Groundwater Quality Trend Monitoring Workplan

April 26, 2017

KINGS RIVER
WATER QUALITY COALITION

GROUNDWATER QUALITY TREND MONITORING WORKPLAN

April 26, 2017

Prepared For:

KINGS RIVER
WATER QUALITY COALITION

KINGS RIVER WATER QUALITY COALITION
4886 E. JENSEN
FRESNO, CA 93275
(559) 365-7958
kingsriverwqc.org

CERTIFICATION:

I certify under penalty of law that I have personally examined and am familiar with the information submitted in this document and all attachments and that, based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the information is true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment.

REGISTERED PROFESSIONAL ENGINEER
DAVID W. DE GROOT
C 70992
EXP. 6/30/17
CIVIL
STATE OF CALIFORNIA

David De Groot, PE
Registered Civil Engineer No. 70992

REGISTERED PROFESSIONAL ENGINEER
MATTHEW D. RAZOR
C 81897
EXP. 3/31/18
CIVIL
STATE OF CALIFORNIA

Matthew Razor, PE
Registered Civil Engineer No. 81897

TABLE OF CONTENTS

ATTACHMENTS

A. Kings River Water Quality Coalition
B. United States Geological Survey Quadrangle Map
C. KRWQC High Vulnerability Area

FIGURES

TABLES

1. INTRODUCTION

The Kings River Water Quality Coalition (Coalition or KRWQC) has prepared this Groundwater Quality Trend Monitoring Workplan (GQTM or Workplan) to address the requirements of the Waste Discharge Requirements General Order No. R5-2013-0120 (General Order) for growers that are members of Third Party within the Tulare Lake Basin area.

This Workplan is being submitted as required under the General Order, within 1 year of receiving Regional Water Quality Control Board (RWQCB) conditional approval of the Groundwater Assessment Report (GAR), which was provided on April 26, 2016. This Workplan is the initial phase outlining the approach to developing the complete GQTM for the KRWQC.

1.1. BACKGROUND

General Order R5-2013-0120, as adopted by the RWQCB in September 2013, requires growers that are members of a Third-Party within the Tulare Lake Basin Area to comply with the Waste Discharge Requirements (*WDRs*) of the Irrigated Lands Regulatory Program (*ILRP*). The ILRP was initiated in 2003 as a voluntary program to monitor agricultural runoff in surface waters and was expanded to include groundwater monitoring with adoption of the General Order. The purpose of the General Order is to address irrigated agricultural discharges that have the potential to impair surface waters and groundwater quality throughout the Tulare Lake Basin.

After approval of the General Order, the KRWQC received approval to act as a Third Party to implement the General Order. The KRWQC is a Joint-Powers Agency organized by the irrigation districts within the Kings and Tulare Lake sub-basins served by the Kings River (See **Attachment A and Attachment B**). Each of the elected or appointed members has a vote during the public, bi-monthly Board Meetings on items regarding policy, budget, or other matters which require Board approval. The KRWQC is staffed by employees of the Kings River Conservation District, who perform all the required tasks under the General Order.

The Kings River Water Quality Coalition is located in the northern and western portions of the Tulare Lake Basin Hydrologic Area (See **Figure 1**).

The General Order specifies the requirements of the GQTM in Section VIII.D.3, (*page 32*) of the Waste Discharge Requirements and further discussed under Attachment B: Monitoring and Reporting Program Sections IV.C and IV.E (*pages 19-22*), which states the following objectives:

1) *To determine current water quality conditions of groundwater relevant to irrigated agriculture.*
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.*

KRWQC is currently participating in the regional effort among several of the Third-Party Coalitions to develop a Regional Workplan for groundwater trend monitoring. The KRWQC Board of Directors has indicated the intent to participate in the regional coordination efforts and to utilize the regionally developed workplan as the KRWQC GQTM once complete.

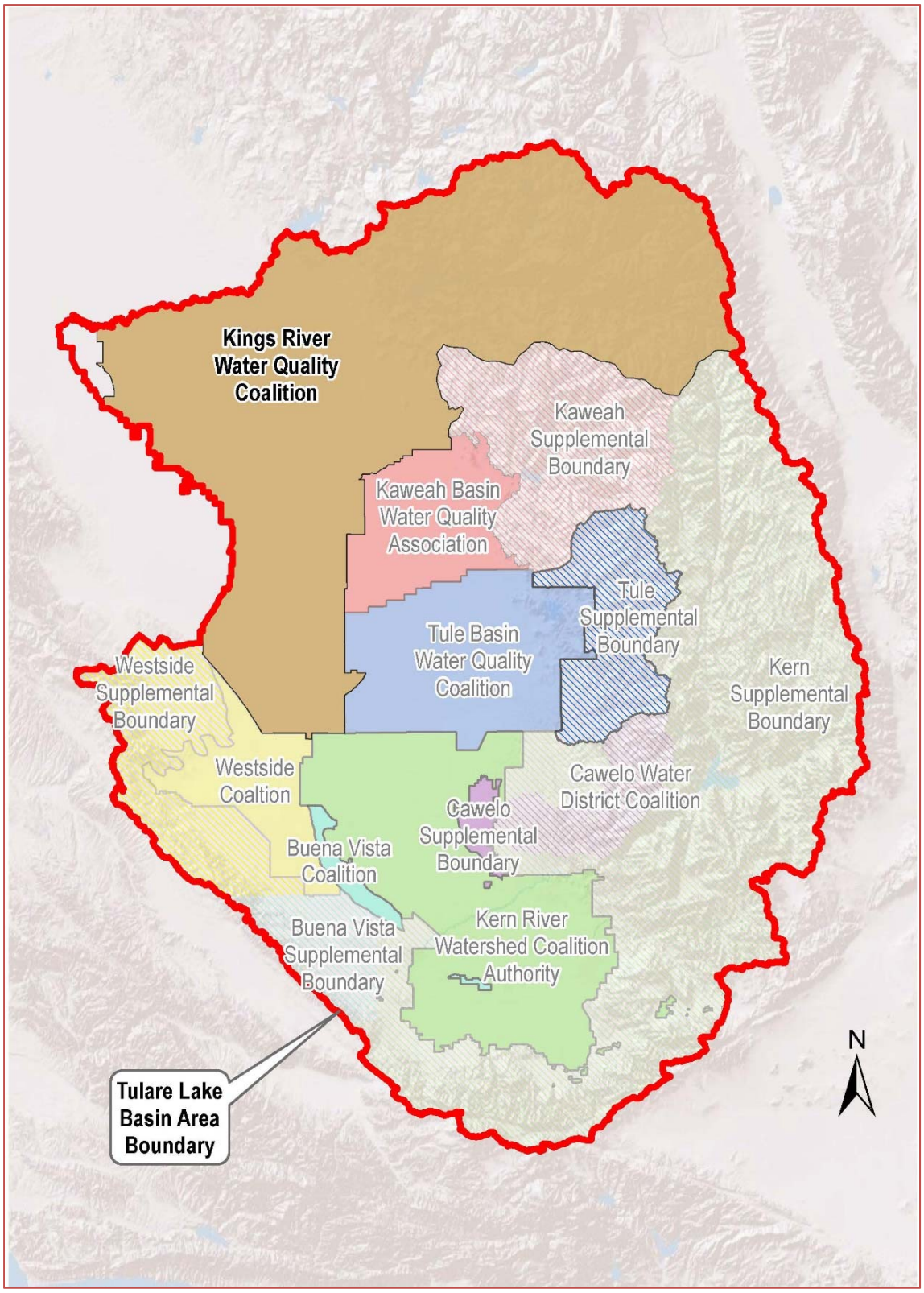


Figure 1 - Kings River Water Quality Coalition Location

1.1.1. PROPOSED GQTM REGIONAL MONITORING PROGRAM

Separate from the Tulare Lake Basin General Order, General Order R5-2012-0116-R3, Waste Discharge Requirements General Order for Growers Within the Eastern San Joaquin River Watershed that are Members of the Third-Party Group (ESJ General Order), is undergoing a draft revision to allow a Regional GQTM program be established, that may lead to a similar revision of General Order R5-2013-0120 for the Tulare Lake Basin. The Revised General Order, Attachment B: Monitoring and Reporting Program Draft of Section IV.C states the following:

> *"This MRP allows developing and implementing a regional Groundwater Quality Trend Monitoring workplan that involves participants in other areas or third-party groups, provided the regional workplan meets the objectives and sampling and reporting requirements described herein. The third-party must submit a copy of the agreement of the parties included in the regional Groundwater Quality Trend Monitoring Group (Trend Monitoring Group). Under this option, the regional workplan may propose a phased approach to develop and implement the workplan elements specified in section IV.E of this MRP."*

The proposed Regional GQTM Program objective is to coordinate between the multiple monitoring programs currently being implemented and allow for the future monitoring programs from other programs to participate in one overall monitoring program. Given the complexity and expense of implementing groundwater monitoring programs, the development of a coordinated Regional GQTM program is envisioned to result in a more effective and efficient monitoring than the utilization of separate programs working without coordination. This will greatly benefit all parties involved in the efforts to assess groundwater quality trends.

1.2. PREVIOUSLY COMPLETED RELATED WORK

The KRWQC has previously completed other documents that provide the background and context for the GQTM, which include the Groundwater Quality Assessment Report (GAR), the Comprehensive Groundwater Quality Management Plan (CGQMP), and the Management Practice Evaluation Workplan (MPEP).

Groundwater Quality Assessment Report (GAR)

The Groundwater Assessment Report (GAR) was one of the foundational reports for implementation of the General Order, with the focus on the assessment of existing groundwater conditions, hydrogeologic conditions, and overlying land uses to determine relative vulnerability of groundwater related to irrigated agriculture. Within the GAR, a high and low vulnerability area was approved by the RWQCB for the KRWQC. The GAR is required to be updated every 5 years, utilizing current information, which will include information and data collected as part of the GQTM.

Comprehensive Groundwater Quality Management Plan (CGQMP)

The Comprehensive Groundwater Quality Management Plan (CGQMP) was prepared with the objective to identify of areas within the KRWQC where groundwater quality results exceed the maximum contaminate level (*MCL*). Further outreach and education of the growers is required in these areas for possible modification of irrigation and/or nitrogen management practices to better protect groundwater quality. The implementation of the GQTM will monitor current groundwater

quality and provide monitoring data that can be utilized as a primary data source for implementation of the CGQMP.

Management Practice Evaluation Workplan (MPEP)

The KRWQC has participated in the preparation of a Management Practice Evaluation Workplan (*MPEP*), in conjunction with the other Coalitions within the Tulare Lake Basin Region, with the objective of identification and tracking of irrigation and fertilizer management practices that are protective of groundwater quality. The groundwater monitoring results collected as part of implementing the GQTM can be utilized to assist in the SWAT modeling and be evaluated in comparison to changes in management practices over time.

2. PROPOSED REGIONAL GQTM APPROACH

The Central Valley includes a vast diversity of land uses, communities, farms, and water supplies that support the agriculture industry. There are many different monitoring programs developed among these different entities, and other monitoring programs and under development. Developing a coordinated regional Groundwater Quality Trend Monitoring (RGQTM) program for the Central Valley will help achieve groundwater management and sustainable goals for years to come.

2.1. BACKGROUND

Groundwater quality monitoring is an element of many programs in the Central Valley. These programs include programs such as the Irrigated Lands Regulatory Program (ILRP), the Dairy Program, and the Oil Fields Program overseen by the Regional Water Quality Control Board (RWQCB). The RWQCB also requires groundwater quality monitoring as part of many individual Waste Discharge Requirements (WDR). In addition to monitoring overseen by the RWQCB, various other state programs, such as the State Water Resources Drinking Water Program, the Sustainable Groundwater Management Act (SGMA), California Statewide Groundwater Elevation Monitoring Program (CASGEM) and Central Valley Salinity Alternatives for Long-Term Sustainability (CV-SALTS) have groundwater monitoring elements. Given the complexity and expense of implementing groundwater monitoring programs, the development of a coordinated regional groundwater quality monitoring program would result in more effective and efficient monitoring than the utilization of separate programs working without coordination. The development of a coordinated approach will benefit all parties involved in the effort to assess groundwater quality within the Central Valley.

2.2. REGIONAL MONITORING PROGRAM DEVELOPMENT

The KRWQC realize the benefits of coordinating the many groundwater monitoring efforts in the Central Valley and will work cooperatively with the RWQCB and other coalitions to develop a Regional Groundwater Quality Trend Monitoring (RGQTM) program. The group will seek participation from other entities such as the State Water Resources Control Board (SWRCB GAMA), California Department of Water Resource (DWR), the Department of Pesticide Regulation, local SGMA Groundwater Sustainability Agencies (GSA), and other interested stakeholders to develop a coordinated groundwater monitoring approach. The CV SALTS process involves entities such as food processors, cities, and the dairy program. These entities are already engaged in regional groundwater monitoring and the goal will be to merge their regional groundwater monitoring efforts into the GRMP in a way that provides value added to both their program and the RGQTM.

One of the challenges to implement the RGQTM is the difference in the timing of the monitoring requirements among different ILRP coalitions and with the other entities that currently or plan to monitor groundwater. Some Coalitions have submitted individual GQTM specific to their areas and other entities such as the GSAs, are still in the process of forming. However, early planning with these other entities will be useful to help coordinate and develop the long-term programs. In addition, many of the individuals paying for the implementation of the monitoring programs are also paying for the implementation of the ILRP groundwater trend monitoring program.

A summary of these potential partners and their monitoring programs is included in **Table 1: Potential Groundwater Monitoring Entities**.

Table 1: Potential Groundwater Monitoring Entities

Program	COCs	Mechanism
ILRP	Nitrate, TDS	Regional Trend Monitoring
Dairy	Nitrate, TDS	Representative Monitoring, Dairy site monitoring
Oil and Gas	TDS, nitrate, COCs associated with drilling and disposal of drilling waste and fracking fluid	Individual Orders to drilling locations
CV SALTS	Nitrate, TDS	Surveillance and Monitoring Program (SAMP) of the SNMP
Groundwater Sustainability Agencies	Any threat for significant and unreasonable degradation of water quality, likely nitrate, TDS	Not yet established monitoring program
DPR Groundwater Protection Program	Pesticides	GPP monitoring on yearly basis
SWRCB Groundwater Ambient Monitoring and Assessment Program	Evaluate aquifers used for municipal supply for variety of chemicals	Domestic well sampling (SWRCB), special studies (LLNL), Priority Basins Monitoring Program (USGS)
DWR - CASGEM	Groundwater elevation	Currently Groundwater Management Plans (AB 3030, SB 1938) reporting

The development with potential participants in a RGQTM program is proposed to occur in three phases; Phase 1 – ILRP coalitions, other CV Salinity Coalition dischargers, and the oil and gas industry, Phase 2 – State and Federal Agencies, and Phase 3 – GSA's. The phasing of participants is not intended to prevent interested stakeholders from participating earlier in the process but rather a recognition of the fact that some stakeholders may not actively engage until their programs become further developed.

Phase 1

Initial contact with the potential Phase I partners in a regional groundwater monitoring program are already underway. Each ILRP coalition leads has been notified of the effort to develop a regional program and have begun discussions with their respective Boards of Directors to determine whether to participate. Additional communication has been made with other CV Salinity Coalition members such as representatives from the Central Valley Dairy Representative Monitoring Program, Publicly Owned Treatment Works (POTWs), and Food Processors to discuss their monitoring requirements and the potential benefits of participating in a regional groundwater monitoring program.

The majority of these other entities already perform groundwater compliance monitoring associated with permits for discharge to land or landfill operations. The objective in coordination with these groups is to understand their current permit requirements and the monitoring programs including the number, location, and sampling frequency of the wells and the constituents of concern in their program, which will be useful information when developing the Regional Plan.

Phase 2

There are numerous state agencies that monitor groundwater including the State Water Resources Control Board, the Department of Pesticide Regulation, US Geological Survey, and the Department of Water Resources. The RGQTM will contact these agencies and determine if coordination of monitoring efforts will result in mutual benefits.

Phase 3

The Groundwater Sustainability Agencies, currently being formed to implement the Sustainable Groundwater Management Act (SGMA) throughout the Central Valley, may also become potential partners. Currently, the focus of the GSA's has been governance, but prior to 2020, many GSA's will begin development of the Groundwater Sustainability Plan (GSP), of which requires groundwater monitoring.

2.3. REGIONAL MONITORING PROGRAM CONCEPTUAL APPROACH

After initial organization of the regional coordinated group are complete, the first activity of the GRMP will be to develop a detailed summary of the existing monitoring programs within the Central Valley.

After RGQTM Group members have identified the existing programs and understand their current status, the Draft RGQTM Work Plan will begin to be developed, utilizing the requirements outlined in the General Order in coordination with the elements identified within the other existing and proposed monitoring programs identified. The Work Plan will define the elements of the RGQTM including the monitoring plan, selection criteria for wells, quality assurance process, monitoring schedule, and the reporting elements.

The RGQTM Group will seek input from the RWQCB staff during the process of developing the initial work plan. Active involvement of RWQCB staff and management will help ensure the successful and timely development of the GRMP.

2.4. PROPOSED SCHEDULE

Table 2: Proposed Schedule identifies the proposed schedule to submit the initial draft of the GRMP during August 2017 as identified in the Draft revisions to the ESJ General Order.

Table 2: Proposed Schedule

Milestone Description	Timeline
Initial RGQTM Group meeting (Coalitions)	April/May 2017
RGQTM Work Plan Development Meetings	May-July 2017
Executed Agreement for RGQTM Group participation	Jul-17
Initial Draft of RGQTM Work Plan Submitted	Aug-17

3. GROUNDWATER QUALITY TREND MONITORING NETWORK DESIGN CRITERIA

3.1. MONITORING OBJECTIVES

The objectives of the Groundwater Quality Trend Monitoring Workplan, as outlined in Attachment B section IV.C (*page 19*) of the General Order, are stated as follows:

1) *To determine current water quality conditions of groundwater relevant to irrigated agriculture.*
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.*

Current water groundwater quality conditions relevant to irrigated agriculture were identified and presented in the GAR. The GAR provides a detailed summary of current and historical groundwater quality conditions as well as irrigated agricultural areas in the coalition boundary that have a high vulnerability to groundwater quality degradation.

The GQTM shall achieve the trend monitoring objectives through close coordination with current and ongoing groundwater monitoring efforts through the development and implementation of a Regional Groundwater Quality Monitoring Plan.

3.2. MONITORING WELL SELECTION CRITERIA

The selection criteria for the monitoring wells to be included within the coordinated regional GQTM Workplan will at a minimum meet the requirements identified in Attachment B, Section IV.C (*page 19*) of the General Order, which include:

1) *Be implemented over both high and low vulnerability areas;*
2) *Employ shallow wells, but not necessarily wells completed in the uppermost zone of first encountered groundwater.*
    a. *Consider using wells in existing monitoring networks;*
3) *Consist of a sufficient number of wells to provide coverage in the Third Party geographic area so that current water quality conditions of groundwater and composite regional effects of irrigated agriculture can be assessed. Rationale for the distribution of trend monitoring wells shall be included in the Workplan.*

3.3. SPATIAL REPRESENTATION CONSIDERATIONS

The rationale for identifying the spatial representation and the number of wells included for the Regional Groundwater Quality Trend Monitoring Workplan will at a minimum meet the requirements identified in Attachment B, Section IV.E (page 21) of the General Order, which include:

1) *The variety of agriculture commodities produced within the Third Party boundaries (particularly those commodities comprising the most irrigated agricultural acreage);*
2) *The conditions discussed/identified in the GAR related to the vulnerability prioritization within the Third Party area;*
3) *The areas identified in the GAR as contributing significant recharge to urban and rural communities where groundwater serves as a significant source of supply.*

A variety of factors shall be considered when determining the extents of the GQTM network for the purpose of adequately monitoring groundwater quality trends. The rationale for the determination of the

spatial coverage of existing groundwater wells to be monitored under the coordinated Regional Groundwater Quality Trend Monitoring Program shall consider the following:

- Vulnerability Priority: As identified in the Groundwater Quality Assessment Report (GAR), a portion of the KRWQC were mapped as vulnerable to groundwater quality impacts. The High Vulnerability Area map is provided in **Attachment C**. Considerations of more dense spatial coverage for areas in higher vulnerable priority areas may be considered.

- Well Characteristics: Considerations for the depth of the well, the pumping capacity of the well, and construction details will be evaluated to determine which existing wells would qualify to participate in the Regional GQTM. In addition, wells selected for the monitoring program shall require a well completion report to determine well construction characteristics and the location to verify the accessibility to monitor and sample.

- Hydrogeological Characteristics: Depth and location of the monitoring well compared to the hydrogeologic information will be considered when identifying specific wells to ensure consistency between samples of monitoring wells from the same aquifer.

3.4. WELL CONSTRUCTION CRITERIA

The specific well information for each monitoring well selected as part of the Regional GQTM Workplan specifically for the KRWQC shall be compiled and submitted after the Regional GQTM Workplan has been approved. During the well selection process, the evaluation criteria will consider the type of well, the depth of the well, the construction of the well, and whether the well is a part of a separate monitoring program identified in the Regional GQTM Workplan.

4. GROUNDWATER SAMPLING SCHEDULE AND PROCEDURES

To effectively implement the groundwater monitoring required by the General Order for the GQTM, consistent schedules for monitoring and collecting the groundwater data along with the methodologies and procedures for analyzing the data is important. As a part of the preparation of the GRMP, the sampling schedules and procedures will be coordinated and consistent, utilizing the common practices identified in this section.

4.1. GROUNDWATER ELEVATIONS

The depth to groundwater will be measured to calculate the groundwater elevation at each well location. Following is the proposed schedule requirements for measurement of depth to groundwater, the standard protocols used for measuring groundwater depth, and the calculation procedure for the determination of the groundwater elevations.

4.1.1 GROUNDWATER ELEVATION MEASUREMENT SCHEDULE

The depth to groundwater at each selected well in the GQTM will be conducted each year at a schedule determined through the coordinated regional GQTM. At a minimum, depth to groundwater will be measured one time per year.

4.1.2 GROUNDWATER DEPTH MEASUREMENT PROTOCOL

Prior to conducting groundwater elevation measurements, all equipment should be properly cleaned using the following decontamination procedure:

- Triple rinse equipment with deionized water.
- Wash equipment with an Alconox solution which is followed by a deionized water rinse.
- Rinse with an approved solvent (*e.g. methanol, isopropyl alcohol, acetone*), if organic contamination is suspected.
- Place equipment on a clean surface such as Teflon or polyethylene sheet to air dry.

The well identification, time of day, date, and description of reference point (*top of well casing, top of riser pipe, or some other reproducible position on the well head*) shall be recorded for each well site measured. The device shall then be lowered into the well casing: Electrical tapes shall be lowered for contact with the water surface, chalked steel tapes shall be lowered generally one foot or more below the water surface to ensure the chalked section of the tape is partially submerged. The steel tape shall contain even foot marks for measurement of depth to water below the reference point.

For electrical tapes, the distance from the water surface to the reference point shall be recorded, as determined by the audio signal or meter. For chalked steel tapes the distance between the reference point and the chalked line on the steel tape at the foot marker shall be recorded.

Measurements shall be repeated at least a second time to ensure accuracy. Remove all downhole equipment when measurements have been recorded. Rinse all downhole equipment and store for transport to the next well location. Equipment shall be decontaminated as described for

measurement at further locations. Physical changes, such as erosion or cracks in the protective concrete pad or extreme variations in total depth to water shall be noted on the field sheet.

In addition, at the time of the field measurements, any nearby wells in operation should be included in the field notes. Lastly, if the selected well measured was in operations within the previous 4 hours of measurement, a note should be included in the field notes.

4.1.3. CALCULATION OF GROUNDWATER ELEVATION

During the verification and final selection of each well, the selected well will be field surveyed using NAVD 88 Datum to establish the vertical elevation of the well casing or reference point. The groundwater elevation above mean sea level shall be calculated using the following equation:

$$E_w = E - D$$

Where:

E_w = Elevation of groundwater above mean seal level (feet) or vertical datum
E = Elevation above sea level of well casing or reference point (feet)
D = Depth to groundwater, see Section 4.1.2 (feet)

4.2. GROUNDWATER QUALITY

The quality of groundwater at each selected well in the GQTMP shall be monitored according to the following schedule and protocols.

4.2.1. GROUNDWATER QUALITY SAMPLING SCHEDULE

Wells selected for the GQTMP monitoring network will be sampled on an annual interval for a select group of water quality parameters and sampled every five years for a more extensive set of parameters as identified in the General Order. The parameters to be analyzed and the frequency of sampling is identified in **Table 3: Trend Monitoring Constituents**. The sampling annually for groundwater quality, month to be determined within the coordinated regional GQTM, will be conducted initially during each phase from each selected well identified within the KRWQC.

Table 3: Trend Monitoring Constituents

Trend Monitoring Constituents			
Annual Sampling		**Five Year Sampling**	
Constituent	**Units**	**Constituent**	**Units**
Electrical Conductivity (EC)	umhos/cm (at 25°C)	Total Dissolved Solids (TDS)	mg/L
pH	Standard Unit	Carbonate	mg/L
Dissolved Oxygen (DO)	mg/L	Bicarbonate	mg/L
Temperature	°C	Chloride	mg/L
Nitrate as Nitrogen	mg/L	Sulfate	mg/L
		Boron	mg/L
		Calcium	mg/L
		Sodium	mg/L
		Magnesium	mg/L
		Potassium	mg/L

4.2.1.1. Annual Sampling

Annual monitoring of GQTMP network wells will include sampling and laboratory analysis of the nitrate concentration of the groundwater; nitrate concentrations will be reported in units of milligrams per liter (mg/L) as nitrogen. Monitoring of select water quality parameters will be taken in the field at the time of the sampling. Field parameters to be measured at an annual frequency include electrical conductivity at 25 °C (EC) in µS/cm, pH, temperature (in °C), and dissolved oxygen (DO) in mg/L. The annual measurement of groundwater for these water quality parameters is consistent with sampling requirements specified in the General Order. Additional field testing for oxidation-reduction potential (ORP or redox potential) may provide information relating to the groundwater quality that is helpful in understanding existing influences on groundwater quality from agricultural operations and potential for future impacts that may impact beneficial uses. Field turbidity in sampled water may indicate issues associated with the sample collection (suspended solids) or other characteristics of the water being tested that may affect the results of laboratory analyses.

4.2.1.2. Five Year Sampling

Every five years GQTM network wells will be tested for a more extensive set of groundwater quality constituents in addition to the laboratory and field water quality parameters included as part of the annual testing. The constituents to be tested for and analyzed in a laboratory every five years include total dissolved solids (TDS) and major cations such as boron, calcium, sodium, magnesium, and potassium and anions including carbonate, bicarbonate, chloride, and sulfate. Results from analyses of cations and anions will be reported in mg/L. Groundwater quality testing in additional wells monitored within other groundwater monitoring programs may not align exactly with the frequency of testing for all water quality parameters specified in the WDRs, although coordination efforts with cooperating monitoring entities will focus on establishing a monitoring program that is consistent and compatible with the monitoring objectives for the GQTM.

4.2.2. GROUNDWATER QUALITY SAMPLING PROTOCOLS

The following groundwater quality sampling protocols describe the procedures to be utilized during sampling of groundwater monitoring wells for constituent analyses. The laboratory completing the analysis must be certified by the appropriate state regulating agency for the laboratory analyses to be performed.

4.2.2.1. SAMPLING WATER SUPPLY WELLS

Water supply wells shall be sampled by purging the well for a period of time adequate to purge the pump riser pipe. If the well is currently pumping, the sample may be taken without purging the well. Water samples shall then be collected from the discharge point nearest the well head. Samples shall be collected directly into laboratory-prepared bottles. Samples may not be taken from any location after any treatment of the water for domestic use, such as from a faucet within the house.

4.2.2.2. SAMPLE CONTAINERS

Appropriate pre-cleaned sample containers and preservatives for the analyses to be performed will be obtained from the subcontracted analytical laboratory. Sample containers shall be labeled before sampling with self-adhesive tags having the following information written in waterproof ink:

- Project number
- Sample I.D. number
- Date and time sample was collected
- Sample Location
- Sample Constituents
- Initials of sample collector

4.2.2.3. CONSTITUENT SAMPLING PROCEDURE PROTOCOLS

Field measurements of temperature, pH, dissolved oxygen (DO), Electrical Conductivity (EC), will be conducted and recorded of aliquots of groundwater and not determined in the laboratory. Field water quality measurements and instrument calibration details will be recorded on the WELL SAMPLING RECORD.

a. Temperature Measurements

Temperature measurements shall be made with a mercury-filled thermometer or an electronic thermistor, and all measurements will be recorded in degrees Celsius.

b. pH Measurement

The pH measurement shall be made as soon as possible after collection of the sample, generally within a few minutes. The pH will be measured by immersing the pH probe into an aliquot of groundwater.

The pH meter shall be calibrated at the beginning of each sampling day, once during each sampling day and whenever appropriate, in accordance with the equipment manufacturer's specifications, as outlined in the instruction manual for the specific pH meter used.

c. Dissolved Oxygen

Dissolved Oxygen (DO) shall be measured by immersing the conductivity probe into an aliquot of groundwater as soon as possible after collection of the sample, generally within a few minutes. Measurements will be reported in units of mg/L.

The DO meter shall be calibrated at the beginning and once during each sampling day in accordance with the equipment manufacturer's specifications, as outlined in the instruction manual for the DO meter used.

d. Electrical Conductivity

Electrical Conductivity (EC) shall be measured by immersing the conductivity probe into an aliquot of groundwater. The probes used should automatically compensate for the temperature of the sample. Measurements will be reported in units of micromhos/cm at 25 degrees Celsius.

The EC meter shall be calibrated at the beginning and once during each sampling day in accordance with the equipment manufacturer's specifications, as outlined in the instruction manual for the EC meter used.

4.2.2.4. WELL SAMPLING RECORD

A Well Sampling Record shall be used to tabulate the following information for each sample:

- Sample I.D.
- Duplicate I.D., if applicable
- Date and time sampled
- Name of sample collector
- Well designation (State well numbering system for water supply wells)
- Owner's name, or other common designation
- Well diameter
- Depth to water on day sampled
- Casing volume on day sampled
- Method of purging (bailing, pumping, etc.)
- Amount of water purged
- Extraordinary circumstances (if any)
- Field measurements temperature (ºC), pH (pH units), specific electrical conductivity (at 25ºC umhos/cm), and dissolved oxygen (mg/l)
- Depth from which sample was obtained
- Number and type of sample container(s)
- Purging pump intake depth
- Times and volumes corresponding to water quality measurements

- Purge rate

4.2.2.5. HANDLING, STORAGE, AND TRANSPORTATION

Efforts will be made to handle, store, and transport supplies and samples safely. Exposure to dust, direct sunlight, high temperature, adverse weather conditions, and possible contamination shall be avoided. Immediately following collection, samples shall be placed in a clean chest that contains ice or blue ice (if cooling is required), and transported to the subcontracted laboratory as soon as practical, or in accordance with the project QAPP. If cooling is required, samples should be chilled at 4°C to prevent degradation.

After samples have been collected and labeled, they shall be maintained under chain-of-custody procedures. These procedures document the transfer of custody of samples from the field to the laboratory. Each sample sent to the laboratory for analysis shall be recorded on a CHAIN-OF-CUSTODY RECORD, which will include instructions to the laboratory for analytical services.

Information contained on the triplicate CHAIN-OF-CUSTODY RECORD shall include:

- Project number
- Signature of sampler(s)
- Date and time sampled
- Sample I.D.
- Number of sample containers
- Sample matrix (water)
- Analyses required
- Remarks, including preservatives, special conditions, or specific quality control measures
- Turnaround time and person to receive laboratory report
- Method of shipment to the laboratory
- Release signature of sampler(s), and signatures of all people assuming custody
- Condition of samples when received by laboratory

Blank spaces on the CHAIN-OF-CUSTODY RECORD shall be crossed out between the last sample listed and the signatures at the bottom of the sheet.

The field sampler shall sign the CHAIN-OF-CUSTODY RECORD and record the time and date at the time of transfer to the laboratory or to an intermediate person. A set of signatures is required for each relinquished/reserved transfer, including intermediate transfers. The original imprint of the chain-of-custody record will accompany the sample containers. A duplicate copy will be placed in the project file.

If the samples are to be shipped to the laboratory, the original CHAIN-OF-CUSTODY shall be sealed inside a plastic bag within the ice chest, and the chest shall be sealed with custody tape which has been signed and dated by the last person listed on the chain-of-custody. U. S. Department of Transportation shipping requirements shall be followed and the sample shipping receipt retained in the project file as part of the permanent chain-of-custody document. The shipping company (e.g. Federal Express, UPS, DHL) will not sign the chain-of-custody forms as a receiver, instead the laboratory shall sign as a receiver when the

samples are received.

4.2.2.6. QUALITY ASSURANCE AND QUALITY CONTROL

To evaluate the precision and accuracy of analytical data, quality control samples, as duplicates and blanks, shall be periodically prepared. These samples will be collected or prepared and analyzed by the laboratory, as specified in the project Quality Assurance Project Plan (QAPP) or by the project manager.

All instrumentation shall be operated in accordance with operating instructions as supplied by the manufacturer, unless otherwise specified in the Quality Assurance Project Plan (QAPP) or by the project manager.

5. REPORTING

All GQTM data specific to the KRWQC, including the well information, sampling results, and historical results will be digitally stored and organized into a database managed by the KRWQC. The data collected from GQTMP will be reported to the RWQCB as identified below.

5.1. REPORTING REQUIREMENTS

Annual reporting of the GQTMP results will be submitted by the Annual Monitoring Report and electronically in accordance with requirements specified in Attachment B Section V.B (page 23) of the General Order, which states:

> *"Annually, by 31 August, the third-party shall submit the prior year's groundwater monitoring results as an Excel workbook containing an export of all data records uploaded and/or entered into the State Water Board GeoTracker database. If any data are missing from the report, the submittal must include a description of what data are missing and when they will be submitted to the Central Valley Water Board. If data are not loaded into the GeoTracker database, this shall also be noted with the submittal."*

5.1.1. ANNUAL MONITORING REPORT

The Annual Monitoring Report, submitted August 31 each year for the previous hydrologic year, will include several visual and tabulated summaries for presentation of the results of the groundwater monitoring program and for identification of trends in groundwater quality over time as follows:

- An overview map of the wells sampled and monitored as part of the GQTM network within the KRWQC
- A tabulation consisting of both the field and laboratory analytical results of the constituents monitored for each well. The tabulation will include results from the current year, and statistical analysis of multi-year data including the minimum, maximum, and mean result;
- Current Year Isopleth Maps of analytical results that present the collected data spatially and identify patterns in groundwater quality within the aquifer system;
- Graphs of time-series groundwater quality based upon the monitored results of groundwater in the GQTMP network;
- Groundwater level contours maps based upon the depths to groundwater will be generated and provided as part of the annual report. Groundwater elevation maps will also be presented to provide a hydrogeologic understanding of the groundwater conditions and for determination of regional groundwater flow directions.

5.2. COORDINATION WITH OTHER GENERAL ORDER REQUIREMENTS

Results from the GQTM will be utilized and coordinated to supplement other requirements of the General Order, including the Groundwater Quality Assessment Report (GAR) Update, the Comprehensive Groundwater Quality Management Plan (CGQMP), and the Management Practice Evaluation Program (MPEP).

5.2.1. GROUNDWATER QUALITY ASSESSMENT REPORT (GAR)

Every five years, the General Order requires the GAR to be updated, specifically utilizing additional data collected during the previous 5-year period. The GAR update will include discussion of results and findings from the GQTM, including graphical and tabulated presentations. The GAR update will incorporate data obtained and collected from the GQTM network monitoring wells and that data will be analyzed statistically for trends. Findings related to groundwater quality trends, spatial patterns in trends, and statistical relationships between trends along with land use composition and management practices will be the focus of the GAR update. A discussion of findings related to data gaps will be included and recommendations for addressing data gaps will be provided. The need for refinements to the GQTM design will be assessed and discussed in the GAR update along with recommendations on modifications of the groundwater trend monitoring program design, as needed.

5.2.2. COMPREHENSIVE GROUNDWATER QUALITY MANAGEMENT PLAN (CGQMP)

The KRWQC prepared a Comprehensive Groundwater Quality Management Plan (*CGQMP*) with the objective of the identification of areas within the KRWQC where groundwater quality results exceed the maximum contaminate level (*MCL*). Further outreach and education of the growers is required in these areas for possible modification of irrigation and/or nitrogen management practices to better protect groundwater quality. The implementation of the GQTM will monitor groundwater quality and provide current monitoring data that can be utilized as a primary data source for implementation of the CGQMP.

5.2.3. MANAGEMENT PRACTICE EVALUATION PROGRAM (MPEP)

The KRWQC has participated in the preparation of a Management Practice Evaluation Workplan (*MPEP*), in conjunction with the other Coalitions within the Tulare Lake Basin Region, with the objective of identification and tracking of irrigation and fertilizer management practices that are protective of groundwater quality. The groundwater monitoring results collected as part of implementing the GQTM can be utilized to assist in the SWAT modeling and be evaluated in comparison to changes in management practices over time.

6. REFERENCES

California Department of Water Resources (DWR), 2003, California's groundwater. DWR Bulletin 118 http://www.water.ca.gov/groundwater/bulletin118/san_joaquin_river.cfm

California Department of Water Resources (DWR), 1980, "Groundwater Basins in California", Bulletin 118-80, 73p.

GEI, Inc., 2014, Kings River Watershed Coalition Authority Groundwater Assessment Report. 400p.

Kings River Water Quality Coalition, 2014, Comprehensive Groundwater Management Plan. 67p.

RWQCB, 2012, Central Valley Regional Valley Water Quality Control Board, Irrigated Lands Regulatory Program, http://www.swrcb.ca.gov/rwqcb5/water_issues/irrigated_lands/index.shtml.

RWQCB, 2013, California Regional Water Quality Control Board-Central Valley Region, Order Number R5-2013-0120, Waste Discharge Requirements General Order for Growers within the Tulare Lake Basin Area that are Members of a Third Party Grou*p*, 202 p.

ATTACHMENT A
Kings River Water
Quality Coalition

Merced
Madera
Fresno
Kings
Tulare
Inyo

MERCED
CHOWCHILLA
MADERA
DELTA-MENDOTA
WESTSIDE
KINGS
KAWEAH
TULARE LAKE
TULE
KERN COUNTY

Le Grand
Minarets
Death Valley
Kings Canyon
Boyd
Sierra
Generals
Forest Rte 22S05

Chowchilla River
Dry Creek
Fresno River
San Joaquin River
Dinkey Creek
Big Creek
North Fork Kings River
Middle Fork Kings River
Kings River
Mill Creek
Mill Flat Creek
South Fork Kings River
Boulder Creek
Roaring River
Eshom Creek
North Fork Kaweah River
Marble Fork Kaweah River
East Fork Kaweah River
South Fork Kaweah River
Saint Johns River
California Aqueduct
North Fork Tule River
North Branch Tule River
Tule River
South Fork Tule River
Deer Creek
White River
Friant-Kern Canal
Little Kern River
Kern River
Fish Creek
Trout Creek
South Fork Kern River
Great Western Divide
Mountain Highway 99

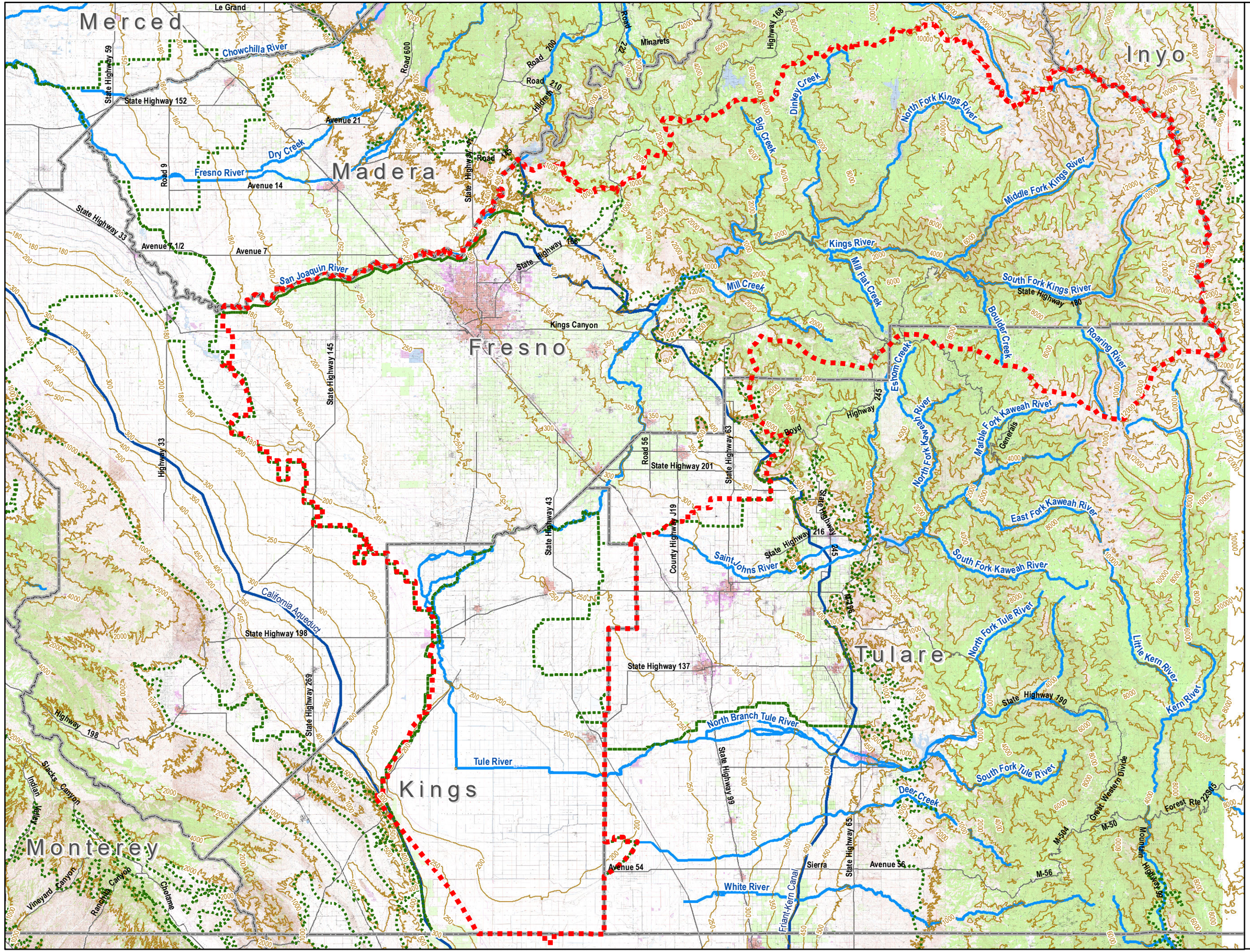
State Highway 59
State Highway 152
Avenue 21
Avenue 14
Avenue 7 1/2
Avenue 7
Road 9
Road 600
Road 200
Road 210
Road 222
Road 40
Hildreth
Highway 168
State Highway 180
State Highway 145
Highway 33
Road 56
State Highway 63
State Highway 43
State Highway 20
State Highway 216
State Highway 245
County Highway J19
State Highway 99
State Highway 137
State Highway 198
State Highway 269
Highway 198
Avenue 54
Avenue 56
State Highway 65
State Highway 41
State Highway 33
State Highway 155
Highway 245
M-236
M-504
M-50
M-56

Legend
KRWQC Boundary (2,748,382 Ac.)
Counties
Bulletin 118 Groundwater Basins
Waterways
California Aquaducts
Roads

N

1 in = 12 miles

ATTACHMENT B
USGS Quadrangle Map



Legend

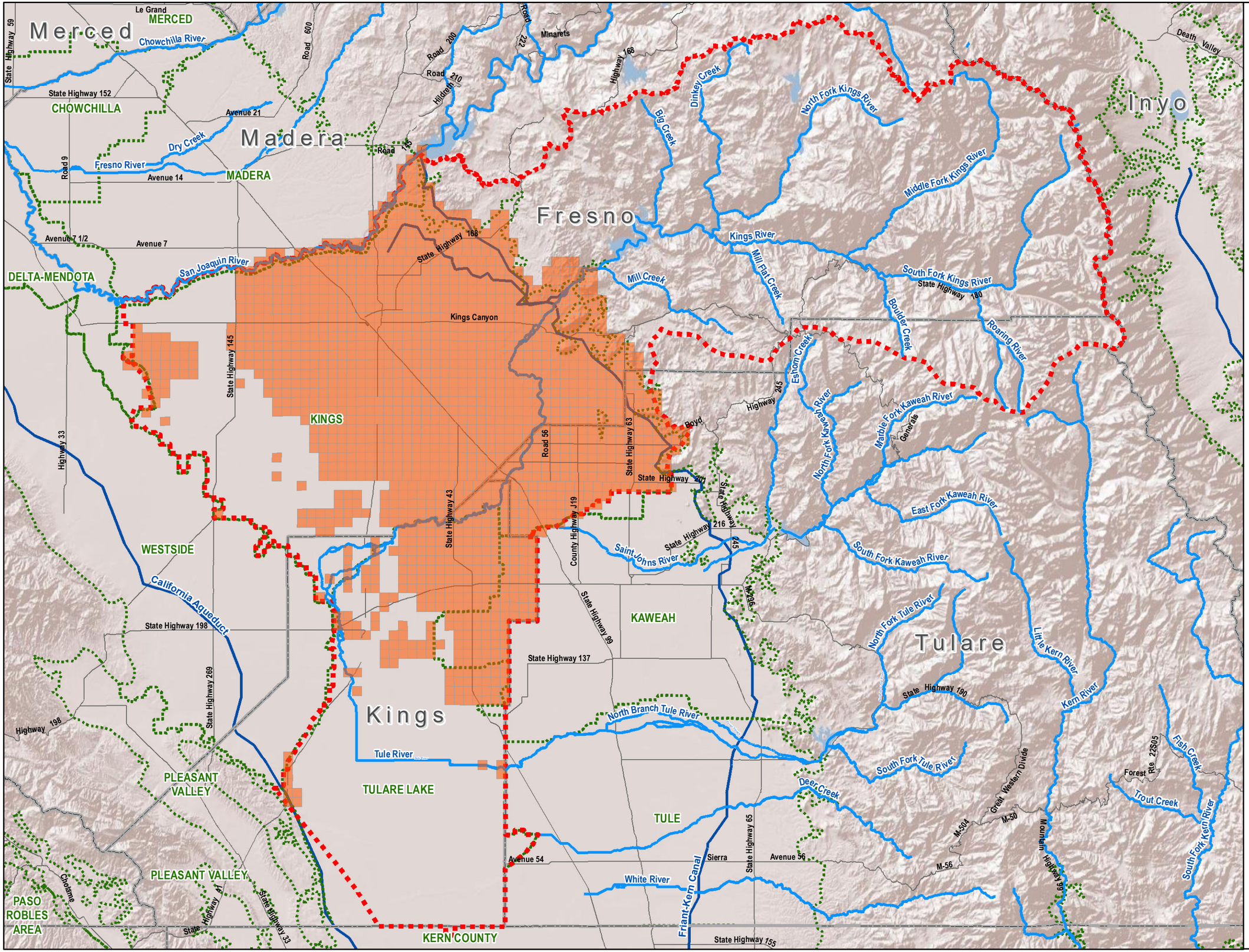
- Counties
- KRWQC Boundary (2,748,382 Ac.)
- Bulletin 118 Groundwater Basins
- Topographic Contours (Feet)
- California Aquaducts
- Waterways
- Roads

N

1 in = 12 miles

Reference:
USGS Quadrangle Map

ATTACHMENT C
KRWQC High Vulnerability Area



Legend

- KRWQC Boundary (2,748,382 Ac.)
- Counties
- Bulletin 118 Groundwater Basins
- Hight Vulnerability Area
- Waterways
- California Aquaducts
- Roads

N

1 in = 12 miles