Eric Hetrick
Project Manager
Marketing Business Unit

Chevron Environmental Management Company
6101 Bollinger Canyon Road
San Ramon, CA 94583
Tel (925) 790-6491
ehetrick@chevron.com

January 20, 2014

Alameda County Health Care Services
1131 Harbor Bay Parkway, Suite 250
Alameda, CA 94502-6577

Re: Former Chevron Service Station 95607
5269 Crow Canyon Road
Castro Valley, CA
ACEH Case #RO 0350

I have reviewed the attached Work Plan for Groundwater Monitoring Well Installation.

I agree with the conclusions and recommendations presented in the referenced report. This information in this report is accurate to the best of my knowledge and all local Agency/Regional Board guidelines have been followed. This report was prepared by Conestoga Rovers Associates, upon who assistance and advice I have relied.

This letter is submitted pursuant to the requirements of California Water Code Section 13267(b)(1) and the regulating implementation entitled Appendix A pertaining thereto.

I declare under penalty of perjury that the foregoing is true and correct to the best of my knowledge.

Sincerely,

Eric Hetrick
Project Manager

Attachment: Work Plan for Groundwater Monitoring Well Installation

CONESTOGA-ROVERS
& ASSOCIATES

5900 Hollis Street, Suite A
Emeryville, California 94608
Telephone: (510) 420-0700 Fax: (510) 420-9170
http://www.craworld.com

January 20, 2014 Reference No. 311950

Mr. Mark Detterman
Alameda County Environmental Health Services
1131 Harbor Bay Parkway
Alameda, California 94502

Re: Work Plan for Groundwater Monitoring Well Installation
Former Chevron Station 95607
5269 Crow Canyon Road
Castro Valley, California
Fuel Leak Case RO0350

Dear Mr. Detterman:

Conestoga-Rovers & Associates (CRA) is submitting this for *Work Plan for Groundwater Monitoring Well Installation* on behalf of Chevron Environmental Management Company (Chevron) for the site referenced above (Figure 1) as requested by Alameda County Environmental Health Services (ACEHS) in their letter dated November 21, 2013 (Attachment A). The letter stated that "(*t)here is renewed focus on well C-9 due to the substantial increase in groundwater concentrations in the well, in conjunction with the consistency of the groundwater flow direction and historic groundwater contaminant concentrations in downgradient wells (especially C-15), emphasizes that the length of the contaminant plume has not been defined*".

Chevron and CRA acknowledge ACEHS's concern about the length of the plume downgradient of C-9. That is why we have agreed to attach C-9 to the dual-phase extraction (DPE) remediation system that has been approved for operation by ACEHS. Additionally, we believe the dissolved concentration data collected from well C-15 prior to being destroyed in 2008 indicate the plume dimensions were shrinking at that time, and should have continued to decrease despite the short-term increase in dissolved concentration at C-9. The plume dimensions should be further reduced by the operation of the DPE system. The DPE system is currently scheduled to be installed and started up in the first and second quarters of 2014. Therefore, CRA requests that execution of this Work Plan be delayed until the DPE system has completed operation to the extent of its practicability. If subsequent quarterly groundwater monitoring indicates a decrease in the dissolved hydrocarbon content at C-9 and the plume length can be defined with the existing monitoring well network, CRA requests that ACEHS agree to not execute the work proposed in this Work Plan.

However, to address ACHES's concerns, CRA conditionally proposes to install one groundwater monitoring well downgradient of well C-9 and between existing well C-16 and former well C-15 (Figure 2). To accomplish the scope of work, CRA proposes to conduct the following.

Site-Specific Health and Safety Plan

CRA will prepare a site-specific health and safety plan to protect site workers. The plan will be reviewed and signed by site workers and visitors. The plan will be kept onsite during the field work.

Permits and Access

CRA will obtain drilling permits from Alameda County Public Works Agency (ACPWA) and schedule the required inspections prior to beginning field work. A minimum of 48-hours of notice will be given to ACEH and ACPWA prior to commencing drilling activities. CRA will also notify the landowners and gain access to the site and offsite properties to install the monitoring well.

Underground Utility Location and Utility Clearance

Underground Service Alert will be contacted to notify utility companies to mark their utilities at the site. CRA will also conduct a geophysical survey of the area to confirm utility locations and identify any previously unidentified utilities. A licensed geophysicist will be contracted to perform the task. The monitoring well location will additionally be hand cleared of utilities to 8 feet below grade (fbg).

Well Installation

After clearing to 8 fbg, the borehole for the well will be advanced using 8-inch diameter hollow-stem augers to a maximum depth of approximately 20 fbg. The well will be constructed using 2-inch diameter Schedule 40 PVC casing with a 0.010-inch slotted screen from approximately 10-15 fbg. The filter pack will consist of #2/12 sand from the bottom of the boring to approximately 2 feet above the screened interval. The well annulus will have a 2-foot bentonite seal above the screen and sand pack, with the remainder backfilled with Portland Type I/II cement to approximately 1 foot below grade. The well location and top-of-casing elevation will be surveyed by a licensed land surveyor. CRA's standard operating procedures for monitoring well installation are included as Attachment B.

Well Development and Sampling

The well will be developed using agitation and pumping. Gettler-Ryan, Inc. of Dublin, California will develop and sample the well no sooner than 72 hours after installation.

Chemical Analysis
Groundwater, soil and disposal samples will be analyzed for the following:

- Total petroleum hydrocarbons as gasoline (TPHg) by Environmental Protection Agency (EPA) Method 8015B modified
- Benzene, toluene, ethylbenzene, total xylenes (BTEX) methyl tertiary-butyl ether (MTBE) and naphthalene by EPA Method 8260B
- Total lead by EPA Method 6010 (waste composite soil samples only).

Waste Disposal
Soil cuttings and waste water generated during the drilling will be placed in Department of Transportation approved 55-gallon drums and stored onsite pending analytical profiling. Once characterized, these wastes will be disposed of at the appropriate Chevron-approved facility.

Reporting
Upon completion of field work and review of the analytical results, CRA will prepare a *Well Installation Report* that at a minimum will contain:

- Descriptions of the drilling and sampling methods
- A boring log with soil descriptions and probe construction details
- Tabulated soil analytical results with a comparison to LTCP criteria
- Laboratory analytical reports and chain-of-custody forms
- Waste disposal details
- Conclusions and recommendations

CLOSING

Prior to installing the well, CRA will obtain the necessary drilling permits, access agreements, and schedule the subcontractors at their earliest availability. Our well installation report will be submitted approximately 6 weeks after completion of field activities and receipt of final laboratory analytical reports.

CONESTOGA-ROVERS
& ASSOCIATES

January 20, 2014 Reference No. 311950

We appreciate your assistance with this project. Please contact Judy Gilbert of CRA at (510) 420-3314 or Mr. Eric Hetrick of Chevron at (925) 790-6491 if you have any questions or comments.

Sincerely,

CONESTOGA-ROVERS & ASSOCIATES

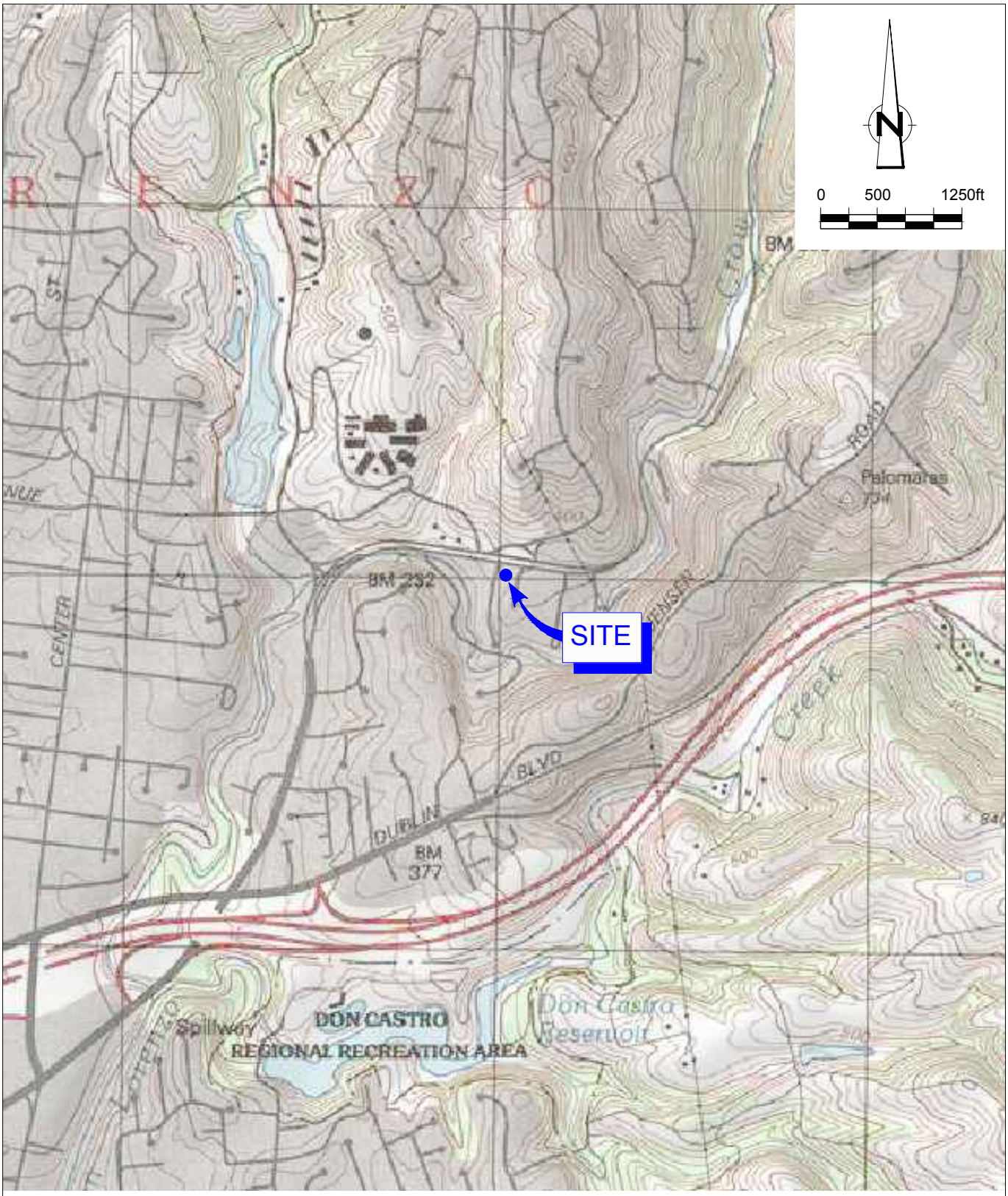
Judy A. Gilbert Brandon S. Wilken, PG 7564

JG/cw/27
Encl.

Figure 1	Vicinity Map
Figure 2	Site Plan with Proposed Monitoring Well Location
Attachment A:	Regulatory Correspondence
Attachment B:	Standard Field Procedures for Monitoring Installation

c.c.: Mr. Eric Hetrick, Chevron EMC *(electronic copy)*
Mr. Kevin Hinkley, Property Owner
Ms. Diane Riggs, Forest Creek Townhomes Association

FIGURES



SOURCE: TOPO! MAPS.

Figure 1

VICINITY MAP
FORMER CHEVRON STATION 95607
5269 CROW CANYON ROAD
Castro Valley, California

311950-95(027)GN-EM001 JAN 2/2014

BASEMAP MODIFIED FROM DRAWING PROVIDED BY GETTLER-RYAN, INC.

311950-95(027)GN-EM002 JAN 2/2014

Figure 2

SITE PLAN
CHEVRON SERVICE STATION 95607
5269 CROW CANYON ROAD
Castro Valley, California

ATTACHMENT A

REGULATORY CORRESPONDENCE

ALAMEDA COUNTY
HEALTH CARE SERVICES
AGENCY
ALEX BRISCOE, Agency Director

ENVIRONMENTAL HEALTH SERVICES
ENVIRONMENTAL PROTECTION
1131 Harbor Bay Parkway, Suite 250
Alameda, CA 94502-6577
(510) 567-6700
FAX (510) 337-9335

November 21, 2013

Mr. Eric Hetrick
Chevron Corporation
6101 Bollinger Canyon Road
San Ramon, CA 94583
(sent via electronic mail to:
ehetrick@chevron.com)

Kevin & Julia Hinkley
Kevin Hinkley Service
5269 Crow Canyon Road
Castro Valley, CA 94552

Subject: Conditional Approval of RAP Addendum and Request for Work Plan; Fuel Leak Case No. RO0000350 and GeoTracker Global ID T0600100344, Chevron #9-5607, 5269 Crow Canyon Road, Castro Valley, CA 94552

Dear Mr. Hetrick, and Mr. and Ms. Hinkley:

Alameda County Environmental Health (ACEH) staff has reviewed the case file for the above referenced site including the *Revised Drilling Scope of Work* (RAP Addendum), dated November 7, 2013. The document was prepared and submitted on your behalf by Conestoga-Rovers & Associates (CRA). Thank you for submitting the report. The Work Plan was prepared to document changes in remedial system presented in the *Remedial Action Plan Implementation Plan,* dated August 2, 2013 in order to address public comments and additional data that has been collected since that time.

Based on ACEH staff review of the RAP Addendum the proposed scope of work is conditionally approved provided the technical approach, and the technical comments listed below are incorporated prior to and during the implementation of the work. Submittal of a further revised work plan or work plan addendum for this scope of work is not required unless an alternate scope of work outside that described in the work plan or technical comments below is proposed. We request that you address the following technical comments, perform the proposed work, and send us the reports described below. Please provide 72-hour advance written notification to this office (e-mail preferred to: mark.detterman@acgov.org) prior to the start of field activities.

TECHNICAL COMMENTS

1. **RAP Addendum Modifications –** The referenced work plan proposes a series of actions with which ACEH is in general agreement of undertaking; however, ACEH requests several modifications to the approach. Please submit a report by the date specified below.

    a. **SVE Installation –** The *Revised Drilling Scope of Work* proposes the installation of two Soil Vapor Extraction (SVE) wells in the vicinity of the former dispenser islands as a result of elevated vapor concentrations in the vicinity. The SVE wells are proposed to be screened between 10 and 20 feet below grade surface (bgs). ACEH requests that this screening interval be re-evaluated prior to well installation due to the detection of vapor concentrations of concern at a shallower depth (seven feet bgs). ACEH's intent is to ensure that potentially shallow secondary sources (soil contamination) be addressed and mitigated by the proposed installation of the two SVE wells.

    b. **Conversion of Monitoring Well C-9 –** The referenced report proposes to convert 4-inch diameter groundwater monitoring well C-9 to a Dual Phase Extraction (DPE) well, and to additionally continue to monitor groundwater from the well. ACEH is not opposed to the conversion of the monitoring well to a DPE well; however, ACEH notes that future groundwater sampling from the well will be biased low and may not represent groundwater

concentrations beyond the zone of influence of the DPE well. This same rational was used for the request for separate DPE wells in the source zone, rather than conversion of monitoring wells C-1, C-3, and C-6.

Please be aware that should this well be converted, additional time may be required in the Verification Monitoring phase of Corrective Actions to verify contaminant rebound conditions are no longer occurring.

c. **Groundwater Monitoring Wells Between C-9 and C-12 –** ACEH has reviewed the analysis for eliminating the two wells currently proposed for installation between wells C-9 and C-12. ACEH is in general agreement that the wells can be eliminated. The recent collection of soil vapor analytical data, in addition to the two other lines of evidence discussed in the referenced document, has helped in this reevaluation of the need for the wells in these locations.

2. **Groundwater Monitoring Well Installation Work Plan; Length of Groundwater Plume –** The renewed focus on well C-9 due to the substantial increase in groundwater concentrations in the well, in conjunction with the consistency of the groundwater flow direction and historic groundwater contaminant concentrations in downgradient wells (especially C-15) emphasizes that the length of the contaminant plume has not been defined. The Regional Water Quality Control Boards (RWQCBs) Environmental Screening Levels (ESL) for Total Petroleum Hydrocarbons as gasoline (TPHg) for groundwater is 100 micrograms per liter (µg/l), and for fresh water aquatic habitat is 500 µg/l TPHg. Well C-15, which is appears to be lateral to the apparent principal plume migration path (downgradient of well C-9), contained 520 µg/l TPHg in the last sampling event (July 2008) before the well was destroyed. Similar concentrations were detected throughout the life of the well, with spikes up to 1,000 µg/l TPHg, at this lateral position. With the presence of Crow Creek, at a distance of approximately 375 feet from the release, and approximately 50 feet downgradient of well C-15, groundwater TPHg concentrations in the primary plume migration path may present a risk to ecological receptors.

   Consequently, ACEH requests, by the date identified below, a groundwater monitoring well work plan for the installation of sufficient groundwater monitoring wells to define the groundwater contaminant plume downgradient of C-9 in order to determine if the level of protection of Crow Creek is sufficient.

TECHNICAL REPORT REQUEST

Please upload technical reports to the ACEH ftp site (Attention: Mark Detterman), and to the State Water Resources Control Board's Geotracker website, in accordance with the specified file naming convention below, according to the following schedule:

- **January 20, 2014** – Groundwater Monitoring Well Work Plan
  File to be named: RO350_WP_L_yyyy-mm-dd

- **February 21, 2014** – First DPE / SVE Post Implementation Quarterly Groundwater Monitoring and Well Installation Report; File to be named: RO350_GWM_R_yyyy-mm-dd

- **30 Days After DPE System Start Up** – First DPE System Remedial Progress Report and As-Built Documentation; File to be named: RO350_REM_R_yyyy-mm-dd

- **TBD** – Quarterly Groundwater Monitoring
  File to be named: RO350_GWM_R_yyyy-mm-dd

- **TBD** – Monthly DPE System Remedial Progress Reports
  File to be named: RO350_GWM_R_yyyy-mm-dd

These reports are being requested pursuant to California Health and Safety Code Section 25296.10. 23 CCR Sections 2652 through 2654, and 2721 through 2728 outline the responsibilities of a responsible

party in response to an unauthorized release from a petroleum UST system, and require your compliance with this request.

Should you have any questions, please contact me at (510) 567--6876 or send me an electronic mail message at mark.detterman@acgov.org.

Sincerely,

Digitally signed by Mark Detterman
DN: cn=Mark Detterman, o, ou,
email=mark.detterman@acgov.org, c=US
Date: 2013.11.21 14:50:48 -08'00'

Mark E. Detterman, PG, CEG
Senior Hazardous Materials Specialist

Enclosures: Attachment 1 – Responsible Party (ies) Legal Requirements / Obligations and Electronic Report Upload (ftp) Instructions

cc: Brandon Wilken, 5900 Hollis Street, Suite A, Emeryville, CA 94608
(sent via electronic mail to bwilken@craworld.com)

Judy Gilbert, Conestoga-Rovers & Assoc., 5900 Hollis Street, Suite A, Emeryville, CA 94608;
(sent via electronic mail to: jgilbert@CRAworld.com)

Dilan Roe (sent via electronic mail to dilan.roe@acgov.org)
Mark Detterman (sent via electronic mail to mark.detterman@acgov.org)
Electronic File, GeoTracker

Attachment 1

Responsible Party(ies) Legal Requirements/Obligations

REPORT/DATA REQUESTS

These reports/data are being requested pursuant to Division 7 of the California Water Code (Water Quality), Chapter 6.7 of Division 20 of the California Health and Safety Code (Underground Storage of Hazardous Substances), and Chapter 16 of Division 3 of Title 23 of the California Code of Regulations (Underground Storage Tank Regulations).

ELECTRONIC SUBMITTAL OF REPORTS

ACEH's Environmental Cleanup Oversight Programs (Local Oversight Program [LOP] for unauthorized releases from petroleum Underground Storage Tanks [USTs], and Site Cleanup Program [SCP] for unauthorized releases of non-petroleum hazardous substances) require submission of reports in electronic format pursuant to Chapter 3 of Division 7, Sections 13195 and 13197.5 of the California Water Code, and Chapter 30, Articles 1 and 2, Sections 3890 to 3895 of Division 3 of Title 23 of the California Code of Regulations (23 CCR). Instructions for submission of electronic documents to the ACEH FTP site are provided on the attached "Electronic Report Upload Instructions."

Submission of reports to the ACEH FTP site is in addition to requirements for electronic submittal of information (ESI) to the State Water Resources Control Board's (SWRCB) Geotracker website. In April 2001, the SWRCB adopted 23 CCR, Division 3, Chapter 16, Article 12, Sections 2729 and 2729.1 (Electronic Submission of Laboratory Data for UST Reports). Article 12 required electronic submittal of analytical laboratory data submitted in a report to a regulatory agency (effective September 1, 2001), and surveyed locations (latitude, longitude and elevation) of groundwater monitoring wells (effective January 1, 2002) in Electronic Deliverable Format (EDF) to Geotracker. Article 12 was subsequently repealed in 2004 and replaced with Article 30 (Electronic Submittal of Information) which expanded the ESI requirements to include electronic submittal of any report or data required by a regulatory agency from a cleanup site. The expanded ESI submittal requirements for petroleum UST sites subject to the requirements of 23 CCR, Division, 3, Chapter 16, Article 11, became effective December 16, 2004. All other electronic submittals required pursuant to Chapter 30 became effective January 1, 2005. Please visit the SWRCB website for more information on these requirements: (http://www.waterboards.ca.gov/water_issues/programs/ust/electronic_submittal/).

PERJURY STATEMENT

All work plans, technical reports, or technical documents submitted to ACEH must be accompanied by a cover letter from the responsible party that states, at a minimum, the following: "I declare, under penalty of perjury, that the information and/or recommendations contained in the attached document or report is true and correct to the best of my knowledge." This letter must be signed by an officer or legally authorized representative of your company. Please include a cover letter satisfying these requirements with all future reports and technical documents submitted for this fuel leak case.

PROFESSIONAL CERTIFICATION & CONCLUSIONS/RECOMMENDATIONS

The California Business and Professions Code (Sections 6735, 7835, and 7835.1) requires that work plans and technical or implementation reports containing geologic or engineering evaluations and/or judgments be performed under the direction of an appropriately registered or certified professional. For your submittal to be considered a valid technical report, you are to present site specific data, data interpretations, and recommendations prepared by an appropriately licensed professional and include the professional registration stamp, signature, and statement of professional certification. Please ensure all that all technical reports submitted for this fuel leak case meet this requirement.

UNDERGROUND STORAGE TANK CLEANUP FUND

Please note that delays in investigation, late reports, or enforcement actions may result in your becoming ineligible to receive grant money from the state's Underground Storage Tank Cleanup Fund (Senate Bill 2004) to reimburse you for the cost of cleanup.

AGENCY OVERSIGHT

If it appears as though significant delays are occurring or reports are not submitted as requested, we will consider referring your case to the Regional Board or other appropriate agency, including the County District Attorney, for possible enforcement actions. California Health and Safety Code, Section 25299.76 authorizes enforcement including administrative action or monetary penalties of up to $10,000 per day for each day of violation.

Alameda County Environmental Cleanup Oversight Programs (LOP and SCP)	**REVISION DATE:** July 25, 2012
	ISSUE DATE: July 5, 2005
	PREVIOUS REVISIONS: October 31, 2005; December 16, 2005; March 27, 2009; July 8, 2010
SECTION: Miscellaneous Administrative Topics & Procedures	**SUBJECT:** Electronic Report Upload (ftp) Instructions

The Alameda County Environmental Cleanup Oversight Programs (petroleum UST and SCP) require submission of all reports in electronic form to the county's FTP site. Paper copies of reports will no longer be accepted. The electronic copy replaces the paper copy and will be used for all public information requests, regulatory review, and compliance/enforcement activities.

REQUIREMENTS

- **Please do not submit reports as attachments to electronic mail.**
- Entire report including cover letter must be submitted to the ftp site as **a single Portable Document Format (PDF) with no password protection**.
- It is **preferable** that reports be converted to PDF format from their original format, (e.g., Microsoft Word) rather than scanned.
- **Signature pages and perjury statements must be included and have either original or electronic signature.**
- **Do not password protect the document**. Once indexed and inserted into the correct electronic case file, the document will be secured in compliance with the County's current security standards and a password. **Documents with password protection will not be accepted**.
- Each page in the PDF document should be rotated in the direction that will make it easiest to read on a computer monitor.
- Reports must be named and saved using the following naming convention:

  RO#_Report Name_Year-Month-Date (e.g., RO#5555_WorkPlan_2005-06-14)

Submission Instructions

1) Obtain User Name and Password
   a) Contact the Alameda County Environmental Health Department to obtain a User Name and Password to upload files to the ftp site.
      i) Send an e-mail to deh.loptoxic@acgov.org
   b) In the subject line of your request, be sure to include **"ftp PASSWORD REQUEST"** and in the body of your request, include the **Contact Information, Site Addresses**, and the **Case Numbers (RO# available in Geotracker) you will be posting for**.

2) Upload Files to the ftp Site
   a) Using Internet Explorer (IE4+), go to ftp://alcoftp1.acgov.org
      (i) Note: Netscape, Safari, and Firefox browsers will not open the FTP site as they are NOT being supported at this time.
   b) Click on Page located on the Command bar on upper right side of window, and then scroll down to Open FTP Site in Windows Explorer.
   c) Enter your User Name and Password. (Note: Both are Case Sensitive.)
   d) Open "My Computer" on your computer and navigate to the file(s) you wish to upload to the ftp site.
   e) With both "My Computer" and the ftp site open in separate windows, drag and drop the file(s) from "My Computer" to the ftp window.

3) Send E-mail Notifications to the Environmental Cleanup Oversight Programs
   a) Send email to deh.loptoxic@acgov.org notify us that you have placed a report on our ftp site.
   b) Copy your Caseworker on the e-mail. Your Caseworker's e-mail address is the entire first name then a period and entire last name @acgov.org. (e.g., firstname.lastname@acgov.org)
   c) The subject line of the e-mail must start with the RO# followed by **Report Upload**. (e.g., Subject: RO1234 Report Upload) If site is a new case without an RO#, use the street address instead.
   d) If your document meets the above requirements and you follow the submission instructions, you will receive a notification by email indicating that your document was successfully uploaded to the ftp site.

ATTACHMENT B

STANDARD FIELD PROCEDURES FOR MONITORING INSTALLATION

STANDARD FIELD PROCEDURES FOR SOIL BORING AND MONITORING WELL INSTALLATION

This document presents standard field methods for drilling and sampling soil borings and installing, developing, and sampling groundwater monitoring wells. These procedures are designed to comply with Federal, State and local regulatory guidelines. Specific field procedures are summarized below.

SOIL BORINGS

Objectives

Soil samples are collected to characterize subsurface lithology, assess whether the soils exhibit obvious hydrocarbon or other compound vapor or staining, and to collect samples for analysis at a State-certified laboratory. All borings are logged using the ASTM D2488-06 Unified Soil Classification System by a trained geologist working under the supervision of a California Professional Geologist (PG).

Soil Boring and Sampling

Prior to drilling, the first 8 feet of the boring are cleared using an air or water knife and vacuum extraction or hand auger. This minimizes the potential for impacting utilities. Soil borings are typically drilled using hollow-stem augers or direct-push technologies such as the Geoprobe®. Soil samples are collected at least every five ft to characterize the subsurface sediments and for possible chemical analysis. Additional soil samples are collected near the water table and at lithologic changes. Samples are collected using lined split-barrel or equivalent samplers driven into undisturbed sediments at the bottom of the borehole.

Drilling and sampling equipment is steam-cleaned prior to drilling and between borings to prevent cross-contamination. Sampling equipment is washed between samples with trisodium phosphate or an equivalent EPA-approved detergent.

Sample Analysis

Sampling tubes chosen for analysis are trimmed of excess soil and capped with Teflon tape and plastic end caps. Soil samples are labeled and stored at or below 4° C on either crushed or dry ice, depending upon local regulations. Samples are transported under chain-of-custody to a State-certified analytic laboratory.

Field Screening

One of the remaining tubes is partially emptied leaving about one-third of the soil in the tube. The tube is capped with plastic end caps and set aside to allow hydrocarbons to volatilize from the soil. After ten to fifteen minutes, a portable volatile vapor analyzer measures volatile hydrocarbon vapor concentrations in the tube headspace, extracting the vapor through a slit in the cap. Volatile vapor analyzer measurements are used along with the field observations, odors, stratigraphy and groundwater depth to select soil samples for analysis.

Water Sampling
Water samples, if they are collected from the boring, are either collected using a driven Hydropunch® type sampler or are collected from the open borehole using bailers. The groundwater samples are decanted into the appropriate containers supplied by the analytic laboratory. Samples are labeled, placed in protective foam sleeves, stored on crushed ice at or below 4°C, and transported under chain-of-custody to the laboratory. Laboratory-supplied trip blanks accompany the samples and are analyzed to check for cross-contamination. An equipment blank may be analyzed if non-dedicated sampling equipment is used.

Grouting
If the borings are not completed as wells, the borings are filled to the ground surface with cement grout poured or pumped through a tremie pipe.

MONITORING WELL INSTALLATION, DEVELOPMENT AND SAMPLING

Well Construction and Surveying
Groundwater monitoring wells are installed to monitor groundwater quality and determine the groundwater elevation, flow direction and gradient. Well depths and screen lengths are based on groundwater depth, occurrence of hydrocarbons or other compounds in the borehole, stratigraphy and State and local regulatory guidelines. Well screens typically extend 10 to 15 feet below and 5 feet above the static water level at the time of drilling. However, the well screen will generally not extend into or through a clay layer that is at least three feet thick.

Well casing and screen are flush-threaded, Schedule 40 PVC. Screen slot size varies according to the sediments screened, but slots are generally 0.010 or 0.020 inches wide. A rinsed and graded sand occupies the annular space between the boring and the well screen to about one to two feet above the well screen. A two feet thick hydrated bentonite seal separates the sand from the overlying sanitary surface seal composed of Portland type I, II cement.

Well-heads are secured by locking well-caps inside traffic-rated vaults finished flush with the ground surface. A stovepipe may be installed between the well-head and the vault cap for additional security.

The well top-of-casing elevation is surveyed with respect to mean sea level and the well is surveyed for horizontal location with respect to an onsite or nearby offsite landmark.

Well Development

Wells are generally developed using a combination of groundwater surging and extraction. Surging agitates the groundwater and dislodges fine sediments from the sand pack. After about ten minutes of surging, groundwater is extracted from the well using bailing, pumping and/or reverse air-lifting through an eductor pipe to remove the sediments from the well. Surging and extraction continue until at least ten well-casing volumes of groundwater are extracted and the sediment volume in the groundwater is negligible. This process usually occurs prior to installing the sanitary surface seal to ensure sand pack stabilization. If development occurs after surface seal installation, then development occurs 24 to 72 hours after seal installation to ensure that the Portland cement has set up correctly.

All equipment is steam-cleaned prior to use and air used for air-lifting is filtered to prevent oil entrained in the compressed air from entering the well. Wells that are developed using air-lift evacuation are not sampled until at least 24 hours after they are developed.

Groundwater Sampling

Depending on local regulatory guidelines, three to four well-casing volumes of groundwater are purged prior to sampling. Purging continues until groundwater pH, conductivity, and temperature have stabilized. Groundwater samples are collected using bailers or pumps and are decanted into the appropriate containers supplied by the analytic laboratory. Samples are labeled, placed in protective foam sleeves, stored on crushed ice at or below 4°C, and transported under chain-of-custody to the laboratory. Laboratory-supplied trip blanks accompany the samples and are analyzed to check for cross-contamination. An equipment blank may be analyzed if non-dedicated sampling equipment is used.

Waste Handling and Disposal

Soil cuttings from drilling activities are usually stockpiled onsite and covered by plastic sheeting. At least three individual soil samples are collected from the stockpiles and composited at the analytic laboratory. The composite sample is analyzed for the same constituents analyzed in the borehole samples in addition to any analytes required by the receiving disposal facility. Soil cuttings are transported by licensed waste haulers and disposed in secure, licensed facilities based on the composite analytic results.

Groundwater removed during development and sampling is typically stored onsite in sealed 55-gallon drums. Each drum is labeled with the drum number, date of generation, suspected contents, generator identification and consultant contact. Upon receipt of analytic results, the water is either pumped out using a vacuum truck for transport to a licensed waste treatment/disposal facility or the individual drums are picked up and transported to the waste facility where the drum contents are removed and appropriately disposed.