2024 Annual Performance Report:

Model Criteria for Groundwater Monitoring in Areas of Oil and Gas Well Stimulation

Reporting Period: January 1, 2024 through December 31, 2024

STATE WATER RESOURCES CONTROL BOARD

April 4, 2025

Table of Contents

GLOSSARY

Area-specific Groundwater Monitoring Plan (GMP) – A groundwater monitoring plan submitted by an oil and gas operator to characterize baseline water quality conditions and detect potential impacts to protected water from well stimulation treatments. A GMP may be developed for a single or multiple oil and gas well(s) to undergo stimulation. The GMP must be developed and implemented in accordance with the State Water Resources Control Board's (State Water Board) Model Criteria for Groundwater Monitoring in Areas of Oil and Gas Well Stimulation..

> **Addendum:** An operator may propose an addendum to a GMP in which additional well(s) to be stimulated would be added to a State Water Board and Regional Water Quality Control Board staff (collectively, Water Boards) approved GMP.

Axial Dimensional Stimulation Area (ADSA) – The estimated maximum length, width, height, and azimuth of the area(s) stimulated by a well stimulation treatment (California Geologic Energy Management Division [CalGEM] Well Stimulation Treatment Regulations, July 1, 2015). CalGEM approves or denies the ADSA as part of the well stimulation permitting process. After approval of the ADSA, a well stimulation permit may be issued to an operator; however, stimulation cannot occur until State Water Board staff has approved either a groundwater monitoring plan or request for exclusion from groundwater monitoring associated with the permitted well(s).

Designated Contractors – The State Water Board is required to designate one or more qualified independent third-party contractors to perform property owner requested water quality sampling and testing (Pub. Resources Code, §3160, subdivision (d)(7)(B). The designated contractor must not work for or be affiliated with an oil and gas operator. A list of approved designated contactors is maintained by the State Water Board.

Exempted aquifer – As defined in 40 Code of Federal Regulations (CFR) part 146.4, an aquifer or a portion thereof which meets the criteria for an underground source of drinking water may be determined to be an "exempted aquifer" if:

> 1) It does not currently serve as a source of drinking water, and
>
> 2) it cannot now and will not in the future serve as a source of drinking water.

In addition, it must meet the requirements of California Public Resources Code (PRC) 3131(a):

> 1) Criteria set forth in Section 146.4 of Title 40 of the Code of Federal Regulations.
>
> 2) The injection of fluids will not affect the quality of water that is, or may reasonably be, used for any beneficial use.
>
> 3) The injected fluid will remain in the aquifer or portion of the aquifer that would be exempted.

Refer to 40 CFR part 146.4 and PRC 3131(a) for regulation specifics.

Groundwater Monitoring – Monitoring of protected water in a specific area to characterize baseline water quality conditions and to assess potential effects to beneficial use waters from well stimulation treatment activities (i.e., monitoring well sampling and gauging of water levels).

Interim Groundwater Monitoring Plan (interim GMP) – A groundwater monitoring plan approved by CalGEM prior to the State Water Board adoption of the Model Criteria for Groundwater Monitoring in Areas of Oil and Gas Well Stimulation and during the interim period (January 1, 2014 – July 6, 2015).

Model Criteria for Groundwater Monitoring in Areas of Oil and Gas Well Stimulation (Model Criteria) – Outlines the methods to be used for assessment, sampling, analytical testing, and reporting of water quality associated with oil and gas well stimulation treatments. Adopted by the State Water Board July 7, 2015.

Performance Measures – Performance measures are a means to evaluate the effectiveness and efficiency of the Model Criteria. Five (5) goals were developed through a process of meetings with stakeholder groups. Performance measures are included in the *Model Criteria for Groundwater Monitoring in Areas of Well Stimulation: Summary of Goals, Strategies, Proposed Performance Measures, and Plans for Implementation* (March 1, 2016).

Protected Water – Water with less than 10,000 milligrams per liter of total dissolved solids and located outside an exempt aquifer.

Regional Groundwater Monitoring Program (RMP) – As required by Senate Bill 4 (Pavley Statutes of 2013), and detailed in the Model Criteria, the State Water Board is to implement an oil and gas regional groundwater monitoring program in order to protect all waters designated for any beneficial use, while prioritizing the monitoring of groundwater that is or has the potential to be a source of drinking water. Factors considered for the RMP include well stimulation treatments, among other events or activities that have the potential to contaminate groundwater. The U.S. Geological Survey is the technical lead on the RMP.

Request for Exclusion from Area-Specific Groundwater Monitoring (request for exclusion) – A document submitted by an oil and gas operator requesting exclusion from groundwater monitoring before proceeding with well stimulation activities. State Water Board staff must provide a written concurrence to the operator for the exclusion from groundwater monitoring.

> **Request to Add Wells to an Existing Exclusion (Added Wells):** An operator may submit requests to add well(s) to stimulate in a Water Boards staff approved exclusion area.

Well stimulation treatment (WST) – A process performed on an oil and gas well to increase production by increasing the permeability of the formation. WSTs include, but are not limited to, hydraulic fracturing treatments and acid well stimulation treatments.

Submittal Status:

Approved - Submittal was reviewed by Water Boards staff and has met the requirements of the Model Criteria.

Denied - Submittal was reviewed by Water Boards staff and has not met the requirements of the Model Criteria.

Cancelled - Submittal was retracted by the operator.

Review in Progress - Submittal is being reviewed by Water Boards staff.

On Hold - Water Boards staff are not currently reviewing the submittal. Submittals may be put “On Hold” for the following reasons:

- Comments have been forwarded to the operator and the operator is working on a revised submittal.
- Water Boards staff are awaiting approval of the Axial Dimensional Stimulation Area (ADSA) from CalGEM.
- The submittal is on hold at the request of the operator.

Monitoring Discontinued – Water Boards staff concurred with operator’s request to discontinue groundwater monitoring

ABBREVIATIONS AND ACRONYMS

ADSA	Axial Dimensional Stimulation Area
Annual Model Criteria Performance Report	Annual Performance Report: Model Criteria for Groundwater Monitoring in Areas of Oil and Gas Well Stimulation
bbl	barrel(s) of oil
CalGEM	California Geologic Energy Management Division
CIPA	California Independent Petroleum Association
COGG	United States Geological Survey California Oil, Gas, and Groundwater Program (see RMP)
GeoTracker	GeoTracker Information System
GMP	Area-specific groundwater monitoring plan
GMR	Area-specific groundwater monitoring report associated with GMPs
Model Criteria	Model Criteria for Groundwater Monitoring in Areas of Oil and Gas Well Stimulation
neighbor notification	CalGEM Well Stimulation Treatment Neighbor Notification Form
operator	oil and gas field operator
RMP	Regional Groundwater Monitoring Program (see COGG)
Regional Water Board	Regional Water Quality Control Board
reporting period	January 1, 2024 - December 31, 2024
State Water Board	State Water Resources Control Board
USGS	United States Geological Survey
Water Boards	State Water Resources Control Board and Regional Water Quality Control Boards
WellSTAR	Well Statewide Tracking and Reporting System
WSPA	Western States Petroleum Association
WST	Well Stimulation Treatment

1.0 INTRODUCTION

This Annual Performance Report summarizes work performed from January 1, 2024 through December 31, 2024 (reporting period) by staff from the State Water Resources Control Board (State Water Board) and associated agencies to implement the *Model Criteria for Groundwater Monitoring in Areas of Oil and Gas Well Stimulation* (Model Criteria).

State Water Board staff developed the Model Criteria to guide the process for assessing potential effects of well stimulation treatments (WSTs) on California's groundwater resources. It outlines groundwater monitoring requirements for area-specific groundwater monitoring conducted by oil and gas operators (operators), as well as the approach State Water Board staff will take to conduct a Regional Monitoring Program (RMP).

A WST cannot be performed until staff from the California Department of Conservation, California Geologic Energy Management Division (CalGEM) issues a WST permit and the State Water Board and appropriate Regional Water Quality Control Board (collectively, Water Boards) staff have:

- approved an operator-submitted groundwater monitoring plan (GMP), or
- approved an operator-submitted request for exclusion from area-specific groundwater monitoring (request for exclusion).

If the operator proposes additional WST in an approved GMP or exclusion area, an addendum to the GMP (addendum) or a request to add wells to an exclusion is required.

The requirement for a GMP is limited to areas where protected water is present. Protected water is defined as:

- Water with less than 10,000 milligrams per liter (mg/L) of total dissolved solids
- Located outside of an exempt aquifer

Efforts performed by State Water Boards staff for implementation of the Model Criteria during the reporting period are presented in six sections of this report. Please note that URLs for hyperlinks can be found in the Web Link Glossary (Appendix A).

1.1 Background

Senate Bill 4 (Pavley, Statutes of 2013) required the State Water Board to establish and implement a comprehensive regulatory groundwater monitoring and oversight program for WSTs (including hydraulic fracturing) in areas of oil and gas operations (California Water Code section 10783). The State Water Board was also required to develop a "model criteria" for groundwater monitoring to assess potential effects of WSTs on California's groundwater resources. The Model Criteria was adopted by the State Water Board on July 7, 2015 (*Resolution No. 2015-0047*) and outlines requirements for groundwater monitoring conducted by operators, as well as the approach the State Water Board will take to conduct the RMP.

Prior to adoption of the Model Criteria, CalGEM developed *SB 4 Interim Well Stimulation Treatment Regulations* which included groundwater monitoring requirements. The interim regulations were effective from January 1, 2014 to July 6, 2015 and required operators to

submit either a groundwater monitoring plan (interim GMP) for CalGEM approval or a letter from State Water Board staff concurring that the well(s) planned for WST did not penetrate protected water. If no new WSTs were planned in an area with a CalGEM approved interim GMP, the operator continued monitoring under the interim GMP. Several interim and Model Criteria GMPs were active during this reporting period. Data from both are uploaded to the State Water Board's GeoTracker information system (*GeoTracker*).

The State Water Board's *Model Criteria for Groundwater Monitoring in Areas of Well Stimulation: Summary of Goals, Strategies, Proposed Performance Measures, and Plans for Implementation* (Performance Measures) specifies that the State Water Board prepare and make publicly available an "Annual Model Criteria Performance Report" with the following five performance measures:

1. Provide transparent and availability of online information and documentation
2. Provide clear milestones and timely deliverables
3. Understand and mitigate impacts of well stimulation on water quality and public health
4. Provide region-specific or localized flexibility, where possible
5. Assess implementation costs

The original performance measures (Appendix B) were presented to the State Water Board on March 1, 2016, and included goals, strategies, and plans for implementing the Model Criteria.

2.0 AREA-SPECIFIC GROUNDWATER MONITORING

CalGEM issued permits are required prior to performing WSTs. The number and status of WST permits can be found on the CalGEM Well Statewide Tracking and Reporting System (*WellSTAR*).

A GMP is required where protected water is present. If the operator proposes WST for additional wells in an area where a GMP is approved, then an addendum to the GMP is required. A GMP is not required where an operator can make a technical demonstration that the wells to be stimulated do not penetrate protected water. Process flowcharts for Water Boards staff review of operator submittals can be found on the *Additional Resources* webpage. A summary table of the 2024 submittals and review timelines is provided below.

Operators are required to submit data from groundwater monitoring wells sampled as part of GMPs to GeoTracker as Groundwater Monitoring Reports (GMRs). Water Boards staff review GMRs and provide feedback to operators via comment letters that are also archived in GeoTracker.

2024 Summary Table: Submittals and Review Timeline Milestones

Type of Submittal	Approved	Partial Concurrence	Denied	Review in Progress	On Hold	Total
GMPs	0	0	0	0	0	**0**
Addenda	0	0	0	0	0	**0**
Requests for Exclusions	0	1	0	0	0	**1**
Requests to Add Wells to an Existing Exclusion	0	0	0	0	0	**0**

2.1 Groundwater Monitoring Plans

Water Boards staff did not receive any new GMPs or addenda during the reporting period. The locations of GMPs and addenda approved to date are shown in Figure 1.

Discontinuation of Monitoring for Groundwater Monitoring Plans

Operators submitted seven requests to discontinue groundwater monitoring at GMPs to date. Water Boards staff evaluated monitoring and sampling data to assess whether WSTs have impacted protected water. Based on the available information provided by the operator, Water Boards staff have found no indication of impact to protected water by WST. The status of the submittals to discontinue groundwater monitoring at GMPs are summarized in Appendix C – Table 1.

If future information indicates a potential impact to protected water, staff will reevaluate these determinations. Any future WSTs proposed in areas where monitoring has been discontinued would require either an approved GMP or concurrence for the exclusion from groundwater monitoring.

Process and Timeline for Reviewing Groundwater Monitoring Plans

When an operator has uploaded a GMP or addendum to GeoTracker, Water Boards staff begins its review process by conducting a completeness check to verify all required information was included. If necessary, Water Boards staff develop comments to obtain any missing or additional information from the operator. If Water Boards staff provide comments or deny a GMP and the operator chooses to pursue WST, the operator is required to submit a revised GMP or addendum. The Axial Dimensional Stimulation Area (ADSA) must be approved by CalGEM before a GMP or addendum can be approved. When submittals are placed “On Hold”, that time is not included in the calculation of total review time. State Water Board staff did not receive any new GMPs or addenda during the reporting period.

Groundwater Monitoring Plans Submitted that Propose Alternative Methods

The Model Criteria allows Water Boards staff to consider proposed alternatives and modifications to the methods for GMPs based on factors such as site-specific conditions (e.g., terrain, geology, access), number and depth of aquifers containing protected water, potential pathways, and risk to receptors (e.g., groundwater resources). Water Boards staff shall provide

at least 15 days' notice and an opportunity for public comment on the proposal prior to approving a proposed alternative or modification. State Water Board staff did not receive an alternative proposal for groundwater monitoring during the reporting period.

2.2 Requests for Exclusion and Added Wells

Water Boards staff may grant an exclusion from groundwater monitoring requirements if staff concur with the absence of protected water. Operators must obtain approval for additional WST wells to be stimulated in an existing exclusion from groundwater monitoring. During this reporting period, Water Boards staff reviewed and partially concurred with one request for exclusion. No requests to add wells to an existing exclusion (added wells) were submitted.

The status and review timeline milestones for the request for exclusion and added wells submittals are summarized in Appendix C - Table 2. The locations of approved, under review, and denied requests for exclusions to date are shown in Figure 2. The request for exclusion reviewed during this reporting period is located in the following county and oil field:

- Kern County – Lost Hills

Process and Timeline for Reviewing Requests for Exclusion

When an operator has uploaded a request for exclusion or added wells to GeoTracker, Water Boards staff begins its review process by conducting a completeness check to verify all required information was included. If necessary, Water Boards staff develop comments to obtain any missing or additional information from the operator. After staff have completed their review, the request for exclusion is either approved or denied. When submittals are placed "On Hold", that time is not included in the calculation of total review time. Request for exclusion approval does not depend on CalGEM approving an ADSA but is based solely on whether sufficient technical information was submitted to clearly demonstrate the absence of protected water.

3.0 PROPERTY-OWNER NOTIFICATIONS AND REQUESTED WATER SAMPLING

No neighbor notifications were sent during this reporting period since no wells were stimulated. If a well is stimulated, operators are required to use an independent third-party to notify property owners, or tenants of a property, located within 1,500 feet of the well to be stimulated or within 500 feet of the surface representation of the horizontal path of the area of stimulation. CalGEM is responsible for maintaining records regarding the third-party notification process. The third-party sends the property owners or tenants a Well Stimulation Treatment Neighbor Notification Form (neighbor notification), which includes information such as the earliest date the well may be stimulated and how the property owner may request water quality testing on an existing water well or surface water suitable for drinking. Additional information regarding this process can be found on the *CalGEM Well Stimulation Treatment Neighbor Notification and Water Sampling* webpage. As of October 29, 2019, neighbor notification forms must be submitted through the WellSTAR electronic database. CalGEM staff provides Water Boards staff the count of neighbor notifications sent to property owners. Historical notification counts are found in Appendix C - Table 3.

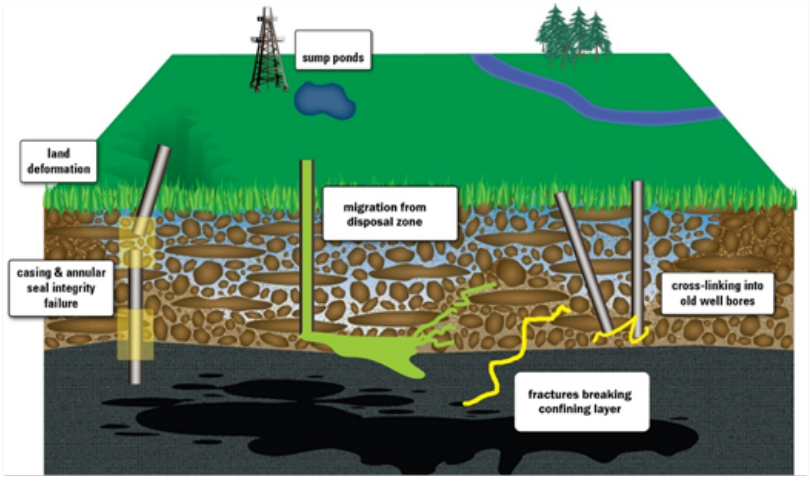
4.0 ASSESS IMPLEMENTATION COSTS

State Water Board staff, in cooperation with operators and representatives from California Independent Petroleum Association (CIPA) and Western States Petroleum Association (WSPA), developed a list of information needed to assess operator costs. CIPA, in collaboration with WSPA, used a third-party aggregator to collect and report estimated operator costs associated with the implementation of the Model Criteria. During the reporting period, the estimated cost for operators to perform tasks associated with area-specific monitoring was $440,714. These costs are described in detail in Appendix C - Table 4.

Water Boards have a total of 14 staff positions dedicated to WST activities budgeted at $2.45 million per year and the RMP has a budget of $7.4 million per year. Both are funded through the Oil, Gas, and Geothermal Administrative Fund.

5.0 REGIONAL MONITORING PROGRAM

The goal of the RMP is to evaluate potential impacts from WST and oil field operations, and to characterize the risk to water designated for any beneficial use (e.g., drinking water). The RMP evaluates pathways (see illustration below) by determining which WSTs and other oil and gas operations have the potential to contaminate groundwater. Potential pathways include the injection of water and/or steam during enhanced oil recovery practices, oilfield water disposal via injection, leakage along improperly constructed and/or compromised wells, surface disposal ponds, or natural geologic sources.



Potential Pathways between Oil & Gas Activities and Protected Groundwater
(Source: USGS, https://ca.water.usgs.gov/projects/oil-gas-groundwater/science/pathways/)

The United States Geological Survey (USGS) is the technical lead of the RMP, which the USGS refers to as the California Oil, Gas, and Groundwater (COGG) Program. The approach used by the USGS includes mapping groundwater salinity, characterizing and monitoring groundwater near oil fields, and characterizing oilfield fluids. Together, with site-specific information about the local geology, hydrology, and historic disposal areas, this approach helps systematically and

comprehensively collect and interpret information that will help support the protection of beneficial use water in California.

USGS and Water Boards staff select study areas using results from the prioritization analysis (*Davis and others, 2018*). Well depth, water chemistry, geophysical, geologic, and oilfield operational data were compiled by USGS into numerical databases for use in the regional analyses. Appendix D presents a summary of work conducted for each of these major tasks:

1. Salinity mapping
2. Groundwater sampling
3. Oilfield fluid sampling
4. Interpretative analysis of the collected data from tasks 1 through 3 in selected fields.

During the reporting period, the USGS identified suitable locations of groundwater wells, oil production wells, and injectate sites that met water and fluid sample criteria for the RMP. Once the well locations were determined, the USGS worked with operators to obtain access to collect samples. Samples collected include 58 water supply and monitoring wells in five study areas and 33 oilfield fluid sample sites in two study areas (Appendix D). State Water Board staff hosted an Oil and Gas Groundwater Monitoring Update on December 12, 2024, where USGS presented a summary of activities and findings. This program update was available to the public and provided an opportunity to submit questions regarding newly published work from the reporting period.

5.1 Published Regional Monitoring Program Results and Findings-2024

In 2024, the RMP completed three groundwater quality assessments near areas of oil and gas operations. Complete references to USGS publications are available on the *State Water Board RMP webpage*. The observations below summarize results from publications in 2024.

- McMahon et al., 2024 “Land-use interactions, Oil-Field infrastructure, and natural processes control hydrocarbon and arsenic concentrations in groundwater, Poso Creek Oil Field, California, USA"
    - Please see the article summary for key findings from the study.
- Warden et al., 2024 "Assessing potential effects of oil and gas development activities on groundwater quality near and overlying the Elk Hills and North Coles Levee Oil Fields, San Joaquin Valley, California"
    - Chemical and isotopic data show groundwater quality mostly consistent with natural processes. Two wells sampled in the 1990’s had increasing chloride and boron concentrations that can likely be attributed to oilfield water injected for disposal. Surface disposal of oilfield water into the 1950’s and natural processes may contribute to elevated dissolved salts in shallow groundwater near the dry Buena Vista Lake.
- Stanton et al., 2024 "Groundwater quality near the Placerita Oil Field, California, 2018: U.S. Geological Survey Scientific Investigations Report 2024–5042"

- Groundwater quality data showed six of 13 samples were potentially mixed with fluids from hydrocarbon-bearing formations. These samples were in areas where naturally occurring hydrocarbons and oil development co-occur at shallow depths.

6.0 LESSONS LEARNED FROM IMPLEMENTATION OF THE MODEL CRITERIA

A summary of opportunities identified by ongoing program evaluation, based on performance measures, is provided below with highlights of actions completed in 2024 and actions planned for 2025:

- Provide transparent and available information online:
  - New groundwater monitoring data was uploaded to GeoTracker and updates were made to the State Water Board Oil and Gas program webpage to include recent USGS publications.
  - In 2025, State Water Board staff will continue to evaluate opportunities to improve data visualizations and data sharing strategies within GeoTracker and on the State Water Board Oil and Gas program webpage.
- Provide clear milestones and timely deliverables:
  - Water Boards staff met with operators to discuss operator submittals and provide feedback on submittal criteria and processes to expedite review. State Water Board staff coordinated with Regional Board staff monthly to streamline and prioritize operator submittals.
  - In 2025, State Water Board staff will continue evaluating any opportunities to increase review efficiency.
- Understand and mitigate impacts of well stimulation on water quality and public health:
  - State Water Board staff hosted a publicly available Oil and Gas Groundwater Monitoring Update on RMP activities and facilitated kick off meetings with the USGS and operators prior to RMP sampling. Additionally, State Water Board staff sent GMR review comments to operators to ensure Model Criteria compliance.
  - In 2025, an Oil and Gas Groundwater Monitoring Update will be held and made available to the public to present technical findings following RMP publications. Water Board staff will continue to assess GMPs for potential impacts of WST on water quality and public health.
- Provide region-specific or localized flexibility:
  - State Water Board staff received no alternative proposals for groundwater monitoring during the reporting period.
- Assess implementation costs:
  - State Water Board staff will continue to identify and assess implementation costs.

FIGURES

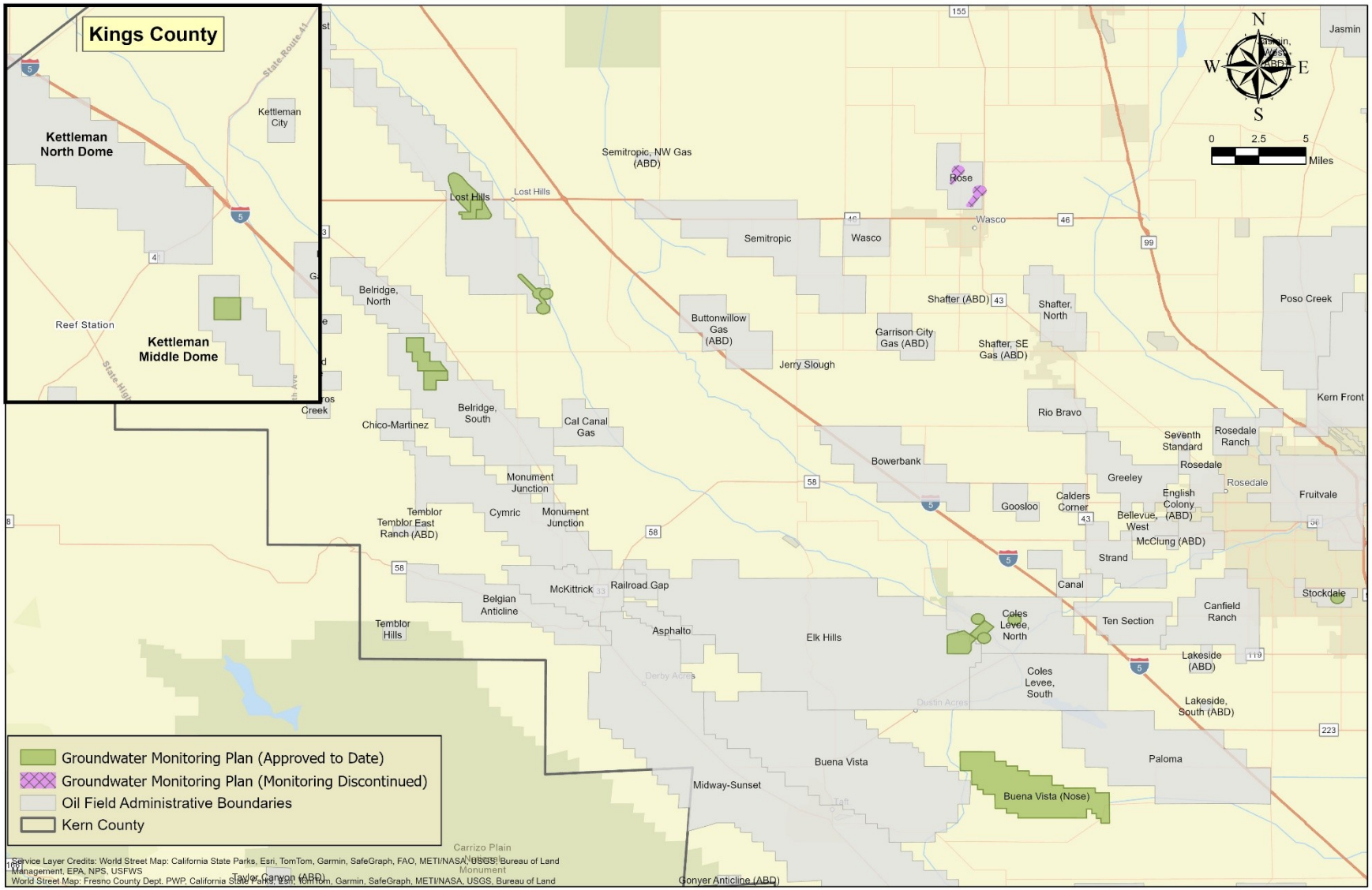


Figure 1. Groundwater Monitoring Plans

(No New Groundwater Monitoring Plans Were Received January 1, 2024- December 31, 2024)

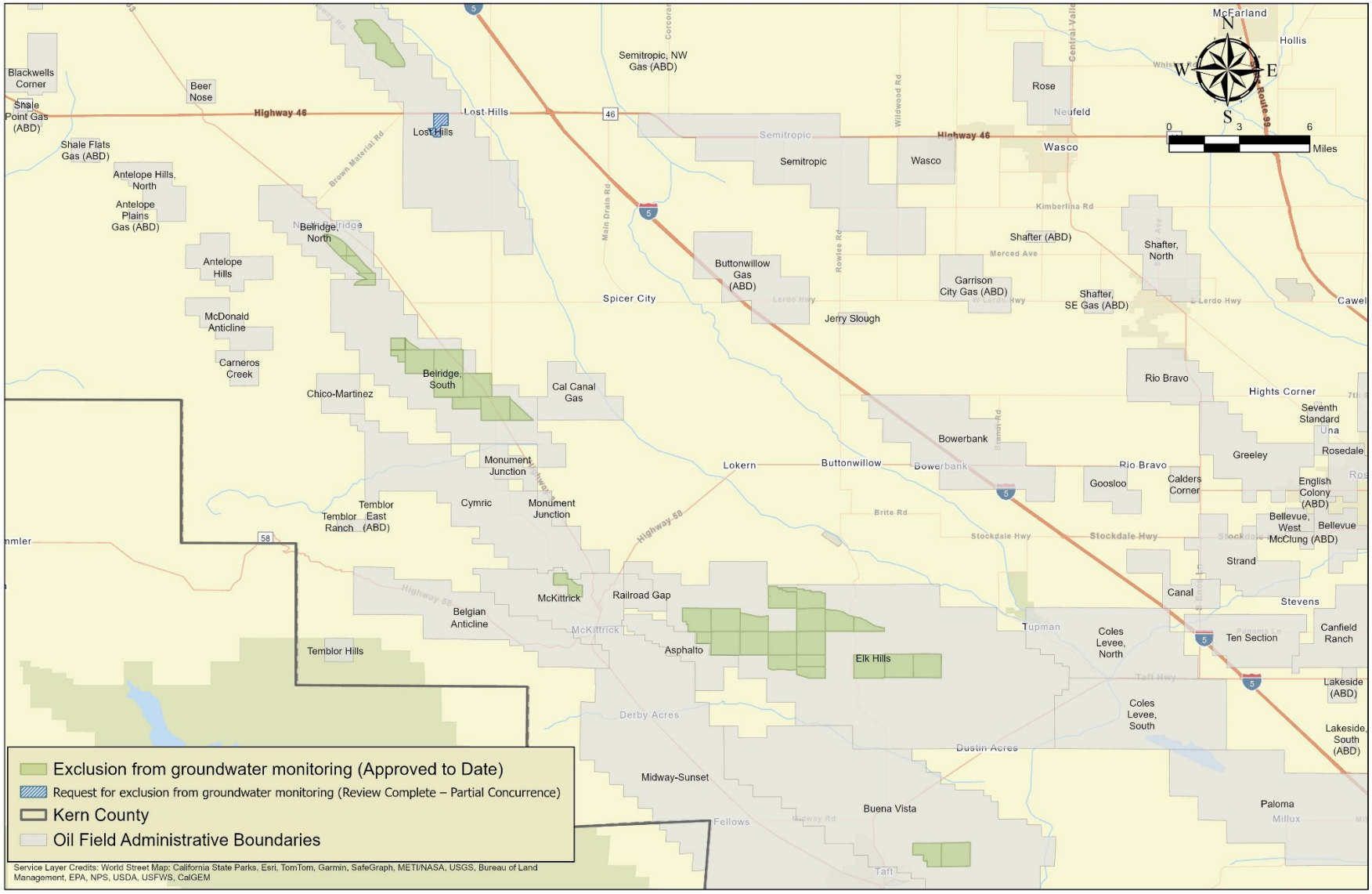


Figure 2. Requests for Exclusion from Groundwater Monitoring

Appendix A - WEB LINK GLOSSARY

Link Text	URL Address	Section
Model Criteria for Groundwater Monitoring in Areas of Oil and Gas Well Stimulation	https://www.waterboards.ca.gov/water_issues/programs/groundwater/sb4/docs/model_criteria_final_070715.pdf	1
Resolution No. 2015-0047	https://www.waterboards.ca.gov/board_decisions/adopted_orders/resolutions/2015/rs2015_0047.pdf	1
SB4 Interim Well Stimulation Treatment Regulations	https://www.conservation.ca.gov/index/Pages/prpsregs.aspx	1
GeoTracker	https://geotracker.waterboards.ca.gov/	1
Model Criteria for Groundwater Monitoring in Areas of Well Stimulation: Summary of Goals, Strategies, Proposed Performance Measures, and Plans for Implementation	https://www.waterboards.ca.gov/water_issues/programs/groundwater/sb4/docs/model_criteria_perf.pdf	1
WellStar	https://wellstar-public.conservation.ca.gov/	2
Additional Resources	https://www.waterboards.ca.gov/water_issues/programs/groundwater/sb4/additional_resources/	2
GAGW10000031	https://geotracker.waterboards.ca.gov/profile_report.asp?global_id=GAGW10000031	2
GAGW10000032	https://geotracker.waterboards.ca.gov/profile_report?global_id=GAGW10000032	2
CalGEM Well Stimulation Treatment Neighbor Notification and Water Sampling	https://www.conservation.ca.gov/calgem/Pages/WSTNeighborNotificationAndWaterSampling.aspx	3
List of Designated Contractors for Water Sampling	https://www.waterboards.ca.gov/water_issues/programs/groundwater/sb4/docs/2023/list-of-designated-contractors-for-water-sampling.pdf	3
Davis and others, 2018	https://pubs.er.usgs.gov/publication/sir20185065	5
State Water Board RMP webpage	https://www.waterboards.ca.gov/water_issues/programs/groundwater/sb4/regional_monitoring/	5
Land-use interactions, Oil-Field infrastructure, and natural processes control hydrocarbon and arsenic concentrations in groundwater, Poso Creek Oil Field, California, USA	https://www.sciencedirect.com/science/article/pii/S0883292724001306?via%3Dihub	5

McMahon et al. article summary	https://www.waterboards.ca.gov/water_issues/programs/groundwater/sb4/regional_monitoring/docs/poso-creek-rmp-summary.pdf	5
Assessing potential effects of oil and gas development activities on groundwater quality near and overlying the Elk Hills and North Coles Levee Oil Fields, San Joaquin Valley, California	https://journals.plos.org/water/article?id=10.1371/journal.pwat.0000258	5
Groundwater Quality Near the Placerita Oil Field, California, 2018	https://pubs.usgs.gov/publication/sir20245042	5

Appendix B - PERFORMANCE MEASURES

Goals	Strategy
Goal #1: Transparency and availability of online information and documentation.	1.1 Improve and expand upon available datasets and the ability to analyze and manipulate that data.
	1.2 Improve online user experience with simplified and clear messaging to make data easier to access.
	1.3 Create data communication/sharing strategy to optimize data and information sharing between the State Water Board, Regional Water Boards, CalGEM, and other agencies, as appropriate.
Goal #2: Provide clear milestones and timely deliverables.	2.1 Make milestones and deliverables outlined in the Model Criteria and Senate Bill 4 (Chapter 313, Statutes of 2013, including Water Code section 10783), publicly available.
	2.2 Prepare review processes, flowcharts, and timelines for reviewing GMPs and requests for exclusion from groundwater monitoring, including interagency collaboration and program efficiencies.
Goal #3: Understand and mitigate impacts of well stimulation on water quality and public health.	3.1 Provide regular assessments of monitoring data, including pilot study results and identification of any chemicals of concern.
	3.2 Mitigate problems as they occur and share mitigation efforts with stakeholders.
	3.3 Develop a plan to re-evaluate the effectiveness of monitoring. Modify the scope of work and approach based on evaluation of the data collected and evaluated.
	3.4 Coordinate with other agencies to identify risk.
Goal #4: Provide region-specific or localized flexibility where possible.	4.1 Consider local conditions when reviewing groundwater plans.
	4.2 Clearly communicate why region- specific activities are occurring.
	4.3 Use consistent flexibility criteria for monitoring.
Goal #5: Assess implementation costs.	5.1 Assess implementation cost for the State Water Board and stakeholders.

Appendix C - TABLES

LIST OF TABLES

Notes and Acronyms for all tables:

-- = not applicable
ADSA = Axial Dimension Stimulation Area
CalGEM = California Geologic Energy Management Division – Department of Conservation
GMP = Groundwater Monitoring Plan
WST = Well Stimulation Treatment
Bbl = Barrel(s) of oil

1. Located in Kern County, unless otherwise noted.
2. Date of Revised Plan submission to GeoTracker or other action by operator.
3. On Hold indicates that Water Boards staff are waiting on additional information from the operator, waiting for the approved ADSA from CalGEM, or the submittal has been placed On Hold at the request of the operator.
4. Days to complete the process equates to the elapsed time between the "GMP Date Accepted" to "Status/Determination Date". For GMPs (new and addenda) with multiple revisions, days to complete the process equates to the sum of days to review the original submittal and the days to review each of the revisions. This time includes communications with the operator, Regional Water Board staff, and CalGEM, review of data and the submittal, and preparation and review of agency correspondence. Refer to the Process Flowchart for Uploading and Reviewing GMPs (new or addenda) on the Additional Resources webpage for the detailed flowchart of the GMP review process.
5. Days to complete the process equates to the elapsed time between the "Request for Exclusion Accepted Date" to "Status/Determination Date". For Requests for Exclusions with multiple revisions, days to complete the process equates to the sum of days to review the original submittal and the days to review each of the revisions. This time includes communications with the operator, Regional Water Board staff, and CalGEM, review of data and the submittal, and preparation and review of agency correspondence. Refer to the Process Flowchart for Reviewing Requests for Exclusion from Groundwater Monitoring on the Additional Resources webpage for the detailed flowchart of the Exclusions from Groundwater Monitoring review process.
6. Days to complete the process equates to the elapsed time between the "Date Accepted Request for Exclusion (added wells)" to "Status/Determination Date". For Request for Exclusion (added wells) with multiple revisions, days to complete the process equates to the sum of days to review the original submittal and the days to review each of the revisions. This time includes communications with the operator, Regional Water Board staff, and CalGEM, review of data and the submittal, and preparation and review of agency correspondence. Refer to the Process Flowchart for Reviewing Well Stimulation Permit Applications on the Additional Resources webpage for the detailed flowchart of the Exclusions from Groundwater Monitoring review process.
7. Reporting period equal to 2.5 years
8. “Production from wells with GW Monitoring (bbl)” = Between 2022 and 2024, operators provided production data for wells stimulated between 2016 and 2021 that required groundwater monitoring. Previous years data only aggregated production for wells stimulated that year.

Table 1: Discontinuation of Monitoring for Groundwater Monitoring Plans Reviewed (To Date)

GeoTracker Global Identification	Oil Field or (Area)	Township (T), Range (R), Section (S)[1]	Operator	Interim or Model Criteria GMP	WST Well(s)	Most Recent WST	Monitoring Period	Monitoring Well(s)	Status/ Determination[3]	Concurrence Date	Comments
GAGW10000031	Rose	Section 26 - T26S, R24E	California Resources Corporation	Interim	1	2014	2014 - 2018	1	Approved	10/3/2022	--
GAGW10000032	Rose	Section 36 - T26S, R24E	California Resources Corporation	Interim	2	2014	2014 - 2022	1	Approved	3/13/2023	--
GAGW10000018	Coles Levee, North	Sections 29, 30 - T30S, R25E	California Resources Elk Hills, LLC	Interim	2	2015	2014 - 2023	3	In Review	--	GMR and request received on 9/29/2023. Comment letter sent on 3/7/2024. GMR and request received on 4/8/2024.
GAGW10007872	Coles Levee, North	Section 31 - T30S, R25E	California Resources Elk Hills, LLC	Interim	1	2015	2015 - 2023	1	In Review	--	GMR and request received on 9/29/2023. Comment letter sent on 3/7/2024. GMR and request received on 4/9/2024.
GAGW10000040	Kettleman Middle Dome	Section 19, T23S, R19E	Innex California, Inc.	Interim	2	2015	2014 - 2023	1	In Review	--	GMR and request received on 9/25/2023. Comment letter sent on 2/22/2024. Operator meeting held on 8/15/2024. Revised GMR and request received on 8/30/2024.
GAGW10000039	Lost Hills	Section 36 - T27S, R21E	Sentinel Peak Resources, LLC	Interim	2	2014	Continuing	1	In Review	--	GMR and request received on 11/8/2023. Comment letter sent on 2/22/2024. GMR and request received on 11/20/2024.

GeoTracker Global Identification	Oil Field or (Area)	Township (T), Range (R), Section (S)[1]	Operator	Interim or Model Criteria GMP	WST Well(s)	Most Recent WST	Monitoring Period	Monitoring Well(s)	Status/ Determination[3]	Concurrence Date	Comments
GAOG10011328	Belridge, South	Section 19 - T28S, R21E	Berry Petroleum Company, LLC	Model Criteria	69	2019	Continuing	7	On Hold	--	Operator meeting held on 2/22/2024. Request for discontinuation of monitoring received for preliminary review on 10/17/2024. Preliminary review comments sent on 11/8/2024.

Table 2: Requests for Exclusion Reviewed (January 1, 2024 - December 31, 2024)

GeoTracker Global Identification	Oil Field or (Area)	Township (T), Range (R), Section (S)[1]	Operator	Request for Exclusion Accepted Date	Days for Initial Response	Interim Review Actions (GeoTracker Submittal Date(s))[2]	Status/ Determination[3]	Number of WST Wells Approved	Status/ Determination Date	Days to Complete Process[5]	Comments
GAOG10021311	Lost Hills	Portions of Sections 4 and 5, T27S, R21E	Aera Energy LLC	6/9/2023	165	Operator submitted a revised Exclusion (2/22/2024)	Review Complete – Partial Concurrence	--	--	--	Operator requested exclusion from groundwater monitoring for the Alluvium and Tulare Formations. CalGEM confirmed Tulare Formation exemption status to Water Boards (08/30/2023). Water Boards staff provided comments to operator on Exclusion (11/21/2023). Revised Exclusion submitted (2/22/2024). Issued partial concurrence letter for the Tulare formation (9/25/2024). Decision regarding alluvium on hold pending additional information from the operator.

Table 5: Number of Neighbor Notifications sent by Operators

Operator	2014	2015	2016	2017	2018	2019	2020	2021	2022 - 2024
Aera Energy, LLC	818	960	29	138	250	233	73	5	-
Berry Petroleum Company, LLC	-	-	-	-	160	219	-	-	-
Breitburn Energy Co., LLC	18	-	-	-	1	-	-	-	-
Central Resources, Inc	19	-	-	-	-	-	-	-	-
Chevron USA, Inc	35	6	-	-	42	-	27	17	-
Crimson Resource Management	194	-	-	-	-	-	-	-	-
DCOR, LLC	11	-	-	-	-	-	-	-	-
Occidental of Elk Hills, Inc	57	36	-	-	-	-	-	-	-
Seneca Resources Corporation	19	4	-	-	-	-	-	-	-
Vintage Production California, LLC	108	-	-		-	-	-	-	-
California Resources Elk Hills, LLC	-	5	42	2	93	57	-	-	-
Linn Operating, Inc	-	273	-	-	-	-	-	-	-
Salt Creek Oil, LLC	-	-	2	-	-	-	-	-	-
Total	**1,279**	**1,284**	**73**	**140**	**546**	**509**	**100**	**22**	**-**

Table 6: Estimated Operator Costs Provided by CIPA and WSPA

Operator Cost Category	2014 – 2016[7]	2017	2018	2019	2020	2021	2022	2023	2024
Number of GMPs Developed	19	7	16	20	1	0	0	0	**0**
GMP Cost	$517,250	$207,843	$131,719	$864,872	$17,645	$0	$0	$0	**$0**
Wells Installed	19	12	8	5	2	1	0	0	**0**
Well Installation Cost	$5,806,232	$2,000,673	$351,744	$1,450,014	$514,860	$117,000	$0	0	**$0**
Samples Collected	105	85	106	95	103	79	89	98	**88**
Reports Submitted	28	12	12	20	24	15	12	13	**10**
Sampling and Reporting Cost	$990,000	$418,702	$273,423	$293,253	$310,615	$267,126	$281,687	$276,371	**$236,590**
Samples Analyzed	86	80	106	95	101	77	56	84	**76**
Sample Analysis Cost	$172,500	$188,490	$288,345	$243,469	$226,620	$249,183	$138,551	$191,847	**$204,124**
Other Subcontractor and Consultant Fees	$111,969	$150,000	$98,601	$20,000	$17,000	$2,371	$0	$63,125	**0**
Total Cost (Capital + Operating Expenses)	$7,597,951	$2,965,708	$1,143,831	$2,871,608	$1,086,740	$635,680	$420,238	$531,343	**$440,714**

Requests for Exclusion	2014 – 2016[7]	2017	2018	2019	2020	2021	2022	2023	2024
Requests for Exclusion	11	7	29	32	10	5	0	2	**1**
Requests for Exclusion Cost	$73,710	$76,075	$46,400	$525,600	$5,400	$3,000	$0	$230,000	**$0**

Total Area-Specific Costs	2014 – 2016[7]	2017	2018	2019	2020	2021	2022	2023	2024
GMP + Exclusion Costs	$7,671,661	$3,041,783	$1,190,231	$3,397,208	$1,092,140	$638,680	$420,238	$761,343	**$440,714**

Regional Monitoring Program	2014 – 2016[7]	2017	2018	2019	2020	2021	2022	2023	2024
RMP Estimated Total Operators Cost	$15,000	$18,000	$265,525	$0	$135,700	$95,296	$0	$0	**$0**

Well Stimulation Treatments and Production	2014 – 2016[7]	2017	2018	2019	2020	2021	2022[8]	2023[8]	2024[8]
WSTs Performed - GMP	176	34	129	96	26	12	0	0	**0**
Oil Production from WSTs - GMP (bbl)	1,362,969	451,478	312,501	362,810	18,728	68,774	637,871	1,399,410	**1,340,895**
WSTs Performed - Exclusions	1,089	122	115	70	34	6	0	0	**0**
Oil Production from WSTs - Exclusions (bbl)	9,438,976	296,336	523,299	166,875	25,903	28,140	--	--	**80,076**

Summary	2014 – 2016[7]	2017	2018	2019	2020	2021	2022	2023	2024
Oil Produced subject to Model Criteria Requirements (bbl)	10,801,945	747,814	835,800	529,685	44,631	96,914	637,871	1,399,410	**1,420,971**
Estimated Groundwater Monitoring and Reporting Cost per Sample	$72,361	$34,891	$10,791	$30,227	$5,381	$6,566	$4,722	$5,422	**$5,008**
Groundwater Monitoring and Reporting Cost per bbl of oil	$5.57	$6.57	$3.66	$7.91	$58.03	$9.24	$0.66	$0.33	**$0.33**
Average Cost of Compliance per Well Stimulated	$43,170	$87,227	$8,867	$29,913	$41,798	$52,973	--	--	**--**

Appendix D - REGIONAL MONITORING PROGRAM WORK CONDUCTED

Appendix D: Summary of USGS Work Conducted to date through December 31, 2024

Oil Field	County	Salinity Mapping	Groundwater Sampling	Oilfield Fluid Sampling	Interpretive Analysis Published
Various	Kern, Los Angeles	X	X	X	X
Ant Hill	Kern		X		
Bellevue	Kern	X	X		
Bellevue	Kern County		X		
Bellevue West	Kern	X	X		
Blackwells Corner	Kern	X			
Buena Vista	Kern	X	X	X	X
Cal Canal Gas	Kern	X			X
Canfield Ranch	Kern	X	X	X	
Cat Canyon	Santa Barbara	X	X	X	
Coalinga	Fresno	X	X	X	
Coalinga East Extension	Fresno	X			
Devils Den	Kern	X	X	X	
Edison	Kern	X	X	X	

Oil Field	County	Salinity Mapping	Groundwater Sampling	Oilfield Fluid Sampling	Interpretive Analysis Published
Elk Hills	Kern	X	X		X
Fruitvale	Kern	X	X	X	X
Greeley	Kern		X	X	
Guijarral Hills	Fresno	X			
Jacalitos	Fresno	X			
Kern River	Kern		X	X	
Lompoc	Kern		X	X	
Lost Hills	Kern	X	X	X	X
Middle Kettleman Dome	Kings County	X	X	X	
Midway-Sunset	Kern	X	X	X	X
Montebello	Los Angeles	X	X	X	X
Mountain View	Kern		X	X	
North Belridge	Kern	X	X	X	X
North Coles Levee	Kern	X	X	X	X
Northwest Lost Hills	Kern County	X			
Orcutt	Santa Barbara		X	X	X

Oil Field	County	Salinity Mapping	Groundwater Sampling	Oilfield Fluid Sampling	Interpretive Analysis Published
Oxnard	Ventura		X	X	X
Placerita	Los Angeles		X	X	X
Pleasant Valley	Fresno	X			
Poso Creek	Kern	X	X	X	X
Pyramid Hills	Kings	X	X	X	
Rio Bravo	Kern	X	X	X	
Rosedale	Kern	X	X		
Rosedale Ranch	Kern	X	X	X	X
San Ardo	Monterey	X	X	X	
Santa Fe Springs	Los Angeles		X	X	
Santa Maria Valley	Santa Barbara		X	X	
South Belridge	Kern	X	X	X	X
South Coles Levee	Kern	X			X
South Cuyama	Santa Barbara	X			X

Oil Field	County	Salinity Mapping	Groundwater Sampling	Oilfield Fluid Sampling	Interpretive Analysis Published
Strand	Kern	X	X		
Ten Section	Kern	X	X	X	
Welcome Valley	Kern	X			
Wilmington-Torrance	Los Angeles		X	X	X
Yowlumne	Kern	X			