CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
LAHONTAN REGION

MEETING OF APRIL 19-20, 2017
BARSTOW

ITEM 9
PACIFIC GAS AND ELECTRIC COMPANY (PG&E), HINKLEY COMPRESSOR STATION, SAN BERNARDINO COUNTY – STATUS REPORT ON ACTIVITIES CONCERNING CHROMIUM CONTAMINATION FROM PACIFIC GAS AND ELECTRIC COMPANY'S HINKLEY COMPRESSOR STATION

CHRONOLOGY	
Nov. 4, 2015	Cleanup and Abatement Order (CAO) No. R6V-2015-0068 directed PG&E, among other things, to continue remedial actions and to achieve cleanup of chromium in groundwater to 50 parts per billion (ppb) by Dec. 31, 2025 and to 10 ppb by Dec. 31, 2032. Annual remediation effectiveness reports are required to be submitted every February 28.

BACKGROUND
This is the first annual summary of PG&E's remediation effectiveness and cleanup status as required by the CAO.

ISSUES
The Water Board will be given a report of corrective actions conducted for chromium contamination cleanup in Hinkley during 2016. PG&E will present proposed actions for 2017. PG&E acknowledges some modifications to remediation occurred in 2016; however, PG&E asserts they are on track for meeting cleanup requirements of the CAO.

DISCUSSION
PG&E, the Hinkley Community independent consultant, Project Navigator, and Water Board staff will make presentations (Enclosures 1, 3 and 5) updating the Board on these topics: • Chromium plume status • Remedial actions in 2016 and planned in 2017 • Domestic wells • Technical Working Group meetings/Background study actions • Public outreach Enclosure 2 is the executive summary from PG&E's 2016 Annual Report on cleanup status and remediation effectiveness, required by the CAO.

Enclosure 4 provides copies of the Hinkley community newsletter, produced by Project Navigator.

Water Board staff will provide an update on the following topics (Enclosure 5) since issuance of the November 2015 CAO:

- Updated Notice of Applicability for In-situ Reactive Zone (IRZ) activities
- Revised hydraulic capture of Cr plume
- Bioreactor time extension
- Revisions to monitoring program
- Background study update

Enclosure 6 is the April 2017 Status of Actions sheet created by Water Board staff to be distributed to the Hinkley community at the second quarterly community meeting on April 27.

Enclosure 7 is the USGS Report describing the Background Study Plan.

PUBLIC OUTREACH/INPUT

The Water Board's quarterly Status of Action sheets are provided and discussed during quarterly Hinkley Community meetings. Water Board orders, letters, and requests for comments are uploaded to Geotracker and posted on the PG&E Hinkley Chromium Cleanup webpage on the Water Board's website. This item was distributed to the Hinkley interested persons email subscription list and posted to the Water Board's website.

PRESENTERS

Lauri Kemper, Lahontan Water Board
Kevin Sullivan/Betsy Brunswick, PG&E
Dr. Ian Webster, Project Navigator
Lisa Dernbach and Anne Holden, Lahontan Water Board

RECOMMENDATION

This is an information item only. The Water Board may provide direction to staff as appropriate.

ENCLOSURE	ITEM	BATES NUMBER
1	PG&E presentation	**9 - 5**
2	Executive Summary of PG&E's 2016 Cleanup Status and Effectiveness Report	**9 - 13**
3	Community Advisory Committee presentation by Project Navigator	**9 - 27**
4	Hinkley Community 2016 newsletters (6)	**9 - 47**
5	Water Board staff presentation	**9 - 61**
6	April 2017 Status of Actions sheet	**9 - 75**
7	USGS Background Study Plan Report	**9 - 79**

ENCLOSURE 1

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Agenda

2016 Review

- Plume Remediation
- Mass Removal
- CAO Implementation
- Sustainability

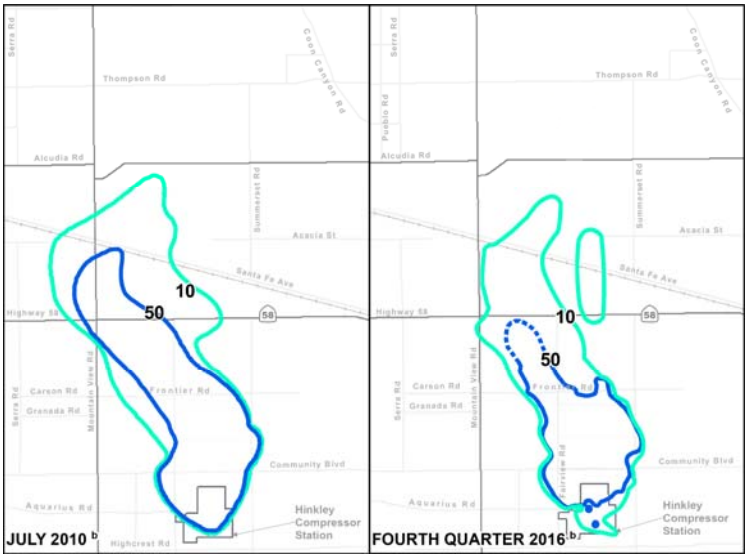
2017 Look ahead

- Construction and Operations
- Monitor Remediation Progress
- Domestic Well Protection

PGE is committed to plume cleanup in accordance with the CAO and EIR.

1

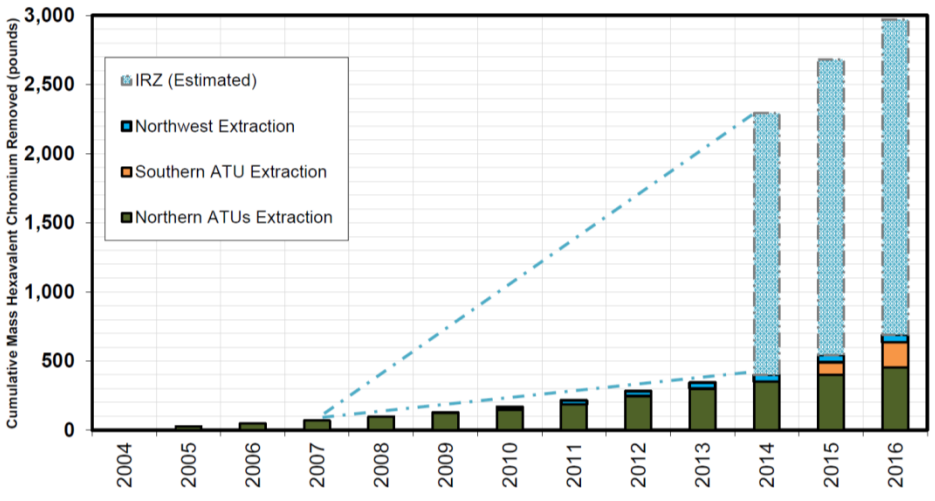
Plume is Retreating



Recommendations: Install new extraction well south of Santa Fe

2

Cumulative Mass Removal Over Time



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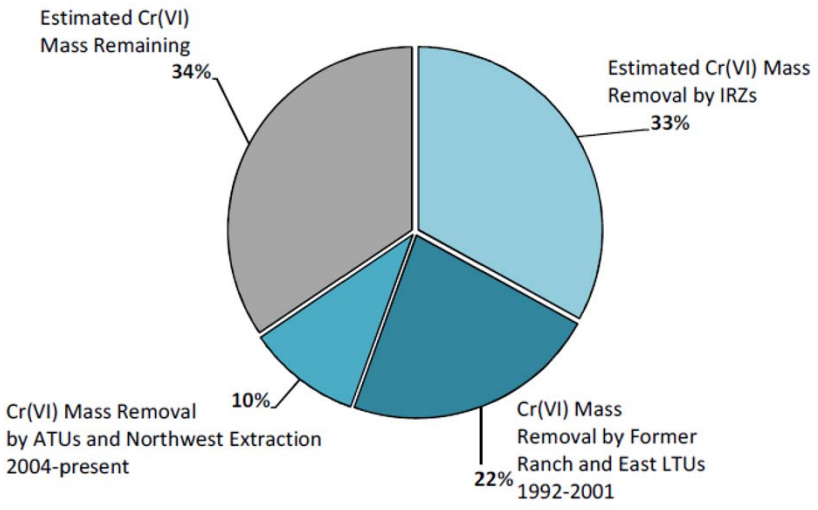
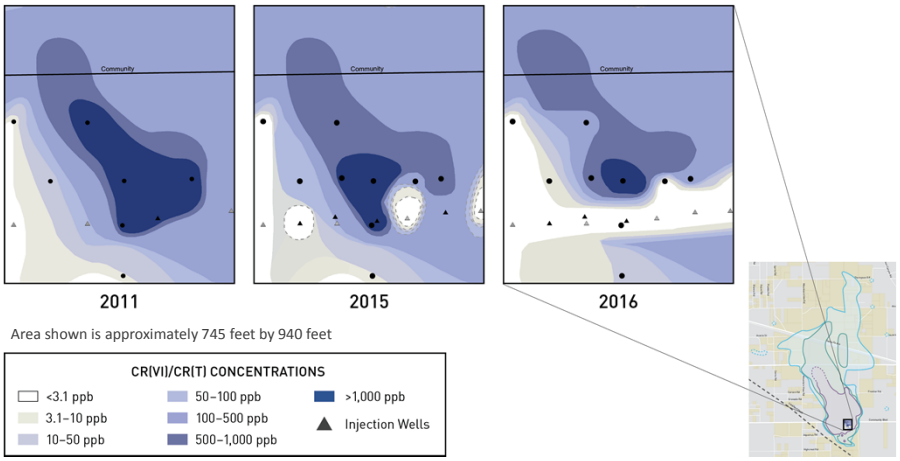
Progress Toward Overall Mass Removal



More Chromium 6 removed than remains.

4

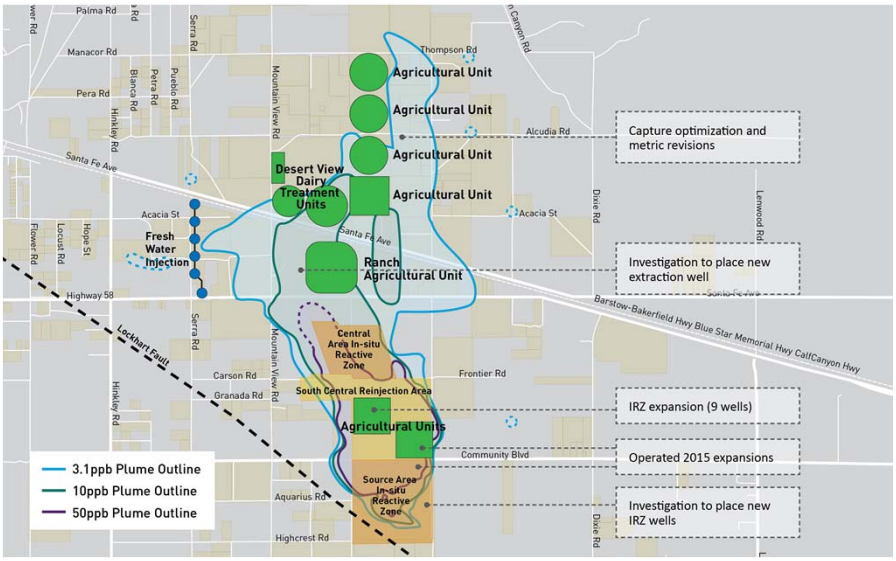
Source Area Treatment



The 2015 IRZ expansion has improved treatment in area of historically highest contamination

5

2016 Activities



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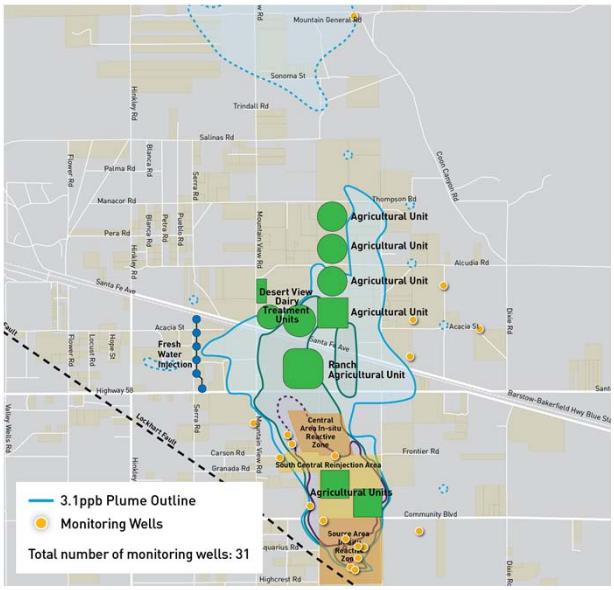
2016 Investigations



7

Implementation of the CAO

- Plume Investigation Workplan
- Lower Aquifer Conceptual Site Model
- Long Term Replacement Water Workplan
- Revised Capture Metric Proposal
- SCRIA IRZ Basis of Design
- Ranch ATU Extraction Well Basis of Design
- Source Area IRZ Basis of Design
- First Annual Effectiveness Evaluation

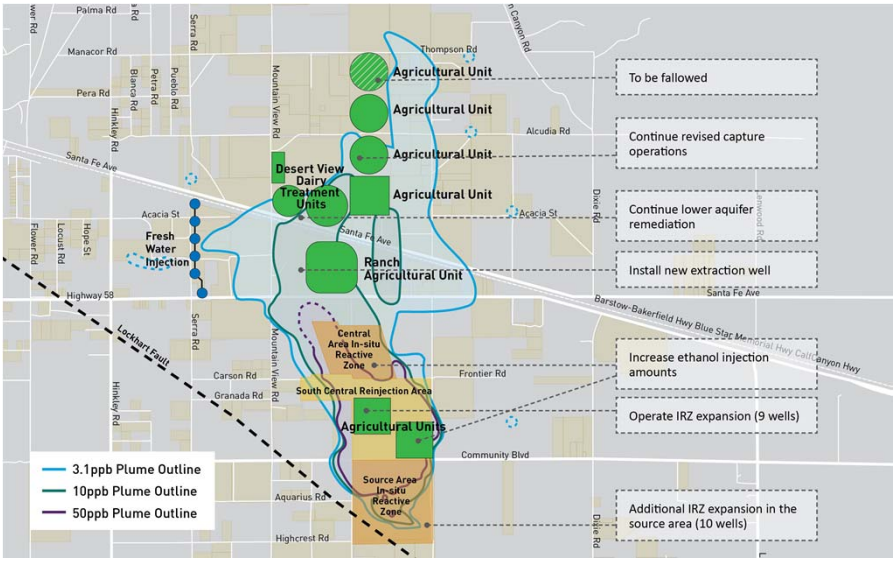
8

Sustainability Accomplishments

- **CONSERVING OUR WATER:** We use highly efficient irrigation technologies that conserve water. Drag-and-drip and Low Energy Precision Application (LEPA) methods on 314 acres — saves more water than traditional spray techniques, by reducing evaporation.
- **IMPROVING WATER QUALITY:** PG&E treatment technologies promote removal of nitrates from area groundwater. While treating the chromium 6 plume, our efforts have also removed more than 200 tons of nitrates from Hinkley groundwater.
- **REDUCING WASTE:** Nitrates in Hinkley groundwater actually benefit alfalfa crop growth and supplement use of fertilizers. Also, PG&E's treatment technologies use less energy than other cleanup methods, minimizing our carbon footprint.
- **KEEPING IT LOCAL:** By partnering with local farmers, PG&E's agricultural operations boost the local economy, preserve farmland and foster working relationships.

9

Recommendations for 2017



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Looking Forward

- *Implementation of the remedy in accordance with the CAO and EIR is* protective of the community
- All domestic well chromium results are below safe drinking water standards
- Model predictions for 2017:
  - that remedy operations will not increase chromium concentrations in domestic wells
  - that remedy byproducts will not impact domestic wells
  - that drawdown will not impact domestic wells

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ENCLOSURE 2

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Executive Summary

This Annual Cleanup Status and Effectiveness Report (January to December 2016) (report) evaluates the effectiveness of remedy components, including hydraulic containment, agricultural operations, and in situ treatment, that have been implemented to date towards reaching remedial targets specified in the Cleanup and Abatement Order (CAO) No. R6V-2015-0068, issued on November 4, 2015 (California Regional Water Quality Control Board, Lahontan Region [Water Board] 2015), and recommends improvements for remedy performance. This report also includes the operational plan for 2017. Table ES-1 summarizes key remedial system implementation in comparison to the operational plan, recent operational changes, effectiveness evaluations, and recommendations for improvements from observations from January to December 2016.

The 2015 CAO established cleanup requirements for the site, including the following cleanup timeframes for the southern plume:

- Reach and maintain 50 parts per billion (ppb) hexavalent chromium [Cr(VI)] and total chromium [Cr(T)] in 90% of the 50 ppb Cr(VI) plume as of the date of the 2015 CAO by December 31, 2025, as determined by a specified set of monitoring wells.
- Reach and maintain 10 ppb Cr(VI) and Cr(T) in 80% of the 10 ppb Cr(VI) plume as of the date of the 2015 CAO by December 31, 2032, as determined by a specified set of monitoring wells.

In 2014, a Remedial Timeframe Assessment (Arcadis U.S., Inc. [Arcadis] 2014) was conducted that estimated remedial timeframes based on a preliminary design of remedial infrastructure and a preliminary plan of construction sequencing and operations. The estimated timeframes from the Remedial Timeframe Assessment informed the cleanup timelines in the 2015 CAO, although the exact deadlines are faster than the range of estimates from the Remedial Timeframe Assessment. Since the Remedial Timeframe Assessment was conducted, Pacific Gas and Electric Company (PG&E) has implemented remedial actions, including investigations in areas of planned remedial infrastructure, construction of additional remedial systems, and operation of remedial systems, including Agricultural Treatment Units (ATUs) and In Situ Reactive Zone (IRZ) systems. The information gathered through implementation of these activities is used to inform and refine the plans for remedy infrastructure and operations, employing an adaptive management approach. In 2016, Basis of Design documents were issued for a new extraction well near the Ranch ATU (Arcadis 2016g), an expansion of the South Central Re-injection Area (SCRIA) IRZ (Arcadis 2016i), and an expansion of the Source Area IRZ (Arcadis 2016l), presenting refined plans for remedy infrastructure. Based on current site information, a refined operational plan for 2016 was developed and presented in the annual effectiveness report for 2015 (herein referred to as “the 2016 operational plan” ([Arcadis 2016b]). This report evaluates the implementation of the remedy according to these plans and evaluates the effectiveness of remedial operations in 2016.

During 2016, remedial systems were generally operated according to the 2016 operational plan, with a few exceptions that are not anticipated to impact overall cleanup. Consistent with plans set out in the Remedial Timeframe Assessment (Arcadis 2014) and the subsequent Basis of Design (Arcadis 2016i), SCRIA IRZ expansion began with installation of nine new injection wells. In addition, an investigation was conducted to support the design of an expansion to the Source Area IRZ. Data collected to date indicate improved treatment from operations of remedial systems, consistent with expectations.

Table ES-1. Summary of Key Remediation System Operations, Effectiveness to Date, and Reccomendations for Improvement

Hydraulic Containment and Treatment Upper Aquifer, North of Highway 58

Planned Remedy versus Actual Implementation	North of Highway 58, the remedy design and planned operations for the Upper Aquifer includes operation of the extraction well network with treatment of extracted groundwater at five northern ATUs and injection of groundwater into the Northwest Freshwater Injection (NWFI) system (Arcadis 2014). Operations of the northern extraction system and NWFI system were within 10% of the 2016 operational plan. Optimization of the northern extraction system for hydraulic control is ahead of plan. The Remedial Timeframe Assessment assumed that operation of the extraction system for the first 10 years of the remedy would be configured with extraction locations and distribution of extraction rates similar to 2011 to 2014 operations, with the first major change in extraction locations and rates occurring after year 10. As the chromium plume in the north has contracted, optimization by shifting extraction to the south began in 2015 (Arcadis 2016b). Optimization of extraction operations continued in 2016, which included testing and implementation of new hydraulic capture metrics and a pilot boring investigation to identify a new extraction well location, as detailed below.
Recent Operational Actions and Improvements	Upper Aquifer hydraulic testing was conducted in the winter of 2015-2016 to pilot test well pairs and well triplets to demonstrate hydraulic containment with revised capture metrics. Based on the testing results, PG&E proposed revised capture metrics (Arcadis 2016h) and subsequently received Water Board comments on the proposed revised capture metrics. PG&E incorporated comments from the Water Board (Arcadis 2016h), and the proposed metrics were approved by the Water Board on November 22, 2016. Operations and reporting under the new metrics commenced in December 2016. Reconfiguration of the northern extraction system has allowed for more efficient ATU operation in 2016 (Arcadis 2016b). This increase in efficiency of water use allowed for fallowing of the Yang, Cottrell, and a portion of the Ranch ATUs for several of the warmest months of the year when crop water demand is highest. Fallowing an ATU during the summer months when water demand is at its height will likely continue in the future and provide the benefits of avoiding groundwater extraction from wells containing low chromium concentrations resulting in unnecessary aquifer drawdown, northward migration of chromium towards extraction wells, or extraction at wells that are not in optimal locations for hydraulic containment or chromium mass removal. Three pilot borings were advanced west of the Ranch ATU to identify a suitable location for a new extraction well. The purpose of the new extraction well is to reduce chromium mass flux towards the northern ATUs, expedite chromium mass removal, and shift extraction from lower chromium concentration extraction wells in the north (and potentially the west) of the plume core to promote continued plume contraction within the current 10-microgram per liter (µg/L) plume area. Construction of this new

well is planned for the first quarter of 2017, with operation anticipated in the summer of 2017. Installation of this new extraction well in year two of the remedy for optimization purposes is ahead of the extraction system optimization planned in year 10 of the Remedial Timeframe Assessment (Arcadis 2014).

System Effectiveness

Successful hydraulic containment of chromium-affected groundwater continues in the southern plume south of Thompson Road and north of Highway 58. During 2016, hydraulic containment compliance was demonstrated by inward groundwater gradients at well pairs and well triplets per the 2015 CAO, and/or inward gradients at alternate well triplets, and groundwater level contour maps (Arcadis 2016c,f,j, Arcadis 2017b). Near the Cottrell ATU, localized outward gradients were calculated for two well pairs (MW-55S/MW-86S and DW-03/MW-68S) and at one well triplet (MW-32S/MW-87S/MW-88S) from January to November 2016. During these periods where localized outward gradients were calculated, hydraulic containment of an area greater than the hydraulic containment targets was demonstrated by alternate well triplets and groundwater level maps. In December 2016, hydraulic containment compliance was demonstrated by inward groundwater gradients at all well pairs and well triplets based on the approved revised the capture metrics (Water Board 2016d).

In the Upper Aquifer, the overall area with Cr(VI) above 10 µg/L continues to decrease on the eastern and western sides of the pumping center and other areas. Also, notably in 2016, the northern extent of Cr(VI) above 50 µg/L is estimated to have significantly decreased. The area with Cr(VI) above 50 µg/L is now estimated to be located south of Highway 58, after being estimated to extend as far north as Santa Fe Avenue for many years. Decreasing chromium trends continue to be observed at many monitoring wells near pumping areas in response to groundwater extraction and hydraulic containment. Optimization of the extraction system ahead of schedule is supporting the cleanup within CAO timeframes. On the western side, chromium concentrations have rapidly decreased east of the NWFI system since injection operations began in 2010 and ATU extraction operations began in earnest in 2011. The 10-µg/L chromium isoconcentration contour has retreated significantly since 2010, and is now located east of Mountain View Avenue, demonstrating that easterly gradients have drawn lower concentration groundwater from the west towards the ATU extraction center to the east. Additionally, groundwater level data indicate that groundwater flow is more influenced by ATU extraction wells than NWFI operations. Full-scale operation of the NWFI system is likely no longer needed for plume containment.

West of the NWFI system, EX-36 is a low-yielding extraction well operated at a flow rate of approximately 1-gallon per minute (gpm). Cr(VI) concentrations at EX-36 have been 2 µg/L or less since this well was installed in 2014. Chromium concentrations are stable at low concentrations at monitoring wells located near EX-36.

Recommended Changes

Continued operation of the current remedial systems is recommended to maintain hydraulic capture under the revised hydraulic containment metrics. To reduce the potential for drawing chromium northward toward extraction wells containing lower chromium concentrations, reduce aquifer drawdown, and improve chromium removal efficiency by targeting extraction of groundwater with higher Cr(VI) concentrations, PG&E recommends continuing to optimize the flow rate distribution of the current extraction well network.

The following actions are proposed to continue improving hydraulic containment and chromium mass removal effectiveness:

- Fallow northern ATUs as needed to maintain optimized extraction flow rates.
- Install a new extraction well on the western side of the Ranch ATU to reduce northward mass flux, expedite chromium mass removal, and to shift extraction to the south to promote continued plume contraction within the current 10-µg/L plume area.
- Turn off or only intermittently operate extraction wells EX-15, EX-16, and EX-20, located on Mountain View Avenue west of (outside) the 10-µg/L isoconcentration contour, to allow for more rapid plume contraction towards ATU extraction wells east of Mountain View Avenue (i.e., IW-01, IW-02, and EX-30). Operation of these extraction wells is not currently needed to maintain hydraulic containment east of the NWFI system. Further, operation of the new extraction well west of the Ranch ATU beginning in the summer of 2017 is expected to make operation of EX-15, EX-16, and EX-20 less beneficial.
- Continue operation of the NWFI system and EX-36 west of the NWFI system per the Revised Action Plan Required by Request for an Action Plan and More Information in Reports Required by Cleanup and Abatement Order No. R6V-2008-0002 and Investigative Order No. R6V-2013-0041 (Arcadis 2013). However, it is recommended that an evaluation of the potential benefits of discontinuing (or reducing) operation one or both systems be conducted in 2017 as they may no longer be necessary for remedy effectiveness.

Hydraulic Containment and Treatment Upper Aquifer South of Highway 58

Planned Remedy versus Actual Implementation and Recent Operations

As planned, operation of the Community East ATU and the northern half of the Fairview ATU continued in 2016 and the southern half of the Fairview ATU came online in February 2016. However, operation of the southern ATUs in 2016 was below the 2016 operational plan for 7 months of the year, resulting in an annual average southern ATU extraction and application rate that was approximately 22% below the 2016 operational plan. The 2016 operational plan was not met due to equipment failures at both southern ATUs, poor soil conditions, additional soil conditioning work, IRZ construction, and actual sustainable winter applications rates that were observed to be lower than the theoretical rates that formed the basis of the 2016 southern ATU operational plan.

System Effectiveness	Although the southern ATU extraction and ATU application rate was less than the 2016 operational plan by approximately 22%, the reduced 2016 extraction operations are not estimated to significantly affect remedial timeframes. The combined annual average extraction and ATU application rate for the southern ATUs in 2016 was approximately 256 gpm. This was less than the 2016 operational plan (328 gpm) and annual average rate of 335 gpm modeled in the Remedial Timeframe Assessment (Arcadis 2014). The lower actual irrigation flow rate for the 2016 reporting period is not estimated to significantly affect remedial timeframes. While the remedial timeframe estimates indicate that overall mass removal is faster with operation of the southern ATU extraction wells, the model estimated overall timeframe to meet cleanup levels (e.g., 50 μg/L throughout the plume area) is not sensitive to southern ATU extraction operations (Haley and Aldrich 2010). Model simulations both with and without southern ATU extraction yielded comparable cleanup timeframe estimates to treat the plume area (e.g., to 50 μg/L). This is because operation of the IRZ system is estimated to have a much more significant effect on cleanup timeframes than ATU extraction.
Recommended Changes	Continue to operate the southern ATU extraction well network to maximize Cr(VI) mass removal, operate the ATUs at agronomic rates, and to enhance IRZ operations.

Hydraulic Containment and Treatment Lower Aquifer

Planned Remedy versus Actual Implementation and Recent Operations	To date, remedial actions implemented to address Cr(VI) in the Lower Aquifer have included the following, in accordance lower aquifer plans: • Limiting extraction at Ryken-8 and Ryken-9 to reduce the potential for downward gradients between the Upper and Lower Aquifers • Suspending extraction at EX-26 to limit the potential for extraction from that well to induce northerly migration of Cr(VI) in the Lower Aquifer • Installation and operation of an extraction well (EX-37) screened across the Upper and Lower Aquifers • Upper Aquifer groundwater extraction to enhance upward vertical gradients from the Lower Aquifer. Limited aquifer testing of Upper Aquifer extraction well EX-29 was conducted to assess the potential benefit of turning this well off.
System Effectiveness	An Updated Conceptual Site Model and Background Chromium Concentrations for Lower Aquifer Report (Lower Aquifer CSM Report; Arcadis 2016e) was prepared in 2016 summarizing the complex hydrostratigraphic conditions where chromium is present in the Lower Aquifer, with recommendations to continue current remedial actions to address chromium.

Current remedial actions taken to address chromium concentrations in the Lower Aquifer are reducing chromium mass and the Lower Aquifer Cr(VI) plume extent as anticipated. Chromium concentrations are decreasing in monitoring wells screened beneath the blue clay aquitard (MW-23C and MW-42C) to levels near or below the lowest concentrations reported for these wells to date. At MW-23C, Cr(VI) concentrations decreased from 10 µg/L during the fourth quarter of 2015 to 5.6 µg/L during the fourth quarter of 2016, representing the lowest concentration reported for this well since 2008. At MW-42C, Cr(VI) concentrations reached their lowest value in the fourth quarter of 2016 (4.8 µg/L) that has been reported for this well since samples were first collected in 2011. Concentrations at monitoring wells (MW-92C and MW-100C) located within the blue clay transition zone where the blue clay is only intermittently present, thin, and sandy, are generally stable at concentrations approximately half of their historical maximums. As discussed in the Lower Aquifer CSM Report, a reduction in Upper Aquifer chromium concentrations will be required before significant concentration reductions can be expected at MW-92C and MW-100C. Upper Aquifer monitoring and extraction wells near MW-92C and MW-100C show declining chromium trends, indicating favorable conditions for future concentration reductions at MW-92C and MW-100C.

Recommended Changes

Continue implementing current remedial actions to reduce the mass of Cr(VI) in the Lower Aquifer. Evaluate the benefit of discontinuing extraction from EX-29 and/or other extraction wells to enhance current remedial actions.

IRZ Treatment

Planned Remedy versus Actual Implementation

The IRZ remedy design and planned operations include sequential buildout beginning in 2015, a few years into the remedy, and after the Habitat Conservation Plan is approved.

- Buildout of the SCRIA IRZ planned for 2016-2017 began in 2016 with the installation of nine new injection wells. This expansion is more robust than planned in the Remedial Timeframe Assessment, which called for three injection wells to be installed in 2016-2017 (Arcadis 2014).
- In 2016, pre-design investigation in the southeast Source Area and system design was completed to support planned 2017 expansion of the Source Area IRZ. Planning, design, and potential construction for the next phase expansions will begin in 2017.
- Following the issuance of the 2015 CAO, IRZ operations in 2016 were conducted within 10% of the 2016 operational plan, with the exception of the Source Area IRZ. Source Area ethanol volumes were 622, 418, and 408 gallons below the plan of 700 to 1,000 gallons and the notification volume of 630 gallons in September, October, and November, respectively. Source Area recirculation rates were 41 and 46 gpm, below the goal of 75 to 105 gpm and the notification rate of 68 gpm in October and November, respectively.

Source Area IRZ

Recent Operational Changes and System Effectiveness

PG&E began operating 13 new injection wells in April 2015, and operation of the 2015 Source Area IRZ expansion continued in 2016. Operations focused on the highest concentration area of the deep zone of the Upper Aquifer in the northern Source Area and other portions of the shallow and deep zone of the Upper Aquifer across the northern Source Area.

Treatment in new areas was observed because of the 2015 expansion, as follows:

- Indications of treatment were observed for the first time in the portion of the Source Area with the highest concentrations at the site – the deep zone near SA-MW-05D. Three 2015 Source Area IRZ injection wells were reconfigured in the fall of 2015 to inject into both the shallow and deep zones after only low-flow rates were achieved through injecting into only the deep zone (SA-RW-31, SA-RW-32, and SA-RW-33). Subsequently, Cr(VI) concentrations at SA-MW-05D and SA-MW-30D declined in 2016 compared to 2015 concentrations, while indications of IRZ treatment, such as low detections of manganese and declining nitrate and sulfate concentrations, have been observed in the area in 2016.
- Evidence of treatment has been observed downgradient of the injection locations operated in 2016 in the northern Source Area, and treatment has been established across most of the area. The intervals for injection were rotated in November to December 2016 at five wells (SA-RW-26 through SA-RW-30) to expand treatment in the Upper Aquifer.
- SA-RW-38, located between Hinkley Compressor Station Surface Impoundments 7R and 8, started operation in the fourth quarter of 2015 to target Cr(VI) concentrations in the shallow zone of the Upper Aquifer near SA-SM-02S and SA-SM-01S. Despite low injectability, likely due to low aquifer permeability, partial treatment has been achieved at monitoring SA-SM-02S in 2016, with Cr(VI) concentrations declining from 2,100 µg/L in the fourth quarter of 2015 to 160 µg/L in the fourth quarter of 2016.
- Treatment of the southwestern Source Area was achieved in 2015. Injections were subsequently suspended in September 2015 due to Cr(VI) concentration increases at the western edge of the Source Area (SA-MW-33S), where concentrations have since declined back below 3.1 µg/L.
- Operational rates were more than 10% lower than 2016 operational plan in the Source Area IRZ in September, October, and November. Operation of several injection wells on the eastern side of the Source Area IRZ (SA-RW-33, SA-RW-34, SA-RW-20, SA-RW-21) where treatment was achieved was suspended in late September when increases in Cr(VI) concentrations at the eastern plume margin were observed at MW-03A and SA-MW-25S [Cr(VI) concentrations of 14 µg/L and 19 µg/L at MW-03A and 5.3 µg/L and 6.9 µg/L at SA-MW-25S, in the Third and Fourth Quarters of 2016, respectively]. Given the short duration of this deviation from the 2016 operational plan, this reduction of flow rate and ethanol volume is

not anticipated to impact achievement of CAO remedial timeframes. Flow rates and ethanol volumes increased back to at least within 10% of plan in December.

Recommendations

- Continue operation of the 2015 expanded Source Area IRZ system, with extraction flow supplemented by diversion from the southern ATUs. Typical operations of the new injections wells are recommending, consisting of operating a subset of injection wells with periodic rotation of well locations and/or screened intervals as areas are treated.
- Continue suspension of injections in the northeastern Source Area to mitigate plume bulging by the southern ATU extraction wells located on Community Boulevard.
- Install and operate additional injection locations in the southern Source Area in 2017. Based on results of the pre-design investigation, new injection locations are designed to target areas of the chromium plume with concentrations greater than 100 µg/L. Additionally, a tighter well spacing than that included in the Remedial Timeframe Assessment (Arcadis 2014) is recommended, consistent with that implemented successfully in the 2015 Source Area IRZ expansion.
- Additional expansions are tentatively planned for 2019 following the approval of the Habitat Conservation Plan and issuance of the Incidental Take Permit.

SCRIA

Recent Operational Changes and System Effectiveness

PG&E completed the previous IRZ system expansion construction during the first half of 2015, which consisted of six new injection wells. This system was more robust than planned in the Remedial Timeframe Assessment (Arcadis 2014), which assumed the addition of two wells. Operation of the new system began in May 2015. Current operations are conducted in conjunction with extraction for the Community East and Fairview ATUs. Hydraulic containment in this area via extraction and ATU operation allowed IRZ injection rates to be returned to higher rates at the IRZ wells present in high Cr(VI) concentration areas of the SCRIA to facilitate treatment.

Treatment in new areas was observed as a result of the 2015 expansion, as follows:

- Improved Cr(VI) treatment was observed in the deep zone of the Upper Aquifer as a result of continuous operation of the eastern portion of the SCRIA 2015 IRZ system expansion. Reagent distribution and treatment has most recently been observed near injection well SC-IW-35, with evidence of treated groundwater at downgradient extraction well X-12. Cr(VI) treatment has been observed and sustained near injection well SC-IW-24 and neighboring monitoring wells. At monitoring well SC-MW-26D downgradient of operating injection well SC-IW-26, the observed Cr(VI) concentration has decreased and a decreasing nitrate trend is observed.

Recommendations

- Continue operation of the eastern portion of the SCRIA IRZ, which began in May 2015, focusing on the deep zone of the Upper Aquifer to target high Cr(VI) concentrations in this area.

- Begin operation of the 2017 SCRIA IRZ expansion injection wells on the western portion of the SCRIA IRZ, focusing on the shallow zone of the Upper Aquifer to target high Cr(VI) concentrations in this area.
- Increase total organic carbon (TOC) dosing concentrations across the system to improve reagent distribution and treatment in the SCRIA IRZ.
- Optimize operation of the Community East and Fairview ATU extraction well network to provide groundwater for IRZ injection and hydraulic containment in the SCRIA to minimize the potential for plume bulging.

Central IRZ

Recent Operational Changes and System Effectiveness

The Central Area IRZ system was expanded to target the deep zone of the Upper Aquifer and a larger lateral extent of the shallow zone of the Upper Aquifer in late 2012. During 2016, injection wells were rotated periodically to maintain Cr(VI) reduction in previously treated areas and target treatment in downgradient areas, including the CA-MW-300, CA-MW-400, CA-MW-500, and CA-MW-600 series wells.

The following trends were observed in 2016:

- All 10 of the CA-MW-100 series deep zone monitoring wells targeted by injections of the 2012 expanded system continued to show evidence of treatment. The clean waterfront expanded in 2016 in the deep zone of the Upper Aquifer and was observed on the east end of the system as far downgradient as CA-MW-506D, located approximately 1,600 feet from the injection wells. On the west end of the system downgradient treatment was observed in the deep zone of the upper aquifer at some locations (e.g. CA-MW-204D, CA-MW-303D) and not others (CA-MW-302D, CA-MW-306D).
- On the western side of the system, treatment improved through operation of injection well CA-RW-15, with Cr(VI) concentrations decreasing and remaining less than 3.1 µg/L at monitoring well CA-MW-110.
- Evidence of treated groundwater has been observed at 34 of 42 downgradient shallow CA-MW-300, CA-MW-400, CA-MW-500, and CA-MW-600 series monitoring wells. Rebound in previously treated locations occurred in several areas as indicated by results from CA-MW-402S, CA-MW-408, CA-MW-310S, CA-MW-301, and CA-MW-601. Operational adjustments (changing injection locations) were made to reestablish treatment in these areas in 2016 or are planned for 2017.

Recommendations

Periodically rotating injection wells is recommended to maintain Cr(VI) reduction in previously treated areas and to reestablish treatment in areas with potential rebounding concentrations of Cr(VI), particularly the monitoring wells noted in the above bullet. Injections will continue to target downgradient areas to sustain observed treatment and reach farther downgradient wells, primarily in the deep zone of the Upper Aquifer (e.g., western and central CA-MW-300, CW-MW-400, and CA-MW-500 series monitoring wells). Additionally, TOC dosing concentrations will be

increased in the middle and western end of the system to improve downgradient reagent distribution and Cr(VI) treatment.

Mass Removal

Agricultural Treatment: Since 1992, groundwater extraction and ATU operations have removed an estimated 2,186 pounds of Cr(VI) from groundwater in the Upper Aquifer. During this time, approximately 206 tons of nitrates present in groundwater from pre-existing land use activities were also removed from groundwater. Despite operational challenges encountered while operating the southern ATU fields, resulting in an approximate 22% reduction in extraction rates in comparison to the 2016 operational plan, approximately 94 pounds of Cr(VI) were removed by the southern ATU extraction network in the plume core south of Highway 58 in 2016. Approximately 50 pounds of Cr(VI) were removed by the northern ATU extraction wells in 2016.

IRZ Systems South of Highway 58: A significant amount of Cr(VI) has been removed from groundwater (an estimated 2,279 pounds) by IRZ operation to date. The method for calculating Cr(VI) mass treated by in situ treatment is more difficult and subject to more uncertainty than calculating estimates of Cr(VI) mass removed by extraction and agricultural treatment. A comparison of estimated mass removed to date to mass remaining to be treated indicates that about two times more chromium has been removed by remediation than remains to be treated. Approximately half of the mass removed to date has been removed by the IRZ systems and approximately half by the agricultural systems. The majority of the mass removed by the agricultural treatment systems to date was achieved by operation of the historical Land Treatment Units in the plume core. Since 2007, the IRZs have accounted for most of the mass removal.

Monitoring Frequency

The 2015 CAO requirement I.C. and I.D. requires that each year in the Annual Cleanup Status and Effectiveness Report the monitoring frequency of monitoring wells used to contour the plume boundary will be reviewed to determine whether the sampling frequency for an individual well should be changed (Water Board 2015). An initial evaluation of the changes in sampling frequencies was submitted on January 11, 2017 (Arcadis 2017a). Based on Water Board comments, the analysis was revised to consider data from consecutive quarters rather than from consecutive sampling events when the CAO requires four or 12 consecutive datapoints to be evaluated. The revised analysis using data from the last quarters of sampling is included in Appendix C (Arcadis 2017c; Appendix C). Water Board staff approved the evaluation and changes determined from the evaluation in an email dated February 1, 2017.

The changes to sampling frequencies in 2017 are summarized as follows:

- The sampling frequency for 100 monitoring wells changed from quarterly to semi-annually given the history of concentrations below 3.1 μg/L or stable or decreasing Cr(VI) concentration trends.

- The sampling frequency for 33 monitoring wells changed from semi-annually to annually given the history of concentrations below 3.1 μg/L or stable or decreasing Cr(VI) concentration trends.
- The sampling frequency for five monitoring wells changed from annually to biennially given the history of non-detect concentrations or decreasing or stable concentration trends.
- The sampling frequency of seven wells changed from semi-annually to quarterly, and five wells changed from annually to semi-annually given increasing Cr(VI) concentration trends.

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ENCLOSURE 3

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IRP Manager's Update

Hinkley Community Outreach Program Regarding Cr6 Groundwater Remediation

April 19, 2017
Barstow, California

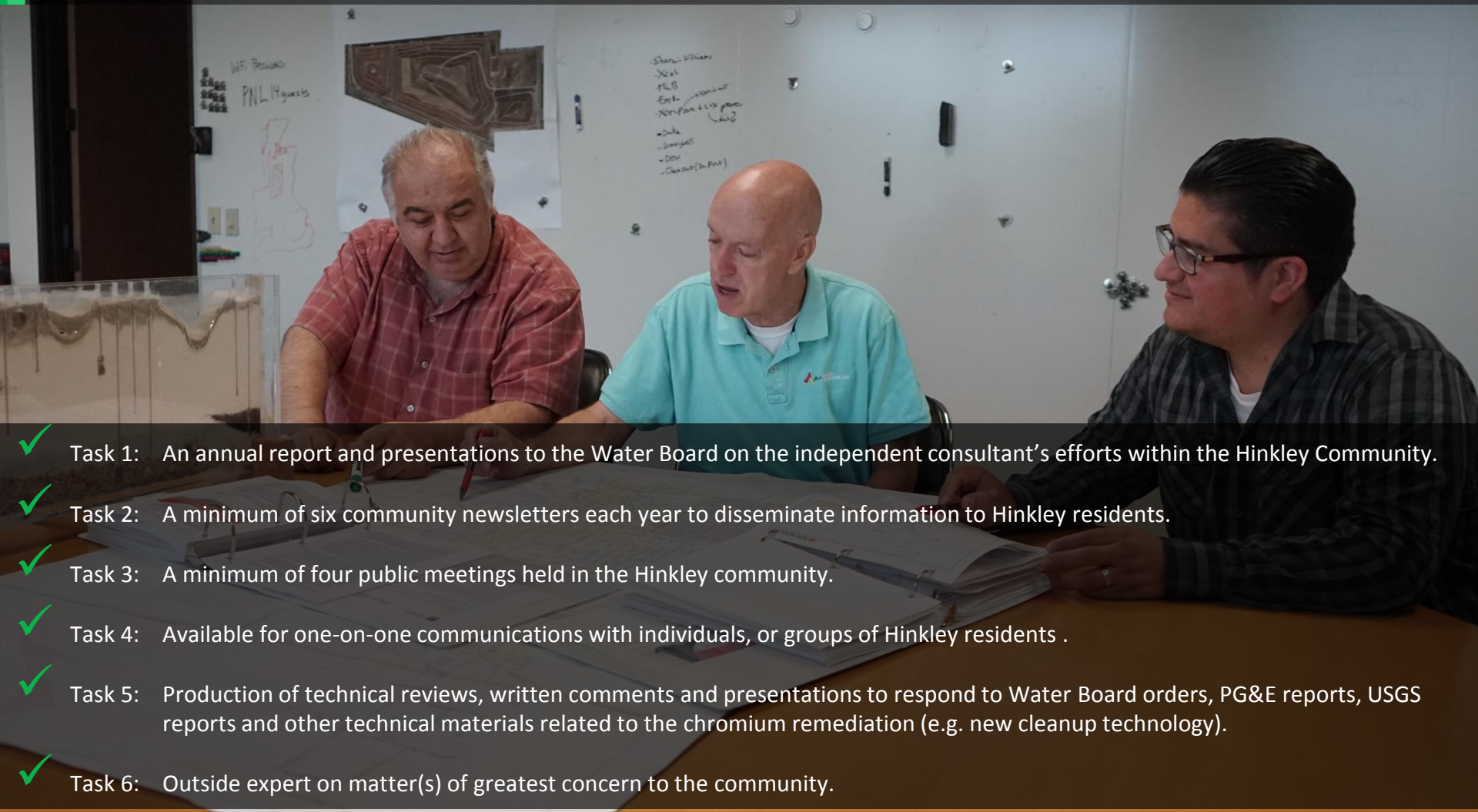
Prepared for

Lahontan Regional Water Quality Control Board
Board Members' Meeting

Prepared by

Dr. Ian A. Webster, as IRP Manager
Project Navigator, Ltd.
iwebster@projectnavigator.com

IRP Manager Provides Independent Services to the Hinkley Community Outlined from the November 4, 2015 CAO No.R6V-2015-0068 Section VIII.B.



- ✓ Task 1: An annual report and presentations to the Water Board on the independent consultant's efforts within the Hinkley Community.
- ✓ Task 2: A minimum of six community newsletters each year to disseminate information to Hinkley residents.
- ✓ Task 3: A minimum of four public meetings held in the Hinkley community.
- ✓ Task 4: Available for one-on-one communications with individuals, or groups of Hinkley residents .
- ✓ Task 5: Production of technical reviews, written comments and presentations to respond to Water Board orders, PG&E reports, USGS reports and other technical materials related to the chromium remediation (e.g. new cleanup technology).
- ✓ Task 6: Outside expert on matter(s) of greatest concern to the community.

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Our Efforts to Date: Some Metrics.

IRP Manager

- Review and Interpretation
- Professional Judgment
- Relationships and Trust Development
- Visualization of Data
- Presentations
- Communications

Hinkley Community

- 44 Community Meetings
- 6 Community Open Houses
- 200 Weekly Office Meetings
- 100's Major Reports Reviewed
- Community Mailers
- 9 Community Workshops
- 290 days of office hours in Hinkley
- Hired experts:
  - EIR
  - Toxicologist
  - Facilitator
- 1000's of Questions Answered
- www.HinkleyGroundwater.com

PG&E's Hinkley Groundwater Remediation Team

MB's of files, 1000's pp of information

Water Board review and comment

Lahontan Water Board

Tonight's Items.

- Outreach "Tools"
- IRP Manager's SOW and Compliance with CAO NO.R6V-2015-0068
- Grand Conclusions

Outreach is Via Three Mechanisms.

The IRP Manager Team uses these three tools to interface with stakeholders in the Hinkley Community

1. Relationships

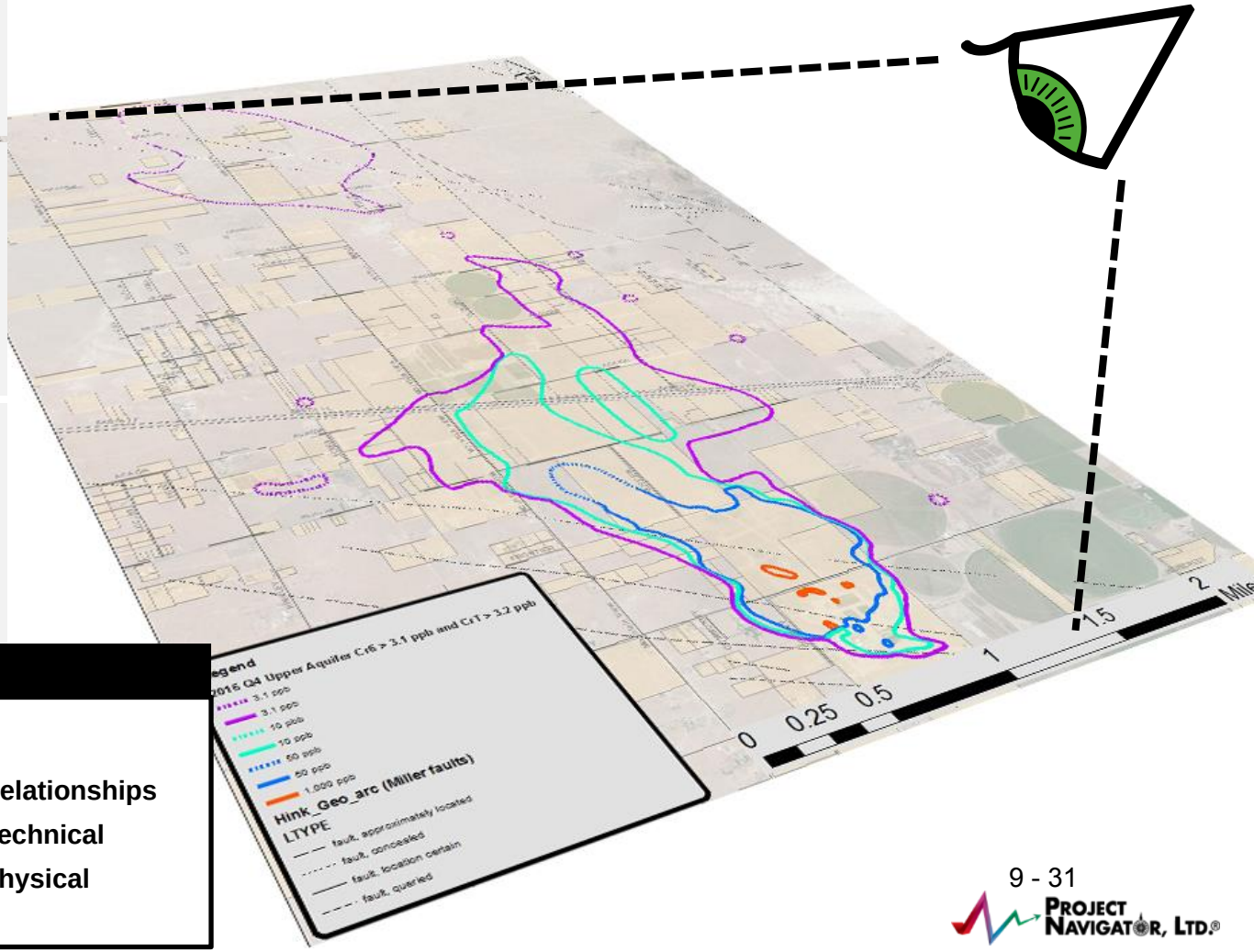
- Accurate Media Reporting
- One-on-Ones
- Relationships Accrued Over 5 Years
- Persistence and Attitude

2. Technical

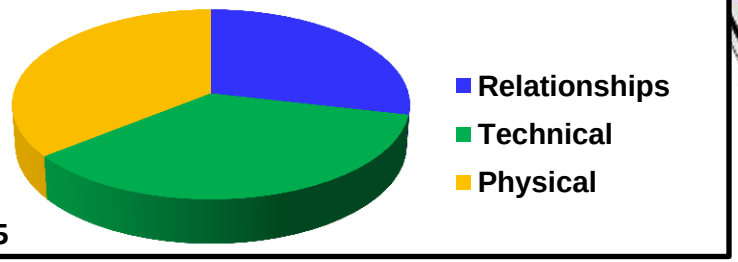
- Website
- Newsletter
- Project Knowledge
- TWG Participation (re BGGS)
- Photo reports, visual descriptions

3. Physical

- Meeting –Visibility
- Community Sponsored Events
- Office – Backroom/Models
- Local Resource
- Field Trips



Effort Equally Distributed



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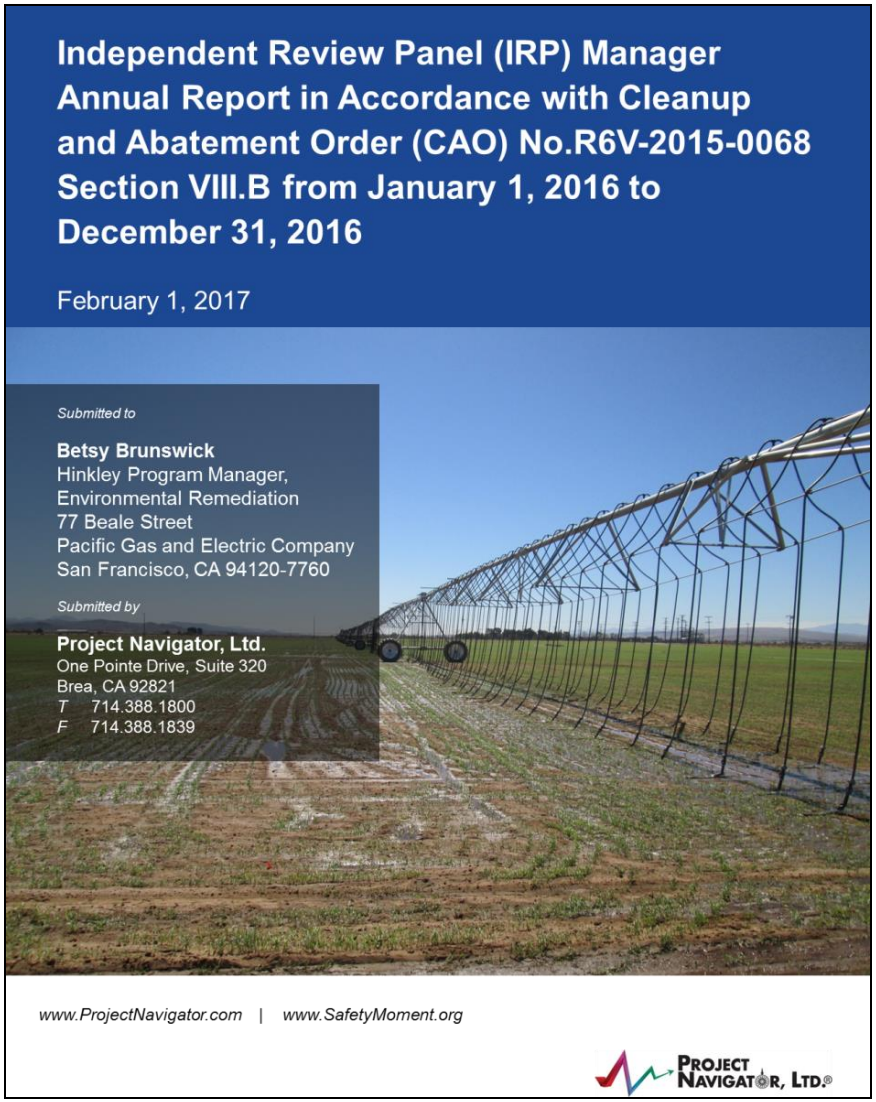
TASK 1:

An Annual Report and Presentation to the Water Board on the Independent Consultant's Efforts Within the Hinkley Community.



IRP Manager, Dr. Ian A. Webster presenting comments on the CAO in front of the State Water Board on November 4, 2015.

TASK 2:

A Minimum of Six Community Newsletter Each Year to Disseminate Information To Hinkley Residents.

We Also Stay In Touch Via The IRP Manager's Newsletter: Contributions, Ideas, Comments, Most Welcome.

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TASK 3:

A Minimum of Four Public Meetings Held in the Hinkley Community.

The IRP Manager Team held Quarterly Meetings during 2016 at the Hinkley Community and Senior Center.

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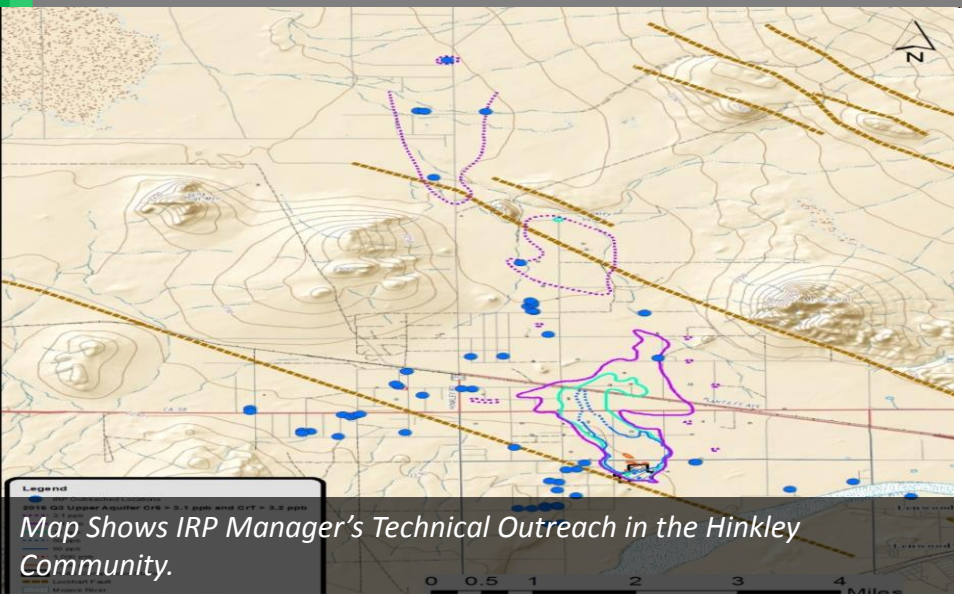
TASK 4:

Available For One-On-One Communications With Individuals, or Groups Of Hinkley Residents (Devote, at least, 100 Hours).



Map Shows IRP Manager's Technical Outreach in the Hinkley Community.

IRP Manager Team hosting a Community Workshop in December 2016.

IRP Manager Team and USGS conducting Outreach for the Background Study.

IRP Manager Team hosting the Annual Hinkley Community BBQ in May 2016.

Task 4 (Continued)

A Recent, Very Worthwhile, Example: Levering the Science of PG&E's Work with High School Seniors: Helping Describe Career Pathways.

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TASK 5:

Production Of Technical Reviews, Written Comments and Presentations to Respond to Water Board Orders, PG&E Reports, USGS Reports and Other Technical Materials Related to the Chromium Remediation.

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1 Pointe Drive
Suite 320
Brea, CA 92821

August 9, 2016

Lauri Kemper, PE
California Regional Water Quality Control Board, Lahontan Region
2501 Lake Tahoe Boulevard
South Lake Tahoe, California 96150

RE: IRP Manager's Comments on Pacific Gas & Electric Company's (P

1. **Updated Conceptual Site Model**
2. **Background Chromium Concentrations Reported on in the Lo Report[1], Hinkley Compressor Station, Hinkley, California.**

Dear Ms. Lauri Kemper:

The Independent Review Panel (IRP) Manager is submitting formal com Pacific Gas and Electric Company's (PG&E's) Updated Conceptual Site M Background Concentrations for Lower Aquifer Report[1] (the **Report**) pre U.S., Inc. in May 2016.

The IRP Manager, Project Navigator Ltd. (PNL), continues to advise and outreach to the Hinkley Community on matters associated with PG&E's remediation activities. PNL also provides independent feedback and wr on technical reports and cleanup and abatement orders pertaining to t Groundwater Chromium Remediation Program to the Water Board. Th herein are submitted consistent with this assignment, and in the spirit IRP Manager.

The Report is in accordance with the Water Board's November 4, 2015 Abatement (CAO)[2] and states the following requirements regarding the **(LA)**:

[1] Arcadis. 2016. *Updated Conceptual Site Model and Background Chromium Concentrations for L* May 2.
[2] CAO No.R6V-2015-0068.

1 of 5

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One Pointe Drive
Suite 320
Brea, CA 92821

April 4, 2016

Lauri Kemper, PE
California Regional Water Quality Control Board, Lahontan Regio
2501 Lake Tahoe Boulevard
South Lake Tahoe, California 96150

RE: IRP Manager's Comments on the Water Board's Amende Abatement Order (CAO) No.R6V-2008-0034A4 (Proposed or Abate the Effects of Contaminants in Groundwater of River Hydrologic Unit, Desert View Dairy, Hinkley, CA.

Dear Lauri:

The Independent Review Panel (IRP) Manager appreciates the o submit formal comments regarding the Lahontan Regional Water Board, (the Water Board) Amended Cleanup and Abatement Ord No.R6V-2008-0034A4-(Proposed) ,"the Proposed CAO[1]," regardi impacts as a result of historical operations at the Desert View Dia

Figure 1 shows the location of the DVD near the intersection of M Road and Alcudia Road in Hinkley, CA. As the IRP Manager, Pro Ltd. (PNL) continues to advise and provide technical outreach to Community on matters associated with PG&E's ongoing Cr6 rem activities. PNL also provides feedback and written comments to t regarding the DVD Proposed CAO and other related matters.

The Proposed CAO encompasses several important components potentially be of interest to Hinkley residents that reside in the no Particular with respect to domestic well monitoring and replaceme alternatives for residents affected by historical operations at the D Affected Area, outlined in the Proposed CAO, is defined as all act and community supply wells in the area bounded by Serra Road Santa Fe Road to the south, Summerset Road to the east, and ex Sonoma Road to the north, including all parcels containing active adjacent to Sonoma Road on the north side (as shown on **Figure**

[1] Lahontan Regional Water Quality Control Board. 2016. *Amended Cleanup an No.R6V-2008-0034A4-(Proposed), requiring Paul Ryken, the Estate of Nick ca Dairy, Inc., K&H van Vliet Children LLC, and the Pacific Gas and Electric Co or Abate the Effects of Contaminations to Groundwater of the Mojave River Hy Desert View Diary, Hinkley, WDID No.6B36040900*. March 2.

1 of 4

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Managing Strategies into Tactical Action

1 Pointe Drive
Suite 320
Brea, CA 92821

714.388.1800 *tel*
714.388.1839 *fax*
www.projectnavigator.com

November 4, 2016

Patty Z. Kouyoumdjian, Executive Officer
California Regional Water Quality Control Board, Lahontan Region
2501 Lake Tahoe Boulevard
South Lake Tahoe, California 96150

RE: Comments on PG&E's Capture Metrics

Dear Patty:

The Independent Review Panel (IRP) Manager is submitting formal comments regarding the Water Board October 5, 2016 Public Review and Comment Opportunity on the Proposed Capture Metrics to the revisions to Cleanup and Abatement Order (CAO) R6T-2015-0068[1].

The IRP Manager, Project Navigator Ltd. (PNL) continues to advise and provide technical outreach to the Hinkley Community on matters associated with PG&E's ongoing Cr(VI) remediation activities. PNL is requested to provide independent feedback and written comments on technical reports and cleanup and abatement orders pertaining to the Hinkley Groundwater Chromium Remediation Program to the Water Board. The comments herein are submitted consistent with this assignment, and in the spirit of the role of the IRP Manager.

As a tool used to ensure that the Cr(VI) plume does not migrate further north, the use of hydraulic control has demonstrated to be successful in containing the migration of Cr(VI) from migrating past Thompson Road. The IRP Manager agrees with technical reports[2] that conclude that hydraulic capture has been successfully implemented. CAO No.R6V-2015-0068 included capture metrics that were a component of the November 4, 2015 CAO. The IRP Manager submitted several comments letters[3] on the CAO No.R6V-2015-0068 and its various components.

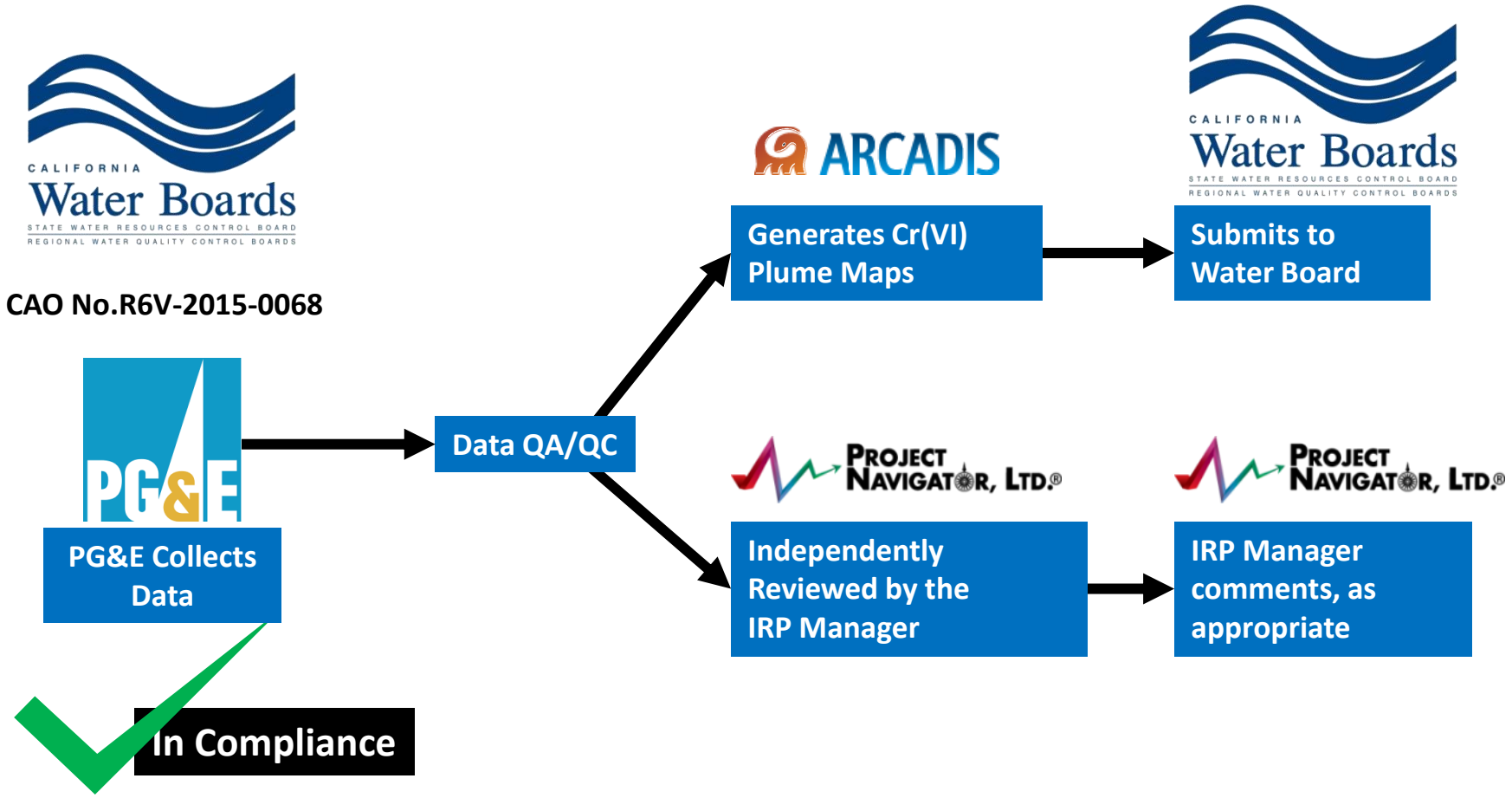
Figure 1 and **Figure 2** show location of the proposed hydraulic capture containment targets compared for the shallow and deep zones of the upper aquifer. *The IRP Manager has no objections with the revised hydraulic capture metrics based on additional*

[1] Water Board. 2016. *Public Review and Comment Opportunity, Proposed Capture Metrics, Pacific Gas and Electric Company's Hinkley Compressor Station, San Bernardino County*. October 5.
[2] Hydraulic Capture Monitoring Reports.
[3] The IRP Manager submitted comments letters on March 13, June 19, and September 30.

1 of 2

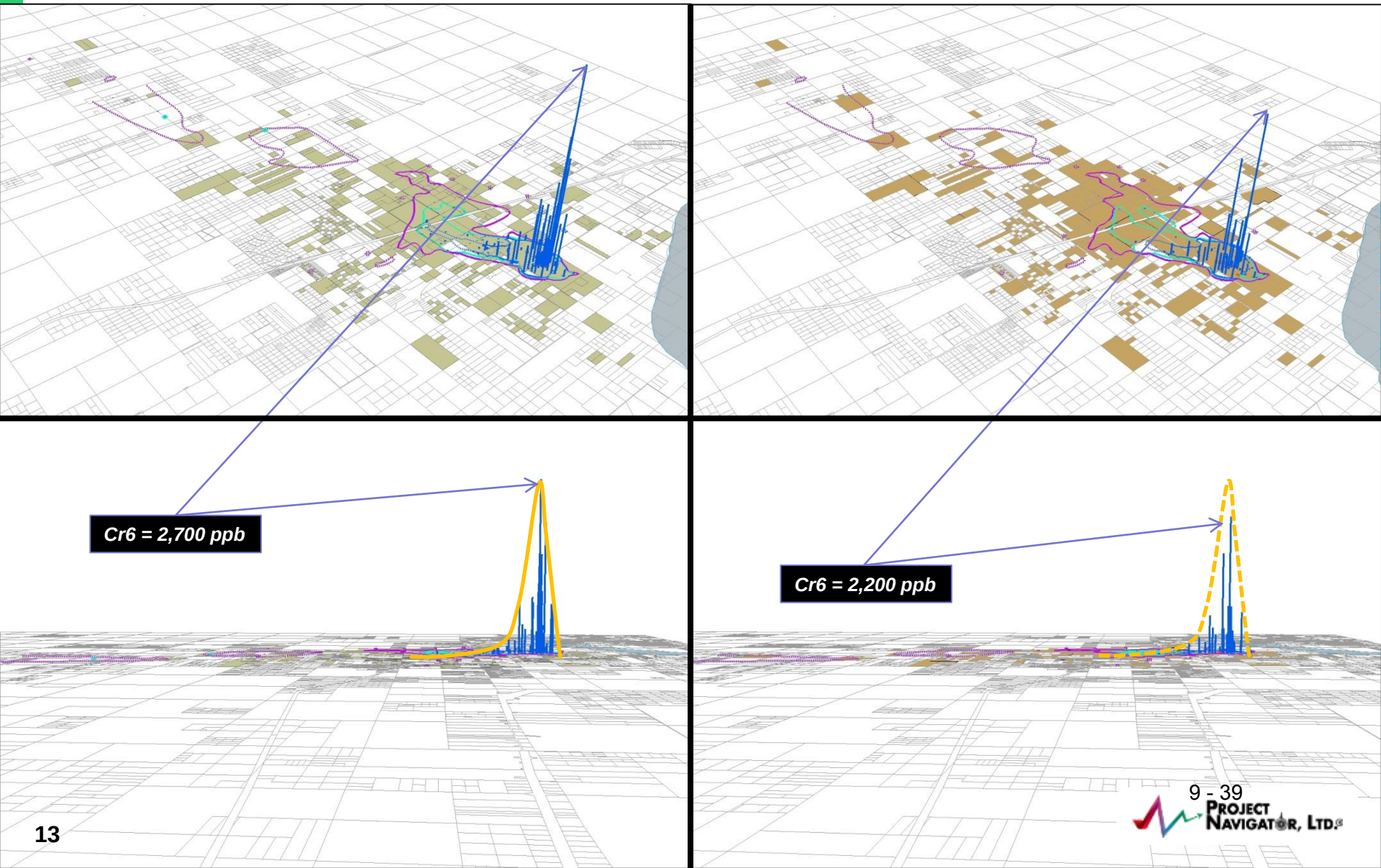
Key Task 5 Point: The IRP Manager Team Reviews All of PG&E's Cr(VI) Data.

This Has Helped Build "Community Trust" in the Process.

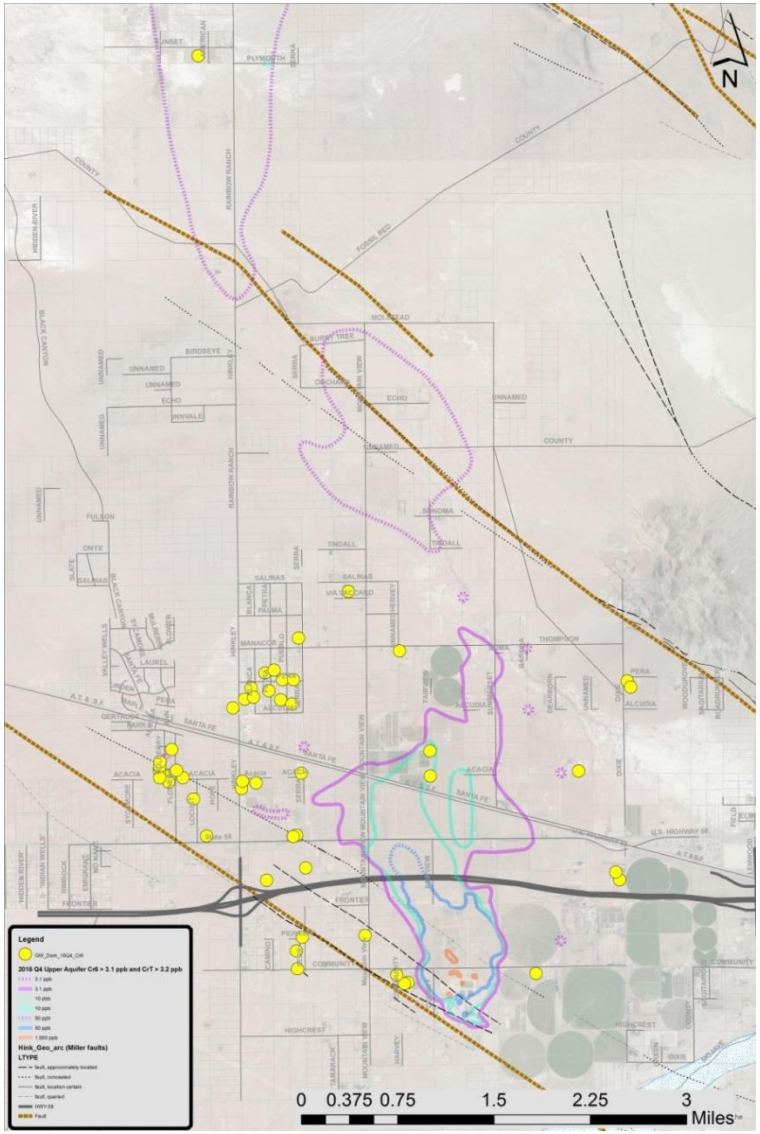


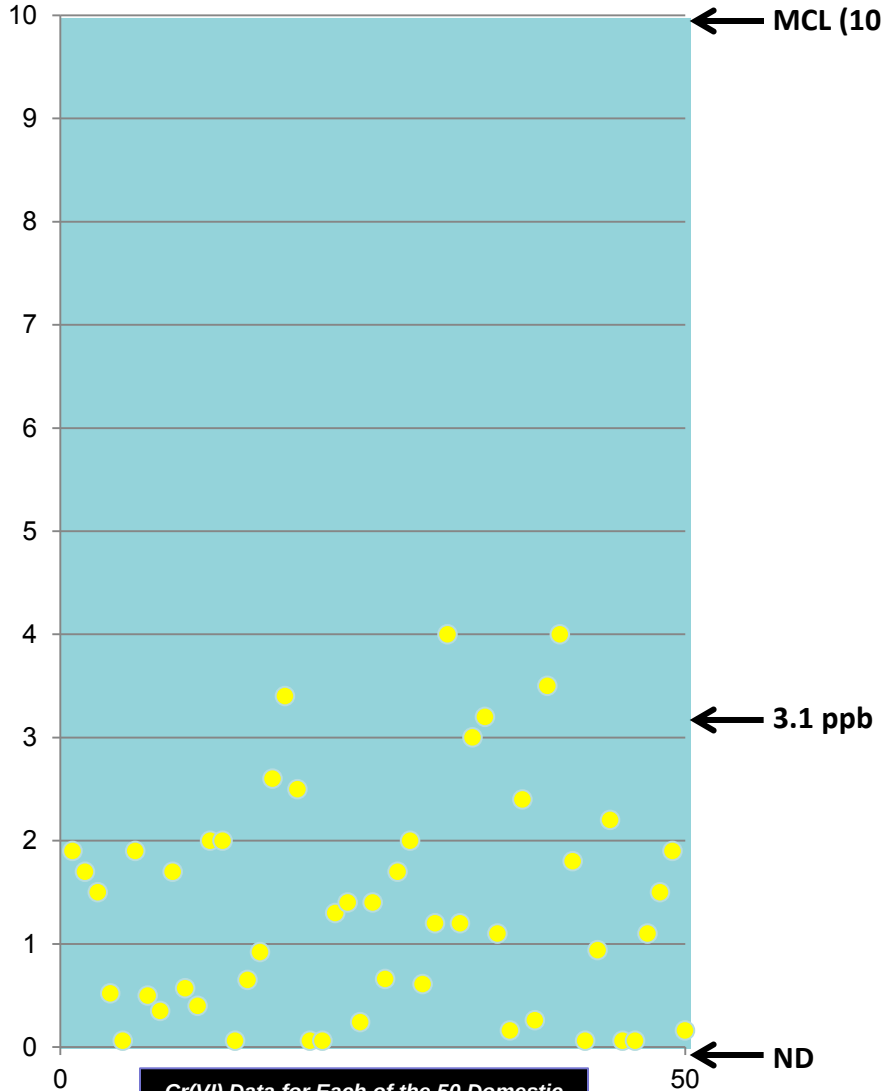
About 20% Reduction of the Highest Concentrations in the Source Area Between Fourth Quarter 2015 and Fourth Quarter 2016.

These Results Indicate that the IRZ Process is Effective.



Key Takeaway: All Domestic Wells Sampled by PG&E in 4th Q 2016 were Below the CA Cr(VI) MCL of 10ppb.





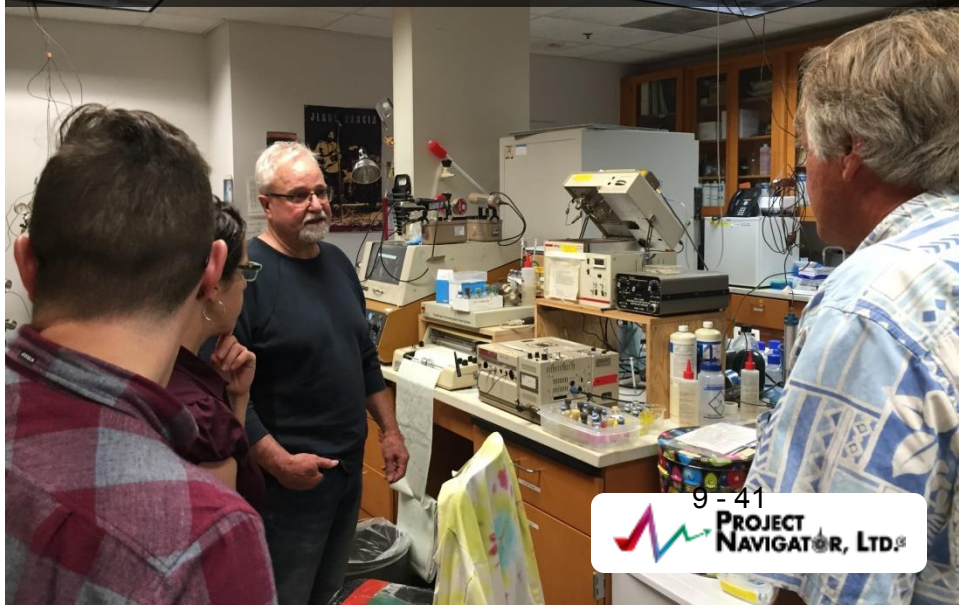
Cr(VI) Data for Each of the 50 Domestic Wells Sampled by PG&E

33 monitoring and domestic wells were sampled in March 2016 as part of the USGS Background Study.

Dr. Dave Miller, of USGS, led the Project Team (Water Board, PG&E and IRP Manager Staff) through a review of hundreds of sampling core boxes collected from monitoring wells throughout the Hinkley Valley. The information will be used to understand how the Upper Aquifer was formed.

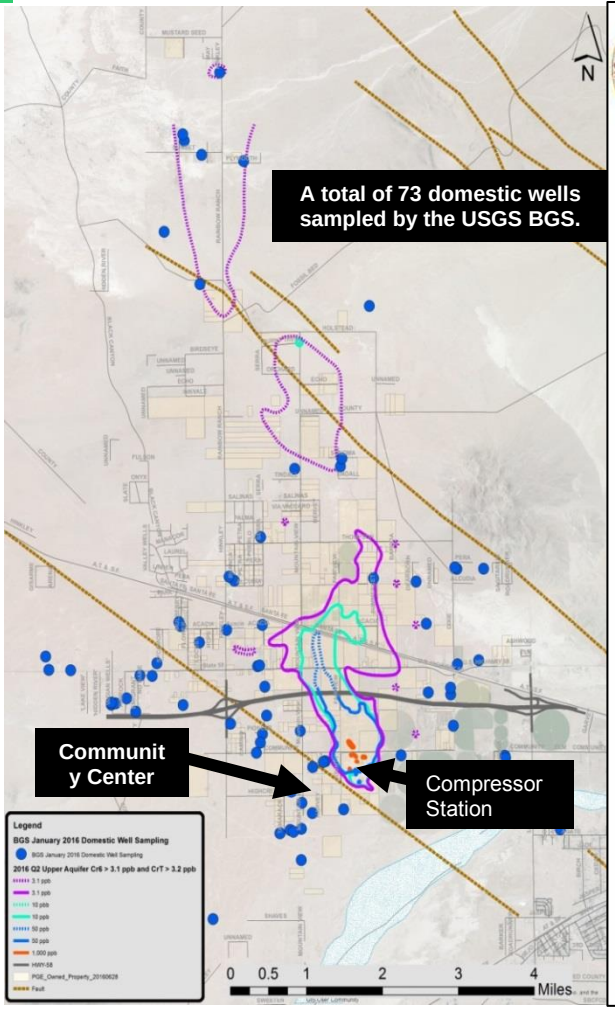
The TWG Met on December 14, 2016 at the IRP Manager's Office to Discuss the Background Study Updates and the 3rd Annual Sampling Event.

Dr. Larry Miller, of the USGS, is Spearheading the BGS's Task 8 Program. All Task 8 Work is Being Performed at the USGS Facility in Menlo Park, California. Significant Progress has been Achieved on Task 8 with an Anticipated Completion Date of 2019.



Task 5 (Continued)

USGS Completed a BGS *Domestic* Well Sampling Event in 2016 and Wrote to the Hinkley Community (Via the IRP Manager) About the Results.



United States Department of the Interior

U. S. GEOLOGICAL SURVEY
California Water Science Center
San Diego Projects Office
4165 Spruance Road, Suite 200
San Diego, CA 92101
Phone: (619) 225-6100 Fax: (619) 225-6101
http://water.wr.usgs.gov

IN REPLY REFER TO

September 15, 2016

To: The Hinkley Independent Review Panel (IRP) Manager:

Between January 27 and 31, 2016, the U.S. Geological Survey (USGS) sampled 72 domestic and agricultural wells in the unincorporated community of Hinkley, CA. The data were collected as part of the USGS study of background hexavalent chromium, Cr(VI), concentrations in the Hinkley area http://ca.water.usgs.gov/pubs/2016/hinkley-chromium-ofr-20161004.html. The wells were largely outside the area of the mapped Cr(VI) plume within Hinkley Valley.

Water from the wells was analyzed for a range of constituents including field parameters (temperature, pH, specific conductance, and dissolved oxygen), selected major and minor ions (chloride, sulfate, fluoride, and bromide), nutrients (nitrate, nitrite, orthophosphate), selected trace elements (iron, manganese, arsenic, total chromium, hexavalent chromium, uranium, and vanadium), and the stable isotopes of oxygen and hydrogen. Samples for major and minor ions, nutrients, and trace elements were filtered and preserved (if required) in the field at the time of collection.

Results of analyses were mailed to well owners in May 2016. Data are available through the U.S. Geological Survey's on-line data base NWIS-Web at http://waterdata.usgs.gov/nwis.

Several of the constituents measured, most notably arsenic, chromium (total and hexavalent), uranium, and nitrate have Maximum Contaminant Levels (MCLs) for drinking water. For the samples collected during January 2016, concentrations exceeded the US Environmental Protection Agency (US EPA) MCL for arsenic of 10 micrograms per liter (µg/L) in 28 of 72 wells, about 39 percent of sampled wells. The highest arsenic concentration in a sampled well was 300 µg/L, 30 times the MCL. Concentrations exceeded the MCL for uranium of 30 µg/L in 6 of 72 wells, about 8 percent of sampled wells; and concentrations exceeded the MCL for nitrate of 10 mg/L as nitrogen in 7 of 72 wells, about 10 percent of sampled wells. The highest uranium concentration in a sampled well was 62 µg/L, more than twice the MCL. The highest Cr(VI) concentration measured was 4 µg/L—less than half of the recently established California MCL for Cr(VI) of 10 µg/L. Water from 34 of 72 wells had concentrations of arsenic, uranium, and/or nitrate above a drinking water MCL. This represents about 47 percent of the wells sampled in the Hinkley, CA area by the USGS between January 27 and 31, 2016.

Sincerely,

John Izbicki
Research Hydrologist
U.S. Geological Survey

Concentrations exceeded the MCL for uranium of 30 µg/L in 7 of the 72 well, about 8 percent of samples wells; and concentrations exceeded the MCL for nitrate of 10 mg/L as nitrogen in 7 of the 72 wells, about 10 percent of sample wells. The highest uranium concentration in a sampled well was 62 µg/L, more than twice the MCL. The highest Cr(VI) concentration measured was 4 µg/L – less than half of the recently established California MCL for Cr(VI) of 10 µg/L. Water from 34 of 72 wells had concentrations of arsenic, uranium, and/or nitrate above a drinking water MCL. This represents about 47 percent of the wells sampled in the Hinkley, CA area by the USGS between January 27 and 31, 2016.

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TASK 6:

Retain Outside Expert(s) On Matter(s) of Greatest Concern to the Community.

Anne Marie Cwieka, of Optimum Results, Inc., is an outside expert who aides the IRP Manager with Hinkley outreach and community meetings.

Grand Conclusions:

- IRP Manager's Scope of Work is in compliance with the Water Board's November 4, 2015 CAO.
- Hinkley Community Members are still actively interested in the technical understanding of PG&E's Cr(VI) Remediation Process, and the USGS Background Study
- The Background Study (BGS) Technical Working Group (incl. Community Membership) meets and provides input to USGS… helps ensure a *transparent* study process.
- PG&E's Remedy is effective in shrinking the footprint of the mapped plume.
- All domestic wells sampled by PG&E for Cr(VI) are below the MCL of 10ppb.

ENCLOSURE 4

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Hinkley Community Newsletter

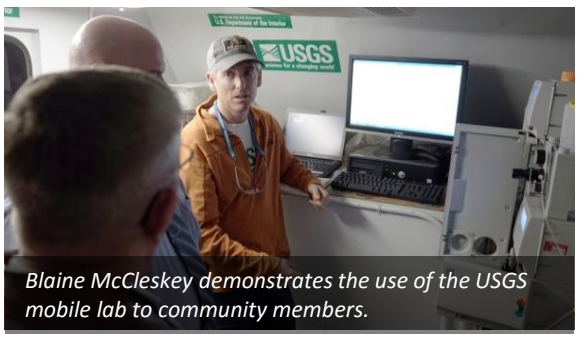
A newsletter issued by the IRP Manager[1] about PG&E's Cr(VI) Remediation Program

Volume 2 Number 1
February 2016

USGS mobile laboratory stationed at the IRP Manager's office the week of January 27-31, 2016.

USGS Sampled Domestic Wells in Hinkley for the Cr6 Background Study

USGS conducted their domestic well sampling event from January 27 – 31, 2016. This round of sampling is now finished. The domestic well data will help USGS understand the Cr6 distribution in groundwater throughout the Hinkley Valley. This free service was open to Hinkley Community members who signed up at Community meetings or by contacting the IRP manager's team. A total of 73 domestic wells were sampled and analyzed in the field. All samples collected from domestic wells were below the California Maximum Contaminant Level (MCL) for Cr6 of 10 parts per billion (ppb). Four domestic wells were between 3ppb and 5ppb, while the rest of the domestic wells were below 3ppb.



Blaine McCleskey demonstrates the use of the USGS mobile lab to community members.

Hinkley Community member, Mr. John Turner, had his domestic well sampled by the USGS and reported a value of 1.95ppb for Cr6. For comparison, Victorville Water District[(2)] reported Cr6 values between ND and 12ppb. Barstow Water Quality Report[(3)] reported values between ND to 1.7ppb and other sources[(4)].

Once all results are validated, USGS plans to send out a letter to those Hinkley Community members who had their domestic well sampled. USGS will issue a letter which will include results for Cr6, iron, manganese, arsenic, chloride, nitrate, sulfate and other key constituents. If you have any questions about your results, you can reach the IRP Manager staff in the contact section below.

Important Upcoming Dates

March 7-23: USGS BGS field work
April 28: Community Meeting at the Hinkley Community and Senior Center hosted by the IRP Manager
6:00pm – 8:00pm

IRP Manager Office Hours at

36236 Serra Rd. Hinkley, CA 92347

Mar 3 : 5:00pm – 8:00pm
Mar 12: 8:00am – 10:00am
at Hinkley Community & Senior Center
Mar 24: 5:00pm – 8:00pm
April 7: 5:00pm – 8:00pm

Contact Information

For more information, please visit the IRP Manager's website at HinkleyGroundwater.com.

If you would like to speak with the IRP[1] Manager's staff, schedule a meeting with IRP staff, suggest input on the newsletter, please call at (714) 388-1821 or email at rsanchez@projectnavigator.com. You can also contact community member Roger Killian at acgeneratorservice@verizon.net.

The IRP Manager staff frequently updates a website dedicated to the Hinkley remediation. For more up-to-date information, please contact the IRP Manager's office or visit the website at www.HinkleyGroundwater.com.

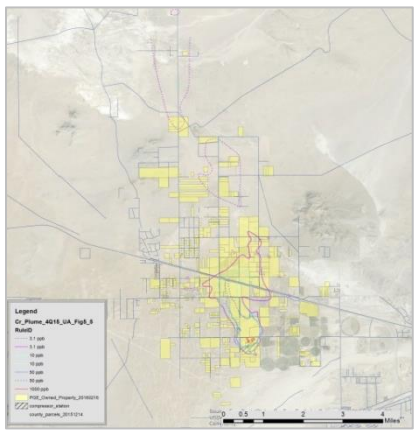
Within Our High Desert Community

The Newberry Springs Economic Development Association has invited the Hinkley Community, as well as other neighboring communities, to apply for future grant funding. The grants will provide opportunities for specific projects addressing poverty, health, education, jobs, economic incentives, and infrastructure.

The next several months will focus on building an organization, defining our specific needs, and forming a team to pursue opportunities.

Our representative from Hinkley is Ms. Penny Harper, R.N. To attend meetings, participate, or for more information, please contact Penny at pennyharper@msn.com.

New Cr6 Plume Map Issued Based on the Requirements from the Nov 4, 2015 Order



The fourth quarter 2015 Cr6 plume map was issued by PG&E to the Water Board. The reported plume has been drawn using the new contouring requirements outlined in the 11/15 CAO. Key facts regarding the 4th quarter plume map are listed below:

Monitoring

- 558 Monitor Wells (MWs) Were Sampled, including
- 96 Domestic and Other Private Wells
- 19 Lower Aquifer Wells

Domestic Well Results

- 11 domestic wells exceeded 3.1ppb (Cr6) and/or 3.2ppb (CrT)
- All 11 domestic wells were below the CA MCL of 10ppb
- Hydraulic Control continues at Thompson Rd

The fourth quarter 2015 Cr6 plume map is available for download at www.HinkleyGroundwater.com.

IRP Manager Hosts First Hinkley Community Meeting of 2016

Over 60 people were in attendance at the Hinkley meeting.

On January 28, the IRP Manager hosted the first Hinkley Community meeting of 2016 at the Community and Senior Center. Over 60 people were in attendance and were updated on the newly adopted Cleanup and Abatement Order (CAO).

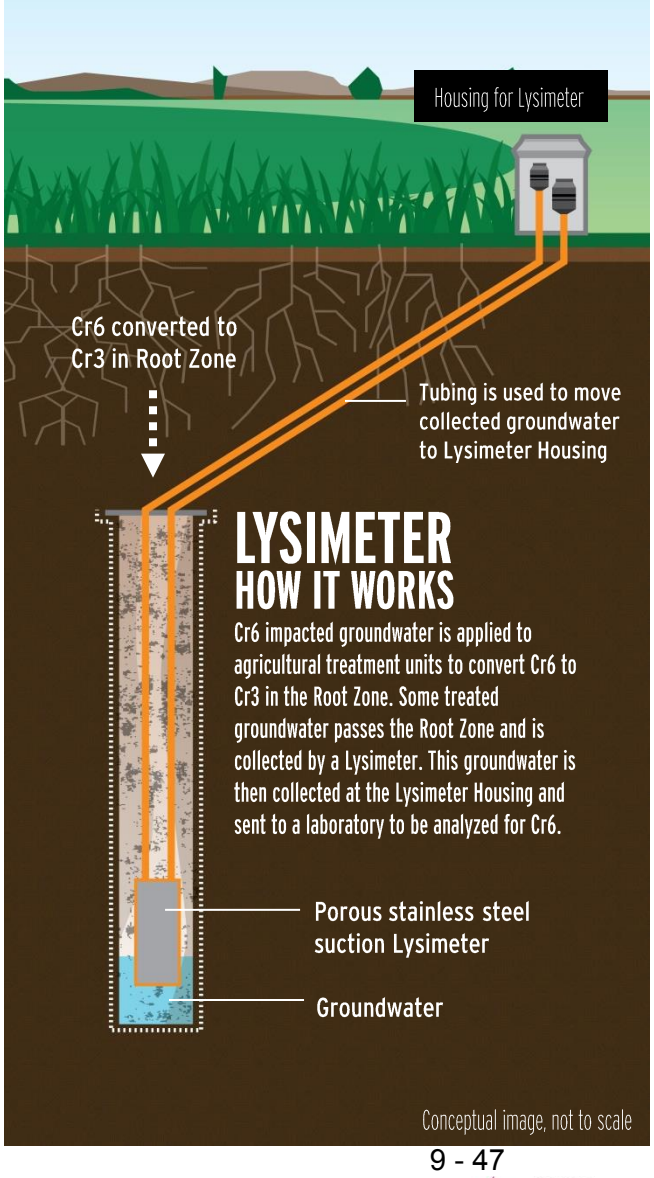
The IRP Manager, Water Board, PG&E, and select Community members shared information about the decrease in the size of the Cr6 plume and the status of the USGS background study. The meeting concluded with inspirational speeches from Community members, John Turner and John Quass, encouraging everyone to improve their efforts to reinvigorate Hinkley and resurrect the school.

Community members, John Turner (left) and John Quass (right), speak to meeting attendees.

Frequently Asked Questions (FAQ)

What is a Lysimeter?

A lysimeter is a measuring device used to determine the efficiency of plants ability to convert Cr6 to Cr3. In the past, they were used at the Desert View Dairy Land Treatment Unit (DVDLTU). Below is a diagram illustrating the use of a lysimeter.



[1]The Independent Review Panel (IRP) Manager is a resource for the Hinkley Community that provides explanations and answers to Community questions regarding PG&E's Hinkley Cr6 Remediation Program.

[2] http://www.victorvilleca.gov/uploadedFiles/April%202015%20CCR(1).pdf. [3] http://www.gswater.com/barstowccr/. [4] http://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/Chromium6sampling.shtml.

Prepared and printed by staff from Project Navigator, Ltd.

Hinkley Community Newsletter

A newsletter issued by the IRP Manager[1] about PG&E's Cr(VI) Remediation Program

Volume 2 Number 2
April 2016

USGS staff collecting groundwater samples during the March 2016 Background Study Sampling Event.

USGS Completes the March 2016 BGS Fieldwork

During March 2016, the USGS, led by Dr. John Izbicki, was busy working around Hinkley collecting groundwater samples from monitoring and domestic wells in the Hinkley Valley as part of the USGS Background Study (BGS). USGS sampled over 30 monitoring and domestic wells as part of the second annual BGS sampling event that will eventually determine the magnitude of naturally occurring Cr(VI) in the Hinkley Valley. Samples will be tested for several constituents to determine the source and age of Cr(VI) in that specific location. Samples will be analyzed for Cr(VI), arsenic, manganese and other key constituents to obtain a comprehensive understanding of water quality throughout the Hinkley Valley. To determine the age and source of groundwater, analyses such as tritium, sulfur hexafluoride (SF6), carbon dating and chlorofluorocarbons (CFCs) will be utilized by the USGS using multiple lines of evidence approach.

USGS staff preparing groundwater samples collected during March 2016 to ship to various labs inside the USGS Sampling Truck.

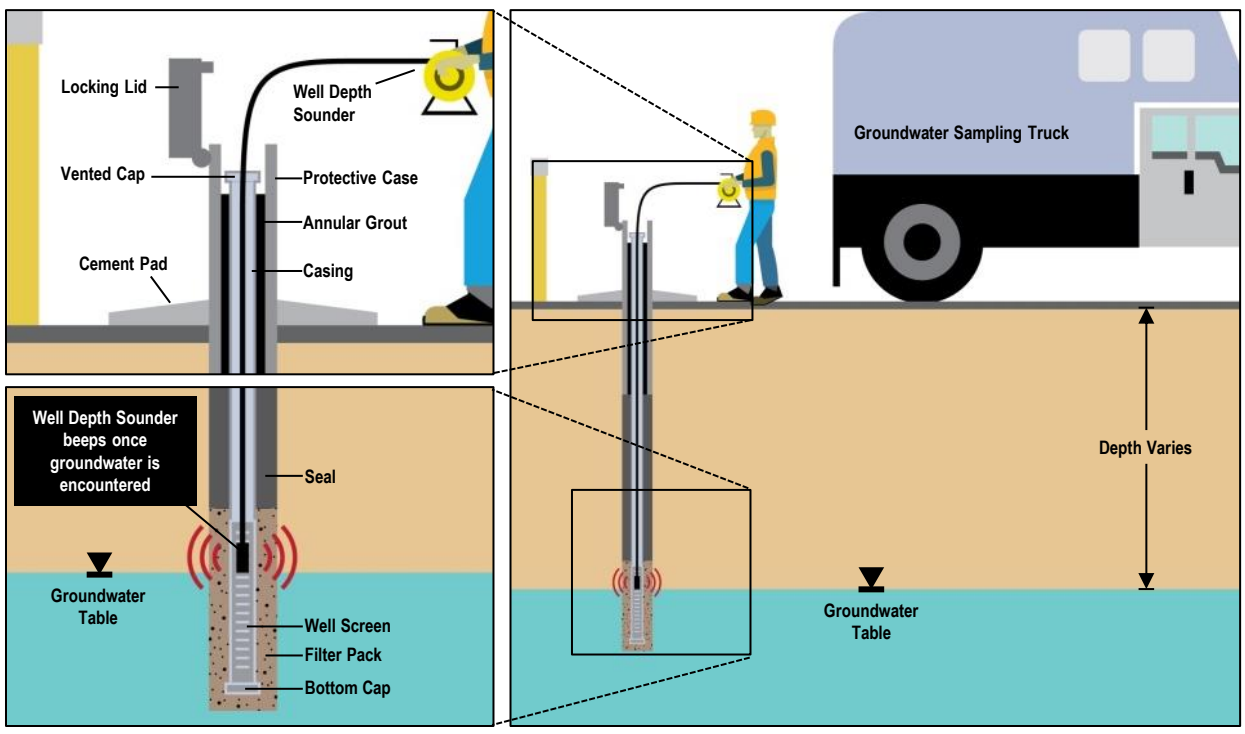
In the latter part of March, USGS conducted a depth-dependent sample at an extraction well in the area north of Santa Fe and Summerset Road. The purpose of the depth-dependent sample was to obtain a comprehensive understanding of local geological conditions , determine the location of groundwater flow, and the concentration profiles for Cr(VI).

Finally, USGS plans to mail out letters to Hinkley residents who had their domestic well sampled as part of the domestic well sampling event during January 2016. Letters will include results for CrT, Cr(VI), arsenic, manganese, iron, and other key constituents analyzed by the USGS. The USGS-led BGS is anticipated to be completed in 2019. If you have any questions regarding the results from your domestic wells, please contact the IRP Manager staff at the contact information provided below (bottom right).

Frequently Asked Questions (FAQs)

How is the groundwater level measured in a domestic or monitoring well?

The groundwater level is measured in a domestic or monitoring well by using an instrument called a **well sounder**. A well sounder consists of a weight suspended on an insulated wire with depth markings and an ammeter to indicate a closed circuit. When the wire touches water, it completes a circuit. Once this happens, the sounder makes a "beeping" sound indicating that groundwater has been reached. The depth marking indicate how far down groundwater is from the surface.



Hinkley Community Members are Invited to Visit the IRP Manager's Office

The IRP Manager's Office is a library of information regarding the Hinkley Cr(VI) Groundwater Remediation Program.

The IRP Manager and staff invites the Hinkley Community to stop by the IRP Manager's office located at 36236 Serra Road to discuss any topic regarding the Hinkley Groundwater Remediation Program. Office hours are held on the first Thursday of each month from 5pm to 8pm at the IRP Manager's office, the second Saturday of each month from 8am to 10 am at the Hinkley Community and Senior Center, the third Thursday of each month from 5pm to 8pm at the IRP Manager's office, or by scheduling an appointment at your preferred time.

Important Upcoming Dates

May 14:	Hinkley Community Yard Sale 8:00am – 10:00am at Hinkley Community & Senior Center
May 28:	Community BBQ at the Hinkley Community and Senior Center hosted by the IRP Manager 11:00 am to 1:00 pm
July 28:	Community Meeting at the Hinkley Community and Senior Center hosted by the IRP Manager 6:00pm – 8:00pm

IRP Manager's Office Hours at
36236 Serra Rd. Hinkley, CA 92347

May 5 :	5:00pm – 8:00pm
May 14:	8:00am – 10:00am at Hinkley Community & Senior Center
May 26:	5:00pm – 8:00pm
June 2:	5:00pm – 8:00pm

Contact Information

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If you would like to speak with the IRP Manager's staff, please schedule a meeting, suggest input on the newsletter, or contact Raudel Sanchez at (714) 388-1821 or email at rsanchez@projectnavigator.com. You can also contact community member Roger Killian at acgeneratorservice@verizon.net.

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April 2016

Penny Harper standing next to solar panels that power her well pump.

Water Security for Every Budget by Penny Harper (A 20-year Hinkley Resident)

What would your life be like tomorrow if you had no running water? Think how inconvenient it was the last time your water was off for a few hours, from electric grid or well pump failure? We Hinkley residents depend on our wells for water since there are no city water pipes out here.

The U.S. public utility electric generating and delivery systems are getting older and out of repair. Most of our well pumps depend on grid electricity, so blackouts mean no running water. So, if you like the modern lifestyle with running water, you will need to prepare for loss of electricity and create your own water security.

Maybe you have or plan to have solar panels installed on your roof. If they are a grid intertie system, you will have no electricity for pumping your well when the grid goes down, unless you have battery or generator backup. Would you know how to connect the generator to the well pump?

Another way to run the well pump is with solar panels not connected to the grid. If you really want to be prepared, you could place a water storage tank on a hill or 10-foot tower. The elevation will provide pressure through a large diameter outflow pipe. Even a green poly tank on the ground full of water would give you water security when the pump won't work. The flow is just slower.

My favorite idea for water security is a wind pump (windmill.) Most of the farms did that before the 1930's. In the 1920's before rural electrification, farms had windmills to pump water. It works when the wind blows, night or day, has nothing electrical; it's all mechanical. You have it pump water into an elevated storage tank.

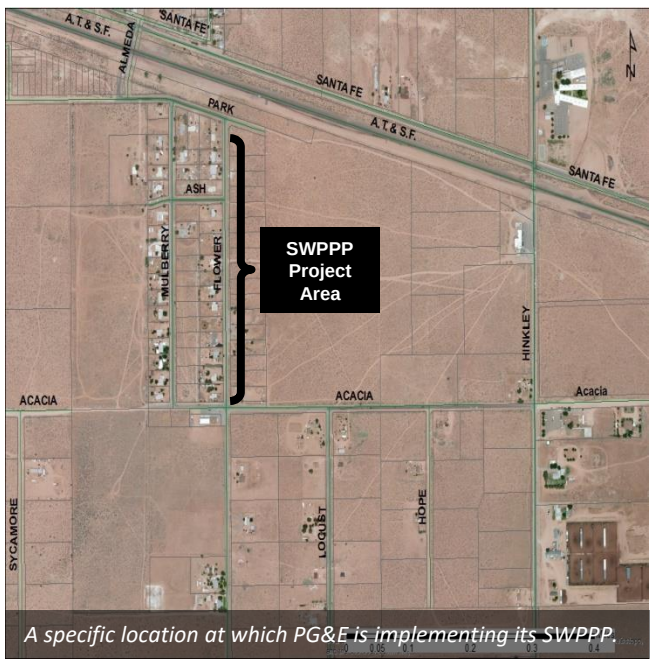
Water can be stored in a swimming pool, pond or reservoir. Do you have gutters on your house to collect rain water into barrels in case El Niño really shows up here some day? A low budget water storage is plastic drums with disinfected water. At the very least, store plastic bottles of water. Use them and rotate them before they get stale.

Doom and gloom? Not if you're prepared. So prepare for the worst and pray for the best.

PG&E's Stormwater Pollution Prevention Plan (SWPPP)

IRP Manager's staff at the PG&E's SWPPP location along Flower Street.

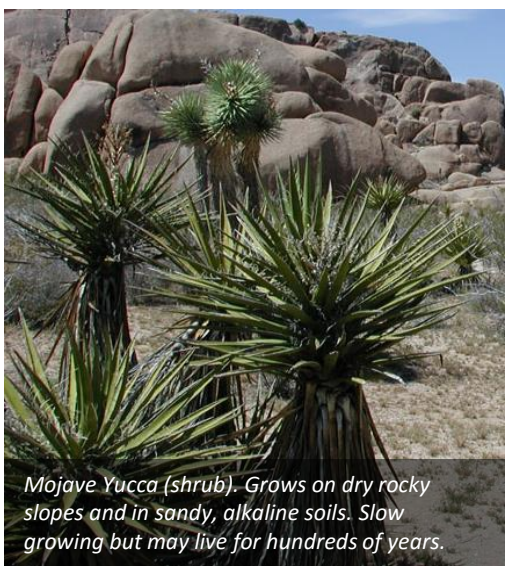
PG&E has submitted a Stormwater Pollution Prevention Plan (SWPPP) to the Water Board in accordance with Water Board Orders. The SWPPP addresses potential stormwater pollution from ongoing construction activities and activities planned in the future. The SWPPP will document completion and stabilization of previous work areas. Activities include removal of debris, targeted home demolition on selected properties, remediation system and pipeline installations that involve trench excavation, site grading , and well drilling.



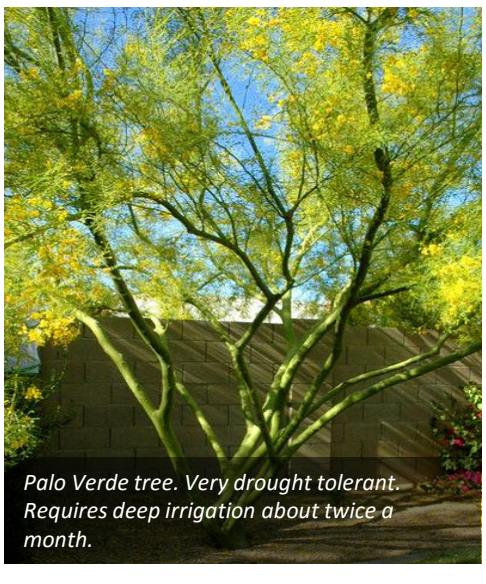
A specific location at which PG&E is implementing its SWPPP.

Four Terrific High Desert, Drought Tolerant Landscape Plants You Can Plant

Creosote Bush (shrub). Likes open spaces. Can grow in pure sand. Important plant for desert animals who use it as a food source and shelter.



Mojave Yucca (shrub). Grows on dry rocky slopes and in sandy, alkaline soils. Slow growing but may live for hundreds of years.



Palo Verde tree. Very drought tolerant. Requires deep irrigation about twice a month.

Mesquite tree. Extremely hardy. Can draw water through its taproot up to 190 feet in depth.

PG&E placed wood chips on properties along Mulberry Street to allow seeds and plants to grow in an arid environment.

[1]The Independent Review Panel (IRP) Manager is a resource for the Hinkley Community that provides explanations and answers to Community questions regarding PG&E's Hinkley Cr(VI) Remediation Program.

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Hinkley Community Newsletter

A newsletter issued by the IRP Manager[1] about PG&E's Cr(VI) Remediation Program

Volume 2 Number 3
June 2016

A large number of Hinkley residents turned out for the Annual Community BBQ.

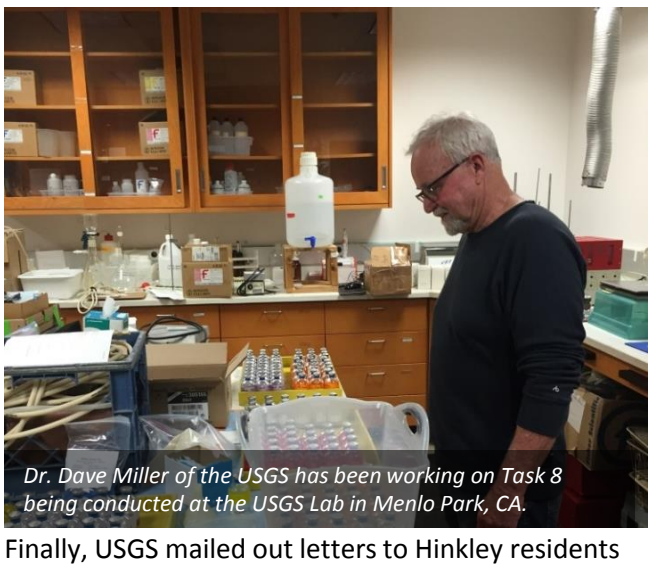
4th Annual Hinkley Community BBQ

On Saturday, May 28, 2016, the IRP Manager and Staff hosted the 4th Annual Community BBQ at the Hinkley Community and Senior Center. Many of Hinkley's residents got a chance to enjoy good food, fun and music. The IRP Manager and Staff would like to thank all who attended, especially the volunteers at the Center who helped make the BBQ a success.

USGS Background Study Update

During May 2016, the USGS sampled six wells that were installed near the Mojave River as part of the Background (BGS) Study. These wells will be used to understand groundwater direction and flow near the river.

The USGS also provided an update on the historical geological formation of the Hinkley Valley and Task 8. Task 8 is the part of the BGS to understand if Cr3 will be converted back to Cr(VI).



Dr. Dave Miller of the USGS has been working on Task 8 being conducted at the USGS Lab in Menlo Park, CA.

Finally, USGS mailed out letters to Hinkley residents who had their domestic well sampled as part of the domestic well sampling event during January 2016. Letters include results for Total Chromium (CrT), Cr(VI), arsenic, manganese, iron, and other key constituents analyzed by the USGS. The USGS-led BGS is anticipated to be completed in 2019. If you have any questions regarding the results from your domestic wells, or have not received your results, please contact the IRP Manager staff at the contact information provided in this newsletter.

Important Upcoming Dates

July 9: Hinkley Community Breakfast and Yard Sale
8:00am – 10:00am
at Hinkley Community & Senior Center

July 28: Community Meeting at the Hinkley Community & Senior Center hosted by the IRP Manager
6:00pm – 8:00pm

IRP Manager's Office Hours at
36236 Serra Rd. Hinkley, CA 92347

July 7: 5:00pm – 8:00pm
July 9: 8:00am – 10:00am
at Hinkley Community & Senior Center
July 21: 5:00pm – 8:00pm
August 4: 5:00pm – 8:00pm

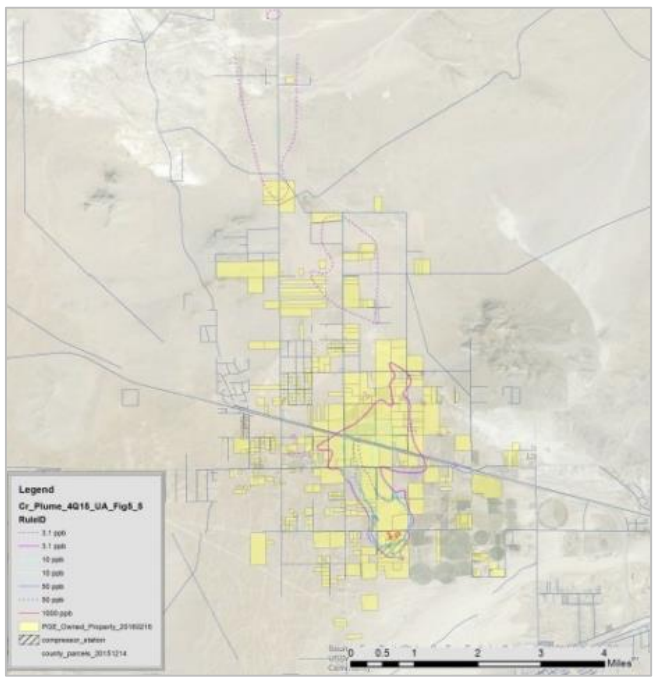
Contact Information

The IRP Manager frequently updates a website dedicated to the Hinkley remediation. For more up-to-date information, please contact the IRP Manager's office or visit the website at www.HinkleyGroundwater.com.

If you would like to speak with the IRP Manager's staff, schedule a meeting, or suggest input on the newsletter, please contact Raudel Sanchez at (714) 388-1821 or email at rsanchez@projectnavigator.com, or Margaret DeAngelis at (858) 204-7366 or email at mdeangelis@projectnavigator.com. You can also contact community member Roger Killian at acgeneratorservice@verizon.net.

The IRP Manager's Library is open to the Hinkley Community. See office hours for times.

First Quarter 2016 Cr(VI) Plume Map Issued on May 10, 2016



The first quarter 2016 chromium plume map was issued by PG&E to the Water Board on May 10, 2016. No major changes were reported in the first quarter plume map compared to the previous quarter. Below is a summary of the monitoring and domestic well results.

Monitoring
- 383 monitor wells (MWs) were sampled, including
- 52 domestic and other private wells
- 9 lower aquifer wells

Domestic Well Results
- 4 domestic wells exceeded 3.1ppb (Cr(VI)) and/or 3.2ppb (CrT)
- All 4 domestic wells were below the CA MCL of 10ppb
- Hydraulic control continues at Thompson Road

The first quarter 2016 Chromium plume map is available for download at www.HinkleyGroundwater.com.

Who is the IRP Manager?

Project Navigator, Ltd. (PNL) was selected in 2012 as the Independent Review Panel (IRP) Manager by the Hinkley Community Advisory Committee (CAC).

PNL is an environmental engineering company based in Brea, CA known for its expertise with complex, long-term environmental remediation projects. PNL also specializes in converting technical information into easy-to-understand visuals that can enhance communication.

The IRP Manager Scope of Work (SOW) is outlined in the Water Board November 4, 2015 Cleanup and Abatement Order (CAO). Tasks include the following:

- Reviews all technical documentation regarding PG&E's Cr(VI) Groundwater Remediation Program
- Provides comments and feedback to the Water Board regarding key reports and Water Board's orders
- Participates in the planning and implementation of the USGS Cr(VI) Background Study
- Perform community outreach to Hinkley residents to explain all the different parts of PG&E's Cr(VI) Groundwater Remediation Program (office hours, quarterly monthly meetings, website, and newsletters)

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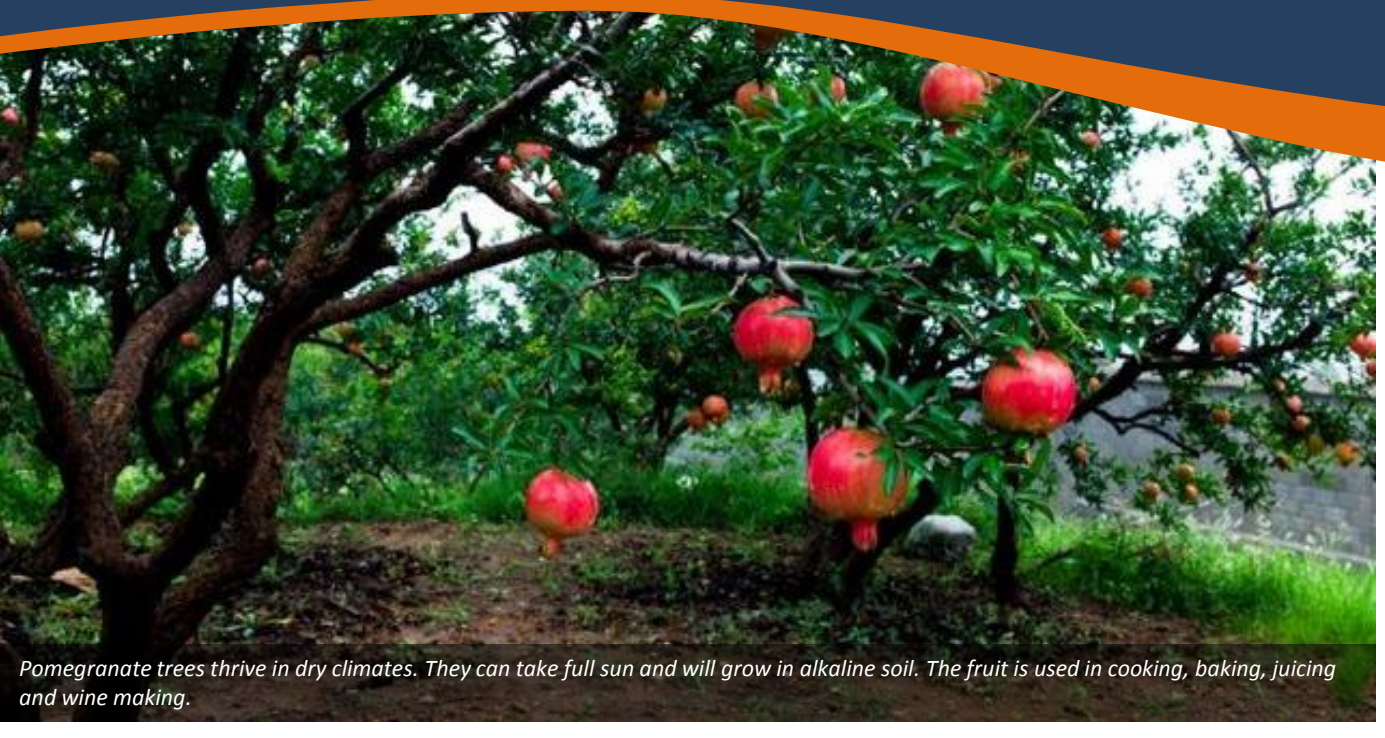
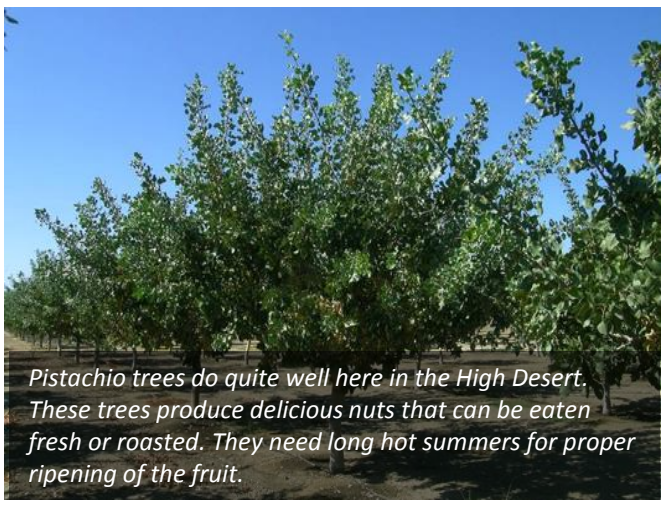


Pomegranate trees thrive in dry climates. They can take full sun and will grow in alkaline soil. The fruit is used in cooking, baking, juicing and wine making.

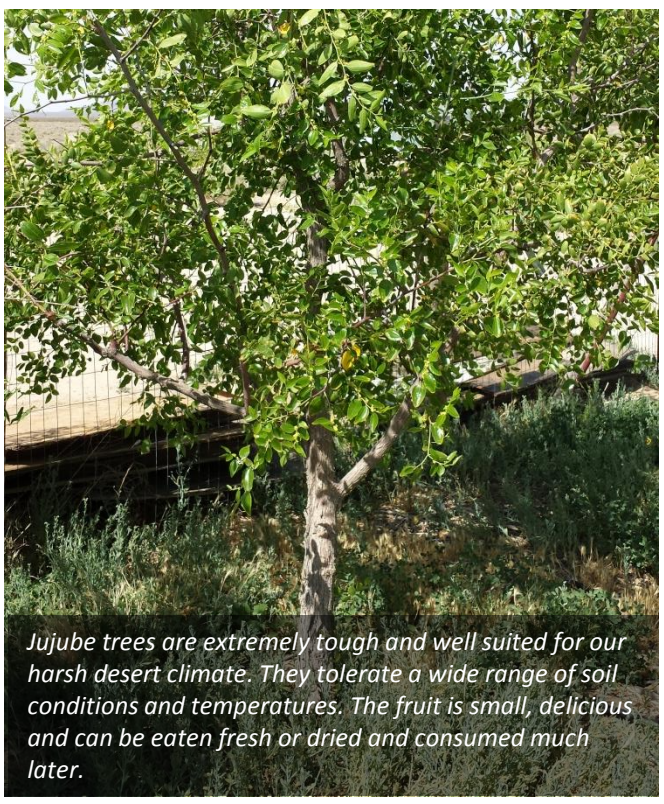


Pistachio trees do quite well here in the High Desert. These trees produce delicious nuts that can be eaten fresh or roasted. They need long hot summers for proper ripening of the fruit.

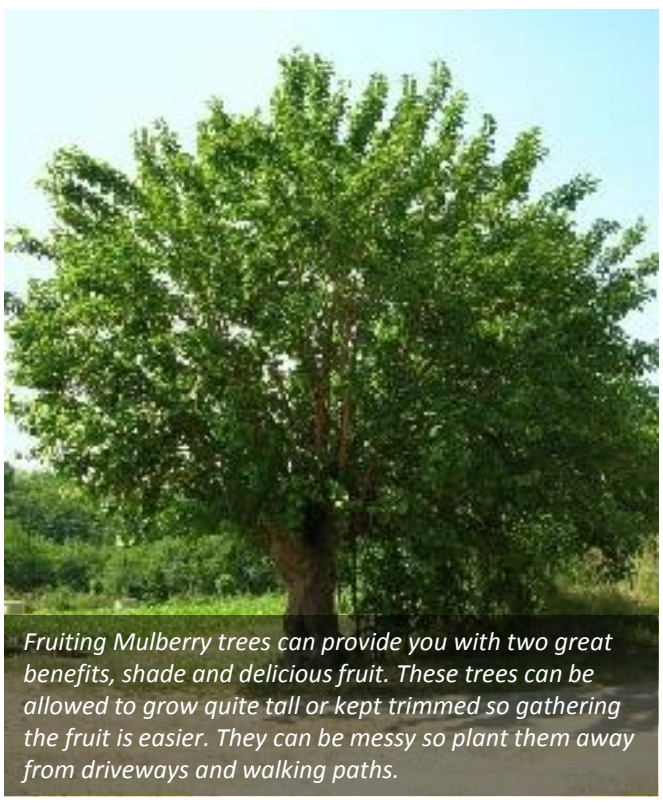
Four food producing trees that do well in the High Desert

Jujube fruit

Mulberries



Jujube trees are extremely tough and well suited for our harsh desert climate. They tolerate a wide range of soil conditions and temperatures. The fruit is small, delicious and can be eaten fresh or dried and consumed much later.

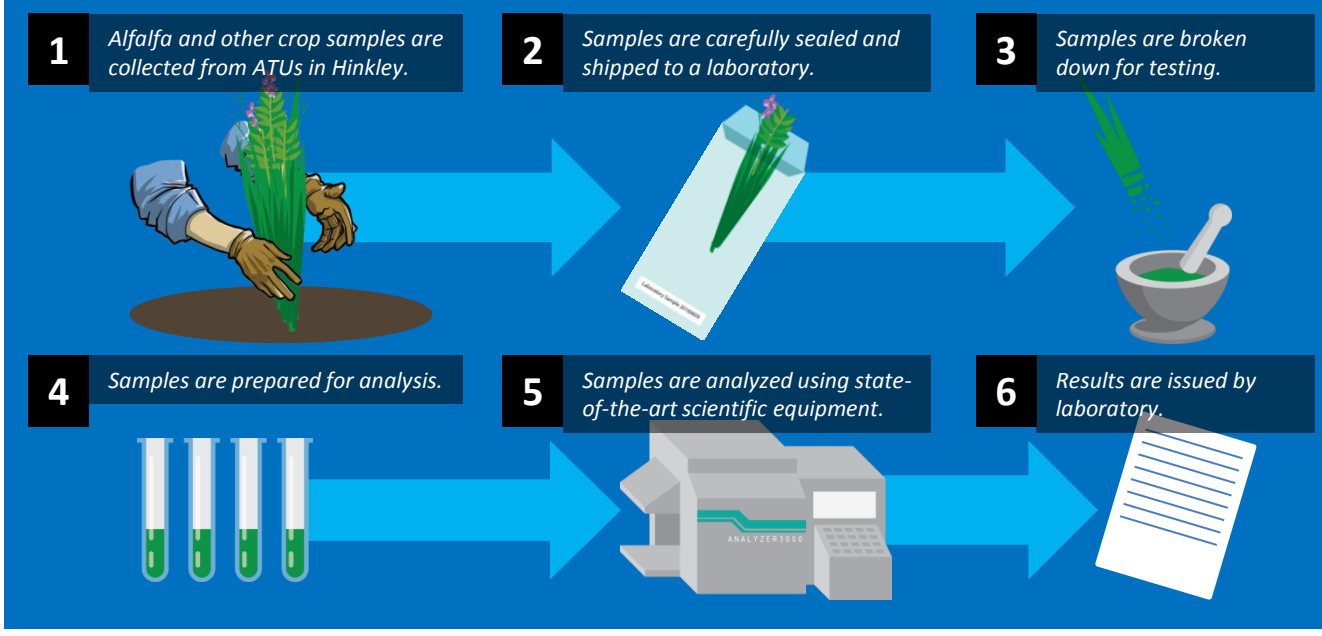


Fruiting Mulberry trees can provide you with two great benefits, shade and delicious fruit. These trees can be allowed to grow quite tall or kept trimmed so gathering the fruit is easier. They can be messy so plant them away from driveways and walking paths.

Frequently Asked Questions (FAQs)

Does PG&E test the plants from the Agriculture Treatment Units (ATUs) used to treat Cr(VI) impacted groundwater?

Yes, as part of the Water Board's Waste Discharge Requirements or WDRs, PG&E is required to test the plants grown at the ATUs to treat Cr(VI). WDRs outlines sampling requirements, amount of water used for irrigation, maximum acreage of ATUs allowed, etc . All samples collected at the ATUs have been non-detect or below the Cr(VI) threshold outlined in the WDRs. Below is a schematic illustrating how plants are sampled at the ATUs.



Arsenic in Your Well Water*

By Penny Harper, RN

Arsenic is a common element that occurs naturally in southwestern rocks and soils. It is often in volcanic rock as at Black Mountain, north of Hinkley. From the rocks, arsenic can dissolve in well water where it is tasteless and colorless. It is poisonous if ingested in large quantities and small amounts can accumulate inside the body. You can tell if there is arsenic in your well water by getting a test done in a lab. Arsenic is also released by PG&E's In-Situ Reactive Zone or IRZ. However, that arsenic is contained within the IRZ area that is between highway 58 and PG&E's Compressor Station. But there are no household water wells there.

There are different forms of arsenic, like arsenic III and V. Inorganic arsenic is from the breakdown of rock . Organic arsenic is in plants that absorb it from water and soil. This form is much less poisonous than the inorganic form.

The U.S. and the California EPA have determined that 10 ppb or less of arsenic in drinking water is safe. Above that level, arsenic in water can damage health. Direct skin contact with water containing arsenic, such as bathing in it, is not considered to cause any harm to the body.

The most common sign of arsenic accumulating in the body is small hard, dry skin growths called keratoses. They look like a callous, but can appear on the face and arms. Excessive exposure to sunlight can cause keratoses too. These growths are classified as precancerous tumors. They are benign as they do not usually grow or spread to other parts of the body like cancer. Long term ingestion of arsenic can also cause stomach pain, nausea, diarrhea, vomiting, numbness of hands and feet. Long term accumulation of inorganic arsenic can cause cancer of the bladder, lungs, kidneys, nasal passages, liver and prostate.

There are natural, noninvasive ways to cleanse arsenic from the body. Cilantro loosens arsenic up, then chlorella tablets trap and remove it through the intestines. There are also chelation methods using oral pills or suppositories. Swishing twice a day with vegetable oil pulls arsenic and other toxic chemicals out of the body. Colon cleanses, liver and gallbladder cleanses also remove toxins. We have the opportunity to sweat out poisons from the body this summer. Be sure to shower off afterwards. Probiotics like Bifidobacteria and Lactobacillus salivarius found in capsules and yogurt help to cleanse also.

Knowledge takes away fear. You can take charge of your health and not be a victim, even here in Hinkley.

**Note from IRP Manager: USGS took arsenic measurements from wells in the Hinkley Valley for the BGS. To date, this data was released to individual well owners.*

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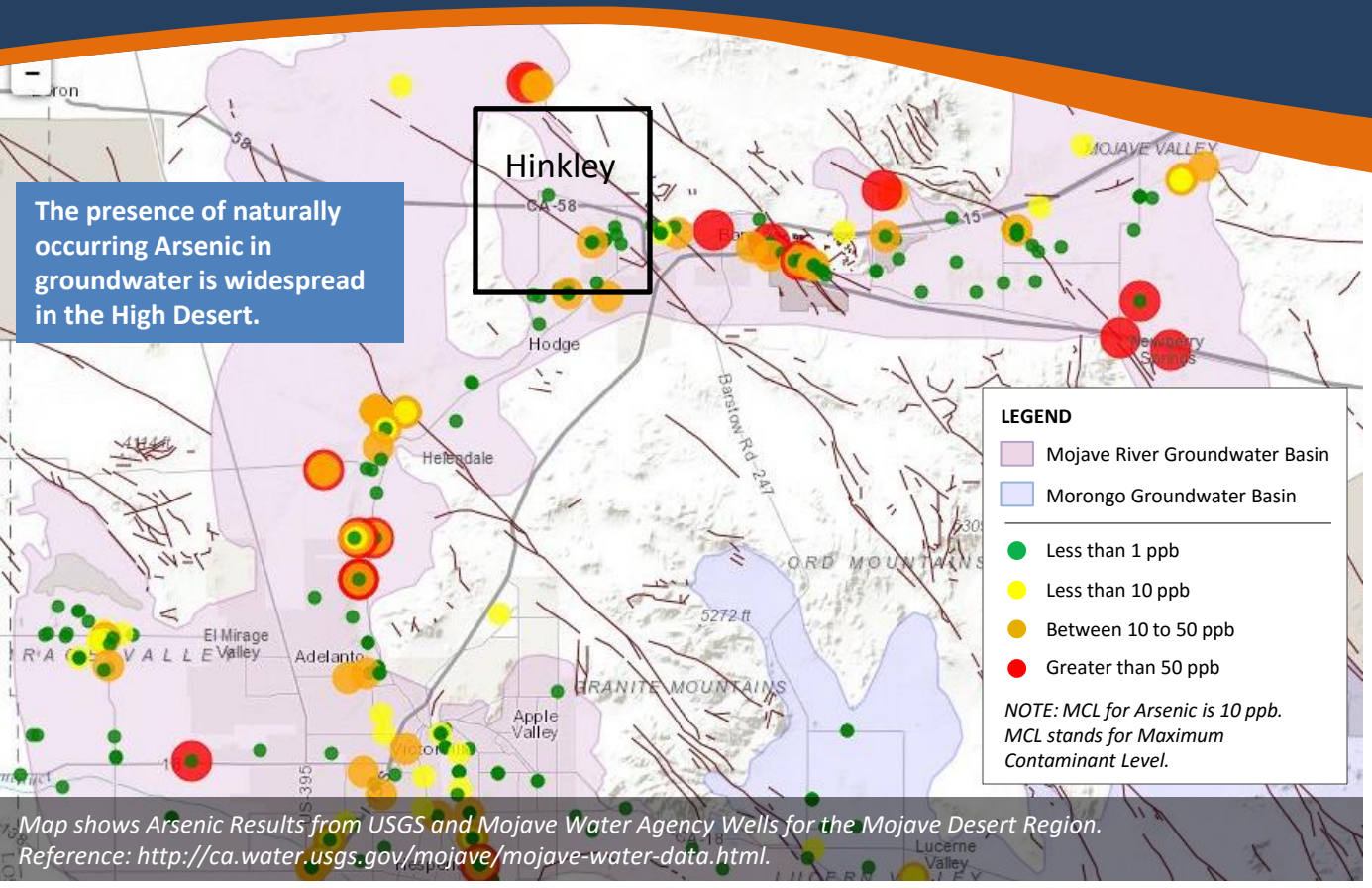
Hinkley Community Newsletter

Volume 2 Number 4
September 2016

A NEWSLETTER ISSUED BY THE IRP MANAGER[1] DISCUSSING ISSUES ASSOCIATED WITH THE HINKLEY VALLEY's Cr(VI) REMEDIATION PROGRAM



The presence of naturally occurring Arsenic in groundwater is widespread in the High Desert.

Map shows Arsenic Results from USGS and Mojave Water Agency Wells for the Mojave Desert Region. Reference: http://ca.water.usgs.gov/mojave/mojave-water-data.html.

Arsenic Distribution throughout the Mojave Desert and Hinkley Valley

There has been discussion in the local press recently regarding Arsenic levels in Hinkley. This article is intended to answer any questions you may have.

Arsenic is a naturally occurring element found in soil and groundwater. Natural processes such as volcanic action, erosion of rocks (see diagram on second page), and forest fires can release arsenic into the environment. Man-made sources of arsenic in the environment include mining and smelting operations; agricultural applications; and the use of industrial products and disposal of waste containing arsenic[2]. Arsenic exists in the forms of As(III) and As(V) in groundwater. The Federal and State Maximum Contaminant Level (MCL) for arsenic is 10 parts per billion (ppb). Arsenic in groundwater can be treated using several treatment technologies such as reverse osmosis, ion exchange, carbon or other absorption media[3]. The type of treatment system one might use will depend on your water quality and form of arsenic (As[III], As[V] or both).

As part of the Groundwater Ambient Monitoring and Assessment Program (GAMA) and other groundwater programs, the USGS and Mojave Water Agency (MWA) test wells throughout the Mojave Desert. This information is collected to understand groundwater quality throughout the region, and thereby better understand and identify any potential risks to groundwater resources. But what will be of specific interest to Hinkley residents is that according to data collected from USGS and MWA, the arsenic concentrations, in the above mapped area, range from non-detect to 219 ppb throughout the Mojave Desert Region.

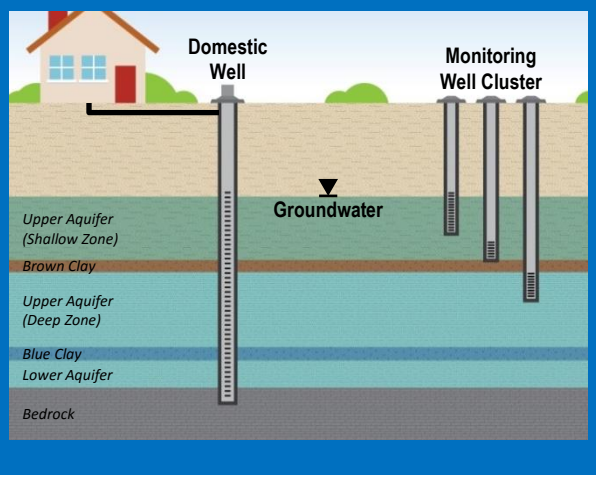
Frequently Asked Questions

What is the difference between a Domestic Well and a Monitoring Well?

A domestic well is used to provide water to a household or used for irrigation purposes. A monitoring well, on the other hand, is used to collect groundwater samples to determine water quality. Only a small amount of water is extracted for monitoring purposes relative to a domestic well's use.

Another difference is that domestic wells can be screened in both the lower and upper aquifers, while a monitoring well is designed with a short screen for accurate measurements at a specific aquifer location.

Below is a diagram illustrating the major differences between domestic and monitoring well systems.



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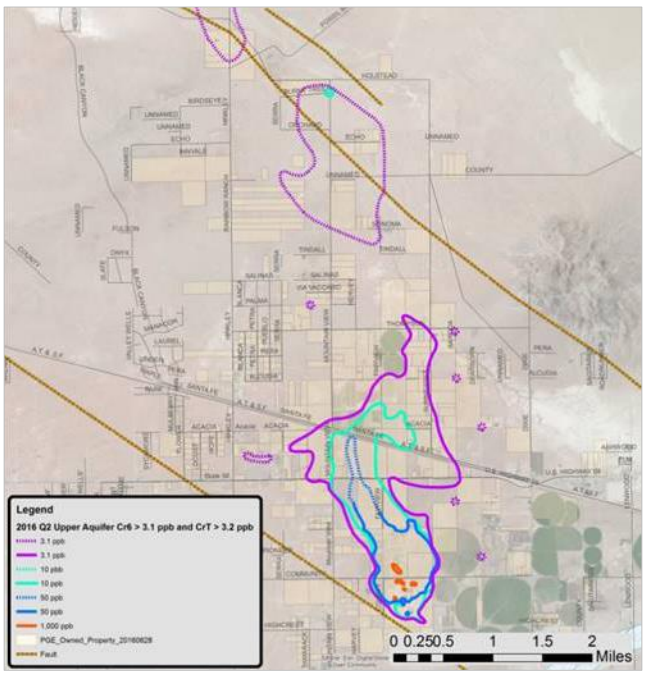
- Provides comments and feedback to the Water Board regarding key reports and Water Board's orders
- Participates in the planning and implementation of the USGS Cr(VI) Background Study
- Perform community outreach to Hinkley residents to explain all the different parts of PG&E's Cr(VI) Groundwater Remediation Program (office hours, quarterly monthly meetings, website, and newsletters)
- This Newsletter is being issued in the spirit of helping fulfill the above technical outreach commitment.

Second Quarter 2016 Cr(VI) Plume Map Issued August 2016



The second quarter 2016 chromium plume map was issued on August 10, 2016 by PG&E to the Water Board. No major changes were reported in the second quarter plume map compared to the previous quarter. Below is a summary of the monitoring and domestic well results.

Monitoring

- 378 monitor wells (MWs) were sampled, including:
  - 50 domestic and other private wells
  - 16 lower aquifer wells

Domestic Well Results

- 4 domestic wells exceeded 3.1ppb (Cr(VI)) and/or 3.2ppb (CrT)
- All 4 domestic wells were below the CA MCL of 10ppb
- Hydraulic control continues at Thompson Road

The second quarter 2016 Chromium plume map is available for download at the IRP Manger's website, www.HinkleyGroundwater.com.

Important Upcoming Dates

Sept 10: *Hinkley Community Breakfast*
8:00 AM – 10:00 AM
at Hinkley Community & Senior Center

Oct 27: *Community Meeting*
6:00 PM – 8:00 PM
at the Hinkley Community & Senior Center hosted by the IRP Manager

IRP Manager's Office Hours

36236 Serra Rd. Hinkley, CA 92347

Sept 1: 5:00 PM – 8:00 PM

Sept 10: 8:00 AM – 10:00 AM
at Hinkley Community & Senior Center

Sept 22: 5:00 PM – 8:00 PM

Oct 6: 5:00 PM – 8:00 PM

Contact Information

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[2] USEPA. 2002. Proven Alternatives for Aboveground Treatment of Arsenic in Groundwater (EPA-542-S-02-002).
[3] http://www.waterboards.ca.gov/drinking_water/certlic/device/Documents/wtd2016/65registered_models_for_arsenic_listing050516.pdf

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A NEWSLETTER ISSUED BY THE IRP MANAGER DISCUSSING ISSUES ASSOCIATED WITH THE HINKLEY VALLEY'S Cr(VI) REMEDIATION PROGRAM

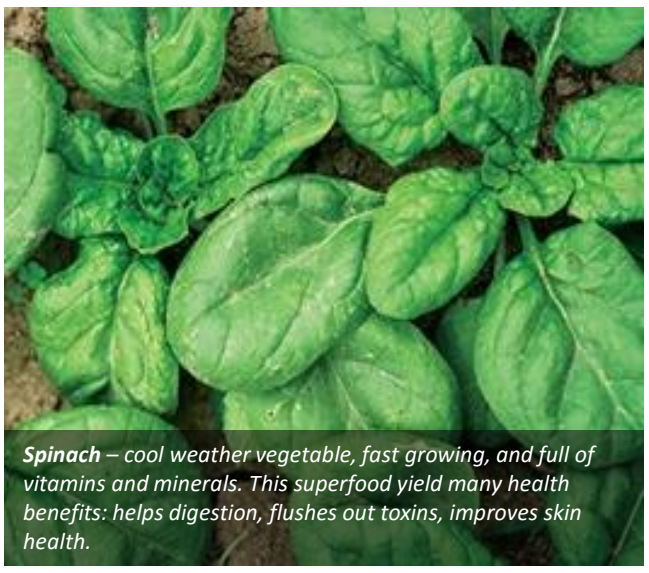
Volume 2 Number 4
September 2016

The IRP Manager plans to expand the newsletter to include topics more broadly related to the Hinkley Valley and its groundwater. These topics will appear on page 2 of the newsletter.

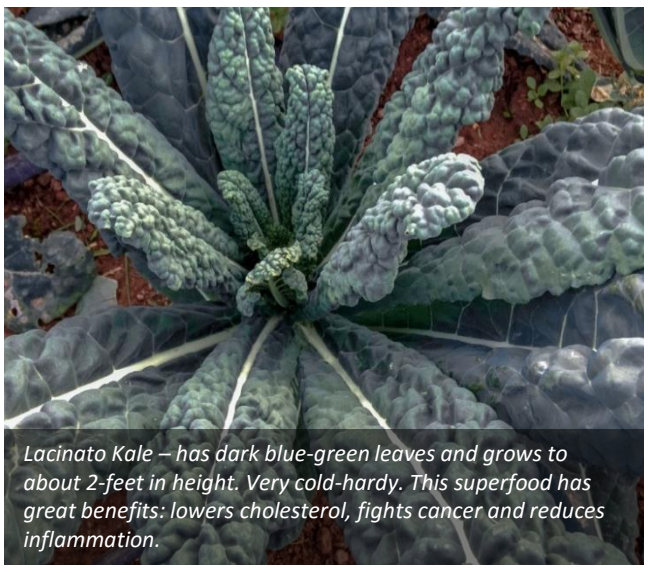
6 Winter Vegetables

THAT GROW WELL IN THE HIGH DESERT

It's Time to Start Thinking About Your Winter Garden!
Plant in September and October.



***Spinach** – cool weather vegetable, fast growing, and full of vitamins and minerals. This superfood yield many health benefits: helps digestion, flushes out toxins, improves skin health.*



Lacinato Kale – has dark blue-green leaves and grows to about 2-feet in height. Very cold-hardy. This superfood has great benefits: lowers cholesterol, fights cancer and reduces inflammation.

Cabbage – cruciferous, cool weather vegetable. Ideal temperature range is between 39°F and 75°F. Thrives in well drained and slightly acidic soil in full sun. Some health benefits: helps with digestion, skin disorders, cancer prevention, weight loss, improves eye health.

Beets – cool weather root vegetable, easy to grow. Produces tasty roots which can be baked, boiled or sautéed. Beets are very rich in nutrients and have anti-cancer and anti-inflammatory properties. Drinking beet juice lowers blood pressure.

Broccoli – cruciferous, cool weather vegetable. Ideal temperature range is between 64°F and 74°F. Some health benefits: reduces inflammation, helps detoxify the body, fights cancer. Stems and leaves are edible.

Radishes – cool-season root vegetable. They grow fast and love to be in full sun . Some health benefits: powerful detoxifier, great for the liver and stomach, anti-cancer, very helpful with urinary disorders, skin disorders and many more.

Local New Solar Electric Power *by Penny Harper, Hinkley Resident*

"There is a new solar electric generating facility being installed on Community Blvd, just 2 miles east of Hinkley. Duke Energy Renewables from Charlotte, N.C., is the power utility and M+W Group out of Arizona is the construction company. It is called the Longboat Solar Power Project. I spoke with a Media Relations representative based in the Duke Energy office in North Carolina. When complete, the site will cover 200 acres and generate 20 megawatts of AC power. They will use photovoltaic panels to generate electricity from the sun. Usually these panels produce direct current which has to be converted to alternating current. Construction started earlier this year and they expect to have it in service by the end of 2016. Very fast, compared with other local large ongoing construction projects.

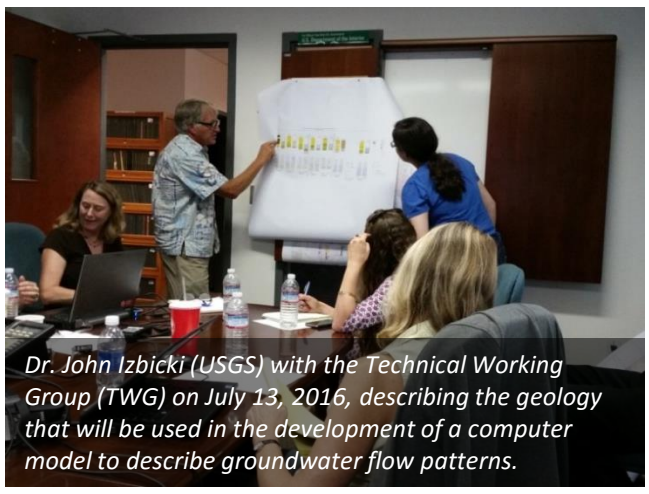
The land that the solar plant is being erected on is part of the 100 plus year old Hills Ranch. It used to be a dairy providing home delivery of fresh milk and employed many local Hinkley residents. A variety of trees were planted that today make the center of the property look like a forest. The present owners, the Hill and Diaz families, have retained a 40 acre island in the middle of the solar fields where their homes and forest are. There are pistachio, hackberry, jujube, apricot, plum, almond, persimmon and ash trees that make the land cooler in the summer and warmer in the winter. Great horned owls have been sighted in the 100 year old cork oak trees. There is an 80 foot mulberry tree that rains fruit every spring.

It is good to see clean, nonpolluting, sustainable energy generation along with respect for historical homesteads and ancient trees."

Note in proof from IRP Manager: We delved more into the background of this facility. More information is available via Duke Energy's website at https://news.duke-energy.com/releases/duke-energy-renewables-acquires-20-mw-longboat-solar-project-in-california-from-edf-renewable-energy.

USGS Cr(VI) Background Study (BGS)

USGS's BGS is in the process of collecting significant amounts of data related to groundwater from within the Hinkley Valley. Regular technical meetings occur both in Hinkley and at USGS to discuss the findings.

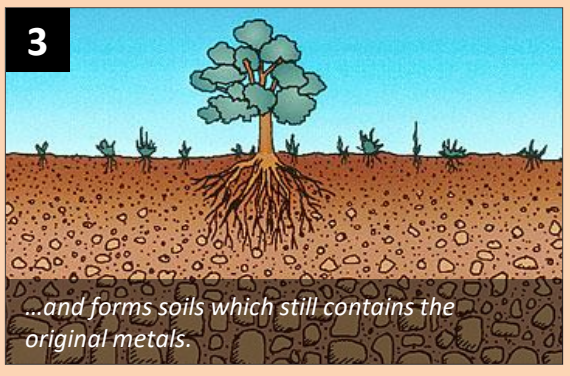


Dr. John Izbicki (USGS) with the Technical Working Group (TWG) on July 13, 2016, describing the geology that will be used in the development of a computer model to describe groundwater flow patterns.

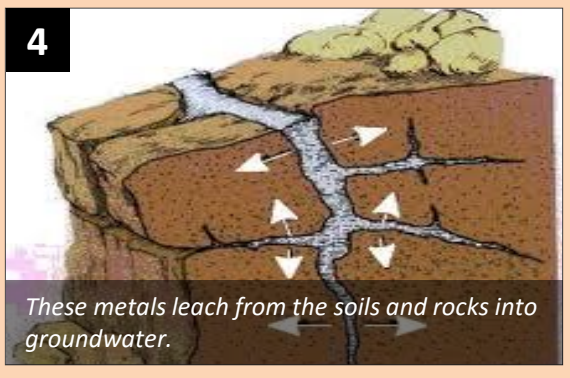
How Arsenic and Other Metals Get Into Groundwater

Native rocks contain metals.

Natural weathering erodes the rocks…



…and forms soils which still contains the original metals.



These metals leach from the soils and rocks into groundwater.

Metals naturally leach from rocks into groundwater. Lighter area shows where minerals have been removed (leached) during weathering.

[1] The Independent Review Panel (IRP) Manager is a resource for the Hinkley Community that provides explanations and answers to Community questions regarding PG&E's Hinkley Cr(VI) Remediation Program.

Prepared and printed by the IRP Manager's staff at Project Navigator, Ltd.®

Hinkley Community Newsletter

Volume 2 Number 5
October 2016

A NEWSLETTER ISSUED BY THE IRP MANAGER[1] DISCUSSING ISSUES ASSOCIATED WITH THE HINKLEY VALLEY's Cr(VI) REMEDIATION PROGRAM

PG&E's Environmental Consultant measuring the water depth at a temporary boring well used to collect groundwater samples as part of the Former Waste Pit Investigation.

Field Work For Former Waste Pit Completed in September 2016

As part of the Water Board's Former Waste Pit Investigation, PG&E conducted field work from September 12 through September 16. The field work was in accordance with PG&E's Water Board approved Work Plan from June 2016. Two temporary wells were completed in the area of Hinkley Rd. and Community Blvd. to assess total petroleum hydrocarbon (TPH) impacts in groundwater. Groundwater samples were collected and sent to certified laboratories. Samples were taken by both the Water Board and PG&E. The Water Board staff provided oversight of the field work.

The Waste Pit was a small unauthorized dump area seemingly used by unknown parties which was discovered in 2013 on PG&E owned property. Wastes included automotive parts and household materials. The Water Board issued an Investigative Order (IO) to PG&E on March 2014. Additional information is provided on page 2 of this Newsletter.

Important Upcoming Dates

Oct 27: *Community Meeting*
6:00 PM – 8:00 PM
at the Hinkley Community & Senior Center hosted by the IRP Manager

Nov 12: *Hinkley Community Breakfast*
8:00 AM – 10:00 AM
at Hinkley Community & Senior Center

IRP Manager's Office Hours

36236 Serra Rd. Hinkley, CA 92347

Nov 3: 5:00 PM – 8:00 PM

Nov 12: 8:00 AM – 10:00 AM
at Hinkley Community & Senior Center

Nov 17: 5:00 PM – 8:00 PM

Dec 1: 5:00 PM – 8:00 PM

The Effect of Arsenic in Soil and Water on Hinkley Farm Produce

By Penny Harper, RN, Hinkley Resident

"Large scale farm produce you can see while driving around the Hinkley area are alfalfa, corn, dairy products, pistachios, and Sudan grass. But not so visible are small scale family gardens with melon, squash, tomatoes, jujubes, Swiss chard, pears, apricots, mulberries, honey, grapes, goat milk, chicken eggs, turkeys, pigs and more. There is a broad variety of food crops we can grow in Hinkley if they are timed with the seasons, protected from weather extremes, and fertilized and watered appropriately. Most of it is eaten or preserved right on the farm and never goes to a public market. But what if we wanted to sell our farm produce to the public? How safe is food grown here?

Arsenic naturally occurs in Hinkley ranging from 0 to 120ppb in groundwater. 10ppb is the federal standard for the maximum contaminant level in drinking water. The National Academy of Sciences recommends an arsenic level below 100ppb in irrigation water. They also noted that 12,000ppb arsenic is toxic to Sudan grass, while 50ppb is toxic to rice. There was no reference of toxicity to people or animals who eat these crops.

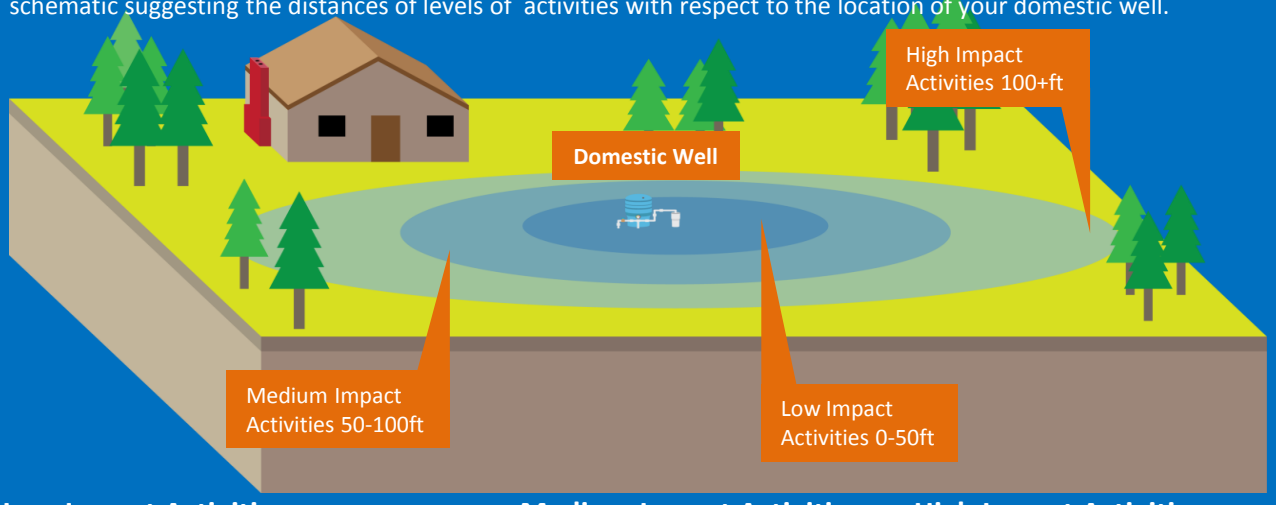
Nevada, like the California high desert, has high levels of metals, including arsenic, in groundwater and soil. A fact sheet from the University of Nevada[3] says the FDA allows no more than 2000ppb of arsenic in fresh produce. "When water that contains arsenic is added to soils, the arsenic may be chemically bound to soil particles in a way that makes it unavailable to plants…before arsenic accumulates in leaves and fruits in concentrations that exceed the FDA standards, plants are likely to die or have severely reduced yields. The more clay the soil has, the more likely that arsenic will be tightly bound and not released to plants in water passing from the soil to the plant."

This means that it is seems safe to eat what we grow, but before being sold to the public, it is advised to test for arsenic levels to be below 2000ppb."

Frequently Asked Questions

What is a Suggested Zone of Protection Around a Well?

The Suggested Zone of Protection is a recommended area around a well to prevent groundwater contamination in order to keep your well water clean. The layer of ground between the surface and groundwater will provide some protection, but is not a perfect filter. The farther away possible contamination activities are from your well, the more soil is available to filter out contaminants if an accidental surface leak or spill release occurs. Below is a schematic suggesting the distances of levels of activities with respect to the location of your domestic well.



Low Impact Activities
- Recreation area
- House
- Outdoor furniture and play areas

Medium Impact Activities
- Garage
- Boat

High Impact Activities
- Chemical storage
- Animal enclosures
- Manure/compost piles
- Machine/auto repair
- Septic system

Reference: A Guide for Private Domestic Well Owners. Water Board March 2015[2]

A Guide to Troubleshooting Your Domestic Wells[2]

Problem	Possible Cause
Water is orange or reddish brown	High levels of iron (Fe) in the groundwater
Porcelain fixtures or laundry are stained brown or black	Manganese (Mn) and/or iron (Fe) can cause staining
White spots on the dishes or white encrustation around fixtures	High levels of calcium (Ca) and magnesium (Mg) can cause hard water, which leaves spots
Water is blue	High levels of copper (Cu)
Water smells like rotten eggs	The presence of hydrogen sulfide (H2S)
Water heater is corroding	Water can be corrosive, depending on its pH. Very corrosive water can damage metal pipes and water heaters
Water appears cloudy, frothy, or colored	Suspended particulates, detergents, and sewage can cause water to appear cloudy, frothy, or colored
Your home's plumbing system has lead pipes, fittings, or solder joints	Corrosive water can cause lead (Pb), copper (Cu), cadmium (Cd), and zinc (Zn) to leach from lead pipes, fittings, and solder joints
Water has a turpentine odor	Methyl tertiary butyl ether (MtBE) or other organic compounds
Water has a chemical smell or taste	Volatile or semi-volatile organic compounds (VOCs) or pesticides

Contact Information

The IRP Manager frequently updates a website dedicated to the Hinkley remediation. For more up-to-date information, please contact the IRP Manager's office or visit the website at www.HinkleyGroundwater.com.
If you would like to speak with the IRP Manager's staff, schedule a meeting, or suggest input on the newsletter, please contact Dr. Raudel Sanchez at (714) 388-1821 or email at rsanchez@projectnavigator.com, or locally Margaret DeAngelis at mdeangelis@projectnavigator.com. You can also contact community member Roger Killian at acgeneratorservice@verizon.net.

[1] The Independent Review Panel (IRP) Manager is a resource for the Hinkley Community that provides explanations and answers to Community questions regarding PG&E's Hinkley Cr(VI) Remediation Program.
[2] http://www.waterboards.ca.gov/gama/docs/wellowner_guide.pdf
[3] https://www.unce.unr.edu/publications/files/ho/2009/fs0909.pdf

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Hinkley Community Newsletter

Volume 2 Number 5
October 2016

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The IRP Manager plans to expand the newsletter to include topics more broadly related to the Hinkley Valley and its groundwater. These topics will appear on page 2 of the newsletter.

6 Palm Trees

THAT WILL SURVIVE IN THE HIGH DESERT

It is possible to create a tropical oasis in the High Desert despite our extreme weather conditions. Some palm trees will not need protection from the elements but others will do better if you provide a microclimate for them.

Canary Island Date Palm – Phoenix canariensis – These palms can reach 60ft tall when full grown. They are cold hardy to 18 degrees, full sun, heat and wind tolerant and drought tolerant once established.

Blue Hesper Palm – Brahea armata - Stunning with teal blue colored fan shaped leaves. Mature, these can reach a height of 40 feet. Full sun, cold hardy to 15 degrees, heat and wind tolerant and drought tolerant once established.

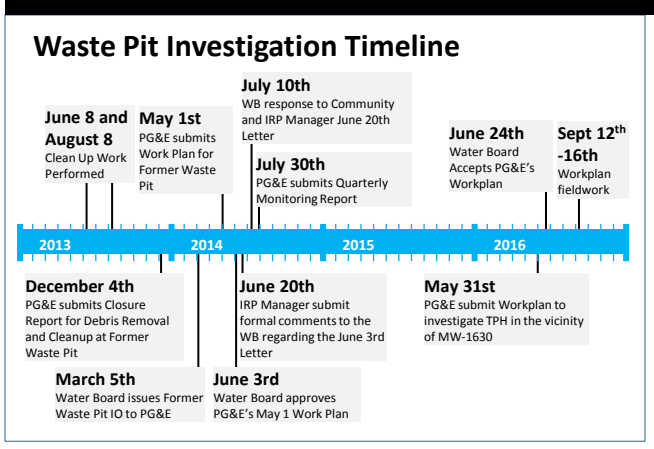
Mexican Fan Palm - Washingtonia robusta– Common through out Southern California, these can grow to 100 feet tall and have a slender trunk. Full sun, cold hardy to 18 degrees, heat and wind tolerant and drought tolerant once established.

Mediterranean Fan Palm – European Fan Palm - Chamaerops humilis - These palms typically form multiple trunks, sport green fan shaped leaves and reach a height of 15 feet tall when full grown. These are cold hardy to 10 degrees, full sun, heat and wind tolerant and very drought tolerant once established.

Blue Mediterranean Fan Palm – Moroccan Blue Bush Fan Palm - Chamaerops humilis 'Cerifera' – These are much like the green variety, but instead have teal blue colored leaves and can grow to a height of 20 feet when mature. They are cold hardy to 10 degrees, full sun, heat and wind tolerant and very drought tolerant once established.

Pindo Palm – Jelly Palm - Butia capitata – These elegant palms have curved feather shaped leaves that resemble the shape of an umbrella. They can reach a height of 20 feet when full grown and are cold hardy down to 15 degrees. They are not as sun hardy, wind or drought tolerant as others but will perform well when given some protection from extremes.

Field Work at Former Waste Pit Completed in September 2016



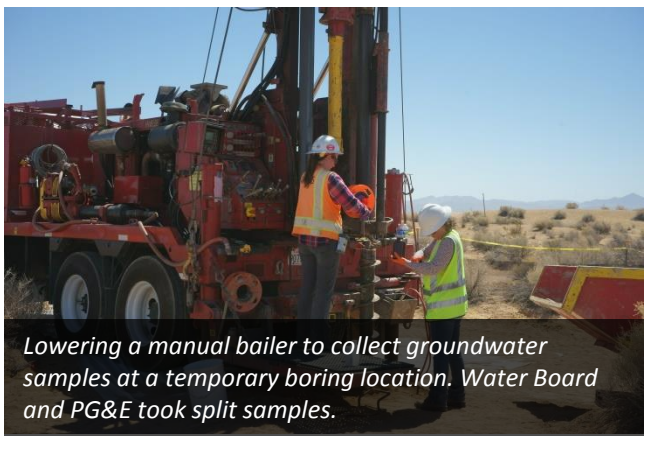
View of the drill rig at the Former Waste Pit Investigation Area located near the intersection of Community Blvd and Hinkley Rd.

Water Board Staff showing community members and the IRP Manager Team core material collected from boring holes at the Waste Pit Investigation Area.

Water Board showing community members core material collected from the temporary boring holes.

Close-up of core material collected from various depths inside of the borehole.

Close-up view of core material. Core material was collected over a period of several days.



Lowering a manual bailer to collect groundwater samples at a temporary boring location. Water Board and PG&E took split samples.

Groundwater collected from a manual bailer is poured into a glass jar and sent to a certified laboratory for further analysis.

Water Board showing groundwater sample collected from temporary boring to community members. Results will be provided by November, 2016.

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Hinkley Community Newsletter

Volume 2 Number 6
December 2016

A NEWSLETTER ISSUED BY THE IRP MANAGER[1]: DISCUSSES ISSUES ASSOCIATED WITH THE HINKLEY VALLEY's Cr(VI) REMEDIATION PROGRAM

The Background Study's (BGS) Technical Working Group (TWG) met at the USGS Office in Sacramento to discuss the progress of the computer model that will be used to understand historical groundwater flows throughout the Hinkley Valley.

USGS Chromium Background Study Progresses

The Technical Work Group (TWG) for the USGS Chromium Background Study (BGS) met on November 28, 2016 in Sacramento, CA to discuss the progress of the BGS, and how to approach creating a computer model of historical Cr(VI) and its flow-patterns throughout the Hinkley Valley. Information from the groundwater computer model will assist the TWG in understanding of how Cr(VI) may have migrated with groundwater in the past, and therefore help predict future Cr(VI) patterns.

Throughout 2016, the USGS Team working on the BGS has made significant progress, especially in completing the domestic well sampling event from January to March 2016, which collected groundwater samples from over 70 domestic wells.

The TWG consists of the members from the USGS, including Dr. John Izbicki, who leads the BGS, the Water Board, PG&E, the Hinkley Community, and the Independent Review Panel (IRP) Manager.

For those interested in learning more about the USGS BGS, Dr. John Izbicki will be attending and speaking at the January 26, 2017 Community Meeting.

Important Upcoming Dates

Jan 26: Quarterly *Community Meeting*
6:30 PM – 8:00 PM
at Hinkley Community & Senior Center

IRP Manager's Office Hours

36236 Serra Rd. Hinkley, CA 92347

Jan 5: 5:00 PM – 8:00 PM

Jan 14: 8:00 AM – 10:00 AM
at Hinkley Community & Senior Center

Jan 19: 5:00 PM – 8:00 PM

Contact Information

The IRP Manager frequently updates the IRP website dedicated to the Hinkley remediation. For more up-to-date information, please contact the IRP Manager's office or visit the website at www.HinkleyGroundwater.com.

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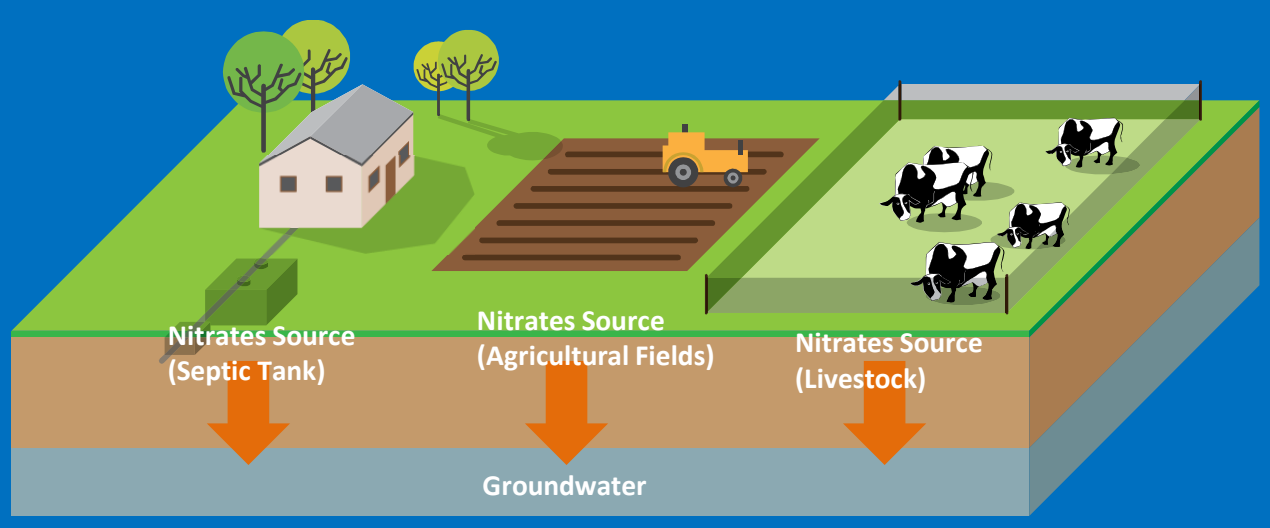
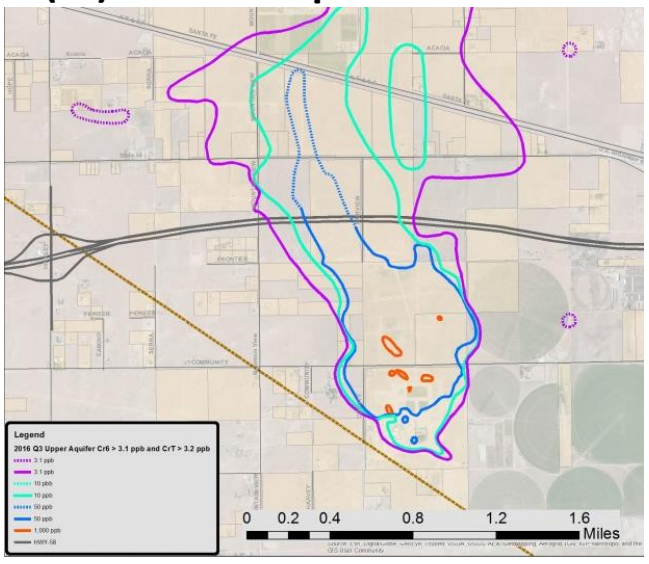
Frequently Asked Questions (FAQs)
How do nitrates get into groundwater?

Nitrates are an essential source of nitrogen for plants. When nitrogen fertilizers are used to enrich soils, nitrates may be carried by rain, irrigation waters and other surface waters through the soil into groundwater. Human and animal wastes can also contribute to nitrate contamination of groundwater. In Hinkley, the vertical travel distance from the surface to groundwater is about 100 feet.



PG&E Issues 3rd Quarter, 2016 Cr(VI) Plume Map



The Q3, 2016 chromium plume map was issued by PG&E to the Water Board in November, 2016. The plume map showed no major changes compared to the 2nd Quarter. Below is a summary of the monitoring and domestic well results.

Monitoring

- 368 monitor wells (MWs) were sampled, including:
  - 45 domestic and other private wells
  - 9 lower aquifer wells

Domestic Well Results

- 3 domestic wells exceeded 3.1ppb (Cr(VI)) and/or 3.2ppb (CrT)
- All 3 domestic wells were below the California drinking water standard (aka MCL) of 10ppb
- Hydraulic control continues at Thompson Road

The above Q3, 2016 Chromium plume map is available for download at the IRP Manger's website, www.HinkleyGroundwater.com.

Who is the IRP Manager?

Project Navigator, Ltd. (PNL) was selected in 2012 as the Independent Review Panel (IRP) Manager by the Hinkley Community Advisory Committee (CAC).

PNL is an environmental engineering company based in Brea, CA known for its expertise in advising on complex, long-term environmental remediation projects. PNL also specializes in converting complex technical information into easy-to-understand visuals that can enhance communication.

The IRP Manager's Scope of Work (SOW) is detailed in the Water Board November 4, 2015 Cleanup and Abatement Order (CAO). Tasks include the following:

- Reviews all technical documentation regarding PG&E's Cr(VI) Groundwater Remediation Program
- Provides comments and feedback to the Water Board regarding key reports and Water Board's orders
- Participates in the planning and implementation of the USGS Cr(VI) Background Study
- Performs outreach to Hinkley residents to explain the different parts of PG&E's Cr(VI) Groundwater Remediation Program (via office hours, quarterly monthly meetings, website, and newsletters)
- This Newsletter is being issued in the spirit of helping fulfill the above technical outreach commitment.

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4 Flowering Plants THAT WILL ATTRACT POLLINATORS TO YOUR GARDEN

English Lavender (Lavandula angustifolia) - Cold hardy, blooms late spring/ early summer.

Firecracker Penstemon (Penstemon eatonii) - Drought tolerant, blooms late winter to spring.

Cleveland Sage (Salvia clevelandii) - Very fragrant, blooms spring to summer.

Purple Coneflower (Echinacaea purpurea) - Drought tolerant once established, blooms throughout spring to late summer.

Former Waste Pit Investigation Update

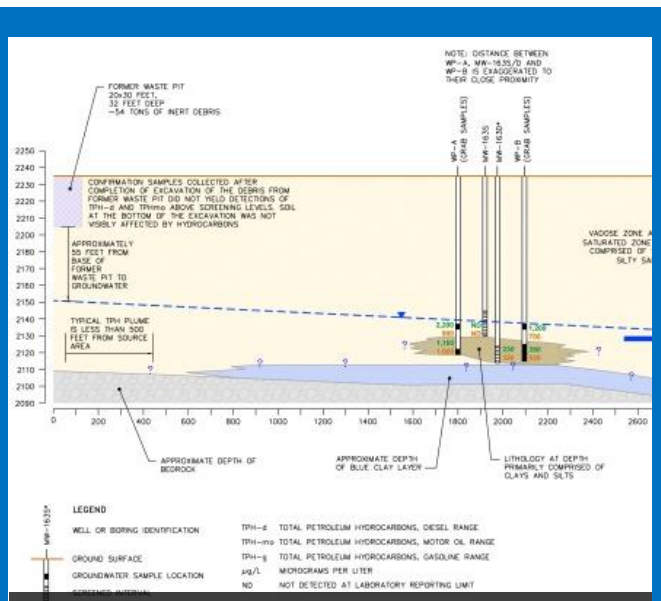

Image from a PG&E Report on the Former Waste Pit showing a cross section of the results from near wells and the two temporary wells.

During September 2016, PG&E sampled two temporary wells near Hinkley Road and Community Blvd. The objective was to assess total petroleum hydrocarbon (TPH) impacts in groundwater. Results from the September, 2016 sampling reported a detection of TPH in groundwater samples.

As a result the Water Board has requested that PG&E prepare a Plan for further investigation. The "Waste Pit" was a small unauthorized dump area, used by unknown parties. The Pit was discovered in 2013 on PG&E owned property. Wastes, now removed, included automotive parts and household materials. The Water Board issued an Investigative Order (IO) to PG&E on March 2014.

Source: *Third Quarter 2016 Former Waste Pit Groundwater Monitoring Report and Grab Groundwater Investigation Results, Hinkley, California, WDID No. 6B361403001*

Permaculture: Sustainable Communities and Chickens

Some Ideas Supplied to the IRP Manager by Community Member, Penny Harper.

"***'Permaculture' means permanent culture.*** It's about building communities that are sustainable and do not collapse. On a smaller scale, it can be about maintaining a home in a rural area that provides healthy food, comfortable housing and renewable energy. In the city, people are dependent on food from distant farms, city sewer and water, and the electric grid. They are dependent on services they have little control over. But in Hinkley, residents have plenty of space to start a vegetable garden, raise a few chickens, and have their own water well and septic system.

The principles of ***permaculture*** start with design and a mind-set, whether one is in a town or a farm. The design copies the cycles of nature, builds resilience to threats, creates abundance, and reuses waste. Mind-set (or belief) arrives with concepts, such as; one can't get something for nothing; if you pollute the environment, you will be damaged too. The result of permaculture is a lifestyle in alignment with the health of the land, water, air, animals, plants and the people who live in your Community.

Permaculture design in the small farm includes multi-use features. Chickens are a good example. They survive well in our desert climate of extreme heat, cold and wind with just a little care. They provide eggs, meat, manure, baby chicks, feathers, soil cultivation and weeding. They will need just a small weather proof shelter that will also protect them from predators. At Aquarius Ranch, the chicken pens are next to the vegetable garden and a mulberry grove. The poultry wrangler, Joan, lets the chickens forage among the young mulberry trees-- with supervision. They weed, cultivate, fertilize and eat as they go. We throw the garden weeds we pull out into the pens. The pens are so nicely sheltered from wind, sun and cold, that they make a good place to build a compost pile. When Joan fills the chicken's water dishes, she turns the hose to sprinkle the compost pile too. In six months, the compost is ready to mix into the garden soil, a short wheelbarrow trip away. The end result is very healthy chickens, increasingly fertile garden soil, eggs for breakfast, and of course, entertainment watching the chickens.

For our Community to survive long term, we need cooperation among the residents, plus clean air and water, local jobs, waste management (trash, recycling, sewage), access to supplies and food, adequate rainfall, reliable affordable electricity and vehicle fuel, and communications (phone, internet, post office). Without these, the less resilient people move away. Those who remain adapt to the deficits and become more self-sufficient, or depend on relief from benevolent organizations."

The IRP Manager Contributed & Participated in the Annual Hinkley Thanksgiving Turkey Giveaway.

The IRP Manager Team's Dr. Halil Kavak and Dr. Raudel Sanchez gave away Thanksgiving Turkeys to Hinkley Community Members.

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ENCLOSURE 5

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AGENDA ITEM 9

Status Report: Activities Concerning Chromium Contamination, PG&E Hinkley Compressor Station

Lahontan Water Board meeting
April 19, 2017
Barstow, CA

Lisa Dernbach, PG, CEG, CHg
Senior Engineering Geologist (Specialist)

Anne Holden, PG
Engineering Geologist

Water Boards

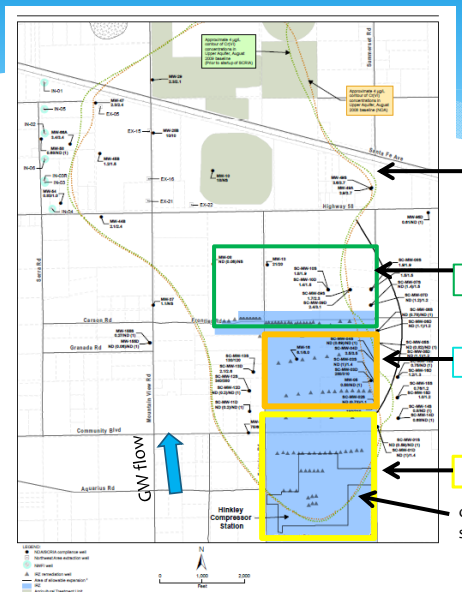
Key Water Board Staff Actions

Since adoption of November 2015 Cleanup and Abatement Order (CAO) R6V-2015-0068:

1. Updated Notice of Applicability for In-situ Reactive Zones
3. Revised hydraulic capture of Cr plume
4. Bioreactor pilot test
5. Revisions to CAO monitoring program
6. Background Study update

2

In-Situ Remediation Zones (IRZs)



Cr plume lines 2008

Central Area In-situ

South Central In-situ

Source Area In-situ

compressor station

= in-situ remediation wells

3

Updated Notice of Applicability for IRZ General WDRs

Issued **April 20, 2016** by Executive Officer to expand activities to hasten cleanup and impose EIR mitigation measures:

- **Does not limit amount of reagents (ethanol, etc.) injected to groundwater**
- **Allows expanded injection locations to better reach high Cr concentrations**
- **Requires monitoring well replacement for dry wells**
- **Reduced monitoring frequency for certain monitoring wells**
- **Allows use of additional well rehabilitation compounds**

4

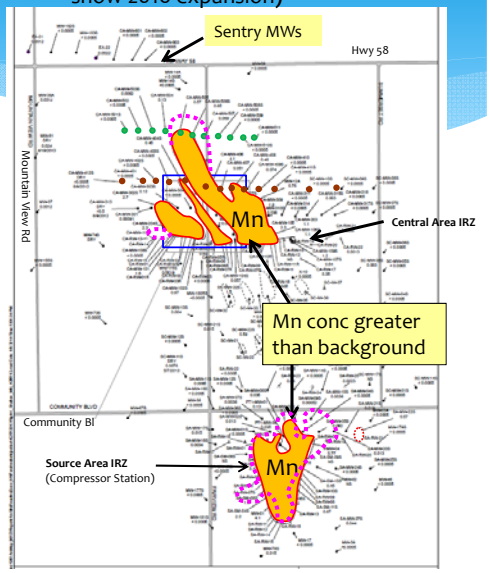
In-situ Byproducts

Current permit allows Mn byproduct plumes to migrate further on PG&E-owned land to railroad/Santa Fe Ave and fewer domestic wells exist now

Monitoring Requirements:

- Extensive monitoring well network with designated contingency wells
- Have EIR mitigation actions in place if byproducts migrate to contingency wells

Map of Mn byproduct plume in shallow zone (dashed pink lines show 2016 expansion)



5

IRZ Expansion

Executive Officer issued IRZ expansion approval letters for new injection wells in 2016 and 2017 for:

- SCRIA (South Central Reinjection Area)
  - ➢ Slower movement in deep zone
- Source Area
  - ➢ Slower movement throughout

Both letters reminded PG&E of other parts in these areas having Cr6 >50 ppb not yet fully addressed by remedial actions

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Planned IRZ Activities

1. Operate 2016/17 IRZ expansion buildouts and evaluate cleanup response
2. Expecting endangered species "take " permits from California F&W and federal F&W in 2018
3. Planning another IRZ expansion buildout to be proposed 2019

CAO Target: By 2025 achieve 50 ppb in 90% of monitoring wells

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Amended Hydraulic Capture Metrics, 2015 CAO

1. PG&E submitted April 2016 proposal to amend hydraulic capture metrics and revise monitoring to verify capture:
   - Conducted pilot tests in 2015-16
   - Capture boundaries are narrower and extend more southward to prevent pumping clean water and focus pumping and contaminant removal where greater mass exists
   - Public comments period in October 2016

2. Executive Officer issued amended capture metrics and revised monitoring to the CAO on November 22, 2017:
   - Requires quarterly reports with monthly data verifying Cr plume is contained from migration
     - ➢ January 2017 report showed compliance

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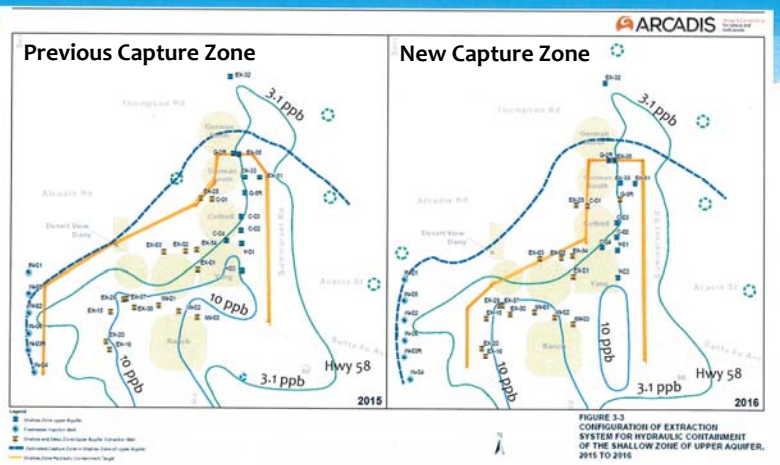
Amended Capture Metrics



9

Notice of Applicability for Bioreactor Pilot Test

Bioreactor pilot test: Pump and treat (above-ground) system testing microbes to treat Cr6- contaminated groundwater

- ✓ Original NOA issued **Dec. 2014** for 12-month pilot test
- ✓ On **April 22, 2016**, approval to extend pilot test for additional six months
- ✓ Project completed in third quarter 2016

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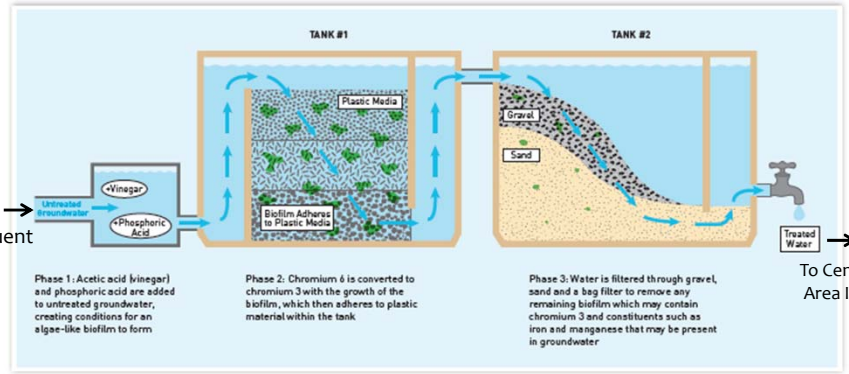
Bioreactor:
Two 10,500 gal tanks



Cr influent →

→ To Central Area IRZ

Source: PG&E Bioreactor Fact Sheet, June 2015

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Cleanup and Abatement Order R6V-2015-0068

Groundwater Monitoring Frequency Annual Evaluation

Anne Holden, PG
Engineering Geologist
Lahontan Water Board

Water Boards

Overview

CAO's monitoring and reporting program (MRP) established process for annual review of groundwater monitoring sampling well frequencies

- Flow charts in attachments B and C of CAO MRP
- Sets clear criteria for retaining, reducing or increasing sampling frequency of monitoring wells
- Does not affect domestic well sampling or other sampling requirements set forth in remediation permits

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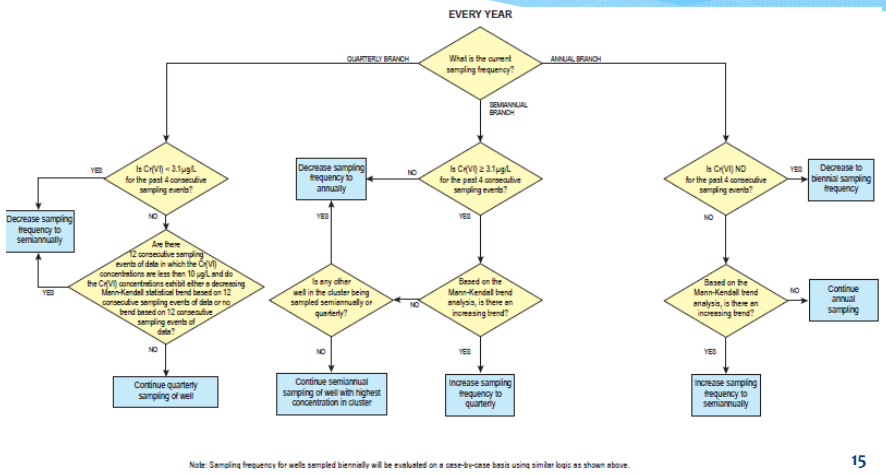
Example: Northern Area Flowchart



Note: Sampling frequency for wells sampled biennially will be evaluated on a case-by-case basis using similar logic as shown above.

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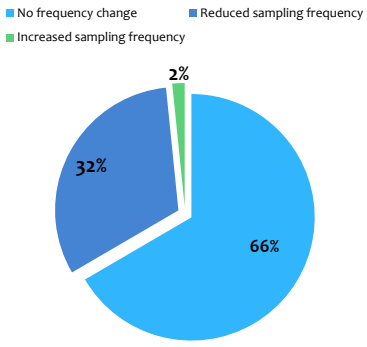
This Year's Results

Of 434 MWs evaluated:



No change to sampling frequency (289 MWs or 66%):

- Met CAO criteria to retain current frequency, or
- Not enough data for trends, or
- Frequency set in other orders

Reduced sampling frequency (138 MWs or 32%):

- Low Cr6 concentrations, decreasing/stable Cr trends or Cr < 3.1/3.2 ppb or non-detect

Increased sampling frequency (7 MWs or 2%):

- Increasing trend; all below 5 ppb, and located in northern plume area

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Take-home messages

* Cr6 below 3.1 ppb, or with stable/decreasing trends in 138 MWs is good news
* 7 MWs with increasing trends in northern area are well below safe drinking water standards (none greater than 5 ppb Cr6; MCL is 10 ppb)
* Setting criteria up-front in CAO simplified annual review process

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USGS Background Study Update

Members of the Background Study Technical Working Group (TWG), in the field in Hinkley

Key Items - Work to Date

* $5.4 million contract between State Water Board and USGS executed
  - ✓ Lahontan staff manages contract
* USGS Open-file Report on background study plan published (enclosure 7)
* 2 informational videos produced
* 3 of 3 seasons of fieldwork completed
  - ✓ 90 monitoring wells sampled; soil/geologic data collected; new wells installed and aquifer tests completed
  - ✓ 73 domestic wells sampled; letters with results mailed
* Numerous TWG meetings (held in Hinkley; also off-site and web-based)
* Community updates by Dr. Izbicki at Hinkley senior center

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Upcoming Work Products

Late 2017: **Mid-term report**

* Study progress and preliminary results

Late 2019: **Final report**

* Science-based, statistically-defensible estimates of range of naturally occurring chromium
* Analysis of potential for Cr3 to re-convert to Cr6 in IRZs

Meanwhile:

* Data analysis, groundwater model validation, TWG meetings continue

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Background Study Information

http://www.waterboards.ca.gov/lahontan/water_issues/projects/pge/index.shtml

http://www.hinkleygroundwater.com/

https://ca.water.usgs.gov/media/hinkley-groundwater-chromium.html

https://www.youtube.com/watch?v=89x1nfEXgGU

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Questions?

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ENCLOSURE 6

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Status of Actions for PG&E Hinkley Chromium Contamination
April 2017

Enforcement

Annual Monitoring Frequency Evaluation: Consistent with Cleanup and Abatement Order (CAO) R6V-2015-0068, PG&E submitted its annual evaluation of the CAO groundwater monitoring program. Attachments B and C of the CAO's monitoring and reporting program are decision trees which specify criteria to evaluate the sampling frequencies of each monitoring well in the CAO program to determine if those frequencies should be changed. Water Board staff reviewed the evaluation, and accepted revisions to the monitoring program. A summary of the changes to the monitoring program is shown below. Note that these changes do not affect domestic well sampling frequency, or sampling frequencies for monitoring wells set by other Water Board remediation permits.

	Number of CAO wells	Percentage of all CAO wells
Total # of CAO monitoring wells	434	
No change to sampling frequency	289	66%
Reduced sampling frequency	138	32%
Increased sampling frequency	7	2%

Annual Remediation Effectiveness Report and Operating Plans: On February 28, 2017, PG&E submitted its Annual Cleanup Status, Remediation Effectiveness and Operational Plans. During 2016, the Northwest Freshwater Injection (NWFI) System, agricultural treatment units (ATUs) north of Highway 58, the Central in-situ remediation zone (IRZ), and South Central IRZ were operated above, at, or within 10 percent of planned operations for the reporting period. The Source Area IRZ and the ATUs near the compressor station were operated at less than the planned rates. The report states that the reduced operations are not anticipated to impact overall cleanup or significantly affect progress towards meeting remediation targets set out in the CAO. PG&E staff did notify Water Board staff on a monthly basis when reductions in operations of greater than 10 percent occurred, as required by the CAO.

Table 3-2 of the report summarizes the 2017 annual operational plans (on a monthly basis) for each remediation system, and includes 1) planned injection rates for the IRZs and the NWFI system; 2) flow rates of extracted water to be applied to ATUs, and 3) the operational status of extraction in the western area. Water Board staff provided comments and questions on the report in a letter dated March 30, 2017. PG&E's report and Water Board staff's comments are available on Geotracker at
http://geotracker.waterboards.ca.gov/profile_report.asp?global_id=SL0607111288

Investigative and Reporting

Chromium Plume Boundary: The 4th quarter 2016 chromium plume map is posted on the Water Board's Hinkley website at: http://www.waterboards.ca.gov/lahontan/water_issues/projects/pge/index.shtml, at the bottom of page. The first quarter 2017 plume map is due on May 10, 2017, consistent with the reporting due dates contained in the CAO**.**

Chromium Plume Boundary Investigation: PG&E installed additional monitoring wells during third quarter 2016 for better defining chromium plume boundaries, in accordance with the CAO. Fourth quarter 2016 results indicate chromium plume boundaries are adequately defined with the new monitoring wells. Future plume maps will be evaluated to ensure boundaries continue to be defined with the current site-wide monitoring well network.

In-situ Reactive Zone (IRZ)

On March 7, the Water Board Executive Officer issued a letter to PG&E accepting its proposal to install an additional 13 injection wells in the Source Area IRZ. The new wells are needed to reach areas of high chromium concentrations in the upper and deep zones of the upper aquifer not reached by current wells. The new injection wells were installed during first quarter 2017and will be connected to the system and start operating in second quarter 2017.

Chromium Background Study

On January 27, 2017, Dr. John Izbicki of the USGS provided an update on the background study at the Hinkley Community and Senior Center. The final round of field data collection for the study was completed in March 2017. In September 2017, an interim project report will be submitted, outlining project progress and any preliminary results. The background study continues to move forward on schedule and within budget, with the final report scheduled for late 2019.

ENCLOSURE 7

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USGS
science for a changing world

Prepared in cooperation with the Lahontan Regional Water Quality Control Board

A Plan for Study of Natural and Man-Made Hexavalent Chromium, Cr(VI), in Groundwater near a Mapped Plume, Hinkley, California

By John A. Izbicki and Krishangi Groover

The Pacific Gas and Electric Company (PG&E) Hinkley compressor station (fig. 1), in the Mojave Desert 80 miles northeast of Los Angeles, is used to compress natural gas as it is transported through a pipeline from Texas to California. Between 1952 and 1964, cooling water used at the compressor station was treated with a compound containing chromium to prevent corrosion. After cooling, the wastewater was discharged to unlined ponds, resulting in contamination of soil and groundwater in the underlying alluvial aquifer (Lahontan Regional Water Quality Control Board, 2013). Since 1964, cooling-water management practices have been used that do not contribute chromium to groundwater.

Figure 1. Pacific Gas and Electric (PG&E) compressor station, Hinkley, California, March 2009. (Photo by Steven Perry, Arcadis, Inc., courtesy of PG&E).

In 2007, a PG&E study of the natural background concentrations of hexavalent chromium, Cr(VI), in groundwater estimated average concentrations in the Hinkley area to be 1.2 micrograms per liter (µg/L), with a 95-percent upper-confidence limit of 3.1 µg/L (CH2M-Hill, 2007). The 3.1 µg/L upper-confidence limit was adopted by the Lahontan Regional Water Quality Control Board (RWQCB) as the maximum background concentration used to map the plume extent. In response to criticism of the study's methodology, and an increase in the mapped extent of the plume between 2008 and 2011, the Lahontan RWQCB (Lahontan Regional Water Quality Control Board, 2012) agreed that the 2007 PG&E background-concentration study be updated.

The purpose of the updated background study is to evaluate the presence of natural and man-made Cr(VI) near Hinkley, Calif. The study also is to estimate natural background Cr(VI) concentrations in the aquifer upgradient and downgradient from the mapped Cr(VI) contamination plume, as well as in the plume and near its margins. The study was developed by the U.S. Geological Survey (USGS) in collaboration with a technical working group (TWG) composed of community members, the Independent Review Panel (IRP) Manager (Project Navigator, Ltd.), the Lahontan RWQCB, PG&E, and consultants for PG&E.

The scope of the study includes eight tasks and publication of four reports (table 1, shown on page 12). The proposal is available at http://ca.water.usgs.gov/projects/hinkley/; a video describing the study is available at http://ca.water.usgs.gov/media/hinkley-groundwater-chromium.html. The study agreement was approved by the State Water Resources Control Board in January 2015; field-data collection began in March 2015; the study is scheduled to be completed in December 2019.

ISSN 2327-6932 (online)
http://dx.doi.org/10.3133/ofr20161004

Task 1: Evaluation of Existing Data

The purpose of this task is to identify areas near the mapped Cr(VI) plume where water-quality is a concern. Results of this task are to provide an assessment of the changes in Cr(VI) concentrations in groundwater in the Hinkley area through time.

PG&E has monitored Cr(VI) contamination near Hinkley since the late 1980s. By December 2014, more than 630 monitoring wells were installed in the area (fig. 2), and more than 15,900 water samples had been collected from those wells and analyzed for Cr(VI). Many of the monitoring locations include multiple wells completed at different depths in the aquifer to provide depth-specific water-level and water-quality data. In addition, more than 5,300 samples were collected from 540 domestic and agricultural wells in the area and analyzed for Cr(VI). The more recent data were not available to the 2007 background study, but have been used by PG&E and the Lahontan RWQCB to define the extent of the Cr(VI) plume.

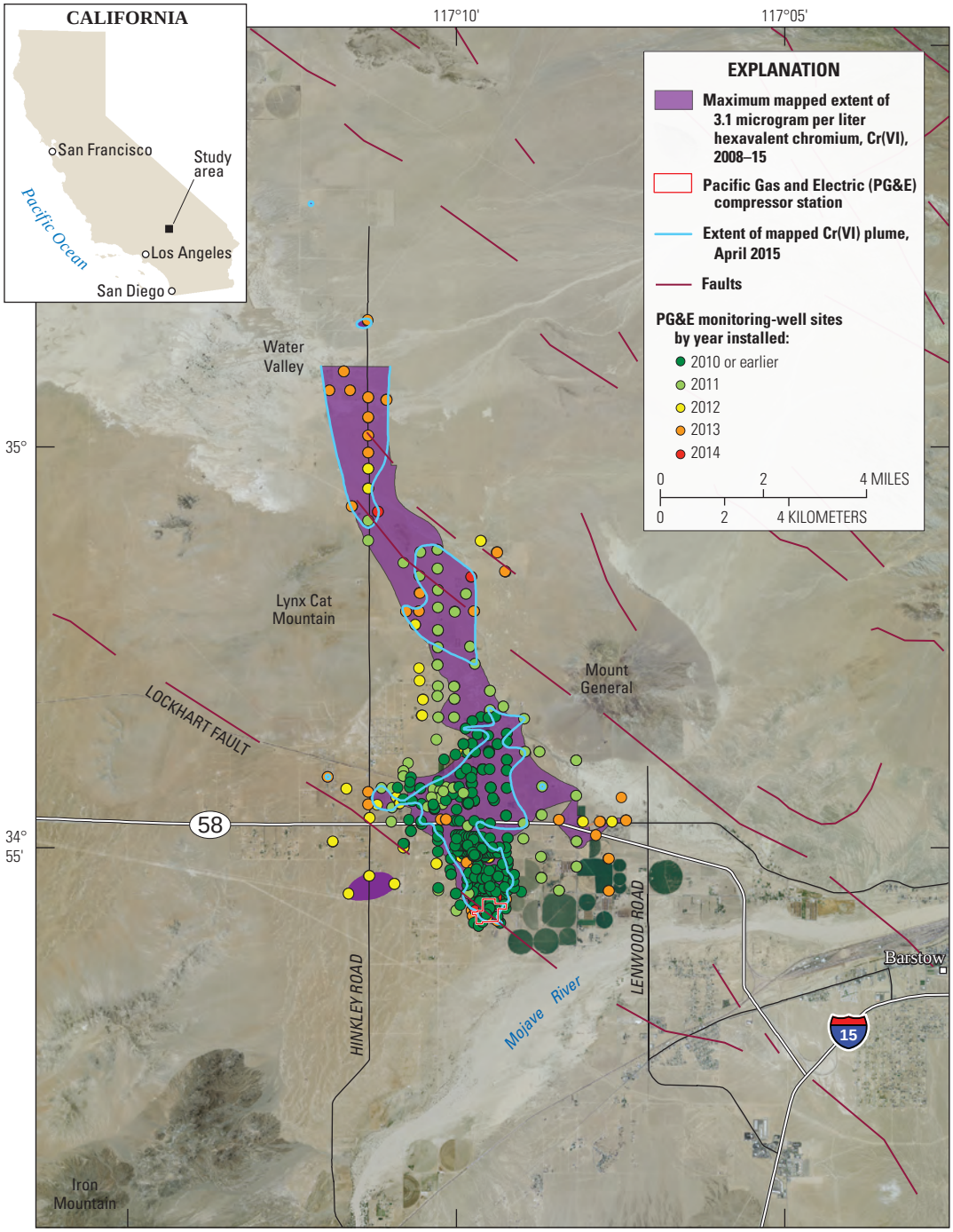

Figure 2. Location of Pacific Gas and Electric monitoring-well sites, Hinkley, California; the maximum extent of hexavalent chromium, Cr(VI), greater than the 3.1 microgram per liter clean-up level for the site; and the extent of the mapped Cr(VI) plume, April 2015.

As part of task 1, existing data are to be examined to determine if there are trends of increasing or decreasing Cr(VI) concentrations with time. Increasing Cr(VI) concentrations with time could indicate areas where the Cr(VI) plume is expanding. Decreasing concentrations could indicate areas where plume management has been successful at controlling the movement of the plume. Changes in concentrations of Cr(VI) and other constituents also could be related to other factors, such as water levels changing as a result of changes in plume-management activities, groundwater pumping, or intermittent groundwater recharge from the Mojave River. The existing data also are to be used to select wells for sample collection as part of this study (task 3).

Although existing data are to be examined primarily with respect to total chromium, Cr(t), and Cr(VI) concentrations, water from monitoring wells and other wells in the area also have been monitored for other constituents of concern to the community, such as arsenic, manganese, uranium, and nitrate. Concentrations and trends of these constituents also are to be examined as part of this task.

Task 2: Analyses of Rock and Alluvium

The purpose of this task is to determine if there are natural geologic sources of chromium in the area and if any such sources are contributing Cr(VI) to groundwater. The natural presence of Cr(VI) in groundwater is influenced by a number of factors, including (1) the concentration of chromium in rock and aquifer materials; (2) the minerals in those materials and their weathering rates; and (3) the abundance and reactivity of manganese oxides on the surfaces of mineral grains that can convert trivalent chromium, Cr(III), weathered from minerals, to Cr(VI). The pH (a measure of the acidity or alkalinity of water) and reduction-oxidation (redox) conditions of groundwater, particularly with respect to dissolved oxygen that allows Cr(VI) to enter and remain in solution, are to be assessed on the basis of existing water-quality data (task 1) and data collected as part of this study (task 3).

Alluvium from the Mojave River and eroded from rock in the hills surrounding the study area is to be examined in the field by using a hand-held X-ray fluorescence (XRF) instrument (fig. 3). Results are to be compared with XRF measurements of core material from wells installed in the area by PG&E (1) to identify areas where alluvium is derived from local sources in the nearby hills surrounding Hinkley Valley or from more distant sources, such as rocks in the San Gabriel or San Bernardino Mountains that were transported to and deposited in the area by the Mojave River, and (2) to determine whether chromium concentrations in the alluvium that composes the aquifers are high or low relative to average continental abundances. XRF measurements are to include core material from the screened intervals of wells selected for sample collection in task 3 and to be compared with water-quality data from those wells (task 6).

Figure 4. Preparation of sequential chemical extractions from alluvium and core material, Hinkley, California, June 2015.

The XRF data also are to be used as a screening tool to select materials for additional analyses. Those analyses include (1) chemical extractions using increasingly aggressive (reactive) solutions to determine how tightly bound chromium and other selected elements are to the surfaces of mineral grains (fig. 4); (2) thin-sections to identify minerals associated with high chromium abundance; (3) separation of heavier, denser minerals from lighter, less-dense minerals, coupled with optical and X-ray diffraction (XRD) identification of the denser minerals possibly associated with high chromium abundance; and (4) digestion and chemical analyses of the denser minerals to determine their elemental composition.

The data are to be used to describe the abundance and potential for weathering of chromium-containing minerals. Results from task 2 are to be considered during selection of wells for sample collection (task 3) and for evaluation of the presence of natural and anthropogenic chromium (task 6).

Figure 3. Hand-held X-ray fluorescence (XRF) instrument used to measure concentrations of up to 28 elements (including chromium) in rock, alluvium, and core material from Pacific Gas and Electric (PG&E) monitoring wells, Hinkley, California, March 2015 (core material archived by PG&E in background).

Task 3: Analyses of Chemical and Environmental Tracers in Water from Wells

The purpose of this task is to determine the chemical and isotopic (including other environmental tracers) composition of water from selected wells throughout the study area with respect to (1) the sources and chemical processes controlling Cr(VI) and (2) the source, movement, and "age" of the groundwater relative to the timing of Cr(VI) releases and migration from the PG&E compressor station.

Water samples are to be collected from up to 90 domestic, agricultural, and monitoring wells. Sample collection will be done in 3 phases over a 3-year period with 40, 30, and 20 wells sampled in each phase. Because of their known construction characteristics, relatively short screen-intervals, and the availability of supporting geologic data, sample collection from monitoring wells, where available, is preferred to sample collection from domestic or agricultural wells. Use of monitoring wells addresses one of the criticisms of the 2007 PG&E background study, which relied on samples collected from domestic wells that had limited construction information. Data collection for each phase is planned to be done approximately 1-year apart in March, at the end of the rainy season, beginning in 2015. This allows for completion of laboratory analyses, such as tritium—which requires more than 9 months to analyze—and for review and preliminary interpretation of results from the first phase to support selection of wells for the second phase. Well selection for the third phase is planned to fill any remaining data gaps and to collect data from previously sampled wells that show trends in Cr(VI) concentrations over time (task 1). Samples from monitoring wells are to be collected by USGS field personnel in collaboration with PG&E consultants (fig. 5) to ensure similar well-purging and other data-collection procedures are used.

Chemical data to be collected include field parameters, major ions, nutrients, selected minor ions and trace elements, including Cr(t), Cr(VI), manganese, arsenic, and uranium (table 2). Chemical data are to be interpreted in terms of (1) health-based standards, (2) their distribution with respect to the mapped plume, (3) the solubility of chromium-containing minerals identified in task 2, and (4) the solubility of Cr(VI) with respect to pH and redox conditions.

Environmental tracers are constituents that can be used to understand the hydrologic history of water or the processes that affect constituents in the water. Environmental tracers can be measured very precisely at low concentrations and can be used to track the movement of contaminants of interest in areas where natural background concentrations could be present. Isotopes, a type of environmental tracer, are atoms of the same element (and, therefore, have the same number of protons in the atomic nucleus) that differ in the number of neutrons in the nucleus. Isotopes can be either stable or radioactive. Stable isotopes have slight, but measurable, differences in their physical properties or chemical reactivity. Radioactive isotopes decay at known and constant rates over time; if their initial abundance is known, their measured abundance can be used to determine the time since recharge, or "age," of a water sample.

Environmental tracers used in this study can be divided into three categories: (1) tracers of the source and movement of water, (2) tracers of the "age" of water, and (3) tracers of chemical reactions and environmental processes.

Tracers of the source and movement of water used in this study include (1) the stable isotopes of oxygen and hydrogen in the water molecule (oxygen-18 and

Figure 5. U.S. Geological Survey personnel and consultants for Pacific Gas and Electric sampling a monitoring well, Hinkley, California, March 2015.

Table 2. Chemical constituents to be analyzed in water from wells as part of task 3 in the U.S. Geological Survey hexavalent chromium, Cr(VI), updated background study, Hinkley, California.

[Field parameters to be measured include water temperature, pH, dissolved oxygen, specific conductance, and alkalinity]

Major ions, in milligrams per liter	Reporting limit
Alkalinity (bicarbonate)	4.6
Calcium	0.02
Chloride	0.02
Fluoride	0.04
Mangnesium	0.01
Potassium	0.03
Silica	0.02
Sodium	0.06
Sulfate	0.02
Residue on evaporation (dissolved solids)	20

Minor ions, in micrograms per liter	Reporting limit
Bromide	30
Iodide	1
Strontium	0.2

Reduction-oxidation couples, in micrograms per liter	Reporting limit
[2]Iron/iron II	2 / 2
[2]Arsenic/arsenic III	0.2 / 0.5
[2]Chromium/chromium VI	0.2 / 0.06

[2]Iron III, arsenic V, and chromium III calculated by difference from their respective reduction-oxidation couples.

Nutrients, in milligrams per liter	Reporting limit
Ammonia, as nitrogen	0.01
Ammonia plus organic nitrogen as nitrogen	0.07
Nitrite, as nitrogen	0.001
[1]Nitrite plus nitrate, as nitrogen	0.04
Phosphorous	0.02
Orthophosphorous, as phosphorous	0.004

[1]Nitrate calculated by difference from nitrite and nitrite plus nitrate.

Trace elements, in micrograms per liter	Reporting limit
Antimony	0.03
Aluminum	2.2
Arsenic	0.1
Barium	0.3
Boron	2
Cadmium	0.3
Chromium	0.2
Iron	3.2
Lithium	0.1
Manganese	0.1
Uranium	0.1
Vanadium	0.6

deuterium), which provide information on the source of recharge (for example, Mojave River or runoff in local streams) and the evaporative history of water, and (2) dissolved atmospheric gasses (nitrogen and argon), which record information on recharge processes.

Tracers of the "age" of water include (1) dissolved industrial gasses, including chlorofluorocarbons and sulfur hexafluoride; (2) tritium, a radioactive isotope of hydrogen that has a half-life of 12.3 years, and its decay product helium-3; and (3) carbon-14, a radioactive isotope of carbon that has a half-life of 5,730 years, and carbon-13, a stable isotope of carbon. Many tracers of the "age" of water are affected by processes during groundwater recharge, chemical reactions in the aquifer, and mixing of water from different sources. These processes are to be evaluated by using results from analyses of water samples and a variety of interpretive tools developed for this purpose (fig. 6).

Tracers of chemical reactions and environmental processes include (1) chromium-53, a stable isotope of chromium that can be used to distinguish natural and man-made sources of chromium and processes that control the reduction of Cr(VI) to Cr(III), and (2) strontium-87/86, a ratio of the stable isotopes of strontium that can be used to evaluate the geologic material with which the water has been in contact over time.

Collectively, chemical and environmental tracer data are to be used to evaluate the source, movement, and "age" of water in aquifers underlying the study area to determine (1) the geochemical "footprint" (areal extent) of water recharged during the period of Cr(VI) releases from the PG&E compressor station; (2) older groundwater recharged prior to the releases; and (3) the effect of mixing of water from different recharge sources that have different hydrologic histories, different "ages," and have been in contact with different geologic materials. Interpretation of these data is to be used to help answer "What Cr(VI) is associated with PG&E releases from the compressor station, and what is not?" (task 6).

Figure 6. U.S. Geological Survey field personnel organizing bottle sets used to collect water samples, Hinkley, California, March 2015.

Task 4: Evaluation of Local Conditions

The purpose of this task is to determine how differences in local geology and hydrology in the western, northern (including Water Valley), and eastern (including the plume and upgradient areas) subareas (fig. 7) influence concentrations of natural Cr(VI) in groundwater and the movement of Cr(VI) released from the compressor station. The scope of work

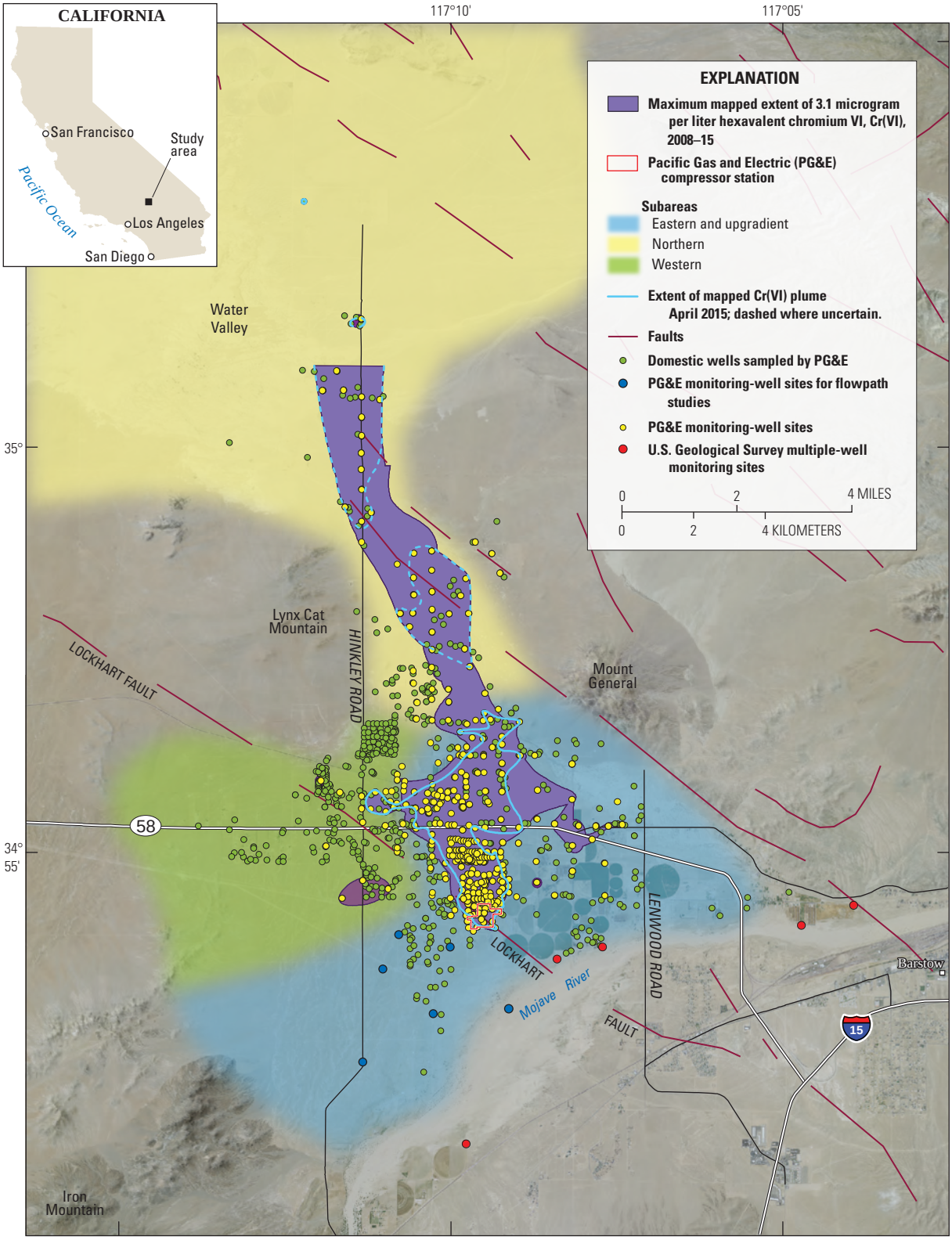

Figure 7. Map showing features of hexavalent chromium study, Hinkley, California: western, northern (including Water Valley), and eastern (including the mapped plume and upgradient) subareas, Pacific Gas and Electric monitoring wells, monitoring wells installed for flow-path studies, U.S. Geological Survey multiple-well monitoring sites, and domestic wells.

for this task is intended to be flexible, so that issues important to the background study that were not apparent during the initial development of the study can be addressed as the study progresses. This task includes a combination of (1) test drilling and monitoring-well installation for groundwater flow-path studies, (2) collection of surface-geophysical data (primarily gravity measurements) to estimate aquifer thickness, (3) collection of borehole-geophysical data to assess aquifer properties and lithology (fig. 8), and (4) collection of hydraulic data for estimation of aquifer properties that control the movement of water and Cr(VI) in the plume and in downgradient areas.

In the western subarea, data are to be collected (1) to estimate the thickness of alluvial deposits; (2) to assess the hydraulic connection between weathered bedrock and overlying alluvial deposits in the aquifer; and (3) to evaluate the effect of the Lockhart Fault, which crosses the western subarea, on groundwater movement. In the northern subarea, data are to be collected on aquifer thickness and hydraulic properties. Spatial variation in aquifer properties to the north are to be related to differences in the sources and depositional environments of alluvium identified on the basis of XRF data (task 2) and chemical and isotopic data (task 3). In the eastern subarea, borehole geophysical data are to be collected to assess changes in the hydraulic properties of the aquifer with depth. Additionally, test drilling and monitoring-well installation are to be done by PG&E consultants in upgradient areas to facilitate flow-path studies (fig. 9). The flow-path studies are designed to provide data on Cr(VI) concentrations, aquifer properties, rates of groundwater movement, and geochemical reactions in the aquifer upgradient of the compressor station. Data collection in each subarea supplements data collected by PG&E during recent years.

Figure 9. Test-drilling by consultants for Pacific Gas and Electric to install monitoring wells for flow-path studies, Hinkley, California, August 2015.

Figure 8. U.S. Geological Survey field crew preparing to set a temporary pump for borehole-geophysical data collection in a well, Hinkley, California, June 2015 (Roger Killian, Hinkley Technical Working Group, in foreground).

As part of task 4, a conceptual geologic framework is to be developed to explain the origin of alluvial and lacustrine deposits in the Hinkley Valley. The conceptual geologic framework is to be based on interpretations made from examinations of core material (task 2) that are supported by water chemistry, environmental-tracer (task 3), geophysical, and hydraulic-property data (collected as part of this task). The conceptual geologic framework is intended to explain some of the differences in geohydrologic units, hydrology, and geochemistry among the western, northern, and eastern subareas. The conceptual geologic framework can provide information to improve the existing conceptual hydrologic model and simulations of groundwater flow in the study area (task 5).

Task 5: Evaluation of Groundwater Movement

The purpose of this task is to evaluate how changes in hydrologic conditions over time have influenced the movement of water and Cr(VI) through the aquifer underlying Hinkley Valley.

It is not possible to go back in time and measure the movement of Cr(VI) from the PG&E compressor station following the releases. It is possible, however, to assemble available geologic and hydrologic data in a computer simulation, or model, of groundwater flow in Hinkley Valley and to use that model to estimate what could have happened after the Cr(VI) releases.

Two models of groundwater flow have been developed for the study area. Both models use the USGS computer code MODFLOW. The PG&E model simulates groundwater flow in Hinkley Valley near and downgradient from the compressor station (fig. 10; ARCADIS/CH2M-Hill, 2011) from the period 1990 to 2010 and is used to evaluate various plume-management alternatives. The USGS model simulates regional groundwater flow in the larger Mojave River basin (Stamos and others, 2001) and is used to evaluate regional water-management alternatives. The USGS model has limited hydrogeologic detail in the Hinkley area, but simulates groundwater flow from 1931 to 1999, which includes the period of Cr(VI) releases. Although each model is suitable for its intended use, neither model is suitable, without modification, for the purposes of this background study.

As part of this task, the PG&E flow model is to be updated and expanded to include a larger area so that model boundaries coincide with hydrologic boundaries (fig. 10). The updated model is to simulate groundwater flow from 1931 to 2010, which includes the period of the releases of Cr(VI) from the compressor station.

The model updates are to be done by PG&E consultants in collaboration with the USGS and include additional data on the distribution and layering of hydraulic properties that conform to the conceptual geologic framework developed as part of task 4. Model inputs, including pumping and infiltration of streamflow from the Mojave River, are to be derived from the existing PG&E or USGS models and data from other recent studies. Areal and local recharge data are to be derived from basin-scale climate and hydrologic data (http://ca.water.usgs.gov/projects/reg_hydro/projects/dataset.html). Model calibration is to include comparison of field-measured and model-simulated hydrographs and water-level contours. A comparison of water-budget estimates from the updated and existing models is planned.

The updated model is to be constrained by chemical and environmental-tracer data (task 3) by using a technique known as "particle tracking." The simulated movement of model particles can be used (1) to evaluate the "footprint" of water recharged during the period of Cr(VI) releases and (2) to estimate the extent of the PG&E Cr(VI) contaminant plume through time. The model simulation results can provide a better understanding of groundwater flow than can be determined from analyses of field data alone. The updated model is not intended to simulate chemical processes affecting the movement of Cr(VI).

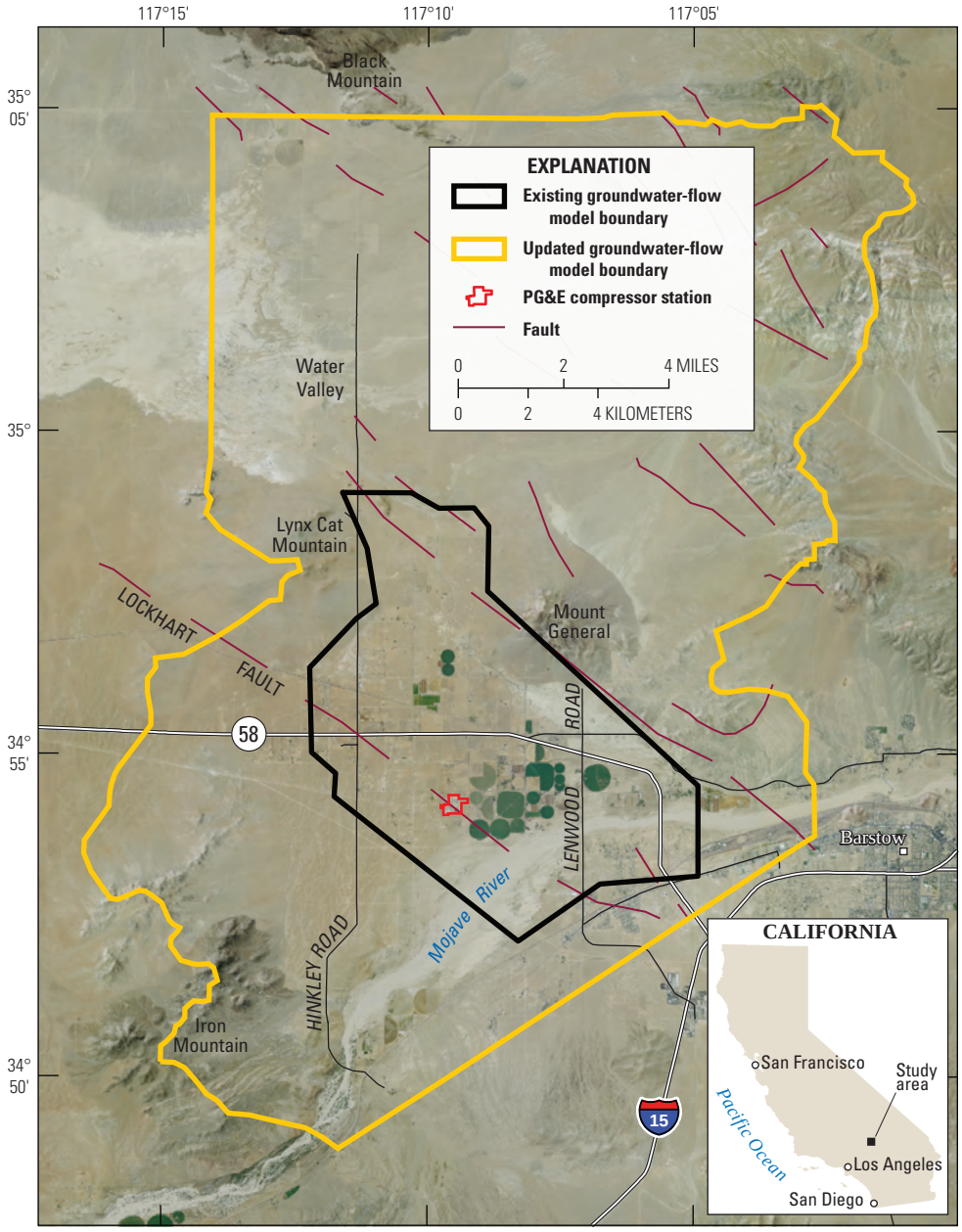

Figure 10. Model extent for existing Pacific Gas and Electric (PG&E) groundwater-flow model and for updated groundwater-flow model, Hinkley, California.

Task 6: Evaluation of Natural and Man-Made Chromium (VI)

The purpose of this task is to identify areas in the aquifer containing man-made Cr(VI) from releases at the PG&E compressor station and areas that contain Cr(VI) from other sources. Although rocks and soils in the study area have comparative low chromium concentrations (fig. 11), some natural chromium may be present.

Data and results from the previous five tasks can be interpreted to answer the question "What Cr(VI) is associated with PG&E releases from the compressor station, and what is not?" This question was not addressed as part of the 2007 background study.

Mineralogical (task 2), chemical, environmental-tracer, and groundwater "age" information (task 3); increased understanding of local geology and hydrology (task 4); and results from the groundwater-flow model (task 5) are expected to provide information on areas that likely were affected by releases from the PG&E compressor station and to identify areas that likely were not affected by releases, but could contain natural Cr(VI). As part of this task, additional Cr(VI) data are to be collected from domestic wells in the study area to provide information on Cr(VI) concentrations in areas not sampled by monitoring wells. These data are to be analyzed onsite in a mobile laboratory (fig. 12). Data from task 6 are to be used to supplement data collected as part of task 3 and, if appropriate, to guide selection of additional wells for analyses as part of task 3.

Figure 12. U.S. Geological Survey mobile laboratory and equipment to analyze chromium (VI).

The USGS plans to assemble data from the previous five tasks, ranking relevant data to simplify complex data sets and produce understandable graphics to facilitate input and discussion from TWG members during data interpretation. Final interpretation of the data is to be process oriented, and data interpretation is the responsibility of the USGS.

Task 7: Estimation of Background Chromium (VI) Concentrations

The purpose of this task is to estimate background Cr(VI) in the parts of the study area affected by discharges from the PG&E compressor station.

The estimated Cr(VI) background concentrations could differ among the western, northern, and eastern subareas as a result of local differences in geology, hydrology, land use, and other factors. As a consequence, there could be different values used for plume management and clean-up goals in different parts of the study area.

The exact nature and statistical rigor associated with estimates of background Cr(VI) concentrations have not yet been determined. For example, is it necessary to precisely estimate background Cr(VI) concentrations in areas that have distinctive geology or hydrology and where results of task 6 show Cr(VI) is natural and not related to releases from the compressor station? How are background Cr(VI) concentrations to be estimated in areas where contamination is present at concentrations greater than what would be natural, but existing wells representative of pre-release conditions do not exist? These issues are to be discussed in the second report from the study, to be prepared in 2016.

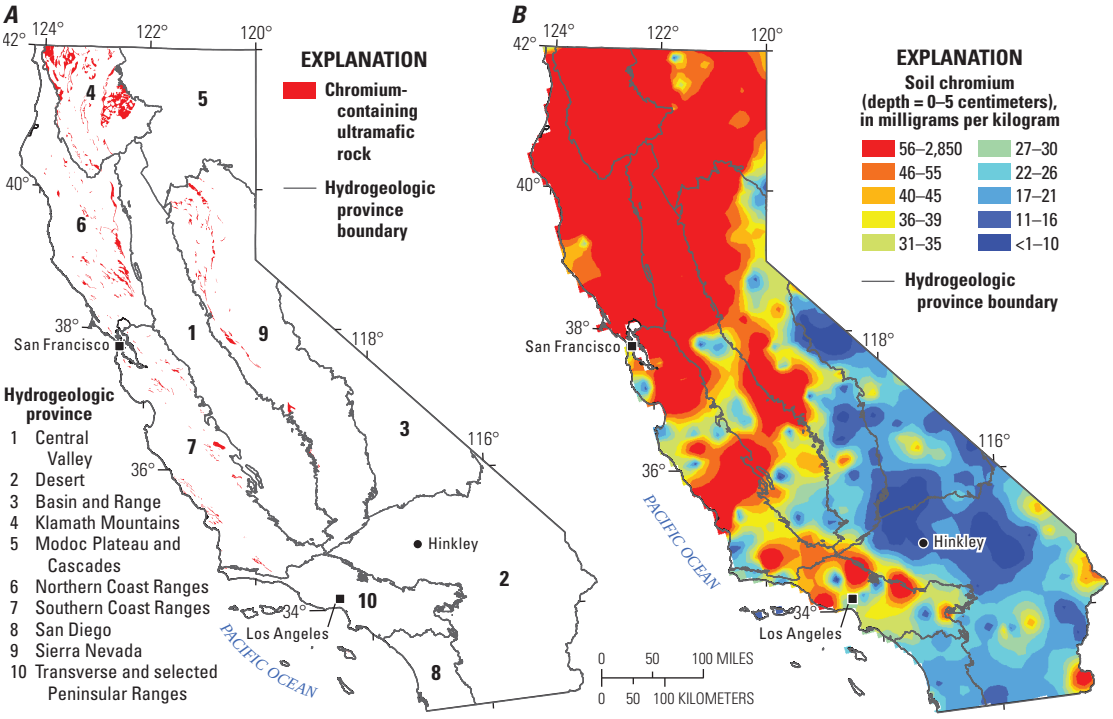

Figure 11. Chromium-containing rocks and soils in California: *A*, chromium-containing rocks, and, *B*, chromium-containing soils (modified from Izbicki and others, 2015).

Task 8: Fate of Chromium During and After In Situ Reduction

To create reduced conditions, where dissolved oxygen is depleted, PG&E is injecting ethanol into wells in the Cr(VI) contamination plume in an area known as the "in situ reactive zone" (IRZ). Reduced conditions in the IRZ convert Cr(VI) to Cr(III), which is only sparingly soluble and is removed from groundwater. The purpose of this task is to determine whether chromium is permanently removed by the IRZ or if changes in hydrology (such as large amounts of groundwater recharge from the Mojave River) that result in oxic conditions (where dissolved oxygen is present) in the IRZ can convert Cr(III) back to Cr(VI) and allow it to reenter groundwater.

There are several factors that could control the mobility of chromium sorbed to aquifer materials in the IRZ. Two factors to be investigated include (1) changes in how chromium is sorbed and mineralized over time and (2) the rate of re-oxidation of sorbed Cr(III) to Cr(VI).

First, chromium sorbed to aquifer materials can be weakly sorbed (and potentially more reactive), more strongly sorbed (and potentially less reactive), or incorporated into the crystalline structure of iron and manganese oxide coatings on the mineral grains that compose the aquifer (least reactive). The nature of chromium sorption could change with time as weakly sorbed chromium is incorporated into less reactive materials. The less abundant, natural stable isotopes of chromium (chromium-50 and chromium-54) are to be used to track the sorption of chromium on aquifer materials in experimental microcosms.

Second, if geochemical conditions change, and groundwater once again becomes oxic, Cr(III) could oxidize to Cr(VI) and reenter groundwater. If Cr(III) is oxidized, is the rate of oxidation environmentally meaningful over decadal time scales? Specialized techniques, such as X-ray absorption near-edge structure (XANES) spectroscopy, can be used to measure the presence of small concentrations of Cr(VI) oxidized in the experimental microcosms.

These issues are to be investigated in a series of laboratory microcosm studies of aquifer materials under controlled conditions for a period of 2 years (fig. 13). Numerous microcosms are to be set-up at the beginning of the experiment and then harvested periodically to provide time-series data. The experimental design considers a range of factors, including (1) the number of microcosms and harvest times needed to provide time-series data on the composition of the water/solid mixture in each microcosm; (2) the amount of ethanol to be added to each microcosm to create conditions similar to those found in the IRZ without under-dosing or over-dosing; (3) the need for buffers to control pH; (4) the use of suitable materials to allow exchange with atmospheric oxygen (for aerobic microcosms), while limiting water loss; and (5) the mass of chromium isotopes to be used as tracers.

These experiments cannot perfectly replicate field conditions and, because of project time constraints, can only be run for about 2 years. Results, however, are expected to provide a basis for management decisions that need to consider the longer time frames present in the field setting.

Project Timeline and Reports

The study is to be completed in December 2019. Important project milestones are shown in figure 14. Several USGS-authored reports are planned: (1) a study overview (this report); (2) a mid-term report that refines the project scope for remaining work, especially tasks 6 and 7, on the basis of preliminary results; and (3) a final report documenting study results. The final report may take the form of a large report that has several chapters corresponding to study tasks or of several smaller reports. In addition, a fact-sheet style report is planned to summarize the study results.

Data from the study are to be made publically available and, after review by the USGS and TWG, posted on the USGS online data base, NWIS-web, at http://waterdata.usgs.gov/nwis.

Figure 13. Experimental microcosms used to evaluate the potential reoxidation of trace elements over time.

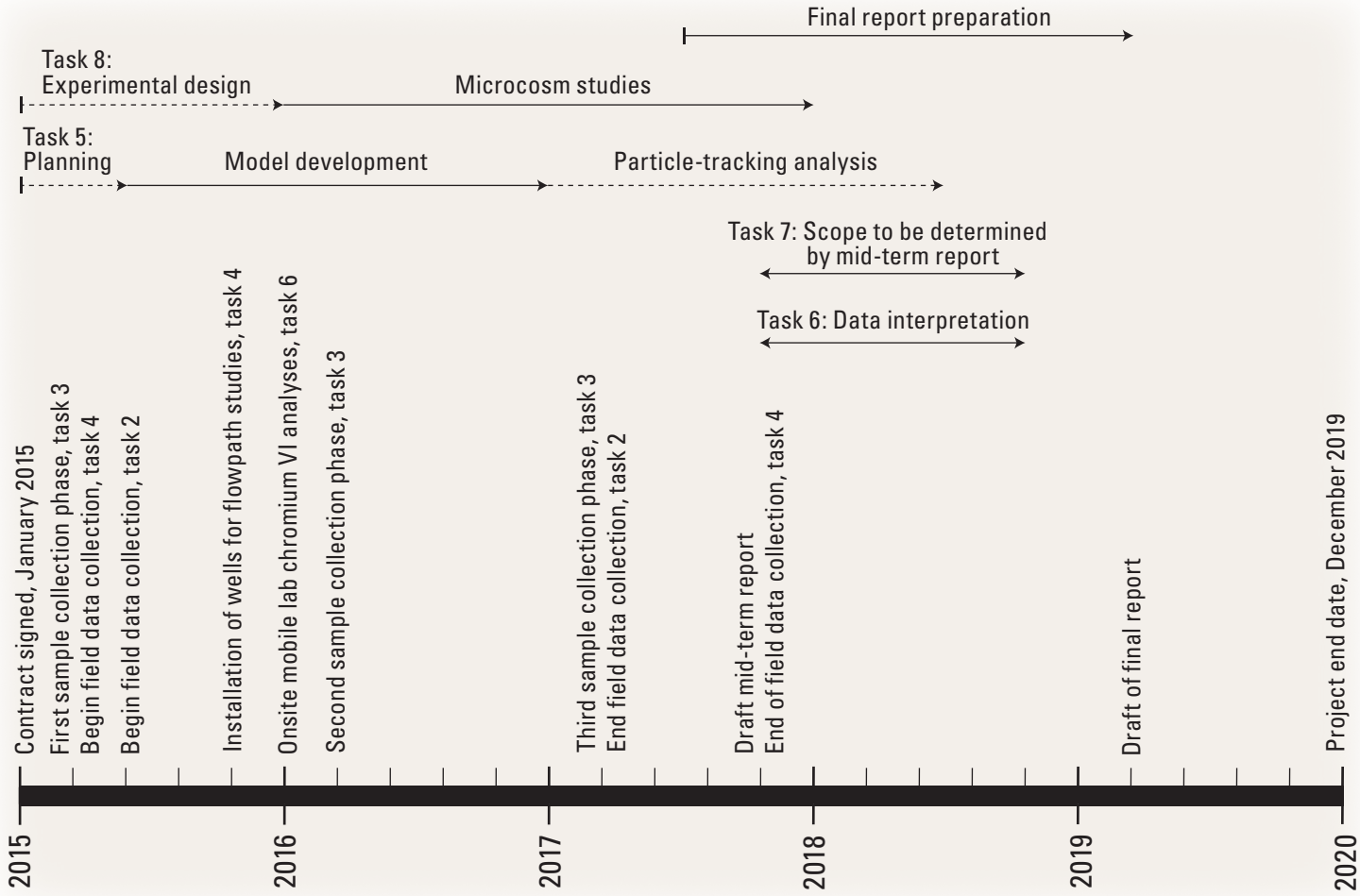

Figure 14. Simplified project timeline. (A more detailed project timeline was provided to the Lahontan Regional Water Quality Control Board for contractual purposes. Task 1 was completed as part of work for design and development the study. Work done as part of task 1 is planned to be updated prior to completion of the study.)

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Table 1. Tasks and questions addressed by the U.S. Geological Survey background study, January 2015 to December 2019, Hinkley, California.

Task		Purpose
Task 1:	Evaluation of existing data.	Identify areas near the mapped hexavalent chromium, Cr(VI), plume having water-quality of concern to the study.
Task 2:	Analyses of rock and alluvium.	Determine if there are natural geologic sources of chromium in the area and if these sources are contributing Cr(VI) to groundwater.
Task 3:	Analyses of chemical and environmental tracers in water from wells.	Determine the chemical and isotopic (including other environmental tracers) composition of water from selected wells throughout the study area with respect to (1) the sources and chemical processes controlling Cr(VI) occurrence and (2) the source, movement, and age of the groundwater relative to the timing of Cr(VI) releases from the Pacific Gas and Electric (PG&E) compressor station.
Task 4:	Evaluation of local conditions.	Determine how differences in local geohydrology in the western, northern (including Water Valley), and eastern (including the plume and upgradient area) subareas influence natural Cr(VI) in groundwater and the movement of anthropogenic (man-made) Cr(VI) from the compressor station.
Task 5:	Evaluation of groundwater movement.	Evaluate how changing hydrologic conditions in the study area over time influence the movement of water and Cr(VI) through aquifers underlying Hinkley Valley.
Task 6:	Evaluation of the presence of natural and anthropogenic Cr(VI).	Identify areas in the aquifer containing man-made Cr(VI) from releases at the PG&E compressor station and areas that contain Cr(VI) from other sources.
Task 7:	Estimation of background Cr(VI) concentrations.	Estimate background Cr(VI) in parts of the study area affected by discharges from the PG&E compressor station.
Task 8:	Fate of chromium during and after in situ reduction.	Determine if chromium in the in situ reactive zone is permanently removed from solution.
Report preparation and project timeline.		Four reports are identified in the proposal, and completion of the project is scheduled for December 2019.

Other Resources

Technical documents and regulatory orders related to the Cr(VI) contamination at Hinkley are available from the Lahontan RWQCB website, http://www.waterboards.ca.gov/lahontan/water_issues/projects/pge/index.shtml.

Other documents intended for the public and interested stakeholders are available from the IRP Manager website, http://www.hinkleygroundwater.com/.

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