

Attachment D-4

Methodology to Initially Prioritize Groundwater Basins/Subbasins Based on Water Quality

Overview

The SNMP recognizes that given the large area covered by the Central Valley Region, it is impractical and unreasonable to expect that the SNMP's nitrate management requirements will be implemented by everyone, everywhere, at the same time. Instead, as described in Section 4.3.2.1, the SNMP recommended a stepwise process for the Central Valley Water Board to utilize in determining what areas of the Central Valley floor should be prioritized for implementation of the nitrate management requirements.

The recommended process results in the identification of initial first and second tier priorities for implementation of nitrate management requirements based on ambient nitrate concentrations in the upper zone of groundwater basins/subbasins. In addition the recommended process allows the Central Valley Water Board to use its discretion to adjust the identified first and second tier priorities recommended by the SNMP based on specific criteria and additional information put forth during the Basin Plan amendment process (see Section 4.3.2.1). The purpose of this attachment is to describe the methodology to complete Step 1 (as described in SNMP Section 4.3.2.1), which resulted in the identification of recommended first and second tier priorities. This attachment also provides an example of how a local/subregional evaluation of nitrate data in the CV-SALTS database may be used to inform further evaluation of the recommended priorities.

Methodology & Results

CV-SALTS considered a number of water quality factors for use in identifying the highest priority areas for implementation of nitrate management requirements. These factors included, for example, ambient nitrate concentrations in wells completed in the upper zone, the predicted nitrate concentration in the upper zone after 50 years based on modeling outcomes, and the estimated rate of change in nitrate concentrations in the upper zone over a 50-year period. Ultimately, it was decided that identification of the highest priority areas should be based on ambient nitrate concentrations, defined as average nitrate concentration in wells completed in the upper zone during the period 2000-2016. This water quality factor was selected to identify the priority areas for implementation because it best represents where known nitrate water quality concerns exist in groundwater.

The dataset for estimating nitrate concentrations in the upper zone was provided by Luhdorff & Scalmanini Consulting Engineers and Larry Walker Associates (2016a), which completed groundwater quality analyses for the Central Valley Region using high resolution techniques. These analyses produced water quality maps and data summaries for three defined groundwater

zones (upper, lower, and production).¹ The outcome of this effort was the most refined and accurate characterization of the ambient groundwater quality available for use in the development of the SNMP. To identify the initial first and second tier priorities the following data from Luhdorff & Scalmanini Consulting Engineers and Larry Walker Associates (2016a) were used:

- One-square mile grid (cell) shapefile that covers the groundwater basins/subbasins underlying the Central Valley floor.
- Estimated ambient nitrate (as N) concentrations for each of the one-square mile grid cells in the upper zone for the period from 2000 to 2016. Where data were not available, these ambient concentrations were estimated using interpolation techniques.

Using these data an Initial Prioritization Score was developed for each groundwater basin/subbasin using the following procedure:

- A rank score of 0 to 10 was assigned to each square mile grid cell based on the average ambient nitrate concentration of that cell using the criteria shown in **Table D4-1**. For example, if the grid cell ambient nitrate concentration was 3.68 mg/L, then according to Table D4-1 a score of “1” was assigned to the cell.
- The scores for each square mile cell within each groundwater basin/subbasin were then averaged together to establish a groundwater basin/subbasin score.

Figure D4-1 illustrates the ambient nitrate concentration results on a one-square mile grid and groundwater basin/subbasin. **Table D4-2** lists the groundwater basins/subbasins in order from the highest to lowest score for the basin/subbasin. The score in the right hand column is the average of the nitrate concentration scores obtained from Table D4-1 and assigned to each one square mile grid within the basin/subbasin. With this information as a guide, CV-SALTS recommended the groundwater basins/subbasins that should be designated as tier one and two priorities. The remaining groundwater basins/subbasins were not assigned a priority at this time.

Table D4-1. Assigning Scores to One Square Mile Grids Based on Ambient Nitrate Concentrations in the Upper Zone

Current Ambient Nitrate (as N)	
Nitrate Concentration Range (mg/L)	Assigned Score
0 - 2	0
2 - 4	1
4 - 6	2
6 - 8	3
8 - 10	4
10 - 12	5
12 - 14	6
14 - 16	7
16 - 18	8
18 - 20	9
> 20	10

¹ See SNMP Section 3.3.1.1 for discussion and illustration of vertical zones used in the characterization of groundwater basins/subbasins in the Central Valley Region.

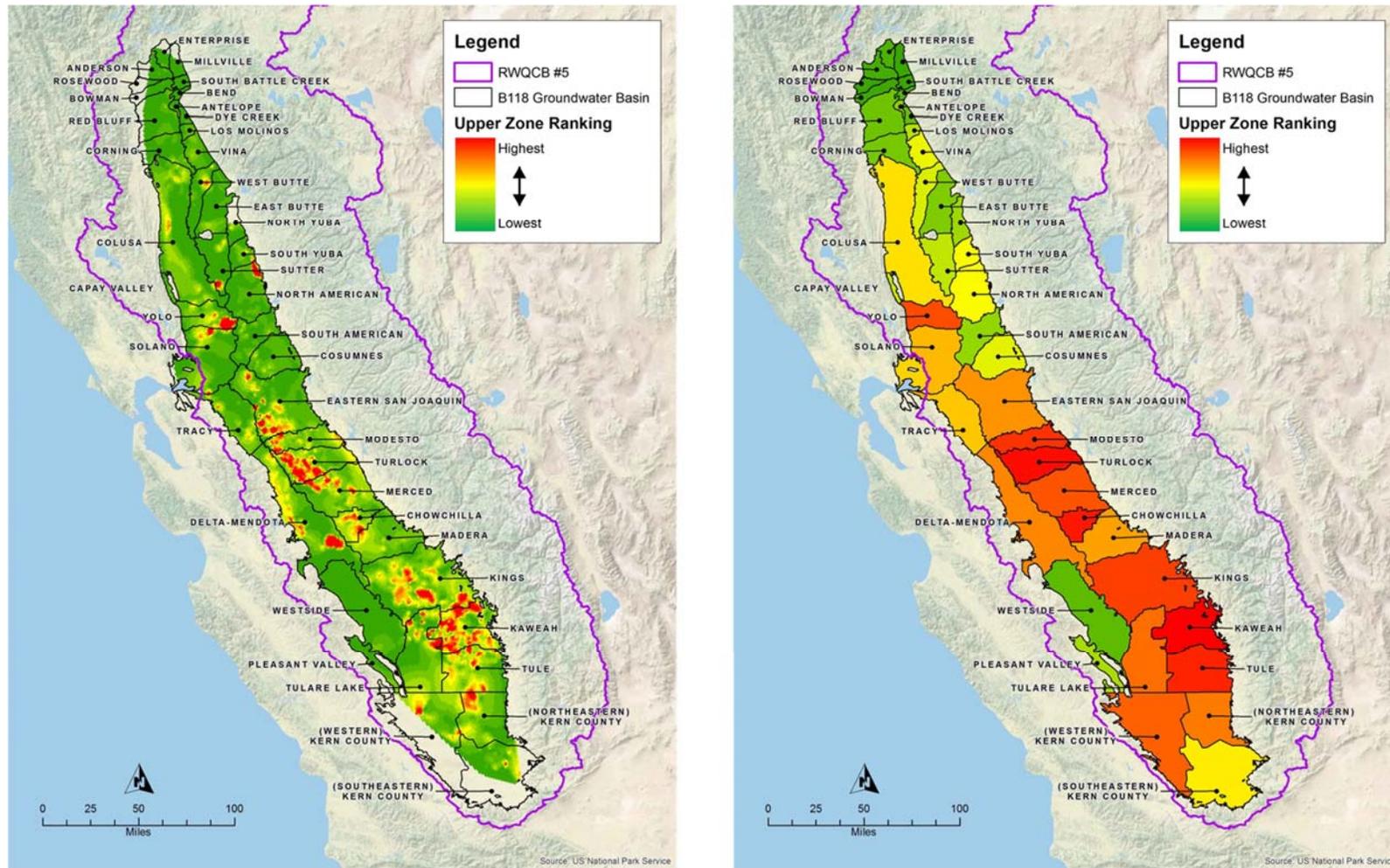


Figure D4-1. Illustration of How Areas within the Central Valley Floor are Ranked Based on Scores Assigned on One-Square Mile (Left) and Groundwater Basin/Subbasin (Right) Scales Based on Ambient Nitrate Concentration Data from the Upper Zone

Table D4-2. Ranking and Priority for Groundwater Basins/Subbasins Based on Ambient Nitrate Concentrations in the Upper Zone¹

Groundwater Basin/Subbasin (DWR Bulletin 118) ²			Initial Prioritization Score
Priority	Number	Name	
Priority 1	5-22.11	Kaweah	5.35
	5-22.03	Turlock	4.27
	5-22.05	Chowchilla	3.78
	5-22.13	Tule	3.48
	5-22.02	Modesto	3.09
	5-22.08	Kings	3.02
Priority 2	5-21.67	Yolo	2.89
	5-22.04	Merced	2.76
	5-22.14	Kern County (Western)	2.70
	5-22.12	Tulare Lake	2.44
	5-22.14	Kern County (Northeastern)	2.37
	5-22.07	Delta-Mendota	2.13
	5-22.01	Eastern San Joaquin	1.98
	5-22.06	Madera	1.93
Not Prioritized by SNMP ³	2-4	Pittsburg Plain	1.70
	5-21.66	Solano	1.37
	5-22.15	Tracy	1.35
	2-3	Suisun-Fairfield Valley	1.34
	5-21.52	Colusa	1.26
	5-22.14	Kern County (Southeastern)	1.21
	5-21.61	South Yuba	1.03
	5-21.64	North American	0.93
	5-21.57	Vina	0.92
	5-22.16	Cosumnes	0.87
	5-21.58	West Butte	0.83
	5-21.68	Capay Valley	0.80
	5-21.62	Sutter	0.71
	5-21.56	Los Molinos	0.70
	5-22.10	Pleasant Valley	0.64
	5-21.60	North Yuba	0.63
	5-21.65	South American	0.53
	5-21.54	Antelope	0.49
	5-21.59	East Butte	0.48
	5-21.51	Corning	0.45
	5-21.50	Red Bluff	0.27
	5-21.55	Dye Creek	0.25
	5-22.09	Westside	0.18
	5-21.53	Bend	0.18
	5-6.04	Enterprise	0.10
	5-6.03	Anderson	0.08
5-6.01	Bowman	0.04	
5-6.06	South Battle Creek	0.00	
5-6.05	Millville	0.00	
5-6.02	Rosewood	0.00	

¹ Water quality data source: Luhdorff & Scalmanini Consulting Engineers and Larry Walker Associates (2016a)² The Kern County subbasin is split into three parts to be consistent with the Tulare Lake Basin Plan³ Areas not prioritized in Priority 1 or 2 will still need to comply with the SNMP nitrate requirements in the future, but implementation of such requirements shall be phased in by the Central Valley Water Board as resources allow.

Note: For this methodology the calculations were done using data summarized in Excel spreadsheets. Calculations may also be done within a GIS environment; however, very small differences between Excel and GIS results at the groundwater basins/subbasin level may be observed. This is a function of how GIS uses spatial tools to calculate averages within defined areas.

Nitrate Data Considerations

The CV-SALTS database is the source of the data used to establish the initial prioritization score (Luhdorff & Scalmanini Consulting Engineers and Larry Walker Associates 2014). This database includes data from all well types in the Central Valley Region, including those used for remediation monitoring. As such, as part of Step 2 of the process to establish the priority and schedule for implementation of the SNMP nitrate management requirements (See SNMP Section 4.3.2.1), a closer examination of the data used to estimate ambient nitrate concentrations in the upper zone may be warranted when evaluating priorities. Below is an example of how further evaluation of nitrate data in the CV-SALTS database can provide additional information to the prioritization process. This information is provided as an illustration only of how stakeholders may use the CV-SALTS database to inform the prioritization process.

Within the Delta-Mendota groundwater basin in the San Joaquin Hydrologic Region (No. 5-22.07) there is a regulated facility site (SL205324280)² that mixes liquid and dry fertilizers. The site is being remediated for nitrate and a variety of other contaminants (Dichlorodiphenyltrichloroethane [DDT] and its breakdown products Dichlorodiphenyldichloroethane (DDD) and Dichlorodiphenyldichloroethylene (DDE), dieldrin, dinoseb, endosulfan II, endrin, and other chlorinated hydrocarbons, pesticides/herbicides).

The CV-SALTS database includes data for 19 wells at this regulated facility, with average nitrate concentrations ranging from 0.2 to 602 mg/L as N for the period 2006-2010, which is within the period used to estimate upper zone ambient nitrate concentrations (2000-20016) (Luhdorff & Scalmanini Consulting Engineers and Larry Walker Associates 2016a). Within the CV-SALTS database, wells that are categorized as “regulated facility” are considered to be shallow wells. Therefore, for the purposes of Step 1 analysis of water quality factors, these wells are included in the upper zone calculations for average nitrate concentrations.

Inclusion of the upper zone regulated facility wells in Step 1 has the greatest impact on the average nitrate concentration of all wells. For example, the average upper zone nitrate concentration for the 478 wells located in the Delta Mendota groundwater subbasin would be calculated as 13.67 mg/L as N (as shown in SNMP Table 3-12). When the 19 wells at the regulated facility site are removed and taking into account the spatial clustering of wells, the average nitrate concentration is much lower at 7.3 mg/L as N. Differences of this nature caused by the inclusion of monitoring wells at a specific facility could be an important consideration during Step 2 of the prioritization process.

² https://geotracker.waterboards.ca.gov/profile_report?global_id=SL205324280

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