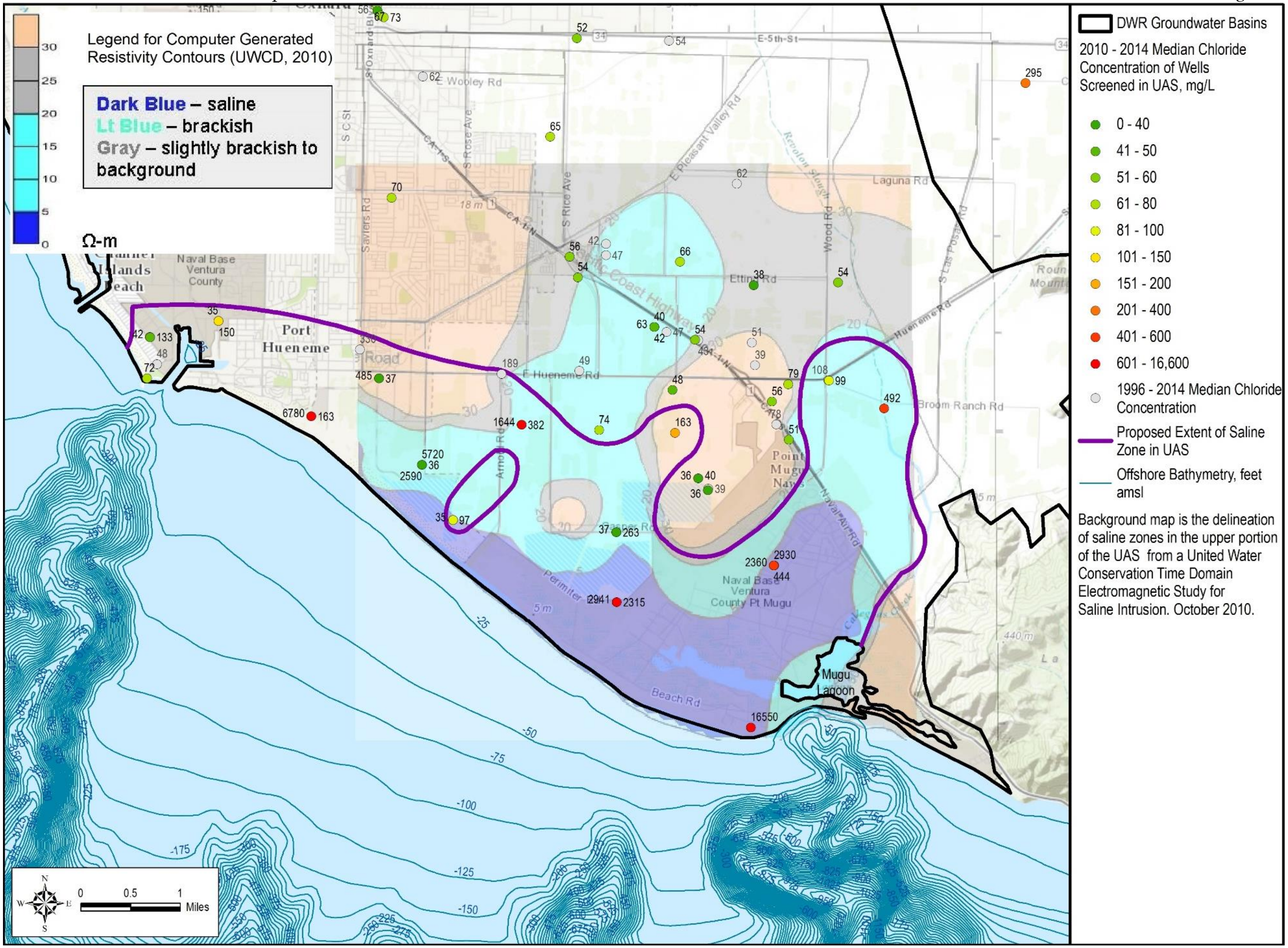

Figure 1: Proposed Upper Aquifer System Saline Zone Based on Chloride Concentrations and Geophysical Study

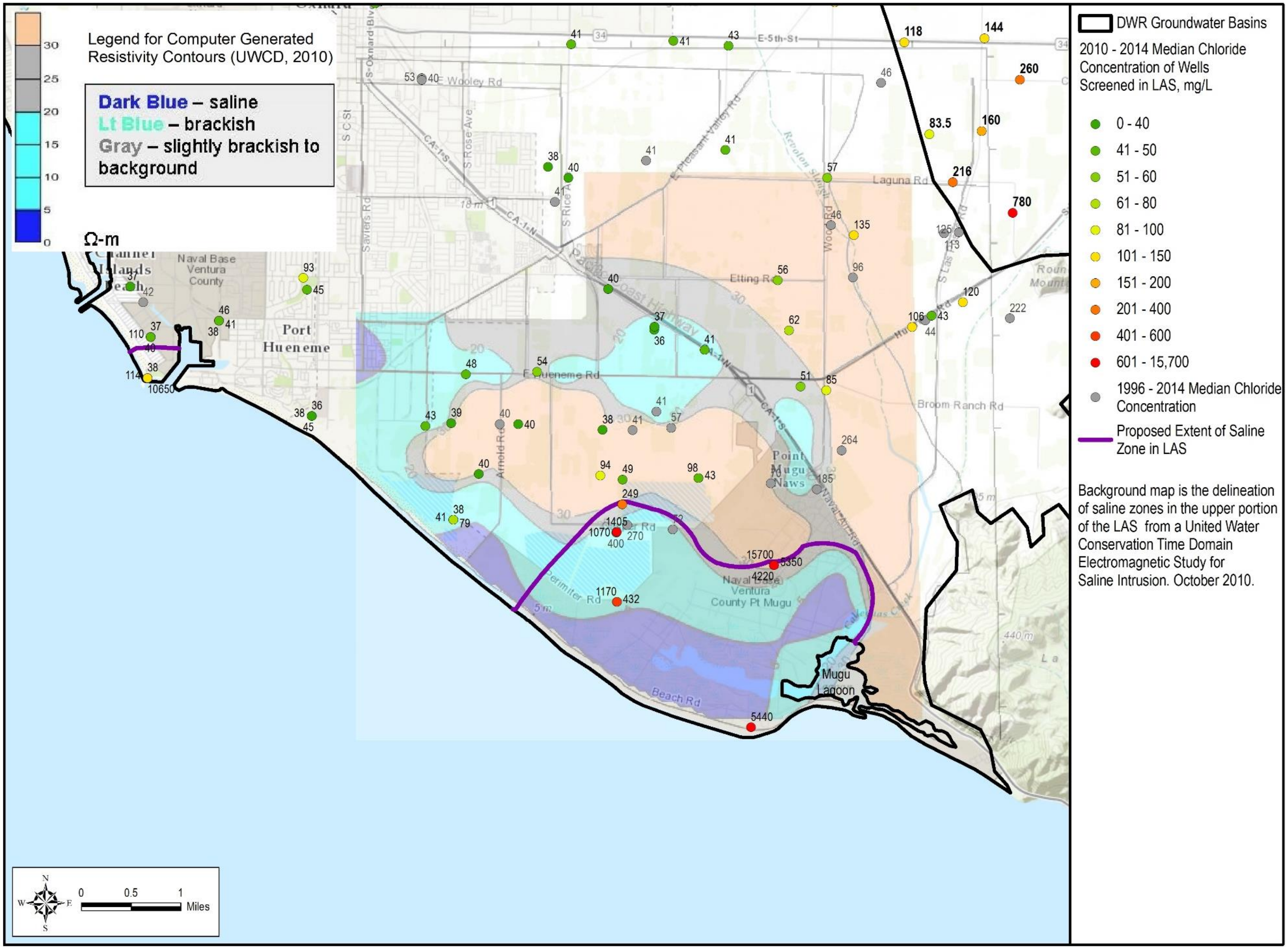

Figure 2: Proposed Lower Aquifer System Saline Zone Based on Chloride Concentrations and Geophysical Study

Public Works Department

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CITY OF OXNARD CALIFORNIA

September 16, 2016

Renee Purdy and Ginachi Amah
Los Angeles Regional Water Quality Control Board
320 West Fourth Street, Suite 200
Los Angeles, CA 90013

Subject: City of Oxnard- Preliminary Draft Oxnard Plain and Pleasant Valley Basin Salt and Nutrient Management Plan (Preliminary Draft Oxnard SNMP)

The purpose of this letter is to request the RWQCB reconsider the comments provided to the City following their review of the Oxnard Plain and Pleasant Valley Basin SNMP, based on the following considerations:

1. Quoting the Recycled Water Policy, section 6.a (2), *"It is the intent of this Policy that salt and nutrients from all sources be managed on a basin-wide or watershed-wide basis in a manner that ensures attainment of water quality objectives and protection of beneficial uses. The State Board finds that the appropriate way to address salt and nutrient issues is through development of regional or subregional salt and nutrient management plans rather than through imposing requirements solely on individual recycled water projects."* The City of Oxnard has met this requirement in two ways - 1) by submitting a timely Preliminary Draft Oxnard SNMP and 2) by producing superior recycled water quality. The Preliminary Draft Oxnard SNMP demonstrates that the City intends to irrigate with, and recharge, recycled water produced by their Advanced Water Purification Facility (AWPF) that has the following treatment processes: microfiltration (MF), Reverse Osmosis (RO), Ultraviolet Advanced Oxidation (UV/AOP). These treatment processes meet the requirements of the California Division of Drinking Water (CDDW) for groundwater recharge. The RO process provides removal of salts and nutrients. Use of the AWPF water for landscape irrigation and/or groundwater recharge has the potential to improve groundwater quality and contribute to attainment of basin water quality objectives.
2. Quoting the Recycled Water Policy 6.b.1.a *"It is the intent of this Policy for every groundwater basin/subbasin in California to have a consistent salt/nutrient management plan. The degree of specificity within these plans and the length of these plans will be dependent on a variety of site-specific factors, including but not limited to size and complexity of a basin, source water quality, stormwater recharge, hydrogeology, and aquifer water quality."* The majority of recycled water projects in the planning area involve the use of desalted water, which is unique, relative to SNMPs completed in other areas. The required degree of specificity should be less for recycled water projects, where salts and nutrients have been removed from the recycled water to the best practicable treatment or control (BPTC).

3. Responses to specific comments provided by the RWQCB (Ginachi Amah dated August 31, 2016) are presented as follows:
    a. Loading Estimates: The comment is correct that the export of loads are not calculated and therefore the net load to the basin (on an annual basis) is not characterized. Calculation of load exports requires development of a water balance for the basins. The Fox Canyon Groundwater Management Agency (FCGMA) has been established as the GSA for the Oxnard Plain and Pleasant Valley Basins (as well as other basins). Development of the Groundwater Sustainability Plan (GSP) is underway (completion date not known), and includes development of a water balance. Through this process, the balance would be vetted and reviewed by a wide group of stakeholders, with the ultimate goal of stakeholder acceptance/agreement on the water balance. Preparation of a water balance at this time for the purpose of calculating net salt and nutrient loads would be duplicative, premature, and would potentially lead to stakeholder opposition to the SNMP analysis and findings. Analysis of net loading, if deemed necessary, should be based on the water balance developed for the GSP.
    b. Impact of Recycled Water Projects: The comment is correct that the conceptual water quality model provided in the draft does not allow for a quantitative assessment of the impacts of the proposed projects on future groundwater quality and the use of assimilative capacity, either locally or basin-wide. To make a prediction of future groundwater quality and use of future assimilative capacity, a current and future water and mass balance would need to be developed. For the reasons stated in 3a (above) the SNMP should use the water balance developed for the GSP. Once the water balance is completed, the necessity of estimating existing and future groundwater quality using a mass balance model will be evaluated. It should be noted, that a recycled water project that will potentially provide a diluting effect on groundwater quality, should not be required to offset loads from other continued existing and future activities and to be responsible for overall groundwater quality improvement. Rather, recycled water projects with desalted water should be considered among other management measures that collectively contribute to attainment of water quality objectives. The Recycled Water Policy does not require a quantitative prediction of future groundwater quality. Arguably, the prediction of future groundwater quality is more important when a recycled water project does not provide better water quality than existing sources.
    c. Assimilative Capacity Analysis: The comment refers to the following statement in the document "the nature of the proposed projects does not require that a quantified value for the available assimilative capacity be estimated." To clarify, the SNMP includes a quantitative estimate of a concentration based assimilative capacity. Again, the need for a more detailed analysis of existing and future mass based assimilative capacity (requires a water balance), should consider that the proposed projects provide better water quality than existing sources. The comment also refers to recycled water quality that exceeds existing water quality for chloride and nitrates in the Oxnard Plain and Pleasant Valley basins (see Table 10). For the Oxnard Plain, this comment does not recognize that the combined recycled water quality and loads to the basin are relevant, rather than the individual sources of recycled water (See section 8.2.1). For the Pleasant Valley Basin, the assumption is that the irrigation with recycled water quality will

contribute to loads to the UAS. The UAS is not a productive system and has a potential MUN beneficial use. The UAS does not have TDS and chloride water quality objectives to calculate assimilative capacity. With respect to nitrate, the range of existing groundwater nitrate concentrations is based on 4 wells; one well with a median concentration of 0.9 mg/L-N and three other wells with median concentrations ranging from 13 mg/L-N to 42.9 mg/L-N. Recycled water (from Camrosa WRF or combination of Camrosa WRF and Camarillo WRP) with a nitrate concentration of less than or equal to 10 mg/L, would exceed the median concentration in one well, but not an area weighted average. Furthermore, the rationale presented in the SNMP follows the rationale provided in the Camrosa recycled water permit, where recycled water quality limits have already been established to protect the MUN beneficial use of the underlying groundwater basins, to prevent future degradation of the groundwater basin, and to help restore the water quality of the impacted aquifer.

d. Basin-wide Monitoring: The comment is correct that the preliminary draft SNMP does not include a monitoring program but rather provides guidance and recommendations for monitoring to be included in the water quality monitoring component of a Groundwater Sustainability Plan (GSP) that is currently in development. The purpose of incorporating the SNMP monitoring plan into the GSP is to minimize monitoring redundancy, provide consistency in analysis and reporting, and to compile data in a single centralized database. While the GSP is underway, the development of the monitoring plan is a future task, and the proposed development of comprehensive monitoring plan that meets the SNMP and GSP objectives should be conducted per the GSP schedule.

e. Anti-degradation Analysis: The comment states that some of the recycled water projects have the potential to use some assimilative capacity in both the Oxnard Plan and Pleasant Valley basins – as such, an anti-degradation analysis is warranted. Response 3c addresses the premise of this comment. The comment also refers to the assumption that an antidegradation analysis is not needed for projects in the Pleasant Valley Basin and suggests that the assimilative capacity for nitrates can be easily assessed using the region-wide water quality objective, and that any degradation above existing TDS and chloride concentrations should be considered even in the absence of basin-specific water quality objectives. It should be noted, that there are 4 wells in the UAS of the Pleasant Valley basin, which provide a very limited groundwater quality data set for characterizing the water quality of the entire UAS. Rather than conducting an antidegradation analysis based on this limited dataset, it is recommended that additional monitoring of the UAS be considered in monitoring plan development process. It is also important to clarify the recycled water quality/loading from the proposed projects. With respect to any use of AWPF water (from Oxnard projects) in the Pleasant Valley Basin, there would be a decrease in loading and a diluting effect of nitrate, TDS, and chloride. With respect of use of recycled water from Camrosa WRF/Camarillo WRP, the recycled water quality would be of better quality than in 3 of the 4 wells for TDS and nitrate, and 2 of the 4 wells for chloride.

4. It has been brought to the RWQCB's attention at a number of meetings that the City has severe budget limitations. In fact, the City acquired a $1M grant to help construct the ASR

Demonstration well and has been developing the necessary documentation to move forward with its construction and implementation (i.e.: FAA approval, Fox Canyon GMA approval, development of the Potable Reuse Engineering Report, etc.). If the City proceeds now, the added mass balance modeling and analysis would add a cost of approximately $200,000 - $300,000 that could be otherwise used more wisely to help implement the well and start helping combat the drought along the central coast. By utilizing the water balance developed as part of the GSP, more accurate and accepted mass balance results would be generated, and would significantly reduce the cost borne by an individual stakeholder (i.e. the City) to complete the analysis.

5. And Lastly, the City feels that with the recent passage of SGMA, some or many of the RWQCB concerns (as noted in response 3) will be addressed at that time and in that documentation process, and therefore are not needed at this time.

Therefore, based on the above rationale, the City of Oxnard respectfully requests that the RWQCB accept the Preliminary Draft Oxnard SNMP, as a draft document (with minor changes to accommodate TAG comments), with the understanding that the SNMP process is well underway, and that obtaining recycled water permits for the proposed projects identified in the Preliminary Draft Oxnard SNMP will not be impacted by delaying the development of a Final Oxnard SNMP. The City of Oxnard requests that the Final Oxnard SNMP be delayed to be coincident with the development of the GSP. It is envisioned that at that time, the involved stakeholders will determine the need for additional modeling and analysis based on the findings of the GSP.

Please feel free to contact me (805-385-8153) or Dan Rydberg (805-385-8055), the Director of Public Works, to discuss any of the above points.

Badaoui Mouderres, PE
Interim Environmental Compliance &
Program Management Division Manager

CC: Cris Morris and Elizabeth Ericksen (RWQCB)
Tracy Clinton and Elisa Garvey (Carollo Engineers)