Pacific Gas and Electric Company

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Via Electronic Mail and FedEx

California Regional Water Quality Control Board Lahontan Region
2501 Lake Tahoe Blvd.
South Lake Tahoe, CA 96150
Attn: Sue Genera
Executive Assistant and Water Board Clerk
RB6enfproceed@waterboards.ca.gov

Re: Proposed 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

PG&E appreciates the opportunity to submit these comments on the Proposed CAO, and supports a thorough and collaborative process to draft a cleanup and abatement order that facilitates our commitment to remediate groundwater in Hinkley. The release of the Proposed CAO is an important step in continuing the significant progress made to date in cleaning up the chromium plume. The Proposed CAO makes great strides by consolidating numerous previous orders, which will improve understanding and transparency. It also provides cleanup requirements that are flexible over time, and allows the remedy to adapt as future remediation progress changes conditions in the field. In these regards, the current draft provides an excellent foundation.

As our comments address, we suggest the Proposed CAO be amended to best reflect the substantial technical experience and knowledge gained by PG&E and the Water Board through the remediation activities to date. PG&E looks forward to working with the Water Board to produce a CAO that is efficient, and which facilitates a scientifically and technically supported remediation. This cover letter highlights some of the more significant issues with the Proposed CAO, and detailed analyses along with suggested edits are in the attached comments.

1) USGS Studies

The Proposed CAO as written does not recognize the importance and value of the USGS background study, which will ultimately help to inform cleanup goals and requirements. PG&E is fully committed to the scientific process, and is actively working to support the USGS in their detailed studies. These studies are a critical component of the remediation because there is substantial uncertainty as to whether the chromium in certain areas is

from PG&E's chromium plume. There is significant scientific evidence to conclude that the chromium detected in groundwater in some areas is not associated with PG&E's historical chromium discharge.

The Proposed CAO as written continues to rely on discredited results from the background values established in 2008, which all parties acknowledge is flawed. The findings of the Proposed CAO should be revised to acknowledge the scientific data that has been submitted to the Water Board over the last several years that demonstrate that the current background values established by the Water Board in 2008 are simply not accurate for broad areas of the site. The written findings of peer reviewers contracted directly by the Water Board support this conclusion, and members of the community have also expressed reservations about the background values.

It is important to fully represent the uncertainty in the source of chromium in these findings because California law guides the Water Board to require cleanup only in areas affected by PG&E's discharge or threatened discharge. The Proposed CAO cleanup requirements must be linked to PG&E's discharge by scientific evidence and findings, and at this time it is not clear that the chromium found to the north and west of the core remediation area is from PG&E's historical discharge. Further studies are required, and will be forthcoming from the USGS. In the meantime, there are robust activities underway to both a) monitor and protect public health based on the current MCL and b) aggressively remediate the most heavily impacted areas containing virtually all of the chromium mass, which are found in the plume core.

2) Cleanup Time Requirements

The Proposed CAO sets forth time requirements to cleanup chromium in groundwater to less than 10 ppb that are not supported by the necessary scientific findings. The remedial timeframe analysis requested by the Water Board and prepared by PG&E was focused on the time to treat the core plume area to 10 ppb. Treating the highest concentrations in the core to 10 ppb is an obvious first priority in the remediation process, pending the results of the USGS study. As the USGS studies may prove, background values in many areas may be higher than the non-detect and 3.1/3.2 ppb Cr(VI)/Cr(T) specified treatment requirements of the Proposed CAO. California law requires that cleanup and abatement ordering provisions required by the Water Board must be supported by factual findings and, in this case, there are no factual or technical findings to support the remedial timeframes to concentrations less than 10 ppb in the Proposed CAO.

3) Replacement Water

PG&E supports the Proposed CAO's appropriate use of the hexavalent chromium Maximum Contaminant Level ("MCL") in replacement water requirements. This use of the MCL is a unique opportunity to remove confusion regarding inconsistent standards, as well as implementation challenges caused by replacement water requirements in other Water Board orders, such as the ATU WDRs. PG&E, like the Water Board, is committed to protecting drinking water for Hinkley residents. In our collective attempt to be protective, it is important not to raise unfounded alarm. Informed by lessons learned in providing replacement water, additional modifications are proposed to minimize the

impact to residents, including the potential use of compact under sink reverse osmosis units in the place of whole house water systems. Additionally, the Proposed CAO should be modified to specifically supersede all other replacement water orders, since a single order and the MCL will help provide clarity to the community and to PG&E.

4) Internal Plume Geometry

There is ample protection for domestic wells caused by any changes in internal plume geometry due to remediation under the Agricultural Treatment Unit Waste Discharge Requirements ("ATU WDRs"). The requirement in the Proposed CAO that the 10 and 50 ppb chromium plume not migrate is not necessary to protect domestic wells and may actually inhibit the efficiency of remediation, as it does not recognize the dynamic nature of groundwater flow within the area of hydraulic containment during remediation.

5) Monitoring and Reporting Plan

PG&E appreciates the improvements in sampling efficiency realized in the Proposed CAO Monitoring and Reporting Program ("MRP"), but as the comments reflect, we continue to recommend the plan PG&E submitted in December 2014 and discussed with the Water Board staff, Water Board Members, and the community. The PG&E-proposed MRP is a carefully drafted monitoring plan designed to ensure that all pertinent water quality data is gathered and analyzed to inform the Water Board, PG&E, and the community of how best to implement remediation activities and goals.

6) IRP Manager

PG&E is committed to providing the community an independent subject matter expert who can answer their questions about our programs, and will therefore continue to support the Independent Review Panel ("IRP") Manager. PG&E underscores that this aspect of the Proposed CAO is a critical component to the success of the cleanup of the chromium-impacted groundwater. We will continue to keep the Hinkley community informed based on the most current scientific data. We have heard from many community members that opportunities to for the public to interact on the remediation program should be sought outside of the currently prescribed process, and that the IRP Manager provides an unbiased venue for this interaction.

PG&E is committed to addressing the groundwater impacts caused by our historical operations in Hinkley, in a manner that is open and transparent, and that is protective of public health and the environment. We look forward to further dialogue with the Water Board and interested parties during the upcoming collaborative revision process for the Proposed CAO.

Sincerely,

Kevin Sullivan
Director, Chromium Remediation Program, PG&E

Attachments

A Main Comment List
B Comments on Proposed CAO with Regards to Background Chromium Levels
C Legal Issues
D Proposed CAO Replacement Water Provisions Comments
E Roadmap of Text Edits
F List of References
G References (provided on DVD)

Attachment A

Main Comment List

Attachment A Main Comment List

1. Finding 4, Page 2. The Proposed Cleanup and Abatement Order (CAO) states: "The groundwater gradient along the north-south axis of the chromium plume ranges from 0.002 to 0.007 feet per foot (vertical drop over horizontal length), with an average rate of 0.004 feet per foot. The Mojave River, located approximately one mile south of the Facility, contributes more than 80 percent of the natural groundwater recharge to the Hinkley Valley." This information is not scientifically or technically accurate. The hydraulic gradient is much flatter than stated in much of the North Hinkley Valley. Additionally, as reported by the U.S. Geological Survey (USGS), nearly 100 percent of the natural groundwater recharge for the Hinkley Valley is sourced by the Mojave River. The Mojave Water Agency operates a groundwater recharge program throughout the Mojave River watershed. One of the recharge basins is located on the north side of the Mojave River, immediately to the southwest of the compressor station near Dixie Road. The source of the recharge water is the State of California Sacramento Delta aqueduct system. Water is periodically discharged from the regional pipeline to the recharge basins. The overall recharge contribution and influence on water quality will be considered in the background study to be conducted by the USGS. The attached technical memorandum entitled, "Comments on Proposed Cleanup and Abatement Order with Regards to Background Chromium Levels" (Attachment B) provides supporting information.

2. Findings 6-10, Pages 2-4. Findings 6-10 do not fully describe the uncertainty of the 3.1/3.2 parts per billion (ppb) hexavalent chromium (Cr[VI])/ total dissolved chromium (Cr[T]) background values established in CAO No. R6V-2008-0002A1 and the importance of the USGS study for establishing the extent of known contamination. The technical memorandum attached as Attachment B to these comments provides a complete summary of these issues. In brief, site data demonstrate that the background values established by CAO No. R6V-2008-0002A1 are not technically accurate, particularly for areas north of Thompson Road (i.e., the North Hinkley Valley and Water Valley). It is likely that the values also are not accurate for the area of the "western finger." The written findings of three peer reviewers contracted directly by the California Regional Water Quality Control Board, Lahontan Region (Water Board) in 2011 also found that the background values established in CAO No. R6V-2008-0002A1 do not accurately represent background values (Water Board 2012). All references are listed in Attachment F and attached electronically in Attachment G). The Water Board subsequently decided to revisit the 2007 background study on which the CAO No. R6V-2008-0002A1 background values were based in response to community concern and criticism of the study's methodology. Additionally, the Water Board has approved a study proposed by the USGS entitled, "Occurrence of natural and anthropogenic Cr(VI) near a mapped plume, Hinkley, CA" (Izbicki 2014). According to the USGS website for the study, "The purpose of this study is to evaluate the occurrence of natural and anthropogenic Cr(VI), and estimate naturally-occurring background Cr(VI) concentrations upgradient, near the plume margins, and downgradient from a mapped Cr(VI) contamination plume near Hinkley, CA." (http://ca.water.usgs.gov/projects/hinkley/index.html). At this time, the most reasonable and technically supported path forward for the proposed CAO is to revise the findings to acknowledge the existing scientific data and identify the current background values as "interim."

Specifically, in findings 6, 7, and 8, Pacific Gas and Electric Company (PG&E) suggests replacing "maximum background levels" with "interim background levels" and "plumes" with "areas where groundwater exceeds interim background levels."

3. Finding 7, Pages 2-3. The proposed CAO states: "The background water quality in the lower aquifer water for chromium is generally at non-detectable levels, per monitoring wells MW-11C and MW-14C, between the Facility and east of Mountain View Road near Santa Fe Road. 'Non-detect' refers to the lowest concentration that a laboratory analytical instrument can detect while minimizing uncertainty." It is premature to conclude the background values for Cr(VI) and Cr(T) in the lower aquifer are non-detect. There have been no detailed studies of background chromium levels for the lower aquifer, and this finding is not technically or scientifically supported. The proposed CAO should acknowledge the existing data and the uncertainty, and the background chromium conditions for the lower aquifer should not be defined until a detailed study has been conducted.

4. Finding 8a, Page 3. This finding includes the "western finger" as an area of known chromium contamination from the compressor station release. However, there is considerable uncertainty in the source of chromium in the "western finger". As detailed in numerous technical reports, there are multiple hypotheses for Cr(VI) in the west, including the following: background Cr(VI) concentrations in this area are greater than 3.1 ppb; the historical and/or relatively recent geochemical changes in groundwater have resulted in Cr(VI) concentrations greater than 3.1 ppb (CH2M HILL et al. 2013; CH2M HILL and Stantec 2013a; CH2M HILL 2013; ARCADIS 2013a,b, 2014a,b). Chromium concentrations unrelated to the compressor station plume exist to the west in the area southwest of the Lockhart Fault and at Mulberry Road, as discussed in more detail in Attachment B, further increasing the uncertainty that Cr(VI) in the western area is sourced from the historical release from the compressor station.

The source of chromium and reason for existence of the western area must be fully understood before it can be definitively concluded that the detected chromium levels are a result of PG&E's historical release and/or if a remedial action is needed. If remediation is needed, the appropriate remedial action and how long it will take to be effective need to be assessed and should not be arbitrarily set forth in the proposed CAO in the absence of supporting technical information. In response to chromium in the western area, PG&E constructed a new extraction well (EX-36) in the western area in response to Water Board direction to take action in this area (ARCADIS 2014b) and began operation in May 2014. The new extraction well is located in the middle of the "western finger" as depicted on plume maps produced according to current Water Board contouring rules. The extraction well yields very little water (i.e., achievable flowrates are less than 1 gallon per minute), and Cr(VI) concentrations are less than 3.1 ppb, as detailed in a report dated July 24, 2014 (ARCADIS 2014b). Together, the Cr(VI) concentration data, lithologic data, and hydrogeological data collected during implementation of the pumping at EX-36 indicate that the extent and mobility of Cr(VI) mass in the western area is limited (ARCADIS 2014b). The results also illustrate the complexity of the hydrogeology and chromium distribution in this area that will need to be further evaluated to fully understand potential remediation in this area and how long it would take to complete.

It is important to fully represent the uncertainty in the source of chromium in these findings because the Water Board is legally prohibited from requiring cleanup in areas not affected by PG&E's discharge or threatened discharge (see Point 3 in Attachment C). At this time, it is not clear that the chromium in the western area is a result of PG&E's historical release and further study is required. Given that the source and background levels of Cr(VI) are uncertain, PG&E recommends the CAO discuss the western area, rather than the "western finger". It is also important to fully evaluate remedial options in this area, rather than assigning an arbitrary and capricious remedial timeframe (see Point 1 in Attachment C). As such, PG&E recommends revising Finding 8a as follows,

"The area with Cr(VI)/Cr(T) concentrations above interim background levels in the south~~ern plume~~ includes the ~~currently contiguous~~ ~~"western finger" of the chromium plume in the upper aquifer,~~area west of Serra Road, between Highway 58 to the south and Acacia Street to the north. However, the source of chromium in this area is uncertain and is the subject of the USGS background study."

The proposed CAO should also delete the word "plume" as it is misleading, and replace it with "areas of groundwater with chromium above the interim background levels."

Note, all proposed text edits are summarized in Attachment E.

5. Finding 8b, Page 3. The proposed CAO states: "Two northern plumes are detached (i.e., non-contiguous) from the southern plume and from each other. The southern-most northern plume, called the North Hinkley Valley northern plume, extends from just south of Sonoma Street to just south of a topographic high feature known as Red Hill at the Hinkley Gap. The north-most northern plume, referred to as the Harper Dry Lake Valley northern plume, extends from northwest of Red Hill up to just south of Brown Ranch Road. The boundaries of the northern plumes are poorly defined or undefined by existing groundwater monitoring wells." PG&E disagrees with the Water Board staff as to whether or not the existing data supports the assertion in this finding that the referenced areas are part of the chromium plume. PG&E has provided the Water Board with numerous technical documents with scientific data supporting a conclusion that chromium in groundwater in these areas is likely associated with background conditions; the attached technical memorandum (Attachment B) provides additional supporting information to complement what has already been submitted to the Water Board. The areas referenced in this finding will be included in the USGS study. The proposed CAO should be revised to acknowledge the existing scientific data submitted by PG&E, the overall uncertainty, and that the USGS study will include the northern area. *The proposed CAO should delete the word "plume" as it is misleading and replace it with "areas of groundwater with chromium above the interim background levels."*

6. Finding 8c, Page 3. Finding 8C identifies three areas of chromium concentrations greater than 10 ppb. It is important to note that the source of chromium in these areas is uncertain, as detailed in Attachment B, and may be naturally occurring. According to public testimony, the Water Board staff concur that the source of chromium in this area is uncertain. At a Water Board meeting on September 10, 2014, Lisa Dernbach of the Water Board staff was asked by Water Board Member Keith Dyas to

explain fluctuations in elevated chromium concentrations at MW-193S3, (listed as a "hotspot" in the proposed CAO), and she responded:

> *"We honestly don't know, because we don't know if that high area of concentration [MW-193] is related to the compressor station release or it's natural. It is going to be studied as part of the USGS background study. It's an unusual concentration to be seen up there in the Harper Lake Valley where, typical of the concentrations we're seeing up there are mostly single digits, a few teens, but that one in the 200 level really took everyone back. It was completely unexpected. So we really don't know what it's attributed to now and what its decrease is attributed to."*

This exchange is consistent with the scientific data presented in Attachment B and is a good illustration of the level of uncertainty in the source of chromium at concentrations in the North Hinkley Valley and Harper Dry Lake Valley. As such, PG&E recommends including this statement in Finding 8c:

"The source of chromium in this area is uncertain and the subject of the USGS background study." PG&E also recommends replacing the term "hot spot" with "areas of higher chromium concentrations that will be studied by the USGS."

Factual findings must be supported by competent evidence. Where such evidence is lacking or compromised, such findings are not supported and thus, are arbitrary. In the case of MW-196, the data sited in the finding is compromised and does not support the finding. As previously reported to the Water Board, the area of higher chromium concentrations at the MW-196 monitoring well cluster in December 2014 appear to be anomalous and unreliable data related to suspected tampering with the monitoring well by third parties (CH2M HILL 2015). PG&E has identified evidence that this well cluster, located in the Harper Dry Lake Valley area, was among several project monitoring wells accessed by unauthorized individuals beginning in 2014. Samples from the MW-196 wells, collected during the fourth quarter 2014 sampling event and after the unauthorized access of these wells, revealed water chemistry data that were extremely unusual in several respects. The oxidation reduction potential measured in the wells was nine times more than the previous quarter, nearly twice as high as the highest seen in any Water Valley monitoring well, and significantly higher than any repeatable measurement taken in over 600 wells and 10,000 samples in the last 14 years of groundwater sampling for the Hinkley remediation project. Additionally, field observations during subsequent purging events noted a strong odor of bleach from some of the wells and foaming of the water, which had never been observed at these wells. Cr(VI) concentrations in post-tampering samples from these wells have been highly variable, fluctuating from as much as 54 to as little as 2.1 ppb during the fourth quarter and from as much as 18 to as little as 2.1 ppb over the course of a single day, for example (both from MW-196S3). Available data indicate the fourth quarter results from samples of the MW-196 monitoring well cluster are anomalous and should not be considered representative of local aquifer conditions (CH2M Hill 2015). The technical memorandum (CH2M HILL 2015) is provided electronically in Attachment G to these comments. The water chemistry trends and field observations provide additional indications of well tampering and the likely introduction of non-natural oxidizing chemicals into the aquifer through the wells or some other localized impact, resulting in anomalous data.

Following the submittal of the initial memorandum detailing the data in January 2015, PG&E conducted large-volume purging from each of the monitoring wells in the MW-196 cluster, extracting more than 19,000 gallons from each of the three monitoring well intervals. As purging was conducted, the oxidation reduction potential values declined toward ambient values, indicating that the localized impact was being removed. Cr(VI) concentrations declined toward baseline in two of the monitoring wells. PG&E is continuing to evaluate next steps to address the residual impacts.

Based on this information and recent anomalous events, PG&E recommends deleting mention of MW-196 from Finding 8c.

7. Findings 9 and 10, Pages 3-4. Findings 9 and 10 of the proposed CAO discuss the potential distance of chromium plume migration from the time of the historical release in the 1950s to present day. Footnote 1 for these two findings states: "The calculation is: (2 feet/day x 365 days/year x 53 years) / 5,280 feet/mile = 7.32 miles of potential migration of the leading edge of the plume. 53 years assumes the time between issuance of CAO No. R6V-2008-0002A4 and the waste discharge is 60 years, minus 7 years for waste chromium to percolate to groundwater." PG&E has submitted numerous technical documents to Water Board staff that illustrate that this calculation is incorrect and should not be relied upon to order remediation activities. The voluminous technical support for disputing this plume migration finding is detailed in Attachment B. In summary, the calculation does not consider the critical information that much of the Hinkley Valley was characterized by a large hydraulic depression from agricultural pumping for several decades that did not allow for groundwater movement to the north past Thompson Road. The calculation also does not account for much slower groundwater velocities in the North Hinkley Valley than estimated here. The USGS will be studying historical and recent groundwater movement in the Hinkley Valley as part of its background study, including a flow model calibrated to historical data. Lastly, the USGS and others have acknowledged the uncertainty in groundwater flow and plan to use other lines of evidence, such as groundwater geochemistry, to support the model conclusions. A significant volume of geochemistry data has been provided to the Water Board to date, and these data are discussed again in the attached technical memorandum (Attachment B). The data provided do not support the calculations provided in the footnote referenced above. Findings 9 and 10 are arbitrary and capricious estimates based upon unrealistic assumptions, are completely inaccurate, and are not properly a finding in the proposed CAO.

The scientific validity of this finding is of critical importance because it is relied upon to justify the need for investigation and remediation in the North Hinkley Valley and Harper Dry Lake Valley. The Water Board cannot require investigation or cleanup unless the areas are affected or likely to be affected by PG&E's discharge or threatened discharge (see Point 3 Attachment C). The information submitted by PG&E in prior technical reports and in Attachment B suggests the opposite – the chromium detected north of Thompson Road is NOT likely to be associated with the PG&E plume. The incorrect calculations in Footnote 1 of this finding do not support a conclusion otherwise.

The evidence the Water Board has put forth in the proposed CAO that chromium north of Thompson Road is associated with the PG&E plume is that the levels are above the 3.1/3/2 ppb Cr(VI)/Cr(T) concentrations, which is based on the misleading and scientifically inaccurate calculation provided in

Footnote 1, as discussed above. As evidenced by scientific studies and data submitted previously to the Water Board, neither of these two items provides the basis for the investigation and remediation requirements in the proposed CAO. The 3.1/3.2 ppb Cr(VI)/Cr(T) values have been proven to be incorrect in this area and the Footnote 1 calculation is inaccurate and not supported by scientific data. In contrast, the numerous reports and significant volume of technical data provided by PG&E, as summarized in Attachment B, clearly demonstrate that the chromium detected north of Thompson Road is NOT likely associated with the PG&E plume. PG&E supports the USGS study that will consider multiple lines of evidence to further the scientific evaluations. In the meantime, the findings of the proposed CAO clearly lack the evidence to support the investigation and remediation requirements and appear to ignore the valid scientific theories and information, which directly contradict the conclusions in these findings.

8. Finding 10, Page 4. "The release from PG&E's Facility is the only known source of anthropogenic chromium in groundwater in the Hinkley upper and lower aquifers. Based on the data and calculations cited in Finding 9 and footnote 1, chromium detections above maximum background levels in groundwater extending from the Facility through the Hinkley Valley into Harper Dry Lake Valley are considered a result of historical releases at the Facility, and are subject to investigation and remediation required by this Order." As stated Comment 7, the calculation in Footnote 1 is inaccurate and has no technical basis. Finding 10 is not technically correct or scientifically supported. The Water Board, USGS, PG&E, and the Hinkley community are members of a Technical Working Group (TWG) that is evaluating several technical issues, including background chromium in the Hinkley Valley. The USGS is conducting a long-term study that will include the evaluation of multiple lines of evidence to estimate the boundaries for the chromium plume and assess natural chromium background levels. The current background values are not accurate for all of the Hinkley Valley and Water Valley, and these values should only be used as "interim" until the USGS completes its study. Investigation and/or remediation requirements based upon these "interim" background levels should be limited to south of Thompson Road until the USGS study is complete. PG&E has committed to support the TWG and the USGS in their study to collectively develop a scientifically based conclusion to plume delineation and chromium background levels as quickly as possible.

It is important to fully represent the uncertainty in the source of chromium in these findings because the Water Board is legally permitted to require cleanup only in areas affected by PG&E's discharge or threatened discharge (see Point 3 in Attachment C). As such, PG&E recommends the following revisions to this finding:

"~~Based on the data and calculations cited in Finding 9 and footnote 1, c~~ Cchromium detections above ~~above maximum~~interim background levels in groundwater contiguous to the original source ~~extending from the Facility through the Hinkley Valley into Harper Dry Lake Valley~~ south of Thompson Road, northeast of the Lockhart fault, and west of Dixie Road, excluding the chromium in the ~~finger"~~ "western area described in Finding 8a, are considered a result of historical releases at the Facility, and are subject to investigation and remediation required by this Order."

9. Finding 14, Page 5. Similar to Comment 2 on Findings 6-10, Finding 14 does not fully describe the uncertainty of the background values established in CAO No. R6V-2008-0002A1 and the importance of the USGS background study, as detailed in Attachment B. The scientifically justified path forward for the proposed CAO is to revise the findings to acknowledge the existing scientific data and identify the current background values as "interim." These values can be used as reference points over the next several years while the USGS completes the updated background study, which is fully supported by the Water Board, PG&E, and the Hinkley community. PG&E recommends that the USGS background study be used to provide a valid, credible, and defensible result for determining where chromium is due to historical releases from the compressor station, rather than the 3.1/3.2 Cr(VI)/Cr(T) ppb levels from CAO No. R6V-2008-0002A1, which have been proven to be inaccurate for all of the Hinkley Valley and Water Valley.

As such, PG&E recommends adding text at end of Finding 14 stating:

"Since CAO No. R6V-2008-0002A1 was adopted, data have been collected and presented to the Water Board demonstrating significant uncertainty in the accuracy of these values in representing background chromium conditions, particularly in the western area and north of Thompson Road but also east of Dixie Road and southwest of the Lockhart Fault. The USGS is conducting a study, with a goal of more accurately defining areas where the PG&E chromium plume is present and what levels of chromium represent background levels. The levels stated above will be used as interim background levels for the South Hinkley Valley (excluding the western area, east of Dixie Road, and southwest of the Lockhart Fault) as the USGS study is conducted. In other areas, such as the western area and north of Thompson Rd, this CAO requires PG&E to support the USGS study. "

10. Finding 15, Page 5. As stated in previous comments, the actual background values at the site are uncertain. It is possible that actual background levels are greater in some areas and lower in others than levels set in CAO No. R6V-2008-0002A1, listed in Finding 14. The Water Board cannot require a Discharger to treat to concentrations less than background (see Point 4 in Attachment C). The State Water Resources Control Board Resolution 92-49 provides a process for developing final cleanup levels.[1] PG&E acknowledges the background values developed by the USGS will be one element of this process. Therefore, it is inappropriate to use the 3.1/3.2 ppb Cr(VI)/Cr(T) levels to determine effectiveness of remedial actions at this time. PG&E recommends using the USGS study as the vehicle to determine what

[1] The relevant text of the resolution is as follows: In overseeing investigations to determine the nature and extent of discharge and appropriate cleanup and abatement measures, the Regional Water Board must require a Discharger to conduct investigation and cleanup in a progressive sequence, provided that the sequence may be adjusted to accommodate site-specific circumstances, beginning with a preliminary site investigation to confirm, among other things, the vertical and horizontal extent of the discharge. (Resolution, Section II.A.1.a.) Then soil and water investigations will be conducted to determine the nature and extent of the discharge with "**sufficient detail to provide the basis for decisions regarding subsequent cleanup and abatement actions."** (Resolution, Section II.A.1.b.) (Emphasis added) Next is the proposal and selection of feasible and effective cleanup and abatement actions, implementation of cleanup action, and monitoring of effectiveness of cleanup. (Resolution, Section II.A.1.c-e.)

chromium is due to the historical releases from the Facility, rather than the uncertain CAO No. R6V-2008-0002A1 levels proposed in Finding 15.

As such, PG&E recommends deleting Finding 15.

11. Finding 17, Page 5. The proposed CAO states: "The Water Board approved and the Executive Officer issued a third amendment to CAO No. R6V-2008-0002 on March 14, 2012, CAO No. R6V-2008-0002A3, replacing plume containment requirements in CAO No. R6V-2008-0002. The Water Board Executive Officer issued a fourth amendment to CAO No. R6V-2008-0002 on January 8, 2013, CAO No. R6V-2008-0002A4, requiring PG&E to conduct further investigations to fully define the chromium boundary in groundwater to the 3.1 ppb Cr(VI) and 3.2 ppb Cr(T) levels."

A sentence should be added to the end of this finding stating these values are "interim" until the USGS completes its studies.

12. Finding 18, Page 5. The proposed CAO states: "Orders in CAO No. R6V-2008-0002A4 required PG&E to define the extent of chromium in the upper aquifer to the maximum background levels. Order A.2.a required that monitoring well locations were not to exceed one-quarter mile distance (1,320 feet) from other monitoring wells in accessible areas. Order C.2 requires that maps include chromium plume boundary lines drawn to connect any monitoring well located within one-half mile (2,600 feet) of any other monitoring well having chromium concentrations exceeding background levels. Accordingly, this Order requires installation of monitoring wells and mapping consistent with these criteria."

This finding should be updated to use the words "interim background levels."

13. Finding 19, Page 6. The proposed CAO states: "In response to requirements in CAO No. R6V-2008-0002A4, PG&E submitted the April 24, 2014 document, 'Status Report for the Northern Areas.' The document proposed to investigate chromium in groundwater in seven areas in the northern plumes. By late 2014, only two areas had been investigated and a third area will have a monitoring well cluster installed on the north side of Red Hill and east of Hinkley Road in early 2015. PG&E has not fully defined the chromium plume boundaries in other areas of the upper aquifer based on its claim of an inability to gain access to private properties and endangered species habitat. Thus, some boundaries in the two northern plumes are not fully defined because they exceed the 1,320-ft distance criteria for monitoring wells and/or do not define chromium concentrations to maximum background levels."

This finding should be edited to replace the word "~~plume~~" with "areas of groundwater with chromium above the interim background levels."

Additionally, this finding should indicate that it is technically infeasible to delineate the boundaries based upon these interim background levels north of Thompson Road and that no additional investigation is required in these areas for the purposes of "plume definition" until the USGS studies are complete and a more complete understanding of background conditions is developed based upon sound scientific data, as described in Attachment B.

14. Finding 20, Page 6. The Remedial Timeframe Assessment (ARCADIS 2014c) discussed in Finding 20 did not evaluate the time to treat Cr(VI) in the North Hinkley Valley, Harper Dry Lake Valley, or the western area. The source of chromium in these areas is uncertain, as discussed in comments 2, 4, 5, 6, 7, and 8 above, and in Attachment B; therefore, it is not known whether remediation by PG&E is appropriate in these areas at this time (see Point 3 in Attachment C). In addition, the conceptual site model in these areas and the groundwater flow model are not developed to the extent required to generate modeling predictions for groundwater cleanup timeframes in these areas. PG&E presented the plan to model only the southern plume core to the Water Board staff at meetings on May 8 and June 6, 2014, and presented the results of the southern plume core modeling to the Water Board at its public meeting on September 10, 2014.

In addition, the Remedial Timeframe Assessment noted that, "the modeling analysis presented in this remedial timeframe assessment is intended to provide a guide for evaluation of remedy performance over time; it does not provide definitive predictions of remedy timeframe and should not be used in cleanup orders with the expectation of certainty" (ARCADIS 2014c). As in all modeling, uncertainty in the remediation timeframe modeling is due to simplifying fundamental assumptions and data uncertainties; therefore, the modeling has inherent limitations and uncertainties when used to predict behavior and responses for real systems (ARCADIS 2014c). In addition to modeling assumptions, the timeframe assessment made several logistical assumptions, such as estimates of when the Habitat Conservation Plan would be approved and an Incidental Take Permit would be issued, and an assumption that the current remedial activities will continue to be permitted over the long term. The inherent uncertainty of modeling and use of assumptions that may change should be recognized in the findings to provide an adequate basis for use of the timeframe predictions in ordering requirements. As there are uncertainties in the remedial timeframe estimates, the estimates do not provide a scientific basis for establishing scientifically justified enforceable deadlines (see Point 1 of Attachment C). Rather, the estimates provide a scientific basis for establishing remedial goals for the site.

PG&E suggests the following edits to clarify the results of the Remedial Timeframe Assessment, to properly describe the level of certainty of the results, and to clarify that the timeframes are goals or milestones rather than enforceable deadlines:

"The updated estimates range from six to 23 years to remediate 99 percent of the 50 ppb southern plume east of Serra Road; and 11 to 50 years to remediate 99 percent of the 10 ppb southern plume east of Serra Road. The ranges reflect remediation times for different modeled hydrologic layers of the upper aquifer (finer-grained versus coarser-grained model layers) and different assumptions of in-situ remediation modeling. These estimates inform the basis for the cleanup ~~requirement deadlines~~ goals in this Order. The timeframe estimates are uncertain given underlying simplifying assumptions in the modeling, uncertainty in conditions throughout the modeled aquifer, operational and construction uncertainties, and assumptions made on the timing and continuation of permitting for the project. "

15. Finding 24, Page 7. PG&E suggests inserting the following statement:

"Over the last several years, as a result of PG&E's remedial actions, the areas of chromium above the interim background levels have not substantially migrated from the South Hinkley Valley across Thompson Road into the North Hinkley Valley."

16. Finding 32, Page 9. Finding 32 states that remedial actions are required in the northern plumes area. There is not sufficient evidence to support this finding. As discussed in comments 7, 8, and 10, the groundwater velocity calculations in Finding 9 are not accurate and do not support the determination in Finding 10 that chromium in the north at concentrations above 3.1/3.2 ppb Cr(VI)/Cr(T) is sourced from the compressor station, nor do they support the determination in Finding 15 that the chromium concentration values of 3.1/3.2 ppb Cr(VI)/Cr(T) can be used across the site to determine where chromium is present as a result of the historical release. The source of chromium in the northern plumes area is uncertain (Attachment B) and is the subject of the USGS background study. The Water Board is not legally permitted to require cleanup in areas that are not linked to PG&E's historical discharge. In addition to the current scientific uncertainty, these areas are subject to study by the USGS, and the existing data pose significant uncertainty that these areas have been affected by PG&E's discharge or threatened discharge, and there is a reasonable likelihood that the detected chromium is associated with natural background conditions (see Point 3 in Attachment C). Given that it is highly uncertain if the chromium north of Thompson Road is a result of PG&E's discharge, it is premature and not legally permissible to require remediation in this area.

As such, PG&E recommends deleting the phrase "~~conduct corrective actions in the northern plumes area and define the extent of chromium in the upper aquifer~~" from Finding 32.

In addition, the finding states that treatment to the CAO No. R6V-2008-0002A1 background levels and non-detect concentrations in the lower aquifer are required. As discussed in Comment 10 above, background levels may be higher than the CAO No. R6V-2008-0002A1 background levels in the upper aquifer and higher than non-detect in the lower aquifer. The Water Board cannot require cleanup to below background concentrations (see Point 4 of Attachment C). Therefore, this requirement to treat to levels that may be below CAO No. R6V-2008-0002A1 background levels should be deleted: *"~~background values of 3.1 ppb Cr(VI) and 3.2 ppb Cr(T) in the upper aquifer; and non-detectable levels of chromium in the lower aquifer near the Desert View Dairy.~~"*

17. Finding 36a, Page 10. This finding states that the monitoring frequencies proposed in PG&E's draft Monitoring and Reporting Program (MRP) described in Finding 35 are not appropriate at this time because remediation expansion is ongoing in the southern plume area. The December 2014 Draft MRP submitted by PG&E and referenced in Finding 35 (CH2M HILL 2014) included technical rationale for proposed sampling frequencies based on analysis of existing and future remediation, groundwater flow conditions, and concentration trends, in conjunction with proposed objectives for sampling. This finding does not provide a technical Water Board analysis of the sampling frequency rationale in PG&E's proposal to explain the finding that a different sampling frequency than what was proposed is needed (such as an evaluation of rate of anticipated change or anticipated area of hydraulic influence by new remediation). Without such analysis, there is very little to support the finding that quarterly sampling is needed at key monitoring wells. Furthermore, the stated objective to "detect and react to any

unforeseen changes in water quality in the southern plume area" is vague and appears to overlap with the monitoring objectives in the Agricultural Treatment Unit Waste Discharge Requirements (ATU WDRs) CAO No. R6V-2014-0023 and Notices of Applicability for the In situ Reactive Zones (IRZs) and Northwest Freshwater Injection (NWFI) that monitor changes in water quality due to remediation. In addition, this finding does not comment on the technical basis for the well sampling frequency proposed for domestic wells in the southern area in the December 2014 Draft MRP submitted by PG&E (CH2M HILL 2014). *PG&E recommends revisions of the monitoring program objectives and sampling frequencies, as discussed below in Comments 43-61 on the proposed CAO MRP.*

18. Finding 36b, Page 10. This finding states that quarterly sampling in the northern plumes area is needed until the plume is completely defined and contained to track changes in concentration and protect public health. The December 2014 Draft MRP submitted by PG&E included technical rationale for proposed sampling frequencies based on analysis of groundwater flow conditions and concentration trends in conjunction with proposed objectives for sampling in the northern area (CH2M HILL 2014). This finding does not provide technical Water Board analysis of the sampling frequency rationale in PG&E's proposal to explain the finding that a different sampling frequency than what was proposed is needed (such as an evaluation of rate of concentration trends). Without such analysis, there is very little to support the finding that quarterly sampling is needed to track concentration changes or protect domestic wells in contrast to the frequencies that PG&E proposed which were sufficient to meet both of these objectives. *PG&E recommends revisions of the monitoring program objectives and sampling frequencies as discussed below in Comments 43-61 on the proposed CAO MRP.*

19. Finding 38, Page 11. *PG&E suggests replacing "maximum background levels" with "interim background levels" in this finding.*

20. Finding 41, Page 12. Water Code section 13304 focuses on affected wells and does not contain language regarding an "affected area." The 1-mile requirement is unsupported by any findings or evidence and includes areas previously determined by the Water Board not to contain chromium from the compressor station release, as detailed in Attachment D. As discussed in Attachment D, experience with prior replacement water orders that contained affected area provisions is that the provisions were divisive and created conflict, as well as unfounded expectations. By removing the geographic limitation created by the concept of an affected area and, instead, focusing on wells that have been affected by PG&E's discharge, the proposed CAO would provide flexibility to address water supply wells impacted by PG&E wherever they may be found in the future. Therefore, PG&E suggests removing the concept of an affected area in favor of incorporating a focus on wells that have been impacted by PG&E's historical releases, with the following edits:

"From 2011 to 2014, in response to CAO No. R6V-2011-0005 and amendments, PG&E provided bottled water and/or whole-house water (WHW) to residences or businesses within the affected area and having detectable chromium in well water. On July 1, 2014, the California Division of Drinking Water's adoption of the 10 ppb Cr(VI) drinking water standard became effective. PG&E ceased providing bottled water and/or WHW on October 31, 2014, since no residence or business had hexavalent chromium above the new standard. However, consistent with the Olin Order, if future monitoring data indicate water in

private supply wells ~~in the affected area (defined in Finding 43)~~ is likely to exceed drinking water standards for Cr(VI) and the detections are linked to PG&E's historical releases, PG&E will be required to submit plans to provide replacement water supply to such wells ~~in either a modification of this Order, or a separate order~~."

21.Finding 42, Page 12. Attachment D provides detailed comments and justification for suggested edits to the replacement water provisions of the proposed CAO, including the triggers to provide work plans, the requirement that the chromium be linked to PG&E's historical releases, the timeline for implementation, and the applicability of replacement water for active drinking water wells versus other type of wells. Finally, the requirements to provide replacement water at concentrations less than the maximum contaminant level (MCL; 10 ppb) in previous orders is legally inappropriate and PG&E recommends clarifying those requirements in this order, as detailed in Attachment D. Based on the rationale in Attachment D, PG&E suggests the following edits to Finding 42:

"Accordingly, this Order requires that PG&E submit replacement water plans where active private supply well concentrations linked to PG&E's historical releases ~~in the affected area~~ exhibit increasing trends indicating the likelihood of future exceedances of the hexavalent chromium Maximum Contaminant Level (MCL)~~, or if a private supply well has hexavalent chromium reaching within 20 percent of the hexavalent chromium MCL (i.e., 8 ppb)~~. Interim replacement water (i.e., bottled water) shall be provided or offered to the well users within 2 working days of the first detection of chromium linked to PG&E's historical releases in an active private supply well at or above the MCL. ~~Permanent replacement water shall be provided within 45 days of such detection. This action requires that PG&E conduct sampling of domestic wells in the Hinkley and Harper Dry Lake Valleys.~~ This requirement for replacement water ~~does not~~ supersedes ~~previous,~~ existing ~~or future~~ requirements to implement mitigation measures contained in the 2013 Environmental Impact Report pertaining to replacement water for private supply wells affected due to remedial activities; for example, those requirements specified in Board Order No. R6V-2014-0023. All prior replacement water orders are hereby superseded to eliminate any requirements to provide replacement water when constituent concentrations are below state and federal drinking water standards."

22. Finding 43, Page 12. As discussed above in Comment 20 and in Attachment D, the Water Code section 13304 focuses on affected wells and does not contain language regarding an "affected area." PG&E suggests deleting Finding 43 defining the affected area:

"~~43. The affected area is defined as all domestic or community wells located laterally within one mile downgradient or cross-gradient from the 3.1 ppb Cr(VI) or 3.2 ppb Cr(T) plume boundaries (whether contiguous or non-contiguous) based upon monitoring data drawn in the most current quarterly site-wide groundwater monitoring report submitted by PG&E. The affected area may change based on new data collected and evaluated each quarter.~~"

23. Finding 44, Page 13. As discussed above and in Attachment D, PG&E recommends changes to the proposed CAO to remove the affected area definition, link the chromium triggers in domestic wells to

PG&E's historical releases, and apply the requirements to active domestic wells. PG&E suggests the following edits to finding 44 to implement these changes:

"Affected wells are defined as active domestic or community wells ~~in the affected area~~ containing chromium linked to PG&E's historical releases in concentrations (measured at any time by PG&E or by local, state or federal agencies) that are above the primary drinking water standards of 10 ppb Cr(VI) or 50 ppb Cr(T). A well is no longer an Affected Well if it tests below the primary drinking water standards of 10 ppb Cr(VI) and 50 ppb Cr(T) for four consecutive quarters of sampling."

24. Finding 51, Page 15. This finding refers to "interim remediation targets" for the first and only time. PG&E suggests deleting this finding or defining the 10 ppb and 50 ppb as interim remediation targets for the southern plume earlier in the findings. The requirement to clean up to background conditions should be removed, as detailed in Comment 10.

25. Ordering Requirement I., Page 15. To clarify which existing workplans apply to this order, PG&E recommends specifying the applicable workplans that corrective actions under this order will be operated under, with the following suggested edits for clarity:

"Corrective actions shall be conducted in accordance with approved current[x] and future workplans, WDRs, Notices of Applicability, monitoring programs, or as modified with the Executive Officer's approval.

[x]Current workplans:

ARCADIS. 2014d. Revised Report of Waste Discharge for Proposed Agricultural Treatment Units. Hinkley Compressor Station. Hinkley, California. May 28.

ARCADIS. 2014e. In-Situ Reactive Zone Design and Construction Status Report. Pacific Gas and Electric Company, Hinkley Compressor Station, Hinkley, California. November 25.

ARCADIS 2012. Lower Aquifer Remedial Action Status Report. PG&E Hinkley Compressor Station. Hinkley, California. February 15.

CH2M HILL and ARCADIS. 2014. Plan for Enhancement of Lower Aquifer Remedy (Installation of EX-37). PG&E Hinkley Compressor Station, Hinkley, California. November 7.

CH2M HILL and ARCADIS. 2015. Fourth Quarter 2014 Monitoring Report for the In Situ Reactive Zone and Northwest Freshwater Injection Projects. Pacific Gas and Electric Company. Hinkley Compressor Station, Hinkley, California. January 15."

Stantec. 2011a. Technical Report – Response to Investigation Order R6V-2011-0043-Delineation of Chromium in the Lower Aquifer. Pacific Gas and Electric Company. Hinkley, California. August 1."

26. Ordering Requirement IV A - D, pages 15 and 16. These requirements should be deleted from the proposed CAO. It is technically infeasible to comply with a "plume definition requirement" using the existing inaccurate background values, particularly in the North Hinkley Valley and Water Valley. Once

the USGS studies are complete, the need for additional investigations can be revisited and any subsequent order will be scientifically supported.

27. Ordering Requirement V.B, Page 17. PG&E recommends deleting the word "continuously" from the requirement to implement groundwater extraction to contain the southern chromium plume. Containment should be required continuously, rather than operations, because continuous operation of the extraction system is not necessary to maintain continuous hydraulic containment. Removal of the requirement to continuously operate will allow for anticipated system downtime for maintenance (e.g., pump changes, well maintenance), downtime for potential construction for system optimization, power outages, harvests, etc. California law does not authorize the Water Board to specify the means of compliance with CAO provisions (see Point 2 in Attachment C). The requirement to operate continuously is equivalent to the Water Board specifying the means of compliance.

PG&E also recommends deleting the statement, "Currently, groundwater extraction between Santa Fe Avenue and Thompson Road is at an annual average pumping rate of 1,111 gallons per minute and discharged to agricultural treatment units." The placement of this fact in the ordering requirement implies an expectation of similar operations in the future. However, this pumping rate may not apply to reconfigurations of the pumping system over time as the remedy is optimized and remediation progresses. These recommendations can be implemented through the following edits to the language in this requirement:

"*As of the date this Order is issued, PG&E shall ~~continuously implement~~ maintain and operate previously approved, or as subsequently approved by the Executive Officer, groundwater extraction to contain the southern chromium plume. ~~Currently, groundwater extraction between Santa Fe Avenue and Thompson Road is at an annual average pumping rate of 1,111 gallons per minute and discharged to agricultural treatment units.~~"*

28. Ordering Requirement V.D., Page 17. Consistent with CAO No. R6V-2008-0002A3, PG&E recommends that alternative methods for demonstrating hydraulic containment be allowed in cases where hydraulic containment metric data do not reflect the actual hydraulic containment status. For example, from February to August 2013, several hydraulic capture metrics indicated an outward groundwater flow across the capture metric boundary due to an area of localized groundwater mounding with elevated groundwater elevations within the hydraulic containment area. Multiple lines of evidence were evaluated and demonstrated that hydraulic containment was maintained during this time, and the Water Board concurred with these conclusions in letters dated June 24, 2013 (Water Board 2013a) and October 22, 2013 (Water Board 2013b), attached electronically to these comments. Provisions for similar circumstances should be preserved in this order through the following addition to V.D.:

"With Water Board staff's written approval, the Discharger may demonstrate plume capture using alternative metrics (i.e., well pairs or triplets, or water level maps) to verify inward plume capture."

29. Ordering Requirement V.D., Page 17. PG&E acknowledges the importance of timely identification of lapses in hydraulic containment and requirements to quickly submit and implement contingency plans

for correction in Ordering Requirements V.D, V.E, and V.F. The timeline for submittal of a contingency plan in V.E. and the requirement to re-establish capture as soon as possible will ensure PG&E is taking all possible measures to regain capture. PG&E requests a clarification that compliance with the CAO is ensured if PG&E complies with the requirements to: operate, monitor, identify when capture is not achieved, submit contingency plans with schedules by the required deadlines, and implement the contingency plan on schedule. This will allow for the time that may be required to regain capture as corrective actions are implemented. For example, in the case where specific hydraulic metrics indicated outward gradients from February to August 2013, corrective actions were implemented and resulted in immediate improvements in metric measurements; however, it took several months for the metrics to return to inward gradients. This example can be used to define the time that may be needed to implement corrective actions, during which PG&E should not be exposed to possible violation of the CAO requirements as onsite experience has demonstrated no threat to water quality during the time period required for the metrics to show inward gradients. To implement this change to the proposed CAO, the following edits to language are suggested in requirement V.D, consistent with the current requirements in CAO No. R6V-2008-0002A3:

"~~PG&E is in violation of~~ The Water Board may find PG&E out of compliance with this Requirement if at any time any of the following conditions occurs:"

30. Ordering Requirement V.D.3, Page 17. This draft requirement would not allow the 50 ppb or 10 ppb Cr(VI)/Cr(T) boundaries to migrate or expand by 1,000 feet or more from current boundaries. This requirement is not necessary to protect domestic wells and may actually inhibit the efficiency of remediation as it does not recognize the dynamic nature of the hydraulics within the area of hydraulic containment during remediation. Domestic wells are protected by the requirements to maintain hydraulic control of the 10 and 50 ppb Cr(VI)/Cr(T) in proposed CAO requirements V.D.1 and V.D.2. In addition, the ATU WDRs contain sampling and modeling requirements to identify and provide replacement water for any domestic wells within a 1-mile downgradient and cross-gradient buffer of the 3.1/3.2 ppb Cr(VI)/Cr(T) plume that are actually or potentially affected by chromium plume movement due to remediation. These measures are very conservative and ample to protect domestic wells with regards to the chromium plume.

Additionally, as remediation progresses, there could be shifts in the geometry of the Cr(VI) plume within the area of hydraulic containment as the pumping regime is optimized or as the hydraulics and operations of the IRZs are varied. Within the area of hydraulic containment, there may also be unknown areas of elevated Cr(VI) concentrations and there may be movement of these as yet unknown concentrations prior to treatment. These variations in plume geometry should be allowed within overall progress toward the remedial goals as long as hydraulic capture is maintained and documented through the hydraulic capture metrics.

As such, PG&E recommends deleting Ordering Requirement V.D.3 from the proposed CAO.

31. Ordering Requirements V.G and V.H, Pages 18-19. PG&E supports the provisions for proposals and approval of the alternate hydraulic capture metrics as the remedy proceeds. Such flexibility will promote efficient and effective Cr(VI) remediation.

32. Ordering Requirements VI.B.1.a/b, VI.B.2, Pages 19-21. In the proposed CAO, cleanup to concentrations less than 10 ppb are required within specified timeframes for several areas of the site: the western area (VI.B.1.a), the Lower Aquifer (VI.B.1.b), and the Northern Plumes (VI.B.2). In the western area and northern plumes area, cleanup to the CAO No. R6V-2008-0002A1 background levels are required; and in the lower aquifer, cleanup to non-detect concentrations are required. These requirements are premature because the source of the chromium in the western area and northern areas have not been determined (as detailed in above comments and Attachment B) and the Water Board can legally require cleanup only in areas affected by PG&E's discharge or threatened discharge (see Point 3 of Attachment C). Actual background concentrations have not been determined and actual background concentrations may be higher than the CAO No. R6V-2008-0002A1 background levels. The Water Board cannot require cleanup to below background concentrations (see Point 4 in Attachment C).

Feasibility study analyses to evaluate remedial alternatives and provide a technical basis for timeframes in these requirements have not been conducted. The feasibility study and addenda submitted in 2010-2011 evaluated various approaches to remediating the southern plume core to 3.1/3.2 ppb Cr(VI)/Cr(T) and 1.2/1.5 ppb Cr(VI)/Cr(T). Subsequently, the Water Board requested an analysis of remedial timeframes in a letter dated February 19, 2014, which stated, "model results shall provide an updated estimate for site-wide chromium cleanup time to achieve less than 50 ppb and the time to achieve less than 10 ppb based upon the chromium cleanup projects permitted to date and including those anticipated to be permitted over the next 18 months. Water Board staff will evaluate this information when developing interim cleanup requirements to be proposed." Therefore, PG&E evaluated cleanup times to treat to 10 and 50 ppb in the southern plume core, the area where chromium is known to be sourced from the PG&E compressor station release and where cleanup activities are permitted and anticipated in the next 18 months while the USGS background study proceeds. PG&E discussed this approach with the Water Board at meetings on May 8 and June 6, 2014. Analyses have not been conducted for cleanup times to concentrations less than 10 ppb in the North Hinkley Valley, Harper Dry Lake Valley, the western area, or the lower aquifer, and there is no technical basis for the timeframes listed in the proposed CAO for these areas. Ordering provisions required by the Water Board must be supported by factual findings (see Point 1 in Attachment C). In this case, there are no factual or technical findings to support the remedial timeframes in these requirements.

In addition, if the background concentrations are ultimately found to be higher than the 3.1/3.2 ppb Cr(VI)/Cr(T) as a result of the USGS study and there are non-detect remedial goals listed for these areas in the proposed CAO, it would not be possible to achieve and sustain values less than background values.

PG&E recommends deleting these requirements from the proposed CAO to allow the process of determining background values, completing delineation, and conducting feasibility studies for these areas. In overseeing investigations to determine the nature and extent of discharge and appropriate

cleanup and abatement measures, the Water Board must require a discharger to conduct investigation and cleanup in a progressive sequence, provided that the sequence may be adjusted to accommodate site-specific circumstances, beginning with a preliminary site investigation to confirm, among other things, the vertical and horizontal extent of the discharge. (State Board Resolution No. 92-49, Section II.A.1.a.) Then soil and water investigations will be conducted to determine the nature and extent of the discharge with "**sufficient detail to provide the basis for decisions regarding subsequent cleanup and abatement actions."** (Resolution No. 92-49, Section II.A.1.b.) (Emphasis added) Next is the proposal and selection of feasible and effective cleanup and abatement actions, implementation of cleanup action, and monitoring of effectiveness of cleanup. (Resolution No. 92-49, Section II.A.1.c-e.)

33. Ordering Requirement VI.A, Page 19. The proposed CAO states, "Changes or reduction in corrective actions (the latter defined by more than 10 percent on a monthly basis) shall require Water Board concurrence prior to implementation." It is unclear what needs to be maintained within 10 percent, but this statement presumably refers to operational flowrates or the number of injection/extraction locations. The proposed CAO sets performance criteria for the remedy and requires PG&E to contain and clean up the plume. Further, precise specification of the operational requirements for remedy implementation limits the ability of PG&E to efficiently implement the remedy and could have unintended consequences. Water Board staff and PG&E communicate regularly, and the Water Board staff is very responsive to PG&E requests to make changes to improve remediation. However, it typically takes several months to submit requests and receive approval for changes to the remediation system operation. Greater flexibility is needed to make operational adjustments within the containment and cleanup requirements to optimize treatment without delays. In addition, flexibility is needed to minimize byproduct generation. For example, as data are collected and it is determined that treatment objectives can be achieved with reduced operations (for instance by turning down an ATU extraction rate or turning off an area of IRZ injection), the changes should be made immediately to avoid unnecessary generation of byproducts. PG&E is ultimately responsible for treating the plume and restoring any byproducts that are generated in the remedial process and it is appropriate that PG&E should retain the ability to determine the best method of implementing remediation and minimizing byproduct generation in real time.

Further, the 10 percent requirement does not take into consideration everyday operations and maintenance occurrences, such as equipment breakdowns and repair, that could cause such a requirement to be violated but which would not impact overall remedy performance. It also does not account for changes that are beyond PG&E's control that could cause decreases in operations that are not previously approved, such as aquifer dewatering due to drought.

Finally, the Water Code does not permit the Water Board to specify the means of compliance with CAO provisions (see Point 2 in Attachment C). The requirement to obtain permission to make operational changes greater than 10 percent is equivalent to the Water Board specifying the means of compliance.

Rather than requiring Water Board approval for operational changes greater than 10 percent, PG&E recommends that operational flexibility be allowed within the following general operational plan:

- For hydraulic containment, the ATU extraction systems and NWFI will be operated to maintain hydraulic capture metrics, per Ordering Requirement V.D and to promote inward gradients south of Highway 58 per the design presented in the 2014 Report of Waste Discharge for the Agricultural Treatment Units (ARCADIS 2014d). The extraction rates are anticipated to vary seasonally, while inward gradients will be maintained continuously per Ordering Requirement V.D. Extraction rates and locations may be adjusted to optimize maintenance of inward gradients, mass removal, and minimization of ATU byproduct generation. Similarly, NWFI rates will be operated as needed to maintain inward gradients.
- Components of the lower aquifer remedy detailed in reports and workplans for the lower aquifer (Stantec 2011b, ARCADIS 2012, CH2M HILL and ARCADIS 2014) will be operated to optimize remediation of the lower aquifer. Improvements to the lower aquifer remedy will be identified and implemented, if necessary, as required by the Water Board letter dated December 22, 2014.
- IRZ operations will consist of operating currently installed recirculation systems, as described in the fourth quarter report for the IRZ (CH2M HILL and ARCADIS 2015); newly installed systems, as described in the most recent IRZ design report (ARCADIS 2014e); and future IRZ systems, which were presented in concept in the Remedial Timeframe Assessment (Finding 20). For the future IRZ expansions presented in concept in the Remedial Timeframe Assessment, more detailed designs will be submitted prior to installation. In general, IRZs recirculation and ethanol amendment systems are operated by optimizing flow from available extraction wells and rotating injections of the extracted water into a subset of injection wells to establish treatment across the system and store reducing capacity. After the initial treatment and reducing capacity is established in a given area, injections are shut down and monitoring is conducted to confirm that residual reducing capacity continues to treat Cr(VI). Ongoing operations will rotate injections to locations where reducing capacity needs to be replenished to maintain treatment. Overall, recirculation rates may decline when injections are not needed to maintain treatment around existing wells and in advance of construction of future wells.

As such, PG&E recommends the following edits to the requirement:

"PG&E shall implement previously approved on-going corrective actions, including but not limited to, agricultural treatment units (ATUs), in-situ remediation, and freshwater injections (see Finding Nos. 22 and 23). Corrective actions shall be conducted in accordance with approved current[x] and future workplans, WDRs, Notices of Applicability, monitoring programs, or these listed documents as modified with the Executive Officer's approval. ~~Changes or reduction in corrective actions (the latter is defined by more than 10 percent reduced operation on a monthly basis) shall require Water Board concurrence prior to implementation.~~ Extraction systems for ATUs and the freshwater injection systems will be operated to maintain hydraulic capture metrics, per requirement V.D. of this CAO. IRZ systems, including current systems described in the fourth quarter IRZ monitoring report (CH2M HILL and ARCADIS 2015) and new systems for 2015 described in the most recent design report (ARCADIS 2014e), will be operated to optimize the establishment and maintenance of treatment through ongoing modifications of injection locations and flowrates. Flowrates and number of injection and extraction locations may be reduced if they are not needed to maintain treatment capacity. Designs and implementation schedules will be

submitted to the Water Board and executed for the IRZ expansions presented in concept in the Remedial Timeframe Assessment (Finding 20) and for optimizations of the IRZs and hydraulic containment systems identified in future 4-year review cycles.

"PG&E shall notify the Water Board of significant changes in operations within 14 days of occurrence:

- *For ATUs and associated extraction systems and the NWFI, significant change is defined as when more than 50 percent of the extraction, injection, or discharge locations are shut down or when the total system flowrate is decreased by greater than 50 percent, or when data show that an ATU is not being maintained by at least 50 percent in area. Normal remedial operations include variations expected with the seasons such as maximum pumping during summer and minimum pumping during winter.*
- *For IRZs, significant change is interpreted to mean when more than 50 percent of the extraction and injection locations are shut down or when the total system flowrate is decreased by greater than 50 percent, or when data show that an IRZ is not being maintained by at least 50 percent in area."*

"[x]Current workplans:

"ARCADIS. 2014d. Revised Report of Waste Discharge for Proposed Agricultural Treatment Units. Hinkley Compressor Station. Hinkley, California. May 28.

"ARCADIS. 2014e. In-Situ Reactive Zone Design and Construction Status Report. Pacific Gas and Electric Company, Hinkley Compressor Station, Hinkley, California. November 25.

"ARCADIS 2012. Lower Aquifer Remedial Action Status Report. PG&E Hinkley Compressor Station. Hinkley, California. February 15.

"CH2M HILL and ARCADIS. 2014. Plan for Enhancement of Lower Aquifer Remedy (Installation of EX-37). PG&E Hinkley Compressor Station, Hinkley, California. November 7.

"CH2M HILL and ARCADIS. 2015. Fourth Quarter 2014 Monitoring Report for the In Situ Reactive Zone and Northwest Freshwater Injection Projects. Pacific Gas and Electric Company. Hinkley Compressor Station, Hinkley, California. January 15.

"Stantec. 2011a. Technical Report – Response to Investigation Order R6V-2011-0043-Delineation of Chromium in the Lower Aquifer. Pacific Gas and Electric Company. Hinkley, California. August 1."

34. Ordering Requirement VI.B.1.a/b, Pages 19-20. In consideration of establishing cleanup goals for the lower aquifer, it should be acknowledged that, near the margins of the sediment interval that acts as an aquitard that separates the upper aquifer from the lower aquifer, there is significant hydraulic communication between the two aquifers. This is particularly evident in the area of monitoring wells MW-28C, MW-92C, and MW-100C. This hydraulic communication dictates that cleanup of both the upper and lower aquifers in these areas must proceed in concert and on the same timeline. As a result, PG&E suggests deleting the list of monitoring wells from this requirement. Successful remediation of this transitional area at the western limits of the lower aquifer will likely require that the upper aquifer and

lower aquifer chromium levels be reduced concurrently because the upper and lower aquifers are in hydraulic communication. Setting a cleanup goal for the lower aquifer that is lower and/or sooner than the upper aquifer in this area is technically infeasible and PG&E suggests deleting these specifications. If such a requirement is retained, it needs to acknowledge that a revision to the conceptual site model for the western limits of the lower aquifer where the Blue Clay aquitard transitions from being a confining layer to a thin, sandy and intermittently present clay layer needs to be developed by PG&E to establish which monitoring wells will be used to assess performance of the lower aquifer remedy.

35. Ordering Requirement VI.B.1.c, Pages 20-21. The draft requirements set cleanup goals for treatment of 90 percent of the 50 ppb Cr(VI) and Cr(T) plume by 2021 and 80 percent of the 10 ppb Cr(VI) and Cr(T) plumes by 2026. Finding 20 states that the Remedial Timeframe Estimates inform the basis for the cleanup requirements in the proposed CAO. The 90 percent listed for the 50 ppb treatment by 2021 does not reflect the range of outcomes estimated by the modeling, which predicts that it could take up to 12 years to reach 90 percent treatment across all model layers (ARCADIS 2014c). The 80 percent listed for the 10 ppb treatment by 2026 does not reflect the range of outcomes estimated by the modeling, which predicts that it could take up to 20 years to reach 80 percent treatment across all model layers (ARCADIS 2014c). For the remedial design and implementation plan that was considered in the Remedial Timeframe Assessment, the range of cleanup time estimates reflects factors such as uncertainty in modeling estimates and inherent lithologic variability at the site, which PG&E cannot control or accelerate in implementation of the design analyzed in the Remedial Timeframe Assessment. The use of only the most optimistic timeframe in this ordering requirement is not supported by Finding 20 of the Remedial Timeframe Assessment, and requirements must be supported the factual findings (see Point 1 of Attachment C). Therefore, PG&E recommends revising the requirement to reflect the maximum predictions of the range. PG&E intends to clean up the plume faster than the maximum predicted times through the adaptive management approach that has been laid out in the 4-year review cycle in the proposed CAO MRP.

This requirement also states the remedial goals for the project. The adaptive management process for complying with these goals is provided in the proposed CAO MRP in Section II.C. MRP Section II.C specifies that evaluations will be conducted every 4 years to evaluate chromium cleanup actions to reach target concentrations listed in CAO Requirement VI. If actual performance is not meeting expectations, workplans including recommendations to increase effectiveness and implementation schedules are required on a specified timeline. In addition to the uncertainty in modeling predictions due to aquifer heterogeneity and the assumptions necessary to conduct the modeling, there are also uncertainties with implementing construction and operation activities. For instance, timing of construction and implementation as new data become available or to collect data that are important for design and construction can alter modeled schedules. Given the uncertainty in the remedial timeframe assessment estimates (Finding 20, as described in Comment 14), the results provide the scientific basis for remedial goals, but not for enforceable deadlines. The Water Board must have a scientific basis for ordering provisions (see Point 1 of Attachment C). PG&E recommends clarifying that the timeframe requirements Ordering Requirement VI are goals or milestones, rather than enforceable deadlines.

To implement these recommendations, PG&E suggests the following edits:

"*c. For all remaining areas of the southern plume, ~~reach~~ the following cleanup goals in the upper aquifer ~~by the listed timeframes~~ are set forth:*

"i.~~,~~ ~~R~~reach and maintain 50 ppb Cr(VI) and Cr(T) ~~in~~ across 90% of ~~all monitoring wells having chromium detection above~~ the 50 ppb Cr(VI) and Cr(T) plume as of the date this Order is issued, by December 31, ~~2021~~ 2027. The 90th percentile shall be based on the number of well locations where chromium concentrations exceed 50 ppb Cr(VI) and Cr(T) as of the date this Order is issued, as shown in Table 8.1 of Attachment 8.

"ii. ~~R~~each and maintain 10 ppb Cr(VI) and Cr(T) ~~in~~ across 80%of ~~all monitoring wells having chromium detection between~~ the 10 ppb Cr(VI) and Cr(T) and 50 ppb Cr(VI) and Cr(T) plumes as defined on the date this Order is issued, by December 31, ~~2026~~ 2035. The ~~80th~~ percentile shall be based on the number of well locations where chromium concentrations exceed 10 ppb Cr(VI) and Cr(T) as of the date this Order is issued, as shown in Table 8.1 of Attachment 8.

"Every four years, the Discharger will evaluate chromium cleanup actions to reach the cleanup goals and submit a four-year comprehensive cleanup status and effectiveness report, per the requirements of Attachment 8, the MRP. If actions are not achieving expected reductions in chromium concentrations, a workplan proposing recommendations and an implementation schedule to increase effectiveness will be submitted by the deadlines listed in Attachment 8, the MRP. Compliance with cleanup requirements will be determined by timely submittal of the four-year comprehensive cleanup status and effectiveness report and timely submittal and implementation of workplans for improvements if cleanup expectations are not being met."

36. Ordering Requirement VII, Pages 22-24. As discussed above in comments on the findings and in detail in Attachment D, PG&E recommends changes to the replacement water provisions to:

- Require a causal link to PG&E's historical releases
- Apply only to active wells after the approval of the owner
- Provide sufficient time to provide replacement water
- Revise the work plan requirements, including:
  - A revision of replacement water workplan triggers based on the Olin precedent
  - A revision of the quarterly workplan requirement that is unnecessarily burdensome and the timelines that are likely impossible to meet
  - A revision to remove the unsupported provision to replace water for all indoor uses and allow for the use of reverse osmosis
- Remove the definition of affected area

Based on these recommendations, PG&E suggests the following edits to Ordering Requirement VII,

"A. Beginning with the ~~second~~ quarter after this Order is issued~~2015~~, within each ~~quarterly~~ groundwater monitoring report required in section VIII below, provide an analysis whether any active domestic well within PG&E's domestic well monitoring and reporting program ~~a revised affected area~~ contains hexavalent chromium concentrations linked to PG&E's historical releases and exhibiting an increasing

trend indicating likely future exceedances of the hexavalent chromium MCL within one year~~, or any private supply well with hexavalent chromium concentrations within 20 percent of the hexavalent chromium MCL (i.e., 8 ppb Cr(VI))~~.

"1. Interim Replacement Water Supply

"i. Within 2 business days of identifying an Affected Well, as defined by Finding 44 (i.e., an active domestic or community well containing chromium linked to PG&E's historical releases in concentrations that are above the primary drinking water standards of 10 ppb Cr(VI) or 50 ppb Cr(T))~~the submittal of each quarterly report delineating a revised affected area~~, supply or offer to supply to active well users interim uninterrupted replacement water (i.e., bottled water or equivalent)~~, to all those served by domestic and community wells in the affected area (Finding 43) where those wells are determined to be affected as defined in Finding 44 of this Order~~.

"ii. Within each groundwater monitoring report required as part of PG&E's domestic well monitoring and reporting program, PG&E shall ~~delineating a revised affected area~~, provide a report to the Water Board listing all properties that have been provided interim uninterrupted drinking water service. The report shall include the well number and describe the general area in Hinkley or the Harper Dry Lake Valley the well is located, such as the southern plume, the Hinkley Valley northern plume, or Harper Dry Lake Valley northern plume. If bottled water is provided, PG&E shall also list the bottled water service being used and the water volume being delivered. Furthermore, if other than commercially available bottled water is being provided, the report shall include documentation to show that interim water supply meets state primary and secondary drinking water standards.

"2. ~~Permanent~~ Long Term Replacement Water Supply

"i. Within 45 days of the date this Order is issued, PG&E shall ~~days of a private supply well identified in VII.A., above, in quarterly groundwater monitoring reports,~~ submit a workplan outlining~~proposing permanent~~ long-term ~~whole house~~ replacement drinking water supply options to supply ~~for all indoor~~ drinking water uses for Affected Wells, as defined by Finding 44. ~~The workplan shall include the well number(s) and describe the general area in Hinkley Valley or the Harper Dry Lake Valley the well is located.~~ Pursuant to California Water Code section 13304, subdivision (f), replacement water 'shall meet all applicable federal, state, and local drinking water standards, and shall have comparable quality to that pumped by the public water system or private well owner before the discharge of waste.' The workplan shall include a plan for providing replacement water for any active private supply well identified pursuant to VII.A., above, should any such well later exceed the drinking water standard and become an Affected Well, as defined by Finding 44. ~~Proposed permanent replacement water shall meet all California primary and secondary drinking water standards, and shall have comparable quality for chromium concentrations to that historically pumped by the private well owner in the past prior to waste chromium exceeding the MCL within the well, or within 80 percent of the MCL. The workplan shall include the following:~~

~~"a. An evaluation of at least three different methods to provide permanent replacement water supply.~~

~~*"b. A discussion on the feasibility and timing to implement each method including the needs for permits, approvals, and environmental analysis.*~~

~~*"c. An evaluation of the quantity of water (gallons per minute) that can be provided by each method compared with typical individual household supply needs.*~~

~~*"d. An evaluation of the quality of water that can be provided by each method in comparison to California primary and secondary drinking water standards.*~~

~~*"e. An analysis of wastes that may be generated by each method, disposal options, costs, and an analysis of potential byproducts in groundwater created by each method. For example, reverse osmosis generates salts and potentially others compounds that are typically sent to septic systems.*~~

~~*"f. An operation, maintenance, and, replacement plan, such as for filters, equipment, etc., of each evaluated method.*~~

~~*"g. A water quality monitoring and reporting plan to verify quality and performance of each evaluated method.*~~

~~*"h. A complete cost analysis including construction, operations, maintenance, and replacement plan of each evaluated method.*~~

~~*"i. A contingency plan to ensure uninterrupted replacement water supply.*~~

~~*"j. State how the workplan and recommended method will be presented to the owner(s) and users of the affected well(s).*~~

"i. Following ~~Within 45 days of~~ approval by the Executive Officer of PG&E's~~a~~ workplan for providing long-term~~permanent~~ alternate drinking water supply and written authorization from the well owner for the installation of a long-term replacement drinking water supply, PG&E shall implement the workplan to provide a long-term~~permanent~~ replacement drinking water supply for all indoor drinking water uses for active private supply wells that are determined to be affected, as defined in Finding 44 of this Order, and where the chromium detections are linked to PG&E's historical releases.~~all affected wells identified in section 1 above. Implementation shall be conducted with the well owner's permission."~~

~~*ii.*~~ *iii. ~~Within 150 days of identification of affected wells identified in section 1 above,~~ Within each groundwater monitoring report required as part of PG&E's domestic well monitoring and reporting program and during which long term replacement water is supplied, PG&E shall provide a report to the Water Board listing all properties that have been provided long term ~~permanent~~ uninterrupted replacement water supply. The report shall include: the affected well number and general area location, the method used to provide replacement water supply, and evidence provided water supply meets state primary and secondary drinking water standards. Describe all actions completed during the reporting period, such as operation and maintenance. Describe any problems that may have occurred and how and when they were corrected or remedied. For instance, if sampling indicates that alternate water supply does not meet federal and state MCLs, describe what corrective actions were implemented to fix the*

problem. If the well owner did not respond or provide permission to access and install ~~permanent~~ long term water supply, provide evidence of such, including actual date and time and manner of communication. Provide proof that monitoring data has been sent to the owner of the affected well(s). Long term replacement reporting will be included in groundwater monitoring reports during which long term replacement water is supplied."

~~"iii. Within 45 days of the end of the each quarter during which long term replacement water is supplied, submit quarterly replacement whole house water (WHW) monitoring reports containing monitoring information on the quality of long term replacement water supply consistent with the alternate water supply monitoring plan, as approved by the Executive Officer. Describe all actions completed during the quarter, such as operation and maintenance. Describe any problems that may have occurred and how and when they were corrected or remedied. Provide proof that monitoring data has been sent to the owner of the affected well(s). Quarterly replacement water WHW reports will be due February 15, May 15, August 15, and November 15 of each year during which long term replacement water is supplied."~~

37. Ordering Requirement VII.2.i, Page 23. The section number "i" for the requirement to provide permanent alternate water supply should be number "ii" because number "i" was already used.

38. Ordering Requirement VI, Page 24. PG&E is committed to informing and educating the community about our programs and will continue to support the Independent Review Panel Manager. PG&E agrees with the requirement to continue this support in the proposed CAO.

39. Ordering Requirement VI and on, Pages 24-28. The ordering requirements are misnumbered starting with the Independent Consultant requirement on Page 24 (numbered VI, which was previously used).

40. Ordering Requirement IX, Page 25. See Comment 51 on Attachment 8 Section III.B.3.d.i, Page 8 regarding required reporting limits.

41. Ordering Requirement XVI, Page 27. The following orders and letters should be included in the list that is replaced by the proposed CAO:

"3/7/06 Water Board letter that set forth requirements for Groundwater Monitoring Program (GMP) reporting

"2/25/11 Water Board letter that set forth sampling and reporting requirements for domestic wells

"8/2/13 Water Board letter requesting western action plan and setting forth semi-annual reporting requirements (included in Attachment 1 of proposed CAO but not listed here in text)

"R6V-2013-0087-required expedited plan, which was previously submitted and added reporting requirements for well rehabilitation (included in Attachment 1 of proposed CAO but not listed here in text)

"11/7/13 Water Board letter requiring plans and information previously submitted and adding a reporting requirement to semi-annual reports revised by the proposed CAO

"2/25/14 Water Board western action plan approval; added monitoring and reporting requirements"

42. Attachment 1. The following orders and letters should be included in the list that is replaced by the proposed CAO in Attachment 1:

"3/7/06 Water Board letter that set forth requirements for GMP reporting

"2/25/11 Water Board letter that set forth sampling and reporting requirements for domestic wells

"11/7/13 Water Board letter requiring plans and information previously submitted and adding a reporting requirement to semi-annual reports revised by the proposed CAO

"2/25/14 Water Board western action plan approval; added monitoring and reporting requirements"

43. Attachment 8, General MRP Comment 1. PG&E supports the Water Board's consolidation of groundwater monitoring requirements from the numerous orders into one MRP in this proposed CAO. However, PG&E recently provided a draft MRP prepared by CH2M HILL (December 2014 Draft MRP, provided electronically in Attachment G to these comments) that was developed with substantial communication with Water Board staff and the community. The draft was dismissed in Finding 36 of this order with very little technical rationale provided for the dismissal, and much of the December 2014 Draft MRP was replaced in the proposed CAO. Through much of 2014, PG&E's hydrogeological consulting team developed concepts for a unified MRP to accompany the forthcoming CAO. In consultation with Water Board staff, the December 2014 Draft MRP focused on clearly defined monitoring objectives in different areas of the site and complementing existing requirements such as previous orders and plans to monitor the ATUs and IRZs, while also recognizing the role and scope of the USGS background study. Water Board staff requested that PG&E submit the draft MRP in advance of the issuance of the proposed CAO, and PG&E posted the December 2014 Draft MRP on Geotracker. Water Board staff also requested that PG&E present the concepts of the draft MRP to the Water Board members and the public during a public meeting and to the Independent Review Panel (IRP) manager, Community Advisory Committee (CAC) members and the USGS at a CAC and TWG meetings. PG&E received comments at all of these meetings and revisions were accordingly reflected in the December 2014 Draft MRP. Despite the efforts to develop an MRP with input from multiple parties, the Water Board staff did not appear to consider the work product in developing the proposed CAO MRP. The Water Board dismissed the December 2014 Draft MRP in Finding 36 of this order with very little technical rationale and no comment on the objectives or on the technical basis for sampling locations and frequencies to meet those objectives. The December 2014 Draft MRP submitted by PG&E is a technically sound approach prepared by a team of hydrogeologists that considered input received by the public and the Water Board (CH2M HILL 2014).

The proposed CAO MRP contains requirements that are redundant with the ongoing USGS background study and redundant with Water Board orders that prescribe monitoring of the ATU and IRZ. The

proposed CAO MRP creates two new numerical thresholds for Cr(VI) compliance that trigger actions lacking a technical basis and/or regulatory authority, contains many other provisions that are difficult to understand that have a tenuous technical and/or regulatory basis, and would create numerous implementation issues, all of which will unnecessarily increase costs and actually weaken the effectiveness of the program.

In light of the significant work completed on the MRP concept thus far, PG&E suggests two alternative paths forward with respect to the proposed CAO MRP.

- Replace Attachment 8 with the December 2014 Draft MRP submitted by PG&E, which already was discussed with Water Board staff, the Water Board Members, the IRP, and the community in numerous venues, and posted on Geotracker since December 2014 (CH2M HILL 2014).
- Revise the proposed CAO MRP in Attachment 8 in response to PG&E's comments below.

44. Attachment 8, General MRP Comment 2. Monitoring Network Design Basis is Flawed and Incomplete. PG&E completely supports the proposed CAO MRP monitoring objectives (page 1):

> "verify the effectiveness of remediation, track progress towards meeting remediation targets, and evaluate threats to and monitor water quality in private supply wells."

However, the design basis in the proposed CAO MRP for monitoring well selection and sampling frequency in order to meet these objectives is flawed and incomplete, creating a network that collects redundant and unnecessary information in many areas and eliminating wells that PG&E would monitor in other areas. The monitoring network in the proposed CAO MRP is designed solely by comparing past Cr(VI) concentrations in each well to numeric thresholds. Also problematic is that the proposed CAO MRP uses different numeric thresholds for Cr(VI) concentrations in different parts of the project area, creating a patchwork of different concentration thresholds of significance in different areas. The design basis does not consider site-specific hydrogeologic features in the selection of monitoring locations such as the groundwater flow direction, limits of saturation, or the presence of the brown clay and weathered bedrock units. The design basis does not consider the proximity of other wells providing equivalent information and their concentration histories and trends. As discussed below in Comment 45, the design basis does not consider the purpose and scope of the USGS background study nor the purpose and scope of existing MRPs for the ATU and IRZs.

The December 2014 Draft MRP submitted to the Water Board was designed utilizing all of these considerations to meet the monitoring objectives stated above (CH2M HILL 2014). PG&E and its consultants designed a monitoring network after extensive trend analysis, hydrogeologic analysis, a holistic review of site chromium concentrations over time, and in light of the ongoing and future remediation activities. PG&E requests that the December 2014 Draft MRP be the reference point for the monitoring network. Specific comments are made below in the individual sections with edits to the existing proposed CAO MRP to reflect this recommendation.

45. Attachment 8, General MRP Comment 3. Redundancy with Other Requirements and USGS Background Study.

- The monitoring network design approach in the proposed CAO MRP would prescribe redundant requirements to the monitoring programs ordered by the Water Board in 2014 for the ATUs in Board Order No. R6V-2014-0023 and proposed by the Water Board for the IRZ in a Water Board letter dated February 19, 2014 (Water Board 2014). This proposed CAO MRP would add approximately 226 samples per year to the IRZ and ATU programs. It is unreasonably burdensome to add redundant and additional monitoring requirements in these areas.
- The proposed CAO MRP would require routine sampling of over 150 monitoring wells that are below 3.1/3.2 ppb Cr(VI)/Cr(T), not in the vicinity of the southern 3.1/3.2 ppb Cr(VI)/Cr(T) contiguous plume boundary, and in an area the USGS is studying. This monitoring is redundant with the USGS' efforts to evaluate the significance of chromium in this area, and unnecessarily costly and burdensome. This monitoring is not needed to protect water supply wells in the southern area because the water supply wells are already sampled under the ATU WDRs and other monitoring ensures plume capture and verifies plume boundaries. See also Comment 49 regarding additional water supply well sampling.

46. Attachment 8, General MRP Comment 4. New Water Quality Thresholds for Cr(VI) and Cr(T)

The proposed CAO MRP creates new standards for hexavalent chromium, which are not supported by regulatory requirements and authority and are not needed to ensure the site is remediated or to protect domestic wells.

- Section I.C.4.b would require that wells with non-detectable levels of Cr(VI) and Cr(T) in the lower aquifer be sampled semi-annually.
- Section I.D would require that wells in the northern area be sampled semi-annually and annually, without any regard to their concentrations, in wells that have a stable history of being below 3.1/3.2 ppb Cr(VI)/Cr(T) values. Sampling frequency is set in the current draft based on the rank order of concentration in the cluster (e.g., second highest in cluster, third highest), completely independent of sampling history or other available information.
- Section I.E.1 would require that wells with chromium concentrations between 2.5/2.6 ppb Cr(IV)/Cr(T) and 3.1 ppb are sampled quarterly. This frequency elsewhere is reserved for the active plume boundaries. In addition, provision 1.E would require monitoring more than 150 wells with chromium concentrations that are below the current background level, and in an area subject to the USGS background study.

PG&E requests that the Water Board remove these new thresholds because they are unnecessary to protect water quality and create an unreasonable compliance burden. The 3.1/3.2 ppb Cr(VI)/Cr(T) values and MCLs are appropriate for the current monitoring objectives.

47. Attachment 8, General MRP Comment 5. Trend Analysis and Review of Monitoring Network Sampling. The proposed CAO MRP introduces into several different parts of the program a new and problematic method of evaluating concentration trends that would be used to modify sampling

frequencies, apparently on a quarterly basis. (see Sections 1.C.2.b, 1.C.3.c, 1.D.1, 1.D.4, 1.D.5, 1.E.4, 1.F.4). PG&E appreciates the concept of adapting the monitoring program based on results; however, the proposed approach will not be comparable to past trend analysis techniques or trend analysis methods being used by the USGS. It will result in over-managing the sampling program based on small quarterly variations in data, potentially reflecting lab and field variability. The approach in the proposed CAO MRP would place all of the decision-making regarding sample frequency on each well's individual Cr(VI) results. In re-assessing monitoring frequency, PG&E consultants recommended looking at individual well Cr(VI) results, other chemical results from the well, hydrogeologic factors such as aquifer structure and groundwater flow, and Cr(VI) concentration trends and chemistry in neighboring wells (CH2M HILL 2014). The trend analysis in the proposed CAO MRP of well trends and sampling frequencies is unnecessary on a quarterly basis and is less robust of an assessment than needed.

A different approach using standard statistical methods will be more effective, easier to implement, and provide comparability to other work. PG&E requests that the Mann-Kendall trend analysis be used; this analysis has been used in the past and is the standard method used by the USGS. Since quarterly results may be subject to seasonal fluctuations and/or laboratory variation, PG&E recommends reviewing the MRP annually with regard to sampling frequencies. This basic approach is included in the December 2014 Draft MRP (CH2M HILL 2014).

48. Attachment 8, General MRP Comment 6. Semi-Annual and Annual Sampling Schedule. Section 1.A indicates that the new MRP would take effect beginning the second quarter 2015. Currently, semi-annual well sampling is completed during the first and third calendar quarters of the year, and annual sampling is performed during the third quarter. The proposed CAO MRP would change that to the second and fourth quarters. See Section I.C, I.D, I.E., and I. If the CAO takes effect second quarter of 2015, PG&E would be required to perform three semi-annual events in 2015, which is unnecessarily burdensome and will result in no added benefit to the management of remediation activities. Additionally, for continuity with past monitoring, PG&E requests that the semi-annual sampling continue on the current sampling schedule.

49. Attachment 8, General MRP Comment 7. Water Supply Well Sampling. Section I.B prescribes requirements for active water supply well sampling, and this section has two main issues.

- Active domestic wells are newly defined in Section I.B.2 to include wells that may become active in the next 6 months, a criterion that is difficult to meet. This definition should only include domestic wells that are active during the sampling quarter. Future changes to water supply well usage outside of the sampling quarter cannot reliably be ascertained. Since the residents' future plans are outside of PG&E's control, it is not a feasible or necessary compliance requirement. PG&E is quite willing to continue to use the same reasonable and effective efforts to contact owners and residents each quarter to verify well status.
- In order to fulfil the proposed CAO MRP objective to "monitor water quality in private supply wells," the water supply well sampling requirements should apply to wells that actively supply drinking water to assess water for evaluation of water quality in comparison to the Cr(VI) and Cr(T) MCLs.

The provisions in the Order to sample agricultural wells are unnecessary. PG&E suggests clarifying throughout the order that sampling is required for domestic wells, rather than agricultural wells.

The following changes are requested:

"2. Collect groundwater samples from monitoring wells and active domestic /community~~/agricultural wells~~ required for that quarter. Active domestic and community wells required as of December 2014 are those wells listed in Table C-1 (from the December 2014 Draft MRP). PG&E must make reasonable efforts to identify new active domestic and community water supply wells in the project area and notify the Water Board for staff to determine if they are to be added to this MRP. ~~or planned for use within the next six months~~. Active domestic wells are those used for domestic supply purpose during a given calendar quarter and include those wells on PG&E–owned property ~~and used that quarter for any purpose~~. Inactive wells are defined as any water well not used that quarter ~~or planned for use within the next six months~~."

50. Attachment 8, Section I.B.3, Page 2. The proposed CAO MRP Section I.B.3 would reduce the reporting limit for U.S. Environmental Protection Agency (EPA) Method 218.6 Cr(VI) analysis from the current 0.2 ppb to 0.1 ppb. The existing reporting limit already exceeds, by a factor of five, the State Water Resources Control Board reporting limit of 1.0 ppb for reporting Cr(VI) concentrations in drinking water (http://www.waterboards.ca.gov/drinking_water/certlic/labs/index.shtml), and is more than adequate to evaluate water quality with respect to the 3.1/3.2 ppb Cr(VI)/Cr(T) values and the MCL (10 ppb). The laboratory has indicated that lowering the reporting limit would add significant cost per sample. In addition, lowering the reporting limit would not advance the remedial objectives or provide additional protectiveness.

PG&E requests the following change:

"3. Water samples shall be analyzed for Cr(VI) using EPA Method 218.6 with a detection level of ~~0.1~~ 0.2 parts per billion (ppb) and Cr(T) using EPA Method 6020 with a detection level of 1 ppb."

51. Attachment 8, Section I.C.1, Page 2. As discussed in Comments 43 to 47 above, this section of the proposed CAO MRP utilizes a flawed and incomplete design approach to layer on significant new monitoring requirements that are redundant with existing and proposed requirements for the ATUs and IRZs. The December 2014 Draft MRP proposed a monitoring objective of monitoring the main contiguous plume boundary in the southern area, in addition to the proposed CAO MRP objectives to evaluate remedial effectiveness and protect domestic wells. PG&E continues to put this monitoring objective and an associated sampling plan based on multiple hydrogeological considerations forward as an alternative technical approach to monitoring.

PG&E requests the following edits to Section I.C.1:

*"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.~~*

a) Implement monitoring to verify the effectiveness of remediation, track progress towards meeting remediation targets, and evaluate threats to and monitor water quality in private supply wells.
b) Implement monitoring at IRZs and ATUs, as prescribed in separate orders, to monitor the progress and effectiveness of remediation, achievement of remedial goals, and water quality at domestic and community water supply wells.
c) Monitoring well network to be designed to confirm the Cr(VI) plume boundary quarterly in each affected aquifer zone, in consideration of groundwater flow directions, chromium concentrations, and hydrogeologic parameters.
d) Additional semi-annual and annual monitoring shall be performed within 2,000 feet downgradient of the plume boundary, as required, to verify that Cr(VI) is not increasing.
e) Monitoring well network for Southern Plume Area is shown on Figure 2 of the Draft MRP dated December 19, 2014 (CH2M HILL 2014)."

52. Attachment 8, Section I.C.2, Page 2 This provision of the proposed CAO MRP would require extensive sampling of monitoring wells that are below 3.1/3.2 ppb Cr(VI)/Cr(T), outside of the southern 3.1/3.2 ppb Cr(VI)/Cr(T) plume boundary, and in an area the USGS is studying. This monitoring is redundant with the USGS' efforts to evaluate the significance of chromium in this area. Additionally, it is unnecessarily costly and burdensome. Blanket collection of data at these low levels at a set frequency is not necessary to meet the stated objective to track remediation progress (which is set at goals of 10 ppb and 50 ppb Cr(VI)/Cr(T) across the majority of the area in the upper aquifer in Section VI.B.1.c of the proposed CAO). This data collection program at levels so far below the MCL is also not needed for the other stated objective of domestic well protection. Domestic wells in the area have chromium concentrations less than the MCL (only 1 in the approximately 100 sampled wells is above the 3.1/3.2 ppb level) and are sampled under the ATU WDRs. PG&E requests that this separate and redundant requirement be deleted from the proposed CAO MRP:

> ***~~"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."~~*

Should the Water Board feel it important to retain sampling in this area, despite being separate and redundant with the USGS study, PG&E would request that the data analysis in Sections I.C.2.a and I.C.2.b be revised. The concentration threshold analysis proposed in these two requirements for evaluating stability is not founded in statistics and standard definitions of stability. It is possible for a well to yield chromium concentrations that fluctuate above and below the 3.1/3.2 ppb Cr(VI)/Cr(T) and still be stable and vice versa. As discussed above in Comment 47, a standard statistical analysis such as the Mann-Kendall trend analysis should be used to define stability and provide better comparability.

53. Attachment 8, Section I.C.3, Pages 2-3. PG&E requests that this provision be deleted and monitoring requirements be consistent with the entire southern plume area, which has the same objectives: monitoring cleanup performance and potential plume changes, with assessment of trends performed, as described in the Annual Report section.

> ***~~"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."~~*

54. Attachment 8, Section I.C.4, Page 3. PG&E concurs with the general approach to lower aquifer monitoring, with two primary comments:

- Provision I.C.4.2 would establish a threshold of non-detectable Cr(VI) or Cr(T) as requiring semi-annual sampling. While PG&E may agree on which wells to monitor on the boundaries of the southern lower plume, this provision would create a de facto water quality standard for the lower aquifer that has not been established via a background study, and PG&E requests that it be removed. Except for well selection, it is intrinsically illogical to require semi-annual sampling in locations where wells have non-detectable Cr(VI).
- Section I.C.3.4.c and I.C.3.4.d of the proposed CAO MRP again establishes a new method for concentration trend analysis that would trigger quarterly reassessment of the monitoring network. (See Comment 47). PG&E requests removing these provisions and relying on accepted statistical methods (i.e., Mann-Kendall) and conducting an annual review of the monitoring network. The review and statistical assessment is recommended on an annual basis.

PG&E requests the following edits to this section:

> ***"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."*~~
>
> *a) Monitoring well network to be designed to confirm the 3.1/3.2 ppb Cr(VI)/Cr(T) plume boundary quarterly in the lower aquifer, in consideration of groundwater flow directions, chromium concentrations, and hydrogeologic parameters."*

55. Attachment 8, Section I.D, Pages 3-4. The northern area is a primary focus of the USGS background study, which is designed to determine whether Cr(VI) in this area is naturally occurring or originated from PG&E's historical release at the compressor station. The origin of the higher Cr(VI) concentrations is subject to differing interpretations based on various lines of evidence, as discussed in detail in Attachment B.

PG&E's hydrogeology experts performed exhaustive analysis of the well concentrations in the northern area monitoring wells and integrated the results from this analysis with a review of hydrogeology and

groundwater flow directions and an evaluation of general chemistry. The resulting recommended monitoring network was presented and reviewed through the public in various venues identified in Comment 43. The December 2014 Draft MRP (CH2M HILL 2014) presents a monitoring regime that would be complete and meet the monitoring objectives of the MRP.

PG&E appreciates that proposed CAO MRP incorporates certain elements to monitoring the northern area that we have discussed with Water Board staff and the community during various meetings in 2014. However, we still have a number of concerns with the proposed CAO MRP for the northern area, including:

- The proposed CAO MRP would require sampling frequencies at all intervals in a multi-well cluster without any regard to their well histories or actual concentrations -- based simply on the rank order of concentration. This method of determining sampling requirements is incomplete and flawed, and creates sampling requirements in wells that already have an established history of being steadily below background concentrations, which is redundant with the USGS background study. See Comments 43, 44, and 45.
- Sections I.D.1, I.D.4 and I.D.5 all contain the new method of evaluating concentration trends and applying them quarterly to re-evaluate sampling frequency. As discussed in Comment 47, PG&E requests a higher standard statistical approach used annually and requests that the Mann-Kendall trend analysis be used.
- PG&E requests that the term "plume" not be used with regard to the northern area in the CAO unless the USGS finds that this area does indeed contain Cr(VI) from PG&E's historical release.

PG&E requests the following edits to this section:

> *"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. The well with the consistently highest concentration in the well cluster will be sampled as the "primary" well for each cluster on a semi-annual sampling frequency. If a second well in the same cluster were to have similarly elevated Cr(VI) concentrations (near or above 3.1 ppb) to the selected "primary" well or an apparent up-trend in Cr(VI) concentrations, then the second well was selected as the "biennial" well to be sampled every 2 years. The other wells in the cluster provide redundant data and are not included in the program.*
> *2. Wells exhibiting significantly fluctuating chromium concentrations will be sampled quarterly*
> *~~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 all **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.~~"

56. Attachment 8, Section 1.E, Page 4. PG&E appreciates that monitoring is appropriate outside the 3.1/3.2 ppb Cr(VI)/Cr(T) contours, as outlined in the December 2014 Draft MRP (CH2M HILL 2014). The December 2014 Draft MRP includes quarterly monitoring of wells needed to delineate the chromium contours, including the 3.1/3.2 ppb Cr(VI)/Cr(T) contours, in the upper and lower aquifers. In addition, the draft program identifies wells generally downgradient of the 3.1/3.2 ppb Cr(VI)/Cr(T) southern contiguous plume and within 2,000 feet to verify that, even with all the other monitoring of the 3.1/3.2 ppb Cr(VI)/Cr(T) contours and boundary, chromium is not migrating to new areas. The December 2014 Draft MRP also specifies routine monitoring throughout the northern area, including wells outside the 3.1/3.2 ppb Cr(VI)/Cr(T) contours where available to track chromium concentrations.

Section I.E would create new numeric thresholds of regulatory significance at 80 percent to regulate areas already confirmed to be below the 3.1/3.2 ppb Cr(VI)/Cr(T) concentrations. See Comment 46 above. This section includes many wells that are clearly cross-gradient or upgradient and that do not provide relevant information to monitoring for plume migration. Most of the wells identified have a decreasing trend, no trend, or have more than 50 percent of their historical results with Cr(VI) as not detected.

As written in the proposed CAO, Section 1.E would require extensive sampling of monitoring wells that are below background levels 3.1/3.2 ppb Cr(VI)/Cr(T), outside of the southern plume boundary, in a key focus area of the USGS background study, creating a program that is redundant with the data collection that will be conducted as part of the background study. See Comment 45.

PG&E shares a strong interest in protecting private water supply wells. CAO No. R6V-2014-0023 already requires sampling chromium monitoring of domestic wells within 1 mile of the southern 3.1/3.2 ppb Cr(VI)/Cr(T) plume currently under remediation. Of the approximately 100 privately-owned domestic wells in this area, none have had Cr(VI) concentrations greater than or equal to the Cr(VI) MCL of 10 ppb. In fact, only one domestic well has chromium concentrations that exceed 3.1/3.2 ppb Cr(VI)/Cr(T). In light of the fact that: 1) Cr(VI) concentrations in this area have consistently been less than the MCL, and 2) there are separate sampling requirements for water supply wells in the southern area, PG&E believes that the extensive requirements in Section1.E to also sample monitoring wells with chromium concentrations less than 3.1/3.2 ppb Cr(VI)/Cr(T) is unnecessary.

This provision again contains the new method of evaluating concentration trends to evaluate sampling frequencies, apparently on a quarterly basis. See Comment 47 for PG&E's concerns with this. PG&E requests that the Mann-Kendall trend analysis be used to evaluate monitoring trends quarterly, and the monitoring program be reviewed for changes annually.

In summary, this provision is largely redundant with the USGS' efforts to evaluate the significance of chromium in this area, is redundant with domestic well protections, contains new regulatory thresholds, requires monitoring and trend analysis provisions that do not support the Hinkley remediation, and as currently drafted, is unnecessary, costly, and burdensome.

PG&E requests the following edits to this section:

> **"*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 downgradient monitoring wells within 2000 feet of the 3.1/3.2 ppb Cr(VI)/Cr(T) contour as of fourth quarter 2014 and which show increasing Cr(VI) or Cr(T) concentration trends as of fourth quarter 2014. For this determination, an "increasing" trend is defined as an upward trending chromium concentration trend since first quarter 2013, based upon the trend calculated using the Mann-Kendall trend analysis(EPA 2009; Gilbert 1987). The wells meeting these criteria, as of the date of this Order, are identified in the December 2014 Draft MRP(CH2M HILL 2014). ~~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 (first and third quarter of each year) at all downgradient monitoring wells that are within 2,000 feet of the 3.1/3.2 ppb Cr(VI)/Cr(T) contour as of fourth quarter 2014 and in which Cr(VI) or Cr(T) concentrations are not increasing. For this determination, a "not increasing" trend is defined as either a downward trending chromium concentration trend or "lack of a trend"(i.e., no upward or downward trend) since first quarter 2013, based upon the trend calculated using the Mann-Kendall trend analysis (EPA 2009; Gilbert 1987) The wells meeting these criteria, as of the date of this Order, are identified in the December 2014 Draft MRP (CH2M HILL 2014).~~*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.~~* "

57. Attachment 8, Section 1.F, Pages 4-5. PG&E's consultants completed exhaustive work through 2014, evaluating domestic well Cr(VI) concentration trends – these results were shared with Water Board members and staff and the community, at the various venues outlined in Comment 43. **No active domestic wells in the Hinkley area exceed the MCL for Cr(VI), after many years of testing, with nearly every well below the 3.1/3.2 ppb Cr(VI)/Cr(T) levels.** CH2M HILL identified certain wells that warranted further sampling based on Cr(VI) concentrations in neighboring monitoring wells or results above the 3.1/3.2 ppb Cr(VI)/Cr(T) values. These are identified in the December 2014 Draft MRP (December 19, 2014). Section 1.F carries forward an approach to monitoring domestic wells that MCL for Cr(VI) in drinking water established in July 2014.

The water supply well monitoring in the southern plume area required as part of CAO No. R6V-2014-0023 would remain in force as part of this proposed CAO. These requirements were created prior to the new MCL for Cr(VI) in July 2014, and the requirements directing monitoring for the evaluation of replacement water trigger criteria at levels lower than the MCL have been subject to comments and also petitioned (See attachment D and PG&E 2013a). With the new MCL, these extensive sampling requirements are not needed, and the wells identified by CH2M HILL in the December 2014 Draft MRP can be sampled to provide a proactive and preventive sampling program to domestic and community supply wells. In the December 2014 Draft MRP, PG&E provided technical rationale based on computer modeling of new remedial components for the sampling of domestic wells in the southern plume area to determine where sampling is needed. The proposed CAO findings and proposed CAO MRP did not provide a basis for not accepting this proposal for domestic wells in the southern area.

PG&E recommends the previously vetted and submitted MRP be used as a sound technical basis for sampling of domestic wells in the southern area.

> ***"F. Domestic/Community~~/Agricultural~~ Water Supply Wells, Northern Plumes[1]***
>
> *For the northern plume area, the following sampling requirements apply to all domestic and community water supply wells one-half mile downgradient and cross gradient of any monitoring well showing detections of total or hexavalent chromium above the maximum contaminant levels established for drinking water.*
>
> *1. Domestic and community water supply wells to be sampled are identified in the December 2014 Draft MRP prepared by CH2M HILL (December 19, 2014).*
>
> *2. Quarterly sampling at all domestic and community wells having hexavalent or total chromium detections at or above maximum contaminant levels established for drinking water~~.drinking water standards~~ following any sampling event.*
> *~~2~~3. Semi-annual sampling in the first and third ~~second and fourth~~ quarters 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.*~~
>
> *[1] Domestic supply well monitoring in the southern plume area ~~is~~ required as part of CAO No. R6V-2014-0023 (Waste Discharge Requirements for Agricultural Treatment Units) is revised per the sampling program provided in the December 2014Draft MRP prepared by CH2M HILL (December 19, 2014)."*

58. Attachment 8, Section I.G.3, Page 5. The Water Board found that chromium from the historical release at the PG&E compressor station is not found in groundwater upgradient of the Lockhart Fault or east of Dixie Road in a letter dated December 12, 2014 (Water Board 2013c), and PG&E agrees this important finding is appropriately included in the CAO. PG&E requests that water supply wells be explicitly addressed in this section to clarify that water supply well sampling also is not required.

Section I.G.3 defines monitoring well redundancy based soley on a distance criterion. PG&E requests a performance-based standard for determining well redundancy that incorporates the various types of information used to design the monitoring network described in Comment 44: available chromium results and trends in the area, hydrogeology, groundwater flow directions, and an assessment as to the wells needed to meet the monitoring objectives for the area. This monitoring network assessment would be performed annually and included in the Annual Report. Note that as written, many of the wells prescribed in the northern area would actually be considered redundant and excluded from sampling, even though they are separately prescribed for sampling in Section 1.D.2 and 1.D.3.

Requested edits to this section are below:

> "*G.* ***No Monitoring Well and Water Supply Well Sampling is Required for the Following Locations:***
>
> *1. Southwest (i.e., upgradient) of the Lockhart Fault*
> *2. On or East of Dixie Road*
> *3. Redundant monitoring wells ~~defined as wells having the lower of chromium detections compared to the other nearby wells and not meeting the monitoring objectives for a given area,~~ may be removed from all sampling events."*

59. Attachment 8, Section III.B, Pages 7-9. Section III.B of the draft CAO has prescriptive requirements on map preparation that are inconsistent with industry practice and the recommendations of PG&E's hydrogeologic team. PG&E requests that these overly prescriptive requirements be removed from the CAO. The proposed CAO MRP retains arbitrary requirements on plume drawing previously petitioned by (PG&E 2013b In the Matter of Lahontan Regional Water Quality Control Board CAO No. R6V-2008-0002-~~A4, Request for Immediate and E~~mergency Stay; Petition for Review and Memorandum of Points and Authorities in Support Thereof, attached electronically to these comments).

Attachment A Main Comment List

PG&E's comments and requested edits are below:

- **Section III.B, Page 7.** The current requirement for defining chromium extent in the lower aquifer is to define to 3.1/3.2 ppb Cr(VI)/Cr(T). This section would newly create a presumptive background chromium concentration for the lower aquifer of non-detect for Cr(VI) – PG&E feels it is premature to re-define the background value in this CAO for the lower aquifer without a background study.

- **Section III.B.1.a/b/c, Page 7.** In these three sections, the proposed CAO MRP over-prescribes map contents and specifies removing the limits of saturated alluvium in the upper aquifer from maps. PG&E consulting hydrogeologists feel that this technically weakens the presentation. These limits are important lateral boundaries to groundwater within the alluvium. Their inclusion shows where the plume can and cannot travel within this material, providing important information on potential plume movement.

  PG&E requests that the proposed CAO MRP eliminate the following text from Section III.B.1.a/b: "~~*These maps are not to show the approximate limit of saturated alluvium in upper aquifer or flow directional arrows."*~~ It is also requested that the Draft CAO delete the following text from Section III.B.1.c because it is not relevant to the lower aquifer: "~~*"Include the approximate limit of saturated alluvium in upper aquifer."*~~

- **Section III.B.2.f, Page 8.** This section, again, over-prescribes mapping methodology by mandating that the maximum concentration detected be used for contouring, irrespective of other evidence or technical information. If a data point is suspect (e.g., analytical issues are identified or concentrations are significantly higher/lower than historical concentrations), the well is typically resampled. At times, the resample value is lower than the original sample and correlates significantly better with historical results. Rather than including the requirement that the maximum quarterly chromium concentration be shown, PG&E requests to revise:

  "Chromium boundary lines on plume maps shall reflect ~~*the reported maximum hexavalent or total chromium concenetrations*~~ *<u>the most representative of groundwater conditions</u> reported in monitoring and extraction wells at all locations for that quarter."*

- **Section III.B.2.f, Page 8.** PG&E believes there is a typo in this requirement and suggests the following edit to clarify that contours shall be drawn through the monitoring well when the monitoring well yields a concentration equal to 3.1/3.2 ppb Cr(VI)/Cr(T):

  "Monitoring wells used to draw the 3.1 ppb Cr(VI) or 3.2 ppb Cr(T) ~~*boundary lines*~~ *<u>contours</u> shall have plume lines drawn through the monitoring well <u>if the well point has a chromium concentration that is equal to 3.1 ppb Cr(VI) or 3.2 ppb Cr(T)</u>."*

- **Section III.B.2.h, Page 8.** This section, again, over-prescribes mapping methodology by mandating how hydrogeologists need to draw contours of chromium concentrations. As stated in PG&E's February 7, 2013 Petition for Review of CAO No. R6V-2008-0002-A4 (PG&E 2013b), a requirement to connect data points from wells an arbitrary distance apart (i.e., one-half mile and 1 mile) is not supported by empirical evidence and exceeds Water Board authority. This requirement is not supported by findings in the CAO and additionally prevents use of relevant data (e.g., groundwater

flow direction) or professional judgment based on site-specific considerations. Additional details can be found in the above-referenced petition.

PG&E suggests deleting this requirement.

- **Section III.B.2.j, Page 8.** See comment directly above regarding connecting data points from wells located an arbitrary distance apart (refer to PG&E's February 7, 2013 Petition, PG&E 2013b).

  The proposed requirement to use data from domestic wells for contouring chromium ignores the significant differences that may exist between data from domestic wells and monitoring wells and the less reliable domestic well testing results. These significant differences in purpose and construction of the wells render comparison of the testing results between monitoring and domestic wells inappropriate and technically unsound. In addition, there is no technical basis for requiring that the plume be drawn in areas where residents have refused to grant access to install a monitoring well. Basing the plume boundary on these arbitrary and artificial requirements also ignores important factors such as technical judgment, site-specific conditions, and groundwater flow. For additional detail, see PG&E's 2013 Petition (PG&E 2013b).

  PG&E suggests deleting this requirement.

- **Section III.B.3.d.i, Page 8.** At low concentrations, a relative percent difference of 25 percent does not constitute a significant difference (e.g., a Cr[VI] concentration = 1.0 ppb and a Cr[T] = 1.3 ppb would result in a relative percent difference of 26 percent). In addition, if one or both analytes are not detected at the laboratory reporting limit, reviewing the difference between the concentrations of the two analytes does not seem necessary (e.g., in fourth quarter 2014, 122 out of 498 GMP samples that were analyzed for both hexavalent and total dissolved chromium had non-detected results for Cr[T], Cr[VI], or both). Furthermore, the accepted error or accuracy associated with each of the analytical methods (EPA Methods 218.6 and 6020A for analyzing hexavalent and total dissolved chromium, respectively) is different. For EPA Method 218.6, the method has criteria of +/- 10 percent from the true value. The EPA Method 6020A method has criteria of +/- 25 percent from the true value. Therefore, if each method is in error by the maximum percentage allowed in the opposite direction (e.g., Cr[VI] is 10 percent greater than the "true" value and Cr[T] is 25 percent less than the "true value"], the Cr(T) and Cr(VI) result can have a relative percent difference of 35 percent and still be within the accepted accuracy range allowed by the EPA.

  PG&E suggests deleting this requirement.

  If the Water Board determines that re-analysis of sample results showing a 25 percent or greater is imperative, PG&E recommends that the following text be included instead:

  "*If sample results show a relative percent difference of 25% of greater between Cr(VI) and Cr(T) concentrations and if both concentrations are greater than 4 ppb, the samples shall be re-analyzed within the same quarter and the ensuing results described. In addition, if sample results have a*

Cr(VI)/Cr(T) difference greater than 1.0 ppb at concentrations below 4 ppb, the sample shall be re-analyzed within the same quarter and the ensuing results described."

- **Section III.B.3.g, Page 9.** The proposed CAO implies that the chromium plume is undefined if there is not a sampling location within one-quarter mile distance (presumably of a well with chromium concentrations that exceed 3.1/3.2 ppb Cr[VI]/Cr[T]). This requirement sets an arbitrary and capricious criterion for plume definition and is not supported by empirical evidence. This requirement is not supported by findings in the CAO (See Point 1 in Attachment C) and additionally prevents use of relevant data (e.g., groundwater flow direction) or professional judgment based on site-specific considerations. In some areas, the plume is defined by the lateral extents of the aquifer (i.e., the limits of saturated alluvium), rather than a data point from a monitoring well.

60. Attachment 8, Table 8-1, Page 11. Table 8-1 contains a listing of the required wells in the southern area based on the monitoring network design and criteria for sampling. Based on the prior comments, PG&E requests the wells identified here need to be updated once the well network and frequency is refined.

The table includes a number of errors. Well IDs "DMW-03", "MW-1", and "SA-SM-015" do not exist. Based on review of the third quarter 2014 data provided in Table 8-1, it is assumed that wells PMW-03, MW-01, and SA-SM-01S were supposed to be referenced instead. In addition, the title of this table indicates that it should be specifying monitoring wells in the southern plume area. Based on review of Attachment 2 to the proposed CAO, MW-154S1 and MW-193S3 are included in the table, but are not located in the southern plume area (and are located in the northern plumes area). Please confirm that these two wells were included in Table 8-1 in error.

In addition, the quarterly monitoring frequency specified in Table 8-1 to demonstrate that the cleanup goals listed in Requirement VI.B are being achieved is excessive; monitoring these wells on a semi-annual or annual basis should be more than sufficient to demonstrate progress is being made toward achieving these goals over the course of the two decades of remediation evaluated under the remedial goals in this Order. In addition, the monitoring required by proposed CAO MRP Sections I.C through I.E appears to be an additional layer of monitoring on top of monitoring that is already required for chromium treatment effectiveness by CAO No. R6V-2014-0023 (ATU wells) and the Water Board's suggested IRZ monitoring program (Water Board 2014), creating unnecessary redundancy, as discussed above in Comment 45. The quarterly monitoring of wells in Table 8-1 and the additional layer of monitoring this adds to the sampling program at the site would require that PG&E collect 200 more samples per year at IRZ wells, in addition to the IRZ monitoring program that has already been suggested in Water Board's February 19, 2014 letter (Water Board 2014). This would mean that quarterly sampling would be required at more than 170 wells in the IRZ area alone, which is excessive when evaluating long-term remediation requirements.

PG&E recommends that Table 8-1 be revised to reflect chromium effectiveness monitoring frequencies already defined in CAO No. R6V-2014-0023 and proposed in the Water Board's February 19, 2014 letter

and use the data collected per these programs to demonstrate achievement of cleanup goals and to correct errors noted in this comment.

61. Attachment 8, Section IV. It is assumed that this provision is relevant to PG&E-owned wells only. This provision in the proposed CAO MRP is overly prescriptive and contains multiple problematic provisions that are not needed for the purpose of regulating water quality, protecting health, or achieving the MRP objectives (MRP, page 1) to:

"verify the effectiveness of remediation, track progress towards meeting remediation targets, and evaluate threats to and monitor water quality in private supply wells."

This requirement creates criteria that conflict with Section I.B.2, which exempts water supply wells that are not active during a given sampling quarter. Provisions IV.A .1 and IV.A.2 are conflicting and problematic; therefore, PG&E requests that they be deleted. In addition:

- IV.A.1 inappropriately links the need to sample inactive water supply wells to the existence of a nearby well cluster. The need for sampling domestic wells is for human health protection if they are active. The monitoring well network is has been built out over many years of investigation to place wells where they are needed. Provision I.B.2 is clear that inactive wells do not need to be sampled.
- IV.A.2 establishes threshold of significance for Cr(VI) 2 ppb, which is arbitrary in light of the new MCL of 10 ppb for Cr(VI), to remove wells from sampling program.
- IV.A.3 establishes a separate process for requesting permission to not sample inactive wells, but this is not needed because the definition of an inactive well is very clear in Section I.B.2. It is not necessary to require another submittal for this purpose.

PG&E requests the following edits:

> ***"IV. CRITERIA FOR ~~REMOVAL OR~~ ABANDONMENT OF PG&E-OWNED INACTIVE DOMESTIC WELLS FROM SAMPLING PROGRAM***
>
> *A. The Discharger may remove PG&E-owned inactive wells from the domestic well sampling requirements specified above in Requirement I.B.2.*
>
> *~~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.~~ 1. Domestic wells removed from the sampling program shall be left in place and secured (capped in place) until they become active again or a decision is made to abandon them under IV.B, below. ~~to be evaluated in the future for potential sampling.~~"*

Attachment B

Comments on Proposed CAO with Regards to Background Chromium Levels

Technical Memo

Stantec

To: Ms. Laurie Kemper, P.E. –
Assistant Executive Officer

2501 Lake Tahoe Blvd
South Lake Tahoe, CA 96150

Date: March 13, 2015

From: Chris R. Maxwell, P.G. # 7269
Principal Geologist

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REGISTERED GEOLOGIST
CHRIS R. MAXWELL NO. 7269 REGISTERED GEOLOGIST
EXP 8/15
STATE OF CALIFORNIA

Reference: Comments on Proposed Cleanup and Abatement Order (CAO) with Regards to Background Chromium Levels – Pacific Gas and Electric Company (PG&E) Hinkley Chromium Remediation Project

1.0 - Introduction

In January 2015 the Lahontan Regional Water Quality Control Board (Water Board) circulated for public comment a proposed Cleanup and Abatement Order (CAO) requiring Pacific Gas and Electric Company (PG&E) to remediate hexavalent chromium (Cr6) in groundwater in Hinkley, California (the Site). This Technical Memorandum (Tech Memo) provides comments on the Water Board's proposed use of the existing chromium background values to establish findings and requirements in the proposed CAO.

In summary, the findings of the proposed CAO should be revised to acknowledge scientific data that has been submitted to the Water Board over the last several years (subsequent to the date that the current problematic background levels were established). These data, which are discussed herein, demonstrate that the current background values established by the Water Board in 2008 are not accurate, particularly for areas north of Thompson Road (i.e., the North Hinkley Valley and Water Valley) and in the area of the "western finger." The written findings of three peer reviewers contracted directly by the Water Board support this conclusion.

The appropriate path forward for the proposed CAO is to revise the findings to acknowledge the existing scientific data and identify the current background values as "interim." These values can be used as reference points over the next several years while the United States Geological Survey (USGS) completes the updated background studies which are fully supported by the Hinkley community, Water Board staff, and PG&E. A new finding should be inserted into the proposed CAO that discusses the purpose and scope of the USGS studies – suggested language is provided in PG&E's detailed comments.

Despite the inaccurate background values, remediation in the core plume area at this time is supported by sufficient data developed through years of investigation. As discussed below, allowing the USGS studies the time necessary to provide scientifically supportable chromium background levels will not delay the implementation of aggressive remediation in the core plume.

Most importantly, the proposed CAO should be revised to remove all requirements for further investigation and/or remediation of chromium in groundwater north of Thompson Road and in the area of the "western finger" until the USGS studies are completed. PG&E is fully committed to the scientific process, working to support the USGS in their detailed studies of these areas.

There is substantial uncertainty as to whether or not the chromium in these areas is associated with PG&E's chromium plume. In fact, as discussed below, there is significant scientific evidence to conclude that the chromium detected in groundwater in these areas is not associated with PG&E's chromium plume. It is appropriate to wait until the USGS studies are complete before the need for further investigation and/or remediation in these areas is contemplated and/or required.

In February 2013, more than two years ago, PG&E provided a work plan to the Water Board proposing additional investigation in areas to the north, including Water Valley. The plan was submitted in response to Investigation Order R6V-2013-0029. At that time, PG&E stated in the Work Plan the following with regards to the proposal:

"PG&E is committed to the best science, engineering and remedial design for the Hinkley Groundwater Remediation Program. To that end, PG&E continues to work with Water Board and the Hinkley community to resolve issues through a technical dialogue. Important milestones, such as the background study implementation and the final remedy decision, must be considered when deciding the scope and timing of future investigation needs." (Section 1.0)

"…in good faith, this Work Plan proposes the installation of additional monitoring wells….PG&E offers that it will be inappropriate to compare the chromium results from wells in these areas to the maximum background levels established for areas to the south. A more appropriate course of action would be to work collectively with the USGS and the community to conduct a timely update to the background study…Based on results from existing monitoring and/or domestic wells in these areas, it is reasonable to conclude that chromium results in some of the new wells proposed in this Work Plan will likely be above the currently established background levels that were intended for areas to the south. These new results should not be used to draw the chromium plume boundaries. Instead the results should be incorporated into PG&E's on-going work with the USGS and the community to evaluate background levels." (Section 1.2)

These statements are re-quoted here in this Tech Memo to provide some overall perspective on the issue of how the background limits have been applied over the last several years, and PG&E's consistent position that the values are not representative of Site conditions, particularly north of Thompson Road, in the area of the "western finger", east of Dixie Road (and perhaps even east of Summerset Road), and west-southwest of the Lockhart Fault.

PG&E clearly stated in writing more than two years ago, and on multiple occasions before and after that work plan, that it was technically infeasible to comply with Water Board Orders to define the chromium plume using the established background levels. This position has not changed; the scientific data collected over the last several years as presented in multiple reports to the Water Board and further discussed herein continues to strongly support this position. It is imperative that the proposed CAO not require investigation or remediation to the north of Thompson Road or in the area of the western finger at this time, and instead allow the USGS studies to proceed in a timely and thoughtful manner. PG&E is fully committed to taking appropriate investigation and remedial action based upon sound science.

2.0 - Background Information

On February 28, 2007 PG&E submitted to the Water Board the *Groundwater Background Study Report, Hinkley Compressor Station, Hinkley, California* (CH2MHILL, 2007). The report presented the data, analysis, and conclusions of a study completed by PG&E to estimate the 95 percent upper tolerance limit (95UTL) concentrations of total dissolved chromium (CrT) and Cr6 in groundwater of the upper aquifer in the Hinkley Valley. The study was conducted following Water Board staff approval of the *Revised Background Study Work Plan, PG&E Compressor Station, Hinkley, California* (CH2MHILL, 2004). The approved work plan incorporated comments from Water Board staff, and input from three University of California (UC) peer reviewers.

The February 2007 Background Study Report concluded that the 95UTL concentrations for CrT and Cr6 in groundwater of the southern part of the Hinkley Valley are 3.23 micrograms per liter (µg/L) and 3.09 µg/L, respectively. These values were intended to describe the upper range of chromium concentrations that are unrelated to the historic release of chromium at the PG&E Compressor Station (i.e., background concentrations).

On November 18, 2008 the Water Board adopted amended Cleanup and Abatement Order (CAO) No. R6V-2008-0002A1. The amended CAO requires, for the purposes of evaluating remediation strategies, that the maximum background concentrations of CrT and Cr6 shall be 3.2 and 3.1 µg/L, respectively.

Since adoption of the 2008 CAO, PG&E has installed several hundred monitoring wells in an effort to define the chromium plume based upon these maximum background values. The investigations have extended to the north approximately five (5) miles into the North Hinkley Valley and Water Valley, and nearly one additional mile to both the east and the west in the South Hinkley Valley. As the investigation areas have expanded, the geology and hydrology in the expanded areas is no longer the same as in the South Hinkley Valley where the prior background studies were conducted. The background values established in the 2008 CAO do not accurately represent conditions in these areas of expanded investigations.

As additional data has been collected, PG&E has provided the Water Board with numerous technical reports presenting the methods and findings of the investigations. The following provides a list of these various reports, which are attached as part of PG&E's detailed comments.

- **Geologic Conditions at Western Edge of Lower Aquifer** (Stantec, January 2011)
- **Response to Investigative Order R6V-2011-0043 Delineation of Cr in the Lower Aquifer** (Stantec, August 2011)
- **Technical Memorandum – Revised Summary of Hydraulic Gradient Data in the Area between Domestic Well 34-65 and the Hinkley Compressor Station Plume** (CH2MHILL, September 2011)
- **Technical Report – Response to Investigation Order No. R6V-2011-0043** (Stantec, September 2011)
- **Technical Memorandum – Update to Upper Aquifer Groundwater Investigation Activities** (Stantec, February 2012)

- **Work Plan for Evaluation of Background Chromium in Groundwater of the Upper Aquifer in the Hinkley Valley** (Stantec, February 2012)

- **Technical Memorandum – First Semester 2012 Update on Upper Aquifer Groundwater Investigation Activities** (Stantec, August 2012)

- **Preliminary Reporting of Geology and Hydrology for Investigations in the Western Area** (Stantec, November 2012)

- **Technical Memorandum: Interpretation of Chromium Sample Results from Newly Installed Monitoring Wells in the Upper Aquifer and Occurrence of Chromium in Groundwater in the Western Area** (CH2MHILL, January 2013)

- **Conceptual Site Model for Groundwater Flow and the Occurrence of Chromium in Groundwater of the Western Area** (CH2M HILL and Stantec, January 2013)

- **Northwest Freshwater Injection System: Summary of Permitting Requirements, Operational History, and System Effectiveness** (CH2MHILL, Stantec, and Arcadis - June 2013)

- **Draft Framework for Evaluation of Background Chromium in the Hinkley Valley** (CH2MHILL and Stantec, July 2013)

- **Compliance with Provision I.C. of Cleanup and Abatement Order R6V-2008-0002-A4 and Requirements of Investigation Order R6V-2013-0029** (Stantec, October 2013)

- **Technical Memorandum Proposing Investigation in Areas North of Thompson Road as Identified in a December 12, 2013 Letter from the California Regional Water Quality Control Board, Lahontan Region to Pacific Gas and Electric Company** (Stantec - January 17, 2014).

2.1 - Peer Review of the 2007 Background Study Report

In 2011, Water Board staff submitted the February 2007 Background Study Report to three technical individuals with expertise in the fields of hydrogeology, statistics, and laboratory analysis. Peer reviewer comments were provided by Water Board staff on October 14, 2011. Many of the concerns raised by the reviewers are also shared by PG&E, and can generally be summarized as follows:

- ***Sampling was Performed Using Wells not constructed for Discrete Sampling in the Upper Aquifer*** – Data was collected from long-screened domestic or agricultural wells, for which in most cases PG&E does not have documentation of well construction. It is likely the majority of these wells have very long screens, some of which penetrate both the upper and lower aquifers. Data collected from these long-screened wells is not comparable to data collected from the monitoring wells installed by PG&E to evaluate the boundaries of the chromium plume, which have short screens (typically 10 to 20 feet) and do not penetrate multiple aquifers.

- ***The Spatial Distribution of Wells was Uneven*** – The background study relied on samples collected from existing domestic and agricultural wells, many of which are clustered in specific geographic areas. The clustering of wells in some areas, and the absence of wells in others, may have resulted in spatial bias of the 95UTL values (i.e., statistical weight was given to a few geographic areas of the Hinkley Valley).

- ***The Statistical Analysis of Data was Inappropriate*** – Several issues were identified pertaining to how the groundwater data was statistically evaluated. Some wells were sampled four times in the study (quarterly for one year), while others were sampled only one or two times. The average concentration for each well (regardless of the number of samples collected) was used to develop single 95UTL values for the entire population of wells.

- ***Laboratory Analytical Methods were Inconsistent and Quality Control was Inadequate*** – Several concerns were noted with the laboratory analysis for CrT and Cr6, including potential quality control issues with one of the two laboratories used during the study. Three different EPA laboratory methods for Cr6 were used for the study (218.6, 7199, and 7196A), and the varying methods could provide different results – especially at the low detection concentrations.

2.2 - USGS Background Study

The USGS background study scope of work is titled: *"Occurrence of Natural and Anthropogenic CrVI near a Mapped Plume, Hinkley, CA."* The scope of work has been funded by PG&E and approved by the Water Board, and includes several tasks to evaluate multiple lines of evidence for chromium in groundwater of the Hinkley Valley including: rock and alluvium mineralogy (Task 2), groundwater geochemistry (Task 3), hydraulic testing (Task 4), and groundwater flow modeling (Task 5). PG&E supports the USGS as an independent scientific organization that will provide great clarity to the complex issue of background chromium in groundwater.

PG&E is part of a Technical Working Group (TWG) that includes representatives from the Water Board, USGS, the Hinkley Community Advisory Committee (CAC), and Project Navigator (IRP Manager). The TWG has been meeting since 2013 to discuss chromium background studies, including the multiple lines of evidence that may be used to explain the occurrence of chromium. PG&E looks forward to continuing collective work with the TWG to achieve timely implementation of the USGS background studies.

The USGS scope of work provides a comprehensive path forward to collect scientific data so that the chromium data can be reasonably interpreted in the context of naturally occurring and/or the PG&E plume. There is an abundance of scientific information currently available that points towards natural chromium as the source(s) in many areas where chromium is present above the 3.1/3.2 values. While the USGS studies will greatly improve upon the volume of data and accuracy of conclusions, the existing information justify a pause in plume-related investigations and requirements for remediation north of Thompson Road, southwest and west of the Lockhart Fault, east of Dixie Road (and perhaps east of Summerset Road), and in the area of the "western finger" while the background related studies proceed.

The following table summarizes the key lines of evidence demonstrating that chromium detected above the established background levels in certain geographic areas is likely not associated with the PG&E plume.

Geographic Area	Lines of Evidence that Detected Chromium is Likely Not Associated with the PG&E Plume			
	Geology and Sediment Mineralogy	Historic Land Use and Agricultural Pumping	Chromium Concentration Gradient	Geochemistry – TDS/N, Stable Isotopes, Age Dating
West - West of Serra Rd and North of Hwy 58 (i.e., Western Finger)				
West – West and Southwest of the Lockhart Fault				
East - East of Dixie Road (and perhaps Summerset Rd)				
North – Thompson Rd to Red Hill				
North - Water Valley (North of Red Hill)				

The color coding denotes how strongly the existing data for these key lines of evidence can be used to explain the natural or anthropogenic nature of chromium. Green indicates strong support that the chromium is naturally occurring and yellow suggests moderate support.

3.0 – Chromium Data Post 2007 Background Study Report

The Hinkley Valley from the compressor station to Red Hill is approximately five and one-half (5.5) miles north to south, and three (3) miles east to west at its widest point. With the installation and sampling of several hundred monitoring wells since November 2008, PG&E has assessed chromium concentrations (where chromium concentrations exceed the defined maximum background values) throughout Hinkley Valley and several additional miles into Water Valley to the north.

If the established maximum background values are accurate, and if one assumes that all detections above established background levels are attributable to PG&E's chromium plume (an assumption not supported by available evidence), then PG&E's plume would essentially extend from the compressor station in the south all the way into Water Valley more than seven (7) miles to the north. In the absence of such supporting evidence, this conclusion is infirm. There are multiple lines of evidence suggesting the chromium in much of the recent areas of investigation are likely not associated with the PG&E plume, and that maximum natural background values for

Cr6 and CrT are higher in some areas of the Hinkley Valley and Water Valley than the levels established in the 2007 background study. Particular areas where PG&E believes the current scientific data support a conclusion that the detected chromium is likely not associated with the PG&E plume area: southwest and west of the Lockhart Fault, east of Dixie Road (and perhaps east of Summerset Road), north of Thompson Road, and in the area of the "western finger."

As discussed above, PG&E supports the USGS as an independent scientific organization to conduct further studies and evaluate background chromium. The lines of evidence which have been explored to date by PG&E will be independently examined by the USGS. PG&E looks forward to the USGS independent data collection, evaluation, and findings.

- **Regional Conditions** – groundwater data from the Mojave River basins and surrounding area indicate the presence of Cr6 equal to and greater than the established background levels, including several municipal water supplies upstream of the compressor station. The USGS will consider regional data in their evaluations.

- **Geology (USGS Task 2)** – investigations conducted to date have documented the presence of rocks particularly in the west and north that are commonly associated with elevated Cr6 levels in groundwater. The USGS will be collecting samples of sediment and rock, and evaluating the influence of these geologic materials on natural chromium levels in groundwater.

- **Geochemistry (USGS Task 3)** – geochemistry can provide insight into the source and age of groundwater. Total dissolved solids (TDS), nitrate, stable isotope, and tritium data all suggest the groundwater in the contiguous plume area south of Thompson Road (roughly defined by the current 10 µg/L contour for Cr6) generally exhibits a different signature than groundwater outside this area. The USGS will be collecting groundwater samples from multiple wells throughout Hinkley Valley and Water Valley and conducting exhaustive geochemical analysis.

- **Land Use, Pumping, and Groundwater Flow (USGS Tasks 4 and 5)** – the Hinkley Valley has been used extensively for agriculture since the 1950s creating substantial hydraulic depressions in the southern part of the Hinkley Valley (i.e., south of Thompson Road). Historic and current data document substantial cones of depression within the PG&E plume that historically and presently limit the potential for east, west, and north plume migration. The USGS will be conducting additional hydraulic studies and numerical groundwater modeling to simulate historic and recent groundwater flow.

  It is important to note here that the proposed CAO estimates groundwater movement in the Hinkley Valley and Water Valley using a groundwater flow velocity reported by PG&E for recent conditions in the area of in-situ remedial activities north of the compressor station. The proposed CAO uses this velocity of two (2) feet per day (ft/d) and the number of days since the historic release of chromium at the compressor station reached groundwater to calculate approximately seven (7) miles of potential plume migration. Based on this calculation the proposed CAO incorrectly concludes it is reasonable to assume the chromium detections in the North Hinkley Valley and Water Valley above the currently established background levels are associated with the PG&E plume. This calculation is the primary supporting justification in the proposed CAO for requirements of additional investigation and remediation in the areas North of Thompson Road.

The groundwater flow calculation in the proposed CAO is inaccurate and not reasonable and does not provide a basis for the proposed investigation and remediation requirements. Most importantly the calculation does not take into account the decades of historic and current groundwater pumping in the Hinkley Valley that has limited/prevented ground water movement to the north. Simply, groundwater has not been flowing north unabated at a rate of two feet per day since then 1950s. These data are discussed in detail below.

The calculation presented in the proposed CAO also does not consider the known fact that groundwater gradients and sediment hydraulic conductivity (and thus velocity) are not the same throughout the Hinkley Valley. The two foot per day groundwater flow rate reported by PG&E for the area north of the compressor station is much faster than observed north of Thompson Road (particularly south of Red Hill) where present day gradients are very flat. These observations are supported by the geochemical data, which is also discussed in detail below.

PG&E has provided this scientific information, including geochemistry and groundwater use and flow, to the Water Board on multiple occasions in the reports referenced above which are also attached to PG&E's detailed comments on the proposed CAO. The information is discussed again in this Tech Memo. The calculation presented in the proposed CAO is technically inaccurate and unreasonable, not supported by science, and ignores the information provided by PG&E over the last several years. By oversimplifying the historic and current groundwater flow and inaccurately presenting the known site conditions, the calculation also fails to recognize the importance of the various studies planned by the USGS to better understand these important issues.

The USGS studies to be conducted under Tasks 3, 4, and 5, particularly the geochemical data and groundwater flow modeling, will provide a more reasonable estimate of where groundwater has traveled since the time period of the historic release of chromium. The Water Board should not rely upon inaccurate calculations that do not take into account available scientific data, and should wait until such time as the USGS completes their studies to develop findings and requirements based upon historic and recent groundwater flow.

- **Concentration Gradient** – the current chromium plume is mapped, based upon Water Board requirements, several miles north of Thompson Road all the way into Water Valley, and east of Summerset Road. Concentrations at select wells near Red Hill (MW-154S1) and in Water Valley (including MW-193S3) are above 20 ug/L.

  Chromium is also present above the 3.1/3.2 levels on the up-gradient side of the Lockhart Fault to the southwest (multiple wells including 34-65 and MW-163D), and at Mulberry Avenue in weathered volcanic rock (MW-203D). These locations are up-gradient of the chromium plume.

  The areas of "hot spots" as referred to in the proposed CAO, including MW-154S1 and MW-193S3, are geographically separated by vast acreage (several square miles in some cases) from other wells with similar concentrations. With the exception of the "hot spots", there is a narrow range of chromium concentrations in these areas - typically less than 5 ug/L.

  There is no concentration gradient from the plume area to these "hot spots". There is no reasonable explanation for these isolated areas of higher chromium concentrations other than natural background levels, or another source(s) other than the PG&E plume.

The following provides additional information on each of these five bulleted topics. The figures referenced are from Appendix G to the above-referenced report titled **Compliance with Provision I.C. of Cleanup and Abatement Order R6V-2008-0002-A4 and Requirements of Investigation Order R6V-2013-0029** (Stantec, October 2013). The figures are attached to this Tech Memo for ease of reference.

3.1 - Regional Conditions - Chromium Concentrations in Groundwater of the Western Mojave Desert

Cr6 concentrations naturally exceed 50 µg/L in alkaline, oxic groundwater in alluvial aquifers in the Western Mojave Desert (Izbicki, 2008). Cr6 was detected at levels up to 6.3 µg/L in supply wells near Victorville and Apple Valley (Golden State Water Company, 2010a,b) and as high as 16.1 µg/L in supply wells for the City of Hesperia (City of Hesperia Water District, 2010). These communities are located in the Mojave River watershed, up-gradient of Hinkley.

Slides from the USGS September 2013 presentation to the TWG discuss chromium concentrations found in the groundwater of supply wells throughout California. As presented by the USGS, Cr6 was detected at or above 3.1 µg/L in approximately:

- 7% of 2,800 tested public supply wells in California;
- 15% of Mojave Water Agency wells; and,
- 56% of wells within the Mojave Desert.

These data indicate that chromium is naturally present in groundwater of the Mojave River watershed and other areas throughout California at levels higher than the currently established background levels used to map the PG&E plume. It is documented in this Tech Memo and in the reports referenced above that the geology and groundwater geochemistry in some parts of the Hinkley Valley and Water Valley is similar to areas in California where elevated Cr6 is naturally present in groundwater.

The USGS studies are needed to expand upon the existing information and fully understand the nature of the Hinkley Valley and Water Valley conditions, and to accurately depict the natural and anthropogenic chromium levels.

3.2 - Mineralogy and Influence on Chromium Levels in Groundwater (USGS Task 2)

Task 2 of the USGS work scope identifies three primary work scopes to evaluate the influence of mineralogy on natural chromium levels in groundwater of the Hinkley Valley. The work scopes generally include a physical and mineralogical evaluation of sediment and rock, followed by leaching extractions to quantify on a relative scale the potential for chromium to be naturally mobilized into groundwater.

There are three key processes whereby the mineralogy could influence natural chromium levels in groundwater. First, groundwater can dissolve chromium from saturated sediments along the groundwater flow path from the source (primarily the Mojave River) to the terminus (Harper Lake). Second, as the water table rises and falls in response to seasonal and/or pumping effects the groundwater will contact sediments that are intermittently saturated and then unsaturated. The groundwater can dissolve chromium from these sediments, particularly if the zone of groundwater fluctuation becomes oxic. Third, recharge water from sources such as dairies and septic leach fields (both plentiful in the Hinkley Valley) can percolate through unsaturated sediments and dissolve chromium. Under this third scenario the percolating water recharging

the aquifer at the water table would contain natural chromium. In each of these three scenarios, natural Cr6 levels can be elevated if the mineralogy (relatively high chromium) and the groundwater or recharge water (relatively oxic) are conducive to the dissolution of Cr6.

Geologic Conditions

The Hinkley Valley is bounded to the west by the Iron Mountains composed of quartzite and marble, the east by Mount General composed of quartize, marble and Tertiary-age dacite (volcanic rock), and the north by smaller hills composed of quartz monzonite (Dibblee, 2008). Red Hill, which bounds the Hinkley Valley to the north, is comprised of quartz monzonite and dacite.

Water Valley includes volcanic rock (basalt) which can be associated with natural chromium concentrations in groundwater above the 3.1/3.2 levels. Volcanic rocks are also present at Red Hill and at Mt. General immediately to the east of the chromium plume. Groundwater flowing through these rocks and/or the sediment derived from these rocks may contain relatively high natural Cr6 levels.

As referenced above, previous studies conducted by the USGS (Izbicki, 2008) outside the Hinkley Valley indicate Cr6 levels may be elevated if recharge water infiltrates through unsaturated zone sediment and/or groundwater levels rise and fall through sediment that contains relatively high natural chromium levels associated with the geologic materials. These recharge conditions have occurred, and continue to occur, in the Hinkley Valley and Water Valley.

Granitic and metamorphic rocks containing an abundance of mafic minerals have been observed in several locations, including west of the Lockhart Fault near well MW-163 where high chromium levels have been observed in groundwater up-gradient of the plume. The Water Board has agreed in writing that the detected chromium at MW-163 is not associated with the plume. Further evaluation of the sediment mineralogy is required to assess the natural contribution of chromium to groundwater.

Geologic materials within the Hinkley Valley include the various rocks referenced above, potentially sediments derived from these rocks, and sediments deposited by the Mojave River. The Mojave River is a major source of unconsolidated sediment in the Hinkley Valley, particularly near the south-north centerline of the basin. The sediments deposited in the Hinkley Valley by the Mojave River were predominantly sourced by erosion of granitic rocks in the San Bernardino Mountains approximately 40 miles to the southwest.

The mineral sources and range of natural chromium known to exist in alluvial basin settings from other studies in the southern portion of the western Mojave Desert (Ball and Izbicki, 2004; Izbicki et al., 2008) can be summarized as follows:

- Highest chromium content is generally found in basalt, ultramafic and mafic rock debris that contains chromite ($FeCr_2O_4$), and other rocks with relatively high mafic mineral content. Groundwater associated with alluvium eroded from these rocks typically contains natural chromium at levels up to and above 50 µg/L.
- Moderate chromium concentrations are generally found in less mafic plutonic, metamorphic, and volcanic rocks. Cr6 concentrations up to 36.6 µg/L in groundwater have been reported under these conditions in the Mojave Desert (Ball and Izbicki, 2004; Nishikawa et al, 2004).

- The lowest chromium content is associated with highly weathered, non-mafic rocks often associated with fluvial deposits derived from granitic materials. The Mojave River sediments are likely an example.
- The chromium content tends to be higher in fine-grained sediment and soil compared to coarser-grained deposits.

Effect of Mineralogy and Groundwater Conditions on Chromium Levels

The mineralogy of sediments in the saturated zone influences the chemistry of the groundwater that is moving through them, particularly in areas of relatively slow groundwater movement (i.e., finer-grained soils, less permeable bedrock or weathered bedrock, near structural boundaries such as faults, and in areas where groundwater gradients are very low). The mineralogy of sediments in the unsaturated zone may also influence the chemistry of pore water that can reach the water table.

Where trivalent chromium-3 (Cr3)-containing minerals are present, the ability of manganese dioxides, common in desert environments, to oxidize Cr3 to Cr6 is well established (Bartlett and James, 1979; Eary and Rai, 1987; Fendorf and Zasoski, 1992). In the presence of manganese oxides, chromium-containing mafic minerals can produce soluble Cr6 in unsaturated zone pore water and groundwater. Manganese is also associated with mafic minerals, and the weathered surfaces of rocks and minerals typically contain secondary manganese oxide mineral coatings. Oxidation of Cr3 to Cr6 can occur when pore water or groundwater is in contact with these solids under oxic conditions. A slight amount of Cr3 is dissolved and becomes oxidized on the surface of the manganese oxides, creating Cr6, while manganese is reduced and partially dissolves. As oxidation of Cr3 proceeds over time, dissolution occurs at the mafic mineral surface and Cr6 may be concentrated in the surrounding groundwater.

Site-Specific Observations

The geologic conditions in the contiguous plume core south of Thompson Road (areas with Cr6 > 10 ppb) are characterized primarily by sediment deposited by the Mojave River. As the study area has expanded over the last several years, monitoring wells have been installed further to the north, east and west within older fluvial deposits and weathered bedrock.

For all of the technical reasons discussed above, the likelihood of finding elevated Cr6 levels in groundwater increases as monitoring wells are installed in geologic environments such as those investigated during the most recent investigations, particularly the North Hinkley Valley near Red Hill and Mt. General, throughout Water Valley, and in the west at Mulberry Avenue. The studies proposed by the USGS will provide detailed information on these various types of sediment, including mineralogy and the potential for chromium to dissolve into groundwater under ambient conditions.

Influence of Unsaturated Zone Mineralogy in Areas of Recharge

The unsaturated (vadose) zone in some areas of the Hinkley Valley likely contains pore water as a result of artificial recharge (such as septic tanks and dairy operations). Another source of porewater could be “residual” groundwater that remains within fine-grained soils as groundwater elevations decreased due to pumping. In local areas near drainages at the valley margins where bedrock is relatively shallow (notably North and East) percolation of intermittent flow along drainages associated with local rainfall could also result in some recharge.

In the western Mojave Desert, naturally occurring Cr6 concentrations have been observed to vary with depth, with generally higher concentrations found at or near the water table under more oxic conditions and decreasing concentrations (often to below detection limits) at greater depths. Figure G6 (from Izbicki, 2008) illustrates the vertical profiles for naturally occurring chromium in the western Mojave Desert along with pH, specific conductance, and other trace metals in water extracted from core samples collected at the water table and within the saturated zone. The highest concentrations of Cr6, specific conductance, and certain trace metals occur either just above or at the water table. The cited 2008 publication identifies the leaching of naturally occurring Cr6 from unsaturated zone soil by infiltration of dairy wastewater as the likely mechanism for the elevated Cr6 concentrations observed at the water table.

A later study also conducted by the USGS specifically focused on the source of Cr6 in shallow water table wells at a dairy near El Mirage in the Mojave Desert (Izbicki, 2008). Laboratory studies performed as part of this study showed that interference in the microbiologically mediated reduction of Cr6 to Cr3 by high nitrate concentrations in dairy wastewater may allow chromium, in the form of Cr6, to remain mobile in the unsaturated zone and reach the water table. The authors concluded that *"The data collected for this study indicate that the source of high-chromium concentrations in water-table wells at the dairy was naturally occurring chromium mobilized from the unsaturated zone as a result of irrigation with dairy wastewater"* (Izbicki, 2008).

These USGS studies have important implications for the interpretation of Cr6 data from the Hinkley site. In areas where activities such as dairy operations or septic leach field waste water disposal has occurred, and where the Site mineralogy contains chromium, the upper aquifer in particular could be susceptible to relatively high concentrations of Cr6 due to leaching from the unsaturated zone. In areas where infiltration is occurring, or has occurred in the past, natural Cr6 concentrations would be expected to be highest in short-screened wells that are screened at or near the water table. The areas below the water table would be expected to exhibit lower Cr6 concentrations due to less influence from recharge and more reducing conditions (i.e. lower oxygen).

Elevated concentrations of nitrate that may tend to inhibit the biologically mediated reduction of Cr6 to Cr3 are associated with dairy waste, particularly with manure spreading operations. This could be an important factor influencing elevated concentrations of Cr6.

Task 4 of the USGS proposal includes scopes of work to evaluate the influence of unsaturated zone mineralogy on the natural occurrence of chromium. Selected unsaturated core material will be collected in areas of recharge and areas of water table rise and fall. The samples will be analyzed for soluble salts (Cl, NO3, SO4, and Br), water extractable Cr6, and water content.

The USGS will also collect core from the unsaturated zone underlying selected drainages and measure water content, water potential, soluble salts, stable isotopes of water, and tritium. The data will be used to assess whether intermittent flow in drainages results in recharge to the bedrock, and natural levels of dissolved chromium in the northern study area. In addition, a water table well will be installed at each location to measure water chemistry and the full suite of tracers discussed above.

3.3 - Groundwater Geochemistry (USGS Task 3)

The source, age, and flow path of groundwater will influence the geochemistry. PG&E has collected numerous samples to assess geochemical groundwater conditions throughout the Hinkley Valley. Analytes have included, TDS, nitrate as nitrogen (nitrate), stable isotopes, and tritium. The following discusses these data.

Total Dissolved Solids and Nitrate

Figures G8 and G7, respectively, present TDS results for select shallow and deep monitoring wells throughout the Hinkley Valley. As shown on Figure G8, the TDS concentrations in shallow-zone wells of the central and eastern Hinkley Valley are significantly greater south of Salinas Road (commonly over 1,000 milligrams per liter [mg/L]) than the values reported for monitoring locations located in the northern Hinkley Valley and in the western Hinkley Valley (less than 500 mg/L, with the exception of a few well locations). TDS concentrations are greatest south of Thompson Road, reaching levels above 4,000 mg/L in the shallow zone of the Upper Aquifer. As shown on Figure G7, a similar spatial distribution to that shown on Figure G8 is observed in the deep zone of the Upper Aquifer with generally decreasing TDS concentrations in wells screened further below the water table.

As shown on Figures G9 and G10, nitrate (as nitrogen) concentrations in the central and eastern Hinkley Valley are much greater than wells located in the west or north Hinkley Valley, similar to the TDS distribution. The highest nitrate levels are reported for shallow zone water table wells south of Thompson Road, where concentrations over 100 mg/L are present. At north Hinkley Valley monitoring wells, nitrate shows a marked decrease a short distance north of Thompson Road. Most monitoring wells north of Salinas Road have nitrate concentrations below 5 mg/L. Both shallow and deep zone monitoring wells located northeast of the Mount General Fault have non-detect levels of nitrate. Most west Hinkley Valley monitoring wells (southwest of the main plume area) also have low nitrate levels (less than 5 mg/L), whereas most monitoring wells located within and east of the main plume area have comparatively high nitrate levels (above 10 mg/L).

Stable Isotopes of Oxygen and Deuterium

Most of the world's precipitation originates from the evaporation of seawater, and the ratio of concentrations of oxygen-18 to oxygen-16 ($\delta^{18}O$) and of deuterium (hydrogen-2) to hydrogen-1 (δD), both relative to ocean water standards, for precipitation throughout the world is linearly correlated and distributed along a line known as the global meteoric water line (Craig, 1961). The $\delta^{18}O$ and δD values for groundwater samples relative to the global meteoric water line provide evidence of the source of the water and fractionation processes (influenced primarily by evaporation and condensation) that have affected the water's stable-isotope values. $\delta^{18}O$ and δD abundances are expressed per mil (parts per thousand [ppt]) difference relative to the standard Vienna Standard Mean Ocean Water (VSMOW). Therefore, the ratio of VSMOW is 0 per mil.

The primary processes that affect $\delta^{18}O$ and δD are evaporation and condensation of water vapor. Water molecules containing the lighter isotopes tend to evaporate more readily, leaving the remaining water molecules relatively "enriched" in the heavier isotopes. Thus, water that has been subject to evaporation shows a heavier isotopic signature. Groundwater influenced by evaporation during irrigation return flow in the Hinkley Valley and discharged cooling tower water from the Hinkley Compressor Station should be enriched in the heavier isotopes.

The distribution of stable isotope data collected by PG&E through April 2013 is shown on Figure G12. Figure G11 presents a plot of all of the δ18O and δD data posted on Figure G12. The data points in the upper right area of the plot are considered to have a "heavier isotopic signature" (that is, they are enriched in the heavier isotopes, oxygen-18 and deuterium), while the data points in the lower left are considered to have a "lighter" isotopic signature. The heavier isotopic signature in the central and eastern Hinkley Valley is interpreted to have resulted from preferential enrichment as partially evaporated agricultural water has percolated back down to the groundwater table, been recaptured by pumping wells, and subsequently reapplied to crops.

This cycle likely began in the 1950s when intensive agriculture in the Hinkley Valley began and was supported by high groundwater withdrawal rates. This process appears to have resulted in a distinct "heavy" isotopic signature in many wells of central and eastern Hinkley Valley compared with the northern and western Hinkley Valley and wells.

On Figure G11, the δD data are color-coded to illustrate the differences discussed above. δD values of less than 60 per mil are shown with blue rectangular symbols, whereas δD values greater than 60 per mil are shown with brown rectangular symbols. A value of 60 per mil was selected as a reasonable cut-off for differences between groundwater subject to and not subject to extensive evaporation.

Tritium

Tritium is a component of water molecules and is not affected by reactions other than radioactive decay. Tritium data can be used to evaluate the relative age of groundwater as being recharged since 1952 or older (Izbicki and Michel, 2004). Figure G13 presents the tritium data analyzed with low-level (0.09 tritium unit [TU]) reporting limits. Rainfall that entered the groundwater system in the Hinkley Valley as Mojave River recharge (or other sources) since 1952 should contain detectable concentrations of tritium (Izbicki and Michel, 2004).

Up-Gradient (South) and Main Plume Area - As shown on Figure G13, tritium data collected from the monitoring wells south of the Hinkley Compressor Station range in concentration from non-detect (ND) up to 0.80 TU. Detections of tritium indicate that the composition of some of this groundwater is a result of the post-1950's recharge. North of the Hinkley Compressor Station and south of Thompson Road, tritium concentrations higher than 1 TU at five wells indicate that some post-1950's recharged groundwater is present. These wells are screened in the shallow and deep zones of the Upper Aquifer and have similar tritium levels. It is probable that tritium in groundwater that has been recharged from the Mojave River has been blended and diluted by historical and more recent groundwater pumping.

East - tritium concentrations are ND at two wells and more than 1 TU at two locations with comparable concentrations at shallow and deep well locations. The eastern area has likely been recharged by groundwater sourced by the Mojave River post 1952.

West - tritium data collected in the west Hinkley Valley range in concentration from ND at most locations up to 0.38 TU. The ND values are consistent with a conceptual Site model, including the stable isotope and groundwater elevation data, suggesting this area has not been influenced by Mojave River recharge since the 1950s. The low levels of tritium detected require further evaluations, and the USGS studies will shed further light on these data including other lines of geochemical evidence to interpret the results.

North - tritium data collected in the North Hinkley Valley range in concentration from ND at most locations up to 0.28 TU. Similar to the west Hinkley Valley, most tritium data in the north Hinkley Valley are ND. The ND values for the North Hinkley Valley are consistent with a conceptual Site model, including the stable isotope, TDS/N, and groundwater elevation data, suggesting this area has likely not been substantially influenced by Mojave River recharge since the 1950s. The low levels of tritium detected require further evaluations, and the USGS studies will shed further light on these data including other lines of geochemical evidence to interpret the results.

Summary of Geochemical Conditions in the Hinkley Valley

A brief summary of the site wide geochemistry distribution is provided below. PG&E expects that the items discussed below will be further expanded upon by the USGS as their new study data becomes available. The key geochemistry elements of the USGS proposal are summarized below in the context of the data collected and presented to date.

West Hinkley Valley: Geochemical data from monitoring well samples from the western Hinkley Valley generally exhibit low TDS and low nitrate concentrations, and a "light" stable isotope ratio (the ratio of concentrations of oxygen-18 to oxygen-16 and of deuterium hydrogen-2 to hydrogen-1) consistent with recharge from the Mojave River that occurred prior to the 1950s and has not been influenced by the decades of agricultural activities occurring in the central and eastern Hinkley Valley. Most groundwater in the west does not contain tritium, or only contains trace levels of tritium. The general lack of tritium in west samples suggests that most of this groundwater may have recharged before the 1950s prior to the release of chromium from the PG&E compressor station.

Central and East Hinkley Valley: Geochemical data from these monitoring well samples (including the central Hinkley Valley where the PG&E chromium plume is present), generally exhibit high TDS and high nitrate concentrations and a "heavy" stable isotope ratio of deuterium and oxygen. This is consistent with Mojave River recharged water that has been influenced by the decades of agricultural activities occurring in the central and eastern Hinkley Valley. The high TDS, high nitrate, and "heavy" isotopic geochemical signature are likely a result of agricultural operations in which extracted groundwater was applied to crops, underwent evaporation, percolated back to groundwater, and was then extracted again and reapplied to crops for many decades. Decades of repeating this process has left a distinct geochemical signature in the groundwater of this area, relative to the west and north Hinkley Valleys. Most groundwater in the eastern Hinkley Valley contains low levels of tritium.

North Hinkley and Water Valley: General chemistry in monitoring well samples north of Sonoma Street and Salinas Road generally contains low TDS and nitrate and a "light" stable isotope ratio of deuterium and oxygen signature similar to Mojave River water and to the Western Area. These results are in contrast to samples from wells in the south central and eastern Hinkley Valley that contain relatively high TDS and nitrate and a "heavy" stable isotopic signature. Most groundwater in the northern Hinkley Valley does not contain tritium or only contains trace levels of tritium. The general lack of tritium in the north suggests that most or all of this groundwater may have recharged before the 1950s, prior to the time when chromium was released.

Geochemical Data Collection per the USGS Work Scope

Under Task 3 of the proposed study to evaluate the natural occurrence of chromium, the USGS will collect at least 60 water samples from existing wells and analyze them for field parameters, major ions, selected minor ions (Sr, Br) and trace elements (CrT, Cr6, Fe, Mn, As, U). The data will be interpreted to determine the potential for occurrence of Cr6 in water with respect to measured pH, mineral solubility, and redox conditions. The program WATEQ4F will be used to assess the speciation of major and minor ion complexes under the measured pH and redox and to infer the origin of the dissolved constituents. The program NETPATH will be used to assess the geochemical reactions along a groundwater flow path that result in dissolution and precipitation of minerals containing chromium.

Under this task the USGS will also analyze at least 60 water samples for multiple tracers that measure different aspects of the source, movement, and age of groundwater since recharge. The tracers include: 1) 18O & 2H in the water molecule; 2) tritium (3H), tritium/helium-3; 3) dissolved gasses (argon, nitrogen); 4) industrial gasses (chlorofluorocarbons, sulfur hexafluoride); and 5) carbon-14. The stable isotopes of water will be used to assess the water source via differences in the isotopic effect of evaporation, which results in enrichment in the heavier isotopes. Dissolved gasses will be used as indicators of groundwater recharge history. Tritium, helium-3, industrial gasses and carbon-14 provide information on the age of groundwater due to their concentrations measured within the atmosphere during specific historical time periods and their subsequent decay.

3.4 - Land Use, Groundwater Pumping, and Groundwater Flow (USGS Tasks 4/5)

Land use and groundwater pumping has a substantial influence on historic and current groundwater flow. For example, to calculate theoretical groundwater movement since the 1950s when chromium was released at the Site, one cannot simply multiple the numbers of days since the release occurred times a single upper end groundwater velocity for the entire Hinkley Valley and Water Valley in feet per day. Pumping associated with agriculture has formed substantial and well documented cones of depression within the chromium plume area, and these features have limited and continue to limit groundwater movement to the north, west, and east. The following presents information on land use and groundwater pumping in the Hinkley Valley.

Land Use and Groundwater Pumping

Land use in the Hinkley Valley has been dominated by agricultural activities including dairy farming and growing crops (such as alfalfa) since the 1950s. Aerial photographs provide evidence of this land use and indicate crop irrigation (and the associated groundwater extraction) was much more intensive in the south central and eastern Hinkley Valley (north and east of the Hinkley Compressor Station and south of Thompson Road) compared to the western (west of the Lockhart Fault) and northern Hinkley Valley (north of Thompson Road).

Hinkley Valley crops were historically irrigated with groundwater supplied from water supply wells typically located adjacent to, or a short distance from each field and applied to the field via either furrow irrigation (the common practice in the Hinkley Valley in the 1950s and 1960s), and in more recent years, by using a center-pivot irrigation system. Annual groundwater withdrawals for a given parcel can be approximated by estimating the irrigated acreage of that parcel based upon aerial photographs.

Available aerial photographs for the Hinkley Valley, for the years spanning from 1944 to 2009, have been examined and annual groundwater extraction amounts have been estimated. Annual extraction amounts for years when aerial photographs are not available have been interpolated based upon available photographs or based upon pumping records from the Water Master and remedial pumping records. These photographs show that irrigated agricultural land use began in earnest in the early 1950s and continues through current times. Figure G1 provides aerial photographs from 1953, 1970, and 1989 to illustrate the consistency of agricultural activities in the area where PG&E is currently conducting groundwater extraction for remedial operations. As shown on the figure, the area that PG&E is farming for remedial operations today (orange area on Figure G1) was also consistently used for agricultural purposes since the 1950s. This indicates that some degree of the hydraulic containment that PG&E is currently achieving with focused pumping for chromium plume containment has also occurred since the 1950s.

To estimate historical pumping versus current PG&E remedial pumping, Figures G2A and G2B show historical and recent agricultural pumping rates (estimated from aerial photographs 1952 to 2009) and recent remedial pumping rates in the area where PG&E is currently conducting remedial pumping operations at the Desert View Dairy (DVD ATU) and adjacent Agricultural Units (AUs) (CH2M HILL and ARCADIS, 2013). The area where historical pumping rates were estimated is comparable with the areas where PG&E is currently conducting remedial pumping shown on Figure G1. Figures G2A and G2B show that recent combined remedial pumping rates for the DVD ATU and the various AUs (no shading on bars) are less than or comparable with the estimated historical agricultural pumping rates for these same areas (shown by hatched bars). These data suggest that starting as early as the 1950s there has been hydraulic containment in the current DVD ATU and AU areas that would have limited groundwater flow outside of the main plume area, generally defined by the current 10 µg/L chromium iso-contour.

These observations are completely in line with the geochemical data discussed above – there is a clear distinct signature in the geochemical data that matches the historic and recent groundwater pumping and resulting areas of hydraulic capture south of Thompson Road. Groundwater has not been flowing north at a rate of two feet per day since the 1950s. In fact, little to no groundwater has flowed from the South Hinkley Valley north of Thompson Road during much of this time period.

Changes in Groundwater Levels and Groundwater Flow

Groundwater in the Hinkley Valley is primarily recharged from intermittent flows from the Mojave River, with limited to no local recharge occurring from rainfall in the adjacent mountains and hills. By the 1950s, overdraft of the Hinkley Valley aquifer, and other Mojave Basin aquifers (as evidenced by significant regional groundwater level declines) was observed. Continued over-pumping formed the basis for early adjudication efforts in the 1960s and formal Stipulated Agreement of the Mojave Basin including the Centro Basin in 1996.

Evaluation of historical groundwater elevation data can be used to estimate historic groundwater flow including regional pumping depressions within the Hinkley Valley. Historical groundwater data from the USGS (http://nwis.waterdata.usgs.gov/nwis/gwlevels), as well as from PG&E's database of groundwater-level measurements, were examined to evaluate historic groundwater gradients and pumping depressions.

Figure G3 shows the location of selected wells in the Western, Northern, and Eastern Areas where hydrographs were prepared. Hydrographs are shown on Figures G4A and G4B. The hydrographs show a rapid decline in groundwater elevations in the southern Hinkley Valley

(central and eastern portions) starting in the 1950s and continuing into the 1960s. These data are consistent with the appearance of agricultural activities in this area in historical aerial photographs from the 1950s. Drawdown in the eastern portion of the Hinkley Valley was greatest during the 1950s and 1960s, as indicated by the rapid drawdown in the 1950s and subsequent recovery in the 1980s at well 010N003W26R001S (an orange "X" on the bottom chart on Figure G4A).

Hydrographs for wells in the west Hinkley Valley are presented on Figure G4B. Very little change is observed in hydrographs for wells in the west Hinkley Valley during the same period that a rapid decline in water levels was occurring in the central and eastern Hinkley Valley. Notably the supply well 010N003W33J001S (blue rectangle on Figure G4B), located in an area where PG&E's short screen monitoring wells have detected chromium up to 10 µg/L, shows almost no change suggesting the limited pumping in the west did not have a hydraulic influence on the chromium plume.

Data from 1958 and 1959 are posted and contoured on Figure G5. Measurements were collected during the winter months when agricultural water use is typically at the lowest stage of the year. Based on these contours, groundwater flow directions are generally from the southwest and southeast towards a large pumping depression in the center of the southern Hinkley Valley near the current DVD ATU and AU areas. These gradients, which are similar to conditions today, suggest the chromium plume would not have migrated to the west, north, or east during this time period.

Historic groundwater data from the following documents also indicate similar patterns in historical groundwater levels in the southern Hinkley Valley (not including the area west of the Lockhart Fault) and indicate substantially depressed groundwater levels during the periods of extensive pumping in the southern Hinkley Valley during the1950s to at least the 1980s:

- California Department of Water Resources (DWR) - "*Mojave River Groundwater Basins Investigation"* (DWR, 1967) – This report illustrates the groundwater flow determined from 1964 groundwater levels showing that the groundwater flow in the southern Hinkley Valley in 1964 was also characterized by a hydraulic depression as a result of the agricultural pumping. A comparable groundwater level map was also prepared by the DWR using groundwater levels collected in 1961 and is included in the 1967 DWR report.

- DWR - "*Hydrogeology and Groundwater Quality in the Lower Mojave River Area, San Bernardino County",* (DWR, 1983) – This report includes a groundwater map using 1978 water level data. The groundwater depression in 1978 is even more pronounced in comparison with 1964 (and 1958). The pronounced groundwater depression in 1978 that surrounded the location of the current DVD ATU and AU areas would have limited northward groundwater flow out of the southern Hinkley Valley into the northern Hinkley Valley and limited flow from the central Hinkley Valley to the west Hinkley Valley.

These historical groundwater elevation maps from 1958, 1961, 1964 and 1978 in concert with the historic hydrographs, supports the conclusion that there was early hydraulic control that prevented or limited the flow of groundwater and migration of the chromium plume outside the pumping center. The multiple lines of evidence, including groundwater flow and geochemistry, clearly indicate groundwater has not been flowing at a rate of two feet per day south to north through the Hinkley Valley and into Water Valley since the 1950s.

The calculation presented in the proposed CAO should be deleted and replaced with text that acknowledges the existing scientific data presented by PG&E and the overall uncertainty in comparing the existing chromium data to the inaccurate background levels that were incorrectly established in 2008. The proposed CAO should reference the planned USGS studies that will consider multiple lines of evidence, consistent with the path agreed upon by the TWG, to develop scientifically balanced conclusions on groundwater flow and the estimated boundaries of the chromium plume.

3.5 - Chromium Concentration Gradient

Chromium data from wells installed in the North Hinkley Valley, Water Valley, and east of Summerset Road (Figure G14) show a relatively narrow range of low chromium concentrations with no apparent up-gradient to down-gradient concentration trend. Note the data presented on this figure has not been updated from when Appendix G was published in 2014; the overall interpretation is unchanged. Wells in the west, particularly on the southwest side of the Lockhart Fault and at Mulberry Road, exhibit relatively high chromium concentrations which are spatially disconnected from the chromium plume.

- **East** - The east area bounded by Summerset and Lenwood Roads (west and east) and Community Blvd. and Acacia Street (south and north) covers approximately two square miles. The range of chromium concentrations is narrow, from numerous wells with ND results to a few wells with concentrations ranging from 3 to 5 µg/L. There is no west to east or south to north concentration gradient suggesting the chromium is sourced by the PG&E plume, and a continuous 3.1 µg/L contour cannot be drawn.

- **North** - The chromium concentrations measured in wells north of Sonoma Street in the North Hinkley Valley to May Road in Water Valley (a 4 ½-mile distance) exhibit no south to north concentration gradient suggestive of a contaminant plume. Cr concentrations in Water Valley are generally higher than Cr concentrations in the North Hinkley Valley. Chromium concentrations in Water Valley (not including the "hot spots" at MW-193 and MW-196 which are not associated with the PG&E plume) have a relatively narrow range, with most detected between 3 to 5 µg/L and a few present between 6 and 8 µg/L.

- **West** - West of the Lockhart Fault chromium is present at well MW-159S, MW-160S, and MW-163S along with several nearby domestic wells at relatively high concentrations. As presented in several of the reports for this area and referenced at the beginning of this Tech Memo (and attached to PG&E's detailed comments on the proposed CAO), groundwater flow is currently and historically has continuously been from southwest to northeast in this area. Further the groundwater level is nearly 20 feet higher in this area compared to the chromium plume, and the plume area and these wells are separated by the Lockhart Fault.

  Chromium data in new well MW-203D on Mulberry Avenue, screened in weathered volcanic rock, is relatively high (above 10 µg/L for Cr6 during several sampling events) compared to previously existing well MW-164S/D and new wells MW-201S/D and MW-202S/D on Hinkley Road. Well MW-203D is at least 4,500 feet northwest of the next closest monitoring well containing chromium above the 3.1/3.2 µg/L chromium values (MW-153S), separated by much lower results at the referenced wells. MW-203D is a good example of naturally occurring chromium that is likely the result of local geologic materials (weathered volcanic rock). The USGS studies will further examine these conditions and shed further light upon the scientific explanation(s) for the observed natural chromium conditions.

Concentration Gradient Summary

Groundwater plumes typically exhibit a somewhat predictable pattern with high concentrations near the source and lower concentrations at the down-gradient limits. The PG&E chromium plume has been influenced by groundwater pumping and natural groundwater flow paths over an extended period of time. It is expected that the chromium plume may exhibit some degree of irregularity in geometry and concentration gradient. However, these factors cannot by themselves explain the vast areas to the north and east with narrow concentration ranges, isolated "hot spots" that clearly are not associated with the PG&E plume, and no apparent concentration gradient over the flow path.

These factors also do not explain the presence of chromium in the west, including up-gradient of the Lockhart Fault, that are disconnected from the plume area(s) by distances up to and exceeding one mile. In fact, the Regional Board Executive Officer in a letter to PG&E concurred that chromium above the established background values southwest of the Lockhart Fault and east of Dixie Road are not associated with the PG&E plume. There are clear and reasonable scientific explanations for these data. PG&E looks forward to working with the TWG and the other members of the USGS to conduct further studies and develop defensible explanations.

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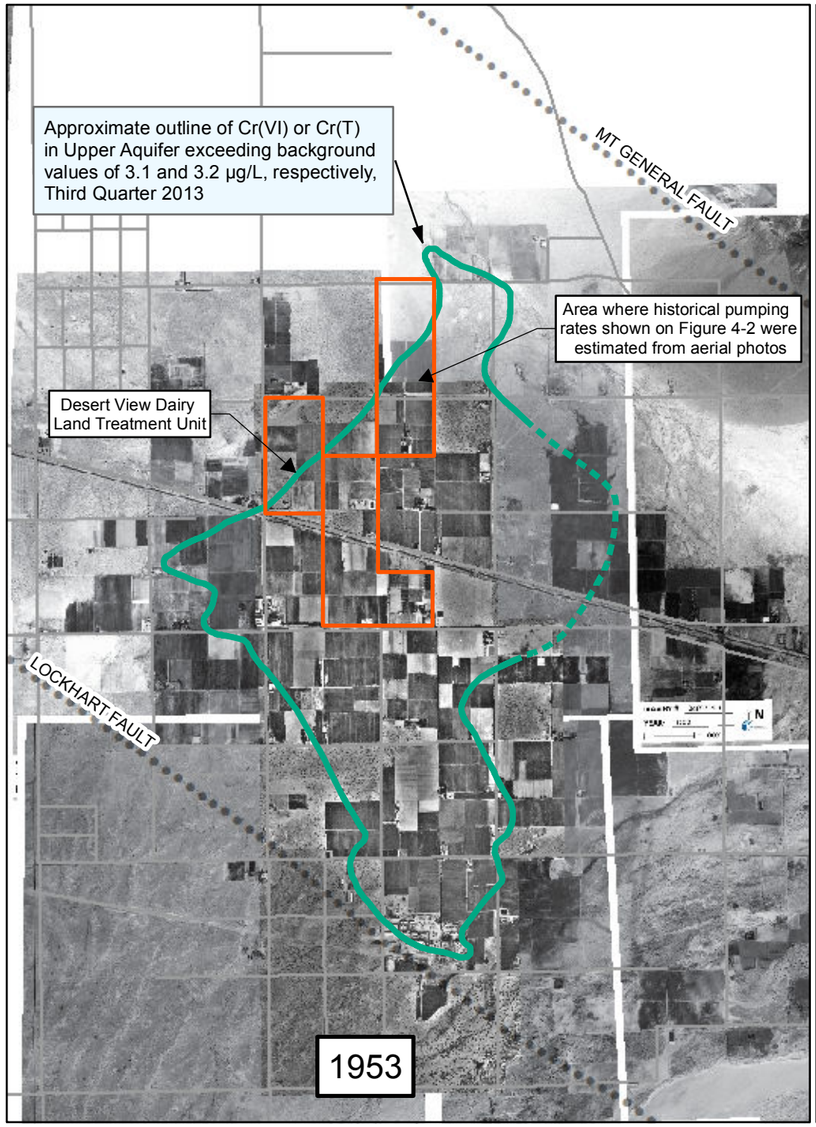
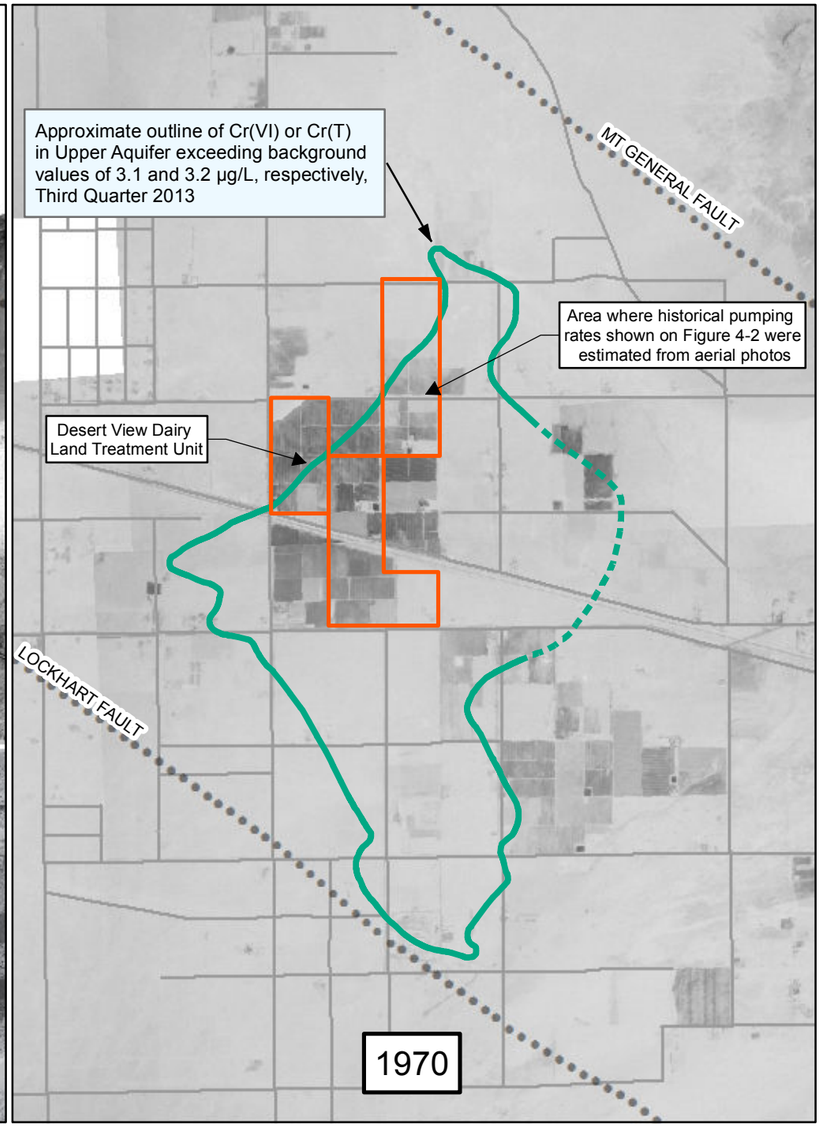
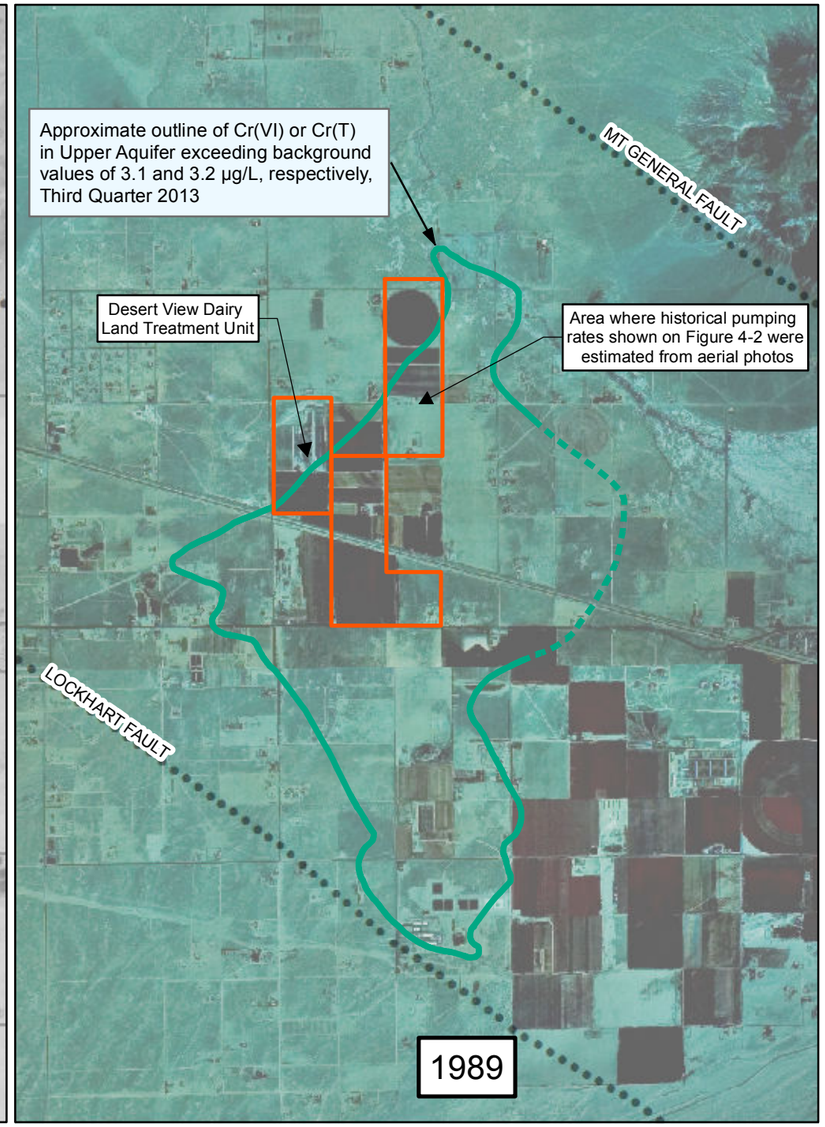






Legend

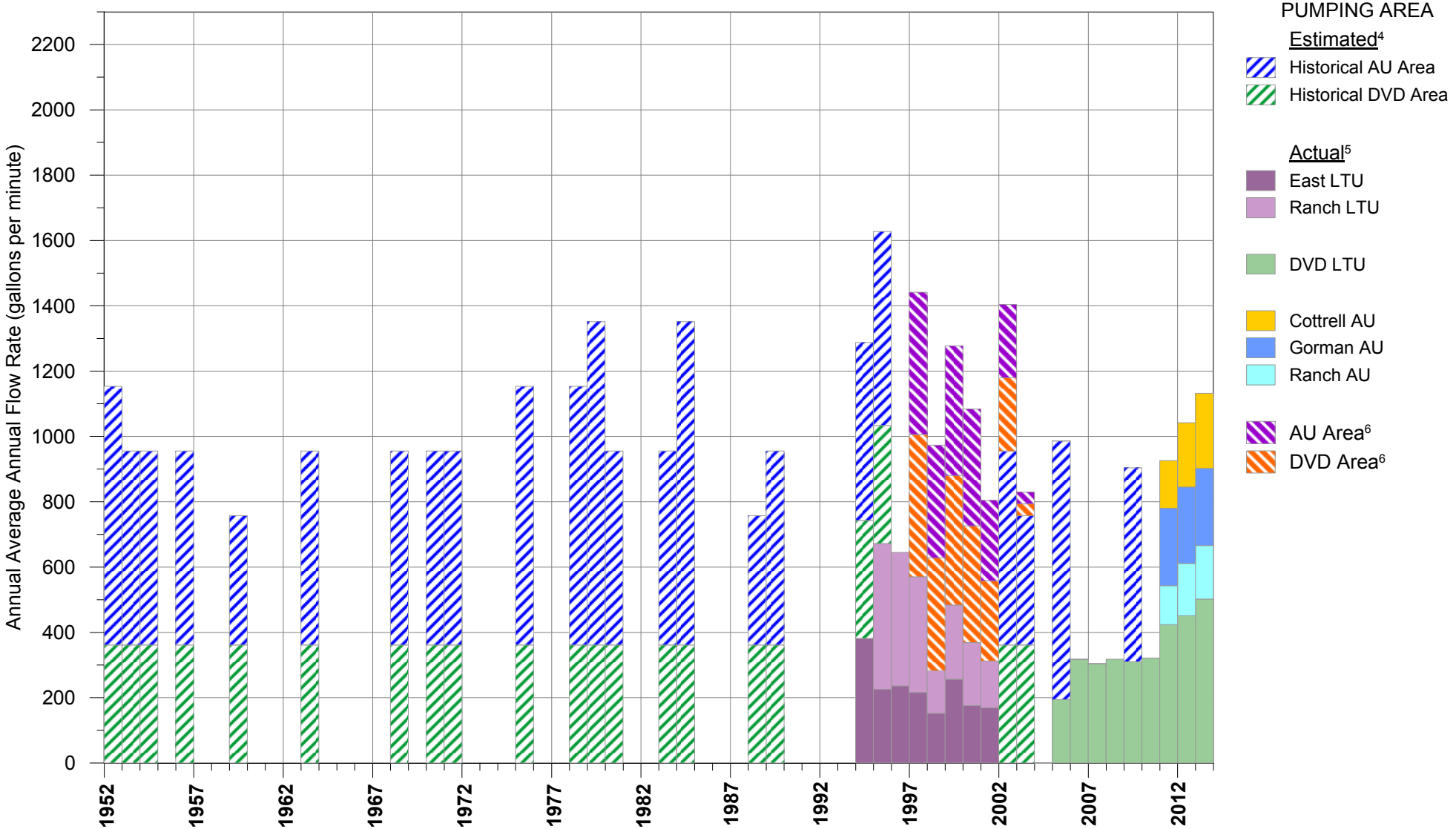
Approximate Trace of Concealed Fault (Stamos et al., 2001)

N

0 3,500

Feet

FIGURE G-1
LAND USE IN THE HINKLEY VALLEY
1953, 1970 AND 1989
PRELIMINARY CONCEPTUAL SITE MODEL FOR GROUNDWATER FLOW AND THE OCCURRENCE OF CHROMIUM IN GROUNDWATER OF THE HINKLEY VALLEY
PACIFIC GAS AND ELECTRIC COMPANY
HINKLEY COMPRESSOR STATION HINKLEY, CALIFORNIA



Notes
AU = Agricultural Unit
DVD LTU = Desert View Dairy Land Treatment Unit
LTU = Land Treatment Unit

1) The Ranch and East LTUs ceased operations in June and July 2001, respectively.
2) The DVD LTU began operations in September 2004.
3) The Cottrell, Gorman, and Ranch AUs were brought online May 17, 2011, March 2, 2011, and May 31, 2011, respectively.
4) Estimated pumping rates for historical DVD and AU areas are based on analysis of aerial and satellite photographs showing active agricultural activity for years 1952-54, 1956, 1959, 1963, 1968, 1970-71, 1975, 1978-80, 1983-84, 1988-89, 1994-95, 2002-03, 2005, and 2009.
5) Solid bars indicate actual pumping data from PG&E remedial operations.
6) Actual pumping rates for wells from California Watermaster.

FIGURE G2A. ESTIMATED AND ACTUAL PUMPING RATES FROM 1952 THROUGH MARCH 2013

PRELIMINARY CONCEPTUAL SITE MODEL FOR GROUNDWATER FLOW AND THE OCCURRENCE OF CHROMIUM IN GROUNDWATER OF THE HINKLEY VALLEY
PACIFIC GAS AND ELECTRIC COMPANY
HINKLEY COMPRESSOR STATION
HINKLEY, CALIFORNIA

CH2MHILL

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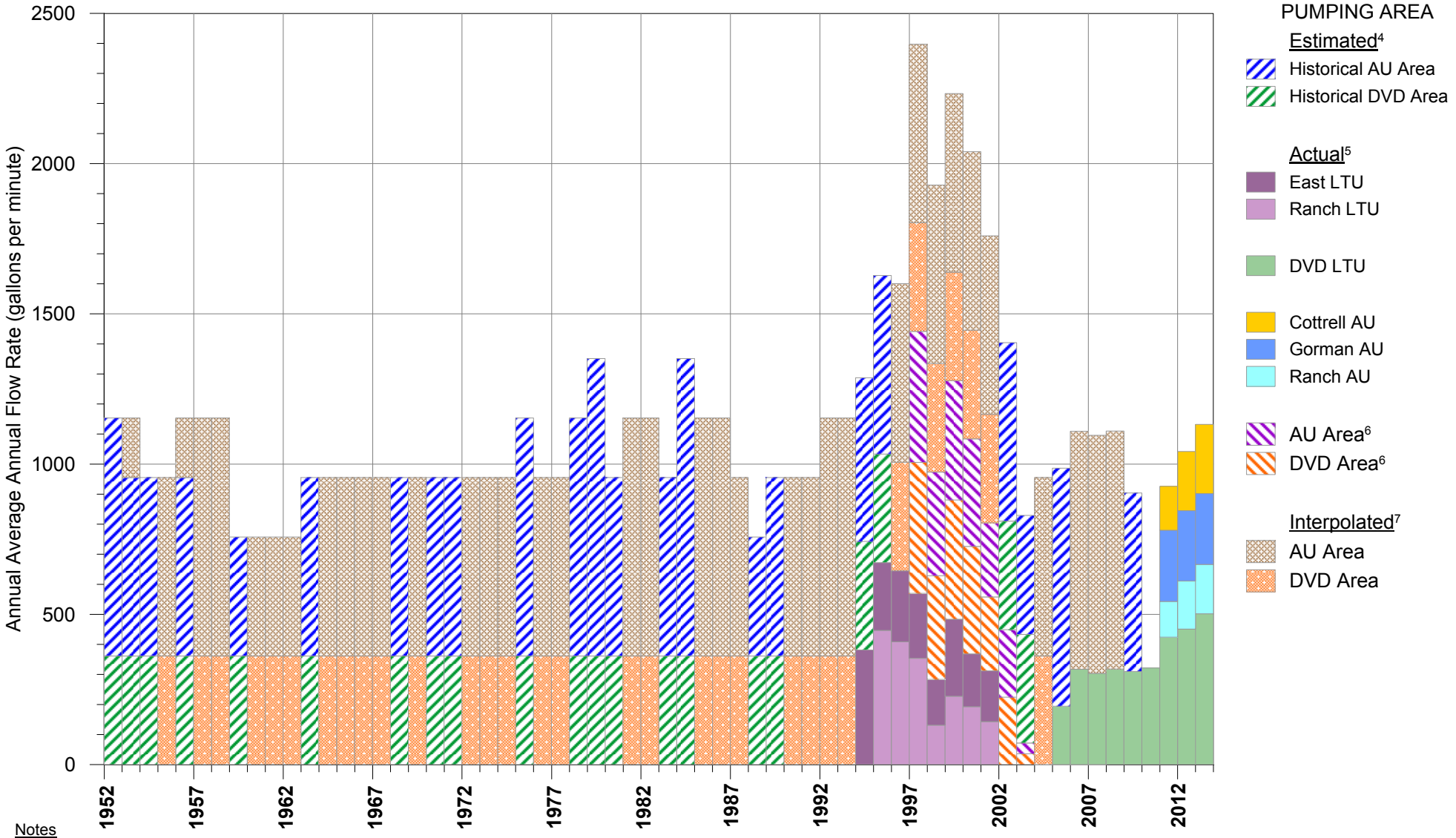

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1) The Ranch and East LTUs ceased operations in June and July 2001, respectively.
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3) The Cottrell, Gorman, and Ranch AUs were brought online May 17, 2011, March 2, 2011, and May 31, 2011, respectively.
4) Estimated pumping rates for historical DVD and AU areas are based on analysis of aerial and satellite photographs showing active agricultural activity for years 1952-54, 1956, 1959, 1963, 1968, 1970-71, 1975, 1978-80, 1983-84, 1988-89, 1994-95, 2002-03, 2005, and 2009.
5) Solid bars indicate actual pumping data from PG&E remedial operations.
6) Actual pumping rates for wells from California Watermaster.
7) Interpolated pumping rates were inferred for periods of time when aerial or satellite photographs were not available but agricultural activity was occurring based on aquifer drawdown analyses from USGS (Stamos et al., 2001).

FIGURE G2B. INTERPOLATED, ESTIMATED AND ACTUAL PUMPING RATES FROM 1952 THROUGH MARCH 2013

PRELIMINARY CONCEPTUAL SITE MODEL FOR
GROUNDWATER FLOW AND THE
OCCURRENCE OF CHROMIUM IN
GROUNDWATER OF THE HINKLEY VALLEY
PACIFIC GAS AND ELECTRIC COMPANY
HINKLEY COMPRESSOR STATION
HINKLEY, CALIFORNIA

CH2MHILL

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Geologic conditions in the Water Valley area shown here as a gray shaded box are significantly different than Hinkley Valley located south of this area. A key difference is the presence of volcanic rocks that are known to contain high levels of natural chromium. Naturally sourced chromium concentrations exceeding 50 ug/L in groundwater have been reported in other Mojave Desert studies conducted in similar environments (Izbiki et al., 2008, others). The source(s) of chromium in this area will be evaluated during the upcoming background study with the United States Geological Survey.

Geologic conditions in the North Hinkley Valley shown here as a light gray shaded area are different than South Hinkley Valley (south of Thompson Road). A key difference is the presence of volcanic rocks that are known to contain high levels of natural chromium. Naturally sourced chromium concentrations exceeding 50 ug/L in groundwater have been reported in other Mojave Desert studies conducted in similar environments (Izbiki et al., 2008, others). The source(s) of chromium in this area will be evaluated during the upcoming background study with the United States Geological Survey.

An evaluation of available hydrogeologic and groundwater quality data for the shaded Western Area shown on this figure was included in the January 14, 2013, document titled *Conceptual Site Model for Groundwater Flow and the Occurrence of Chromium in Groundwater of the Western Area Report* (CH2MHILL and Stantec, 2013). The findings of the January 14 report indicate that groundwater in the Western Area contains naturally occurring chromium.

Approximate outline of Cr(VI) or Cr(T) in Upper Aquifer exceeding background values of 3.1 and 3.2 µg/L, respectively, Third Quarter 2013

Historical and current groundwater level data indicate that the groundwater flow direction in this area is towards the chromium plume core area (northwest). In addition, water chemistry data suggest that some groundwater from wells in this area has a different geochemical makeup than groundwater from wells located within the chromium plume core area. The source(s) of chromium in this area will be evaluated during the upcoming background study with the United States Geologic Survey.

Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

LEGEND

- Wells Plotted on Hydrographs

N

0 1,500 3,000

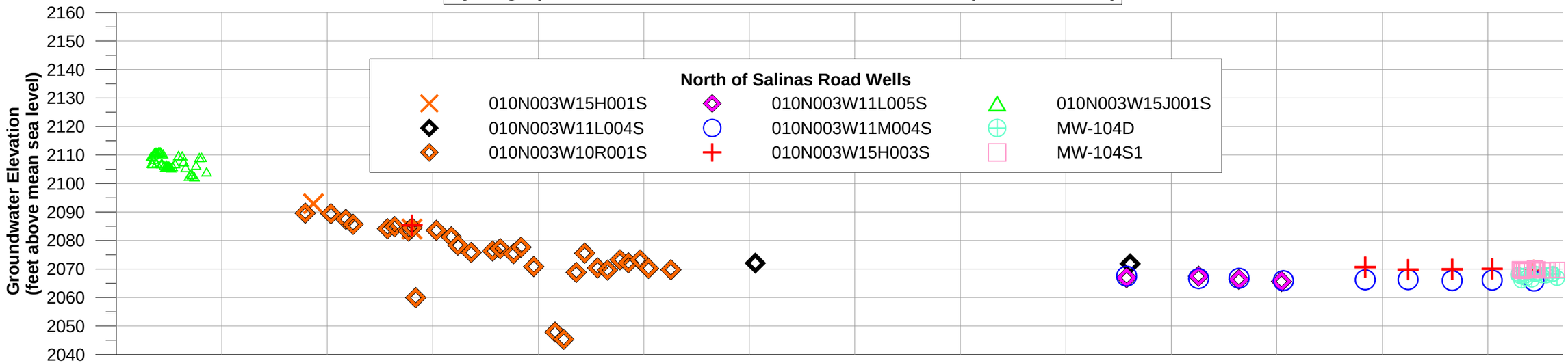
Feet

FIGURE G-3
LOCATION OF WELLS PLOTTED ON HYDROGRAPHS

PRELIMINARY CONCEPTUAL SITE MODEL FOR GROUNDWATER FLOW AND THE OCCURRENCE OF CHROMIUM IN GROUNDWATER OF THE HINKLEY VALLEY
PACIFIC GAS AND ELECTRIC COMPANY
HINKLEY COMPRESSOR STATION HINKLEY, CALIFORNIA

Note:
Aerial imagery data source: Esri, i-cubed, USDA, USGS, AEX, GeoEye, Getmapping, Aerogrid, IGN, IGP, and the GIS User Community.
Image aquisition date: May 5, 2010

Hydrographs for Wells Located North of Salinas Road (Northern Area)



Hydrographs for Wells Located in the Southern Hinkley Valley (Eastern Area)

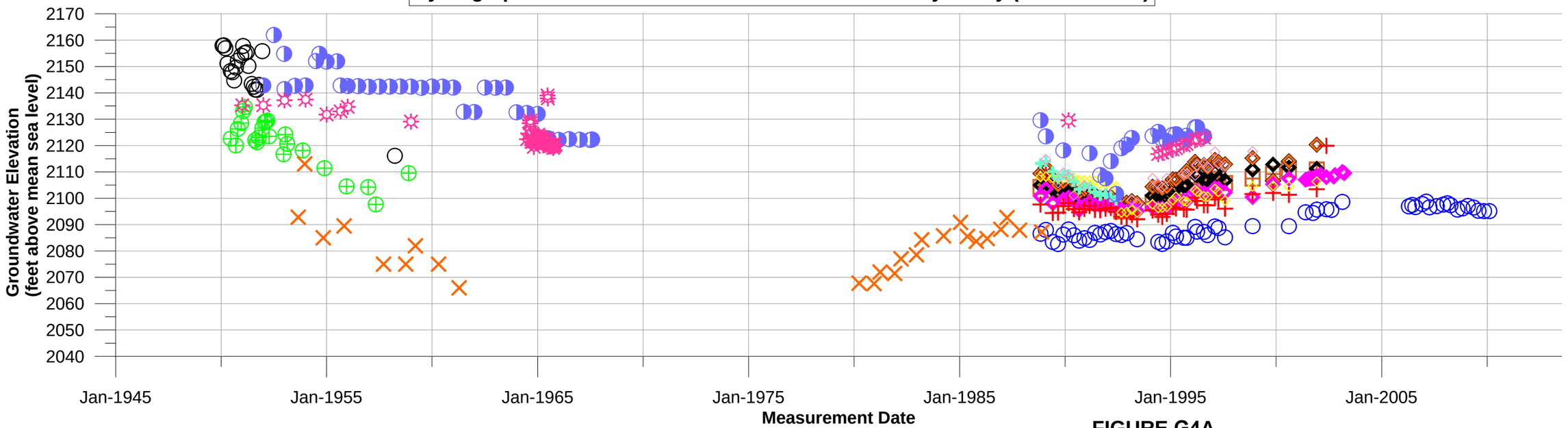


FIGURE G4A
NORTHERN, CENTRAL AND EASTERN HINKLEY VALLEY HYDROGRAPHS
PRELIMINARY CONCEPTUAL SITE MODEL FOR GROUNDWATER FLOW AND THE OCCURANCE OF CHROMIUM IN GROUNDWATER OF THE HINKLEY VALLEY
PACIFIC GAS AND ELECTRIC COMPANY
HINKLEY COMPRESSOR STATION HINKLEY, CALIFORNIA

CH2MHILL

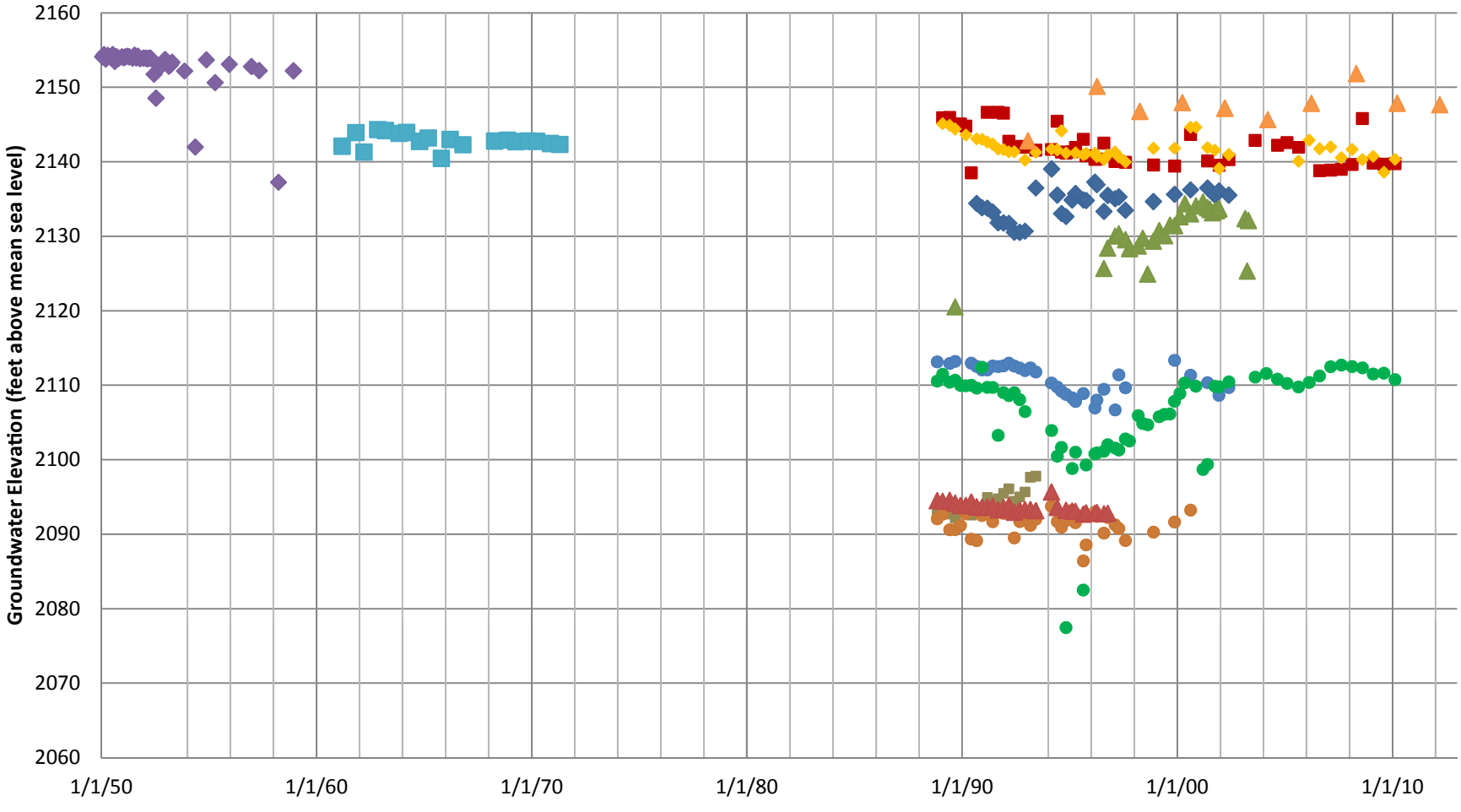


FIGURE G4B
WESTERN AREA WELL HYDROGRAPHS

PRELIMINARY CONCEPTUAL SITE MODEL
FOR GROUNDWATER FLOW AND THE
OCCURRENCE OF CHROMIUM IN
GROUNDWATER OF THE HINKLEY VALLEY
PACIFIC GAS AND ELECTRIC COMPANY
HINKLEY COMPRESSOR STATION
HINKLEY, CALIFORNIA

CH2MHILL

Geologic conditions in the Water Valley area shown here as a gray shaded box are significantly different than Hinkley Valley located south of this area. A key difference is the presence of volcanic rocks that are known to contain high levels of natural chromium. Naturally sourced chromium concentrations exceeding 50 ug/L in groundwater have been reported in other Mojave Desert studies conducted in similar environments (Izbiki et al., 2008, others). The source(s) of chromium in this area will be evaluated during the upcoming background study with the United States Geological Survey.

Geologic conditions in the North Hinkley Valley shown here as a light gray shaded area are different than South Hinkley Valley (south of Thompson Road). A key difference is the presence of volcanic rocks that are known to contain high levels of natural chromium. Naturally sourced chromium concentrations exceeding 50 ug/L in groundwater have been reported in other Mojave Desert studies conducted in similar environments (Izbiki et al., 2008, others). The source(s) of chromium in this area will be evaluated during the upcoming background study with the United States Geological Survey.

Historical and current groundwater level data indicate that the groundwater flow direction in this area is towards the chromium plume core area (northwest). In addition, water chemistry data suggest that some groundwater from wells in this area has a different geochemical makeup than groundwater from wells located within the chromium plume core area. The source(s) of chromium in this area will be evaluated during the upcoming background study with the United States Geologic Survey.

Approximate outline of Cr(VI) or Cr(T) in Upper Aquifer exceeding background values of 3.1 and 3.2 µg/L, respectively, Third Quarter 2013

An evaluation of available hydrogeologic and groundwater quality data for the shaded Western Area shown on this figure was included in the January 14, 2013, document titled *Conceptual Site Model for Groundwater Flow and the Occurrence of Chromium in Groundwater of the Western Area Report* (CH2MHILL and Stantec, 2013). The findings of the January 14 report indicate that groundwater in the Western Area contains naturally occurring chromium.

MT GENERAL FAULT

LOCKHART FAULT

010N003W02J001S 1/6/1959: 2095.8
010N003W02R001S 1/6/1959: 2090
010N003W11M002S 1/7/1959: 2085
010N003W11M003S 1/7/1959: 2090
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010N002W32N001S 12/2/1958: 2144.67
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009N002W17D003S 10/8/1958: 2168.94
PGE-01 1/1/1959: 2129.100098
PGE-02 1/1/1959: 2142.350098
PGE-03 1/1/1959: 2123.669922
PGE-04 1/1/1959: 2137.070068
PGE-06 1/1/1959: 2144.570068

2080 2090 2100 2110 2120 2130 2140 2150 2160 2170 2180 2190

Roy Rd, Holstead Rd, Mountain General Rd, Burnt Tree Rd, Fossil Bed Rd, American Way, Coon Canyon Rd, Sierra Rd, Orchard St, Sonoma St, Tindall Rd, Hinkley Rd, Salinas Rd, Blanca Rd, Palma Rd, Serra Rd, Manaco, Petra Rd, Pueblo Rd, Pera Rd, Thompson Rd, Alcudia Rd, Mountain View Rd, Summerset Rd, Dixie Rd, Lenwood Rd, Acacia St, Santa Fe Ave, Park Ave, Mulberry Ave, Flower Rd, Sycamore St, Hope St, Locust Rd, Willow Springs Rd, Kinski Rd, Lake View Rd, Valley View Rd, Hidden River Rd, Indian Wells Rd, Red Rock Rd, Hillview Rd, Rainbow Rd, Frontier Rd, Carson Rd, Granada Rd, Pioneer Rd, Catskill Rd, Camino Rd, Fairview Rd, Valley Wells Rd, Aquarius Rd, Highcrest Rd, Hervey Rd, Riverview Rd, Community Blvd, Riverview Rd, Agate Rd, Birch Rd, Jasper Rd, Shaves Ave, West Mountain Rd, Willow Springs Rd, Kinski Rd, 58

Legend

- Reported Groundwater Elevation Measuring Point
- Potentiometric Elevation Contours (feet above mean sea level, 10 ft contour interval)
- General Groundwater Flow Direction
- Approximate Trace of Concealed Fault (Stamos et al., 2001)

Notes:
1. Locations of wells are approximate and some were reported to the nearest 1/16th tract. As such, contours are approximate.
2. Groundwater elevation data are from the United States Geological Survey (USGS, 2004) and USGS Water Resources of CA website. http://waterdata.usgs.gov/ca/nwis/nwis
3. Data posted are from 10/1/1958 through 1/9/1959.
4. Background photo is from 1958
5. µg/L = micrograms per liter.

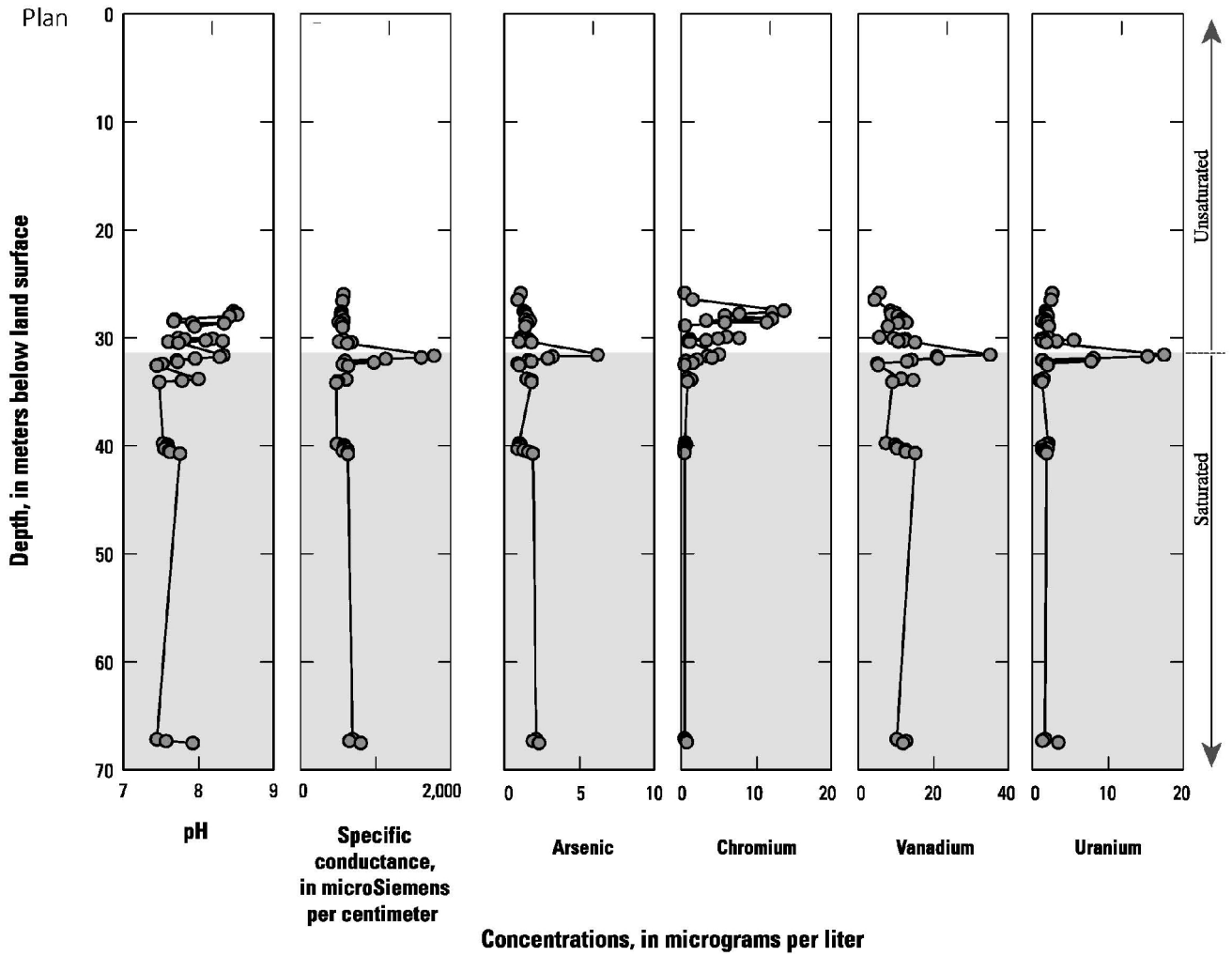
N

0 2,500 Feet

FIGURE G-5
GROUNDWATER ELEVATION CONTOURS IN UPPER AND LOWER AQUIFERS, WINTER 1958-1959
PRELIMINARY CONCEPTUAL SITE MODEL FOR GROUNDWATER FLOW AND THE OCCURRENCE OF CHROMIUM IN GROUNDWATER OF THE HINKLEY VALLEY
PACIFIC GAS AND ELECTRIC COMPANY
HINKLEY COMPRESSOR STATION HINKLEY, CALIFORNIA

CH2MHILL

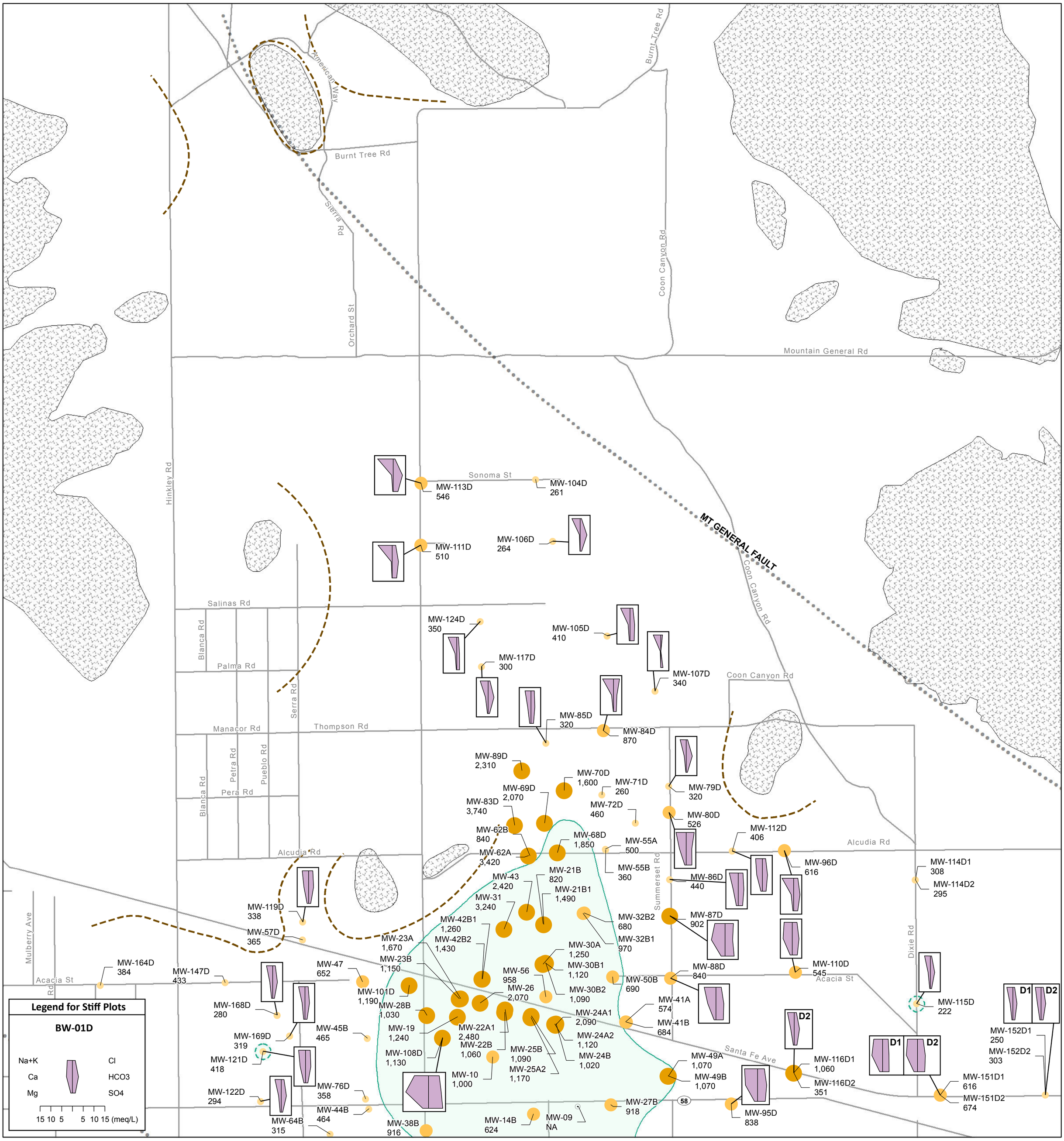
V:\18571\PG&E\MXD_Files\2nd Half 2013\Oct 30 2013 Report\Figure G6 (Profile of GW data) (2012-2-17)8x11.mxd



Notes:
1. Figure taken from: J.A. Izbiki et al., Applied Geochemistry 23 (2008) 1325-1352.
2. Data collected from core material from Sheep Creek fan upgradient from El Mirage, western Mojave Desert, southern California.

Stantec
57 LAFAYETTE CIRCLE, 2ND FLOOR
LAFAYETTE, CALIFORNIA
PHONE: (925) 299-9300 FAX: (925) 299-9302

FOR:			FIGURE:
Pacific Gas & Electric Groundwater Remediation Project Hinkley, California	**PROFILE OF GROUNDWATER DATA FROM IZBICKI**		G6
JOB NUMBER: 185702482	DRAWN BY: TF	CHECKED BY: BD	APPROVED BY: CM	DATE: 02/17/12



Legend

Total Dissolved Solids (TDS) value in milligrams per liter (mg/L)

- 0 to <= 500 mg/L
- >500 to <= 1000 mg/L
- > 1000 mg/L
- Monitoring Well
- Approximate Limit of Saturated Alluvium Upper Aquifer
- Approximate Trace of Concealed Fault (Stamos et al., 2001)
- Approximate outline of Cr(VI) or Cr(T) in Deep Zone of the Upper Aquifer exceeding background values of 3.1 and 3.2 µg/L, respectively, Fourth Quarter 2012
- Bedrock Exposed at Ground Surface

Notes:
1) Map Source:
Geologic Map of the Barstow and Daggett 15 minute quadrangles (Dibblee, 2008)

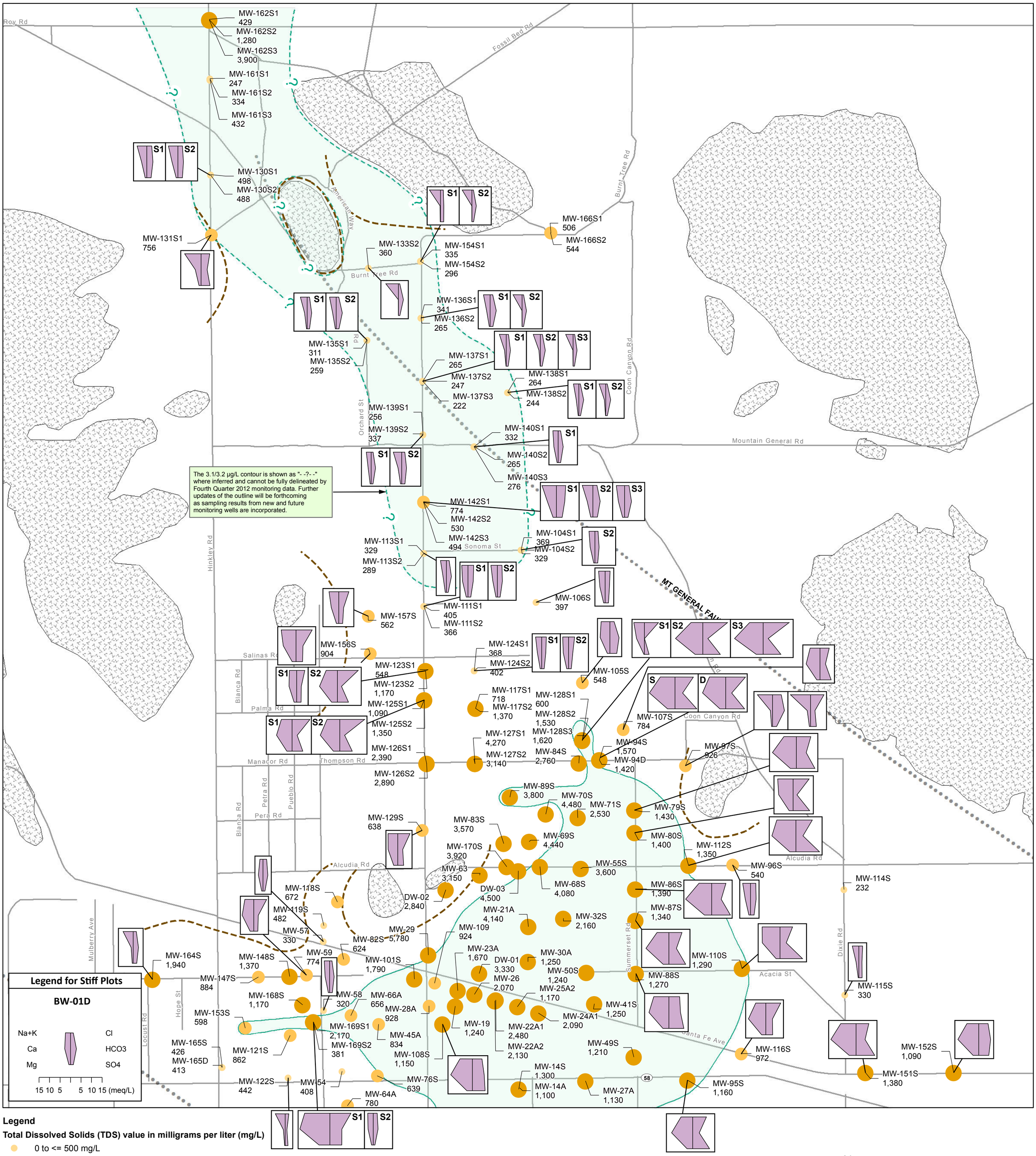
NA = Not Analyzed

N

0 1,000 2,000 3,000
Feet

FIGURE G7
TOTAL DISSOLVED SOLIDS AND STIFF PLOTS FOR DEEP ZONE OF UPPER AQUIFER
PRELIMINARY CONCEPTUAL SITE MODEL FOR GROUNDWATER FLOW AND THE OCCURRENCE OF CHROMIUM IN GROUNDWATER OF THE HINKLEY VALLEY
PACIFIC GAS AND ELECTRIC COMPANY
HINKLEY COMPRESSOR STATION
HINKLEY, CALIFORNIA

CH2MHILL



Notes:
1) Map Source:
Geologic Map of the Barstow and Daggett 15 minute quadrangles (Dibblee, 2008)

FIGURE G8
TOTAL DISSOLVED SOLIDS AND STIFF PLOTS FOR SHALLOW ZONE OF UPPER AQUIFER
PRELIMINARY CONCEPTUAL SITE MODEL FOR GROUNDWATER FLOW AND THE OCCURRENCE OF CHROMIUM IN GROUNDWATER OF THE HINKLEY VALLEY
PACIFIC GAS AND ELECTRIC COMPANY
HINKLEY COMPRESSOR STATION
HINKLEY, CALIFORNIA

CH2MHILL

Geologic conditions in the Water Valley area shown here as a gray shaded box are significantly different than Hinkley Valley located south of this area. A key difference is the presence of volcanic rocks that are known to contain high levels of natural chromium. Naturally sourced chromium concentrations exceeding 50 ug/L in groundwater have been reported in other Mojave Desert studies conducted in similar environments (Izbiki et al., 2008, others). The source(s) of chromium in this area will be evaluated during the upcoming background study with the United States Geological Survey.

Geologic conditions in the North Hinkley Valley shown here as a light gray shaded area are different than South Hinkley Valley (south of Thompson Road). A key difference is the presence of volcanic rocks that are known to contain high levels of natural chromium. Naturally sourced chromium concentrations exceeding 50 ug/L in groundwater have been reported in other Mojave Desert studies conducted in similar environments (Izbiki et al., 2008, others). The source(s) of chromium in this area will be evaluated during the upcoming background study with the United States Geological Survey.

Approximate outline of Cr(VI) or Cr(T) in Upper Aquifer exceeding background values of 3.1 and 3.2 µg/L, respectively, Third Quarter 2013

Historical and current groundwater level data indicate that the groundwater flow direction in this area is towards the chromium plume core area (northwest). In addition, water chemistry data suggest that some groundwater from wells in this area has a different geochemical makeup than groundwater from wells located within the chromium plume core area. The source(s) of chromium in this area will be evaluated during the upcoming background study with the United States Geologic Survey.

An evaluation of available hydrogeologic and groundwater quality data for the shaded Western Area shown on this figure was included in the January 14, 2013, document titled *Conceptual Site Model for Groundwater Flow and the Occurrence of Chromium in Groundwater of the Western Area Report* (CH2MHILL and Stantec, 2013). The findings of the January 14 report indicate that groundwater in the Western Area contains naturally occurring chromium.

Legend

Nitrate (as nitrogen) value in milligrams per liter (mg/L)

- 0 to <= 5 mg/L
- >5 to <= 10 mg/L
- > 10 mg/L
- Approximate Limit of Saturated Alluvium Upper Aquifer
- Approximate Trace of Concealed Fault (Stamos et al., 2001)
- Bedrock Exposed at Ground Surface

N

0 1,000 2,000 3,000

Feet

Notes:
1) Map Source:
Geologic Map of the Barstow and Daggett 15 minute quadrangles (Dibblee, 2008)

ND = Non Detected

FIGURE G-9
NITRATE AS NITROGEN IN SHALLOW ZONE OF UPPER AQUIFER
PRELIMINARY CONCEPTUAL SITE MODEL FOR GROUNDWATER FLOW AND THE OCCURRENCE OF CHROMIUM IN GROUNDWATER OF THE HINKLEY VALLEY
PACIFIC GAS AND ELECTRIC COMPANY
HINKLEY COMPRESSOR STATION HINKLEY, CALIFORNIA

CH2MHILL

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Geologic conditions in the North Hinkley Valley shown here as a light gray shaded area are different than South Hinkley Valley (south of Thompson Road). A key difference is the presence of volcanic rocks that are known to contain high levels of natural chromium. Naturally sourced chromium concentrations exceeding 50 ug/L in groundwater have been reported in other Mojave Desert studies conducted in similar environments (Izbiki et al., 2008, others). The source(s) of chromium in this area will be evaluated during the upcoming background study with the United States Geological Survey.

Approximate outline of Cr(VI) or Cr(T) in Upper Aquifer exceeding background values of 3.1 and 3.2 µg/L, respectively, Third Quarter 2013

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An evaluation of available hydrogeologic and groundwater quality data for the shaded Western Area shown on this figure was included in the January 14, 2013, document titled *Conceptual Site Model for Groundwater Flow and the Occurrence of Chromium in Groundwater of the Western Area Report* (CH2MHILL and Stantec, 2013). The findings of the January 14 report indicate that groundwater in the Western Area contains naturally occurring chromium.

Legend

Nitrate (as nitrogen) value in milligrams per liter (mg/L)

- 0 to <= 5 mg/L
- >5 to <= 10 mg/L
- > 10 mg/L
- Approximate Limit of Saturated Alluvium Upper Aquifer
- Approximate Trace of Concealed Fault (Stamos et al., 2001)
- Bedrock Exposed at Ground Surface

N

0 1,000 2,000 3,000

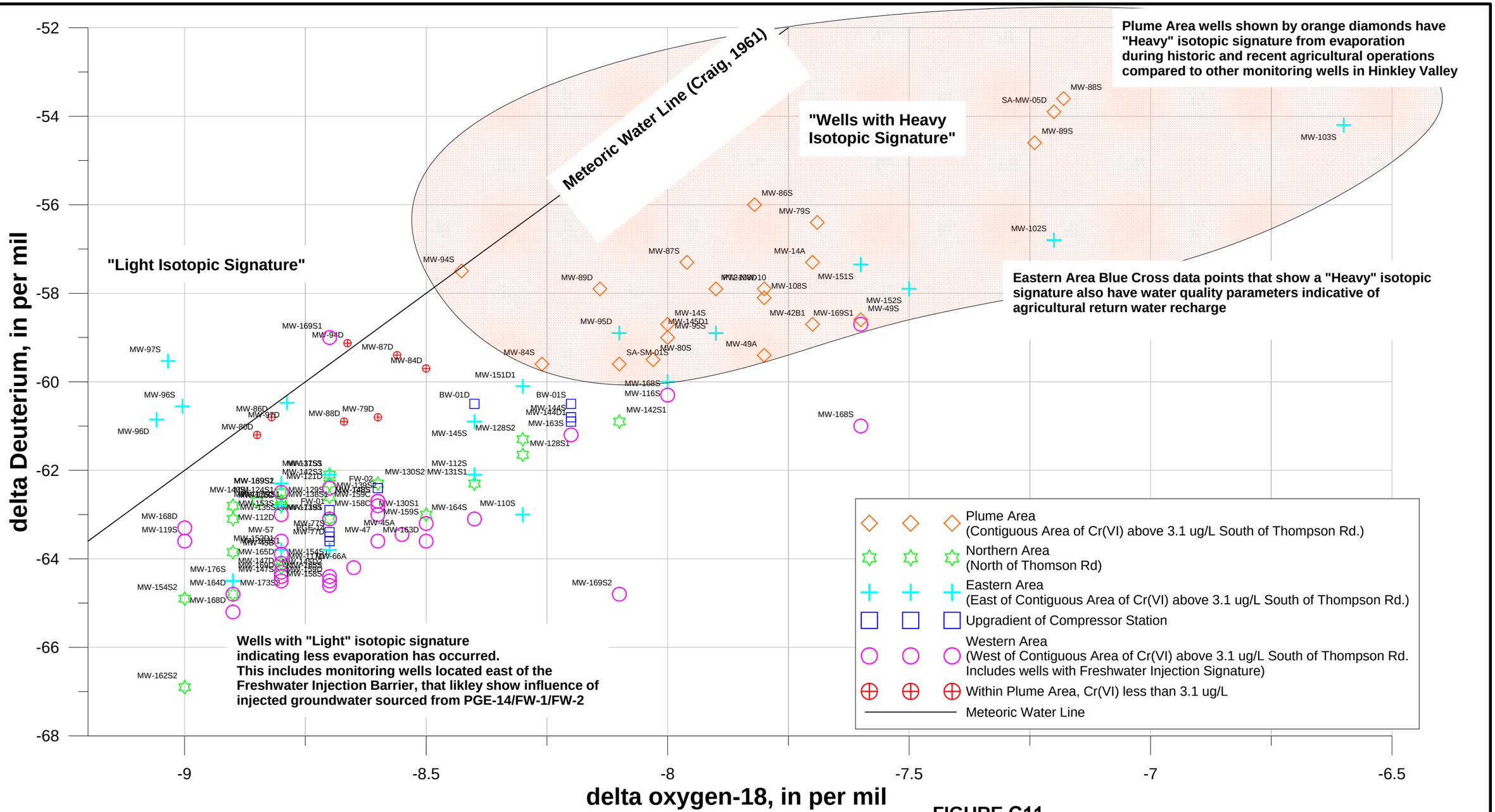
Feet

Notes:
1) Map Source:
Geologic Map of the Barstow and Daggett 15 minute quadrangles (Dibblee, 2008)

ND = Not Detected

FIGURE G-10
NITRATE AS NITROGEN IN DEEP ZONE OF UPPER AQUIFER
PRELIMINARY CONCEPTUAL SITE MODEL FOR GROUNDWATER FLOW AND THE OCCURRENCE OF CHROMIUM IN GROUNDWATER OF THE HINKLEY VALLEY
PACIFIC GAS AND ELECTRIC COMPANY
HINKLEY COMPRESSOR STATION HINKLEY, CALIFORNIA

CH2MHILL



Note:
See Figure 5-9 for well locations.
ug/L = micrograms per liter
Cr(VI) = hexvalent chromium

FIGURE G11
STABLE ISOTOPES OF OXYGEN AND DEUTERIUM, ALL AVAILABLE DATA
PRELIMINARY CONCEPTUAL SITE MODEL FOR GROUNDWATER FLOW AND THE OCCURANCE OF CHROMIUM IN GROUNDWATER OF THE HINKLEY VALLEY
PACIFIC GAS AND ELECTRIC COMPANY
HINKLEY COMPRESSOR STATION HINKLEY, CALIFORNIA

CH2MHILL

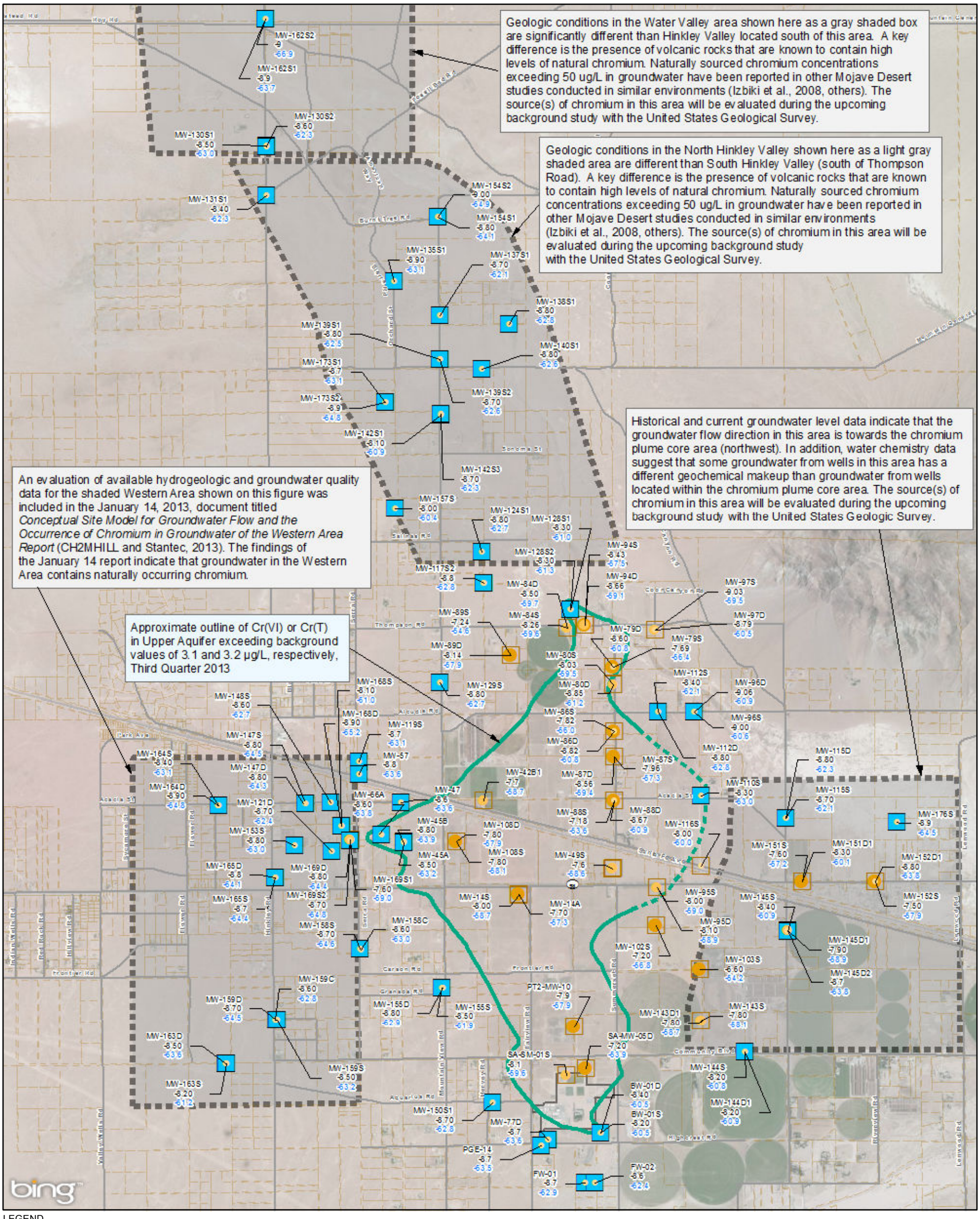
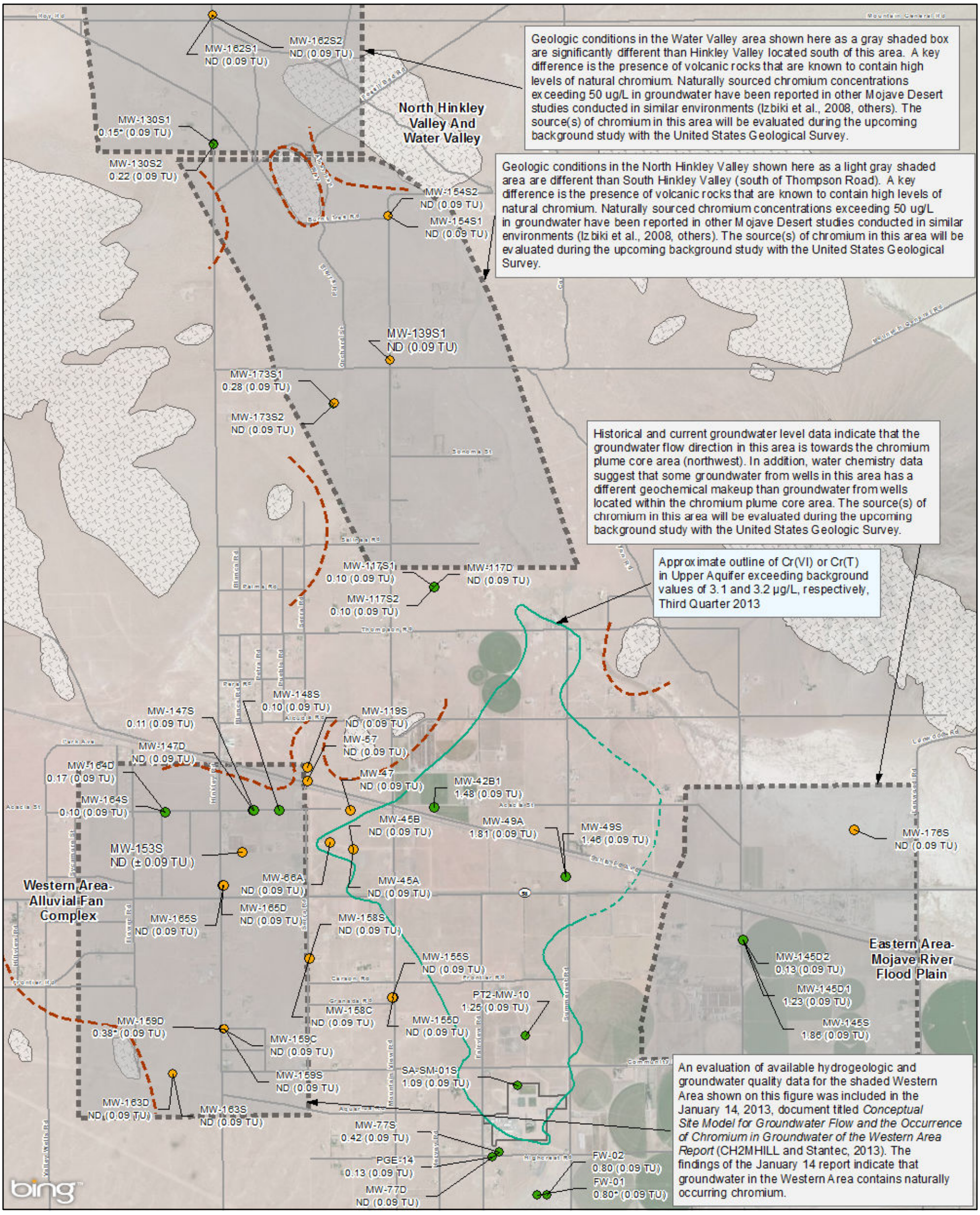


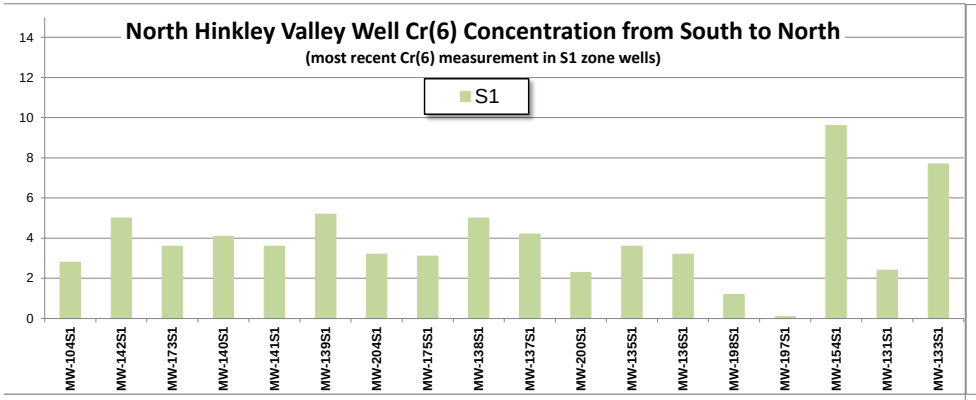
FIGURE G-12
DISTRIBUTION OF STABLE ISOTOPES OF OXYGEN AND DEUTERIUM
PRELIMINARY CONCEPTUAL SITE MODEL FOR GROUNDWATER FLOW AND THE OCCURRENCE OF CHROMIUM IN GROUNDWATER OF THE HINKLEY VALLEY
PACIFIC GAS AND ELECTRIC COMPANY
HINKLEY COMPRESSOR STATION HINKLEY, CALIFORNIA

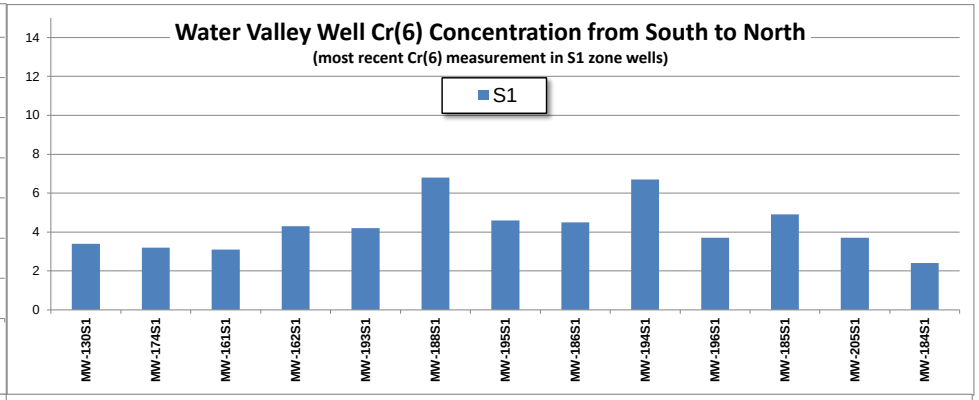


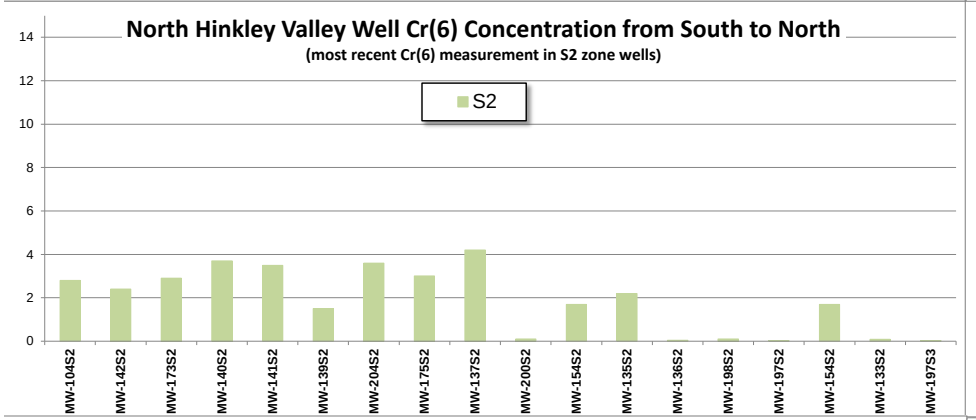
Note:
1. * Indicates average of duplicate samples.
2. Tritium results reported in tritium units (TUs).
   The analytical reporting limit for all samples was 0.09 TUs.

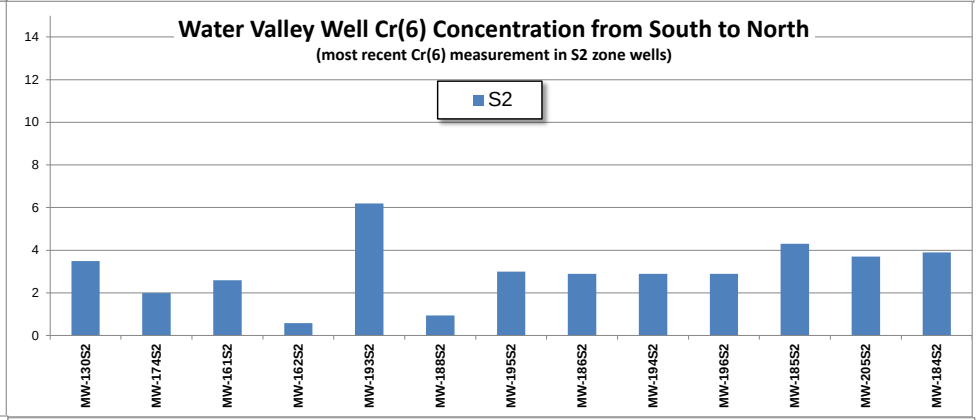
FIGURE G-13
DISTRIBUTION OF LOW LEVEL TRITIUM SAMPLING RESULTS

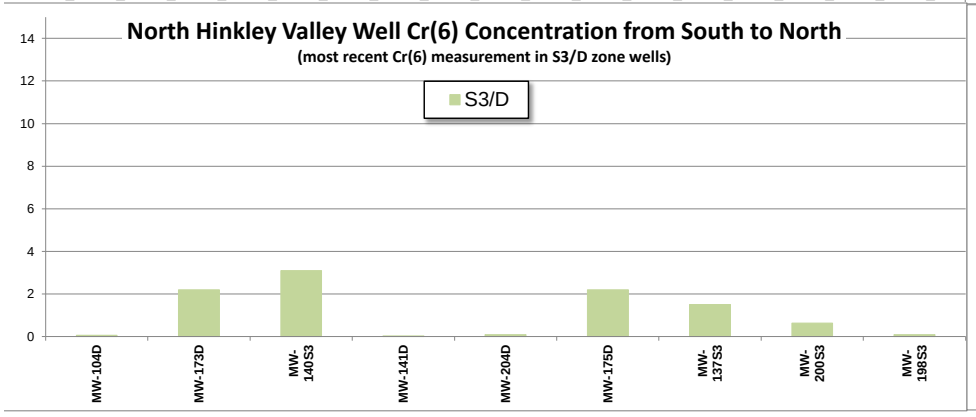
PRELIMINARY CONCEPTUAL SITE MODEL FOR GROUNDWATER FLOW AND THE OCCURRENCE OF CHROMIUM IN GROUNDWATER OF THE HINKLEY VALLEY
PACIFIC GAS AND ELECTRIC COMPANY
HINKLEY COMPRESSOR STATION HINKLEY, CALIFORNIA











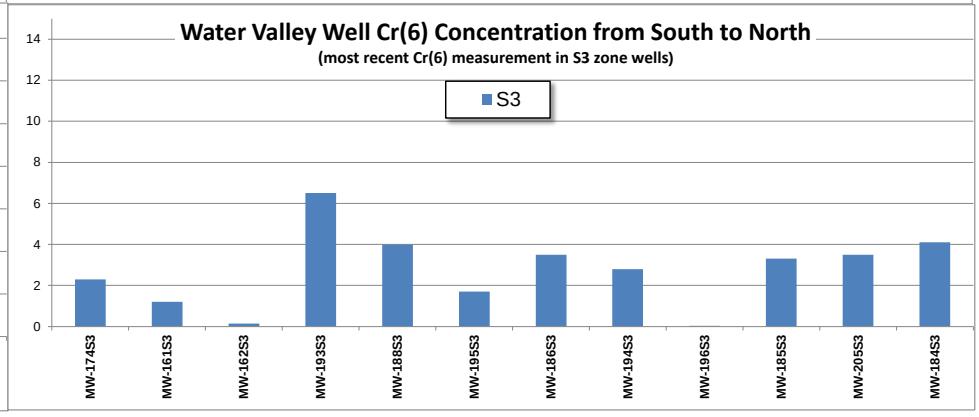


Figure G14

Northern Area- South to North Cr6 Concentration (µg/L) in Monitoring Wells (Approximately Upgradient to Downgradient)

Attachment C

Legal Issues

Attachment C Legal Issues

To avoid repetition and bulk, the following legal principles pertaining to California Regional Water Quality Control Board, Lahontan Region (Water Board) regulatory actions are referenced only by number throughout PG&E's comments. The principles are described here.

1. Water Board Actions Must Be Supported by Factual and/or Scientific Findings

Unless Water Board Cleanup and Abatement Order (CAO) requirements are supported by factual and/or scientific findings, they would be an abuse of discretion per Code of Civ. Proc., § 1094.5, subd. (b); Wat. Code, §§ 13320, subd. (a) & 13330. "Abuse of discretion is established if the respondent has not proceeded in the manner required by law, the order or decision is not supported by the findings, or the findings are not supported by the evidence." (Code of Civ. Proc., § 1094.5, subd. (b).) A regional board's actions must have strong support in the evidence and be further supported by findings which bridge the logical gap between the evidence and action. (Topanga Assn. for a Scenic Community v. County of Los Angeles (1974) 11 Cal.3d 506, 514.)

2. California Water Code Section 13360 prohibits the Water Board from Specifying the Means of Compliance With CAO Provisions

The Water Board exceeds its statutory authority when it specifies the means for Pacific Gas and Electric Company (PG&E) to comply with CAO provisions. (see Wat. Code, § 13360.) "No waste discharge requirement or other order of a regional board . . . shall specify the design, location, type of construction, or particular manner in which compliance may be had with that requirement, order, or decree, and the person so ordered shall be permitted to comply with the order in any lawful manner." (Wat. Code, § 13360, subd. (a).) The limitation on the Water Board's authority to direct the method of compliance under Section 13360 has been described, by analogy, as follows: "That is to say, the Water Board may identify the disease and command that it be cured but not dictate the cure." (Tahoe-Sierra Pres. Council v. State Water Res. Control Bd. (1989) 210 Cal.App.3d 1421, 1438.)

3. Water Board Cleanup and Abatement Requirements Are Only Permitted In Areas Affected By PG&E's Discharge or Threatened Discharge

CAO cleanup requirements must be linked to PG&E's discharge by the evidence and findings. State Water Resources Control Board Resolution No. 92-49 authorizes regional boards to require investigation and cleanup and abatement for any location "affected by the discharge or threatened discharge." (Resolution No. 92-49, section II.A.3.) This presupposes that the investigation and cleanup and abatement requirements are linked to that discharger's activities. If the CAO imposes requirements that it does not link to PG&E's discharge using findings and evidence, the requirements are not authorized by California law. An administrative agency's findings must be sufficient to allow parties to determine the basis for the agency's action. (Topanga Assn. for a Scenic Community v. County of Los Angeles (1974) 11 Cal.3d 506, 514.) The findings must form an analytic bridge between the evidence and the agency's conclusion. (Id. at p. 515.)

4. California Law Does Not Authorize the Water Board To Require Cleanup In Areas Below Background Levels

Any CAO requirements to cleanup contamination in areas below natural background levels are not authorized by California law. Water Code section 13304 requires cleanup of all waste discharged and restoration of affected water to background conditions. (Resolution No. 92-49, finding 4.) "[U]nder no circumstances shall these provisions be interpreted to require cleanup and abatement which achieves water quality conditions that are better than background conditions[.]" (Resolution No. 92-49, section III.F.1.) Regional boards shall "ensure that dischargers are required to clean up and abate the effects of discharges in a manner that promotes attainment of either background water quality, or the best water quality which is reasonable if background levels of water quality cannot be restored[.]" (Resolution No. 92-49, section III.G.)

Attachment D

Proposed CAO Replacement Water Provisions Comments

Attachment D Proposed CAO Replacement Water Provisions Comments

Finding 40 of the proposed Cleanup and Abatement Order (CAO) correctly states California law regarding the California Regional Water Quality Control Board, Lahontan Region's (Water Board's) authority to require replacement water. However, some replacement water provisions found in the proposed CAO Findings 38-44 and Ordering Section VII continue to perpetuate improper requirements regarding replacement water that are not supported by law nor by factual findings. This proposed CAO is a unique opportunity to remedy the following confusing or inappropriate requirements that continue to cause confusion and implementation challenges. *(See various PG&E correspondence[1] related to replacement water program attached electronically to these comments, Attachment G)*

Affected Wells

Finding 40 correctly states California law that "an 'affected well' for which regional boards have discretion to require replacement water pursuant to Water Code 13304(a), [i]s one that does not meet the federal, state, and local drinking water standards." Using that definition, Finding 44 defines an "affected well" in Hinkley as a well "containing chromium in concentrations (measured at any time by PG&E or by local, state, or federal agencies) that are above the primary drinking water standard of 10 part per billion (ppb) hexavalent chromium (Cr[VI]) or 50 ppb total dissolved chromium (Cr[T])."

However, the proposed CAO specifically does not apply its correct statement of California law to existing Water Board orders or mitigation measures contained in the 2013 Environmental Impact Report pertaining to replacement water which are improper and actually conflict with the proposed CAO and California law. For example, Finding 42 states: "This requirement for replacement water does not supersede previous, existing or future requirements to implement mitigation measures contained in the 2013 Environmental Impact Report pertaining to replacement water for private supply wells affected due to remedial activities; for example, those requirements specified in Board Order No. R6V-2014-0023 [the Agricultural Treatment Unit, or 'ATU Order']."

The ATU Order cited in the proposed CAO is a prime example of an improper replacement water requirement under California law. The ATU Order defines an affected well as follows: "Actually affected domestic wells will be defined as any domestic water supply well with chromium (hexavalent or total) concentrations that exceed any of the following criteria due to activities authorized by this Order: [1] Maximum background levels (if pre-remedial reference levels were below maximum background levels), or [2] Concentrations increase by 10 percent or more (if pre-remedial reference levels exceed maximum background levels)." The ATU Order then requires PG&E to provide replacement water to "actually affected domestic wells" as defined by the ATU Order. On its face, the ATU Order requires PG&E to provide replacement water for wells containing chromium at levels below the relevant drinking water standards. PG&E objected to this (and similar provisions) when they were enacted (PG&E 2013a,

[1] PG&E 2012a. PG&E. Pacific Gas and Electric Company comments on the July 25, 2012 Draft Cleanup and Abatement Order; August 9; PG&E 2012b, PG&E Letter Re: Proposed Amended Cleanup and Abatement Order No. R6V-2008-0002-A4; November 16; PG&E 2013c, PG&E Formal Request for Modification of Replacement Water Orders, February 7; PG&E 2013d, PG&E Formal Request for Modification of Interim Bottled Water Store and Test Program. March 7.

Attachment G). The ATU Order does not comply with California law regarding replacement water. The proposed CAO specifically exempts the ATU Order (and all prior replacement water orders) from complying with California replacement water law as correctly outlined in the proposed CAO. PG&E requests that the Water Board use the proposed CAO to supersede and conform all replacement water requirements in prior orders so that they comply with California law as outlined in the proposed CAO, meaning that they do not require replacement water until and unless a well contains constituents above the applicable drinking water standard.

Finally, the proposed CAO does not include any provision for removing a well from the affected well list when the well moves below the state and federal drinking water standards. As with prior replacement water CAO's for Hinkley and other areas across California, PG&E suggests that the CAO include a provision that removes a well from the "affected well" list after four consecutive quarterly samples are below the state and federal drinking water standards.

No Causal Link To PG&E

All of the proposed CAO replacement water provisions lack language requiring a link between the chromium in a specific well and PG&E's discharge. This is noteworthy because Finding 41 includes this concept: "[I]f future monitoring data indicate water in private supply wells in the affected area (defined in Finding 43) is likely to exceed drinking water standards for Cr(VI) and the detections are linked to PG&E's historical releases, PG&E will be required to submit plans to provide replacement water . . . ." CAO investigation or cleanup requirements must be linked to PG&E's discharge by the evidence and findings. State Water Resources Control Board Resolution No. 92-49 authorizes regional boards to require investigation and cleanup and abatement for any location "affected by the discharge or threatened discharge." (Resolution No. 92-49, section II.A.3.) This presupposes that the investigation and cleanup and abatement requirements are linked to that discharger's activities. The proposed CAO imposes replacement water requirements that it does not link to PG&E's discharge using findings and evidence. As a result, the requirements are not authorized by California law. An administrative agency's findings must be sufficient to allow parties to determine the basis for the agency's action. (Topanga Assn. for a Scenic Community v. County of Los Angeles (1974) 11 Cal.3d 506, 514.) The findings must form an analytic bridge between the evidence and the agency's conclusion. (Id. at p. 515.) The proposed CAO should be modified to require that any chromium detections (above or below 10 parts per billion [ppb]) be linked to PG&E's historical releases before any replacement water requirements would apply.

Requirements Should Only Apply To Active Domestic Wells After the Approval of the Owner and Should Provide Sufficient Time To Provide Replacement Water

The proposed CAO replacement water provisions apply to "any domestic well within the revised affected area." However, there are numerous domestic wells in the Hinkley area that are not in use for one reason or another. The replacement water provisions should not apply to wells that are not currently being used to supply drinking water. Additionally, as the Water Board experienced during the Whole House Replacement Water Program, some Hinkley residents do not want replacement water and will not allow PG&E to provide either interim or permanent replacement water. The replacement water

ordering provisions should make clear that they only apply to active wells and to properties where the owner has authorized replacement water.

Provision VII.A.2.i.[sic] on page 23, [should be "ii" as there is a previous "i" on page 22] requires the provision of replacement water within 45 days of approval of PG&E's work plan. This provision prejudges the time required to provide replacement water and ignores the prior experiences in Hinkley. On average, with the previous replacement water systems, it took approximately 9 months between the time a resident was identified as eligible for the permanent replacement water system and the time the unit was turned over to the resident for use. Many factors contributed to this time period including: testing to confirm eligibility; resident decisions to install the systems; ordering and manufacturing the custom replacement water systems; construction of the necessary onsite infrastructure (e.g., electrical, plumbing, permitting, etc.); and start-up testing. Once a resident signed an access agreement, it typically took PG&E 5 months to install and turn over a system. Many of these items are not within the control of PG&E. Well owners also often take time to provide permission to access their property and install necessary infrastructure. The current proposed CAO language acknowledges the well owner permission issue, but only states that "implementation shall be conducted with the well owner's permission." This language does not clearly state that proposed CAO requirements will not apply without the permission and cooperation of the well owner.

Requirements For Replacement Water Work Plans

A. Replacement Water Work Plan Triggers

The proposed CAO cites the Olin case to support provisions that would require PG&E to provide workplans for replacement water in two situations: a) "a domestic well within a revised affected area contains hexavalent chromium concentrations exhibiting an increasing trend indicating likely future exceedances of the hexavalent chromium MCL within one year," or b) "any private supply well with hexavalent chromium concentrations within 20 percent of the hexavalent chromium MCL (i.e., 8 ppb Cr(VI))."

PG&E does not object to performing an analysis of domestic well sampling results to determine whether wells exhibit an increasing trend that PG&E's experts determine is likely to exceed the Cr(VI) maximum contaminant level (MCL) within 1 year. As written, the proposed CAO properly imposes this requirement on PG&E without specifying the manner in which PG&E is to comply with the requirement. The Water Board exceeds its statutory authority when it specifies the means for PG&E to comply with CAO provisions. (see Wat. Code, § 13360.) "No waste discharge requirement or other order of a regional board . . . shall specify the design, location, type of construction, or particular manner in which compliance may be had with that requirement, order, or decree, and the person so ordered shall be permitted to comply with the order in any lawful manner." (Wat. Code, § 13360, subd. (a).) The limitation on the Water Board's authority to direct the method of compliance under Section 13360 has been described, by analogy, as follows: "That is to say, the Water Board may identify the disease and command that it be cured but not dictate the cure." (Tahoe-Sierra Pres. Council v. State Water Res. Control Bd. (1989) 210 Cal.App.3d 1421, 1438.) If Water Board staff were to mandate a specific process

for PG&E's analysis of the data or to disagree with PG&E's analysis and require a replacement water plan for a well that PG&E had determined was not likely to exceed the MCL within 1 year, such an action would require a modification of the proposed CAO or a new order from the Water Board. PG&E would then have an opportunity to seek review of that modified or new order, if necessary.

In contrast to requiring a trend analysis and determination whether a well is likely to exceed the MCL within 1 year, the Olin holding does not provide any support for a blanket requirement to provide water replacement work plans for any well containing Cr(VI) at 8 ppb. Olin only refers to requiring plans where trends indicate the likelihood of future exceedances.[2] Similarly, there is no factual or scientific support cited for this requirement. Unless Water Board CAO requirements are supported by factual and/or scientific findings, they are an abuse of discretion per Code of Civ. Proc., § 1094.5, subd. (b); Wat. Code, §§ 13320, subd. (a) & 13330. "Abuse of discretion is established if the respondent has not proceeded in the manner required by law, the order or decision is not supported by the findings, or the findings are not supported by the evidence." (Code of Civ. Proc., § 1094.5, subd. (b).) A regional board's actions must have strong support in the evidence and be further supported by findings which bridge the logical gap between the evidence and action. (Topanga Assn. for a Scenic Community v. County of Los Angeles (1974) 11 Cal.3d 506, 514.) Without a scientific or factual finding indicating that wells containing 8 ppb Cr(VI) are likely to exceed the drinking water standard, this requirement is improper.

PG&E also suggests that this and similar provisions be modified to remove references to quarterly groundwater monitoring because the groundwater monitoring interval is very likely to change for at least some wells over the course of the project.

B. Repeated Studies and Workplans Every Quarter Are Unnecessarily Burdensome and the Timelines Are Likely Impossible To Meet

Provision VII.A.2.i. requires PG&E to submit a detailed workplan proposing permanent whole house replacement water within 45 days of the submittal of each quarterly groundwater monitoring report. This requirement is unnecessarily burdensome and does not allow sufficient time to perform the tasks outlined in this section. PG&E could develop a template replacement water plan that could be applied in an efficient manner with little to no delay that would otherwise be caused by quarterly plan development and approval. As the proposed CAO is implemented over time, PG&E could update and/or apply that plan as necessary. Finally, as written, these provisions are an example of the proposed CAO improperly specifying the specific means for compliance with the CAO. As outlined above, this is not permitted by California law.

C. Replacing All Indoor Water Use Is Unsupported and Precludes Use of Reverse Osmosis

[2] "Nothing in this Order shall be read to prevent a regional water board from issuing a water replacement order directing future actions preparatory to providing timely replacement water in the event that the appropriate standard is met or exceeded in the future. Regional water boards may also require that dischargers submit water replacement plans prior to documentation of contaminant levels exceeding the relevant standard. Where water quality data exhibit trends indicating the likelihood of future exceedances, it is prudent and appropriate for regional water boards to take such action before actual well exceedances occur." Olin

Provision VII.A.2.i. also requires a work plan to replace water "for all indoor uses." This requirement is unsupported by any factual or scientific evidence or findings, particularly any facts or findings providing any justification for requiring replacement water beyond replacing drinking water. As outlined above, without factual or scientific evidence or findings in the proposed CAO, these requirements would be an abuse of discretion under California law. Similarly, neither Water Code 13304 nor Olin support requiring replacement water for all indoor uses.

In addition, the most efficient and least disruptive option to provide replacement water in Hinkley would be the installation of reverse osmosis treatment units on drinking water taps. Without any further studies, we know that reverse osmosis units meet all drinking water requirements and are relatively inexpensive to install and maintain. Reverse osmosis units are certified by the California Department of Public Health to meet current drinking water standards for total chromium and other constituents including arsenic, nitrates and uranium. These units use a tested technology that is commonly used in California (including throughout the Hinkley Valley) and throughout the United States. For these reasons, PG&E offered reverse osmosis units to homeowners in Water Valley in early 2014 (Stantec 2014). The requirement to replace water for "all indoor uses" precludes reliance on this proven technology which is the least intrusive and widely preferred treatment option. This provision also improperly specifies the means for compliance with the CAO which is prohibited by California law, as outlined above.

Affected Area

Water Code section 13304 focuses on affected wells and does not contain language regarding an "affected area." Experience with prior replacement water orders that contained affected area provisions is that the provisions were divisive and created conflict as well as unfounded expectations. By removing the geographic limitation created by the concept of an affected area and, instead, focusing on wells that have been affected by PG&E's discharge as described above, the proposed CAO would provide flexibility to address water impacted by PG&E wherever it may be found in the future. Therefore, PG&E suggests removing the concept of an affected area in favor of incorporating a focus on wells that have been impacted by PG&E's historical releases.

Finding 43 defines the affected area as "all domestic or community wells located laterally within one mile downgradient or cross-gradient from the 3.1 ppb Cr(VI) or 3.2 ppb Cr(T) plume boundaries (whether contiguous or non-contiguous) . . . ." The 1-mile requirement is unsupported by any findings or evidence. As outlined above, this means that this requirement is not supported by California law. In addition, the 1-mile requirement could include areas east of Dixie Road or west of the Lockhart fault that the Water Board previously concluded were not impacted by PG&E. Finally, the 1-mile requirement would require PG&E action in areas that are below natural background levels for chromium. Any CAO requirements in areas below natural background levels are not authorized by California law. Water Code section 13304 requires cleanup of all waste discharged and restoration of affected water to background conditions. (Resolution No. 92-49, finding 4.) "[U]nder no circumstances shall these provisions be interpreted to require cleanup and abatement which achieves water quality conditions that are better than background conditions[.]" (Resolution No. 92-49, section III.F.1.) Regional boards shall "ensure that

dischargers are required to clean up and abate the effects of discharges in a manner that promotes attainment of either background water quality, or the best water quality which is reasonable if background levels of water quality cannot be restored[.]" (Resolution No. 92-49, section III.G.) The affected area should be defined by confirmed monitoring well results without adding an unsupported buffer area outside of plume boundaries. The area outside of the plume boundaries has not been "affected," by definition.

The 1-mile requirement additionally includes properties within 1mile of the non-contiguous plume boundaries as part of the affected area. Previous replacement water orders have only required replacement water based on the contiguous plume boundary. The proposed CAO does not include any factual, evidentiary, or legal findings supporting the significant change to include non-contiguous plume boundaries. Without findings and evidence, this provision is improper under California law as outlined above. There is no scientific or factual basis to conclude that all Cr(VI) in the non-contiguous northern plume areas comes from PG&E. Indeed, the record demonstrates that there are numerous reasons to believe that Cr(VI) in the northern areas is unrelated to PG&E. *[see Attachment B and references therein attached electronically to these comments].* The USGS is currently conducting a new background study that will provide additional information to help determine the source of hexavalent chromium in the northern areas. No replacement water requirements are appropriate in the non-contiguous plume area prior to a scientific conclusion that the chromium in this area can be tied to historical releases caused by PG&E.

Attachment E

Roadmap of Text Edits

Attachment E Roadmap of Suggested Text Edits

Section	Page	Edit

This attachment provides a summary of PG&E's proposed text edits. Rationale for each suggested edit is provided in the main comment list (Attachment A), as well as in Attachments B, C, and D.

Finding 4	2	Edit to reflect the full range of hydraulic gradients in the North Hinkley Valley. Edit to recognize 100 percent of natural recharge is from the Mojave River.
Findings 6-10	2-4	Replace "~~maximum background levels~~" with "interim background levels" and "~~plumes~~" with "areas where groundwater exceeds interim background levels."
Finding 7	2-3	The finding should acknowledge the existing data and the uncertainty, and the background chromium conditions for the lower aquifer should not be defined until a detailed study has been conducted.
Finding 8a	3	"The area with Cr(VI)/Cr(T) concentrations above interim background levels in the south~~ern plume~~ includes the ~~currently contiguous "western finger" of the chromium plume in the upper aquifer,~~ the area west of Serra Road, between Highway 58 to the south and Acacia Street to the north. However, the source of chromium in this area is uncertain and is the subject of the USGS background study." Delete the word "~~plume~~" as it is misleading, and replace it with "areas of groundwater with chromium above the interim background levels."
Finding 8b	3	Delete the word "~~plume~~" as it is misleading and replace it with "areas of groundwater with chromium above the interim background levels."
Finding 8c	3	Edit: "The source of chromium in this area is uncertain and the subject of the USGS background study." PG&E also recommends replacing the term "~~hot spot~~" with "areas of higher chromium concentrations that will be studied by the USGS." Delete mention of MW-196.
Findings 9	3-4	Delete:~~" Finding 12 in Amended R6V-2008-0002A4 (discussed below in Findings 17, 18, and 19) provides a calculation of the length for the chromium plume since the time of the initial 1952 discharge as 7.32 miles1[1]. This value~~

[1] ~~1 The calculation is: (2 feet/day x 365 days/year x 53 years) / 5,280 feet/mile = 7.32 miles of potential migration of the leading edge of the plume. 53 years assumes the time between issuance of CAO No. R6V-2008-0002A4 and the waste discharge is 60 years, minus 7 years for waste chromium to percolate to groundwater.~~

Attachment E Roadmap of Suggested Text Edits

Section	Page	Edit
		~~represents the potential migration distance of the leading edge of the plume. This estimate is based on a groundwater flow velocity estimate of 2 feet per day, provided by PG&E and supported by data from the United States Geological Survey and the Mojave Water Agency. The value is a conservative average value from a range of measurements. Using the rate of 2 feet per day groundwater flow velocity, the chromium plume has the potential to migrate an additional 1,460 feet or 0.28 miles since Order R6V-2008-002A4 was issued two years prior to this Order. Added to the original calculation provided, there is a total potential migration distance of 7.6 miles, putting the plume into the Harper Dry Lake Valley which is hydraulically downgradient of the Facility. The 7.6-mile calculation is consistent with the approximately 8-mile distance shown on plume maps in the 2014 3rd Quarter Report described in Finding 7.~~
Finding 10	4	Edit: "~~Based on the data and calculations cited in Finding 9 and footnote 1, c~~Cchromium detections above ~~above maximum~~interim background levels in groundwater contiguous to the original source ~~extending from the Facility through the Hinkley Valley into Harper Dry Lake Valley~~ south of Thompson Road, northeast of the Lockhart fault and west of Dixie Road, excluding the chromium in the ~~"~~western area ~~finger"~~ described in Finding 8a, are considered a result of historical releases at the Facility, and are subject to investigation and remediation required by this Order."
Finding 14	5	Add: "Since CAO No. R6V-2008-0002A1 was adopted, data have been collected and presented to the Water Board demonstrating significant uncertainty in the accuracy of these values in representing background chromium conditions, particularly in the western area and north of Thompson Road but also east of Dixie Road and southwest of the Lockhart Fault. The USGS is conducting a study, with a goal of more accurately defining areas where the PG&E chromium plume is present and what levels of chromium represent background levels. The levels stated above will be used as interim background levels for the South Hinkley Valley (excluding the western area, east of Dixie Road, and southwest of the Lockhart Fault) as the USGS study is conducted. In other areas, such as the western area and north of Thompson Rd, this CAO requires PG&E to support the USGS studies. "
Finding 15	5	Delete: "~~The maximum background levels of 3.1 ppb Cr(VI) and 3.2 ppb Cr(T) are used to determine the effectiveness of remediation actions and to determine if the chromium plume has migrated into areas previously unaffected by the discharge of waste. These levels also provide for the basis for determining which wells are considered to contain waste chromium attributed to historic discharges from the Facility. A revised background study, conducted by the United States Geological Survey, is underway, expected to be completed within five years. Following study completion, the Water Board may consider updating chromium background levels and setting final cleanup levels."~~
Finding 17	5	A sentence should be added to the end of this finding stating these values are "interim" until the USGS completes its studies.

Attachment E Roadmap of Suggested Text Edits

Section	Page	Edit
Finding 18	5	This finding should be updated to use the words "interim background levels."
Finding 19	6	This finding should be edited to replace the word "~~plume~~" with "areas of groundwater with chromium above the interim background levels." Additionally, this finding should indicate that it is technically infeasible to delineate the boundaries based upon these interim background levels north of Thompson Road, and that no additional investigation is required in these areas for the purposes of "plume definition" until such time as the USGS studies are complete and a more complete understanding of background conditions is developed based upon sound scientific data, as described in Attachment B.
Finding 20	6	Edit: "The updated estimates range from six to 23 years to remediate 99 percent of the 50 ppb southern plume east of Serra Road; and 11 to 50 years to remediate 99 percent of the 10 ppb southern plume east of Serra Road. The ranges reflect remediation times for different modeled hydrologic layers of the upper aquifer (finer-grained versus coarser-grained model layers) and different assumptions of in-situ remediation modeling. These estimates inform the basis for the cleanup ~~requirement deadlines~~ goals in this Order. The timeframe estimates are uncertain given underlying simplifying assumptions in the modeling, uncertainty in conditions throughout the modeled aquifer, operational and construction uncertainties, and assumptions made on the timing and continuation of permitting for the project. "
Finding 24	7	Insert the following statement: "Over the last several years, as a result of PG&E's remedial actions, the areas of chromium above the interim background levels have not substantially migrated from the South Hinkley Valley across Thompson Road into the North Hinkley Valley."
Finding 32	9	Delete the phrase "~~conduct corrective actions in the northern plumes area and define the extent of chromium in the upper aquifer~~". Delete: "~~background values of 3.1 ppb Cr(VI) and 3.2 ppb Cr(T) in the upper aquifer; and non-detectable levels of chromium in the lower aquifer near the Desert View Dairy.~~"
Finding 38	11	Replace "~~maximum background levels~~" with "interim background levels".
Finding 41	12	Edit: "From 2011 to 2014, in response to CAO No. R6V-2011-0005 and amendments, PG&E provided bottled water and/or whole-house water (WHW) to residences or businesses within the affected area and having detectable chromium in well water. On July 1, 2014, the California Division of Drinking Water's adoption of the 10 ppb Cr(VI) drinking water standard became effective. PG&E ceased providing bottled water and/or WHW on October 31, 2014,

Attachment E Roadmap of Suggested Text Edits

Section	Page	Edit
		since no residence or business had hexavalent chromium above the new standard. However, consistent with the Olin Order, if future monitoring data indicate water in private supply wells ~~in the affected area (defined in Finding 43)~~ is likely to exceed drinking water standards for Cr(VI) and the detections are linked to PG&E's historical releases, PG&E will be required to submit plans to provide replacement water supply to such wells ~~in either a modification of this Order, or a separate order~~."
Finding 42	12	Edit: "Accordingly, this Order requires that PG&E submit replacement water plans where active private supply well concentrations linked to PG&E's historical releases ~~in the affected area~~ exhibit increasing trends indicating the likelihood of future exceedances of the hexavalent chromium Maximum Contaminant Level (MCL)~~, or if a private supply well has hexavalent chromium reaching within 20 percent of the hexavalent chromium MCL (i.e., 8 ppb)~~. Interim replacement water (i.e., bottled water) shall be provided or offered to the well users within 2 working days of the first detection of chromium linked to PG&E's historical releases in an active private supply well at or above the MCL. ~~Permanent replacement water shall be provided within 45 days of such detection. This action requires that PG&E conduct sampling of domestic wells in the Hinkley and Harper Dry Lake Valleys.~~ This requirement for replacement water ~~does not~~ supersedes ~~previous,~~ existing ~~or future~~ requirements to implement mitigation measures contained in the 2013 Environmental Impact Report pertaining to replacement water for private supply wells affected due to remedial activities; for example, those requirements specified in Board Order No. R6V-2014-0023. All prior replacement water orders are hereby superseded to eliminate any requirements to provide replacement water when constituent concentrations are below state and federal drinking water standards."
Finding 43	12	Delete:"~~43. The affected area is defined as all domestic or community wells located laterally within one mile downgradient or cross-gradient from the 3.1 ppb Cr(VI) or 3.2 ppb Cr(T) plume boundaries (whether contiguous or non-contiguous) based upon monitoring data drawn in the most current quarterly site-wide groundwater monitoring report submitted by PG&E. The affected area may change based on new data collected and evaluated each quarter.~~"
Finding 44	13	Edit: "Affected wells are defined as active domestic or community wells ~~in the affected area~~ containing chromium linked to PG&E's historical releases in concentrations (measured at any time by PG&E or by local, state or federal agencies) that are above the primary drinking water standards of 10 ppb Cr(VI) or 50 ppb Cr(T). A well is no longer an Affected well if it tests below the primary drinking water standards of 10 ppb Cr(VI) and 50 ppb Cr(T) for four consecutive quarters of sampling."
Finding 51	15	Edit: "This Order requires cleanup of chromium-contaminated groundwater ~~to interim remediation targets, including background conditions~~, which may result in one or more significant and unavoidable impacts described above."

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I	15	Edit: "Corrective actions shall be conducted in accordance with approved current[x] and future workplans, WDRs, Notices of Applicability, monitoring programs, or as modified with the Executive Officer's approval. [x]Current workplans: ARCADIS. 2014d. Revised Report of Waste Discharge for Proposed Agricultural Treatment Units. Hinkley Compressor Station. Hinkley, California. May 28. ARCADIS. 2014e. In-Situ Reactive Zone Design and Construction Status Report. Pacific Gas and Electric Company, Hinkley Compressor Station, Hinkley, California. November 25. ARCADIS 2012. Lower Aquifer Remedial Action Status Report. PG&E Hinkley Compressor Station. Hinkley, California. February 15. CH2M HILL and ARCADIS. 2014. Plan for Enhancement of Lower Aquifer Remedy (Installation of EX-37). PG&E Hinkley Compressor Station, Hinkley, California. November 7. CH2M HILL and ARCADIS. 2015. Fourth Quarter 2014 Monitoring Report for the In Situ Reactive Zone and Northwest Freshwater Injection Projects. Pacific Gas and Electric Company. Hinkley Compressor Station, Hinkley, California. January 15." Stantec. 2011b. Technical Report – Response to Investigation Order R6V-2011-0043-Delineation of Chromium in the Lower Aquifer. Pacific Gas and Electric Company. Hinkley, California. August 1."
IV	15-16	Delete:~~"IV. Chromium Plume Definition in the Upper Aquifer~~ ~~"PG&E shall define the extent of total and hexavalent chromium in the upper aquifer from the source area at the compressor station into the Harper Dry Lake Valley where chromium discharge threatens beneficial uses. As of the date this Order is issued, undefined plume areas are: east of Summerset Road and Acacia Street; eastern boundary for the Hinkley Valley northern plume; northwest of MW-154S1, north and west of MW-196; and east and west of Hinkley Road starting at MW-161 and north to Grasshopper Road.~~ ~~"A. To achieve defining the chromium plume to the maximum background levels, PG&E shall conduct the following actions in areas where access is currently allowed:~~

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~~"1. Install monitoring well Red Hill 5, east of Hinkley Road at Burnt Tree Road, as proposed in the "Status Report for Northern Areas," dated April 24, 2014 (see Finding 19) and confirmed in an October 22, 2014 electronic message. Following installation and development, add the well to the Groundwater Monitoring and Reporting Program (Attachment 8 of this CAO) beginning first quarter 2015.~~

~~"2. Within 30 days of the date this Order is issued, submit a workplan proposing a multi-depth monitoring well location within the 2,700-foot distance separating Summerset Road and MW-110S on Acacia Street in the southern plume where chromium concentrations at both locations exceed maximum background levels. The workplan shall include proposed well designs and describe the method and manner of installation. In addition, the workplan shall evaluate potential well installation areas north and west of MW-196 out to one mile. If a location is accessible, the workplan shall propose multi-depth monitoring wells and describe the method and manner of installation. If the location is not accessible, explain why.~~

~~"3. Install the wells required in Order IV.A.2 within 90 days of the Executive Officer's approval. Following development and sampling, add the new wells to the Groundwater Monitoring Program (see Attachment 8) beginning in third quarter 2015.~~

~~"B. PG&E shall submit a workplan to install monitoring wells (for further plume definition) to the Water Board within 30 days of any change in land access status. Changes in land access status include, but are not limited to, being provided 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. The workplan shall state the date of the change and propose a multi-depth monitoring well(s) to determine chromium concentrations in groundwater at that location. The workplan shall include proposed well designs and describe the method and manner of installation.~~

~~"C. Unless otherwise ordered, all monitoring wells required by the Water Board shall be installed, developed, and sampled within 6 months of the date of approval when access to land is allowed.~~

~~"D. All monitoring wells installed under requirements in this Order shall be added to the Groundwater Monitoring and Reporting Program (MRP) (see Requirement VIII, Attachment 8) upon the first sampling event. Monitoring well designs and boring logs shall be included as attachments in quarterly groundwater monitoring reports. All new wells shall be sampled at a quarterly frequency."~~

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V.B	17	Edit: "As of the date this Order is issued, PG&E shall ~~continuously implement~~ maintain and operate previously approved, or as subsequently approved by the Executive Officer, groundwater extraction to contain the southern chromium plume. ~~Currently, groundwater extraction between Santa Fe Avenue and Thompson Road is at an annual average pumping"~~
V.D	17	Add: "With Water Board staff's written approval, the Discharger may demonstrate plume capture using alternative metrics (i.e., well pairs or triplets, or water level maps) to verify inward plume capture." Edit: "~~PG&E is in violation of~~ The Water Board may find PG&E out of compliance with this Requirement if at any time any of the following conditions occurs:"
V.D.3	17	Delete: ~~"If the 50 ppb Cr(VI)/Cr(T) or 10 ppb Cr(VI)/Cr(T) boundaries migrate or expand 1,000 feet or more from current boundaries during any monitoring event."~~
VI.A	19	Edit: "PG&E shall implement previously approved on-going corrective actions, including but not limited to, agricultural treatment units (ATUs), in-situ remediation, and freshwater injections (see Finding Nos. 22 and 23). Corrective actions shall be conducted in accordance with approved current[x] and future workplans, WDRs, Notices of Applicability, monitoring programs, or these listed documents as modified with the Executive Officer's approval. ~~Changes or reduction in corrective actions (the latter is defined by more than 10 percent reduced operation on a monthly basis) shall require Water Board concurrence prior to implementation.~~ Extraction systems for ATUs and the freshwater injection systems will be operated to maintain hydraulic capture metrics, per requirement V.D. of this CAO. IRZ systems, including current systems described in the fourth quarter IRZ monitoring report (CH2M HILL and ARCADIS 2015) and new systems for 2015 described in the most recent design report (ARCADIS 2014e), will be operated to optimize establishment and maintenance of treatment through ongoing modifications of injection locations and flowrates. Flowrates and number of injection and extraction locations may be reduced if they are not needed to maintain treatment capacity. Designs and implementation schedules will be submitted to the Water Board and executed for the IRZ expansions presented in concept in the Remedial Timeframe Assessment (Finding 20) and for optimizations of the IRZs and hydraulic containment systems identified in future 4-year review cycles. "PG&E shall notify the Water Board of significant changes in operations within 14 days of occurrence: · For ATUs and associated extraction systems and the NWFI, significant change is defined as when more than 50 percent of the extraction, injection or discharge locations are shut down or when the total system flowrate is

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decreased by greater than 50 percent, or when data show that an ATU is not being maintained by at least 50 percent in area. Normal remedial operations include variations expected with the seasons such as maximum pumping during summer and minimum pumping during winter.

- For IRZs, significant change is interpreted to mean when more than 50 percent of the extraction and injection locations are shut down or when the total system flowrate is decreased by greater than 50 percent, or when data show that an IRZ is not being maintained by at least 50 percent in area."

"[x]Current workplans:

"ARCADIS. 2014d. Revised Report of Waste Discharge for Proposed Agricultural Treatment Units. Hinkley Compressor Station. Hinkley, California. May 28.

"ARCADIS. 2014e. In-Situ Reactive Zone Design and Construction Status Report. Pacific Gas and Electric Company, Hinkley Compressor Station, Hinkley, California. November 25.

"ARCADIS 2012. Lower Aquifer Remedial Action Status Report. PG&E Hinkley Compressor Station. Hinkley, California. February 15.

"CH2M HILL and ARCADIS. 2014. Plan for Enhancement of Lower Aquifer Remedy (Installation of EX-37). PG&E Hinkley Compressor Station, Hinkley, California. November 7.

"CH2M HILL and ARCADIS. 2015. Fourth Quarter 2014 Monitoring Report for the In Situ Reactive Zone and Northwest Freshwater Injection Projects. Pacific Gas and Electric Company. Hinkley Compressor Station, Hinkley, California. January 15.

"Stantec. 2011b. Technical Report – Response to Investigation Order R6V-2011-0043-Delineation of Chromium in the Lower Aquifer. Pacific Gas and Electric Company. Hinkley, California. August 1."

VI.B.1.a 19 Delete: "~~a. 'Western Finger'~~

~~PG&E shall clean up and abate chromium concentrations greater than maximum background levels west of Serra Road between Highway 58 and Acacia Street. During 2014, greater than maximum background levels existed at monitoring well locations MW-121, MW-153, and MW-169.~~

~~i. Continue implementing on-going corrective actions in accordance with the Water Board's October 30, 2013, conditional acceptance of the Western Area Action Plan (extraction of contaminated groundwater).~~

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		~~ii. Reach and maintain maximum background levels in all monitoring wells in the "Western Finger" west of Serra Road by July 31, 2016."~~
VI.B.1.b.	20	Edit: "b. Lower Aquifer "PG&E shall clean up and abate chromium concentrations greater than non-detect levels in the lower aquifer. ~~During 2014, greater than non- detect concentrations exist at: MW-23C, MW-28C, MW-31C, MW-42C, MW-92C, and MW-100C.~~ "i. Continue implementing on-going groundwater extraction east of Mountain View Road to remediate chromium in lower aquifer groundwater, as proposed in PG&E's November 7, 2014 "Plan for Enhancement of Lower Aquifer Remedy" and in accordance with the Water Board's conditional acceptance dated December 22, 2014. "ii. By March 31, 2015, install extraction well EX-37, east of Mountain View Road and south of Santa Fe Road, as proposed in the November 7, 2014 Memorandum from Arcadis and CH2MHill. "iii. Begin pumping from EX-37 by June 30, 2015. Disposal options for extracted groundwater may include but are not limited to temporary or permanent storage tank(s), agricultural fields, and the South Central Reinjection Area (SCRIA). "~~iv. Reach and maintain non-detectable chromium concentrations in all lower aquifer monitoring wells by December 31, 2018."~~
VI.B.1.c	20-21	Edit: "c. For all remaining areas of the southern plume, ~~reach~~ the following cleanup goals in the upper aquifer ~~by the listed timeframes~~ are set forth: "i. Reach and maintain 50 ppb Cr(VI) and Cr(T) ~~in~~ across 90% of ~~all monitoring wells having chromium detection above~~ the 50 ppb Cr(VI) and Cr(T) plume as of the date this Order is issued, by December 31, ~~2021~~ 2027. The 90th percentile shall be based on the number of well locations where chromium concentrations exceed 50 ppb Cr(VI) and Cr(T) as of the date this Order is issued, as shown in Table 8.1 of Attachment 8. "ii. Reach and maintain 10 ppb Cr(VI) and Cr(T) ~~in~~ across 80%of ~~all monitoring wells having chromium detection between~~ the 10 ppb Cr(VI) and Cr(T) and 50 ppb Cr(VI) and Cr(T) plumes as defined on the date this Order is issued, by December 31, ~~2026~~ 2035. The 80th percentile shall be based on the number of well locations where chromium

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		concentrations exceed 10 ppb Cr(VI) and Cr(T) as of the date this Order is issued, as shown in Table 8.1 of Attachment 8. "Every four years, the Discharger will evaluate chromium cleanup actions to reach the cleanup goals and submit a four-year comprehensive cleanup status and effectiveness report, per the requirements of Attachment 8, the MRP. If actions are not achieving expected reductions in chromium concentrations, a workplan outlining recommendations and an implementation schedule to increase effectiveness will be submitted by the deadlines listed in Attachment 8, the MRP. Compliance with cleanup requirements will be determined by timely submittal of the four-year comprehensive cleanup status and effectiveness report and timely submittal and implementation of workplans for improvements if cleanup expectations are not being met."
VI.B.2	21-22	Delete: ~~"2. Northern Plumes~~ ~~"a. PG&E shall clean up and abate chromium "hot spots" in the two northern plumes, defined as any monitoring, extraction, remediation well or piezometer data having hexavalent or total chromium concentrations greater than 10 ppb as of the date this Order is issued. As of the date this Order is issued, "hot spots" exist at MW-154S1, MW-193S3, and MW-196S2. PG&E shall also clean up groundwater in the upgradient flow direction of any domestic/community/agricultural well with data showing chromium concentrations greater than 3.1 ppb Cr(VI) or 3.2 ppb Cr(T): wells 11-10, 21N-03, 21N-04, 21N-05, 28N-04, 28N-05, and 33N-02.~~ ~~"b. By August 31, 2015, submit a workplan to remediate "hot spots" in groundwater within one mile of any domestic well containing concentrations greater than 3.1 ppb Cr(VI) or 3.2 ppb Cr(T). Identify the domestic well number and describe its general location. The workplan shall propose a cleanup action to begin by January 2, 2016 to remediate groundwater so as to reach maximum chromium background levels in the domestic well within an 18-month period of implementation.~~ ~~"c. By November 30, 2015, where no or insufficient monitoring well data exist, submit a workplan to remediate chromium in groundwater upgradient of domestic wells where data shows concentrations greater than 3.1 ppb Cr(VI) or 3.2 ppb Cr(T). Identify the domestic well number and describe its general location. The workplan shall propose a cleanup action to begin by April 1, 2016 to remediate groundwater so as to reach maximum chromium background levels in the domestic well within a 36- month period of implementation.~~

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		~~"d. By February 28, 2016, submit a workplan and implementation schedule to remediate remaining "hot spots" in the two northern plumes not already addressed in Requirements VI.2.a and b. Identify the monitoring well number and describe its general location. Provide a time schedule for remedial actions proposed and the estimated time to reach maximum background chromium levels for wells having concentrations between 10 ppb and 99 ppb Cr(VI)/Cr(T) as of the date this Order is issued and to 10 ppb Cr(VI)/Cr(T) for wells having concentrations of 100 ppb Cr(VI)/Cr(T)or greater as of the date this Order is issued.~~ ~~"e. If after October 31, 2015, new "hot spots" in monitoring, extraction, remediation wells and piezometer wells are identified in future quarterly groundwater monitoring reports, within 45 days of the quarterly report due date, submit a workplan and implementation schedule proposing the method and manner to remediate the "hot spot." Identify the well number and describe its general location. Provide an estimate cleanup time and basis for the estimate."~~
VII	22-24	Edit: "A. Beginning with the ~~second~~ quarter after this Order is issued~~2015~~, within each ~~quarterly~~ groundwater monitoring report required in section VIII below, provide an analysis whether any active domestic well within PG&E's domestic well monitoring and reporting program ~~a revised affected area~~ contains hexavalent chromium concentrations linked to PG&E's historical releases and exhibiting an increasing trend indicating likely future exceedances of the hexavalent chromium MCL within one year~~, or any private supply well with hexavalent chromium concentrations within 20 percent of the hexavalent chromium MCL (i.e., 8 ppb Cr(VI))~~. "1. Interim Replacement Water Supply "i. Within 2 business days of identifying an Affected Well as defined by Finding 44 (i.e., an active domestic or community well containing chromium linked to PG&E's historical releases in concentrations that are above the primary drinking water standards of 10 ppb Cr(VI) or 50 ppb Cr(T))~~the submittal of each quarterly report delineating a revised affected area~~, supply or offer to supply to active well users interim uninterrupted replacement water (i.e., bottled water or equivalent)~~, to all those served by domestic and community wells in the affected area (Finding 43) where those wells are determined to be affected as defined in Finding 44 of this Order~~. "ii. Within each groundwater monitoring report required as part of PG&E's domestic well monitoring and reporting program, PG&E shall ~~delineating a revised affected area~~, provide a report to the Water Board listing all properties that have been provided interim uninterrupted drinking water service. The report shall include the well number and describe the general area in Hinkley or the Harper Dry Lake Valley the well is located, such as the southern plume, the Hinkley Valley northern plume, or Harper Dry Lake Valley northern plume. If bottled water is

provided, PG&E shall also list the bottled water service being used and the water volume being delivered. Furthermore, if other than commercially available bottled water is being provided, the report shall include documentation to show that interim water supply meets state primary and secondary drinking water standards.

"2. ~~Permanent~~ Long Term Replacement Water Supply

"i. Within 45 days of the date this Order is issued, PG&E shall ~~days of a private supply well identified in VII.A., above, in quarterly groundwater monitoring reports,~~ submit a workplan outlining~~proposing permanent~~ long term ~~whole house~~ replacement drinking water supply options to supply ~~for all indoor~~ drinking water uses for Affected Wells as defined by Finding 44. ~~The workplan shall include the well number(s) and describe the general area in Hinkley Valley or the Harper Dry Lake Valley the well is located.~~ Pursuant to California Water Code section 13304, subdivision (f), replacement water 'shall meet all applicable federal, state, and local drinking water standards, and shall have comparable quality to that pumped by the public water system or private well owner before the discharge of waste.' The work plan shall include a plan for providing replacement water for any active private supply well identified pursuant to VII.A., above, should any such well later exceed the drinking water standard and become an Affected Well as defined by Finding 44. ~~Proposed permanent replacement water shall meet all California primary and secondary drinking water standards, and shall have comparable quality for chromium concentrations to that historically pumped by the private well owner in the past prior to waste chromium exceeding the MCL within the well, or within 80 percent of the MCL. The workplan shall include the following:~~

~~"a. An evaluation of at least three different methods to provide permanent replacement water supply.~~

~~"b. A discussion on the feasibility and timing to implement each method including the needs for permits, approvals, and environmental analysis.~~

~~"c. An evaluation of the quantity of water (gallons per minute) that can be provided by each method compared with typical individual household supply needs.~~

~~"d. An evaluation of the quality of water that can be provided by each method in comparison to California primary and secondary drinking water standards.~~

~~"e. An analysis of wastes that may be generated by each method, disposal options, costs, and an analysis of potential byproducts in groundwater created by each method. For example, reverse osmosis generates salts and potentially others compounds that are typically sent to septic systems.~~

~~"f. An operation, maintenance, and, replacement plan, such as for filters, equipment, etc., of each evaluated method.~~

~~"g. A water quality monitoring and reporting plan to verify quality and performance of each evaluated method.~~

~~"h. A complete cost analysis including construction, operations, maintenance, and replacement plan of each evaluated method.~~

~~"i. A contingency plan to ensure uninterrupted replacement water supply.~~

~~"j. State how the workplan and recommended method will be presented to the owner(s) and users of the affected well(s).~~

~~"i. ii~~Following ~~Within 45 days of~~ approval by the Executive Officer of PG&E's~~a~~ workplan for providing long term~~permanent~~ alternate drinking water supply and written authorization from the well owner for the installation of a long term replacement drinking water supply, PG&E shall implement the workplan to provide a long term~~permanent~~ replacement drinking water supply for all indoor drinking water uses for active private supply wells that are determined to be affected as defined in Finding 44 of this Order and where the chromium detections are linked to PG&E's historical releases.~~all affected wells identified in section 1 above~~. ~~Implementation shall be conducted with the well owner's permission."~~

~~ii.~~ iii. ~~Within 150 days of identification of affected wells identified in section 1 above,~~ Within each groundwater monitoring report required as part of PG&E's domestic well monitoring and reporting program and during which long term replacement water is supplied, PG&E shall provide a report to the Water Board listing all properties that have been provided long term ~~permanent~~ uninterrupted replacement water supply. The report shall include: the affected well number and general area location, the method used to provide replacement water supply, and evidence provided water supply meets state primary and secondary drinking water standards. Describe all actions completed during the reporting period, such as operation and maintenance. Describe any problems that may have occurred and how and when they were corrected or remedied. For instance, if sampling indicates that alternate water supply does not meet federal and state MCLs, describe what corrective actions were implemented to fix the problem. If the well owner did not respond or provide permission to access and install ~~permanent~~ long term water supply, provide evidence of such, including actual date and time and manner of communication. Provide proof that

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		monitoring data has been sent to the owner of the affected well(s). Long term replacement reporting will be included in groundwater monitoring reports during which long term replacement water is supplied."
		~~"iii. Within 45 days of the end of the each quarter during which long term replacement water is supplied, submit quarterly replacement whole house water (WHW) monitoring reports containing monitoring information on the quality of long term replacement water supply consistent with the alternate water supply monitoring plan, as approved by the Executive Officer. Describe all actions completed during the quarter, such as operation and maintenance. Describe any problems that may have occurred and how and when they were corrected or remedied. Provide proof that monitoring data has been sent to the owner of the affected well(s). Quarterly replacement water WHW reports will be due February 15, May 15, August 15, and November 15 of each year during which long term replacement water is supplied."~~
VI and on	24-28	Correct: The ordering requirements are mis-numbered starting with the Independent Consultant requirement on Page 24 (numbered VI, which was previously used).
IX	25	Revise reporting limit for Cr(VI) to 0.2 ppb.
XVI	27	Add the following orders and letters:
		"3/7/06 Water Board letter that set forth requirements for Groundwater Monitoring Program (GMP) reporting
		"2/25/11 Water Board letter that set forth sampling and reporting requirements for domestic wells
		"8/2/13 letter requesting western action plan and setting forth semi-annual reporting requirements (included in Attachment 1 of proposed CAO but not listed here in text)
		"R6V-2013-0087 required expedited plan previously submitted and added reporting requirements for well rehabilitation (included in Attachment 1 of proposed CAO but not listed here in text)
		"11/7/13 Water Board letter requiring plans and information previously submitted and adding a reporting requirement to semi-annual reports revised by the proposed CAO
		"2/25/14 western action plan approval, added monitoring and reporting requirements"
Attachment 1		Add the following orders and letters:
		"3/7/06 Water Board letter that set forth requirements for GMP reporting

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		"2/25/11 Water Board letter that set forth sampling and reporting requirements for domestic wells "11/7/13 Water Board letter requiring plans and information previously submitted and adding a reporting requirement to semi-annual reports revised by the proposed CAO "2/25/14 western action plan approval, added monitoring and reporting requirements"
Attachment 8		
I.B.2.	1	Edit: "Collect groundwater samples from monitoring wells and active domestic /community~~/agricultural wells~~ required for that quarter. Active domestic and community wells required as of December 2014 are those wells listed in Table C-1 (from CH2M Hill's draft MRP). PG&E must make reasonable efforts to identify new active domestic and community water supply wells in the project area, and notify the Board for staff to determine if they are to be added to this MRP. ~~or planned for use within the next six months~~. Active domestic wells are those used for domestic supply purpose during a given calendar quarter, and include those wells on PG&E–owned property ~~and used that quarter for any purpose~~. Inactive wells are defined as any water well not used that quarter ~~or planned for use within the next six months~~."
I.B.3	2	Edit: "Water samples shall be analyzed for Cr(VI) using EPA Method 218.6 with a detection level of ~~0.1~~ 0.2 parts per billion (ppb) and Cr(T) using EPA Method 6020 with a detection level of 1 ppb."
I.C.1	2	Edit: "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.~~

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		a) Implement monitoring to verify the effectiveness of remediation, track progress towards meeting remediation targets, and evaluate threats to and monitor water quality in private supply wells. b) Implement monitoring at IRZs and ATUs, as prescribed in separate order, to monitor the progress and effectiveness of remediation, achievement of remedial goals, and water quality at domestic and community water supply wells. c) Monitoring well network to be designed to confirm the Cr(VI) plume boundary quarterly in each affected aquifer zone, in consideration of groundwater flow directions, chromium concentration, and hydrogeologic parameters. d) Additional semi-annual and annual monitoring shall be performed within 2000 feet downgradient of the plume boundary as required to verify that Cr(VI) is not increasing. e) Monitoring well network for Southern Plume Area is shown on Figure 2 of the CH2M Hill Draft MRP dated December 19, 2014"
I.C.2	2	Delete: ~~"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."~~
I.C.3	2-3	Delete: ~~"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.~~

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		~~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."~~
I.C.4	3	"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."~~ a) Monitoring well network to be designed to confirm the 3.1/3.2 ppb Cr(VI)/Cr(T) contours quarterly in the lower aquifer, in consideration of groundwater flow directions, chromium concentrations, and hydrogeologic parameters."
I.D	3-4	"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. The well with the consistently highest concentration in the well cluster will be sampled as the "primary" well for each cluster on a semi-annual sampling frequency. If a second well in the same cluster were to have similarly elevated Cr(VI) concentrations (near or above 3.1 ppb) to the selected "primary" well or an apparent up-trend in Cr(VI) concentrations, then the second well was selected as the "biennial" well to be sampled every 2 years. The other wells in the cluster provide redundant data and are not included in the program. 2. Wells exhibiting significantly fluctuating chromium concentrations will be sampled quarterly ~~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~~

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		~~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 all 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.~~"
1.E	4	"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 downgradient monitoring wells within 2000 feet of the 3.1/3.2 ppb Cr(VI)/Cr(T) contour as of fourth quarter 2014 and which show increasing hexavalent or total chromium concentration trends as of fourth quarter 2014. For this determination, an "increasing" trend is defined as an uptrending chromium concentration trend since first quarter 2013, based upon the trend calculated using the Mann Kendall Trend Test (EPA, 2009; Gilbert, 1987). The wells meeting these criteria, as of the date of this Order, are identified in the CH2M Hill Draft MRP dated December 19, 2014. ~~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 (first and third quarter of each year) at all downgradient monitoring wells that are within 2000 feet of the 3.1/3.2 ppb Cr(VI)/Cr(T) contour as of fourth quarter 2014 and in which hexavalent or total chromium concentration are not increasing. For this determination, a "not increasing" trend is defined as either a downtrending chromium concentration trend or "lack of a trend"(i.e. no upward or downward trend) since first quarter 2013, based upon the trend calculated using the Mann Kendall Trend Test (EPA, 2009; Gilbert, 1987) The wells meeting these criteria, as of the date of this Order, are identified in the CH2M Hill Draft MRP dated December 19, 2014.~~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.~~

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		~~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.~~ "
1.F	4-5	"F. Domestic/Community~~/Agricultural~~ Water Supply Wells, Northern ~~Plumes~~ Area [1] For the northern ~~plume~~ area, the following sampling requirements apply to all domestic and community water supply wells one-half mile downgradient and cross gradient of any monitoring well showing detections of total or hexavalent chromium above the maximum contaminant levels established for drinking water. 1. Domestic and community water supply wells to be sampled are identified in the Draft MRP by CH2M Hill (December 19, 2014). 2. Quarterly sampling at all domestic and community wells having hexavalent or total chromium detections at or above maximum contaminant levels established for drinking water.~~drinking water standards~~ following any sampling event. ~~2~~3. Semi-annual sampling in the first and third ~~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.~~ [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) is revised per the sampling program provided in the Draft MRP by CH2M Hill (December 19, 2014) ."
I.G.3	5	"G. No Monitoring Well and Water Supply Well Sampling is Required for the Following Locations: 1. Southwest (i.e., upgradient) of the Lockhart Fault 2. On or East of Dixie Road 3. Redundant monitoring wells ~~defined as wells having the lower of chromium detections compared to the other nearby wells and not meeting the monitoring objectives for a given area,~~ may be removed from all sampling events."

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III.B.1.a	7	Delete:"~~These maps are not to show the approximate limit of saturated alluvium in upper aquifer or flow directional arrows."~~
III.B.1.b	7	Delete: ~~"Do not include the approximate limit of saturated alluvium in the upper aquifer.~~
III.B.1.c	7	Delete:~~"Include the approximate limit of saturated alluvium in upper aquifer."~~
III.B.2.f	8	"Chromium boundary lines on plume maps shall reflect ~~the reported maximum hexavalent or total chromium concenetrations~~ the most representative of groundwater condition reported in monitoring wells and extraction wells at all locations for that quarter."
III.B.2.f	8	"Monitoring wells used to draw the 3.1 ppb Cr(VI) or 3.2 ppb Cr(T) ~~boundary lines~~ contours shall have plume lines drawn through the monitoring well if the well point has a chromium concentration that is equal to 3.1 ppb Cr(VI) or 3.2 ppb Cr(T)."
III.B.2.h	8	Delete: ~~"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."~~
III.B.2.j	8	Delete: ~~"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 e.1 ppb Cr(VI) or 3.2 ppb Cr(T) and within a one mile distance of the prior quarter's plume boundary."~~
III.B.3.d.i	8	Delete this requirement. If Water Board determines that re-analysis of sample results showing a 25% or greater is imperative, it is recommended that the following text be included instead, "If sample results show a relative percent difference of 25% of greater between Cr(VI) and Cr(T) concentrations and if both concentrations are greater than 4 ppb, then the samples shall be re-analyzed within the same quarter and the ensuing results described. In addition, if sample results have a Cr(VI)/Cr(T) difference greater than 1.0 ppb at concentrations below 4 ppb, then the sample shall be re-analyzed within the same quarter and the ensuing results described."

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Table 8-1	11	Revise Table 8-1 to reflect chromium effectiveness monitoring frequencies already defined in Water Board Order R6V-2014-0023 and proposed the Water Board's February 19, 2014 letter. Correct errors noted in comments in Attachment A on this requirement.
IV	12	"IV. CRITERIA FOR ~~REMOVAL OR~~ ABANDONMENT OF PG&E-OWNED INACTIVE DOMESTIC WELLS FROM SAMPLING PROGRAM A. The Discharger may remove PG&E-owned inactive wells from the domestic well sampling requirements specified above in Requirement I.B.2. ~~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.~~ 1. Domestic wells removed from the sampling program shall be left in place and secured (capped in place) <u>until they again become active, or a decision is made to abandon them under IV.B below.</u> ~~to be evaluated in the future for potential sampling.~~"

Notes

Suggested deletions are shown in ~~strikethrough~~.

Suggested additions are shown in <u>underline</u>.

Attachment F

List of References

Attachment F List of References

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PG&E 2013b. In the Matter of Lahontan Regional Water Quality Control Board Cleanup and Abatement Order No. R6V-2008-0002-A4; Request for Immediate and Emergency Stay; Petition for Review and Memorandum of Points and Authorities in Support Thereof. February 7.

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Attachment G
References (provided on DVD)