SOMACH SIMMONS & DUNN
A Professional Corporation
THERESA A. DUNHAM, ESQ. (SBN 187644)
500 Capitol Mall, Suite 1000
Sacramento, CA 95814
Telephone: (916) 446-7979
Facsimile: (916) 446-8199

Attorneys for Petitioner
CENTRAL COAST GROUNDWATER
COALITION

Received
MAR 2015
Office of the
Chief Counsel

BEFORE THE

CALIFORNIA STATE WATER RESOURCES CONTROL BOARD

In the Matter of Central Coast Groundwater Coalition (CCGC) Petition for Review of Action and Failure to Act by the California Regional Water Quality Control Board, Central Coast Region, in Rejecting CCGC Contour Maps for Compliance With Cooperative Groundwater Monitoring Requirements, Order No. R2-2012-0011, as modified by Order WQ-2013-0101.	SWRCB/OCC File ______________ CENTRAL COAST GROUNDWATER COALITION'S PETITION FOR REVIEW; MEMORANDUM IN SUPPORT OF PETITION (Wat. Code, § 13320)

The Central Coast Groundwater Coalition (CCGC or Petitioner), in accordance with section 13320 of the Water Code and Conditional Waiver of Waste Discharge Requirements for Discharges from Irrigated Lands, Order No. R3-2012-0011 (Agricultural Order) as modified by State Water Resources Control Board Order WQ-2013-0101, hereby petitions for review certain decisions and determinations made by the California Regional Water Quality Control Board, Central Coast Region, as delegated to the Regional Board's Executive Officer. The issues and a summary of the bases for the Petition follow.

The CCGC is a non-profit public, mutual benefit corporation incorporated pursuant to state law. The CCGC was formed with the specific purpose of providing growers within the Central Coast region of California subject to the provisions of the Agricultural Order and the associated Monitoring and Reporting Order Nos. R3-2012-0011-01, R3-2012-0011-02, and

R3-2012-0011-03 (collectively, "MRPs") with the option of participating in a cooperative groundwater monitoring program in lieu of conducting individual groundwater monitoring that is otherwise required by the MRPs.

1. NAME AND ADDRESS OF PETITIONER:

Central Coast Groundwater Coalition
P. O. Box 828
Salinas, CA 93902
Attn: Mr. Parry Klassen
Telephone: (707) 725-6182, ext. 3005
Email: pklassen@unwiredbb.com

In addition, all materials in connection with this Petition should be provided to CCGC's counsel at the following address:

Somach Simmons & Dunn
A Professional Corporation
Theresa A. Dunham, Esquire
500 Capitol Mall, Suite 1000
Sacramento, CA 95814
Telephone: (916) 446-7979
Facsimile: (916) 446-8199
Email: tdunham@somachlaw.com

2. THE SPECIFIC ACTION OR INACTION OF THE REGIONAL BOARD WHICH THE STATE BOARD IS REQUESTED TO REVIEW:

The CCGC petitions the State Water Resources Control Board (State Board) to review the Central Coast Regional Water Quality Control Board (Regional Board) Executive Officer's rejection of the CCGC's contour maps for the specific purpose of publicly displaying individual well data collected by the CCGC from its members. In letters to the CCGC dated February 20, 2015, *Irrigated Lands Regulatory Program: Response to Central Coast Groundwater Coalition Technical Memorandum and Contour Maps, Groundwater Nitrate, Salinas Valley, California* (February 2015 Rejection Letter), attached hereto as Attachment 1, and March 20, 2015, *Irrigated Lands Regulatory Program: Comments on Central Coast Groundwater Coalition Technical Memorandums for Northern Counties* (March 2015 Rejection Letter) attached hereto as Attachment 2, the Regional Board's Executive Officer alleges that the CCGC's contour maps for the Salinas Valley (February 2015 Rejection Letter) and for the Pajaro and Gilroy-Hollister

Valleys (March 2015 Rejection Letter) fail to comply with Conditions 10 through 13, and cannot be revised to comply with such conditions, that are contained and part of the Regional Board's approval of the CCGC's May 31, 2013 final workplan. (Letter to Abby Taylor-Silva from Kenneth A. Harris Jr. (July 11, 2013) *Agricultural Regulatory Program – Approval of Central Coast Cooperative Groundwater Program* (Workplan Approval Letter), attached hereto as Attachment 3.)[1] Specifically, the Regional Board's Executive Officer determined that CCGC's draft contour maps for the Salinas Valley "do not meet Conditions 10 through 13 of the Executive Officer's Workplan Approval letter and the contour maps alone are not sufficient for providing reliable information to the public, in lieu of the actual groundwater data." (February 2015 Rejection Letter, p. 2.) Most recently, the Regional Board's Executive Officer determined that CCGC's draft contour maps for the Pajaro and Gilroy-Hollister Valleys "do not meet Conditions 10 through 13." (March 2015 Rejection Letter, p. 1.) The Regional Board further advised the CCGC that review of this action could be petitioned to the State Board in accordance with section 13320 of the Water Code. (February 2015 Rejection Letter, p. 3.) This Petition is filed in accordance with Water Code section 13320, the February 2015 Rejection Letter, and communication received from the Regional Board's counsel that the Regional Board Executive Officer's decision is an action subject to petition. With this Petition, the CCGC is requesting State Board review of the Regional Board's requirement to post individual well data to the internet for public display, and the Regional Board Executive Officer's rejection of contour maps for their intended purpose of informing the public about nitrate concentrations in shallow groundwater.

3. THE DATE ON WHICH THE REGIONAL BOARD ACTED OR REFUSED TO ACT:

The Regional Board rejected the CCGC's draft contour maps for the Salinas Valley on February 20, 2015, and rejected the CCGC's draft contour maps for the Pajaro and Gilroy-

[1] The Regional Board's approval letter refers to the "Central Coast Cooperative Groundwater Program." This was the CCGC's original name, which was subsequently changed to "Central Coast Groundwater Coalition." For the purposes of this Petition, we will refer to the third party cooperative program as the CCGC.

SOMACH SIMMONS & DUNN
A Professional Corporation

Hollister Valleys on March 20, 2015. With this rejection, the Regional Board is triggering the need for public display of individual well data pursuant to an unwritten, vague Regional Board policy. Unless otherwise provided, the CCGC contends that all actions and inactions of the Regional Board challenged herein are not supported by adequate findings or evidence in the record and/or are inconsistent with applicable law.

4. STATEMENT OF REASONS WHY THE REGIONAL BOARD'S ACTION WAS INAPPROPRIATE OR IMPROPER:

A full and complete statement of the reasons why the Regional Board's actions were inappropriate or improper is provided in the accompanying Statement of Points and Authorities.

5. THE MANNER IN WHICH THE PETITIONER IS AGGRIEVED:

The Regional Board's premature rejection of the CCGC's draft contour maps, and the Regional Board's resistance to work further with the CCGC to develop such maps for their intended purpose, will mean that individual nitrate groundwater data for domestic and agricultural supply wells monitored by the CCGC on behalf of its cooperative members will be publicly displayed on the State Board's GeoTracker Groundwater Ambient and Monitoring Assessment (GAMA) Program database. The display of such information publicly is contrary to the understanding of the CCGC with respect to agreements reached between the CCGC and the Regional Board in conjunction with the Workplan Approval Letter. Further, rejection of the contour maps is arbitrary and does not reflect the technical and scientific validity associated with the contour maps and their specific intended purpose of being used to inform the public of nitrate drinking water quality in agricultural areas. Moreover, the data in question is available publicly to individuals and/or entities that choose to obtain such information through a Public Records Act request pursuant to California Government Code section 6250 et seq. The sole issue here is the public display and availability of individual well data through the internet on an open database, which is accessible to anyone in the world at any time versus requiring members of the public to seek individual well data through the submittal of a Public Records Act request.

SOMACH SIMMONS & DUNN
A Professional Corporation

6. THE SPECIFIC ACTION BY THE STATE OR REGIONAL BOARDS REQUESTED:

Based on the foregoing, the CCGC requests that the State Board modify, or order the Regional Board to modify its responses to the CCGC's technical memoranda with direction as follows:

A. Find that technically sound contour maps for the Salinas, Pajaro, and Gilroy-Hollister Valleys can comply with and meet Conditions 10 through 13 of the Workplan Approval Letter, and that final contour maps can be sufficient for providing reliable information to the public in lieu of displaying actual individual well data on GeoTracker;

B. Find that the Regional Board has prematurely denied the use of such contour maps for their intended purpose, and that the Regional Board must rescind its February 2015 Rejection Letter and March 2015 Rejection Letter;

C. Find and declare that the right to privacy of individuals outweighs the need to publicly display individual well data on GeoTracker, and that the public's right to access governmental information is preserved by requesting such data through a Public Records Act request; and,

D. Make any necessary revisions consistent with the above terms and provisions of this Petition.

7. A STATEMENT OF POINTS AND AUTHORITIES IN SUPPORT OF LEGAL ISSUES RAISED IN THIS PETITION:

The CCGC's statement of points and authorities is set forth below.

///

///

///

///

///

///

SOMACH SIMMONS & DUNN
A Professional Corporation

8. A STATEMENT THAT THE PETITION HAS BEEN SENT TO THE APPROPRIATE REGIONAL BOARD:

A true and correct copy of the Petition was mailed by First Class mail on March 23, 2015, to the Regional Board at the following address:

Kenneth A. Harris, Jr., Executive Officer
California Regional Water Quality Control Board, Central Coast Region
895 Aerovista Place, Suite 101
San Luis Obispo, CA 93401

9. A STATEMENT THAT THE SUBSTANTIVE ISSUES OR OBJECTIONS RAISED IN THE PETITION WERE RAISED BEFORE THE REGIONAL BOARD:

The substantive issues and objections in this Petition were raised before the Regional Board at the January 30, 2015 Regional Board meeting, and in written comments submitted on January 26, 2015.

STATEMENT OF POINTS AND AUTHORITIES

I. INTRODUCTION

The Central Coast Groundwater Coalition (CCGC) is a third-party cooperative groundwater-monitoring program that was established to provide agricultural growers within the Central Coast region an alternative to conducting and reporting individual groundwater monitoring data. The cooperative program was designed to gather data in a more efficient manner, and through the collection of significant data and information, provide technically and scientifically sound characterizations of groundwater quality in the Central Coast region. In particular and relevant to this Petition, the CCGC is looking to characterize drinking water for nitrate in agricultural areas by evaluating the spatial distribution of nitrate concentrations in the Salinas, Pajaro, and Gilroy-Hollister Valleys and by providing conservative estimates of where groundwater nitrate concentrations are likely to be above the maximum contaminant level (MCL) for nitrate.

In an agreement reached between the CCGC and the Regional Board, the Regional Board agreed to publicly display cooperative program data as contour maps, as long as the contour maps meet the conditions specified in the Workplan Approval Letter. If such conditions are not met, then individual well data collected by the CCGC would be displayed publicly on the GeoTracker GAMA database. At issue here is the Regional Board's decision to reject the use of the CCGC contour maps for their intended purpose of publicly displaying data, thus triggering the requirement that all individual domestic and agricultural supply well data collected by the CCGC be publicly displayed on the GeoTracker GAMA database starting March 15, 2016.

The Regional Board's decision was made in advance of receiving final technical memoranda and contour maps, and was based on circumstances unrelated to the actual technical validity of said maps. Rather, the Regional Board's rejection of such maps was based solely on staff's changed belief that all data collected should be displayed publicly on the GeoTracker GAMA database. While one could speculate as to the reasons for this change in position, such speculation is irrelevant. What matters here is that the Regional Board has prematurely and arbitrarily rejected the use of contour maps for the specific and intended purpose of publicly displaying nitrate concentration data and information in a manner that would be useful to the public. With this rejection, the Regional Board is unilaterally deciding that all individual domestic and agricultural supply well data must be publicly displayed on GeoTracker. The CCGC contends that the Regional Board's actions fail to honor its agreements as specified in the Workplan Approval Letter and, as a result, growers participating in the cooperative program will be harmed because domestic and agricultural supply well data that they thought would be available publicly only through a Public Records Act request will now be displayed publicly on the internet. Moreover, the Regional Board's action here makes unilateral, unwritten policy decisions that are better left to the State Board. To rectify this wrong, the State Board needs to find that the Regional Board's rejection of the CCGC's contour maps is inappropriate, and that contour maps can be used to inform the public of potential nitrate concentrations in domestic and agricultural supply wells in agricultural areas. Ultimately, the State Board must find that display of individual well data on GeoTracker is not required by law, and has limited public purpose with respect to informing others of nitrate concentrations in shallow groundwater.

II. BACKGROUND

On March 15, 2012, the Regional Board adopted Conditional Waiver of Waste Discharge Requirements Order No. R3-2012-0011 for Discharges from Irrigated Lands (Agricultural Order), and Monitoring and Reporting Program Order Nos. R3-2012-0011-01, R3-2012-0011-02, and R3-2012-0011-03 (collectively, "MRPs"). The MRPs included groundwater monitoring and reporting requirements for all individuals, although the frequency of monitoring varied depending on the tier in which a grower's operation was classified. For growers in all tiers, the MRPs included a provision that allowed growers to participate in a cooperative groundwater monitoring program in lieu of conducting individual groundwater monitoring.

In relevant part, the MRPs provide as follows:

> In lieu of conducting groundwater monitoring, Dischargers may participate in a cooperative groundwater monitoring effort to help minimize costs and to develop an effective groundwater monitoring program. Qualifying cooperative groundwater monitoring and reporting programs may include, but are not limited to, regional or subregional groundwater programs developed for other purposes as long as the proposed cooperative groundwater monitoring program meets the Central Coast Water Board's general purpose of characterizing groundwater quality and ensuring the protection of drinking water sources. At a minimum, the cooperative groundwater monitoring effort must include sufficient monitoring to adequately characterize the groundwater aquifer(s) in the local area of the participating Dischargers, characterize the groundwater quality of the uppermost aquifer, and identify and evaluate groundwater used for domestic drinking water purposes. (See, e.g., MRP Order No. R3-2012-0011-03, p. 9.)[2]

In response to this provision, some growers in the Central Coast came together to establish a cooperative groundwater monitoring program for the northern areas of the Central Coast. Other growers worked collectively to develop cooperative groundwater monitoring programs for other areas.[3] The cooperative program, now known as the CCGC, submitted a final workplan, *Northern Central Coast Cooperative Groundwater Program* (May 2013 Workplan), for Regional Board review on May 31, 2013. The May 2013 Workplan applied to participating growers (i.e.,

---

[2] http://www.waterboards.ca.gov/centralcoast/water_issues/programs/ag_waivers/docs/adopted2012ag_order/tier3_finalmrp_070114.pdf, as of March 23, 2015.

[3] Ultimately, growers in the southern portion of the Central Coast region joined the northern cooperative program. The details of this are not relevant to this Petition for Review, which focuses specifically on the rejection of Salinas, Pajaro, and Gilroy-Hollister Valleys' contour maps.

SOMACH SIMMONS & DUNN
A Professional Corporation

CCGC members) in Monterey, Santa Cruz, Santa Clara, and San Benito Counties. On July 9, 2013, a slightly revised workplan was submitted with clarifications.

On July 11, 2013, the Regional Board's Executive Officer (Kenneth A. Harris, Jr.) issued an approval letter to the CCGC, granting approval of the third-party program as described in the combined workplans. (Workplan Approval Letter, p. 1.) As part of its approval, specific conditions were included in the Workplan Approval Letter. Relevant to this Petition are Conditions 10 through 13, *Adequacy of Sampling Locations and Density, Contour Maps*, which are discussed in section III.E below.

During this time period, the State Board was conducting its review of the Agricultural Order and the MRPs due to petitions filed by various parties. As part of its review, the cooperative groundwater program provisions in the Agricultural Order and the MRPs were discussed at length by the State Board, and the State Board modified the provisions in its Order WQ 2013-0101. (See Order WQ 2013-0101, pp. 33-35.) The State Board's revisions further emphasized concerns with domestic well water exceeding drinking water standards for nitrate, and required notification to users of such domestic well water if sampling results indicated that the water did in fact exceed drinking water standards. (Order WQ 2013-0101, p. 34.) At the time of State Board review, the CCGC had originally proposed to use contour maps to provide for statistical projections of groundwater quality to avoid the need to monitor all domestic wells for growers participating in the cooperative program. The State Board upheld this approach by stating that cooperative groundwater monitoring proposals needed to include at least one of three approaches for evaluating drinking water in participating grower wells. One approach was to conduct direct sampling of all domestic wells, and another was to use a statistically valid projection of groundwater quality at the location of the well. (Order WQ 2013-0101, p. 33.)

After the State Board issued its order, and for a variety of reasons, the CCGC decided to conduct direct sampling of all domestic wells for its grower members. This sampling occurred from and included direct sampling of 672 domestic wells throughout the Central Coast region. Thus, in short, statistical projections and contour maps were no longer going to be used for characterizing grower member domestic well water quality. However, the CCGC still intended to

SOMACH SIMMONS & DUNN
A Professional Corporation

use contour maps in accordance with the Workplan Approval Letter to meet certain conditions associated with informing the public of nitrate concentrations in shallow groundwater. Specifically, and as expressed in the Workplan Approval Letter, the contour maps need to be sufficient "such that individual domestic well owners that reside in agricultural areas within the cooperative groundwater monitoring program boundary can make informed decisions related to their drinking water quality and potential health exposure to nitrate." (Workplan Approval Letter, p. 4.)

Over the course of 2014, CCGC representatives and Regional Board staff met on numerous occasions to discuss implementation of the cooperative monitoring program, including preparation of contour maps. The Final Report, including final contour maps, was due to the Regional Board on March 15, 2015. (See *Central Coast Groundwater Coalition Work Plan for Monterey, Santa Clara, Santa Cruz, and San Benito Counties* (updated November 1, 2013), p. 15, attached hereto as Attachment 4.) As part of this iterative process, the CCGC submitted two separate draft reports for the Salinas Valley for review and discussion.[4] (*Distribution of Groundwater Nitrate Concentrations, Salinas Valley, California* (April 30, 2014) (April Draft Technical Memorandum), attached hereto as Attachment 5; *Groundwater Nitrate, Salinas Valley, California, Technical Memorandum* (December 10, 2014) (December Draft Technical Memorandum), attached hereto as Attachment 6.) Late in 2014, and after submittal of the Draft Final Report (which is the December Draft Technical Memorandum), CCGC representatives were informed by Regional Board staff that they would not approve contour maps in lieu of public display of individual well data collected by the CCGC on the GeoTracker GAMA database. Rather, Regional Board staff indicated that it was their belief that contour maps could not be developed in a manner that would satisfy Conditions 10 through 13 and, thus, such maps would be rejected for that specific purpose.

At the January 30, 2015 Regional Board meeting, this issue was discussed before the full Regional Board. (See, e.g., Letter to Mr. Kenneth A. Harris Jr. from Mr. Parry Klassen dated

[4] Draft reports for the Pajaro and Gilroy-Hollister Valleys were to follow and would be based on collective decisions made with respect to the Salinas Valley.

SOMACH SIMMONS & DUNN
A Professional Corporation

January 26, 2015, attached hereto as Attachment 7; see also Central Coast Groundwater Coalition PowerPoint Presentation dated January 27, 2015 (CCGC PowerPoint Presentation), attached hereto as Attachment 8.) No direct action was taken by the Regional Board except to uphold the Executive Officer's discretion to consider the adequacy of contour maps for their intended purpose of informing the public in accordance with the Workplan Approval Letter.

The Regional Board Executive Officer's determination to reject contour maps was formalized in his February 2015 Rejection Letter for the Salinas Valley, and in his March 2015 Rejection Letter for the Pajaro and Gilroy-Hollister Valleys. Such rejection was prior to receipt of a Final Report and final contour maps for the three valleys.[5] The CCGC's only recourse is to now bring this Petition to the State Board, seeking review of the Regional Board's rejection of contour maps in lieu of public display of individual well data on GeoTracker, and the Regional Board's unilateral decision that all individual well data must be available to the public on the State Board's GeoTracker database. For the reasons discussed herein, the State Board must reject the Regional Board's position with respect to the use of contour maps and public display of individual well data.

III. ARGUMENT

The CCGC petitions the Regional Board's determination as expressed in its February 2015 Rejection Letter and March 2015 Rejection Letter on several grounds. First, the CCGC's cooperative groundwater monitoring program has complied with all provisions specified in the MRPs (as originally adopted by the Regional Board and as revised by the State Board). Second, the CCGC's draft contour maps meet Conditions 10 through 13 of the Workplan Approval Letter, and would further meet these conditions when submitted in their final form. Third, the Regional Board's action to disapprove of the contour maps for their intended purpose has no basis in law or policy, and the requirement to display individual well data on GeoTracker has limited utility to inform others that reside in agricultural areas about their potential health

[5] Subsequent to issuance of the February 2015 Rejection Letter, the Regional Board agreed to extend the date for submittal of the Final Report for the Salinas, Pajaro, and Gilroy-Hollister Valleys to no later than June 1, 2015. (See March 2015 Rejection Letter, p. 4.)

SOMACH SIMMONS & DUNN
A Professional Corporation

exposure to nitrates. And, fourth, the Regional Board's actions undermine the value and intent of third party programs.

A. CCGC Agrees That Protection of Public Health Is a Key Component of the CCGC's Cooperative Groundwater Monitoring Program

As a preliminary matter, the CCGC wants to clearly state that it agrees protection of public health from exposure to nitrate that may be found in drinking water is a key component of the CCGC's cooperative groundwater monitoring program. Because of this, the CCGC voluntarily decided to monitor all of its member domestic wells for nitrate rather than relying on contours to estimate nitrate concentrations in member domestic wells. This resulted in 672 domestic wells being monitored throughout the Central Coast region. (See CCGC PowerPoint Presentation, p. 2.) Out of the 672 domestic wells monitored, 229 domestic wells had nitrate concentrations that exceeded the drinking water MCL (i.e., nitrate drinking water standard). In accordance with the State Board's Order, users of the 229 domestic wells were timely notified of the health affects associated with drinking water that exceeded the nitrate drinking water standard.

Further, where there were exceedances (or in some cases concentrations near the drinking water standard), CCGC members voluntarily conducted follow-up actions to provide replacement water. Based on information provided to the CCGC, users of 214 domestic wells monitored by the CCGC were provided some form of replacement water.[6] The CCGC continues to work with its members, the Regional Board, and local health departments to ensure that all users of domestic well water under the control of CCGC members are protected from potential health exposures associated with nitrate in drinking water.

---

[6] Based on information provided to the CCGC, the collective information provided by members indicates that 41 of the domestic wells with exceedances are not used, 6 members had not responded, 4 users declined the offer of replacement water, and in 7 instances no replacement water was supplied. (CCGC PowerPoint Presentation.)

SOMACH SIMMONS & DUNN
A Professional Corporation

B. Use of Contour Maps for Intended Purpose Does Not Prevent Members of the Public From Obtaining the Data in Question Through the California Public Records Act

With respect to this Petition, it is essential for the State Board and the public to understand that use of contour maps for the express purpose identified in the Workplan Approval Letter and as intended by the CCGC does not prevent or prohibit members of the public from lawfully obtaining individual well data submitted to the Regional Board through a Public Records Act request pursuant to Government Code Section 6250 et seq. The CCGC is required to submit data it has collected on behalf of its members to the Regional Board. The CCGC has complied with this requirement and this is not an issue in dispute. All individual well sample results are reported to the Regional Board timely after laboratory results have been verified.

Upon receiving a request under the Public Records Act, the Regional Board is required to respond to the request within 10 days. (Gov. Code, § 6253.) In this case, with respect to domestic and agricultural supply well data, due to public health and safety concerns, the Regional Board provides the raw data in its possession but blurs well locations to within a one-half mile radius of the actual well location. (See Agricultural Order, p. 27.) This blurring is consistent with the drinking water well location information displayed on GeoTracker from other regulatory programs.

Thus, the issue before the State Board in this Petition is not the public availability of the data in question, but the open, public display of this data on the internet through the state's GeoTracker website. Specifically, should contour maps be used to display nitrate concentration data and information in agricultural areas of the Central Coast rather than requiring individual domestic and agricultural supply well data to be posted on an open, public website? We contend for the reasons specified below that the answer must be yes.

C. The Public Display of Individual Well Data Has No Basis In Law or Policy

Putting aside issues associated with contour maps momentarily, as a general policy matter, the Regional Board has no legal basis for requiring the display of individual domestic and agricultural supply well data on the state's GeoTracker database. As just indicated, the data in question (subject to blurring) can be obtained through submittal of a Public Records Act request.

SOMACH SIMMONS & DUNN
A Professional Corporation

Thus, the primary objective of the Public Records Act, which is to ensure public access to government records, is intact. (See *Rogers v. Superior Court* (1993) 19 Cal.App.4th 467, 475-476 ["The Act was intended to safeguard the accountability of government to the public. (Citation omitted.) To this end, the Act makes public access to government records a fundamental right of citizenship; in enacting this chapter, the Legislature, mindful of the right of individuals to privacy, finds and declares that access to information concerning the conduct of the people's business is a fundamental and necessary right of every person of this state."].)

Beyond the Public Records Act, section 13269 of the Water Code requires that monitoring results obtained as a requirement of a Conditional Waiver of discharge requirements be made available to the public. (Wat. Code, § 13269(a)(2).) This Water Code requirement is met and achieved through the availability of the information through a Public Records Act request. Also, the intent of this requirement is met through the preparation and public display of contour maps. Further, other than requiring public availability, the Water Code does *not* require public display of individual monitoring data on the state's GeoTracker database.

With respect to the Agricultural Order, it states "Groundwater quality data must be submitted in a format compatible with the electronic deliverable format (EDF) used by the State Water Board's GeoTracker data management system, *or as directed by the Executive Officer*." (Agricultural Order, p. 27, Condition 63, emphasis added.) In accordance with this provision, and through discussions with the CCGC, the Executive Officer agreed that contour maps could be used to display CCGC data as long as such maps met the conditions specified in the Workplan Approval Letter. (See Workplan Approval Letter, p. 6 ["We understand that the cooperative program participants have significant concerns and objections to displaying individual well locations to the public on maps available on the internet using GeoTracker. The Central Coast Water Board agrees to display cooperative program data as contour maps on GeoTracker after January 1, 2015, as long as 1) the contour maps meet the conditions described in Conditions 10 through 13 above and are approved by the Executive Officer . . . . If by January 1, 2015, the functionality does not exist in GeoTracker to properly display the approved contour maps, the cooperative program has the option to submit static images (e.g. pdf, bitmap) of the contour maps

SOMACH SIMMONS & DUNN
A Professional Corporation

by March 15, 2015 . . . ."].) Moreover, while the Agricultural Order requires submittal of groundwater data in a format compatible with the state's EDF, there is nothing in the order that mandates public availability of individual data on the internet. Even if such requirement did exist, the Executive Officer is clearly left with the discretion to decide otherwise.

Further, the Groundwater Quality Monitoring Act of 2001 does not mandate the public display of individual well data on GeoTracker. Although this Act expresses the Legislature's intent with respect to development of a comprehensive groundwater monitoring program and public availability of such information collected, the Groundwater Quality Monitoring Act does not mandate public display of individual data. In fact, it appears that the Act understands and anticipates that statistical methods (like those used to develop the contour maps in question) would or could be used to characterize groundwater quality for purposes of informing the public. Specifically, the State Board was required to "[i]ntegrate existing monitoring programs and design new program elements as necessary to establish a comprehensive monitoring program capable of assessing each groundwater basin in the state through direct and other statistically reliable sampling approaches." (Wat. Code, § 10781(a).)

Moreover, from a policy perspective, the groundwater monitoring program required by the Agricultural Order is distinctly different than groundwater monitoring that occurs with other State and Regional Board programs. In the past, the State and Regional Boards have required publicly-owned treatment works (POTWs), industrial facilities, and other similarly regulated entities to collect groundwater monitoring data for various pollutants of concern. Those regulated are then asked to provide the data to the state in an electronic format so that it can be included in the state's GeoTracker database. The collection of data in these programs is primarily to determine if an entity's discharge of waste to groundwater is causing an impact on groundwater quality, and to determine compliance with waste discharge requirements.

The groundwater monitoring program in the Agricultural Order serves a different purpose. First, data is being collected from domestic and individual agricultural supply wells—not monitoring wells. Second, the value of the data collected is not for compliance purposes but for other purposes. As indicated in State Board Order WQ 2013-0101, data being collected in this

SOMACH SIMMONS & DUNN
A Professional Corporation

program does not serve purposes related to compliance but is being collected to characterize groundwater quality to help identify and prioritize follow-up areas, and to inform domestic well users of hazards associated with water that exceeds nitrate drinking water standards. (See State Board Order WQ 2013-0101, pp. 30-31 ["Given the importance of characterizing groundwater quality in the region, the significant danger to the public of consuming drinking water with high nitrate concentrations, and the need for dischargers to know the nitrogen levels in their irrigation water supply, we find that the Central Coast Water Board reasonably required initial sampling of drinking water wells and agricultural supply wells."].)

Third, and most importantly, this is data from individual farms and homes located throughout the Central Coast. Unlike most businesses or public treatment plants, agricultural operations are often co-located with a farmer's home, or homes rented or made available to agricultural workers. Thus, domestic and agricultural supply well data collected through the Agricultural Order is data and information that is most likely directly related to an individual residence—not a traditional place of business. While the data collected can be obtained through a Public Records Act request, that process at least ensures that the Regional Board is aware of who is requesting such data and information. This is important because it provides for some level of accountability should individuals residing in homes be bothered or harassed by members of the public based on the availability of the domestic and agricultural supply well data. Conversely, the availability of this data on the internet through the GeoTracker database eliminates any level of accountability and allows for this data be obtained by anyone, anywhere anonymously.

Accordingly, there is nothing in the law, or in the Agricultural Order, that mandates the public display of individual well data on GeoTracker. Further, considering that the data in question here is associated with individual homes and farming operations, the need for an extra step in obtaining the information through a Public Records Act request far outweighs the need for displaying individual data on the internet.[7] Thus, the State Board must find that the Regional

[7] Although this Petition is specific to data collected by the CCGC, the same arguments here would apply to individual data submitted by individual growers that are *not* part of the CCGC. We understand through conversations with individual growers that they too are not comfortable with the public display of their data and information but did not know how to stop this from occurring.

Board's requirement for public display of individual well data on GeoTracker is not required by law, and further, such requirement has public policy implications with respect to the right to privacy of individuals that far exceeds any public value associated with the open, public display of individual domestic and agricultural supply well data on the internet.

D. CCGC's Cooperative Groundwater Monitoring Program Complies With the Agricultural Order and its MRPs

Before discussing the contour maps in question, it is important for context to understand what is required of a cooperative groundwater monitoring program and how the CCGC's program is complying with these requirements. Primarily, cooperative groundwater monitoring programs must meet the "Central Coast Water Board's general purpose of characterizing groundwater quality and ensuring the protection of drinking water sources. . . . At a minimum, the cooperative groundwater monitoring effort must include sufficient monitoring to adequately characterize the groundwater aquifer(s) in the local area of the participating Dischargers, characterize the groundwater quality of the uppermost aquifer, and identify and evaluate groundwater used for domestic drinking water purposes." (See State Board Order WQ 2013-0101, p. 33.) The CCGC has complied with this requirement by collecting samples from all domestic wells and agricultural supply wells under the control of all of its members. The CCGC has further complied with notification requirements to domestic well users pursuant to State Board Order WQ 2013-0101.

With respect to characterization of the uppermost aquifer, such characterization efforts are underway and will be completed for the northern counties by June 1, 2015. (See March 2015 Rejection Letter, p. 4 ["Based on the comments provided above, the CCGC is required to submit the final Technical Memorandums for Salinas Valley, Pajaro Valley, and Gilroy-Hollister, as well as the Characterization Report for the northern counties no later than June 1, 2015."].) Based on recent conversations with Regional Board staff and draft efforts to date, it is anticipated that the final Technical Memorandums and characterization report will be acceptable to the Regional Board. (See, e.g., March 2015 Rejection Letter, p. 4 ["In closing, we appreciate the significant progress that CCGC has made to implement a cooperative groundwater monitoring program for growers. The results of this initial groundwater monitoring effort and lessons learned provides an important foundation to understand nitrate impacts to shallow groundwater in agricultural areas of the Central Coast region, and will also inform future groundwater monitoring programs."].) The CCGC is working closely with Regional Board staff to ensure that the final Technical Memorandums and characterization report meet Regional Board expectations and are written in a manner that makes them useful to the public. The CCGC is confident that the final reports will satisfy the Agricultural Order, the MRPs, and comply with the Regional Board's original Workplan Approval Letter, as modified by the March 2015 Rejection Letter. Thus, compliance with the Agricultural Order and the MRPs is not at issue here.

E. CCGC Draft Contour Maps Comply With Conditions 10 through 13

In July of 2013, the CCGC and the Regional Board reached a compromise that would allow the CCGC to protect its members from having individual domestic and agricultural supply well data being displayed on the internet through the state's GeoTracker database, even though as discussed above there is no legal requirement for such a public display of data. (Workplan Approval Letter, p. 6.) In short, the Regional Board agreed that CCGC member data could be displayed through publicly available contour maps rather than as individual well data points as long as the contour maps satisfied Conditions 10 through 13 of the Workplan Approval Letter. The conditions are in relevant part as follows:

- Condition 10: "The sampling density, resolution and scale must be sufficient such that individual domestic well owners that reside in agricultural areas within the cooperative groundwater monitoring program boundary can make informed decisions related to their drinking water quality and potential health exposure to nitrate." (Workplan Approval Letter, p. 4.)
- Condition 11: "For the purposes of determining the adequacy of the number and density of well sampling, as well as for purposes of producing contour maps of nitrate concentration, proper geostatistical methods must be utilized (e.g., copulas or similar method)." (Workplan Approval Letter, p. 4.)

SOMACH SIMMONS & DUNN
A Professional Corporation

SOMACH SIMMONS & DUNN
A Professional Corporation

- Condition 12: "Contour maps for the cooperative program must be developed by, or under the review of a registered Professional Geologist or Professional Engineer based on a sampling design that is statistically defensible given the spatial variability of the aquifer (i.e., hydrogeological heterogeneity, etc.) and local conditions." (Workplan Approval Letter p. 5.)
- Conditional 13: "The Technical Memo(s) you submit with the contour maps must clearly describe the method used to contour groundwater monitoring data, the associated confidence intervals and the areas of uncertainty." (Workplan Approval Letter, p. 5.)

State Board Order WQ 2013-0101 requires the Regional Board to "work in good faith with dischargers to make [a third party groundwater monitoring program] a viable option." (State Board Order WQ 2013-0101, p. 31.) This requirement to work in good faith arguably extends to Executive Officer decisions and determinations made with respect to determining compliance with the Workplan Approval Letter, and specifically, for determining the adequacy of contour maps for their intended purpose. The Regional Board has failed to work in good faith with respect to evaluation of contour maps, and such determinations associated with the contour maps are arbitrary.

First, it is important to understand that the Regional Board's Executive Officer made his decision based on draft contour maps and decided to not engage in further dialogue as to what the CCGC could do to improve the maps for objective consideration by the Regional Board. Specifically, and taking the Salinas Valley as an example, the CCGC believed that the conversation with respect to contour maps was an iterative approach. Accordingly, the CCGC submitted its first technical memorandum and draft contour maps to the Regional Board on April 30, 2014. (See April Draft Technical Memorandum.) A second report (December Draft Technical Memorandum) was then submitted on December 10, 2014, which incorporated additional data and information due to comments received from Regional Board staff on the April Draft Technical Memorandum. It was the CCGC's belief that these reports were interim deliverables and that based on a dialogue between CCGC's professional consultants and Regional Board staff, a final report with final contour maps would be delivered to the Regional Board by the March 15, 2015 deadline. Instead, rather than working with the CCGC to assist in the development of final contour maps that would satisfy the Regional Board's Executive Officer and waiting for delivery of final maps, the Regional Board's Executive Officer rejected the draft Salinas Valley contour maps almost one month prior to submittal of a final work product. In the February 2015 Rejection Letter, the Executive Officer indicated that it was unlikely that the contour maps "can be improved to meet Conditions 10 through 13 of the Workplan Approval letter, due to high variability of groundwater nitrate data, and lack of available data and resulting uncertainty in some areas, yielding little benefit for continued CCGC investment in pursuit of meeting the Workplan Approval conditions."[8] (February 2015 Rejection Letter, p. 2.) In other words, there was nothing that the CCGC could do to fashion the contour maps into something that the Executive Officer would approve to avoid public display of individual CCGC member well data on GeoTracker. However, in the same paragraph, the Executive Officer stated that, "the contour maps can be improved and may be useful to help inform the public's understanding of the nitrate in shallow groundwater." (February 2015 Rejection Letter, p. 2.)

At the heart of the Executive Officer's determination is a mistaken belief that the public has a right to obtain and view individual well data through the GeoTracker database system, and that any alternative to that right must display data in such a manner that is equivalent to display of individual data points. The Executive Officer's determination in this regard is wrong. As discussed previously, there is no legal obligation that individual well data be made available to the public through the GeoTracker database. While the state may want to include as much data as possible on GeoTracker, nothing in law mandates that data be available to the public in this manner. Rather, the data may be obtained lawfully through a Public Records Act request, and public policy concerns associated with open, internet availability of such data outweigh the need to provide the data on GeoTracker.

Next, and as stated in the February 2015 Rejection Letter, contour maps are a useful tool for informing the public regarding nitrate concentrations in shallow groundwater. In fact, the

[8] The Executive Officer also signaled that he would be rejecting the Pajaro Valley and Gilroy-Hollister Valley contour maps as well, which was recently conveyed in the March 2015 Rejection Letter.

SOMACH SIMMONS & DUNN
A Professional Corporation

CCGC contends that such contour maps are far more helpful to the public as compared to individual data points because it extrapolates limited data in a sound, statistical manner to display potential areas of concern for the public in general. From contour maps, members of the public can then determine if they should have their well(s) tested. Comparatively, it is difficult to make such a judgment call based on an individual data point that may or may not be near an individual's domestic well.

Third, the Regional Board's reasons for alleging that the draft Salinas Valley contour maps fail to satisfy Conditions 10 through 13 of the Workplan Approval Letter are arbitrary and outcome-based. For example, the Regional Board alleges that Condition 10 is not satisfied because there is no discussion in the April and December Draft Technical Memorandums regarding the sufficiency of sampling density. (February 2015 Rejection Letter, p. 6, Table 1.) In response, the CCGC contends that the Workplan Approval Letter does not provide any specification with respect to what would be considered sufficient. Further, sufficiency is a subjective term. The Regional Board has not indicated what it would consider to be sufficient. Thus, it becomes an almost impossible standard to meet. In another example, the February 2015 Rejection Letter criticizes the fact the samples below 400 feet were excluded from the draft Salinas Valley contour maps. As explained in the December Draft Technical Memorandum, such samples were excluded because approximately 80 percent of all domestic supply wells are found between 0 and 400 feet, and a majority of wells below 400 feet are irrigation supply wells. (See December Draft Technical Memorandum, p. 24.) Thus, the CCGC found it appropriate to exclude such samples because the intended purpose of the contour maps is to inform the public with respect to nitrate concentrations in shallow groundwater.

In other criticism, the Regional Board alleges that the CCGC did not increase sampling to increase confidence or confirm adequacy of contours. As indicated above, the CCGC sampled all domestic wells of all its members. Further, the CCGC used all available data, including individual well data gathered that was not part of the CCGC program. Any domestic wells not sampled would *not* be on agricultural parcels and it is not reasonable to expect the CCGC to find and monitor domestic wells outside of the irrigated lands program. Also, the Regional Board

SOMACH SIMMONS & DUNN
A Professional Corporation

alleges that the CCGC failed to provide confidence intervals. This is simply not true. Figures 20a and 20b from the December Draft Technical Memorandum are confidence intervals on contours. (December Draft Technical Memorandum, pp. 54-55.) Other relevant information is provided on Figures 13 and 15 (standard deviations of kriged concentrations), and Figures 16-19 (probability of exceedance of various concentrations). (December Draft Technical Memorandum, pp. 45, 47-52.)

In summary, the draft Salinas Valley contour maps, and by extension the Pajaro Valley and Gilroy-Hollister Valley contour maps, do satisfy Conditions 10 through 13 of the Workplan Approval Letter when reviewed objectively. Further, to the extent that the Regional Board needed further information and justification, the CCGC intended to respond to and address all comments of concern in the final maps, which were to be delivered on March 15, 2015. However, the Regional Board's Executive Officer prematurely rejected all such maps claiming that their usefulness in lieu of open, public display of individual data points on the internet could not be satisfied. Such a decision is non-sensical considering that there is no legal requirement for the public display of individual data on GeoTracker and that the Regional Board does find the maps useful for informing the public regarding nitrate concentrations in shallow groundwater. Accordingly, the State Board must find that the Regional Board's requirement for the public display of individual well data is unjust, and that the contour maps prepared by the CCGC are a useful tool for informing the public with respect to nitrate concentrations in shallow groundwater.

F. Regional Board's Actions Disincentivize Third Party Programs Contrary to the State Board's Express Findings

The State Board has consistently recognized and encouraged the formation of third party groups to assist with monitoring and other administrative duties. (See State Board Order WQ 2004-0003, p. 9 ["We strongly believe that in light of this number of operations, it is to the benefit of both the regulators and the regulated community to encourage the formation of Coalition Groups."].) Specifically, the State Board acknowledges that "monitoring requirement for Groups are much greater and will provide much more useful information." (State Board Order WQ 2004-0003, p. 9.) Further, and most recently, the State Board has continued to express

SOMACH SIMMONS & DUNN
A Professional Corporation

its support for third party approaches when it reviewed the Agricultural Order and made the following finding:

> Finally, while this last point is not reflected in specific revisions to Provision 11, we believe it is important here for us to express our support of third party approaches generally. There are a number of advantages to utilizing a third party approach to regulation of agricultural discharges. From a resource perspective, third parties allow a regional water board to leverage limited regulatory staff to acting as intermediaries between the regional water board staff and the growers, freeing regional water board resources to focus on problem areas or actors. Third parties also may have the expertise to provide technical assistance and training to grower at a scale that cannot be matched by regional water board staff resources, and, in many cases, third parties already have relationships in place with the dischargers. We recognize the need to be wary of third party programs that report compliance at too high a level of generality. As a result, we expert the Central Coast Water Board to review proposals carefully to ensure consistency with legal requirements to verify the adequacy and effectiveness of waiver conditions and provide sufficient feedback mechanisms for determination of whether the required controls are achieving the Agricultural Order's stated purposes. [Footnote omitted.] However, we also expect the Central Coast Water Board to give fair and due consideration to proposed third party projects and programs and work with third party groups in good faith to develop viable alternatives. (See State Board Order WQ 2013-0101, pp. 13-14.)

The CCGC program is clearly a third party program as envisioned by the State Board. While its focus is specific to groundwater monitoring requirements that would otherwise be imposed on its members, its purpose is to meet individual requirements as well as providing more useful information through the characterization of local aquifers. For example, and as discussed above, the CCGC is preparing contour maps for agricultural areas within the Central Coast region, and has compiled extensive data from a variety of sources to characterize groundwater quality in general. In comparison, from those *not* participating in the CCGC or another third party groundwater monitoring program, the Regional Board will receive *only* limited, individual well sample results. Individuals are not required to provide any other data or information. Thus, clearly, the CCGC's work product will be superior in that it takes all available data and synthesizes the information so that the Regional Board and the public have useful information for making future policy and regulatory decisions.

The Regional Board attempts to dispute the value of the contour maps by claiming that they report compliance at too high a level of generality. This statement is unsupportable for several reasons. First, all individual well results are reported to the Regional Board and available

SOMACH SIMMONS & DUNN
A Professional Corporation

to the public through a Public Records Act request. Thus, compliance with obtaining individual results is clearly demonstrated through CCGC's reporting of such information to the Regional Board. Second, and as discussed at length previously, the issue here is specifically related to the public display of individual well data on the internet. Again, the issue is unrelated to the level of reporting.

From a policy perspective, third party programs are successful when there is an incentive to participate in the third party's efforts versus going alone. For many CCGC members, the primary incentive for joining CCGC was to obtain some level of protection from the public display of sample results taken from private domestic and agricultural supply wells. The Regional Board's decision here completely undermines that incentive, which in turn undermines the value of the CCGC as a third party. Because of this decision, many growers in the Central Coast region may be hesitant to participate in such third party programs in the future. Should that occur, the state and the public will lose the valuable information prepared by the third party, which here is characterizing and synthesizing groundwater data. This alone should cause the State Board to reject the Regional Board's position on this issue.

IV. CONCLUSION

In conclusion, the Regional Board is seeking to reject the CCGC's contour maps for informing the public in order to implement an unwritten, unilateral policy that is otherwise not required by law. Such actions are arbitrary and must be overturned by the State Board. Moreover, such actions fail to weigh and consider the privacy rights of individuals as compared to a general decision to have individual well data publicly available on the internet for viewing by anybody, anywhere anonymously.

///

///

///

///

///

///

SOMACH SIMMONS & DUNN
A Professional Corporation

For the foregoing reasons, Petitioner requests that the State Board grant the relief requested herein.

SOMACH, SIMMONS & DUNN
A Professional Corporation

Dated: March 23, 2015

By [signature: Theresa A. Dunham]
Theresa A. Dunham
Attorneys for Petitioner
CENTRAL COAST GROUNDWATER COALITION

SOMACH SIMMONS & DUNN
A Professional Corporation

PROOF OF SERVICE

I am employed in the County of Sacramento; my business address is 500 Capitol Mall, Suite 1000, Sacramento, California; I am over the age of 18 years and not a party to the foregoing action.

On March 23, 2015, I served the following document(s)

CENTRAL COAST GROUNDWATER COALITION'S PETITION FOR REVIEW; MEMORANDUM IN SUPPORT OF PETITION (Wat. Code, § 13320)

XX (by mail) on all parties in said action, in accordance with Code of Civil Procedure § 1013a(3), by placing a true copy thereof enclosed in a sealed envelope, with postage fully prepaid thereon, in the designated area for outgoing mail, addressed as set forth below:

Kenneth A. Harris, Jr., Executive Officer California Regional Water Quality Control Board, Central Coast Region 895 Aerovista Place, Suite 101 San Luis Obispo, CA 93401	

I declare under penalty of perjury that the foregoing is true and correct. Executed on March 23, 2015, at Sacramento, California.

[signature]

Crystal Rivera

SOMACH SIMMONS & DUNN
A Professional Corporation

ATTACHMENT 1

February 20, 2015

Sent via Electronic Mail

Mr. Parry Klassen
Central Coast Groundwater Coalition
Post Office Box 828
Salinas, California 93902
pklassen@unwiredbb.com

Dear Mr. Klassen:

IRRIGATED LANDS REGULATORY PROGRAM: RESPONSE TO CENTRAL COAST GROUNDWATER COALITION TECHNICAL MEMORANDUM AND CONTOUR MAPS, GROUNDWATER NITRATE, SALINAS VALLEY, CALIFORNIA

The Central Coast Groundwater Coalition (CCGC) submitted a Technical Memorandum titled "Distribution of Groundwater Nitrate Concentrations, Salinas Valley, California" dated April 30, 2014 and a revised Technical Memorandum titled "Groundwater Nitrate, Salinas Valley, California" dated December 10, 2014. We appreciate the substantial efforts CCGC has made to conduct the groundwater monitoring and present the data and results in the initial and revised Technical Memorandums. We also recognize the very significant progress that CCGC has made to implement a cooperative groundwater monitoring program for growers since July 2013, in compliance with the Agricultural Order R3-2012-0011 (Agricultural Order) and associated Monitoring and Reporting Programs (MRPs).

The revised Technical Memorandum is an important document because in addition to fulfilling the groundwater monitoring regulatory requirements of the Agricultural Order and MRPs for growers participating in the CCGC, it provides the Central Coast Water Board, public and stakeholders (e.g. research organizations, environmental and public health agencies, industry groups, drinking water groups, etc.) with data and information regarding shallow groundwater nitrate concentrations in the Salinas Valley. The revised Technical Memorandum confirms that shallow groundwater in the Salinas Valley is severely impacted by nitrate with 26% of the groundwater wells sampled exceeding the drinking water standard, and maximum concentrations as high as 614 mg/L nitrate as NO_3. The report also identifies specific areas of the Salinas Valley where the percent of wells with average nitrate concentrations exceeding the drinking water standard is as high as 51% (Forebay Subarea). Due to the significant impacts to groundwater that serves as a source of drinking water, the Central Coast Water Board must prioritize safe drinking water and maximize the public's access to information and data regarding nitrate impacts to groundwater.

As we discussed at our February 10, 2015, CCGC Coordination Meeting, Central Coast Water Board staff recognizes that the nitrate concentration contour maps included with the revised Technical Memorandum present CCGC's interpretation based on the available nitrate data for

ATTACHMENT 1

shallow groundwater in the Salinas Valley. Central Coast Water Board staff respects the significant work effort that CCGC and its consultants have put into contour map development, and acknowledges groundwater data can be contoured into multiple, potentially widely differing interpretations, as evidenced in the two disparate contour map interpretations provided in CCGC's April and December 2014 submittals for the Salinas Valley. Staff also agrees that having access to data in a visual format such as a contour map, in addition to the actual data, can add value to the public's general understanding of nitrate impacts to shallow groundwater. Notwithstanding these considerations, staff has determined that the CCGC contour maps do not meet Conditions 10 through 13 of the Executive Officer's Workplan Approval letter and the contour maps alone are not sufficient for providing reliable information to the public, in lieu of the actual groundwater data[1]. A summary of staff's evaluation of the CCGC contour maps is included in Attachment 1 to this letter.

As we discussed at the February 10, 2015, CCGC Coordination Meeting, it is unlikely that the contour maps can be improved to meet Conditions 10 through 13 of the Workplan Approval letter, due to the high variability of groundwater nitrate data, and lack of available data and resulting uncertainty in some areas, yielding little benefit for continued CCGC investment in pursuit of meeting the Workplan Approval conditions. Despite the fact that the contour maps do not meet Conditions 10 through 13 of the Workplan Approval letter, staff recognizes that the contour maps can be improved and may be useful to help inform the public's understanding of nitrate in shallow groundwater, as a supplement to the actual data. CCGC has indicated that it plans to improve the nitrate concentration maps to better define the areas where there is sufficient data, clearly describe the associated confidence levels, and properly identify data gaps and areas of uncertainty. Central Coast Water Board staff will continue to meet with CCGC and their consultant to define expectations for finalizing the contour maps as a supplement to the actual data displayed on GeoTracker GAMA. Once the Technical Memorandum and associated contour map(s) are finalized, the Central Coast Water Board will make the Technical Memorandum and associated contour map available to the public on the Water Board's website.

Staff's determination is specific to the CCGC Technical Memorandum and associated nitrate concentration contour maps for the Salinas Valley. However, based on staff's review of the CCGC Technical Memorandums and associated nitrate concentration contour maps submitted for the Pajaro Valley and Gilroy-Hollister Valley, similar issues exist regarding insufficient data density, conformity, and confidence and staff anticipates a similar determination for contour maps in these areas. In addition, CCGC representatives have indicated the desire to treat CCGC members similarly, both within a specific program area and across different CCGC program areas, to support CCGC member equity and to treat CCGC data consistently.

---

[1]CCGC submitted workplans for implementing a cooperative groundwater monitoring program on May 31, 2013 and Nov. 1, 2013, http://www.waterboards.ca.gov/centralcoast/water_issues/programs/ag_waivers/docs/groundwater/1finalccgc_workplan_110113.pdf

The Executive Officer issued a letter approving the CCGC Workplan On July 11, 2013. The letter specified Conditions 10-13 for evaluating CCGC contour maps and Conditions 19-21 for displaying CCGC information on GeoTracker. http://www.waterboards.ca.gov/centralcoast/water_issues/programs/ag_waivers/docs/groundwater/2ccgc_workplan_approval_071113.pdf.

At the Jan. 30, 2015 Board Meeting, the Central Coast Water Board agreed that the process for reviewing and approving CCGC contour maps, as established in the Executive Officer's Workplan Approval letter, is appropriate. At the Jan. 30, 2015 Board Meeting, staff also presented their evaluation of the CCGC contour maps for the Salinas Valley and proposed next steps. http://www.waterboards.ca.gov/centralcoast/board_info/agendas/2015/january/item16/index.shtml.

Based upon these evaluations and determinations, and consistent with the Agricultural Order, the **Central Coast Water Board will display the CCGC data for the public as individual wells**[2] **on GeoTracker GAMA on March 15, 2016.**

Recognizing the CCGC members' desire for anonymity, staff agrees to identify the individual CCGC wells with the CCGC well identification number provided by CCGC, rather than displaying individual farm information. Until the actual CCGC data is displayed on GeoTracker GAMA, the Central Coast Water Board will continue to provide CCGC data to the public in response to any relevant Public Records Act Request (PRAR). Additionally, the March 15, 2016, date to display CCGC data on GeoTracker GAMA does not affect the Water Board's ability to conduct its regulatory work including publishing, presenting or using individual CCGC well data in any reports or presentations at any time.

This letter changes the Workplan Approval Letter's date for display of data to March 15, 2016. This letter also documents the Executive Officer's determination that the CCGC contour maps do not meet the conditions in the Workplan Approval Letter. Any person affected by this action of the Central Coast Water Board may petition the State Water Resources Control Board (State Board) to review the action in accordance with Section 13320 of the California Water Code and Title 23, California Code of Regulations, Section 2050 and following. The State Water Board must receive the petition by 5:00 p.m., 30 days after the date of this letter, except that if the thirtieth day following the date of this letter falls on a Saturday, Sunday, or State Holiday, the petition must be received by the State Water Board by 5:00 p.m. on the next business day. Copies of the law and regulations applicable to filing petitions will be provided upon request and may be found on the Internet at:
http://www.waterboards.ca.gov/public_notices/petitions/water_quality.

If you have any questions, please contact John Robertson at (805) 542-4630 or John.Robertson@waterboards.ca.gov, or Angela Schroeter at (805) 542-4644 or Angela.Schroeter@waterboards.ca.gov.

Sincerely,

Digitally signed by Kenneth A Harris Jr
DN: cn=Kenneth A Harris Jr, o=Central Coast Regional Water Quality Control Board, ou=Executive Officer, email=Ken.Harris@waterboards.ca.gov, c=US
Date: 2015.02.20 14:24:44 -08'00'

Kenneth A. Harris, Jr.
Executive Officer

cc:

Tim Borel, Central Coast Groundwater Coalition
tborel@foxyproduce.com

Abby Taylor-Silva, Grower-Shipper Assoc.
abby@growershipper.com

---

[2] Pursuant to Condition 65 of the Agricultural Order, well location and data will only be displayed on GeoTracker GAMA within a one-half mile radius of the actual well location.

Kara Stuart, Central Coast Groundwater Coalition
karamstuart@gmail.com

Michael L. Johnson, Michael L. Johnson LLC
mjohnson@mlj-llc.com

Melissa Turner, Michael L. Johnson LLC
mturner@mlj-llc.com

Pearl Kan, California Rural Legal Assistance, Inc.
pkan@crla.org

Jessica Jahr, State Water Board
Jessica.Jahr@waterboards.ca.gov

Tamarin Austin, State Water Board
Tamarin.Austin@waterboards.ca.gov

John Robertson, Central Coast Water Board
John.Robertson@waterboards.ca.gov

Angela Schroeter, Central Coast Water Board
Angela.Schroeter@waterboards.ca.gov

Hector Hernandez, Central Coast Water Board
Hector.Hernandez@waterboards.ca.gov

P:\Ag-ILRP\2 - Program Management\1 -Board Meetings and EO Reports\2015\January2015\Item16_ContourMaps\CCGC_Contour Map_Final_022015.docx

ATTACHMENT 1

Central Coast Water Board Staff Evaluation of the CCGC Contour Maps per Conditions 10-13 of the Executive Officers' Workplan Approval Letter

Agricultural Order R3-2012-0011 and associated MRPs require growers to conduct individual or cooperative groundwater monitoring. Growers who conduct groundwater monitoring must submit data electronically to the Water Board's GeoTracker data management system. However, the public availability of information for growers who choose to comply with groundwater monitoring requirements as individuals is different than for growers who participate in the Central Coast Groundwater Coalition (CCGC). Growers who choose to comply with groundwater monitoring requirements as individuals conduct the required groundwater monitoring and reporting, and the results are displayed on GeoTracker GAMA consistent with the reporting and display for other groundwater programs regulated by the Water Board. The requirements for cooperative groundwater monitoring and reporting, including display of information on GeoTracker, is described in the CCGC Workplan and Executive Officer's approval of the CCGC Workplan.

The CCGC submitted workplans for implementing a cooperative groundwater monitoring program on May 31, 2013, and Nov. 1, 2013. The Executive Officer issued a letter approving the CCGC Workplan on July 11, 2013, with additional revisions on December 17, 2013, (collectively referred to as the Workplan Approval letter). Per the Workplan Approval letter, the CCGC can submit contour maps to display nitrate concentration to the public, in lieu of displaying individual well data – if the contour maps meet Conditions 10 through 13 of the Workplan Approval letter and the contour maps are approved by the Executive Officer. Additionally, the Workplan Approval letter also included Conditions 19 through 21 to describe the process and conditions for displaying CCGC data on GeoTracker.

At the January 30, 2015, Board Meeting, the Central Coast Water Board evaluated the process for reviewing and approving CCGC contour maps, as established in the Executive Officer's Workplan Approval letter, and did not make any changes. Board Members also discussed staff's evaluation of the CCGC contour maps for the Salinas Valley and proposed next steps.

Based on an evaluation of the CCGC nitrate concentration contour maps for groundwater in the Salinas Valley submitted on April 30, 2014, and December 10, 2014, in comparison with the actual well data, and based upon an evaluation of Part 2 of CRLA's discretionary review request, staff has determined that the CCGC contour maps do not meet Conditions 10 through 13 in the Workplan Approval letter. The CCGC groundwater monitoring data reported to the Central Coast Water Board in compliance with the Agricultural Order may be interpreted visually in a number of different ways depending upon the underlying assumptions and model inputs used. Staff finds that the CCGC contour maps are highly interpretive and, in many areas, do not provide the public with a precise or accurate representation of groundwater quality. This is due, in part, to the lack of existing data and CCGC member wells in some parts of the CCGC program area for the Salinas Valley and the relatively broad range in standard deviation from +/- 2.5 mg/L to +/- 10 mg/L Nitrate as NO_3. Table 1 below summarizes the contour map criteria identified in the Workplan Approval letter and the information provided by CCGC.

Table 1. Summary of CCGC Contour Map Criteria

Contour Map Criteria Identified in July 11, 2013 CCGC Workplan Approval	CCGC Contour Map Submitted April 30, 2014	CCGC Contour Map Submitted Dec. 10, 2014
Condition 10: Sampling density, resolution and scale must be sufficient such that individual domestic well owners that reside in agricultural areas within the cooperative groundwater monitoring program boundary can make informed decisions related to their drinking water quality and potential health exposure to nitrate.	Tech Memo accompanying contour map does not include any information to describe well density or to determine if this density is sufficient. Well density on maps appears sparse in some areas.	Revised Tech Memo describes a range in well density from 1 well per 25 acres, to 1 well per 14 acres only for wells where the standard deviation was less than 2.5 mg/L NO3. The Revised Tech Memo does not describe the well density for all wells. The Revised Tech Memo indicates that the well density values appear generally sufficient for mapping of areas where groundwater is likely to be over the MCL. However, there is no evaluation of whether the well density is sufficient given the spatial variability of the aquifer and specific local conditions.
Condition 10: Contour maps must characterize groundwater nitrate concentrations at specific depth, focus on shallow groundwater, and indicate depth represented on the map.	Tech Memo states that data for wells that are shallower than 400 feet are used to develop contour maps, but depth range is not indicated on the contour map.	Contour maps state that wells with depths greater than 400 feet are excluded. Contour maps do not specifically describe the 180 foot aquifer or discrete aquifer zones.
Condition 10: The analysis will be performed to achieve the highest level of certainty possible with the wells that are selected for sampling, and the analysis will explicitly provide the confidence value for any location on the map. If the CCGC determines that there are more wells that may be sampled in order to achieve a higher confidence interval, they must immediately inform the Executive Officer and present a plan, including schedule, for additional sampling as appropriate, to be approved by the Executive Officer. *Condition 11:* The CCGC must include additional sampling for use as a	No additional sampling was attempted or suggested to increase confidence or confirm adequacy of contours. CCGC members may have numerous irrigation and drinking water wells on their property. For the Salinas Valley, sampling was focused on only domestic drinking water wells – no additional sampling from irrigation wells was attempted to assist with groundwater characterization or development of contour maps. In addition, wells may also exist in the program area that do not belong to CCGC members but are available for sampling. These additional data points could assist to increase confidence or confirm adequacy of contours.	Same as April 30, 2014, version.

validation data set to confirm adequacy of contours.	CCGC did not bring additional wells to the attention of the Executive Officer.	
Condition 11: Any contour maps produced must include the confidence interval for estimated values. Contour map must present the data within an adequate confidence interval that is acceptable for providing reliable information to the public.	Confidence intervals are not addressed in the report or contour maps. Kriged nitrate concentration maps do not include any information regarding range of confidence interval and do not state that contours reflect predicted nitrate concentration. Contour maps do not indicate when data has been excluded from the interpretation.	Kriged nitrate concentration maps are identified as estimated values, but do not include any information regarding range of confidence interval. CCGC excluded data from contour maps for wells greater than 400 feet, in addition to other reasons. For example, data was also excluded due to very high concentrations which CCGC suspects are from a localized contamination site or where data was collected prior to the year 2000. Contour maps indicate data has been excluded from the interpretation only based on depth, but do not identify data excluded for other reasons. Maps are included that display standard deviation of the nitrate concentration contour map, estimated probability of exceeding the drinking water standard, and distribution of nitrate concentration at the 66% and 95% confidence intervals. CCGC consultants describe that the 66% and 95% upper bound maps are produced by adding one or two standard deviations, respectively, to the estimated concentrations, and that this indicates that there is a 66% or 95% confidence level that the actual concentration is between the upper and lower bound concentrations However, no confidence intervals are provided relative to the kriged nitrate concentration contour map.
Condition 11: Contour maps should use the State Drinking Water Standard of 45 mg/L Nitrate as NO3 and the initial contour intervals must be approximately every 10 mg/L	Nitrate concentration contour map includes appropriate contour intervals up to 45 mg/L Nitrate. After 45 mg/L, map only indicates 45-390.5 mg/L. This uppermost contour interval	Same concerns as April 30, 2014 version. After 45 mg/L Nitrate, map indicates a 45-90 mg/L and > 90 mg/L Nitrate range in concentration. The map does not provide adequate

Nitrate as NO3. After reaching the 45 mg/L Nitrate as NO3, contour, you may increase the size of the contour interval, if appropriate.	does not appropriately identify areas above the drinking water standard, including maximum concentrations reported as high as 690 mg/L Nitrate as NO3. This lack of information (contour differentiation above 45 mg/L) would provide substantial value.	data and information for concentrations ranging from 90 – 690 mg/L Nitrate.
Condition 12: The sampling density, resolution and scale must be approved by the Executive Officer, in advance of contour map preparation, to avoid the problem of not having sufficient data to produce an acceptable contour map.	CCGC did not provide specific information regarding sampling density, resolution, and scale to the Executive Officer in advance of the submittal of the contour map, and so none was approved.	CCGC did not provide specific information regarding sampling density, resolution, and scale to the Executive Officer in advance of the submittal of the contour map, and so none was approved.
Condition 12: Contour maps for the cooperative program must be developed by, or under the review of a registered Professional Geologist or Professional Engineer	Contour maps were prepared by Steven Deverel, a registered Professional Geologist in the State of California.	Contour maps were prepared by Steven Deverel, a registered Professional Geologist in the State of California.
Condition 12: Contour maps must be based on a sampling design that is statistically defensible given the spatial variability of the aquifer (i.e., hydrogeological heterogeneity, etc.) and specific local conditions.	Contour maps are based on CCGC sampling and available data, with some data excluded. There is no discussion to evaluate whether the data is sufficient given the spatial variability of the aquifer and specific local conditions.	Same as April 30, 2014, version. Revised Tech Memo does include discussion related to standard deviation.
Condition 12: Contour maps must be provided as a geographic information systems (GIS) shapefile according to a specific time schedule.	CCGC provided GIS files to the Water Board.	GIS files not provided at time the Staff Report was written.
Condition 13: Contour maps must clearly describe the method used to contour the groundwater monitoring data, the associated confidence intervals and the areas of uncertainty.	Contour method used is kriging. Confidence intervals are not included on the map or in the report. Areas of uncertainty are not represented on contour map.	Kriged nitrate concentration maps are identified as estimated values, but do not include any information regarding range of confidence interval. See discussion above.

ATTACHMENT 2

California Water Boards

Edmund G. Brown Jr.
Governor

Matthew Rodriquez
Secretary for
Environmental Protection

Central Coast Regional Water Quality Control Board

March 20, 2015

Sent via Electronic Mail Only

Mr. Parry Klassen
Central Coast Groundwater Coalition
Post Office Box 828
Salinas, California 93902
pklassen@unwiredbb.com

Dear Mr. Klaasen:

IRRIGATED LANDS REGULATORY PROGRAM: COMMENTS ON CENTRAL COAST GROUNDWATER COALITION TECHNICAL MEMORANDUMS FOR NORTHERN COUNTIES

We appreciate the significant progress that the Central Coast Groundwater Coalition (CCGC) has made to implement a cooperative groundwater monitoring program for growers, in compliance with the Central Coast Regional Water Quality Control Board (Central Coast Water Board) Agricultural Order R3-2012-0011 (Agricultural Order) and associated Monitoring and Reporting Programs (MRPs). This letter clarifies expectations for finalizing the CCGC Technical Memorandums for the northern counties and associated groundwater nitrate concentration contour maps as a supplement to the actual data displayed on GeoTracker GAMA. As stated in the February 20, 2015 letter, the Central Coast Water Board's Executive Officer has determined that the CCGC groundwater nitrate concentration contour maps of Salinas Valley do not meet Conditions 10 through 13 of the Executive Officer's Workplan Approval letter and the contour maps alone are not sufficient for providing reliable information to the public in lieu of the actual groundwater data. Similarly, staff have competed their review of the CCGC Technical Memorandums and associated nitrate concentration contour maps submitted for the Pajaro Valley and Gilroy-Hollister Valley and find that similar issues exist regarding insufficient data density, conformity, and confidence and staff has also determined that the contour maps for these areas do not meet Conditions 10 through 13 of the Executive Officer's Workplan Approval letter (see Attachment 1). Additionally, CCGC representatives have indicated the desire to treat CCGC members similarly, both within a specific program area and across different CCGC program areas, to support CCGC member equity and to treat CCGC data consistently. Based upon these evaluations and determinations, and consistent with the Agricultural Order, the Central Coast Water Board will display all CCGC data for the public as individual wells[1] on GeoTracker GAMA on March 15, 2016, as noted in our February 20, 2015 letter.

[1] Pursuant to Condition 65 of the Agricultural Order, well location and data will only be displayed on GeoTracker GAMA within a one-half mile radius of the actual well location.

ATTACHMENT 2

While the contour maps alone are not sufficient for providing reliable information to the public in lieu of the actual groundwater data, Central Coast Water Board staff recognizes that contour maps provide value and can be useful to help inform the public's understanding of nitrate in shallow groundwater, as a supplement to the actual data.

We have discussed the content and status of the Technical Memorandums on several occasions, most recently on February 10, 2015, March 10, 2015 and March 18, 2015. As the timeframes identified in the CCGC Work Plan approval are already delayed, the next step is to finalize the Technical Memorandums and Characterization Report for the northern counties in a timely manner per staff's limited comments described below. Once the Technical Memorandums and associated contour map(s) are finalized, the Central Coast Water Board will make the Technical Memorandums and associated contour map(s) available to the public on the Water Board's website. It is important to note that because the CCGC groundwater data will be available to the public and the contour maps are a supplement to the actual data, the expectations for finalizing the Technical Memorandums and associated contour maps have changed. It is important to finalize the Technical Memorandums and associated contour maps so that they are useful to the public, but the time and effort to complete the work should be kept to a minimum in the interest of both CCGC's and the Central Coast Water Board staff's time and resources.

General Comments Applicable to All Technical Memorandums

The following general comments are applicable to all Technical Memorandums for the northern areas (Salinas Valley, Pajaro Valley, Gilroy-Hollister). To streamline revisions, staff is not providing detailed comments on the individual Technical Memorandums, as the comments below apply to each of the documents. CCGC Technical Memorandums that adequately address the general comments below will be considered acceptable for final approval by the Central Coast Water Board.

1. Professional Certification. Please include professional registration name and number on the title page for the professional geologist or engineer responsible for preparing the submittal.

2. Executive Summary. Please confirm that the accuracy of statistical and probability descriptions are consistent with results of the contouring method. In addition, please add a description of data gaps and uncertainty.

3. Sample Density. Please describe the well density for all wells included in the report, including for those areas where there is larger standard deviation in groundwater nitrate concentration.

4. Data Analysis. A re-analysis of groundwater quality data is not required to finalize the report. However, it is important to confirm that described statistics and information presented on the contour maps is consistent with the results of the data analysis and that any associated uncertainty is appropriately described.

5. Contour Maps. Areas for which there is insufficient data should not be included in contouring, and the rationale for contour inclusion or exclusion should be described (e.g., proximity analysis, variability of groundwater quality data, hydrogeologic considerations). For each Technical Memorandum, at least one groundwater nitrate concentration map must be included. Additional subbasin contour maps are useful but

not required; CCGC should appropriately weigh the cost/value to further improve subbasin contour maps. Additionally, please also include a description of the methods and parameters used to develop the contour maps, so that the effort may be replicated in the future if necessary (include in text or as part of an appendix).

6. Describe Uncertainty. For any contour map or figure where data is estimated, predicted, or otherwise uncertain, the map or figure must clearly identify that results are estimated and also generally describe the associated uncertainty or confidence level. Within the text of the Technical Memorandum, please clarify the discussion on uncertainty or confidence levels in layman's terms to improve the public's understanding of what is being reported. Separate maps to describe uncertainty or confidence level (standard deviation, probability, confidence level) are useful but not required; CCGC should appropriately weigh the cost/value to further improve maps visually depicting uncertainty.

7. Exclusion of Data. In several areas, the report indicates that groundwater data and results have been excluded from the analysis. In such cases, each map, table or figure must clearly indicate that data has been excluded and a summary statement regarding specifically what data was excluded and the rationale for exclusion.

8. Reference actual data. Please include a reference on the contour map or figure to indicate that all CCGC data used to develop the contour map or figure is available on the Water Board's online GeoTracker data management system at: https://geotracker.waterboards.ca.gov/gama/

9. Contour Map Legend. Please revise nitrate concentration categories on the legend to properly reflect range of concentrations, including maximums. For example, identifying a contour that is >90 mg/L NO3 does not adequately describe the inclusion of concentrations of up to 200+, 300+, 400+ mg/L NO3. We are not prescribing a specific contour interval, only to instruct CCGC to appropriately describe range of concentrations presented.

10. Additional Data - Potentially Explanatory Factors. The CCGC has collected additional data that provides valuable context to understanding agricultural water quality and potential solutions. Please include a discussion of types of data collected (i.e., age-dating, oxygen/hydrogen/nitrogen isotopes, pharmaceuticals, caffeine, etc.). Please also include a summary data table and include actual data in the appendix. Inclusion of this data and/or inclusion of a qualitative interpretation of this type of data is helpful in understanding groundwater quality and potential solutions.

11. Appendix - Data. Please confirm that all well information and groundwater quality data collected by the CCGC in compliance with the MRP and approved workplans is included in the Appendix and uploaded to GeoTracker. At a minimum, the data presentation should include CCGC well ID number, well type, available well construction information – well depth, top of perforation, bottom of perforation, length of perforated interval, analytical result and whether or not result exceeds the drinking water standard, and any necessary qualifier (duplicate sample taken, laboratory QA/QC issue, field blank issue, etc). If any data is excluded in the analyses, that should be identified in the appendix.

12. Appendix - Exceedance Notification Follow-Up Report. Please include a complete Exceedance Notification Follow-Up Report for the relevant geographic area. This report should be consistent with that submitted separately to the Water Board (including CCGC

well ID number, field point class, sample date, nitrate result, notification date, and replacement water action).

General Comments – Characterization of Nitrate Concentrations in Shallow Groundwater, Northern Central Coast Region

The CCGC Workplan approval requires CCGC to submit a report characterizing nitrate concentrations in shallow groundwater for the northern counties of the CCGC program area (Characterization Report). Consistent with our discussion with CCGC and its consultants on March 18, 2015, the primary audience for the Characterization Report is the public and the intent is to present a brief overview of the CCGC program areas, methods used, data gaps and limitations, and a summary of the results and conclusions compiled from the individual Technical Memorandums. The Characterization Report should provide a broad overview of nitrate in shallow groundwater for the northern counties and also provide focused information on nitrate impacts to domestic drinking water wells. The Characterization Report should be written in layman's terms and inform the reader that greater technical detail can be found in the accompanying Technical Memorandums.

As discussed above, because CCGC groundwater data will be available to the public on GeoTracker GAMA and the contour maps are a supplement to the actual data, the expectations for finalizing the Technical Memorandums and associated contour maps has changed and the anticipated scope has correspondingly diminished. Central Coast Water Board staff is committed to working with CCGC to finalize the Technical Memorandums and Characterization Report in a timely manner so that they are useful to the public. **Based on the comments provided above, CCGC is required to submit the final Technical Memorandums for Salinas Valley, Pajaro Valley, and Gilroy-Hollister, as well as the Characterization Report for the northern counties no later than June 1, 2015.**

In closing, we appreciate the significant progress that CCGC has made to implement a cooperative groundwater monitoring program for growers. The results of this initial groundwater monitoring effort and lessons learned provides an important foundation to understand nitrate impacts to shallow groundwater in agricultural areas of the Central Coast region, and will also inform future groundwater monitoring programs. Thank you for your continued efforts and those of your membership in this endeavor. If you have any questions regarding this letter, please contact Angela Schroeter at (805) 542-4644 or Angela.Schroeter@waterboards.ca.gov, or John.Robertson at (805) 542-4630 or John.Robertson@waterboards.ca.gov.

Sincerely,

John M. Robertson

Digitally signed by John M. Robertson
DN: cn=John M. Robertson, o=State Water Board/Cal EPA, ou=Central Coast Regional Water Quality Control Board, email=john.robertson@waterboards.ca.gov, c=US
Date: 2015.03.20 15:38:50 -07'00'

for Kenneth A. Harris, Jr.
Executive Officer

cc:

Tim Borel, Central Coast Groundwater Coalition
tborel@foxyproduce.com

Abby Taylor-Silva, Grower-Shipper Association
abby@growershipper.com

Kara Stuart, Central Coast Groundwater Coalition
karamstuart@gmail.com

Michael L. Johnson, Michael L. Johnson LLC
mjohnson@mlj-llc.com

Melissa Turner, Michael L. Johnson LLC
mturner@mlj-llc.com

Vicki Kretsinger, Luhdorff and Scalmanini
vkretsinger@lsce.com

Pete Leffler, Luhdorff and Scalmanini
pleffler@lsce.com

Pearl Kan, California Rural Legal Assistance
pkan@crla.org

Tamarin Austin, State Water Resources Control Board
Tamarin.Austin@waterboards.ca.gov

John Robertson, Central Coast Water Board
John.Robertson@waterboards.ca.gov

Angela Schroeter, Central Coast Water Board
Angela.Schroeter@waterboards.ca.gov

Chris Rose, Central Coast Water Board
Chris.Rose@waterboards.ca.gov

Hector Hernandez, Central Coast Water Board
Hector.Hernandez@waterboards.ca.gov

ATTACHMENT 1

Central Coast Water Board Staff Evaluation of the CCGC Contour Maps for Pajaro Valley and Gilroy-Hollister per Conditions 10-13 of the Executive Officers' Workplan Approval Letter

Agricultural Order R3-2012-0011 and associated MRPs require growers to conduct individual or cooperative groundwater monitoring. Growers who conduct groundwater monitoring must submit data electronically to the Water Board's GeoTracker data management system. However, the public availability of information for growers who choose to comply with groundwater monitoring requirements as individuals is different than for growers who participate in the Central Coast Groundwater Coalition (CCGC). Growers who choose to comply with groundwater monitoring requirements as individuals conduct the required groundwater monitoring and reporting, and the results are displayed on GeoTracker GAMA consistent with the reporting and display for other groundwater programs regulated by the Water Board. The requirements for cooperative groundwater monitoring and reporting, including display of information on GeoTracker, is described in the CCGC Workplan and Executive Officer's approval of the CCGC Workplan.

The CCGC submitted workplans for implementing a cooperative groundwater monitoring program on May 31, 2013, and Nov. 1, 2013. The Executive Officer issued a letter approving the CCGC Workplan on July 11, 2013, with additional revisions on December 17, 2013, (collectively referred to as the Workplan Approval letter). Per the Workplan Approval letter, the CCGC can submit contour maps to display nitrate concentration to the public, in lieu of displaying individual well data – if the contour maps meet Conditions 10 through 13 of the Workplan Approval letter and the contour maps are approved by the Executive Officer. Additionally, the Workplan Approval letter also included Conditions 19 through 21 to describe the process and conditions for displaying CCGC data on GeoTracker. At the January 30, 2015, Board Meeting, the Central Coast Water Board evaluated the process for reviewing and approving CCGC contour maps, as established in the Executive Officer's Workplan Approval letter, and did not make any changes.

The Technical Memorandums and associated contour maps are important because in addition to fulfilling the groundwater monitoring regulatory requirements of the Agricultural Order and MRPs for growers participating in the CCGC, it provides the Central Coast Water Board, public and stakeholders (e.g. research organizations, environmental and public health agencies, industry groups, drinking water groups, etc.) with data and information regarding shallow groundwater nitrate concentrations. The Technical Memorandums confirm that shallow groundwater is severely impacted by nitrate. Due to the significant impacts to groundwater that serves as a source of drinking water, the Central Coast Water Board must prioritize safe drinking water and maximize the public's access to information and data regarding nitrate impacts to groundwater.

Based on an evaluation of the CCGC nitrate concentration contour maps for groundwater in the Pajaro Valley submitted on July 31, 2014, and revised January 12, 2015, in comparison with the actual well data, staff has determined that the CCGC contour maps do not meet Conditions 10 through 13 in the Workplan Approval letter. Similarly, staff evaluated CCGC nitrate concentration contour maps for groundwater in the Gilroy-Hollister area submitted on October 31, 2014, and has also determined that the CCGC contour maps do not meet Conditions 10 through 13 in the Workplan Approval letter. The CCGC groundwater monitoring data reported to the Central Coast Water Board in compliance with the Agricultural Order may be interpreted visually in a number of different ways depending upon the underlying assumptions and model inputs used. Staff finds that the CCGC contour maps are highly interpretive and, in many areas, do not provide the public with a precise or accurate representation of groundwater quality. This is due, in part, to the lack of existing data and CCGC member wells in some parts of the CCGC program area for the Pajaro Valley and Gilroy-Hollister areas, and the relatively broad range in standard deviation of nitrate concentrations in groundwater. Table 1 below summarizes the contour map criteria identified in the Workplan Approval letter and the information provided by CCGC.

Table 1. Summary of CCGC Contour Map Criteria

Contour Map Criteria Identified in July 11, 2013 CCGC Workplan Approval	CCGC Contour Map Pajaro Valley Submitted Jan. 12, 2015	CCGC Contour Map Gilroy-Hollister Submitted Oct. 31, 2014
Condition 10: Sampling density, resolution and scale must be sufficient such that individual domestic well owners that reside in agricultural areas within the cooperative groundwater monitoring program boundary can make informed decisions related to their drinking water quality and potential health exposure to nitrate.	Tech Memo accompanying contour map does not include any information to describe well density. Well density on maps appears sparse in some areas. There is no evaluation of whether the well density is sufficient given the spatial variability of the aquifer and specific local conditions, or if the well density is sufficient to produce reliable contour maps of nitrate concentrations in groundwater.	Tech Memo accompanying contour map does not include any information to describe well density or to determine if this density is sufficient. Well density on maps appears sparse in some areas. There is no evaluation of whether the well density is sufficient given the spatial variability of the aquifer and specific local conditions, or if the well density is sufficient to produce reliable contour maps of nitrate concentrations in groundwater.
Condition 10: Contour maps must characterize groundwater nitrate concentrations at specific depth, focus on shallow groundwater, and indicate depth represented on the map.	Tech Memo states that data for wells that are shallower than 400 feet are used to develop contour maps, depth is specified on the contour maps.	Tech Memo states that data for wells that are shallower than 420 feet are used to develop contour maps; however depth is not specified on contour maps.
Condition 10: The analysis will be performed to achieve the highest level of certainty possible with the wells that are selected for sampling, and the analysis will explicitly provide the confidence value for any location on the map. If the CCGC determines that there are more wells that may be sampled in order to achieve a higher confidence interval, they must immediately inform the Executive Officer and present a plan, including schedule, for additional	CCGC sampled primarily domestic wells in the Pajaro Valley, with some irrigation wells. The Tech Memo does not describe any effort to consider additional sampling to increase confidence or confirm adequacy of contours (e.g. additional CCGC irrigation wells, or domestic or irrigation wells that that do not belong to CCGC members but are available for sampling). These additional data points could assist to increase confidence or confirm adequacy of contours.	CCGC sampled primarily domestic wells in the Gilroy-Hollister area, with some irrigation wells. The Tech Memo does not describe any effort to consider additional sampling to increase confidence or confirm adequacy of contours (e.g. additional CCGC irrigation wells, or domestic or irrigation wells that that do not belong to CCGC members but are available for sampling). These additional data points could assist to increase confidence or confirm adequacy of contours.

sampling as appropriate, to be approved by the Executive Officer. *Condition 11:* The CCGC must include additional sampling for use as a validation data set to confirm adequacy of contours.	CCGC did not bring additional wells to the attention of the Executive Officer.	CCGC did not bring additional wells to the attention of the Executive Officer.
Condition 11: Any contour maps produced must include the confidence interval for estimated values. Contour map must present the data within an adequate confidence interval that is acceptable for providing reliable information to the public.	Confidence intervals and standard deviations are described in the Tech Memo. For example, the Tech Memo describes a 66% confidence interval, which translates to a mapped value that is accurate to within plus or minus 10 mg/L nitrate as NO3, and a 95% confidence interval which translates to a mapped value that is accurate to within plus or minus 20 mg/L nitrate as NO3. The Tech Memo only presents maps for lower bound of the confidence intervals (best case scenario) and does not include information for the upper bound. While the Tech Memo includes information regarding confidence intervals, staff has determined that the confidence levels are not adequate for providing reliable information to the public, in lieu of the actual data. This is due largely because some contoured areas are absent any data or have very sparse data.	Confidence intervals and standard deviations are described in the Tech Memo (66% and 95%). The Tech Memo only presents maps for lower bound of the confidence intervals (best case scenario) and does not include information for the upper bound. While the Tech Memo includes information regarding confidence intervals, staff has determined that the confidence levels are not adequate for providing reliable information to the public, in lieu of the actual data. This is due largely because some contoured areas are absent any data or have very sparse data.
Condition 11: Contour maps should use the State Drinking Water Standard of 45 mg/L Nitrate as NO3 and the initial contour intervals must be approximately every 10 mg/L Nitrate as NO3. After reaching the 45 mg/L Nitrate as NO3, contour, you may increase the size of the contour interval, if appropriate.	Nitrate concentration contour map includes six contour intervals from <22.5 mg/L to 316 mg/L nitrate as NO3, reflecting the minimum and maximum concentrations.	Nitrate concentration contour map indicates four contour intervals from 0-99-22.5 mg/L to >45 mg/L Nitrate range in concentration. The map does not present adequate information for concentrations ranging from 45 – 240 mg/L nitrate as NO3.
Condition 12: The sampling density,	CCGC did not provide specific information regarding sampling	CCGC did not provide specific information regarding sampling

resolution and scale must be approved by the Executive Officer, in advance of contour map preparation, to avoid the problem of not having sufficient data to produce an acceptable contour map.	density, resolution, and scale to the Executive Officer in advance of the submittal of the contour map, and so none was approved.	density, resolution, and scale to the Executive Officer in advance of the submittal of the contour map, and so none was approved.
Condition 12: Contour maps for the cooperative program must be developed by, or under the review of a registered Professional Geologist or Professional Engineer	Contour maps were prepared by Steven Deverel, a registered Professional Geologist in the State of California.	Contour maps were prepared by Steven Deverel, a registered Professional Geologist in the State of California.
Condition 12: Contour maps must be based on a sampling design that is statistically defensible given the spatial variability of the aquifer (i.e., hydrogeological heterogeneity, etc.) and specific local conditions.	Contour maps are based on CCGC sampling and available data, with some data excluded. There is no discussion to evaluate whether the data is sufficient given the spatial variability of the aquifer and specific local conditions.	Contour maps are based on CCGC sampling and available data, with some data excluded. There is no discussion to evaluate whether the data is sufficient given the spatial variability of the aquifer and specific local conditions.
Condition 12: Contour maps must be provided as a geographic information systems (GIS) shapefile according to a specific time schedule.	CCGC provided GIS files to the Water Board.	CCGC provided GIS files to the Water Board.
Condition 13: Contour maps must clearly describe the method used to contour the groundwater monitoring data, the associated confidence intervals and the areas of uncertainty.	Contour method used is kriging. Areas of uncertainty are not represented on contour map. Several areas included in the contour map have no well data to support contouring, or the data is very sparse.	Contour method used is kriging. Areas of uncertainty are not represented on contour map. Several areas included in the contour map have no well data to support contouring, or the data is very sparse.

DRAFT – March XX, 2015

Sent via Electronic Mail

Mr. Parry Klassen
Central Coast Groundwater Coalition
Post Office Box 828
Salinas, California 93902
pklassen@unwiredbb.com

Dear Mr. Klaasen:

IRRIGATED LANDS REGULATORY PROGRAM: COMMENTS ON CENTRAL COAST GROUNDWATER COALITION SUBMITTAL – GROUNDWATER NITRATE, SALINAS VALLEY, CALIFORNIA

The Central Coast Groundwater Coalition (CCGC) submitted a Technical Memorandum titled "Distribution of Groundwater Nitrate Concentrations, Salinas Valley, California" dated April 30, 2014 and a revised Technical Memorandum titled "Groundwater Nitrate, Salinas Valley, California" dated December 10, 2014. We recognize the very significant progress that CCGC has made to prepare these reports and implement a cooperative groundwater monitoring program for growers since July 2013, in compliance with the Central Coast Regional Water Quality Control Board (Central Coast Water Board) Agricultural Order R3-2012-0011 (Agricultural Order) and associated Monitoring and Reporting Programs (MRPs). This letter is to clarify expectations for finalizing the Salinas Valley Technical Memorandum and associated groundwater nitrate concentration contour maps as a supplement to the actual data displayed on GeoTracker GAMA.

On November 10, 2014, the Central Coast Water Board provided CCGC with comments on the April 30, 2014 version of the Salinas Valley Technical Memorandum. In addition, we discussed the Salinas Valley Technical Memorandums on several occasions, most recently on February 10, 2015 and March 10, 2015. On February 20, 2015, the Central Coast Water Board issued a letter to the CCGC communicating the Executive Officer's determination that the CCGC groundwater nitrate concentration contour maps of Salinas Valley do not meet Conditions 10 through 13 of the Executive Officer's Workplan Approval letter and the contour maps alone are not sufficient for providing reliable information to the public, in lieu of the actual groundwater data[1]. As described in the February 20, 2015 letter, staff recognizes that contour maps can be

---

[1] CCGC submitted workplans for implementing a cooperative groundwater monitoring program on May 31, 2013 and Nov. 1, 2013, http://www.waterboards.ca.gov/centralcoast/water_issues/programs/ag_waivers/docs/groundwater/1finalccgc_workplan_110113.pdf

The Executive Officer issued a letter approving the CCGC Workplan On July 11, 2013. The letter specified Conditions 10-13 for evaluating CCGC contour maps and Conditions 19-21 for displaying CCGC information on GeoTracker.

(footnote continued on next page)

useful to help inform the public's understanding of nitrate in shallow groundwater, as a supplement to the actual data.

At our February 10, 2015 and March 10, 2015 meetings, we agreed that although there is insufficient data to improve the contours maps such that they could be approved, CCGC can exert some minimal effort to finalize the Salinas Valley Technical Memorandum to maximize their usefulness for the public. Central Coast Water Board staff reviewed the December 10, 2014 revised Technical Memorandum titled "Groundwater Nitrate, Salinas Valley, California" and is providing the following comments below. Please revise the Technical Memorandum based on the comments below, and submit a final document to the Central Coast Water Board by XXX XX, 2015. Once the Technical Memorandum and associated contour map(s) are finalized, the Central Coast Water Board will make the Technical Memorandum and associated contour map(s) available to the public on the Water Board's website.

General

1. Professional Certification. Please include professional registration number on the title page for the professional geologist or engineer responsible for preparing the submittal.

2. Executive Summary. Page 5 (last par.) – Page 6 (par. 1-3), please confirm accuracy of statistical and probability descriptions consistent with results of the contouring method. For example, page 5 (last par.) states "Forty-nine percent (49%) of the area within of the Forebay Subarea is mapped as having concentrations of nitrate in groundwater greater than the MCL." Please confirm that this and similar statements are still correct. In addition, please add a general description of data gaps and uncertainty.

Results and Discussion Section - Adequacy of Sampling Locations and Density, Contour Maps

3. Sample Density, Page 23 (last par), Page 43 (last 3 par), page 69 (bullet 5) – The Technical Memorandum describes a range in well density from 1 well per 25 acres, to 1 well per 14 acres only for wells where the standard deviation was less than 2.5 mg/L NO3. Please describe the well density for all wells, including for those areas where there is larger standard deviation.

4. Confirm Statistics. Pending final data analysis and contour mapping, please confirm that statistics described are still accurate. For example, Table (p. 32, last row) "Percent of area mapped as over MCL."

Contour Maps, Tables, and Figures

5. Do Not Contour Areas Where Data is Determined to be Insufficient. In the mapping methods section, please include a discussion for how it was determined that there was

---

(footnote continued from previous page)
http://www.waterboards.ca.gov/centralcoast/water_issues/programs/ag_waivers/docs/groundwater/2ccgc_workplan_approval_071113.pdf.

At the Jan. 30, 2015 Board Meeting, the Central Coast Water Board agreed that the process for reviewing and approving CCGC contour maps, as established in the Executive Officer's Workplan Approval letter, is appropriate. At the Jan. 30, 2015 Board Meeting, staff also presented their evaluation of the CCGC contour maps for the Salinas Valley and proposed next steps. http://www.waterboards.ca.gov/centralcoast/board_info/agendas/2015/january/item16/index.shtml.

sufficient data for contour mapping of nitrate concentrations, and how areas with insufficient data were identified (based on variability of results, heterogeneity in hydrogeologic conditions, etc). For example, Figures 12a, 12b, 12c - do not contour in areas where there is insufficient data density.

6. Describe Uncertainty. For any contour map or figure where data is estimated, predicted, or otherwise uncertain, the map or figure must clearly identify that results are estimated and also generally describe the associated uncertainty or confidence level. On page 53, please clarify the discussion on confidence levels in layman's terms to improve the public's understanding of what is being reported. For example, describe how 95% confidence level different from 66% confidence level (e.g. Figures 21a). For Figures 20a and 20b, results are presented for the "Lower Bound", biasing the interpretation to the best case scenario. If these figure are maintained, a complementary figure presenting the "Upper Bound" should also be included.

7. Reference actual data. Please include a reference on the contour map or figure to indicate that all CCGC data used to develop the contour map or figure is available on the Water Board's online GeoTracker data management system at: *https://geotracker.waterboards.ca.gov/gama/*

8. Exclusion of Data. In several areas, the report indicates that groundwater data and results have been excluded from the analysis. In such cases, each map, table or figure must clearly indicate that data that has been excluded and a summary statement regarding the rationale for exclusion.

9. Contour Map Legend. Please revise nitrate concentrations categories on the legend to properly reflect range of concentrations, including maximums. For example, identifying a contour that is >90 mg/L NO3 does not adequately describe the inclusion of concentrations of up to 200+, 300+, 400+ mg/L NO3.

Conclusions

10. Please specifically address the objectives of the monitoring and whether or not the conducted monitoring is sufficient to adequately characterize the groundwater aquifer(s) in the local area of the participating Dischargers, adequately characterize the groundwater quality of the upper-most aquifer, and adequately identify and evaluate groundwater used for domestic drinking water purposes. Additionally, please provide recommendations for proposed follow on sampling work (as discussed above) to improve confidence intervals and data density, as well as any proposed further work in analyzing existing data.

11. In addition to statements regarding standard error, please also describe relative overall uncertainty of the contour maps and interpretations. Please also summarize any data gaps or other limitations, along with recommendation for proposed further work to address the data gaps.

Appendix – Data Tables and Comparison of GeoTracker Results with Nitrate Mapping

12. Well Information and Results. Please confirm that all data collected by the CCGC in compliance with the MRP and approved workplans is included in the Appendix and uploaded to GeoTracker. At a minimum, the data presentation should include CCGC

well ID number, well type, available well construction information – well depth, top of perforation, bottom of perforation, length of perforated interval, analytical result and whether or not result exceeds the drinking water standard, and any necessary qualifier (duplicate sample taken, laboratory QA/QC issue, field blank issue, etc). If any data is excluded in the analyses, that should be identified in the appendix.

13. Exceedance Notification Follow-Up Report. Please include a complete Exceedance Notification Follow-Up Report for this geographic area. This report should be consistent with that submitted separately to the Water Board (including CCGC well ID number, field point class, sample date, nitrate result, notification date, replacement water action).

Other

14. Potentially Explanatory Factors. The CCGC has collected additional data that provides valuable context to understanding agricultural water quality and potential solutions. A discussion of groundwater age classification is included in the Technical Memorandum, however no data is reported to describe stable isotopes (oxygen, hydrogen, nitrogen). Were samples analyzed for these analytes? Inclusion of this data and/or inclusion of a qualitative interpretation of this type of data would be helpful in understanding groundwater quality and potential solutions.

15. Typographical Errors. Page 69 (last bullet). Monterrey is misspelled.

This Technical Memorandum demonstrates both significant effort and progress over the past year to conduct groundwater monitoring in compliance with the Agricultural Order and MRPs, and contributes important information to better understand nitrate concentrations in groundwater in the Salinas Valley. As discussed above, **please revise the Technical Memorandum based on the comments above and submit a final document to the Central Coast Water Board by XXX XX, 2015.** Once the Technical Memorandum and associated contour map(s) are finalized, the Central Coast Water Board will make the Technical Memorandum and associated contour map(s) available to the public on the Water Board's website. If you have any questions, please contact Hector Hernandez at (805) 542-4641 or hector.hernandez@waterboards.ca.gov or Angela Schroeter at (805) 542-4644.

Sincerely,

DRAFT – March XX, 2015

Kenneth A. Harris, Jr.
Executive Officer

cc:

Tim Borel, Central Coast Groundwater Coalition
tborel@foxyproduce.com

Abby Taylor-Silva, Grower-Shipper Association
abby@growershipper.com

Kara Stuart, Central Coast Groundwater Coalition
karamstuart@gmail.com

Michael L. Johnson, Michael L. Johnson LLC
mjohnson@mlj-llc.com

Melissa Turner, Michael L. Johnson LLC
mturner@mlj-llc.com

Pete Leffler, Luhdorff and Scalmanini
pleffler@lsce.com

Vicky Kretsinger, Luhdorff and Scalmanini
vkretsinger@lsce.com

John Robertson, Central Coast Water Board
John.Robertson@waterboards.ca.gov

Angela Schroeter, Central Coast Water Board
Angela.Schroeter@waterboards.ca.gov

Hector Hernandez, Central Coast Water Board
Hector.Hernandez@waterboards.ca.gov

ATTACHMENT 3

July 11, 2013

Sent via Hard Copy and Electronic Mail

Northern Central Coast Groundwater Task Force
Abby Taylor-Silva
Vice President, Policy and Communications
Grower-Shipper Association of Central California
512 Pajaro St.
Salinas, CA 93901
abby@growershipper.com

Dear Ms. Taylor-Silva:

AGRICULTURAL REGULATORY PROGRAM - APPROVAL OF CENTRAL COAST COOPERATIVE GROUNDWATER PROGRAM (CCCGP)

On May 31, 2013, you submitted a final workplan titled "*Northern Central Coast Cooperative Groundwater Program*" (workplan) to the Central Coast Regional Water Quality Control Board (Central Coast Water Board). The stated purpose of this document was to set forth the workplan for a Northern Central Coast Cooperative Groundwater Program that satisfies the groundwater monitoring requirements in Order No. R3-2012-0011 Conditional Waiver of Waste Discharge Requirements for Discharges from Irrigated Lands (Agricultural Order) and the associated Monitoring and Reporting Program Orders (MRPs) for participating landowners and growers in Monterey, Santa Cruz, Santa Clara, and San Benito Counties. On July 9, 2013, you submitted a slightly revised workplan with clarifications.

I am pleased to grant approval of the cooperative program as described in the July 9, 2013 workplan, with the following specific conditions and comments described below. These conditions are important and required to clarify and confirm our expectations about how you will comply with the Agricultural Order and the associated MRPs on behalf of individual landowners and growers who participate in your cooperative program. I find these conditions to be flexible and responsive to your concerns, as well as reasonable given the severity of groundwater quality conditions and impacts to drinking water in agricultural areas. We appreciate the effort you've made to create this workplan and recognize the significant progress that you have made in improving the workplan since our initial meeting in January 2013.

BACKGROUND

The Central Coast Water Board adopted the Agricultural Order and associated MRPs on March 15, 2012. The Agricultural Order and the MRPs specify that enrolled landowners and growers have the option to comply with groundwater monitoring requirements by either monitoring groundwater individually on their agricultural operations, or by joining a groundwater cooperative monitoring program. The workplan states that the cooperative program will implement two related technical tasks: locating and sampling domestic supply wells on participant owned/leased/operated land, and characterizing groundwater aquifers in the cooperative program area with a focus on the quality of shallow groundwater.

We recognize that cooperative third party approaches may provide a number of short and long-term advantages. For example, third parties may have the expertise to provide a high level of technical assistance and training to growers to achieve measureable water quality improvement. In addition, cooperative efforts provide leadership and can bring participants together to better understand the severity of groundwater quality impairment related to irrigated agriculture and maximize regional efforts toward improving water quality.

CONDITIONS

Phased Approach

1. As previously discussed, use of a phased approach provides additional time and flexibility to implement the cooperative program. The phased approach also requires multiple "phased" approvals and therefore comes with some risks, as an approval of the phased workplan does not obligate me or any future Executive Officer to approve any subsequent section or part when details are submitted for approval in the future.

2. If the Executive Officer makes a final determination that any section or part of the phased workplan is not approved or if the cooperative program fails to implement any part of the workplan as approved (including approved time schedule or a deliverable), growers become individually responsible for implementing the MRP and may be subject to enforcement.

3. Implementation begins upon approval of the workplan. All phases of the workplan must be completed by March 15, 2015, including submittal of all deliverables to the Central Coast Water Board.

Third-Party Organization

4. The workplan indicates that you will form a non-profit organization to direct and administer the workplan and that the organization will be formed immediately after approval of the workplan (p. 21). Within 30 days of this letter, you must provide the Central Coast Water Board with an update on the status of the non-profit organization.

5. The workplan indicates that by September 1, 2013, you will provide the list of participating landowners and growers and quarterly thereafter, you will provide a list of newly participating landowners and growers (p. 21). As a modification to these deliverables, on September 1, 2013, you must submit the list of participating landowners and growers. The subsequent quarterly submittals must also provide a complete list of participating landowners and growers, clearly identifying those that are new. In addition, the quarterly submittals must also provide a list of any landowners and growers who are no longer participating in the cooperative program and the date of their termination.

Domestic Drinking Water Wells

6. The workplan indicates that you will conduct sampling of domestic drinking water wells in three phases, with sampling to begin by September 1, 2013 and complete by September 1, 2014. As previously discussed, the sampling of domestic drinking water wells is the Central Coast Water Board's highest priority for the cooperative programs. Failure to provide well lists, conduct sampling, or upload data to GeoTracker according to the schedules described in Tables 3, 4, and 5 of the workplan (p. 11-13) is a violation of the Agricultural Order and MRP, and grounds for immediate disapproval/termination of the cooperative program.

7. The workplan indicates that the initial list of wells to be sampled will be submitted on September 1, 2013, along with a sampling schedule. The workplan also indicates that well sampling will start on the same date (September 1, 2013) and that a final list of wells to be sampled will be submitted on November 1, 2013. The latter well list will include justification for selected wells and for those that are excluded.

8. As discussed on April 26, 2013 and described in our May 20, 2013 letter, the cooperative program must sample all domestic drinking water wells on participant owned/leased/operated land, unless an acceptable technical rationale is provided for sampling a representative subset in specific areas. In Tables 3, 4, and 5 of the workplan, you indicate that you will submit a list of all wells on participant owned/leased/operated land. This list serves to describe the universe of all domestic drinking water wells available for sampling prior to selection. The list of all wells must include the actual well location (latitude and longitude), along with all available information regarding construction details for each well (i.e., screen interval, total depth, lithology/stratigraphy in screened portion, etc.).

9. The workplan presents criteria to prioritize wells for sampling (including well log availability, depth/screened interval, and condition of well head and seal) (p. 8). The Central Coast Water Board's highest priority is to evaluate domestic drinking water well water quality and minimize exposure to unsafe drinking water, regardless of whether or not the well log is available or the depth/screened interval is precisely known. Staff recognizes that use of known well construction information as a sampling criteria is common for groundwater assessments, that the lack of this type of information may affect the use of these specific data for the overall groundwater characterization, and that as a result additional wells may be needed for groundwater characterization.

   You must sample all domestic drinking water wells on participant owned/leased/operated land; unless an acceptable technical rationale is provided for sampling a representative subset in specific areas. The absence of well construction details or a well log is not an appropriate criterion/rationale to justify not sampling a domestic drinking water well, especially if that well potentially serves unsafe drinking water. Sufficient technical rationale must provide evidence that groundwater quality from the well not sampled is represented by other wells sampled with reasonable certainty, based on factors such as close proximity, same aquifer, and similar well depth and screened interval. Technical rationale will be carefully evaluated especially in areas of known or likely exceedance of safe drinking water standards. The proposed list of wells for sampling and any technical rationale for sampling a subset must be evaluated by Water Board staff and approved by the Executive Officer prior to implementation.

Adequacy of Sampling Locations and Density, Contour Maps

10. The workplan indicates that you will determine the adequacy of the number of wells for characterizing domestic drinking water well water quality based on the spatial variability of groundwater nitrate concentrations at various depths and geostatistical methods. You must also consider the hydrogeologic variability to determine if the sampling density is sufficient to represent domestic drinking water quality on and near participant owned/leased/operated land within reasonable certainty. The sampling density, resolution and scale must be sufficient such that individual domestic well owners that reside in agricultural areas within the cooperative groundwater monitoring program boundary can make informed decisions related to their drinking water quality and potential health exposure to nitrate.

    In follow-up discussions, your consultant Mr. Michael Johnson indicated that once the samples are collected, analyzed, and you have conducted a proper statistical analysis, you will then re-evaluate the numbers of wells and need to collect additional samples to estimate the concentrations in any given area within an acceptable confidence interval, with the intent of achieving the highest confidence interval possible using all publicly available well samples and integrating the wells sampled by the program. The Groundwater Cooperative Program analysis will be performed to achieve the highest level of certainty possible with the wells that are selected for sampling, and that the analysis will explicitly provide the confidence value for any location on the map. If you determine that there are more wells that may be sampled in order to achieve a higher confidence interval, you must immediately inform the Executive Officer and present a plan, including schedule, for additional sampling as appropriate, to be approved by the Executive Officer.

11. The workplan indicates that you will prepare a Technical Memo on nitrate concentration and also produce contour maps. In our discussions, you indicated that these deliverables are intended to be the primary tool for providing summary information and displaying water quality information to the public. For the purposes of determining the adequacy of the number and density of well sampling, as well as for the purposes of producing contour maps of nitrate concentration, proper geostatistical methods must be utilized (e.g. copulas[1] or similar method). Contour maps should use the State Drinking Water Standard of 45 mg/L Nitrate as NO3 and the initial contour intervals must be approximately every 10 mg/L Nitrate as NO3. After reaching the 45 mg/L Nitrate as NO3 contour, you may increase the size of the contour interval, if appropriate. Any contour maps produced must include the confidence interval for estimated values, and the quality assurance project plan (QAPP) must include additional sampling for use as a validation data set to confirm adequacy of contours. Contour maps must be reviewed by Water Board staff and approved by the Executive Officer prior to acceptance for display on GeoTracker. If the Executive Officer determines that the contour map does not

[1] Bardossy, Andras and Jing Li. Geostatistical interpolation using copulas, (July 2008). Water Resources Research, V.44 No.7; Summary citation from AGRICOLA online catalog of the National Agricultural Library (NAL) http://openagricola.nal.usda.gov/Record/IND44120067

present the data within an adequate confidence interval that is acceptable for providing reliable information to the public, the Executive Officer may not approve the use of the contour map on GeoTracker.

12. Contour maps for the cooperative program must be developed by, or under the review of a registered Professional Geologist or Professional Engineer based on a sampling design that is statistically defensible given the spatial variability of the aquifer (i.e., hydrogeological heterogeneity, etc.) and specific local conditions. The sampling density, resolution and scale must be approved by the Executive Officer, in advance of contour map preparation, to avoid the problem of not having sufficient data to produce an acceptable contour map. Contour maps must be provided as a geographic information systems (GIS) shapefile according the time scheduled identified in Table 3 though Table 6.

13. The Technical Memo(s) you submit with the contour maps must clearly describe the method used to contour the groundwater monitoring data, the associated confidence intervals and the areas of uncertainty. In addition, the Technical Memo(s) must include the list of wells specifically used in the development of the contour map and also describe any wells excluded from the contour map development (i.e. outliers) along with rationale for exclusion. The Technical Memo must also include identification and discussion of areas of insufficient data or data gaps as well as recommendations for resolving data gaps.

Timeframe for Sampling

The workplan does not include any sampling to evaluate the temporal variability (i.e., capturing seasonal or land-use variability, etc.) in groundwater quality in the wells sampled. The cooperative program commits to the Central Coast Water Board to perform additional sampling after the initial sampling outlined in this program is completed to determine temporal variability in wells determined by the cooperative program and the Central Coast Board to be high priority.

Deliverables

14. The following deliverable is identified in the workplan but not included in Table 8: Quality Assurance Project Plan (QAPP) due August 15, 2013 (p.19). The Executive Officer must approve the QAPP prior to initiating sampling activities.

15. Deliverables must be submitted in accordance with the schedule identified in Tables 3 through 8 of the workplan. In cases where the identified due date is not a business day, the deliverable is due on the next business day. The Executive Officer must approve deliverables prior to implementation or acceptance for display. In addition, Water Board staff review and Executive Officer approval of planning deliverables (including QAPP, lists of wells, number of wells selected, sampling density, and sampling schedule) are intended to inform adequacy and readiness to proceed with the next steps of workplan implementation.

Reporting and Public Disclosure of Information

16. All data must be uploaded as unique monitoring points with all relevant well location, well construction information (as available), water quality data, and appropriate quality assurance/quality control information to the regulatory side of GeoTracker within 30 days of sample delivery to the laboratory.

17. As previously discussed, it is the policy of the Central Coast Water Board to provide all members of the public with broad and convenient access to its records and to promptly make the fullest possible disclosure of its records. Therefore, upon receipt of a Public Records Act Request (PRAR), the Central Coast Water Board will provide information to the requestor except for that information that is exempt from disclosure under the California Public Records Act (CPRA).

18. In response to concerns related to public health and safety, the Central Coast Water Board will not disclose the precise location of any groundwater well sampled as part of the cooperative program in response to a PRAR. Consistent with the same protocol and standard care implemented to protect locations of public drinking water supply wells regulated by the California Department of Public Health (CDPH), I will recommend to the Central Coast Water Board or the State Water Resources Control Board that they revise the Agricultural Order and MRP to indicate that "Consistent with the display of public supply wells regulated by CDPH on GeoTracker, groundwater well location and data will only be referenced within a one-mile square of the actual well location." Any public use of well location data such as reports and public presentation by the Central Coast Water Board will follow the same protocols to protect the locations of wells.

Internet Display of Information on GeoTracker

19. We understand that the cooperative program participants have significant concerns and objections to displaying individual well locations to the public on maps available on the Internet using GeoTracker. The Central Coast Water Board agrees to display cooperative program data as contour maps on GeoTracker after January 1, 2015[2], as long as 1) the contour maps meet the conditions described in Conditions 10 through 13 above and are approved by the Executive Officer, and 2) the State Water Resources Control Board makes the necessary modifications to GeoTracker so that it can properly display the contour maps with other existing data currently in GeoTracker.

    If by January 1, 2015, the functionality does not exist in GeoTracker to properly display the approved contour maps, the cooperative program has the option to submit static images (e.g. pdf, bitmap) of the contour maps by March 15, 2015; If the cooperative program does not choose to submit static images of the contour maps or if the cooperative program does not submit contour maps that meet Conditions 10 through 13 above, then the data will be displayed as individual wells on GeoTracker and the well location and data will only be referenced within a one-mile square of the actual well location, using the existing mapping functionality for CDPH wells in GeoTracker.

[2] Note that the delay of display of data on GeoTracker until January 1, 2015 does not affect the immediate availability of information to the public in response to a PRAR.

20. Withholding the display of individual well information on maps on the public side of GeoTracker limits the Central Coast Water Board's ability to provide all members of the public with broad and convenient access to its records and to promptly make the fullest possible disclosure of its records. Therefore, I do not agree to withhold the cooperative program individual well data from maps on the public side of GeoTracker in perpetuity unless reviewed and approved by the Central Coast Water Board as they evaluate and adopt future irrigated lands orders or similar order for discharges of waste from irrigated agricultural operations applying to this program's participants. Doing so affects the Central Coast Water Board's ability to adapt in the future to changing needs, and may have unanticipated consequences on the Central Coast Water Board's ability to readily provide information to the public in cases where there is an acute and imminent threat to public health or safety, or to address issues related to consistency between regions and regulatory programs.

    I will agree to withhold the display of individual wells sampled by the cooperative program on maps on the public side of GeoTracker for at least the term of the Agricultural Order, which expires on March 14, 2017. The decision to maintain cooperative program data on the regulatory-only side of GeoTracker would be an issue for Regional Board review as part of a renewed Waiver, or other similar order for discharges of waste from irrigated agricultural operations. Further, if the existing Waiver expires prior to adoption of renewed Waiver or other similar order, this data would remain on the regulatory-only side of GeoTracker until such time that a renewed Waiver or other similar order is adopted. If moved to the public side of GeoTracker during the term of this Agricultural Order, any well data point locations will be shown with an uncertainty to at least one (1) mile squared.

21. The agreement to withhold the display of individual wells sampled by the cooperative program on maps on the public side of GeoTracker for the term of the Agricultural Order only pertains to the display of individual wells on maps. It does not affect the ability of the Water Board to provide groundwater quality data for individual wells to the public using available reports in GeoTracker (e.g. tabulated results in response to public queries). Additionally, it does not affect the Water Board's ability to publish, present or use individual well data in any reports or presentations. In all cases, the Central Coast Water Board would show with an uncertainty the precise locations of groundwater wells by one mile squared as described above.

Future Monitoring Needs

22. Groundwater monitoring programs like that described in the workplan evolve through time as the initial monitoring data is evaluated and the conceptual model of the basin is subsequently revised in an iterative manner. As part of this evolving understanding of the basins, new wells may prove: 1) beneficial to cover areas poorly understood or to monitor key groundwater flow paths, 2) cost-effective, by reducing the number of wells necessary to represent an area from both hydrogeological and water quality perspectives, and 3) necessary in future orders to address gaps in data and our understanding of groundwater quality in agricultural areas. I recommend that you work closely with your consultants and my staff as we seek to optimize the monitoring system going forward, and as unanticipated issues arise.

RECOMMENDATIONS

In addition to conducting the required groundwater monitoring, we appreciate your efforts to focus on finding solutions to address groundwater quality problems from existing agricultural practices and in communicating both the significance of the impairments and the necessary actions to quantify and address these water quality problems. We recognize that the cooperative program participants have made the commitment to address groundwater quality problems, especially related to drinking water sources. The workplan indicates that in cases where results indicate the exceedance of the safe drinking water standard, the cooperative program will make the landowner/tenant/operator aware so that they may take immediate steps to address the problem and minimize exposure to unsafe drinking water. At that time, the cooperative program will request permission of the landowner/tenant/operator to inform the Central Coast Water Board if replacement drinking water is currently begin provided to well users. We also recommend that the cooperative program consider providing resources or other assistance to limited resource individuals and disadvantaged communities affected by nitrate contamination who may need assistance in resolving water quality problems and ensuring safe drinking water.

The workplan also indicates that you will inform landowners and growers about their responsibility to use farming practices that are protective of groundwater resources. We recognize that this type of outreach is critical to improve water quality. We encourage the cooperative program and participants to take a leadership role in demonstrating urgency and innovation to implement practices that will reduce nitrate loading to groundwater and protect drinking water.

ACCEPTANCE OF CONDITIONS

The above described conditions are required for my approval of the workplan. Based on our discussions, you have indicated to me that you agree to these conditions.

In closing, I want to emphasize that Central Coast Water Board staff recognize that cooperative third party approaches may provide a number of short and long-term advantages that can bring participants together to maximize regional efforts toward understanding and improving water quality. We appreciate your efforts to work together to develop an effective cooperative program, and we find the conditions for approval described in this letter to be flexible and responsive to your concerns, as well as reasonable given the severity of groundwater quality conditions and impacts to drinking water in agricultural areas. We understand that the cooperative program participants are committed to improving water quality and we sincerely hope your efforts to implement the program are successful.

If you have any questions, please contact **Angela Schroeter at (805) 542-4644 or Aschroeter@waterboards.ca.gov** or John Robertson at (805) 542-4630 or JRobertson@waterboards.ca.gov.

Sincerely,

Digitally signed by Kenneth A Harris Jr
DN: cn=Kenneth A Harris Jr, o=CCRWQCB, ou=Interim Executive Officer, email=kharris@waterboards.ca.gov, c=US
Date: 2013.07.11 16:42:05 -07'00'

Kenneth A. Harris Jr.
Interim Executive Officer

cc:

Norm Groot *[Via Email Only]*
Executive Director
Monterey County Farm Bureau
norm@montereycfb.com

Mindy Sotelo *[Via Email Only]*
Executive Director
San Benito County Farm Bureau
sbcfb@garlic.com

Jennifer Scheer *[Via Email Only]*
Executive Director
Santa Clara County Farm Bureau
sccfb@sccfarmbureau.org

Cynthia Mathiesen *[Via Email Only]*
President
Santa Cruz County Farm Bureau
jessbrown@sbcglobal.net

Ms. Gail Delihant *[Via Email Only]*
Director CA Government Affairs
Western Growers
GDelihant@WGA.com

ATTACHMENT 4

Central Coast Groundwater Coalition Work Plan for Monterey, Santa Clara, Santa Cruz, and San Benito Counties

Updated November 1, 2013

ATTACHMENT 4

Table of Contents

Table of Tables

Table of Figures

List of Acronyms

DPH	Department of Public Health
CCGC	Central Coast Groundwater Coalition
GIS	Geographic Information System
MCL	Maximum Contaminant Level
MRP	Monitoring and Reporting Program
QAPP	Quality Assurance Project Plan
SOP	Standard Operating Procedure

Introduction

The CCRWQCB adopted Order No. R3-2012-0011 Conditional Waiver of Waste Discharge Requirements for Discharges from Irrigated Lands (Conditional Waiver) and associated Monitoring and Reporting Program Orders (MRPs) on March 15, 2012. The Conditional Waiver and the MRPs specify that landowners and growers (here forward referred to as L&Gs) in Tiers 1, 2 and 3 may meet groundwater monitoring requirements by either monitoring groundwater individually on their agricultural operations, or by joining a groundwater cooperative monitoring program. The purpose of this document is to set forth the plan for a Central Coast Groundwater Coalition (CCGC) that satisfies the requirements in the Conditional Waiver and MRPs for participating L&Gs in Monterey, Santa Cruz, Santa Clara, and San Benito Counties. The steps outlined in this work plan provide a foundation for a CCGC that L&Gs can support, and that satisfies the requirements as set forth in the MRPs which states, "At a minimum, the cooperative groundwater monitoring effort must include sufficient monitoring to adequately characterize the groundwater aquifer(s) in the local area of the participating Dischargers, characterize the groundwater quality of the uppermost aquifer, and identify and evaluate groundwater used for domestic drinking water purposes." (Page 9 of the MRP - Tiers 1, 2, 3).

One of its primary purposes is to provide the Water Board with information that fills the gaps in the current understanding of groundwater quality throughout the region. Depending on the further development of the Conditional Waiver and its implementation, the program may also eventually provide information to the Water Board on existing farming practices and additional farming practices that will result in improved groundwater quality over time.

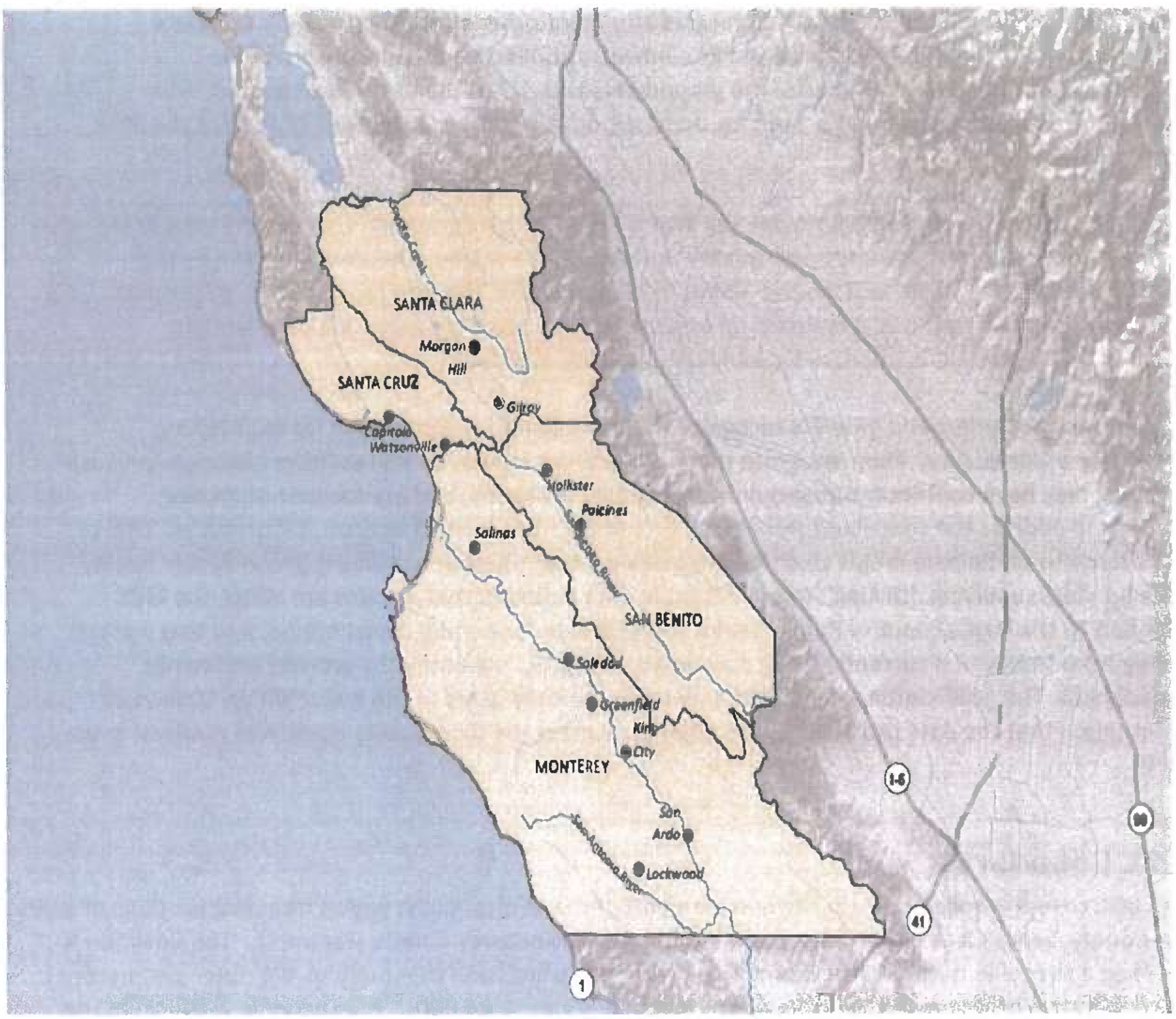
Agricultural landowners and growers recognize there is a shared responsibility for maintaining acceptable water quality. They recognize that past fertilizer inputs, as well as other historical land use practices, may have contributed to groundwater quality problems, and are focused on finding solutions to address the contribution that may be coming from existing agricultural practices. L&Gs who choose to participate in this coalition are making a commitment to address groundwater quality in the aquifers supplying drinking water. If sample data indicates that nitrates are above the MCL identified by the Department of Public Health (DPH) as safe for human consumption, and that water coming from that well is currently being consumed, the CCGC will notify the grower/landowner immediately. The notification will allow the member to notify users of the water within 10 days of confirmation that the data provided by the laboratory meet the data quality objectives outlined in the QAPP.

CCGC Boundaries

The CCGC covers enrolled L&Gs in the northern part of the Central Coast region including portions of Santa Cruz County, Santa Clara County, San Benito County, and Monterey County (Figure 1). The Coalition is providing a shapefile to the Water Board along with this submission that outlines the outer perimeter of the cooperative program region (Projection – NAD 83, Scale – 1:24,000). The shapefile will include the extent of the agricultural regions in the four counties. Parcels enrolled in the actual Coalition region will be a subset of this area (see below).

L&Gs in the four counties are all potential participants in this program. Over 1,500 L&Gs have indicated that they will join a Coalition monitoring and reporting program but there are numerous other L&Gs that selected individual reporting as the preferred method of compliance with the Conditional Waiver. Because enrollment in the Coalition is unlikely to include all L&Gs in the northern region, the exact participating parcels and subsequent perimeter boundary will reflect the actual land ownership and lease agreements in place each year. The final Coalition boundaries reflect the agricultural lands of L&Gs within the portions of the four counties that are members the Coalition region. The membership region is likely to be dynamic from year to year as some leases change hands and some land leaves the Coalition and some land enters the program. However, the spatial distribution of the member parcels will not negatively impact the ability of the CCGC to characterize the concentration of nitrate in domestic supply wells, nor will it negatively impact the ability of the CCGC to characterize the domestic drinking water supply and shallow aquifers across the Coalition region.

Figure 1. Geographic area of the CCGC.



The Coalition will provide to the CCRWQCB a list of members on ~~September 1~~ November 15, 2013, and will provide an annual update on September 1 of each year. In the first year of the CCGC existence, the CCCGP will provide quarterly updates to the list of members as new members may enter the program as they become aware of its existence. Because a number of leases change hands during October, the Coalition will provide an annual update shapefile of the Coalition land area by November ~~1~~ 15 of 2013 and on November 1 of each year beginning in ~~2013~~ 2014.

Task Deliverables

Table 1. Deliverables for Coalition Boundary Delineation.

Deliverable	Elements	Date
Shapefile of external boundaries of Coalition region	ArcGIS shapefile in NAD 83 at 1:24,000 scale; general outline of the Coalition region without individual member landholdings or leases	May 31, 2013
List of members who have enrolled and paid fees to the Coalition	Excel spreadsheet of member IDs, member names, member farm operation names, and contact information as specified below in section	~~September 1~~ November 15, 2013 and annually thereafter on September 1
Shapefile of Coalition region on a parcel by parcel basis	ArcGIS shapefile in NAD 83 at 1:24,000 scale; includes the land owned and/or leased by Coalition members at the individual parcel level	November ~~1~~ 15, 2013 and annually thereafter on November 1

Description of Cooperative Program Coalition Technical Activities

Approach

The Coalition will undertake two related technical tasks; locating and sampling domestic supply wells on member owned/leased land, and characterizing groundwater aquifers in the CCGC region with a focus on shallow groundwater. The domestic supply wells sampled will be those not sampled by the counties and consequently, the concentration of nitrate in the water in those wells is not known. The CCGC will use data generated by the counties, as well as data submitted to GeoTracker by individual L&Gs to be in compliance with the Conditional Waiver to complete the characterization of the domestic drinking water-supply and shallow groundwater aquifer. The primary focus is characterization of the domestic drinking water-supply aquifer.

Domestic supply well identification and sampling from the start of the Coalition to September 1, 2014, and will be completed in three (3) phases. Each phase consists of identifying a subset of wells to sample from a specific geographic area within the Coalition region and then conducting sampling of those wells. Sampling involved in all three phases will be completed by September 1, 2014

The location and sampling of wells on member parcels will occur in three phases during 14 months with activities beginning during the summer of 2013. Phasing will occur by basin as follows. During Phase I wells in the Salinas Valley and Lockwood Valley will be located and sampled. Phase II will focus on locating and sampling wells in the Pajaro Valley, and Phase III will focus on locating and sampling wells in the Gilroy-Hollister area. Figure 2 shows the location of the phased areas. Using maps and lists of member parcels, we will identify all wells that can be potentially sampled within each basin. These will include domestic wells with single and double connections. These wells will be identified via a combination of Google Earth maps overlaid on a map of member parcels.

The phasing is required because the process of obtaining well logs and reviewing for information on screening depth(s) (see below) to identify wells for sampling is time consuming. Once a list of candidate wells have been identified, the list must be narrowed to those wells that are located on CCGC member parcels, that are accessible, and that are reasonably certain to provide a valid sample (see below). This process is expected to take up to several weeks as individual members are contacted, arrangements are made to visit the wells, and samples are collected.

Based on recent information (see reports cited below and the recent report released by Harter et al. 2012), it appears that groundwater conditions in the Salinas Valley/Lockwood Valley may be the lowest quality in the CCGC region, and those valleys may have the largest number of unsampled domestic supply wells. Consequently, the CCGC will initiate its sampling and characterization efforts in those areas, moving to the Pajaro Valley, and finally the Gilroy-Hollister area last. The three phases are overlapping in that once the list of wells is finalized and arrangements are made for sampling, work on developing the next list will be initiated.

Locating and Sampling Domestic Supply Wells

The CCGC will gather available well logs for all domestic wells that are filed with the Department of Water Resources with written authorization from the CCRWQCB. Because of the time-sensitive nature of this project, in order for the CCGC to meet the deadlines, the CCRWQCB has agreed to authorize the CCGC and its consultants to obtain the well logs from the Department of Water Resources upon final approval of this groundwater program. Wells that do not have a well log will be assigned low priority for sampling. For wells with well logs, the utility of sampling each well will be assessed using additional information including but not limited to well density in the immediate vicinity and well depth. These criteria will be used to prioritize wells to be sampled based on answers to the following questions.

- Based on the depth and screened interval for each domestic well, are there reliable and existing data for the depth interval and immediate area that can provide sufficient information about drinking water quality without sampling the well in question (immediate area is defined by the degree of spatial uncertainty in the available water quality data, see bullet point 3 below)?
- Can the well water be accessed for reliable sampling?
    - That is, is the well head and casing intact and can a reliable water sample be collected?
    - Are there obvious potential avenues for surface contamination to enter the well?
- What do the existing data indicate about spatial variability of the water quality in the area?

Based on the analysis of existing data, the level of spatial uncertainty in water quality data in the area surrounding the well will be quantified and for each well, a determination will be made of how sampling each well can reduce uncertainty. This is an iterative process and the density of wells within a subbasin or area within a subbasin may depend on the concentration of nitrate in the wells that are selected for sampling. It is possible that after the list of wells to sample is finalized, there could be a need for additional samples. Consequently, a step in each phase has been added that allows additional wells to be identified and sampled to allow adequate characterization of drinking water. A list of any new wells that are proposed for sampling will be submitted to the CCRWQCB for Executive Officer approval.
Except as provided in the section entitled "Deliverables and Schedule", all referred to well lists in this document would be available only through a valid public records act request, in which case well

coordinates would be shown with an uncertainty by one mile squared.

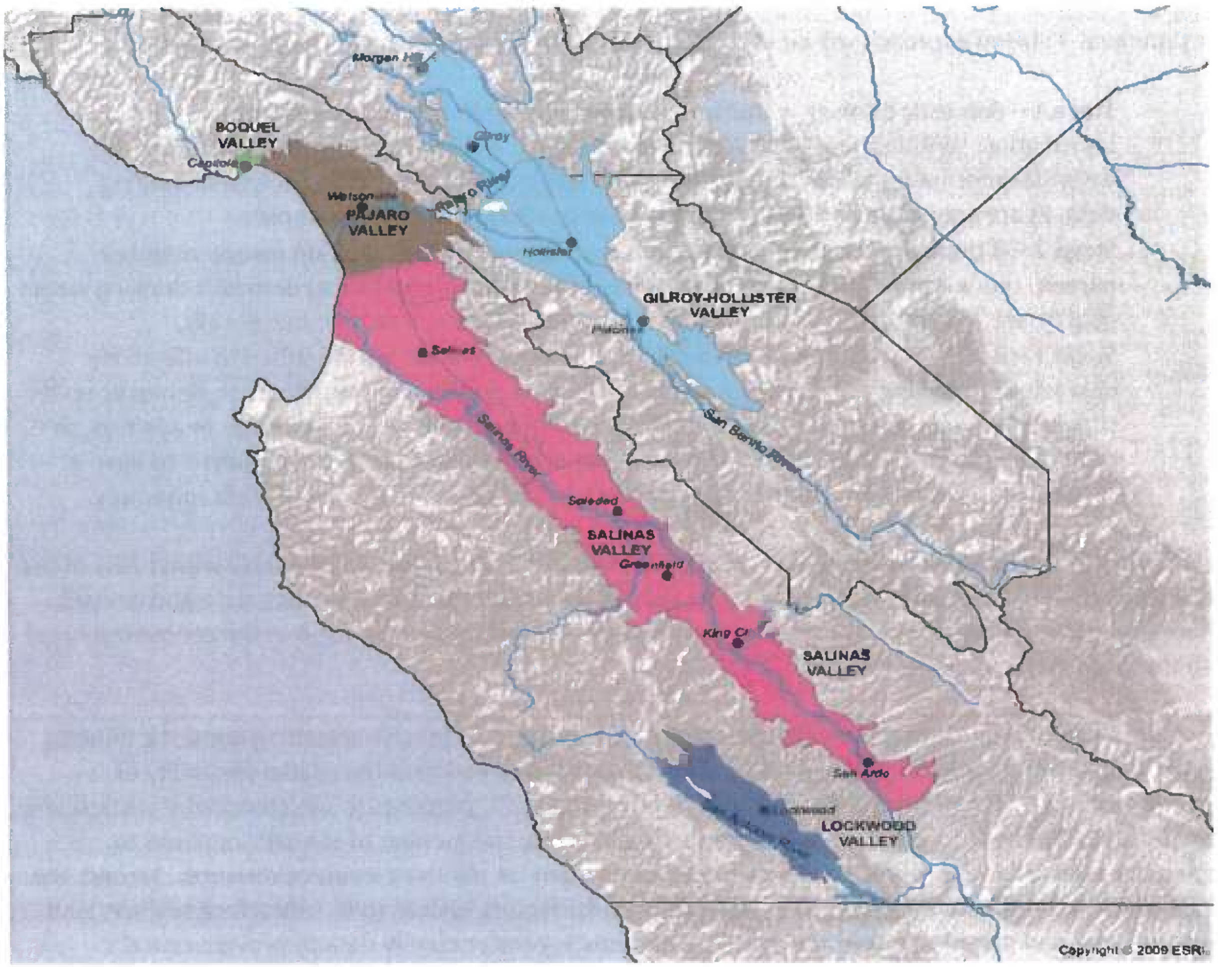
In summary, a staged approach will be used to identify wells for sampling within member parcels.

- Stage 1 – domestic drinking water supply wells with depth and screened interval information. Within those wells identified in Stage 1, wells will be selected that 1) provide essential information about the quality of drinking water based on the analysis of existing data, 2) are accessible and 3) will provide good quality groundwater samples.
- Stage 2 – If there are wells with depth and screened interval information on non-member parcels, this will greatly improve the certainty in the characterization of domestic drinking water quality, we will work with Water Board staff to gain access and sample these wells.
- Stage 3 – if after Stages 1 and 2 an insufficient number of wells are identified to effectively characterize drinking water quality within reasonable certainty in specific areas, domestic water supply wells without depth and screened interval information will be sampled. In addition, as required by Order WQ 2013-0101, any well that is estimated by a contour analysis to have a concentration of nitrate within 50% of the MCL will be added to the list of wells to sample.

In addition to the three stages listed above, any well that has a concentration of nitrate within 20% of the MCL (80% of the MCL) will be sampled within a year of the original sample collection date and annually thereafter. The second sample is to determine if seasonal conditions could result in the concentration of nitrate in the well exceeding the MCL.

The approach for determining the adequacy of the number of wells for characterizing domestic drinking water quality is threefold. First, the existing data will be used to estimate the spatial variability of groundwater nitrate concentrations at various depths. The CCGC proposes to use standard statistical and geostatistical methods to estimate based on the existing data, the number of samples required to represent a value for the central tendency (mean or median) for different levels of variance. Second, the CCGC will use the characterization of the aquifer to assess factors such as soils, subsurface texture, land use and land- and water-management practices and existing water quality data to provide causal explanation of groundwater nitrate concentration distributions. Third, the CCGC will use this assessment and the distribution of existing water quality data to select wells identified during Stage 1 and 2 for sampling based on this analysis and discussions with the Water Board staff to develop consensus with regard to wells to be sampled and the criteria used to develop the list of wells. The objective is to identify an optimal number of wells that allow characterization within an acceptable level of variance. The CCGC will endeavor to minimize to the extent possible, the spatial estimation variance and maximize the confidence level with existing domestic supply wells.

Figure 2. Groundwater basins in the CCCGP region.



The CCGC expects to identify a sufficient number of wells in the first two stages that when combined with existing data, will result in adequate characterization of drinking water quality. However, as indicated above if any well is estimated to have a concentration of nitrate at 50% of the MCL that well will be added for sampling during the third stage. As described above, the initial list of wells selected for sampling will necessarily be larger than the number of wells eventually sampled because many wells may not be accessible, may not be located on member parcels, or will not provide groundwater quality samples that can contribute to characterizing the concentration of nitrate in domestic supply wells. In addition to nitrate, samples may be analyzed for constituents that will aid in aquifer characterization. A list of constituents is shown in Table 2. Constituents listed in line one of Table 2 (Compliance with Conditional Waiver and MRPS) will be analyzed in all circumstances. Constituents listed in lines 2-5 may be analyzed in situations where doing so would aid in aquifer characterization, as determined by the CCGC. All wells will be sampled and the groundwater analyzed for at least the constituents specified in line one of Table 2 by the dates detailed in Table 3. The other constituents listed in lines 2-5 of Table 2 may be sampled if it is determined that it is necessary to obtain specific information needed to better characterize the aquifers.

Table 2. Constituents to be monitored to characterize drinking water and the shallow aquifers.

Function	Constituents
1. Compliance with Conditional Waiver and MRPs[1]	pH, SC, TDS, total alkalinity, CA, Mg, Na, K, SO_4, Cl, NO_3-NO_2
2. Potential for denitrification	Oxidation-reduction potential, N^{15} and O^{18} isotopes
3. Nitrogen source analysis	N^{15} and O^{18} isotopes, pharmaceuticals
4. Age of water in aquifer	Tritium/H4, chlorofluorocarbons[2]
5. Source of water	Ca, Mg, Na, K, Cl, CO_3, SO_4, Br, O^{18}, deuterium, N^{15}

[1]From Table 3 of MRP documents.

Deliverables and Schedule

Table 3. Phase I deliverables and dates for sampling and analysis performed on samples collected in the Salinas Valley/Lockwood Valley.

Deliverable	Elements	Date
Salinas Valley/Lockwood Valley list of wells[1], sampling schedule and initiation of sampling	Initial list of wells to sample and initiation of sampling[2]; list will include all wells on member owned, leased, or operated lands as best the CCCGP can determine as of that date	September 1, 2013
Salinas Valley/Lockwood Valley final list of wells	including justification for wells selected and wells excluded; discussion of final list with CCRWQCB staff if desired	~~November 1~~ December 15, 2013
Data entry to regulatory side of GeoTracker	Complete uploading of groundwater quality data from Salinas Valley/Lockwood Valley	February 28, 2014[3] (Completion of data entry from wells identified in November 1, 2013 list)
Develop supplemental list of wells for sampling (if necessary)	List of wells needed to complete characterization of nitrate concentrations in domestic drinking water supply and shallow groundwater	March 1, 2014
Technical Memo on concentration of nitrates in domestic supply wells in the Salinas Valley/ Lockwood Valley	Finalize data upload to GeoTracker, discussion of sampling results including contour map and shapefile of nitrate concentrations	April 30, 2014

[1] Except as provided in this section, all referred to well lists in this document would be available only through a valid public records act request, in which case well coordinates would be shown with an uncertainty by one mile squared.

[2] Because the list of wells to sample must be approved by the Executive Officer, sampling will begin as soon as approval is received including possibly September 2, 2013.

[3] Data entry will begin within 30 days of sample delivery to the laboratory as required. Dates provided in these rows indicate when the groundwater quality data entry into the regulatory-only side of GeoTracker, where it will remain, for at least the term of the Agricultural Order which expires on March 14, 2017.

Table 4. Phase II deliverables and dates for sampling and analysis performed on samples collected in the Pajaro Valley.

Deliverable	Elements	Date
Pajaro Valley list of wells[1], Initial list of wells to sample; schedule and initiation of sampling	Initial list of wells to sample; list will include all wells on member owned, leased, or operated lands	~~January 2, 2014~~ December 1, 2013
Pajaro Valley final list of wells	Final list of wells to sample including justification for wells selected and wells excluded; discussion of final list with CCRWQCB staff if desired; sampling begins upon approval of list from Executive Officer	February, 1 2014
Data entry to regulatory side of GeoTracker	Uploading of groundwater quality data from Pajaro Valley	April 30, 2014[2] (Completion of data entry from wells identified in November 1, 2013 list)
Develop supplemental list of wells for sampling (if necessary)	List of wells needed to complete characterization of nitrate concentrations in domestic drinking water supply and shallow groundwater	June 1, 2014
Technical Memo on concentration of nitrates in domestic supply wells in the Pajaro Valley	Finalize data upload to GeoTracker, discussion of sampling results including contour map and shapefile of nitrate concentrations	July 31, 2014

[1] Except as provided in this section, all referred to well lists in this document would be available only through a valid public records act request, in which case well coordinates would be shown with an uncertainty by one mile squared.

[2] Data entry will begin within 30 days of sample delivery to the laboratory as required. Dates provided in these rows indicate when the groundwater quality data entry into the regulatory-only side of GeoTracker, where it will remain, for at least the term of the Agricultural Order which expires on March 14, 2017.

Table 5. Phase III deliverables and dates for sampling and analysis performed on samples collected in the Gilroy-Hollister area.

Deliverable	Elements	Date
Gilroy-Hollister list of wells, 2014 sampling schedule and initiation wells on member of sampling[1]	Initial list of wells to sample; list owned, leased, or operated	February 1, will include all
Final list of wells to sample selected and wells excluded; discussion of final list with CCRWQCB staff if desired	March 31, 2014 including justification for wells	
Data entry to regulatory side of quality data from Gilroy-Hollister	Uploading of groundwater data entry from wells identified in	July 31, 2014[2] (Completion of November 1, 2013 list)
Develop supplemental list of 2014 wells for sampling (if necessary) concentrations in domestic drinking groundwater	List of wells needed to complete characterization of nitrate water supply and shallow	August 1,
Technical Memo on 2014 concentration of nitrates in domestic supply wells in the contour map and shapefile of nitrate	Finalize data upload to GeoTracker, discussion of sampling results including concentrations	October 31,

[1] Except as provided in this section, all referred to well lists in this document would be available only through a valid public records act request, in which case well coordinates would be shown with an uncertainty by one mile squared.

[2] Data entry will begin within 30 days of sample delivery to the laboratory as required. Dates provided in these rows indicate when the groundwater quality data entry into the regulatory-only side of GeoTracker, where it will remain, for at least the term of the Agricultural Order which expires on March 14, 2017.

All well sampling activities will be concluded by August 31, 2014. The CCGC will provide a short memorandum to the CCRWQCB by September 15, 2014 indicating that all sampling activities were completed by the September 1, 2014 deadline. By December 15, 2014, the CCGC will submit a detailed report to the CCRWQCB summarizing the information obtained during the domestic supply well monitoring program. The summary will include the overall distribution of domestic supply wells that are not sampled by the counties, a description of the depths of those wells to the extent known, contour maps of the concentration of nitrate in all wells sampled stratified for different screening depths, and an accounting of the number/percentage of domestic supply wells that are supplying water with concentrations of nitrate above the primary MCL.

The Coalition participants have significant concerns and objections to displaying individual well locations to the public on maps available on the Internet using GeoTracker. Instead of displaying individual well locations to the public, the CCRWQCB agrees to display Coalition data as contour maps on GeoTracker after January 1, 2015[1], as long as 1) the contour maps meet the conditions described in

[1] Note that the delay of display of data on GeoTracker until January 1, 2015 does not affect the immediate availability of information to the public in response to a PRAR.

Conditions 10 through 13 contained in the June 10, 2013 Conditional Approval Letter from the Central Coast Regional Water Quality Control Board to Abby Taylor-Silva, representing the Central Coast Groundwater Coalition, and are approved by the Executive Officer, and 2) the State Water Resources Control Board makes the necessary modifications to GeoTracker so that it can properly display the contour maps with other existing data currently in GeoTracker.

If by January 1, 2015, the functionality does not exist in GeoTracker to properly display the approved contour maps, the Coalition has the option to submit static images (e.g. pdf, bitmap) of the contour maps by March 15, 2015; If the Coalition does not choose to submit static images of the contour maps or if the Coalition does not submit contour maps that meet Conditions 10 through 13 as described above, then the data will be displayed as individual wells on GeoTracker and the well location and data will only be referenced within a one-mile square of the actual well location, using the existing mapping functionality for CDPH wells in GeoTracker.

Contour Confidence Interval

The analysis by the CCGC will be performed to achieve the highest level of certainty possible using all publicly available well samples and integrating the wells that are selected for sampling by this program, and that the analysis will explicitly provide the confidence value for any location on the map. If wells owned by individuals who are not members of the CCGC can be used to increase the level of confidence, those owners can be contacted to determine if they are willing to allow samples of the water to be collected.

HydroFocus is a hydrogeology consulting company retained by the CCGC to provide expertise in developing the groundwater program. HydroFocus was asked to determine the possibility providing high-confidence interval contours by reviewing all of the available nitrate data for the Salinas Valley. They plotted the kriging standard error for the concentrations of nitrate as N for 670 well samples from the Salinas Valley. The standard errors range from 10% to 20%. Therefore, for the 670 well samples and a grid spacing of about 1 mile, the estimated concentration of nitrate at any point where there is not a well will theoretically be within approximately plus or minus 20% of the range of the estimated value at points where there are not samples. Therefore for points on the grid where there are no samples, the confidence level for the estimated concentration is 80% to 90%. For a contour interval of 5 mg/L than encompasses known concentrations ranging from 5 to 10 mg/L nitrate as N, an estimated value of 9 mg/L with the 20% standard error would be result actual values being outside the contour range some of the time.

The analysis performed by HydroFocus used data for 670 well samples. HydroFocus has been searching for potential domestic drinking water supply wells in the Salinas Valley and has identified about 500 locations where domestic supply wells may exist. Across the northern region, the Salinas Valley is assumed to be the most densely populated region within the CCGC region. Consequently, for the domestic drinking water supply wells in the Salinas Valley and most probably in the entire region, even if a sample is collected from every well, the sample size will likely be too small to generate a 90% or 95% confidence interval for all locations. Therefore, the number of available wells dictates that there will be a higher level of uncertainty associated with the contours in certain, but not all, areas.

Temporal Variability

The Coalition commits to the CCRWQCB to perform additional sampling after the initial sampling outlined in this program is completed to determine temporal variability in wells determined by the CCGC and the CCRWQCB to be high priority.

Table 6. Report deliverables and dates.

Deliverable	Elements	Date
Memo to CCRWQCB documenting the completion of groundwater sampling	Final list of wells sampled	September 15, ~~2013~~ 2014
Initial characterization of the shallow groundwater aquifer	Aquifer characterization using information known about geology and water quality in the CCGC region	December 15, ~~2013~~ 2014
Draft final report on concentration of nitrates in domestic supply wells across the Coalition region	Discussion of sampling results December 15, 2014 concentration of nitrates in including contour maps and domestic supply wells across the shapefiles of nitrate concentration contours, depths of domestic supply wells, number/percentage of wells with NO3 above the MCL; discussion of any data gaps in knowledge of shallow groundwater quality	December 15, 2014
Final report incorporating Water Board comments	Discussion of sampling results including contour maps and shapefiles of nitrate concentration contours, depths of domestic supply wells, number/percentage of wells with NO3 above the MCL	March 15, 2015

Characterizing groundwater aquifers with focus on domestic drinking water supply and shallow groundwater

The primary objective for characterizing groundwater aquifers will be to develop 1) a process-level understanding of distribution of nitrate contamination in domestic supply wells with single connections or a small number of connections and 2) identify regions for evaluation of agricultural land- and water-management practices to reduce discharges to groundwater. The CCGC covers enrolled L&Gs in the northern part of the Central Coast region including portions of Santa Cruz County, Santa Clara County, San Benito County, and Monterey County (Figure 1).

The region contains three principle groundwater basins where agriculture is the predominant land use; Pajaro Valley, Salinas Valley and the Gilroy-Hollister basins (Figure 2). As the project proceeds, these groundwater basins will be characterized more fully using the known geology and available information for the aquifer. For the initial characterization to be completed by December 15, 2013, the CCGC will focus on describing the groundwater quality in each aquifer based on the existing data and hydrogeologic conditions.

Initially, aquifer characterization will be conducted on two levels. The CCGC will 1) characterize the distribution of nitrate concentrations in aquifers used for domestic drinking water supply, and 2) use existing data to provide information about the source of the nitrates and the age of the groundwater (year of recharge). A more complete characterization, due December 2014, will utilize groundwater data collected by the CCGC to more fully explain the nature of groundwater degradation and its causality.

Notification of Growers

The goal of the member notification system is to identify wells that have a concentration of nitrate above the MCL and make sure the users of the water are notified. The CCGC has developed a notification system that will guarantee that members are notified that the domestic supply well is above the MCL with sufficient time to notify users of the water within the 10 day period specified by Order WQ 2013-0101. In addition, if the statistical analysis of the available data indicates that there are un-sampled wells with an estimated concentration of nitrate above the MCL, members who own those wells will be notified in a timeframe that will allow users of the water to be notified within 10 days of the statistical analysis. A more detailed description is included in the addendum at the end of the work plan.

Current knowledge of aquifer conditions

The groundwater basins to be evaluated within the framework of this workplan are generally geologically similar. They are intermountain valleys where there is extensive faulting and resultant deep Tertiary and Quaternary alluvial fill and drainage to the Pacific Ocean. Water bearing units include unconsolidated and semi-consolidated alluvial fan and river deposits interbedded with marine clays. Episodic changes in sea level during the Miocene through Pleistocene led to alternating deposition between coarse grained materials in riverine and alluvial fan environments, and fine grained sediments in estuarine and marine environments. The following discussion of the basins and subbasins was extracted from the Department of Water Resources Bulletin 118, USGS publications and consultant reports.

The Pajaro Valley basin contains water-bearing geologic units that include from oldest to youngest, the Purisima Formation, the Aromas Sand Formation, Terrace Deposits, Quaternary alluvium, and Dune Deposits. The Purisima Formation is mainly of marine origin, and contains a thick sequence of highly variable sediments ranging from shale beds near the base to continental deposits in the upper portion. The sediments are poorly consolidated, moderately permeable gravel, sands, silts, and silty clays. The Aromas Sand is considered the primary water-bearing unit of the basin and consists of upper eolian and lower fluvial sand units that are separated by confining layers of interbedded clays and silty clay. The Terrace Deposits consist of unconsolidated gravel, sand, silt, and clay overlain by alluvium. The alluvium is composed of Pleistocene terrace materials that are overlain by Holocene alluvium, consisting of sand, gravel, and clay deposited by the Pajaro River, and dune sands, with an average thickness of 50 to 300 ft.

South of the Pajaro Valley Basin, in the Monterey Bay and the Salinas Valley area, the Langley Area and 180/400-Foot subbasins include from oldest to youngest, the Pliocene to Pleistocene Paso Robles Formation, the Pleistocene Aromas Sands, Quaternary terrace deposits, Holocene alluvium, and sand dunes. The 180/400-Foot subbasin includes three water-bearing units, the 180-Foot, the 400-Foot, and the 900-Foot aquifers, named for the average depths of each aquifer. The confined 180-Foot Aquifer occurs only in this subbasin, as its confining blue clay layer thins and disappears east and south of the subbasin and does not extend into the Eastside Aquifer subbasin.

The 180-Foot Aquifer consists of interconnected sand, gravel, and clay lenses, and ranges in thickness from 50 to 150 ft. The 180-Foot Aquifer is separated from the 400-Foot Aquifer by a zone of less coarse- grained strata and confining units that range in thickness from 10 to 70 feet. The 400-Foot Aquifer is about 200-ft thick and consists of sands, gravels, and clay lenses. The upper portion of the aquifer appears to be correlated with the Aromas Sand and the lower portion with the upper part of the Paso Robles Formation. The 900-Foot Aquifer, present in the lower (northern) Salinas Valley, consists of alternating layers of sand, gravels and clays and is separated from the 400-Foot Aquifer by a blue marine clay-confining unit.

The Corral de Tierra Area subbasin includes the following water-bearing units, from oldest to youngest: the Miocene and Pliocene Santa Margarita Formation, the Pliocene Paso Robles Formation, the Pleistocene Aromas Formation, and Pleistocene and Holocene age alluvial deposits. The Paso Robles Formation is the primary water-bearing unit in the area and consists of sand, gravel, and clay interbedded with some minor calcareous beds. The East Side subarea includes a narrow strip on the eastern half of the valley. It is similar in geologic structure as the 180/400-Foot Aquifer subbasin except that the confining blue clay layer thins and disappears east of the subbasin.

The upper Salinas Valley contains the Forebay Aquifer and Upper Valley Aquifer subbasins. The Forebay subarea encompasses the entire width of the unconsolidated alluvial fill between Gonzales and the bluff line two miles south of Greenfield. The primary water-bearing units of this subbasin are the same units that produce water in the adjacent 180/400-Foot Aquifer Subbasin; 180-Foot Aquifer and the 400-Foot Aquifer. However, the near-surface confining unit of the 180/400-Foot Aquifer Subbasin does not extend into the Forebay subbasin. Groundwater in the Forebay Aquifer subbasin is unconfined and occurs in lenses of sand and gravel that are interbedded with finer grained material.

The Upper Valley subarea includes the entire alluvial fill in the valley floor between the bluff line two miles south of Greenfield to the southern end of the San Ardo Valley. The primary aquifer is unconfined and deposits range from unconsolidated to semi-consolidated. It consists of inter-bedded gravel, sand, and silt of the Paso Robles Formation, alluvial fan and river deposits. These deposits are equivalent to the 180-Foot and 400-Foot Aquifer units of the lower Salinas Valley. However, confining units comparable to those separating aquifers in the lower Salinas Valley are present. Groundwater is unconfined and is replenished primarily with water from the Salinas River and its tributaries.

Recharge in the Salinas and Pajaro valleys occurs from infiltration from the Salinas River and deep percolation of irrigation water. Flow in the Salinas River is seasonally controlled for conjunctive use. Precipitation, subsurface and boundary inflow, and seawater intrusion are other sources of recharge of lesser importance. The Salinas Valley and Pajaro Valley groundwater basins are drained by the Salinas and the Pajaro rivers. Directions of groundwater flow generally follow the topography of the basins, from high altitudes towards the drainages, and down valleys towards Monterey Bay. Major water supply and water quality issues include overdraft of aquifers and contamination by nitrate.

Concentrations of nitrate in groundwater vary temporally and spatially. Primary sources of data include irrigation, public supply, and monitoring wells. Concentrations of nitrate above 100 mg/L and up to several hundred mg/L are observed sporadically in all of the Salinas Valley subbasins. Kulongoski and Belitz[2] used a non-parametric statistical analysis to examine the relationship between nitrate and potential explanatory factors including land use, well construction, groundwater age, and geochemical condition. Nitrate concentrations were slightly higher in wells with groundwater ages classified as modern or mixed compared to wells classified as pre-modern.

The Gilroy-Hollister Basin in San Benito and Santa Clara counties includes the Llagas, Bolsa, Hollister, and San Juan Bautista groundwater subbasins. The Llagas subbasin extends from the groundwater divide at Cochran Road near Morgan Hill in the north to the Pájaro River in the south in Santa Clara County. It is drained to the south by tributaries of the Pájaro River, including Uvas and Llagas creeks. The water bearing formations include Pliocene to Holocene age continental deposits of unconsolidated to semi- consolidated gravel, sand, silt and clay. Recharge to the Llagas subbasin occurs from a variety of sources: natural recharge from streams, principally Uvas and Llagas Creeks; percolation of precipitation and irrigation water, and artificial recharge. Nitrate in groundwater is a key water quality issue in this subbasin. Since 1997, more than 600 wells in south Santa Clara County including the Llagas and Coyote subbasins have been tested for nitrate. More than half exceed the federal safe drinking standard for nitrate.

Todd Engineers[3] summarized the water quality data for the remaining subbasins in San Benito County. Key constituents of concern include boron, chloride, hardness, metals, nitrate, sulfate, potassium, and TDS. In some parts of the Basin, concentrations of these constituents do not meet water quality standards necessary to support drinking water beneficial uses (MUN). In most areas of the Basin in San Benito County, concentrations of key constituents of concern remained relatively unchanged from 2005 – 2010. In the eastern portion of northern San Juan Subbasin, nitrate and chloride concentrations have decreased over time owing to land use and groundwater-level changes. Concentration of nitrate in shallow groundwater is generally higher than the concentration of nitrate in deeper groundwater. Average nitrate concentrations in all subbasins in San Benito County are below the MCL.

The Bolsa Area subbasin lies within the northwest portion of the Gilroy-Hollister Valley Groundwater Basin, and is bounded on the north by the Pajaro River, to the southwest by the Flint Hills. The aquifer consists mainly of clay, silt, sand, and gravel ranging in age from Tertiary to Holocene. Holocene alluvium consists of unconsolidated lenticular beds of gravel, sand, silt, and clay deposited by streams as flood plain, alluvial-fan, slope-wash, and terrace deposits. Thickness generally ranges from 0 to 300 feet. The Purisima Formation while lithologically similar to the overlying alluvium is generally more consolidated and less permeable. The Purisima Formation ranges from the surface in some areas to several thousand feet. Vertical groundwater flow is restricted by an extensive clay confining layer. The water quality constituents of greatest concern are salinity, nitrate, boron, hardness, and trace elements that occasionally exceed drinking water standards.

[2] Justin T. Kulongoski and Kenneth Belitz. 2005. Program Status and Understanding of Groundwater Quality in the Monterey Bay and Salinas Valley Basins, 2005: California GAMA Priority Basin Project, US Geological Investigations Report 2011 – 5058.

[3] Todd Engineers. 2012. Technical Memorandum 1, Hydrogeologic Conceptual Model for Northern San Benito County Salt and Nutrient Management Plan.

The Hollister Area subbasin lies within the northeast portion of the Gilroy-Hollister Valley Groundwater Basin. The Calaveras fault is the western boundary and abuts the Bolsa Area subbasin. The northern portion of the subbasin drains toward Monterey Bay by the Pajaro River and its tributaries. The southern portion is drained by the San Benito River and its tributaries. Groundwater occurs in the alluvium of Holocene age and older alluvium. The aquifers consist of clay, silt, sand, and gravel, and poorly consolidated sandstone. The unconsolidated or poorly consolidated Tertiary or Quaternary rocks underlying the alluvium have been divided into three units which consist of a thick sequence of clay, silt, sand and gravel. Most recharge to the subbasin is derived from rainfall and stream flow from creeks entering the basin. Pacheco Pass Water District operates North Fork Dam on Pacheco Creek for the primary purpose of supplying groundwater recharge to the northeast portion of the subbasin. Water levels have generally risen since 1987 when surface water was delivered. The water quality constituents of greatest concern are salinity, nitrate, boron, hardness, and trace elements that occasionally exceed drinking water standards.

The San Juan Bautista Area subbasin lies within the southwest portion of the Gilroy-Hollister Valley Groundwater Basin, is bounded on the north by Sargent Fault and Sargent anticline and abuts the Bolsa Area subbasin. Groundwater occurs in the alluvium of Holocene age, and the Purisima Formation of Pliocene age. The subbasin is drained primarily by the San Benito River and its tributary creeks. The Pajaro River drains the northern boundary. The primary source of recharge is the San Benito River which is managed to provide groundwater recharge. Groundwater level measurements since 1913 indicate significant declines from early in the century to the 1970's. Water levels have risen over 100 feet since 1976 due to the construction of Hernandez Reservoir on the San Benito River in 1961 and the delivery of imported surface water beginning in 1987.

Quality Assurance Project Plan/Sampling Analysis Plan

Quality Assurance

A Surface Water Ambient Monitoring Program (SWAMP) comparable Quality Assurance Program Plan (QAPP) will be developed for the project. The QAPP will include all 24 elements found in the SWAMP checklist. Analytes covered in the QAPP are from Table 3 of MRP documents (MRP No. R3-2012-0011-01, MRP No. R3-2012-0011-02, and MRP No. R3-2012-0011-03) and Table 2 above.

Briefly, the QAPP will include but is not limited to:

- Project organizational structure;
- A discussion of the field methods to be used;
- Meter maintenance and calibration;
- Sample collection methods;
- Chain of custody form;
- Field and laboratory SOPs;
- Sample containers; and
- Sample processing and preservation methods.

Field parameters and analytes will be listed and the laboratory method(s) of analysis will be provided. Data quality objectives will be provided and the quality control samples (e.g. duplicates, blanks) needed to meet those objectives will be discussed. The laboratory identified to perform the analysis will be provided and the analytical methods used will be described. Laboratory SOPs will be included as well as the laboratory QA/QC measures (e.g. spikes, blanks). The QAPP will be circulated for approval prior to initiation of sampling and analysis. The QAPP will be provided to the Water Board by August 15, 2013.

Sampling and Analysis Plan

A sampling plan for the domestic supply wells will be developed and submitted to the CCRWQCB. The Sampling Plan will:

- Develop the logistical details of field sampling, e.g., timing;
- Identify who will perform sampling;
- Describe how sampling will be coordinated with landowners and tenants;
- Identify wells to be sampled and timing of sampling;
- Describe type of well (domestic supply, agricultural supply, monitoring); and
- Provide map of wells using same NAD 83 and 1:24,000 scale as provided for the cooperative program boundary

Third Party Implementation

Member Organization and Member Responsibilities

The CCGC will form a non-profit organization to direct and administer the activities of the program and its contractors. The purpose of the Coalition's organizational structure is to organize agricultural L&Gs to support Coalition activities, and to conduct the monitoring, reporting, and outreach activities. The program anticipates forming a non-profit organization immediately after acceptance of the work plan. The organization will be functional within 75 days after initiation of the paperwork needed to file for non-profit status.

To perform the CCGC tasks, it is necessary to have an organization in place to:

- Collect and manage the funds to pay for required activities;
- Conduct outreach, implement, and assume responsibility for the tasks to be completed; and
- Coordinate with the CCRWQCB to resolve issues that may arise.

Organization responsibilities include:

- Tracking members and reporting required member information to CCRWQCB;
- Collect fees to operate program;
- Manage communications and notifications to members and CCRWQCB;
- Conduct sampling to remain in compliance with the MRP requirements;
- Manage water quality monitoring data;
- Manage contracts for technical work;
- Interpret data;
- Submit reports to CCRWQCB on behalf of members;
- Document its organizational and management structure; and
- Provide members with annual summaries of expenditures of revenue.

One of the CCGC's long-term goals is to inform L&Gs about their responsibility to use farming practices that are protective of groundwater resources. This goal needs to be accomplished with a cost effective data collection program to properly characterize groundwater quality, and to assist L&Gs in implementing effective practices to protect groundwater quality.

Participating in the CCGC will carry responsibilities for members including:

- Paying dues necessary to fund CCGC activities (monitoring, reporting, outreach); and

- Completing any required reports/forms requested by the CCGC.

Enrollment forms will include a signed provision allowing the CCRWQCB to provide the CCGC with information on the eNOI. Failure to meet membership responsibilities will result in dismissal from the CCGC. Once a grower is dismissed from the CCGC, their name is no longer included in the annual member list provided to the CCRWQCB by the CCGC organization. These responsibilities provide assurances to the CCRWQCB and stakeholders that membership in the CCGC provides for the proper characterization of local groundwater conditions and a commitment on the part of members to be protective of groundwater quality.

Coalition Responsibilities

The CCGC will insure that there is sufficient financial support to implement the program and will include the approximate cost to implement the program and identification of resources available (e.g., the fees and number of participating L&Gs to generate the funds necessary to meet the budgeted costs) to fully implement all technical and administrative aspects of the program.

The CCGC will insure sampling is conducted by dates established in the Coalition program, sampling schedule (see Table 8).

The CCGC will insure data and reports are submitted to the CCRWQCB in format specified and by dates established in Table 8.

The CCGC will insure all participating L&Gs are providing any required information and are taking necessary steps to address any obstacles, or issues that arise to implementing the Coalition program.

The CCGC will insure that any activities conducted on behalf of the third-party by other groups meet the terms and requirements of the program. The CCGC is responsible for any activities conducted on its behalf.

The CCGC will establish and conduct governance, including but not limited to:

i. As a legally defined entity (i.e. non-profit corporation; local or state government; Joint Powers Authority) or have a binding agreement among multiple entities that clearly describes the mechanisms in place to ensure accountability to participating L&Gs;

ii. With a governing structure that includes a governing board of directors composed in whole or in part of participating L&Gs, and that provides participating L&Gs with a mechanism to direct or influence the governance of the third party through appropriate by-laws.

iii. With appropriate authorization from participating L&Gs to access individual grower eNOI information in GeoTracker (e.g., AW#, current contact information);

iv. The CCGC will describe and provide evidence for i-iii, above.

The CCGC will provide the following information and reports to the CCRWQCB and participating L&Gs, on the dates specified:

- By September 1, 2013 the documentation of its organizational or management structure and its by-laws or operating procedures. The documentation shall identify persons responsible for ensuring that the program is implemented as approved. The CCGC must also provide to the CCRWQCB confirmation that this information was provided to participating L&Gs;
- By September 1, 2013, the list of participating L&Gs, and quarterly, thereafter, the list of new

enrollees, as follows:

- Participating grower information in Microsoft Access or Excel format, including AW#, Ranch Name and GeoTracker global ID for each participating grower, physical mailing address, and email address. Information provided must be accurate and consistent with that reported in the electronic-Notice of Intent (eNOI);

The CCGC must also provide to the CCRWQCB, confirmation that the following information was provided to participating L&Gs;

- On September 1, 2013, in the Draft Final Report by December 15, 2014, and the Final Report by March 15, 2015, the annual summaries of expenditures of fees and revenues. The CCGC must also provide to the CCRWQCB, confirmation that this information was provided to the participating L&Gs;
- By September 1, 2013 and annually thereafter, notification to participating L&Gs of the following, and provide confirmation to the CCRWQCB of such notification to participating L&Gs:
- Participating L&Gs, as enrolled L&Gs in the Agricultural Order, are individually responsible for the successful implementation of the program and that this individual responsibility has two consequences if the CCGC is not successfully implemented: 1) The CCRWQCB or Executive Officer will require individual dischargers to conduct individual monitoring per the requirements of the Agricultural Order, 2) The CCRWQCB may take enforcement action against individual dischargers. The failure of a third party group to successfully implement an approved program cannot be used as an excuse for lack of individual discharger compliance;
- Quarterly, beginning within three months of notice of approval, if the third-party group is unable to implement any aspect of the program that could result in a violation of the program's monitoring or reporting requirements, notification describing the inability to implement and the possible violations. The CCGC must also provide to the CCRWQCB, confirmation that this information was provided to participating L&Gs;
- Quarterly, beginning within three months of notice of approval, notification to participating L&Gs of any changes to the program approved by the Executive Officer or the CCRWQCB and confirmation to the CCRWQCB that this notification was provided to participating L&Gs.

Table 7. Coalition administrative deliverables.

Deliverable	Elements	Date
List of participating L&Gs	List of members in good standing	~~September 1~~ November 15, 2013
Member parcel map specifying exact CCGC area	GIS shapefile of geographical boundary of program based upon member parcels	November ~~1~~ 15, 2013 and annually thereafter
Quarterly update of member list	List of members who enrolled in last quarter, in Access or Excel format	January 1, 2014; April 1, 2014, July 1, 2014, October 1, 2014
Organizational/administrative structure	Category, names of Board of Directors, Executive Director, Contractors as appropriate; operating procedures; fees and expenditures, confirmation of member notification	September 1, 2013; December 15, 2014; March 15, 2015 and annually thereafter

Member notification of responsibilities as a discharger	Consequences to members for not accepting member responsibilities; CCRWQCB notification that members have been contacted	September 1, 2013
Notice of inability to successfully conduct business as required by the CCRWQCB	Confirmation of member notification	Quarterly as necessary starting 90 days after formation of cooperative program organization

Summary

Table 8. Chronology of all submissions to the Central Coast Regional Water Board by the CCGC on behalf of its members.

Deliverable	Date
Shapefile of external boundaries of Coalition region May 31, 2013	May 31, 2013
QAPP provided to the CCRWQCB	August 15, 2013
List of members who have enrolled and paid fees to the Coalition September 1, 2013 and annually thereafter on September 1	September 1, 2013 and annually thereafter on September 1
Salinas Valley/Lockwood Valley list of wells[1], sampling schedule, and initiation of sampling September 1, 2013	September 1, 2013
List of participating L&Gs September 1, 2013	~~September 1~~ November 15, 2013
Organizational/administrative structure September 1, 2013; December 15, 2014; March 15,	September 1, 2013; December 15, 2014; March 15, 2015 and annually thereafter 2015 and annually thereafter
Member notification of responsibilities as a discharger September 1, 2013	September 1, 2013
Shapefile of cooperative program region including thereafter on individual parcels owned or operated by all members November 1, 2013 and annually thereafter on individual parcels owned or operated by all members November 1	November ~~1~~ 15, 2013 and annually
Salinas Valley/Lockwood Valley final list of wells November 1, 2013	wells November 1, 2013
Initial characterization of the shallow groundwater aquifer	December 15, 2013
Quarterly update of member list	January 2, 2014; April 1, 2014, July 1, 2014, October 1, 2014
Pajaro Valley list of wells, sampling schedule and initiation of sampling January 2, 2014 – June 30, 2014 initiation of sampling	January 2, 2014 – June 30, 2014
Gilroy-Hollister list of wells, sampling schedule, and initiation of sampling February 1, 2014 initiation of sampling	February 1, 2014
Pajaro Valley final list of wells February 1, 2014	February 1, 2014
Begin Salinas Valley/Lockwood Valley data entry to regulatory side of GeoTracker February 28, 20142 (Completion of data entry from regulatory side of GeoTracker wells identified in November 1, 2013 list)	February 28, 2014[2] (Completion of data entry from wells identified in November 1, 2013 list)
Develop supplemental list of wells for sampling in Salinas Valley/Lockwood Valley (if necessary) March 1, 2014	March 1, 2014

Gilroy-Hollister final list of wells March 31, 2014	March 31, 2014
Technical Memo on concentration of nitrates in domestic supply wells in the Salinas Valley/Lockwood Valley	April 30, 2014
Begin Pajaro Valley data entry to regulatory side of GeoTracker April 30, 2014	April 30, 2014
Develop supplemental list of wells for sampling in Pajaro Valley (if necessary) June 1, 2014	June 1, 2014
Technical Memo on concentration of nitrates in domestic supply wells in the Pajaro Valley July 31, 2014 domestic supply wells in the Pajaro Valley	July 31, 2014
Begin Gilroy-Hollister data entry to regulatory side of GeoTracker July 31, 2014 (Completion of data entry from wells	July 31, 2014 (Completion of data entry from wells identified in November 1, 2013 list)
Develop Gilroy-Hollister supplemental list of wells for sampling (if necessary) August 1, 2014 sampling (if necessary)	August 1, 2014
Memo to CCRWQCB confirming the completion of groundwater sampling September 15, 2014 groundwater sampling	September 15, 2014
Technical Memo on concentration of nitrates in domestic supply wells in the Gilroy-Hollister October 31, 2014 domestic supply wells in the Gilroy-Hollister	October 31, 2014
Draft final report on concentration of nitrates in domestic supply wells across the Coalition region December 15, 2014 domestic supply wells across the cooperative program	December 15, 2014
Final report incorporating CCRWQCB comments March 15, 2015	March 15, 2015
Notice of inability to successfully conduct business as required by the CCRWQCB Quarterly as necessary starting 90 days after notice of required by the CCRWQCB approval of cooperative program organization	Quarterly as necessary starting 90 days after notice of approval of cooperative program organization

[1] Except as provided in the section entitled "Deliverables and Schedule", all referred to well lists in this document would be available only through a valid public records act request, in which case well coordinates would be shown with an uncertainty by one mile squared.

[2] Data entry will begin within 30 days of sample delivery to the laboratory as required. Dates provided in these rows indicate when the groundwater quality data entry into the regulatory-only side of GeoTracker, , where it will remain, for at least the term of the Agricultural Order which expires on March 14, 2017.

Addendum – Member Notification

Notification of Members

The goal of the member notification system is to identify wells that have a concentration of nitrate above the MCL and make sure the users of the water are notified. The CCGC has developed a notification system that will guarantee that members are notified that the domestic supply well is above the MCL with sufficient time to notify users of the water within the 10 day period specified by Order 2013-0101. In addition, if the statistical analysis of the available data indicates that there are un-sampled wells with an estimated concentration of nitrate above the MCL, members who own those wells will be notified in a timeframe that will allow users of the water to be notified within 10 days of the statistical analysis.

Notification of members occurs several times during the monitoring and reporting process as described below.

- Outreach to members requesting the location of domestic supply wells on their property
- Notification to growers indicating that their wells were sampled and providing the responsibilities of the grower should the concentration of nitrate in the well exceed the MCL
- Federal Express notification within 36 hours of receipt of the results, informing the member that the concentration of nitrate in their well is above the MCL and providing the standardized notice to give to users of the water
- Mail notification to all remaining growers of the concentration of nitrate in their domestic supply wells and any follow-up activity that will occur
- Federal Express notification sent to member reporting the results of the contour analysis (concentration of nitrate above the MCL)

A brief discussion of each of these steps is provided below.

Outreach to members requesting the location of domestic supply wells on their property

When the CCGC is ready to initiate monitoring of domestic supply wells in a region, the CCGC contacts the member with a request for the location of all wells providing water for domestic use. Members respond with the requested information and a list of wells is developed. The list of wells provided will be compared to the wells listed by the member on their eNOI to guarantee that the wells scheduled for sampling are domestic supply wells. Wells scheduled for sampling are visited to determine the suitability of the well for sampling and to discuss with the member the use of the well to further confirm that all domestic supply wells are identified and available for sampling.

Notification to growers indicating that their wells were sampled

Once the member's wells have been sampled, they are sent a pre-notification letter confirming the sampling, providing information about the potential outcomes of the laboratory analysis of the water, and stating that the member will receive one of several types of follow-up notifications determined by the concentration of nitrate in the well. One pre-notification letter per well is sent to the member such that a single member could receive several pre-notification letters depending on the number of wells across their ranches.

Exceedance report to the Regional Board if necessary

All laboratory analyses will be uploaded to GeoTracker by the well, and also sent to the CCGC for review of the quality assurance information. When the CCGC determines that the data meet the data quality objectives outlined in the QAPP, the data are considered validated. Validation is generally performed within

24 hours after receipt of the data from the laboratory. If the results of the laboratory analyses indicate that the concentration of nitrate in the well exceeds the MCL, the CCGC will notify the CCRWQCB within 24 hours of data validation. The notification will include all relevant data including but not limited to well ID, Ranch Name, sample date, and concentration.

Federal Express notification of the member

When the data are validated and it is determined that the concentration of nitrate in a member domestic supply well exceeds the MCL, the member will be notified of the exceedance. A standard notification letter will be sent via Federal Express overnight delivery to every member for every well that is in exceedance. All members will receive the notification letter within 36 hours of the CCGC learning of the exceedance in the member's well. Accompanying the notification letter will be the announcement that the member can provide to users of the well that they are drinking water with a concentration of nitrate above the MCL. The 36 hour delivery allows sufficient time for the member to notify the users of the well within the 10 day period required by Order WQ 2013-0101.

Mail notification to all remaining members of the concentration of nitrate in their domestic supply wells

All members that own domestic supply wells with a concentration of nitrate below the MCL will be notified by regular US Mail of the results of the analysis and any follow-up activity that will occur. If the well has a concentration of nitrate between 80% and 100% of the MCL, the member will be notified that the well will be resampled within a year and annually thereafter for the life of the Conditional Waiver.

Federal Express notification sent to member reporting the results of the contour analysis (concentration of nitrate above the MCL)

When the estimated concentration of nitrate in a member domestic supply well exceeds the MCL, the member will be notified of the exceedance. A standard notification letter will be sent by Federal Express overnight delivery to every member for every well that is estimated to be in exceedance. All members will receive the notification letter within 36 hours of the CCGC learning of the exceedance in the member's well. Accompanying the notification letter will be the announcement that the member can use to notify the users of the well that they are drinking water with a concentration of nitrate above the MCL. The 36 hour delivery allows sufficient time for the member to notify the users of the well within the 10 day period required by the Conditional Waiver.

ATTACHMENT 5

Distribution of Groundwater Nitrate Concentrations
Salinas Valley, California,
April 30, 2014

Prepared for the Central Coast Groundwater Coalition

by

HydroFocus, Inc., Davis, CA

ATTACHMENT 5

Distribution of Groundwater Nitrate Concentrations, Salinas Valley, California, April 30, 2014

Contents

Introduction and Background

The Central Coast Regional Water Quality Control Board (Regional Water Board) adopted Order No. R3-2012-0011 Conditional Waiver of Waste Discharge Requirements for Discharges from Irrigated Lands (Conditional Waiver) and associated Monitoring and Reporting Program Orders (MRPs) on March 15, 2012. The Conditional Waiver and the MRPs specify that landowners and growers (here forward referred to as L&Gs) may meet groundwater monitoring requirements by either monitoring groundwater individually on their agricultural operations, or by joining a groundwater cooperative monitoring program. A work plan approved by the Central Coast Regional Water Quality Control Board on June 20, 2013, set forth the plan for a Northern Central Coast Cooperative Groundwater Program that satisfies the requirements in the Conditional Waiver and MRPs for participating L&Gs in Monterey, Santa Cruz, Santa Clara, and San Benito Counties. The steps outlined in the work plan provide a foundation for a Groundwater Cooperative Program (GCP) that satisfies the requirements as set forth in the MRPs. A key GCP purpose undertaken by the Central Coast Groundwater Coalition (CCGC) is to provide the Regional Water Board with information that fills the gaps in the current understanding of groundwater quality for domestic consumption throughout the region. Nitrate is the primary constituent of concern and the focus of this report. The program will also provide information about the effects of land- and water-management practices that will result in improved groundwater quality over time.

The primary objectives of the tasks described in the work plan are to develop 1) a process-level understanding of the spatial distribution of nitrate concentrations in domestic supply wells with single connections or a small number of connections and 2) identify regions for evaluation of agricultural land- and water-management practices to reduce discharges to groundwater. The work plan also described the approach for sampling and reporting.

This Technical Memorandum is the first in a series of reports that will provide information about the spatial distribution of nitrate concentrations in groundwater used for drinking water in the CCGC service area. This technical memorandum will attempt to answer questions about where groundwater used for drinking water is likely to have nitrate concentrations over the Maximum Contaminant Level (MCL) and the associated uncertainty associated with the concentration estimates.

To assess the spatial variability in groundwater nitrate concentrations, we evaluated and herein present results of laboratory analysis of groundwater samples collected from wells on CCGC member L&G's properties in the Salinas Valley. Also, we have integrated the analytical results from other sampling conducted by the California Department of Public Health, US Geological Survey (USGS), Monterey County Water Resources Agency (MCWRA) and L&Gs who conducted individual sampling. Our approach was to process and evaluate available analytical data for the groundwater used for drinking by subarea and then integrate the data to create water quality maps for the entire Salinas Valley. Figure 1 shows the Salinas Valley and subareas where data were available for mapping[1]; Langley, Pressure, East Side, Forebay and Upper Valley subareas.

[1] The locations of CCGC member wells were obfuscated to protect member privacy. The locations of CCGC member wells shown on Figure 1 were randomly adjusted up to 1 mile in both the east-west and north-south directions. The wells are plotted within a 4 mi^2 block centered over the actual well location. This block is 4-times the area of obfuscation required by a Public Records Act Request (PRAR).

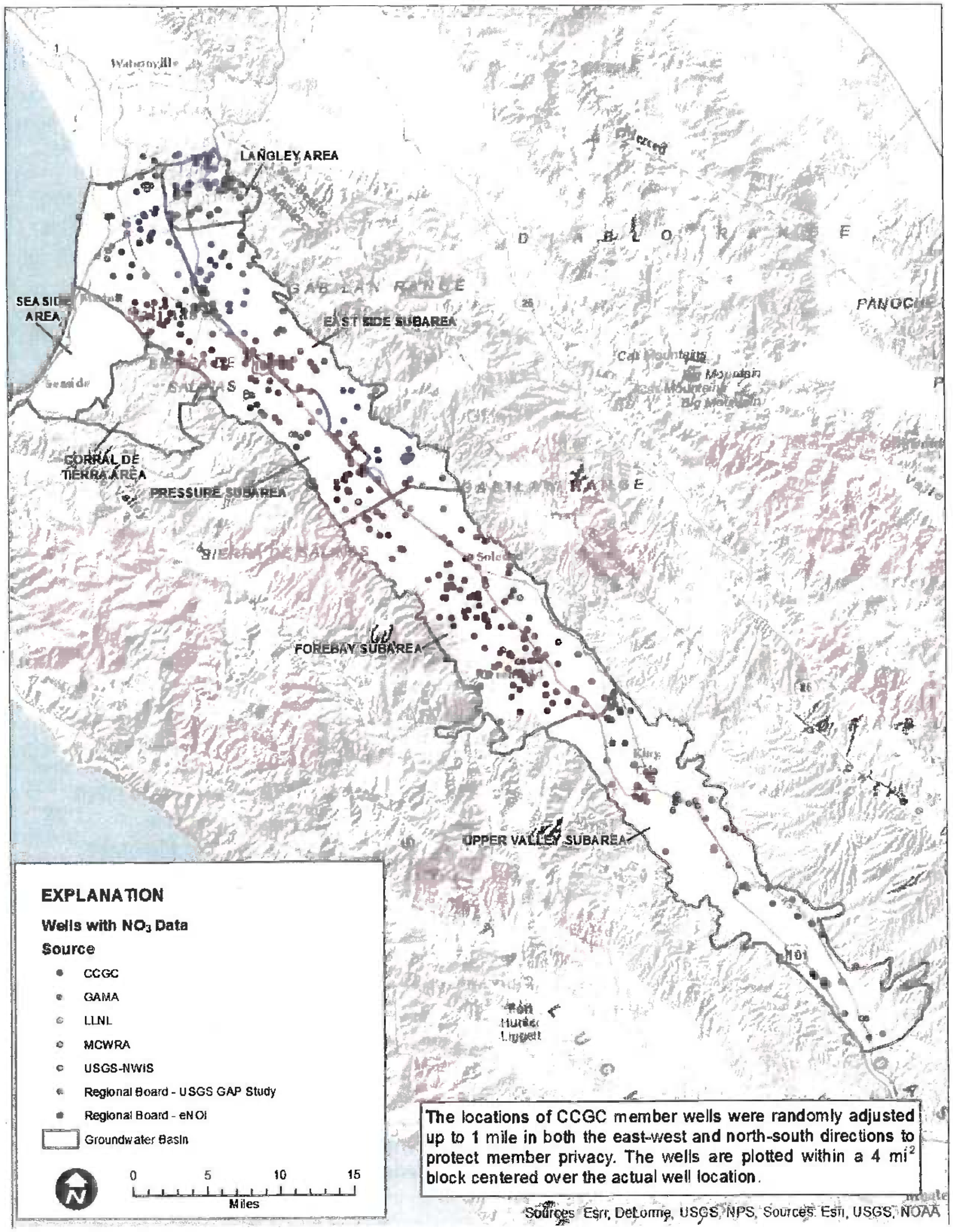


Figure 1. Subareas and locations of wells used for mapping of nitrate concentrations.

Hydrogeologic Context

The Salinas Valley Groundwater Basin contains four primary subareas or sub-basins (Figure 1). Much of the discussion in this section is from Department of Water Resources Bulletin 118. The Pressure, East Side, Forebay, and Upper Valley subareas are hydraulically connected but are distinguished by their hydrogeologic characteristics. Durbin and others[2] reported three important characteristics that differentiate the subareas; confining conditions, specific capacity of wells, and the source of groundwater recharge. The fifth subarea, the Langley subarea, is a series of low hills bounded to the east by the geologic contact of Tertiary sediments with granitic bedrock and to the north by a drainage divide in the Carneros Hills. The west and south boundaries are shared with the Pressure and East Side subareas.

Hydrogeologic Characteristics of Subareas

The Pressure subarea is underlain by three aquifers that range from semi-confined to confined[3]; the 180-ft, 400-ft, and Deep aquifers. Groundwater in the East Side subarea is generally semi-confined, groundwater in the Forebay subarea varies spatially from semi-confined to unconfined, and groundwater in the Upper Valley subarea is largely unconfined. Specific capacities of irrigation wells (yield divided by drawdown) generally increase up-valley and the proportions of recharge from irrigation return flow and stream infiltration vary among the subareas.

The Pressure or 180/400-Foot aquifer subarea includes, from oldest to youngest, the Pliocene to Pleistocene Paso Robles Formation, the Pleistocene Aromas Sands, Quaternary terrace deposits, Holocene alluvium, and sand dunes. There are three water-bearing units, the 180-Foot, the 400-Foot, and the 900-Foot aquifers, named for the average depths of each aquifer. The confined 180-Foot Aquifer occurs only in this subarea, as its confining blue clay layer thins and disappears east and south of the subarea and does not extend into the East Side subarea. In the Pressure subarea, water bearing units between 180 and 400 feet below land surface have been referred to as the Pressure 400-Foot aquifer zone. Water bearing units below the 400-Foot aquifer zone are referred to as the "Pressure Deep" zone[4].

The 180-Foot Aquifer consists of interconnected sand, gravel, and clay lenses, and ranges in thickness from 50 to 150 feet. The 180-Foot Aquifer is generally separated from the 400-Foot Aquifer by a zone of less coarse-grained strata and confining units that range in thickness from 10 to 70 feet. The 400-Foot Aquifer is about 200-feet thick and consists of sands, gravels, and clay lenses. The upper portion of the aquifer appears to be correlated with the Aromas Sand and the lower portion with the upper part of the Paso Robles Formation. The 900-Foot Aquifer, present in the lower (northern) Salinas Valley, consists of

---

[2] Durbin, T.J. Kapple, G.W. & Freckleton, J.R. (1978) Two-Dimensional and Three-Dimensional Digital Flow Models for the Salinas Valley Ground Water Basin, California. pp. 78–113, United States Geological Survey Water Resources Investigations Report 78-113..

[3] The terms confined and semi-confined refer to the depth distribution of water levels in wells screened in different aquifers. In a confined aquifer, groundwater is under sufficient pressure such that the water level in a well screened solely in the confined aquifer rises above the elevation of the top of aquifer. Semi-confined aquifers are intermediate between confined and unconfined aquifers. The extent of confinement is due to the heterogeneous nature of the subsurface fine-grained layers which causes spatially varying degrees of confinement.

[4] Geomatrix, 2001, FINAL REPORT Evaluation and Proposed Redesign of the Salinas Valley Ground Water Monitoring Network, Salinas Valley, California

alternating layers of sand, gravels and clays and is separated from the 400-Foot Aquifer by a blue marine clay confining unit.

Groundwater in the 180- and 400-foot confined aquifers is generally interconnected with the semi-confined water bearing zones in the east, which allows flow from and to the East Side subarea (Figure 1). The geology underlying the East Side subarea is lithologically similar to the Pressure subarea except that the mostly well-defined confining blue clay layer generally thins and disappears to the east. In the East Side subarea, wells screened above 350 feet below land surface have been designated as East Side Shallow wells and those screened below this depth have been referred to as East Side deep wells[5].

The upper Salinas Valley encompasses the Forebay and Upper Valley subareas. The Forebay subarea overlays the entire width of the unconsolidated alluvial fill between Gonzales and the bluff line two miles south of Greenfield. The primary water-bearing units of this subarea are the same units that produce water in the adjacent Pressure subarea. However, the near-surface confining unit does not extend into the Forebay subarea. Groundwater in the Forebay subarea ranges from unconfined to semi-confined and occurs in lenses of sand and gravel that are inter-bedded with finer grained material such as clays and silts.

The Upper Valley subarea includes the entire alluvial fill in the valley floor between the bluff line two miles south of Greenfield to the southern end of the San Ardo Valley. The primary aquifer is unconfined and deposits range from unconsolidated to semi-consolidated. It consists of inter-bedded gravel, sand, and silt of the Paso Robles Formation, alluvial fan, and river deposits. These deposits are equivalent to the 180-Foot and 400-Foot Aquifer units of the lower Salinas Valley. However, confining units comparable to those separating aquifers in the lower Salinas Valley are not present and groundwater is unconfined.

In the Forebay and Upper Valley subareas, aquifers have not been officially distinguished as deep or shallow. In the Forebay subarea, wells with at least 80% of perforations less than 350 feet below land surface or the total well depth less than 350 feet below land surface are considered shallow. Wells with perforations below this depth are considered as deep[6]. In the Upper Valley subarea, wells with at least 80% of perforations less than 250 feet below land surface deep or the total well depth less than 250 feet below land surface are considered as shallow. Wells with perforations below this depth are considered as deep[7].

Recharge

Recharge in the Salinas Valley occurs primarily from infiltration from the Salinas River and deep percolation of irrigation water except in the Langley area where recharge is primarily from precipitation. Flow in the Salinas River is seasonally controlled for conjunctive use. Precipitation, subsurface and boundary inflow, and seawater intrusion are other sources of recharge of lesser importance. Durbin and others [8] reported that the Pressure subarea is recharged largely by irrigation and stream recharge in

---

[5] ibid
[6] Ibid
[7] Ibid
[8] Durbin, T.J. Kapple, G.W. & Freckleton, J.R. (1978) Two-Dimensional and Three-Dimensional Digital Flow Models for the Salinas Valley Ground Water Basin, California. pp. 78–113, United States Geological Survey Water Resources Investigations Report 78-113..

approximately equal volumes. They also reported that the Forebay and Upper Valley subareas receive recharge from irrigation return and infiltration from the Salinas River; estimates indicate that the river provides approximately twice as much recharge as irrigation return. Changing irrigation practices such as increased use of drip irrigation during the last 20 years[9] have may have resulted in changes to the recharge volumes for the difference subareas. The East Side subarea does not receive recharge from the Salinas River and most of its recharge is from irrigation return water. Directions of groundwater flow generally follow the topography of the basins, from high altitudes towards the drainages, and down valley towards Monterey Bay.

Groundwater Quality Studies and Data

Previous studies of groundwater quality in the Salinas Valley demonstrate that concentrations of nitrate (as NO_3) in groundwater vary spatially. Primary sources of data include irrigation, public supply, and monitoring wells[10]. Concentrations of nitrate above the MCL of 45 mg/L and up to several hundred mg/L have been observed in all of the subareas.

There are four primary programs that have sampled groundwater to assess groundwater nitrate contamination in the Salinas Valley as follows.

- Sampling of irrigation and monitoring wells by the MCWRA;
- Public water systems are required to systematically test their well water and the results are reported to Monterey County Health Department;
- Groundwater Ambient Monitoring and Assessment (GAMA) study conducted by the California State Water Resources Control Board and USGS sampled public supply wells throughout the basin;
- Central Coast Ambient Monitoring Program – Groundwater Assessment and Protection (CCAMP-GAP) Domestic Well Project for the Salinas and Pajaro valleys sampled domestic wells in cooperation with the USGS.

The MCWRA has used a network of wells to monitor groundwater conditions in the Salinas Valley Groundwater Basin since the 1940s. The network of wells provides the information needed to manage and protect groundwater resources and sustain beneficial uses. The MCWRA monitors over 300 wells for water quality. Most of the wells are used for irrigation. The MCWRA[11] reported nitrate concentrations in several hundred wells sampled in 1993 and 2007. They reported that 25 % (1993) to

---

[9] MCWRA (Monterey County Water Resources Agency). (2011) 2010 Ground Water Summary Report, http://www.mcwra.co.monterey.ca.us/Agency_data/GEMS_Reports/2010%20Summary%20Report.pdf

[10] e.g. Boyle, D., King, A., Kourakos, G., Lockhart, K., Mayzelle, M., Fogg, G.E. & Harter, T. (2012) Groundwater Nitrate Occurrence. Technical Report 4 in: Addressing Nitrate in California's Drinking Water with a Focus on Tulare Lake Basin and Salinas Valley Groundwater. Report for the State Water Resources Control Board Report to the Legislature. Center for Watershed Sciences, University of California, Davis

Justin T. Kulongoski and Kenneth Belitz. 2005. Program Status and Understanding of Groundwater Quality in the Monterey Bay and Salinas Valley Basins, 2005: California GAMA Priority Basin Project, US Geological Investigations Report 2011 – 5058.

[11] Monterey County Water Resources Agency, 2010, Technical Memorandum – NITRATE Tasks 2.01, 2.02, 2.04-2b EPA Grant XP-96995301 – Groundwater Sampling, Reporting and Storage, Groundwater Sampling Data, QA/QC, Data Reduction and Representation

37 % (2007) had nitrate concentrations exceeding the MCL. Reported concentrations ranged from 1 to over 500 mg/L nitrate. Among the subareas, the largest number of exceedances occurred in East Side and Forebay subareas. Concentrations generally increased from 1993 to 2007.

The Monterey County Health Department mandates that any water supply system with two connections or more must be tested annually. At the state level, systems with 15 or more connections (or serving more than 25 people for more than 60 days out of the year) are required to be tested annually. These data are stored in GeoTracker. GeoTracker is an online information system that provides access to groundwater quality information. The GeoTracker data collected under the auspices of this and other programs and projects are apparently not subject to the same levels of quality control as the data collected and processed by the CCGC as is discussed in the Results and Discussion section. In specific cases, we have attempted to rectify data that was obviously entered incorrectly. We also recognize that there are suspicious outlier data for domestic supply wells in the GeoTracker database. In addition to correcting data where we encountered obvious discrepancies, we calculated temporal averages for all wells with multiple analytical results and for coincident points we used the maximum of the averages. This process is discussed in greater detail in the Appendix.

Under the auspices of the Groundwater Ambient Monitoring and Assessment (GAMA) Program, Kulongoski and Belitz[12] analyzed groundwater nitrate data for domestic supply wells throughout the Salinas Valley. About 23,000 individual analytical results were included in their assessment of groundwater quality for the Monterey/Salinas study unit. They identified over a dozen wells where nitrate concentrations were over the MCL. They used a non-parametric statistical analysis to examine the relationship between nitrate and potential explanatory factors including land use, well construction, groundwater age, and geochemical condition. They reported that nitrate concentrations over the MCL were generally associated with shallow wells (less than 350 feet) and groundwater that was either of mixed pre-modern and modern or modern age[13].

Most recently, Boyle and others[14] assessed nitrate concentrations in the Salinas Valley. They reported that the majority of the public supply wells in the Salinas Valley have concentrations below the MCL. A key reason for this is likely due to regulation by the Monterey County Health Department of water-supply wells with 2 or more connections. When the MCL of a particular contaminant is exceeded, wells are often abandoned, or use is discontinued and there is no further sampling. This can remove potentially high nitrate samples from the record, maintaining the biased statistic that the majority of wells sampled are below the MCL. They also reported that the higher average nitrate concentrations were located in wells in the northeastern, central, and southern portions of the Salinas Valley.

[12] Justin T. Kulongoski and Kenneth Belitz. 2005. Program Status and Understanding of Groundwater Quality in the Monterey Bay and Salinas Valley Basins, 2005: California GAMA Priority Basin Project, US Geological Investigations Report 2011 – 5058.

[13] Modern water recharged during or after the 1950s.

[14] Boyle, D., King, A., Kourakos, G., Lockhart, K., Mayzelle, M., Fogg, G.E. & Harter, T. (2012) Groundwater Nitrate Occurrence. Technical Report 4 in: Addressing Nitrate in California's Drinking Water with a Focus on Tulare Lake Basin and Salinas Valley Groundwater. Report for the State Water Resources Control Board Report to the Legislature. Center for Watershed Sciences, University of California, Davis.

Methods and Data Sources

Sampling of CCGC Member Wells

Within the Salinas Valley, the most recently collected groundwater nitrate data was obtained from 166 domestic wells on L&G properties sampled by HydroFocus and Michael L. Johnson, LLC personnel during 2013 and 2014. Upon arrival at the well and using electronic sounders accurate to the nearest 0.01 feet, field personnel measured the depth to groundwater in the well (if there was access), relative to the top (the highest point) of the well casing. The measuring point location and depth to groundwater were recorded on the field sheet.

Field parameters (pH, water temperature, specific conductance, oxidation-reduction potential (ORP) and dissolved oxygen (DO)) were measured at each well using a Yellow Springs Instruments multimeter. Meters were calibrated for all parameters at least 2 times per day, once in the morning prior to beginning sampling and once in the afternoon. At each well, field parameters were measured upon arrival. If the preliminarily-measured field-parameter values were more than 20% outside of the range of calibration value, the meter was recalibrated. Meters were calibrated with standards close to or that bracketed the values for the well sample and standards were maintained at temperatures (in water baths) close to the temperature of the well water. The meter was checked with zero DO solution at first site of the day, or more frequently if needed. The pH probe was calibrated using buffers bracketing the preliminary sample result. Oxidation-reduction potential (ORP) was calibrated using Zobell solution[15]. Personnel recorded calibration data on field sheets. After calibration, tubing was connected to the well outlet and directed the well discharge to a flow-through chamber. As well water was pumped from the well, field parameters were recorded approximately every 5 minutes.

To the extent possible, purging of the well occurred prior to sample collection in order to remove stagnant water from within the well casing and ensure that a representative sample was obtained. Stabilization of the field parameters was used as an indication that the sample water was representative of groundwater. Stability was defined as ± 0.1 for pH, ± 3% for conductivity, ± 10 mV for ORP and ± 10% for DO for at least three consecutive readings Sampling began as soon as possible after parameter stabilization.

Field personnel collected all samples using the pumps in the domestic wells. The sample was collected as close to the well head as possible. In most cases, the sample was collected through plastic tubing connected to a spigot at or near the well head. In rare cases, the sample was collected from an indoor or outdoor faucet. Well water flowed into a flow-through chamber and into a collection bucket for measuring volume of flow per unit time. Samples analyzed for dissolved constituents (including nitrate) were filtered in the field using 0.45-µm capsule filters certified to meet EPA standards for trace metal analysis. Sample bottles and sampling equipment were rinsed thoroughly three times with the water to be sampled prior to sample collection. Bottles pretreated with preservatives were not rinsed prior to sample collection. Samples collected for metals were preserved with nitric acid in the field. Test strips were used to verify that the pH was less than 2 in preserved samples.

Field personnel collected ten percent of the total samples for quality assurance purposes (duplicate and field blank samples). Field duplicate samples were collected and processed in the field and analyzed to

[15] Nordstrom, D.K., 1977, Thermochemical redox equilibria of ZoBell's solution, Geochimica e Cosmochimica Acta, 41:1835-1841

evaluate the heterogeneity of the matrices. The duplicate samples were submitted to the laboratory as semi blind samples. Field blank samples were processed in the field identically as the other samples using deionized water as sample water. The blank samples were submitted to the laboratory as semi blind samples.

All samples collected for the MRP constituents were placed immediately on ice and transported to Monterey Bay Analytical Services on the day of collection. Before leaving the field to deliver samples, sampling personnel checked the ice level to ensure the temperature of the ice chest would remain around 6°C, and added ice if necessary. Chain of Custody form(s) were completed for each sampling day.

Other Sources of Nitrate Data

Using GeoTracker GAMA[16], we downloaded all data for the Salinas Valley. The GeoTracker GAMA database includes data from the California Department of Public Health, GAMA – SWRCB data collection efforts and Regulated Sites. We also downloaded data from the USGS National Water Information System[17] for wells in the Salinas Valley which contain samples analyzed for nitrate. We also extracted data from the GAMA special study carried out by Lawrence Livermore National Laboratory[18]. The Central Coast Regional Board provided two sets of nitrate data; data uploaded as part of the individual well sampling (eNOI) process belonging to by L&Gs enrolled in the Irrigated Lands Regulatory Program and data collected by the USGS as part of the Regional Water Quality Control Board Central Coast Ambient Monitoring Program - Groundwater Assessment and Protection (CCAMP-GAP) Domestic Well Project for the Salinas and Pajaro Valleys. The MCWRA provided a Technical Memorandum[19] that contained historical nitrate values for monitoring wells.

Mapping of Nitrate Concentrations in Groundwater

We used the theory of regionalized variables, or geostatistics, and the ArcGIS Geostatistical Analyst program to create a map of groundwater nitrate concentrations in the Salinas Valley. The theory of regionalized variables relies on the assumption that data collected in geographic areas is randomly distributed[20]. Kriging, the process of interpolation from measured values of some variable z measured at N locations relies on the determination of the spatial covariance or semivariogram of the variable at points x_i. The semivariogram (γ) is defined as:

---

[16] http://geotracker.waterboards.ca.gov/gama/, accessed 2/6/2014

[17] http://waterdata.usgs.gov/nwis, accessed 4/4/2013

[18] Moran JE, Esser BK, Hillegonds D, Holtz M, Roberts SK, Singleton MJ, Visser A, 2011, California GAMA Special Study, Nitrate Fate and Transport in the Salinas Valley. Final Report for the California State Water Resources Control Board. GAMA Special Studies Task 10.5: Surface water-groundwater interaction and nitrate in Central Coast streams. LLNL-TR-484186.

[19] Monterey County Water Resources Agency, Technical Memorandum – NITRATE Tasks 2.01, 2.02, 2.04.2b EPA Grant XP-96995301 – Ground Water Sampling, Reporting, and Storage, Ground Water Sampling, Data QA/QC, Data Reduction and Representation. To EPA Region IX, July 30, 2010.

[20] David, M. 1977. Geostatistical ore reserve. New York (NY): Elsevier Scientific
Journel, A.G. and Ch. J. Huijbregts. 1978. Mining Geostatistics. San Diego (CA): Academic Press Harcourt Brace & Company, Publishers.
Matheron, G. 1963. Principles of Geostatistics. Economic Geology 58: 1246-1266.

$$\gamma(h) = \frac{variance[z(x_i) - z(x_j)]}{2}$$

where:

h is the lag or average distance between data points and
z(x) is the groundwater nitrate concentration

We therefore calculated the semivariogram to estimate the spatial covariance in the area of nitrate concentrations. We then interpolated with kriging which uses a linear combination of weighting factors and measured values of $z(x_j)$ that minimizes the estimation variance. We kriged subareas separately (except the East Side, Langley, and Pressure subareas) and then combined the subarea maps into one map.

The objective of kriging for this study was to characterize the spatial distribution of the nitrate concentrations in the Salinas Valley and provide a conservative estimate of where groundwater nitrate concentrations are likely to be above the MCL. This is different from the original objective of kriging which is to quantitatively assess amounts of exploitable elements for mining. Because of the high spatial variability and non-Gaussian nature of the distribution we used ArcGIS Geostatistical Analyst to implement Bayesian trans-Gaussian kriging methodology[21] to account for the uncertainty in the statistical distribution of concentrations. ArcGIS Geostatistical Analyst generates a semi-continuous surface of estimated values. The semi-continuous surface was exported to a raster with a 200 meter cell size for development of maps showing the distribution of groundwater nitrate concentrations.

Mapping Assumptions

We assumed that water-quality data collected from 2000 to 2014 are most representative for the area at this time. Using this time frame, we attempted to insure that we effectively captured the distribution of nitrate concentrations and delineated where groundwater for drinking water is likely to be over the MCL. As discussed above and as indicated by the data in the Appendix, when drinking water supply wells are determined to contain nitrate concentrations above the MCL, use and sampling can be discontinued. Thus we used the 13 year time period for data gathering in attempt to capture wells where sampling may have been discontinued. Where there was more than one value for samples collected at different times from a well within this time frame, we calculated the average of all values. Data from supply wells downloaded from GeoTracker have obfuscated coordinates[22], which creates a dataset where multiple wells may plot at the same location. To create the kriged estimates, we used the maximum of time-averaged nitrate concentrations at each of these "coincident" points for map creation. There were over 300 coincident points.

Analytical data downloaded from GeoTracker is reported as either nitrate or nitrate as nitrogen. We generally assumed that this designation is correct. However, we identified instances where this designation was incorrectly assigned. We identified seven wells in which we successfully matched GAMA and the L&G's eNOI data for identical wells where the eNOI concentrations was reported as nitrate and GAMA reported NO_3 as N (The values were identical). This classification error can result in a large difference in data used for contouring since values differ by greater than 4 times. We therefore assumed that the eNOI data classification was correct since analyses and values are uploaded directly

[21] Ju¨rgen Pilz and Gunter Spock, 2007, Why do we need and how should we implement Bayesian kriging methods, Stoch Environ Res Risk Assess (2008) 22:621–632
[22] These locations are accurate to within 1 square mile of the actual location.

from the laboratory. We were able to match data for samples collected by the L&G and the CCGC for one well. Our (CCGC) values agreed with values (for the same well) reported in the eNOI, giving credibility to the assumption that the eNOI uses the correct nitrate classification. We corrected the GAMA nitrate values for these seven wells based on the eNOI data. We also compared data from monitoring wells in reports referenced in GeoTracker with values in the GeoTracker database and found discrepancies which we also corrected in our database.

The CCAMP-GAP project samples were obtained from household faucets. Where applicable, we matched the GAP sites to USGS – NWIS sites. Where there were comparison samples, all nitrate concentrations for tap samples agreed well with concentrations obtained at the well head.

Consistent with the discussion in the Hydrogeologic Context section and the objectives of characterizing the domestic water supply and shallow groundwater and reasonably delineating areas where concentrations are likely to be over the MCL, we assumed that the shallow aquifer extends to a maximum depth of 400 feet, and therefore any wells with known depths greater than 400 feet were removed from the dataset for mapping. For mapping purposes, we also eliminated irrigation wells and domestic/irrigation wells[23] with unknown depths as these wells are generally deeper than 400 feet. However, we recognize that that there are many shallow irrigation and irrigation/domestic wells throughout the Salinas Valley. Finally, we assumed that wells with unknown depths having uses of Domestic, Public Supply, Observation, or unknown were all less than 400 feet deep.

For creation of maps where CCGC domestic well locations are shown, we obfuscated locations as follows. For each pair of well-location coordinates, the value of the location coordinate was altered using a random-number generation algorithm in Microsoft Excel. The coordinates were randomly altered in both the east-west and north-south directions to place the well location somewhere within 1 mile of the actual location. This resulted in plotting of the well location within a 4-square mile block centered over the actual well location. In some cases the obfuscated well location plotted some distance from the L&G parcel.

[23] These are wells that were originally installed as irrigation wells and then converted to use for domestic supply.

Well Construction Information

In an attempt to learn about domestic well construction, we obtained all available well completion reports from DWR for the Salinas Valley Groundwater Basin. From these reports, we identified over 1,610 reports that designated wells as domestic use and extracted well construction information. Of these, 1,558 reports provided well depth information and 1,469 reports provided bottom of screen information. We summarized the data for well depth by township.

Results and Discussion

Figure 1 shows the locations of wells and sources of data used in our analysis of the distribution of groundwater nitrate concentrations in the Salinas Valley. Data sources included GAMA, Lawrence Livermore National Laboratory, MCWRA, USGS, the Central Coast Regional Water Quality Control Board and samples collected under the auspices of the CCGC groundwater program. The total number of wells used for mapping the distribution of nitrate concentrations equaled 838. In the Salinas Valley, the total area of the member parcels equals 115,523 acres. Member parcels are present throughout most of the valley. However, the density of member parcels is lower in the northern-most Langley subarea and the northern Pressure subarea (Figure 2)[24].

Well Construction

The results of our analysis of well-completion information contained in DWR well completion reports show that the large majority of the domestic wells are screened within 400 feet of land surface. We focused on wells that were designated shallower than 400 feet (consistent with the discussion in the Hydrogeologic Context section). The average depth for the bottom of the well screens for all well completion reports where this information was available for domestic wells is 284 feet. Two-hundred and forty eight (248) well completion reports (16 %) stated that the bottom of the well screen was greater than 400 feet. For any domestic well therefore, there is 84 % likelihood that the well screens intercept water from less than 400 feet. The average well depth was 306 feet. Three-hundred and fifty (350) well completion reports (25.5 %) stated that the bottom of the well screen was greater than 400 feet

[24] The locations of CCGC member wells were obfuscated to protect member privacy. The locations of CCGC member wells shown on Figure 2 were randomly adjusted up to 1 mile in both the east-west and north-south directions. The wells are plotted within a 4 mi^2 block centered over the actual well location. Therefore, the wells may not be shown on the member parcels on which they are actually located.

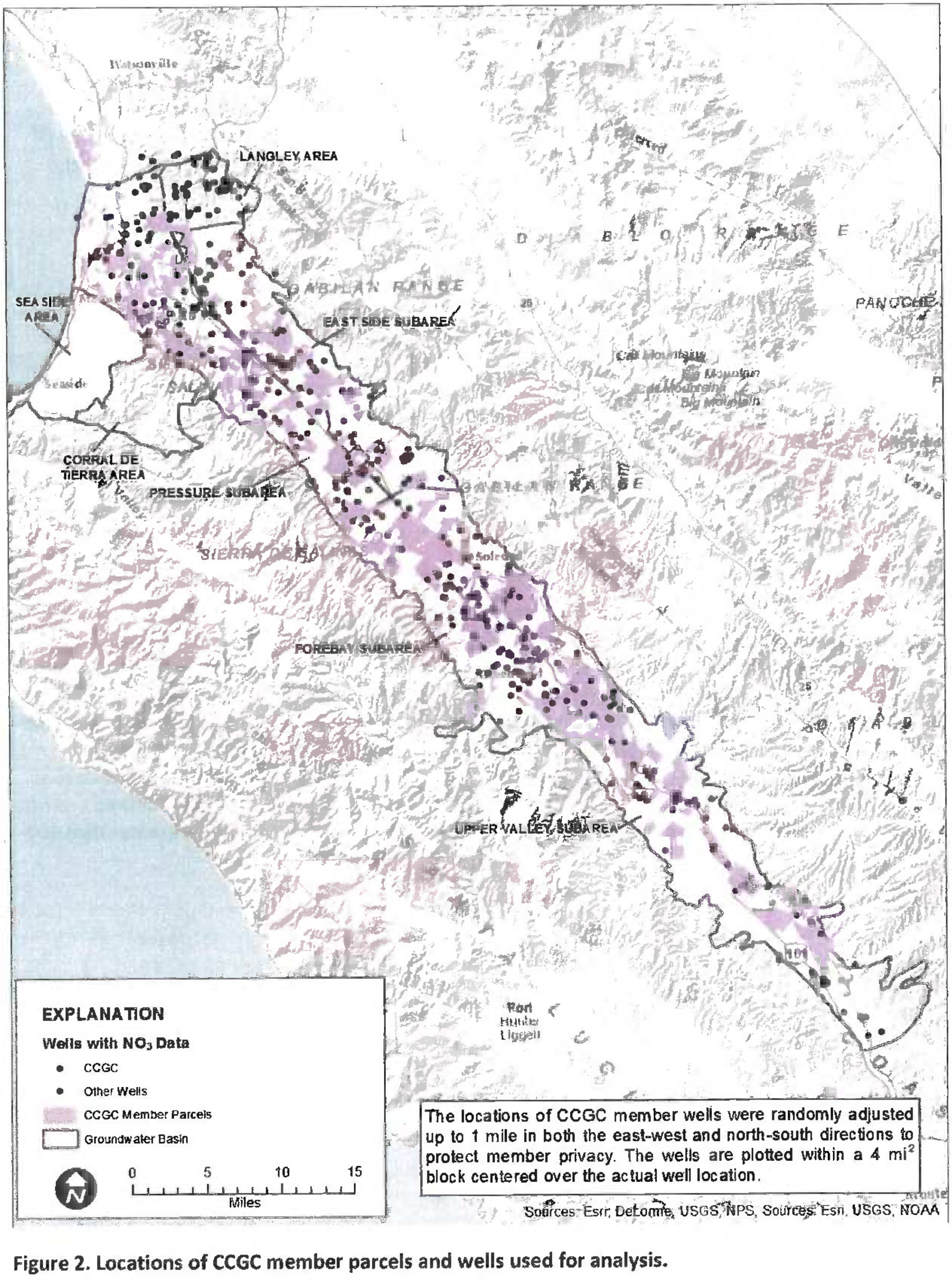


Figure 2. Locations of CCGC member parcels and wells used for analysis.

Figure 3 shows the distribution of average domestic well depths by township for the Salinas Valley and vicinity. Figure 3 shows that the average domestic well depth ranges from 109 to 386 feet. The average well depth generally decreases from the lower Salinas Valley to the Upper Valley. For a subsample of the 166 wells sampled on Coalition L&Gs' properties in the Salinas Valley, we were able to match well completion reports or received well construction information from L&Gs. We were also able to obtain well depths and screened interval data for non-CCGC wells used in our analysis. In total, we obtained well depth information for 108 wells. Figure 4 shows the distribution of well depths[25]. Well depths vary substantially from 20 to 1,010 feet. Most wells (75 %) were shallower than 400 feet. Where well depth and screened interval information was available, we excluded wells deeper than 400 feet (consistent with the discussion in the Hydrogeologic Context section) for purposes of developing maps of nitrate concentrations.

[25] The locations of CCGC member wells were obfuscated to protect member privacy. The locations of CCGC member wells shown on Figure 4 were randomly adjusted up to 1 mile in both the east-west and north-south directions. The wells are plotted within a 4 mi^2 block centered over the actual well location.

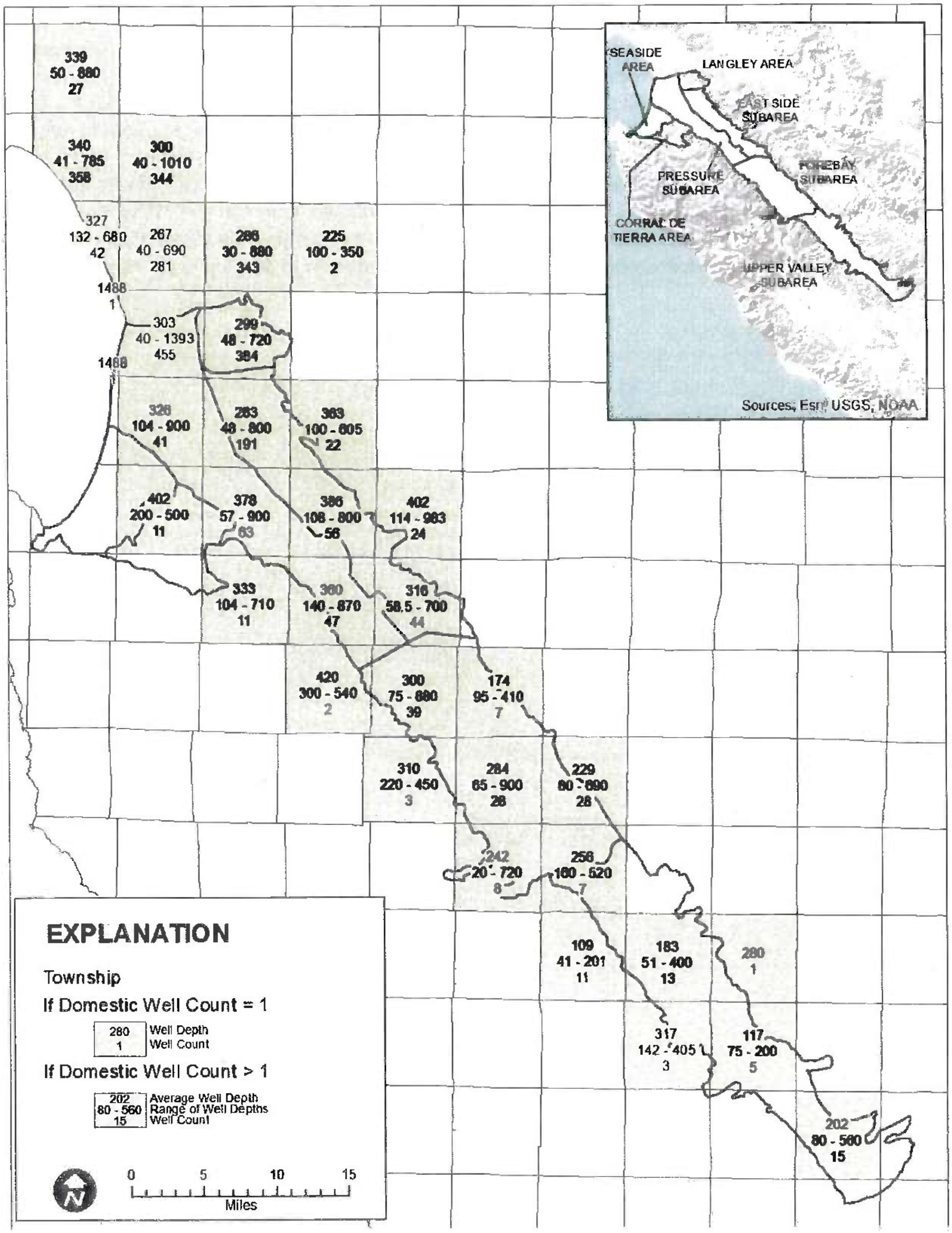


Figure 3. Average and range of domestic well depths by township.

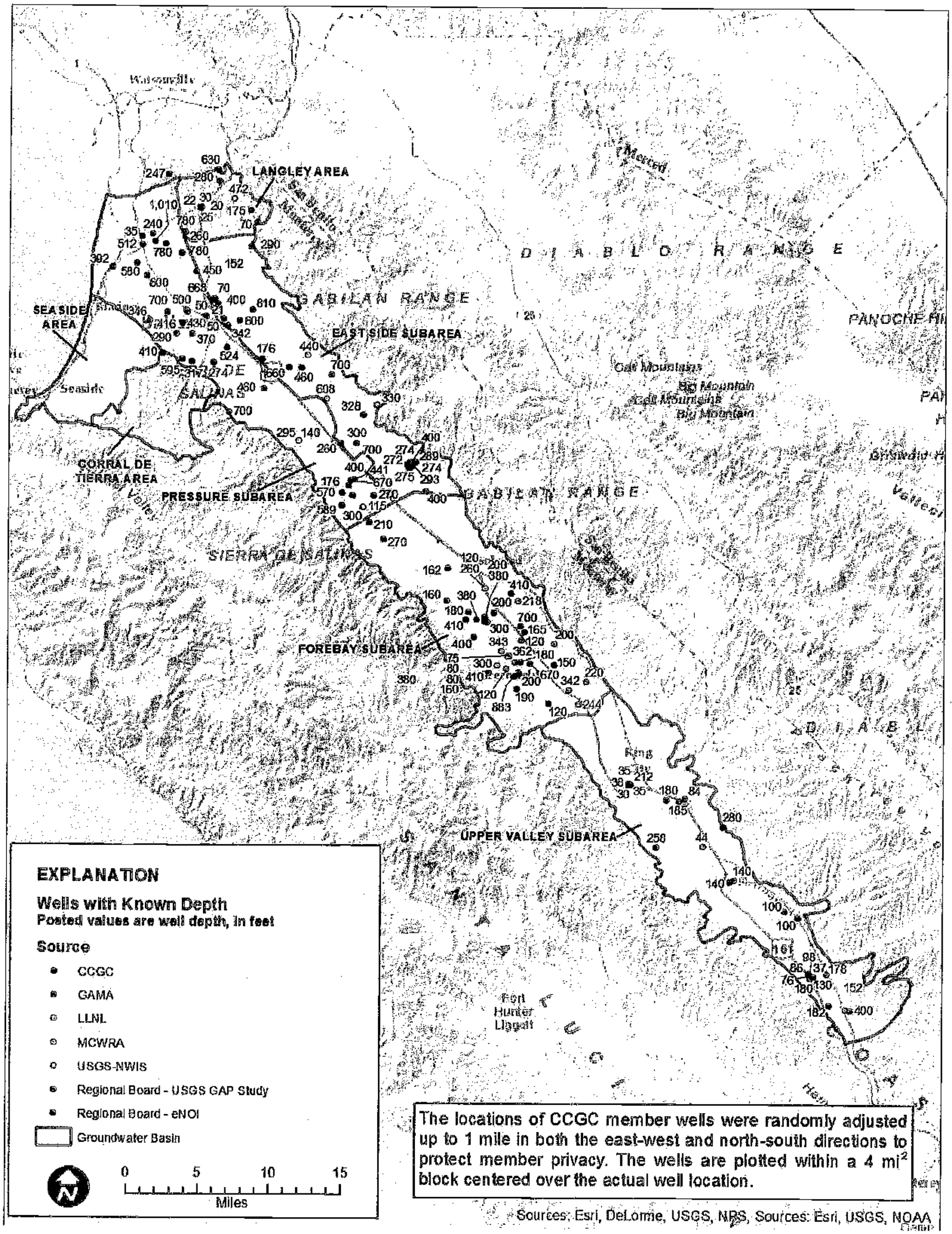


Figure 4. Distribution of known well depths.

Distribution of Groundwater Nitrate Concentrations and Associated Uncertainty

Results from 838 wells were used to characterize the distribution of groundwater nitrate (as NO_3) concentrations. Summary statistics for time-averaged nitrate concentrations are shown in Table 1. The mean concentration was 36.4 mg/L as NO_3. The median was 10.4 mg/L as NO_3. Values ranged from less than the detection limit of 0.05 mg/L to 690 mg/L. One hundred and seventy-seven wells (21 %) had time-averaged concentrations over the MCL of 45 mg/L. In the five subareas, the mean nitrate concentration ranged from a low of 13.75 mg/L in the Langley subarea to 66.24 mg/L in the Forebay subarea. The percent of wells with average nitrate concentrations exceeding the MCL ranged from 8 % in the Langley subarea to 43 % in the Forebay subarea.

Table 1. Summary Statistics for Average Groundwater Nitrate Concentrations

	Entire Salinas Valley	Langley Subarea	Pressure Subarea	East Side Subarea	Forebay Subarea	Upper Valley Subarea
Mean	36.44	13.75	18.27	62.70	66.24	55.50
Median	10.44	6.24	5.75	24.74	31.00	14.28
Standard Error	69.65	17.32	32.70	112.77	80.48	81.38
Minimum	0.05	0.05	0.05	0.05	0.22	0.05
Maximum	690.00	96.50	249.00	690.00	323.00	482.00
Number of wells	838	233	236	146	139	84
Number of wells (percentage) with concentrations over the MCL	177 (21%)	18 (8%)	26 (11%)	43 (29%)	60 (43%)	30 (36%)
Total Area	349,321	15,344	84,323	57,454	94,030	98,170
Percent of area mapped as over MCL	58%	5%	13%	86%	83%	66%

Boxplots (Figure 5) show the range and median of time-averaged groundwater nitrate concentrations for the five subareas. In the Pressure subarea, groundwater nitrate concentrations are generally below the MCL but there are some wells with concentrations that exceed the MCL ranging up to several hundred mg/L. Similarly in the Langley and East Side subareas, the majority of the values fall below the MCL but a substantial number of wells had concentrations exceeding the MCL, ranging into the hundreds of mg/L. In the Forebay and Upper Valley subareas, relatively larger percentages of values exceeded the MCL and concentrations range up to 100 mg/L or greater.

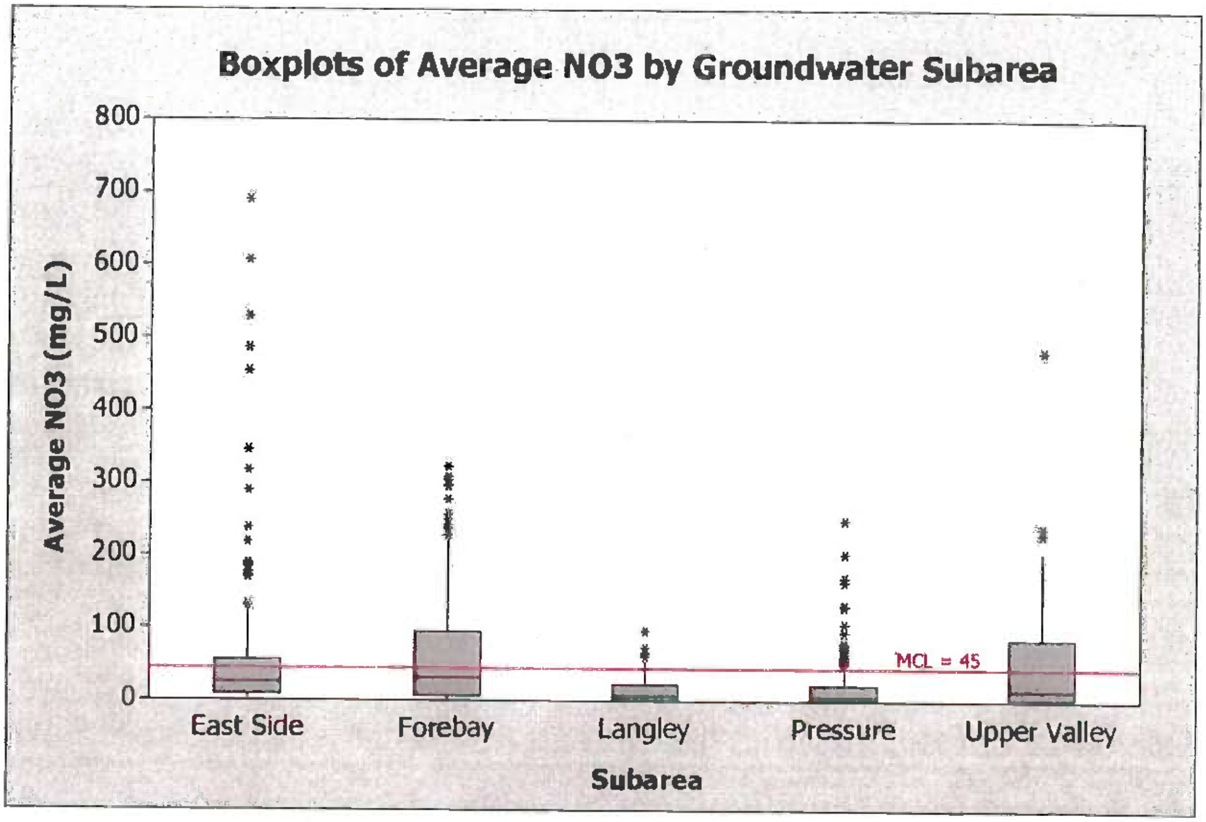


Figure 5. Boxplots showing medians and ranges for average nitrate concentrations for the five subareas. The grey rectangle represents the inner quartile range of the data. The horizontal line in the rectangle represents the median. Vertical lines represent 90 % of the data. Asterisks represent values beyond 90 % of the data.

Figure 6 shows areal distribution of groundwater nitrate concentrations and the kriging results in the Salinas Valley[26]. In the Appendix, we provide a modified version of Figure 6 with posted values for the wells or well clusters. Mapped groundwater nitrate concentrations in the Pressure subarea are generally less than one-half of the MCL due to widespread distribution of a large number of low nitrate concentrations. Exceptions include localized areas east and northeast of Castroville where concentrations range from less than detection to over the MCL. Similarly, there are areas of concentrations over the MCL southwest and southeast of Chualar and northwest and west of Gonzales. In the Langley subarea, mapped groundwater nitrate concentrations are generally less than one-half of the MCL. Exceptions include small areas in the northwestern, northern, southwestern and southern parts of the subarea.

[26] The locations of CCGC member wells were obfuscated to protect member privacy. The locations of CCGC member wells shown on Figure 4 were randomly adjusted up to 1 mile in both the east-west and north-south directions. The wells are plotted within a 4 mi^2 block centered over the actual well location. The actual locations were used when kriging the nitrate concentration surface.

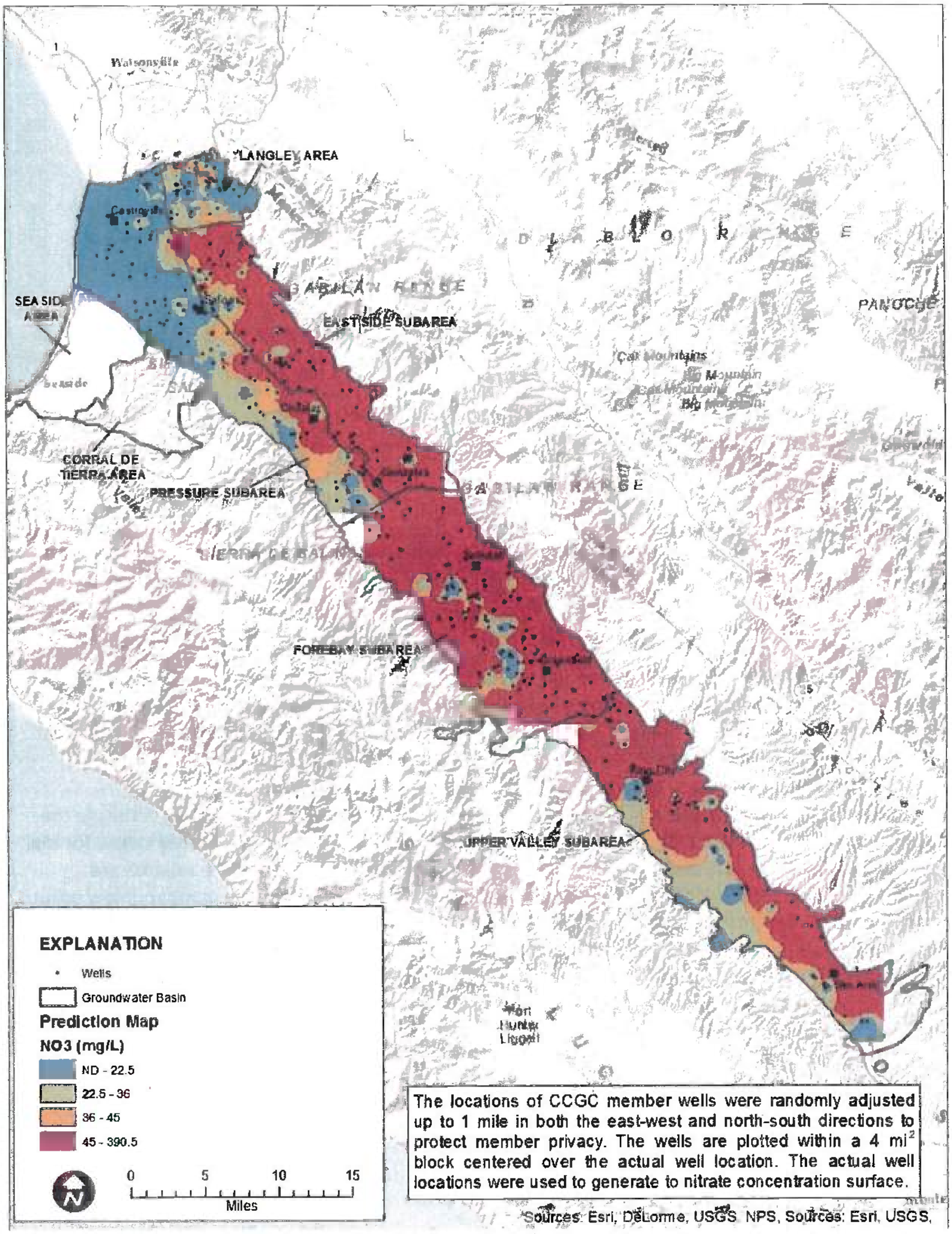


Figure 6. Kriged nitrate concentrations and delineation of areas with varying concentration ranges.

In contrast, there are large areas in the East Side subarea where groundwater nitrate concentrations are mapped as greater than the MCL. These include the area north of Salinas where concentrations as high as 189 mg/L were observed and areas east and southeast of Salinas and east, northeast, and southeast of Chualar and Gonzales where concentrations were measured as high as several hundred mg/L.

Eighty-three percent (83%) of the area within of the Forebay subarea is mapped as having concentrations of nitrate in groundwater greater than the MCL. The large area mapped as greater than the MCL is influenced by the preponderance of high values spatially distributed throughout the subarea. For example, in the area northwest of Soledad (Figure 6), the majority of the wells have concentrations that are over the MCL. Similarly, large numbers of values close to or over the MCL have a dominant influence on the extent of red areas from Soledad to Greenfield and south of Greenfield.

In the Upper Valley subarea there are a relatively small number of sample points to map. Similar to the Forebay subarea, the spatial distribution of high nitrate values results in a large mapped areas where concentrations were over the MCL.

Figure 7 shows the distribution of the standard error of the estimated nitrate concentrations[27]. The distribution of standard error is proportional to the number of points and spatial variability of the nitrate concentrations. The large number of points corresponding to low concentrations in the northern Forebay subarea (blue areas) result in low standard error values and higher certainty relative to the East Side subareas where there are fewer points and greater variability in concentrations. Also, standard error values increase towards the southern valley due fewer points and increasing spatial variability. The combination of data paucity and large spatial variability in concentrations above the MCL in the Forebay, East Side and Upper Valley subareas results in high standard error values above 50 mg/L in areas where concentrations are generally mapped above the MCL (Figure 6).

Figures 8 and 9 show the locations of CCGC member parcels overlain on the mapped areas of varying concentration ranges and standard error values shown in Figure 6. Member parcels are generally evenly distributed throughout the Salinas Valley and overlay all concentration ranges (Figure 8). However, the density of parcels in the northern Pressure subarea and Langley subarea is low. Member parcels are also relatively sparse in the Upper Valley subarea. Additional domestic wells on member parcels where high standard error values are mapped may offer some opportunity for greater certainty in groundwater characterization (Figure 9), especially in East Side and Upper Valley subareas. We estimate that there are about 40 additional domestic wells on L&G parcels that the CCGC plans to sample.

[27] The locations of CCGC member wells were obfuscated to protect member privacy. The locations of CCGC member wells shown on Figure 4 were randomly adjusted up to 1 mile in both the east-west and north-south directions. The wells are plotted within a 4 mi^2 block centered over the actual well location. The actual locations were used when generating the standard error surface.

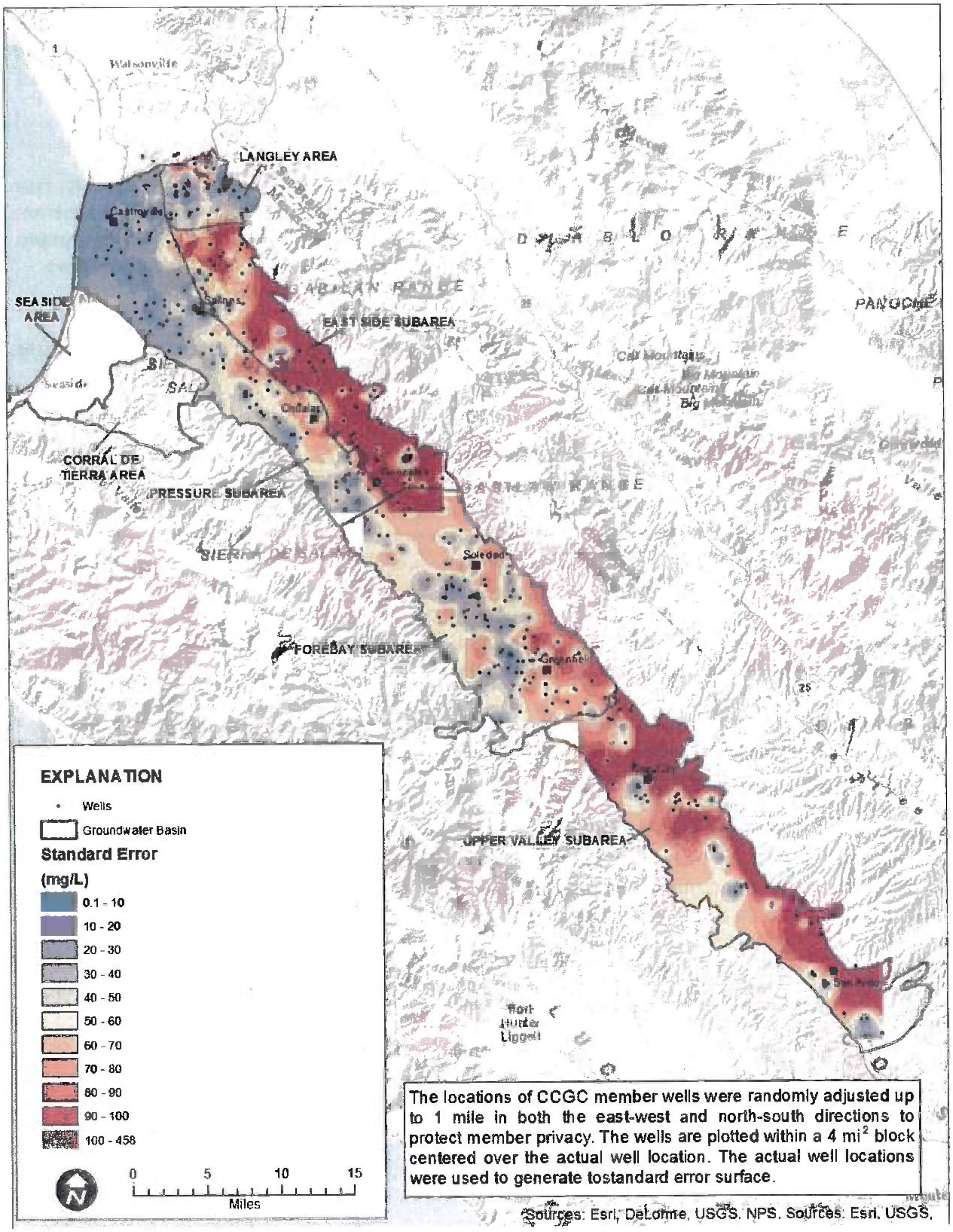


Figure 7. Distribution of standard error of kriged nitrate concentrations.

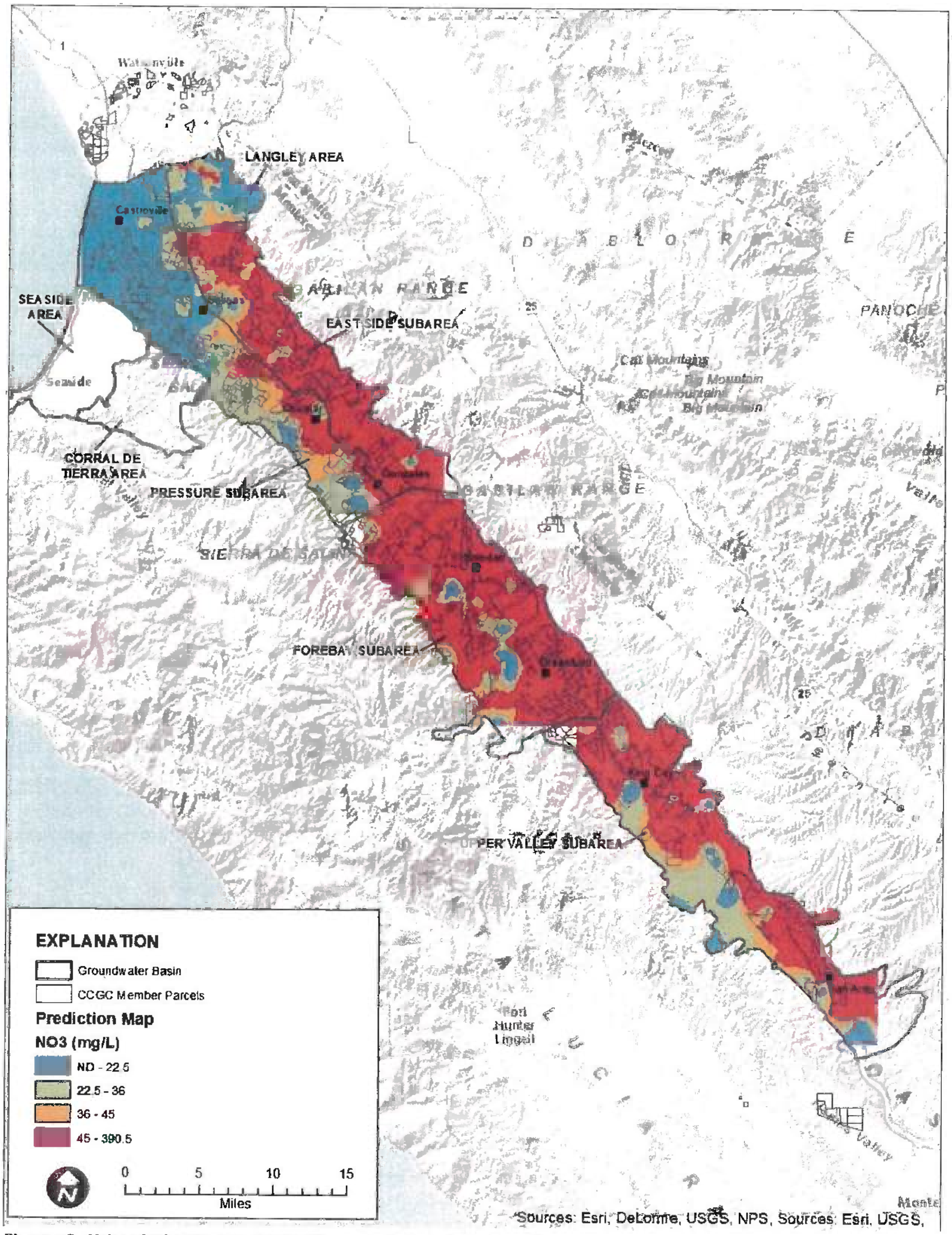


Figure 8. Kriged nitrate concentrations and member parcels.

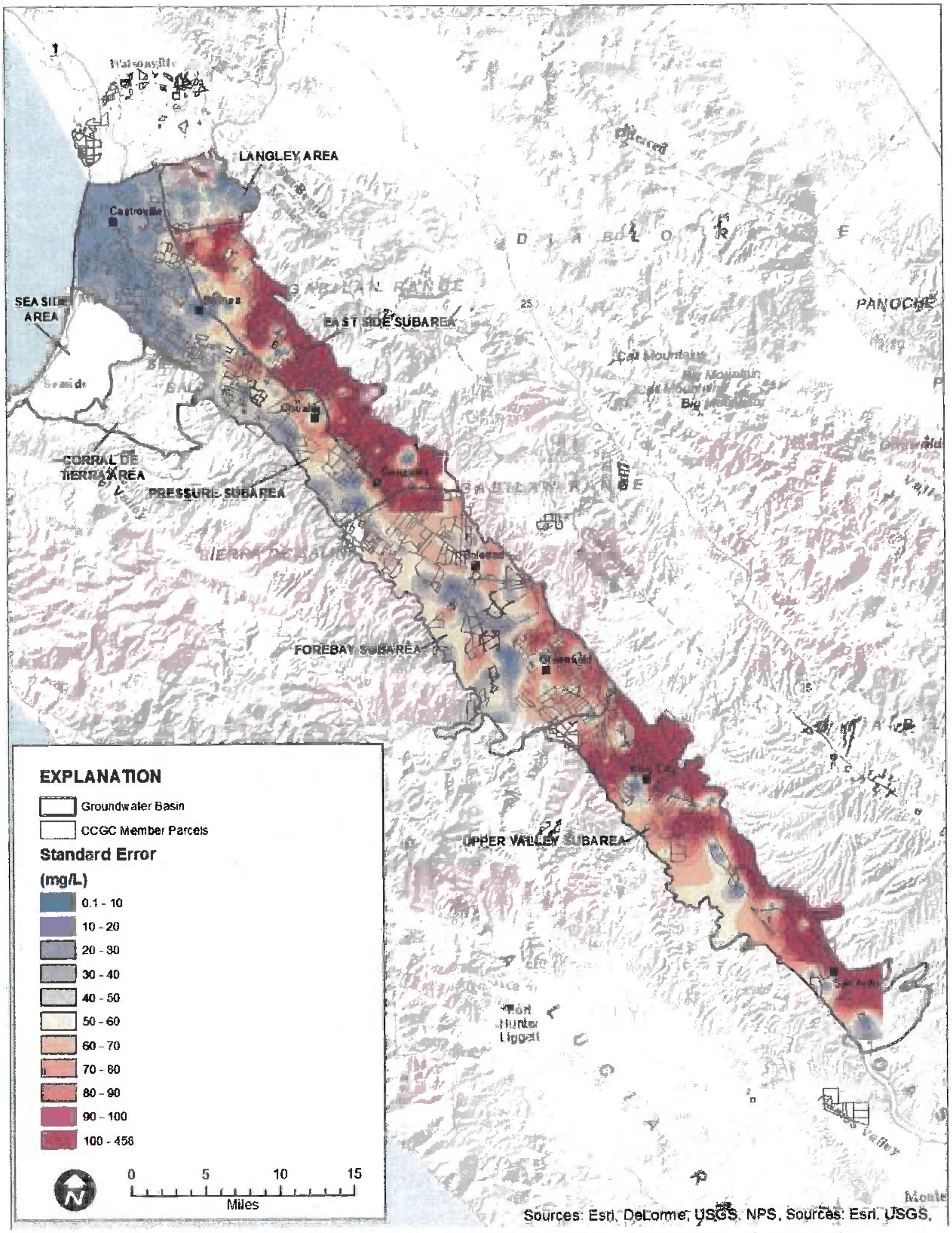


Figure 9. Distribution of standard error of kriged nitrate concentrations and member parcels.

The Appendix presents a comparison of GeoTracker results and the distribution of nitrate concentrations shown in Figure 6. For most of the valley, the comparison indicates general agreement between the two maps. The Upper Valley, Forebay and East Side subareas contain few discrepant points. In the Pressure subarea, we specifically detailed 14 points where the delineation of concentrations is discrepant and 20 points where there is general agreement. The majority of the discrepant points are in areas where the density of member parcels is very low. In the Langley subarea, we identified five GeoTracker points where values are discrepant with our maps and eight locations that show consistency. The Langley subarea is mostly devoid of CCGC member parcels. The discrepancies in the northern Pressure and Langley subareas are due largely to a preponderance of points with low nitrate concentrations (see Figure A1 in the Appendix) distributed throughout. This resulted in kriged values that are generally lower than the MCL.

Conclusions

Analysis and mapping of groundwater nitrate concentration data for wells that represent the domestic supply aquifers in the Salinas Valley led us to the following conclusions.

- The large majority of domestic wells (84%) in the Salinas Valley are screened within 400 feet of land surface.
- For 838 wells for which we determined average nitrate concentrations in the Salinas Valley, 21% had concentrations over the maximum contaminant level (MCL).
- Within the five subareas, the percentage of wells exceeding the MCL varied from 8% in the Langley subarea to 48% in the Forebay subarea.
- Within the Salinas Valley, 58% of the area was mapped as having nitrate concentrations over the MCL.
- Within the five subareas, the percentage of the area mapped as having high nitrate concentrations varied from 5% in the Langley subarea to 13%, 86%, 83% and 66% in the Pressure, East Side, Forebay and Upper Valley subareas, respectively.
- We estimated the uncertainty in the mapped areas by determining the standard error of the kriged concentrations. Standard error values varied from less than 10 mg/L to over 100 mg/L. Standard error values were generally less than 75 mg/L for most of the valley.
- There are about 40 additional domestic wells that have not been sampled on L&G properties that the CCGC intends to sample in 2014 to help reduce uncertainty in the distribution of nitrate concentrations.

Future groundwater characterization in the Salinas Valley will include additional data that will provide information about groundwater age and source of nitrates. Also, the CCGC will assess nitrate concentrations in groundwater relative to land- and water-management practices and hydrologic factors.

Appendix – Nitrate Map with Posted Concentrations and Comparison of GeoTracker Results with Nitrate Mapping

Nitrate Map with Posted Concentrations

To facilitate comparison of kriged nitrate values shown in Figure 6, we included a map of the posted values overlain on the kriged values (Figure A1). Zero values on Figure A1 represent values that were less than the reporting limit.

Comparison of GeoTracker Results with Nitrate Mapping

We used GeoTracker to display nitrate concentration results for comparison with the groundwater nitrate map (Figure 6). Figure A2 shows the GeoTracker results overlaid on the nitrate map (Figure 6). In general, for those areas where there are member parcels (Figure 2 and A3) GeoTracker results are consistent with the areas delineated for varying concentrations. We identified the well locations (Figure A2) where there is disagreement and described the reasons below. The locations of disagreement are listed from south to north by subareas.

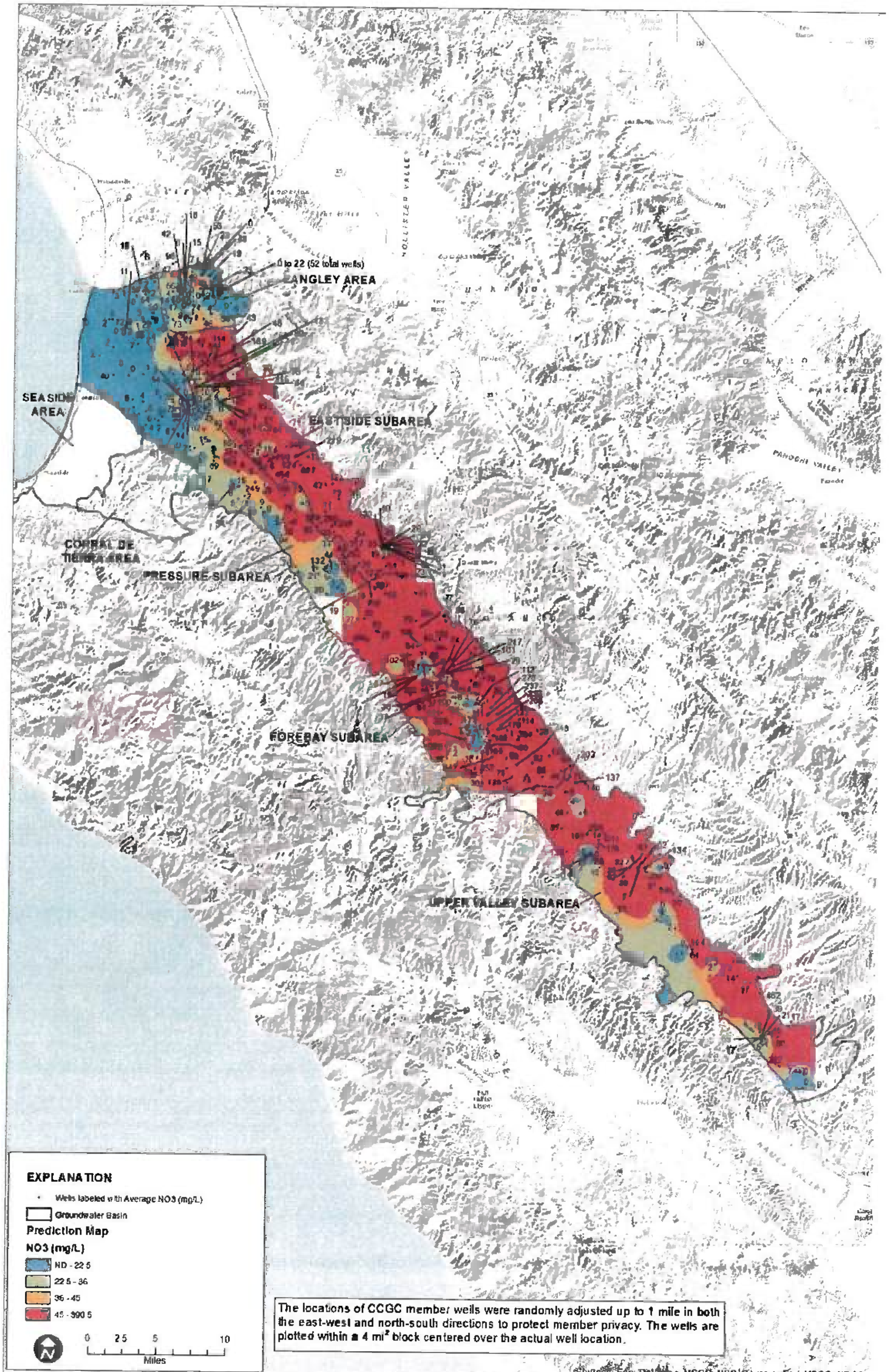


Figure A1. Kriged nitrate concentrations, delineation of areas with varying concentration ranges, and average nitrate values from wells used for kriging.

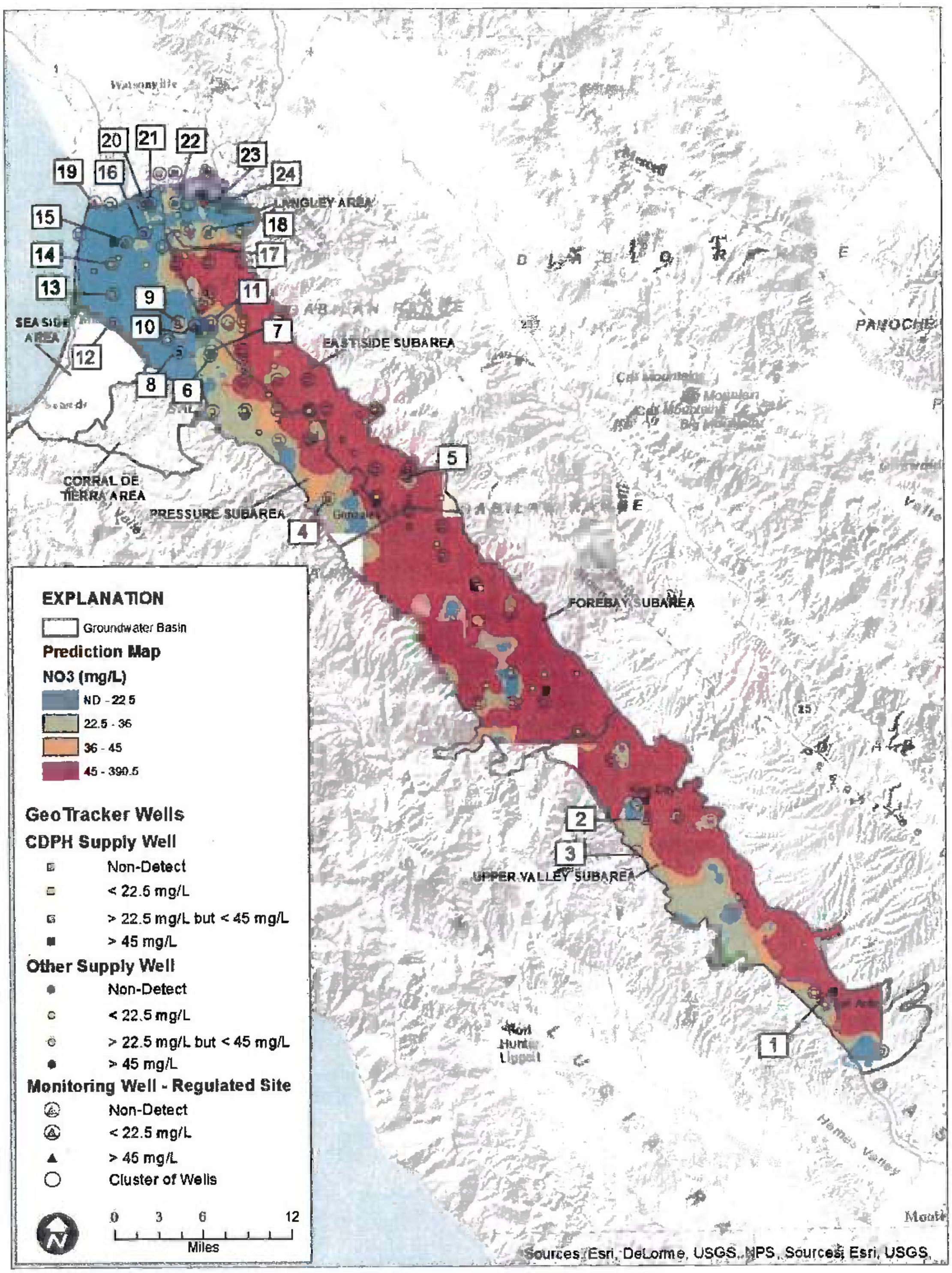


Figure A2. GeoTracker wells locations and kriged nitrate concentrations.

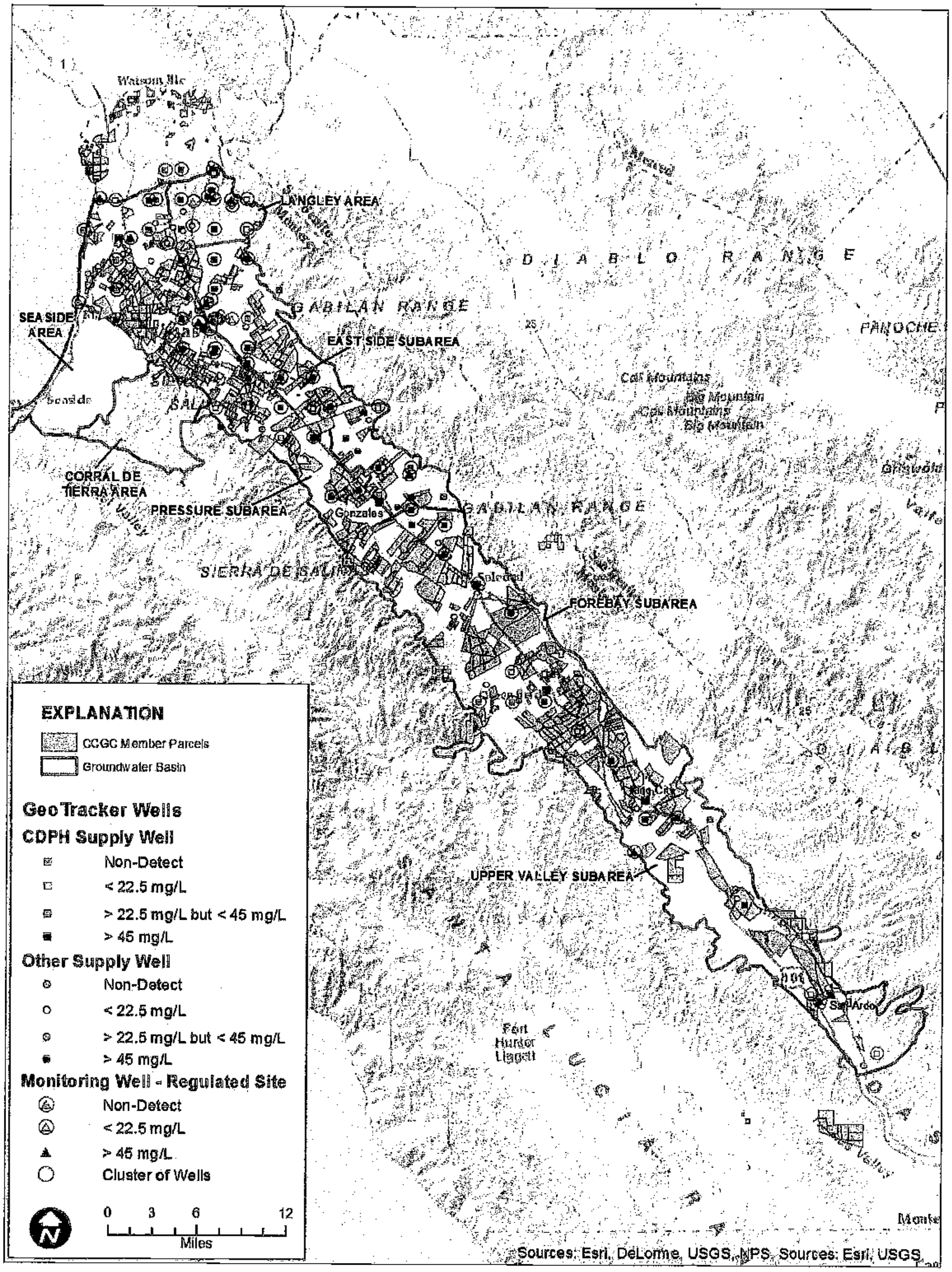


Figure A3. GeoTracker wells and CCGC member parcel locations.

Upper Valley Subarea

Location 1

This location is southwest of San Ardo and contains five monitoring wells. GeoTracker maps this as over the MCL. The location is between member parcels surrounded by an area of high uncertainty as indicated by Figure 7. Figure A4 shows the nitrate values in the wells.

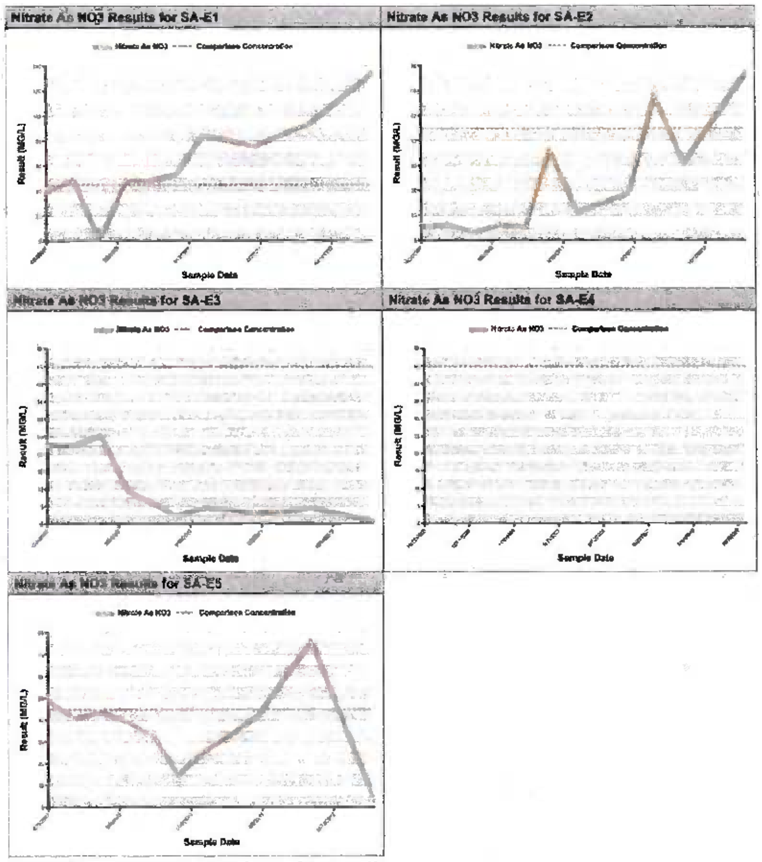


Figure A4. Nitrate values for wells at Location 1

The data displayed in Figure A4 demonstrate the following.

- SA-E1: Many of the points fall above the MCL. The average NO_3 value is 64.9 mg/L and there is an upward trend in the data.
- SA-E2: Only two points fall above the MCL. The average NO_3 value for all points is 21.4 mg/L and there is an upward trend in the data.
- SA-E3: All data points fall beneath the MCL. The average NO_3 value falls far below the MCL at 10.1 mg/L;
- SA-E4: The only sample point falls beneath the MCL at 16.8 mg/L;
- SA-E5: Only two points fall above the MCL. The average NO_3 value is 39.4 mg/L.

The average of all five wells is 30.5 mg/L which is below the MCL, however the maximum of the average values is 64.9 mg/L which is above the MCL. The maps show this cluster within the 36-45 mg/L zone near the area delineated as over the MCL.

Location 2

There are results for 12 CDPH wells at this location south of King City where there are no CCGC member parcels. The entire dataset for three wells fall earlier than 2000, so these were excluded from our analysis since we only included data from 2000 to present. The nine remaining wells have averages ranging from 4.4 mg/L to 143 mg/L which when averaged together equal 30.7 mg/L. This cluster falls within the 22.5-36 mg/L region and is surrounded by a large area of high uncertainty (Figure 7) and is close to the area delineating concentrations above the MCL.

Location 3

There are 12 wells located in this cluster. When the Salinas Valley – Upper Valley Aquifer Groundwater Basin GIS Layer is selected in GeoTracker, this cluster disappears. Per GeoTracker staff, this means the wells are not located within the basin and are plotting there due to the obfuscation. These wells were not included in our analysis since they do not fall within the Salinas Valley Groundwater Basin.

Upper Valley Subarea Summary

For the six GeoTracker locations in the Upper Valley subarea which indicate concentrations over the MCL (Figure A2), two plot at the edge of the area we delineated as above the MCL, one is outside the basin and three plot within the area delineated as over the MCL on Figure 6. Most of the Upper Valley subarea is mapped as having the highest level of uncertainty due a small number of data points.

Forebay Subarea

There are 20 GeoTracker points mapped with concentrations ranging from less than 22.5 to over the MCL. Seven locations where GeoTracker indicated values are over the MCL are in agreement with Figures 6 and A2. Four GeoTracker points indicate concentrations less than the MCL are consistent with Figures 6 and A2. Six GeoTracker points show concentrations less than the MCL where our mapping delineates an area greater than the MCL.

Pressure Subarea

Location 4

This location west of Gonzales contains six wells for which results are shown in Figure A5.

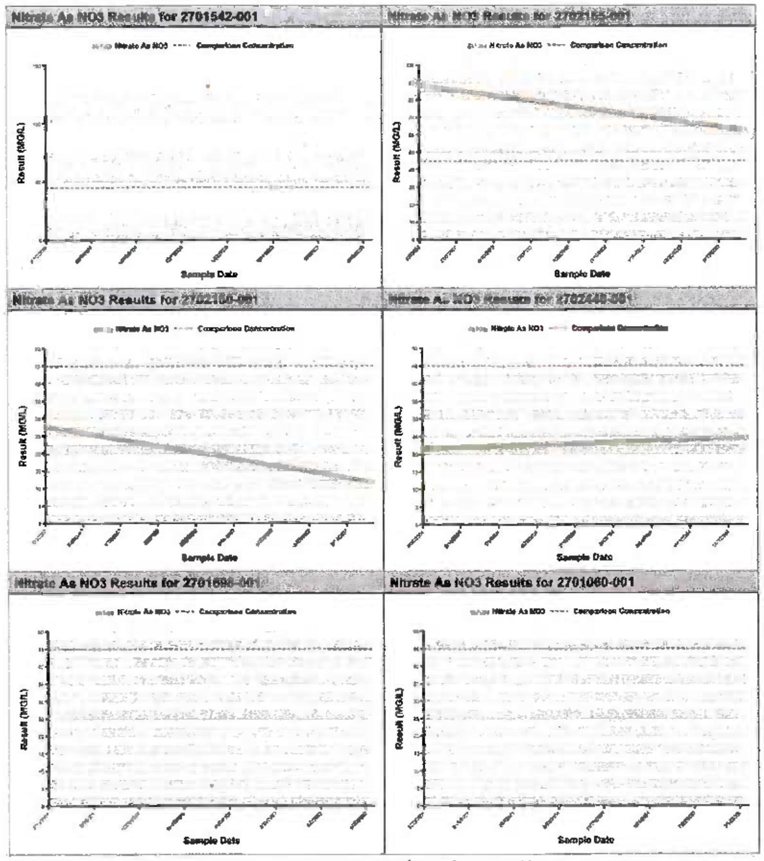


Figure A5. Nitrate concentration values for wells at Location 4

For these wells:

- 2701542-001: The only sample point falls above the MCL at 132 mg/L;
- 2702155-001: Two sample points fall above the MCL, and the average NO_3 value is 76 mg/L;
- 2702150-001: All sample points fall below the MCL, averaging 20 mg/L;
- 2702440-001: Both sample points fall below the MCL and the average value is 23.5 mg/L;
- 2701698-001: The only sample point falls below the MCL at 6 mg/L;
- 2701060-001: The only sample point falls below the MCL at 2 mg/L.

The average value from all six average NO_3 values is 43.3 mg/L. However, the well coordinates obtained from the GeoTracker download suggest these wells are part of two separate clusters of three wells. When we split the wells into their two respective clusters according to GeoTracker coordinates, the average for wells 2702155-001, 2702440-001, and 2701698-001 is 35.2 mg/L with a high value of 76 mg/L and the average for wells 2701542-001, 2702150-001, and 2701060-001 is 51.3 mg/L with a high value of 132 mg/L. According to the GeoTracker map, this well cluster falls within the 22.5-36 mg/L zone in an area of moderately low uncertainty (Figure 7). Therefore, both well clusters at this location are under predicted by our mapping due to averaging of concentrations.

Location 6

This well cluster plots south of Salinas and contains two wells. Figure A6 shows the data from these two wells.

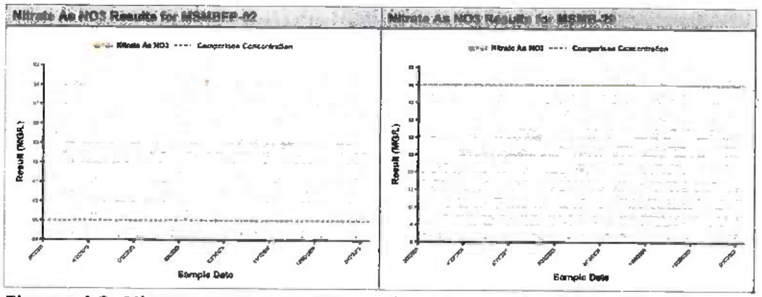


Figure A6. Nitrate concentration values for wells at Location 6

- MSMBFP-02: The only sample point falls above the MCL at 52.2 mg/L;
- MSMB-29: The only sample point falls below the MCL at 21 mg/L.

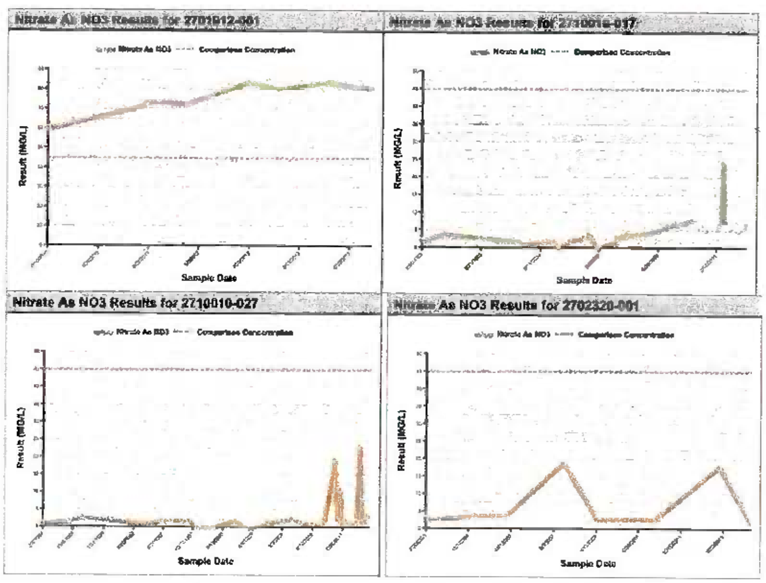
Our maps underestimate relative to the GeoTracker result for this location even though we used the maximum average value of 52.2 mg/L due to a large number of wells with low concentrations in this area.

Location 7

There are 13 wells located in this cluster. The wells have averages which range from 1.4 mg/L to 61 mg/L. This cluster falls within the 36-45 mg/L zone, however when we downloaded the actual coordinate information from GeoTracker these wells were split into two separate clusters, one containing eight wells and one containing five wells. When split, the maximum of the average values are 61.7 mg/L and 2.8 mg/L. This cluster falls within the 22.5-36 mg/L zone. Therefore, the 61.7 mg/L cluster is under predicted and the 2.8 mg/L cluster is over predicted.

Location 8

There are 12 CDPH wells located at this cluster site, however GeoTracker indicates that only seven are located within the Pressure subarea. Figure A6 below shows the results from the seven wells within the Pressure subarea.



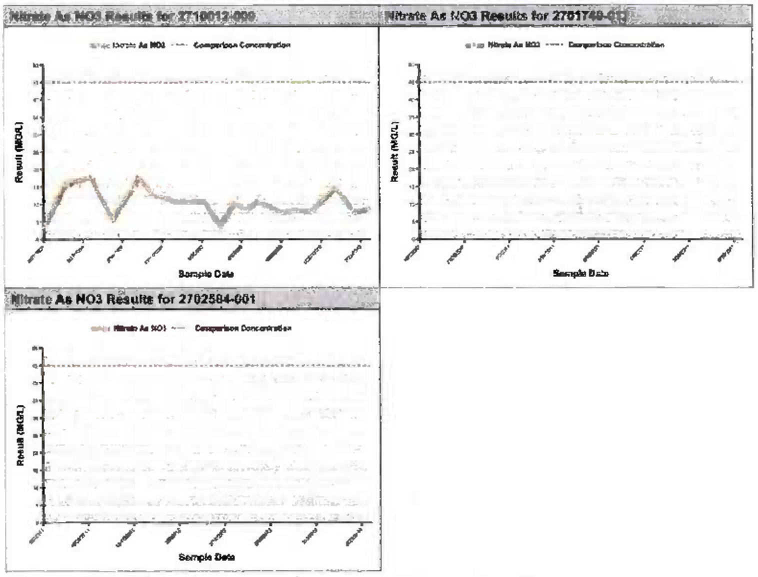


Figure A7. Nitrate values for wells at Location 8

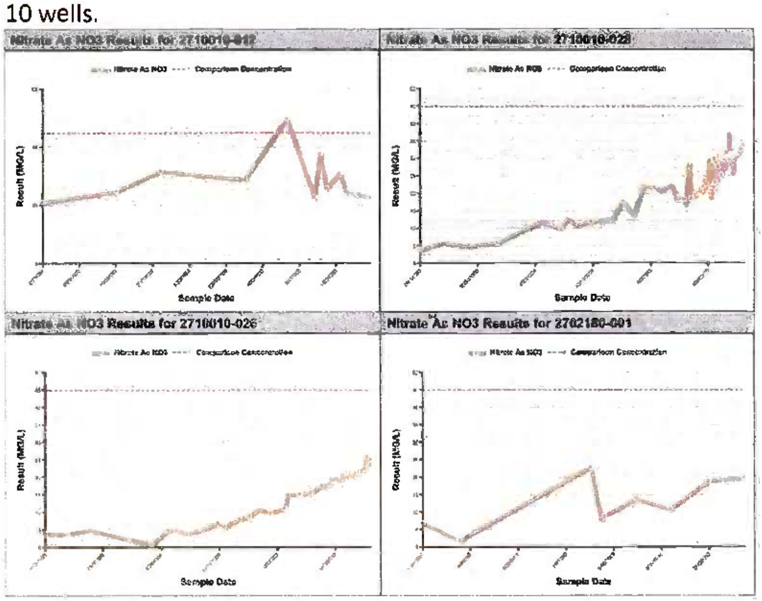
The data displayed in Figure A7 demonstrate the following.

- 2701912-001: All sample points fall above the MCL, and average 76.9 mg/L.
- 2710010-017: All sample points fall below the MCL and average 6.2 mg/L.
- 2710010-027: All sample points fall below the MCL and average 3.7 mg/L.
- 2702320-001: All sample points fall below the MCL and average 6.2 mg/L.
- 2710012-009: All sample points fall below the MCL and average 9.6 mg/L.
- 2701740-012: The only sample point falls below the MCL at 9 mg/L.
- 2702584-001: The only sample point falls below the MCL and is non-detect.

For mapping, we used the maximum average value of 76.9 mg/L but the concentration was under predicted due a preponderance of low values in this area.

Location 9

There are 10 CDPH wells located at this cluster site. Figure A8 shows the sampling results from these 10 wells.



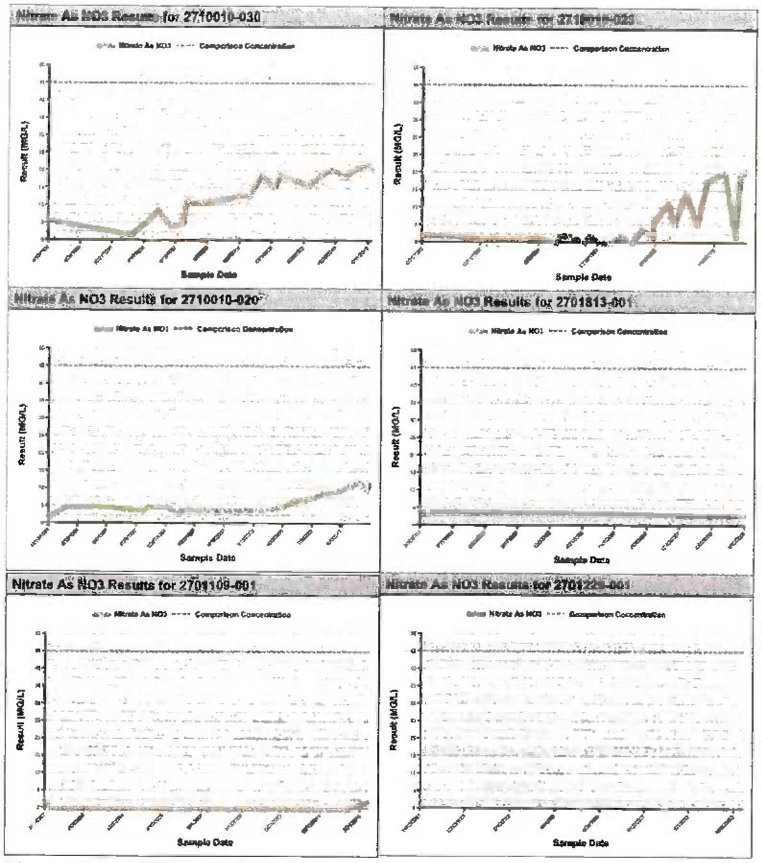


Figure A8. Nitrate values for wells at Location 9

The graphs above show the following.

- 2710010-012: All sample points were collected before 2000; hence this well has been excluded from our dataset. The only exceedance for this cluster was in this well and is likely a false exceedance.
- 2710010-028: Includes data from years 1983-2013, with all values being below the MCL. The average NO_3 value of data only post 2000 is 28.1 mg/L.
- 2710010-026: All values of NO_3 collected between 1983-2013 are below MCL. Average NO_3 for samples collected 2000 is 17.6 mg/L.
- 2702180-001: All values are below the MCL and the average value of NO_3 is 12.6 mg/L.
- 2710010-030: Data includes years 1986-2013 and all values are below MCL. Average NO_3 after the year 2000 is 17.7 mg/L.
- 2710010-023: Data includes years 1983-2013 and all values are below MCL. Average of NO_3 after the year 2000 is 8.2 mg/L.
- 2710010-020: Data includes years 1983-2013 and all values are below MCL. Average of NO_3 after the year 2000 is 6.5 mg/L.
- 2701813-001: The three samples collected have NO_3 values below the MCL with and average value of 3.7 mg/L.
- 2701109-001: All five samples collected have NO_3 values below MCL and average 0.95 mg/L.
- 2701229-001: One sample collected with a non-detect value, which is well below the MCL.

The maximum average value of NO_3 for this cluster is 28.1 mg/L. This well cluster falls within the 22.5-36 mg/L zone and therefore the high average value of 28.1 is correctly represented assuming that the single exceedance for well 2710010-012 is an outlier.

Location 10

This cluster of environmental monitoring wells includes wells found at the former Puregrow regulated site. This site has possible contamination of fertilizer and monitoring wells in the area record exceedingly high values of NO_3, which do not correspond with agricultural influences. This cluster also includes other environmental monitoring wells associated with other regulated sites which are located less than half a mile from the Puregrow site. Since these wells are located within the Salinas urban area and at or near the fertilizer contamination site, they were excluded from our analysis.

Location 12

This location contains two CDPH wells which fall within the Pressure subarea and other wells which GeoTracker delineates as falling outside the Salinas Valley Groundwater Basin boundary. The two wells we considered for our analysis can be seen below in Figure A9.

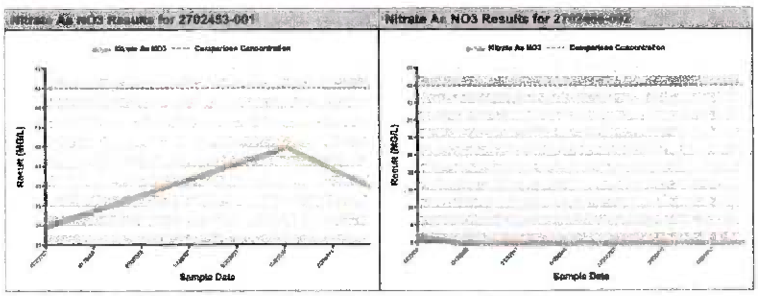


Figure A9. Nitrate values for wells at Location 12

- 2702453-001: The three NO_3 values were below the MCL, their average being 40 mg/L;
- 2702456-002: All values were below the MCL with an average of 0.5 mg/L.

The maximum of the averages of both wells in this cluster is 40 mg/L. The map underpredicts relative to GeoTracker.

Location 13

This location contains two wells which are the same two wells found at location 12. This location is present only when the Salinas Valley – 180/400 Foot Aquifer Groundwater Basin layer is selected in GeoTracker. Per GeoTracker staff, this duplication is due to the 1-mile obfuscation and query display. Therefore, this cluster may actually fall in a 1-mile diameter surrounding location 12 and 13.

Location 14

There are three CDPH wells located in this cluster. Figure A10 shows the data from these wells.

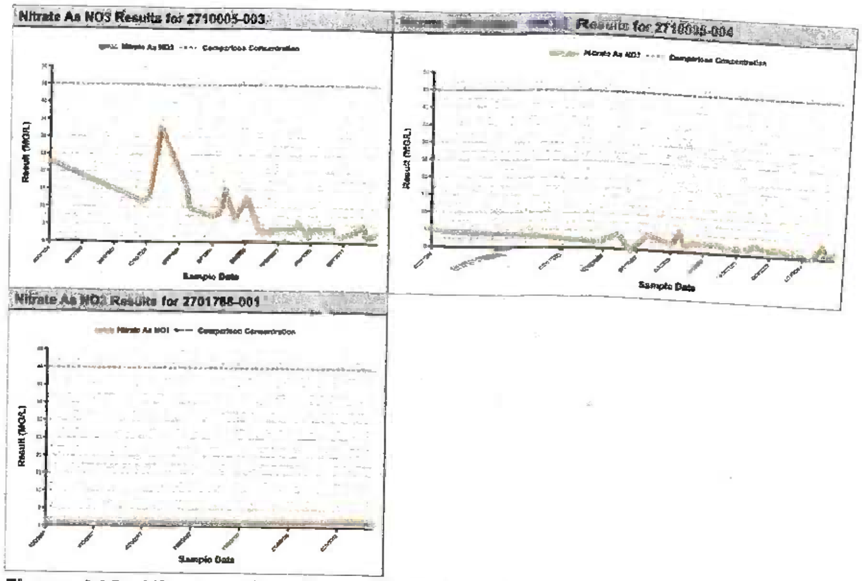


Figure A10. Nitrate values for wells at Location 14

- 2710005-003: All values plot below the MCL with a NO_3 average value of 5.2 mg/L.
- 2710005-004: All values plot below the MCL with a NO_3 average value of 2.3 mg/L.
- 2701768-001: Both values plot below the MCL and average 1.5 mg/L.

The high average value of 5.2 mg/L is correctly represented by the <22.5 mg/L zone.

Location 15

There are 6 environmental monitoring wells from a regulated site located here. Figure A11 shows the data from these wells.

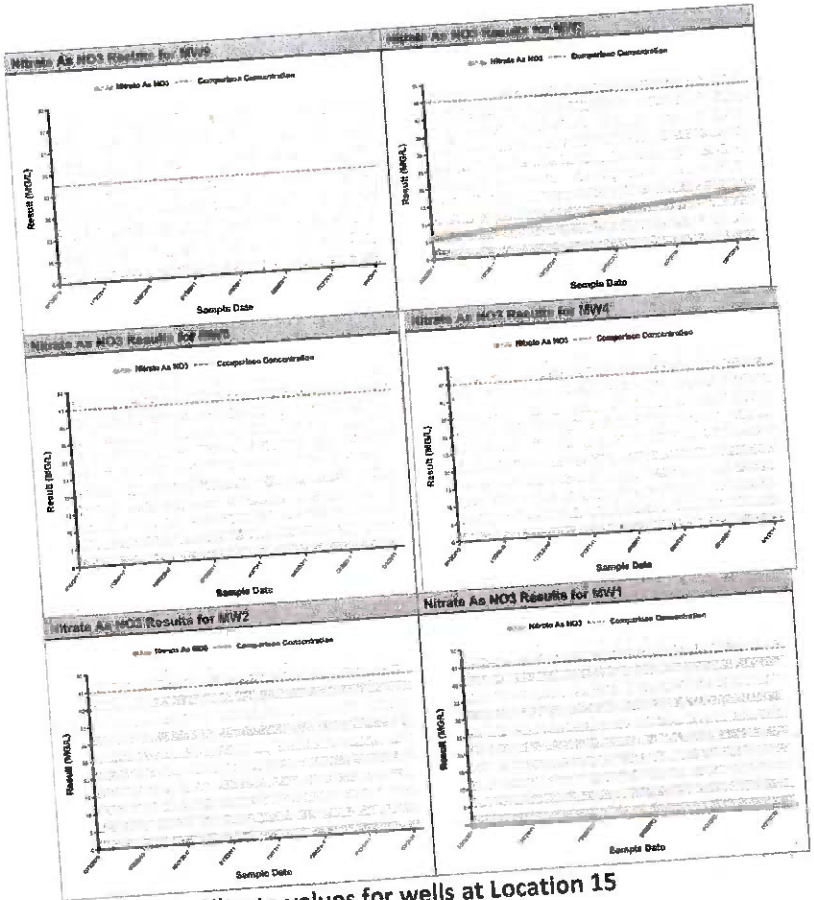


Figure A11. Nitrate values for wells at Location 15

- MW9: The only sample point has a value of 72 mg/L which is above the MCL.
- MW3: Both sample points fall below the MCL and average 10.6 mg/L.
- MW6: The only sample point has a value of 7.6 mg/L which is below the MCL.
- MW4: The only sample point is below the MCL at 1.7 mg/L.
- MW2: The only sample point is non-detect.
- MW1: Both sample points are non-detect.

When averaged together, the six monitoring wells have an average NO_3 value of 15.3 mg/L. This well cluster plots within the <22.5 mg/L zone, which is consistent with the average NO_3 value but is not represented by the high value of 72 mg/L. There are no CCGC member parcels near this well cluster.

Location 16

There are 10 wells located in this cluster. Figure A12 below summarizes the results.

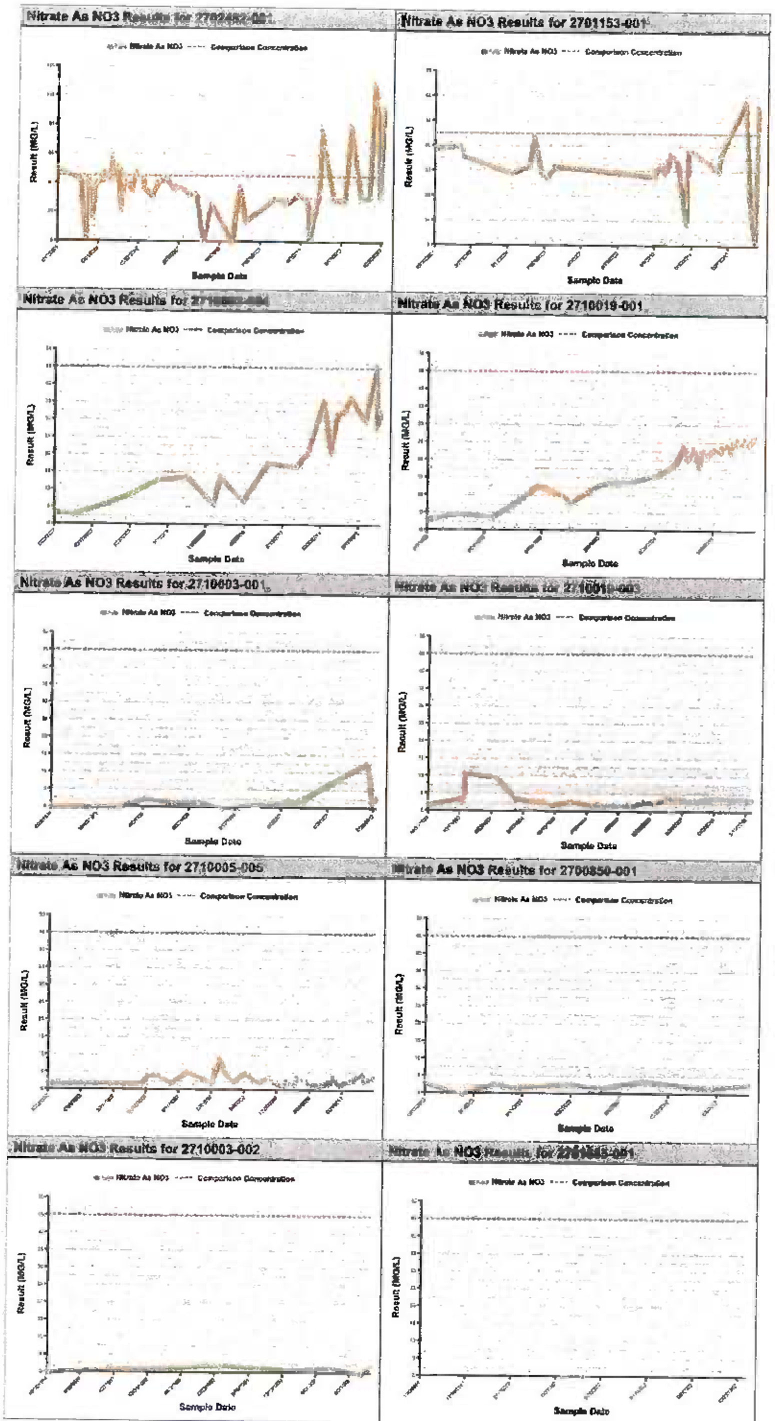


Figure A12. Nitrate values for wells at Location 16

- 2702482-001: Multiple sample points are higher than MCL. The average NO_3 value is 39.9 mg/L.
- 2701153-001: Two sample points have NO_3 values above the MCL, however the average is 32.7 mg/L.
- 2710003-004: Only one sample point is above the MCL, and the average is 19.9 mg/L.
- 2710019-001: All sample points are below the MCL and average 21.7 mg/L.

- 2710003-001: All sample points are below the MCL, and average 4.3 mg/L.
- 2710019-003: All sample points are below the MCL, and average 3.1 mg/L.
- 2710005-005: All sample points are below the MCL. The post 2000 NO_3 values average 3.4 mg/L.
- 2700850-001: All NO_3 values are below the MCL, averaging 2.5 mg/L.
- 2710003-002: All NO_3 values are below the MCL, averaging 1 mg/L.
- 2701685-001: The only sample point is non-detect.

The average for all the wells in this cluster is equal to 12.8 mg/L. The maximum average value of 39.9 mg/L is under predicted on the map by the location of the point in <22.5 mg/L zone.

Location 19

This cluster of environmental monitoring wells falls outside of the Pressure subarea and is therefore not included in our dataset.

Location 20

There are 29 wells in this cluster with NO_3 averages ranging from 2 to 58.5 mg/L. The average of all the wells in this cluster is 15.6 mg/L. This cluster location plots on the interface between the <22.5 mg/L and 22.5-36 mg/L zones. There are no CCGC member parcels near this location.

Location 21

This cluster contains 6 wells. NO_3 results can be seen in Figure A13.

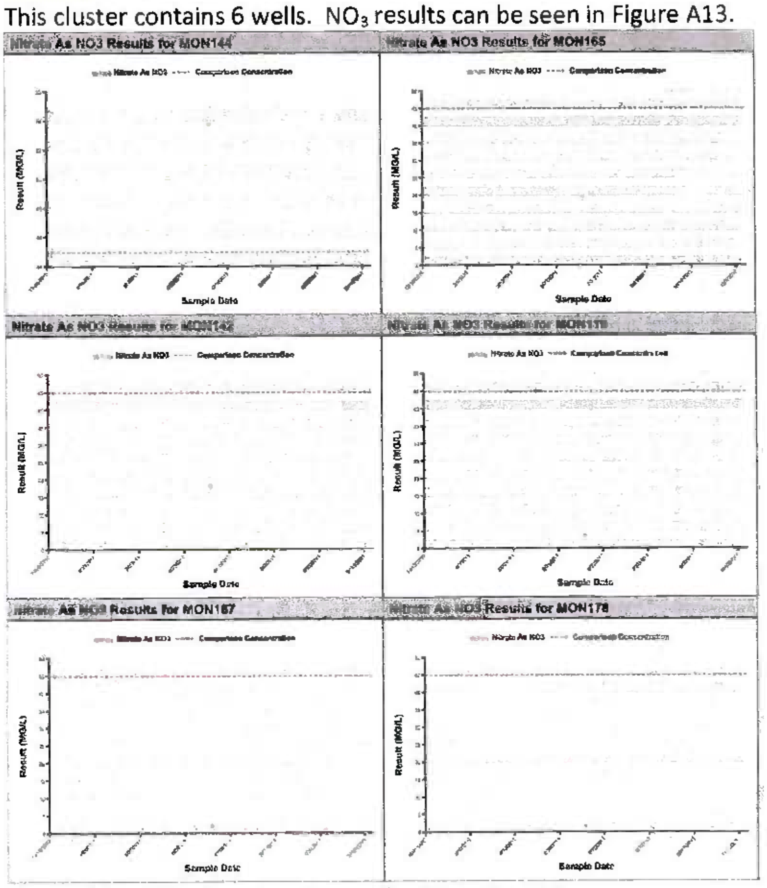


Figure A13. Nitrate values for wells at Location 21

- MON144: The only sample point is above the MCL at 53.8 mg/L.
- MON165: The only sample point is below the MCL at 19.8 mg/L.
- MON142: The only sample point is below the MCL at 18.4 mg/L.
- MON119: The only sample point is below the MCL at 3.7 mg/L;
- MON167: The only sample point is below the MCL at 2.33 mg/L;
- MON178: The only sample point is below the MCL at 1.78 mg/L;

The average NO_3 of the six wells in this cluster is 16.6 mg/L. The maximum average value of 53.8 mg/L is being under predicted by the well cluster being mapped in the <22.5 mg/L zone. There are no CCGC member parcels near this location.

Pressure Subarea Summary

In addition to the 14 points described above, there are 22 GeoTracker points mapped with concentrations ranging from non-detect to over the MCL. Three locations where GeoTracker indicated a value over the MCL are in agreement with Figures 6 and A2. Fourteen GeoTracker locations indicate concentrations less than the MCL consistent with Figures 6 and A2. Two GeoTracker points show concentrations less than the MCL where our mapping delineates an area greater than the MCL.

East Side Subarea

Location 5

There are results for 12 environmental monitoring wells at this regulated site east of Gonzales where there are no CCGC member parcels. Average NO_3 concentrations range from 0.7 to 30.6 mg/L, and the combined average is 20.4 mg/L. This cluster plots on the interface between the <22.5 mg/L and 22.5-36 mg/L zones.

Location 11

There are 27 wells located in this cluster. Samples for one well were collected before 2000. Average NO_3values range from 4.3 to 55.8 mg/L and the average NO_3 for all 27 wells is 23.9 mg/L. This cluster plots on the interface of the 0.05-22.5 mg/L and 22.5-36 mg/L zones, and is therefore under predicted on our maps.

East Side Subarea Summary

In addition to the two points described above, there are 29 GeoTracker points mapped with concentrations ranging from less than 22.5 mg/L to over the MCL. At seventeen locations where GeoTracker indicated values are over the MCL are in agreement with Figures 6 and A1. Three GeoTracker locations indicate concentrations less than the MCL consistent with Figures 6 and A2. Seven GeoTracker points show concentrations less than the MCL where our mapping delineates an area greater than the MCL. Most of the East Side subarea has a very high level of uncertainty due to a lack of data points and a large concentration range (Figure 7).

Langley Subarea

Location 17

There are 19 wells located in this cluster, with average NO_3 values ranging from non-detect to 73 mg/L. This cluster is located on the interface of the 22.5-36 mg/L and 36-45 mg/L zones. There are no CCGC member parcels in this area.

Location 18

There are eleven CDPH wells located within this cluster location. Average NO_3 values range from 1.7 to 46 mg/L. No CCGC member parcels are located in this area. This cluster is located in the 36-45 mg/L zone.

Location 22

There are 26 wells in this cluster with NO_3 concentration averages ranging from 0.64 to 65.5 mg/L. This cluster falls within the 22.5-36 mg/L zone and is therefore under predicted. There are no nearby CCGC member parcels.

Location 23

There are 26 wells in this cluster with NO_3 averages ranging between 0.25 and 66.5 mg/L. This cluster falls on the interface between the 36-45 mg/L and >45 mg/L zones. This area does not contain any CCGC member parcels.

Location 24

There are 53 environmental monitoring wells associated with a regulated site at this location. Average NO_3 values range from non-detect to 15.1 mg/L. This well cluster plots within the <22.5 mg/L zone and in an area where there are no member parcels.

Langley Subarea Summary

In addition to the five points described above, there are 11 GeoTracker points mapped with concentrations ranging from non-detect to greater than the MCL. Eight GeoTracker locations which plot within the Salinas Valley Groundwater Basin are consistent with Figures 6 and A1. Two points plot outside the groundwater basin. The Langley subarea is mostly devoid of CCGC member parcels (Figure A3).

ATTACHMENT 6

Groundwater Nitrate, Salinas Valley, California, Technical Memorandum

December 10, 2014

Prepared for the Central Coast Groundwater Coalition
by
HydroFocus, Inc., Davis, CA

PROFESSIONAL GEOLOGIST
STEVEN DEVEREL
No. GEO 8690
expires 3/2016
STATE OF CALIFORNIA

Steven Deverel, Ph.D., P.G.
Principal Hydrologist

ATTACHMENT 6

Distribution of Groundwater Nitrate Concentrations, Salinas Valley, California, December 5, 2014

Contents

Executive Summary

The Central Coast Regional Water Quality Control Board (Regional Water Board) adopted Order No. R3-2012-0011 Conditional Waiver of Waste Discharge Requirements for Discharges from Irrigated Lands (Conditional Waiver) and associated Monitoring and Reporting Program Orders (MRPs) on March 15, 2012. The Conditional Waiver and the MRPs specify that landowners and growers may meet groundwater monitoring requirements by either monitoring groundwater individually on their agricultural operations, or by joining a groundwater cooperative monitoring program. The approved workplan submitted by the Central Coast Groundwater Coalition (CCGC) set forth plans for satisfying the objectives in the MRP. The CCGC aims to provide information that fills the gaps in the current understanding of groundwater quality for domestic consumption throughout the region. Nitrate is the primary constituent of concern and the focus of this report. The program also commits to provide information about the effects of land- and water-management practices that will result in improved groundwater quality over time.

The primary objectives of the tasks described in the CCGC work plan are to develop 1) a process-level understanding of the spatial distribution of nitrate concentrations in domestic supply wells with single connections or a small number of connections and 2) identify regions for evaluation of agricultural land- and water-management practices to reduce discharges to groundwater. In addition, the Monitoring and Reporting program requires that at a minimum, the cooperative groundwater monitoring effort must include sufficient monitoring to adequately characterize the groundwater aquifer(s) in the local area of the participating Dischargers, characterize the groundwater quality of the upper-most aquifer, and identify and evaluate groundwater used for domestic drinking water purposes. This Technical Memorandum is the first in a series of reports that attempts to satisfy the objectives of the CCGC workplan and requirements of the MRP in the Salinas Valley.

The Salinas Valley Groundwater Basin contains four primary subareas or sub-basins. The Pressure, East Side, Forebay, and Upper Valley subareas are hydraulically connected but are distinguished by their hydrogeologic characteristics. Three important characteristics differentiate the subareas; the presence of fine-grained (clay and silt) layers that may restrict groundwater flow, the capacity of aquifers to supply groundwater to wells, and the source of groundwater recharge. In general, groundwater in the northernmost Pressure and Eastside subareas is influenced by relatively well-defined fine-grained layers that restrict vertical water movement. These fine-grained layers tend to thin and disappear in the southern subareas, the Forebay and Upper Valley.

Groundwater recharge in the Salinas Valley occurs primarily from infiltration from the Salinas River and Arroyo Seco, and deep percolation of irrigation water except in the Langley area where recharge is primarily from precipitation. Groundwater generally flows from high altitudes towards the drainages, and down valley towards Monterey Bay. Groundwater has historically flowed horizontally northward from the Pressure to the Eastside Subarea due to low groundwater levels in the Eastside Subarea.

We evaluated and herein present results of laboratory analysis of groundwater samples collected from wells on CCGC member L&G's properties in the Salinas Valley. Also, we integrated the analytical results from other sampling conducted by the California Department of Public Health, US Geological Survey (USGS), Monterey County Water Resources Agency (MCWRA) and L&Gs who conducted individual sampling. Our approach was to process and evaluate available analytical data for the groundwater used for drinking by subarea and then integrate the data to create water quality maps for the entire Salinas Valley.

We collected water samples from and measured field parameters in 221 domestic wells on CCGC properties. Field parameters (pH, water temperature, specific conductance, oxidation-reduction potential (ORP) and dissolved oxygen (DO)) were measured at each well. Concentrations of nitrate and major ions (calcium, magnesium, potassium, sodium, chloride, sulfate and bicarbonate) were determined in all samples. At selected wells, samples were collected for determination of tritium, noble gases, and chlorofluorocarbons for determination of the recharge age.

We used geostatistics to create a map of groundwater nitrate concentrations in the Salinas Valley. We assumed that water-quality data collected from 2000 to 2014 are most representative for the area at this time. Using this time frame, we attempted to insure that we effectively captured the distribution of nitrate concentrations and delineated where groundwater for drinking water is likely to be over the MCL. Sources of nitrate data for mapping included GeoTracker, USGS National Water Information System, Lawrence Livermore National Laboratory, L&Gs enrolled in the Irrigated Lands Regulatory Program, data collected by the USGS as part of the Regional Water Quality Control Board Central Coast Ambient Monitoring Program - Groundwater Assessment and Protection (CCAMP-GAP) Domestic Well Project for the Salinas and Pajaro Valleys and data provided by the Monterrey County Water Resources Agency. Using well completion reports gathered from DWR from throughout the Salinas Valley and hydrogeologic information, we attempted to restrict the data for mapping to wells completed within 400 feet of land surface to best characterize groundwater quality in the shallow aquifer and for domestic supply. Results from 939 wells were used to characterize the distribution of groundwater nitrate (as NO_3) concentrations. For wells with multiple sample dates from 2000 to 2014, we used the maximum nitrate concentrations by well.

The mean nitrate concentration in groundwater used for domestic supply for the entire Valley was 44.7 mg/L as NO_3. The median was 15 mg/L as NO_3. Values ranged from less than the detection limit of 0.09 mg/L to 614 mg/L. Two hundred and forty wells (26 %) had time-averaged concentrations over the MCL of 45 mg/L. In the five subareas, the mean nitrate concentration ranged from a low of 15.4 mg/L in the Langley Subarea to 86.9 mg/L in the Forebay Subarea. The percent of wells with average nitrate concentrations exceeding the MCL ranged from 9 % in the Langley Subarea to 51 % in the Forebay Subarea. Where well depths were available, nitrate concentrations were higher in wells completed within 400 feet of land surface.

Mapped groundwater nitrate concentrations in the Pressure Subarea are generally less than one-half of the MCL due to widespread distribution of a large number of low nitrate concentrations. Exceptions include areas of concentrations over the MCL southwest and southeast of Chualar and northwest and west of Gonzales. In the Langley Subarea, mapped groundwater nitrate concentrations are generally less than one-half of the MCL. There are large areas in the East Side subarea where groundwater nitrate concentrations are mapped as greater than the MCL. These include the area north of Salinas where concentrations as high as 189 mg/L were observed and areas east and southeast of Salinas and east, northeast, and southeast of Chualar and Gonzales where concentrations were measured as high as several hundred mg/L. Forty-nine percent (49%) of the area within of the Forebay Subarea is mapped as having concentrations of nitrate in groundwater greater than the MCL. In the Upper Valley Subarea there are a relatively small number of sample points. The spatial distribution of high nitrate values results in clustered areas where concentrations were over the MCL near King City and along the eastern boundary both north and south of San Ardo.

Indicator maps show the estimated probability of exceeding varying nitrate concentrations. From the area east of Chualar south through Greenfield the probability of exceeding the MCL (45 mg/L) is greater than 60%. In most of the remainder of the Valley, the probability is generally greater than 50% except for the northern Pressure area and the southwestern portions of the Upper Valley and Forebay subareas.

We mapped groundwater nitrate concentrations incorporating the estimation error. The standard deviation ranges from less than 2.5 to 5 mg/L where wells are located. The standard deviation is as high as 10 mg/L where there are no wells. The lack of available data in the Upper Valley and to a lesser extent the Pressure and Eastside subareas, is the primary limitation for mapping of groundwater nitrate concentrations. A secondary limitation is the lack of depth information for wells.

At the 95 % confidence level, in the Upper Valley Subarea, isolated areas near King City and north and south of San Ardo are mapped as having concentrations over 22.5 mg/L. Most of this subarea is mapped as less than 22.5 mg/L. In the Forebay and Eastside subareas, the area mapped as greater than 22.5 mg/L encompasses most of the subareas south of Salinas. Most of the Pressure area is mapped as less than 22.5 mg/L. Appendix A presents a comparison of GeoTracker results with the distribution of nitrate concentrations. For most of the valley, the comparison indicates good agreement between the two maps. All subareas contain few discrepant points that are primarily the result of artifacts of the GeoTracker mapping techniques and obfuscation of the well coordinates.

Determination of the approximate age of groundwater samples provides additional insight about factors and processes affecting nitrate concentrations. The majority of the samples collected in the Forebay and Upper Basin subareas indicate groundwater recharge ages less than 30 years old. In contrast, the majority of the samples in the Pressure and Eastside sub-basins indicate recharge ages greater than 30 years.

Introduction and Background

The Central Coast Regional Water Quality Control Board (Regional Water Board) adopted Order No. R3-2012-0011 Conditional Waiver of Waste Discharge Requirements for Discharges from Irrigated Lands (Conditional Waiver) and associated Monitoring and Reporting Program Orders (MRPs) on March 15, 2012. The Conditional Waiver and the MRPs specify that landowners and growers (here forward referred to as L&Gs) may meet groundwater monitoring requirements by either monitoring groundwater individually on their agricultural operations, or by joining a groundwater cooperative monitoring program. A work plan approved by the Central Coast Regional Water Quality Control Board on June 20, 2013, set forth the plan for a Northern Central Coast Cooperative Groundwater Program that satisfies the requirements in the Conditional Waiver and MRPs for participating L&Gs in Monterey, Santa Cruz, Santa Clara, and San Benito Counties. The steps outlined in the work plan provide a foundation for a Groundwater Cooperative Program (GCP) that satisfies the requirements as set forth in the MRPs. A key GCP purpose undertaken by the Central Coast Groundwater Coalition (CCGC) is to provide the Regional Water Board with information that fills the gaps in the current understanding of groundwater quality for domestic consumption throughout the region. Nitrate is the primary constituent of concern and the focus of this report. The program will also provide information about the effects of land- and water-management practices that will result in improved groundwater quality over time.

The primary objectives of the tasks described in the work plan are to develop 1) a process-level understanding of the spatial distribution of nitrate concentrations in domestic supply wells with single connections or a small number of connections and 2) identify regions for evaluation of agricultural land- and water-management practices to reduce discharges to groundwater. The work plan also described the approach for sampling and reporting. In addition, the Monitoring and Reporting program requires that at a minimum, the cooperative groundwater monitoring effort must include sufficient monitoring to adequately characterize the groundwater aquifer(s) in the local area of the participating Dischargers, characterize the groundwater quality of the upper-most aquifer, and identify and evaluate groundwater used for domestic drinking water purposes.

This Technical Memorandum is the first in a series of reports that will provide information about the spatial distribution of nitrate concentrations in groundwater used for drinking water in the CCGC service area. This technical memorandum will attempt to answer questions about where groundwater used for drinking water is likely to have nitrate concentrations over the Maximum Contaminant Level (MCL) and the associated uncertainty associated with the concentration estimates.

To assess the spatial variability in groundwater nitrate concentrations, we evaluated and herein present results of laboratory analysis of groundwater samples collected from wells on CCGC member L&G's properties in the Salinas Valley. Also, we integrated the analytical results from other sampling conducted by the California Department of Public Health, US Geological Survey (USGS), Monterey County Water Resources Agency (MCWRA) and L&Gs who conducted individual sampling. Our approach was to focus to the upper most aquifer. We therefore processed and evaluated available analytical data for the shallow groundwater used for drinking by subarea and then integrate the data to create water quality maps for the entire Salinas Valley. Figure 1 shows the Salinas Valley and subareas where data were available for mapping[1]; Langley, Pressure, East Side, Forebay and Upper Valley subareas.

[1] The locations of CCGC member wells were obfuscated to protect member privacy. The locations of CCGC member wells shown on Figure 1 were randomly adjusted up to 0.5 miles in both the east-west and north-south directions. The wells are plotted within a 1 mi^2 block centered over the actual well location. This block is consistent with the area of obfuscation required by a Public Records Act Request (PRAR).

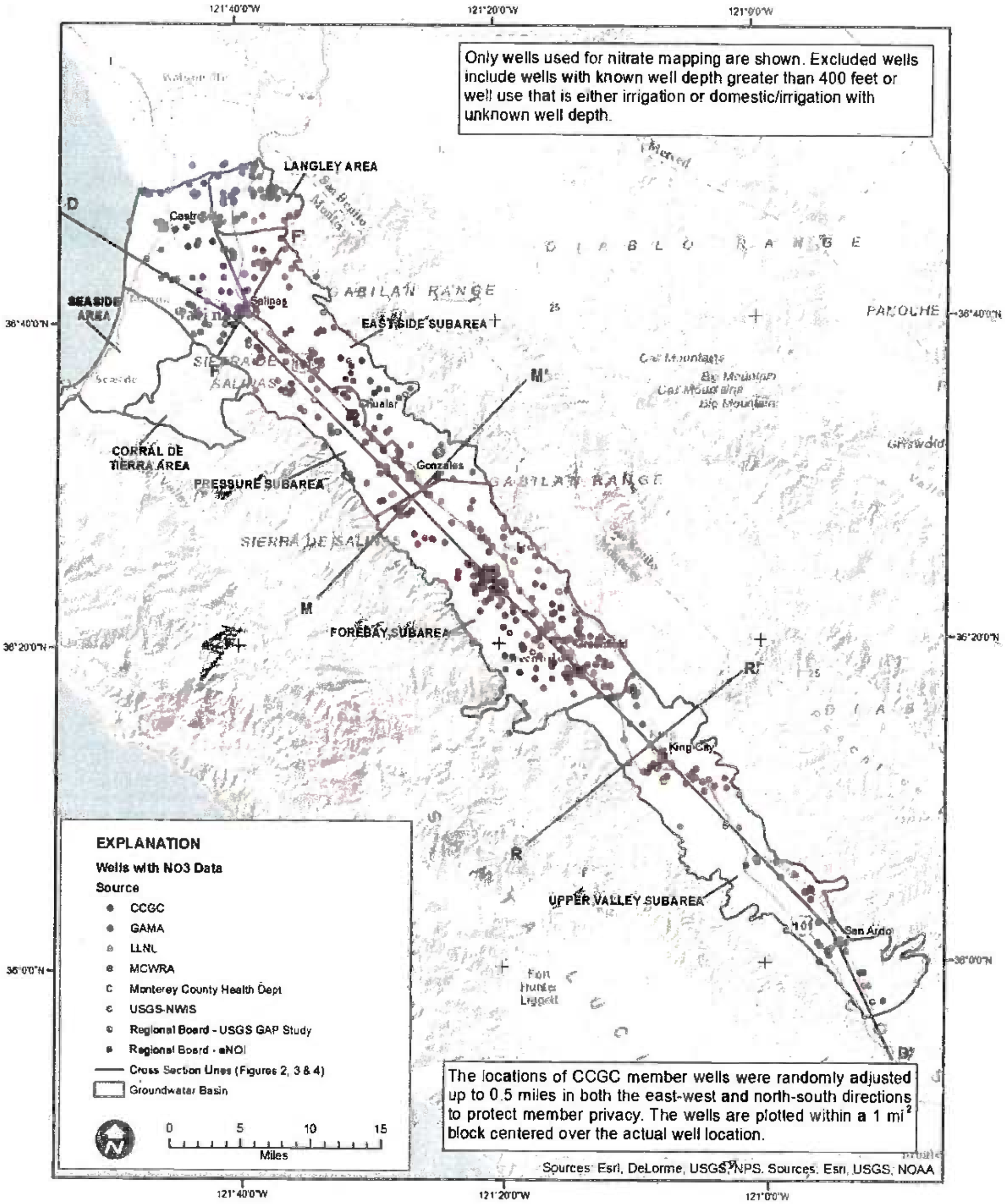


Figure 1. Subareas and locations of wells used for mapping of nitrate concentrations.

Hydrogeologic Context

The Salinas Valley Groundwater Basin contains four primary subareas or sub-basins (Figure 1). Much of the discussion in this section is from Department of Water Resources Bulletin 118. The Pressure, East Side, Forebay, and Upper Valley subareas are hydraulically connected but are distinguished by their hydrogeologic characteristics. Durbin and others[2] reported three important characteristics that differentiate the subareas; confining conditions, specific capacity of wells, and the source of groundwater recharge. The fifth subarea, the Langley Subarea, is a series of low hills bounded to the east by the geologic contact of Tertiary sediments with granitic bedrock and to the north by a drainage divide in the Carneros Hills. The west and south boundaries are shared with the Pressure and East Side subareas.

Hydrogeologic Characteristics of Subareas

The Pressure Subarea is generally underlain by three aquifers that range from semi-confined to confined[3]; the 180-ft, 400-ft, and Deep aquifers. Groundwater in the East Side subarea is generally semi-confined, groundwater in the Forebay Subarea varies spatially from semi-confined to unconfined, and groundwater in the Upper Valley Subarea is largely unconfined. Specific capacities of irrigation wells (yield divided by drawdown) generally increase up-valley and the proportions of recharge from irrigation return flow and stream infiltration vary among the subareas.

The Pressure or 180/400-Foot aquifer subarea includes, from oldest to youngest, the Pliocene to Pleistocene Paso Robles Formation, the Pleistocene Aromas Sands, Quaternary terrace deposits, Holocene alluvium, and sand dunes. There are three water-bearing units, the 180-Foot, the 400-Foot, and the 900-Foot aquifers, named for the average depths of each aquifer. The confined 180-Foot Aquifer occurs only in this subarea, as its confining blue clay layer thins and generally disappears east and south of the subarea and does not extend into the East Side subarea. In the Pressure Subarea, water bearing units between 180 and 400 feet below land surface have been referred to as the Pressure 400-Foot aquifer zone. Water bearing units below the 400-Foot aquifer zone are referred to as the "Pressure Deep" zone[4].

The 180-Foot Aquifer consists of interconnected sand, gravel, and clay lenses, and ranges in thickness from 50 to 150 feet. The 180-Foot Aquifer is generally separated from the 400-Foot Aquifer by a zone of less coarse-grained strata and confining units that range in thickness from 10 to 70 feet. The 400-Foot Aquifer is about 200-feet thick and consists of sands, gravels, and clay lenses. The upper portion of the aquifer appears to be correlated with the Aromas Sand and the lower portion with the upper part of the Paso Robles Formation. The 900-Foot Aquifer, present in the lower (northern) Salinas Valley, consists of

---

[2] Durbin, T.J. Kapple, G.W. & Freckleton, J.R. (1978) Two-Dimensional and Three-Dimensional Digital Flow Models for the Salinas Valley Ground Water Basin, California. pp. 78–113, United States Geological Survey Water Resources Investigations Report 78-113..

[3] The terms confined and semi-confined refer to the depth distribution of water levels in wells screened in different aquifers. In a confined aquifer, groundwater is under sufficient pressure such that the water level in a well screened solely in the confined aquifer rises above the elevation of the top of aquifer. Semi-confined aquifers are intermediate between confined and unconfined aquifers. The extent of confinement is due to the heterogeneous nature of the subsurface fine-grained layers which causes spatially varying degrees of confinement.

[4] Geomatrix, 2001, FINAL REPORT Evaluation and Proposed Redesign of the Salinas Valley Ground Water Monitoring Network, Salinas Valley, California

alternating layers of sand, gravels and clays and is separated from the 400-Foot Aquifer by a blue marine clay confining unit.

Groundwater in the 180- and 400-foot confined aquifers is generally interconnected with the semi-confined water bearing zones in the east (Figure 1). The geology underlying the East Side subarea is lithologically similar to the Pressure Subarea except that the mostly well-defined confining blue clay layer generally thins and generally disappears to the east. In the East Side subarea, wells screened above 350 feet below land surface have been designated as East Side Shallow wells and those screened below this depth have been referred to as East Side deep wells[5].

The Forebay and Upper Valley subareas comprise the upper Salinas Valley. The Forebay Subarea overlays the entire width of the unconsolidated alluvium between Gonzales and the bluff line two miles south of Greenfield. The primary water-bearing units of this subarea are the same units that produce water in the adjacent Pressure Subarea. However, the near-surface confining unit generally does not extend into the Forebay Subarea. Groundwater in the Forebay Subarea ranges from unconfined to semi-confined and occurs in lenses of sand and gravel that are inter-bedded with finer grained material such as clays and silts.

The Upper Valley Subarea includes the entire alluvial fill in the valley floor between the bluff line two miles south of Greenfield to the southern end of the San Ardo Valley. The primary aquifer is unconfined and deposits range from unconsolidated to semi-consolidated. It consists of inter-bedded gravel, sand, and silt of the Paso Robles Formation, alluvial fan, and river deposits. These deposits are equivalent to the 180-Foot and 400-Foot Aquifer units of the lower Salinas Valley. However, confining units comparable to those separating aquifers in the lower Salinas Valley are not present and groundwater is unconfined.

In the Forebay and Upper Valley subareas, aquifers have not been officially distinguished as deep or shallow. In the Forebay Subarea, wells with at least 80% of perforations less than 350 feet below land surface or the total well depth less than 350 feet below land surface are considered shallow. Wells with perforations below this depth are considered as deep[6]. In the Upper Valley Subarea, wells with at least 80% of perforations less than 250 feet below land surface deep or the total well depth less than 250 feet below land surface are considered as shallow. Wells with perforations below this depth are considered as deep[7].

Figure 2 is a generalized cross section from Montgomery Watson[8]showing the depths of the aquifer zones within the Salinas Valley from Northwest to Southeast. Figure 3 is a cross section from Kennedy/Jenks Consultants[9] showing the depths of the aquifer zones near Salinas from Southwest to Northeast. These cross sections show the confining layers influence the hydrogeology in the northernmost groundwater subareas, especially the Pressure, East Side, and Forebay subareas. The

[5] ibid
[6] Ibid
[7] Ibid
[8] Montgomery Watson. 1994, Salinas River Basin Water Resources Management Plan Task 1.09 Salinas Valley Groundwater Flow and Quality Model Report.
[9] Kennedy/Jenks Consultants, 2004, Hydrostratigraphic Analysis of the Northern Salinas Valley. Final Report Prepared for Monterey County Water Resources Agency.

southern Salinas Valley Upper Valley Subarea is less influenced by confining clays and generally has a shallower aquifer zone (Figure 4). Figure 1 shows all cross section locations.

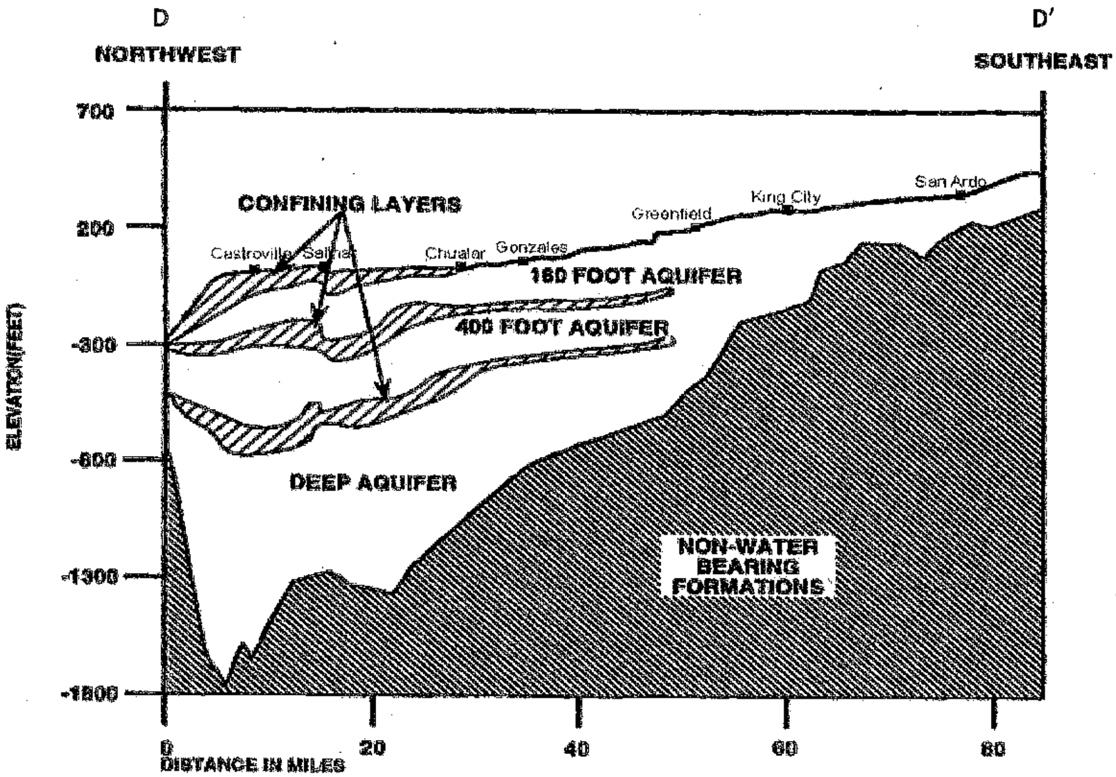


Figure 2. Conceptual Geologic Cross Section, Northwest to Southeast (down Valley). Modified from Montgomery Watson, 1994, Salinas River Basin Water Resources Management Plan Task 1.09 Salinas Valley Groundwater Flow and Quality Model Report.

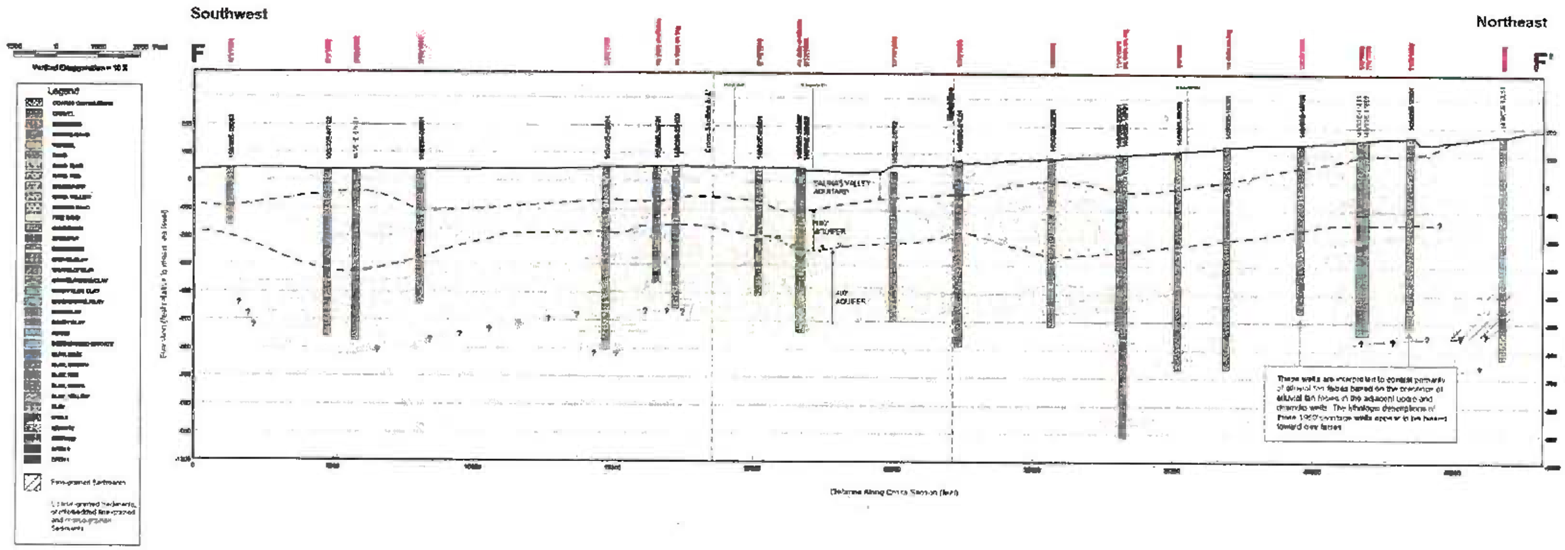


Figure 3. Geologic Cross Section, Southwest to Northeast (cross Valley) near Salinas. From Kennedy/Jenks Consultants, 2004, Hydrostratigraphic Analysis of the Northern Salinas Valley. Final Report Prepared for Monterey County Water Resources Agency.

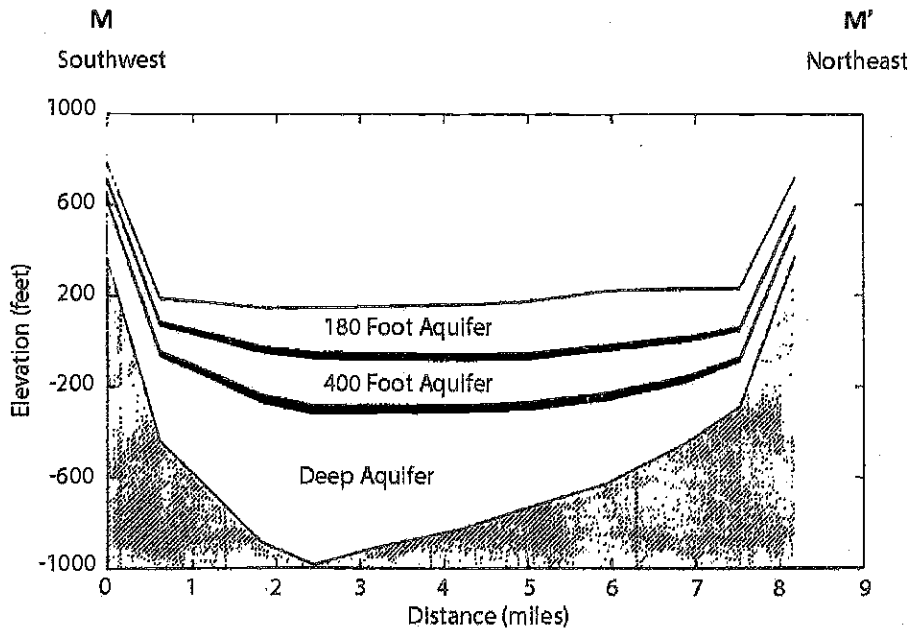


Figure 4a. Conceptual Aquifer Cross Section, Southwest to Northeast (cross Valley) near Gonzales. Modified from Montgomery Watson. 1994, Salinas River Basin Water Resources Management Plan Task 1.09 Salinas Valley Groundwater Flow and Quality Model Report.

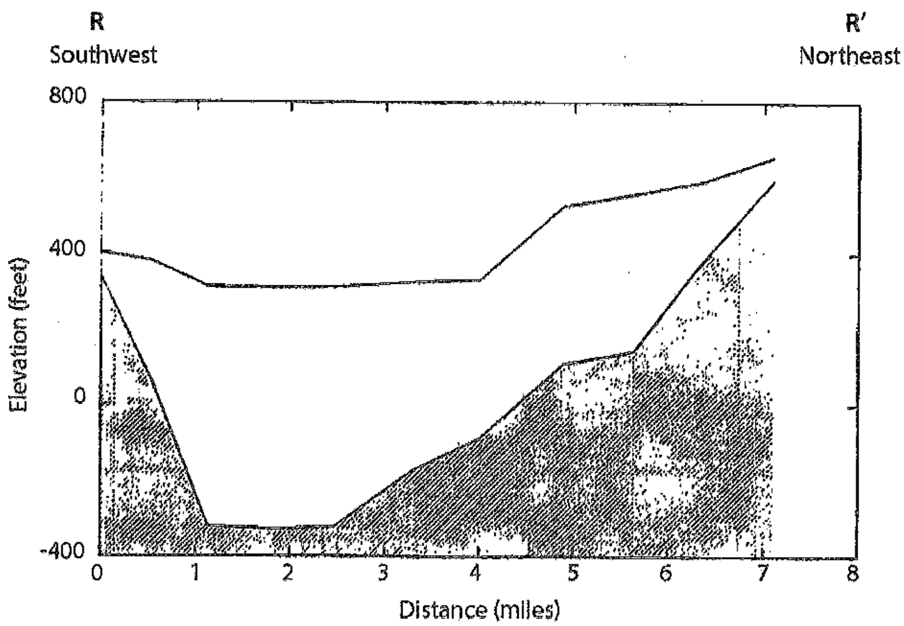


Figure 4b. Conceptual Aquifer Cross Section, Southwest to Northeast (crossValley) near King City. Modified from Montgomery Watson. 1994. Salinas River Basin Water Resources Management Plan Task 1.09 Salinas Valley Groundwater Flow and Quality Model Report.

Recharge

Recharge in the Salinas Valley occurs primarily from infiltration from the Salinas River and Arroyo Seco, and deep percolation of irrigation water except in the Langley area where recharge is primarily from precipitation. Flow in the Salinas River is seasonally controlled for recharging the groundwater system. Infiltration of water from the Salinas River is relatively constant from year to year, partly because river flows are partially regulated by Nacimiento and San Antonio reservoirs[10]. From 1970 to 1992, pumpage return flows were about 60 % of recharge from stream flow.[11] Precipitation, subsurface and boundary inflow, and seawater intrusion are other sources of recharge of lower proportion compared to infiltration. Durbin and others [12] reported that the Pressure Subarea is recharged largely by irrigation and stream recharge in approximately equal volumes. They also reported that the Forebay and Upper Valley subareas receive recharge from irrigation return and infiltration from the Salinas River; their estimates indicate that the river provides approximately twice as much recharge as irrigation return. The East Side subarea does not receive recharge from the Salinas River and most of its recharge is from irrigation return water.

Directions of groundwater flow generally follow the topography of the basins, from high altitudes towards the drainages, and down valley towards Monterey Bay. Groundwater generally flows horizontally from south to north in the Salinas Valley from the Upper Valley to the Pressure subareas and most recently recharged groundwater is expected in the Upper Valley sub-basin. Groundwater has historically flowed horizontally northward from the Pressure to the Eastside Subarea due to low groundwater levels in the Eastside Subarea. [13] Changing irrigation practices such as increased use of drip irrigation during the last 20 years[14] may have resulted in changes to the recharge volumes and nitrate loads for the difference subareas.

Groundwater Quality Studies and Data

Previous studies of groundwater quality in the Salinas Valley demonstrate that concentrations of nitrate (as NO_3) in groundwater vary spatially. Primary sources of data include irrigation, public supply, and monitoring wells[15]. Concentrations of nitrate above the MCL of 45 mg/L and up to several hundred mg/L have been observed in all of the subareas.

---

[10] Salinas Valley Ground Water Basin Hydrology Conference, 1995, Hydrogeology and Water Supply of Salinas Valley, White Paper prepared for Monterey County Water Resources Agency

[11] ibid

[12] Durbin, T.J. Kapple, G.W. & Freckleton, J.R. (1978) Two-Dimensional and Three-Dimensional Digital Flow Models for the Salinas Valley Ground Water Basin, California. pp. 78–113, United States Geological Survey Water Resources Investigations Report 78-113..

[13] Monterey County Water Resources Agency, 2011, Lines of Equal Ground Water Elevation in the Pressure 180-Foot, East Side Shallow, Forebay and Upper Valley Aquifers, http://www.mcwra.co.monterey.ca.us/groundwater_elevation_contours/documents/GWLcontours%20Fall%2020 11%20Shallow.pdf

[14] MCWRA (Monterey County Water Resources Agency). (2011) 2010 Ground Water Summary Report, http://www.mcwra.co.monterey.ca.us/Agency_data/GEMS_Reports/2010%20Summary%20Rep ort.pdf

[15] e.g. Boyle, D., King, A., Kourakos, G., Lockhart, K., Mayzelle, M., Fogg, G.E. & Harter, T. (2012) Groundwater Nitrate Occurrence. Technical Report 4 in: Addressing Nitrate in California's Drinking Water with a Focus on Tulare Lake Basin and Salinas Valley Groundwater. Report for the State Water Resources Control Board Report to the Legislature. Center for Watershed Sciences, University of California, Davis

There are four primary programs that have sampled groundwater to assess groundwater nitrate contamination in the Salinas Valley as follows.

- Sampling of irrigation and monitoring wells by the MCWRA [152 wells sampled];
- Public water systems are required to systematically test their well water and the results are reported to Monterey County Health Department;
- Monterrey County Health Department is responsible for sampling domestic water supply wells that serve 2 or more residences;
- Groundwater Ambient Monitoring and Assessment (GAMA) studies conducted by the California State Water Resources Control Board [84 wells considered, 39 within Salinas Valley] and USGS [98 wells considered, 46 wells within Salinas Valley - 21 wells with NO3 data] sampled domestic and public supply wells throughout the basin;
- Central Coast Ambient Monitoring Program – Groundwater Assessment and Protection (CCAMP-GAP) Domestic Well Project for the Salinas and Pajaro valleys sampled domestic wells in cooperation with the USGS [90 wells considered, 74 within Salinas Valley].

The MCWRA has used a network of wells to monitor groundwater conditions in the Salinas Valley Groundwater Basin since the 1940s. The network of wells provides the information needed to manage and protect groundwater resources and sustain beneficial uses. The MCWRA monitors over 300 wells for water quality. Most of the wells are used for irrigation. The MCWRA[16] reported nitrate concentrations in several hundred wells sampled in 1993 and 2007. They reported that 25 % (1993) to 37 % (2007) had nitrate concentrations exceeding the MCL. Reported concentrations ranged from 1 to over 500 mg/L nitrate. Among the subareas, the largest number of exceedances occurred in East Side and Forebay subareas. Concentrations generally increased from 1993 to 2007.

The Monterey County Health Department mandates that any water supply system with two connections or more must be tested annually. At the state level, systems with 15 or more connections (or serving more than 25 people for more than 60 days out of the year) are required to be tested annually. These data are stored in GeoTracker. GeoTracker is an online information system that provides access to groundwater quality information. The GeoTracker data collected under the auspices of this and other programs and projects are apparently not subject to the same levels of quality control as the data collected and processed by the CCGC as is discussed in the Results and Discussion section. In specific cases, we have attempted to rectify data that was obviously entered incorrectly. We also recognize that there are suspicious outlier data for domestic supply wells in the GeoTracker database. In addition to correcting data where we encountered obvious discrepancies, we calculated temporal averages for all wells with multiple analytical results and for coincident points we used the maximum of the averages. This process is discussed in greater detail in the Appendix.

Justin T. Kulongoski and Kenneth Belitz. 2005. Program Status and Understanding of Groundwater Quality in the Monterey Bay and Salinas Valley Basins, 2005: California GAMA Priority Basin Project, US Geological Investigations Report 2011 – 5058.

[16] Monterey County Water Resources Agency, 2010, Technical Memorandum – NITRATE Tasks 2.01, 2.02, 2.04-2b EPA Grant XP-96995301 – Groundwater Sampling, Reporting and Storage, Groundwater Sampling Data, QA/QC, Data Reduction and Representation

As part of the Groundwater Ambient Monitoring and Assessment (GAMA) Program, Kulongoski and Belitz[17] analyzed groundwater nitrate data for public supply wells throughout the Salinas Valley. About 23,000 individual analytical results were included in their assessment of groundwater quality for the Monterey/Salinas study unit. They identified over a dozen wells where nitrate concentrations were over the MCL. They used a non-parametric statistical analysis to examine the relationship between nitrate and potential explanatory factors including land use, well construction, groundwater age, and geochemical condition. They reported that nitrate concentrations over the MCL were generally associated with shallow wells (less than 350 feet) and groundwater that was either of mixed pre-modern and modern or modern age[18]. Additionally, the State Water Board sampled 38 domestic wells within the Salinas Valley and Pajaro Valley as part of the GAMA Program Domestic Well Project[19]. Nine wells had detections greater than the MCL, 7 of which occurred in Salinas Valley. Additionally, stable water isotopes, nitrogen isotopes, and boron isotopes were collected at each well site. The wells which exceed the MCL had overlapping ranges on nitrate isotopic concentrations and therefore nitrate sources could not be distinguished from nitrogen isotopes alone.

Most recently, Boyle and others[20] assessed nitrate concentrations in the Salinas Valley. They reported that the majority of the public supply wells in the Salinas Valley have concentrations below the MCL. A key reason for this is likely due to regulation by the Monterey County Health Department of water-supply wells with 2 or more connections. When the MCL of a particular contaminant is exceeded, wells are often abandoned, or use is discontinued and there is no further sampling. This can remove potentially high nitrate samples from the record, maintaining the biased statistic that the majority of wells sampled are below the MCL. They also reported that the higher average nitrate concentrations were located in wells in the northeastern, central, and southern portions of the Salinas Valley.

---

[17] Justin T. Kulongoski and Kenneth Belitz. 2005. Program Status and Understanding of Groundwater Quality in the Monterey Bay and Salinas Valley Basins, 2005: California GAMA Priority Basin Project, US Geological Survey Scientific Investigations Report 2011 – 5058.

[18] Modern water recharged during or after the 1950s.

[19] California Water Boards (2011) State Water Board GAMA Program Domestic Well Project Monterey County Focus Area.

[20] Boyle, D., King, A., Kourakos, G., Lockhart, K., Mayzelle, M., Fogg, G.E. & Harter, T. (2012) Groundwater Nitrate Occurrence. Technical Report 4 in: Addressing Nitrate in California's Drinking Water with a Focus on Tulare Lake Basin and Salinas Valley Groundwater. Report for the State Water Resources Control Board Report to the Legislature. Center for Watershed Sciences, University of California, Davis.

Methods and Data Sources

Sampling of CCGC Member Wells

Within the Salinas Valley, the most recently collected groundwater nitrate data was obtained from 221 domestic wells on L&G properties sampled by HydroFocus and Michael L. Johnson, LLC personnel from October 2013 through August 2014. One-hundred and sixty-six (166) domestic well samples from October 2013 through March 2014 were considered for the Tech Memo submitted on April 30, 2014. Fifty five (55) domestic well samples were collected from April 2014 through August 2014. The results of this sampling are included in this Tech Memo. These wells were not included in the original Tech Memo because we were waiting on CCGC member responses to access and sample the wells.

Upon arrival at the well and using electronic sounders accurate to the nearest 0.01 feet, field personnel measured the depth to groundwater in the well (if there was access), relative to the top (the highest point) of the well casing. The measuring point location and depth to groundwater were recorded on the field sheet.

Field parameters (pH, water temperature, specific conductance, oxidation-reduction potential (ORP) and dissolved oxygen (DO)) were measured at each well using a Yellow Springs Instruments Multimeter. Meters were calibrated for all parameters at least 2 times per day, once in the morning prior to beginning sampling and once in the afternoon. At each well, field parameters were measured upon arrival. If the preliminarily-measured field-parameter values were more than 20% outside of the range of calibration value, the meter was recalibrated. Meters were calibrated with standards close to or that bracketed the values for the well sample and standards were maintained at temperatures (in water baths) close to the temperature of the well water. The meter was checked with zero DO solution at first site of the day, or more frequently if needed. The pH probe was calibrated using buffers bracketing the preliminary sample result. Oxidation-reduction potential (ORP) was calibrated using Zobell solution[21]. Personnel recorded calibration data on field sheets. After calibration, tubing was connected to the well outlet and directed the well discharge to a flow-through chamber. As well water was pumped from the well, field parameters were recorded approximately every 3 minutes.

To the extent possible, purging of the well occurred prior to sample collection in order to remove stagnant water from within the well casing and ensure that a representative sample was obtained. Stabilization of the field parameters was used as an indication that the sample water was representative of groundwater. Stability was defined as ± 0.1 for pH, ± 3% for conductivity, ± 10 mV for ORP and ± 10% for DO for at least two consecutive readings Sampling began as soon as possible after parameter stabilization.

Field personnel collected all samples using the pumps in the domestic wells. The sample was collected as close to the well head as possible. In most cases, the sample was collected through plastic tubing connected to a spigot at or near the well head. In rare cases, the sample was collected from an indoor or outdoor faucet. Well water flowed into a flow-through chamber and into a collection bucket for measuring volume of flow per unit time. Samples analyzed for dissolved constituents (including nitrate) were filtered in the field using 0.45-µm capsule filters certified to meet EPA standards for trace metal analysis. Sample bottles and sampling equipment were rinsed thoroughly three times with the water to

[21] Nordstrom, D.K., 1977, Thermochemical redox equilibria of ZoBell's solution, Geochimica e Cosmochimica Acta, 41:1835-1841

be sampled prior to sample collection. Bottles pretreated with preservatives were not rinsed prior to sample collection. Samples collected for metals were preserved with nitric acid in the field. Test strips were used to verify that the pH was less than 2 in preserved samples.

Field personnel collected ten percent of the total samples for quality assurance purposes (duplicate and field blank samples). Field duplicate samples were collected and processed in the field and analyzed to evaluate the heterogeneity of the matrices. The duplicate samples were submitted to the laboratory as semi blind samples. Field blank samples were processed in the field identically as the other samples using deionized water as sample water. The blank samples were submitted to the laboratory as semi blind samples. Appendix C provides the quality assurance results.

All samples collected for the MRP constituents were placed immediately on ice and transported to Monterey Bay Analytical Services on the day of collection. Before leaving the field to deliver samples, sampling personnel checked the ice level to ensure the temperature of the ice chest would remain around 6° C, and added ice if necessary. Chain of Custody form(s) were completed for each sampling day.

At selected wells, samples were collected for determination of tritium, noble gases, and chlorofluorocarbons for determination of the recharge age. These constituents were collected after well purging and collection of the MRP constituents. Prior to collecting the tritium sample, sampling personnel removed any wristwatches. The unfiltered samples were collected by inserting the plastic tubing connected to the well connection into the tritium bottle. The tubing was inserted about 1/3 of the way into the bottle and was slowly removed as the bottle was filled.

Noble gases samples were collected in copper tubes. Prior to sample collection, copper tubes were placed on backing plates with two clamps, one on each end. Plastic tubing leading from the well hook up was attached to one tube end, and blank plastic tubing was attached to the other tube end. As water flowed through the tube, the line was inspected for any air bubbles. The copper tube was continuously tapped to ensure bubbles were not trapped inside. When there was certainty that no bubbles were present, the upper clamp was sealed followed by the lower clamp. Copper tubes were stored at room temperature and shipped to Lawrence Livermore National Laboratory under standard Chain of Custody procedures.

Chlorofluorocarbons (CFCs) were collected in laboratory provided glass bottles with aluminum foil lined caps. At each site, three samples were collected. Using Viton tubing leading into a bucket, three bottles and three caps were completely submerged in sample water. Each bottle was individually filled from the Viton tubing until it overflowed under water. Once submerged and filled, a cap was chosen, completely submerged, and tapped underwater to ensure no air bubbles were trapped. The Viton tubing was removed from the sample bottle and the cap was tightly screwed on under water. The bottle was removed and checked for any visible bubbles. If bubbles were present, the sampled process was repeated with a new cap. If no bubbles were present, electrical tape was used to secure the cap in a clockwise direction.

Analytical Methods

Nitrate

Nitrate samples were analyzed by Monterey Bay Analytical Services using EPA method 300.0.

Major Ions and Total Dissolved Solids

All major ions and total dissolved solids were analyzed by Monterey Bay Analytical Services. Calcium, magnesium, potassium, and sodium were analyzed by EPA method 200.7. Chloride and sulfate were analyzed by EPA method 300.0. Total dissolved solids were analyzed by EPA approved Standard Methods 2540C.

Tritium and Noble Gases

Water samples are chilled, heated, and chilled in cycles in which the headspace gases are pumped away. After five cycles, almost all the ^3He is removed. The sample then sits for 10 days, allowing the ^3He from tritium decay to accumulate. The gas is then analyzed using a mass spectrometer. Tritium and its daughter helium-3 allow for calculation of the initial tritium present at recharge, and therefore groundwater age can be calculated by equation 2.

$$Groundwater\ Recharge\ Age\ (yrs) = -17.8 * ln\left(1 + \frac{3He_{trit}}{3H}\right) \quad (2)$$

The tritium-helium age date provides a mean age for water that contains tritium (post-1955 water). In wells containing pre-modern water (pre-1955), an estimate of groundwater age comes from helium amounts due to radioactive decay of uranium and thorium.
In the laboratory, samples are released from the copper tubes, tubes are heated, and then the water is frozen effectively trapping the dissolved gases in the headspace. Dissolved gases are measured by either mass spectrometer or a high-sensitivity capacitive manometer. The measured amounts of Ne, Ar, Kr, and Xe are used to determine the He present in the sample.

Chlorofluorocarbons

Selected groundwater samples were analyzed for CFC's using a purge-and-trap gas chromatography procedure with an electron capture detector (see http://water.usgs.gov/lab/chlorofluorocarbons/lab/analytical_procedures/) by the Tritium Laboratory at the University of Miami Rosenthiel of Marine and Atmospheric Science.

Other Sources of Nitrate Data

Using GeoTracker GAMA[22], we downloaded all data for the Salinas Valley. The GeoTracker GAMA database includes data from the California Department of Public Health, GAMA – SWRCB data collection efforts and Regulated Sites. We also downloaded data from the USGS National Water Information System[23] for wells in the Salinas Valley which contain samples analyzed for nitrate. We also extracted data from the GAMA special study carried out by Lawrence Livermore National Laboratory[24]. The Central Coast Regional Board provided two sets of nitrate data; data uploaded as part of the individual well sampling (eNOI) process belonging to by L&Gs enrolled in the Irrigated Lands Regulatory Program and data collected by the USGS as part of the Regional Water Quality Control Board Central Coast Ambient Monitoring Program - Groundwater Assessment and Protection (CCAMP-GAP) Domestic Well

---

[22] http://geotracker.waterboards.ca.gov/gama/, accessed 2/6/2014

[23] http://waterdata.usgs.gov/nwis, accessed 4/4/2013

[24] Moran JE, Esser BK, Hillegonds D, Holtz M, Roberts SK, Singleton MJ, Visser A, 2011, California GAMA Special Study, Nitrate Fate and Transport in the Salinas Valley. Final Report for the California State Water Resources Control Board. GAMA Special Studies Task 10.5: Surface water-groundwater interaction and nitrate in Central Coast streams. LLNL-TR-484186.

Project for the Salinas and Pajaro Valleys. The MCWRA provided a Technical Memorandum[25] that contained historical nitrate values for monitoring wells.

Mapping of Nitrate Concentrations in Groundwater

We used the theory of regionalized variables, or geostatistics, to create maps of groundwater nitrate concentrations in the Salinas Valley. The mapping was performed using SURFER and ArcGIS Geostatistical Analyst software. The theory of regionalized variables relies on the assumption that data collected in geographic areas is randomly distributed[26]. Kriging, the process of interpolation from measured values of some variable z measured at N locations relies on the determination of the spatial covariance or semivariogram of the variable at points x_i. The semivariance (γ) is defined as:

$$\gamma(h) = \frac{variance[z(x_i) - z(x_j)]}{2} \qquad (3)$$

where:

h is the lag or average distance between data points and
z(x) is the groundwater nitrate concentration

We therefore calculated the semivariogram to estimate the spatial covariance in the area of nitrate concentrations. We then interpolated with kriging which uses a linear combination of weighting factors and measured values of $z(x_j)$ that minimizes the estimation variance. We kriged subareas separately (except the East Side, Langley, and Pressure subareas) and then combined the subarea maps into one map.

The objective of kriging for this study was to characterize the spatial distribution of the nitrate concentrations in the Salinas Valley and provide a conservative estimate of where groundwater nitrate concentrations are likely to be above the MCL. This is different from the original objective of kriging which is to quantitatively assess amounts of exploitable elements for mining. Because of the high spatial variability and non-Gaussian nature of the distribution we transformed the concentrations to logarithms of the concentrations and used SURFER to calculate the semivariogram. Kriging was carried out using exact well locations, where available. SURFER generates a grid of estimated values. We specified a 10 meter cell size for development of maps showing the distribution of groundwater nitrate concentrations.

We also used indicator kriging within ArcGIS Geostatistical Analyst to develop maps that display the probability that concentrations in wells will exceed one-half of the MCL, 80 % of the MCL, the MCL and twice the MCL. For indicator kriging, the data are transformed into either zeroes or ones depending on whether they are above or below a specified threshold. The transformed data values are used as input to ordinary kriging and the indicator kriging predication at a location is in interpreted as the probability that the threshold is exceeded[27]. Indicator kriging does not provide any information on how far above

---

[25] Monterey County Water Resources Agency, Technical Memorandum – NITRATE Tasks 2.01, 2.02, 2.04.2b EPA Grant XP-96995301 – Ground Water Sampling, Reporting, and Storage, Ground Water Sampling, Data QA/QC, Data Reduction and Representation. To EPA Region IX, July 30, 2010.

[26] David, M. 1977. Geostatistical ore reserve. New York (NY): Elsevier Scientific
Journel, A.G. and Ch. J. Huijbregts. 1978. Mining Geostatistics. San Diego (CA): Academic Press Harcourt Brace & Company, Publishers.
Matheron, G. 1963. Principles of Geostatistics. Economic Geology 58: 1246-1266.

[27] Konstantin Krivoruchko, 2011, Spatial Statistical Data Analysis for GIS Users, ESRI Press, 928 pp.

or below the threshold the values are might be, only the probability that they are above or below the threshold.

Mapping Assumptions

We assumed that water-quality data collected from 2000 to 2014 are most representative for the area at this time. Using this time frame, we attempted to insure that we effectively captured the distribution of nitrate concentrations and delineated where groundwater for drinking water is likely to be over the MCL. As discussed above and as indicated by the data in the Appendix, when drinking water supply wells are determined to contain nitrate concentrations above the MCL, use and sampling can be discontinued. Thus we used the 13 year time period for data gathering in attempt to capture wells where sampling may have been discontinued. Where there was more than one value for samples collected at different times from a well within this time frame, we used the maximum of all values.

Data from supply wells downloaded from GeoTracker have obfuscated coordinates[28], which creates a dataset where multiple wells may plot at the same location. There are several limitations of the obfuscated and clustered data from GeoTracker. The obfuscated well locations are sometimes not accurate. Moreover, clustered data limited our ability to fully map areas where there is likely impairment of groundwater quality due to high nitrate. To provide a conservative map of where groundwater is likely over the MCL, for input to our mapping process, we used the maximum of all concentrations at each of these "coincident" points for map creation. There were 332 coincident points.

Analytical data downloaded from GeoTracker is reported as either nitrate or nitrate as nitrogen. We generally assumed that this designation is correct. However, we identified instances where this designation was incorrectly assigned. We identified seven wells in which we successfully matched GAMA and the L&G's eNOI data for identical wells where the eNOI concentrations was reported as nitrate and GAMA reported NO_3 as N. This classification error can result in a large difference in data used for contouring since values differ by greater than 4 times. We therefore assumed that the eNOI data classification was correct since analyses and values are uploaded directly from the laboratory. We were able to match data for samples collected by the L&G and the CCGC for one well. Our (CCGC) values agreed with values (for the same well) reported in the eNOI, giving credibility to the assumption that the eNOI uses the correct nitrate classification. We corrected the GAMA nitrate values for these seven wells based on the eNOI data. We also compared data from monitoring wells in reports referenced in GeoTracker with values in the GeoTracker database and found discrepancies which we also corrected in our database.

The CCAMP-GAP project samples were obtained from household faucets. Where applicable, we matched the GAP sites to USGS – NWIS sites. Where there were comparison samples, all nitrate concentrations for tap samples agreed well with concentrations obtained at the well head.

Consistent with the discussion in the Hydrogeologic Context section and the objectives of characterizing the domestic water supply and shallow groundwater and reasonably delineating areas where concentrations are likely to be over the MCL, we assumed that the shallow aquifer used for domestic drinking water supply generally extends to a maximum depth of 400 feet, and therefore any wells with known depths greater than 400 feet were removed from the dataset for mapping. For mapping purposes, we also eliminated irrigation wells and domestic/irrigation wells[29] with unknown depths as

[28] These locations are accurate to within 1 square mile of the actual location.

[29] These are wells that were originally installed as irrigation wells and then converted to use for domestic supply.

these wells are generally deeper than 400 feet. However, we recognize that that there are many shallow irrigation and irrigation/domestic wells throughout the Salinas Valley. Finally, we assumed that wells with unknown depths having uses of Domestic, Public Supply, Observation, or unknown were all less than 400 feet deep.

We recognize that the definition of shallow varies from within 400 feet in the northern Valley to within 250 feet in the Upper Valley as is described in the Hydrogeologic Context section. For this analysis we considered the depth interval that supplies drinking water as the primary concern for mapping. As indicated by the well completion reports gathered and analyzed for the Salinas Valley and described below, the large majority of domestic wells are screened within 400 feet. Therefore in the interest of striking a balance between characterizing the shallow aquifer and including as many domestic wells as possible, we used the 400-ft depth for the entire Salinas Valley Groundwater Basin.

For creation of maps where CCGC domestic well locations are shown, we obfuscated locations as follows. For each pair of well-location coordinates, the value of the location coordinate was altered using a random-number generation algorithm in Microsoft Excel. The coordinates were randomly altered in both the east-west and north-south directions to place the well location somewhere within 0.5 miles of the actual location. This resulted in plotting of the well location within a 1-square mile block centered over the actual well location. In some cases the obfuscated well location plotted some distance from the L&G parcel.

To create maps of nitrate concentrations that take the estimation deviation into account, we calculated the lower bound of the 66% and 95% confidence intervals from the standard deviation maps. The 66% confidence interval is calculated as the estimated nitrate concentration minus the standard deviation and the 95% confidence interval is calculated as the estimated nitrate concentration minus two standard deviations.

Well Construction Information

In an attempt to learn about domestic well construction, we obtained all available well completion reports from DWR for the Salinas Valley Groundwater Basin. From these reports, we identified over 1,552 reports that designated wells as domestic use and extracted well construction information. Of these, 1,517 reports provided well depth information and 1,429 reports provided bottom of screen information for the Salinas Valley. We also obtained 75 well completion reports designated as public supply wells for the entire Salinas Valley. We summarized the data for well depth by township.

Results and Discussion

Figure 1 shows the locations of wells and sources of data used in our analysis of the distribution of groundwater nitrate concentrations in the Salinas Valley. Data sources included GAMA, Lawrence Livermore National Laboratory, MCWRA, Monterey County Health Department, USGS, the Central Coast Regional Water Quality Control Board and samples collected under the auspices of the CCGC groundwater program. The total number of wells used for mapping the distribution of nitrate concentrations equaled 939. In the Salinas Valley, the total area of the member parcels equals 120,785 acres. Member parcels are present throughout most of the valley. However, the density of member parcels is lower in the Langley Subarea, the northern Pressure Subarea, and the southern Upper Valley Subarea (Figure 5)[30].

Well Construction

The results of our analysis of well-completion information contained in DWR well completion reports show that the large majority of the domestic wells have depths within 400 feet of land surface; by subarea – 82 % in the Langley Subarea, 76 % in the Pressure Subarea, 70 % in the East Side subarea, 80 % in the Forebay Subarea, and 92 % in the Upper Valley Subarea. We focused this study on wells that were designated shallower than 400 feet. Domestic well total depth and depth to screen bottom statistics by subarea are summarized in Table 1.

---

[30] The locations of CCGC member wells were obfuscated to protect member privacy. The locations of CCGC member wells shown on Figure 5 were randomly adjusted up to 0.5 miles in both the east-west and north-south directions. The wells are plotted within a 1 mi^2 block centered over the actual well location. Therefore, the wells may not be shown on the member parcels on which they are actually located.

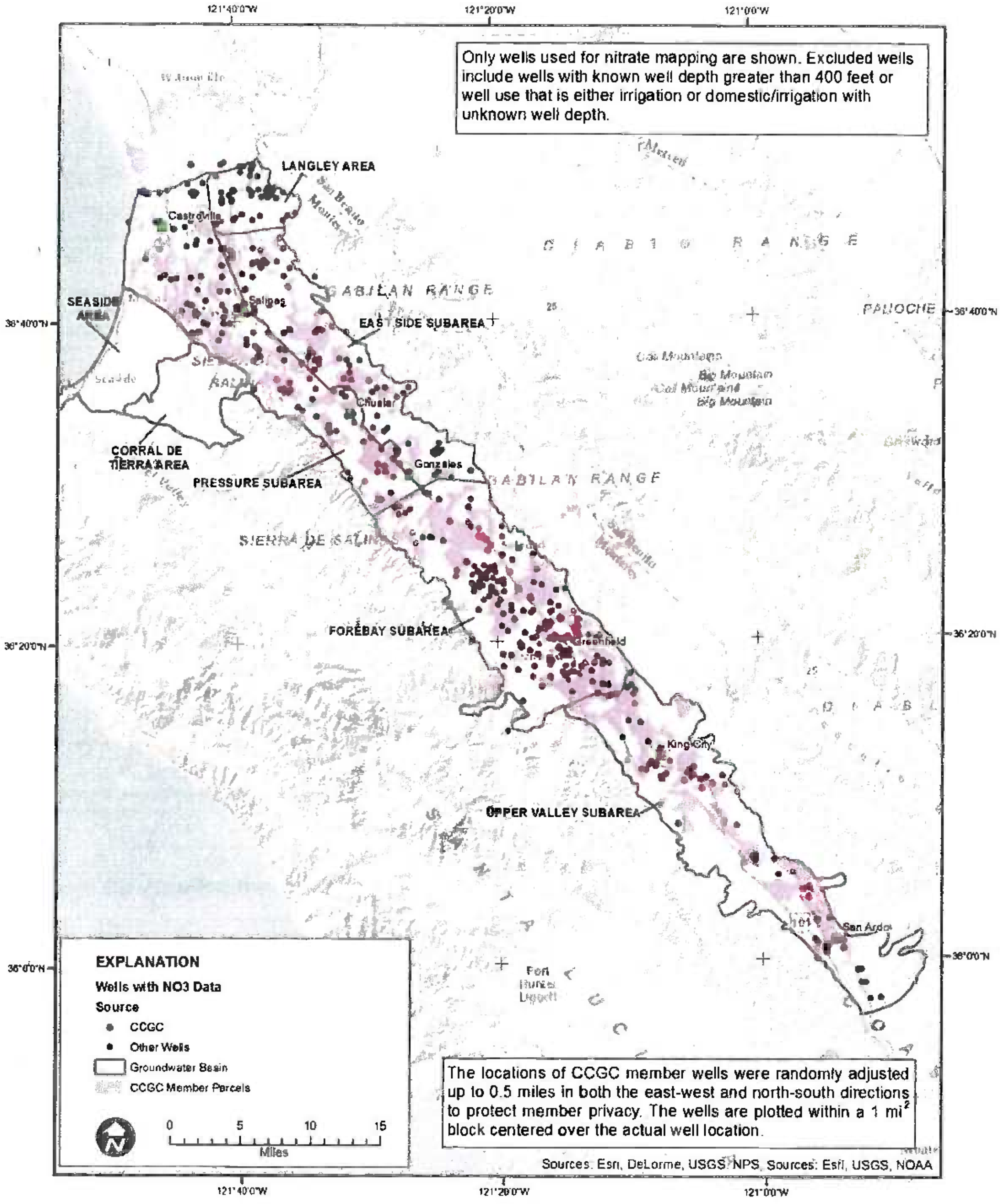


Figure 5. Locations of CCGC member parcels and wells used for analysis.

Table 1. Summary Statistics for Domestic Depth and Screen Bottom reported on well completion reports by subarea

	Langley Subarea	Pressure Subarea	East Side Subarea	Forebay Subarea	Upper Valley Subarea
Well Depth					
Average	302	318	332	272	204
Median	300	295	300	200	153
Minimum	48	40	58.5	75	75
Maximum	720	1488	983	900	560
Number of wells	481	577	320	103	36
Screen Bottom					
Average	295	309	329	260	194
Median	299	288	299	185	140
Minimum	44	13	72	70	70
Maximum	700	1448	963	900	560
Number of wells	466	537	292	99	35
Percentage of wells depths within 400 feet of land surface	81.5 %	76.4 %	70.3 %	79.6 %	91.7 %

Langley Subarea

In the Langley Subarea, the average depth to the bottom of the well screens from all domestic well completion reports where this information was available is 295 feet. Seventy-three (73) well completion reports (16 %) reported that the bottom of the well screen was greater than 400 feet. Therefore, for any domestic well there is 84 % likelihood that the well screen intercepts water from less than 400 feet. The average well depth was 302 feet. Eighty-nine (89) well completion reports (19 %) reported that the bottom of the well was greater than 400 feet.

Pressure Subarea

In the Pressure Subarea, the average depth to the bottom of the well screens from all domestic well completion reports where this information was available is 309 feet. One Hundred Fourteen (114) well completion reports (21 %) stated that the bottom of the well screen was greater than 400 feet. For any domestic well therefore, there is 79 % likelihood that the well screen intercepts water from less than 400 feet. The average well depth was 318 feet. One Hundred Thirty-Six (136) well completion reports (24 %) reported that the bottom of the well was greater than 400 feet.

East Side Subarea

In the East Side subarea, the average depth to the bottom of the well screens from all domestic well completion reports where this information was available is 328 feet. Eighty-three (83) well completion reports (28 %) reported that the bottom of the well screen was greater than 400 feet. Therefore, for any domestic well there is 72 % likelihood that the well screen intercepts water from less than 400 feet. The average well depth was 332 feet. Ninety-five (95) well completion reports (30 %) reported that the bottom of the well was greater than 400 feet.

Forebay Subarea

In the Forebay Subarea, the average depth to the bottom of the well screens from all domestic well completion reports where this information was available is 260 feet. Seventeen (17) well completion reports (17 %) stated that the bottom of the well screen was greater than 400 feet. For any domestic well therefore, there is 83 % likelihood that the well screen intercepts water from less than 400 feet. The average well depth was 271 feet. Twenty-one (21) well completion reports (20 %) reported that the bottom of the well was greater than 400 feet.

Upper Valley Subarea

In the Upper Valley Subarea, the average depth to the bottom of the well screens from all domestic well completion reports where this information was available is 194 feet. Two (2) well completion reports (6 %) reported that the bottom of the well screen was greater than 400 feet. Therefore, for any domestic well there is 94 % likelihood that the well screen intercepts water from less than 400 feet. The average well depth was 204 feet. Three (3) well completion reports (8 %) reported that the bottom of the well was greater than 400 feet.

Figure 6 shows the distribution of average domestic well depths by township for the Salinas Valley and vicinity. Figure 6 shows that the average domestic well depth ranges from 109 to 386 feet. The average well depth generally decreases from the lower Salinas Valley to the Upper Valley. For a subsample of the 227 wells sampled on Coalition L&Gs' properties in the Salinas Valley, we were able to match well completion reports or received well construction information from L&Gs. We were also able to obtain well depths and screened interval data for non-CCGC wells used in our analysis. In total, we obtained well depth information for 195 wells. Figure 7 shows the distribution of well depths[31]. Well depths vary substantially from 10 to 1,364 feet. Most wells (72 %) were shallower than 400 feet. Where well depth and screened interval information was available, we excluded wells deeper than 400 feet for purposes of developing maps of nitrate concentrations.

---

[31] The locations of CCGC member wells were obfuscated to protect member privacy. The locations of CCGC member wells shown on Figure 4 were randomly adjusted up to 0.5 miles in both the east-west and north-south directions. The wells are plotted within a 1 mi^2 block centered over the actual well location.

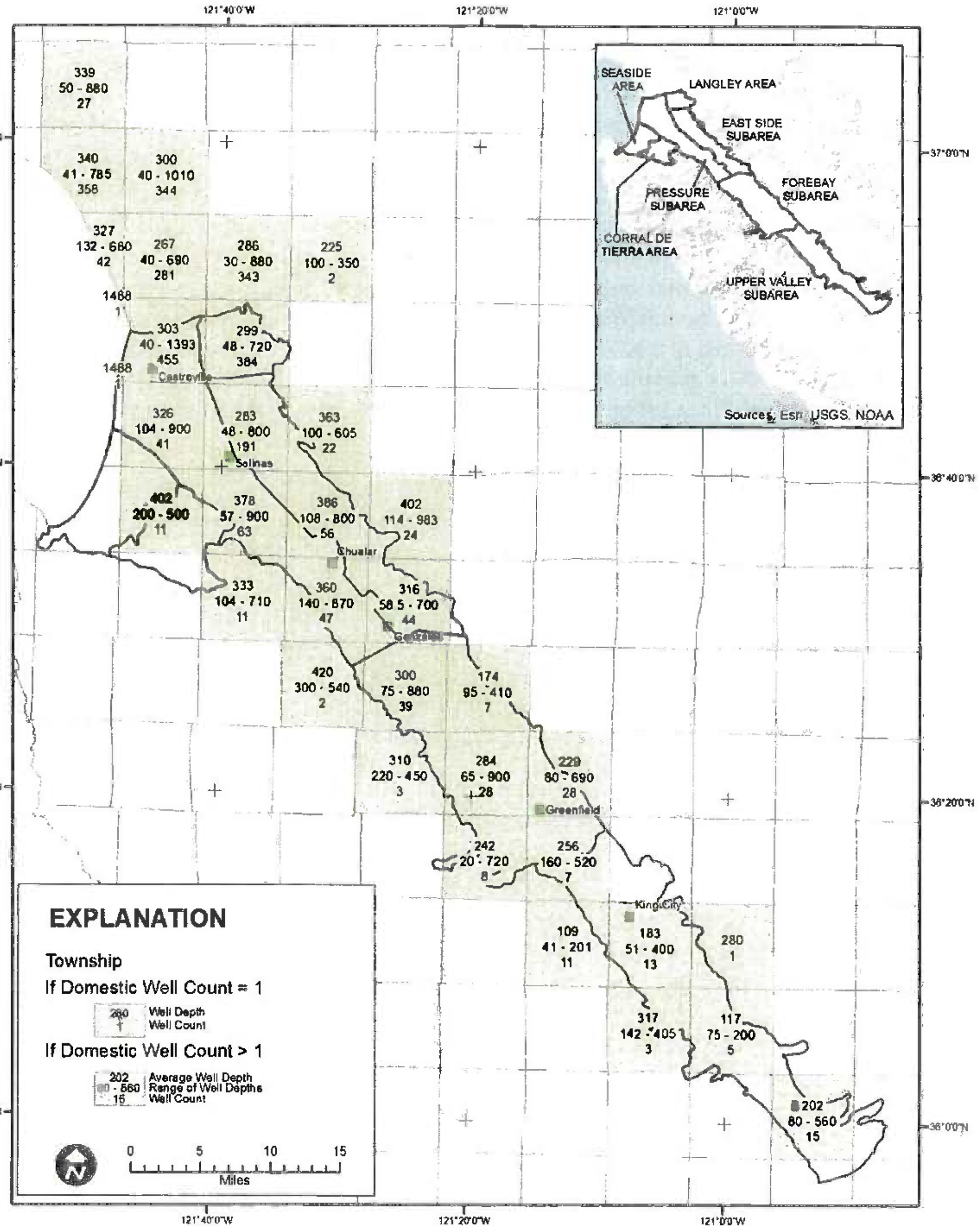


Figure 6. Average and range of domestic well depths by township.

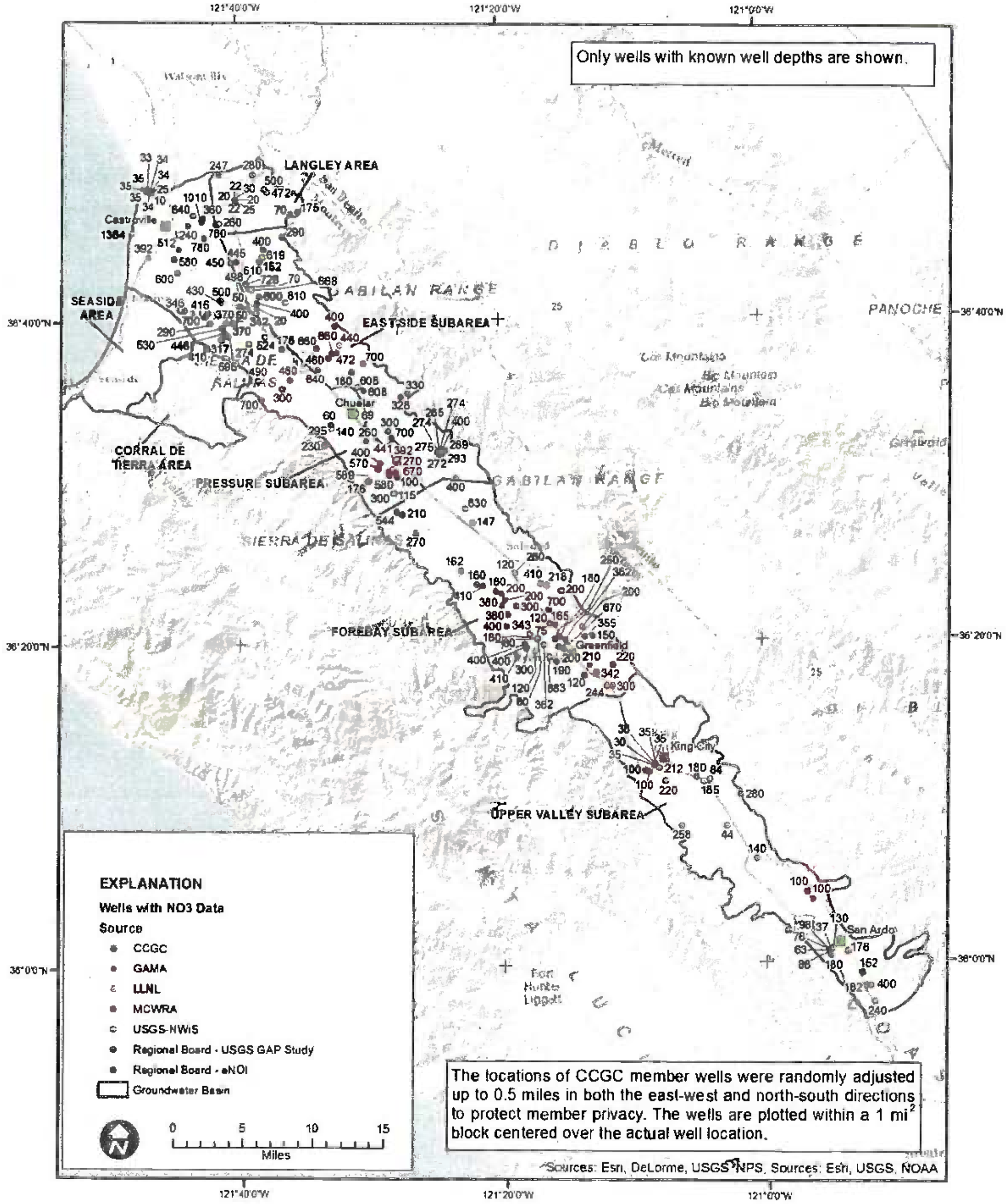


Figure 7. Distribution of known well depths.

Figure 8 shows the distribution of average public supply well depths by section for the Salinas Valley. These well depths were extracted from available DWR well completion reports with the designation of either Public Supply or Municipal well. Most public supply wells in the northern half of the Salinas Valley are deeper than 400 feet; however there are some sections, especially toward the valley fringes that have shallower well depths. Four sections in the lower half of the Salinas Valley have average public supply wells less than 400 feet deep.

Well depth statistics in Table 2 shows that the average depth from these wells is generally deeper than 400 feet. Twenty-five percent of the wells were completed with 400 feet. However, very few well logs (75) in the DWR database are classified as Public Supply compared with the extensive public supply wells designated in GeoTracker GAMA. In Salinas Valley over 415 wells downloaded from GeoTracker are listed as CDPH supply wells, 398 of which have nitrate data collected since the year 2000. Therefore, at least 323 wells in the CDPH database are likely classified as other sources, probably domestic, on the DWR well completion reports. As discussed above, most domestic well depths are mostly shallower than 400 feet. The CDPH well dataset includes any public water system that supplies water to either 15 service connections or 25 people at least 60 days of the year. These wells could be anything from a well serving a campground, a rural school or an agricultural facility to sources that serve a large community[32]. Therefore, incorporating the CDPH supply well data into our dataset may introduce some deeper water sources. However, assuming that most of the CDPH wells, as the DWR well completion report indicate, were classified as domestic when installed, it is likely that most of the CDPH wells are completed within 400 feet.

Table 2. Summary Statistics for Public Supply Wells - Well Depth and Screen Bottom reported on DWR well completion reports

	Well Depth	Screen Bottom
Average	558	530
Median	575	543
Minimum	130	124
Maximum	1,500	1,080
Number of wells	75	74

[32] Personal communication with Jan Sweigert, District Engineer of SWRCB Division of Drinking Water, 12/5/2014.

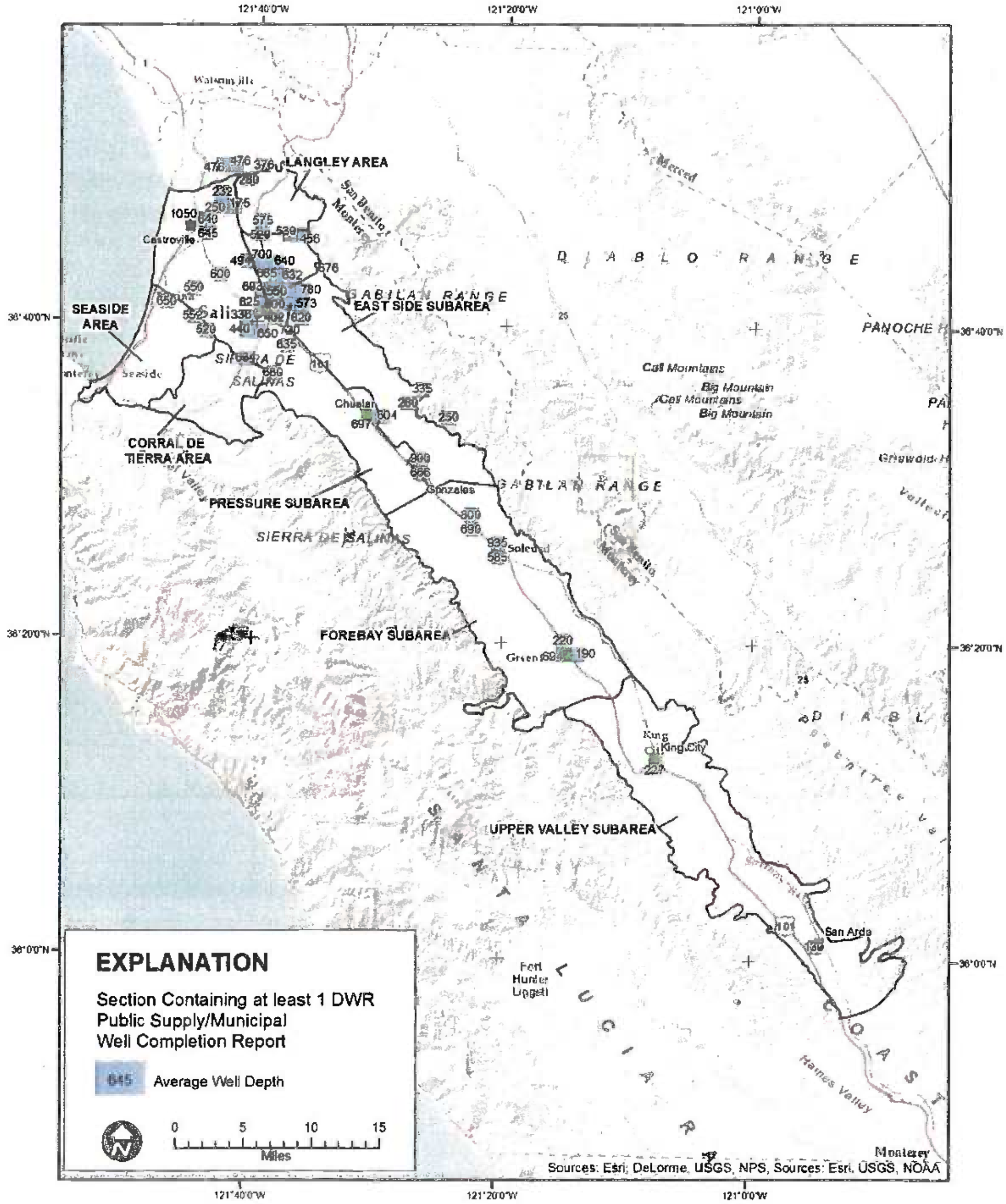


Figure 8. Average public supply well depths by section.

Distribution of Groundwater Nitrate Concentrations and Associated Uncertainty

Results from 939 wells were used to map the distribution of groundwater nitrate (as NO_3) concentrations. For wells with multiple sample dates from 2000 to 2014, we used the maximum nitrate concentrations for each well.

Summary statistics for average nitrate concentrations are shown in Table 3. The mean concentration was 44.7 mg/L as NO_3. The median was 15.0 mg/L as NO_3. Values ranged from less than the detection limit of 0.09 mg/L to 614 mg/L. Two hundred and forty wells (26 %) had time-averaged concentrations over the MCL of 45 mg/L. In the five subareas, the mean nitrate concentration ranged from a low of 15.4 mg/L in the Langley Subarea to 86.9 mg/L in the Forebay Subarea. The percent of wells with average nitrate concentrations exceeding the MCL ranged from 9 % in the Langley Subarea to 51 % in the Forebay Subarea.

Table 3. Summary Statistics for Average Groundwater Nitrate Concentrations

	Entire Salinas Valley	Langley Subarea	Pressure Subarea	East Side Subarea	Forebay Subarea	Upper Valley Subarea
Mean	44.7	15.4	20.7	67.4	87.1	56.4
Median	15.0	7.42	6.48	25.8	46.5	15.0
Standard Deviation	2.56	1.18	2.30	8.86	7.17	8.77
Minimum	0.09	0.16	0.1	0.16	0.4	0.09
Maximum	614	96.5	249	614	511	482
Number of wells	939	232	262	154	202	89
Number of wells (percentage) with average concentrations over the MCL	240 (26%)	20 (9%)	32 (12%)	52 (34%)	104 (51%)	32 (36%)
Total Area (acres)	349,321	15,344	84,323	57,454	94,030	98,170
Percent of area mapped as over MCL	28%	0.6%	11%	54%	49%	10%

Table 4 shows the summary statistics for wells sampled on CCGC parcels. The mean concentration from domestic wells was 100 mg/L and the median was 55.5 mg/L. Concentrations ranged from less than the detection limit to 614 mg/L.

Table 4. Summary Statistics for Average Groundwater Nitrate Concentrations Sampled under the CCGC

	Domestic and Domestic/Irrigation	Irrigation
Mean	100	127
Median	54	15.5
Standard Deviation	8.21	113
Minimum	0.4	6
Maximum	614	690
Number of wells	221	6
Number of wells (percentage) with concentrations over the MCL	121 (55 %)	1 (17 %)

Two hundred and twenty one (221) domestic source wells were sampled by the CCGC in the Salinas Valley. From the 1,517 DWR well completion reports with well depth information in Salinas Valley, 1,173 have well depths less than 400 feet. These data indicate that the CCGC sampled about 15 % of domestic wells for which DWR well completion reports exist in the Salinas Valley. A total of 341 known domestic wells were used in our analysis which would indicate a representation of 22% of domestic wells for which DWR well completion reports exist in the Salinas Valley. It is uncertain how many of these wells remain in operation. Figure 9 shows the known domestic well locations based on the wells sampled by the CCGC and data obtained from other sources and sections with DWR domestic well completion reports. Figure 9 indicates that the domestic well data used for this report adequately represents the areas where, based on DWR well completion reports, where domestic wells have been installed.

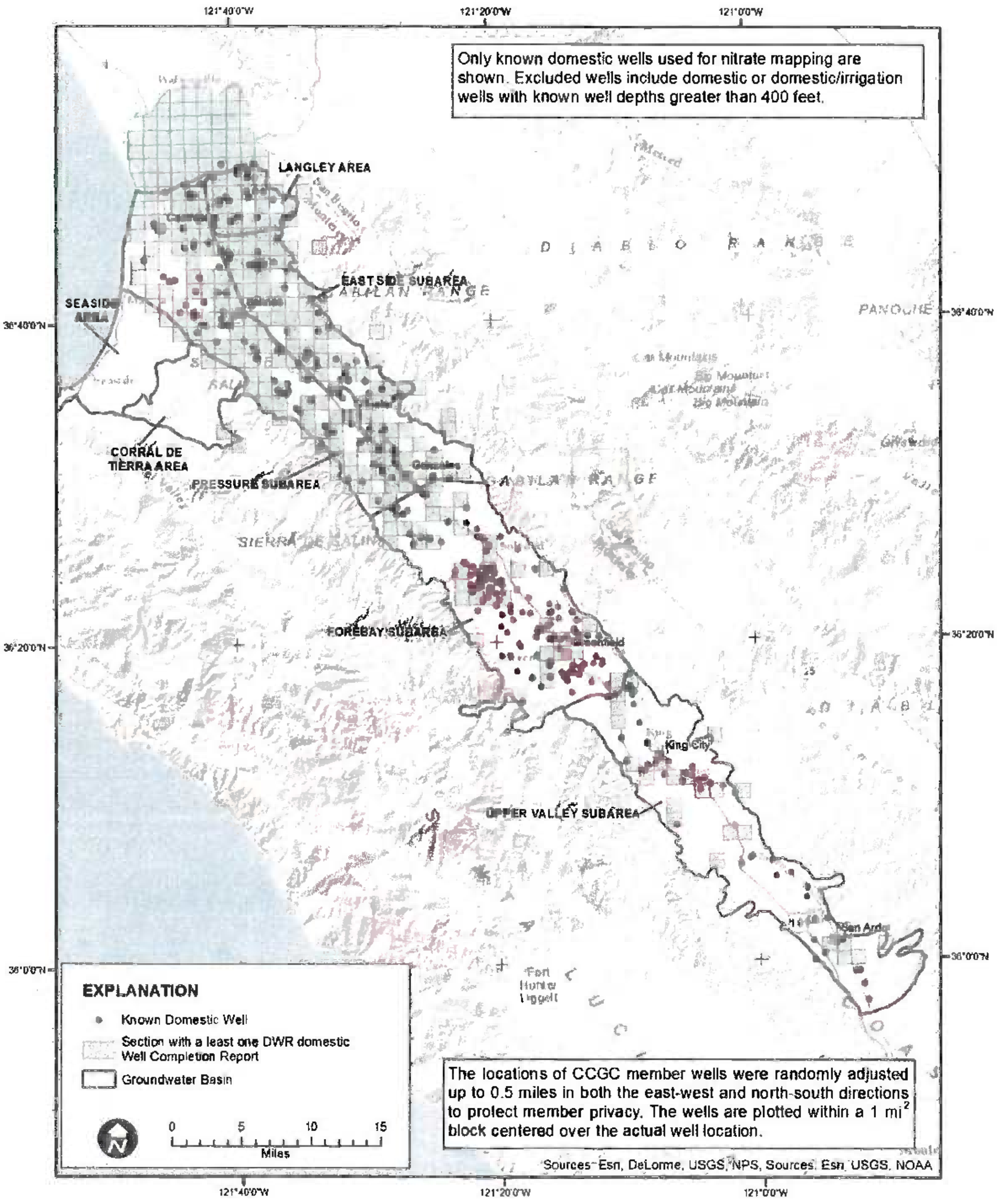


Figure 9. Known domestic wells sampled by CCGC, individual L&Gs, USGS, State Board (GAMA) and sections containing at least one DWR domestic well completion report.

Boxplots (Figure 10) show the range and median of time-averaged groundwater nitrate concentrations for the five subareas. In the Pressure Subarea, groundwater nitrate concentrations are generally below the MCL but there are some wells with concentrations that exceed the MCL ranging up to several hundred mg/L. Similarly in the Langley, the majority of the values fall below the MCL but a number of wells had concentrations exceeding the MCL, ranging up to 100 mg/L. The median nitrate concentrations from the East Side subarea falls below the MCL, however there is very large variability in the nitrate concentrations. Some outlier wells contain nitrate concentrations exceeding 600 mg/L. In the Forebay and Upper Valley subareas, relatively larger percentages of values exceeded the MCL and concentrations range up to 100 mg/L or greater, however the median nitrate concentration from both these subareas falls below the MCL.

Figures 11a through 11e show boxplots of nitrate concentrations by depth for the Langley Subarea, Pressure Subarea, East Side subarea, Forebay Subarea, and Upper Valley Subarea. In the Langley Subarea, nitrate concentrations are generally less than the MCL. Only one point, from a depth interval of 251-300 feet, exceeded the MCL. In the East Side subarea, median nitrate concentrations above the MCL were observed in depth ranges 151-200, 401-450, and 451-500. In the Pressure Subarea, median nitrate concentrations exceed the MCL in the shallow depths from 0 to 100 feet. The median nitrate concentrations from greater depths are all less than the MCL; however there are sample points that exceed the MCL at most depth intervals. In the Forebay Subarea, median nitrate concentrations exceeded the MCL in depth ranges from 101 to 350 feet. In the Upper Valley Subarea, nitrate concentrations exceeded the MCL at depths shallower than 200 feet. The six sample points greater than 200 feet are all well below the MCL. For the entire Salinas Valley, wells greater than 400 feet deep generally have lower nitrate concentrations

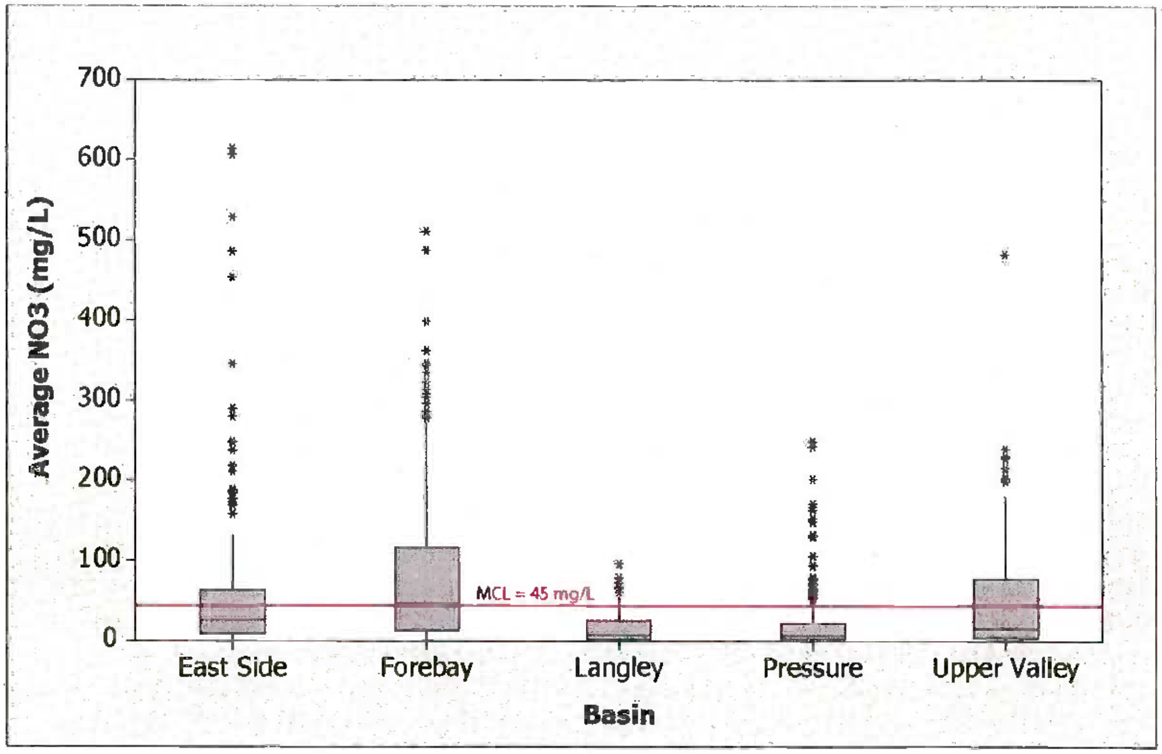


Figure 10. Boxplots showing medians and ranges for average nitrate concentrations for the five subareas. The grey rectangle represents the inner quartile range of the data. The horizontal line in the rectangle represents the median. Vertical lines represent 90 % of the data. Asterisks represent values beyond 90 % of the data.

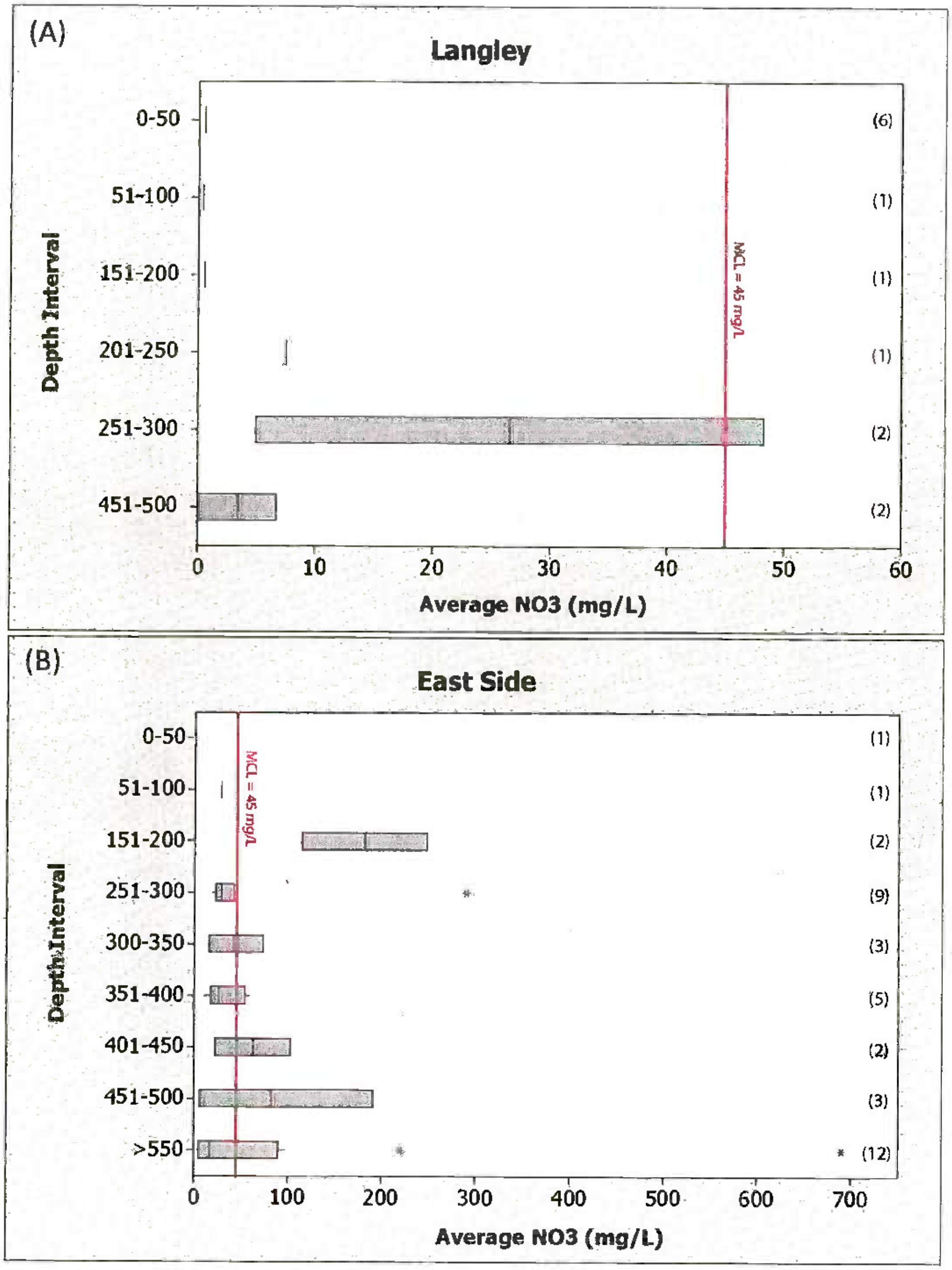
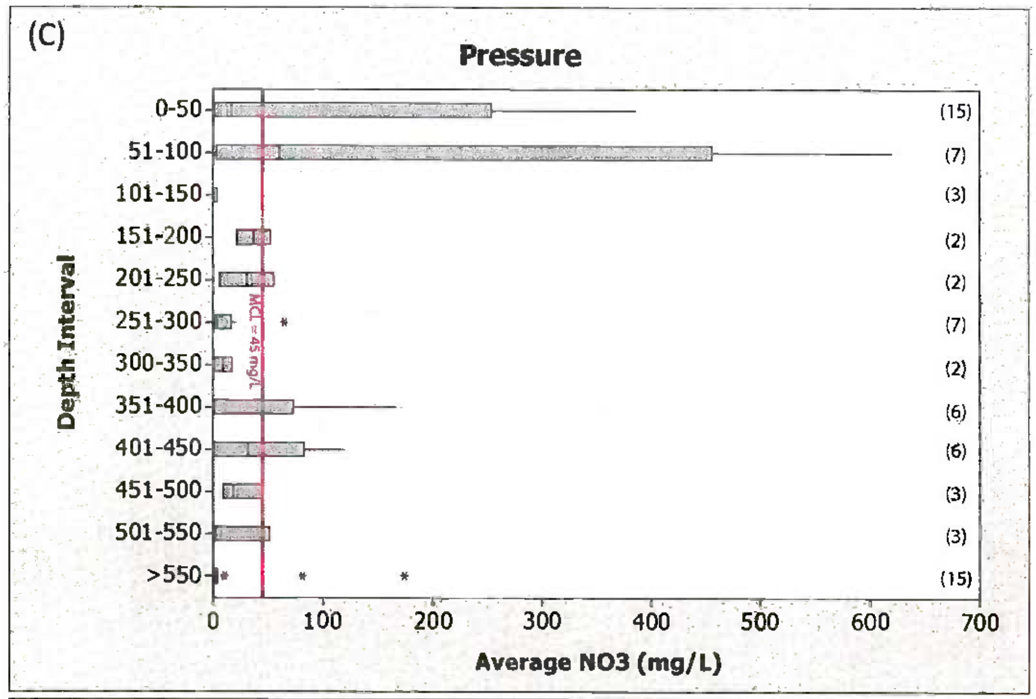


Figure 11. Boxplots showing medians and ranges for average nitrate concentrations for the Langley (a), East Side (b), Pressure (c), Forebay (d), and Upper Valley (e) subbasins by depth. The grey rectangle represents the inner quartile range of the data. The horizontal line in the rectangle represents the median. Vertical lines represent the range of 90 % of the data. Asterisks represent concentrations beyond the range of 90 % of the data. The numbers in parentheses provide the well count.



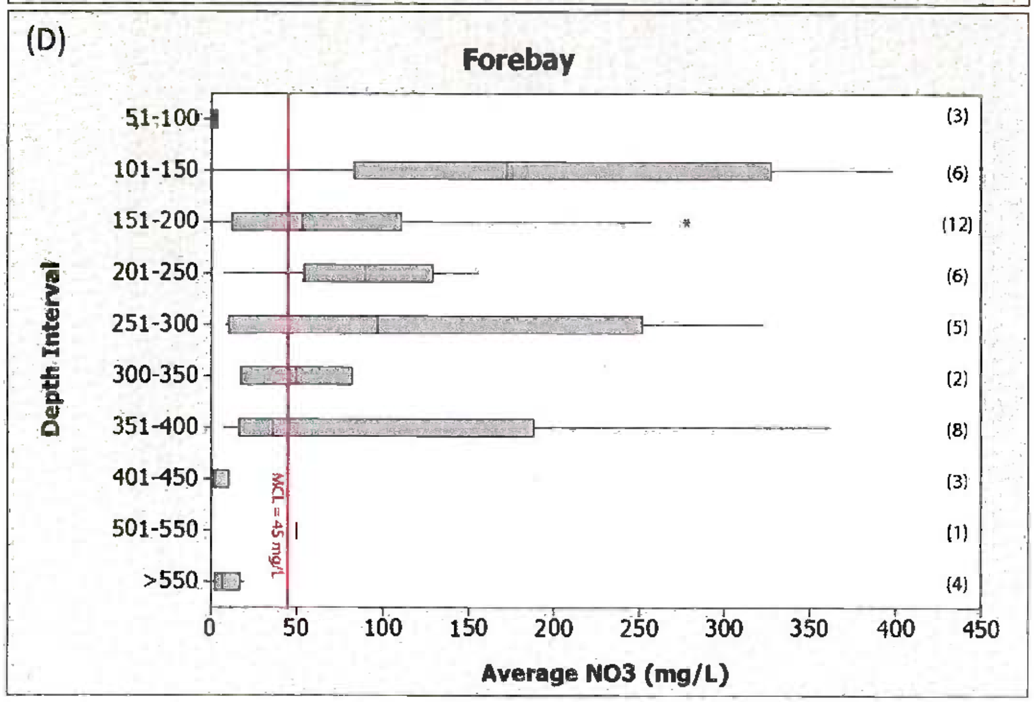


Figure 11 (continued). Boxplots showing medians and ranges for average nitrate concentrations for the Langley (a), East Side (b), Pressure (c), Forebay (d), and Upper Valley (e) subbasins by depth. The grey rectangle represents the inner quartile range of the data. The horizontal line in the rectangle represents the median. Vertical lines represent the range of 90 % of the data. Asterisks represent concentrations beyond the range of 90 % of the data. The numbers in parentheses provide the well count.

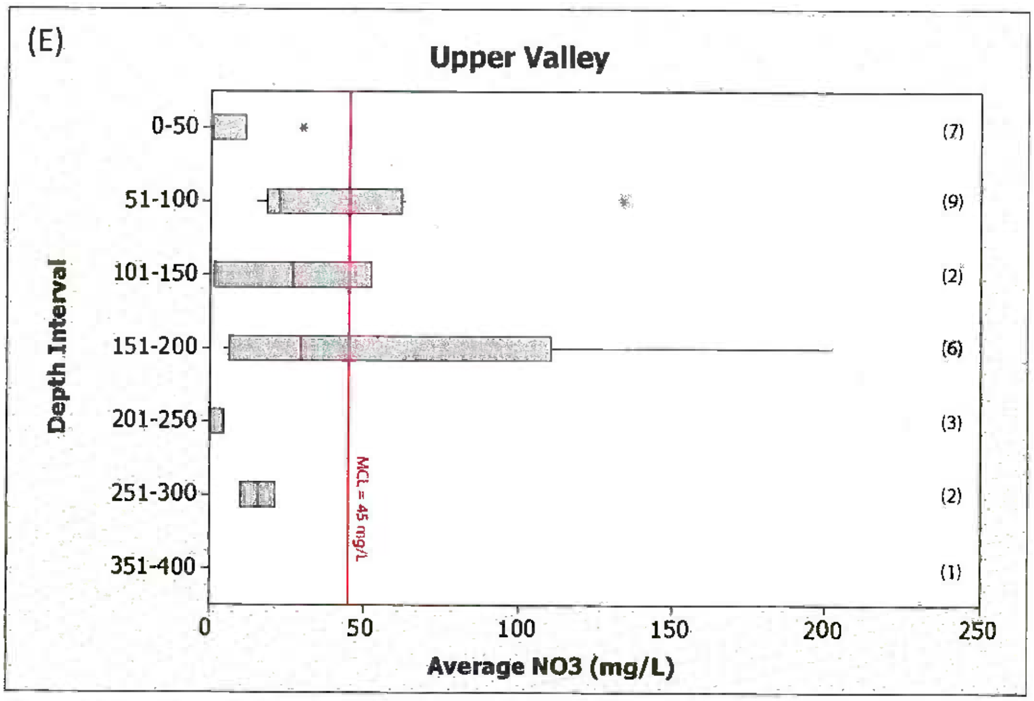


Figure 11 (continued). Boxplots showing medians and ranges for average nitrate concentrations for the Langley (a), East Side (b), Pressure (c), Forebay (d), and Upper Valley (e) subbasins by depth. The grey rectangle represents the inner quartile range of the data. The horizontal line in the rectangle represents the median. Vertical lines represent the range of 90 % of the data. Asterisks represent concentrations beyond the range of 90 % of the data. The numbers in parentheses provide the well count.

Results from 939 wells were used to determine the areal distribution of groundwater nitrate (as NO_3) concentrations. Figure 12 shows areal distribution of groundwater nitrate concentrations and the kriging results in the Salinas Valley[33]. In Appendix A, we provide a modified version of Figure 12 with posted values for the wells or well clusters.

Mapped groundwater nitrate concentrations in the Pressure Subarea are generally less than one-half of the MCL due to widespread distribution of a large number of low nitrate concentrations. Exceptions include areas of concentrations over the MCL southwest and southeast of Chualar and northwest and west of Gonzales. In the Langley Subarea, mapped groundwater nitrate concentrations are generally less than one-half of the MCL. Exceptions include small areas in the northern parts of the subarea.

[33] The locations of CCGC member wells were obfuscated to protect member privacy. The locations of CCGC member wells shown on Figure 4 were randomly adjusted up to 0.5 miles in both the east-west and north-south directions. The wells are plotted within a 1 mi^2 block centered over the actual well location. The actual locations were used when kriging the nitrate concentration surface.

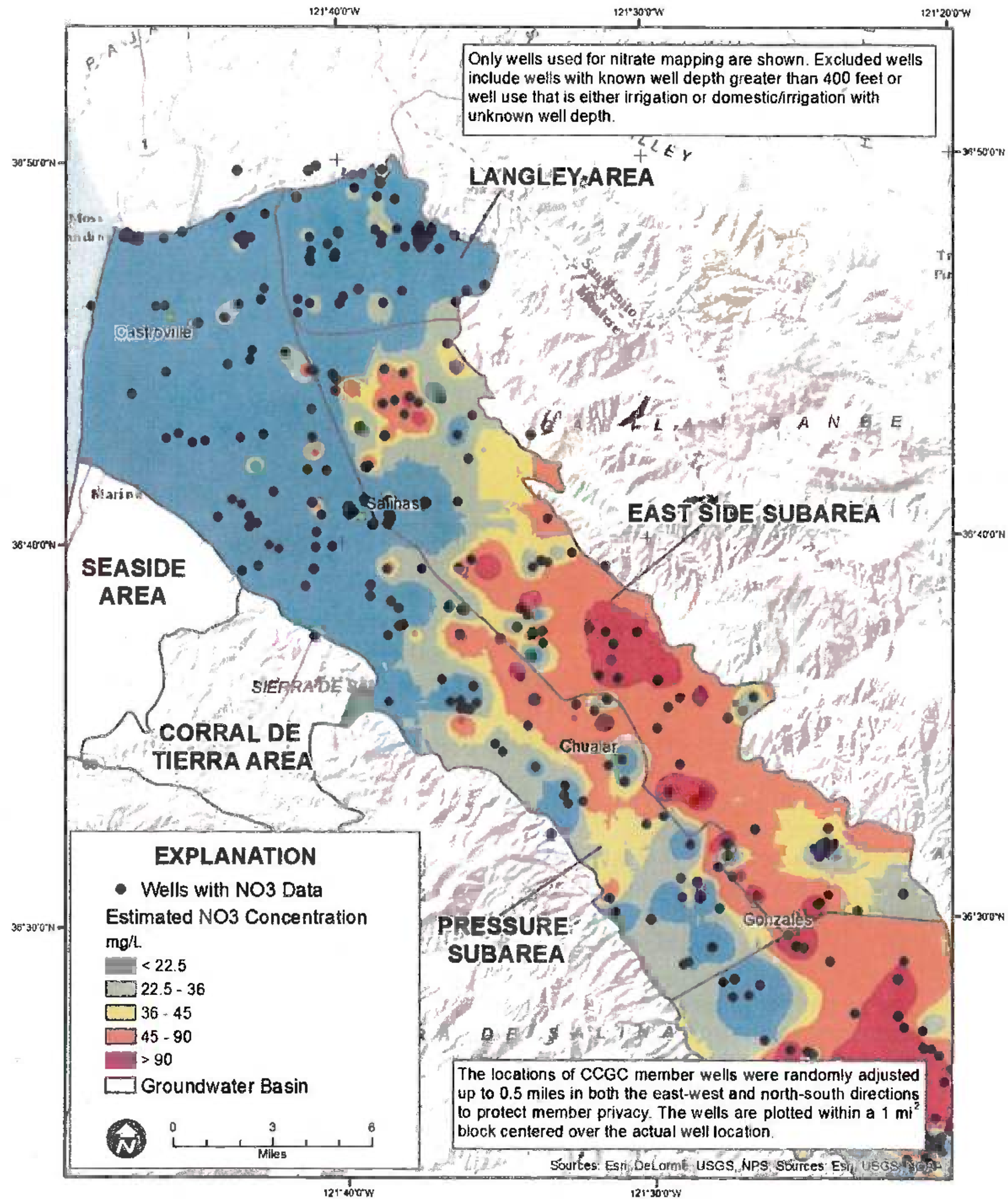


Figure 12a. Kriged nitrate concentrations and delineation of areas with varying concentration ranges – Pressure, East Side, and Langley Subareas.

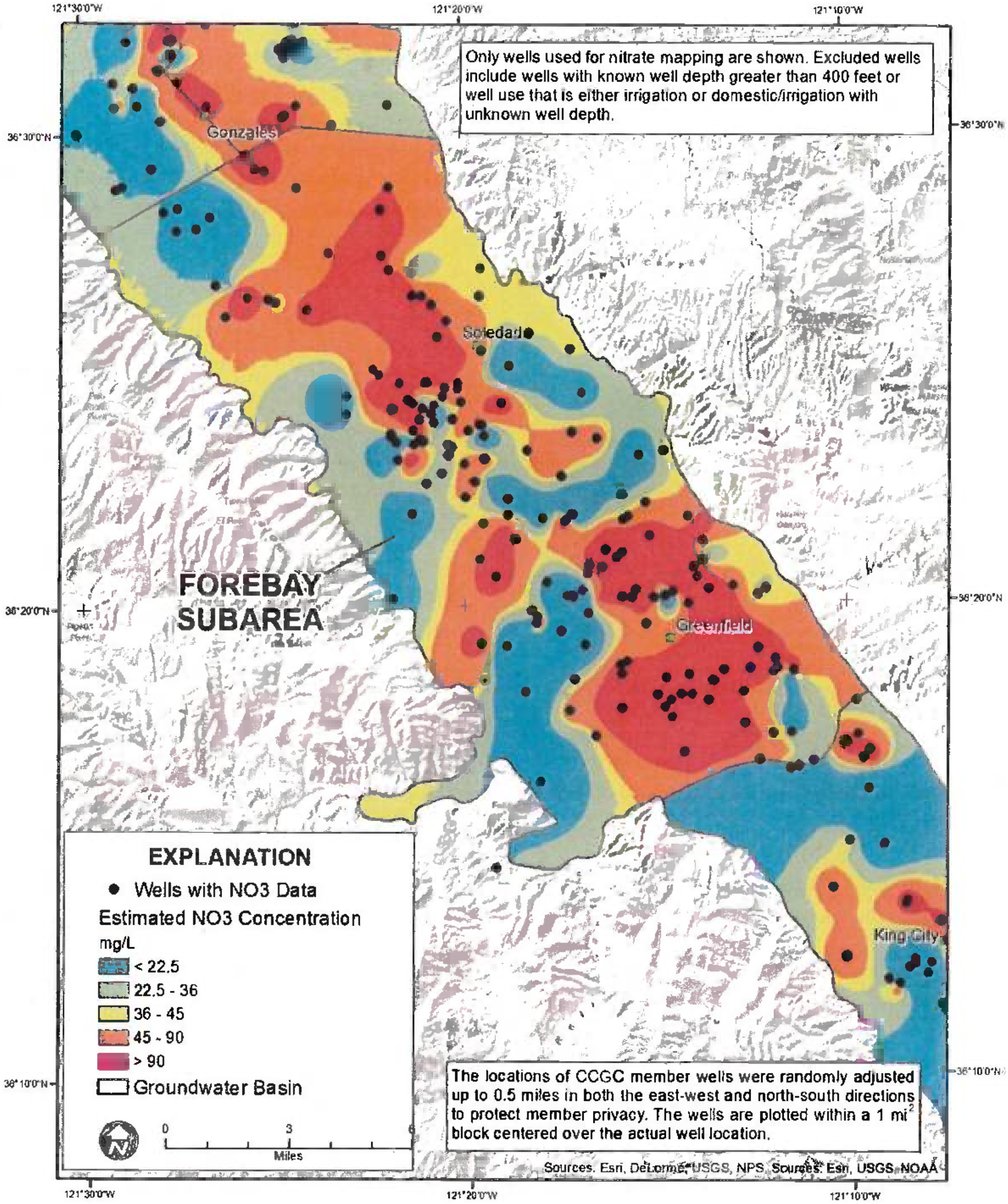


Figure 12b. Kriged nitrate concentrations and delineation of areas with varying concentration ranges – Forebay Subarea.

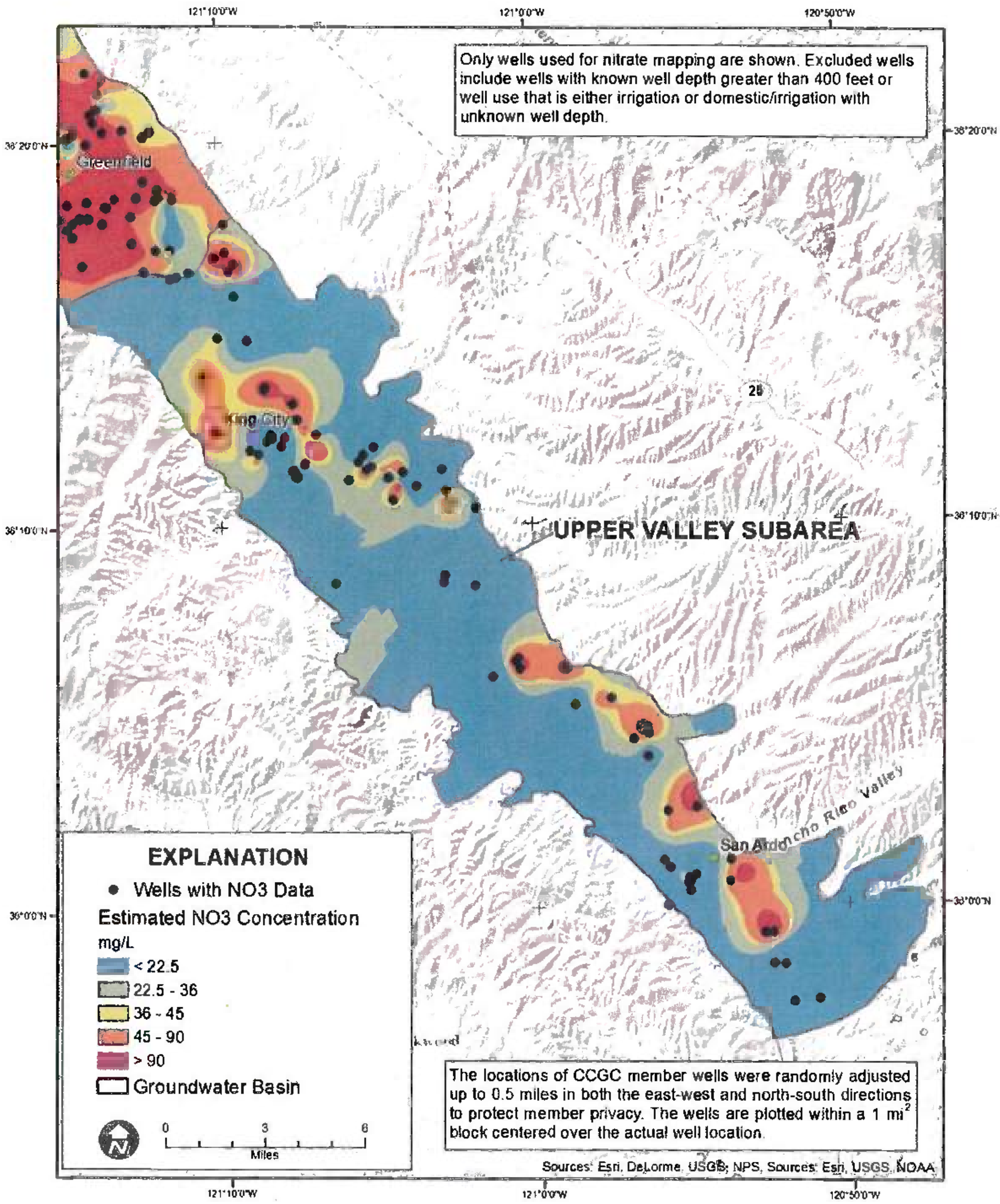


Figure 12c. Kriged nitrate concentrations and delineation of areas with varying concentration ranges – Upper Valley Subarea.

In contrast, there are large areas in the East Side subarea where groundwater nitrate concentrations are mapped as greater than the MCL. These include the area north of Salinas where concentrations as high as 189 mg/L were observed and areas east and southeast of Salinas and east, northeast, and southeast of Chualar and Gonzales where concentrations were measured as high as several hundred mg/L.

Forty-nine percent (49%) of the area within of the Forebay Subarea is mapped as having concentrations of nitrate in groundwater greater than the MCL. The large area mapped as greater than the MCL is influenced by the preponderance of high values spatially distributed throughout the subarea. For example, in the area northwest of Soledad (Figure 12), the majority of the wells have concentrations that are over the MCL. Similarly, large numbers of values close to or over the MCL have a dominant influence on the extent of red areas from Soledad to Greenfield and south of Greenfield.

In the Upper Valley Subarea there are a relatively small number of sample points. The spatial distribution of high nitrate values results in clustered areas where concentrations were over the MCL near King City and along the eastern boundary both north and south of San Ardo.

Figure 13 shows the distribution of the standard deviation of the estimated nitrate concentrations[34]. The distribution of standard deviation is proportional to the number of points and spatial variability of the nitrate concentrations. The large number of points corresponding to low concentrations of points in the Forebay Subarea (lighter pink areas) result in low standard deviation values and higher certainty relative to the East Side subareas where there are fewer points and greater variability in concentrations. Also, standard deviation values increase towards the southern valley due fewer points and increasing spatial variability. The combination of data paucity and large spatial variability in concentrations above the MCL in the northwestern Pressure, East Side and Upper Valley subareas results in high standard deviation values up to 10 mg/L. Most of the area of high standard deviation in the Upper Valley Subarea corresponds with nitrate concentrations lower than half the MCL (Figure 12).

The density of wells associated with the distribution of standard deviation varies by subarea. Areas on the map where the standard deviation values are less than 5.0 mg/L correspond to areas where there are wells. Areas without wells correspond to standard deviation values greater than 5.0 mg/L. In the Pressure and Eastside subareas, the spatial density of wells where the standard deviation was less than 5 was 1 well per 25 acres. In the Forebay and Upper Valley subareas, the density was 1 well per 65 and 14 acres, respectively.

Figures 14 and 15 show the locations of CCGC member parcels overlain on the mapped areas of varying concentration ranges and standard deviation values shown in Figure 12. Member parcels are generally evenly distributed throughout the Salinas Valley and overlay all concentration ranges (Figure 14). However, the density of parcels in the northern Pressure Subarea and Langley Subarea is low. Member parcels are also relatively sparse in the Upper Valley Subarea

There are six remaining domestic wells located on L&G parcels in which the leasee does not have access to the well, and therefore could not be sampled by the CCGC. These wells are owned by the land

[34] The locations of CCGC member wells were obfuscated to protect member privacy. The locations of CCGC member wells shown on Figure 4 were randomly adjusted up to 0.5 miles in both the east-west and north-south directions. The wells are plotted within a 1 mi^2 block centered over the actual well location. The actual locations were used when generating the standard error surface.

owners who are not members of the CCGC and did not allow the CCGC to sample their wells. The parcels on which these wells reside are in areas with at least 4 other sample points within 1 mi^2.

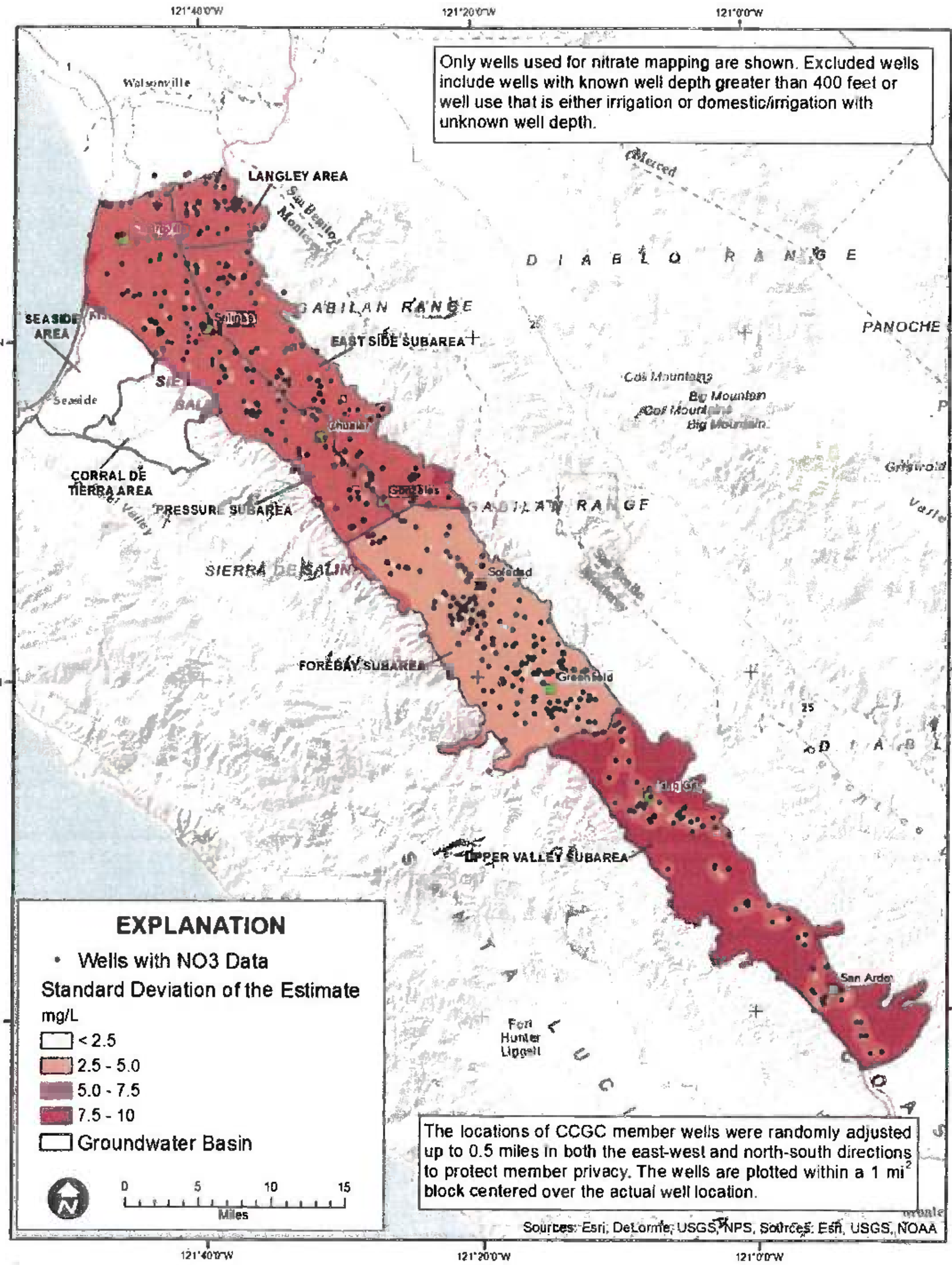


Figure 13. Distribution of standard deviation of kriged nitrate concentrations.

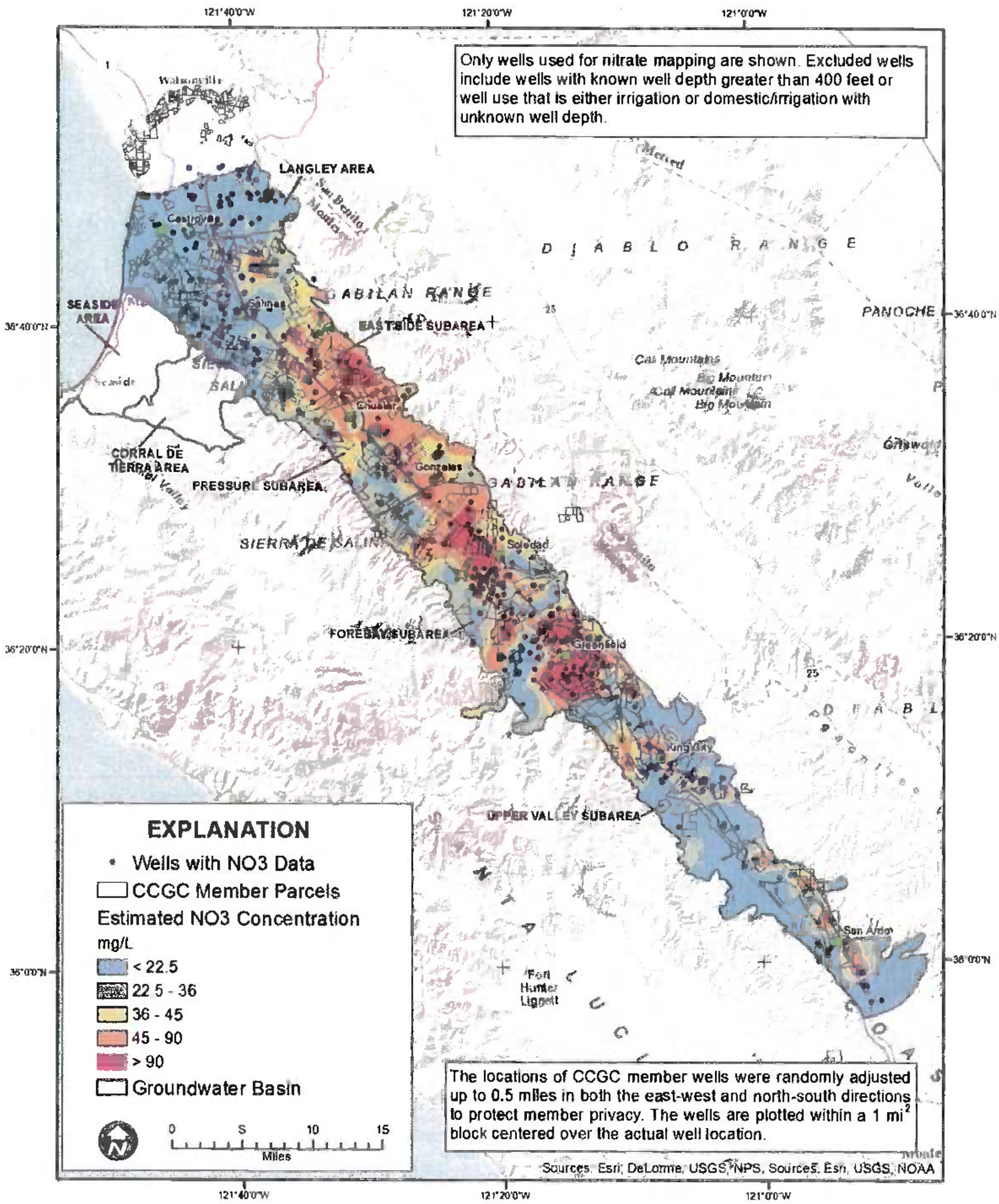


Figure 14. Kriged nitrate concentrations and member parcels.

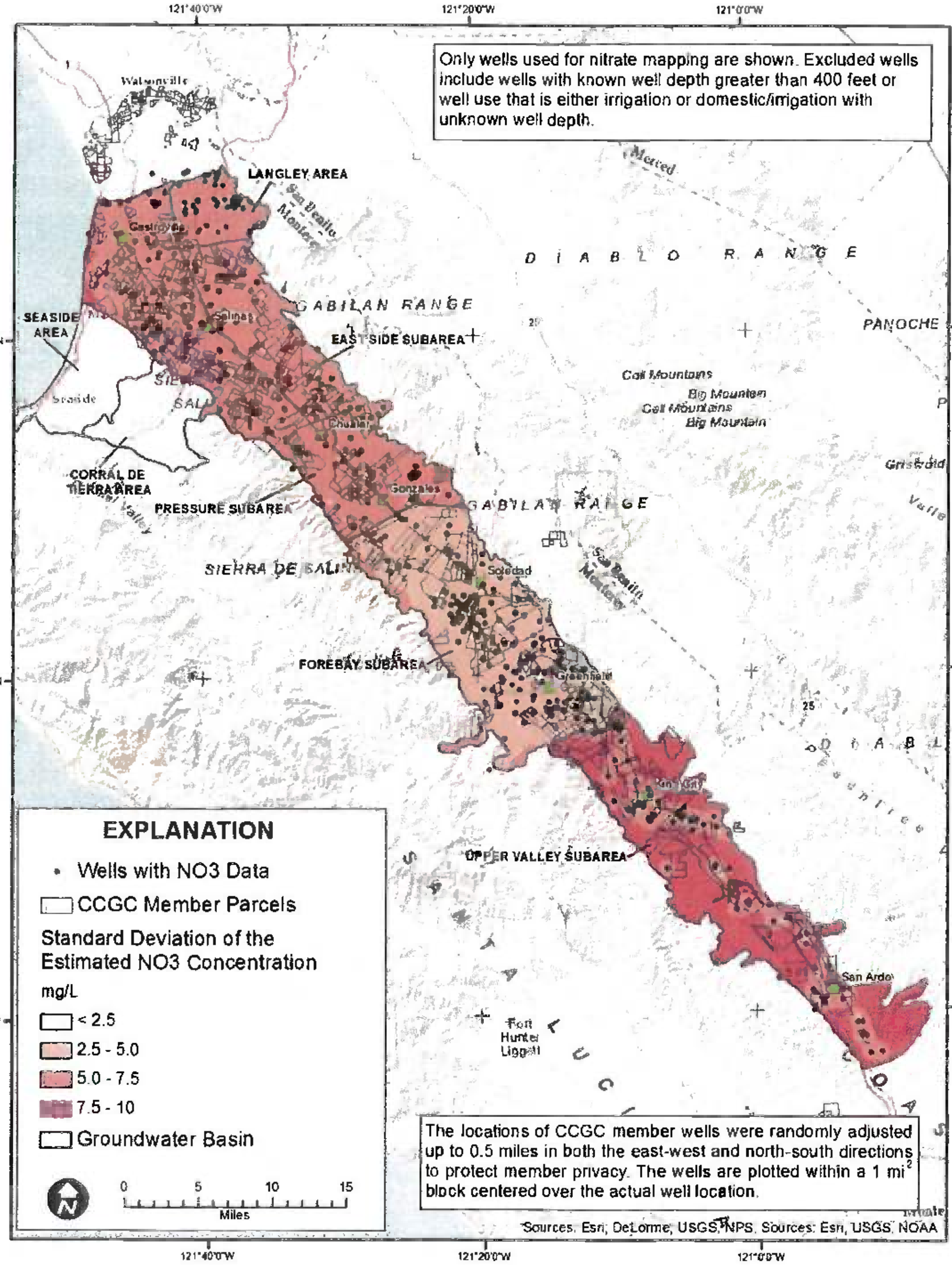


Figure 15. Distribution of standard deviation of kriged nitrate concentrations and member parcels.

Figures 16 through 19 show the probability of exceeding different nitrate concentrations based on the indicator kriging results. Figure 16 shows that in much of the East Side and Forebay subareas there is a 60 – 70 % probability of exceeding half the MCL (22.5 mg/L). Most of the remaining area in Valley is mapped as having a probability of over 40-50%. Figure 17 shows that in much of the southern East Side subarea and most of the Forebay Subarea there is 60 – 70% probability of groundwater nitrate concentrations exceeding 80% of the MCL (36 mg/L). For most of the remainder of the Valley, the estimated probability is 40 – 50%. Figure 18 shows that from the area east of Chualar down through Greenfield have a 50 – 60% probability of exceeding the MCL (45 mg/L). The estimated probability for the remainder of the Valley is generally greater than 30%. Finally, Figure 19 shows that concentrated areas near Chualar, Gonzales, and Greenfield have high probability of exceeding double the MCL (90 mg/L).

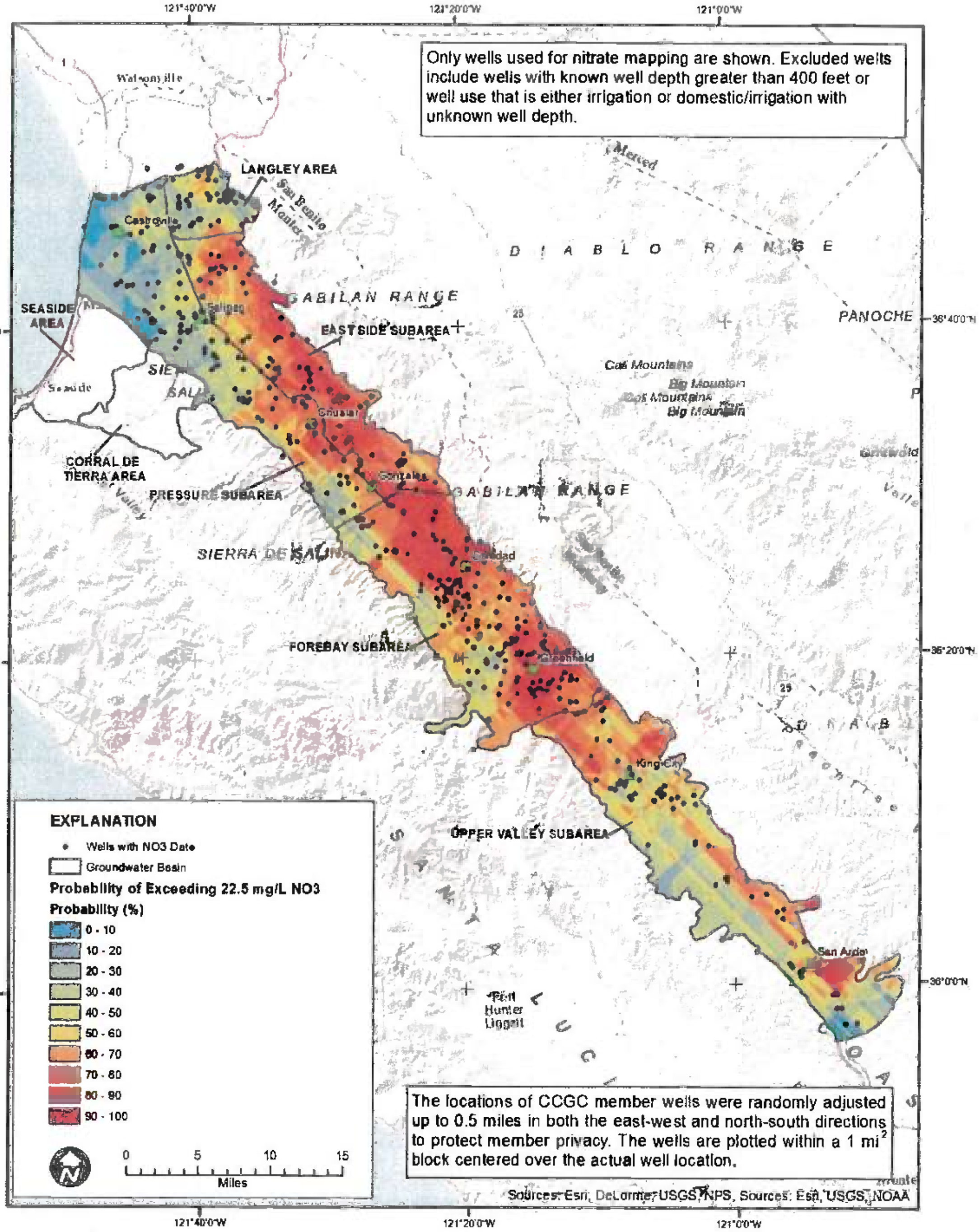


Figure 16. Distribution of estimated probability of exceeding nitrate concentrations of 22.5 mg/L in groundwater.

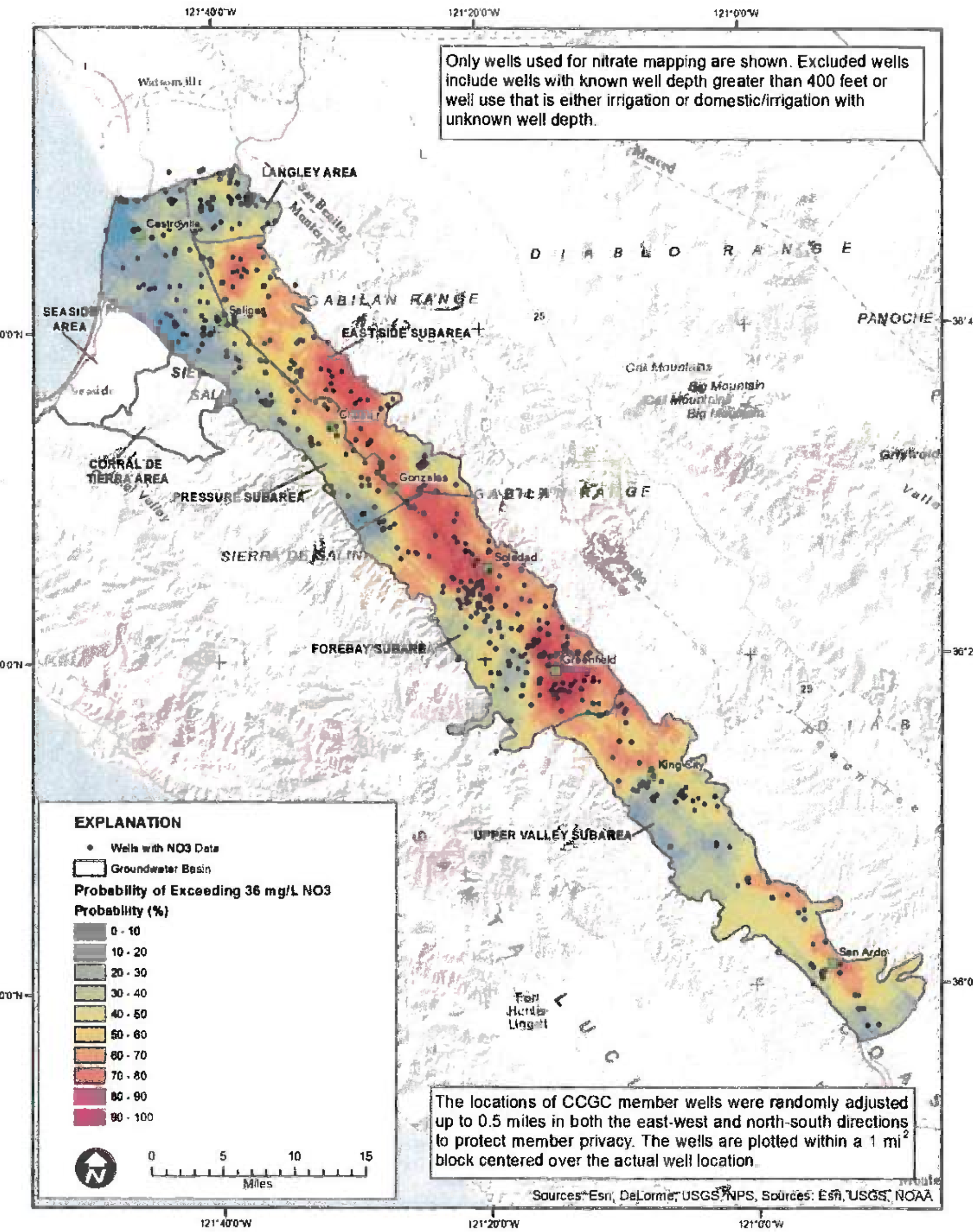


Figure 17. Distribution of estimated probability of exceeding nitrate concentrations of 36 mg/L in groundwater.

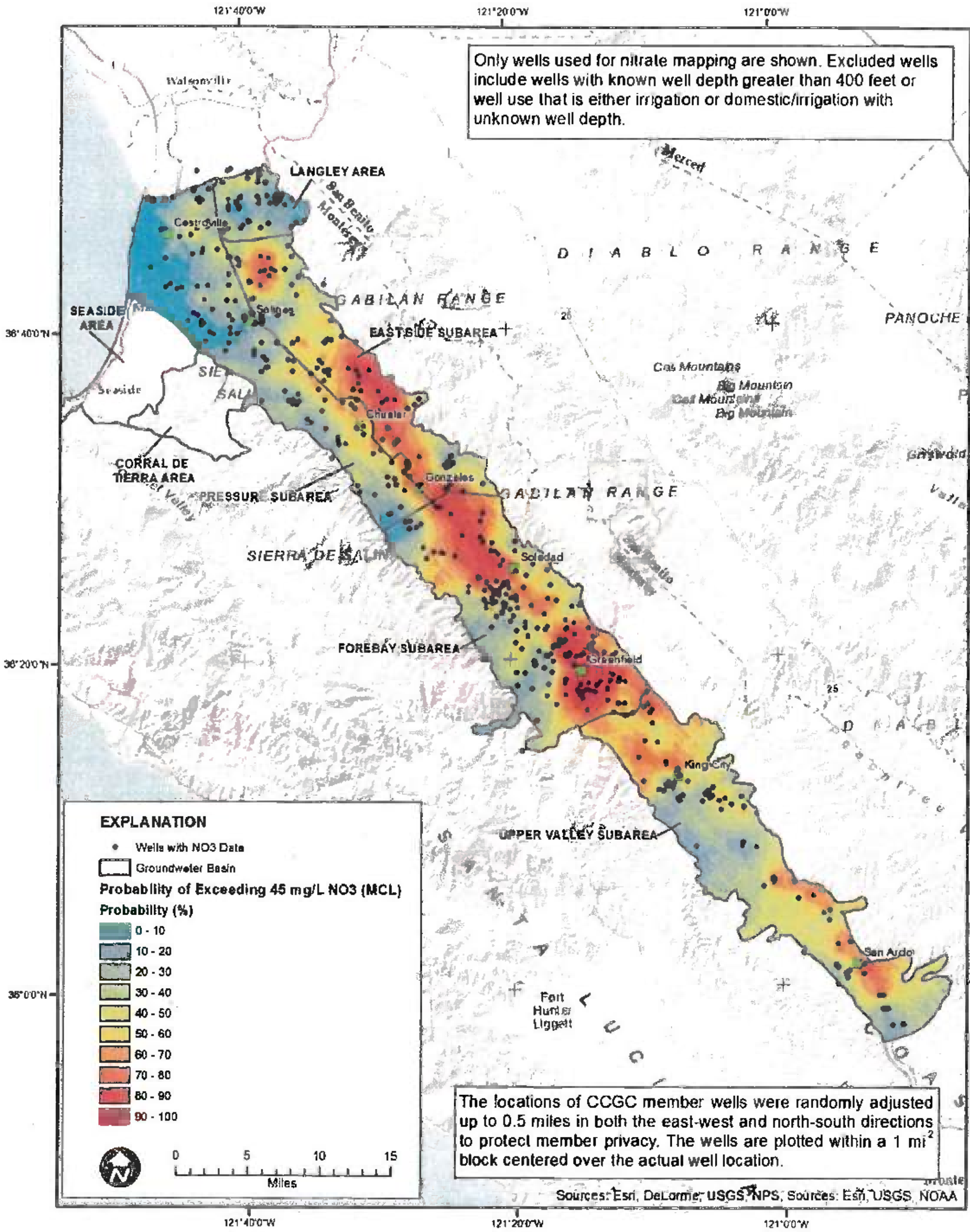


Figure 18. Distribution of estimated probability of exceeding nitrate concentrations of 45 mg/L in groundwater.

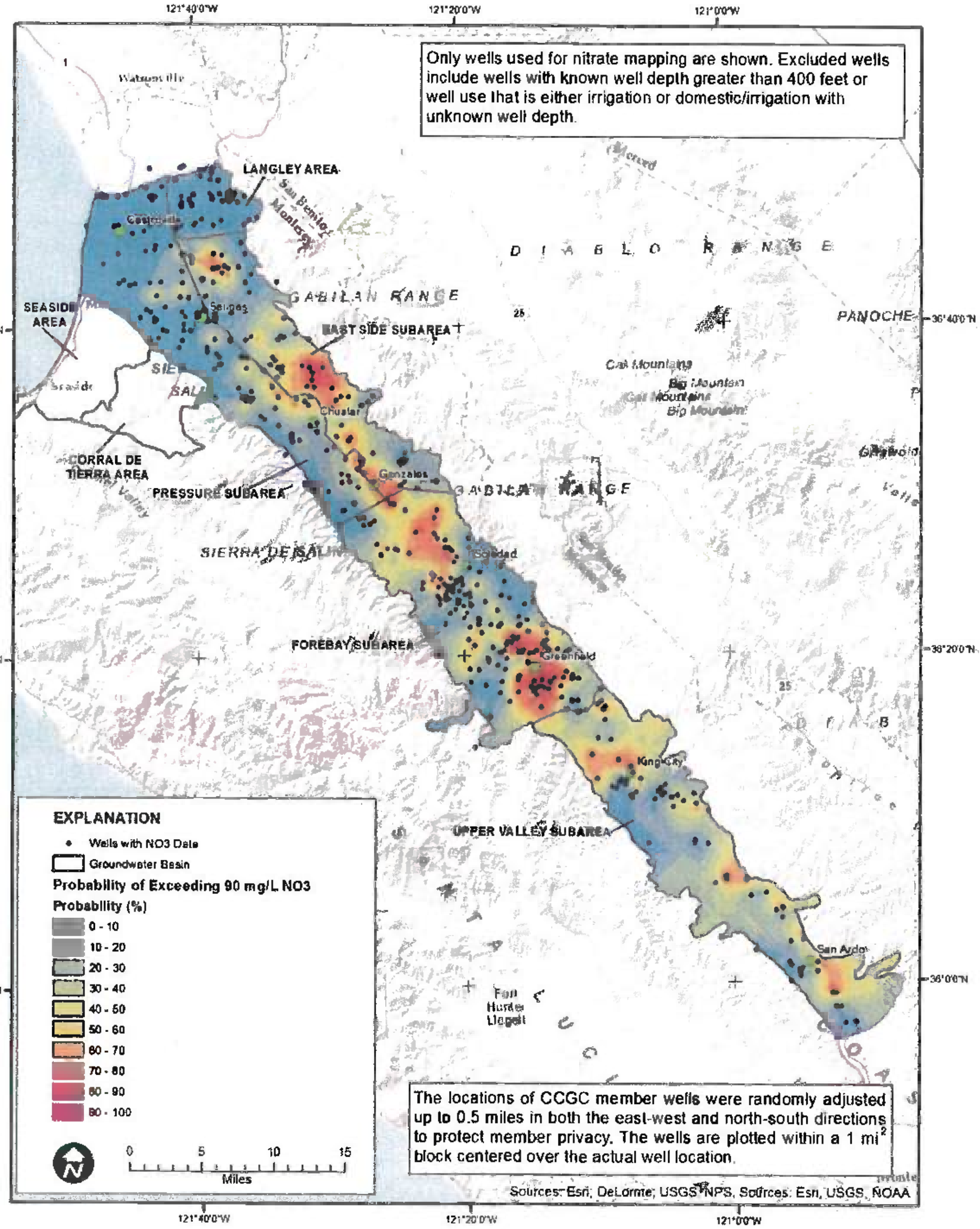


Figure 19. Distribution of estimated probability of exceeding nitrate concentrations of 90 mg/L in groundwater.

Figure 20 shows the distribution of concentrations accounting for the standard deviation of the estimated nitrate concentrations shown in Figure 12. The map of standard deviations of the estimated concentrations (Figure 13) shows that the standard deviations are less in the Forebay Subarea than they are in the Pressure, Langley, East Side, and Upper Valley subareas. Therefore, the differences in concentrations between those shown in Figure 12 and those shown in Figure 20 are less in the Forebay Subarea than in the other subareas. At the 66% confidence level, the area estimated to have a concentration above the MCL is slightly smaller than shown in Figure 12 (Figure 21). In the East Side subarea this is most noticeable in the area northeast of Salinas and east of Gonzalez. In the Pressure Subarea this is most noticeable northwest of Chualar. In the Forebay Subarea this is most noticeable west of Greenfield and in the Upper Valley Subarea it is most noticeable in the areas near King City and San Ardo (Figure 21). In all subareas, the areas mapped as having concentrations less than 22.5 mg/L is greater at the 66% confidence level than shown in Figure 12.

At the 95% confidence level, the effect is more pronounced. The areas shown to have a concentration above the MCL are even smaller and the areas shown to have a concentration less than 22.5 mg/L are even larger. In the East Side Subarea, the northern half of the Forebay Subarea, and isolated areas near King City and San Ardo in the Upper Valley Subarea much of the area is show as having an estimated concentration greater than 36 mg/L in Figure 12, but area shown as greater than 36 mg/L in these areas is less at the 95% confidence level.

Figure 21 shows the comparison of Figure 12 with Figure 20 for the area mapped as exceeding the MCL. Specifically, hatched areas represent the area exceeding the MCL in Figure 12 in Figure 21. At the 66% confidence level (Figure 21a) the hatched area generally matches the orange and red areas delineating those areas where concentrations are mapped as greater than the MCL. There are small differences north of Salinas and south and southwest of Chualar and north of Gonzales. Within the Forebay Subarea, the match is almost identical. There a small discrepancies in the Upper Valley Subarea. At the 95% confidence level, the differences are more pronounced in the Eastside and Pressure subareas as indicated by the yellow areas. In the Pressure area there are small differences in the northern part of the Subarea and near Soledad. There are also differences in the Upper Valley Subarea around the orange and red areas.

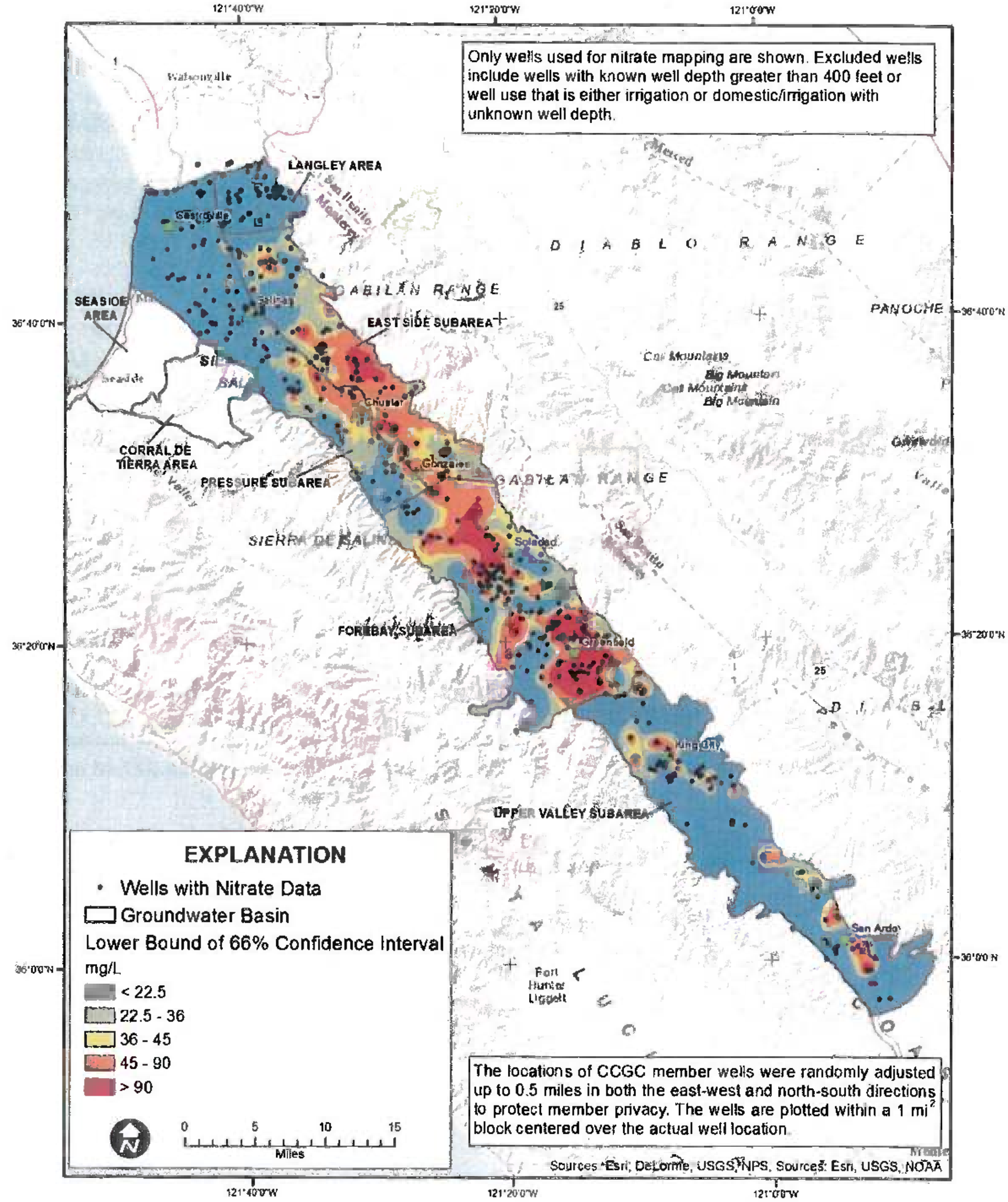


Figure 20a. Distribution of concentrations of nitrate at the 66 % confidence interval.

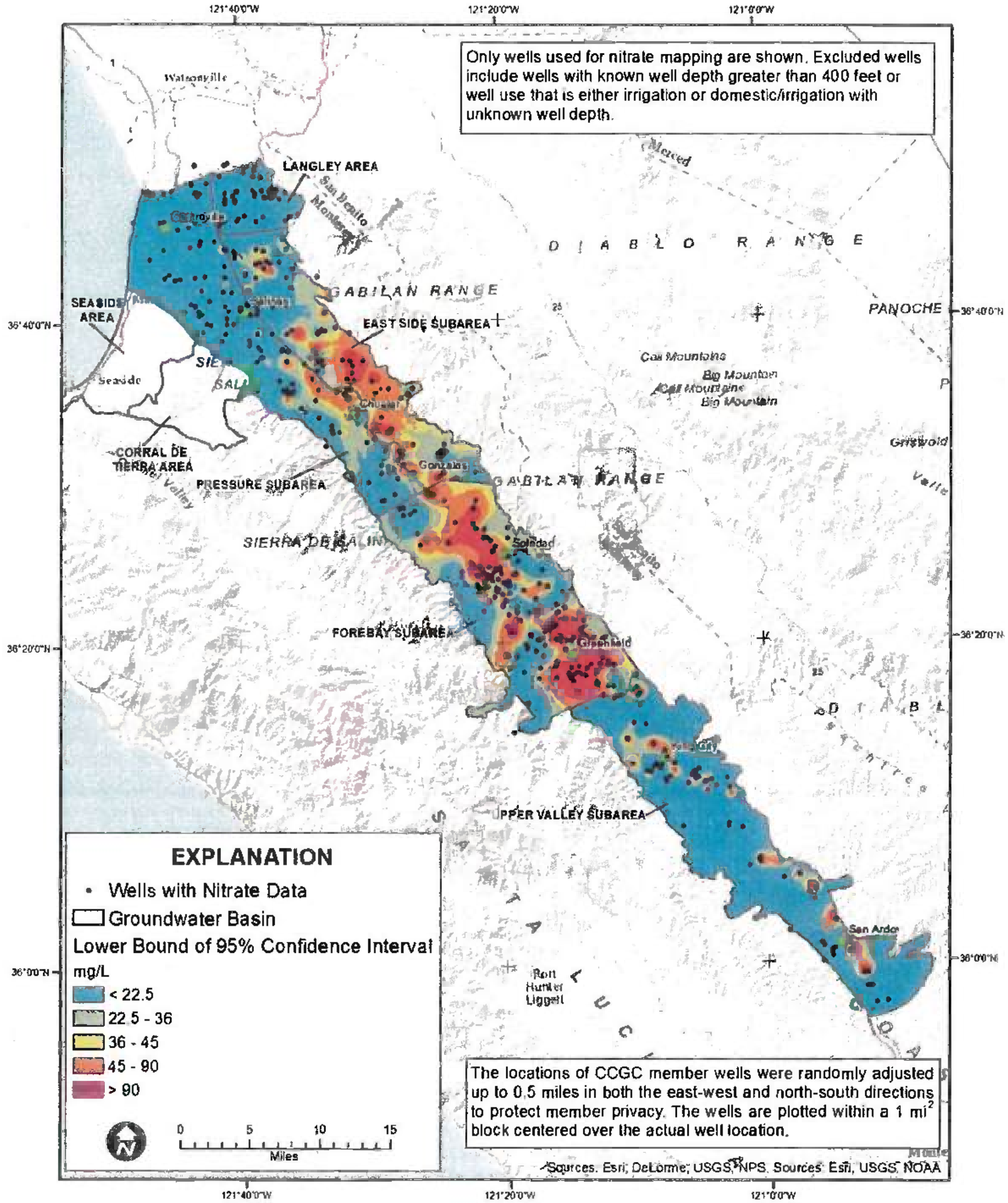


Figure 20b. Distribution of concentrations of nitrate at the 95 % confidence interval.

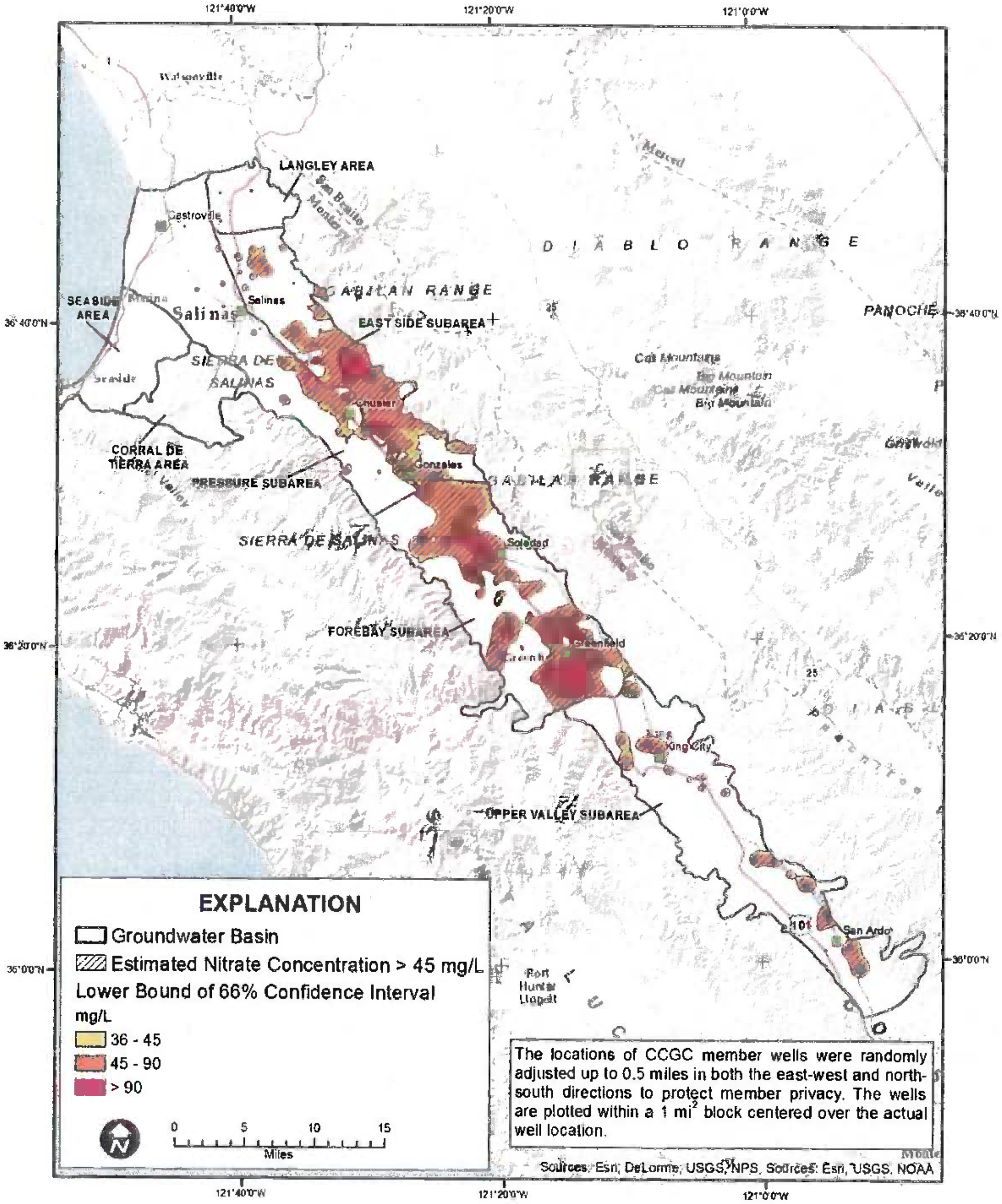


Figure 21a. Overlay of 66% confidence level estimated areas over the MCL and areas over the MCL shown in Figure 12.

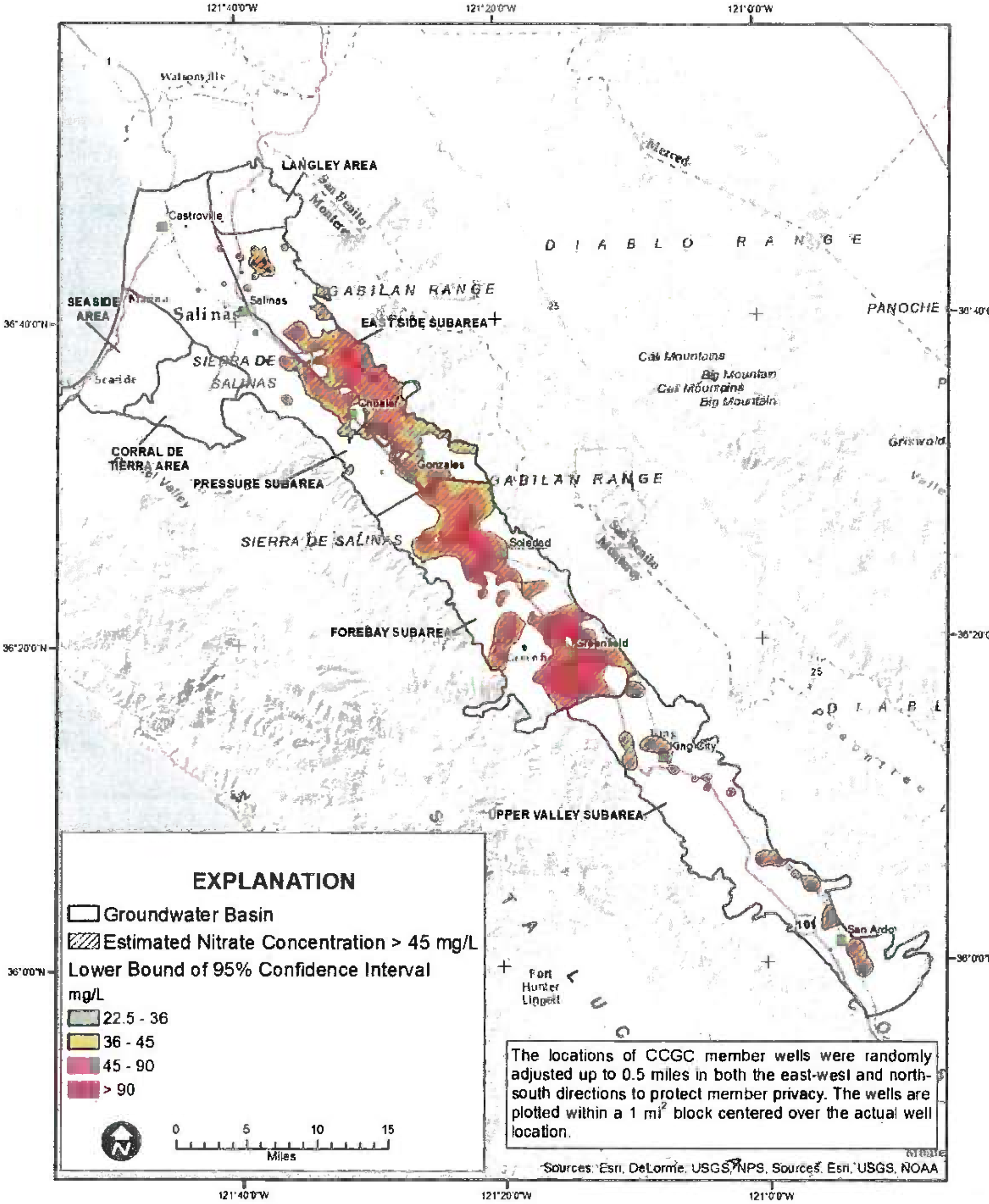


Figure 21a. Overlay of 95% confidence level estimated areas over the MCL and areas over the MCL shown in Figure 12.

Appendix A presents a comparison of GeoTracker results and the distribution of nitrate concentrations shown in Figure 12. For most of the valley, the comparison indicates good agreement between the two maps. All subareas contain few discrepant points. There are two primary reasons why the concentrations reported on the GeoTracker sites may appear to disagree with the estimated nitrate concentrations at some locations. At some sites, the GeoTracker concentrations do agree with the estimated concentrations, but at the scale at which the maps are drawn, the agreement between the GeoTracker concentrations and the estimated concentrations is not visible. At other GeoTracker sites, the disagreement is due to the obfuscation and clustering of well locations that occurs when viewing the sites on GeoTracker. We identified the locations (Figure A2) where there is apparent disagreement between high reported GeoTracker concentrations and the estimated concentrations. Of the 52 points delineated by GeoTracker as being over the MCL, 43 are consistent with our estimated contours, 4 are discrepant due to obfuscation and clustering, and 4 wells were excluded from our dataset due to very high concentrations from a localized contamination site or data collected prior to the year 2000. Finally, in the Langley subarea one GeoTracker site has a maximum nitrate concentration of 45 mg/L and our estimated nitrate concentration is 44.6 mg/L.

Factors Affecting the Distribution of Nitrate Concentrations

We used determination of major ions, nitrate and groundwater age dating to understand factors and processes affecting groundwater nitrate concentrations.

Major Ions and Piper Diagrams

We used Piper diagrams[35] to interpret factors and processes affecting groundwater nitrate concentrations. Piper diagrams provide a graphic way of viewing the relative concentrations of major ions in groundwater (calcium, magnesium, sodium, potassium, chloride, sulfate, bicarbonate and carbonate). Figures 23 to 26 show the Piper diagrams for the samples collected by the CCGC in the Salinas Valley for the four sub-basins.

Boyle and others[36] hypothesized that variation in major-ion chemistry in Salinas Valley groundwater result from geochemical processes occurring along groundwater flow paths. Specifically, relatively high concentrations of calcium and magnesium are associated with more recently recharged water. Calcium and magnesium can move from groundwater to clays and displace sodium which tends to increase in concentration as groundwater moves along its flow path. Additionally, groundwater tends to continuously dissolve carbonate minerals found naturally in geological materials as it travels through the subsurface which results in higher concentrations of bicarbonate in older waters. Consistently, Lee[37] demonstrated this geochemical evolution in the southeastern United States. The results of major ion analysis in CCGC well samples are consistent with this geochemical evolution and variations in major ion concentrations are associated with varying nitrate concentrations (Figures 23 to 26).

---

[35] Hem, Hem JD (1985) Study and Interpretation of the Chemical Characteristics of Natural Water. Third Edition. U.S. Geolgoical Survey Water-Supply Paper 2254

[36] Boyle, Dylan, King, Aaron, Kourakos, Giorgos, Lockhart, Katherine, Mayzelle, Megan, Fogg, Graham E. and Harter, Thomas, 2012, Addressing Nitrate in California's Drinking Water With a Focus on Tulare Lake Basin and Salinas Valley Groundwater Report for the State Water Resources Control Board Report to the Legislature, Technical Report 4

[37] Lee, R.W., 1985, Geochemistry of Groundwater in Cretaceous Sediments of the Southeastern Coastal Plain of Eastern Mississippi and Western Alabama, Water Resources Research, 21, 1451 - 1556

Specifically, points representing groundwater samples collected in the four subareas show a general chemical shift from the calcium-magnesium/chloride-sulfate waters to sodium/potassium bicarbonate waters (see Figure 22 for groundwater chemical characteristics). Groundwater generally flows horizontally from south to north in the Salinas Valley from the Upper Valley to the Pressure subareas and the most recently recharged groundwater is expected in the Upper Valley sub-basin. Groundwater has historically flowed horizontally northward from the Pressure to the Eastside Subarea due to low groundwater levels in the Eastside Subarea[38]. The majority of the points on the Upper Valley Piper diagram fall in the calcium/magnesium-chloride/sulfate sector in the central diamond. The anion triangle (lower right) shows a chemical shift from primarily sulfate to bicarbonate/carbonate dominance. The points on the cation triangle (lower left) indicate a shift towards sodium from calcium dominance. The highest nitrate concentrations and concentrations over the MCL were determined in samples whose points plot in the calcium/magnesium-sulfate/chloride sectors.

In the Forebay sub-basin, a similar pattern is evident in which 1) points representing calcium/magnesium-chloride/sulfate groundwater transition to points representing calcium/magnesium-bicarbonate/carbonate groundwater and 2) the highest nitrate concentrations and propensity of concentrations over the MCL are associated with calcium/magnesium-chloride/sulfate groundwater. Points in the anion triangle similarly indicate a shift from chloride and sulfate to bicarbonate/carbonate dominance. Points in the cation triangle indicate a shift from calcium towards sodium dominance.

In the Pressure Subarea, there is a greater presence of sodium/bicarbonate-carbonate groundwater and less presence of calcium/magnesium-chloride/sulfate groundwater. The anion and cation triangles indicate a general shift from chloride and sulfate to bicarbonate/carbonate dominance and calcium to sodium dominance, respectively. Calcium/magnesium-chloride/sulfate groundwater samples have the highest nitrate concentrations in this subarea. A similar groundwater geochemical evolution pattern is evident in the Eastside sub-basin Piper diagram; general shifts from calcium/magnesium-chloride/sulfate groundwater to sodium/bicarbonate-carbonate groundwater in the central diamond and from calcium towards sodium and chloride towards bicarbonate water in the cation and anion triangles, respectively.

---

[38] Monterey County Water Resources Agency,2011, Lines of Equal Ground Water Elevation in the Pressure 180-Foot, East Side Shallow, Forebay and Upper Valley Aquifers, http://www.mcwra.co.monterey.ca.us/groundwater_elevation_contours/documents/GWLcontours%20Fall%202011%20Shallow.pdf

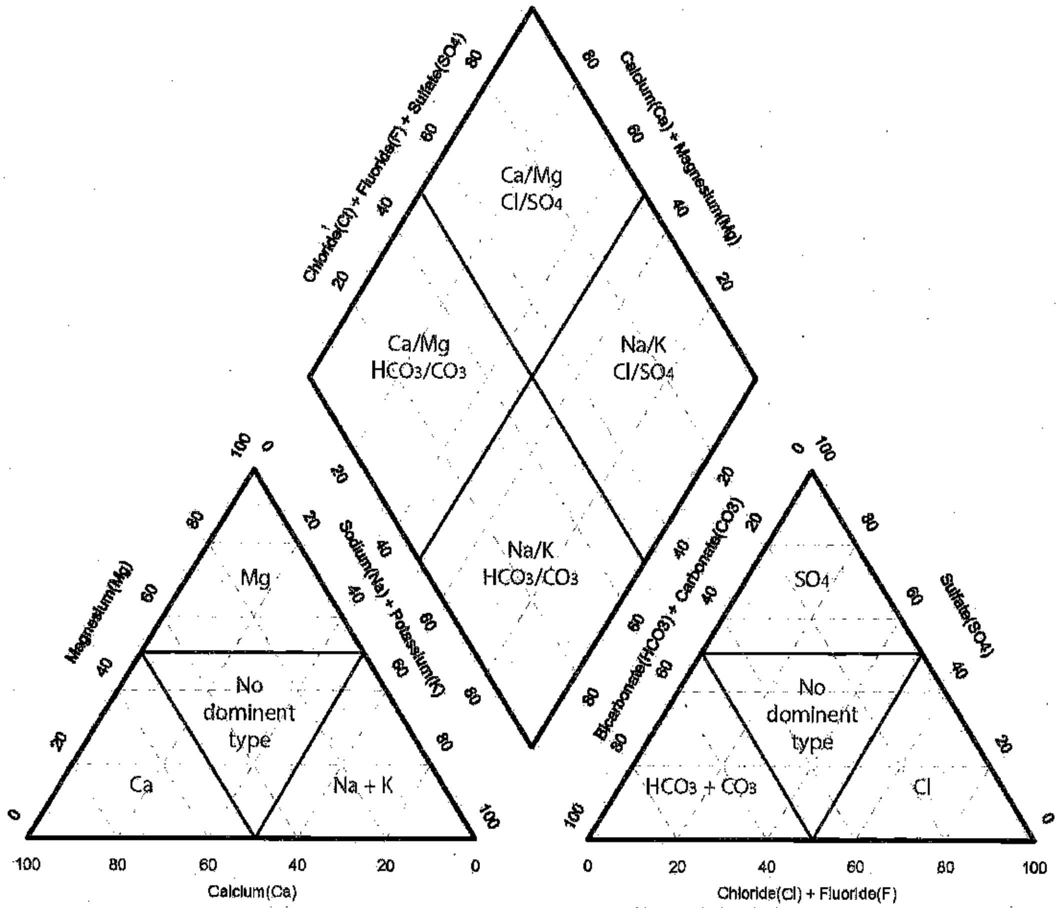


Figure 22. Chemical characteristics and areas of ionic dominance represented by the Piper diagram.

Upper Valley Wells

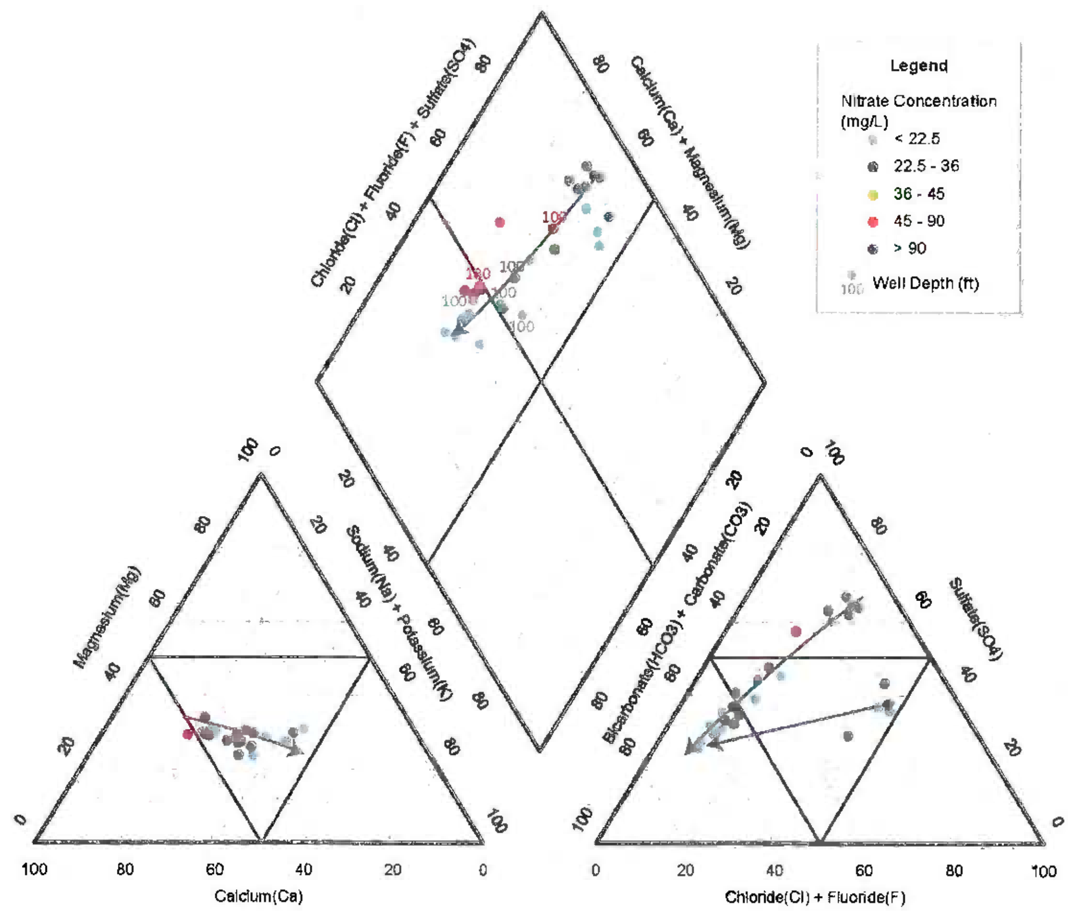


Figure 23. Piper Plot for Upper Valley Subarea wells sampled by the CCGC. Arrows indicate the hypothesized general direction of geochemical evolution along the groundwater flow.

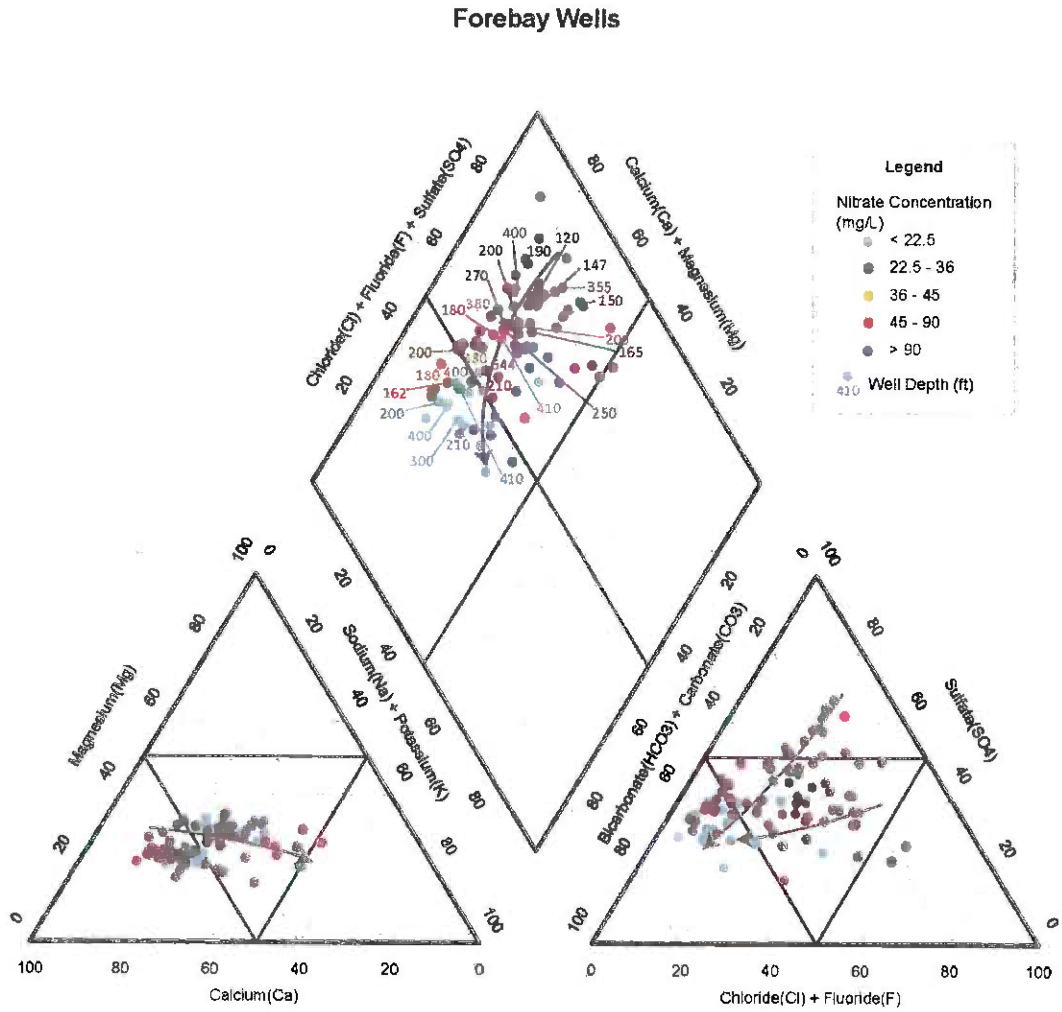


Figure 24. Piper Plot for Forebay Subarea wells sampled by the CCGC. Arrows indicate the hypothesized general direction of geochemical evolution along the groundwater flow.

Pressure Wells

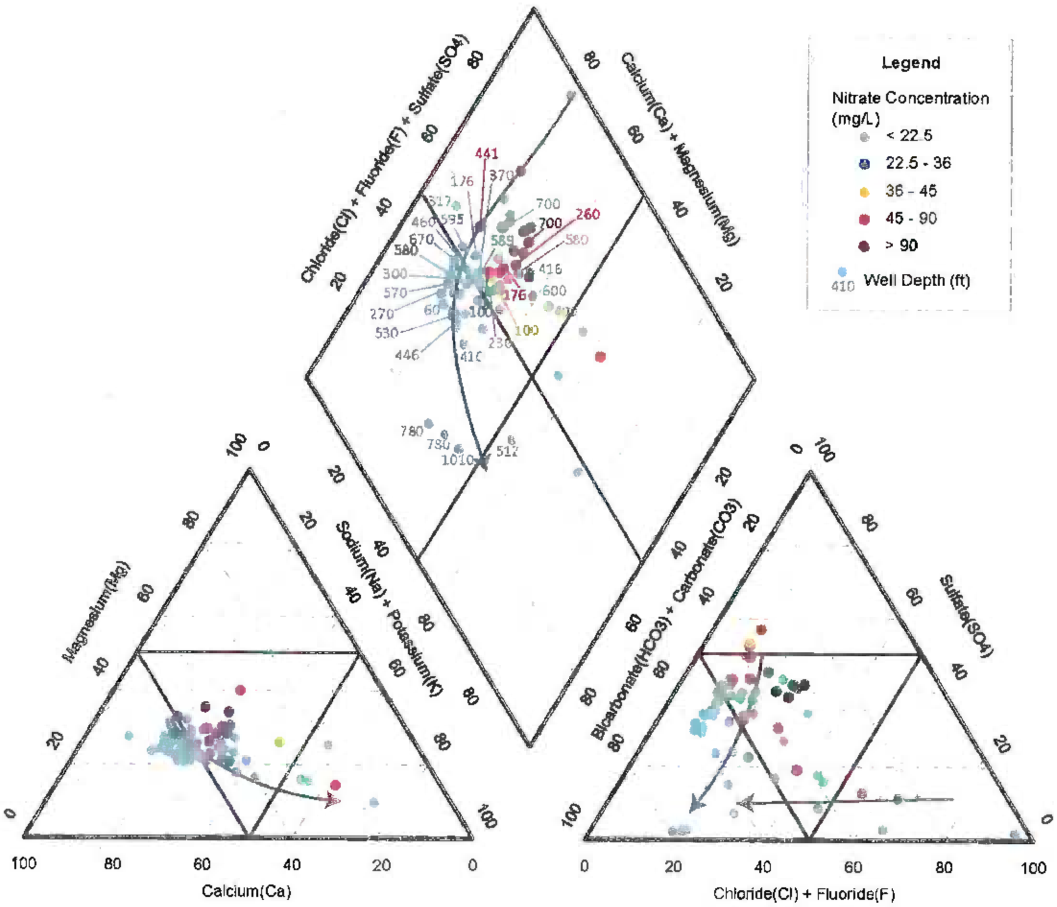


Figure 25. Piper Plot for Pressure Subarea wells sampled by the CCGC. Arrows indicate the hypothesized general direction of geochemical evolution along the groundwater flow.