Mr. Jerry Wickham
Hazardous Materials Specialist
Alameda County Health Care Services Agency
Environmental Health Services
Environmental Protection
1131 Harbor Bay Parkway, Suite 250
Alameda, CA 94502

RE: Eagle Gas Station
4301 San Leandro Street
Oakland, California 94601

LOP StID# 2118
Fuel Leak Case No. RO0000096
USTCF Claim No. 014551
Clearwater Group Project # ZP046M

Dear Mr. Wickham,

As the legally authorized representative of the above-referenced project location, I have reviewed the *Proposed Modifications to Work Plan* prepared by my consultant of record, Clearwater Group. I declare, under penalty of perjury, that the information and/or recommendations contained in this report are true and correct to the best of my knowledge.

Sincerely,

Muhammad Jamil

Mr. Muhammad Jamil

Date: 1-15-09

CLEARWATER
GROUP
Environmental Services

January 14, 2009

Mr. Jerry Wickham, PG, CEG, CHG
Environmental Health Services
Environmental Protection
1131 Harbor Bay Parkway, Suite 250
Alameda, California 94502-6577

Re: **Fuel Leak Case No. RO0000096**
Proposed Modifications to Work Plan
Eagle Gas Station
4301 San Leandro Street
Oakland, California 94601

Clearwater Group Project Numbers ZP046M and ZP046K

Dear Mr. Wickham:

Clearwater Group (Clearwater) would like to take this opportunity to propose the following modifications to its previously proposed Dual Phase Extraction (DPE) test design and to its quarterly groundwater sample collection protocol; in addition Clearwater requests concurrence to further reduce the number of wells sampled during each quarterly groundwater monitoring event and to perform additional off-site surveying to assist in determining if a nearby depression (the 42nd Street underpass) serves as a discharge point for the site's groundwater.

The initial design for a DPE test was presented in Clearwater's July 2, 2008, *Soil and Groundwater Investigation Work Plan* (Work Plan). The ACEH reviewed the Work Plan and responded in a letter dated September 4, 2008, to Ms. Farah Naz C/O Muhammad Jamil (**Attachment A**). This letter addresses the ACEH's concern about short–circuiting of the DPE vacuum due to the depth of the DPE test well seal being less than 5 feet below ground surface.

Clearwater has redesigned the DPE test design in response to these ACEH comments and with input from DPE contractors and designers. The revised DPE test design utilizes a slanted DPE extraction trench, rather than a vertical well. **Figure 1** presents the proposed location of the DPE test, and **Figure 2** presents a cross–section view of the proposed DPE test trench design. The DPE trench's one-foot thick bentonite seal will be set five feet below ground surface. In addition, the five feet of fill placed above the bentonite seal, to fill the trench, will be Control Density Fill (CDF), which consists of a soil/cement slurry. The CDF slurry is fluid enough to be poured into the excavation. Once the CDF cures, it forms a solidified soil mass, eliminating the need for soil compaction. Unlike cement, cured CDF is excavatable using a backhoe. The DPE test trench and monitoring wells will be installed under the supervision of a State of California C57 licensed well drilling contractor.

The design and location of the radius of influence DPE test wells (T-1, T-2, and T-3, **Figure 1**) are unchanged from the Work Plan design, and the depth of all the DPE well seals will be to a minimum of 5 feet below ground surface.

Due to the time required to having this design approved and installed, Clearwater requests an extension for submittal of the DPE Test Report until May 2008.

Clearwater seeks ACEH concurrence to alter the groundwater sample collection protocol from purging and sampling, using a disposable bailer, to low-flow (minimum drawdown) groundwater sampling methodology. **Attachment B** presents Clearwater's proposed low-flow groundwater sampling protocol. Low-flow groundwater sampling is requested in order to get better quality groundwater sample results. In addition, the volume of purge water requiring disposal will be significantly reduced.

If low-flow sampling is acceptable, Clearwater requests a reduction in the number of wells sampled during each quarterly groundwater monitoring event. One problem of low-flow groundwater sampling is that it increases the time required to perform the quarterly groundwater monitoring events because of the longer purge time and increased equipment set-up and take-down time. The site groundwater has been monitored quarterly since October 2000, and Clearwater is concerned about the amount of funding remaining available for site remediation. Therefore, Clearwater proposes further reducing the number of wells sampled to five wells (MW-1, MW-3, MW-4, MW-8, and MW-7D [deep zone well]), in addition to newly installed groundwater monitoring wells MW-9, MW-9D, MW-10, MW-10D, and MW-11D (**Figures 2** and **3**).

The newly installed wells will be sampled quarterly for a minimum of one hydrologic cycle (one year). After one year of monitoring, Clearwater will evaluate whether the newly installed wells should be put on a reduced sampling schedule. During each quarterly monitoring event, the depth to water will be measured in all the wells, in order to determine the groundwater gradients and flow directions.

Clearwater has investigated the complex groundwater flow pattern at the Eagle Gas site for several years. Clearwater recently installed shallow- and deep-zone groundwater monitoring wells offsite at two locations. Wells MW-9 (shallow zone) and MW-9D (deep zone) were installed along High Street, and wells MW-10 and MW-10D were installed within the Vulcan Lofts at 4401 San Leandro Street (**Figure 3**). An additional deep-zone well (MW-11D) was installed onsite, near the corner of High Street and San Leandro Street (**Figure 3**). The new wells have not been surveyed yet. Clearwater will submit a separate Well Installation Report, to the ACEH by January 30, 2009, detailing the installation of the above wells.

Clearwater has observed water discharging along the south side of the 42nd Street underpass, just above road grade. Preliminary to designing a test to determine whether the 42nd Avenue

underpass serves as a local groundwater discharge feature, it will be critical to obtain groundwater elevation data from other previously installed, nearby, offsite wells. The groundwater elevation data will be incorporation into the groundwater elevation data, from the site's monitoring well network, in order to understand the site and offsite area groundwater flow.

The Oakland Unified School District (OUSD) facility, at 900 High Street (**Figure 2**), had groundwater monitoring wells installed to investigate an underground storage tank leak (ACEH case number RO0000914). The Geotracker website does not give well construction data and does not indicate whether the groundwater monitoring wells have been abandoned.

The Geotracker website indicates that the former Clorox Company site, at 850 42nd Avenue, Oakland has an active groundwater monitoring program (the wells are currently sampled only for mercury). The SFBRWQCB file number is SL20224842 and the lead regulator is Mr. Cleet Carlton.

Review of the Geotracker file also indicates that the Clorox site is bordered by a Caltrans installed retaining wall, with interior drains connected to storm drains, which in turn lead to the Caltrans "Storage Box" or groundwater storage vault. **Attachment C** presents figures obtained from the Geotracker website and shows the subdrain system. The retaining wall supports the embankment of the Highway 77/42nd Avenue underpass. The retaining wall subdrain is also (confusingly) referred to as the Highway 185 South Side Subdrain System. The source of the above figures was Woodward-Clyde Consultants, *Clorox Remedial Action Assessment*, 1985. Clearwater believes that the retaining wall and the adjoining 42nd Avenue underpass, to the northeast of the retaining wall, may be groundwater discharge areas affecting the Eagle Gas site's groundwater flow pattern.

Clearwater proposes to access the OUSD and Clorox wells, in order to survey the wells and collect depth to groundwater data from these wells during the site quarterly groundwater monitoring events. An alternative would be to exchange depth to groundwater information with Clorox's environmental consultant during concurrent groundwater sampling events. Clearwater reviewed the Clorox files on Geotracker and could not determine which elevation survey baseline (NAD23, NAD88, etc.) the well top of casing elevations were referenced to. The survey will be performed by a licensed surveyor working to Geotracker requirements. During the same survey the surveyor will also survey the ground surface elevation difference between the site and the 42nd Avenue underpass subdrains.

Clearwater will merge the groundwater elevation data from the OUSD and Clorox sites, the onsite wells, and the newly installed offsite wells (well MW-9/MW-9D and MW-10/MW-10D; **Figure 3**) for future quarterly groundwater monitoring events.

Clearwater will evaluate whether sampling of the water seeping into the 42nd Street underpass is warranted. At this time, Clearwater does not request concurrence from the ACEH to sample either the OUSD or Clorox wells for petroleum hydrocarbons.

CLEARWATER
GROUP
Environmental Services

In summary, Clearwater and its client would appreciate a timely response to the above requests. The Eagle Gas site is currently shut down for repairs to its secondary recovery product lines. Installing the DPE test system while the site is not operating will be beneficial to all parties. Please do not hesitate to contact me if you have any questions or concerns, either by email (rnelson@clearwatergroup.com) or at 510-307-9943 extension 237.

Sincerely,
CLEARWATER GROUP

REGISTERED GEOLOGIST
ROBERT L. NELSON
No. 2087
CERTIFIED
ENGINEERING
GEOLOGIST
STATE OF CALIFORNIA

Robert L. Nelson, PG #6270, CEG #2087
Senior Geologist

PROFESSIONAL GEOLOGIST
JAMES ALAN
JACOBS
NO. 88
CERTIFIED
HYDROGEOLOGIST
STATE OF CALIFORNIA

James A. Jacobs, PG #4815, CHG #88
Chief Hydrogeologist

CC: Mr. Muhammad Jamil

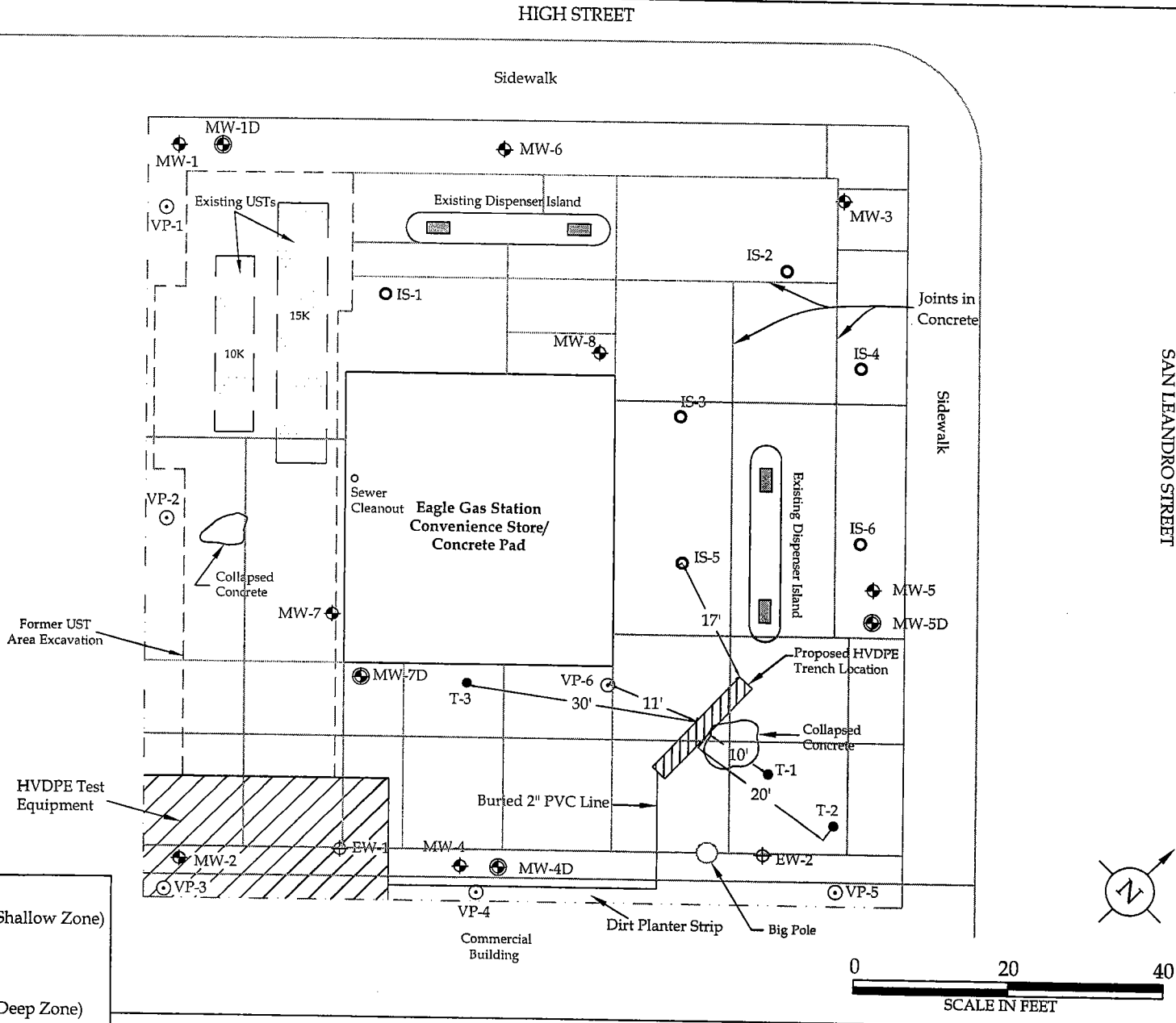
Figures:

Figure 1: Site Plan Showing Proposed Location of DPE Test
Figure 2: Proposed DPE Test Trench Design
Figure 3: Offsite Groundwater Monitoring Well Locations

Attachments:

Attachment A: ACEH Letter of September 4, 2008
Attachment B: Low-Flow (Minimal Drawdown) Groundwater Monitoring Standard Operating Procedures
Attachment C: Figure 5, from Woodward-Clyde Consultants, 1985, *Clorox Remedial Action Assessment,* Subdrain System at Highway 185 Underpass
Figure 6, from Woodward-Clyde Consultants, 1985, *Clorox Remedial Action Assessment,* Highway 185 South Side Subdrain System

FIGURES



LEGEND

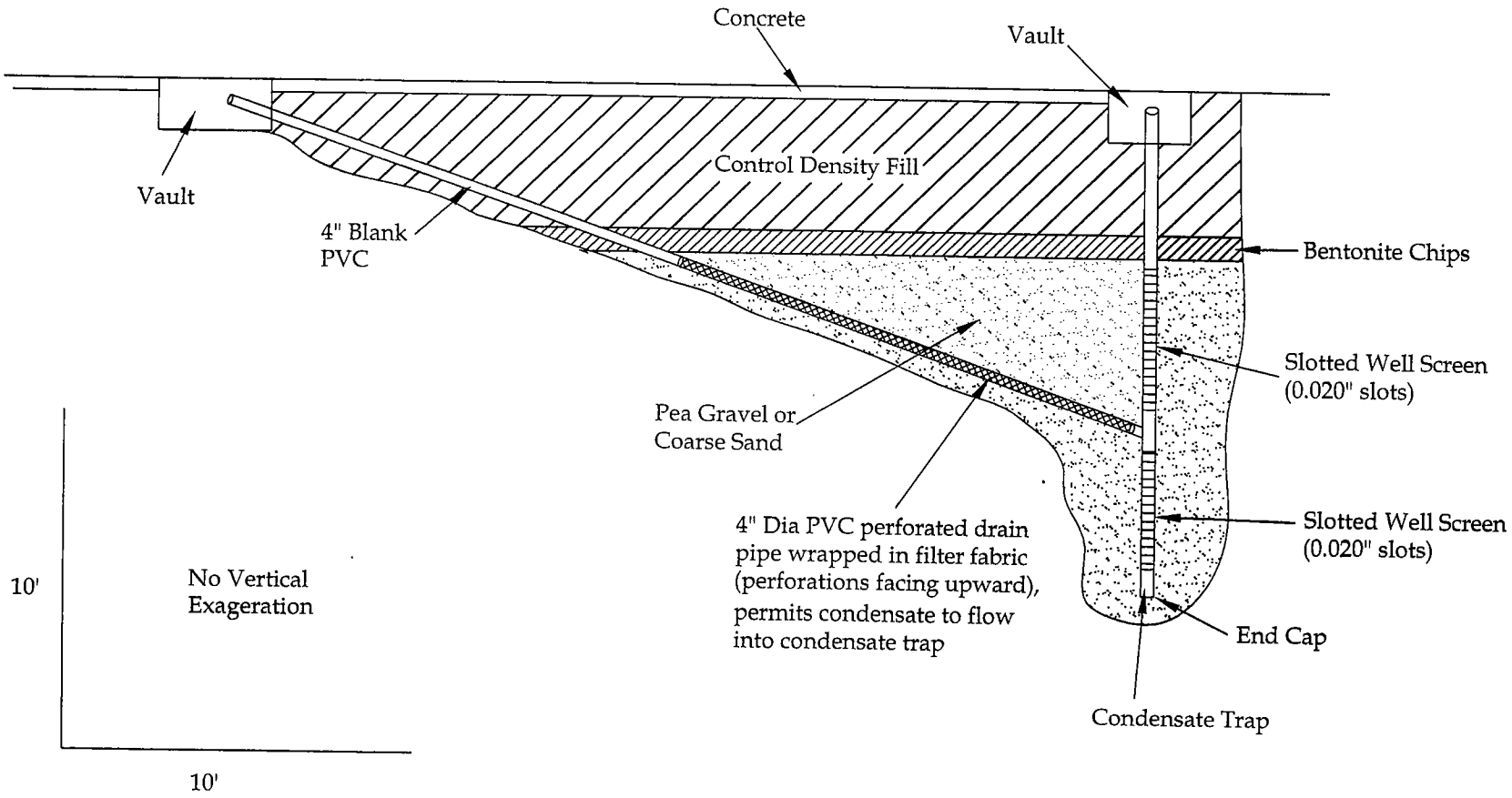
MW-4	Location of Monitoring Well (Shallow Zone)
EW-1	Location of Extraction Well
IS-1	Location of iSOC Well
MW-1D	Location of Monitoring Well (Deep Zone)
VP-1	Soil Vapor Well Location
	Property Line
T-2	2" Diameter HVDPE Radius of Influence (ROI) Measurement Well

Site Plan Showing Proposed Location of DPE Test
Eagle Gas
4301 San Leandro Street
Oakland, California

CLEARWATER GROUP

Project No.	Figure Date	Figure
ZP046K	12/08	1

H:\Department\Jobs\ZP046 Eagle Gas\ZP046K 2008 Investigation\Well Installation\Drilling Figs\Fig 1 Site Plan Showing Proposed Location of DPE Test



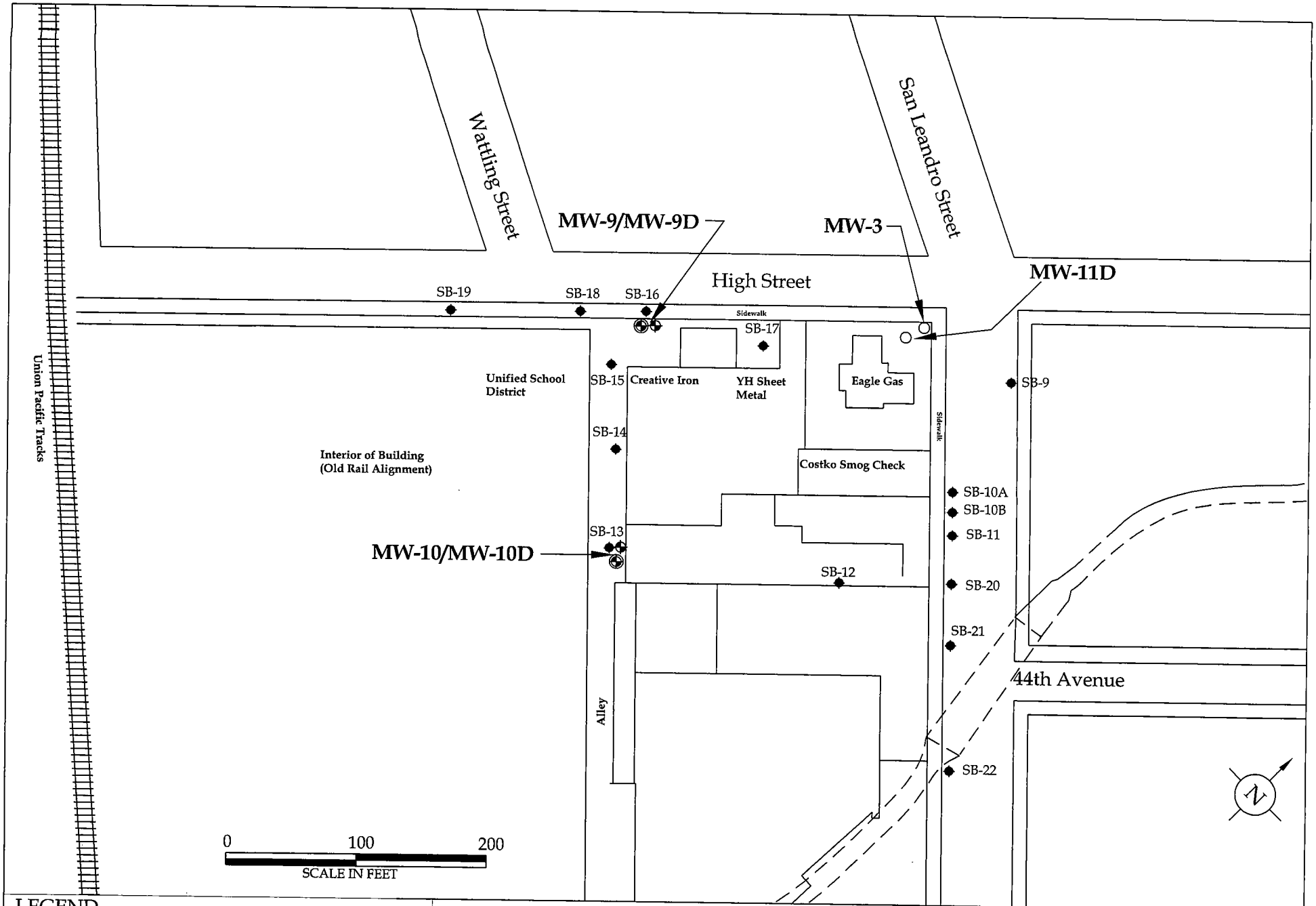
Proposed DPE Test Trench Design

Eagle Gas
4301 San Leandro Street
Oakland, California

CLEARWATER GROUP

Project No.	Figure Date	Figure
ZP046K	12/08	2

H:\Department\Jobs\ZP046 Eagle Gas\ZP046K 2008 Investigation\Well Installation\Drilling Figs\Fig 2 Proposed DPE Test Trench Design



LEGEND

- Shallow (Zone A) Groundwater Monitoring Well Location
- Deep (Zone B) Groundwater Monitoring Well
- 2007 Soil Boring Location

Offsite Groundwater Monitoring Well Locations
Eagle Gas
4301 San Leandro Street
Oakland, California

CLEARWATER GROUP

Project No.	Figure Date	Figure
ZP046K	**12/08**	**3**

H:\Department\Jobs\ZP046 Eagle Gas\ZP046K 2008 Investigation\Well Installation\Drilling Figs\Fig 3 Offsite Groundwater Monitoring Well Locations

ATTACHMENT A

ACEH Letter of September 4, 2008

ALAMEDA COUNTY
HEALTH CARE SERVICES
AGENCY
DAVID J. KEARS, Agency Director

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

September 4, 2008

Ms. Farah Naz c/o
Mr. Muhammad Jamil
40092 Davis Street
Fremont, CA 94538

Subject: Fuel Leak Case No. RO0000096 and Geotracker Global ID T0600143649, Eagle Gas, 4301 San Leandro Street, Oakland, CA 94601

Dear Ms. Naz:

Alameda County Environmental Health (ACEH) staff has reviewed the fuel leak case file for the above-referenced site including the recently submitted document entitled, "*2008 Soil and Groundwater Investigation Work Plan*," dated July 2, 2008 and received by ACEH on July 17, 2008. The Work Plan proposes:

- conducting an off-site passive soil vapor survey;
- installing off-site wells and one on-site well;
- determining whether the 42nd Avenue freeway on-ramp is a groundwater discharge area;
- performing a high-vacuum dual phase extraction (DPE) pilot test.

The proposed scope of work is generally acceptable with the exception of the proposed off-site passive soil vapor survey. As discussed in technical comment 1, we do not concur with the implementation of the proposed passive soil vapor survey. Well installation, determining whether the 42nd Avenue freeway on-ramp is a groundwater discharge area, and the DPE pilot test may be implemented provided that the technical comments below are addressed and incorporated during field implementation of the proposed activities. We request that you address the following technical comments, perform the proposed work, and send us the reports described below.

TECHNICAL COMMENTS

1. **Proposed Passive Soil Vapor Sampling (Gore Sorber®) Survey.** The proposed passive soil vapor sampling (Gore Sorber®) survey is proposed largely within areas where soil and groundwater sampling was previously conducted. The purpose of many of the proposed lines of passive soil vapor samples appears to be corroboration of previous soil and groundwater sampling results. Since the soil and grab groundwater sample data provide much more direct evidence of contamination than the proposed passive soil vapor sampling survey, corroboration of the soil and grab groundwater sample data does not appear to add significant value to the investigation. Therefore, we do not concur with the proposed passive soil vapor sampling (Gore Sorber®) survey. If you choose to implement the passive soil vapor survey, we recommend that the State Water Resources Control Board UST Cleanup Fund not reimburse you for the costs.

2. **Proposed Monitoring Wells.** The proposed locations for monitoring wells MW-3D, MW-9, MW-9D, MW-10, and MW-10D are acceptable. Pilot soil borings that are continuously sampled for logging purposes or CPT borings are to be used to select filter pack and screen intervals for the wells. In order to prevent the potential for cross-contamination, filter packs and screen intervals must not extend between shallow first-encountered groundwater and lower permeable intervals. In no case shall the filter pack or screen interval for the shallow wells extend below a depth of 25 feet bgs. The deeper wells shall be installed within the lower permeable unit typically encountered at depths of approximately 35 to 45 feet bgs and must not have screen intervals longer than 10 feet. Please present documentation of the well installation in the DPE Pilot Test Report below. Groundwater sampling results are to be incorporated into the quarterly groundwater monitoring reports requested below.

3. **Groundwater Monitoring Program.** The proposed elimination of quarterly groundwater sampling of wells MW-6, IS-1, IS-2, IS-3, IS-6, and EW-1 is approved. Please submit future groundwater monitoring results in the reports requested below.

4. **Dual-Phase Extraction Pilot Test.** The proposal to install one extraction well and three observation wells to conduct a DPE pilot test is generally acceptable and may be implemented. We concur with the proposal to install one extraction well and three observation wells for the proposed dual-phase extraction (DPE) pilot test. Targeting the clayey gravel layer for the DPE pilot testing is acceptable. However, our previous January 10, 2008 requested further discussion of the rationale for installation of the screen interval for the extraction well as shallow as 3.5 feet bgs. Review of historical soil analytical data indicates that most of the mass of contamination appears to be in the zone of seasonal water table fluctuations between depths of approximately 8 to 14 feet bgs. We request that the top of the screen interval for the DPE extraction and observation wells be no shallower than 5 feet bgs. If you disagree with this request and wish to proceed with installation of extraction and observation wells with well screens as shallow as 3.5 feet bgs, you must provide further justification including a discussion of the shallow contamination that is being targeted, how the potential for short circuiting with the surface will be addressed, and any additional steps that will be taken to assure the integrity of the surface seal. Please present results from the DPE pilot test in the Well Installation and DPE Pilot Test Report requested below.

5. **Sewer System Leaks.** As discussed in Appendix H of the 2007 Soil and Groundwater Investigation Report, two leaks were found in the sewer line from the station building. Please report on progress in repairing the leaks in the reports requested below.

6. **Potential Discharge to 42nd Avenue.** Please present the drawings of the 42nd Avenue On-ramp and your plans for evaluating whether contaminated groundwater from the site is discharging to this area in the Well Installation and DPE Pilot Test Report requested below.

TECHNICAL REPORT REQUEST

Please submit technical reports to Alameda County Environmental Health (Attention: Jerry Wickham), according to the following schedule:

- **November 5, 2008** – Third Quarter 2008 Groundwater Monitoring Report

- **January 11, 2009** – Well Installation and DPE Pilot Test Report
- **February 5, 2009** – Fourth Quarter 2008 Groundwater Monitoring Report
- **May 5, 2009** – First Quarter 2009 Groundwater Monitoring Report
- **August 5, 2009** – Second Quarter 2009 Groundwater Monitoring Report

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.

ELECTRONIC SUBMITTAL OF REPORTS

ACEH's Environmental Cleanup Oversight Programs (LOP and SLIC) require submission of reports in electronic form. The electronic copy replaces paper copies and is expected to be used for all public information requests, regulatory review, and compliance/enforcement activities. Instructions for submission of electronic documents to the Alameda County Environmental Cleanup Oversight Program FTP site are provided on the attached "Electronic Report Upload Instructions." Submission of reports to the Alameda County FTP site is an addition to existing requirements for electronic submittal of information to the State Water Resources Control Board (SWRCB) Geotracker website. In September 2004, the SWRCB adopted regulations that require electronic submittal of information for all groundwater cleanup programs. For several years, responsible parties for cleanup of leaks from underground storage tanks (USTs) have been required to submit groundwater analytical data, surveyed locations of monitoring wells, and other data to the Geotracker database over the Internet. Beginning July 1, 2005, these same reporting requirements were added to Spills, Leaks, Investigations, and Cleanup (SLIC) sites. Beginning July 1, 2005, electronic submittal of a complete copy of all reports for all sites is required in Geotracker (in PDF format). Please visit the SWRCB website for more information on these requirements (http://www.swrcb.ca.gov/ust/cleanup/electronic_reporting).

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, 6835, 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, later 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.

If you have any questions, please call me at (510) 567-6791 or send me an electronic mail message at jerry.wickham@acgov.org.

Sincerely,

Jerry Wickham, California PG 3766, CEG 1177, and CHG 297
Senior Hazardous Materials Specialist

Enclosure: ACEH Electronic Report Upload (ftp) Instructions

cc: Leroy Griffin, Oakland Fire Department, 250 Frank H. Ogawa Plaza, Ste. 3341, Oakland, CA 94612-2032

Robert Nelson, Clearwater Group, 229 Tewksbury Avenue, Point Richmond, CA 94801

Donna Drogos, ACEH
Jerry Wickham, ACEH
File

Alameda County Environmental Cleanup Oversight Programs (LOP and SLIC)	ISSUE DATE: July 5, 2005
	REVISION DATE: December 16, 2005
	PREVIOUS REVISIONS: October 31, 2005
SECTION: Miscellaneous Administrative Topics & Procedures	SUBJECT: Electronic Report Upload (ftp) Instructions

Effective **January 31, 2006**, the Alameda County Environmental Cleanup Oversight Programs (LOP and SLIC) 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

- Entire report including cover letter must be submitted to the ftp site as a **single portable document format (PDF) with no password protection.** (Please do not submit reports as attachments to electronic mail.)
- 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)

Additional Recommendations

- A separate copy of the tables in the document should be submitted by e-mail to your Caseworker in **Excel** format. These are for use by assigned Caseworker only.

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 dehloptoxic@acgov.org
      or
      ii) Send a fax on company letterhead to (510) 337-9335, to the attention of Alicia Lam-Finneke.
   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 and Firefox browsers will not open the FTP site.
   b) Click on File, then on Login As.
   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 dehloptoxic@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 at 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)

ATTACHMENT B

Low-flow (Minimal Drawdown) Groundwater Monitoring Standard Operating Procedure

CLEARWATER GROUP

Low-Flow (Minimal Drawdown) Groundwater Monitoring
Standard Operating Procedure

The purpose of this standard operating procedure (SOP) is to provide a method which minimizes the amount of impact the purging process has on the ground water chemistry during sample collection and to minimize the volume of water that is being purged and disposed. This will take place by placing the pump intake within the screen interval and by keeping the drawdown at a minimal level (0.33 feet) (Puls and Barcelona, 1996) until the water quality parameters have stabilized and sample collection is complete. The flow rate at which the pump will be operating will be depended upon both hydraulic conductivity of the aquifer and the drawdown with the goal of minimizing the drawdown. The flow rate from the pump during purging and sampling will be at a rate that will not compromise the integrity of the analyte that is being sampled. This sampling procedure may or may not provide a discrete ground water sample at the location of the pump intake. The flow of ground-water to the pump intake will be dependent on the distribution of the hydraulic conductivity (K) of the aquifer within the screen interval. In order to minimize the drawdown in the monitoring well a low-flow rate must be utilized. Low-flow refers to the velocity with which water enters the pump intake from the surrounding formation in the immediate vicinity of the well screen. It does not necessarily refer to the flow rate of water discharged at the surface, which can be affected by flow regulators or restrictions (Puls and Barcelona, 1996). This SOP was developed by the Superfund/RCRA Ground Water Forum and draws from an USEPA's Ground Water Issue Paper, Low-Flow (Minimal Drawdown) Ground-Water Sampling Procedure, by Robert W. Puls and Michael J. Barcelona. Also, available USEPA Regional SOPs regarding Low-Stress(Low Flow)Purging and Sampling were used for this SOP.

SCOPE AND APPLICATION

This SOP should be used primarily at monitoring wells which have a screen or an open interval with a length of ten feet or less and can accept a sampling device which minimizes the disturbance to the aquifer or the water column in the well casing. The screen or open interval should have been optimally located to intercept an existing contaminant plume(s) or along flowpaths of potential contaminant releases. Knowledge of the contaminant distribution within the screen interval is highly recommended and is essential for the success of this sampling procedure. The ground-water samples which are collected using this procedure are acceptable for the analyses of ground-water contaminants which may be found at Superfund and RCRA contamination sites. The analytes may be volatile, semi-volatile organic compounds, pesticides, PCBs, metals and other inorganic compounds. The screened interval should be located within the contaminant plume(s) and the pump intake should be placed at or near the known source of the contamination within the screened interval. It is critical to place the pump intake in the exact location or depth for each sampling event. This argues for the use of dedicated, permanently installed sampling devices whenever possible. If this is not possible then the placement of the pump intake should be positioned with a calibrated sampling pump hose sounded with a weighted-tape or using a pre-measured hose. The pump intake should not be placed near the bottom of the screened interval to avoid disturbing any sediment that may have settled at the bottom of the well.

Water-quality indicator parameters and water levels must be measured during purging, prior to sample collection. Stabilization of the water quality parameters as well as monitoring water levels are a prerequisite to sample collection. The water-quality indicator parameters which are recommended include the following: specific electrical conductance, dissolved oxygen, turbidity, oxidation-reduction potential, pH, and temperature. The latter two parameters are useful data, but are generally insensitive as purging parameters. Oxidation-reduction potential may not always be appropriate stabilization parameter, and will depend on site-specific conditions. However, readings should be recorded because of its value as a double check for oxidation conditions, and for fate and transport issues. Also, when samples are collected for metals, semi-volatile organic compounds, and pesticides every effort must be made to reduce turbidity to 10 NTUs or less (not just the stabilization of turbidity) prior to the collection of the water sample. In addition to the measurement of the above parameters, depth to water must be measured during purging (U.S. Environmental Protection Agency, 1995).

Proper well construction, development and maintenance are essential for any ground-water sampling procedure. Prior to conducting the field work, information on the construction of the well and well development should be obtained and that information factored into the site specific sampling procedure. The attached Sampling Checklist is an example of the type of information that is useful.

Stabilization of the water-quality indicator parameters is the criterion for sample collection. But if stabilization is not occurring and the procedure has been strictly followed, then sample collection can take place once three (minimum) to six (maximum) casing volumes have been removed (Schuller et al., 1981 and U.S. Environmental Protection Agency., 1986; Wilde et al., 1998; Gibs and Imbrigiotta., 1990). The specific information on what took place during purging must be recorded in the field notebook or in the ground-water sampling log. This SOP is not to be used where non-aqueous phase liquids (immiscible fluids) are present in the monitoring well.

EQUIPMENT

Depth-to-water measuring device - An electronic water-level indicator or steel tape and chalk, with marked intervals of 0.01 foot. Interface probe for determination of liquid products (NAPL) presence, if needed. Steel tape and weight - Used for measuring total depth of well. Lead weight should not be used. Sampling pump - Submersible or bladder pumps with adjustable rate controls are preferred. Pumps are to be constructed of inert materials, such as stainless steel and teflon®. Pump types that are acceptable include gear and helical driven, centrifugal (low-flow type) and air-activated piston. Adjustable rate, peristaltic pump can be used when the depth to water is 20 feet or less. Tubing - Teflon® or Teflon® lined polyethylene tubing is preferred when sampling for organic compounds. Polyethylene tubing can be used when sampling in organics. Power Source - If a combustion type (gasoline or diesel driven)generator is used, it must be placed downwind of the sampling area. Flow measurement supplies - flow meter, graduated cylinder and a stop watch. Multi-Parameter meter with flow-through-cell - This can be one instrument or more contained in a flow-through cell. The water-quality indicator parameters which must be monitored are pH, ORP/EH, dissolved oxygen (DO), turbidity, pecific conductance, and temperature. Turbidity readings must be collected before the flow cell because of the potential for sediment buildup which can bias the turbidity measurements. Calibration fluids for all

instruments should be NIST-traceable and there should be enough for daily calibration through out the sampling event. The inlet of the flow cell must be located near the bottom of the flow cell and the outlet near the top. The size of the flow cell should be kept to a minimum and a closed cell is preferred. The flow cell must not contain any air or gas bubbles when monitoring for the water-quality indicator parameters. Decontamination Supplies - Including a reliable and documented source of distilled water and any solvents (if used). Pressure sprayers, buckets or decontamination tubes for pumps, brushes and non-phosphate soap will also be needed. Sample bottles, sample preservation supplies, sample tags or labels and chain of custody forms. Approved Field Sampling and Quality Assurance Project Plan. Well construction data, field and water quality data from the previous sampling event. Well keys and map of well locations. Field notebook, ground-water sampling logs and calculator. A suggested field data sheet (ground-water sampling record or ground-water sampling log) are provided in the attachment. Filtration equipment, if needed. An in-line disposable filter is recommended. Polyethylene sheeting which will be placed on ground around the well head. Personal protective equipment specified in the site Health and Safety Plan. Air monitoring equipment as specified in the Site Health and Safety Plan. Tool box - All needed tools for all site equipment used. A 55-gallon drum or container to contain the purged water. Materials of construction of the sampling equipment (bladders, pumps, tubing, and other equipment that comes in contact with the sample) should be limited to stainless steel, Teflon®, glass and other inert material. This will reduce the chance of the sampling materials to alter the ground-water where concentrations of the site contaminants are expected to be near the detection limits. The sample tubing diameter thickness should be maximized and the tubing length should be minimized so that the loss of contaminants into and through the tubing walls may be reduced and the rate of stabilization of ground-water parameters is maximized. The tendency of organics to sorb into and out of material makes the appropriate selection of sample tubing material critical for trace analyses (Pohlmann and Alduino, 1992; Parker and Ranney, 1998).

PURGING AND SAMPLING PROCEDURES

The following describes the purging and sampling procedures for the Low-Stress (Low Flow)/ Minimal Drawdown method for the collection of ground-water samples. These procedures also describe steps for dedicated and non-dedicated systems. Pre-Sampling Activities (Non-dedicated and dedicated system)

1. Sampling locations must begin at the monitoring well with the least contamination, generally up-gradient or furthest from the site or suspected source. Then proceed systematically to the monitoring wells with the most contaminated ground water.

2. Check and record the condition of the monitoring well for damage or evidence of tampering. Lay out polyethylene sheeting around the well to minimize the likelihood of contamination of sampling/purging equipment from the soil. Place monitoring, purging and sampling equipment on the sheeting.

3. Unlock well head. Record location, time, date and appropriate information in a field logbook or on the ground-water sampling log (See attached ground-water sampling record and ground-water sampling log as examples).

4. Remove inner casing cap.

5. Monitor the headspace of the monitoring well at the rim of the casing for volatile organic compounds (VOC) with a Photo-ionization detector (PID) or Flame ionization detector (FID), and record in the logbook. If the existing monitoring well has a history of positive readings of the headspace, then the sampling must be conducted in accordance with the Health and Safety Plan.

6. Measure the depth to water (water level must be measured to nearest 0.01 feet) relative to a reference measuring point on the well casing with an electronic water level indicator or steel tape and record in logbook or ground-water sampling log. If no reference point is found, measure relative to the top of the inner casing, then mark that reference point and note that location in the field logbook. Record information on depth to ground water in the field logbook or ground water sampling log. Measure the depth to water a second time to confirm initial measurement; measurement should agree within 0.01 feet or re-measure.

7. Check the available well information or field information for the total depth of the monitoring well. Use the information from the depth of water in step six and the total depth of the monitoring well to calculate the volume of the water in the monitoring well or the volume of one casing. Record information in field logbook or ground-water sampling log. Purging and Sampling Activities.

8A. Non-dedicated system - Place the pump and support equipment at the wellhead and slowly lower the pump and tubing down into the monitoring well until the location of the pump intake is set at a pre-determined location within the screen interval. The placement of the pump intake should be positioned with a calibrated sampling pump hose, sounded with a weighted-tape, or using a pre-measured hose. Refer to the available monitoring well information to determine the depth and length of the screen interval. Measure the depth of the pump intake while lowering the pump into location. Record pump location in field logbook or groundwater sampling log.

8B. Dedicated system - Pump has already been installed, refer to the available monitoring well information and record the depth of the pump intake in the field logbook or ground-water sampling log.

9. Non-dedicated system and dedicated system - Measure the water level (water level must be measured to nearest 0.01 feet) and record information on the ground-water sampling log, leave water level indicator probe in the monitoring well.

10. Non-dedicated and dedicated system - Connect the discharge line from the pump to a flow-through cell. A "T" connection is needed prior to the flow cell to allow for the collection of water for the turbidity measurements. The discharge line from the flow-through cell must be directed to a container to contain the purge water during the purging and sampling of the monitoring well.

11. Non-dedicated and dedicated system - Start pumping the well at a low flow rate (0.2 to 0.5 liter per minute) and slowly increase the speed. Check water level. Maintain a steady flow rate while maintaining a drawdown of less than 0.33 feet (Puls and Barcelona, 1996). If drawdown is greater than 0.33 feet lower the flow rate. 0.33 feet is a goal to help guide with the flow rate adjustment. It should be noted that this goal may be difficult to achieve under some

circumstances due to geologic heterogeneities within the screened interval, and may require adjustment based on site-specific conditions and personal experience (Puls and Barcelona, 1996).

12. Non-dedicated and dedicated system - Measure the discharge rate of the pump with a graduated cylinder and a stop watch. Also, measure the water level and record both flow rate and water level on the groundwater sampling log. Continue purging, monitor and record water level and pump rate every three to five minutes during purging. Pumping rates should be kept at minimal flow to ensure minimal drawdown in the monitoring well.

13. Non-dedicated and dedicated system - During the purging, a minimum of one tubing volume (including the volume of water in the pump and flow cell) must be purged prior to recording the water-quality indicator parameters. Then monitor and record the water-quality indicator parameters every three to five minutes. The water-quality indicator field parameters are turbidity, dissolved oxygen, specific electrical conductance, pH, redoxpotential and temperature. Oxidation-reduction potential may not always be an appropriate stabilization parameter, and will depend on site-specific conditions. However, readings should be recorded because of its value as a double check for oxidizing conditions. Also, for the final dissolved oxygen measurement, if the readings are less than 1 milligram per liter, it should be collected and analyze with the spectrophotometric method (Wilde et al., 1998 Wilkin et al., 2001), colorimetric or Winkler titration (Wilkin et al., 2001). The stabilization criterion is based on three successive readings of the water quality field parameters; the following are the criteria which must be used:

Parameter Stabilization Criteria Reference
pH ± 0.1 pH units Puls and Barcelona, 1996;
Wilde et al.,
Specific electrical conductance (SEC)
± 3% FS/cm Puls and Barcelona, 1996
oxidation-reduction potential (ORP)
± 10 millivolts Puls and Barcelona 1996
turbidity ± 10 % NTUs (when turbidity is greater than 10 NTUs)
Puls and Barcelona, 1996
Wilde et al., 1998
dissolved oxygen ± 0.3 milligrams per liter Wilde et al., 1998

Once the criteria have been successfully met indicating that the water quality indicator parameters have stabilized, then sample collection can take place.

14. If a stabilized drawdown in the well can't be maintained at 0.33 feet and the water level is approaching the top of the screened interval, reduce the flow rate or turn the pump off (for 15 minutes) and allow for recovery. It should be noted whether or not the pump has a check valve. A check valve is required if the pump is shut off. Under no circumstances should the well be pumped dry. Begin pumping at a lower flow rate, if the water draws-down to the top of the screened interval again turn pump off and allow for recovery. If two tubing volumes (including the volume of water in the pump and flow cell) have been removed during purging then sampling can proceed next time the pump is turned on. This information should be noted in the field notebook or ground-water sampling log with a recommendation for a different purging and sampling procedure.

15. Non-dedicated and dedicated system - Maintain the same pumping rate or reduce slightly for sampling (0.2 to 0.5 liter per minute) in order to minimize disturbance of the water column.

Samples should be collected directly from the discharge port of the pump tubing prior to passing through the flow-through cell. Disconnect the pump's tubing from the flow-through-cell so that the samples are collected from the pump's discharge tubing. For samples collected for dissolved gases or Volatile Organic Compounds (VOCs) analyses, the pump's tubing needs to be completely full of ground water to prevent the ground water from being aerated as the ground water flows through the tubing. The sequence of the samples is immaterial unless filtered (dissolved) samples are collected and they must be collected last (Puls and Barcelona, 1996). All sample containers should be filled with minimal turbulence by allowing the ground water to flow from the tubing gently down the inside of the container. When filling the VOC samples a meniscus must be formed over the mouth of the vial to eliminate the formation of air bubbles and head space prior to capping. In the event that the ground water is turbid,(greaterthen 10 NTUs), a filtered metal (dissolved) sample also should be collected. If filtered metal sample is to be collected, then an in-line filter is fitted at the end of the discharge tubing and the sample is collected after the filter. The in-line filter must be pre-rinsed following manufacturer's recommendations and if there are no recommendations for rinsing, a minimum of 0.5 to 1 liter of ground water from the monitoring well must pass through the filter prior to sampling.

16A. Non-dedicated system - Remove the pump from the monitoring well. Decontaminate the pump and dispose of the tubing if it is non-dedicated.

16B Dedicated system - Disconnect the tubing that extends from the plate at the wellhead (or cap) and discard after use.

17. Non-dedicated system - Before locking the monitoring well, measure and record the well depth (to 0.1 feet). Measure the total depth a second time to confirm initial measurement; measurement should agree within 0.01 feet or re-measure.

18. Non-dedicated and dedicated system - Close and lock the well.

DECONTAMINATION PROCEDURES

Decontamination procedures for the water level meter and the water quality field parameter sensors. The electronic water level indicator probe/steel tape and the water-quality field parameter sensors will be decontaminated by the following procedures:

1. The water level meter will be hand washed with phosphate free detergent and a scrubber, then thoroughly rinsed with distilled water.

2. Water quality field parameter sensors and flow-through cell will be rinsed with distilled water between sampling locations. No other decontamination procedures are necessary or recommended for these probes since they are sensitive. After the sampling event, the flow cell and sensors must be cleaned and maintained per the manufacturer's requirements. Decontamination Procedure for the Sampling Pump Upon completion of the ground water sample collection the sampling pump must be properly decontaminated between monitoring wells. The pump and discharge line including support cable and electrical wires which were in contact with the ground water in the well casing must be decontaminated by the following procedure:

1. The outside of the pump, tubing, support cable and electrical wires must be pressured sprayed with soapy water, tap water and distilled water. Spray outside of tubing and pump until water is flowing off of tubing after each rinse. Use bristle brush to help remove visible dirt and contaminants.

2.Place the sampling pump in a bucket or in a short PVC casing (4-in. diameter) with one end capped. The pump placed in this device must be completely submerged in the water. A small amount of phosphate free detergent must be added to the potable water (tap water).

3. Remove the pump from the bucket or 4-in. casing and scrub the outside of the pump housing and cable.

4. Place pump and discharge line back in the 4-in. casing or bucket, start pump and re-circulate this soapy water for 2 minutes (wash).

5. Re-direct discharge line to a 55-gallon drum, continue to add 5 gallons of potable water (tap water)or until soapy water is no longer visible.

6. Turn pump off and place pump into a second bucket or 4-in. Casing which contains tap water, continue to add 5-gallons of tap water (rinse).

7. Turn pump off and place pump into a third bucket or 4-in. casing which contains distilled/deionized water, continue to add three to five gallons of distilled/deionized water (final rinse).

8. If a hydrophobic contaminant is present (such as separate phase, high levels of PCB's, etc.) An additional decon step, or steps, may be added. For example, an organic solvent, such as reagent-grade isopropanol alcool may be added as a first spraying/bucket prior to the soapy water rinse/bucket.

FIELD QUALITY CONTROL

Quality control (QC) samples must be collected to verify that sample collection and handling procedures were performed adequately and that they have not compromised the quality of the ground water samples. The appropriate EPA program guidance must be consulted in preparing the field QC sample requirements for the site-specific Quality Assurance Project Plan (QAPP).

There are five primary areas of concern for quality assurance (QA) in the collection of representative ground-water samples:

1. Obtaining a ground-water sample that is representative of the aquifer or zone of interest in the aquifer. Verification is based on the field log documenting that the field water-quality parameters stabilized during the purging of the well, prior to sample collection.

2. Ensuring that the purging and sampling devices are made of materials, and utilized in a manner, which will not interact with or alter the analyses.

3. Ensuring that results generated by these procedures are reproducible; therefore, the sampling scheme should incorporate co-located samples (duplicates).

4. Preventing cross-contamination. Sampling should proceed from least to most contaminated wells, if known. Field equipment blanks should be incorporated for all sampling and purging equipment, and decontamination of the equipment is therefore required.

5. Properly preserving, packaging, and shipping samples. All field quality control samples must be prepared the same as regular investigation samples with regard to sample volume, containers, and preservation. The chain of custody procedures for the QC samples will be identical to the field ground water samples. The following are quality control samples which must be collected during the sampling event:

Sample Type Frequency
Field duplicates 1 per 20 samples
Matrix spike 1 per 20 samples
Matrix spike duplicate 1 per 20 samples
Equipment blank Per Regional requirements or policy
Trip blank (VOCs) 1 per sample cooler
Temperature blank 1 per sample cooler

HEALTH AND SAFETY CONSIDERATIONS

Depending on the site-specific contaminants, various protective programs must be implemented prior to sampling the first well. The site Health and Safety Plan should be reviewed with specific emphasis placed on the protection program planned for the sampling tasks. Standard safe operating practices should be followed, such as minimizing contact with potential contaminants in both the liquid and vapor phase through the use of appropriate personal protective equipment. Depending on the type of contaminants expected or determined in previous sampling efforts, the following safe work practices will be employed:

Particulate or metals contaminants

1. Avoid skin contact with, and incidental ingestion of, purge water.

2. Use protective gloves and splash protection.

Volatile organic contaminants

1. Avoid breathing constituents venting from well.

2. Pre-survey the well head space with an appropriate device as specified in the Site Health and Safety Plan.

3. If monitoring results indicate elevated organic constituents, sampling activities may be conducted in level C protection. At a minimum, skin protection will be afforded by disposable protective clothing, such as Tyvek®. General, common practices should include avoiding skin contact with water from preserved sample bottles, as this water will have pH less than 2 or

greater than 10. Also, when filling pre-acidified VOA bottles, hydrochloric acid fumes may be released and should not be inhaled.

POST-SAMPLING ACTIVITIES

Several activities need to be completed and documented once ground-water sampling has been completed. These activities include, but are not limited to:

1. Ensure that all field equipment has been decontaminated and returned to proper storage location. Once the individual field equipment has been decontaminated, tag it with date of cleaning, site name, and name of individual responsible.

2. All sample paperwork should be processed, including copies provided to the Regional Laboratory, Sample Management Office, or other appropriate sample handling and tracking facility.

3. All field data should be complied for site records.

4. All analytical data when processed by the analytical laboratory, should be verified against field sheets to ensure all data has been returned to sampler.

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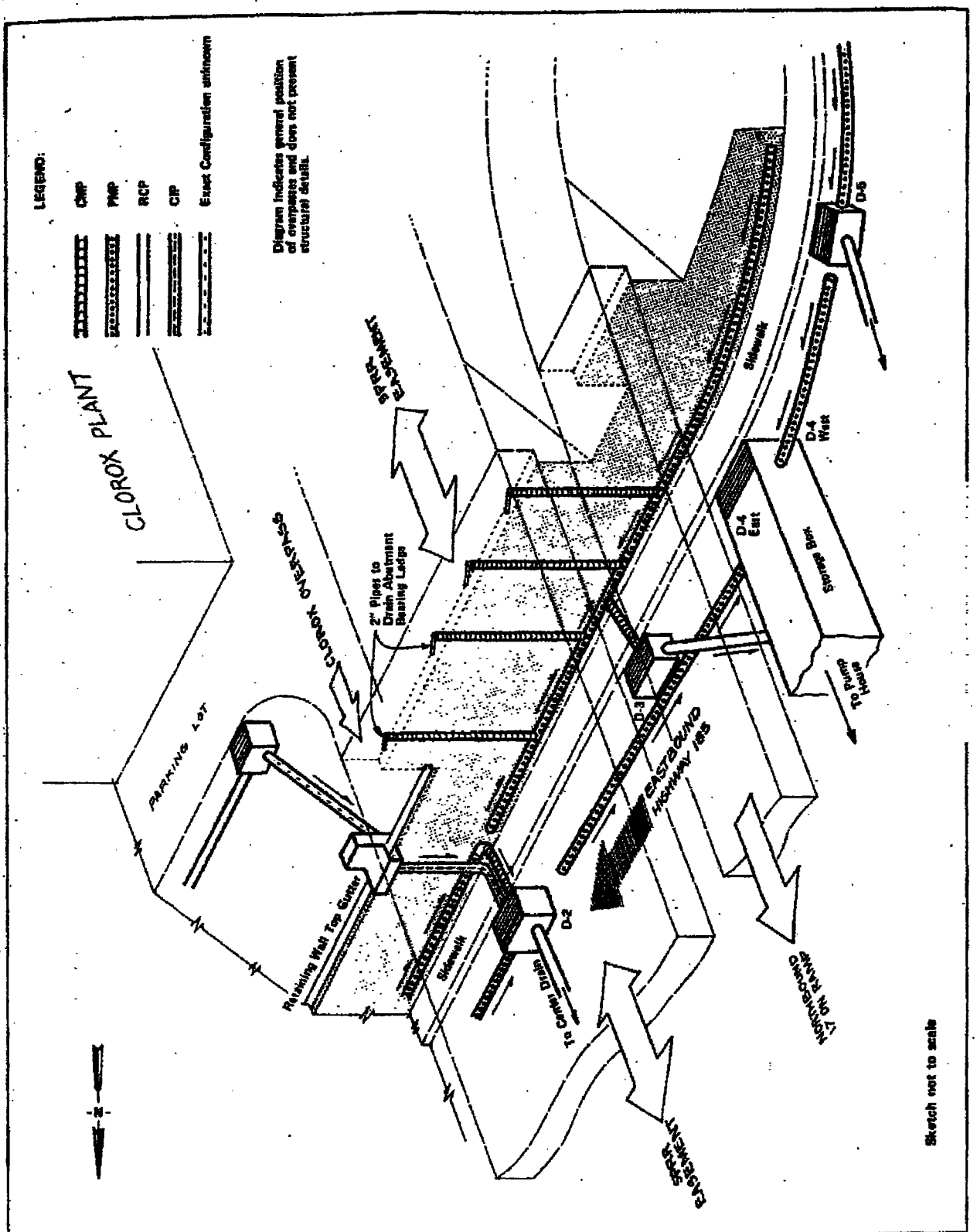
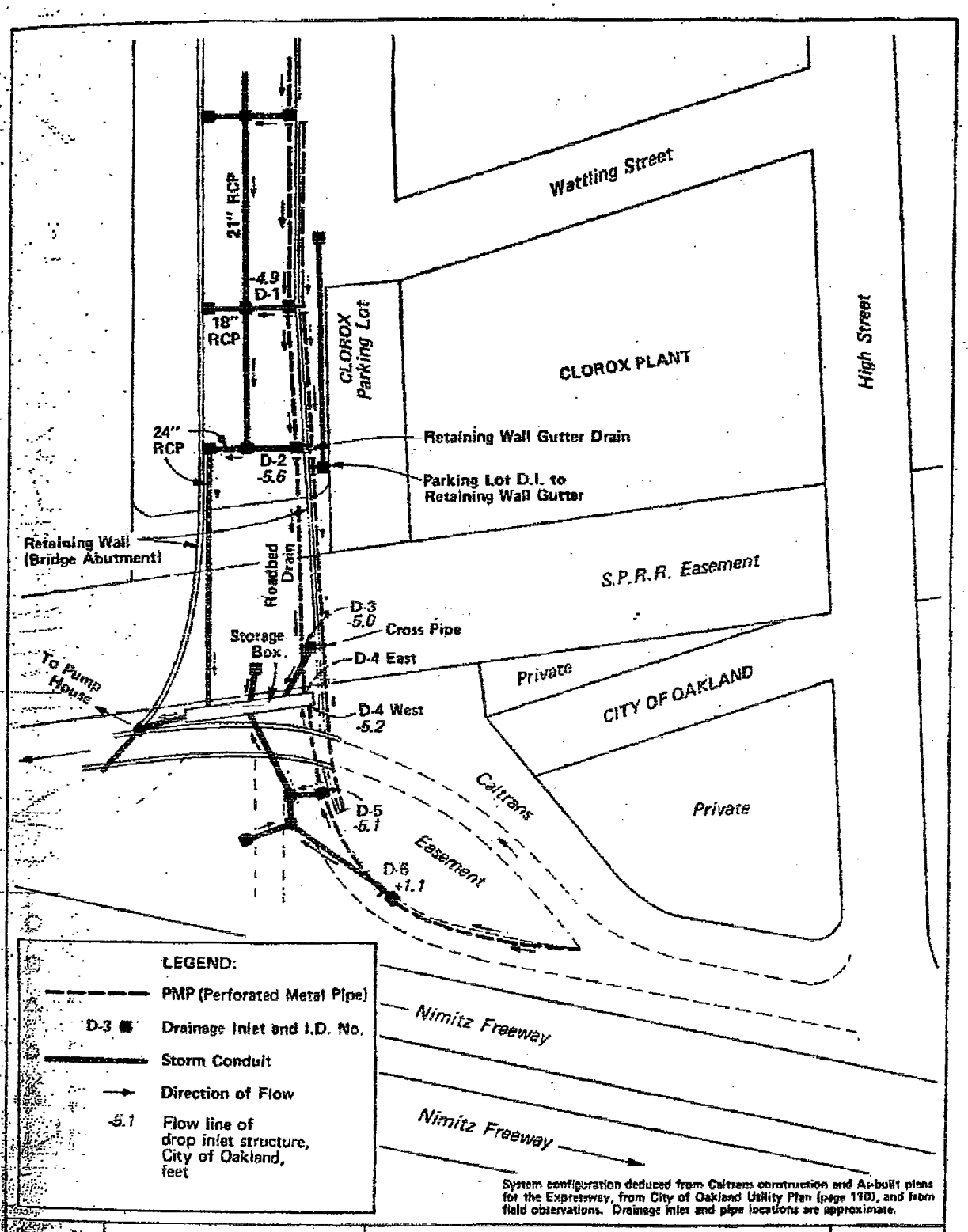
ATTACHMENT C

- Figure 5, from Woodward-Clyde Consultants, 1985, Clorox Remedial Action Assessment, Subdrain System at Highway 185 Underpass
- Figure 6, from Woodward-Clyde Consultants, 1985, Clorox Remedial Action Assessment, Highway 185 South Side Subdrain System



Project No. 90021C	Clorox Remedial Action Assessment	SUBDRAIN SYSTEM AT HIGHWAY 185 UNDERPASS	June 1985
Woodward-Clyde Consultants			Figure 5



Project No. 900216	Clorox Remedial Action Assessment	HIGHWAY 185 SOUTH SIDE SUBDRAIN SYSTEM	June 1985
Woodward-Clyde Consultants			Figure 6