Topock Project Executive Abstract

Document Title: *Summary of Findings Associated with the Evaluation of Alternative Freshwater Sources in the Topock Remediation Project Area, Pacific Gas and Electric Company, Topock Compressor Station, Needles, California* Submitting Agency: DTSC, DOI Final Document? ☒ Yes ☐ No	Date of Document: 4/2/2014 Who Created this Document?: (i.e. PG&E, DTSC, DOI, Other) PG&E
Priority Status: ☒ HIGH ☐ MED ☐ LOW Is this time critical? ☒ Yes ☐ No Type of Document: ☐ Draft ☐ Report ☐ Letter ☒ Memo ☐ Other / Explain:	Action Required: ☐ Information Only ☒ Review & Input ☐ Other / Explain:
What does this information pertain to? ☐ Resource Conservation and Recovery Act (RCRA) Facility Assessment (RFA)/Preliminary Assessment (PA) ☐ RCRA Facility Investigation (RFI)/Remedial Investigation (RI) (including Risk Assessment) ☐ Corrective Measures Study (CMS)/Feasibility Study (FS) ☒ Corrective Measures Implementation (CMI)/Remedial Action (RA) ☐ California Environmental Quality Act (CEQA)/Environmental Impact Report (EIR) ☐ Interim Measures ☐ Other / Explain:	Is this a Regulatory Requirement? ☒ Yes ☐ No If no, why is the document needed?
What is the consequence of NOT doing this item? What is the consequence of DOING this item? This technical memorandum is required to communicate the findings of the Evaluation of Alternative Freshwater Sources for the groundwater remedy as directed with DTSC's September 4, 2013, letter, DOI's September 4, 2013, letter, and DTSC and DOI's joint email on November 6, 2013. Feedback received on this document will be considered for a subsequent draft, as necessary, which will be included as an appendix to the forthcoming Groundwater Remedy Pre-final (90%) Basis of Design document. This report is in compliance with the RFI/RI process.	Other Justification/s: ☐ Permit ☐ Other / Explain:

Brief Summary of attached document:

As an element of the final groundwater remedy design, freshwater sources, including groundwater supply wells and the Colorado River, have been considered for use during remedy operation. The average and maximum volume of freshwater required for remedy operation is estimated to be 450 and 900 gallons per minute (gpm), respectively, based on groundwater modeling. In the Basis of Design Report/Intermediate (60%) Design for the Final Groundwater Remedy, PG&E presented a plan to obtain freshwater from a well on the Havasu National Wildlife Refuge (HNWR)—well HNWR-1. This evaluation was conducted based on concern raised by DTSC in their August 8, 2012 letter regarding water quality from the proposed remedy freshwater source.

This technical memorandum summarizes the activities conducted and associated findings for the evaluation of alterative freshwater sources as defined in the Final Implementation Plan for Evaluation of Alternative Freshwater Sources in the Topock Remediation Project Areas, Pacific Gas and Electric Company, Topock Compressor Station, Needles, California (Work Plan).

Written by: Pacific Gas and Electric Company

Recommendations:

Provide input to the regulatory agencies.

How is this information related to the Final Remedy or Regulatory Requirements:

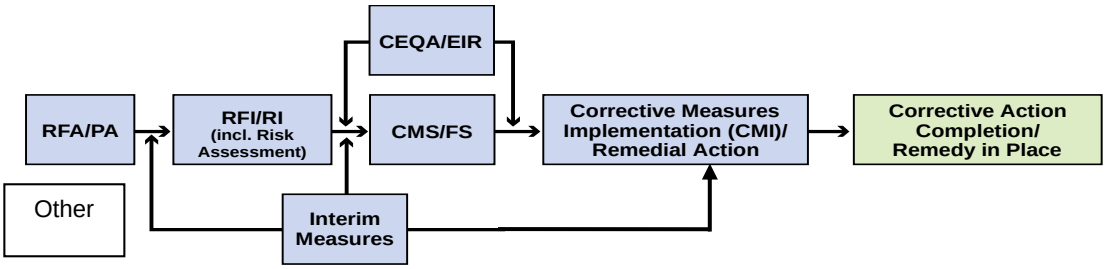
This technical memorandum communicates the conclusions and associated recommendations for the Evaluation of Alternate Freshwater Sources for the groundwater remedy.

Other requirements of this information?

None.

Related Reports and Documents:

Click any boxes in the Regulatory Road Map (below) to be linked to the Documents Library on the DTSC Topock Web Site (www.dtsc-topock.com).



Legend
RFA/PA – RCRA Facility Assessment/Preliminary Assessment
RFI/RI – RCRA Facility Investigation/CERCLA Remedial Investigation (including Risk Assessment)
CMS/FS – RCRA Corrective Measure Study/CERCLA Feasibility Study

Summary of Findings Associated with the Evaluation of Alternative Freshwater Sources in the Topock Remediation Project Area, Pacific Gas and Electric Company, Topock Compressor Station, Needles, California

DOCUMENT ID:	PGE20140402A
PREPARED FOR:	Pacific Gas and Electric Company
PREPARED BY:	CH2M HILL
DATE:	April 2, 2014

PROFESSIONAL GEOLOGIST
MICHAEL J. CAVALIERE
No. 7988
5/31/2015
STATE OF CALIFORNIA

Summary

This technical memorandum summarizes the activities conducted and associated findings for the evaluation of alterative freshwater sources as defined in the *Final Implementation Plan for Evaluation of Alternative Freshwater Sources in the Topock Remediation Project Areas, Pacific Gas and Electric Company, Topock Compressor Station, Needles, California* (Work Plan) (CH2M HILL, 2013b). The following primary activities were conducted at the two freshwater source evaluation locations (Site B and the area of the existing Havasu National Wildlife Refuge (HNWR) well, referred to herein as the HNWR-1 Site) (see Figure 1) during the implementation of the Work Plan, which was conducted in phases from October 2013 to February 2014:

- Installed exploratory boreholes at Site B and the HNWR-1 Site to a depth of 400 feet below ground surface (bgs) to facilitate collecting lithologic and zone-specific groundwater samples.
- Constructed a new well at Site B using the exploratory borehole as a pilot hole.
- Conducted an in-well video survey of the existing HNWR-1 well to confirm well construction details and evaluate the general well condition.
- Performed well and aquifer testing, including step-rate extraction tests and 72-hour constant rate extraction tests, at the existing HNWR-1 well and the new Site B well to evaluate well performance and estimate aquifer properties.
- Irrigated water pumped during Site B well development and all well testing activities at the HNWR future re-vegetation plot, as indicated in the Work Plan (CH2M HILL, 2013b).
- Conducted pre-construction surveys for biological, paleontological, and cultural resources (post-construction biological survey is pending).
- Conducted monitoring for biological, paleontological, and cultural resources during all fieldwork.

In addition to discussion during routine project meetings, three conference calls with the Technical Working Group (TWG) were held to provide updates on project activities and provide preliminary summaries of the data collected. These calls were held on November 4, 2013, January 29, 2014, and February 28, 2014. In addition to these calls, options for freshwater supply for the remedy and conceptual pipeline routing and infrastructure that would be associated with the freshwater supply well(s) were discussed during the March 19, 2014, TWG meeting.

Following is a summary of key findings from this evaluation:

- **Refined understanding of the unconsolidated aquifer in Arizona.** Data collected from the exploratory boreholes indicate that the unconsolidated aquifer at both locations is comprised largely of well-graded gravels with sand. Grab water quality samples at both locations indicate a stratified aquifer with higher

specific conductance (saltier) water occurring deeper in the borehole, and a more fresh (less salty) water occurring in the shallower intervals. The fresh (less salty) water at Site B is approximately 100 feet thicker than at the HNWR-1 Site. Both the Site B and HNWR-1 Site exploratory locations are located within the large fluvial plain of the pre-dam era Colorado River, and the detailed drilling logs describe these clean fluvial deposits at a greater frequency and thickness than the fluvial deposits on the California side of the River, which represents the thin western edge of the fluvial plain.

- **Refined understanding of the current condition of HNWR-1.** HNWR-1 will currently supply enough water of sufficient quality to supply the groundwater remedy at the nominal design flow rate of 450 gallons per minute (gpm), but not the maximum flow rate of 900 gpm. While the construction of the well was sufficient for its original intent (irrigation), it is not sufficient for long-term daily operation as a reliable element of the groundwater remedy. Due to the design and construction of the well the options for aggressive and effective well maintenance are limited. Further, operational flexibility to lower the pump and generate more flow is limited by the smaller diameter of the lower portion of the well.
- **Aquifer quality and well performance at Site B.** The Site B well will supply enough water to support the maximum designed remedy flow rate and the well construction allows optimal flexibility for operation (i.e., pump depth) and maintenance options; however, based on current well construction and operation during testing, the water quality is currently not optimal.
- **EIR Mitigation Measures WATER-1.** Constant-rate extraction tests conducted for a duration of 72 hours at both HNWR-1 and the Site B well suggest that neither will substantially adversely affect the production rates of existing nearby wells (see EIR Mitigation Measure WATER-1, Addendum No. 1).

Following is the recommended path forward for establishing a reliable freshwater supply for the groundwater remedy:

1. Conduct a depth-specific characterization of the Site B well to evaluate the potential for well modifications to improve water quality.
2. Install a new well at the HNWR-1 Site to provide the primary source of freshwater for use as part of the groundwater remedy.
3. Design the infrastructure required to plumb and operate both the new well at the HNWR-1 Site and the Site B well in order to provide maximum flexibility and reliability in the remedy freshwater supply.

1.0 Introduction

Pacific Gas and Electric Company (PG&E) is implementing the selected groundwater remedy for chromium in groundwater at the PG&E Topock Compressor Station (TCS, or the Compressor Station) in San Bernardino County, California. Remedial activities at the Topock site are being performed in conformance with the requirements of the Resource Conservation and Recovery Act (RCRA) Corrective Action pursuant to a Corrective Action Consent Agreement (CACA) entered into by PG&E and the California Department of Toxic Substances Control (DTSC) in 1996, as well as the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) pursuant to pursuant to a Remedial Design/Remedial Action Consent Decree between the United States and PG&E, entered by the United States District Court for the Central District of California on November 21, 2013.

As an element of the final groundwater remedy design, freshwater sources, including groundwater supply wells and the Colorado River, have been considered for use during remedy operation. The average and maximum volume of freshwater required for remedy operation is estimated to be 450 and 900 gpm, respectively, based on groundwater modeling. In the *Basis of Design Report/Intermediate (60%) Design for the Final Groundwater Remedy* (CH2M HILL, 2013b), PG&E presented a plan to obtain freshwater from a well on HNWR—well HNWR-1. This evaluation was conducted based on concern raised by DTSC in their August 8, 2012 (DTSC, 2012) letter regarding water quality from the proposed remedy freshwater source.

This technical memorandum summarizes the activities conducted and associated findings for the evaluation of alterative freshwater sources as defined in the Work Plan (CH2M HILL, 2013b).

1.1 Approvals and Authorizations

The Topock Alternative Freshwater Source Evaluation was executed in conformance with the following approvals and authorizations:

- DTSC acceptance of the Work Plan (CH2M HILL, 2013b) and approval for implementation subject to conditions set forth in the letter (DTSC, 2012), which included Mitigation Measures adopted by the certified Final Environmental Impact Report (DTSC, 2011) as specified in the EIR Addendum (No. 1) for the Alternative Freshwater Source Evaluation.
- U.S. Department of Interior [DOI], Bureau of Land Management [BLM], U.S. Fish and Wildlife Service [USFWS], and Bureau of Reclamation [Reclamation] acceptance of the Work Plan (CH2M HILL, 2013b) and approval for implementation subject to the conditions set forth in the letter (DOI, 2013).
- HNWR acceptance of the Work Plan (CH2M HILL, 2013b) and approval for implementation subject to the conditions set forth in the email to Yvonne Meeks of PG&E (HNWR, 2012).

1.2 Coordination with Agencies and Tribes

Immediately prior to conducting any ground disturbing activities, a project initiation meeting was held at the Topock Compressor Station on October 2, 2013. During this meeting, representatives from PG&E, the regulatory agencies and Tribes discussed the details of the planned fieldwork, biological, paleontological, cultural, and historical sensitivities associated with the project area, and conducted a walk of the fieldwork sites. During work, in addition to discussion during routine project meetings, three conference calls with the TWG were held to provide updates on project activities and provide preliminary summaries of the data collected. These calls were held on November 4, 2013, January 29, 2014, and February 28, 2014. In addition to these calls, options for freshwater supply for the remedy and conceptual pipeline routing and infrastructure that would be associated with the potential freshwater supply well(s) was discussed during the March 19, 2014, TWG meeting. Tribal monitors participated throughout the fieldwork and were provided with routine field schedule updates.

1.3 Technical Memorandum Organization

The remainder of this technical memorandum is organized in the following manner:

- **Section 2.0** summarizes the field activities conducted throughout the evaluation.
- **Section 3.0** present the analysis of the data collected during the evaluation, including the results of laboratory analysis of groundwater samples, and analysis of hydraulic testing data.
- **Section 4.0** summarizes the PG&E recommended path forward for establishing a freshwater supply for the groundwater remedy.
- **Section 5.0** provides a list of works cited in this technical memorandum.

2.0 Summary of Field Activities

Field activities were conducted in three general phases including exploratory drilling and data collection, well construction and development, and well and aquifer testing. All project activities were performed under the supervision of both a California and Arizona Professional Geologist. This section describes the details of each element of work conducted.

2.1 Site Access, Preparation, Compliance Monitoring, and Security

An onsite biologist conducted a pre-construction survey before work began. Biological monitoring was conducted daily throughout fieldwork by a field contact representative (FCR) that was trained by the biologist prior to the beginning of work. The post-construction surveys for each investigation site is pending and will be completed following fence installation at Site B (scheduled for April 2014) or after any additional

fieldwork (see Section 4). After complete, the pre- and post-construction survey data will be used to assess and document compliance with the Programmatic Biological Assessment (PBA) (CH2M HILL, 2007). The results of these surveys will be provided a biological resources completion report, which is scheduled for submittal to BLM and the Havasu National Wildlife Refuge (HNWR) 60 days after the completion of fieldwork.

An onsite archaeologist and an onsite paleontologist conducted a pre-construction survey before work began for cultural and paleontological resources, respectively. All site activities were monitored daily by an onsite archaeologist. Tribal monitors, which were invited to observe all site activities, did monitor many of the activities. In addition, a paleontologist was present at the beginning of ground-disturbing activities and provided paleontological awareness training for all site personnel. The paleontologist was on-call throughout the fieldwork, but was not contacted by the field team as paleontological resources were not observed during drilling.

Access for drilling and associated equipment was established at both the HNWR-1 Site and Site B along access routes identified in the Work Plan (CH2M HILL, 2013b) by importing gravel from local quarries. The existing land surface at the work sites was not graded. Prior to work, both sites consisted of flat, sandy areas that were previously disturbed by HNWR activities as part of an ongoing re-vegetation effort. Site B was devoid of vegetation. The HNWR-1 Site was sparsely vegetated with Russian thistle, which is viewed by HNWR as an invasive, nuisance species. The Russian thistle in the HNWR-1 Site work area was removed at the direction of the HNWR and as directed in the field by the onsite biologist. No listed species or nesting birds were observed during the pre-activity or post-activity surveys.

After the work areas were established, temporary fencing was installed to control site access. Onsite security was utilized to monitor the work areas during non-working hours. No incidences of unauthorized site access were detected during any of the work phases.

Each drilling location was surveyed for underground utilities prior to work. The surveys included participating in the Arizona Blue Stake mark-and-locate program and using surface geophysical techniques typically used for utility location (e.g., radio frequency line location tool).

Project activities were conducted in compliance with the items identified in Attachment B of the Work Plan (CH2M HILL, 2013a), which includes compliance with Applicable and Relevant or Appropriate Requirements, the PBA (CH2M HILL, 2007), the Programmatic Agreement (BLM, 2010), and the Cultural and Historic Properties Management Plan (BLM, 2012). Compliance monitoring activities associated with the EIR Addendum No. 1 Mitigation Measures Reporting Program (MMRP), which is also included in Attachment B to the Work Plan (CH2M HILL, 2013a), were conducted continuously during fieldwork associated with the Work Plan (CH2M HILL, 2013b) and are documented in the quarterly compliance reports, which are available on the DTSC website for the Topock Project Site. While discussing Site B well construction activities during the February 12, 2014, Consultative Working Group (CWG) meeting, representatives from the Tribes raised a question whether the disturbance associated with filling a shallow slump around the conductor casing (see Section 2.3) was addressed by the MMRP for EIR Addendum No. 1. While the slump was an unplanned result of drilling, the total volume of the subsurface Site B well disturbance is still less than that provided for in the EIR Addendum. Based on the depth and diameter assumptions in the Work Plan (CH2M HILL, 2013b), the total “planned volume” of the well is approximately 316 cubic yards. Based on final well construction, including the estimated dimension of the slump that was filled, the total subsurface volume disturbed by Site B drilling and well installation activities is approximately 262 cubic yards.

2.2 Exploratory Drilling, Data Collection, and Borehole Decommissioning

At each Site B and the HNWR-1 Site, one exploratory borehole was installed to a depth of 400 feet bgs to facilitate collecting lithologic and zone-specific groundwater samples. Each borehole was drilled using the dual-rotary method (using a Foremost DR-24 drill rig), which rotates both an outer, primary casing and the drill string (attached to the drill bit), independently. This method injects compressed air down the drill string, and out the bit, to return drill cuttings from the bottom of the borehole to the ground surface within the

inside of the primary casing. The primary casing remains in place as the borehole is drilled to maintain borehole stability. An 8-inch (nominal diameter) primary casing was used to drill both exploratory boreholes. No chemical additives were used during drilling. Freshwater was introduced to the borehole at various times during drilling at both sites to counteract heaving conditions (i.e., the water was used to provide hydraulic head within the drill casing to counteract formation materials moving up into the drill casing). Freshwater used during drilling was obtained from the Golden Shores Water Company. Drill cuttings recovered during drilling were logged in accordance with the methods and procedures identified in the Work Plan (CH2M HILL, 2013b). The lithologic logs for both boreholes are provided in Attachment A.

After the water table was reached, zone-specific groundwater samples were collected from the borehole approximately every 50 feet to assess changes in water quality with depth and qualitative changes in borehole capacity. Eight zone-specific groundwater samples were collected from each of the exploratory boreholes for laboratory analysis as defined in the Work Plan (CH2M HILL, 2013b). With the exception of the sample collected from 400 feet in the HNWR-1 Site borehole, which was collected using a bailer because the zone did not produce enough water to be pumped, each sample was collected by removing the drill string from within the primary casing and operating a submersible pump within the borehole (i.e., inside the primary casing). Water quality measurements were monitored at the surface (e.g., specific conductance, pH, oxidation-reduction potential) throughout purging for sample collection. Dissolved oxygen was not measured during the collection of groundwater samples from the borehole because the drilling method injects large volumes of air while drilling, which aerates the groundwater and obscures the natural distribution of dissolved oxygen in the groundwater. All groundwater samples were analyzed in accordance with the Work Plan, with all samples being analyzed for Title 22 (CAM 17) metals, silica, fluoride, and nitrate. A subset of samples (approximately half of those collected) were analyzed for the list of water quality parameters that were used to previously characterize the existing HNWR-1 well, including CAM 17 metals, perchlorate, petroleum hydrocarbons, pesticides, polyaromatic hydrocarbons, polychlorinated biphenyls, herbicides, chloride, sulfate, nitrate, nitrite, fluoride, bromide, phosphate, general minerals, total organic carbon, pH, gross alpha and beta, and stable isotopes of hydrogen and oxygen. Specifically, this included the samples from 100, 200, and 300 feet bgs in both the HNWR-1 Site borehole and Site B, and at 400 feet bgs in the Site B borehole only. While a sample for the “longer list” laboratory analysis was planned for the 400 feet bgs sample in the HNWR-1 Site borehole, this sample was only analyzed for the “shorter list” due to sample volume constraints. Even though the zone specific samples were analyzed by a certified laboratory, the data are considered screening level quality because of the method of sample collection (i.e., pumping or bailing from an open borehole during construction).

After each of the exploratory boreholes were drilled to total depth and the final zone-specific groundwater sample was collected, the 8-inch primary casing (exploratory casing) was left in place pending discussion of the exploratory data with the TWG and decision on the next steps for the evaluation. During this time, each casing was secured at the surface by welding a cap over the top and placing hydrated bentonite clay around casing where it interfaced with the surface soils. This approach to temporarily securing the exploratory casing was discussed with and approved by ADWR. Following discussion of the exploratory data with the TWG on November 4, 2013, the exploratory casing at Site B was removed and the borehole was subsequently reamed for the installation of the Site B well (see Section 2.3). Subsequent to the installation of the Site B well, the exploratory casing at the HWNR-1 Site was removed and the borehole was decommissioned in accordance with the Work Plan (CH2M HILL, 2013b). Specifically, the borehole was decommissioned in accordance with variance option “Alternative 4” of ADWR’s *Well Abandonment Handbook* (ADWR, 2008). The borehole was decommissioned by backfilling from total depth (400 feet) to 22 feet bgs with pea gravel. The interval from 2 to 22 feet bgs was sealed using cement bentonite grout (installed via positive pressure tremie), and the upper most 2 feet was backfilled with granular material from the existing site area (i.e., drill cuttings from the borehole and surface soil adjacent to the borehole).

2.3 Site B Well Construction and Development

Following joint direction received from DTSC and DOI (DTSC, 2013b) the exploratory boring at Site B was reamed for the installation of a new well. Well design was based on evaluation of lithologic data from recovered drill cuttings, and the results of field measurement and laboratory analysis of zone-specific groundwater samples. Borehole drilling, well construction, and well development activities were conducted from November 2013 to February 2014. The materials and methods used for constructing and developing the Site B well are presented in this section. A well construction diagram is provided in Attachment A-1. Although drilling and well installation activities conducted as part of the Work Plan (CH2M HILL, 2013b) are exempt from the requirement to obtain well installation permits from the ADWR pursuant to the CERCLA Section 121(e)(1) permitting exemption, NOI to install wells at both the HNWR-1 Site (used only for the exploratory borehole at this time) and Site B were filed (provided in Attachment A) and the substantive requirements associated with the approved NOIs were followed.

The Site B well was drilled and constructed using the dual-rotary drilling method (using a Foremost DR-40 drill rig) as follows:

1. **Removed the exploratory casing.** The 8-inch exploratory casing was pulled from total depth (400 feet bgs) using the drill rig. The portion of the exploratory borehole from 400 to 320 feet bgs was sealed using cement bentonite grout (installed via positive pressure tremie). The remainder of the borehole was left open and allowed to collapse since this portion would be subsequently reamed for well construction.

2. **Installed the conductor casing.** A conductor casing was installed to stabilize the upper portion of the borehole, provide a primary surface seal (per ADWR well standards), and isolate the completed well from shallower groundwater. A 31-inch-diameter (nominal) borehole was drilled to 77 feet bgs, and a 24-inch (nominal) mild-steel conductor casing was installed (all joints were welded). The annulus between the conductor casing and the borehole wall from 77 feet bgs to ground surface was sealed using cement bentonite grout (installed via positive pressure tremie).

3. **Drilled the borehole for well construction.** After the seal for the conductor casing had cured, a 21-inch-diameter (nominal) borehole was drilled out the bottom of the conductor casing to a total depth of 325 feet bgs, which is 5 feet into the top of the sealed portion of the exploratory borehole. As previously discussed, a shallow surface slumping event occurred around the outside of the conductor casing during drilling. While not desirable, this is not uncommon when drilling with compressed air. The slump resulted in a shallow void around the outside of the conductor casing in the vadose zone (the bottom of the void was confirmed near the interface of the water table at approximately 19 feet bgs using a tag line). The diameter of the void at the ground surface was approximately 5 to 7 feet. It is estimated that the slump was caused by zones of weakness created in the early stages of borehole drilling for conductor casing installation (a condition exacerbated by the fine-grained nature of the shallow vadose zone). These zones of weakness were bridged during sealing of the conductor casing, and continued to settle during the drilling of the 21-inch borehole until the slumping event occurred. The slump was stabilized using cement bentonite grout that was poured from the ground surface.

4. **Installing the well casing and annular materials.** After the 21-inch borehole was drilled to total depth, the well casing was installed within the primary drill casing. The well casing and screen are 14 inches in diameter and composed of 316L stainless steel (all joints were welded). All well screen is wire wrapped with 0.090-inch open spacing between wires. Filter pack material was installed through the primary casing, and all sealing materials were installed via tremie within the primary drill casing, which was removed from the borehole in stages as annular materials were installed around the well casing. All filter pack annular material is composed of Tacna 4x10 gradation sand. The well was constructed with the following casing and screen intervals (described from the bottom of the well to the ground surface):

    - 320 to 305 feet bgs – cased with a welded cap on the bottom and filter sand in the annular space (this section comprises the sump).

- 305 to 265 feet bgs – screened with filter sand in the annular space.
- 265 to 245 feet bgs – cased with an intermediate annular seal composed of hydrated bentonite pellets from 260-250 feet bgs. This section provides operational flexibility in the event the lower screened section needs to be isolated, or sealed, and can also be used as a lower pump chamber.
- 245 to 195 feet bgs – screened with filter sand in the annular space.
- 195 to 185 feet bgs – cased with filter sand in the annular space. This section provides operational flexibility in the event an intermediate pump chamber is determined beneficial to operation.
- 185 to 145 feet bgs – screened with filter sand in the annular space.
- 145 feet bgs to ground surface – cased with the annular space sealed from 120 feet bgs to the ground surface with cement bentonite grout. The section is the primary pump chamber and also provide a secondary surface seal. A 2-inch-diameter, 304L stainless steel gravel feed tube was installed in the annular space from 130 feet bgs to the ground surface.

5. **Completed the well head.** The stainless steel well casing (i.e., production casing) was completed approximately 3 feet above ground surface, and sealed with a blank flange plate (bolted with gasket). The gravel feed tube was also completed above grade and sealed with a 2-inch compression cap. The mild steel conductor casing was extended above the production casing with a hinged cap that is secured with a padlock, which is similar to other wells associated with the Topock Remediation Project.

A well construction diagram summarizing this information is provided in Attachment A-1.

After the secondary seal installed between the conductor casing and the production casing had cured, development of the well began. Development was initially conducted using the drill rig using a dual-swab air lift tool. This high-energy development method uses compressed air to extract groundwater from the well. The dual-swab tool uses a steel casing with openings along a 20-foot interval and rubber gaskets (swabs) at the top and bottom of the 20 foot section to focus the pumping energy along specific intervals of well screen. Following air lift development, a line-shaft pump was installed in the well and used to surge the well at multiple flow rates. Sand production and water quality measurements (e.g., specific conductance, pH, oxidation-reduction potential, and dissolved oxygen) were monitored on the effluent water at the surface during well development. Approximately 385,000 gallons were removed during initial air-lift development, and approximately 2,270,200 gallons were removed during pump development.

Following construction, development, and testing (see Section 2.5), in-well video and plumbness surveys were conducted to verify well details and condition on February 20, 2014. The video survey confirmed the well construction details outlined above and that the well screen, casing, and welded joints were in good condition (a summary of the Site B video survey is provided in Attachment A-1). The video log also confirmed that some sand and silt had settled in the sump during final development and testing activities. A portion of the material was subsequently removed by bailer, but some of the more densely compacted material will need to be removed by air-lift at a later date (i.e., at the time the well is put into operation). An in-well gyroscope was used to verify that the well casing was plumb.

2.4 HNWR-1 Well Construction and Condition

A video survey of the existing HNWR-1 well was conducted on October 21, 2013, to verify well construction details and condition (a summary of the HNWR-1 video survey is provided in Attachment A-2). The existing submersible pump was temporarily removed from the well to provide access for the down-hole camera, and was re-installed immediately following the survey. The video survey in combination with well installation notes previously provided by the HNWR confirms that the well was constructed with a 10-inch-diameter, mild steel well casing from 2.75 feet above ground surface to approximately 118.5 feet bgs. The 10-inch casing shows moderate to heavy scaling below the water table and has been perforated (apparently post-installation using a roller perforator) from approximately 90.5 feet bgs to 118.5 feet bgs, where the well reduces to 8 inches in diameter (based on visual estimation, a caliper survey was not conducted) and the

material changes to stainless steel, wire-wrap screen. An adapter section of the reduced diameter is in place from approximately 118.5 to 119.5 feet bgs, and the stainless steel, wire-wrap screen was observed to a depth of approximately 156 feet bgs where soft fill prevented further video confirmation; however, the camera was lowered to a total depth of approximately 165 feet bgs before being refused (this depth was difficult to verify given the fill in the bottom of the well). The well screen is noted to be partially plugged based on the video survey.

Interpretation of this video survey in combination with available well installation notes suggests that the 10-inch well casing was installed by drilling with a casing advance method to a total depth of 160 feet bgs. A 40-foot-long screen section was then fabricated (two 20-foot screen sections welded together, and presumably with a cap welded to the bottom) with a 6-inch K-packer (i.e., a series of rubber rings mounted onto a section of steel pipe) welded to the top of the screen section. The screen assembly was then landed on the bottom of the borehole at 157 feet bgs (it is inferred that there was approximately 3 feet of heaved formation within the 10-inch casing). With the screen assembly in the bottom of the borehole, the 10-inch casing was retracted with the drill rig to expose the screen assembly, leaving approximately 2.3 feet of 10-inch casing below the K-packer. The installation of filter sand or gravel is not noted in the installation notes, and it would not be possible to have installed filter pack material given this construction method. Given the casing advance drilling method, the perforations in the 10-inch must have been cut with the casing in situ, otherwise the casing would have failed during drilling. The driller's notes indicated that a temporary surface casing (i.e., conductor casing) was used then pulled after the 10-inch casing was in its final position (with the screen exposed), and "grouted up." A conceptual well construction diagram for HNWR-1 that summarizes this inferred construction is provided in Attachment A-2.

While this well was adequate for the irrigation purpose for which it was designed, it is not adequate for long-term operation as part of the groundwater remedy freshwater supply. The well construction severely limits the options available for future well rehabilitation, and the effectiveness of rehabilitation overall. The lack of filter pack and the relatively large aperture perforations in the 10-inch casing are especially problematic as formation material will move readily into the well when surged. The construction details for the surface seal, which protects the well for infiltration of fluids from the surface, are not completely known.

2.5 Well and Aquifer Testing

Hydraulic testing was performed at both the existing HNWR-1 well and the Site B well to assess well performance and estimate aquifer properties. Step-rate tests were conducted in both wells to estimate the upper end of flow that could be sustained during the subsequent constant-rate tests conducted in each well. All groundwater discharged during the well tests was surface irrigated to the area designated in the Work Plan (CH2M HILL, 2013b) (see Section 2.6). The duration of both constant-rate extraction tests was constrained to 72-hours so that the irrigation area could be managed with zero run-off.

Effluent water quality measurements (e.g., specific conductance, pH, oxidation-reduction potential, and dissolved oxygen) were monitored in the field during all well tests. Dissolved oxygen was not measured during the HNWR-1 step-rate test due to a malfunctioning sensor. Water quality samples for laboratory analysis were collected from the pump effluent during both constant-rate tests to assess if water quality changed over time. Samples were collected during the tests at 1 hour, 6 hours, 12 hours, 24 hours, 48 hours, and 72 hours after the start of the test. All samples were analyzed in accordance with the Work Plan (CH2M HILL, 2013b). In addition to field parameters, groundwater samples were analyzed for CAM 17 metals, silica, fluoride, and nitrate. In addition, as requested by the TRC during the January 29, 2014, conference call with the TWG, all groundwater samples were analyzed for stable isotopes of hydrogen and oxygen. Samples from the beginning and end of the test (1 hour and 72 hours) were analyzed for a longer list of analytes, including CAM 17 metals, perchlorate, petroleum hydrocarbons, pesticides, polyaromatic hydrocarbons, polychlorinated biphenyls, herbicides, chloride, sulfate, nitrate, nitrite, fluoride, bromide, phosphate, general minerals, total organic carbon, pH, and gross alpha and beta.

Pressure transducers were utilized in several observation wells in the project area to observe potential effects of pumping at each of the wells during the constant-rate tests. In addition to the pumping wells (the Site B well and HNWR-1), monitoring the level of the Colorado River (I-3 gauging station) and barometric pressure, the following observation wells and surface water bodies were instrumented during testing (listed roughly from east to west): monitoring well near the Serrano supply well, Topock-2 (operated by Southwest Water Company), Topock-3 (operated by Southwest Water Company), GSRV-2, Topock-66 (test well for fire water supply), MW-55-120, MW-55-45, Catfish Paradise (surface water body north of South Dike), Lost Lake (surface water body south of South Dike), MW-54-85, MW-54-140, MW-54-195, and MW-49-195 (on the California side of the Colorado River). The location of these wells and surface water bodies are presented on Figure 1.

Testing details specific to each well are summarized in the following subsections.

HNWR-1. A step-rate extraction test was conducted at HNWR-1 on October 16, 2013, and a 72-hour constant-rate extraction test was conducted from February 11 to 14, 2014. Both tests were conducted using the existing electric submersible pump (Grundfos 800S750-3 pump with a 75-horsepower motor), which was installed with the intake at approximately 88 feet bgs (approximately 3 feet above the top of the well casing perforations). The step-rate test consisted of six 90-minute steps with the following average flow rates: 278 gpm, 382 gpm, 472 gpm, 557 gpm, 658 gpm, and 767 gpm. A seventh step was attempted at 875 gpm (maximum pump flow) but the pump began to cavitate after approximately 30 minutes, indicating that water level drawdown in the well had dropped below the minimum operating head required above the pump. Based on analysis of the step-rate extraction test, a flow of 700 gpm was chosen for the constant-rate test. A plot of the drawdown data collected during the HWNR-1 step-rate test is provided in Figure B-1 in Attachment B. HNWR-1 is located approximately 750 feet from the operational Topock-2 and -3 supply wells, which are operated by Southwest Water Company to provide freshwater to the Topock Compressor Station, Topock-66 restaurant, and nearby residences. Prior to the beginning of the HNWR-1 constant-rate test, project staff coordinated with the Southwest Water Company to fill available storage on the compressor station and for the residences/Topock-66 restaurant so that well operation could be minimized during the HNWR-1 testing period.

Site B. A step-rate extraction test was conducted at the Site B well on February 7, 2014, and a 72-hour constant-rate extraction test was conducted from February 7 to 10, 2014. Both tests were conducted using a line-shaft turbine pump that was temporarily installed for well development and testing. The intake of the test pump was located at approximately 138 feet bgs (approximately 7 feet above the top of the well screen). The step-rate test consisted of six 80-minute steps with the following average flow rates: 507 gpm, 694 gpm, 911 gpm, 1,101 gpm, 1,292 gpm, and 1,494 gpm. A plot of the drawdown data collected during the Site B step-rate test is provided in Figure B-2 in Attachment B. Based on analysis of the step-rate extraction test and projecting the amount of water could be applied over time to the irrigation area (based on irrigation that had been conducted to date), a flow of 1,000 gpm was chosen for the constant-rate test.

2.6 Management of Material Generated during Evaluation

Three types of materials were generated during fieldwork: drill cuttings, purged groundwater, and trash, all of which were managed in accordance with the Work Plan (CH2M HILL, 2013b). Drill cuttings and purged groundwater were managed in accordance with site-specific and regulatory practice for groundwater supply well drilling. Because this work was conducted as part of a CERCLA response action, implementation plan activities conducted onsite were covered under the permit exemption codified in Section 121(e)(1) of CERCLA. While the permit exemption applies to the administrative or procedural elements (e.g., preparing and submitting permit applications and obtaining permits), the substantive requirements of the applicable laws remain. Groundwater discharge and drill cuttings were managed in compliance with the substantive requirements of Aquifer Protection General Permit 1.04, as authorized by Arizona Administrative Code Section R18-9-B301(D).

Drill cuttings were diverted from the cuttings return pipe on the rig using a cyclone that was staged over the top of a roll-off bin. From the roll-off bin all drill cuttings were spread to the ground surface adjacent to the borehole. Chemical additives were not used during drilling, therefore cuttings sampling was not necessary to determine suitability for discharge to the ground surface. Drill cuttings were not discharged to any jurisdictional areas. Clay was recovered in the drill cuttings from both boreholes. In accordance with the Work Plan (CH2M HILL, 2013b), the clay material was gathered and separated from the other drill cuttings for storage on dye-free cotton muslin fabric and labeled. The material was recovered from the cuttings bin as many small clay balls, which were subsequently aggregated into a larger ball that was approximately the size of a soccer ball. The material was securely stored at the work site, and the agencies and Tribes were informed of the clay. The material was subsequently managed by the project archaeologist in coordination with the Tribes.

Purged groundwater was generated during drilling, well development, and well testing. Water generated during drilling and air-lift development (see Section 2.3) was discharged to the ground surface in the same area as the drill cuttings. Water was generated at a higher rate during pump development and well testing. This water was surface irrigated to the area designated in the Work Plan (CH2M HILL, 2013b). The water was pumped through a temporary, aboveground conveyance pipeline to as many as 12 sprinklers in the irrigation area (see Figure 2). During key development activities, discharge was irrigated directly to the ground without the use of a sprinkler to avoid discharge pressure limitations associated with the sprinkler equipment; however, all discharge activities were conducted in a manner that did not promote scouring or erosion of the irrigation area. A total volume of approximately 10.5 million gallons was discharged to the irrigation area during pump development at Site B and all well testing activities at both wells. Purged groundwater was neither discharged nor allowed to run-off to jurisdictional areas, the Colorado River, nor Arizona County Highway 10.

Incidental trash was removed from the work area daily and was transferred to a standard trash bin at the TCS for offsite disposal.

3.0 Results of the Evaluation

This section presents the analysis of data collected during the activities detailed in Section 2. Section 4 discusses the integration of all available data from this evaluation, and associated recommendations for the path forward in establishing a freshwater supply for the groundwater remedy.

3.1 Exploratory Data

This section presents the analysis of lithologic data collected during drilling, and the results of screening level groundwater samples collected from the initial exploratory boreholes.

Lithology and Hydrostratigraphy. Based on data collected from the exploratory boreholes, a single unconsolidated aquifer was drilled at both locations that is comprised largely of well graded gravels with sand. A combination of finer-grained sands and slits and gravel is observed in the upper 40 feet of the HNWR-1 Site and the upper 100 feet of Site B. Within this interval, a layer of lean clay was encountered at Site B between 70 and 80 feet bgs. This finer-grained material is likely a combination of overbank deposits from the Colorado River and alluvial material sourced from Sacramento Wash. Below these finer-grained intervals, the lithology encountered was predominantly comprised of fluvial river gravels with sand. Both boreholes are located within the large fluvial plain of the pre-dam era Colorado River, and the detailed drilling logs describe these clean fluvial deposits at a greater frequency and thickness than the fluvial deposits on the California side of the River, which represents the thin western edge of the fluvial plain. Bedrock was not encountered at either the HNWR-1 Site or Site B; however, low penetration rates during drilling the deeper portion of the HNWR-1 Site exploratory borehole might be an indication that the total depth of this borehole was closer to bedrock that the Site B borehole (see also specific conductance data from the deeper portion of the HNWR-1 Site borehole, and the limited groundwater recovery at the bottom of the borehole). The additional lithologic data collected during this evaluation has been added to the conceptual cross-section that was included in the Work Plan (CH2M HILL, 2013b) (see Figure 3).

The water table was encountered at approximately 9 and 19 feet bgs at the HNWR-1 Site and Site B, respectively (based on water level data collected from the HNWR-1 and Site B wells), and the ground surface at Site B is approximately 8 feet higher than at the HNWR-1 Site. The HNWR-1 well has been surveyed for elevation, but the survey for the Site B well is pending; therefore, detailed comparison of groundwater elevation between the two sites (accounting for river level influence) cannot be completed at this time. Regardless, the groundwater elevation at the two sites appears to be very similar.

Screening-level Groundwater Samples. This section presents the results of field water quality measurements (Table 1) and laboratory analysis of the 8 screening level, zone-specific groundwater samples collected from the HWNR-1 Site and Site B exploratory boreholes (Tables 2 through 9).

Field Measurements. Field water quality measurements monitoring during sample collection, included specific conductance, temperature, pH, oxidation-reduction potential, and turbidity, as well as depth to water within the primary drill casing during purging. Specific conductance measurements indicate a change in water type in both boreholes with higher specific conductance (saltier) water occurring deeper in the borehole, and a lower specific conductance (less salty) water occurring in the shallower intervals. This transition was observed between the 350- and 400-foot-bgs samples at Site B, and between the 250- and 300-foot-bgs samples at the HNWR-1 Site. Therefore, the thickness of fresh (less salty) water at Site B is approximately 100 feet greater than at the HNWR-1 Site. Based on measurement of ORP, the deeper, saltier water in each borehole tends to be reduced while the shallower, fresher water is aerobic (i.e., positive oxygen-reduction potential). This is consistent with the conceptual site model of shallower groundwater being a combination of river water and infiltration from Sacramento Wash, with the older, saltier water along the bottom of the basin. This trend is observed in both alluvial and bedrock wells and is consistent with the theory that in this lower portion of the Mohave basin, older connate water is upwelling from the deeper portions of basin. During the eons that it could take for groundwater to move through the basin, the salts are leached from the rocks, increasing specific conductance, and dissolved oxygen is lost through reactions with reduced mineral species.

The temperature of the groundwater in both boreholes ranged from approximately 32 to 42 degrees Celsius (approximately 90 to 107 degrees Fahrenheit). Measurements collected from shallow to deeper within each borehole indicate increasing temperature with depth. The measurement collected from the deepest sample in the HWNR-1 Site borehole was lower than would be expected based on the trend of measurements from shallower samples. This is because this sample was collected with a bailer, while all the other samples were collected using a submersible pump. Variations in temperature measurements can be an artifact of submersible pump operation to purge the groundwater. In general, pumping with less hydraulic head above the pump (i.e., more drawdown) will result in a temperature measurement that is biased higher. For example, the majority of temperature measurements from the HNWR-1 Site borehole are approximately 36 degrees Celsius while pumping with approximately 80 feet of drawdown. In the Site B borehole, similar pumping conditions resulted in a similar temperature measurement, while lower temperature measurements were observed when pumping with less drawdown. Heat from the drilling tools can also create variations in temperature from one measurement interval to the next. Section 3.1 discusses the temperature measurements taken while pumping within the wells, which removes some of this variability.

Measurements of pH were consistent between both boreholes, ranging from approximately 7.5 to 8.5, which is consistent with measurements throughout the project area.

Metals. In general, concentrations of metals observed in zone-specific samples were similar between the two boreholes. Dissolved arsenic concentrations ranged from non-detect to 12 micrograms per liter (μg/L) at the HNWR-1 Site, and from 0.97 to 13 μg/L at Site B. The detected ranges of chromium were also similar between the two boreholes with a range of non-detect to 11 μg/L at the HNWR-1 Site, and non-detect to 16 μg/L at Site B. Samples from the zones that correspond to the deeper, saltier water have very low to non-detect concentrations of hexavalent chromium, which is consistent with the reducing conditions discussed in

the field measurements above. Similarly, dissolved arsenic concentrations are also very low to non-detect in these samples suggesting a different water type.

Organics. Organic analyses included perchlorate, total petroleum hydrocarbon (TPH), pesticides, polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), and herbicides. All results for perchlorate, pesticides, PAHs, PCBs, and herbicides were non-detect. TPH as diesel was detected at concentrations slightly above the reporting limit in the 100- and 200-foot-bgs samples from the Site B borehole (58 and μg/L, respectively), and TPH as motor oil was detected slightly above the reporting limit in the 400-foot-bgs sample from the same borehole (53 μg/L). These TPH detections are believed to be associated with the lubricants used in the air compressor or on the drilling tools, and would not be expected to persist.

Other Constituents. Review of the results of other analyses including contract laboratory program (CLP) inorganics and general chemistry indicates that the samples from the depths that correspond to the deeper, saltier water have higher concentrations of calcium, iron, magnesium, potassium, sodium, chloride, and sulfate. The concentration of nitrate as nitrogen was particularly elevated (200 milligrams per liter (mg/L)) in the shallowest sample collected from the Site B borehole. This concentration is attributed to nitrogen released from the decay of the dense vegetation that covered this area for many years but was burned prior to the initiation of the HNWR Re-vegetation Project.

Analyses of the zone-specific samples for stable isotopes of hydrogen and oxygen indicate a consistent isotopic signature within each borehole, and across the two boreholes. In the *Final RCRA Facility Investigation/Remedial Investigation Report* (Final RFI/RI Report) (CH2M HILL, 2009), stable isotopes of oxygen and hydrogen were used to generally identify three water groups: 1) river water and river-influenced groundwater, 2) local alluvial groundwater, and 3) industrial water from historical facility discharges. The groups are intermixed to varying degrees. When compared with the isotopic signature of other wells in the project area, the samples from the exploratory boreholes correspond with alluvial and fluvial non-plume wells, which is consistent with the conceptual model of the aquifer for this area.

3.2 Aquifer Testing Data

The constant-rate extraction tests at HNWR-1 and Site B were each conducted for 72 hours. Drawdown at HNWR-1 and Site-B is shown in Figures B-3 and B-4 in Attachment B. The HNWR-1 test was conducted at flow rate of 700 gpm, which maintained approximately 44 feet of water level drawdown in the well. Similarly, the Site B test was conducted at flow rate of 1,000 gpm, which maintained approximately 60 feet of drawdown in the well. During the Site B test, the drawdown in the well recovered approximately 2 feet throughout most of the test duration; however, the water level stabilized during the final hours of the test. Because the recovery trend eventually stabilized, this recovery is attributed to increased well efficiency over most of the testing period and not recharge associated with the infiltration of surface irrigated test water, which would be expected to show an exponential recovery curve. This slight draw-up of the water level in Site B during testing did not have an adverse effect on analysis of the data.

The water level data collected during the HNWR-1 and Site B constant-rate extraction tests were downloaded from the transducers and compiled following completion of the tests. Pumping at HNWR-1 produced measurable drawdown and recovery in the Topock-2 and Topock-3 wells (less than 1 foot) (Figure B-5 in Attachment B). Pumping from the Site B well produced measurable drawdown in the HNWR-1, Topock-2, and Topock-3 wells. The Topock-2 well began pumping approximately 7 hours before the conclusion of the 72-hour Site B test and remained pumping until several hours after the conclusion of the test. This prevented the Topock-2 and Topock-3 well data from being used for aquifer test analysis after this time, but usable data were collected over the majority of the test period.

Data from monitoring well clusters MW-54 and MW-55, MW-49-135, and data from the Topock-66, and Serrano wells were corrected using the U.S. Geological Survey deconvolution software (Halford, et al, 2012) to filter out the influence of river and barometric fluctuations on these wells. Inspection of deconvoluted data from these wells indicated no measurable drawdown from either the Site B or HNWR-1 test.

Hydrographs with raw (uncorrected) data and corrected data from these wells are presented in Figures B-6 through B-10 in Attachment B. Initial review of the uncorrected data at MW-55 and Topock-66, as discussed during the February 28 conference call with the TWG, indicated potential drawdown of up to 0.2 feet, though final data corrected for the influence of the river indicated no measureable drawdown from either the Site B or HNWR-1 test. The Site B well data recorded during the HNWR-1 test were also deconvoluted, and these data did not exhibit measurable drawdown (Figure B-4 in Attachment B). Any drawdown that may have occurred at these wells would be less than the post-deconvolution "noise" level of about 0.05 feet (0.6 inches).

The pumping well and observation well data from both of these tests were analyzed to estimate aquifer properties using the aquifer test software MLU (Hemker and Post, 2014; Hemker, 1999). For each test, the drawdown at pumping and observation wells was plotted and representative points on the drawdown curves were selected to define the drawdown input to MLU. A simple five-layer system was set-up in MLU, consistent with the layout of the numerical model. Layers 1-4 in the MLU analysis were each set to be 150 feet thick at HNWR-1, and 300 feet thick at Site-B, which reflects field observations of increasing aquifer thickness in the vicinity of Site B. Layer 5 at both sites was set to 300 feet.

The modeled fits to the observed drawdown data are shown in Figures B-11 and B-12. The estimated hydraulic conductivity (K) of the aquifer in this area is about 200 feet/day (ft/day), based on the results of the tests and the estimated thickness of the zone affected by the tests. These results were compared to the parameters in the numerical model, which is currently calibrated to a range of K-values from 30 – 200 ft/day, with typical K-values at 30 ft/day. Results from these aquifer tests represent a higher K than most areas of the Topock site on the California side of the Colorado River, where the typical K is about 30 ft/day. However, given the nature of the material encountered during drilling (sand and gravel), the estimated K from these tests corresponds well with the highest permeability materials found in the floodplain within the Topock project area on the California side, which have an estimated K of about 200 ft/day. The aquifer test area is within the large fluvial plain of the pre-dam era Colorado River, and the detailed drilling logs describe these clean fluvial deposits at a greater frequency and thickness than the fluvial deposits on the California side, which represents the thin western edge of the fluvial plain.

As a result of the test analysis, the transmissivity estimated for the aquifer is greater than that in the current flow model. When the flow model was last calibrated, there were no hydraulic data available in the area of these tests, and only regional indications of the aquifer thickness. The exploratory borehole at the HNWR-1 Site was drilled to a depth of 400 feet without encountering bedrock, which is double the assigned depth in the current model. Both the thickness and transmissivity of the fluvial deposits in this area will be increased in the model from the Topock Marina eastward to the edge of the regional model domain. The effects of these changes on the modeled site remedy effectiveness are expected to be minor, but there will be less regional influence of the freshwater pumping well(s) due to the higher permeability assigned to this area of the model.

Analysis of Water Quality Data. This section presents the results of field water quality measurement (Table 1) and laboratory analysis of the 12 groundwater samples collected from the HWNR-1 and Site B wells during constant-rate testing (Tables 2 through 9). In addition, these tables include the results from one sample collected from the HNWR-1 well on October 22, 2013, which was a "one-off" sample collected per the standard operating procedure for the Topock Groundwater Monitoring Program. Compared to the zone-specific samples collected from the exploratory boreholes, the samples collected during well testing are representative of a combined condition across the entire screened interval. HNWR-1 is effectively screened across the interval from 90.5 to 156 feet bgs and the Site B well is effectively screened across the interval from approximately 140 to 305 feet bgs.

Field Measurements. Field water quality measurements, including specific conductance, temperature, pH, oxidation-reduction potential, turbidity, and dissolved oxygen, were monitored during all testing activities (with the exception of dissolved oxygen during the HNWR-1 step test, which was not measured due to a

malfunctioning sensor). The water quality measurements collected during the step-rate and constant-rate tests were consistent at each well, which suggests that the water type entering the well screens does not vary significantly when each well is pumped across the range of flows utilized during step-rate testing, or throughout the duration of the constant-rate tests. The average specific conductance measurement collected during the constant-rate tests for HNWR-1 and Site B were 833 and 1,291 microSiemens per centimeter (μS/cm), respectively, which is consistent with the measurements collected from the corresponding depths in the respective exploratory boreholes. Oxidation-reduction potential and dissolved oxygen measurements also remained consistent during the respective tests, and are representative of the oxidizing water observed at these depths in the exploratory boreholes. Measurement of pH was consistent during both tests at approximately 7.9.

Temperature measurements were consistent throughout the constant-rate tests and consistent with measurements collected during the exploratory sampling. The average temperature during the constant-rate tests were approximately 37.6 and 35.8 degrees Celsius (approximately 99.7 and 96.4 degrees Fahrenheit) at HNWR-1 and Site B, respectively. The difference in temperature between the two wells could be attributed to the different pumps used for each test. The HNWR-1 test was conducted with a submersible pump, which has a motor (i.e., heat source) in the well, while the Site B test was conducted with a line-shaft pump that does not have a motor in the well. Comparing this temperature data to that from the groundwater on the California side of the Colorado River, the average temperature in the monitoring wells within the planned injection zone for the groundwater remedy is 29.6 degrees C, calculated among the means at each well. The overall range in temperature measurements is 23.2 to 34.7 degrees C. The density at 37.6 degrees, which was the average measurement at HNWR-1 (and the higher of the two sites), is approximately 0.003 kilograms per liter (kg/L) lower than that at 29.6 degrees, assuming equal TDS. This slight difference is not expected to cause a significant separation between injected and receiving waters, especially given the inherent heterogeneity of the alluvial aquifer. Also, the 8-degree difference in temperature is not significant enough for the warmer water to cause greater leaching of matrix minerals, since the solubility of the various oxides, hydroxides, and silicate minerals is virtually identical at these two temperatures.

Metals. The concentrations of metals detected in samples collected during constant-rate testing were consistent throughout each respective test. Detected concentrations of dissolved arsenic ranged from 14 to 16 and 17 to 18 μg/L in the HNWR-1 and Site B wells, respectively. These concentrations are consistent with those detected previously in HNWR-1. Detected concentrations of chromium ranged from 19 to 20 and 33 to 34 μg/L in the HNWR-1 and Site B wells, respectively. While the concentration in HNWR-1 is consistent with those detected previously in HNWR-1, the concentrations at Site B are higher. These higher concentrations likely occur because Site B is further north than HNWR-1, and therefore closer to the higher background concentrations of chromium that enter the basin from the Black Mountains, which are composed of ultra-mafic rocks that contain naturally occurring chromium and other metals.

Organics. Organic analyses included perchlorate, TPH, pesticides, PAHs, PCBs, and herbicides. All results for perchlorate, pesticides, PAHs, PCBs, and herbicides were non-detect. TPH as diesel and TPH as motor oil were detected at concentrations of 92 (estimated) and 130 μg/L, respectively in the sample collected from the Site B well immediately before the constant-rate test was ended. These TPH detections are believed to be associated with the pump tools and lubrication oil (a highly refined mineral oil) used along the shaft of the pump that operates within the well. These detections are not expected to persist.

Other Constituents. Other analyses including CLP inorganics, bromide, chloride, fluoride, nitrate/nitrite as nitrogen, soluble silica, sulfate, and total organic carbon were all consistent with the concentrations detected in samples from the exploratory boreholes of the corresponding depths. All results for gross alpha and gross beta were either non-detect or below the respective California maximum contaminant levels for drinking water, which are 15 and 50 picocuries per liter, respectively.

The results for stable isotopes of hydrogen and oxygen from samples collected during the constant-rate tests are consistent with the results discussed for the exploratory samples (see Section 3.1).

4.0 Recommendations for Design of the Groundwater Remedy

The following conclusions about the HNWR-1 and Site B wells are based on review of hydraulic and water quality data collected during this evaluation:

- HNWR-1 will currently supply enough water of sufficient quality to supply the groundwater remedy at the nominal design flow rate of 450 gpm, but not the maximum flow rate of 900 gpm. While the construction of the well was sufficient for its original intent (irrigation), it is not sufficient for long-term daily operation as reliable element of the groundwater remedy. Due to the design, construction, and condition of the well, as the well performance declines over time, the options for well maintenance are limited. Further, operational flexibility to lower the pump and generate more flow is limited by the diameter of the lower portion of the well.
- The Site B well will supply enough water to support the maximum designed remedy flow rate and the well construction allows optimal flexibility for operation (i.e., pump depth) and maintenance options; however, based on the current well construction and operation during well testing, the water quality is currently not optimal.
- Constant-rate extraction tests conducted for a duration of 72 hours at both HNWR-1 and the Site B well suggest that neither will substantially adversely affect the production rates of existing nearby wells (see EIR Mitigation Measure WATER-1, Addendum No. 1).

Based on these conclusions, the recommended path forward for establishing a reliable freshwater supply for the groundwater remedy includes:

1. **Depth-specific characterization of the Site B well.** While the current water quality from the Site B well is not optimal for the groundwater remedy (in and of itself), based on the analysis of well testing data, the well represents a viable freshwater source that can be used as a contingency option for the remedy water supply or to supplement another freshwater supply well[1]. It is recommended that depth-specific flow and water quality data be collected to support future decisions related to well operation for the groundwater remedy. For example, if depth-specific data suggests chromium is entering the well at a specific interval, the well operation or construction could potentially be modified to lower the chromium concentration in freshwater supplied by the well.
2. **Install a new well at the HNWR-1 Site.** A well that is designed and constructed for use as part of the groundwater remedy at the HNWR-1 Site could be expected to produce adequate quality and quantity of groundwater (i.e., the maximum designed remedy flow rate). A properly designed and constructed well would allow for the full range of well maintenance options for reliable, long-term operation. The new well would be installed by over-drilling/reaming the backfilled HNWR-1 Site exploratory borehole such that an additional borehole is not required.
3. **Design the infrastructure** that would be required to plumb and operate the Site B well as part of the groundwater remedy to support future contingency actions, as necessary. Conceptual pipeline routing and associated infrastructure is included as Attachment D. In addition, design infrastructure to service the new well at the HNWR-1 site.

The implementation of these steps should occur in parallel with the development of the 90 Percent Basis of Design Report so that the conclusions of the additional work can be included in the document.

[1] Additional wells that could be used to supplement Site B include well(s) at the HWNR-1 site, Topock-2, and Topock-3. At the request of the TRC during the March 19, 2014 TWG meeting, a water quality report from Southwest Water, Inc. is provided in Attachment C.

5.0 References

Arizona Department of Water Resources (ADWR). 2008. *Well Abandonment Handbook*. September.

BLM. 2012. *Cultural and Historic Properties Management Plan (CHPMP) Topock Remediation Project*. U.S. Department of the Interior, Bureau of Land Management. January.

BLM. 2010. *Programmatic Agreement among the Bureau of Land Management, Arizona Historic Preservation Officer, California State Historic Preservation Officer, and the Advisory Council on Historic Preservation for the Topock Remediation Project in San Bernardino County, California and Mohave County, Arizona*. U.S. Department of the Interior, Bureau of Land Management. October.

CH2M HILL. 2013a. *Basis of Design Report/Intermediate (60 Percent) Design Submittal for the Final Groundwater Remedy, PG&E Topock Compressor Station, Needles, California*. Prepared for the Pacific Gas and Electric Company. April 5.

CH2M HILL. 2013b. *Final Implementation Plan for Evaluation of Alternative Freshwater Sources in the Topock Remediation Project Areas, Pacific Gas and Electric Company, Topock Compressor Station, Needles, California*. August 2.

CH2M HILL. 2009. *Final RCRA Facility Investigation/Remedial Investigation Report, Volume 2, Topock Compressor Station, Needles, California.* February 11.

CH2M HILL. 2007. *Programmatic Biological Assessment for the Pacific Gas and Electric Topock Compressor Station Remedial and Investigative Action*. Prepared for the Pacific Gas and Electric Company.

Department of Toxic Substances Control (DTSC). 2013a. *Approval of Final Implementation Plan for Evaluation of Alternative Freshwater Sources for SWMU 1/AOC 1 and AOC 10, Groundwater Remedy by Pacific Gas and Electric Company (PG&E) Topock Compressor Station, Needles, California (EPA ID NO. CAT080011729)*. September 4.

Department of Toxic Substances Control (DTSC). 2013b. Email to Yvonne Meeks/PG&E. *Agencies' Direction on Fresh Water Implementation Activities*. November 6.

Department of Toxic Substances Control (DTSC). 2012. Letter to California Regional Water Quality Control Board. *Proposed Injection of Groundwater with Arsenic Concentration Above Maximum Contaminant Level at Pacific Gas and Electric Company (PG&E), Topock Compressor Station, Needles, California (EPA ID No. CAT080011729)*. November 6.

Department of Toxic Substances Control (DTSC). 2011. *Final Environmental Impact Report for the Topock Compressor Station Groundwater Remediation Project*. California Department of Toxic Substances Control. January.

Havasu National Wildlife Refuge (HNWR). 2012. Email from Linda Miller to Yvonne Meeks/PG&E. *Approval from HNWR: PG&E Topock – Request to Federal Property for Surveys*. September 26.

Halford, K., Garcia, C.A., Fenelon, J., and Mirus, B. (Halford et al.). 2012. Advanced methods for modeling waterlevels and estimating drawdowns with SeriesSEE, an Excel add-In, U.S. Geological Survey Techniques and Methods 4–F4.

Hemker, C.J. 1999. Transient well flow in vertically heterogeneous aquifers. Journal of Hydrology 225:1-18.

Hemker, C.J. and V.E.A. Post. 2014. MLU(c) Aquifer Test Software, v 2.25.58. Website address: www.microfem.com/products/mlu.html.

U.S. Department of the Interior (DOI). 2013. Letter to Yvonne Meeks/PG&E. *PG&E Topock Compressor Station Remediation Site – Approval of the Implementation Plan for Evaluation of Alternative Freshwater Sources in the Topock Remediation Project Area*. September 4.

U.S. Department of the Interior, Bureau of Land Management (BLM). 2012. *Cultural and Historic Properties Management Plan (CHPMP) Topock Remediation Project*. January.

U.S. Department of the Interior, Bureau of Land Management (BLM). 2010. *Programmatic Agreement among the Bureau of Land Management, Arizona Historic Preservation Officer, California State Historic Preservation Officer, and the Advisory Council on Historic Preservation for the Topock Remediation Project in San Bernardino County, California and Mohave County, Arizona*. October.

Tables

TABLE-1

Summary of Field Measurements

Summary of Findings Associated with the Evaluation of Alternative Freshwater Sources in the Topock Remediation Project Area

PG&E Topock Compressor Station, Needles, California

				Field Water Quality Measurements						Hydraulic Measurements				
Location	Date	Step or Elapsed Time	Approximate Sample Depth (feet)	ORP (mV)	Spec. Conduct. (uS/cm)	Temp. (°C)	pH	Dissolved Oxygen (mg/L)	Turbidity (NTU)	Volume Purged (gallons)	Average Pumping Rate (gpm)	Approximate Static Water Level*	Approximate Pumping Water Level*	Drawdown (feet)
Site B (Exploratory)	6-Oct-13	--	58	219	636	32.3	8.18	--	84	50	1	19	not stable	--
	7-Oct-13	--	100	107	996	34.1	8.40	--	44	1,538	13	23	30	7
	7-Oct-13	--	150	161	1,519	33.6	8.22	--	47	976	18	24	25	2
	8-Oct-13	--	200	172	1,328	35.2	8.20	--	49	823	16	24	36	12
	9-Oct-13	--	250	115	929	36.0	8.15	--	16	621	17	26	84	59
	9-Oct-13	--	300	108	1,471	36.3	7.93	--	36	1,769	19	24	28	4
	10-Oct-13	--	350	77	1,182	37.0	8.21	--	30	1,668	12	24	56	32
	15-Oct-13	--	400	-99	10,313	38.1	7.46	--	45	1,253	12	24	37	13
Site B (Step-rate Test)	7-Feb-14	Step 1	--	195	1,280	32.3	8.07	4.8	5	--	507	19	46	27
	7-Feb-14	Step 2	--	196	1,275	32.2	8.05	6.5	3	--	694	19	57	38
	7-Feb-14	Step 3	--	190	1,257	33.3	8.03	5.9	1	--	911	19	73	54
	7-Feb-14	Step 4	--	186	1,275	34.2	8.02	5.7	2	--	1,101	19	86	67
	7-Feb-14	Step 5	--	197	1,243	33.4	8.05	5.6	2	--	1,292	19	102	83
	7-Feb-14	Step 6	--	201	1,251	34.5	8.01	4.8	2	--	1,494	19	120	101
Site B (Constant-rate Test)	7-Feb-14	1 hour	--	154	1,278	35.9	7.98	5.3	2	--	1,000	19	78	59
	8-Feb-14	6 hours	--	123	1,279	35.8	7.97	5.3	1	--	1,000	19	80	61
	8-Feb-14	12 hours	--	147	1,285	35.3	7.96	4.8	1	--	1,000	19	80	61
	8-Feb-14	24 hours	--	127	1,293	35.9	7.94	4.4	1	--	1,000	19	79	60
	9-Feb-14	48 hours	--	102	1,301	35.8	7.93	4.1	1	--	1,000	19	78	59
	10-Feb-14	72 hours	--	109	1,311	35.8	7.93	3.9	1	--	1,000	19	78	59
HNWR-1 Site (Exploratory)	16-Oct-13	--	50	134	972	34.5	7.96	--	43	319	17	11	13	2
	17-Oct-13	--	100	183	875	34.9	8.08	--	11	1,990	20	11	11	0
	17-Oct-13	--	150	184	892	38.9	8.19	--	47	645	17	11	31	21
	17-Oct-13	--	200	175	1,018	39.7	8.30	--	34	464	12	11	27	16
	18-Oct-13	--	250	170	1,405	41.0	8.12	--	34	749	16	12	28	17
	19-Oct-13	--	300	-290	26,300	40.2	8.33	--	27	781	16	13	not stable	--
	19-Oct-13	--	350	-224	47,192	42.4	7.97	--	50	921	19	13	not stable	--
	20-Oct-13	--	400	123	25,830	35.1	7.98	--	135	1	bailer	--	--	--
HNWR-1 (Step-rate Test)	16-Oct-13	Step 1	--	89	867	35.8	8.06	--	8	--	278	9	22	13
	16-Oct-13	Step 2	--	102	859	35.7	8.16	--	4	--	382	9	30	21
	16-Oct-13	Step 3	--	109	858	35.6	8.15	--	3	--	472	9	36	27
	16-Oct-13	Step 4	--	116	860	35.3	8.13	--	2	--	557	9	43	34
	16-Oct-13	Step 5	--	119	860	36.1	8.12	--	2	--	658	9	51	42
	16-Oct-13	Step 6	--	128	862	36.1	8.14	--	3	--	757	9	60	51
	16-Oct-13	Step 7	--	130	863	36.2	8.11	--	2	--	875	9	66	57
HNWR-1 (Constant-rate Test)	11-Feb-14	1 hour	--	129	811	37.7	8.00	3.1	1	--	700	9	52	43
	11-Feb-14	6 hours	--	107	815	37.5	7.99	3.4	1	--	700	9	52	43
	11-Feb-14	12 hours	--	98	828	37.4	7.98	3.3	1	--	700	9	52	43
	12-Feb-14	24 hours	--	91	843	37.3	7.97	3.3	1	--	700	9	52	43
	13-Feb-14	48 hours	--	81	850	37.2	7.96	3.4	0	--	700	9	52	43
	14-Feb-14	72 hours	--	84	851	37.1	7.95	3.2	2	--	700	9	52	43

Notes:

uS/cm - MicroSiemens per centimeter

mg/L - Milligrams per liter

mV - Millivolts

°C - degrees Celsius

NTU - Nephelometric Turbidity Units

gpm - gallons per minute

Field water quality measurements collected using a field meter equipped with a flow cell (unless a bailer was used)

* Approximate water level measurements are expressed as feet below ground surface.

TABLE-2

Groundwater Sample Results: Metals

Summary of Findings Associated with the Evaluation of Alternative Freshwater Sources in the Topock Remediation Project Area

Pacific Gas and Electric Company, Topock Compressor Station, Needles, California

				Metals (µg/L)																	
Location	**Phase**	**Date**	**Depth/ Time**	**Antimony, dissolved**	**Arsenic, dissolved**	**Barium, dissolved**	**Beryllium, dissolved**	**Cadmium, dissolved**	**Chromium, dissolved**	**Cobalt, dissolved**	**Copper, dissolved**	**Hexavalent Chromium**	**Lead, dissolved**	**Mercury, dissolved**	**Molybdenum, dissolved**	**Nickel, dissolved**	**Selenium, dissolved**	**Silver, dissolved**	**Thallium, dissolved**	**Vanadium, dissolved**	**Zinc, dissolved**
HNWR-1	GW Sampling	10/22/13	92 - 156 ft	ND (0.5)	**14**	**110**	ND (1)	ND (3)	**17**	ND (3)	ND (5)	**20**	ND (10)	ND (0.2)	**9.1**	ND (5)	**0.68**	ND (3)	ND (0.5)	**20**	**12**
	Constant-rate test	02/11/14	1 hrs	ND (0.5)	**16**	**120**	ND (0.5)	ND (0.5)	**18**	ND (0.5)	ND (1)	**20**	ND (1)	ND (0.2)	**9**	ND (1)	**0.79**	ND (0.5)	ND (0.5)	**18**	ND (10)
	Constant-rate test	02/12/14	6 hrs	ND (0.5)	**16**	**110**	ND (0.5)	ND (0.5)	**19**	ND (0.5)	ND (1)	**20**	ND (1)	ND (0.2)	**9.4**	ND (1)	**0.75**	ND (0.5)	ND (0.5)	**19**	ND (10)
	Constant-rate test	02/12/14	12 hrs	ND (0.5)	**16**	**110**	ND (0.5)	ND (0.5)	**18**	ND (0.5)	ND (1)	**20**	ND (1)	ND (0.2)	**9**	ND (1)	**0.73**	ND (0.5)	ND (0.5)	**18**	ND (10)
	Constant-rate test	02/12/14	24 hrs	ND (0.5)	**15**	**120**	ND (0.5)	ND (0.5)	**18**	ND (0.5)	ND (1)	**19**	ND (1)	ND (0.2)	**9.1**	ND (1)	**0.77**	ND (0.5)	ND (0.5)	**17**	ND (10)
	Constant-rate test	02/13/14	48 hrs	ND (0.5)	**15**	**130**	ND (0.5)	ND (0.5)	**17**	ND (0.5)	ND (1)	**19**	ND (1)	ND (0.2)	**9.2**	ND (1)	**0.76**	ND (0.5)	ND (0.5)	**17**	ND (10)
	Constant-rate test	02/14/14	72 hrs	ND (0.5)	**14**	**120**	ND (0.5)	ND (0.5)	**16**	ND (0.5)	ND (1)	**19**	ND (1)	ND (0.2)	**8.9**	ND (1)	**0.75**	ND (0.5)	ND (0.5)	**16**	ND (10)
HNWR-1 Site	Exploratory	10/16/13	50 ft	ND (0.5)	**6**	**87**	ND (1)	ND (3)	**6.1**	ND (3)	ND (5)	**6**	ND (10)	ND (0.2)	**9.5**	ND (5)	**0.96**	ND (3)	ND (0.5)	**16**	**14**
	Exploratory	10/17/13	100 ft	ND (0.5)	**10**	**110**	ND (1)	ND (3)	**12**	ND (3)	ND (5)	**11**	ND (10)	ND (0.2)	**8.7**	ND (5)	**0.83**	ND (3)	ND (0.5)	**18**	ND (10)
	Exploratory	10/17/13	150 ft	ND (0.5)	**6.9**	**78**	ND (1)	ND (3)	**8.8**	ND (3)	ND (5)	**9**	ND (10)	ND (0.2)	**10**	ND (5)	**0.52**	ND (3)	ND (0.5)	**13**	ND (10)
	Exploratory	10/17/13	200 ft	ND (0.5)	**11**	**100**	ND (1)	ND (3)	**11**	ND (3)	ND (5)	**9**	ND (10)	ND (0.2)	**8.9**	ND (5)	**0.57**	ND (3)	ND (0.5)	**16**	ND (10)
	Exploratory	10/18/13	250 ft	ND (0.5)	**12**	**580**	ND (1)	ND (3)	**3.3**	ND (3)	ND (5)	**1**	ND (10)	ND (0.2)	**15**	ND (5)	**0.57**	**5.7**	ND (0.5)	ND (3)	ND (10)
	Exploratory	10/19/13	300 ft	ND (2.5)	**0.8**	**91**	ND (1)	ND (3)	ND (1)	ND (3)	**14**	ND (1)	ND (10)	ND (0.2)	**120**	ND (5)	ND (2.5)	ND (3)	ND (2.5)	**11**	ND (10)
	Exploratory	10/19/13	350 ft	ND (2.5)	**3**	**240**	ND (5)	ND (15)	ND (1)	ND (15)	**26**	ND (1)	ND (50)	ND (0.2)	**160**	ND (25)	ND (2.5)	ND (15)	ND (12)	ND (15)	ND (50)
	Exploratory	10/20/13	400 ft	ND (2.5)	ND (0.5)	**150**	**1.3**	ND (3J)	ND (1)	ND (3)	**8.1**	ND (1)	ND (10)	ND (0.2)	**39**	**6.9**	ND (2.5)	**12**	ND (12)	ND (3)	**11**
Site B	Exploratory	10/06/13	58 ft	ND (0.5)	**1.3**	**110**	ND (1)	ND (3)	ND (1)	ND (3)	ND (5)	ND (0.2)	ND (10)	ND (0.2)	**11**	ND (5)	**1.6**	ND (3)	ND (0.5)	**9.2**	ND (10)
	Exploratory	10/07/13	100 ft	ND (0.5)	**13**	**130**	ND (1)	ND (3)	**2.3**	ND (3)	ND (5)	**2.1**	ND (10)	ND (0.2)	**17**	ND (5)	**0.78**	ND (3)	ND (0.5)	**11**	ND (10)
	Exploratory	10/07/13	150 ft	ND (0.5)	**13**	**140**	ND (1)	ND (3)	**16**	ND (3)	**5.9**	**16**	ND (10)	ND (0.2)	**17**	ND (5)	**0.99**	ND (3)	ND (0.5)	**12**	ND (10)
	Exploratory	10/08/13	200 ft	ND (0.5)	**13**	**130**	ND (1)	ND (3)	**7.7**	ND (3)	**7.8**	**5.2**	ND (10)	ND (0.2)	**13**	ND (5)	**0.89**	ND (3)	ND (0.5)	**13**	ND (10)
	Exploratory	10/09/13	250 ft	ND (0.5)	**10**	**140**	ND (1)	ND (3)	**3.2**	ND (3)	ND (5)	**2.8**	ND (10)	ND (0.2)	**8.6**	ND (5)	**0.78**	ND (3)	ND (0.5)	**12**	ND (10)
	Exploratory	10/09/13	300 ft	ND (0.5)	**4.5**	**140**	ND (1)	ND (3)	ND (1)	ND (3)	ND (5)	ND (0.2)	ND (10)	ND (0.2)	**8.5**	ND (5)	**0.88**	ND (3)	ND (0.5)	**7**	ND (10)
	Exploratory	10/10/13	350 ft	ND (0.5)	**12**	**94**	ND (1)	ND (3)	**5.7**	ND (3)	ND (5)	**4.6**	ND (10)	ND (0.2)	**8.8**	ND (5)	**0.69**	ND (3)	ND (0.5)	**16**	ND (10)
	Exploratory	10/15/13	400 ft	ND (0.5)	**0.97**	**120**	ND (1)	ND (3)	ND (1)	ND (3)	**11**	ND (0.2)	ND (10)	ND (0.2)	**6.9**	ND (5)	**0.81**	**6.7**	ND (2.5)	ND (3)	**26**
	Constant-rate test	02/07/14	1 hrs	ND (0.5)	**17**	**170**	ND (0.5)	ND (0.5)	**31**	ND (0.5)	ND (1)	**33**	ND (1)	ND (0.2)	**12**	ND (1)	**0.86**	ND (0.5)	ND (0.5)	**17**	ND (10)
	Constant-rate test	02/08/14	6 hrs	ND (0.5)	**17**	**150**	ND (0.5)	ND (0.5)	**31**	ND (0.5)	ND (1)	**33**	ND (1)	ND (0.2)	**11**	ND (1)	**0.92**	ND (0.5)	ND (0.5)	**16**	ND (10)
	Constant-rate test	02/08/14	12 hrs	ND (0.5)	**18**	**160**	ND (0.5)	ND (0.5)	**31**	ND (0.5)	ND (1)	**33**	ND (1)	ND (0.2)	**12**	ND (1)	**0.9**	ND (0.5)	ND (0.5)	**17**	ND (10)
	Constant-rate test	02/08/14	24 hrs	ND (0.5)	**17**	**160**	ND (0.5)	ND (0.5)	**32**	ND (0.5)	ND (1)	**34**	ND (1)	ND (0.2)	**12**	ND (1)	**0.89**	ND (0.5)	ND (0.5)	**17**	ND (10)
	Constant-rate test	02/09/14	48 hrs	ND (0.5)	**18**	**160**	ND (0.5)	ND (0.5)	**31**	ND (0.5)	ND (1)	**34**	ND (1)	ND (0.2)	**12**	ND (1)	**0.94**	ND (0.5)	ND (0.5)	**16**	ND (10)
	Constant-rate test	02/10/14	72 hrs	ND (0.5)	**18**	**170**	ND (0.5)	ND (0.5)	**33**	ND (0.5)	ND (1)	**34**	ND (1)	ND (0.2)	**12**	ND (1)	**0.92**	ND (0.5)	ND (0.5)	**17 J**	ND (10)

Notes:

Detected results are bolded

-- = not analyzed

ft = feet below ground surface

GW = Groundwater

hrs = hours

J = concentration or reporting limit estimated by laboratory or data validation

ND = not detected at the listed reporting limit

µg/L = micrograms per liter

TABLE-3

Groundwater Sample Results: Contract Laboratory Program Inorganics

Summary of Findings Associated with the Evaluation of Alternative Freshwater Sources in the Topock Remediation Project Area

Pacific Gas and Electric Company, Topock Compressor Station, Needles, California

				Contract Laboratory Program (CLP) Inorganics (µg/L)					
Location	**Phase**	**Date**	**Depth/ Time**	**Calcium, dissolved**	**Iron, dissolved**	**Magnesium, dissolved**	**Manganese, dissolved**	**Potassium, dissolved**	**Sodium, dissolved**
HNWR-1	Constant-rate test	02/11/14	1 hrs	**19,000**	ND (20)	**3,200**	ND (0.5)	**4,100**	**130,000**
	Constant-rate test	02/14/14	72 hrs	**23,000**	ND (20)	**4,200**	ND (0.5)	**4,600**	**140,000**
HNWR-1 Site	Exploratory	10/17/13	100 ft	**26,000**	**42**	**5,100**	---	**5,100**	**140,000**
	Exploratory	10/17/13	200 ft	**17,000**	**110**	**2,000**	---	**4,900**	**180,000**
	Exploratory	10/19/13	300 ft	**27,000**	**880**	**1,800**	---	**5,800**	**230,000**
Site B	Constant-rate test	02/07/14	1 hrs	**32,000 J**	**22**	**5,600**	ND (0.5)	**5,000**	**230,000**
	Constant-rate test	02/10/14	72 hrs	**37,000**	ND (20)	**6,400**	ND (0.5)	**5,200**	**240,000**
	Exploratory	10/07/13	100 ft	**20,000**	**26**	**4,400**	---	**4,700**	**160,000**
	Exploratory	10/08/13	200 ft	**28,000**	**200**	**5,200**	---	**5,200**	**200,000**
	Exploratory	10/09/13	300 ft	**34,000**	**76**	**6,800**	---	**5,800**	**220,000**
	Exploratory	10/15/13	400 ft	**360,000**	**550**	**27,000**	---	**16,000**	**1,900,000**

Notes:

Detected results are bolded

-- = not analyzed

ft = feet below ground surface

GW = Groundwater

hrs = hours

J = concentration or reporting limit estimated by laboratory or data validation

ND = not detected at the listed reporting limit

µg/L = micrograms per liter

TABLE-4

Groundwater Sample Results: Polycyclic Aromatic Hydrocarbons

Summary of Findings Associated with the Evaluation of Alternative Freshwater Sources in the Topock Remediation Project Area

Pacific Gas and Electric Company, Topock Compressor Station, Needles, California

				Polyaromatic Hydrocarbons (µg/L)																	
Location	**Phase**	**Date**	**Depth/ Time**	**1-Methyl naphthalene**	**2-Methyl naphthalene**	**Acenaph-thene**	**Acenaph-thylene**	**Anthracene**	**Benzo-(ghi)-perylene**	**Benzo(a)-anthracene**	**Benzo(a)-pyrene**	**Benzo(b)-fluor anthene**	**Benzo(k)-fluor anthene**	**Chrysene**	**Dibenzo- (a,h)-anthracene**	**Fluoranthene**	**Fluorene**	**Indeno(1,2,3-cd)pyrene**	**Naph-thalene**	**Phen-anthrene**	**Pyrene**
HNWR-1	Constant-rate test	02/11/14	1 hrs	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)
	Constant-rate test	02/14/14	72 hrs	ND (0.21)	ND (0.21)	ND (0.21)	ND (0.21)	ND (0.21)	ND (0.21)	ND (0.21)	ND (0.21)	ND (0.21)	ND (0.21)	ND (0.21)	ND (0.21)	ND (0.21)	ND (0.21)	ND (0.21)	ND (0.21)	ND (0.21)	ND (0.21)
HNWR-1 Site	Exploratory	10/17/13	100 ft	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)
	Exploratory	10/17/13	200 ft	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)
	Exploratory	10/19/13	300 ft	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)
Site B	Exploratory	10/07/13	100 ft	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)
	Exploratory	10/08/13	200 ft	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)
	Exploratory	10/09/13	300 ft	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)
	Exploratory	10/15/13	400 ft	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)
	Constant-rate test	02/07/14	1 hrs	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)
	Constant-rate test	02/10/14	72 hrs	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)

Notes:

Detected results are bolded

-- = not analyzed

ft = feet below ground surface

GW = Groundwater

hrs = hours

ND = not detected at the listed reporting limit

µg/L = micrograms per liter

TABLE-5

Groundwater Sample Results: Pesticides

Summary of Findings Associated with the Evaluation of Alternative Freshwater Sources in the Topock Remediation Project Area

Pacific Gas and Electric Company, Topock Compressor Station, Needles, California

				Pesticides (µg/L)																			
Location	**Phase**	**Date**	**Depth/ Time**	**4,4-DDD**	**4,4-DDE**	**4,4-DDT**	**Aldrin**	**alpha-BHC**	**alpha-Chlordane**	**beta-BHC**	**delta-BHC**	**Dieldrin**	**Endo sulfan I**	**Endo sulfan II**	**Endosulfan sulfate**	**Endrin**	**Endrin aldehyde**	**gamma-BHC**	**gamma-Chlordane**	**Heptachlor**	**Heptachlor Epoxide**	**Methoxy chlor**	**Toxaphene**
HNWR-1	Constant-rate test	02/11/14	1 hrs	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.05)	ND (0.025)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.25)	ND (2.5)
	Constant-rate test	02/14/14	72 hrs	ND (0.052)	ND (0.052)	ND (0.052)	ND (0.026)	ND (0.026)	ND (0.026)	ND (0.026)	ND (0.026)	ND (0.052)	ND (0.026)	ND (0.052)	ND (0.052)	ND (0.052)	ND (0.052)	ND (0.026)	ND (0.026)	ND (0.026)	ND (0.026)	ND (0.26)	ND (2.6)
HNWR-1 Site	Exploratory	10/17/13	100 ft	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.05)	ND (0.025)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.25)	ND (2.5)
	Exploratory	10/17/13	200 ft	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.05)	ND (0.025)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.25)	ND (2.5)
	Exploratory	10/19/13	300 ft	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.05)	ND (0.025)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.25)	ND (2.5)
Site B	Exploratory	10/07/13	100 ft	ND (0.051)	ND (0.051)	ND (0.051)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.051)	ND (0.025)	ND (0.051)	ND (0.051)	ND (0.051)	ND (0.051)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.25)	ND (2.5)
	Exploratory	10/08/13	200 ft	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.05)	ND (0.025)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.25)	ND (2.5)
	Exploratory	10/09/13	300 ft	ND (0.051)	ND (0.051)	ND (0.051)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.051)	ND (0.025)	ND (0.051)	ND (0.051)	ND (0.051)	ND (0.051)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.25)	ND (2.5)
	Exploratory	10/15/13	400 ft	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.05)	ND (0.025)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.25)	ND (2.5)
	Constant-rate test	02/07/14	1 hrs	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.05)	ND (0.025)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.25)	ND (2.5)
	Constant-rate test	02/10/14	72 hrs	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.05)	ND (0.025)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.25)	ND (2.5)

Notes:

Detected results are bolded

-- = not analyzed

ft = feet below ground surface

GW = Groundwater

hrs = hours

ND = not detected at the listed reporting limit

µg/L = micrograms per liter

TABLE-6

Groundwater Sample Results: Polychlorinated Biphenyls

Summary of Findings Associated with the Evaluation of Alternative Freshwater Sources in the Topock Remediation Project Area

Pacific Gas and Electric Company, Topock Compressor Station, Needles, California

				Polychlorinated Biphenyls (µg/L)						
Location	**Phase**	**Date**	**Depth/ Time**	**Aroclor 1016**	**Aroclor 1221**	**Aroclor 1232**	**Aroclor 1242**	**Aroclor 1248**	**Aroclor 1254**	**Aroclor 1260**
HNWR-1	Constant-rate test	02/11/14	1 hrs	ND (0.5)	ND (1)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)
	Constant-rate test	02/14/14	72 hrs	ND (0.52)	ND (1)	ND (0.52)	ND (0.52)	ND (0.52)	ND (0.52)	ND (0.52)
HNWR-1 Site	Exploratory	10/17/13	100 ft	ND (0.5)	ND (1)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)
	Exploratory	10/17/13	200 ft	ND (0.5)	ND (1)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)
	Exploratory	10/19/13	300 ft	ND (0.5)	ND (1)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)
Site B	Exploratory	10/07/13	100 ft	ND (0.51J)	ND (1J)	ND (0.51J)	ND (0.51J)	ND (0.51J)	ND (0.51J)	ND (0.51J)
	Exploratory	10/08/13	200 ft	ND (0.5J)	ND (1J)	ND (0.5J)	ND (0.5J)	ND (0.5J)	ND (0.5J)	ND (0.5J)
	Exploratory	10/09/13	300 ft	ND (0.51)	ND (1)	ND (0.51)	ND (0.51)	ND (0.51)	ND (0.51)	ND (0.51)
	Exploratory	10/15/13	400 ft	ND (0.5)	ND (1)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)
	Constant-rate test	02/07/14	1 hrs	ND (0.5)	ND (1)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)
	Constant-rate test	02/10/14	72 hrs	ND (0.5)	ND (1)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)

Notes:

Detected results are bolded

-- = not analyzed

ft = feet below ground surface

GW = Groundwater

hrs = hours

ND = not detected at the listed reporting limit

µg/L = micrograms per liter

TABLE-7

Groundwater Sample Results: Total Petroleum Hydrocarbons

Summary of Findings Associated with the Evaluation of Alternative Freshwater Sources in the Topock Remediation Project Area

Pacific Gas and Electric Company, Topock Compressor Station, Needles, California

				Total Petroleum Hydrocarbons (µg/L)		
Location	**Phase**	**Date**	**Depth/ Time**	**TPH-d**	**TPH-g**	**TPH-mo**
HNWR-1	Constant-rate test	02/11/14	1 hrs	ND (50)	ND (100)	ND (50)
	Constant-rate test	02/14/14	72 hrs	ND (50)	ND (100)	ND (50)
HNWR-1 Site	Exploratory	10/17/13	100 ft	ND (50)	ND (100)	ND (50)
	Exploratory	10/17/13	200 ft	ND (50)	ND (100)	ND (50)
	Exploratory	10/19/13	300 ft	ND (50)	ND (100)	ND (50)
Site B	Constant-rate test	02/07/14	1 hrs	ND (50J)	ND (100)	ND (50)
	Constant-rate test	02/10/14	72 hrs	**92 J**	ND (100)	**130**
	Exploratory	10/07/13	100 ft	**58**	ND (100)	ND (51)
	Exploratory	10/08/13	200 ft	**62**	ND (100)	ND (50)
	Exploratory	10/09/13	300 ft	ND (51)	ND (100)	ND (51)
	Exploratory	10/15/13	400 ft	ND (50)	ND (100)	**53**

Notes:

-- = not analyzed

ft = feet below ground surface

GW = Groundwater

hrs = hours

J = concentration or reporting limit estimated by laboratory or data validation

TABLE-8

Groundwater Sample Results: Anions, General and Radiochemistry Parameters

Summary of Findings Associated with the Evaluation of Alternative Freshwater Sources in the Topock Remediation Project Area

Pacific Gas and Electric Company, Topock Compressor Station, Needles, California

				General Chemistry and Radiochemistry (mg/L except where footnoted)														
Location	Phase	Date	Depth/ Time	Bromide	Chloride	Deuterium *	Fluoride	Gross Alpha *	Gross Beta *	Nitrate as Nitrogen	Nitrite as Nitrogen	Orthophosphate, dissolved	Oxygen 18 *	Perchlorate *	pH *	Soluble silica	Sulfate	Total organic carbon
HNWR-1	GW Sampling	10/22/13	92 - 156 ft	ND (0.5)	**140**	--	**3.9**	--	--	**2.5**	ND (2.5)	--	--	--	--	**27**	**45**	--
	Constant-rate test	02/11/14	1 hrs	ND (0.5)	**140**	**-73.63**	**4**	**7.42**	ND (4)	**2.6**	ND (1)	ND (0.02)	**-10.11**	ND (2)	**7.9 J**	**24**	**45**	ND (1)
	Constant-rate test	02/12/14	6 hrs	--	--	**-73.42**	**4**	--	--	**2.7**	--	--	**-10.11**	--	--	**25 J**	--	--
	Constant-rate test	02/12/14	12 hrs	--	--	**-73.16**	**3.9**	--	--	**2.6**	--	--	**-10.4**	--	--	**25**	--	--
	Constant-rate test	02/12/14	24 hrs	--	--	**-72.92**	**3.9**	--	--	**2.7**	--	--	**-10.04**	--	--	**25**	--	--
	Constant-rate test	02/13/14	48 hrs	--	--	**-74.32**	**3.8**	--	--	**2.5**	--	--	**-10.52**	--	--	**25**	--	--
	Constant-rate test	02/14/14	72 hrs	ND (0.5)	**140**	**-72.54**	**3.9**	**6.34 J**	ND (4)	**2.5**	ND (1)	ND (0.02)	**-10.44**	ND (2)	**7.7 J**	**27**	**51**	ND (1)
HNWR-1 Site	Exploratory	10/16/13	50 ft	--	--	--	**3.8**	--	--	**2.5**	--	--	--	--	--	**26**	--	--
	Exploratory	10/17/13	100 ft	ND (0.5)	**140**	**-72.9**	**3.8**	**3.49**	**5.17**	**2.5**	ND (2.5)	ND (0.02)	**-10.1**	ND (2)	**8 J**	--	**51**	ND (1)
	Exploratory	10/17/13	150 ft	--	--	--	**4.5**	--	--	**2.4**	--	--	--	--	--	**20**	--	--
	Exploratory	10/17/13	200 ft	ND (0.5)	**180**	**-72.8**	**4.3**	ND (3)	**4.14**	**2.3**	ND (2.5)	ND (0.02)	**-9.7**	ND (2)	**8 J**	--	**53**	ND (1)
	Exploratory	10/18/13	250 ft	--	--	--	**5.6**	--	--	**2.1**	--	--	--	--	--	**21**	--	--
	Exploratory	10/19/13	300 ft	ND (10)	**11,000**	**-78**	**8.1**	ND (3)	ND (131)	ND (10)	ND (50)	ND (0.02)	**-10.2**	ND (20)	**7.8 J**	--	**670**	ND (1)
	Exploratory	10/19/13	350 ft	--	--	--	**8.4**	--	--	ND (10)	--	--	--	--	--	**20**	--	--
	Exploratory	10/20/13	400 ft	--	--	--	--	--	--	--	--	--	--	--	--	**3.7**	--	--
Site B	Exploratory	10/06/13	58 ft	--	--	--	**2**	--	--	**200**	--	--	--	--	--	**31**	--	--
	Exploratory	10/07/13	100 ft	ND (0.5)	**170**	**-75.9**	**5**	**4.71 J**	ND (4)	**2.5**	ND (2.5)	ND (0.02)	**-11**	ND (2)	**7.8 J**	--	**58**	ND (1)
	Exploratory	10/07/13	150 ft	--	--	--	**4.8**	--	--	**2.4**	--	--	--	--	--	**22**	--	--
	Exploratory	10/08/13	200 ft	ND (0.5)	**250**	**-75.9**	**4.2**	**5.9 J**	**8.05**	**2.5**	ND (2.5)	ND (0.02)	**-10.8**	ND (2)	**7.8 J**	--	**71**	ND (1)
	Exploratory	10/09/13	250 ft	--	--	--	**3.9**	--	--	**2.6**	--	--	--	--	--	**21**	--	--
	Exploratory	10/09/13	300 ft	ND (0.5)	**310**	**-76.5**	**4.1**	**3.6 J**	**4.53**	**2.6**	ND (2.5)	ND (0.02)	**-10.5**	ND (2)	**7.6 J**	--	**78**	ND (1)
	Exploratory	10/10/13	350 ft	--	--	--	**4.7**	--	--	**2.5**	--	--	--	--	--	**19**	--	--
	Exploratory	10/15/13	400 ft	ND (2.5)	**3,100**	**-78.8**	**4.1 J**	**3.66**	ND (21.9)	ND (2.5)	ND (10)	ND (0.02)	**-10.9**	ND (10)	**7.3 J**	--	**330**	ND (1)
	Constant-rate test	02/07/14	1 hrs	ND (0.5)	**270**	**-75.45**	**4.3**	**5.51**	ND (4)	**2.4**	ND (2.5)	ND (0.02)	**-10.15**	ND (2)	**7.8 J**	**23**	**70**	ND (1)
	Constant-rate test	02/08/14	6 hrs	--	--	**-75.84**	**4.3**	--	--	**2.5**	--	--	**-10.27**	--	--	**22**	--	--
	Constant-rate test	02/08/14	12 hrs	--	--	**-77.46**	**4.4**	--	--	**2.5**	--	--	**-10.42**	--	--	**23**	--	--
	Constant-rate test	02/08/14	24 hrs	--	--	**-75.52**	**4.2**	--	--	**2.4**	--	--	**-10.32**	--	--	**19 J**	--	--
	Constant-rate test	02/09/14	48 hrs	--	--	**-76.74**	**4.1**	--	--	**2.4**	--	--	**-10.4**	--	--	**23**	--	--
	Constant-rate test	02/10/14	72 hrs	ND (0.5)	**270**	**-74.54**	**4.3**	**4.38**	ND (4)	**2.5**	ND (2.5)	ND (0.02)	**-10.07**	ND (2)	**7.9 J**	**24**	**71**	ND (1)

Notes:

Detected results are bolded

* Oxygen-18 and Deuterium in differences from global standards in parts per thousand

* Gross alpha and beta in picocuries per liter

* Perchlorate in micrograms per liter (µg/L)

* pH in pH units

All other parameters in milligrams per liter (mg/L)

-- = not analyzed

ft = feet below ground surface

GW = Groundwater

hrs = hours

J = concentration or reporting limit estimated by laboratory or data validation

ND = not detected at the listed reporting limit

TABLE-9

Groundwater Sample Results: Herbicides

Summary of Findings Associated with the Evaluation of Alternative Freshwater Sources in the Topock Remediation Project Area

Pacific Gas and Electric Company, Topock Compressor Station, Needles, California

				Herbicides (µg/L)									
Location	**Phase**	**Date**	**Depth/ Time**	**2,4,5-T**	**2,4,5-TP (Silvex)**	**2,4-D**	**2,4-DB**	**Dalapon**	**Dicamba**	**Dichlorprop**	**Dinoseb**	**MCPA**	**MCPP**
HNWR-1	Constant-rate test	02/11/14	1 hrs	ND (0.012)	ND (0.016)	ND (0.065)	ND (0.32)	ND (2.4J)	ND (0.037)	ND (0.012)	ND (0.04)	ND (0.29J)	ND (0.3J)
	Constant-rate test	02/14/14	72 hrs	ND (0.012)	ND (0.016)	ND (0.065)	ND (0.32)	ND (2.4J)	ND (0.037)	ND (0.012)	ND (0.04)	ND (0.29J)	ND (0.3J)
HNWR-1 Site	Exploratory	10/17/13	100 ft	ND (0.09)	ND (0.07)	ND (0.4)	ND (3)	ND (10J)	ND (0.08)	ND (0.5)	ND (0.2)	ND (10J)	ND (10J)
	Exploratory	10/17/13	200 ft	ND (0.09)	ND (0.07)	ND (0.4)	ND (3)	ND (10)	ND (0.08)	ND (0.5)	ND (0.2)	ND (10)	ND (10)
	Exploratory	10/19/13	300 ft	ND (0.09)	ND (0.07)	ND (0.4)	ND (3)	ND (10J)	ND (0.08)	ND (0.5)	ND (0.2)	ND (10J)	ND (10J)
Site B	Exploratory	10/07/13	100 ft	ND (0.09)	ND (0.07)	ND (0.4)	ND (3)	ND (10J)	ND (0.08J)	ND (0.5J)	ND (0.2)	ND (10J)	ND (10J)
	Exploratory	10/08/13	200 ft	ND (0.09)	ND (0.07)	ND (0.4)	ND (3)	ND (10)	ND (0.08J)	ND (0.5J)	ND (0.2)	ND (10)	ND (10)
	Exploratory	10/09/13	300 ft	ND (0.09J)	ND (0.07)	ND (0.4)	ND (3)	ND (10)	ND (0.08)	ND (0.5)	ND (0.2)	ND (10J)	ND (10J)
	Exploratory	10/15/13	400 ft	ND (0.09)	ND (0.07)	ND (0.4)	ND (3)	ND (10J)	ND (0.08)	ND (0.5)	ND (0.2)	ND (10J)	ND (10J)
	Constant-rate test	02/07/14	1 hrs	ND (0.09)	ND (0.07)	ND (0.4)	ND (3)	ND (10J)	ND (0.08)	ND (0.5)	ND (0.2)	ND (10J)	ND (10J)
	Constant-rate test	02/10/14	72 hrs	ND (0.09)	ND (0.07)	ND (0.4)	ND (3)	ND (10J)	ND (0.08)	ND (0.5)	ND (0.2)	ND (10J)	ND (10J)

Notes:

Detected results are bolded

-- = not analyzed

ft = feet below ground surface

GW = Groundwater

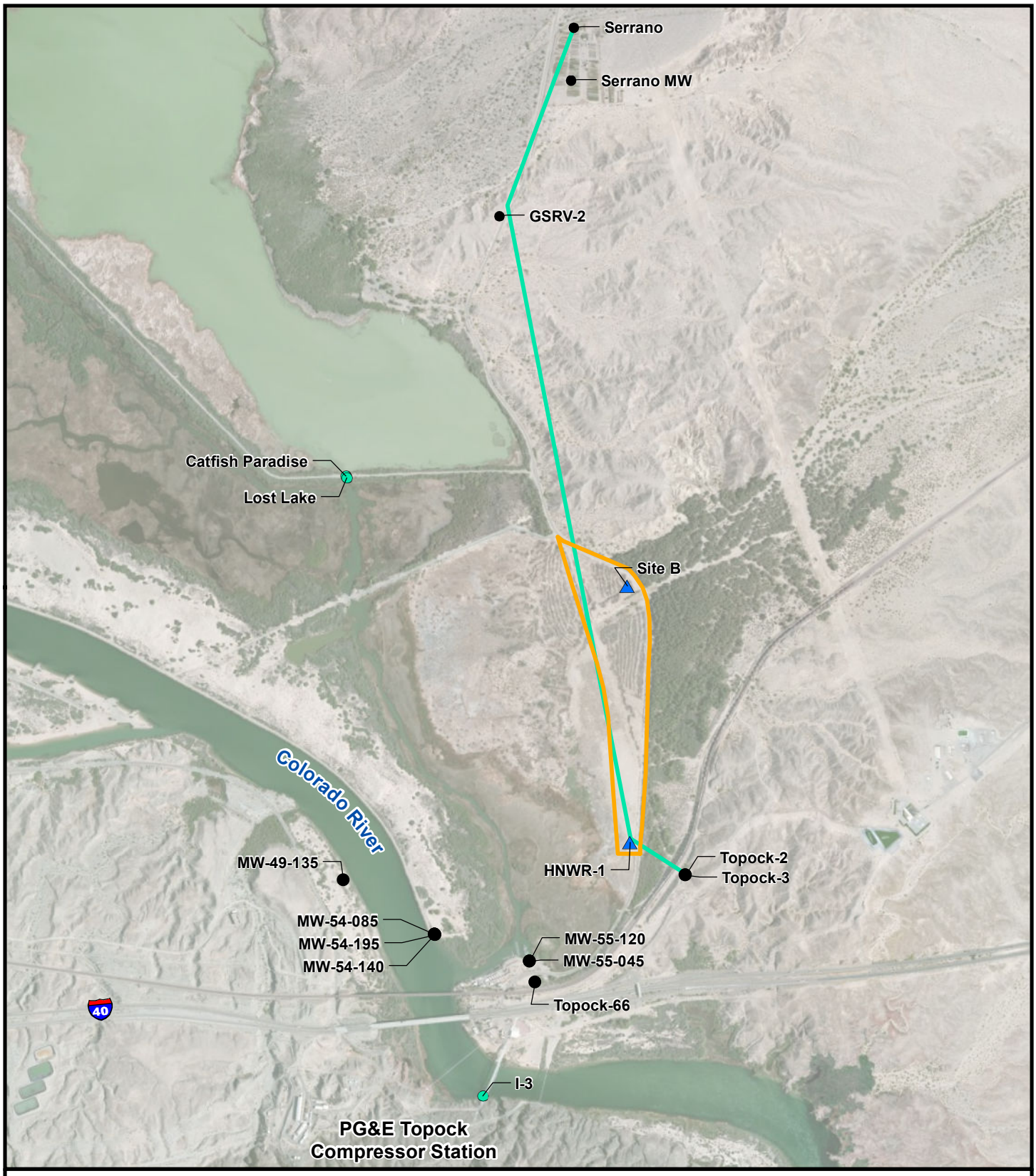
hrs = hours

J = concentration or reporting limit estimated by laboratory or data validation

ND = not detected at the listed reporting limit

µg/L = micrograms per liter

Figures



LEGEND

- Pumping Well/Observation Well
- Observation Well
- Surface Water Body
- Conceptual Geologic Cross Section
- Boundary of Work Area

N

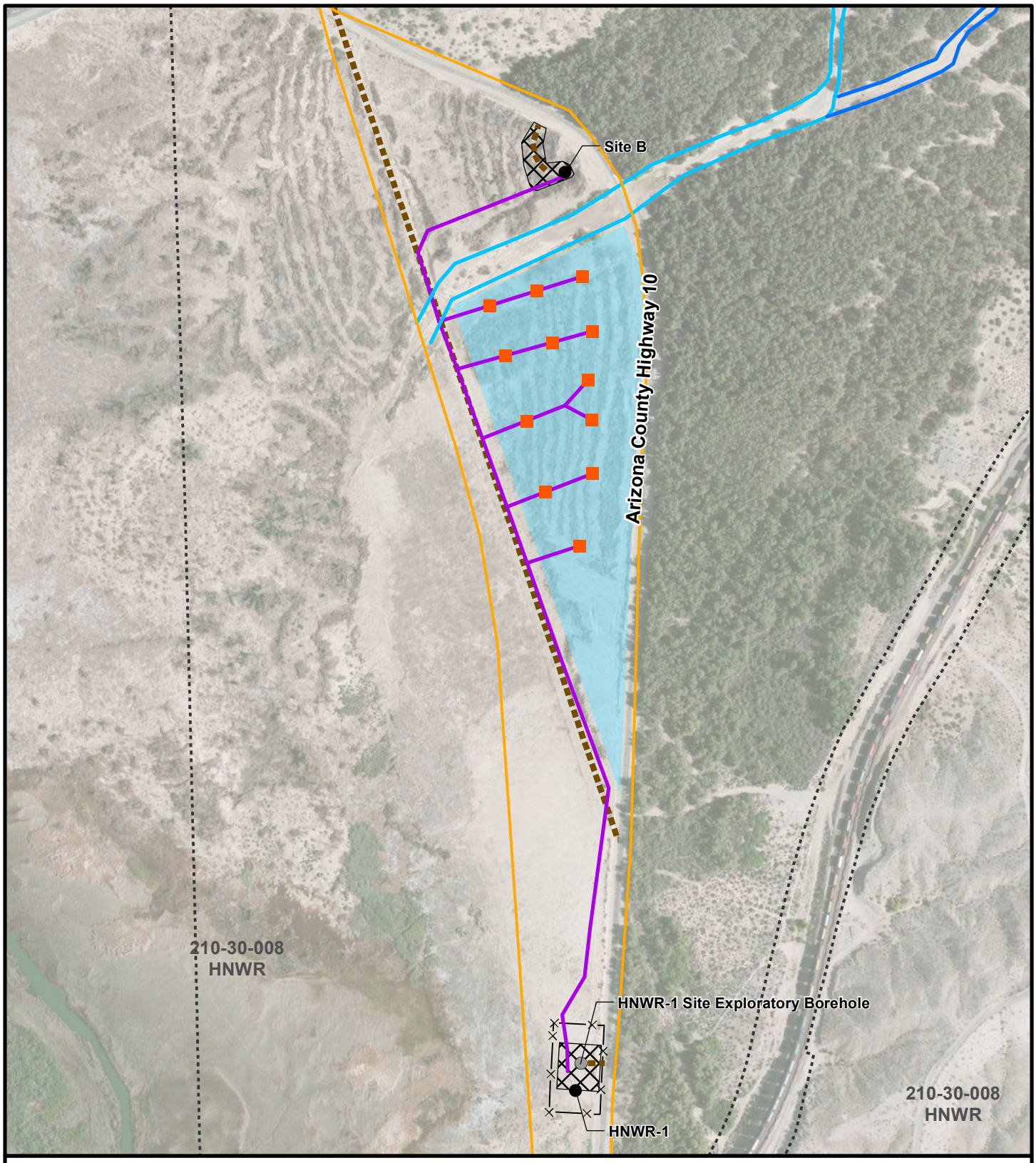
0 600 1,200 2,400 Feet

FIGURE 1
SITE MAP

SUMMARY OF FINDINGS ASSOCIATED WITH THE EVALUATION OF ALTERNATIVE FRESHWATER SOURCES IN THE TOPOCK REMEDIATION PROJECT AREA
PG&E TOPOCK COMPRESSOR STATION
NEEDLES, CALIFORNIA

CH2MHILL

Path: \\Zinfandel\proj\PacificGasElectricCo\TopockProgram\GIS\MapFiles\2014FWIP\FIG1_SiteMap.mxd Date Saved: 3/25/2014 10:41:59 AM



Well Location
Exploratory Boring
Approximate Sprinkler Location During Irrigation
Approximate Route of Sprinkler Piping During Irrigation
Access Route
Irrigation Area
Fence Line (Approximate)
Gravel Work Area (Approximate)

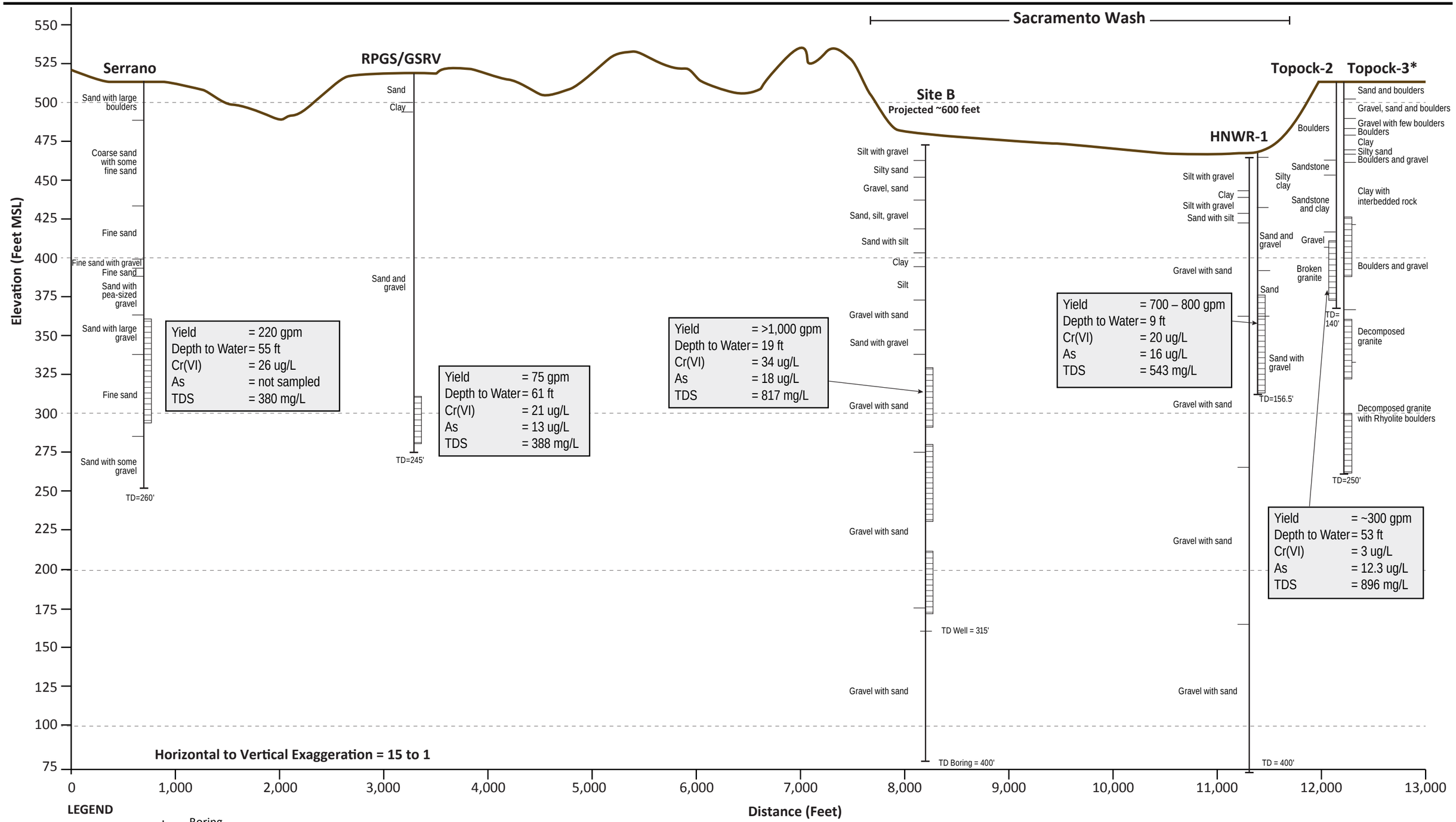
Approximate Property Lines
Outer Boundary of Work Area
Waters of the State
USACE Jurisdiction

0 125 250 500 Feet

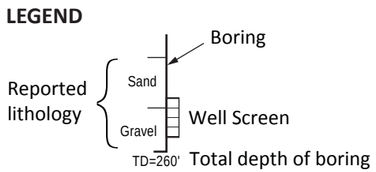
N

Note: Fence line for Site B is pending discussion with HNWR. Estimated installation date is April 2014.

FIGURE 2
SITE B AND HNWR-1 SITE WORK AREAS
SUMMARY OF FINDINGS ASSOCIATED WITH THE EVALUATION OF ALTERNATIVE FRESHWATER SOURCES IN THE TOPOCK REMEDIATION PROJECT AREA
PG&E TOPOCK COMPRESSOR STATION
NEEDLES, CALIFORNIA



LEGEND



NOTE:
The lithology shown here was obtained from available driller's well logs and has not been independently verified by CH2M HILL with the exception of Site B and HNWR-1 exploratory borings to 400ft.

* In an effort to improve water quality the two deep screens in Topock-3 were isolated after installation. This well currently produces water from the shallow-most screen only.

FIGURE 3
Conceptual Geologic Cross Section
Summary of Findings Associated with the Evauluation of Alternative Freshwater Sources in the Topock Remediation Project Area
PG&E Topock Compressor Station, Needles, California

Attachment A
Well Construction Information

Attachment A-1
Site B Well

Arizona Department of Water Resources
Water Management Division
P.O. Box 36020 Phoenix, Arizona 85067-6020
(602) 771-8500 • (602) 771-8690 fax
• www.azwater.gov •

Notice of Intent to Drill, Deepen, Replace or Modify a Well
(except a Non-Exempt Well in an Active Management Area)

$150 or $100 FEE

- Review instructions prior to completing form in black or blue ink.
- You must include with your Notice:
  - Check or money order in the amount of the appropriate filing fee.
  - For a well located within an AMA or INA, the fee is $150.00.
  - For a well not located within an AMA or INA, the fee is $100.00 if the well will be used solely for domestic purposes (see page 2 and instructions) and will have a pump with a maximum capacity of not more than 35 gallons per minute. Otherwise, the fee is $150.00.
- Authority for fee: A.R.S. § 45-596 and A.A.C. R12-15-104.

AMA / INA	B	SB	FILE NUMBER
RECEIVED DATE	WS		WELL REGISTRATION NUMBER
ISSUED DATE	WQARF	CERCLA	55 -
LEGAL REVIEW IF APP	REASONING		

SECTION 1. COUNTY OR LOCAL HEALTH AUTHORITY APPROVAL (if applicable)

If water from the proposed well will be used for domestic purposes on a parcel of land of 5 or fewer acres, the applicable county or local health authority must endorse all items in Section 1 within one year before submission to the Department of Water Resources. You must also attach a site plan (pg. 3).

CHECK ONE

☐ County or Local Health Authority Recommends Approval (pursuant to A.R.S. § 45-596 (G) and (F))
- ☐ Field Inspection Performed
- ☐ Site Plan Review Only

☐ Insufficient Information to Make a Determination

Official County or Local Seal or Stamp

COUNTY OR LOCAL AUTHORITY NAME AND TITLE

TELEPHONE NUMBER | DATE | COUNTY OR LOCAL AUTHORITY SIGNATURE

SECTION 2. REGISTRY INFORMATION

Well Type

CHECK ONE

☐ Exempt
(Pump has a maximum capacity of not more than 35 gpm and water is not used for irrigation purposes inside an AMA.) (*See instructions.*)

☒ Non-Exempt
(Pump has a maximum capacity of more than 35 gpm and the well is located outside an AMA.) (*See instructions.*)

DESIGN PUMP CAPACITY: 1,000 Gallons Per Minute

Proposed Action

CHECK ONE

☒ Drill New Well
☐ Deepen
☐ Replace
☐ Modify

If Deepening, Replacing or Modifying:

ORIGINAL WELL REGISTRATION NUMBER: 55 - NA

MAXIMUM CAPACITY OF ORIGINAL WELL: NA Gallons Per Minute

DISTANCE & DIRECTION FROM ORIGINAL WELL: NA Feet

Location of Well

WELL LOCATION ADDRESS (IF ANY): NA

COUNTY WHERE WELL IS LOCATED: Mohave

TOWNSHIP (N/S)	RANGE (E/W)	SECTION	160 ACRE	40 ACRE	10 ACRE
T16N	R21W	35	NW ¼	NE ¼	SW ¼

COUNTY ASSESSOR'S PARCEL ID NUMBER			# OF ACRES
BOOK	MAP	PARCEL	
210	30	008	365

Place of Water Use (*Mandatory Information, see instructions.*)

Is the groundwater basin where the well will be drilled the same as the place where the water will be used?	Yes	No
		X

TOWNSHIP (N/S)	RANGE (E/W)	SECTION	160 ACRE	40 ACRE	10 ACRE
Used as part of the Topock Comp. Station's remediation.					

SECTION 3. OWNER INFORMATION

Well Owner

FULL NAME OF COMPANY, ORGANIZATION, OR INDIVIDUAL: Pacific Gas & Electric Company

MAILING ADDRESS: PG&E Topock Compressor Station PO Box 337

CITY / STATE / ZIP CODE: Needles CA 92363

CONTACT PERSON NAME AND TITLE: Curt Russell Topock Site Manager

TELEPHONE NUMBER: 760-791-5884 | FAX: 760-326-5542

Landowner (if different from Well Owner)

FULL NAME OF COMPANY, GOVERNMENT AGENCY, OR INDIVIDUAL: Havasu National Wildlife Refuge

MAILING ADDRESS: 317 Mesquite Ave

CITY / STATE / ZIP CODE: Needles, CA 92363

CONTACT PERSON NAME AND TITLE: Linda L. Miller, Refuge Manager

TELEPHONE NUMBER: 760-326-3853 *22 | FAX: 760-326-5745

SECTION 4.

Questions	Yes	No	If Yes:
1. Is the proposed well site within 100 feet of a septic tank system, sewer disposal area, landfill, hazardous materials or petroleum storage area or tank?		X	You must also request a variance (A.A.C. R12-15-818).
2. Is there another well name or identification number associated with this well (e.g., Lot 35 Well, Smith Well, etc.)?		X	PLEASE STATE
3. Is the proposed well a NEW well to be located within an Active Management Area? (*See instructions.*)		X	Unless the well is a replacement well and the total number of operable exempt wells on the land is not increasing, you must also file a supplemental form A.R.S. § 45-454(C) & (D).
4. Is the proposed well the second exempt well on this parcel for the same use?		X	If the proposed well is in an Active Management Area, you must also file a supplemental form A.R.S. § 45-454(I).

(Site B)

Notice of Intent to Drill, Deepen, Replace or Modify a Well

WELL REGISTRATION NUMBER: 55-

SECTION 5. DRILLING AUTHORIZATION

Drilling Firm

NAME: Layne Christensen Company, LLC

DWR LICENSE NUMBER: #7

ROC LICENSE NUMBER: 071734

TELEPHONE NUMBER: 480-267-8416

FAX: 480-895-8699

MAILING ADDRESS: 12030 East Riggs Road

CITY / STATE / ZIP CODE: Chandler AZ 85249

DATE CONSTRUCTION IS SCHEDULED TO BEGIN: October 2, 2013

SECTION 6. WATER / SITE INFORMATION

Principal Use of Water (CHECK ONE)	Other Uses of Water (CHECK ALL THAT APPLY)
☐ Irrigation	☒ Irrigation
☐ Commercial	☒ Commercial
☐ Domestic	☐ Domestic
☐ Municipal	☐ Municipal
☐ Industrial	☒ Industrial
☐ Stock	☐ Stock
☒ Remediation	☐ Remediation
☐ Dewatering	☐ Dewatering
☐ Other* (please specify):	☐ Other* (please specify):

NOTE: If this is a Notice of Intent to construct a new well that will be used for the purpose of withdrawing groundwater for transportation to an Active Management Area (AMA) pursuant to A.R.S. § 45-552, 45-553, 45-554 or 45-555(A), the authorization to drill the well issued in association with this Notice **shall not be considered the approval to transport groundwater to an AMA.** *(see instructions.)*

SECTION 7. PROPOSED WELL CONSTRUCTION DESIGN (attach separate sheet if needed)

Borehole			Casing													
DEPTH FROM SURFACE		BOREHOLE DIAMETER (inches)	DEPTH FROM SURFACE		OUTER DIAMETER (inches)	MATERIAL TYPE (T)				PERFORATION TYPE (T)						GROUTING MATERIAL
FROM (feet)	TO (feet)		FROM (feet)	TO (feet)		STEEL	PVC	ABS	IF OTHER TYPE, DESCRIBE	BLANK OR NONE	WIRE WRAP	SHUTTER SCREEN	MILLS KNIFE	SLOTTED	IF OTHER TYPE, DESCRIBE	
0	400	24	0	100	14.625	X*				X						Cement
			100	400	14.625	X					X					

* ADWR well construction standards require a surface seal consisting of a minimum of 20 feet of steel casing. Cement grout must be used to fill the annular space between the surface casing and the borehole. (A.A.C. R12-15-811(B))

The Department's issuance of an authorization to drill a well is not a determination of whether water withdrawn from the well is legally surface water or groundwater. The legal nature of the water withdrawn from the well may be the subject of court action in the future as part of a determination of surface water rights in your area. If there are court proceedings that could affect your well, you will be notified and be given the opportunity to participate. If you have questions regarding the legal nature of the water to be withdrawn from your proposed well, please consult with an experienced civil engineer, hydrologist or water rights attorney.

For the purposes of determining appropriate fees outside AMAs or INAs, "domestic purposes" is defined as "uses related to the supply, service and activities of households and private residences and includes the application of water to less than 2 acres of land to produce plants or parts of plants for sale or human consumption, or for use as feed for livestock, range livestock or poultry, as such terms are defined in A.R.S. § 3-1201."

SECTION 8. OPTIONAL BY PROPERTY OWNER AND WELL OWNER ONLY

☐ By checking this box, I hereby provide ADWR permission to enter the property for the purpose of taking water level measurements at this well. *(See instructions.)*

SECTION 9. WELL OWNER AND PROPERTY OWNER SIGNATURE

I state that this notice is filed in compliance with A.R.S. § 45-596 and is complete and correct to the best of my knowledge and belief.

TYPE OR PRINT NAME AND TITLE: Curt Russell (PG&E Topock Project/Site Manager), Linda Miller (Refuse Manager)

SIGNATURE OF WELL OWNER: [signature] DATE: 9-26-2013

SIGNATURE OF LANDOWNER, IF APPLICABLE (SEE INSTRUCTIONS): [signature] Refuse Manager (Site B) DATE: 09/26/13

Notice of Intent to Drill, Deepen, Replace or Modify a Well

WELL REGISTRATION NUMBER
55 -

CHECK ONE: ☒ FILING MANUALLY
☐ FILING ELECTRONICALLY* *DRILLER'S E-MAIL ADDRESS:

*COUNTY OR LOCAL HEALTH AUTHORITY APPROVAL CODE	COUNTY APPROVAL CODE
If applicant is filing this NOI electronically via the ADWR website and County approval is required, please indicate approval by providing a County Approval Code.	NA

WELL SITE PLAN

NAME OF WELL OWNER	COUNTY ASSESSOR'S PARCEL ID NUMBER		
	BOOK	MAP	PARCEL
Pacific Gas & Electric Company	210	30	008

- If this well will be a domestic well on 5 acres or less, please draw the following: (1) the boundaries of your property; (2) the proposed well location; (3) the locations of all septic tank systems and sewer systems on the property or within 100 feet of the well location, even if on neighboring properties; and (4) any permanent structures on the property that may aid in locating the well. If the parcel is vacant land or lacks a septic tank or sewer system, please indicate this.
- Indicate the distance between the proposed well location and any septic tank system or sewer system.

See Attached map.

Located on vacant, Havasu Wildlife Refuge, land.

N W E S

1" = ____ ft

COUNTY OR LOCAL AUTHORITY NAME AND TITLE		*Official County or Local Seal or Stamp*
COUNTY OR LOCAL AUTHORITY SIGNATURE		
TELEPHONE NUMBER	DATE	

(Site B)

GROUNDWATER PARTNERS	PROJECT NUMBER: 428373.FS.06	WELL ID: SITE B	SHEET: 1 OF: 14

SOIL BORING LOG

PROJECT:	Topock Alternative Freshwater Source Evaluation	LOCATION:	Site B: 1.5 miles north of I-40 and HWY 10, Golden Shores, AZ
DRILLING METHOD AND EQUIPMENT:	Pilot borehole drilled with dual rotary, DR-24, 8-inch diameter drive casing. Reamed borehole with DR-40, 20-inch diameter drive casing.		
GROUND SURFACE ELEVATION (FT):	473	DRILLING CONTRACTOR:	Layne Christensen; Driller: S. Walker
LATITUDE: 34° 43' 57.19"	START: 10/4/13	WELL INFO:	14" SS Steel, 0.090", Screen: CWW
LONGITUDE: 114°28' 41.07"	FINISH: 10/15/13	LOGGER:	E. Ludwig P.G., Garrett Frey

WATER LEVEL (FT BGS): 21

TOTAL DEPTH (FT BGS): 400

DEPTH (FT) BELOW SURFACE	WELL CONSTRUCTION	USCS GROUP SYMBOL	SOIL DESCRIPTION SOIL NAME, USCS GROUP SYMBOL, COLOR, RELATIVE DENSITY, CONSISTENCY, GRAIN SIZE, GRAIN SHAPE, PLASTICITY	COMMENTS DEPTH OF CASING, PENETRATION RATE, DATE AND TIME
0	10.3 SAND SACK SLURRY CEMENT GROUT (WITHIN 24 INCH CONDUCTOR CASING) 14" DIAMETER BLANK, STAINLESS STEEL TYPE 316 L CASING			Soil samples were collected using a 5-gallon bucket and/or shovel from the cyclone.
5		ML	**SILT WITH GRAVEL (ML)** - Dark grayish brown (10YR 4/2), 90% non-plastic silt, 10% gravel, gravel is coarse to fine, subangular, dry	
10				
15		SM	**SILTY SAND (SM)** - Dark grayish brown (10YR 4/2), 70% fine to medium poorly graded sand, 30% non-plastic silt, subangular, dry	Increase in gravel at 15' Slightly moist
20				1446 10/04/2013
				1540 10/04/2013
25		GW	**WELL GRADED GRAVEL WITH SAND (GW)** - Reddish brown (5YR 4/4), 70% gravel, 25% coarse sand, 5% fine sand, subangular, loose, moist	
30				

GROUNDWATER PARTNERS	PROJECT NUMBER: 428373.FS.06	WELL ID: SITE B	SHEET: 2 OF: 14

SOIL BORING LOG

PROJECT:	Topock Alternative Freshwater Source Evaluation	LOCATION:	Site B: 1.5 miles north of I-40 and HWY 10, Golden Shores, AZ
DRILLING METHOD AND EQUIPMENT:	Pilot borehole drilled with dual rotary, DR-24, 8-inch diameter drive casing. Reamed borehole with DR-40, 20-inch diameter drive casing.		
GROUND SURFACE ELEVATION (FT):	473	DRILLING CONTRACTOR:	Layne Christensen; Driller: S. Walker
LATITUDE:	34° 43' 57.19"	START: 10/4/13	WELL INFO: 14" SS Steel, 0.090", Screen: CWW
LONGITUDE:	114°28' 41.07"	FINISH: 10/15/13	LOGGER: E. Ludwig P.G., Garrett Frey
WATER LEVEL (FT BGS):	21	TOTAL DEPTH (FT BGS):	400

DEPTH (FT) BELOW SURFACE	WELL CONSTRUCTION	USCS GROUP SYMBOL	SOIL DESCRIPTION SOIL NAME, USCS GROUP SYMBOL, COLOR, RELATIVE DENSITY, CONSISTENCY, GRAIN SIZE, GRAIN SHAPE, PLASTICITY	COMMENTS DEPTH OF CASING, PENETRATION RATE, DATE AND TIME
30	10.3 SAND SACK SLURRY CEMENT GROUT (WITHIN 24 INCH CONDUCTOR CASING) 14" DIAMETER BLANK, STAINLESS STEEL TYPE 316 L CASING	GW	**WELL GRADED SAND WITH GRAVEL (GW)** - Reddish brown (5YR 4/4), 70% gravel, 25% coarse sand, 5% fine sand, subangular, loose, moist	Hose plugged (1530) Hose unplugged (1700)
35		SP-SM	**POORLY GRADED SAND WITH SILT (SP-SM) -** Dark yellowish-brown (10YR 4/4) 90% very fine to fine sands, 10% silt, subangular, wet	All sample are saturated below 35 ft 1717 10/04/2013
40		GW	**WELL GRADED GRAVEL (GW) -** 95% subangular gravel up to 3/4", 5% coarse sand	0800 10/05/2013 0750 Tagged static at 20 ft
45		GW	**WELL GRADED GRAVEL WITH SAND (GW)** - 85% subangular gravel, 15% coarse subangular sand, 5% fine sand, subangular, loose, moist	
50				
55		SP	**POORLY GRADED SAND WITH SILT (SP)** - 95% subangular medium to coarse sands, 5% gravel up to 1/8"	
60				

GROUNDWATER PARTNERS	PROJECT NUMBER: 428373.FS.06	WELL ID: SITE B	SHEET: 3 OF: 14

SOIL BORING LOG

PROJECT:	Topock Alternative Freshwater Source Evaluation	LOCATION:	Site B: 1.5 miles north of I-40 and HWY 10, Golden Shores, AZ
DRILLING METHOD AND EQUIPMENT:	Pilot borehole drilled with dual rotary, DR-24, 8-inch diameter drive casing. Reamed borehole with DR-40, 20-inch diameter drive casing.		
GROUND SURFACE ELEVATION (FT):	473	DRILLING CONTRACTOR:	Layne Christensen; Driller: S. Walker
LATITUDE:	34° 43' 57.19"	START: 10/4/13	WELL INFO: 14" SS Steel, 0.090", Screen: CWW
LONGITUDE:	114°28' 41.07"	FINISH: 10/15/13	LOGGER: E. Ludwig P.G., Garrett Frey
WATER LEVEL (FT BGS):	21	TOTAL DEPTH (FT BGS):	400

DEPTH (FT) BELOW SURFACE	WELL CONSTRUCTION	USCS GROUP SYMBOL	SOIL DESCRIPTION SOIL NAME, USCS GROUP SYMBOL, COLOR, RELATIVE DENSITY, CONSISTENCY, GRAIN SIZE, GRAIN SHAPE, PLASTICITY	COMMENTS DEPTH OF CASING, PENETRATION RATE, DATE AND TIME
60	10.3 SAND SACK SLURRY CEMENT GROUT (BOTTOM OF CONDUCTOR CASING AT 75 FEET) 14" DIAMETER BLANK, STAINLESS STEEL TYPE 316 L CASING	SP	**POORLY GRADED SAND WITH SILT (SP)** - 95% subangular medium to coarse sands, 5% gravel up to 1/8"	
65		GW	**WELL GRADED GRAVEL (GW) -** 95% subangular gravel up to 1", 5% coarse sand	
70		CL	**LEAN CLAY (CL)** - Dark grayish brown (10YR 4/2), medium plasticity, stiff, 95% clay, 5% silt	
75				
80		ML	**SILT (ML)** - Dark grayish brown (10YR 4/2), poorly graded, low plasticity, silt is coarse	
85				
90				

GROUNDWATER PARTNERS	PROJECT NUMBER: 428373.FS.06	WELL ID: SITE B	SHEET: 4 OF: 14

SOIL BORING LOG

PROJECT:	Topock Alternative Freshwater Source Evaluation	LOCATION:	Site B: 1.5 miles north of I-40 and HWY 10, Golden Shores, AZ
DRILLING METHOD AND EQUIPMENT:	Pilot borehole drilled with dual rotary, DR-24, 8-inch diameter drive casing. Reamed borehole with DR-40, 20-inch diameter drive casing.		
GROUND SURFACE ELEVATION (FT):	473	DRILLING CONTRACTOR:	Layne Christensen; Driller: S. Walker
LATITUDE:	34° 43' 57.19"	START: 10/4/13	WELL INFO: 14" SS Steel, 0.090", Screen: CWW
LONGITUDE:	114°28' 41.07"	FINISH: 10/15/13	LOGGER: E. Ludwig P.G., Garrett Frey
WATER LEVEL (FT BGS):	21	TOTAL DEPTH (FT BGS):	400

DEPTH (FT) BELOW SURFACE	WELL CONSTRUCTION	USCS GROUP SYMBOL	SOIL DESCRIPTION SOIL NAME, USCS GROUP SYMBOL, COLOR, RELATIVE DENSITY, CONSISTENCY, GRAIN SIZE, GRAIN SHAPE, PLASTICITY	COMMENTS DEPTH OF CASING, PENETRATION RATE, DATE AND TIME
90	BENTONITE AQUAGUARD GROUT (BOREHOLE DIAMETER: 20 INCHES FROM 75 TO 320 FEET) 14" DIAMETER BLANK, STAINLESS STEEL TYPE 316 L CASING			
95		ML	**SILT (ML)** - Dark grayish brown (10YR 4/2), poorly graded, low plasticity, silt is coarse	
100				1200 10/6/2013
105				
110		GW	**WELL GRADED GRAVEL WITH SAND (GW)** - 70% rounded to subrounded gravel up to 2", 30% fine to very fine sand	
115				
120		MH	**ELASTIC SILT (MH)** - Brown (7.5YR 4/4), low to medium elasticity	

GROUNDWATER PARTNERS	PROJECT NUMBER: 428373.FS.06	WELL ID: SITE B	SHEET: 5 OF: 14

SOIL BORING LOG

PROJECT:	Topock Alternative Freshwater Source Evaluation	LOCATION:	Site B: 1.5 miles north of I-40 and HWY 10, Golden Shores, AZ
DRILLING METHOD AND EQUIPMENT:	Pilot borehole drilled with dual rotary, DR-24, 8-inch diameter drive casing. Reamed borehole with DR-40, 20-inch diameter drive casing.		
GROUND SURFACE ELEVATION (FT):	473	DRILLING CONTRACTOR:	Layne Christensen; Driller: S. Walker
LATITUDE:	34° 43' 57.19"	START: 10/4/13	WELL INFO: 14" SS Steel, 0.090", Screen: CWW
LONGITUDE:	114°28' 41.07"	FINISH: 10/15/13	LOGGER: E. Ludwig P.G., Garrett Frey
WATER LEVEL (FT BGS):	21	TOTAL DEPTH (FT BGS):	400

DEPTH (FT) BELOW SURFACE	WELL CONSTRUCTION	USCS GROUP SYMBOL	SOIL DESCRIPTION (SOIL NAME, USCS GROUP SYMBOL, COLOR, RELATIVE DENSITY, CONSISTENCY, GRAIN SIZE, GRAIN SHAPE, PLASTICITY)	COMMENTS (DEPTH OF CASING, PENETRATION RATE, DATE AND TIME)
120				
125				1218 10/7/2013 1250 10/7/2013
130	TACNA-AX10 FILTER PACK 14" DIAMETER BLANK, STAINLESS STEEL TYPE 316 L CASING	SP	**POORLY GRADED SAND WITH GRAVEL (SP)** - 60% fine to medium sand, 40% well graded rounded to subrounded gravel up to 2"	
135				
140		GW	**WELL GRADED GRAVEL WITH SAND (GW)** - Dark reddish gray (2.5YR 4/1) and dark greenish gray (GLEY 2 4/1), 70-90% rounded to subangular gravel up to 2", 10-30% poorly graded subangular medium sand	
145				
150				

GROUNDWATER PARTNERS	PROJECT NUMBER: 428373.FS.06	WELL ID: SITE B	SHEET: 6 OF: 14

SOIL BORING LOG

PROJECT:	Topock Alternative Freshwater Source Evaluation	LOCATION:	Site B: 1.5 miles north of I-40 and HWY 10, Golden Shores, AZ
DRILLING METHOD AND EQUIPMENT:	Pilot borehole drilled with dual rotary, DR-24, 8-inch diameter drive casing. Reamed borehole with DR-40, 20-inch diameter drive casing.		
GROUND SURFACE ELEVATION (FT):	473	DRILLING CONTRACTOR:	Layne Christensen; Driller: S. Walker
LATITUDE:	34° 43' 57.19"	START: 10/4/13	WELL INFO: 14" SS Steel, 0.090", Screen: CWW
LONGITUDE:	114°28' 41.07"	FINISH: 10/15/13	LOGGER: E. Ludwig P.G., Garrett Frey
WATER LEVEL (FT BGS):	21	TOTAL DEPTH (FT BGS):	400

DEPTH (FT) BELOW SURFACE	WELL CONSTRUCTION	USCS GROUP SYMBOL	SOIL DESCRIPTION SOIL NAME, USCS GROUP SYMBOL, COLOR, RELATIVE DENSITY, CONSISTENCY, GRAIN SIZE, GRAIN SHAPE, PLASTICITY	COMMENTS DEPTH OF CASING, PENETRATION RATE, DATE AND TIME
150				
155				
160	TACNA AX10 FILTER PACK 14" DIAMETER 0.090" SLOT, 5 PANELS STEEL TYPE 316 WIRE WRAP FORCE MAIN WELL SCREEN			
165		GW	**WELL GRADED GRAVEL WITH SAND (GW)** - Dark reddish gray (2.5YR 4/1) and dark greenish gray (GLEY 2 4/1), 70-90% rounded to subangular gravel up to 2", 10-30% poorly graded subangular medium sand	1700 10/7/2013 0836 10/8/2013
170				
175				
180				

GROUNDWATER PARTNERS	PROJECT NUMBER: 428373.FS.06	WELL ID: SITE B	SHEET: 7 OF: 14

SOIL BORING LOG

PROJECT:	Topock Alternative Freshwater Source Evaluation	LOCATION:	Site B: 1.5 miles north of I-40 and HWY 10, Golden Shores, AZ
DRILLING METHOD AND EQUIPMENT:	Pilot borehole drilled with dual rotary, DR-24, 8-inch diameter drive casing. Reamed borehole with DR-40, 20-inch diameter drive casing.		
GROUND SURFACE ELEVATION (FT):	473	DRILLING CONTRACTOR:	Layne Christensen; Driller: S. Walker
LATITUDE:	34° 43' 57.19"	START: 10/4/13	WELL INFO: 14" SS Steel, 0.090", Screen: CWW
LONGITUDE:	114°28' 41.07"	FINISH: 10/15/13	LOGGER: E. Ludwig P.G., Garrett Frey
WATER LEVEL (FT BGS):	21	TOTAL DEPTH (FT BGS):	400

DEPTH (FT) BELOW SURFACE	WELL CONSTRUCTION	USCS GROUP SYMBOL	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, RELATIVE DENSITY, CONSISTENCY, GRAIN SIZE, GRAIN SHAPE, PLASTICITY	COMMENTS: DEPTH OF CASING, PENETRATION RATE, DATE AND TIME
180				
185				
190	14" DIAMETER BLANK, STAINLESS STEEL TYPE 316 L CASING; TAGNAFAX10 FILTER PACK			0856 10/8/2013 1038 10/8/2013
195		GW	**WELL GRADED GRAVEL WITH SAND (GW)** - Dark reddish gray (2.5YR 4/1) and dark greenish gray (GLEY 2 4/1), 70-90% rounded to subangular gravel up to 2", 10-30% poorly graded subangular medium sand	
200	14" DIAMETER 0.020" SLOT STAINLESS STEEL TYPE 316 L WIRE WRAP ROSCOE MOSS WELL SCREEN			1047 10/8/2013 1525 10/8/2013
205				
210				

GROUNDWATER PARTNERS	PROJECT NUMBER: 428373.FS.06	WELL ID: SITE B	SHEET: 8 OF: 14

SOIL BORING LOG

PROJECT:	Topock Alternative Freshwater Source Evaluation	LOCATION:	Site B: 1.5 miles north of I-40 and HWY 10, Golden Shores, AZ
DRILLING METHOD AND EQUIPMENT:	Pilot borehole drilled with dual rotary, DR-24, 8-inch diameter drive casing. Reamed borehole with DR-40, 20-inch diameter drive casing.		
GROUND SURFACE ELEVATION (FT):	473	DRILLING CONTRACTOR:	Layne Christensen; Driller: S. Walker
LATITUDE:	34° 43' 57.19"	START: 10/4/13	WELL INFO: 14" SS Steel, 0.090", Screen: CWW
LONGITUDE:	114°28' 41.07"	FINISH: 10/15/13	LOGGER: E. Ludwig P.G., Garrett Frey
WATER LEVEL (FT BGS):	21	TOTAL DEPTH (FT BGS):	400

DEPTH (FT) BELOW SURFACE	WELL CONSTRUCTION	USCS GROUP SYMBOL	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, RELATIVE DENSITY, CONSISTENCY, GRAIN SIZE, GRAIN SHAPE, PLASTICITY	COMMENTS: DEPTH OF CASING, PENETRATION RATE, DATE AND TIME
210				
215				
220	TACNA-AX10 FILTER PACK 14" DIAMETER 0.030" SLOT, 5 PANELS STEEL TYPE 316 WIRE WRAP FORCE MAIN WELL SCREEN			1542 10/8/2013 1625 10/8/2013
225		GW	**WELL GRADED GRAVEL WITH SAND (GW)** - Dark reddish gray (2.5YR 4/1) and dark greenish gray (GLEY 2 4/1), 70-90% rounded to subangular gravel up to 2", 10-30% poorly graded subangular medium sand	
230				
235				
240				1645 10/8/2013

GROUNDWATER PARTNERS	PROJECT NUMBER: 428373.FS.06	WELL ID: SITE B	SHEET: 9 OF: 14

SOIL BORING LOG

PROJECT:	Topock Alternative Freshwater Source Evaluation	LOCATION:	Site B: 1.5 miles north of I-40 and HWY 10, Golden Shores, AZ
DRILLING METHOD AND EQUIPMENT:	Pilot borehole drilled with dual rotary, DR-24, 8-inch diameter drive casing. Reamed borehole with DR-40, 20-inch diameter drive casing.		
GROUND SURFACE ELEVATION (FT):	473	DRILLING CONTRACTOR:	Layne Christensen; Driller: S. Walker
LATITUDE:	34° 43' 57.19"	START: 10/4/13	WELL INFO: 14" SS Steel, 0.090", Screen: CWW
LONGITUDE:	114°28' 41.07"	FINISH: 10/15/13	LOGGER: E. Ludwig P.G., Garrett Frey
WATER LEVEL (FT BGS):	21	TOTAL DEPTH (FT BGS):	400

DEPTH (FT) BELOW SURFACE	WELL CONSTRUCTION	USCS GROUP SYMBOL	SOIL DESCRIPTION SOIL NAME, USCS GROUP SYMBOL, COLOR, RELATIVE DENSITY, CONSISTENCY, GRAIN SIZE, GRAIN SHAPE, PLASTICITY	COMMENTS DEPTH OF CASING, PENETRATION RATE, DATE AND TIME
240				
245				
250	COATED BENTONITE PELLETS 1/4			1542 10/8/2013 1200 10/9/2013
255	14" DIAMETER BLANK, STAINLESS STEEL TYPE 316 L CASING	GW	**WELL GRADED GRAVEL WITH SAND (GW)** - Dark reddish gray (2.5YR 4/1) and dark greenish gray (GLEY 2 4/1), 70-90% rounded to subangular gravel up to 2", 10-30% poorly graded subangular medium sand	
260				
265				
270				1235 10/9/2013

GROUNDWATER PARTNERS	PROJECT NUMBER: 428373.FS.06	WELL ID: SITE B	SHEET: 10 OF: 14

SOIL BORING LOG

PROJECT:	Topock Alternative Freshwater Source Evaluation	LOCATION:	Site B: 1.5 miles north of I-40 and HWY 10, Golden Shores, AZ
DRILLING METHOD AND EQUIPMENT:	Pilot borehole drilled with dual rotary, DR-24, 8-inch diameter drive casing. Reamed borehole with DR-40, 20-inch diameter drive casing.		
GROUND SURFACE ELEVATION (FT):	473	DRILLING CONTRACTOR:	Layne Christensen; Driller: S. Walker
LATITUDE:	34° 43' 57.19"	START: 10/4/13	WELL INFO: 14" SS Steel, 0.090", Screen: CWW
LONGITUDE:	114°28' 41.07"	FINISH: 10/15/13	LOGGER: E. Ludwig P.G., Garrett Frey
WATER LEVEL (FT BGS):	21	TOTAL DEPTH (FT BGS):	400

DEPTH (FT) BELOW SURFACE	WELL CONSTRUCTION	USCS GROUP SYMBOL	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, RELATIVE DENSITY, CONSISTENCY, GRAIN SIZE, GRAIN SHAPE, PLASTICITY	COMMENTS: DEPTH OF CASING, PENETRATION RATE, DATE AND TIME
270				Drilling is very slow
275				
280	TACNA-AX10 FILTER PACK 14" DIAMETER 0.030" SLOT, 5 PANELS STEEL TYPE 316 WIRE WRAP FOR OPEN HOLE WELL SCREEN			1456 10/9/2013 1530 10/9/2013
285		GW	**WELL GRADED GRAVEL WITH SAND (GW)** - Dark reddish gray (2.5YR 4/1) and dark greenish gray (GLEY 2 4/1), 70-90% rounded to subangular gravel up to 2", 10-30% poorly graded subangular medium sand	
290				
295				
300				1608 10/9/2013

GROUNDWATER PARTNERS	PROJECT NUMBER: 428373.FS.06	WELL ID: SITE B	SHEET: 11 OF: 14

SOIL BORING LOG

PROJECT:	Topock Alternative Freshwater Source Evaluation	LOCATION:	Site B: 1.5 miles north of I-40 and HWY 10, Golden Shores, AZ
DRILLING METHOD AND EQUIPMENT:	Pilot borehole drilled with dual rotary, DR-24, 8-inch diameter drive casing. Reamed borehole with DR-40, 20-inch diameter drive casing.		
GROUND SURFACE ELEVATION (FT):	473	DRILLING CONTRACTOR:	Layne Christensen; Driller: S. Walker
LATITUDE: 34° 43' 57.19"	START: 10/4/13	WELL INFO:	14" SS Steel, 0.090", Screen: CWW
LONGITUDE: 114°28' 41.07"	FINISH: 10/15/13	LOGGER:	E. Ludwig P.G., Garrett Frey

WATER LEVEL (FT BGS): 21

TOTAL DEPTH (FT BGS): 400

DEPTH (FT) BELOW SURFACE	WELL CONSTRUCTION	USCS GROUP SYMBOL	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, RELATIVE DENSITY, CONSISTENCY, GRAIN SIZE, GRAIN SHAPE, PLASTICITY	COMMENTS: DEPTH OF CASING, PENETRATION RATE, DATE AND TIME
300				0910 10/10/2013
305				
310	14" DIAMETER BLANK, STAINLESS STEEL TYPE 316 L CASING			
315		GW	**WELL GRADED GRAVEL WITH SAND (GW)** - Dark reddish gray (2.5YR 4/1) and dark greenish gray (GLEY 2 4/1), 70-90% rounded to subangular gravel up to 2", 10-30% poorly graded subangular medium sand	
320				0928 10/10/2013 0949 10/10/2013
325	NEAT CEMENT GROUT (BOREHOLE DIAMETER FROM 320 TO 400 FEET IS 8.5 INCHES)			
330				

GROUNDWATER PARTNERS	. 428373.FS.06	WELL ID: SITE B	SHEET: 12 OF: 14

SOIL BORING LOG

PROJECT:	*Topock Alternative Freshwater Source Evaluation*	LOCATION:	*Site B: 1.5 miles north of I-40 and HWY 10, Golden Shores, AZ*
DRILLING METHOD AND EQUIPMENT:	*Pilot borehole drilled with dual rotary, DR-24, 8-inch diameter drive casing. Reamed borehole with DR-40, 20-inch diameter drive casing.*		
GROUND SURFACE ELEVATION (FT):	*473*	DRILLING CONTRACTOR: Layne Christensen; Driller: S. Walker	
LATITUDE: *34° 43' 57.19"*	START: *10/4/13*	WELL INFO: *14" SS Steel, 0.090", Screen: CWW*	WATER LEVEL (FT BGS): *21*
LONGITUDE: *114°28' 41.07"*	FINISH: *10/15/13*	LOGGER: *E. Ludwig P.G., Garrett Frey*	TOTAL DEPTH (FT BGS): *400*

DEPTH (FT) BELOW SURFACE	WELL CONSTRUCTION	USCS GROUP SYMBOL	SOIL DESCRIPTION SOIL NAME, USCS GROUP SYMBOL, COLOR, RELATIVE DENSITY, CONSISTENCY, GRAIN SIZE, GRAIN SHAPE, PLASTICITY	COMMENTS DEPTH OF CASING, PENETRATION RATE, DATE AND TIME
330	NEAT CEMENT GROUT (BOREHOLE DIAMETER FROM 320 TO 400 FEET IS 8.5 INCHES)			
335				
340				1016 10/10/2013 1055 10/10/2013
345		GW	**WELL GRADED GRAVEL WITH SAND (GW)** - Dark reddish gray (2.5YR 4/1) and dark greenish gray (GLEY 2 4/1), 70-90% rounded to subangular gravel up to 2", 10-30% poorly graded subangular medium sand	
350				1102 10/10/2013 0710 10/15/2013
355				
360				

GROUNDWATER PARTNERS	. 428373.FS.06	WELL ID: SITE B	SHEET: 13 OF: 14

SOIL BORING LOG

PROJECT:	Topock Alternative Freshwater Source Evaluation	LOCATION:	Site B: 1.5 miles north of I-40 and HWY 10, Golden Shores, AZ
DRILLING METHOD AND EQUIPMENT:	Pilot borehole drilled with dual rotary, DR-24, 8-inch diameter drive casing. Reamed borehole with DR-40, 20-inch diameter drive casing.		
GROUND SURFACE ELEVATION (FT):	473	DRILLING CONTRACTOR:	Layne Christensen; Driller: S. Walker
LATITUDE: 34° 43' 57.19"	START: 10/4/13	WELL INFO:	14" SS Steel, 0.090", Screen: CWW
LONGITUDE: 114°28' 41.07"	FINISH: 10/15/13	LOGGER:	E. Ludwig P.G., Garrett Frey
WATER LEVEL (FT BGS): 21	TOTAL DEPTH (FT BGS): 400		

DEPTH (FT) BELOW SURFACE	WELL CONSTRUCTION	USCS GROUP SYMBOL	SOIL DESCRIPTION SOIL NAME, USCS GROUP SYMBOL, COLOR, RELATIVE DENSITY, CONSISTENCY, GRAIN SIZE, GRAIN SHAPE, PLASTICITY	COMMENTS DEPTH OF CASING, PENETRATION RATE, DATE AND TIME
360	NEAT CEMENT GROUT (BOREHOLE DIAMETER FROM 320 TO 400 FEET IS 8.5 INCHES)			
365				
370				0740 10/15/2013 0815 10/15/2013
375		GW	**WELL GRADED GRAVEL WITH SAND (GW)** - Dark reddish gray (2.5YR 4/1) and dark greenish gray (GLEY 2 4/1), 70-90% rounded to subangular gravel up to 2", 10-30% poorly graded subangular medium sand	
380				
385				
390				0920 10/15/2013

GROUNDWATER PARTNERS	. 428373.FS.06	WELL ID: SITE B	SHEET: 14 OF: 14

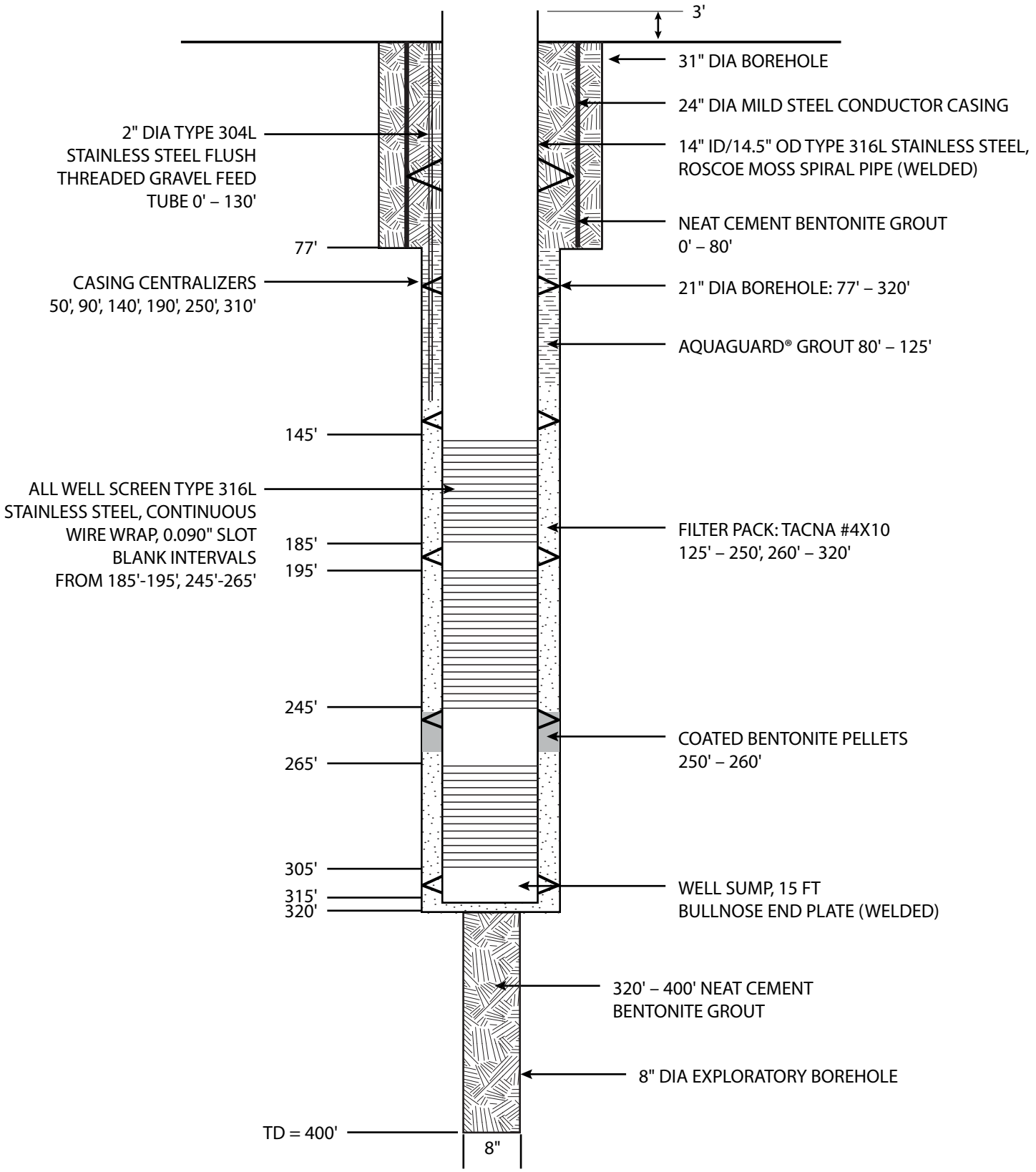
SOIL BORING LOG

PROJECT:	*Topock Alternative Freshwater Source Evaluation*	LOCATION:	*Site B: 1.5 miles north of I-40 and HWY 10, Golden Shores, AZ*
DRILLING METHOD AND EQUIPMENT:	*Pilot borehole drilled with dual rotary, DR-24, 8-inch diameter drive casing. Reamed borehole with DR-40, 20-inch diameter drive casing.*		
GROUND SURFACE ELEVATION (FT):	*473*	DRILLING CONTRACTOR: Layne Christensen; Driller: S. Walker	
LATITUDE: *34° 43' 57.19"*	START: *10/4/13*	WELL INFO: *14" SS Steel, 0.090", Screen: CWW*	WATER LEVEL (FT BGS): *21*
LONGITUDE: *114°28' 41.07"*	FINISH: *10/15/13*	LOGGER: *E. Ludwig P.G., Garrett Frey*	TOTAL DEPTH (FT BGS): *400*

DEPTH (FT) BELOW SURFACE	WELL CONSTRUCTION	USCS GROUP SYMBOL	SOIL DESCRIPTION SOIL NAME, USCS GROUP SYMBOL, COLOR, RELATIVE DENSITY, CONSISTENCY, GRAIN SIZE, GRAIN SHAPE, PLASTICITY	COMMENTS DEPTH OF CASING, PENETRATION RATE, DATE AND TIME
390 395 400	NEAT CEMENT GROUT (BOREHOLE DIAMETER FROM 320 TO 400 FEET IS 8.5 INCHES)	GW	**WELL GRADED GRAVEL WITH SAND (GW)** - Dark reddish gray (2.5YR 4/1) and dark greenish gray (GLEY 2 4/1), 70-90% rounded to subangular gravel up to 2", 10-30% poorly graded subangular medium sand	Total depth of pilot borehole: 400 ft. 0928 10/15/2013

CH2MHILL®	PROJECT NUMBER: 428373.FS.06	WELL NUMBER: SITE B
	WELL COMPLETION DIAGRAM	

PROJECT: Topock Alternative Freshwater Source Evaluation	LOCATION: 1 mi north I-40 & HWY 10, Golden Shores, AZ	
DRILLING METHOD/EQUIPMENT: Exploratory boring dual air rotary, Foster DR-24, 8" dia; reamed to construct well, Foster DR-40		
DRILLING CONTRACTOR: Layne Christensen	START: 11/20/2013 END: 1/23/2014	LOGGER: E. Ludwig, G. Frey (Groundwater Partners, Inc.)
34° 43' 57.19", 114° 28' 41.07"	SURFACE ELEVATION (FT): 473	DEPTH TO WATER (FT BGS): 21



ES110712123135BAO_Well_completion-diagram.ai_032514_lho

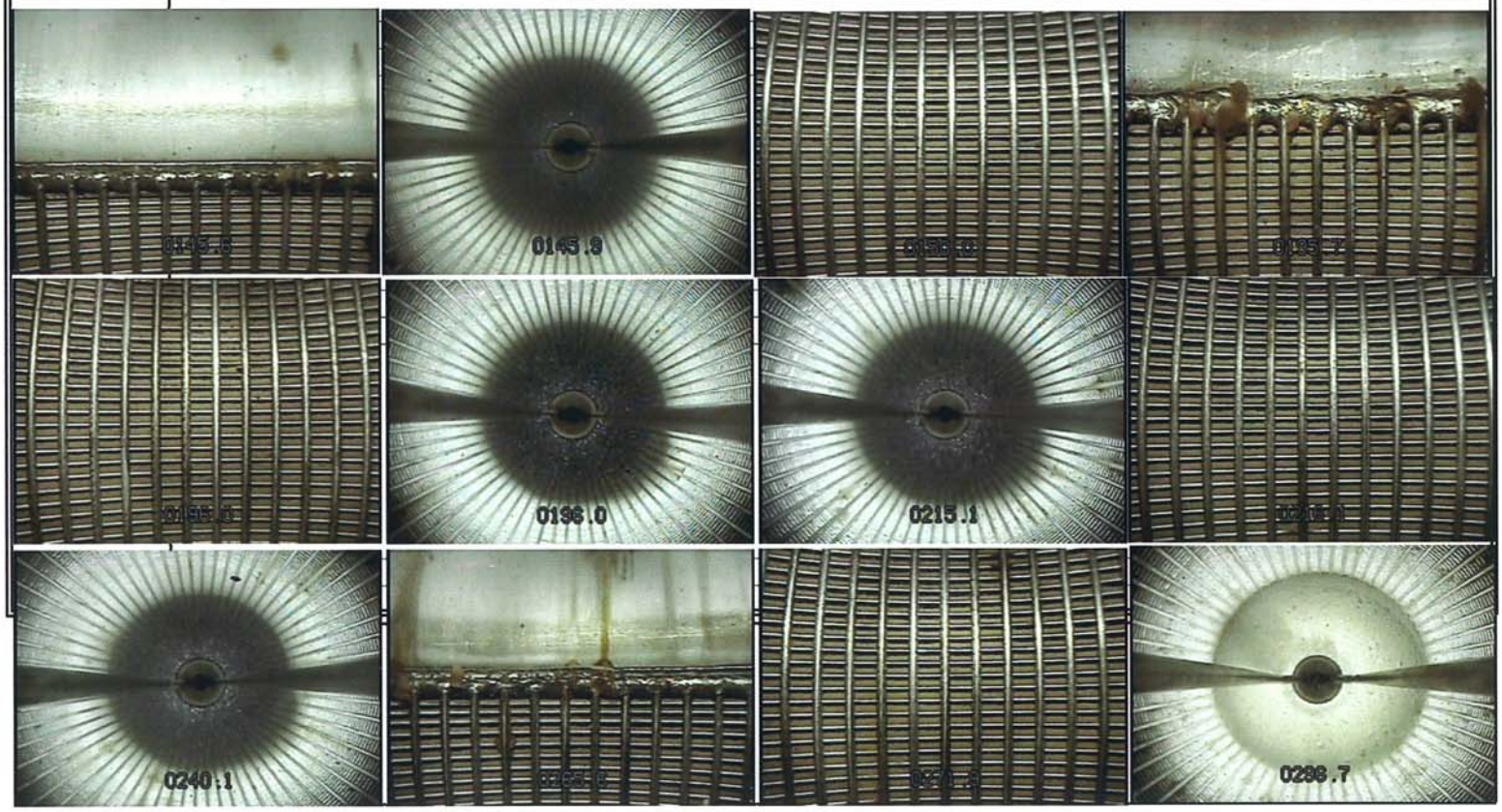
Pacific Surveys

a full service geophysical well logging company

Video Survey Report

Company:	Groundwater Partners Inc.		**Date:**	20-Feb-14	
Well:	Site B		**Run No.**	One	**Truck** PS-5
Field:	Topock		**Job Ticket:**	18047	
State:	Nevada		**Total Depth:**	302 ft	
			Water Level:	19 ft	SWL
Location:	2 miles North of Golden Shores		**Oil on Water:**	No	**Amount:** 0 ft
	GPS: N34o43.955' W114o28.687'		**Operator:**	Abreau	
Zero Datum:	Ground Level	**Tool Zero:**	Side-Scan		**Dead Space** 1.75 ft
Reason for Survey:	New Well Construction		**Guides Set @** 14.00"		

Depth	Observations		
0.0 ft	Begin survey at ground surface.	**Perforation:**	**As-Built**
18.5 ft	SWL; Water slightly turbid with light suspended bio-material; Visibility good.	Wire-Wrap	145.00 ft to 185.00ft
50.0 ft	Casing appears clean and in good condition.		195.00 ft to 245.00ft
100.0 ft	Casing appears clean and in good condition.		265.00 ft to 305.00ft
145.6 ft	Top of perforations; Perforations appear open and in good condition.		
185.1 ft	Bottom of perforated interval; all perforations appear open and in good condition.		
195.7 ft	Top of perforations; Perforations appear open and in good condition.		
204.0 ft	Perforations appear twisted slightly; All perforations appear intact with no separations,		
205.0 ft	Bottom of twisted perforations.		
245.0 ft	Bottom of perforated interval; all perforations appear open and in good condition.		
265.6 ft	Top of perforations; Perforations appear open and in good condition.		
298.4 ft	Top of settled bio-material; camera descends easily into material.	**Casing Size**	**As-Built**
302.4 ft	Hard fill; Camera stops; end survey.	14.00	0.00 ft to 315.00ft
		CSG Material	SST
		Screen Material	SST



800.919.7555
909.625.6262

4456 via st. ambrose
claremont ca 91711
www.pacificsurveys.com

fax: 909.399.3180

Attachment A-2
HNWR-1 Well

Arizona Department of Water Resources
Water Management Division
P.O. Box 36020 Phoenix, Arizona 85067-6020
(602) 771-8500 • (602) 771-8690 fax
• www.azwater.gov •

Notice of Intent to Drill, Deepen, Replace or Modify a Well

(except a Non-Exempt Well in an Active Management Area)

$150 or $100 FEE

- Review instructions prior to completing form in black or blue ink.
- You must include with your Notice:
  - Check or money order in the amount of the appropriate filing fee.
  - For a well located within an AMA or INA, the fee is $150.00.
  - For a well not located within an AMA or INA, the fee is $100.00 if the well will be used solely for domestic purposes (see page 2 and instructions) and will have a pump with a maximum capacity of not more than 35 gallons per minute. Otherwise, the fee is $150.00.
- Authority for fee: A.R.S. § 45-596 and A.A.C. R12-15-104.

AMA / INA	B	SS	FILE NUMBER
RECEIVED DATE	WS		WELL REGISTRATION NUMBER
ISSUED DATE	MGARF	CERCLA	55 -
LEGAL REVIEW IF APP	REASONING		

SECTION 1. COUNTY OR LOCAL HEALTH AUTHORITY APPROVAL (if applicable)

If water from the proposed well will be used for domestic purposes on a parcel of land of 5 or fewer acres, the applicable county or local health authority must endorse all items in Section 1 within one year before submission to the Department of Water Resources. You must also attach a site plan (pg. 3).

CHECK ONE

☐ County or Local Health Authority Recommends Approval (pursuant to A.R.S. § 45-596 (G) and (F))
- ☐ Field Inspection Performed
- ☐ Site Plan Review Only

☐ Insufficient Information to Make a Determination

Official County or Local Seal or Stamp

COUNTY OR LOCAL AUTHORITY NAME AND TITLE

TELEPHONE NUMBER | DATE | COUNTY OR LOCAL AUTHORITY SIGNATURE

SECTION 2. REGISTRY INFORMATION

Well Type

CHECK ONE

☐ Exempt (Pump has a maximum capacity of not more than 35 gpm and water is not used for irrigation purposes inside an AMA.) (*See instructions.*)

☒ Non-Exempt (Pump has a maximum capacity of more than 35 gpm and the well is located outside an AMA.) (*See instructions.*)

DESIGN PUMP CAPACITY: 1,000 Gallons Per Minute

Proposed Action

CHECK ONE

☒ Drill New Well
☐ Deepen
☐ Replace
☐ Modify

If Deepening, Replacing or Modifying:

ORIGINAL WELL REGISTRATION NUMBER: 55 - NA

MAXIMUM CAPACITY OF ORIGINAL WELL: NA Gallons Per Minute

DISTANCE & DIRECTION FROM ORIGINAL WELL: NA Feet

Location of Well

WELL LOCATION ADDRESS (IF ANY): NA

COUNTY WHERE WELL IS LOCATED: Mohave

TOWNSHIP (N/S)	RANGE (E/W)	SECTION	160 ACRE	40 ACRE	10 ACRE
T16N	R21W	35	SW ¼	SE ¼	NW ¼

COUNTY ASSESSOR'S PARCEL ID NUMBER

BOOK	MAP	PARCEL	# OF ACRES
210	30	008	365

Place of Water Use (*Mandatory Information, see instructions.*)

Is the groundwater basin where the well will be drilled the same as the place where the water will be used? Yes ☐ No ☒

TOWNSHIP (N/S)	RANGE (E/W)	SECTION	160 ACRE	40 ACRE	10 ACRE
Used as part of the Topock Comp. Station's remediation.					

SECTION 3. OWNER INFORMATION

Well Owner

FULL NAME OF COMPANY, ORGANIZATION, OR INDIVIDUAL: Pacific Gas & Electric Company

MAILING ADDRESS: PG&E Topock Compressor Station PO Box 337

CITY / STATE / ZIP CODE: Needles CA 92363

CONTACT PERSON NAME AND TITLE: Curt Russell Topock Site Manager

TELEPHONE NUMBER: 760-791-5884 FAX: 760-326-5542

Landowner (*if different from Well Owner*)

FULL NAME OF COMPANY, GOVERNMENT AGENCY, OR INDIVIDUAL: Havasu National Wildlife Refuge

MAILING ADDRESS: 317 Mesquite Ave

CITY / STATE / ZIP CODE: Needles, CA 92363

CONTACT PERSON NAME AND TITLE: Linda L. Miller, Refuge Manager

TELEPHONE NUMBER: 760-326-3853 x22 FAX: 760-326-5745

SECTION 4.

Questions	Yes	No	If Yes:
1. Is the proposed well site within 100 feet of a septic tank system, sewer disposal area, landfill, hazardous materials or petroleum storage area or tank?		X	You must also request a variance (A.A.C. R12-15-818).
2. Is there another well name or identification number associated with this well (e.g., Lot 35 Well, Smith Well, etc.)?		X	PLEASE STATE
3. Is the proposed well a NEW well to be located within an Active Management Area? (*See instructions.*)		X	Unless the well is a replacement well and the total number of operable exempt wells on the land is not increasing, you must also file a supplemental form A.R.S. § 45-454(C) & (D).
4. Is the proposed well the second exempt well on this parcel for the same use?		X	If the proposed well is in an Active Management Area, you must also file a supplemental form A.R.S. § 45-454(I).

(Near HNWR-1)

Notice of Intent to Drill, Deepen, Replace or Modify a Well

WELL REGISTRATION NUMBER
55-

SECTION 5. DRILLING AUTHORIZATION	
Drilling Firm	
NAME: Layne Christensen Company, LLC	
DWR LICENSE NUMBER: #7	ROC LICENSE NUMBER: 071734
TELEPHONE NUMBER: 480-267-8416	FAX: 480-895-8699
MAILING ADDRESS: 12030 East Riggs Road	
CITY / STATE / ZIP CODE: Chandler AZ 85249	
DATE CONSTRUCTION IS SCHEDULED TO BEGIN: October 2, 2013	

SECTION 6. WATER / SITE INFORMATION	
Principal Use of Water	**Other Uses of Water**
CHECK ONE	CHECK ALL THAT APPLY
☐ Irrigation	☒ Irrigation
☐ Commercial	☒ Commercial
☐ Domestic	☐ Domestic
☐ Municipal	☐ Municipal
☐ Industrial	☒ Industrial
☐ Stock	☐ Stock
☒ Remediation	☐ Remediation
☐ Dewatering	☐ Dewatering
☐ Other* (please specify):	☐ Other* (please specify):

NOTE: If this is a Notice of Intent to construct a new well that will be used for the purpose of withdrawing groundwater for transportation to an Active Management Area (AMA) pursuant to A.R.S. § 45-552, 45-553, 45-554 or 45-555(A), the authorization to drill the well issued in association with this Notice shall not be considered the approval to transport groundwater to an AMA. *(see instructions.)*

SECTION 7. PROPOSED WELL CONSTRUCTION DESIGN (attach separate sheet if needed)

Borehole			Casing													
DEPTH FROM SURFACE		BOREHOLE DIAMETER (inches)	DEPTH FROM SURFACE		OUTER DIAMETER (inches)	MATERIAL TYPE (T)				PERFORATION TYPE (T)						GROUTING MATERIAL
FROM (feet)	TO (feet)		FROM (feet)	TO (feet)		STEEL	PVC	ABS	IF OTHER TYPE, DESCRIBE	BLANK OR NONE	WIRE WRAP	SHUTTER SCREEN	MILLS KNIFE	SLOTTED	IF OTHER TYPE, DESCRIBE	
0	400	26	0	100	14.625	X*				X						Cement
			100	400	14.625	X					X					

* ADWR well construction standards require a surface seal consisting of a minimum of 20 feet of steel casing. Cement grout must be used to fill the annular space between the surface casing and the borehole. (A.A.C. R12-15-811(B))

The Department's issuance of an authorization to drill a well is not a determination of whether water withdrawn from the well is legally surface water or groundwater. The legal nature of the water withdrawn from the well may be the subject of court action in the future as part of a determination of surface water rights in your area. If there are court proceedings that could affect your well, you will be notified and be given the opportunity to participate. If you have questions regarding the legal nature of the water to be withdrawn from your proposed well, please consult with an experienced civil engineer, hydrologist or water rights attorney.

For the purposes of determining appropriate fees outside AMAs or INAs, "domestic purposes" is defined as "uses related to the supply, service and activities of households and private residences and includes the application of water to less than 2 acres of land to produce plants or parts of plants for sale or human consumption, or for use as feed for livestock, range livestock or poultry, as such terms are defined in A.R.S. § 3-1201."

SECTION 8. OPTIONAL BY PROPERTY OWNER AND WELL OWNER ONLY

☐ By checking this box, I hereby provide ADWR permission to enter the property for the purpose of taking water level measurements at this well. *(See instructions.)*

SECTION 9. WELL OWNER AND PROPERTY OWNER SIGNATURE

I state that this notice is filed in compliance with A.R.S. § 45-596 and is complete and correct to the best of my knowledge and belief.

TYPE OR PRINT NAME AND TITLE: Curt Russell (PG&E Topock Project/Site Manager), Linda Miller (Refuge Manager)

SIGNATURE OF WELL OWNER: [signature] — DATE: 9-26-2013

SIGNATURE OF LANDOWNER, IF APPLICABLE (SEE INSTRUCTIONS): [signature] Refuge Manager — DATE: 09/26/13

(Near HNWR-1)

Notice of Intent to Drill, Deepen, Replace or Modify a Well

WELL REGISTRATION NUMBER
55 -

CHECK ONE: ☒ FILING MANUALLY
☐ FILING ELECTRONICALLY* *DRILLER'S E-MAIL ADDRESS:

*COUNTY OR LOCAL HEALTH AUTHORITY APPROVAL CODE	COUNTY APPROVAL CODE
If applicant is filing this NOI electronically via the ADWR website and County approval is required, please indicate approval by providing a County Approval Code.	NA

WELL SITE PLAN

NAME OF WELL OWNER	COUNTY ASSESSOR'S PARCEL ID NUMBER BOOK	MAP	PARCEL
Pacific Gas & Electric Company	210	30	008

- If this well will be a domestic well on 5 acres or less, please draw the following: (1) the boundaries of your property; (2) the proposed well location; (3) the locations of all septic tank systems and sewer systems on the property or within 100 feet of the well location, even if on neighboring properties; and (4) any permanent structures on the property that may aid in locating the well. If the parcel is vacant land or lacks a septic tank or sewer system, please indicate this.
- Indicate the distance between the proposed well location and any septic tank system or sewer system.

See Attached map.

Located on vacant, Havasu Wildlife Refuge, land.

N W E S

1" = ____ ft

COUNTY OR LOCAL AUTHORITY NAME AND TITLE		Official County or Local Seal or Stamp
COUNTY OR LOCAL AUTHORITY SIGNATURE		
TELEPHONE NUMBER	DATE	

 (Near HNWR-1)

GROUNDWATER PARTNERS	PROJECT NUMBER: 428373.FS.06	WELL ID: HNWR-1/PGE-BH-02	SHEET: 1 OF: 14

SOIL BORING LOG

PROJECT:	Topock Alternative Freshwater Source Evaluation	LOCATION:	HNWR-1 Site: 1.0 mile north of I-40 and HWY 10, Golden Shores, AZ
DRILLING METHOD AND EQUIPMENT:	Dual Rotary, DR-24, 8-inch diameter drive casing		
GROUND SURFACE ELEVATION (FT):	465	DRILLING CONTRACTOR:	Layne Christensen; Driller: S. Walker
LATITUDE:	34° 43' 24.55"	START: 10/16/13	WELL INFO: No Well Installed	WATER LEVEL (FT BGS): NA
LONGITUDE:	114° 28' 42.22"	FINISH: 10/20/13	LOGGER: E. Ludwig P.G., Garrett Frey	TOTAL DEPTH (FT BGS): 400

DEPTH (FT) BELOW SURFACE	MONITORING WELL CONSTRUCTION	USCS GROUP SYMBOL	SOIL DESCRIPTION SOIL NAME, USCS GROUP SYMBOL, COLOR, RELATIVE DENSITY, CONSISTENCY, GRAIN SIZE, GRAIN SHAPE, PLASTICITY	COMMENTS DEPTH OF CASING, PENETRATION RATE, DATE AND TIME
0	NEAT CEMENT GROUT	ML	**SILT WITH GRAVEL (ML)** - Dark grayish brown (10YR 4/2), 95% non-plastic silt, 5% gravel, gravel is coarse to fine, subangular	1145 16/16/2013 Soil samples were collected using a 5-gallon bucket from the cyclone.
5				Dry Slightly moist
10				Moist
15				Wet All sample are saturated below 15 ft
20				1200 10/16/2013
		CL	**LEAN CLAY (CL) -** Dark grayish brown (10YR 4/2), medium plasticity, 95% clay, 5% silt	1228 10/16/2013
25		ML	**SILT WITH GRAVEL (ML)** - Dark grayish brown (10YR 4/2), 95% non-plastic silt, 5% gravel, gravel is coarse to fine, subangular	
30				

GROUNDWATER PARTNERS	PROJECT NUMBER: 428373.FS.06	WELL ID: HNWR-1/PGE-BH-02	SHEET: 2 OF: 14

SOIL BORING LOG

PROJECT:	Topock Alternative Freshwater Source Evaluation	LOCATION:	HNWR-1 Site: 1.0 mile north of I-40 and HWY 10, Golden Shores, AZ
DRILLING METHOD AND EQUIPMENT:	Dual Rotary, DR-24, 8-inch diameter drive casing		
GROUND SURFACE ELEVATION (FT):	465	DRILLING CONTRACTOR:	Layne Christensen; Driller: S. Walker
LATITUDE:	34° 43' 24.55"	START: 10/16/13	WELL INFO: No Well Installed	WATER LEVEL (FT BGS): NA
LONGITUDE:	114° 28' 42.22"	FINISH: 10/20/13	LOGGER: E. Ludwig P.G., Garrett Frey	TOTAL DEPTH (FT BGS): 400

DEPTH (FT) BELOW SURFACE	MONITORING WELL CONSTRUCTION	USCS GROUP SYMBOL	SOIL DESCRIPTION SOIL NAME, USCS GROUP SYMBOL, COLOR, RELATIVE DENSITY, CONSISTENCY, GRAIN SIZE, GRAIN SHAPE, PLASTICITY	COMMENTS DEPTH OF CASING, PENETRATION RATE, DATE AND TIME
30		ML	**SILT WITH GRAVEL (ML)** - Dark grayish brown (10YR 4/2), 95% non-plastic silt, 5% gravel, gravel is coarse to fine, subangular	
35		SP-SM	**POORLY GRADED SAND WITH SILT AND GRAVEL (SP-SM) -** Brown (10YR 5/3) 70% very fine to fine sands, 10% silt, 20% subangular well graded gravel up to 1/2"	
40		GW	**WELL GRADED GRAVEL WITH SAND (GW)** - Dark reddish gray (2.5YR 4/1) and dark greenish gray (GLEY 2 4/1), 60-90% rounded to subangular gravel up to 2", 10-40% poorly graded subangular medium sand	1236 10/16/2013 1311 10/16/2013
45	PEA GRAVEL			Slow penetration rates 45-55'
50				
55				
60				1335 10/16/2013

GROUNDWATER PARTNERS	PROJECT NUMBER: 428373.FS.06	WELL ID: HNWR-1/PGE-BH-02	SHEET: 3	OF: 14

SOIL BORING LOG

PROJECT:	Topock Alternative Freshwater Source Evaluation	LOCATION:	HNWR-1 Site: 1.0 mile north of I-40 and HWY 10, Golden Shores, AZ
DRILLING METHOD AND EQUIPMENT:	Dual Rotary, DR-24, 8-inch diameter drive casing		
GROUND SURFACE ELEVATION (FT):	465	DRILLING CONTRACTOR:	Layne Christensen; Driller: S. Walker
LATITUDE:	34° 43' 24.55"	START: 10/16/13	WELL INFO: No Well Installed	WATER LEVEL (FT BGS): NA
LONGITUDE:	114° 28' 42.22"	FINISH: 10/20/13	LOGGER: E. Ludwig P.G., Garrett Frey	TOTAL DEPTH (FT BGS): 400

DEPTH (FT) BELOW SURFACE	MONITORING WELL CONSTRUCTION	USCS GROUP SYMBOL	SOIL DESCRIPTION SOIL NAME, USCS GROUP SYMBOL, COLOR, RELATIVE DENSITY, CONSISTENCY, GRAIN SIZE, GRAIN SHAPE, PLASTICITY	COMMENTS DEPTH OF CASING, PENETRATION RATE, DATE AND TIME
60				
65				
70				
75	PEA GRAVEL	GW	**WELL GRADED GRAVEL WITH SAND (GW)** - Dark reddish gray (2.5YR 4/1) and dark greenish gray (GLEY 2 4/1), 60-90% rounded to subangular gravel up to 2", 10-40% poorly graded subangular medium sand	
80				1559 10/16/2013 1634 10/16/2013
85				
90				

GROUNDWATER PARTNERS	PROJECT NUMBER: 428373.FS.06	WELL ID: HNWR-1/PGE-BH-02	SHEET: 4 OF: 14

SOIL BORING LOG

PROJECT:	Topock Alternative Freshwater Source Evaluation	LOCATION:	HNWR-1 Site: 1.0 mile north of I-40 and HWY 10, Golden Shores, AZ
DRILLING METHOD AND EQUIPMENT:	Dual Rotary, DR-24, 8-inch diameter drive casing		
GROUND SURFACE ELEVATION (FT):	465	DRILLING CONTRACTOR:	Layne Christensen; Driller: S. Walker
LATITUDE:	34° 43' 24.55"	START: 10/16/13	WELL INFO: No Well Installed	WATER LEVEL (FT BGS): NA
LONGITUDE:	114° 28' 42.22"	FINISH: 10/20/13	LOGGER: E. Ludwig P.G., Garrett Frey	TOTAL DEPTH (FT BGS): 400

DEPTH (FT) BELOW SURFACE	MONITORING WELL CONSTRUCTION	USCS GROUP SYMBOL	SOIL DESCRIPTION SOIL NAME, USCS GROUP SYMBOL, COLOR, RELATIVE DENSITY, CONSISTENCY, GRAIN SIZE, GRAIN SHAPE, PLASTICITY	COMMENTS DEPTH OF CASING, PENETRATION RATE, DATE AND TIME
90				
95				
100				1647 13/16/2013 0834 13/17/2013
105	P5A-GR/A/GL	GW	**WELL GRADED GRAVEL WITH SAND (GW)** - Dark reddish gray (2.5YR 4/1) and dark greenish gray (GLEY 2 4/1), 60-90% rounded to subangular gravel up to 2", 10-40% poorly graded subangular medium sand	
110				
115				
120				0848 10/17/2013

GROUNDWATER PARTNERS	PROJECT NUMBER: 428373.FS.06	WELL ID: HNWR-1/PGE-BH-02	SHEET: 5 OF: 14

SOIL BORING LOG

PROJECT:	Topock Alternative Freshwater Source Evaluation	LOCATION:	HNWR-1 Site: 1.0 mile north of I-40 and HWY 10, Golden Shores, AZ
DRILLING METHOD AND EQUIPMENT:	Dual Rotary, DR-24, 8-inch diameter drive casing		
GROUND SURFACE ELEVATION (FT):	465	DRILLING CONTRACTOR:	Layne Christensen; Driller: S. Walker
LATITUDE:	34° 43' 24.55"	START: 10/16/13	WELL INFO: No Well Installed	WATER LEVEL (FT BGS): NA
LONGITUDE:	114° 28' 42.22"	FINISH: 10/20/13	LOGGER: E. Ludwig P.G., Garrett Frey	TOTAL DEPTH (FT BGS): 400

DEPTH (FT) BELOW SURFACE	MONITORING WELL CONSTRUCTION	USCS GROUP SYMBOL	SOIL DESCRIPTION SOIL NAME, USCS GROUP SYMBOL, COLOR, RELATIVE DENSITY, CONSISTENCY, GRAIN SIZE, GRAIN SHAPE, PLASTICITY	COMMENTS DEPTH OF CASING, PENETRATION RATE, DATE AND TIME
120				
125				1218 10/17/2013
				1250 10/17/2013
130				
135	PGA/GRA/GL	GW	**WELL GRADED GRAVEL WITH SAND (GW)** - Dark reddish gray (2.5YR 4/1) and dark greenish gray (GLEY 2 4/1), 60-90% rounded to subangular gravel up to 2", 10-40% poorly graded subangular medium sand	
140				0935 10/17/2013
				1016 10/17/2013
145				
150				1018 10/17/2013

GROUNDWATER PARTNERS	PROJECT NUMBER: 428373.FS.06	WELL ID: HNWR-1/PGE-BH-02	SHEET: 6 OF: 14

SOIL BORING LOG

PROJECT:	Topock Alternative Freshwater Source Evaluation	LOCATION:	HNWR-1 Site: 1.0 mile north of I-40 and HWY 10, Golden Shores, AZ
DRILLING METHOD AND EQUIPMENT:	Dual Rotary, DR-24, 8-inch diameter drive casing		
GROUND SURFACE ELEVATION (FT):	465	DRILLING CONTRACTOR:	Layne Christensen; Driller: S. Walker
LATITUDE:	34° 43' 24.55"	START: 10/16/13	WELL INFO: No Well Installed	WATER LEVEL (FT BGS): NA
LONGITUDE:	114° 28' 42.22"	FINISH: 10/20/13	LOGGER: E. Ludwig P.G., Garrett Frey	TOTAL DEPTH (FT BGS): 400

DEPTH (FT) BELOW SURFACE	MONITORING WELL CONSTRUCTION	USCS GROUP SYMBOL	SOIL DESCRIPTION SOIL NAME, USCS GROUP SYMBOL, COLOR, RELATIVE DENSITY, CONSISTENCY, GRAIN SIZE, GRAIN SHAPE, PLASTICITY	COMMENTS DEPTH OF CASING, PENETRATION RATE, DATE AND TIME
150				1350 10/17/2013
155				
160				
165	PEA/GRAVEL	GW	**WELL GRADED GRAVEL WITH SAND (GW)** - Dark reddish gray (2.5YR 4/1) and dark greenish gray (GLEY 2 4/1), 60-90% rounded to subangular gravel up to 2", 10-40% poorly graded subangular medium sand	
170				1410 10/17/2013 1442 10/17/2013
175				
180				

GROUNDWATER PARTNERS	PROJECT NUMBER: 428373.FS.06	WELL ID: HNWR-1/PGE-BH-02	SHEET: 7 OF: 14

SOIL BORING LOG

PROJECT:	Topock Alternative Freshwater Source Evaluation	LOCATION:	HNWR-1 Site: 1.0 mile north of I-40 and HWY 10, Golden Shores, AZ
DRILLING METHOD AND EQUIPMENT:	Dual Rotary, DR-24, 8-inch diameter drive casing		
GROUND SURFACE ELEVATION (FT):	465	DRILLING CONTRACTOR:	Layne Christensen; Driller: S. Walker
LATITUDE:	34° 43' 24.55"	START: 10/16/13	WELL INFO: No Well Installed	WATER LEVEL (FT BGS): NA
LONGITUDE:	114° 28' 42.22"	FINISH: 10/20/13	LOGGER: E. Ludwig P.G., Garrett Frey	TOTAL DEPTH (FT BGS): 400

DEPTH (FT) BELOW SURFACE	MONITORING WELL CONSTRUCTION	USCS GROUP SYMBOL	SOIL DESCRIPTION SOIL NAME, USCS GROUP SYMBOL, COLOR, RELATIVE DENSITY, CONSISTENCY, GRAIN SIZE, GRAIN SHAPE, PLASTICITY	COMMENTS DEPTH OF CASING, PENETRATION RATE, DATE AND TIME
180				
185				
190				1457 10/17/2013 1537 10/17/2013
195	PEA/GRAVEL	GW	**WELL GRADED GRAVEL WITH SAND (GW)** - Dark reddish gray (2.5YR 4/1) and dark greenish gray (GLEY 2 4/1), 60-90% rounded to subangular gravel up to 2", 10-40% poorly graded subangular medium sand	
200				1545 10/17/2013 0818 10/18/2013
205				
210				

GROUNDWATER PARTNERS	PROJECT NUMBER: 428373.FS.06	WELL ID: HNWR-1/PGE-BH-02	SHEET: 8 OF: 14

SOIL BORING LOG

PROJECT:	Topock Alternative Freshwater Source Evaluation	LOCATION:	HNWR-1 Site: 1.0 mile north of I-40 and HWY 10, Golden Shores, AZ
DRILLING METHOD AND EQUIPMENT:	Dual Rotary, DR-24, 8-inch diameter drive casing		
GROUND SURFACE ELEVATION (FT):	465	DRILLING CONTRACTOR:	Layne Christensen; Driller: S. Walker
LATITUDE:	34° 43' 24.55"	START: 10/16/13	WELL INFO: No Well Installed	WATER LEVEL (FT BGS): NA
LONGITUDE:	114° 28' 42.22"	FINISH: 10/20/13	LOGGER: E. Ludwig P.G., Garrett Frey	TOTAL DEPTH (FT BGS): 400

DEPTH (FT) BELOW SURFACE	MONITORING WELL CONSTRUCTION	USCS GROUP SYMBOL	SOIL DESCRIPTION SOIL NAME, USCS GROUP SYMBOL, COLOR, RELATIVE DENSITY, CONSISTENCY, GRAIN SIZE, GRAIN SHAPE, PLASTICITY	COMMENTS DEPTH OF CASING, PENETRATION RATE, DATE AND TIME
210				
215				
220				0834 10/18/2013 0900 10/18/2013
225	PEA GRAVEL	GW	**WELL GRADED GRAVEL WITH SAND (GW)** - Dark reddish gray (2.5YR 4/1) and dark greenish gray (GLEY 2 4/1), 60-90% rounded to subangular gravel up to 2", 10-40% poorly graded subangular medium sand	
230				
235				
240				0913 10/18/2013

GROUNDWATER PARTNERS	PROJECT NUMBER: 428373.FS.06	WELL ID: HNWR-1/PGE-BH-02	SHEET: 9 OF: 14

SOIL BORING LOG

PROJECT:	Topock Alternative Freshwater Source Evaluation	LOCATION:	HNWR-1 Site: 1.0 mile north of I-40 and HWY 10, Golden Shores, AZ
DRILLING METHOD AND EQUIPMENT:	Dual Rotary, DR-24, 8-inch diameter drive casing		
GROUND SURFACE ELEVATION (FT):	465	DRILLING CONTRACTOR:	Layne Christensen; Driller: S. Walker
LATITUDE:	34° 43' 24.55"	START: 10/16/13	WELL INFO: No Well Installed	WATER LEVEL (FT BGS): NA
LONGITUDE:	114° 28' 42.22"	FINISH: 10/20/13	LOGGER: E. Ludwig P.G., Garrett Frey	TOTAL DEPTH (FT BGS): 400

DEPTH (FT) BELOW SURFACE	MONITORING WELL CONSTRUCTION	USCS GROUP SYMBOL	SOIL DESCRIPTION SOIL NAME, USCS GROUP SYMBOL, COLOR, RELATIVE DENSITY, CONSISTENCY, GRAIN SIZE, GRAIN SHAPE, PLASTICITY	COMMENTS DEPTH OF CASING, PENETRATION RATE, DATE AND TIME
240				0943 10/18/2013
245				
250				
255	PGA-GRAVEL	GW	**WELL GRADED GRAVEL WITH SAND (GW)** - Dark reddish gray (2.5YR 4/1) and dark greenish gray (GLEY 2 4/1), 60-90% rounded to subangular gravel up to 2", 10-40% poorly graded subangular medium sand	0950 10/18/2013 1328 10/18/2013
260				1337 10/18/2013 1453 10/18/2013
265				
270				

GROUNDWATER PARTNERS	PROJECT NUMBER: 428373.FS.06	WELL ID: HNWR-1/PGE-BH-02	SHEET: 10 OF: 14

SOIL BORING LOG

PROJECT:	Topock Alternative Freshwater Source Evaluation	LOCATION:	HNWR-1 Site: 1.0 mile north of I-40 and HWY 10, Golden Shores, AZ
DRILLING METHOD AND EQUIPMENT:	Dual Rotary, DR-24, 8-inch diameter drive casing		
GROUND SURFACE ELEVATION (FT):	465	DRILLING CONTRACTOR:	Layne Christensen; Driller: S. Walker
LATITUDE:	34° 43' 24.55"	START: 10/16/13	WELL INFO: No Well Installed	WATER LEVEL (FT BGS): NA
LONGITUDE:	114° 28' 42.22"	FINISH: 10/20/13	LOGGER: E. Ludwig P.G., Garrett Frey	TOTAL DEPTH (FT BGS): 400

DEPTH (FT) BELOW SURFACE	MONITORING WELL CONSTRUCTION	USCS GROUP SYMBOL	SOIL DESCRIPTION SOIL NAME, USCS GROUP SYMBOL, COLOR, RELATIVE DENSITY, CONSISTENCY, GRAIN SIZE, GRAIN SHAPE, PLASTICITY	COMMENTS DEPTH OF CASING, PENETRATION RATE, DATE AND TIME
270				
275				
280				1424 10/18/2013
				1458 10/18/2013
285	PEA GRAVEL	GW	**WELL GRADED GRAVEL WITH SAND (GW)** - Dark reddish gray (2.5YR 4/1) and dark greenish gray (GLEY 2 4/1), 60-90% rounded to subangular gravel up to 2", 10-40% poorly graded subangular medium sand	Slow penetration rates
290				
295				
300				1523 10/18/2013

GROUNDWATER PARTNERS	PROJECT NUMBER: 428373.FS.06	WELL ID: HNWR-1/PGE-BH-02	SHEET: 11 OF: 14

SOIL BORING LOG

PROJECT:	Topock Alternative Freshwater Source Evaluation	LOCATION:	HNWR-1 Site: 1.0 mile north of I-40 and HWY 10, Golden Shores, AZ
DRILLING METHOD AND EQUIPMENT:	Dual Rotary, DR-24, 8-inch diameter drive casing		
GROUND SURFACE ELEVATION (FT):	465	DRILLING CONTRACTOR:	Layne Christensen; Driller: S. Walker
LATITUDE:	34° 43' 24.55"	START: 10/16/13	WELL INFO: No Well Installed	WATER LEVEL (FT BGS): NA
LONGITUDE:	114° 28' 42.22"	FINISH: 10/20/13	LOGGER: E. Ludwig P.G., Garrett Frey	TOTAL DEPTH (FT BGS): 400

DEPTH (FT) BELOW SURFACE	MONITORING WELL CONSTRUCTION	USCS GROUP SYMBOL	SOIL DESCRIPTION SOIL NAME, USCS GROUP SYMBOL, COLOR, RELATIVE DENSITY, CONSISTENCY, GRAIN SIZE, GRAIN SHAPE, PLASTICITY	COMMENTS DEPTH OF CASING, PENETRATION RATE, DATE AND TIME
300				1035 10/19/2013
305				
310				
315	-PEA-GRAVEL-	GW	**WELL GRADED GRAVEL WITH SAND (GW)** - Dark reddish gray (2.5YR 4/1) and dark greenish gray (GLEY 2 4/1), 60-90% rounded to subangular gravel up to 2", 10-40% poorly graded subangular medium sand	
320				1058 10/19/2013 1131 10/19/2013
325				
330				

GROUNDWATER PARTNERS	428373.FS.06	WELL ID: HNWR-1/PGE-BH-02	SHEET: 12 OF: 14

SOIL BORING LOG

PROJECT:	Topock Alternative Freshwater Source Evaluation	LOCATION:	HNWR-1 Site: 1.0 mile north of I-40 and HWY 10, Golden Shores, AZ
DRILLING METHOD AND EQUIPMENT:	Dual Rotary, DR-24, 8-inch diameter drive casing		
GROUND SURFACE ELEVATION (FT):	465	DRILLING CONTRACTOR:	Layne Christensen; Driller: S. Walker
LATITUDE:	34° 43' 24.55"	START: 10/16/13	WELL INFO: No Well Installed	WATER LEVEL (FT BGS): NA
LONGITUDE:	114° 28' 42.22"	FINISH: 10/20/13	LOGGER: E. Ludwig P.G., Garrett Frey	TOTAL DEPTH (FT BGS): 400

DEPTH (FT) BELOW SURFACE	MONITORING WELL CONSTRUCTION	USCS GROUP SYMBOL	SOIL DESCRIPTION SOIL NAME, USCS GROUP SYMBOL, COLOR, RELATIVE DENSITY, CONSISTENCY, GRAIN SIZE, GRAIN SHAPE, PLASTICITY	COMMENTS DEPTH OF CASING, PENETRATION RATE, DATE AND TIME
330				
335				
340				1151 10/19/2013 1234 10/19/2013
345	-PEA-GRAVEL-	GW	**WELL GRADED GRAVEL WITH SAND (GW)** - Dark reddish gray (2.5YR 4/1) and dark greenish gray (GLEY 2 4/1), 60-90% rounded to subangular gravel up to 2", 10-40% poorly graded subangular medium sand	
350				1243 10/19/2013 1720 10/19/2013
355				
360				1730 10/19/2013

GROUNDWATER PARTNERS	. 428373.FS.06	WELL ID: HNWR-1/PGE-BH-02	SHEET: 13 OF: 14

SOIL BORING LOG

PROJECT:	Topock Alternative Freshwater Source Evaluation	LOCATION:	HNWR-1 Site: 1.0 mile north of I-40 and HWY 10, Golden Shores, AZ
DRILLING METHOD AND EQUIPMENT:	Dual Rotary, DR-24, 8-inch diameter drive casing		
GROUND SURFACE ELEVATION (FT):	465	DRILLING CONTRACTOR:	Layne Christensen; Driller: S. Walker
LATITUDE:	34° 43' 24.55"	START: 10/16/13	WELL INFO: No Well Installed	WATER LEVEL (FT BGS): NA
LONGITUDE:	114° 28' 42.22"	FINISH: 10/20/13	LOGGER: E. Ludwig P.G., Garrett Frey	TOTAL DEPTH (FT BGS): 400

DEPTH (FT) BELOW SURFACE	MONITORING WELL CONSTRUCTION	USCS GROUP SYMBOL	SOIL DESCRIPTION SOIL NAME, USCS GROUP SYMBOL, COLOR, RELATIVE DENSITY, CONSISTENCY, GRAIN SIZE, GRAIN SHAPE, PLASTICITY	COMMENTS DEPTH OF CASING, PENETRATION RATE, DATE AND TIME
360				0745 10/20/13
365				
370				
375	-PEA-GRAVEL-	GW	**WELL GRADED GRAVEL WITH SAND (GW)** - Dark reddish gray (2.5YR 4/1) and dark greenish gray (GLEY 2 4/1), 60-90% rounded to subangular gravel up to 2", 10-40% poorly graded subangular medium sand	
380				0815 10/20/2013 0920 10/20/2013
385				
390				

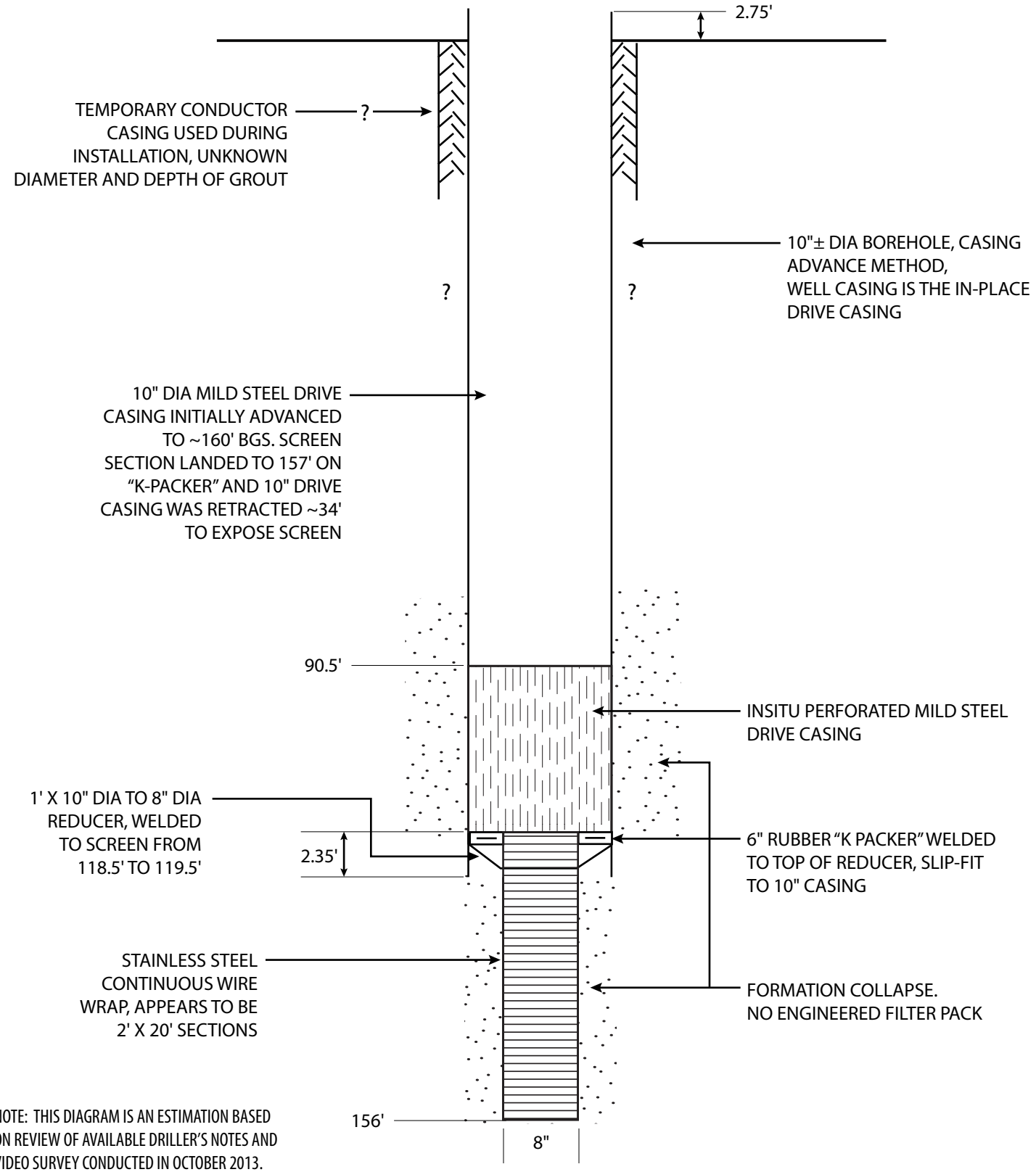
GROUNDWATER PARTNERS	. 428373.FS.06	WELL ID: HNWR-1/PGE-BH-02	SHEET: 14	OF: 14

SOIL BORING LOG

PROJECT:	*Topock Alternative Freshwater Source Evaluation*	LOCATION:	*HNWR-1 Site: 1.0 mile north of I-40 and HWY 10, Golden Shores, AZ*
DRILLING METHOD AND EQUIPMENT:	*Dual Rotary, DR-24, 8-inch diameter drive casing*		
GROUND SURFACE ELEVATION (FT):	*465*	DRILLING CONTRACTOR:	Layne Christensen; Driller: S. Walker
LATITUDE:	*34° 43' 24.55"*	START: *10/16/13*	WELL INFO: *No Well Installed*	WATER LEVEL (FT BGS): *NA*
LONGITUDE:	*114° 28' 42.22"*	FINISH: *10/20/13*	LOGGER: *E. Ludwig P.G., Garrett Frey*	TOTAL DEPTH (FT BGS): *400*

DEPTH (FT) BELOW SURFACE	MONITORING WELL CONSTRUCTION	USCS GROUP SYMBOL	SOIL DESCRIPTION SOIL NAME, USCS GROUP SYMBOL, COLOR, RELATIVE DENSITY, CONSISTENCY, GRAIN SIZE, GRAIN SHAPE, PLASTICITY	COMMENTS DEPTH OF CASING, PENETRATION RATE, DATE AND TIME
390				
395		GW	**WELL GRADED GRAVEL WITH SAND (GW)** - Dark reddish gray (2.5YR 4/1) and dark greenish gray (GLEY 2 4/1), 60-90% rounded to subangular gravel up to 2", 10-40% poorly graded subangular medium sand	
400				Total depth of pilot borehole: 400 ft. 0955 10/20/2013

CH2MHILL®	PROJECT NUMBER: 428373.FS.06	WELL NUMBER: HNWR-1
	WELL COMPLETION DIAGRAM	
PROJECT: Topock Alternative Freshwater Source Evaluation		LOCATION: 0.3 mi north I-40 & HWY 10, Golden Shores, AZ
DRILLING METHOD/EQUIPMENT: Casing advance (unknown) - *see note below*		
DRILLING CONTRACTOR: ADT Drilling	START: 10/25/2010 END: 11/4/2010	LOGGER: R. Firasch (driller)
34° 43' 24", 114° 28' 42"	SURFACE ELEVATION (FT): 465	DEPTH TO WATER (FT): 9



NOTE: THIS DIAGRAM IS AN ESTIMATION BASED ON REVIEW OF AVAILABLE DRILLER'S NOTES AND VIDEO SURVEY CONDUCTED IN OCTOBER 2013.

Layne Christensen Co.
12030 E. Riggs Rd.
Chandler, AZ. 85249
Phone: (480) 895-9404

Well Inspection Report

CLIENT: CH2M HILL
ADDRESS:
CONTACT: ELI LUDWIG
JOB LOCATION: TOPOCK AZ

WELL NUMBER: HNWR-1 **JOB NUMBER:** 27178

SURVEYED BY: G SQUIRES **DATE:** OCT21/13

REVIEWED BY: **WATER LEVEL:** 7'10"

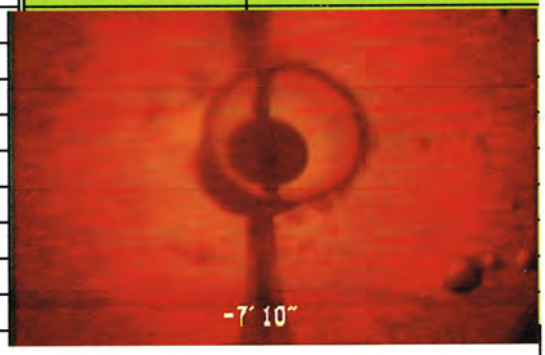
WATER CONDITION: MOSTLY CLEAR **TOTAL DEPTH:** Unknown

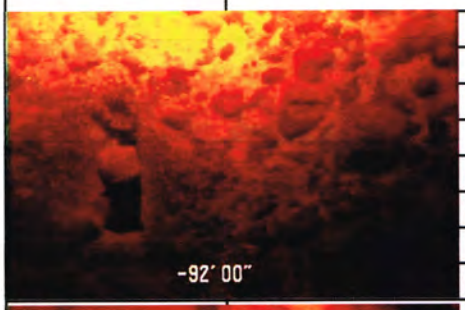
CASING DIAMETER: 10" REDUCES TO 8" AT 118'6" **SURVEY DEPTH:** 156'2"

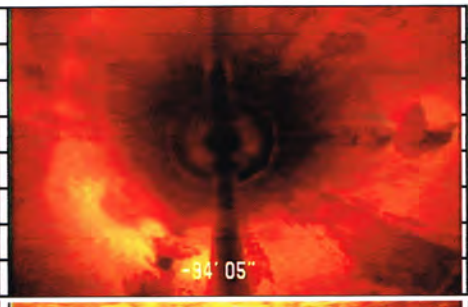
NOTES:

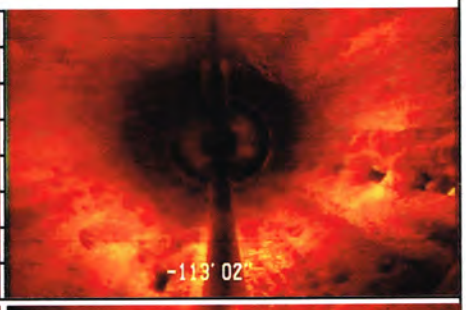
DEPTH	REMARKS
0-	TOP OF FLANGE SIDE VIEW
7'10"	STATIC WATER LEVEL (CLOUDY)
50'	WATER STARTS TO CLEAR
85'	SLIGHTLY HEAVIER SCALE
90'7	START PERFS ROLLER PERFS
118'6"	REDUCTION TO 8"
119'4"	TRANSITION TO WIRE WRAP SCREEN
121'2"	PARTIALLY PLUGGED SCREEN
156'2"	TOP OF SOFT FILL PAPER DEBRIS IN WELL

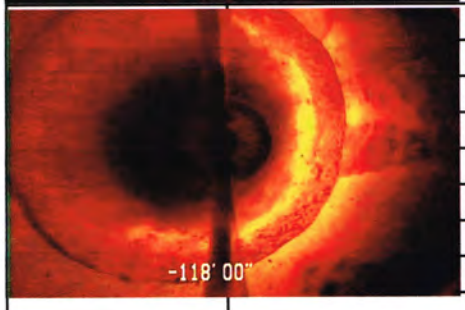
Perforation:	ROLLER PERFS
90'7"-156'2"	WIRE WRAP SCREEN

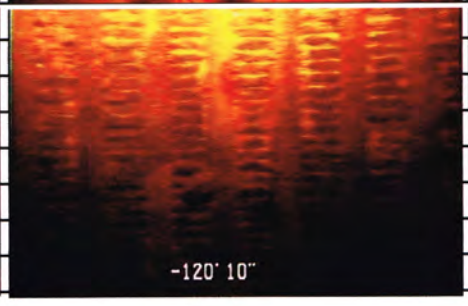


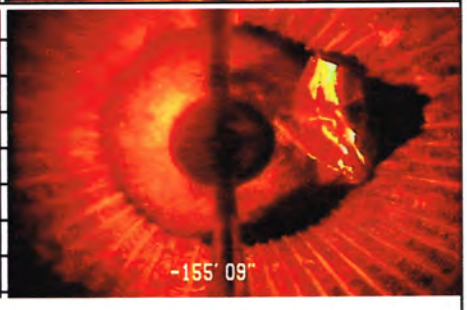












Attachment B
Well and Aquifer Testing Data

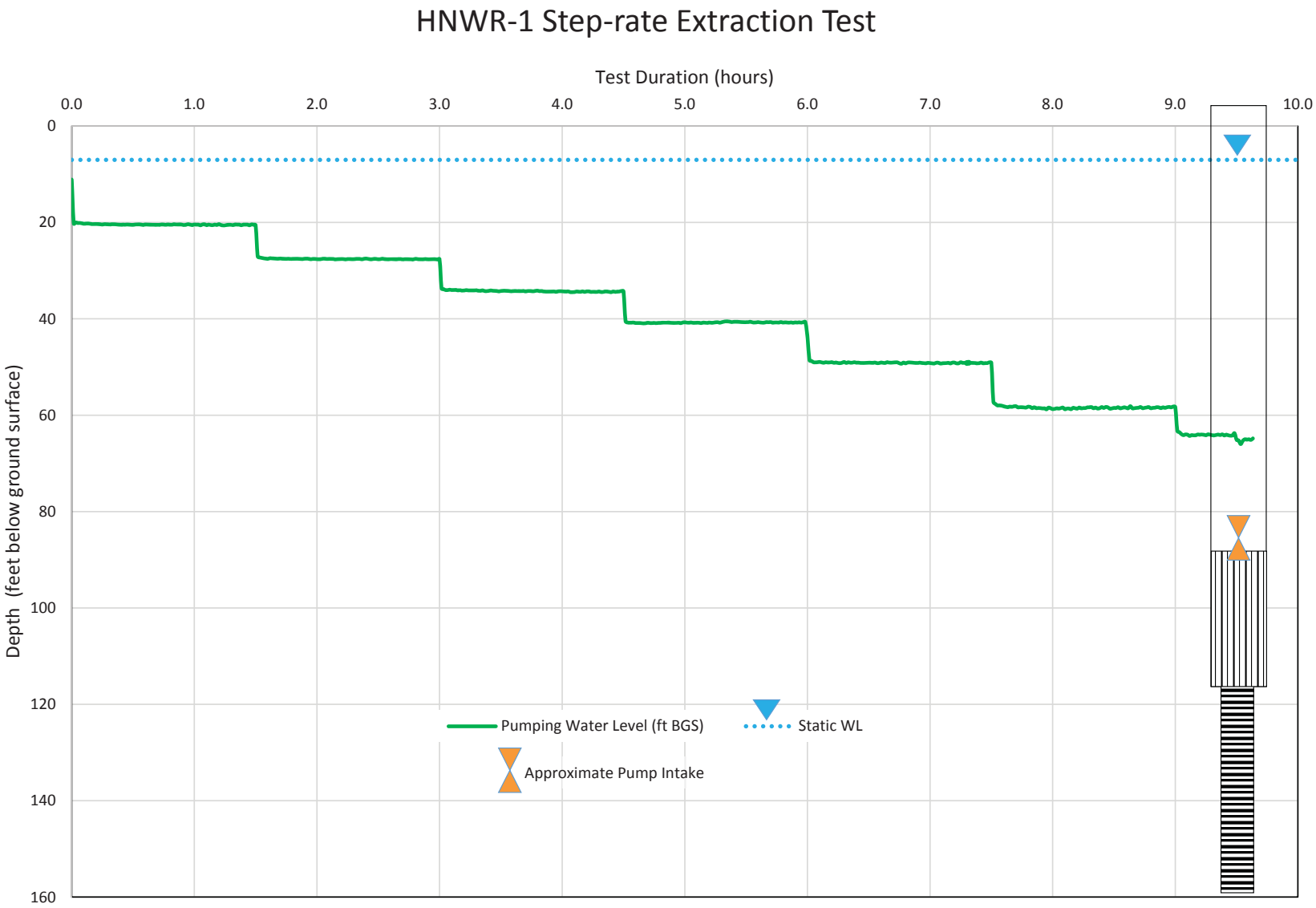


FIGURE B-1
Attachment B – Well and Aquifer Testing Data
Summary of Findings Associated with the Evaluation of
Alternative Freshwater Sources in the Topock Remediation Project Area
Pacific Gas and Electric Company
Topock Compressor Station, Needles, California

CH2MHILL®

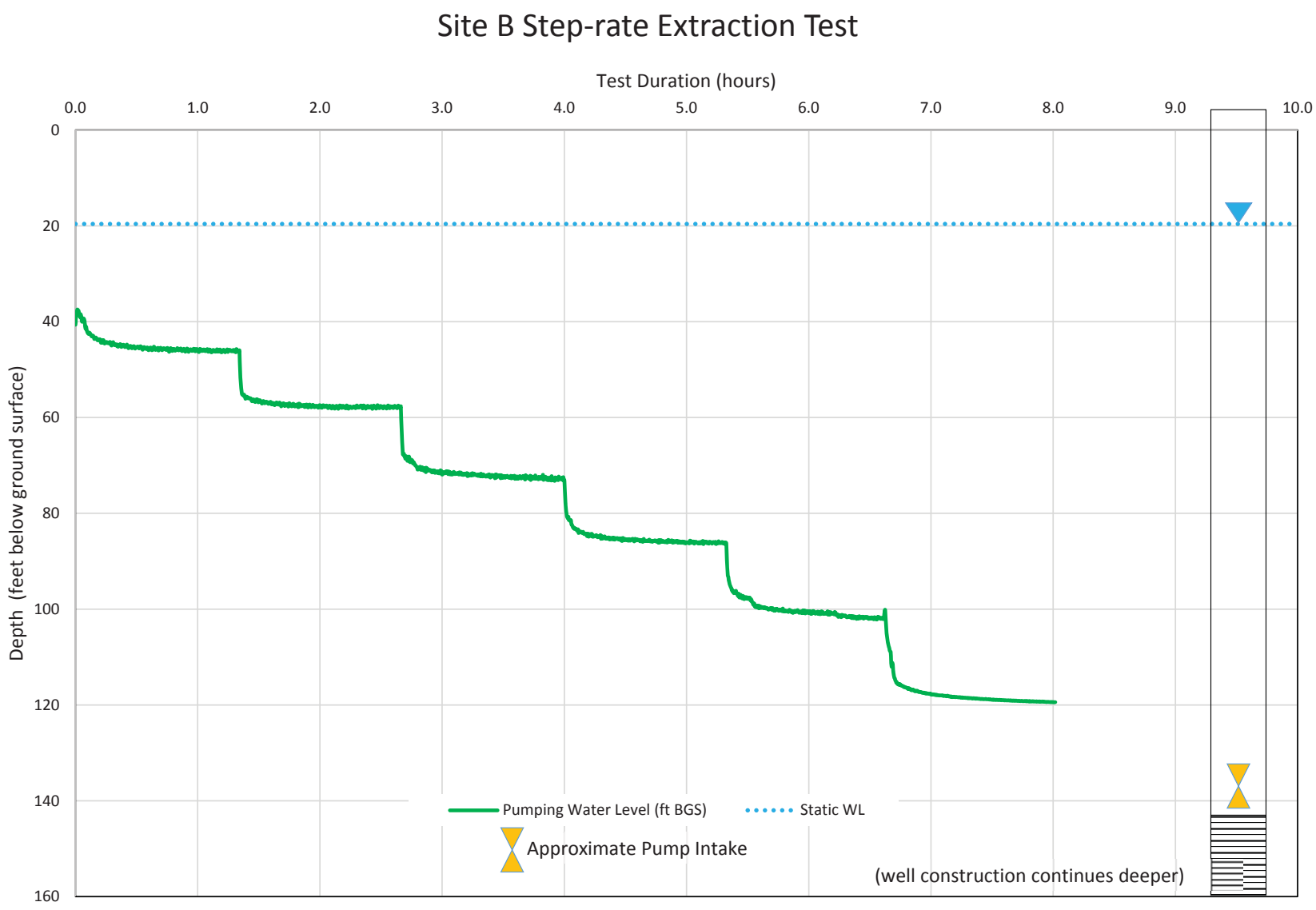


FIGURE B-2
Attachment B – Well and Aquifer Testing Data
Summary of Findings Associated with the Evaluation of
Alternative Freshwater Sources in the Topock Remediation Project Area
Pacific Gas and Electric Company
Topock Compressor Station, Needles, California

CH2MHILL

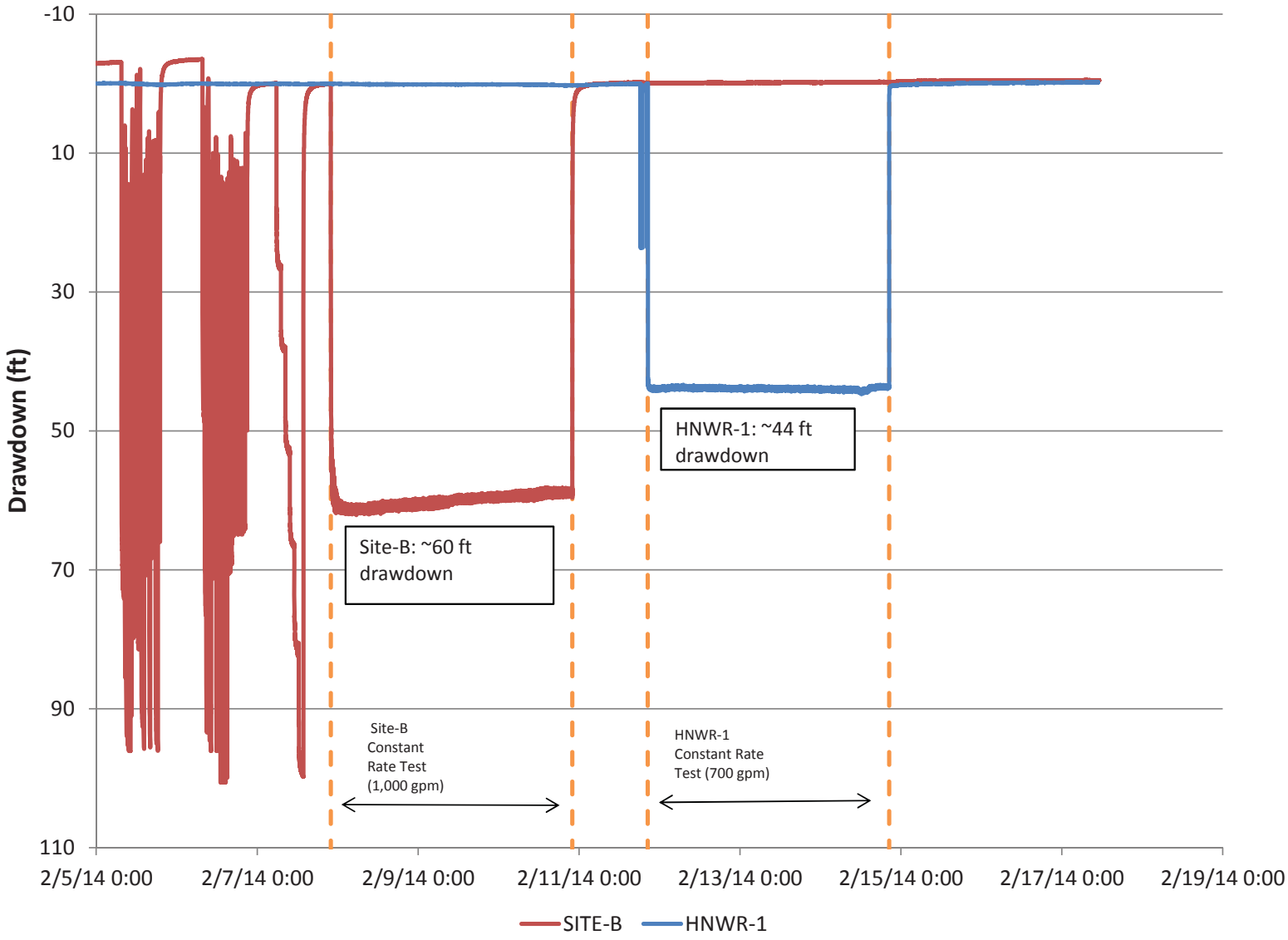


FIGURE B-3
Attachment B – Well and Aquifer Testing Data
Summary of Findings Associated with the Evaluation of
Alternative Freshwater Sources in the Topock Remediation Project Area
Pacific Gas and Electric Company
Topock Compressor Station, Needles, California

CH2MHILL®

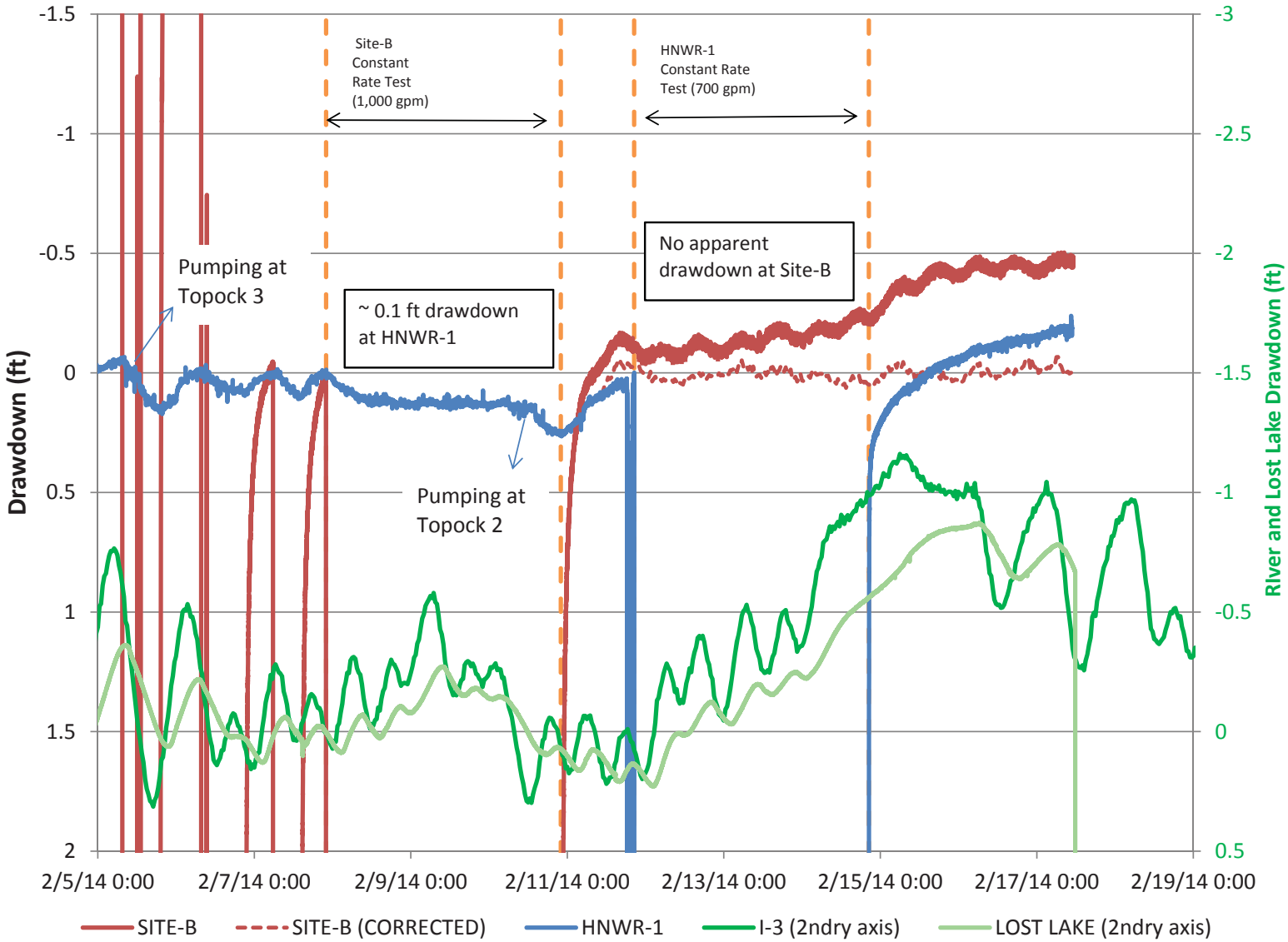


FIGURE B-4
Attachment B – Well and Aquifer Testing Data
Summary of Findings Associated with the Evaluation of
Alternative Freshwater Sources in the Topock Remediation Project Area
Pacific Gas and Electric Company
Topock Compressor Station, Needles, California

CH2MHILL.

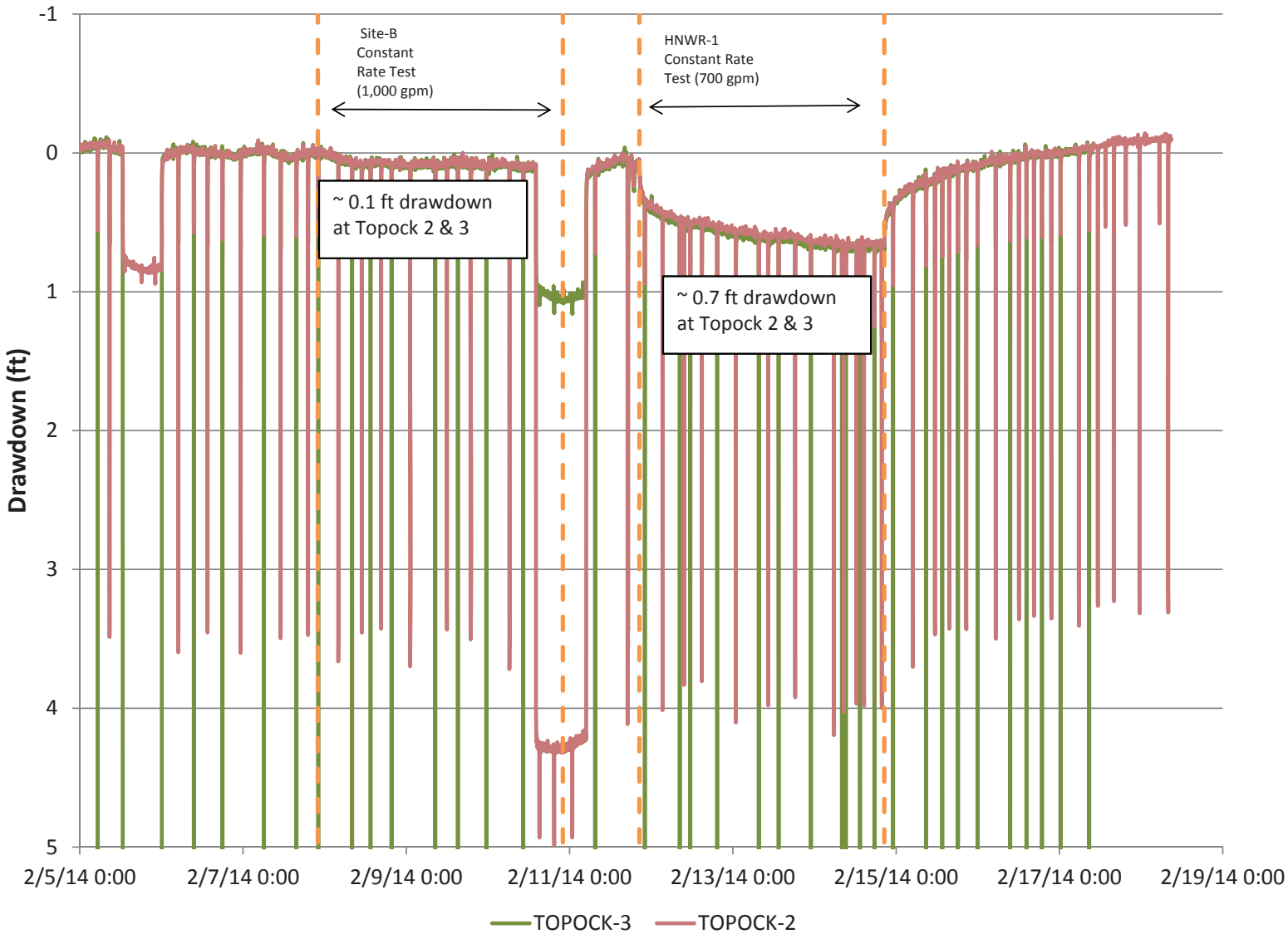


FIGURE B-5
Attachment B – Well and Aquifer Testing Data
Summary of Findings Associated with the Evaluation of
Alternative Freshwater Sources in the Topock Remediation Project Area
Pacific Gas and Electric Company
Topock Compressor Station, Needles, California

CH2MHILL®

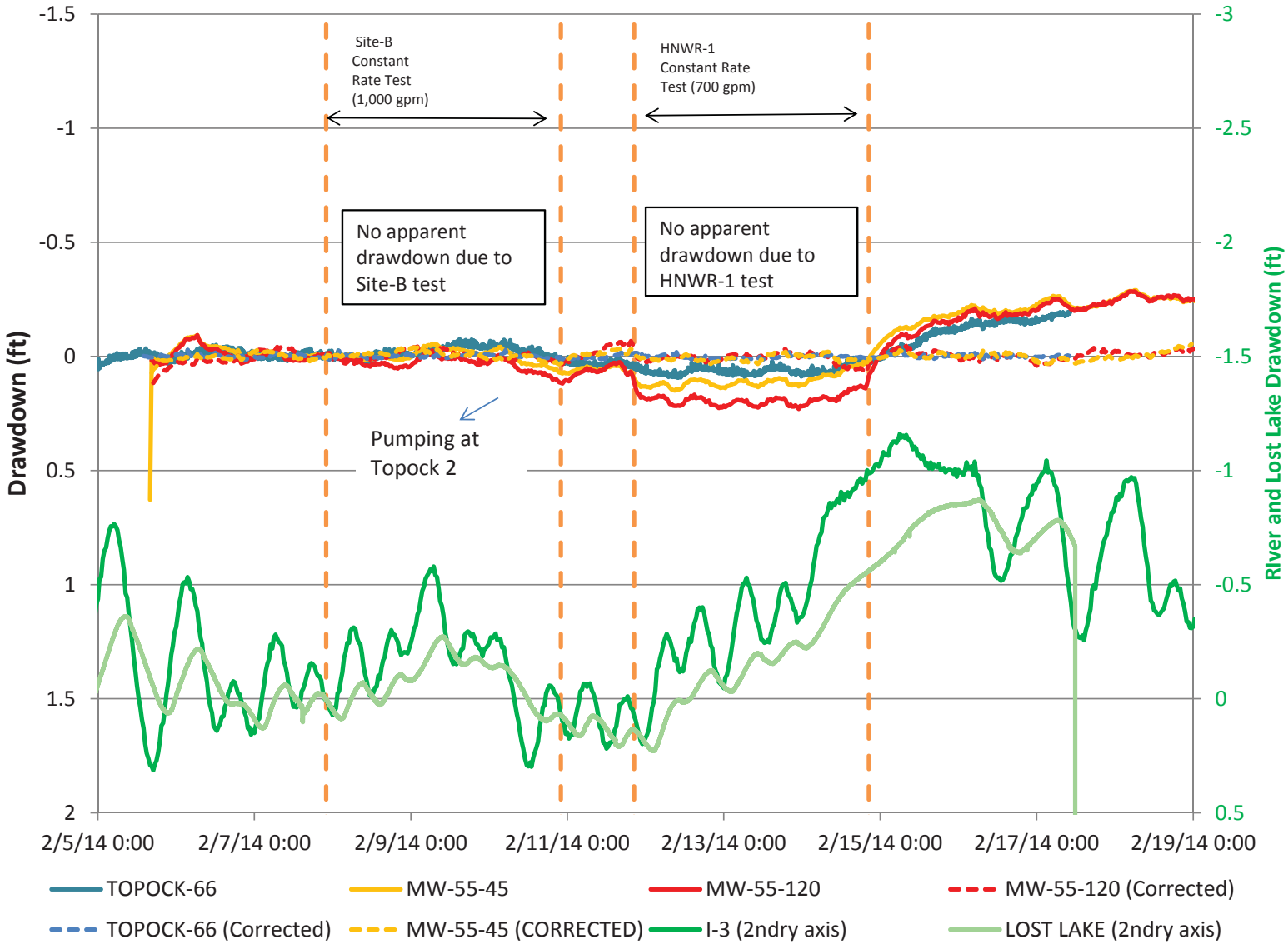


FIGURE B-6
Attachment B – Well and Aquifer Testing Data
Summary of Findings Associated with the Evaluation of
Alternative Freshwater Sources in the Topock Remediation Project Area
Pacific Gas and Electric Company
Topock Compressor Station, Needles, California

CH2MHILL

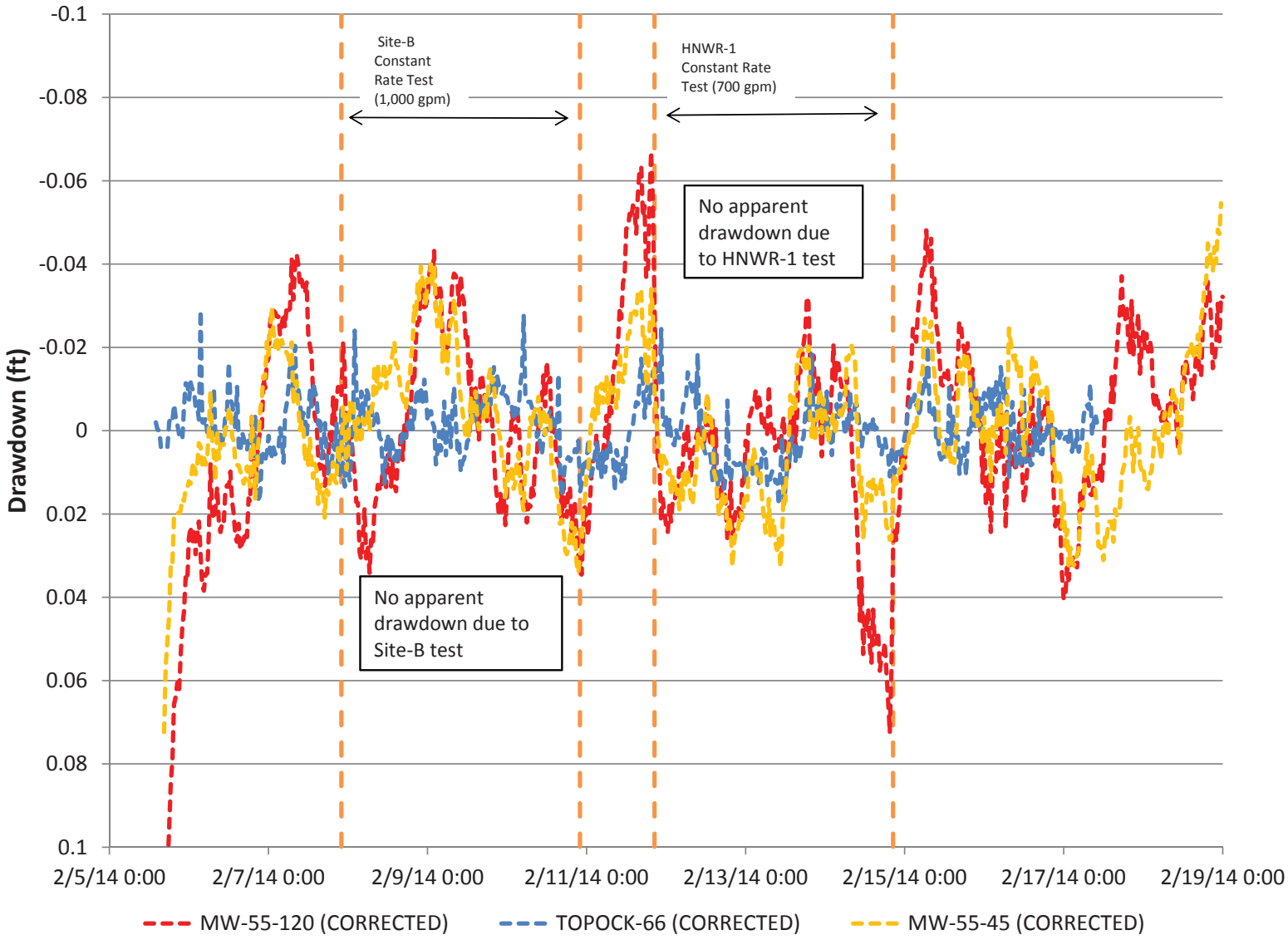


FIGURE B-7
Attachment B – Well and Aquifer Testing Data
Summary of Findings Associated with the Evaluation of
Alternative Freshwater Sources in the Topock Remediation Project Area
Pacific Gas and Electric Company
Topock Compressor Station, Needles, California

CH2MHILL®

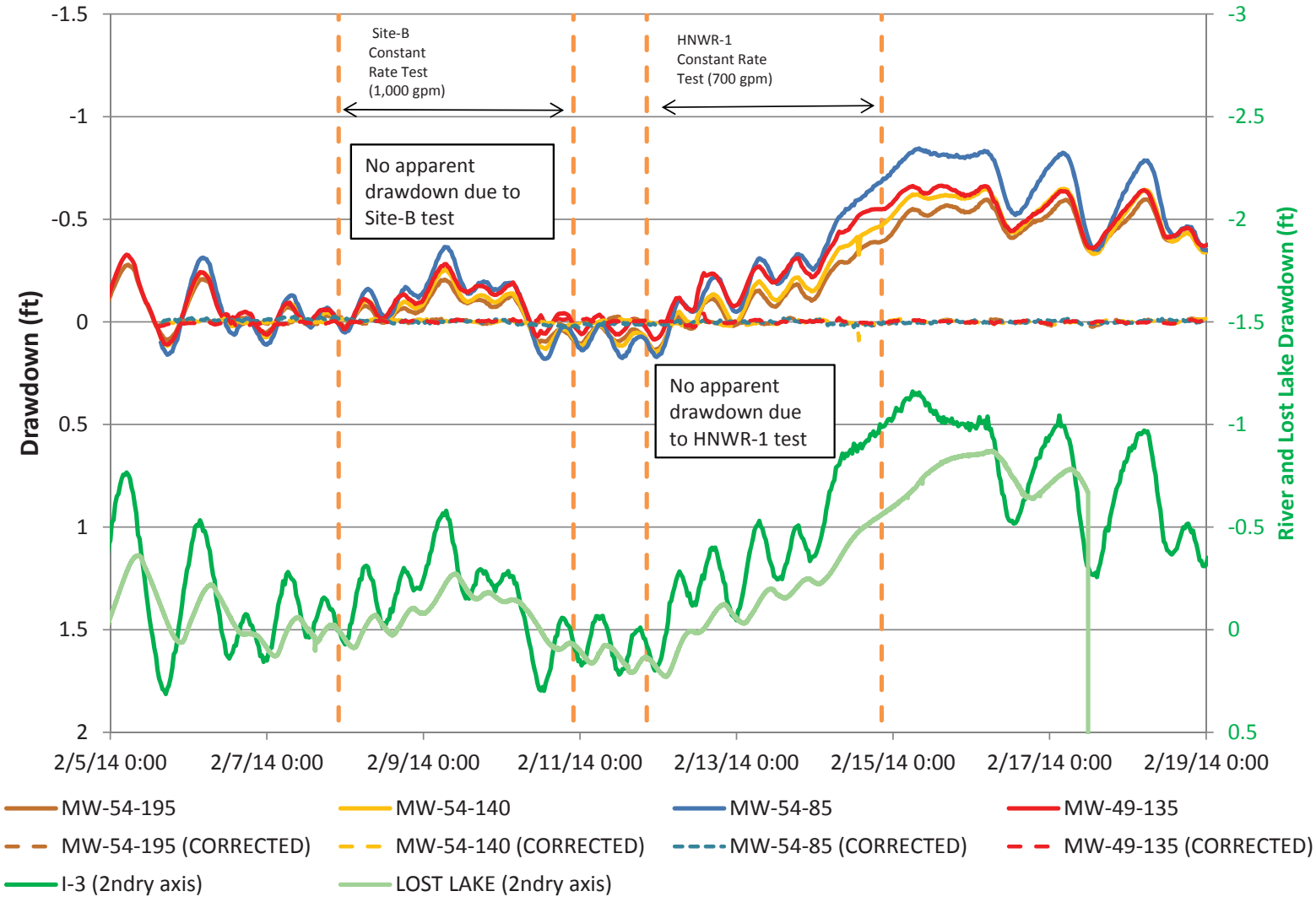


FIGURE B-8
Attachment B – Well and Aquifer Testing Data
Summary of Findings Associated with the Evaluation of
Alternative Freshwater Sources in the Topock Remediation Project Area
Pacific Gas and Electric Company
Topock Compressor Station, Needles, California

CH2MHILL

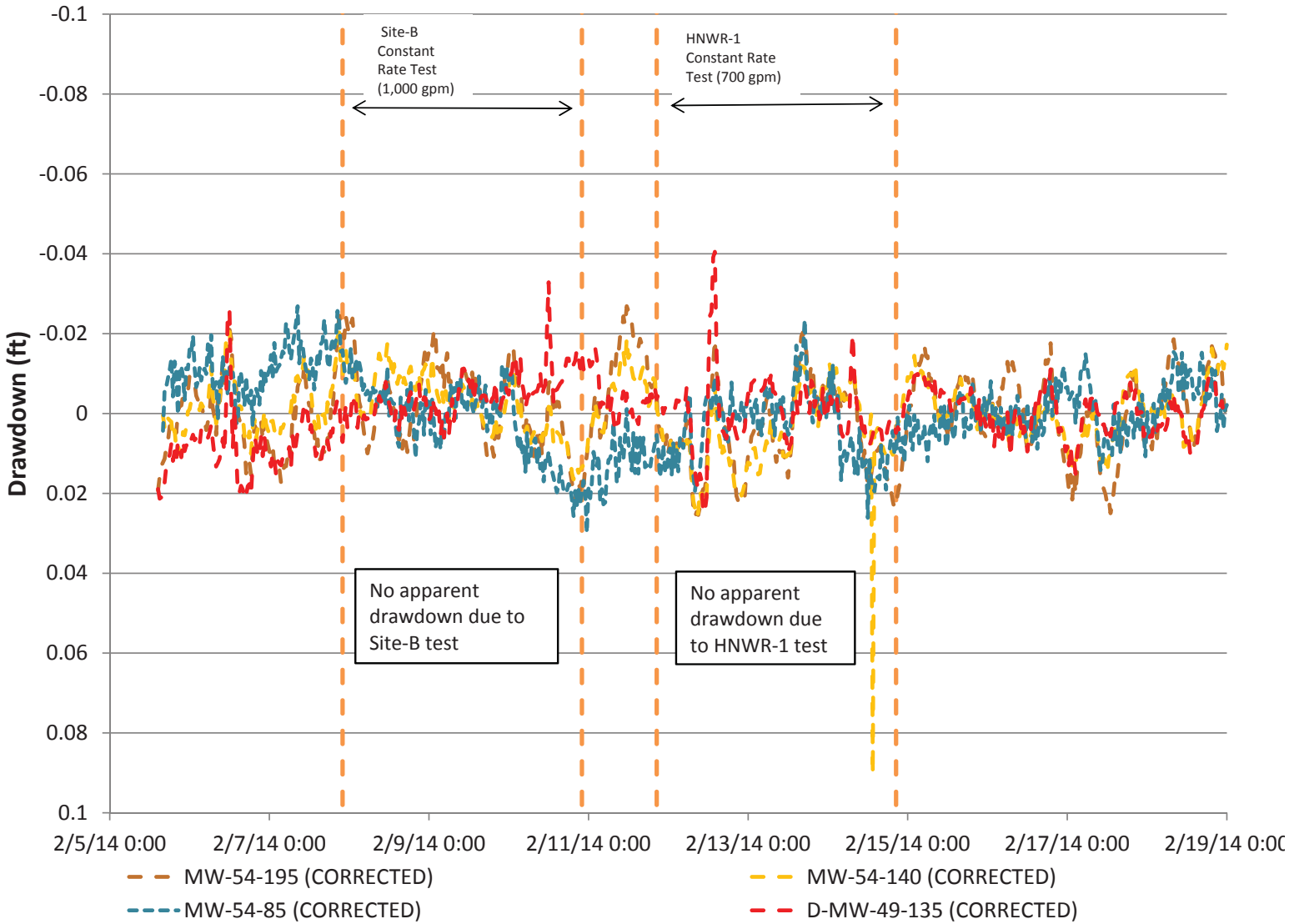


FIGURE B-9
Attachment B – Well and Aquifer Testing Data
Summary of Findings Associated with the Evaluation of
Alternative Freshwater Sources in the Topock Remediation Project Area
Pacific Gas and Electric Company
Topock Compressor Station, Needles, California

CH2MHILL

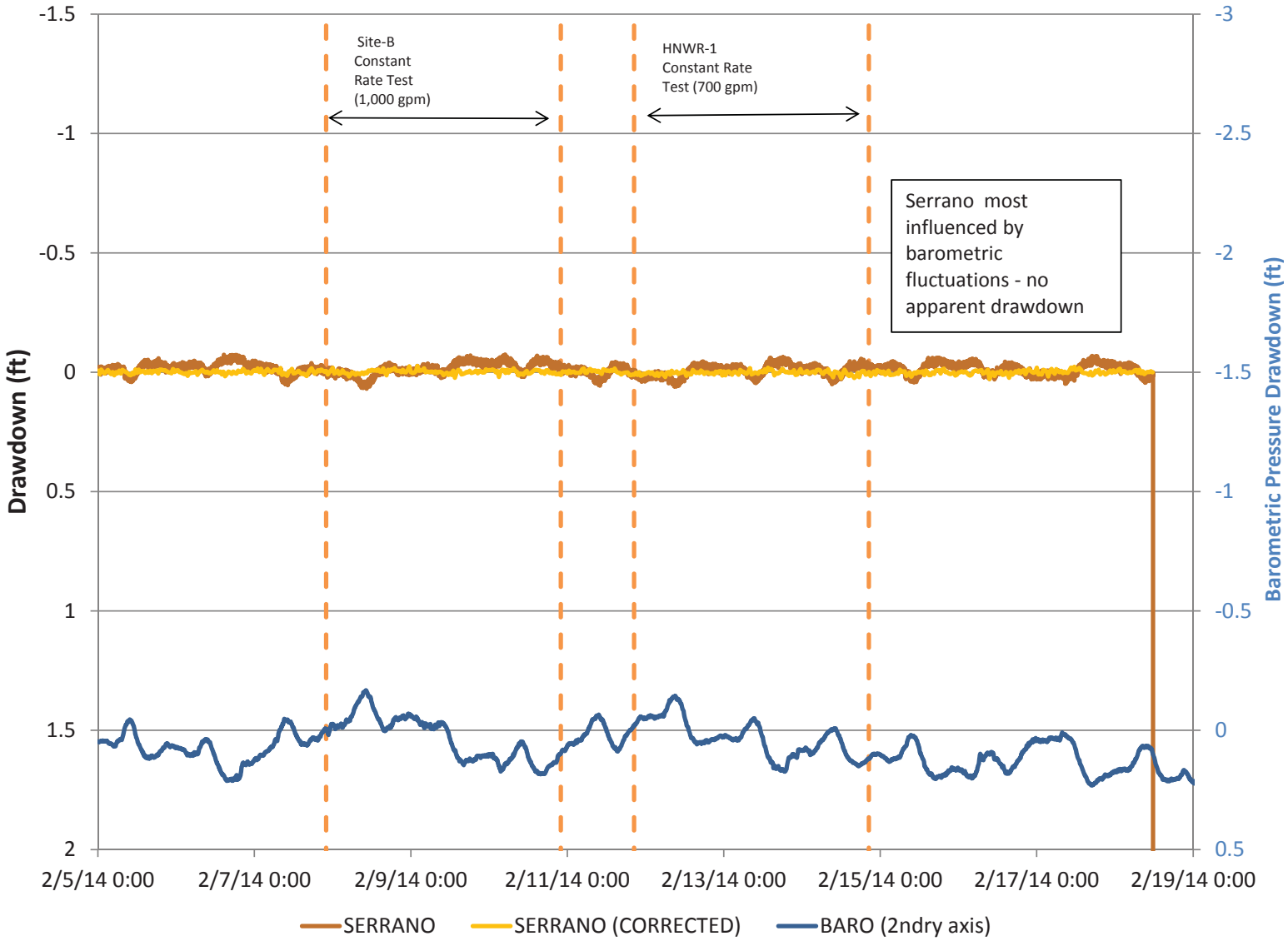


FIGURE B-10
Attachment B – Well and Aquifer Testing Data
Summary of Findings Associated with the Evaluation of
Alternative Freshwater Sources in the Topock Remediation Project Area
Pacific Gas and Electric Company
Topock Compressor Station, Needles, California

CH2MHILL.

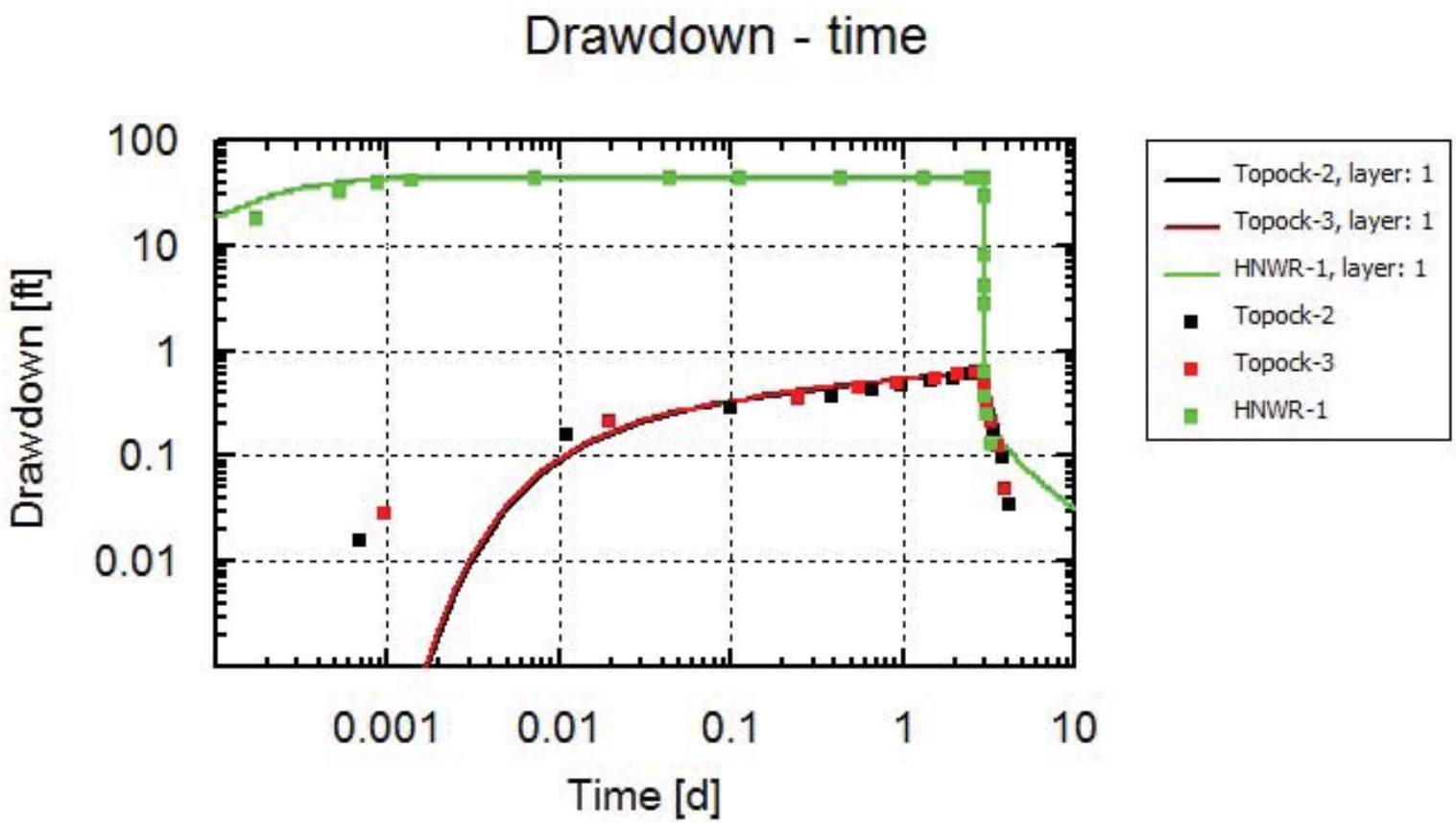


FIGURE B-11
Attachment B – Well and Aquifer Testing Data
Summary of Findings Associated with the Evaluation of
Alternative Freshwater Sources in the Topock Remediation Project Area
Pacific Gas and Electric Company
Topock Compressor Station, Needles, California

CH2MHILL®

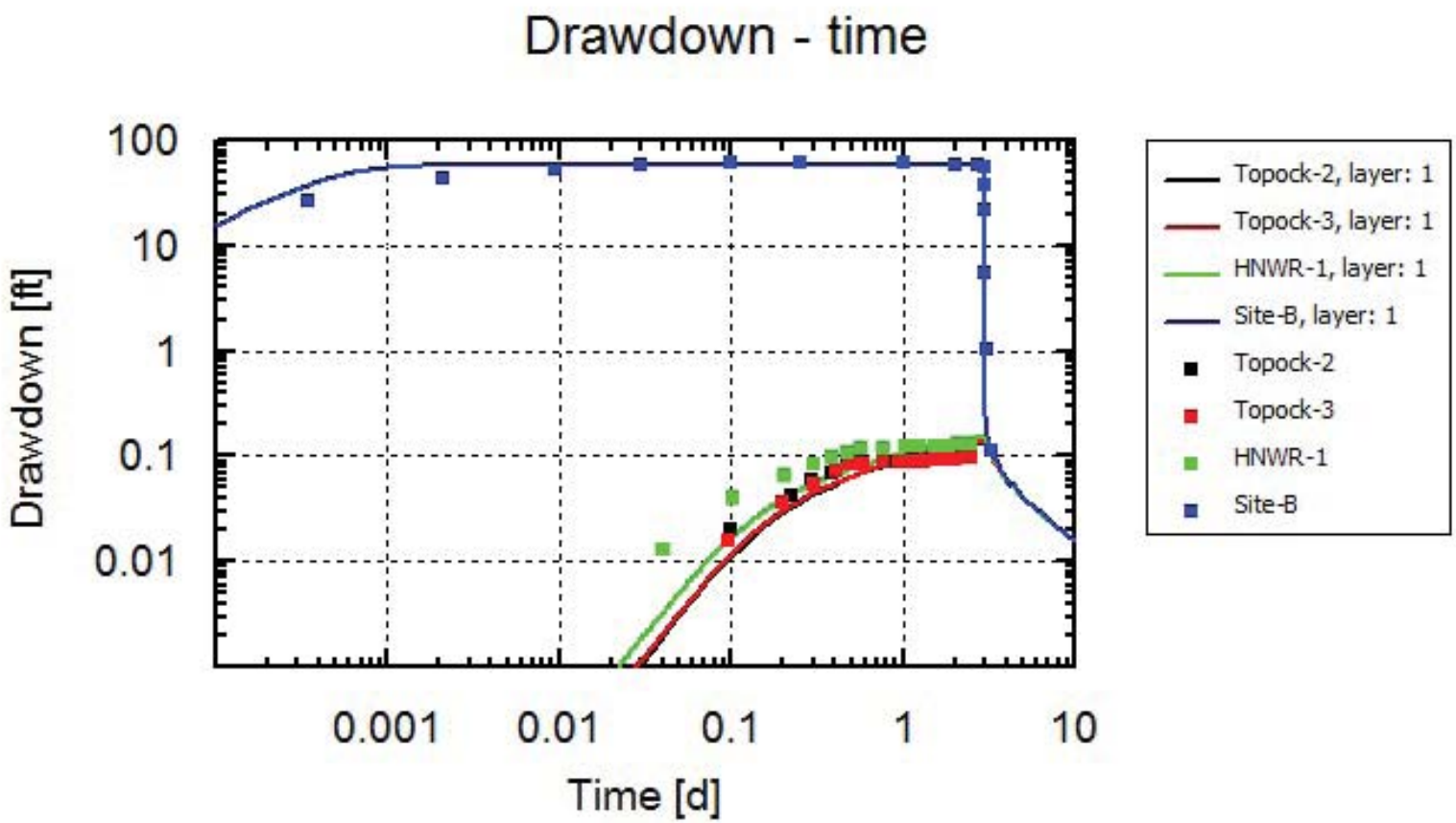


FIGURE B-12
Attachment B – Well and Aquifer Testing Data
Summary of Findings Associated with the Evaluation of
Alternative Freshwater Sources in the Topock Remediation Project Area
Pacific Gas and Electric Company
Topock Compressor Station, Needles, California

CH2MHILL®

Attachment C
Water Quality Report for Topock-2 and Topock-3

Mohave
ENVIRONMENTAL LABORATORY
License No. AZ0037

Customer Name: Southwest Water
Lab ID: 30646
Sample Type: Drinking Water
Sampled By: V. Hewlett

Date Received: 01/11/12 11:35
Date Reported: 01/16/12

Analytical Results

Parameter	Method	Result	Units	Detect Limit	Date	Analyst
30646-01						
Sample Date: 01/11/12 10:00						
Wellhead						
08-033						
Metals						
Chromium VI	SM3500Cr-D	<0.005	mg/L	0.005	1/11/2012	JP
Wet Chemistry						
Specific Conductance	SM2510-B	1,500	umhos/cm	10	1/12/2012	JP

Samples received in laboratory @ 20.2 degrees C.

Sheila Poff
Authorized Signature

2840 Sweetwater Drive, Lake Havasu City, AZ 86406 2840 N. 2nd Street, Suite B, Parker, AZ 85344
Phone: 928-764-9800 Fax: 928-764-9805
www.mohavelab.com

Variances & Exemptions {V&E} – State or EPA permission not to meet an MCL or a treatment technique under certain conditions.

Action Level – The concentration of a contaminant which, if exceeded, triggers treatment or other requirements which a water system must follow.

Treatment Technique {TT} – {Mandatory language} a treatment technique is a required process intended to reduce the level of a contaminant in drinking water.

Maximum Contaminant level – {Mandatory language} The "Maximum Allowed" {MCL} is the highest level of a contaminant that is allowed in drinking water. MCLs are set as close to the MCLGs as feasible using the best available treatment technology.

Maximum Contaminant Level Goal – {Mandatory language} The "Goal" {MCLG} is the level of a contaminant in drinking water below which there is no known or expected or expected risk to health. MCLGs allow for a margin of safety.

As you can see by the table, our system had no violations. We are proud that your drinking water meets or exceeds all Federal and State requirements. We have learned through our monitoring and testing that some constituents have been detected. The EPA has determined that your water **IS SAFE** at these levels.

All sources of drinking water are subject to potential contamination by substances that are naturally occurring or man made. These substances can be microbes, inorganic or organic chemicals and radioactive substances. All drinking water, including bottled water, may reasonably be expected to contain at least a small of some contaminants. The presents of contaminates does not necessarily indicate that the water poses a health risk. More information about contaminants and potential health effects can be obtained by calling the Environmental Protection Agency's Safe Drinking Water Hotline at 1-800-426-4791

MCLs are set very stringent levels. To understand the possible health effects described for many regulated constituents, a person would have to drink 2 liters of water every day at the MCL level for a lifetime to have a one-in-a-million chance of having the described health effect.

Some people may be more vulnerable to contaminants in drinking water than the general population. Immuno-compromised persons such as persons with cancer undergoing chemotherapy, persons who have undergone organ transplants, people with HIV?AIDS or other immune system disorders, some elderly and infants can particularly at risk from infections. These people should seek advice about drinking water from their health providers. EPA/CDC guidelines on appropriate means to lessen the risk of infection by cryptosporidium and other microbiological contaminants are available from the Safe Water Hotline 1-800-426-4791.

We at SOUTHWEST WATER INC. work hard to provide top quality water to every tap. We ask that all our customers help us protect our water sources, which are the heart of our community, our way of life and our children's future. Please call our office if you have any questions: 928-219-9358.

SOUTHWEST WATER INC.

ANNUAL CONSUMER CONFIDENCE REPORT

08-033 Date: July 2011

Reporting Period For 2010

SOUTHWEST WATER INC. is pleased to present to you this year's Annual Quality Water Report. This report is designed to inform you about the quality of water and services we deliver to you every day. Our constant goal is to provide you with a safe end dependable supply of drinking water. We want you to understand the efforts we make to continually improve the water treatment process and protect our water resources. We are committed to ensuring the quality of your water. Our water source is in the Warm Springs Aquifer.

SOUTHWEST WATER INC. routinely monitors for constituents in your drinking water according to Federal and State laws. As water travels over the land or underground, it can pick up substances or contaminates such as microbes, inorganic and organic chemicals and radioactive substances. All drinking water, including bottled drinking water may be reasonably expected to contain at least small amounts of some constituents. It is very important to remember that the presence of these constituents does not necessarily pose a health risk.

In this table you will find many terms and abbreviations you might not be familiar with. To help you better understand these terms we have provided the following definitions:

Non-detects {ND} - Laboratory analysis indicates that constituent is not present.

Parts per million {ppm} or Milligrams per liter – {mg/l} – One part per million corresponds to one minute in two years or a single penny in $10,000.

Parts per billion {ppb} or Micrograms per liter – One part per billion corresponds to one minute in 2,000 years, or a single penny $10,000,000.

Parts per trillion {ppq} or nanograms per liter {nanograms/l} – One part per quadrillion corresponds to one minute in 2,000,000 years, or one penny in $10,000,000,000.

Parts per quadrillion {ppq} or pictograms per liter {pictogram/l} – one part per quadrillion corresponds to one minute in 2,000,00,000 years or one penny in $10,000,000,000,000.

Picocuries per liter {pCiL} – Picocuries per liter is a measure of the radioactivity in water.
Millirems per year {mrem/yr} – Measure of radiation absorbed by the body.

Million fibers per liter {MFL} – million fibers per liter is a measure of the asbestos fibers that are longer than 10 micrometers.

SOUTHWEST WATER INC.

ANNUAL CONSUMER CONFIDENCE REPORT

08-033 Date: June ..2012

Reporting Period For 2011

SOUTHWEST WATER INC. is pleased to present to you this year's Annual Quality Water Report. This report is designed to inform you about the quality of water and services we deliver to you every day. Our constant goal is to provide you with a safe end dependable supply of drinking water. We want you to understand the efforts we make to continually improve the water treatment process and protect our water resources. We are committed to ensuring the quality of your water. Our water source is in the Warm Springs Aquifer.

SOUTHWEST WATER INC. routinely monitors for constituents in your drinking water according to Federal and State laws. As water travels over the land or underground, it can pick up substances or contaminates such as microbes, inorganic and organic chemicals and radioactive substances. All drinking water, including bottled drinking water may be reasonably expected to contain at least small amounts of some constituents. It is very important to remember that the presence of these constituents does not necessarily pose a health risk.

In this table you will find many terms and abbreviations you might not be familiar with. To help you better understand these terms we have provided the following definitions:

Non-detects {ND} - Laboratory analysis indicates that constituent is not present.

Parts per million {ppm} or Milligrams per liter – {mg/l} – One part per million corresponds to one minute in two years or a single penny in $10,000.

Parts per billion {ppb} or Micrograms per liter – One part per billion corresponds to one minute in 2,000 years, or a single penny $10,000,000.

Parts per trillion {ppq} or nanograms per liter {nanograms/l} – One part per quadrillion corresponds to one minute in 2,000,000 years, or one penny in $10,000,000,000.

Parts per quadrillion {ppq} or pictograms per liter {pictogram/l} – one part per quadrillion corresponds to one minute in 2,000,00,000 years or one penny in $10,000,000,000,000.

Picocuries per liter {pCiL} – Picocuries per liter is a measure of the radioactivity in water.
Millirems per year {mrem/yr} – Measure of radiation absorbed by the body.

Million fibers per liter {MFL} – million fibers per liter is a measure of the asbestos fibers that are longer than 10 micrometers.

Variances & Exemptions {V&E} – State or EPA permission not to meet an MCL or a treatment technique under certain conditions.

Action Level – The concentration of a contaminant which, if exceeded, triggers treatment or other requirements which a water system must follow.

Treatment Technique {TT} – {Mandatory language} a treatment technique is a required process intended to reduce the level of a contaminant in drinking water.

Maximum Contaminant level – {Mandatory language} The "Maximum Allowed" {MCL} is the highest level of a contaminant that is allowed in drinking water. MCLs are set as close to the MCLGs as feasible using the best available treatment technology.

Maximum Contaminant Level Goal – {Mandatory language} The "Goal" {MCLG} is the level of a contaminant in drinking water below which there is no known or expected or expected risk to health. MCLGs allow for a margin of safety.

As you can see by the table, our system had no violations. We are proud that your drinking water meets or exceeds all Federal and State requirements. We have learned through our monitoring and testing that some constituents have been detected. The EPA has determined that your water **IS SAFE** at these levels.

All sources of drinking water are subject to potential contamination by substances that are naturally occurring or man made. These substances can be microbes, inorganic or organic chemicals and radioactive substances. All drinking water, including bottled water, may reasonably be expected to contain at least a small of some contaminants. The presents of contaminates does not necessarily indicate that the water poses a health risk. More information about contaminants and potential health effects can be obtained by calling the Environmental Protection Agency's Safe Drinking Water Hotline at 1-800-426-4791

MCLs are set very stringent levels. To understand the possible health effects described for many regulated constituents, a person would have to drink 2 liters of water every day at the MCL level for a lifetime to have a one-in-a-million chance of having the described health effect.

Some people may be more vulnerable to contaminants in drinking water than the general population. Immuno-compromised persons such as persons with cancer undergoing chemotherapy, persons who have undergone organ transplants, people with HIV?AIDS or other immune system disorders, some elderly and infants can particularly at risk from infections. These people should seek advice about drinking water from their health providers. EPA/CDC guidelines on appropriate means to lessen the risk of infection by cryptosporidium and other microbiological contaminants are available from the Safe Water Hotline 1-800-426-4791.

We at SOUTHWEST WATER INC. work hard to provide top quality water to every tap. We ask that all our customers help us protect our water sources, which are the heart of our community, our way of life and our children's future. Please call our office if you have any questions: 928-219-9358.

Arizona Department of Environmental Quality

Drinking Water Inorganic Chemical Analysis Reporting Form

Entry Point to the Distribution System (EPDS) Only

PWS ID#: AZ0408-033

PWS Name: Southwest Water

4/7/2011 — Sample Date

06:00 (24 hr clock) — Sample time

V. Hewlett — Owner/Contact Person Name

Owner/Contact Fax Number

928-715-8100 — Owner/Contact Person Phone Number

Sample Type

[X] Compliance Monitoring

Sample Collection Point

[x] EPDS # 001

Sampling Site ID

For MCL or Composite Level Exceedance

_____ Original Violation Specimen Number

Sample Type

[ ] Confirmation

[ ] Confirmation Composite

INORGANIC CHEMICAL ANALYSIS

>>> To be completed by laboratory personnel <<<

Analysis Method	MCL	Reporting Limit	Contaminant Name	Cont Code	Analysis Run Date	Result	Exceeds MCL	Exceeds Reporting Limit
EPA 200.9	0.010	0.005	Arsenic	1005			[ ]	
SM 3111D	2	1	Barium	1010			[ ]	
EPA 200.9	0.005	0.0025	Cadmium	1015			[ ]	
EPA 200.9	0.1	0.05	Chromium	1020			[ ]	
SM4500-F-C	4	0.5	Fluoride	1025			[ ]	
EPA 245.1	0.002	0.001	Mercury	1035			[ ]	
EPA 300.0	10	2.5	Nitrate (as N)	1040	4/7/11	2.2	[ ]	[ ]
EPA 300.0	1	0.25	Nitrite (as N)	1041			[ ]	[ ]
EPA 200.0	0.05	0.025	Selenium	1045			[ ]	
EPA 200.9	0.006	0.003	Antimony	1074			[ ]	
EPA 200.9	0.004	0.002	Beryllium	1075			[ ]	
EPA 335.4	0.2	0.1	Cyanide	1024			[ ]	
EPA 200.9	No MCL	0.05	Nickel*	1036			[ ]	
EPA 200.9	0.002	0.001	Thallium	1085			[ ]	
SM 3111B	No MCL	10	Sodium*	1052			[ ]	

>>>>> LABORATORY INFORMATION <<<<<

To be completed by laboratory personnel

Lab ID Number: AZ0037

Specimen Number: 28295-01

Name: Mohave Environmental Laboratory 2580 Landon Dr. Ste. A Bullhead City, AZ 86429

Printed Name and Phone Number of Lab Contact: Sheila Poff 928-754-8101

Authorized Signature: Sheila Poff

Date Public Water System Notified:

Comments:

All units must be reported in milligrams per liter (mg/l)

*Contaminants without an MCL

DWAR 2IN: Revised 7/2009

Microbiological Contaminants

Contaminant	MCL	MCLG	Unit	Result	Violation (Yes or No)	Sample Date	Likely Source of Contamination
Total Coliform Bacteria for Systems that collects>40 samples per month	No more than 5% of monthly samples can be positive	0	Absent or Present	a	N	2011	Naturally present in the environment
Total Coliform Bacteria for Systems that collects<40 samples per month	No more than 1 positive monthly sample	0	Absent or Present	a	N	2011	Naturally present in the environment
Fecal coliform and E. Coli	A routine sample & a repeat sample are total coliform positive, & one is also fecal coliform or *E. coli positive*	0	Absent or Present	a	N	2011	Human and animal fecal waste

Lead and Copper

Contaminant	AL	ALG	Units	90th Percentile	Number of Sites over AL	Violation (Yes or No)	Sample Date/Year	
Copper	1.3	0	ppm	.018	5	N	07-11	
Lead	15	0	ppb	0184	5	N	07-11	

Inorganic Contaminants

Contaminate	MCL	UN	Units	Level Detected/ Range	Violation	Sample Date	
Nitrate (as Nitrogen) Poe#1	10	10	ppm	2.2	N	04-11	Runoff from fertilizer use; leaching from septic tanks, sewage; erosion of natural deposits

Secondary Contaminants

Secondary standards are non-enforceable guidelines for contaminants that may cause cosmetic effects or aesthetic effects in drinking water. EPA recommends these standards but does not require water systems to comply.

Contaminant	Secondary Standard	MCLG	Units	Level detected/ Range	Violation		

Violations

The following violations were received by our water system or were ongoing in the calendar year 2011

Type/Description	Compliance Period
NONE	

Please contact **Victor Hewlett** at SouthWest Water inc. 928.219.9358 to learn more about what you can do to help protect your drinking water sources, any questions about the annual drinking water quality report, to learn more about our system, or to attend scheduled public meetings. We want you, our valued customers, to be informed about the services we provide and the quality water we deliver to you every day.

Health Effects Information About the Above Tables

Nitrate in drinking water at levels above 10 ppm is a health risk for infants of than six months of age. High nitrate levels in drinking water can cause blue baby syndrome. Nitrate levels may rise quickly for short periods-of-time because of rainfall or agricultural activity. If you are caring for an infant, and detected nitrate levels are above 5 ppm, you should ask advice from your health care provider.

Report for 2012

Microbiological Contaminants

Contaminant	MCL	MCLG	Unit	Result	Violation (Yes or No)	Sample Date	Likely Source of Contamination
Total Coliform Bacteria for Systems that collects>40 samples per month	No more than 5% of monthly samples can be positive	0	Absent or Present	a	N	2010	Naturally present in the environment
Total Coliform Bacteria for Systems that collects<40 samples per month	No more than 1 positive monthly sample	0	Absent or Present	a	N	2010	Naturally present in the environment
Fecal coliform and E. Coli	A routine sample & a repeat sample are total coliform positive, & one is also fecal coliform or *E. coli positive*	0	Absent or Present	a	N	2010	Human and animal fecal waste

Lead and Copper

Contaminant	AL	ALG	Units	90th Percentile	Number of Sites over AL	Violation (Yes or No)	Sample Date/Year	
Copper	1.3	0	ppm	.020	5	N	07-10	
Lead	15	0	ppb	0195	5	N	07-10	

Inorganic Contaminants

Contaminate	MCL	UN	Units	Level Detected/ Range	Violation	Sample Date	
Nitrate (as Nitrogen) Poe#1	10	10	ppm	2.1	N	04-10	Runoff from fertilizer use; leaching from septic tanks, sewage; erosion of natural deposits

Secondary Contaminants

Secondary standards are non-enforceable guidelines for contaminants that may cause cosmetic effects or aesthetic effects in drinking water. EPA recommends these standards but does not require water systems to comply.

Contaminant	Secondary Standard	MCLG	Units	Level detected/ Range	Violation		

Violations

The following violations were received by our water system or were ongoing in the calendar year 2010

Type/Description	Compliance Period
NONE	

Please contact **Victor Hewlett** at SouthWest Water inc. 928.219.9358 to learn more about what you can do to help protect your drinking water sources, any questions about the annual drinking water quality report, to learn more about our system, or to attend scheduled public meetings. We want you, our valued customers, to be informed about the services we provide and the quality water we deliver to you every day.

Health Effects Information About the Above Tables

Nitrate in drinking water at levels above 10 ppm is a health risk for infants of than six months of age. High nitrate levels in drinking water can cause blue baby syndrome. Nitrate levels may rise quickly for short periods-of-time because of rainfall or agricultural activity. If you are caring for an infant, and detected nitrate levels are above 5 ppm, you should ask advice from your health care provider.

Report for 2011

Attachment D
Conceptual Infrastructure and Pipeline Alignment
(Presentation from March 19, 2014 TWG Meeting)

FIGURE 1
HNWR-1 WELL SITE FACING WEST–EXISTING CONDITIONS
GROUNDWATER REMEDY PROJECT
PG&E TOPOCK COMPRESSOR STATION,
NEEDLES, CALIFORNIA

CH2MHILL.

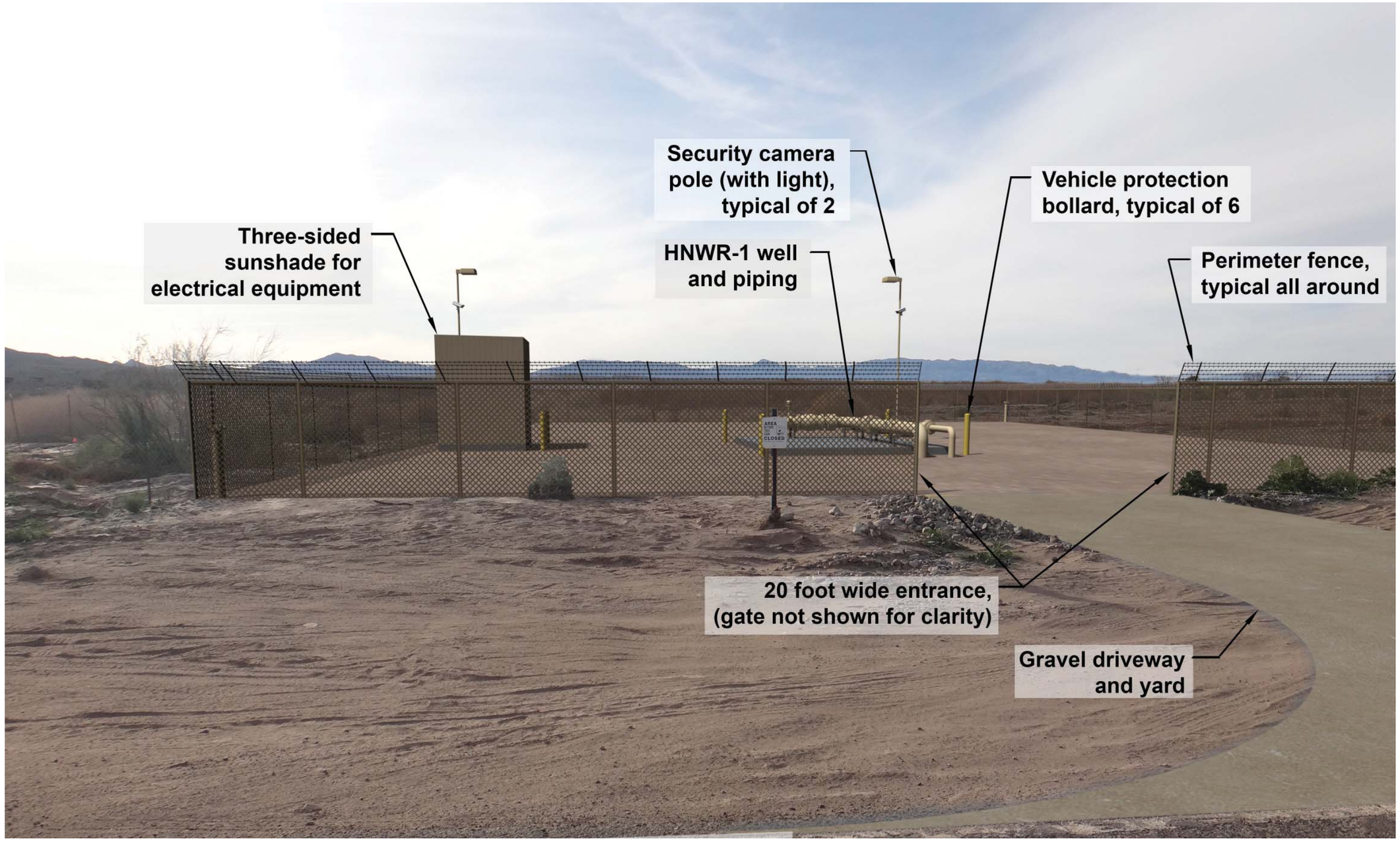


FIGURE 2
HNWR-1 WELL SITE FACING WEST – PROPOSED INFRASTRUCTURE PER 60% DESIGN
GROUNDWATER REMEDY PROJECT
PG&E TOPOCK COMPRESSOR STATION,
NEEDLES, CALIFORNIA

Notes:
Conceptual Visualization - This is for illustration purposes only.

CH2MHILL

ES031314234154BAO_Topock_visualization.indd_031714_lho

Document Path: \\Zinfandel\proj\PacificGasElectricCo\TopockProgram\GIS\MapFiles\2014\Pipeline\PGEC_Pipeline_Overview.mxd Date Saved: 3/14/2014 9:14:59 AM

LEGEND

- Pipeline B per 60% design – above ground
- Pipeline B per 60% design – underground
- Conceptual portion of Pipeline B – underground
- Existing utilities
- Construction staging areas
- Wells (at well sites)

FIGURE 3
CONCEPTUAL PIPELINE B ALIGNMENT
PAGE 1 OF 15
GROUNDWATER REMEDY PROJECT
PG&E TOPOCK COMPRESSOR STATION,
NEEDLES, CALIFORNIA

CH2MHILL.

Document Path: \\zmfandel\proj\PacificGasElectricCo\TopockProgram\GIS\MapFiles\2014\Pipeline\PGEC_Pipeline_Mapbook.mxd Date Saved: 3/17/2014 11:06:36 AM

LEGEND

- Pipeline B per 60% design – above ground
- Pipeline B per 60% design – underground
- Existing utilities
- Construction staging areas

FIGURE 4
CONCEPTUAL PIPELINE B ALIGNMENT
PAGE 2 OF 15
GROUNDWATER REMEDY PROJECT
PG&E TOPOCK COMPRESSOR STATION,
NEEDLES, CALIFORNIA

CH2MHILL.

Document Path: \\2mhande\proj\PacificGasElectricCo\TopockProgram\GIS\MapFiles\2014\Pipeline\PGEC_Pipeline_Mapbook.mxd Date Saved: 3/17/2014 11:06:36 AM

LEGEND

- Pipeline B per 60% design – underground
- Existing utilities
- Underground electrical
- Construction staging areas

FIGURE 5
CONCEPTUAL PIPELINE B ALIGNMENT
PAGE 3 OF 15
GROUNDWATER REMEDY PROJECT
PG&E TOPOCK COMPRESSOR STATION,
NEEDLES, CALIFORNIA

CH2MHILL.

Document Path: \\Zinfandel\proj\PacificGasElectricCo\TopockProgram\GIS\MapFiles\2014\Pipeline\PGEC_Pipeline_Mapbook.mxd Date Saved: 3/17/2014 11:06:36 AM

LEGEND

- Pipeline B per 60% design – above ground
- Pipeline B per 60% design – underground
- Existing utilities

FIGURE 6
CONCEPTUAL PIPELINE B ALIGNMENT
PAGE 4 OF 15
GROUNDWATER REMEDY PROJECT
PG&E TOPOCK COMPRESSOR STATION,
NEEDLES, CALIFORNIA

CH2MHILL.

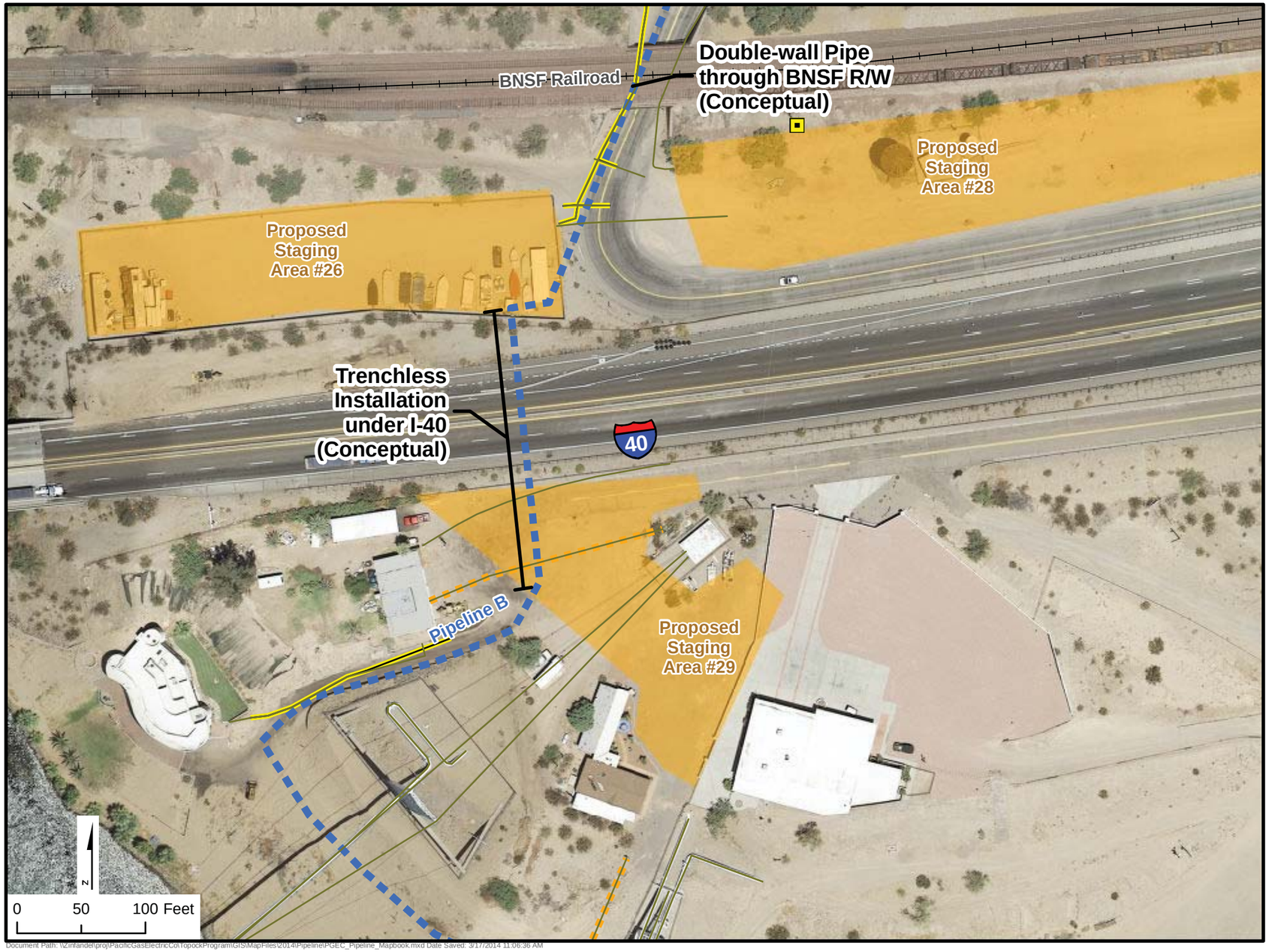
Document Path: \\Zinfandel\proj\PacificGasElectricCo\TopockProgram\GIS\MapFiles\2014\Pipeline\PGEC_Pipeline_Mapbook.mxd Date Saved: 3/17/2014 11:06:36 AM

LEGEND

- Pipeline B per 60% design – above ground
- Pipeline B per 60% design – underground
- Existing utilities

FIGURE 7
CONCEPTUAL PIPELINE B ALIGNMENT
PAGE 5 OF 15
GROUNDWATER REMEDY PROJECT
PG&E TOPOCK COMPRESSOR STATION,
NEEDLES, CALIFORNIA

CH2MHILL



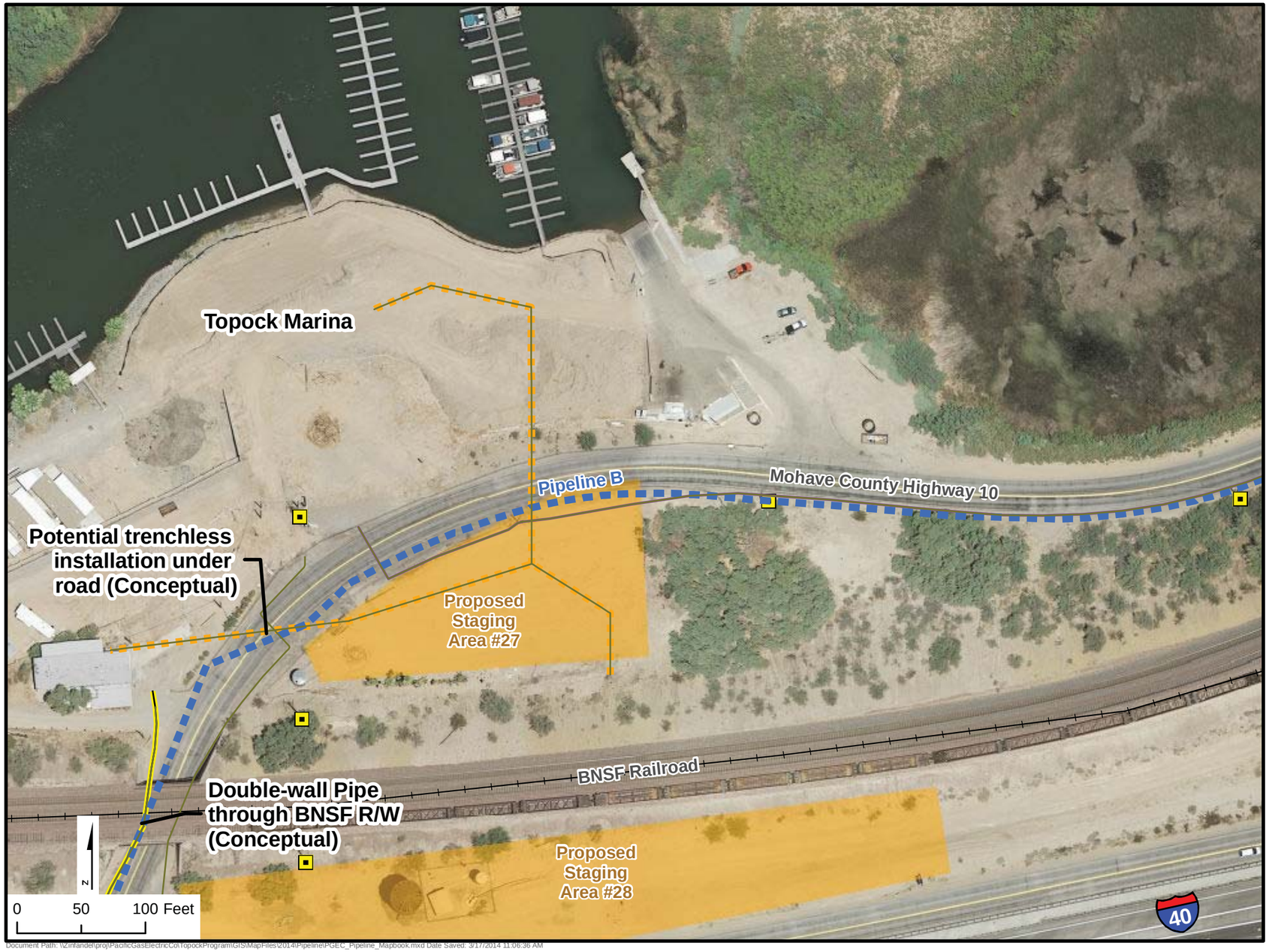
Document Path: \\2mhandel\proj\PacificGasElectricCo\TopockProgram\GIS\MapFiles\2014\Pipeline\PGEC_Pipeline_Mapbook.mxd Date Saved: 3/17/2014 11:06:36 AM

LEGEND

- Pipeline B per 60% design – underground
- Existing utilities
- Overhead electrical poles
- Unknown/private utility
- Construction staging areas

FIGURE 8
CONCEPTUAL PIPELINE B ALIGNMENT
PAGE 6 OF 15
GROUNDWATER REMEDY PROJECT
PG&E TOPOCK COMPRESSOR STATION,
NEEDLES, CALIFORNIA

CH2MHILL



Document Path: \\zmfandel\proj\PacificGasElectricCo\TopockProgram\GIS\MapFiles\2014\Pipeline\PGEC_Pipeline_Mapbook.mxd Date Saved: 3/17/2014 11:06:36 AM

LEGEND

- Pipeline B per 60% design – underground
- Existing utilities
- Overhead electrical poles
- Unknown/private utility
- Underground electric
- Construction staging areas

FIGURE 9
CONCEPTUAL PIPELINE B ALIGNMENT
PAGE 7 OF 15
GROUNDWATER REMEDY PROJECT
PG&E TOPOCK COMPRESSOR STATION,
NEEDLES, CALIFORNIA

CH2MHILL.

Document Path: \\zinfandel\proj\PacificGasElectricCo\TopockProgram\GIS\MapFiles\2014\Pipeline\PGEC_Pipeline_Mapbook.mxd Date Saved: 3/17/2014 11:06:36 AM

LEGEND

- Pipeline B per 60% design – underground
- Existing utilities
- Overhead electrical poles

FIGURE 10
CONCEPTUAL PIPELINE B ALIGNMENT
PAGE 8 OF 15
GROUNDWATER REMEDY PROJECT
PG&E TOPOCK COMPRESSOR STATION,
NEEDLES, CALIFORNIA

CH2MHILL

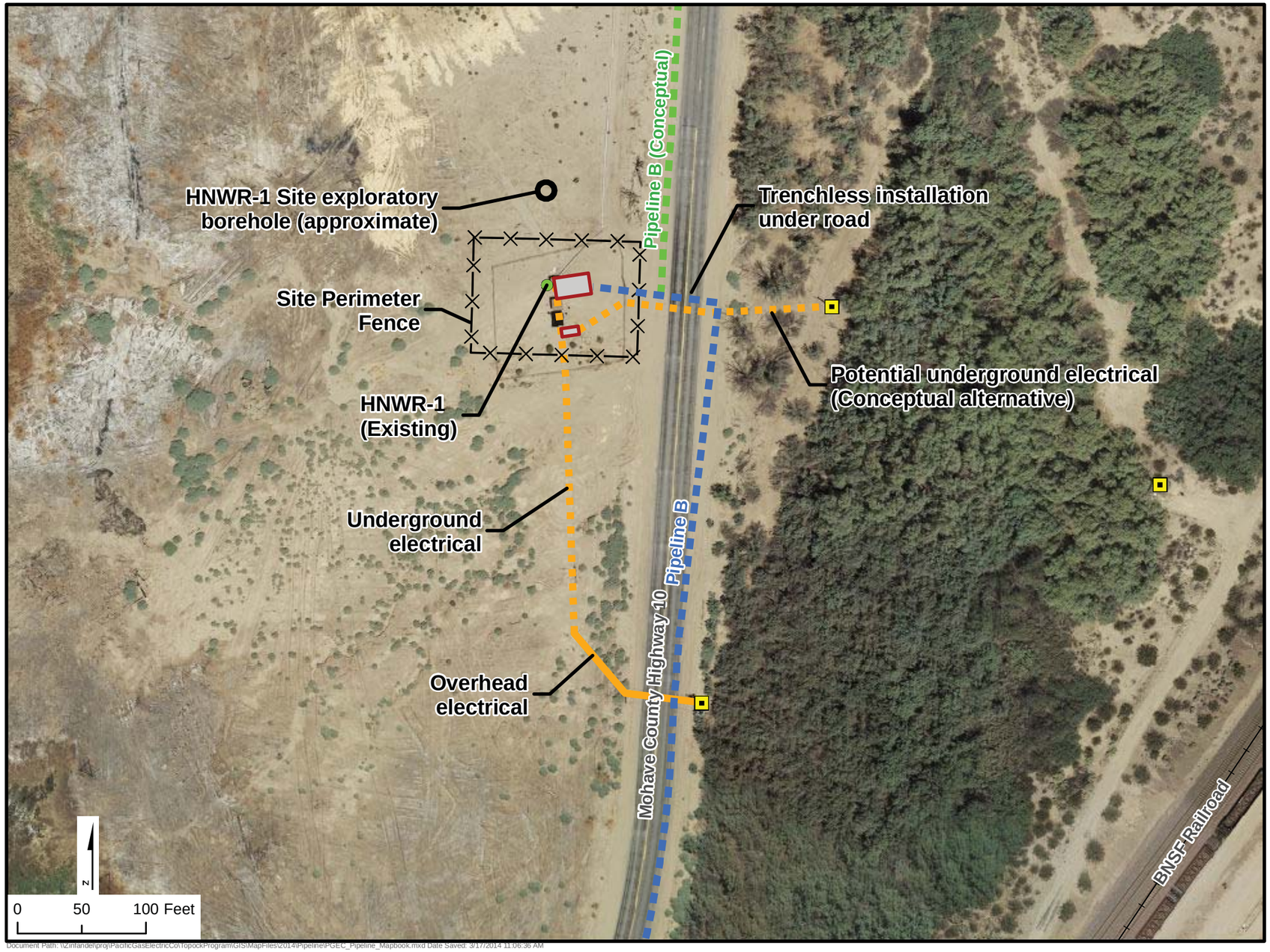
Document Path: \\Zinfandel\proj\PacificGasElectricCo\TopockProgram\GIS\MapFiles\2014\Pipeline\PGEC_Pipeline_Mapbook.mxd Date Saved: 3/17/2014 11:06:36 AM

LEGEND

- Pipeline B per 60% design – underground
- Existing utilities
- Overhead electrical poles

FIGURE 11
CONCEPTUAL PIPELINE B ALIGNMENT
PAGE 9 OF 15
GROUNDWATER REMEDY PROJECT
PG&E TOPOCK COMPRESSOR STATION,
NEEDLES, CALIFORNIA

CH2MHILL.



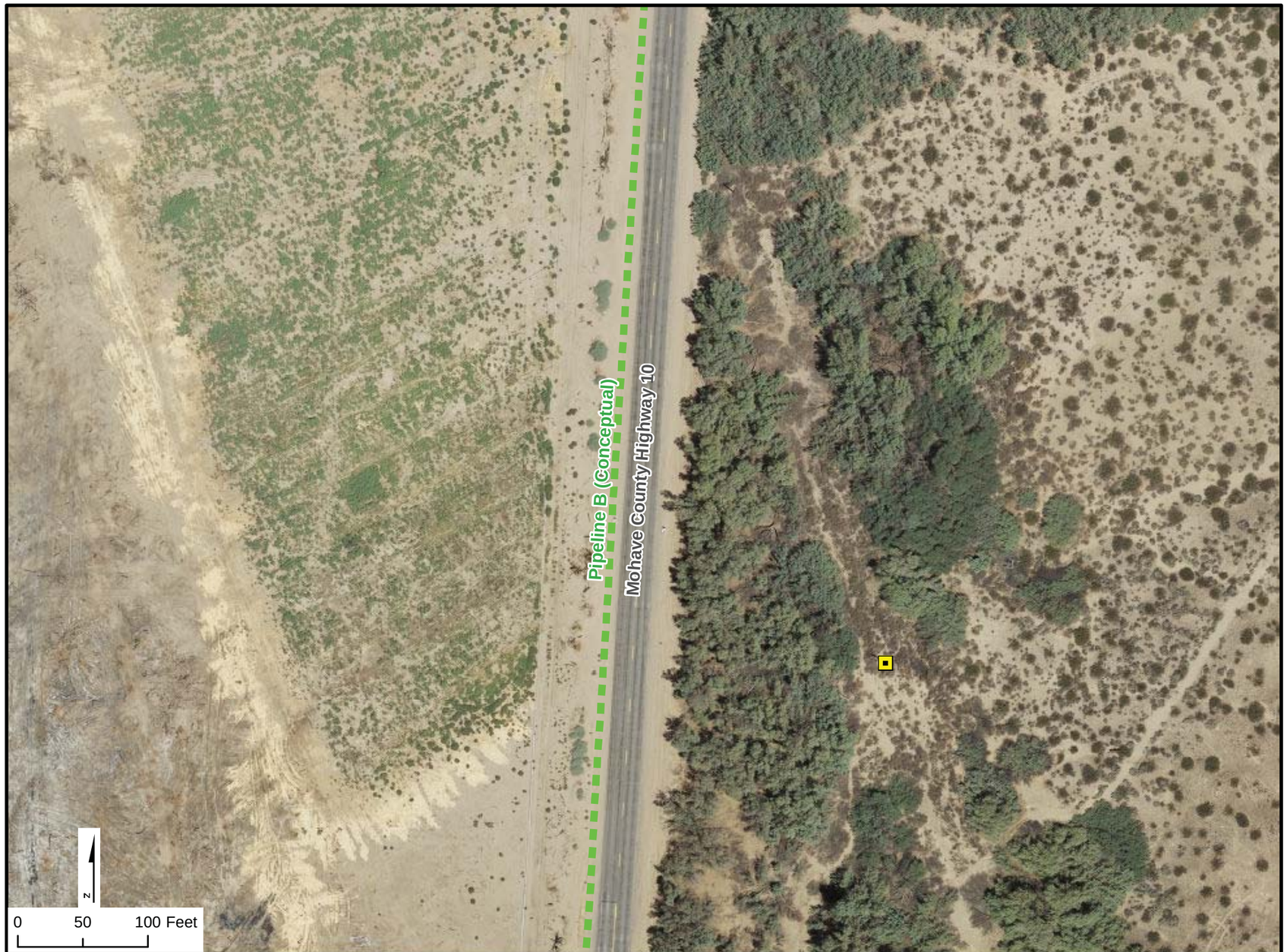
Document Path: \\Zinfandel\proj\PacificGasElectricCo\TopockProgram\GIS\MapFiles\2014\Pipeline\PGEC_Pipeline_Mapbook.mxd Date Saved: 3/17/2014 11:06:36 AM

LEGEND

- Conceptual portion of Pipeline B – underground
- Pipeline B per 60% design – underground
- Overhead electrical
- Underground electrical
- Overhead electrical poles
- Wells (at well sites)
- Concrete pads or structures (at well sites)
- – X – Fences

FIGURE 12
CONCEPTUAL PIPELINE B ALIGNMENT
PAGE 10 OF 15
GROUNDWATER REMEDY PROJECT
PG&E TOPOCK COMPRESSOR STATION,
NEEDLES, CALIFORNIA

CH2MHILL



Document Path: \\zmfandel\proj\PacificGasElectricCo\TopockProgram\GIS\MapFiles\2014\Pipeline\PGEC_Pipeline_Mapbook.mxd Date Saved: 3/17/2014 11:06:36 AM

LEGEND

- Conceptual portion of Pipeline B – underground
- Overhead electrical poles

FIGURE 13
CONCEPTUAL PIPELINE B ALIGNMENT
PAGE 11 OF 15
GROUNDWATER REMEDY PROJECT
PG&E TOPOCK COMPRESSOR STATION,
NEEDLES, CALIFORNIA

CH2MHILL®

Document Path: \\Zinfandel\proj\PacificGasElectricCo\TopockProgram\GIS\MapFiles\2014\Pipeline\PGEC_Pipeline_Mapbook.mxd Date Saved: 3/17/2014 11:06:36 AM

LEGEND

- Conceptual portion of Pipeline B – underground

FIGURE 14
CONCEPTUAL PIPELINE B ALIGNMENT
PAGE 12 OF 15
GROUNDWATER REMEDY PROJECT
PG&E TOPOCK COMPRESSOR STATION,
NEEDLES, CALIFORNIA

CH2MHILL®

Document Path: \\Zinfandel\proj\PacificGasElectricCo\TopockProgram\GIS\MapFiles\2014\Pipeline\PGEC_Pipeline_Mapbook.mxd Date Saved: 3/17/2014 11:06:36 AM

LEGEND

- Conceptual portion of Pipeline B – underground

FIGURE 15
CONCEPTUAL PIPELINE B ALIGNMENT
PAGE 13 OF 15
GROUNDWATER REMEDY PROJECT
PG&E TOPOCK COMPRESSOR STATION,
NEEDLES, CALIFORNIA

CH2MHILL®

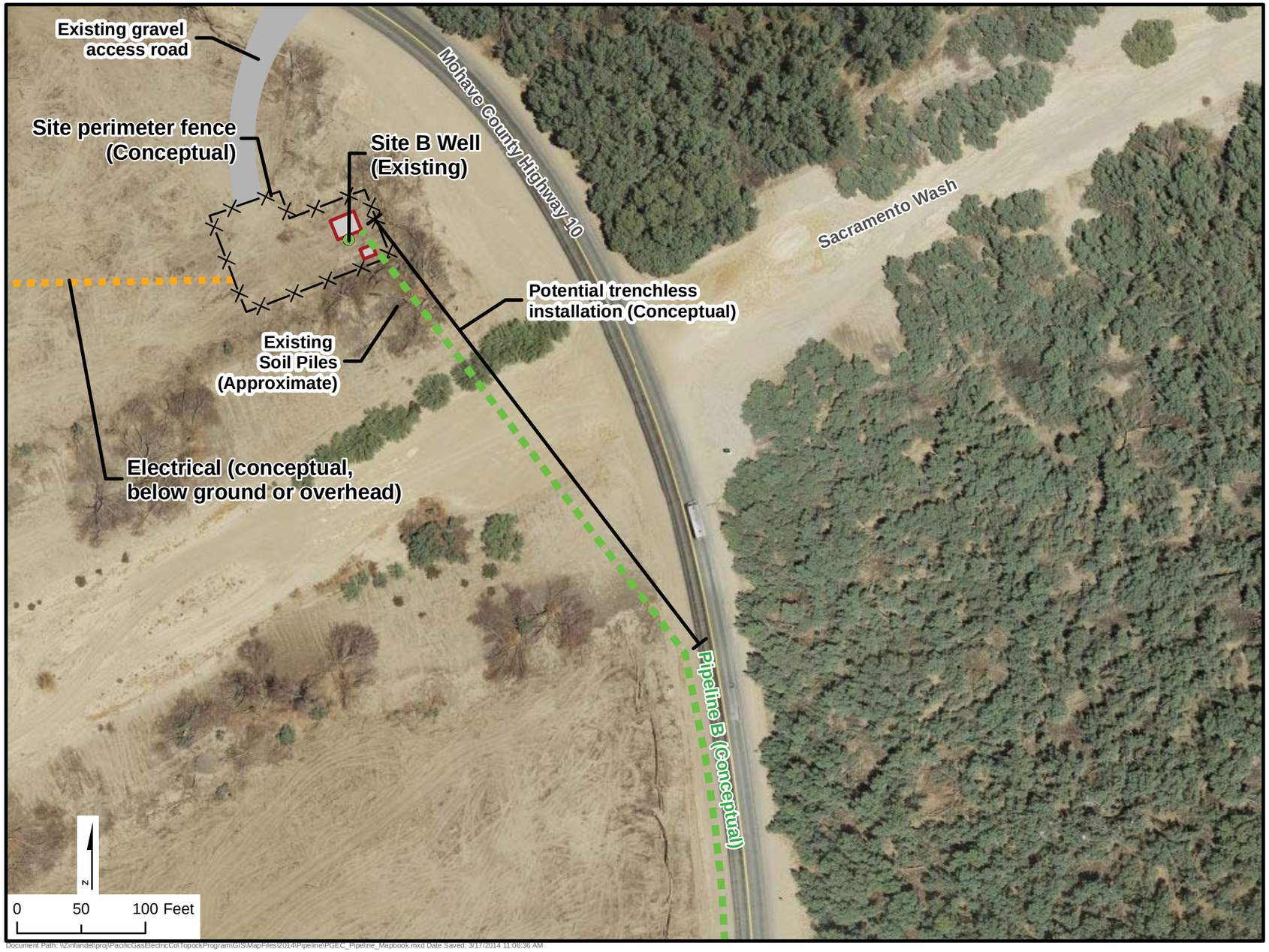
Document Path: \\Zinfandel\proj\PacificGasElectricCo\TopockProgram\GIS\MapFiles\2014\Pipeline\PGEC_Pipeline_Mapbook.mxd Date Saved: 3/17/2014 11:06:36 AM

LEGEND

- Conceptual portion of Pipeline B – underground

FIGURE 16
CONCEPTUAL PIPELINE B ALIGNMENT
PAGE 14 OF 15
GROUNDWATER REMEDY PROJECT
PG&E TOPOCK COMPRESSOR STATION,
NEEDLES, CALIFORNIA

CH2MHILL.



Document Path: \\Zinfandel\proj\PacificGasElectricCo\TopockProgram\GIS\MapFiles\2014\Pipeline\PGEC_Pipeline_Mapbook.mxd Date Saved: 3/17/2014 11:06:36 AM

LEGEND

- Conceptual portion of Pipeline B – underground
- Electrical - below ground or overhead
- Wells (at well sites)
- Concrete pads or structures (at well sites)
- – X – Fences

FIGURE 17
CONCEPTUAL PIPELINE B ALIGNMENT
PAGE 15 OF 15
GROUNDWATER REMEDY PROJECT
PG&E TOPOCK COMPRESSOR STATION,
NEEDLES, CALIFORNIA

CH2MHILL.