



NCWA
Northern California Water Association

2018 ANNUAL GROUNDWATER MONITORING RESULTS

for the Sacramento Valley Water Quality Coalition

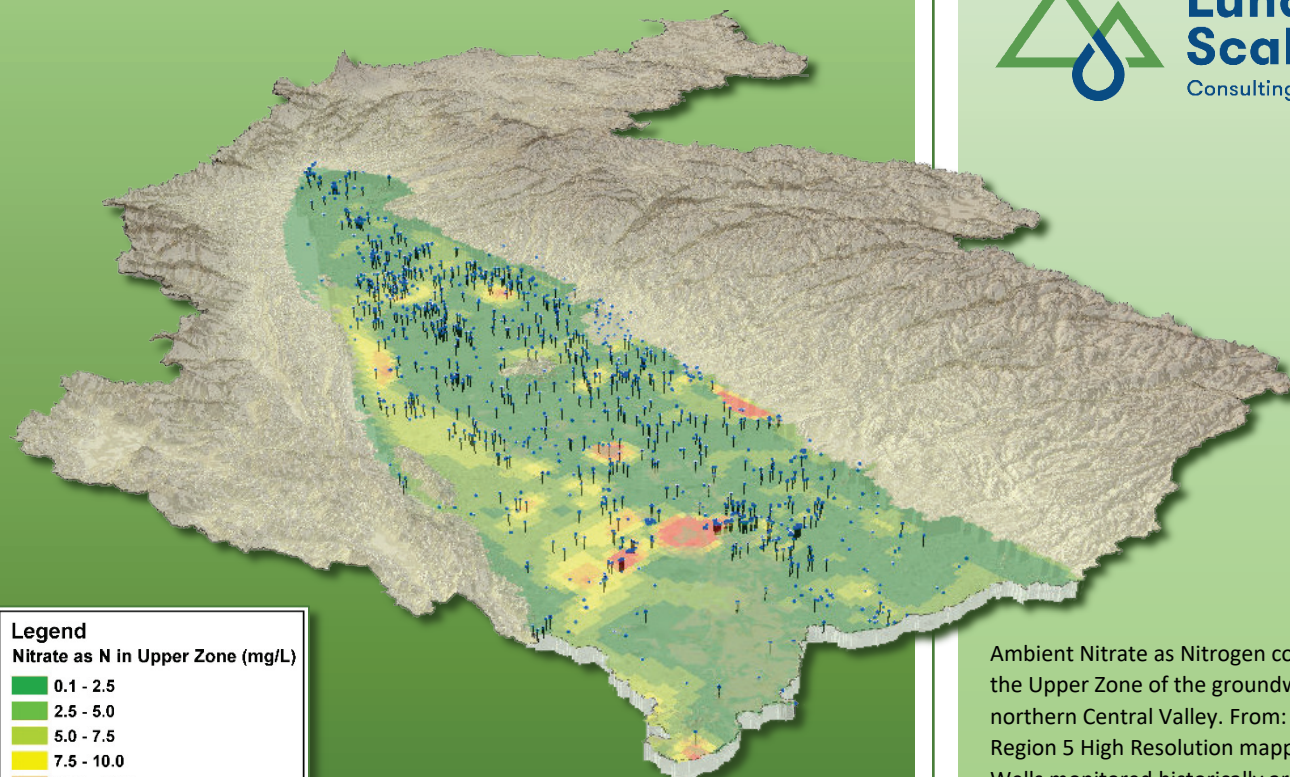


May 1, 2019

Submitted by



**Luhdorff &
Scalmanini**
Consulting Engineers



Legend	
Nitrate as N in Upper Zone (mg/L)	
0.1 - 2.5	Green
2.5 - 5.0	Light Green
5.0 - 7.5	Yellow-Green
7.5 - 10.0	Yellow
10.0 - 15.0	Orange
15.0 - 20.0	Red-Orange
> 20.0	Red

Ambient Nitrate as Nitrogen concentrations in the Upper Zone of the groundwater system in the northern Central Valley. From: LSCE et al. (2016), Region 5 High Resolution mapping for CV-SALTS. Wells monitored historically are shown. A subset of these wells is being considered for the ongoing Trend Monitoring network.

Signature Page



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1 EXECUTIVE SUMMARY

As part of compliance with the Central Valley Regional Water Quality Control Board's (Regional Board or CVRWQCB) *Order No. R5-2014-0030-R1 Waste Discharge Requirements General Order for Growers in the Sacramento River Watershed that are Members of the Third-Party Group*, hereafter referred to as the WDRs (CVRWQCB, 2014), the Sacramento Valley Water Quality Coalition (Coalition or SVWQC) must develop and implement a Groundwater Quality Trend Monitoring (GQTM) Program. The initial Coalition GQTM well network sampling event occurred in Fall 2018 during late November and early December and included sampling of 21 wells for nitrate and major cations and anions. One well originally included in the GQTM network for Fall 2018 could not be sampled because the well owner decided not to participate in the program prior to commencement of the sampling event. Five wells previously not included in the GQTM Workplan (LSCE, 2017 and 2018a) or the subsequent Addendum (LSCE, 2018b), were added to the GQTM network prior to the Fall 2018 sampling event and were also sampled. The results from all of the wells sampled in Fall 2018 as part of the GQTM program are presented.

The groundwater quality results from the Fall 2018 sampling included nitrate concentrations above the primary drinking water maximum contaminant level (MCL) of 10 milligrams per liter (mg/L) in three network wells. Additionally, four sampled wells had concentrations of total dissolved solids (TDS) above the recommended secondary drinking water MCLs of 500 mg/L and elevated boron concentrations above the State public health goal (PHG) of 1,000 micrograms per liter ($\mu\text{g/L}$) occurred in five of the sampled wells. In accordance with the SVWQC GQTM Workplan documents (LSCE, 2018a-c), evaluation of patterns and trends in groundwater quality and any relationships with agricultural practices will be conducted at five-year intervals commencing after sufficient GQTM data have been developed for evaluating temporal trends in groundwater quality.

2 BACKGROUND AND GQTM OBJECTIVES

The Central Valley Regional Water Quality Control Board's (Regional Board or CVRWQCB) *Order No. R5-2014-0030-R1 Waste Discharge Requirements General Order for Growers in the Sacramento River Watershed that are Members of the Third-Party Group*, hereafter referred to as the WDRs (CVRWQCB, 2014), requires the Sacramento Valley Water Quality Coalition (Coalition or SVWQC) to develop and implement a Groundwater Quality Trend Monitoring (GQTM) Program. The WDRs Attachment B, Section IV.C. (p. 1-2) states:

1. Objectives. The objectives of Groundwater Quality Trend Monitoring are (1) to determine current water quality conditions of groundwater relevant to irrigated agriculture, and (2) to develop long-term groundwater quality information that can be used to evaluate the regional effects (i.e., not site-specific effects) of irrigated agriculture and its practices.

2. Implementation. To reach the stated objectives for the Groundwater Quality Trend Monitoring program, the third-party shall develop a groundwater quality monitoring network that will (1) be implemented over both high and low vulnerability areas in the third-party area; and will (2) employ shallow wells, but not necessarily wells completed in the uppermost zone of first encountered groundwater. The use of existing wells is less costly than installing wells specifically designed for groundwater quality monitoring, while still yielding data which can be compared with historical and future data to evaluate long-term groundwater quality trends. The third party may also consider using existing monitoring networks such as those used by AB 3030 and SB 1938 plans.

3. *Reporting.* The results of trend monitoring are to be included in the third-party's Monitoring Report and shall include a map of the sampled wells, tabulation of the analytical data, and time concentration charts. Groundwater quality monitoring data are to be submitted electronically to the State Water Board's GeoTracker Database and to the Central Valley Water Board.

Following collection of sufficient data (sufficiency to be determined by the method of analysis proposed by the third-party or Trend Monitoring Group) from each well, the third-party is to evaluate the data for trends. The methods to be used to evaluate trends shall be proposed by the third-party or Trend Monitoring Group in the Groundwater Quality Trend Monitoring Workplan described in section IV.E below."

Between September 2017 and May 2018, the Coalition submitted two phases of the *Sacramento Valley Water Quality Coalition Groundwater Quality Trend Monitoring Workplan* (LSCE, 2017 and 2018a) to address the requirements for the GQTM Program as outlined in the WDRs Attachment B, Sections III.C and III.E. A subsequent Addendum to the Workplan was also submitted in July 2018 (LSCE, 2018b) to address comments on the Workplan provided by the Regional Board. The Addendum to the Workplan presented an initial proposed GQTM well network considered the beginning of an evolving network, not a static end result. The Regional Board issued a Conditional Approval letter on September 24, 2018 (CVRWQCB, 2018) indicating the GQTM sampling should commence in Fall 2018.

The Coalition's boundary coincides with the boundary of the Sacramento River watershed and encompasses more than 18.2 million acres, including about 1.3 million acres of irrigated agricultural land. The Groundwater Quality Assessment Report (CH2M, 2016) prepared for the Coalition region provides an overview of hydrogeologic and groundwater quality conditions in the Coalition region.

3 GROUNDWATER QUALITY TREND MONITORING

The first sampling event of the GQTM Program occurred in Fall 2018 and the results from this sampling event are presented in this report. The initial Fall 2018 GQTM sampling was conducted utilizing network wells selected to accomplish the GQTM Program objectives of monitoring regional and long-term trends in groundwater quality in relation to agricultural practices as outlined in the GQTM Workplan (LSCE, 2017 and 2018a) and subsequent Addendum (LSCE, 2018b) with the expectation that the network would evolve and expand in future years. The July 2018 Addendum to the GQTM Workplan identified 17 wells for inclusion in the GQTM network and for which verbal participation agreements had been obtained. Subsequent to the submittal of the Workplan Addendum, five additional network wells were identified and included in the Fall 2018 GQTM sampling event. Three of the original GQTM network wells presented in the Addendum were replaced with other nearby wells due to lack of agreement or cooperation by the well owners prior to the Fall 2018 sampling event or because more suitable wells were identified in the area. Information and results from all of the GQTM network wells sampled in Fall 2018 are presented below.

3.1 Groundwater Quality Sampling Sites

Information related to the Fall 2018 GQTM network wells are summarized in **Table 1** and their locations are displayed on **Figure 1**. A spreadsheet file containing information on the GQTM network wells is also provided in the accompanying electronic data submittal package. Land uses mapped in 2016 based on

USDA Cropscape¹ data are shown in **Figure 1** in relation to the GQTM network wells sampled in Fall 2018. The fraction of land use types within one mile of GQTM network wells is illustrated in **Figure 2**. As discussed in the GQTM Workplan and Addendum, the wells provide representation of groundwater quality conditions and trends across the Coalition region and are located to evaluate groundwater trends in areas associated with a variety of different land use activities. The approach taken in prioritizing areas for more targeted monitoring under the GQTM is discussed in the Workplan.

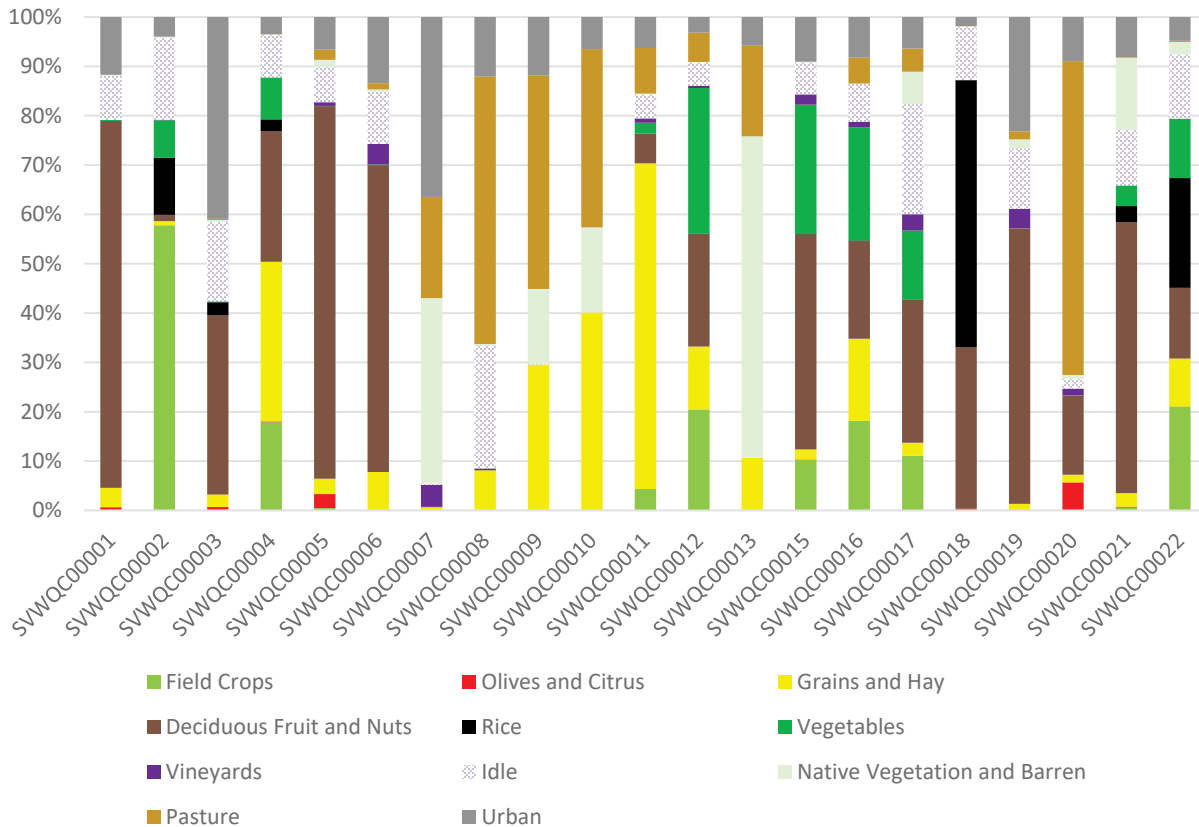


Figure 2: 2016 Land Use Types within One Mile of 2018 GQTM Network Wells

¹ <https://nassgeodata.gmu.edu/CropScape/>

Table 1: 2018 GQTM Network Wells

GQTM Well ID	State Well Number	WCR Number	Well Use	Well Construction Information					Latitude (NAD83)	Longitude (NAD83)	Depth Bottom of Upper Zone (feet) ¹	Percent Screens in Upper Zone	Explanation of Monitored Depth
				Seal Depth (feet)	Seal Mat.	Total Well Depth (feet)	Depth Top of Screen (feet)	Depth Bottom of Screen (feet)					
SVWQC00001	17N/03E-18	0935397	PWS	20	Bent	110	96	open hole	39.32260	-121.67860	113	100%	Screens entirely in Upper Zone
SVWQC00002	11N/03E-20	178763	Dom	20		48	135	150	38.78590	-121.65650	182	100%	Screens entirely in Upper Zone
SVWQC00003	18N/02E-35	139863	Irrig	24	Bent	105	63	85	39.36560	-121.70920	117	100%	Screens entirely in Upper Zone
SVWQC00004	18N/01W-16		PWS	50		120			39.41960	-121.96700	137	100%	Screens entirely in Upper Zone
SVWQC00005	22N/02W-32	369971	PWS	80	Bent	225	145	225	39.71070	-122.10610	139	0%	Older very shallow domestic wells skew Upper Zone depth from CV-SALTS; more recent wells typically deeper (average depth of domestic wells built since 1970 is 153 feet). Well also has gravel envelope below 80 feet and likely reflects groundwater characteristics from 80 to 225 feet.
SVWQC00006	13N/01W-19	702875	PWS	60	Cem	260	180	260	38.96060	-122.01810	234	68%	Mostly in Upper Zone; bottom of screens similar depth to average domestic well depth in area (260 feet)
SVWQC00007	13N/09W-10	916600	PWS	50	Cem	121	55	105	38.98350	-122.84660	105*	100%	Screens entirely above average domestic well depth in area (105 feet)
SVWQC00008	13N/05E-13		Irrig			111	70	110	38.97400	-121.36060	98	70%	Mostly in Upper Zone; screens above average domestic well depth in area (140 feet)
SVWQC00009	42N/09E-25	138832	PWS	120		400	120	open hole	41.44680	-120.87940	191*	25%	Upper Zone not determined by CV-SALTS for area outside the CV Floor; well is open hole below 120 feet, intake partially in zone above average domestic well depth in area (191 feet). Well depths are 75 to 640 feet in the area.
SVWQC00010	21N/15E-12		Dom			159			39.69030	-120.25010	144	100%	Screens entirely in Upper Zone
SVWQC00011	06N/01E-17	116111	Dom	20	Cem	105	70	80	38.36600	-121.89610	302	100%	Screens entirely in Upper Zone
SVWQC00012	07N/02E-17	51591	Irrig	20		165	115	165	38.44920	-121.77670	196	100%	Screens entirely in Upper Zone

GQTM Well ID	State Well Number	WCR Number	Well Use	Well Construction Information					Latitude (NAD83)	Longitude (NAD83)	Depth Bottom of Upper Zone (feet) ¹	Percent Screens in Upper Zone	Explanation of Monitored Depth
				Seal Depth (feet)	Seal Mat.	Total Well Depth (feet)	Depth Top of Screen (feet)	Depth Bottom of Screen (feet)					
SVWQC00013	23N/15E-30	e016556	Stock	95	Cem	193	115	130	39.81700	-120.34780	146*	100%	Screens entirely above average domestic well depth in area (146 feet)
SVWQC00014		214018	PWS	50	Cem	170	40	140	40.14094	-120.86948	152*	100%	Screens entirely above average domestic well depth in area (152 feet)
SVWQC00015	10N/02E-08	36076	PWS	65	Cem	226	145	212	38.72670	-121.76940	226	100%	Screens entirely in Upper Zone
SVWQC00016	09N/02E-09	72206	PWS	80	Cem	181	134	157	38.64050	-121.76380	272	100%	Screens entirely in Upper Zone
SVWQC00017	10N/01W-18	428830	Irrig	60	Cem	144	80	210	38.70900	-122.01270	184	80%	Screens mostly in Upper Zone
SVWQC00018	20N/02E-26	95228	Dom	20		82	60	open hole	39.56190	-121.70780	142	100%	Screens entirely in Upper Zone
SVWQC00019	13N/02W-03	2734	Dom			126			39.01040	-122.06760	228	100%	Screens entirely in Upper Zone
SVWQC00020	24N/03W-08	486342	Dom	21	Bent	161	134	161	39.94540	-122.22980	163	100%	Screens entirely in Upper Zone
SVWQC00021	18N/01W-30		Dom			120	90	120	39.37720	-122.01330	142	100%	Screens entirely in Upper Zone
SVWQC00022	12N/01E-13	E067697	Dom	80	Bent	160	110	150	38.88300	-121.81910	247	100%	Screens entirely in Upper Zone

¹ Depth of bottom of Upper Zone is defined by CV-SALTS (LSCE and LWA, 2016) based on typical domestic well depths and other hydrogeologic characteristics. The depth of bottom of Upper Zone from CV-SALTS ranges from about 100 feet to 300 feet in most places within the Central Valley Floor of the Coalition; average nearby domestic well depths are presented where Upper Zone depth was not determined by CV-SALTS.

* Wells are located in areas peripheral to the Central Valley Floor; average domestic well depth in the vicinity is presented for consideration of the target depth zone because no value for depth to Upper Zone bottom was determined by CV-SALTS.

PWS = public water supply; Dom = domestic; Irrig = irrigation; Bent = bentonite; Cem = cement

3.2 Fall 2018 Groundwater Quality Sampling Activities

Fall 2018 groundwater quality sampling for the SVWQC GQTM Program took place between November 13 and December 14, 2018. The sampling of several network wells was delayed due to inaccessibility resulting from weather and air-quality-related conditions caused by precipitation and regional wildfire activity presenting safety concerns for conducting sampling activities. Fifteen wells were sampled during November 2018 and six wells were sampled during early December 2018.

Aside from the delays and access challenges noted above, the Fall 2018 well sampling was conducted at each well without notable issues. Wells were measured for depth to water (if access to water level measurements was available) upon arrival at each site and prior to conducting any well purging. All wells were purged and sampled in accordance with the standard operation procedures (SOP) for sampling activities using existing pumping equipment or installed sampling pumping equipment. All sampled wells were monitored for field parameters including pH, temperature, electrical conductivity (EC), dissolved oxygen (DO), oxidation-reduction potential (ORP), and turbidity during the well purging and sampling event. In all wells sampled, the pumped water had achieved stabilization of field parameters prior to sample collection and no remarkable occurrences during the sampling process were noted. All water samples were stored on ice after collection and delivered to California Laboratory Services in Sacramento for analysis of nitrate and major cations and anions, in accordance with the GQTM requirements. Field forms from the sampling activities are provided as part of the electronic data submittal package submitted together with this document.

3.3 Groundwater Quality Sampling Results

The results from the Fall 2018 GQTM sampling event are presented in **Table 2**. Water quality results exceeding applicable drinking water standards are highlighted in bold in **Table 2**. For the purpose of comparing results with water quality objectives, the results are discussed below relative to drinking water standards. Some of the more notable water quality results from the sampling are discussed below.

In the Fall 2018 sampling, analytical water quality results for three of the sampled wells, SVWQC00012, SVWQC00016, and SVWQC00020, exceeded the primary drinking water MCL of 10 mg/L for nitrate (as nitrogen) and one well (SVWQC00019) had a nitrate concentration just below the MCL. About half of the sampled wells had undetectable nitrate concentrations. Four of the sampled wells exceeded the secondary recommended drinking water MCLs of 500 mg/L for total dissolved solids (TDS) concentrations although most wells had relatively low TDS concentrations less than 300 or 400 mg/L. The wells exceeding the recommended MCL for TDS were SVWQC00012, 00013, 00015, and 00016. One well (SVWQC00011) also had elevated concentrations of sulfate exceeding the secondary recommended drinking water MCL of 250 mg/L, although all other wells sampled had much lower concentrations below 100 mg/L. Five wells had somewhat low pH values, below the suggested lower limit of 6.5 for drinking water.

Letters summarizing the Fall 2018 sampling results for individual wells and noting any identified water quality exceedances have been transmitted to all GQTM network well owners. Additional communication with owners of network wells exhibiting nitrate exceedances is also in process to make

well owners aware of management practices contained in the Coalition's Groundwater Quality Management Plan or other management practices intended to protect groundwater quality. These practices may include actions related to wellhead protection as well as agricultural management practices.

A spreadsheet with tabulated results for the Fall 2018 sampling is included with the accompanying electronic data submittal package. All laboratory analytical report files and chain of custody forms associated the sampling and analytical testing are also provided in the electronic data submittal package.

Table 3: Fall 2018 GQTM Sampling Results

Site ID	Date Sampled	UNITS:	Nitrate (as nitrogen)	Total Dissolved Solids (TDS)	Boron	Calcium	Magnesium	Potassium	Sodium	Chloride	Sulfate	Bicarbonate (as CaCO ₃)	Carbonate (as CaCO ₃)	pH	Specific Conductance (EC)	Temperature	Dissolved Oxygen (DO)	Oxidation-Reduction Potential (ORP)	Turbidity	Depth to Water		
			mg/L	mg/L	µg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	pH Units	uS/cm	°C	mg/L	mV	NTU	ft, bgs
			MDL:	0.4	10	20	1	1	1	1	0.5	0.5	5	5	5	NA						
			MCL:	10 ¹	500/ 1,000 ²	1,000 ⁴					250/ 500 ²	250/ 500 ²				6.5/ 8.5 ³						
SVWQC00001	11/13/2018		3.5	290	26	30	27	0	15	11	39	190	0	6.34	548	16.7	2.6	573	0.29	N/A		
SVWQC00002	11/16/2018		0	390	960	24	20	3.4	56	57	27	240	0	7.95	527	16.5	6.7	-38	0.2	15.2		
SVWQC00003	11/13/2018		1.1	230	24	20	20	1.2	15	5.4	6	170	0	6.71	427	17.2	1.55	561.4	0.04	13.9		
SVWQC00004	11/13/2018		2.9	480	150	61	39	2.6	51	28	40	410	0	6.57	955	16.2	3.59	548	0.32	21.8		
SVWQC00005	11/15/2018		3.8	330	190	46	19	1.2	18	22	28	210	0	7.23	434	16.1	10.9	24.4	2.42	On		
SVWQC00006	11/26/2018		4.3	310	250	35	27	1.3	34	40	9.2	210	0	7.89	518	17.6	72.51	-102.3	0.39	On		
SVWQC00007	12/7/2018		0	160	100	17	26	1.5	7	3.7	4	150	0	7.12	408	16.5	3.8	609.9	0.1	On		
SVWQC00008	12/14/2018		1.9	290	200	16	8.3	1.8	48	46	40	73	0	6.7	522	16.7	4.99	636	0	60.6		
SVWQC00009	11/14/2018		0	310	460	8.5	4.1	14	64	14	31	180	0	6.09	544	21.7	2.63	575.2	5.77	74.3		
SVWQC00010	12/13/2018		0	150	34	15	10	4.7	13	1.8	2.5	110	0	6.39	321	16.6	1.09	648	0	34.5		
SVWQC00011	11/20/2018		6.6	980	140	140	56	1.6	83	140	270	300	0	7.43	1,298	16.7	2.06	-131	0.62	13.6		
SVWQC00012	11/20/2018		11	690	1,000	64	78	2	53	22	66	620	0	7.82	1,088	17.3	8.08	-120	0.44	N/A		
SVWQC00013	12/13/2018		0	630	1,700	35	16	4.1	150	210	0	270	0	6.31	1,332	16.9	1.1	637	1.52	17.0		
SVWQC00015	12/7/2018		5.4	450	2,300	65	51	2.9	64	74	51	320	0	6.4	1,064	16.9	3.44	595	0.38	36.3		

Site ID	Date Sampled	UNITS:	Nitrate (as nitrogen)	Total Dissolved Solids (TDS)	Boron	Calcium	Magnesium	Potassium	Sodium	Chloride	Sulfate	Bicarbonate (as CaCO3)	Carbonate (as CaCO3)	pH	Specific Conductance (EC)	Temperature	Dissolved Oxygen (DO)	Oxidation-Reduction Potential (ORP)	Turbidity	Depth to Water		
			mg/L	mg/L	µg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	pH Units	uS/cm	°C	mg/L	mV	NTU	ft, bgs
			MDL:	0.4	10	20	1	1	1	1	0.5	0.5	5	5	5	NA						
			MCL:	10 ¹	500/ 1,000 ²	1,000 ⁴					250/ 500 ²	250/ 500 ²				6.5/ 8.5 ³						
SVWQC00016	11/16/2018		19	880	3,200	75	68	3.7	94	130	62	550	0	7.39	1,288	17.5	4.92	29.9	1.88	39.4		
SVWQC00017	12/14/2018		0.57	330	1,600	39	27	3.4	39	64	32	200	0	6.88	771	17.1	4.76	633	0	45.2		
SVWQC00018	11/13/2018		6	340	0	39	25	1.5	20	4.7	49	200	0	6.56	614	16.2	3.1	580	0.5	N/A		
SVWQC00019	11/20/2018		9.8	380	590	33	28	1.7	50	56	23	200	0	7.14	602	18.1	7.05	-125	1.18	81.8		
SVWQC00020	11/15/2018		12	240	0	38	14	1.1	7.1	9.4	20	130	0	7.22	342	17.1	8.45	38.5	2.49	98.38		
SVWQC00021	11/13/2018		0	320	130	37	22	2.5	40	7.7	33	260	0	6.99	645	17.6	2.81	332	0.75	16		
SVWQC00022	11/19/2018		0	380	970	42	26	4.6	63	10	33	340	0	7.86	618	16.4	45	-153	0.41	21.78		

¹ Primary Maximum Contaminant Level (MCL) for drinking water

² Secondary MCL (recommended/upper range) for drinking water

³ Suggested lower/upper acceptable range for drinking water

⁴ State Notification (Action) level - A health-based notification level established by the State of California for some constituents lacking MCLs; if a public water system detects a constituent at concentrations above the action level, local governing bodies must be notified.

ND = Not detected above laboratory report limit (MDL) shown; N/A = no access for water level measurements; On = well running

Bold values indicate results above an MCL or action level

3.4 Evaluation of Groundwater Quality Trends and Patterns

Maps of TDS and nitrate concentrations from the Fall 2018 GQTM sampling event are presented as **Figures 3 and 4**. As discussed above and illustrated in **Figure 3**, nitrate concentrations in wells sampled in Fall 2018 were generally, low although three nitrate MCL exceedances (>10 mg/L) did occur. The wells exceeding the nitrate MCL are symbolized in red in **Figure 3**. All three nitrate exceedances occurred in wells located within the Central Valley Floor area of the Coalition region. No detectable nitrate concentrations occurred in samples collected from wells located in the groundwater basins outside of the Central Valley. Otherwise no notable spatial patterns in nitrate concentrations are apparent from the Fall 2018 GQTM sampling results. TDS concentrations in sampled wells shown in **Figure 4** indicate overall low TDS concentrations in most wells with three wells of relatively higher TDS concentrations located in the southwestern part of the Coalition region. One additional well with TDS concentrations above the secondary recommended MCL of 500 mg/L is located in Sierra Valley, a groundwater basin outside of the Central Valley floor.

The primary objective of the GQTM Program is to evaluate regional temporal trends in groundwater quality as they relate to agricultural practices. As discussed in the GQTM Workplan, more extensive evaluation of groundwater quality data and identification of any trends and associated relationships with agricultural practices will be conducted and summarized at five-year intervals and once a sufficient period of record of groundwater quality data has been developed for assessing such trends.

Although the groundwater quality results from the Fall 2018 sampling event represent the first groundwater quality datapoint collected through sampling conducted as part of GQTM program, several network wells have historical water quality data from monitoring conducted by other entities. Charts of time-series data for TDS and nitrate concentrations in network wells with a historical time-series record are contained in **Appendix A**. Most of the charts show relatively stable to decreasing trends in nitrate and TDS concentrations based on available historical groundwater quality data for GQTM network wells. As network wells develop a time-series record of multiple datapoints, similar charts will be developed and maintained for all network wells to inform the analysis and evaluation of groundwater quality trends in GQTM network wells as implementation of the Program continues.

3.5 Summary of Quality Assurance Evaluation for Fall 2018 Sampling Event

Consistent with the QAPP, field measurements of electrical conductivity (EC) at 25°C, pH, dissolved oxygen (DO), and temperature were obtained during the sample retrieval and the laboratory performed analysis for nitrate as nitrogen, boron, sodium, potassium, calcium, magnesium, chloride, sulfate, carbonate and bicarbonate alkalinity, and total dissolved solids (TDS).

3.5.1 Purging, sample handling, and custody

Wells were generally purged according to the SOP. However, several wells were not purged of three casing volumes prior to sample collection (SVWQC00004, 00016, 00022, 00013, and 00010). In two cases, it is not clear from the field sheets if three casing volumes were purged prior to sample collection (SVWQC00018 and 00002). In all cases, samples were retrieved upon stabilization of indicator parameters (i.e., EC and pH) and after the turbidity of the discharging water dropped below 10 NTUs.

Purging and sampling activities were documented on field sheets provided in the QAPP. Samples were collected in laboratory-supplied bottles and transported under prescribed chain of custody to the laboratory according to the QAPP.

3.5.2 Field duplicates and field blanks

The QAPP prescribes the analysis of one duplicate sample and one field blank sample for every 20 samples retrieved. Therefore, two duplicates and two blanks were required. Three duplicates and three blanks were retrieved.

3.5.3 Laboratory QA/QC

The laboratory performed all QA/QC as specified in the QAPP including lab blanks, lab duplicates, matrix spikes, and lab control spikes. Results of this testing were within the QAPP acceptance criteria for precision and accuracy with rare exceptions. Laboratory internal QA/QC includes redundancy. In all cases, sample analytical results were accepted based on the totality of QA/QC results.

In two cases (lab report 18K1053; Wells SVWQC00016 and 00020), nitrate was reanalyzed out of hold time after initial analysis indicated that the sample needed dilution. Results were 19 and 12 mg/L, respectively for these samples. Based on previous conversations with laboratory staff, this is not expected to have a significant effect on the analytical results.

3.5.4 Quality Assurance Evaluation Conclusions

All groundwater quality data are considered acceptable based on the stabilization of indicator parameters during purging and the review of QA/QC procedures and results. Care will be taken in the future to purge a minimum of three casing volumes even if indicators have stabilized prior to that, unless exceptions apply as described in the QAPP.

3.6 Electronic Data Submittal and Data Uploaded to Geotracker

In accordance with the requirements for reporting of annual groundwater monitoring results, an electronic data submittal is being provided to accompany this report. Included in the electronic data submittal are the following items:

- Excel worksheet containing export of data uploaded to Geotracker
- Excel worksheet containing:
 - Summary table of information on 2018 GQTM network wells, including latitude and longitude information
 - Summary table of results from Fall 2018 GQTM sampling event in tabular form
 - Summary sheet of laboratory analytical methods
- GIS shapefile dataset with locations of GQTM network wells sampled
- Field forms for Fall 2018 GQTM sampling event
- Laboratory analytical report files including chain of custody forms and laboratory narrative of QC failures and identification of any analytical problems and anomalies

4 CONCLUSIONS AND RECOMMENDATIONS

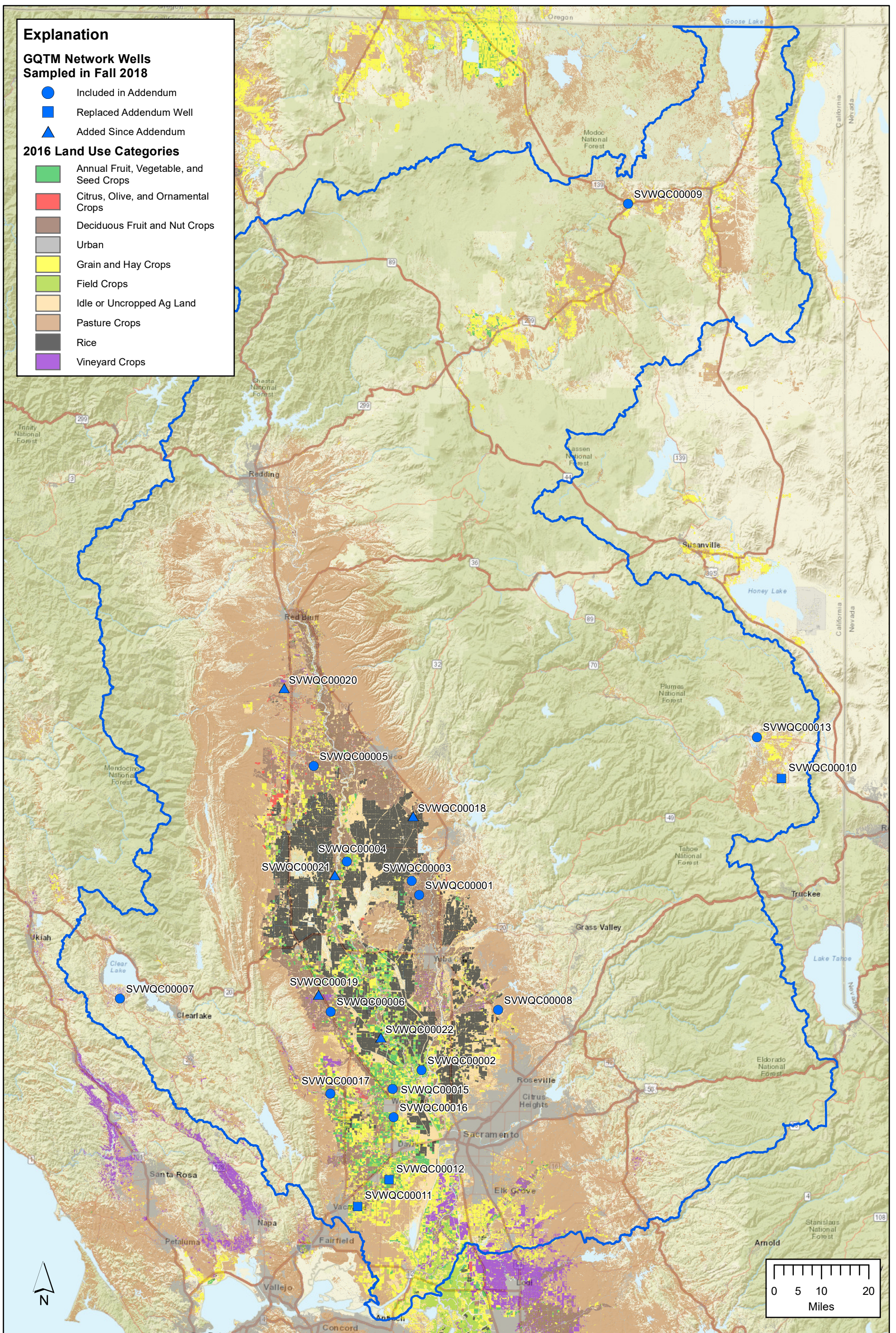
The Fall 2018 GQTM sampling event was successfully completed with 21 GQTM wells being sampled. The 21 wells sampled included wells originally included in the Workplan Addendum, several wells selected to replace wells proposed in the Addendum due to lack of access or decision of well owner not to participate, and five additional wells identified subsequent to the Addendum. Water quality results from the 2018 sampling indicate three wells with nitrate concentrations above the MCL and four wells with TDS concentrations over the recommended MCL. Boron concentrations were high in five wells and one well had elevation sulfate concentrations above the recommended MCL. Insufficient data are available for evaluating trends and patterns in groundwater quality at this point in the GQTM program implementation. In accordance with the GQTM Workplan, such evaluations will be conducted at five-year intervals starting in reporting on the first five years of GQTM data.

A few items have been identified in the quality assurance evaluation that can be improved or corrected during future GQTM sampling events to better comply with protocols and procedures outlined in the QAPP, including greater thoroughness in completing field forms and performance of field blank analytical testing. However, neither of these issues have been determined to affect the reliability or usability of the data obtained as part of the Fall 2018 sampling event.

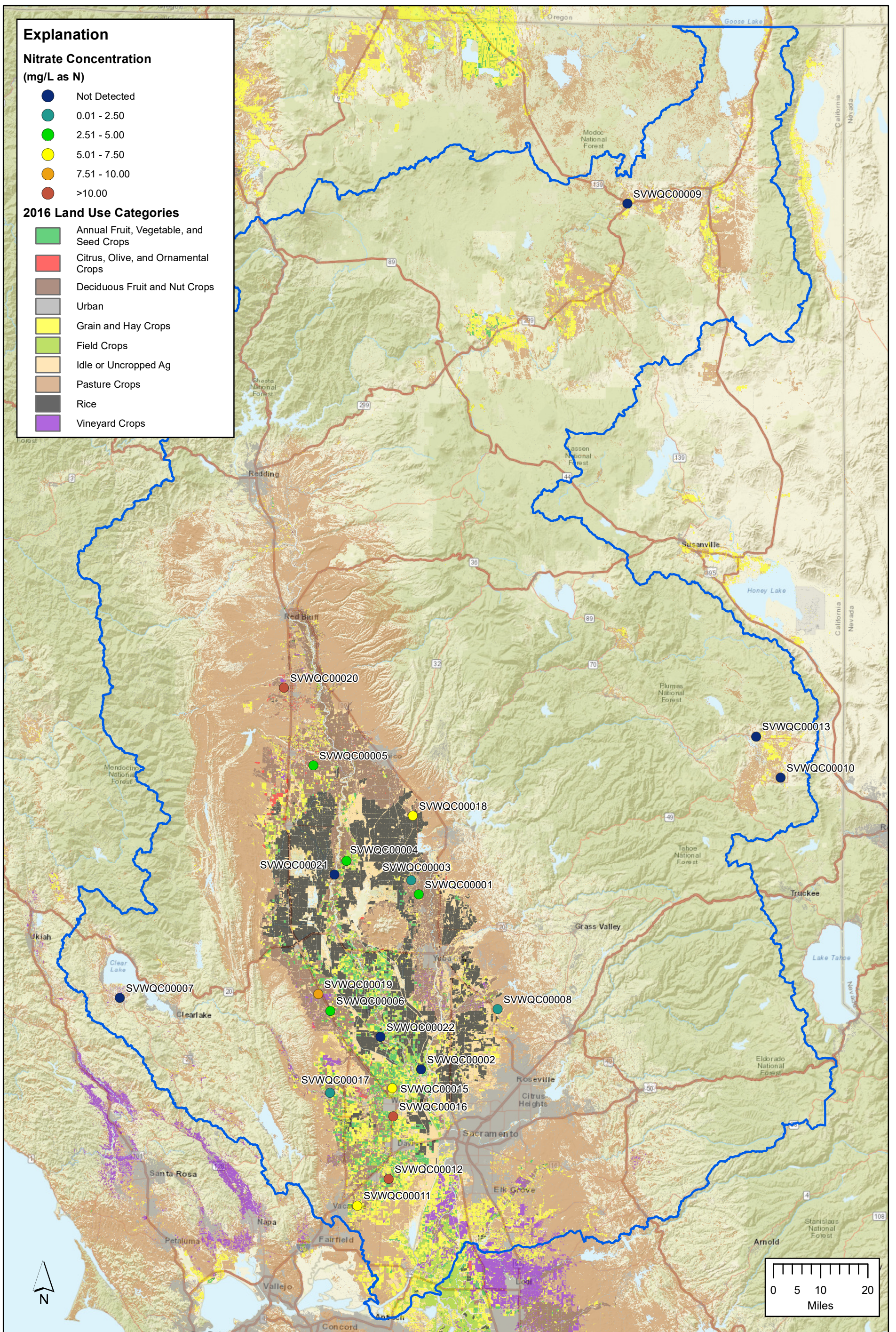
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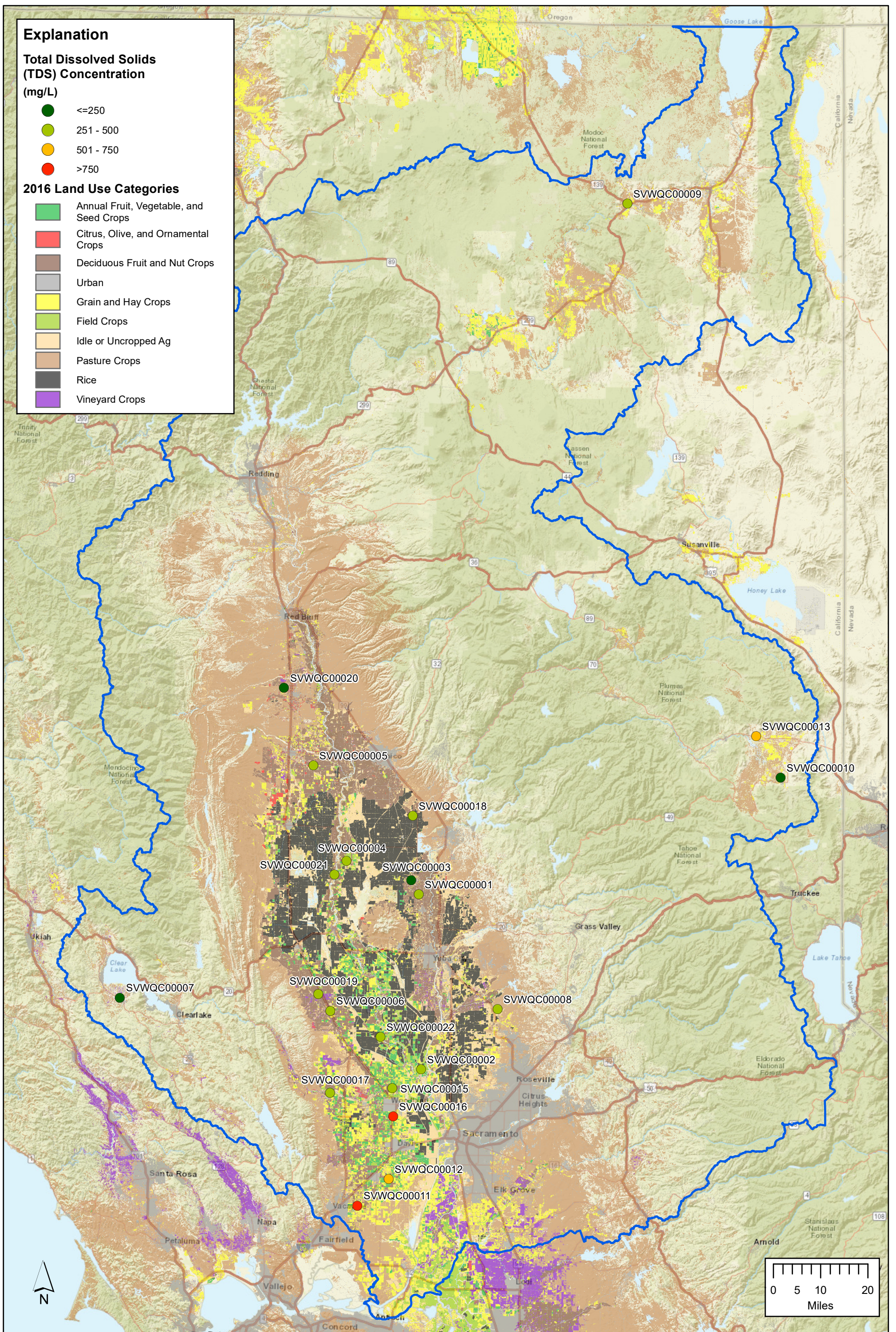
Map Figures



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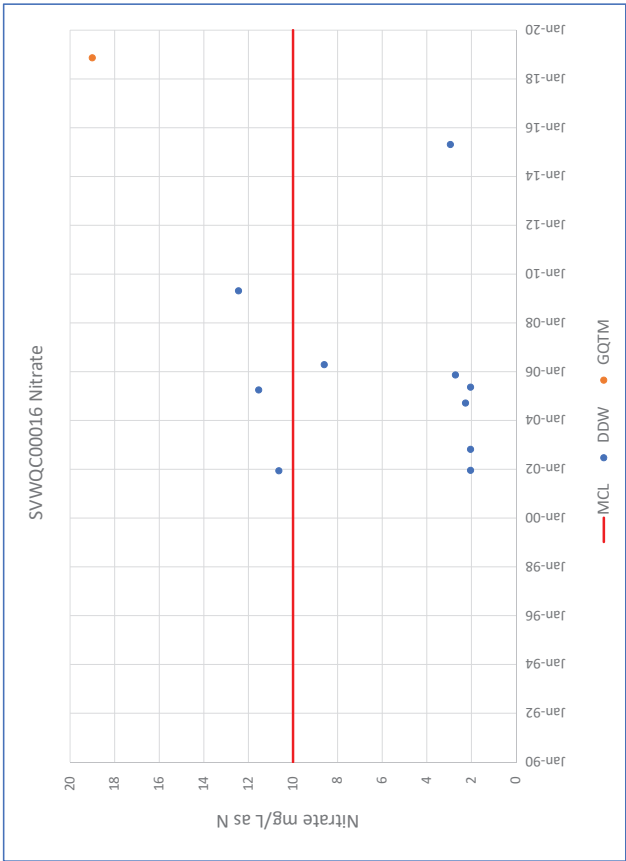
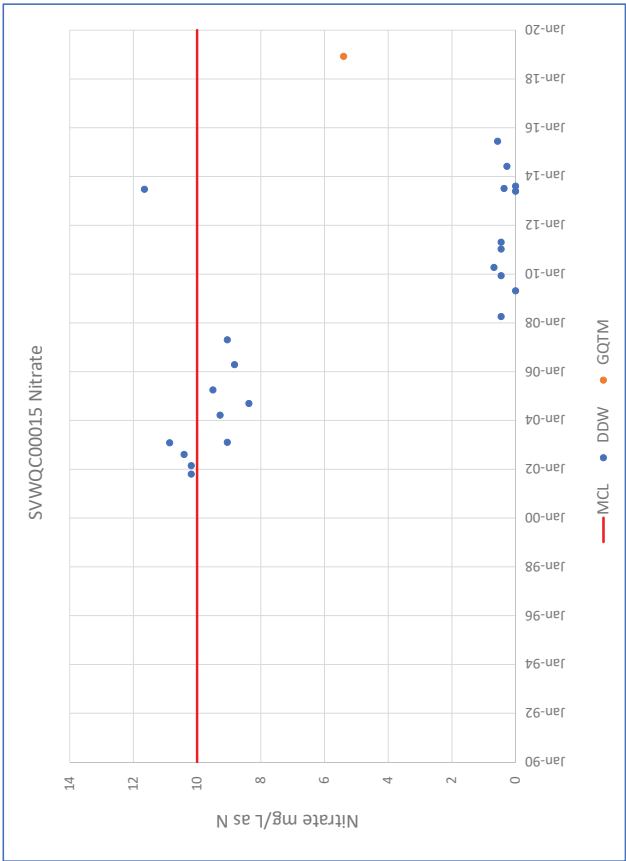
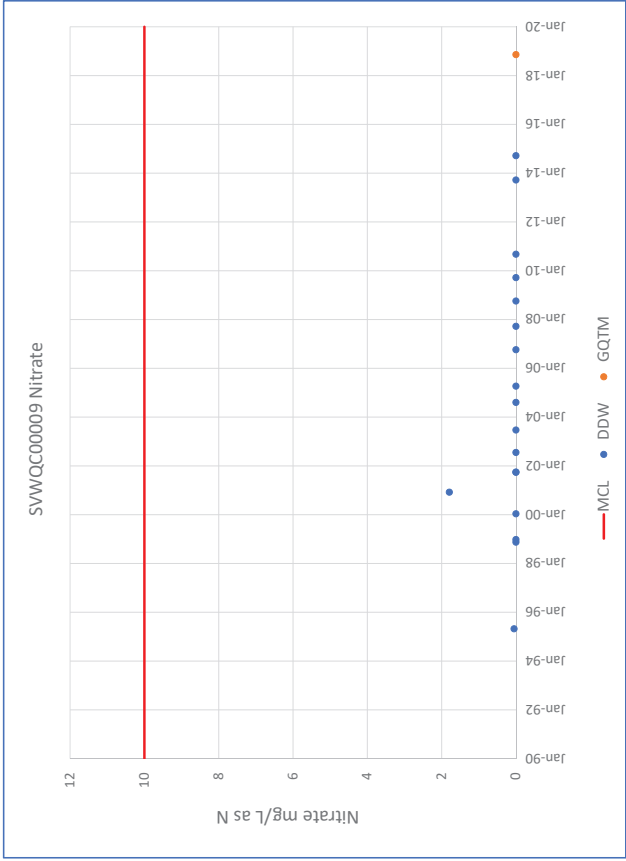
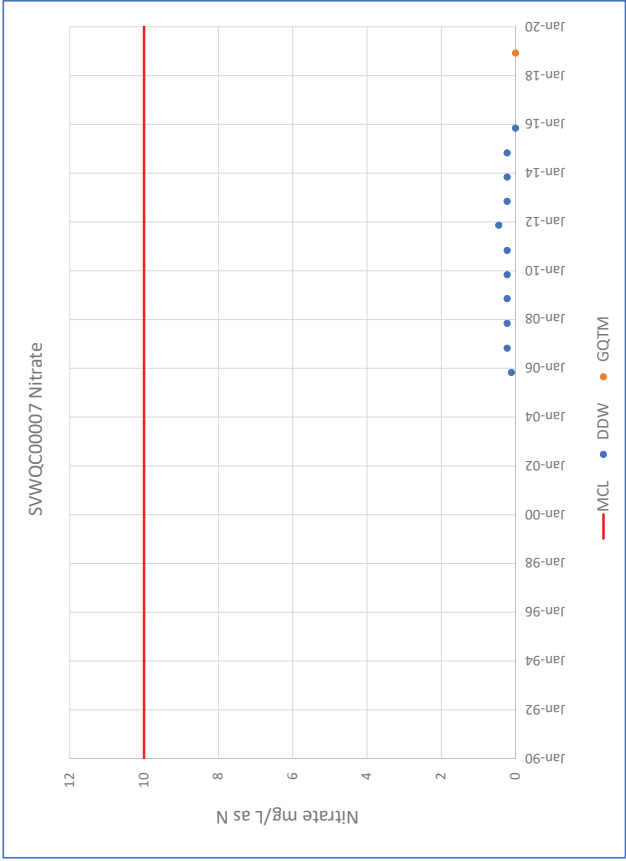


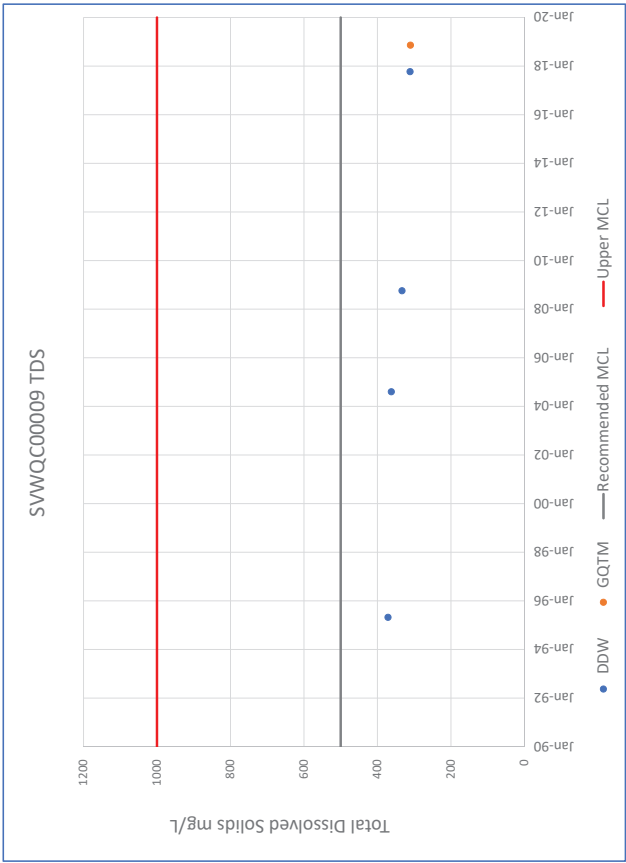
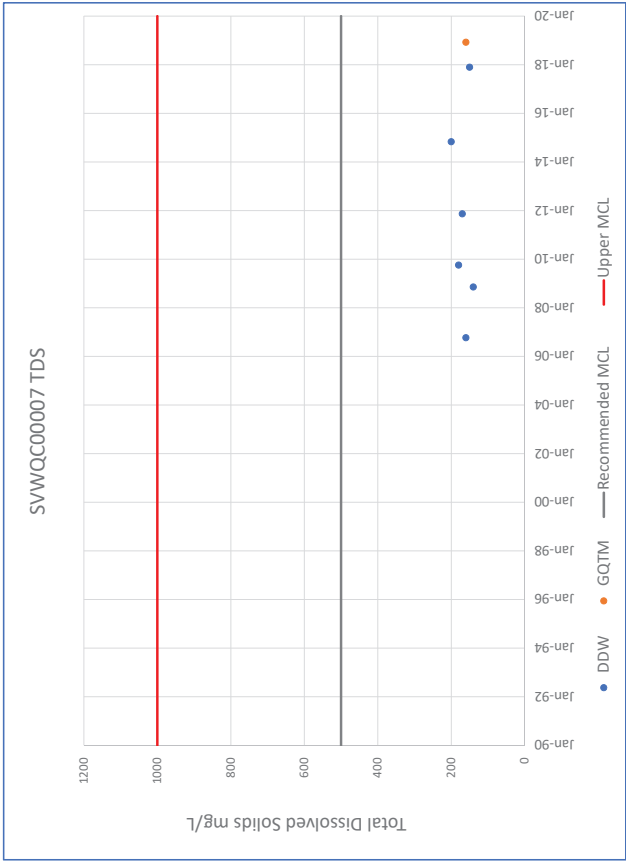
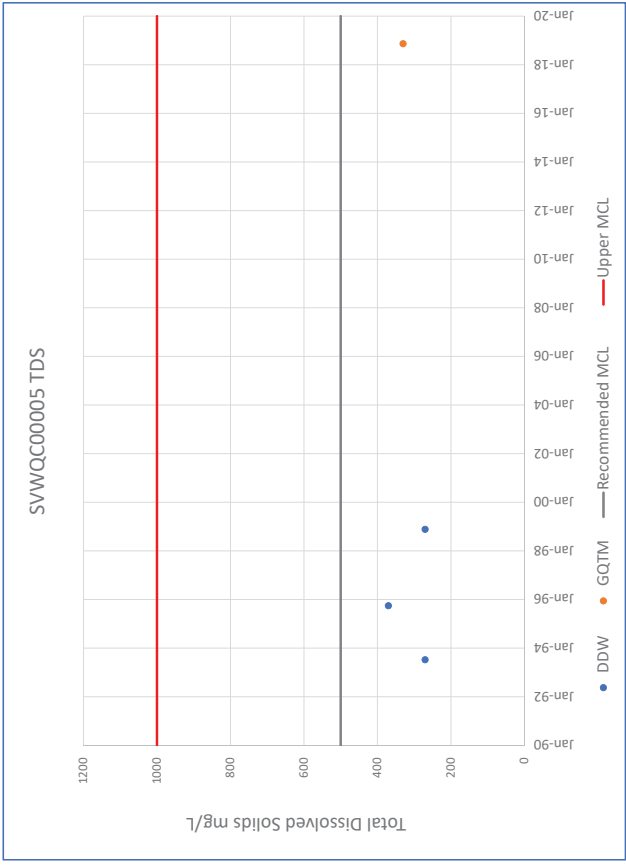
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**Appendix A:
Time-Series Charts of Nitrate and TDS Concentrations
in GQTM Network Wells**





Appendix B: Electronic Data Submittal

This appendix is submitted separately as an electronic data submittal containing a variety of data submittal requirements including tabular summary data sheets of sampling results, original laboratory analytical report files, field forms, analytical methods, and GIS files