

**CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
LAHONTAN REGION**

**CLEANUP AND ABATEMENT ORDER
NO. R6V-2015-PROP
WDID NO. 6B369107001**

**REQUIRING PACIFIC GAS AND ELECTRIC COMPANY
TO CLEAN UP AND ABATE WASTE DISCHARGES
OF TOTAL AND HEXAVALENT CHROMIUM TO THE
GROUNDWATERS OF THE MOJAVE HYDROLOGIC UNIT**

Groundwater Monitoring and Reporting Program

San Bernardino County

California Water Code section 13267 authorizes the Regional Water Quality Control Board (Water Board) to require technical and monitoring reports. This Monitoring Program establishes monitoring requirements consistent with the California Water Code. Pursuant to Water California Water Code section 13223, this monitoring program may be amended by the Water Board Executive Officer.

This monitoring and reporting program (MRP) requires PG&E to collect water samples, conduct monitoring actions, and submit technical reports to evaluate compliance with the terms and conditions of this Order, and to assure protection of waters of the state and restoration of beneficial uses. Consistent with Water Code section 13267, this Order requires implementation of a MRP that is intended to verify the effectiveness of remediation, track progress toward meeting remediation targets, evaluate threats to and monitor water quality in private supply wells.

I. GROUNDWATER MONITORING REQUIREMENTS

- A. **Beginning second quarter 2015, and every quarter (three months) thereafter,** PG&E shall implement a site-wide monitoring well and domestic well sampling and monitoring program. Monitoring well and domestic/community/agricultural well sampling shall be conducted at the frequency and using the criteria prescribed in this "Groundwater Monitoring and Reporting Program."
- B. PG&E shall:
1. Collect groundwater elevation data to the nearest 0.01 foot from all monitoring wells required for that quarter.
 2. Collect groundwater samples from monitoring wells and domestic/community/agricultural wells required for that quarter. Active is defined as any water supply well used during that quarter or planned for use within the next six months. Active wells include those wells on PG&E-owned property and used that quarter for any purpose. Inactive wells are defined as

any water supply well not used that quarter or not planned for use within the next six months.

3. Water samples shall be analyzed for Cr(VI) using EPA Method 218.6 with a detection level of 0.1 parts per billion (ppb) and Cr(T) using EPA Method 6020 with a detection level of 1 ppb.

C. Southern Plume Area, including "Western Finger" and Lower Aquifer

This area is defined as the southern plume area connected to the source area at the Facility, shown in Attachment 2. Within this area, the Discharger shall conduct the following sampling:

1. At wells with concentrations greater than or equal to maximum background values as of fourth quarter 2014:

- a) Quarterly sampling at all single monitoring wells and at multi-depth monitoring wells showing the highest hexavalent or total chromium detections as of fourth quarter 2014.
- b) Semi-annual sampling in the second and fourth quarter of each year at multi-depth monitoring wells showing the second and third highest hexavalent or total chromium detections above maximum background levels as of fourth quarter 2014.
- c) Annual sampling in the fourth quarter of each year for all **multi-depth** monitoring wells showing the third highest hexavalent or total chromium detections as of fourth quarter 2014.

2. At wells with concentrations less than maximum background values as of fourth quarter 2014:

- a) Quarterly sampling at all monitoring wells showing unstable hexavalent or total chromium detections below maximum background levels as of fourth quarter 2014. "Unstable" is defined as any chromium detection above maximum background levels since first quarter 2013.
- b) Semi-annual sampling in second and fourth quarter of each year at all monitoring wells showing stable hexavalent or total chromium detections below maximum background levels as of fourth quarter 2014. "Stable" is defined as all chromium detections below maximum background levels since first quarter 2013. Once four consecutive sampling events show chromium concentrations below maximum background levels, sampling frequency can be reduced to annual sampling.
- c) Annual sampling in the fourth quarter of each year at all monitoring wells showing hexavalent or total chromium detections that have always been below maximum background levels and were installed and sampled by January 2011.

3. "Western Finger" (west of Serra Road)

- a) Quarterly sampling within the plume (i.e., chromium concentrations exceed the maximum background levels), at all monitoring wells showing

hexavalent or total chromium detections **above** the maximum background levels as of fourth quarter 2014.

b) Semiannual sampling in the second and fourth quarter of each year at multi-depth monitoring wells showing hexavalent or total chromium detections **at or below** the maximum background levels as of fourth quarter 2014.

c) If four consecutive or four out of five samples in different sampling periods detect chromium in monitoring wells at increasing or decreasing concentrations that puts the well into one of the above categories, the Discharger shall increase or decrease, respectively, the sampling frequency accordingly.

4. Lower Aquifer

a) Quarterly sampling within the plume (i.e., chromium concentrations **exceed non-detect levels**) at all lower aquifer monitoring wells showing hexavalent or total chromium detections **above** the non-detect level as of fourth quarter 2014.

b) Semiannual sampling outside the plume at all lower aquifer monitoring wells showing hexavalent or total chromium detections **at or below** non-detect level as of fourth quarter 2014.

c) If four consecutive or four out of five samples in different sampling periods detect chromium in monitoring wells at increasing or decreasing concentrations that puts the well into one of the above categories, the Discharger shall increase or decrease, respectively, the sampling frequency accordingly.

d) If a single well, or all depths at a multi-depth monitoring well location contain less than the maximum background levels for four or more consecutive sampling events with a stable or decreasing trend, monitoring should follow section E below for Outside Plume Boundaries.

D. **Northern Plumes Area**

This area is defined as north of Thompson Road and into the Harper Dry Lake Valley, shown on Attachment 2. Plume(s) may be contiguous or non-contiguous. The Discharger shall conduct the following sampling:

1. Quarterly sampling at all **single** monitoring wells and at **multi-depth** monitoring wells showing the **highest** hexavalent or total chromium detections greater than the maximum background levels as of fourth quarter 2014. If four consecutive or four out of five samples in different sampling periods detect chromium in monitoring wells at decreasing concentrations that puts the well into one of the below categories, the Discharger may decrease the sampling frequency accordingly. In this instance, the new well showing the highest chromium concentrations greater than the maximum background levels is then moved to a quarterly sampling frequency.

2. Semi-annual sampling in the second and fourth quarter of each year at **multi-depth** monitoring wells showing the **second highest** hexavalent or total chromium detections as of fourth quarter 2014.
3. Annual sampling in the fourth quarter of each year for all **multi-depth** monitoring wells showing the third highest hexavalent or total chromium detections as of fourth quarter 2014.
4. For wells in semi-annual or annual sampling frequency, if two consecutive or two out of three samples in different sampling periods detect chromium in monitoring wells at increasing or decreasing concentrations that puts the well into another of the above categories, the Discharger shall increase or decrease, respectively, the sampling frequency accordingly.
5. If a single well or all depths at a multi-depth monitoring well location contain less than the maximum background levels for four or more consecutive sampling events with a stable or decreasing trend, monitoring should follow section E below for Outside Plume Boundaries.

E. Outside Plume Boundaries (site-wide), Upper Aquifer

Outside all upper aquifer plume boundary lines (except in the "Western Finger"), the Discharger shall conduct the following monitoring well sampling:

1. Quarterly sampling at all monitoring wells showing hexavalent or total chromium detections between 3.0 ppb Cr(VI) or 3.1 ppb Cr(T) and 80 percent of the maximum background levels (i.e., 2.5 ppb Cr(VI) or 2.6 ppb CrT) as of fourth quarter 2014.
2. Semi-annual sampling in the second and fourth quarter of each year at all monitoring wells showing hexavalent or total chromium detections **less than** 80 percent of the maximum background levels (i.e., 2.5 µg/l Cr(VI) or 2.6 ppb CrT) as of fourth quarter 2014.
3. Annual sampling in the fourth quarter of each year for all monitoring wells showing hexavalent or total chromium detections less than 2.5 ppb Cr(VI) or 2.6 ppb CrT in four or more consecutive sampling events with a stable or decreasing trend.
4. If four consecutive or four out of five samples in different sampling periods detect chromium in monitoring wells at increasing or decreasing concentrations that puts the well into one of the above categories, the Discharger shall increase or decrease, respectively, the sampling frequency accordingly.

F. Domestic/Community/Agricultural Water Supply Wells, Northern Plumes¹

For the northern plume area, the following sampling requirements apply to all water supply wells one-half mile downgradient and cross gradient of any northern

¹ Domestic supply well monitoring in the southern plume area is required as part of Board Order R6V-2014-0023 (Waste Discharge Requirements for Agricultural Treatment Units).

plume area monitoring well showing detections of total or hexavalent chromium above maximum levels.

1. Quarterly sampling at all domestic and community wells having hexavalent or total chromium detections at or above drinking water standards following any sampling event.
2. Semi-annual sampling in the second and fourth quarter of each year at all domestic and community wells having hexavalent or total chromium detections at or above the maximum background levels.
3. Annual sampling in the fourth quarter of each year at all domestic and community wells having hexavalent or total chromium detections below the maximum background levels.
4. If two consecutive or two out of three samples in different sampling periods detect chromium in supply wells at increasing or decreasing concentrations that puts the well into one of the above categories, the Discharger shall increase or decrease, respectively, the sampling frequency accordingly.

G. No Monitoring Well Sampling is Required for the Following Locations:

1. Southwest (i.e., upgradient) of the Lockhart Fault
2. East of Dixie Road
3. Redundant monitoring wells (defined as being less than 200 feet from other monitoring wells except those screened across different depths) having the lower of chromium detections compared to the other nearby well may be removed from all sampling events.

II. REPORTING TYPES

A. Quarterly Groundwater Monitoring Reports

Beginning with third quarter 2015, quarterly groundwater monitoring reports for site-wide monitoring well and domestic/community/agricultural well monitoring are due by **October 30, 2015**, and every quarter (three months) thereafter (i.e., January 30th, April 30th, July 30th, and October 30th of each year). The quarterly reports shall include required information for maps and reports as described below in Requirements III.B.1., B.2., and B.3. Chromium plume maps and Geotracker submittals shall be implemented according to the due dates described in Requirements II.C. and II.D.

B. Annual Cleanup Status and Effectiveness Reports

Beginning February 28, 2016, submit annual cleanup effectiveness reports to reach target concentrations listed in CAO Requirement VI. The reports shall describe all clean up actions planned and/or implemented during the previous calendar year. PG&E shall explain why any planned cleanup actions were not implemented. Each report shall discuss the actual effectiveness of the final

cleanup remedy compared to the prior year's data and expected effectiveness. Provide a calculation for chromium mass removed over the year and the cumulative mass removed since initial remedial actions were implemented in 1992. If current actions are not achieving expected reductions in chromium concentrations, the report shall propose recommendations and an implementation schedule to increase effectiveness. **Within 30 days of the annual report due date**, implement the recommended actions that do not require Water Board approval. Subsequent annual status reports shall be submitted by February 28 of each calendar year, starting with the year 2017.

C. Four-Year Comprehensive Cleanup Status and Effectiveness Reports

Beginning March 30, 2020, submit a report containing a comprehensive evaluation of chromium cleanup actions to reach target concentrations listed in CAO Requirement VI. These four-year comprehensive reports shall summarize the information listed above in the annual reports, II.B, during the previous four years of remedial action. The fourth year data shall be compared to data from the year this Order is issued, and all intermittent four-year reports. Data collected over the four-year period shall be used to update groundwater models for predicting chromium cleanup to target concentrations. The report shall also provide research of best available technologies that may be available to remediate chromium in groundwater sooner than target deadlines in this Order. Using the groundwater model results, evaluate the progress to reach target chromium concentrations by the associated deadlines. Describe whether current actions are or are not achieving expected reductions in chromium concentrations. If cleanup actions are not achieving expected reductions, submit a workplan **within 30 days of the date of the 4-year report due date** proposing recommendations and an implementation schedule to increase effectiveness. If best available technology is not recommended, the report and workplan shall state why and provide supporting information. The 4-year reports can consider, evaluate, and include corrective actions previously approved by the Water Board. Subsequent four-year comprehensive reports shall be submitted by March 30 every four years, starting with the year 2024.

III. GROUNDWATER MONITORING REPORTS

- A. Quarterly groundwater monitoring reports shall include all monitoring data, laboratory reports, related maps, tables of historical data, calculations, statistical test results for that quarter, and recommendations, such as locations for the installation of additional monitoring wells within a quarter mile of any domestic well(s), as needed.
- B. Quarterly reports shall define the full lateral and vertical extent of chromium in groundwater, based on the monitoring information gathered pursuant to the MRP, for hexavalent and total chromium to at least the maximum background levels of 3.1 ppb and 3.2 ppb, respectively, in the upper aquifer, and to non-

detect concentrations in the lower aquifer, and determine the direction of groundwater flow. At a minimum, quarterly monitoring reports shall contain the information listed below.

1. Map Types

- a. Show the extent of total and hexavalent chromium in groundwater in the upper aquifer. These maps are not to show the approximate limit of saturated alluvium in upper aquifer or flow directional arrows. Each quarterly report shall contain two maps:
 - i. A map showing the maximum plume boundary throughout the uppermost saturated zone. Chromium concentrations shall be shown next to each monitoring well sampled. Include the location of domestic wells sampled.
 - ii. A separate map showing the maximum plume boundary that quarter compared to the plume boundary in the prior quarter.
- b. Potentiometric map for the upper aquifer showing the groundwater flow directions, estimated flow velocity, and calculated gradients, along the length of the mapped chromium plume and areas where PG&E collected water table data. Do not include the approximate limit of saturated alluvium in upper aquifer.
- c. Potentiometric map for the lower aquifer showing the groundwater flow directions, estimated flow velocity, and calculated gradients, along the length of the mapped chromium plume where water table data exist. Include the approximate limit of saturated alluvium in upper aquifer.
- d. Map showing all active and inactive domestic/community/agricultural supply wells, including those wells on PG&E-owned property and used that quarter for any purpose. Chromium concentrations shall be shown next to each water supply well sampled.
- e. Chromium plume maps shall be submitted to the Water Board in digitized form (such as a pdf document). At least one of the submitted maps shall contain monitoring data and plume lines and be printed by the public on 8-1/2 inch by 11 inch and 11 inch by 17 inch paper. Another submitted map shall contain only plume lines and be printed by the public on 8-1/2 inch by 11 inch paper.

2. Map Content

- a. Map contents shall be consistent between each map, including data, color, symbols, etc.
- b. Text font size on maps shall be 9 points or greater.
- c. Street names shall be shown in black color to be easily legible.

- d. Location of all active supply wells used for remedial actions and the compressor station operations.
- e. Approximate location of the Lockhart Fault.
- f. Chromium boundary lines on plume maps shall reflect the reported maximum hexavalent or total chromium concentration reported in monitoring wells and extraction wells at all locations for that quarter. Monitoring wells used to draw the 3.1 ppb Cr(VI) or 3.2 ppb Cr(T) boundary lines shall have plume lines drawn through the monitoring well.
- g. Chromium plume boundary lines shall show monitoring and extraction well concentration contours representing the maximum extent of the following: 1,000 ppb Cr(VI) or Cr(T), 50 ppb Cr(T), 10 ppb Cr(VI), 3.1 ppb Cr(VI) or 3.2 ppb Cr(T).
- h. Plume boundary lines shall be drawn to connect any monitoring well located within one-half mile (2,600 ft) of any other monitoring well having chromium concentrations of 3.1 ppb Cr(VI) or 3.2 ppb Cr(T) or greater. Where access is not granted to install additional monitoring wells, plume boundary lines shall be drawn to connect monitoring wells exceeding background concentrations up to one mile apart.
- i. The dashed line representing the inferred chromium boundary of 3.1 ppb Cr(VI) or 3.2 ppb Cr(T) shall be a dark color so as to stand out in contrast to other markings on the map.
- j. Where access to private property or endangered species habitat has not been granted for six months or more, the chromium plume boundary shall be drawn around any domestic well containing chromium concentrations exceeding 3.1 ppb Cr(VI) or 3.2 ppb Cr(T) and within a one mile distance of the prior quarter's plume boundary.
- k. Domestic wells having chromium concentrations exceeding maximum background levels and which become inactive in the prior quarter can be removed from maps only if a monitoring well exists and is monitored within one-quarter mile distance of that domestic well.

3. Report Content

- a. Describe depth to groundwater, changes from prior quarter, and calculated gradients and flow direction.
- b. Table of groundwater elevation data for all monitoring and remediation wells sampled over prior 12 months,
- c. Potentiometric map showing the groundwater flow direction and the calculated flow gradient,
- d. Laboratory results:
 - i. Sample results showing a difference of 25% or greater between Cr(VI) and Cr(T) concentrations shall be re-analyzed within same quarter and the ensuing results described.

- ii. Tabulate laboratory results for monitoring wells, remediation wells, domestic/community/agricultural supply wells, and include data over the prior 12-months of sampling for each well.
- e. Describe all required monitoring wells or water supply wells not sampled during quarter and provide an explanation why.
- f. Interpret chromium plume boundary in the upper and lower aquifers compared to boundary lines in prior quarter. State if this quarter's boundary lines are stable or have migrated. If migration occurred, explain why it migrated (if due to PG&E's actions, natural groundwater movement, or actions by others).
- g. If the chromium plume boundary is undefined in certain areas (sampling locations are more than one-quarter mile distance), submit a workplan proposing additional sampling locations in accessible areas and an implementation schedule.
- h. Describe methods and actions for installing wells, as needed.
- i. The domestic well sampling and monitoring requirements shall be included in the main body of the report (not as an appendix) and include:
 - i. Total number and sampling results for wells that quarter, including number of wells exceeding maximum background levels and chromium MCLs.
 - ii. Required water supply wells not sampled that quarter with an explanation.
 - iii. Map showing all active domestic wells in sampling program and detected chromium concentrations for each monitoring event.
 - iv. Table of inactive water supply wells.
- j. Include appendices for boring logs and well designs for any wells installed during the quarter.
- k. Include appendix with description explaining the difference between monitoring well labels, such as A, B, C versus S and D, etc.
- l. Include appendix of Standard Operating Procedures for sampling procedures of monitoring wells and domestic wells.
- m. Include appendix of laboratory reports and field notes.
- n. Discuss calculated groundwater flow direction and velocity based on groundwater elevation data and not surface topography.
- o. Discuss the status of conditions that prevent access to land for installation of monitoring wells. Such conditions may include, but not be limited to, permission to access to private property by the owner, acquisition of private property, and approval from agencies, such as Department of Fish and Wildlife, to lands that may be considered endangered species habitat or threatened species habitat. Note if conditions change such that access is available.

C. Plume Map Submittals

Chromium plume maps shall be submitted to the Water Board in digitized form (such as a pdf document) within **one** business day of the report due date. At least one of the submitted maps shall contain monitoring data and plume lines and be printed by the public on 8-1/2 inch by 11 inch and 11 inch by 17 inch paper. Another submitted map shall contain only plume lines and be printed by the public on 8-1/2 inch by 11 inch paper.

D. Geotracker Submittals

Reports shall be uploaded to the State Water Resources Control Board's Geotracker database, within **one** business day of the report due date, so that reports can be viewed by the public at the link: https://geotracker.waterboards.ca.gov/profile_report.asp?global_id=SL0607111288. If report appendices are uploaded as separate files, the appendix number or letter shall be included in the file name.

E. Other Monitoring Requirements Not Superseded

Requirements for site-wide groundwater monitoring and domestic well sampling and monitoring do not supersede sampling requirements in Water Board orders R6V-2008-0014 and R6V-2014-0023 and related Notices of Applicability.

III. MONITORING FOR COMPLIANCE WITH CAO CLEANUP REQUIREMENTS FOR SOUTHERN PLUME

The monitoring and remediation wells listed in Table 8.1 shall be evaluated in four-year comprehensive reports required above by Requirement II.C. All wells in Table 8.1 shall be monitored **quarterly** for total and hexavalent chromium to assess progress toward and compliance with cleanup requirements specified in CAO Requirement VI.B. The concentrations of chromium listed in Table 8.1 are of third quarter 2014.

Table 8.1. Monitoring Wells for Evaluating Compliance with CAO Cleanup Requirements for Southern Plume.

Compliance MWs for 50 ppb Target	Cr(VI) (ppb)	CrT (ppb)	Compliance MWs for 10 ppb Target	Cr(VI) (ppb)	CrT (ppb)
CA-MW-107D	150		PMW-01	42	
CA-MW-108S	76		CA-MW-204D	29	
CA-MW302D	99	99	CA-MW-312D	28	29
CA-MW-315D	75	76	CA-MW-402S	40	39
CA-MW-405D	74	75	CA-MW-404S	19	19
DMW-03	320	360	CA-MW-411S	25	25
MW-1	550	610	CA-MW-412D	28	29
MW-11B	1400	1400	CA-MW-506D	13	14
MW-15	1700	1800	CA-MW-508D	32	32
MW-17	110	99	EX-02	20	18
MW-178D	290		EX-15	11	11
MW-178S	220		EX-20	13	13
MW-18	53		EX-26	22	
MW-180RD	95		EX-30	41	43
MW-180RS	92		EX-34	21	
MW-193S3	140	150	IW-01	26	28
MW-20	700	720	IW-02	15	17
MW-36	84	87	MW-03	13	12
PT2-MW-10	510		MW-04	33	34
SA-MW-01S	400	450	MW-10	22	23
SA-MW-02D	150	160	MW-108D	35	35
SA-MW-04S	220	250	MW-108S	41	39
SA-MW-05D	3900	4100	MW-109	13	12
SA-MW-06S	520	570	MW-12B	12	13
SA-MW-07D	880		MW-13	22	23
SA-MW-09S	470		MW-14B	35	32
SA-MW-10D	400	430	MW-14S	29	29
SA-MW-11S	430		MW-154S1	13	14
SA-MW-11D	120		MW-179D	26	
SA-MW-15D	90		MW-182D	39	
SA-MW-16S	340	390	MW-182S	30	
SA-MW-17S	190	210	MW-183D	22	
SA-MW-18D	64	69	MW-183S	33	
SA-MW-20D	830	910	MW-22B	29	29
SA-MW-26S	360	380	MW-23B	44	47
SA-SM-015	740		MW-27A	12	11
SA-SM-02D	1800		MW-28B	14	15

Compliance MWs for 50 ppb Target	Cr(VI) (ppb)	CrT (ppb)	Compliance MWs for 10 ppb Target	Cr(VI) (ppb)	CrT (ppb)
SA-SM-08D	290	310	MW-30B2	12	13
SA-SM-11D	95	100	MW-38B	28	27
SC-MW-03D	320	350	MW-39D	23	
SC-MW-12S	330	340	MW-41S	11	14
SC-MW-13S	110	120	MW-42B1	33	33
SC-MW-21S	440		MW-42B2	45	48
SC-MW-26D	1000		MW-43	10	11
SC-MW-38D	55	52	MW-50S	14	14
# OF WELLS	45		MW-68D	12	11
90 % OF TOTAL (compliance target)	41		SA-SM-10D	22	
Minimum Cr value (3Q 2014, ppb)	52		X-16	15	
Maximum Cr value (3Q 2014, ppb)	4100		Y-01	12	
			Y-03	11	
			# OF WELLS	50	
			80% OF TOTAL (compliance target)	40	
			Minimum Cr value (3Q 2014, ppb)	10	
			Maximum Cr value (3Q 2014, ppb)	48	

IV. CRITERIA FOR REMOVAL OR ABANDONMENT OF INACTIVE DOMESTIC WELLS FROM SAMPLING PROGRAM

A. The Discharger may remove inactive wells from the domestic well sampling requirements specified above in Requirement I.B.2, if such wells meet the following criteria:

1. The domestic well is located within 2,000 feet of a multi-depth monitoring well, or
2. The domestic well does not contain hexavalent or total chromium concentrations of 2.0 µg/L or greater since September 2011.
3. Prior to removing domestic wells from the sampling program, the Discharger shall provide the Water Board with a list of inactive domestic wells and the rationale for removal from the sampling program within each quarterly report.
4. Domestic wells removed from the sampling program shall be left in place and secured (capped in place) to be evaluated in the future for potential sampling.

- B. The Discharger may abandon inactive domestic wells which are screened across both the upper and lower aquifers.
1. Prior to abandonment, the Discharger will provide the Water Board with a list of inactive domestic wells proposed for abandonment at least 14 days before initiating abandonment actions.
 2. Upon Water Board staff's acceptance of the list, the Discharger will abandon inactive domestic wells in accordance with state Well Standards and county ordinances.

PROPOSED