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# Workplan
# Remediation and Investigation Activities
# AutoPro Facility
# 5200 Telegraph Avenue
# Oakland CA

Prepared For:
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Martinez CA

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## INTRODUCTION AND SUMMARY

This workplan describes groundwater gradient determination, limited additional excavation, soil sampling, in-pit bioremediation, and groundwater monitoring procedures to be conducted at the AutoPro facility, 5200 Telegraph Avenue, Oakland CA (Figure 1). The work will be performed in phases, which will expedite closure of open excavations (Figure 2) and allow determination of the nature and extent of soil and groundwater contamination. The phases include:

1. Piezometer Installation and Gradient Measurement
2. Soil Excavation and Confirmation Sampling
3. In-pit Bioremediation and Excavation Closure
4. Groundwater Monitoring

Initially, three 1-inch diameter driven well-point piezometers will be installed, surveyed, and monitored to define the direction of the local groundwater gradient. The direction of the gradient will dictate the order (beginning on the upgradient side of the property) in which the current excavations are enlarged, bioremediated, and closed. The gradient direction will also determine the location of the planned monitoring wells.

Additional excavation will be performed at the former locations of the tanks (3 existing open excavations) to remove contaminated soil. Constraints on available space at the property will limit the possible extent of additional excavation. The limits of excavation will be ascertained in the field by observing staining and odor, and through semiquantitative field screening analyses (polyethylene bag sampling system, Hanby Method, jar headspace test, etc.) of soil samples collected during excavation. Upon reaching the excavation limits (either by reaching the limits of contamination or due to physical constraints), confirmation samples will be collected from the sidewalls and base to either (1) document cleanup of soil contamination, or (2) document levels of residual contamination, as the case may be.

Prior to backfilling the excavations, standing water in the bottom of the open excavations, which may have been impacted by an onsite release (particularly in the diesel/gasoline tanks excavation), will be biotreated with a commercial strain of adapted bacteria. The excavations will then be closed, the area paved, and groundwater monitoring activities conducted.

Two-inch diameter monitoring wells will be installed downgradient and within 10-feet of the suspected release areas. The wells will be developed and sampled one time to assess whether groundwater is impacted.

## BACKGROUND

Table 1 contains a chronology of environmental activities at the subject property.

The property has been operated by AutoPro as a Mercedes Benz repair shop since 1979. Prior to purchase by AutoPro, a Shell service station occupied the property. Five underground storage tanks were present on the property during Shell's operation (Figure 2) and consisted of:

- one 8,000-gallon gasoline
- one 1,000-gallon waste oil
- one 5,000-gallon diesel and two 5,000-gallon gasoline, connected to a common pump island

AutoPro used the waste oil tank and pumped diesel for private use. The three gasoline tanks have reportedly remained dormant since 1979.

In July 1990, the Alameda County Department of Environmental Health requested AutoPro to pay renewal fees on the underground storage tanks or have them removed. AutoPro contracted Pacific Excavators to remove the tanks.

On 19 December 1990, Pacific Excavators removed the 5 tanks and the diesel dispenser. The gasoline dispensers had been previously removed. The two 5,000-gallon gasoline tanks and one 5,000-gallon diesel tank were removed from a common excavation (referred to as diesel/gasoline tanks excavation). The waste oil tank and 8,000-gallon gasoline tanks were removed from separate excavations (referred to as the gasoline-only and waste oil excavations). Figure 2 shows the three excavations. During removal of the 5 tanks, observations by Pacific Excavators indicated the tanks were tight and had not leaked. ? no

With the exception of the waste oil tank, the tanks contained little or no product. Upon excavation, H & H Environmental Services cut open the waste oil tank (onsite), and removed and disposed of ±385 gallons of sludge and contained liquids.

During removal of the 5 tanks, Pacific Excavators excavated tank backfill material (sand) but did not overexcavate native material. Pacific Excavators did not remove product and vent lines, which are currently exposed in the excavation sidewalls and likely run to the former pump islands and/or the vent stacks located at the northwest corner of the garage (Figure 2).

After tank removal, Sampling Specialists collected verification samples from the excavations and stockpiles of excavated soil; 10 soil samples were collected (2 from beneath each tank - Figure 2) within the open excavations and 5 samples from 4 stockpiles. Analytical results of soil sampling are contained in Table 2. Sampling of groundwater was also performed by Sampling Specialists; 2 samples were collected from groundwater standing at the base of the diesel/gasoline tanks excavation. Analytical results of groundwater sampling appear in Table 3.

Elevated levels of oil & grease were detected in soil samples from the waste oil excavation. Low concentrations of total petroleum hydrocarbons as gasoline (TPH-gasoline) and total petroleum hydrocarbons as diesel (TPH-diesel) were measured in the same soil samples. Low to nondetectable concentrations of benzene, toluene, ethylbenzene, and xylenes (BTEX) were also observed. Purgeable halocarbons were not detected. A stockpile sample from the waste oil excavation revealed a low concentration of oil & grease and nondetect concentrations of TPH-gasoline, TPH-diesel, and BTEX.

Elevated concentrations of TPH-gasoline and TPH-diesel, low concentrations of BTEX, and detectable but not elevated concentrations of lead were measured in soil samples from the diesel/gasoline tanks excavation. One of two samples collected from the diesel/gasoline tanks excavation stockpile revealed elevated concentrations of TPH-gasoline and TPH-diesel, with the remaining parameters and other sample results near or below detection limits .

One of the two soil samples collected from the gasoline-only excavation contained elevated concentrations of TPH-gasoline. The remaining parameters and other sample results showed low concentrations, nondetectable concentrations, or nonelevated concentrations (in the case of lead). The stockpile sample showed nondetectable concentrations of the organic parameters and a nonelevated concentration of lead. The stockpile of excavated material from the gasoline-only excavation was subsequently transported offsite to the Vasco Road landfill on 26 February 1991.

Two groundwater samples collected from standing water at the base of the gasoline/diesel excavation revealed elevated concentrations of TPH-gasoline and TPH-diesel and detectable concentrations of BTEX and lead.

The soils exposed in the excavation sidewalls at the AutoPro facility consist predominantly of silty sand containing thin silt strata. Groundwater is present in the excavations at a depth of approximately 12 feet below ground surface.

To address the residual soil contamination, Pacific Excavators has recommended additional excavation followed by confirmation sampling. Also, according to the regulatory guidance applicable to this project (*Tri-Regional Board Staff Recommendations For Preliminary Evaluation and Investigation of Underground Tank Site, 10 August 1990)*, groundwater monitoring will be needed. The Alameda County Department of Environmental Health has indicated a workplan is necessary before additional work is performed on the property.

PURPOSE

The activities described in this workplan will allow expedited closure of the tank excavations and will address selected objectives of the Alameda County Department of Environmental Health, including:

- Better definition of the horizontal and vertical extent of soil contamination
- Better definition of the sources and nature of groundwater contamination
- Determination of the local groundwater gradient direction
- Evaluation of potential remedial alternatives

Although tank removal has mitigated most threats to groundwater quality, residual soil contamination still provides a source of degradation. To mitigate this lesser, yet continued source of groundwater contamination, this workplan describes limited additional excavation of contaminated soil, by enlarging the existing excavations. The direction of the groundwater gradient (derived from 3 drive-point piezometers) will dictate the order in which the excavations are enlarged (beginning on the upgradient-side of the property). The limits of the additional excavation will likely be controlled by physical characteristics of the facility, combined with in-field evaluation of the extent of contamination. Upon completion of the additional excavation, confirmation samples will be collected from the sidewalls and base of the enlarged excavations and analyzed to either (1) document the removal of soil contamination, or (2) document the levels of residual contamination.

Before closing the excavations, standing water at the base of the excavations will be biotreated with a commercial strain of adapted bacteria. This activity will help remediate low-level groundwater contamination. This activity will also decrease the potential for cross-contaminating clean backfill material, particularly below the groundwater table.

Groundwater monitoring will consist of 3 drive-point piezometers (installed before limited additional excavation) and two monitoring wells. The piezometers will be installed first to allow measurement of the local groundwater gradient. The wells will be installed downgradient and within 10 feet of the perimeter of the excavations. Anticipated well and drive-point piezometer locations are shown on Figure 3. Additional soil samples may be collected for chemical analysis during monitoring well installation, contingent upon the analytical results of confirmation sampling. Groundwater from the monitoring wells will be sampled once. Contingent upon the first round of groundwater sampling, recommendations may be forwarded to continue or terminate the groundwater monitoring program.

Soil and groundwater monitoring should comply with Regional Water Quality Control Board guidance (*Tri-Regional Board Staff Recommendations for Preliminary Evaluation and Investigation of Underground Tank Sites*, San Francisco Bay Regional Water Quality Control Board, 10 August 1990).

SCOPE OF WORK

Phase 1 - Drive-Point Piezometer Installation and Gradient Measurement

Prior to drive-point piezometer installation, permit notification will be provided to the Alameda County Flood Control and Water Conservation District - Zone 7.

Drive-Point Piezometer Installation Three drive-point piezometers will be installed to allow determination of the local hydraulic gradient. Figure 3 identifies proposed locations for the planned piezometers. Drive-point piezometers will be installed in accordance with Standard Operating Procedure SOP 5A - Drive-Point Piezometers (Appendix A), the requirements delineated in Table 4, and the schematic shown on Figure 4. Soilgas samples should be collected during piezometer installation and analyzed in the field using an organic vapor meter.

To help minimize clogging, piezometers will be constructed using well-points with a screen opening size of 0.010 inches. Clogging of the screen may cause the need for piezometer development by flushing with distilled water and pumping with a peristaltic pump.

Gradient Measurement Groundwater elevations will be determined by surveying the elevations of measuring points on the drive-point piezometers and then measuring the water levels in each piezometer. Measuring point elevations of each piezometer will be surveyed relative to an onsite temporary benchmark with an assumed elevation. Water level elevations will be measured weekly for approximately 3 weeks and the gradient direction interpreted. If inconsistent gradient directions are interpreted, additional measurements may be needed.

Phase 2 - Soil Excavation and Confirmation Sampling

Prior to beginning additional excavation, notification will be provided to the Bay Area Air Quality Management District in accordance with Regulation 8 Rule 40.

Additional Excavation The excavation furthest upgradient on the property will be enlarged first and the excavation furthest downgradient enlarged last. The extent of additional excavation will be determined using field screening techniques (Hanby Method, polyethylene bag sampling system, field organic vapor monitor, odor, visual observation), subject to physical constraints (buildings, utilities, public thoroughfares, etc). During excavation, field check samples should be collected from the excavation sidewalls for vapor screening using the polyethylene bag sampling system (SOP 10 - Analysis of Soil and Water Using the Polyethylene Bag Sampling System) and the Hanby Method (SOP 11- Hanby Method for Analysis of Soil and Water). SOP's are contained in Appendix A.

The polyethylene bag sampling system involves collecting a sample, placing it in a recloseable bag, agitating the sample to release vapor from the sample to the headspace of the bag, and measuring the headspace vapor concentration using an organic vapor meter. The Hanby Method provides a colorimetric indication of the presence of aromatic hydrocarbons including benzene, toluene, ethylbenzene, xylenes, gasoline, and diesel.

When field methods indicate the limits of contamination have been reached, or when physical constraints are encountered which prevent further excavation, confirmation samples will be collected.

Confirmation Sampling Confirmation sampling will be conducted in accordance with SOP 9A - Verification Sampling For Underground Storage Tank Removal (Appendix A) and the requirements set forth in Table 5. Confirmation sampling will either confirm the efficacy of contaminated soil removal or determine residual concentrations of contamination.

Confirmation samples will be collected (1) at approximate 20-foot intervals around the perimeter of the enlarged excavations at the approximate elevation of the water level, and (2) at approximate 20-foot intervals at the base of the excavations. If a layer of soil contamination only exists coincident with the groundwater table, additional confirmation samples may be collected from the excavation sidewalls, at higher elevations, to more accurately define the nature and extent of soil contamination.

Confirmation samples will be tested for analytes specified in Table 5. The analytes were selected because of their detection (in elevated concentrations) in soil samples collected during tank removal (Table 2). Waste oil excavation samples will be analyzed for oil & grease, TPH-gasoline, TPH-diesel, and BTEX. For the waste oil excavation, all analyses need not be performed on every sample and a stratified testing program may be conducted to determine representative results. Confirmation samples from the diesel/gasoline excavation will be analyzed for TPH-gasoline, TPH-diesel, and BTEX. Confirmation samples from the gasoline-only excavation will be analyzed for TPH-gasoline and BTEX.

Phase 3 - In-Pit Bioremediation and Closure of Excavations

In-Pit Bioremediation The upgradient-most excavation will be bioremediated first and the downgradient-most excavation will be bioremediated last.

Oxygen will be added to the excavation water by introducing a solution of concentrated hydrogen peroxide (35% solution in water). A volume of peroxide equivalent to approximately 0.005% of standing water in the excavation will be added. The addition will likely raise the dissolved oxygen level to approximately 8 milligrams/liter, close to saturation. The residual hydrogen peroxide level is expected to be below 2,000 parts per million, an acceptable threshold for biotoxicity. The initial hydrogen peroxide reaction will require approximately 2 hours, at which time some of the native bacteria within the excavation water will probably be oxidized, and after which time inoculated bacteria are expected to survive.

The oxygenated water will then be inoculated with a commercial strain of adapted bacteria (such as Formulation L-104 from Solmar Corporation). Approximately 5 pounds of dried bacteria will be regenerated in 25 gallons of water and then added to the water within the excavations.

Dependent upon existing levels of nitrogen and phosphorous within the excavation water, a commercial fertilizer (such as Miracle Grow, with a nitrogen content [ammonium salts] equal to approximately 3 times the phosphorous content [phosphate salts]) may also be added and mixed to provide nutrients for the inoculated bacterial population. Fertilizer will be added if nutrient levels are below 1 part per million, as measured with field test kit. The amount of fertilizer will be added to boost nutrient levels to approximately 2 parts per million.

Closure of Excavations The excavations will be backfilled using clean imported material. After backfill, the ground surface will be paved.

Phase 4 - Groundwater Monitoring

Prior to monitoring well installation, permit application will be submitted to the Alameda County Flood Control and Water Conservation District - Zone 7.

Drilling and Soil Sampling Drilling and soil sampling will be performed in accordance with SOP 1A - Hollow-Stem Auger Drilling and Split-Spoon Soil Sampling (Appendix A) and the requirements delineated in Table 6. Boreholes will be continuously sampled and logged. Soil samples will be retained for potential chemical and/or physical testing at approximate 5-foot intervals or discernable changes in material type, whichever is more frequent. Samples will be screened in the field using an organic vapor monitor and if field observations indicate the presence of soil contamination, then additional samples may be collected from the contaminated horizon. If the results of Phase 1 excavation do not document complete removal of contaminated soil, additional soil samples will be collected from the borings to accurately determine the nature and extent of contamination.

If field observations during drilling do not indicate the presence of soil contamination, then 1 representative soil sample from beneath the water table will be analyzed. This analysis will serve to define the vertical extent of soil contamination. Specific analytical parameters for each boring are set forth in Table 6. If the results of Phase 1 excavation do not document complete removal of contaminated soil, additional analyses may be performed to accurately determine the nature and extent of contamination.

Well Completion 2-inch diameter monitoring wells will be constructed following the practices outlined in SOP 2A - Completion of Borings as Wells (Appendix A), the schematic shown on Figure 5, and the specifications contained in Table 7.

Due to the anticipated silty soils, monitoring wells should be installed with 10 feet of 0.010-inch factory-slotted Schedule 40 PVC screen and a filter pack of number 2/12 clean sand. Since the detection of either dissolved or floating contaminants is desired, the well screen will straddle the water table.

The conditions anticipated during preparation of this workplan may not be encountered and modifications to the well completion specifications may be appropriate. For example, if an aquitard or non-water bearing soil horizon is encountered at a depth of 2.5 feet below the water table, then drilling should stop and the well screen should extend to only 2.5 feet below the water table. Such field design modifications preserve the natural integrity of the aquifer system thus reducing concerns about cross-contamination.

Well Development Monitoring wells will be developed in accordance with SOP 3A - Well Development (Appendix A). Well development should produce relatively non-turbid formation water, subject to reasonable time limitations. Due to the silty nature of the soils at the property, sufficient water may not be produced by the formation to develop the monitoring well according to the desired criteria.

Well Sampling Monitoring well sampling will be performed as described in SOP 4A - Well Purging and Sampling (Appendix A) and Table 8. Sampling will be conducted approximately 1 week after well development. Groundwater sampling will consist of initial purging to draw fresh formation water into the well. If the well does not provide sufficient recharge, the purge step may be abbreviated.

Groundwater samples will be analyzed for the analytes delineated in Table 8. These analytes were selected based upon their detection (in elevated concentrations) in soil and groundwater samples collected during tank removal (Tables 2 and 3).

Well Abandonment. If groundwater contamination is not detected upon completion of sampling, the monitoring wells should be abandoned by destruction. Well destruction should be designed and completed in accordance with applicable regulations of the Alameda County Flood Control and Water Conservation District and the California Department of Water Resources (Bulletins 74-81 and 74-90).

Requirements for well destruction include the following:

- Verification of well construction details
- Documentation of the condition of the well prior to abandonment
- Removal of obstructions and foreign material prior to destruction
- Removal of well material including filter pack, well screen and riser, bentonite seal, and cement-bentonite seal
- Filling of the created hole with appropriate sealing material (cement-bentonite mixture)

Investigation-Derived Waste

The work described in this workplan will generate the following wastes:

- Soil stockpiles, soil cuttings, and excess soil samples
- Development and purge water
- Decontamination wastewater

Decontamination water may be discharged to the sanitary sewer.

Development and purge water may be containerized together and stored on-site.

Soil may be stored in stockpiles covered with visqueen, pending determination of potential handling strategies (disposal at a local landfill, onsite treatment, etc.).

Wastes represented by chemical measurements in soil and groundwater where chemicals are not detected may be treated as inert. Limited quantities of inert waters may be discharged to sanitary sewers, subject to sanitary district approval. Inert soils may be disposed of at a local Class III landfill or may be reused as fill material.

Non-inert wastes require specific interpretation with respect to current regulations. These regulations require classification of the waste by the generator; accordingly, it will be the responsibility of AutoPro to classify and arrange for treatment and/or disposal of these wastes.

Reporting

One report will be submitted upon completion of groundwater monitoring. The report will document the installation and monitoring of piezometers, the limited additional excavation and confirmation sampling, soil sampling during drilling, monitoring well construction, well development, and soil and groundwater analytical results. The report will describe variations from the procedures outlined in this workplan.

## QUALITY ASSURANCE/QUALITY CONTROL

Specific quality control procedures are discussed in the standard operating procedures of Appendix A. Quality control samples should consist of the following:

- Laboratory blanks, replicates, and spikes for soil analyses
- Laboratory blanks, replicates, and spikes for groundwater analyses
- Optional travel blanks for groundwater analyses
- Optional field replicates and cross-contamination blanks for groundwater

Field-Generated Quality Control Samples An optional travel blank for BTEX analysis may be submitted for the groundwater samples. Optional cross-contamination blank and replicate groundwater samples may be collected and analyzed for each parameter. The cross-contamination blank should be collected by passing deionized water through and around the decontaminated sample-contacting equipment.

Laboratory-Generated Quality Control Samples The laboratory should report results of laboratory blank, laboratory replicate, and laboratory spike analyses conducted during soil and groundwater analysis. The results of laboratory-generated quality control samples should be provided in addition to any field quality control samples.

Field Meter Quality Control Procedures During well development and groundwater sampling, meters for measurement of field parameters (pH, specific conductance, and temperature) should be calibrated daily. Calibration standards should generally approximate or span the anticipated range of measurements. Recalibration may be appropriate if unusual measurements are noticed. Calibration data should be documented on the instrument calibration log.

The field organic vapor monitor (used for site safety, in conjunction with the polyethylene bag sampling system, and to screen soil samples during drilling) should be calibrated using a standard gas prior to the beginning of each field day. Recalibration may be appropriate if unusual measurements are noticed. Calibration data should be documented on the instrument calibration log.

## HEALTH AND SAFETY

The Site Safety Plan in Appendix B presents the procedures which should be followed to protect the safety of on-site workers during planned field work at the subject property. Physical and chemical hazards, such as working around heavy equipment and exposure to chemicals, are addressed. Work is planned in a previously investigated area, with existing data suggesting minimal chemical hazards. Nevertheless, the procedures in the Site Safety Plan are intended to comply with the pertinent sections of 29 CFR 1910.120, Hazardous Waste Operations and Emergency Response.

Table 1

Chronology of Environmental Activity

| Date of Activity | Work Performed By | Description |
|---|---|---|
| Unknown | Unknown | Installation of one 8,000-gallon steel tank for storage of gasoline, two 5,000-gallon steel tanks for storage of gasoline, one 5,000-gallon steel tank for storage of , and one 1,000-gallon steel tank for storage of waste oil. Tanks not necessarily installed at the same time. |
| Circa 1979 | Unknown | Removal of gasoline fuel dispensers |
| Unknown-1979 | | Operated as a Shell service station |
| 1979-Present | | Purchase of property by AutoPro. AutoPro has operated the property as a Mercedes Benz repair shop since purchase. |
| July 1990 | | Request from Alameda County Department of Environmental Health to AutoPro to remove or pay permit fees for underground storage tanks |
| 19 December 1990 | Pacific Excavators | Removal of 5 underground storage tanks and the diesel dispenser; limited excavation of tank backfill soil |
| 26 February 1991 | Pacific Excavators | Stockpile of soil excavated from the 8,000-gallon gasoline tank was transported and disposed of at the Vasco Road landfill |

Table 2

Soil Analytical Results From Samples Collected During Tank Removal

| Sample Location | Sample Designation | Sample Date | Sampled By | Sample Type | Sample Depth (feet) | Soil Classification | Oil & Grease (mg/kg) | Total Petroleum Hydrocarbons as Gasoline (mg/kg) | Total Petroleum Hydrocarbons as Diesel (mg/kg) | Benzene (mg/kg) | Toluene (mg/kg) | Ethyl-benzene (mg/kg) | Xylenes (mg/kg) | Lead (mg/kg) | Purgeable Halocarbons (mg/kg) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Waste Oil Excavation - south end | AP-1 | 19 December 1990 | SS | Grab | ±6 | not recorded | 8,000 | 36 | 32 | <0.005 | 0.034 | 0.12 | 0.37 | NM | <0.005 |
| Waste Oil Excavation - north end | AP-2 | 19 December 1990 | SS | Grab | ±6 | not recorded | 12,000 | 19 | 47 | <0.005 | <0.005 | 0.066 | 0.12 | NM | NM |
| Waste Oil Excavation stockpiles | AP-3 & 18 | 19 December 1990 | SS | Composite ? | NM | not recorded | 240 | <1 | <1 | <0.005 | <0.005 | <0.005 | <0.005 | NM | NM |
| Diesel/Gasoline Excavation - east end of diesel tank | AP-4 | 19 December 1990 | SS | Grab | ±11 | not recorded | NM | 2,300 | 4,500 | 0.059 | 0.57 | 2.7 | 30 | 39.6 | NM |
| Diesel/Gasoline Excavation - west end of diesel tank | AP-5 | 19 December 1990 | SS | Grab | ±11 | not recorded | NM | 320 | <1 | <0.005 | 0.19 | 1.5 | 0.22 | 15.3 | NM |
| Diesel/Gasoline Excavation - east end of northern gasoline tank | AP-6 | 19 December 1990 | SS | Grab | ±11 | not recorded | NM | 2,900 | NM | 4.5 | 2.4 | 0.36 | 2.9 | 47.1 | NM |
| Diesel/Gasoline Excavation - west end of northern gasoline tank | AP-7 | 19 December 1990 | SS | Grab | ±11 | not recorded | NM | 540 | NM | <0.005 | <0.005 | 3.4 | 13 | 18.4 | NM |
| Diesel/Gasoline Excavation - east end of southern gasoline tank | AP-8 | 19 December 1990 | SS | Grab | ±11 | not recorded | NM | 38 | NM | <0.005 | <0.005 | 0.23 | 0.11 | 11.6 | NM |
| Diesel/Gasoline Excavation - west end of southern gasoline tank | AP-9 | 19 December 1990 | SS | Grab | ±11 | not recorded | NM | 1,100 | NM | 0.073 | 0.67 | 11 | 4.9 | 23.2 | NM |
| Gasoline-Only Excavation - east end | AP-10 | 19 December 1990 | SS | Grab | ±11 | not recorded | NM | 340 | NM | 0.0078 | 0.13 | 0.17 | 0.19 | 17.1 | NM |
| Gasoline-Only Excavation - west end | AP-11 | 19 December 1990 | SS | Grab | ±11 | not recorded | NM | 8.8 | NM | <0.005 | <0.005 | <0.005 | <0.005 | 9.38 | NM |
| Diesel/Gasoline Excavation stockpile | AP-12 | 19 December 1990 | SS | Grab | NM | not recorded | NM | <1 | NM | <0.005 | <0.005 | <0.005 | <0.005 | NM | NM |
| Diesel/Gasoline Excavation stockpile | AP-14 | 19 December 1990 | SS | Grab | NM | not recorded | NM | 130 | 56 | <0.005 | <0.005 | 0.11 | 1.1 | NM | NM |
| Gasoline-Only Excavation stockpile | AP-17 | 19 December 1990 | SS | Grab | NM | not recorded | NM | <1 | NM | <0.005 | <0.005 | <0.005 | <0.005 | 5.32 | NM |

General Notes

(a) SS = Sampling Specialists, Pacheco CA

(b) NM = not measured

(c) Laboratory analyses by Chromalab, San Ramon CA

(d) Purgeable Halocarbons = EPA Method 8010

Table 3

Groundwater Analytical Results From Samples Collected During Tank Removal

| Sample Location | Sample Designation | Sample Date | Sampled By | Sample Type | Total Petroleum Hydrocarbons as Gasoline (mg/l) | Total Petroleum Hydrocarbons as Diesel (mg/l) | Benzene (mg/l) | Toluene (mg/l) | Ethyl-benzene (mg/l) | Xylenes (mg/l) | Lead (mg/l) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Diesel/Gasoline Excavation | APGW-1 | 19 December 1990 | SS | Grab | 110 | NM | 0.13 | 0.071 | 0.19 | 0.18 | 1.61 |
| Diesel/Gasoline Excavation | APGW-2 | 19 December 1990 | SS | Grab | NM | 68 | NM | NM | NM | NM | NM |

General Notes

(a) SS = Sampling Specialists, Pacheco CA

(b) NM = not measured

(c) Laboratory analyses by Chromalab, San Ramon CA

Table 4

Piezometer Installation Requirements

| Item | Requirement |
|---|---|
| Riser Type | Steel rod with flush-threaded couplings |
| Riser Diameter | Approximate ±1/2-inch ID, ±1-1/2-inch OD |
| Riser Length | Approximately 12 feet |
| Drive Point | Plain or stainless steel, ±1-1/4-inch ID, ±1-1/2-inch OD |
| Screen Length | 2 feet |
| Slots | 0.010-inch, wire wrapped or factory-slotted |
| Riser and Screen Decontamination | Steam clean, pressure wash, or soap wash and tap water rinse prior to installation |
| Grout Seal | Neat cement or cement-bentonite from approximately 18 inches to surface |
| Closure | Threaded top plug (not locking) |

Table 5

Soil Sampling and Testing Requirements During Confirmation Sampling

| Item | Requirement |
|---|---|
| Sampling Interval and Sample Type | Collect 1 set of grab samples in liners from the sidewalls, at 20-foot centers along perimeter at the elevation of the groundwater table. Collect another set of grab samples in liners from the excavation base, at 20-foot centers. If the the first set of sidewall samples serve to document a contaminated layer coincident with the groundwater table, yet overlying soil is uncontaminated, collect a third set of samples from the sidewalls, at 20-foot centers, above the groundwater table. Collect samples from representative soil types if different soil types are present. |
| Sampler | 2 inch diameter by 3-to 6-inch long liner |
| Sampling Procedure | Excavate intact, freshly exposed bucket-full of native soil using the backhoe. Expose fresh soil within the central portion of the backhoe bucket with a trowel. Drive liner into freshly-exposed soil. Remove liner by excavating with trowel. Monitor liner hole with field organic vapor monitor. |
| Sampler Decontamination | Wash with soap, rinse with tap water, rinse with distilled water |
| Field Observations and Measurements | Screen samples with field organic vapor monitor. Visually classify samples according to ASTM D 2488 - Standard Practice for Description and Identification of Soils (Visual-Manual Procedure). Measure sample depth and horizontal sample location. Complete field sketch of soil sample location. |
| Samples Retained for Chemical Testing-Waste Oil Excavation | Oil & Grease (Standard Method 5520 D&F)), Total Petroleum Hydrocarbons as Diesel (EPA Method 3510/8015), Total Petroleum Hydrocarbons as Gasoline (EPA Method 5030/8015), and BTXE (EPA Method 8020). Conduct selective testing program - all analyses need not be performed on all samples. |
| Samples Retained for Chemical Testing-Diesel/Gasoline Excavation | Total Petroleum Hydrocarbons as Diesel (EPA Method 3510/8015), Total Petroleum Hydrocarbons as Gasoline (EPA Method 5030/8015), BTXE (EPA Method 8020) |
| Samples Retained for Chemical Testing-Gasoline-Only Excavation | Total Petroleum Hydrocarbons as Gasoline (EPA Method 5030/8015), BTXE (EPA Method 8020) |
| Sample Handling for Chemical Testing | Cap liner with Teflon, plastic cap, and duct tape (do not use electrical tape). Label liner, place in ziplock bag, and store on ice in cooler until delivery to the laboratory. Log chemical samples on chain-of-custody form and maintain sample security. |
| Quality Control | None |

Table 6

Soil Sampling and Testing Requirements During Drilling

| Item | Requirement |
|---|---|
| Sampling Interval and Sample Type | Collect split-spoon samples continuously from surface to total depth. Collect samples in liners. Retain samples for possible chemical and/or physical testing at approximate 5-foot intervals or detectable changes in strata, whichever is more frequent. Collect additional samples in liners for potential chemical testing if elevated organic vapor readings are observed. Remaining samples may be collected without liners for classification purposes or collected in lines and not retained. |
| Sampler | Split-spoon sampler, 1.4-inch ID without liners, 2-inch ID with liners |
| Liners | 2-inch diameter by 3- or 6-inch length, brass or stainless |
| Sampler and Liner Decontamination | Pressure wash, steam clean, or soap wash split-spoon between samples and borings. For liners, wash with soap, rinse with tap water, rinse with distilled water. |
| Field Observations and Measurements | Screen samples with field organic vapor monitor. Visually classify samples according to ASTM D 2488 - Standard Practice for Description and Identification of Soils (Visual-Manual Procedure). Measure penetration resistance (blows/foot) during driving of split-spoon. Measure and record horizontal location of boring on site sketch. |
| Hollow-Stem Auger | Approximate 4-inch ID (approximate 8-inch OD of auger flights) |
| Samples Retained for Physical Testing | Archive one sample (liner) from the formation material encountered within the screened interval (for potential grain size distribution analysis (ASTM D 422) if groundwater sampling discloses contamination and additional wells are needed) |
| Sample Handling for Physical Testing | Cap liner with plastic end caps, label, and store at room temperature |
| Chemical Testing | Retain samples for chemical testing at approximate 5-foot intervals or detectable changes in strata, whichever is more frequent. If field observations do not indicate contamination, analyze 1 sample from beneath the groundwater table. For the boring located downgradient of the waste oil excavation, analyze for Total Petroleum Hydrocarbons as Diesel (EPA Method 3510/8015), Oil & Grease (Standard Method 5520 D&F), and Total Petroleum Hydrocarbons as Gasoline (EPA Method 5030/8015)/BTXE (EPA Method 8020). For the boring located downgradient of the diesel/gasoline and gasoline-only excavations, analyze for Total Petroleum Hydrocarbons as Diesel (EPA Method 3510/8015) and Total Petroleum Hydrocarbons as Gasoline (EPA Method 5030/8015)/BTXE (EPA Method 8020). Add selected additional analyses if contamination is observed during drilling or if additional analyses are needed to accurately characterize the nature and extent of contamination. |
| Sample Handling for Chemical Testing | Cap liner with Teflon, plastic cap, and duct tape (do not use electrical tape). Label liner, place in ziplock bag, and store on ice in cooler until delivery to the laboratory. Log chemical samples on chain-of-custody form and maintain sample security. |
| Quality Control | None |

Table 7

Well Completion Specifications

| Item | Requirement |
|---|---|
| Casing Type | Schedule 40 PVC, flush-threaded couplings |
| Casing Diameter | Nominal 2-inch ID |
| Total Depth | ±20-feet |
| Centralizers | None |
| Bottom Cap | 2-inch flush threaded or slip PVC (if slip cap, anchored with screws) |
| Sediment Trap | None |
| Screen Length | 10-feet |
| Slots | 0.010-inch, factory-slotted |
| Casing and Screen Decontamination | Steam clean or pressure wash prior to installation |
| Filter Pack | #2/12 or similar clean silica sand |
| Filter Pack Interval | 6-inches below bottom cap to approximately 1-foot above top of screened interval |
| Bentonite Seal | Natural bentonite, minimum 1-foot layer above filter pack |
| Grout | Cement-bentonite (approximately 5% bentonite) |
| Surface Completion | 8-inch diameter, flush-mounted, traffic-rated box with locking top cap |

Table 8

Groundwater Sampling and Testing Requirements

| Item | Requirement |
|---|---|
| Sampling Frequency | Once, conducted ±1 week after well development |
| Purge Equipment | Pump or bailer |
| Purge Equipment Decontamination | Pressure wash, steam clean, or wash with soap, rinse with tap water, rinse with distilled water |
| Field Measurements and Observations | Water level prior to purge, turbidity (qualitative clarity and color), pH, temperature, specific conductivity, purge volume |
| Purge Criteria | For wells that recharge readily, stabilization of field measurements and removal of at least 3 but no more that 10 standing casing volumes. For slow recharging wells, purge dry twice and sample when recharged enough to submerge bailer. For extremely slow recharging well, purge dry once and sample when recharged enough to submerge bailer. |
| Sampler | Teflon bailer with bottom-emptying device |
| Sampler Decontamination | Wash with soap, rinse with tap water, rinse with distilled water |
| Natural Sample Collection | Lower bailer to midpoint of standing water column to collect sample, discharge sample from bottom of bailer to bottom of sample containers without aeration |
| Water Sampling Analyses | Total Petroleum Hydrocarbons as Diesel, Total Petroleum Hydrocarbons as Gasoline, Benzene, Toluene, Xylenes, and Ethylbenzene, Oil & Grease, and Lead |
| Sample Containers | One 1-liter amber glass bottle for Oil & Grease, two 1-liter glass bottles for Total Petroleum Hydrocarbons as Diesel, three 40-milliliter glass vials for Total Petroleum Hydrocarbons as Gasoline and BTEX |
| Sample Analyses | Well downgradient of waste oil excavation - oil & grease, TPH-diesel, and TPH-gasoline/BTEX. Well downgradient of diesel/gasoline and gasoline-only excavation - TPH-diesel and TPH-gasoline/BTEX. |
| Sample Handling and Preservation | Verify no headspace in VOA's. Optional acidification of BTEX only (not combination BTEX and TPH-gasoline) with HCl to pH<2. Label containers, place in ziplock bags, store on ice in cooler, enter onto chain-of-custody, maintain sample custody until sent to laboratory. |
| Quality Control Samples | Optional travel blank per sampling event for BTXE. Optional cross-contamination blanks and replicates. |

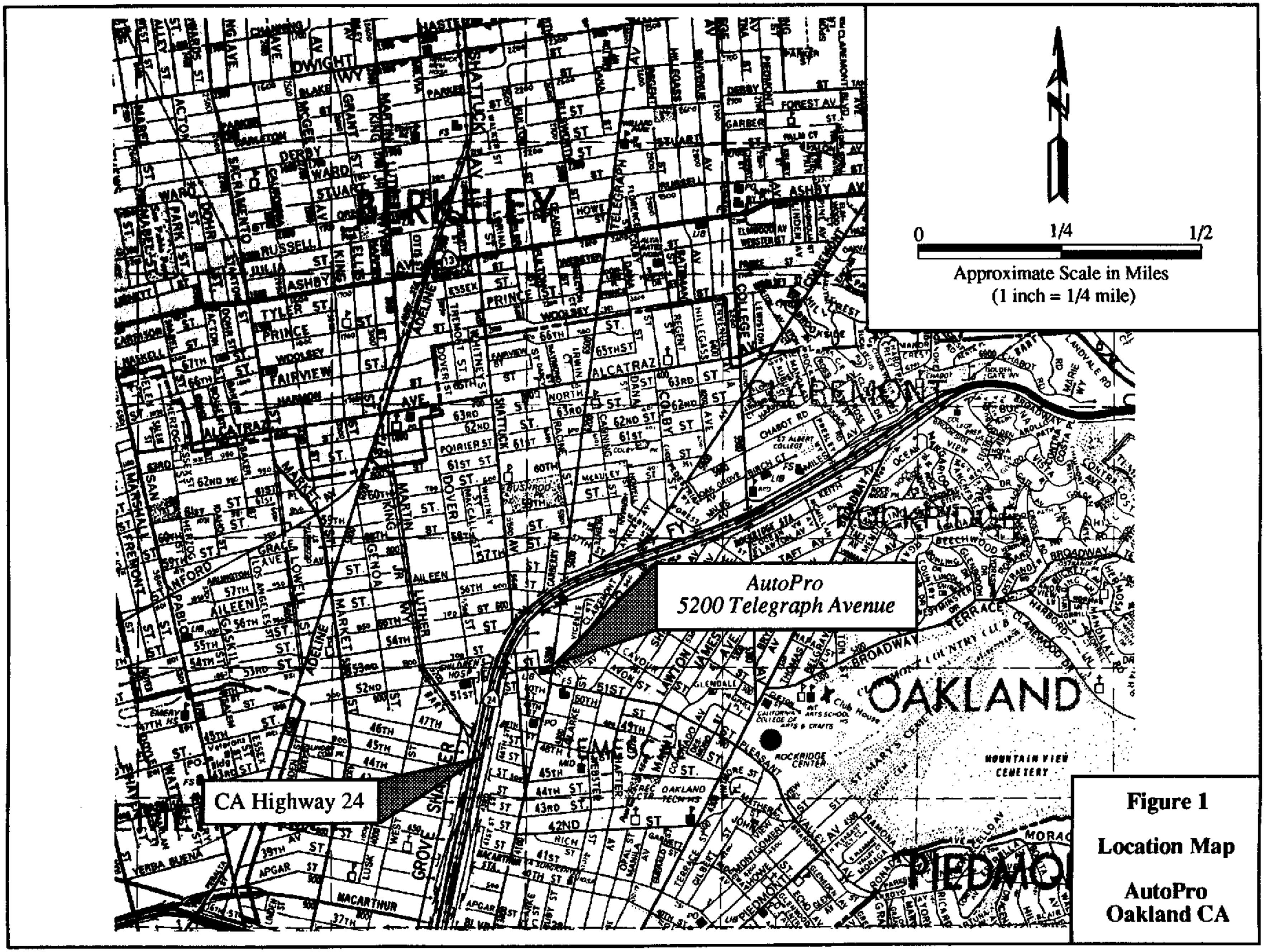


**Figure 1**

**Location Map**

**AutoPro**
**Oakland CA**

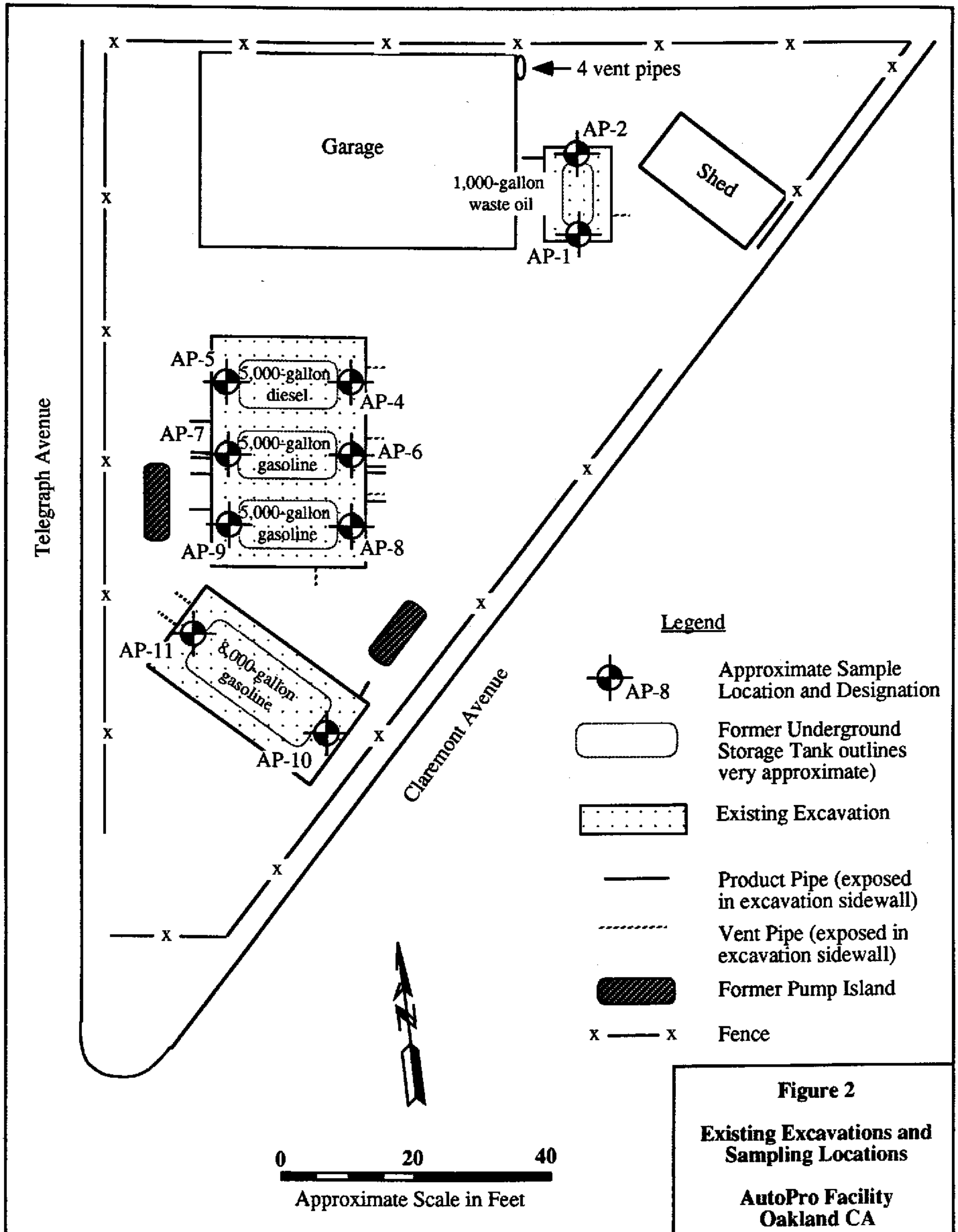


**Figure 2**

**Existing Excavations and Sampling Locations**

**AutoPro Facility**
**Oakland CA**

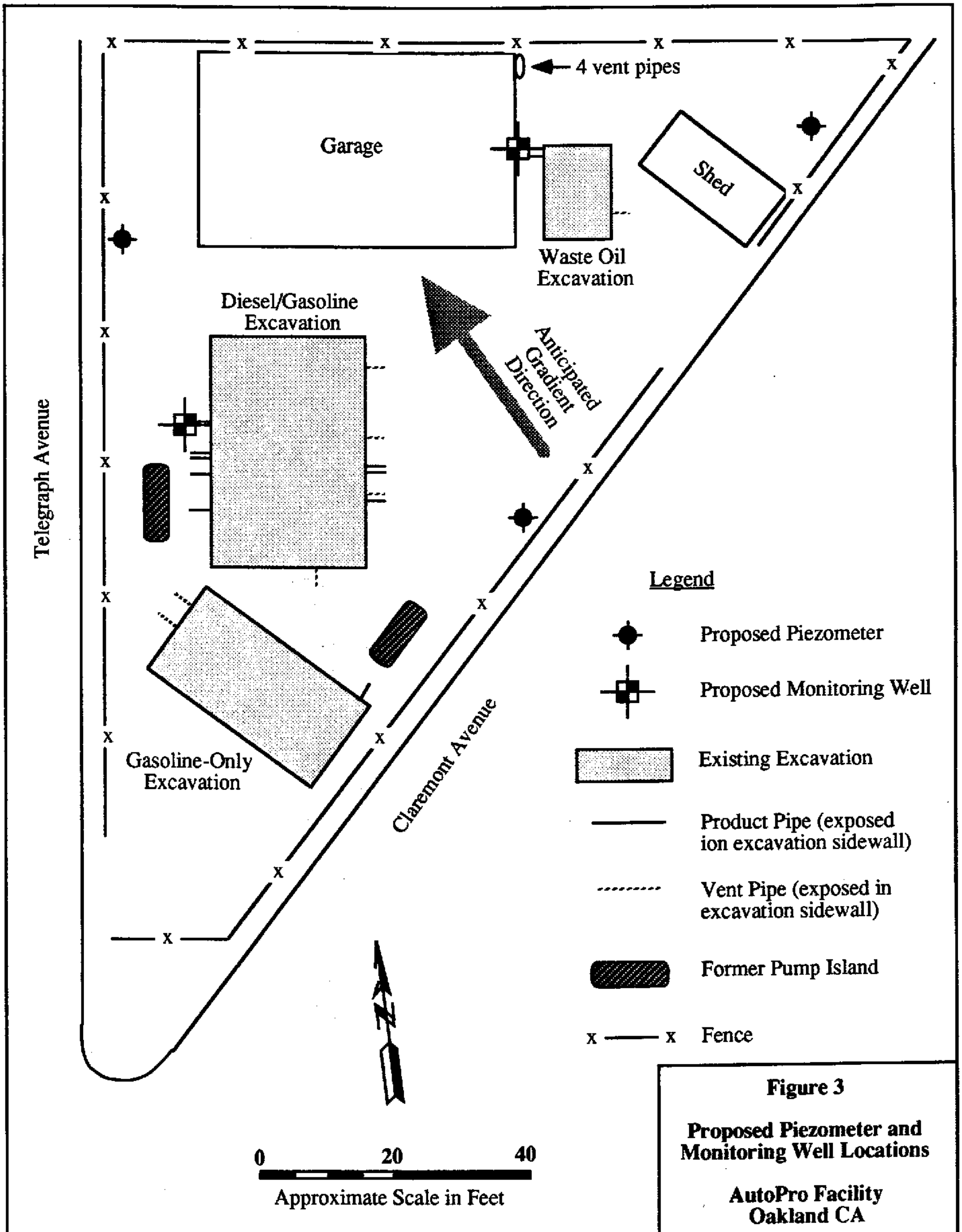


**Figure 3**

**Proposed Piezometer and Monitoring Well Locations**

**AutoPro Facility Oakland CA**

STREAMBORN

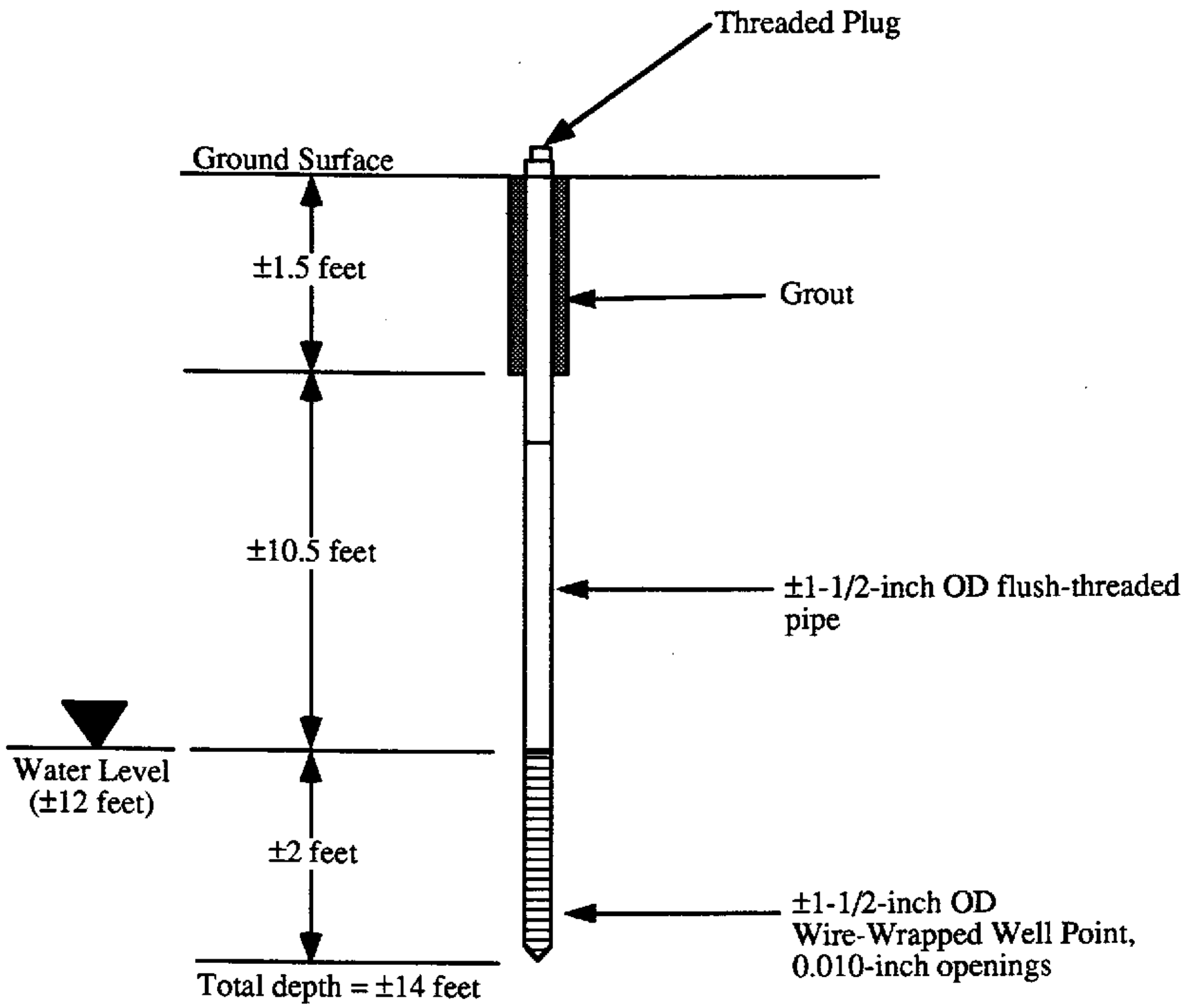


**Figure 4**

**Drive-Point Piezometer Schematic**

**AutoPro Facility Oakland CA**

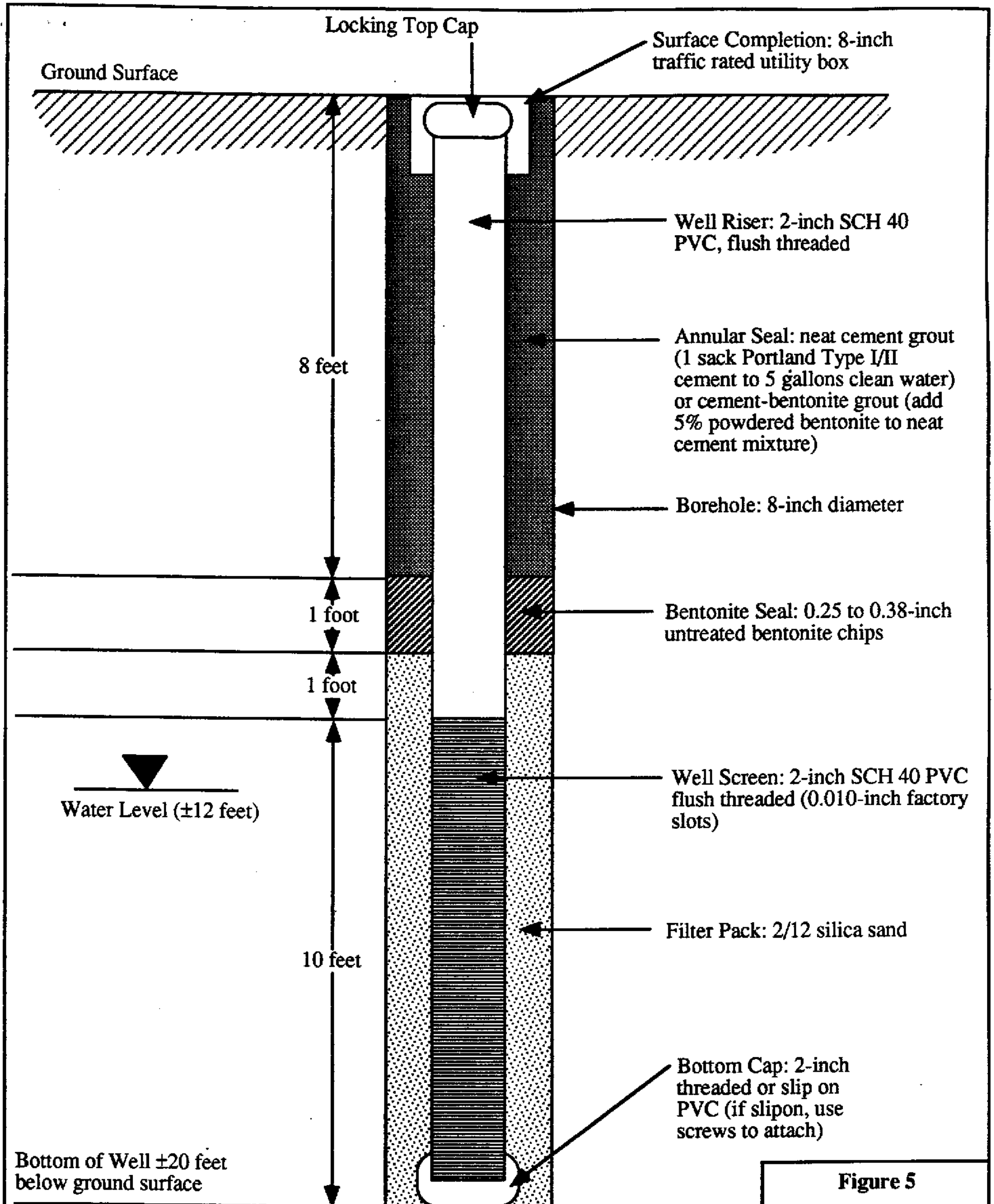


**Figure 5**

**Monitoring Well Schematic**

**AutoPro Facility Oakland CA**

STREAMBORN

# APPENDIX A

Standard Operating Procedures (SOP)

- SOP 1A - Hollow-Stem Auger Drilling and Split-Spoon Soil Sampling
- SOP 2A - Completion of Borings as Wells
- SOP 3A - Well Development
- SOP 4A - Well Purging and Sampling
- SOP 5A - Drive-Point Piezometers
- SOP 9A - Verification Soil Sampling for Underground Storage Tank Removal
- SOP 10 - Analysis of Soil and Water Using the Polyethylene Bag Sampling System
- SOP 11 - Hanby Method for Analysis of Soil and Water

# STANDARD OPERATING PROCEDURE (SOP) 1A
# HOLLOW-STEM AUGER DRILLING AND SPLIT-SPOON SOIL SAMPLING

## 1.0 INTRODUCTION AND SUMMARY

This SOP describes methods for drilling with the use of hollow-stem augers and soil sampling with the use of spilt-spoon samplers. Drilling activities covered by this SOP may be conducted to obtain soil samples or to create a borehole within which a well may be constructed. Soil samples may be obtained to log subsurface materials, to collect samples for chemical characterization, or to collect samples for physical parameter characterization.

The soil sampling techniques described in this SOP are generally suitable for chemical characterization and physical classification tests; because a driven split-spoon sampler is employed, the resulting soil samples should generally be considered "disturbed" with respect to physical structure and may not be suitable for measuring sensitive physical parameters, such as strength and compressibility. The augering techniques described in this SOP generally produce a borehole with a diameter corresponding to the outside diameter of the auger flights, a relatively small annulus of remoulded soil surrounding the outside diameter of the auger flights, and limited capability for cross-contamination between subsurface strata as the leading flights of the augers pass from contaminated strata to uncontaminated underlying strata. However, should conditions require strict measures to help prevent cross-contamination or maintain the integrity of an aquitard, consideration should be given to augmenting the procedures of this SOP, for example, by using pre-drilled and grouted isolation casing.

The procedures for hollow-stem auger drilling and split-spoon soil sampling generally consist of initial decontamination, advancement of the augers, driving and recovery of the split-spoon sampler, logging and packaging of the soil samples, decontamination of the split-spoon, and continued augering and sampling until the total depth of the borehole is reached. Withdrawal of the augers upon reaching the total depth requires completion of the borehole by grouting, by constructing a well, or other measures; borehole completion is not covered in this SOP.

## 2.0 EQUIPMENT AND MATERIALS

- Drill rig, drill rods, hollow-stem augers, and drive-weight assembly (for driving the split-spoon sampler) should conform to ASTM D 1586 - Standard Method for Penetration Test and Split-Barrel Sampling of Soils, except: (1) hollow-stem augers may exceed 6.5 inches inside diameter as may be necessary for installing 4-inch diameter well casing, (2) hollow-stem augers should have a center bit assembly (end plug), (3) alternative drive-weight assemblies or downhole hammers are acceptable as long as the type, weight, and equivalent free fall are noted on the boring log.
- Split-spoon sampler should conform to ASTM D 1586 - Standard Method for Penetration Test and Split-Barrel Sampling of Soils, except: (1) split-spoon should be fitted with liners for collection of chemical characterization sample, and (2) allowable split-spoon diameters include nominal 1-1/2-inch inside diameter by nominal 2-inch outside diameter (Standard Penetration Test split-spoon), nominal 2-inch inside diameter by nominal 2-1/2-inch outside diameter (California Modified split-spoon),

or nominal 2-1/2-inch inside diameter by nominal 3-inch outside diameter (Dames & Moore split-spoon). The split-spoon type and length of the split-barrel portion of the sampler should be noted on the boring log, as should the use of a sample catcher if employed.

- Liners should be 3- to 6-inch length, fitted with plastic end-caps, brass or stainless steel, with a nominal diameter corresponding to that of the inside diameter of the split-spoon sampler. The boring log should note whether brass or stainless steel liners were used.
- Teflon sheets, approximate 6-mil thickness, precut to a diameter or width of the liner diameter plus approximately 1 inch
- 1/2-pint widemouth glass jars, laboratory cleaned
- Kimwipes, certified clean silica sand, or deionized water (for blank sample preparation)
- Duct tape
- Sample labels, boring log forms, chain-of-custody forms, hazardous waste labels, and daily report forms
- Ziploc plastic bags of size to accommodate a liner
- Stainless steel spatula and knife
- Cooler with ice or dry ice (do not use blue ice)
- Field organic vapor monitor. The make, model, and calibration information of the field organic vapor monitor (including compound and concentration of calibration gas) should be noted on the boring log.
- Aluminum foil, and rubber bands
- Pressure washer or steam cleaner
- Large trough (such as a water tank for cattle), plastic-lined pit, or equivalent for decontamination of hollow-stem augers, drill rod, and end plug
- Buckets and bristle brushes for decontamination of liners, split-spoon sampler, and other small gear
- Low residue, organic free soap such as Liqui-nox or Alconox
- Distilled water
- Steel, 55-gallon, open-top drums conforming to the requirements of DOT 17H

As specified in the Site Safety Plan, additional safety and personnel decontamination equipment and materials may be needed.

## 3.0 TYPICAL PROCEDURES

The following typical procedures are intended to cover the majority of drilling and sampling conditions. However, normal field practice requires re-evaluation of these procedures and implementation of alternate procedures upon encountering unusual or unexpected subsurface conditions. Deviations from the following typical procedures may be expected and should be noted on the boring log.

1 Decontaminate drill rig, drill rods, hollow-stem augers, split-spoon sampler and other drilling equipment immediately prior to mobilization to the site.

2 Investigate the location of the proposed boreholes for buried utilities and obstructions. At least 48 hours before drilling, contact known or suspected utility services individually or through collective services such as "USA" and "Underground Alert". As appropriate, retain private buried utility location services or geophysical investigation services to search for buried utilities and obstructions. Also as appropriate, pothole suspect utility locations prior to drilling or relocate boreholes. During initial advancement of each borehole, drill cautiously and have the driller pay particular attention to the "feel" of the hollow-stem auger. The suspected presence of an obstruction, buried pipeline or cable, utility trench backfill, or similar may be cause for suspension of drilling, subject to further investigation.

3 Advance the hollow-stem auger, fitted with end plug, to the desired sampling depth. Note depth interval, augering conditions, and driller's comments on boring log. Samples should be taken at intervals of 5 feet or less in homogeneous strata and at detectable changes of strata.

4 Remove drill rod and end plug from the hollow stem and note presence of water mark on drill rod, if any. If below the groundwater table in clean sand, allow water level in hollow-stem to equilibrate prior to removing end plug and remove plug slowly so as to minimize suction at the base of the plug. Also, monitor top of hollow-stem using field organic vapor monitor, as appropriate.

5 Decontaminate split-spoon, liners, spatulas and knives, and other equipment that may directly contact the chemical characterization sample. Fit split-spoon with liners and attach to drill rod.

6 Lower split-spoon sampler through hollow-stem of auger until sampler is resting on soil. Note discrepancy between elevation of tip of sampler and leading edge of augers, if any. If more than 6-inches of slough exists inside the hollow-stem augers, consider the conditions unsuitable and re-advance the hollow-stem augers and end plug to a new sampling depth.

7 Drive and recover the split-spoon according to the requirements of ASTM D 1586 - Standard Method for Penetration Test and Split-Barrel Sampling of Soils. Record depth interval, hammer blows for each 6-inches, and sample recovery on boring log. Monitor the recovered split-spoon with the field organic vapor monitor, as appropriate.

8 Remove either bottom-most or second-from-bottom liner (or both) from split-spoon for purposes of chemical characterization and physical parameter testing. Observe soil at each end of liner(s) for purposes of completing sample description. Place teflon sheet at each end of liner, cover with plastic caps, and tape plastic caps with duct tape (do not use electrical tape) to further minimize potential loss of moisture or volatile

compounds. Label liner(s) and place in ziploc bag on ice or dry ice inside cooler.

9 Extrude soil from remaining liner(s) and subsample representative 1-inch cube (approximate dimensions). Place subsample in widemouth glass jar, cover jar with aluminum foil and seal foil to jar with rubber band. Allow jar to equilibrate at ambient conditions for approximately 5 minutes and screen for organic vapors by inserting the probe of the field organic vapor monitor through the aluminum foil. Record depth interval, observed sample reading, and ambient (background) reading on the boring log. Glass jars may be reused by discarding the soil subsample and wiping any residue from the jar using a paper towel.

10 Visually classify soil sample in approximate accordance with ASTM D 2488 - Standard Practice for Description and Identification of Soils (Visual-Manual Procedure). Descriptions should include moisture content, color, textural information, group symbol, group name, and odor. Optional descriptions, especially if classification is performed with protective gloves, include particle angularity and shape, clast composition, plasticity, dilatancy, dry strength, toughness, and reaction with HCl. Add notes on geologic structure of sample, as appropriate. Record depth interval, visual classification, and other notes to the boring log.

11 Repeat steps 3 through 10 until total depth of borehole is reached.

12 Complete borehole according to the requirements specified elsewhere.

13 Decontaminate hollow-stem augers, drill rod, and end plug between boreholes and after finishing last borehole prior to drill rig leaving site.

14 Change decontamination solutions and clean decontamination trough, buckets, and brushes between boreholes.

15 Containerize soil cuttings, excess soil sample, and decontamination wastewaters in steel drums. Affix hazardous waste labels to the drums.

16 Complete pertinent portion of the chain-of-custody form and daily activity report.

## 4.0 QUALITY ASSURANCE AND QUALITY CONTROL

Quality control sampling consists of sequential replicates, collected at an approximate frequency of 1 sequential replicate for every 10 natural samples. Sequential replicates are collected by packaging two adjacent liners of soil from a selected split-spoon drive. Each sample is labeled according to normal requirements. The replicate samples obtained in such a manner are suitable for assessing the reproducibility of both chemical and physical parameters. Interpretations of data reproducibility should recognize the potential for significant changes in soil type, even over 6-inch intervals. Accordingly, sequential replicates do not supply the same information as normally encountered duplicate or split samples. Duplicate or split samples are better represented by the laboratory performing replicate analyses on adjacent subsamples of soil from the same liner.

Optional quality control samples may be collected to check for cross-contamination using field blanks. Field blanks may be prepared by (1) swipe sampling decontaminated liners and split-spoon with kimwipes, (2) pouring clean silica sand into a decontaminated split-spoon sampler that has been fitted with liners, or (3) pouring deionized water over the decontaminated liners and split-spoon and collecting the water that contacts the sampling implements for aqueous analysis. Field blanks may be prepared at the discretion of the field staff given reasonable doubt regarding the efficacy of the decontamination procedures.

The comparability of the field visual classification may be checked by conducting laboratory classification tests. Requests for laboratory testing verification of the field classification should be left to the discretion of the field staff.

Field decisions that may also affect the quality of collected data include the frequency of sampling and the thoroughness of documentation. Subject to reasonable limitations of budget and schedule, the completeness, comparability, and representativeness of data obtained using this SOP will be enhanced by decreasing the sampling interval (including collecting continuous samples with depth) and increasing the level of detail for sample classification and description of drilling conditions. More frequent sampling and more detailed documentation may be appropriate in zones of chemical concentration or in areas of critical geology (for example, zones of changing strata or cross-correlation of confining strata).

5.0 DOCUMENTATION

Observations, measurements, and other documentation of the drilling and soil sampling effort should be recorded on the following:

- Daily Report
- Field Notebook
- Boring Log
- Sample Label
- Chain-of-Custody

Documentation should include any deviations from this SOP, notations of unusual or unexpected conditions, and documentation of the containerization and disposition/disposal of investigation-derived waste. Specific instructions for selected forms are provided below.

5.1 <u>Sample Label</u>

- Project name and project number
- Boring or well number
- Sample depth interval (feet below ground surface), record the depth interval using notation similar to "19.2-19.7", generally do not record just one depth "19.2" because of uncertainty regarding the location such depth corresponds to (midpoint, top, etc.)
- Sample date and sample time
- Sampler
- Optional designation of orientation of sample within the subsurface, for example, an arrow with "up" or "top" designated

5.2 Boring Log

- Project name and project number
- Boring number
- Description of boring location, including taped or paced measurements to noticeable topographic features (a location sketch should be considered)
- Date and time drilling started and completed
- Drilling company and name of drilling supervisor, optional names and responsibilities of drillers helpers
- Manufacturer and model number of drill rig
- Inside diameter of the hollow stem and outside diameter of the auger flights of the hollow-stem augers, optional description of type of bit on end plug and leading edge of auger, optional description of the size of drill rod
- Depth at which groundwater was first encountered with the notation "during drilling"
- Method of borehole completion
- Other notations and recordings described previously in 2. EQUIPMENT AND MATERIALS and 3. TYPICAL PROCEDURES

## 6.0 DECONTAMINATION

Prior to entering the site, the drill rig and appurtenant items (drill rod, hollow-stem augers, end plug, split-spoon sampler, shovels, troughs and buckets, drillers stand, etc.) should be decontaminated by steam cleaning or pressure washing. Between each borehole, appurtenant items that contacted downhole soil (essentially all appurtenant items including drill rod, hollow-stem augers, end plug, split spoon sampler, shovels, troughs and buckets, etc.) should be decontaminated by steam cleaning or pressure washing. Prior to leaving the site, the drill rig and appurtenant items should be decontaminated by steam cleaning and pressure washing. Onsite decontamination should be conducted within the confines of a trough or lined pit to temporarily contain the wastewater. Between each borehole and prior to demobilization, the trough or lined pit should be decontaminated by steam cleaning or pressure washing. If a rack or other support is used to suspend appurtenant items over the trough or lined pit during decontamination, only the rack or other support needs to be decontaminated between boreholes.

Prior to each sample, the split-spoon sampler, liners, sample catcher, spatulas and knives, and other equipment or materials that may directly contact the sample should be decontaminated. Decontamination for these items should consist of a soap wash (Alconox, Liquinox, or other organic free - low residue soap), followed by a tap water rinse, followed by a distilled water rinse. Wastewater from the soap wash should be temporarily contained. Wastewater from the tap water and distilled water rinses may be discharged to the ground surface or a sanitary sewer.

Between each borehole, buckets and brushes should be decontaminated by steam cleaning or pressure washing. Before each borehole, fresh decontamination solutions should be prepared.

## 7.0 INVESTIGATION-DERIVED WASTE

Wastes resulting from the activities of this SOP may include soil cuttings, excess soil sample, decontamination wastewaters, and miscellaneous waste (paper, plastic, gloves, jars, aluminum foil, etc.) Unless otherwise prohibited by the Site Safety Plan, miscellaneous waste should be double-bagged in plastic garbage bags and disposed of as municipal waste.

Soil cuttings and excess soil sample from each borehole should be placed in individual steel drums with hazardous waste labels affixed. Solids from multiple boreholes may be combined within a single drum if field observations (presence or absence of chemical staining and field organic vapor monitoring) indicate the solids are similarly uncontaminated or similarly contaminated. Given sufficient drums and reasonable doubt, separate drums should be used for each borehole.

Decontamination wastewaters for each borehole should be placed in individual steel drums with hazardous waste labels affixed. Wastewaters from multiple boreholes may be combined, subject to the same limitations as solids.

## 8.0 SAFETY

Normal and special safety precautions are described in the Site Safety plan. The Site Safety plan should be reviewed periodically during drilling to keep mindful of important safety measures. Physical hazards typically prevail because the drill rig contains exposed rotating and hammering equipment and because drill rod and augers are heavy material with sharp edges.

Chemical hazards are typically discovered upon withdrawal of the end plug or withdrawal of the soil-filled split-spoon sampler from the hollow-stem auger, as well as removal of the soil-filled liners from the split-barrel. Opportune monitoring for volatile chemicals may be conducted at these times. Splash protection and direct contact protection are also essential measures to minimize the potential for chemical exposure.

## 9.0 REFERENCES

American Society for Testing and Materials, 1989. 1989 Annual Book of ASTM Standards, Section 4 - Construction, Volume 4.08 - Soil and Rock, Building Stones; Geotextiles. ASTM, Philadelphia, PA. 1989.

Aller, L., T.W. Bennett, G. Hackett, R.J. Petty, J.H. Lehr, H. Sedoris, and D.M. Nielsen, 1989. Handbook of Suggested Practices for the Design and Installation of Ground-Water Monitoring Wells. National Water Well Association, Dublin, OH. 1989.

U.S. Environmental Protection Agency, 1989a. A Compendium of Superfund Field Operations Methods, EPA/540/P-87/001, OSWER Directive 9355.0-14. USEPA, Office of Emergency and Remedial Response, Washington, DC. December 1989.

U.S. Environmental Protection Agency, 1989b. Soil Sampling Quality Assurance User's Guide - Second Edition. National Technical Information Service, PB 89-189 864/AS, Springfield, VA. 1989.

# STANDARD OPERATING PROCEDURE (SOP) 2A
# COMPLETION OF BORINGS AS WELLS

## 1.0 INTRODUCTION AND SUMMARY

This SOP describes methods for installation of a monitoring well within an existing borehole. The well construction techniques discussed in this SOP are generally suitable for construction of wells screened in one groundwater zone which will be used for water quality sampling and/or observations of groundwater elevation (piezometers). Typically, 2- or 4-inch diameter wells, with total depths less than 80 feet will be installed using this SOP. Large diameter or deep wells may require modification of the methods described herein. Discussion of specific well casing and screen material is beyond the scope of this SOP, and well casing and screen material should be selected on a site specific basis. The permitting activities of this SOP apply in California and different permits are needed in other locations.

The procedures for construction of wells generally consist of well permitting, well design, decontamination of well casing and screen, simultaneous assembly and lowering of casing and screen into the borehole, placement of the filter-pack around the screen, installation of a bentonite seal above the filter pack, sealing of the remaining annular space with grout, and surface completion. The procedures described below are intended to conform to practices outlined in Handbook of Suggested Practices for the Design and Installation of Groundwater Monitoring Wells (Aller, et al., 1989); A Compendium of Superfund Field Operations Methods (U. S. EPA, 1989); and California Well Standards (Final Draft), (California Department of Water Resources, 1990) .

## 2.0 EQUIPMENT AND MATERIALS

- Pressure washer or steam cleaner
- Grout mixing equipment
- Tap water
- Hand tools (pipe wrenches, chain wrenches, pipe vise, shovels, rubber mallet, etc.)
- Tape measure long enough to reach the bottom of the boring
- Well casing, screen, and end caps
- Centralizers (if required)
- Buckets and bristle brushes for decontamination
- Low residue, organic free soap such as Liquinox or Alconox
- Filter pack material (typically clean sand of specified gradation)
- Bentonite pellets (or powder) for seal above filter pack, unaltered sodium bentonite
- Cement for grout
- Locking hasp
- Protective surface casing
- Well construction log and daily report forms

- Calculator

Site specific conditions may require other specialized equipment, thus great care should be taken to anticipate conditions reasonably expected to occur during well installation.

## 3.0 TYPICAL PROCEDURES

The following procedures apply to most well installations. However, normal field practice requires re-evaluation and modification of these procedures upon encountering unexpected situations during well construction. Deviations from the following procedures are to be expected and should be documented.

1 Determine local jurisdiction charged with regulation of wells and apply for required local permits. Local jurisdictions may include county, water district, or city. Determine special design considerations (such as minimum length of grout seal) and inspection requirements (such as witnessing the placement of the grout seal). Also file notice of intent to construct well with the California Department of Water Resources using its standardized form.

2 Well design begins with the conception of the specific purpose for the well, and should include consideration of the specific analytes of interest, anticipated subsurface conditions at the intended well location, and the soil conditions encountered during drilling and recorded on the boring log.

   Design considerations discussed in this SOP are limited to portions of the well subject to modification by information gathered during drilling. Such information includes depth to groundwater, thickness of water bearing strata, and grain size distribution of the water bearing strata. Conceptual well designs should be modified as required in the field to prevent connection of naturally separate groundwater zones, to allow an adequate surface seal to be installed, and to maximize the chance for detection of the contaminants of concern. Modifications of conceptual designs should be discussed with the project supervisor prior to implementation whenever possible.

3 Prior to installation in the borehole, well casing and screen should be decontaminated and inspected to help minimize cross-contamination which may affect subsequent water quality samples.

   Decontamination should comprise steam cleaning, pressure washing, or equivalent, with tap water rinse. If oil or grease contamination is suspect, decontamination should also include a soap wash and tap water rinse. This procedure should be applied to both the outside and the inside of well casing and screen immediately before assembly and well installation.

4 Assembly of the well screen and blank casing is accomplished simultaneously with insertion into the boring. Initially, a bottom plug is attached to the bottom of the screen and the screen is lowered into the boring. The next length of casing (screen or blank depending on the specific well design) is attached and the process is repeated until the well extends from the ground surface to the bottom of the boring. Various types of mechanical clamps are used to prevent dropping of the well screen into the well during assembly. It is useful to leave surplus blank casing extending above grade at this point to facilitate subsequent construction activities.

Measure the length of well screen and blank casing inserted into the boring and record the quantities on the well construction log. The total length of well screen and casing should be confirmed by taping.

5 Install the filter pack by pouring filter pack material into the annulus between the casing and borehole. Unless otherwise delineated in the Workplan, Quality Assurance Project Plan, or Sampling Plan, install filter pack from (1) an elevation approximately 6 inches beneath the elevation of the bottom cap of the well casing to (2) approximately 2 feet above the top of the screened interval.

If augers or drill casing remain in the ground during well construction, the annulus between the well material and the casing may be used as a tremie If the well is constructed in an open borehole, then the filter pack should be placed using a tremie pipe. The filter pack should be poured slowly into the borehole and the depth to the top of the filter pack should be "tagged" periodically with a tape. Adequate time should be allowed for the sand to settle through standing water prior to tagging or the tape may be lost by burial. Tagging is time consuming, however it provides reasonable checks of filter pack bridging during installation.

If augers or other temporary casing are being used as a tremie, they should be withdrawn as the filter pack is placed. During placement, the elevation of the tip of the augers/temporary casing should be kept slightly above the top of the filter pack. Minimizing the separation between the top of the filter pack and tip of the augers/temporary casing during filter pack placement will help prevent inclusions of formation material or slough within the filter pack. However, if the tip of the augers/temporary casing is not kept above the top of the filter pack and the filter pack is allowed to settle within the augers/temporary casing, a filter pack bridge may occur and the well casing may become "locked" inside the augers/temporary casing.

The quantity of filter pack material required to fill the annulus should be calculated. The quantity of filter pack material actually installed in the well should be measured and compared to the calculated quantity. Both quantities should be recorded on the well construction log.

6 The bentonite seal is installed by pouring bentonite pellets or slurried bentonite powder onto the top of the filter pack. Unless otherwise delineated in the Workplan, Quality Assurance Project Plan, or Sampling Plan, the bentonite seal should extend approximately two feet above the top of the filter pack. The quantity and type of bentonite used should be recorded on the well construction log. The top of the bentonite seal should be measured by taping. If bentonite pellets are used and the seal exists above the groundwater table, water should be poured on top of the pellets after their installation and the pellets should be allowed to hydrate for approximately 10 minutes before proceeding with installation of the overlying grout seal.

7 The grout seal should be tremied into the well to prevent inclusions of formation material or slough in the annular seal. Unless otherwise delineated in the Workplan, Quality Assurance Project Plan, or Sampling Plan, grout seal may consist of (1) neat cement grout, using 1 sack (94 pounds dry weight) of Type I/II Portland cement to 5 gallons of water, or (2) cement-bentonite grout using the same basic formula but substituting approximately 5% powdered bentonite for part of the cement. Local

requirements may require inspection of grout seal placement by the regulating authority.

If augers or temporary casing remain in the borehole during grouting, the level of the grout should be kept above the tip of the augers or casing to help prevent inclusions of formation material in the grout seal.

The volume of the grout actually used should be recorded on the well construction log and compared to the calculated annular volume of the sealed interval. Any discrepancies should be noted on the well construction log.

8 Complete the surface of the well by installing a protective surface casing and locking mechanism around the top of the well casing. Unless otherwise delineated in the Workplan, Quality Assurance Project Plan, or Sampling Plan, the protective casing should be anchored approximately 3 feet into the grout annulus.

9 The completed well should be protected from disturbance while bentonite seal hydrates and grout cures. Further well activities, such as development or sampling, should be withheld for a period of 3 to 7 days to allow these materials to obtain an initial set.

10 Complete and file form DWR 188 plus reports or forms required by local agencies.

## 4.0 QUALITY ASSURANCE AND QUALITY CONTROL

Quality assurance checks for well completion include comparison of theoretical versus actual volumes of filter pack, bentonite seal, and grout seal. Discrepancies that indicate actual "take" was less than theoretical may indicate inclusions of formation material or slough within the annulus. Specific attention to such discrepancies is necessary if the bentonite seal and grout seal are needed to separate contaminated from uncontaminated zones that may be penetrated by the well.

Other quality assurance details include accurate measurement and documentation of the lengths and types of materials used to complete the well.

## 5.0 DOCUMENTATION

Observations, measurements, and other documentation of the well completion effort should be recorded on the following:

- Daily Report
- Field Notebook
- Well Completion Log
- DWR 188

Documentation should include any deviations from this SOP, as well as documentation of the containerization and disposition/disposal of investigation-derived waste.

## 6.0 DECONTAMINATION

Materials used for filter pack, bentonite seal, and grout seal should be new at the beginning of each project. Typically, damaged or partially-used containers of material that are brought onsite by drillers or other material suppliers should not be used for well completion. If there is sufficient question regarding contamination of materials, obtain representative samples for later laboratory testing.

Well casing and screen should be decontaminated immediately prior to insertion within the borehole. Casing and screen with oil or grease staining may be rejected or decontaminated by washing with soap, rinsing with tap water, and then steam cleaning, pressure washing or equivalent. New and visually clean casing and screen should be decontaminated by steam cleaning, pressure washing, or equivalent.

If augers or temporary casing are removed during well construction, these materials should be decontaminated by steam cleaning, pressure washing, or equivalent.

## 7.0 INVESTIGATION-DERIVED WASTE

Wastewater from casing and screen decontamination may be discharged to the ground surface near the well subject to the landowner's permission. Otherwise, these wastewaters may be discharged to the sanitary sewer.

Borehole fluids displaced during well completion, excess grout, and decontamination wastes from the cleaning of augers or temporary casing should be placed in steel drums. The drums should be labeled with a hazardous waste label indicating the generator's name and accumulation date. The drums should also be labeled with a description of contents and well number from which the wastes originated.

## 8.0 SAFETY

Primary chemical hazards during well completion are associated with dermal exposure to borehole fluids that may be displaced during completion. Primary protection against dermal exposure includes splash protection and gloves.

Other specific site safety guidance is provided in the Site Safety Plan.

## 9.0 REFERENCES

Aller, L., T.W. Bennett, G. Hackett, R.J. Petty, J.H. Lehr, H. Sedoris, and D.M. Nielsen, 1989. Handbook of Suggested Practices for the Design and Installation of Ground-Water Monitoring Wells. National Water Well Association, Dublin, OH. 1989.

U.S. Environmental Protection Agency, 1989. A Compendium of Superfund Field Operations Methods, EPA/540/P-87/001, OSWER Directive 9355.0-14. USEPA, Office of Emergency and Remedial Response, Washington, DC. December 1989.

# STANDARD OPERATING PROCEDURE (SOP) 3A
# WELL DEVELOPMENT

## 1.0 INTRODUCTION AND SUMMARY

This SOP describes procedures to develop wells that have been properly installed. Typically, fine soil particles are entrained within the filter pack and adjacent formation during well installation. The well development procedures described herein are intended to help remove the fine soil particles, resulting in enhanced hydraulic response of the well and increased representativeness of water quality samples collected from the well.

Typically, this SOP will be used to develop 2- or 4-inch diameter monitoring wells and occasionally larger diameter monitoring or pumping wells; all screened within a single groundwater zone. The procedures described herein should be modified for domestic wells. The procedures described herein may also need modification if product is observed in the well.

Well development activities generally include decontaminating the downhole equipment, repetitive combinations of surging/swabing and overpumping/bailing, measurement and observation of well yield, turbidity, and field parameters, and containerizing the development wastewater. Development is typically conducted until (1) no further improvement in well response and turbidity is observed, or (2) a reasonable time has been devoted to development.

## 2.0 EQUIPMENT AND MATERIALS

- Pressure washer or steam cleaner
- Buckets and bristle brushes for decontamination
- Low residue, organic free soap such as Liquinox or Alconox
- Tap water
- Steel, 55-gallon, open-top drums conforming to the requirements of DOT 17H
- Field organic vapor monitor. The make, model, and calibration information of the field organic vapor monitor (including compound and concentration of calibration gas) should be documented.
- Glass beaker, ±250 milliliter for measurement of field parameters. A similar flow-through cell may also be used.
- Water level meter
- pH, temperature, and specific conductivity instruments, including pH and specific conductivity standards approximating or spanning the natural groundwater parameters.
- Vented surge block or swab of appropriate diameter for the screened interval of the well casing.
- Bailing and/or overpumping equipment consisting of one or a combination of the following:

  Bailer: Steel or PVC. Dedicated or new bailer rope. Generally as large a diameter as will fit down well.

Surface Centrifugal Pump: Limited to water lift of approximately 20 feet. Dedicated or new flexible plastic suction hose. Foot valve and flow control valve optional.

Air-Lift Pump: Dual-casing assembly with eductor casing (outer casing) to extend at least 2 feet beyond inner casing. Foot valve should be provided at the bottom of the eductor casing to prevent release of aerated water into the well when the air lift pump is turned off. Air from compressor should be dual-filtered to remove oil.

As specified in the Site Safety Plan, additional safety and personnel decontamination equipment and materials may be needed.

3.0 TYPICAL PROCEDURES

The following procedures are intended to cover the majority of well development conditions. However, normal field practice requires re-evaluation of these procedures upon encountering unusual or unexpected conditions such as observation of free product, measuring elevated pH in the development water, or observing dramatic increases in turbidity as development progresses. Deviations from the following procedures may be expected and should be documented.

1. Development should generally be initiated after the well sealing materials (grout) have obtained an initial cure. Typically, development may begin 3 to 7 days after well completion.
2. Remove top cap and perform field organic vapor monitoring of well casing.
3. Measure static water level and total depth of well. Compare total depth to well completion diagram. Calculate volume of standing water in casing.
4. Decontaminate downhole equipment (see section DECONTAMINATION in this SOP).
5. Begin bailing or overpumping using as high an evacuation rate as possible. Record the following at the beginning of development and during each bail/overpump cycle:

    - Volume removed and time
    - pH, temperature, and specific conductance
    - Turbidity (clarity and color)
    - Approximate drawdown and well yield
    - Whether well was bailed/pumped dry
    - Other observations (such as presence of product) as appropriate

    Bail/overpump until at least one casing volume of standing water has been removed. Continue bailing/overpumping if the removed water remains very turbid, indicating removal of fines from the screened interval. Terminate bailing/overpumping upon improvement of clarity.
6. Surge/swab the well to loosen fines from the screened interval. Position vented surge block several feet above the screened interval and surge/swab with upward motion. Lower the surge/swab several feet and repeat, keep surging/swabing progressively lower intervals until the bottom of the screened interval is reached. For each interval, surge/swab for several minutes or as indicated by field experimentation.

7. Repeat items 5 and 6 until evacuated water at the end of the bailing/overpumping cycle is low or non-turbid, field parameters are representative of natural groundwater conditions, and well yield has stabilized at a value representative of the intercepted groundwater zone. Terminate development after a reasonable period of time even if these conditions are not observed. Unless otherwise specified in the Workplan, Quality Assurance Project Plan, or Sampling Plan, 4 hours may typically be taken as a reasonable time effort.

8. Terminate development by bailing or overpumping for an extended period of time to remove fines that have been loosened by the last cycle of surging/swabing. Record final observations.

9. Containerize development water and decontamination wastewater in steel drum(s). Label drum(s) with hazardous waste label, description of contents, and well number from which waste originated.

## 4.0 QUALITY ASSURANCE AND QUALITY CONTROL

Meters for measurement of field parameters should be calibrated at least once per day. Calibration standards should generally approximate or span natural groundwater characteristics. Recalibration may be appropriate if unusual measurements are noticed. Calibration activities should be documented on the instrument calibration log.

Quantitative turbidity measurements may be taken with a turbidity meter (both field and laboratory versions are available). If qualitative descriptions of turbidity are used, these terms (very-, moderate-, low-turbidity) may be further defined on the development log. Representative samples may also be collected and returned to the laboratory for measurement with a turbidity meter.

Because well development is typically the first activity of a newly completed well and because the activity is fairly vigorous, the following precautions may be appropriate:

- If product is observed but not anticipated within the groundwater zone intercepted by a well, and the well penetrated a contaminated overlying groundwater zone, well development may be interrupted subject to further consideration or study. Faulty well sealing may result in migration of product from overlying to underlying groundwater zones, which is exacerbated during development.
- If elevated pH is observed but not anticipated, and the well is being developed soon after completion, well development may be interrupted subject to further consideration or study. Elevated pH may originate from grout that has not yet cured, or from grout contamination of the filter pack.
- If turbidity increases dramatically after surging/swabing and does not return to previously observed levels, the cause may be a broken well casing, broken screen, or dislodged end cap, which allows soil to enter the casing unretarded by the filter pack. Probing the well may disclose a break or faulty joint. Consider interrupting well development if this condition is suspected.

## 5.0 DOCUMENTATION

The well completion schematic should be taken into the field to serve as reference information. Observations, measurements, and other documentation of the development effort should be recorded on the following:

- Daily Report
- Field Notebook
- Instrument Calibration Log
- Well Development Log

Documentation should include any deviations from this SOP, as well as the documentation of the containerization and disposition/disposal of investigation-derived waste.

## 6.0 DECONTAMINATION

Prior to entering the site, well development equipment should be decontaminated by steam cleaning, pressure washing, or equivalent.

Prior to development of each well, down-well equipment should be decontaminated by steam cleaning or pressure washing, washing with soap, and rinsing with tap water, or equivalent.

Prior to leaving the site, equipment should be steam cleaned, pressure washed, or equivalent.

## 7.0 INVESTIGATION-DERIVED WASTE

Development water and decontamination wastewater should be containerized in steel drums. Drums should be labeled with hazardous waste labels, including: generator's name and accumulation date. The drums should also be labeled with a description of contents and well number of waste origination. Waste from different wells may be combined in single drums, but chemically-affected and clean wastes should not be mixed.

## 8.0 SAFETY

Primary chemical hazards during well development are associated with dermal exposure. Primary protection against dermal exposure includes splash protection and gloves. Air-lift pumping may also exacerbate the release of volatile organic compounds from groundwater to air, thus increasing the risk of exposure; frequent monitoring with the field organic vapor monitor may be employed to mitigate this risk.

Other specific site safety guidance is provided in the Site Safety Plan.

## 9.0 REFERENCES

Aller, L., T.W. Bennett, G. Hackett, R.J. Petty, J.H. Lehr, H. Sedoris, and D.M. Nielsen, 1989. Handbook of Suggested Practices for the Design and Installation of Ground-Water Monitoring Wells. National Water Well Association, Dublin, OH. 1989.

U.S. Environmental Protection Agency, 1989. A Compendium of Superfund Field Operations Methods, EPA/540/P-87/001, OSWER Directive 9355.0-14. USEPA, Office of Emergency and Remedial Response, Washington, DC. December 1989.

# STANDARD OPERATING PROCEDURE (SOP) 4A
# WELL PURGING AND SAMPLING

## 1.0 INTRODUCTION AND SUMMARY

This SOP describes procedures to purge and sample wells that have been properly installed and developed. Typically, this SOP will be used for sampling monitoring wells with 2- or 4-inch diameter casing. The sampling described herein is appropriate for a variety of groundwater analyses, including: total and dissolved metals, volatile and semi-volatile organic compounds, and general minerals. For newly installed and developed well, the purging and sampling described in this SOP is typically performed at least 7 days after well development to allow ambient groundwater conditions to re-establish in the vicinity of the well.

The procedures described in this SOP should be modified for domestic wells or wells with dedicated sampling equipment. The procedures should also be modified if product is observed in the well.

Typical well sampling and purging activities include decontaminating the purging and sampling equipment, purging the stagnant water from the well casing and filter pack by pumping or bailing, measuring field parameters and evacuated volume of groundwater during purging, terminating the purging process when field parameters stabilize, collecting groundwater samples by pumping or bailing, and labeling and preserving the collected samples.

## 2.0 EQUIPMENT AND MATERIALS

- Buckets and bristle brushes for decontamination
- Low residue, organic free soap such as Liquinox or Alconox
- If sampling is to be performed for metals, dilute (10%) reagent-grade nitric acid (for decontamination)
- Tap water (for decontamination)
- Distilled water (for decontamination and quality control blank samples)
- Cooler with ice (do not use blue ice or dry ice)
- Ziplock bags of size to accommodate sample containers
- Steel, 55-gallon, open-top drums, DOT 17H
- Field organic vapor monitor. The make, model, and calibration information of the field organic vapor monitor (including compound and concentration of calibration gas) should be documented.
- Laboratory-cleaned containers of proper type and size for the analytical parameters (refer to Table 1)
- Reagent-grade chemicals for sample preservation, as required for the analytical parameters (refer to Table 1)
- If dissolved metals analyses are required, 45-micron cellulose acetate filters and filtering device. Alternate filter type and size (cellulose nitrate, Teflon, or glass-fiber pre-filters) may be required as specified in the Quality Assurance Project Plan or Sampling Plan. The make, type, and size of filter, including disposable filters, should be documented.

- Glass beaker, ±250 milliliter for measurement of field parameters. A similar flow-through cell may also be used.
- Water level meter
- pH, temperature, and specific conductivity instruments, including pH and specific conductivity standards approximating or spanning the natural groundwater parameters. As specified in the Quality Assurance Project Plan or Sampling Plan, oxidation-reduction potential (ORP) or dissolved oxygen meters may also be required.
- Purging equipment consisting of one of the following:

  Bailer: Steel, PVC, Teflon, or stainless steel. Dedicated or new bailer rope.

  Bladder Pump: Plastic or Teflon bladder. 4-inch or 6-inch diameter by ±4-foot long decontamination chambers.

  Submersible Electric Pump: Normally used where relatively large quantities of purge water are expected from wells with quick recharge. Pump should have flow control valve and foot valve. 6-inch diameter by ±4-foot long decontamination chambers.

  Surface Centrifugal Pump: Limited to water lift of approximately 20 feet. Dedicated or new flexible plastic suction hose. Foot valve. Flow control valve.
- Sampling device consisting of one of the following:

  Bailer: Teflon or stainless steel. Dedicated or new bailer rope. If samples are collected for volatile organic compound analysis, bailer should also be fitted with bottom-emptying device.

  Bladder Pump: Teflon bladder. Dedicated or new Teflon or Tygon tubing for sample discharge line. 4-inch or 6-inch diameter by ±4-foot long decontamination chambers.

As specified in the Site Safety Plan, additional safety and personnel decontamination equipment and materials may be needed.

## 3.0 TYPICAL PROCEDURES

The following procedures are intended to cover the majority of purging and sampling conditions. However, normal field practice requires re-evaluation of these procedures and implementation of alternate procedures upon encountering unusual or unexpected conditions. Deviations from the following procedures may be expected and should be documented.

1. Remove top cap and perform field organic vapor monitoring of well casing
2. Measure static water level and total depth and compare to historic measurements. Remeasure if discrepancies are noted with historic data. Document observations of product, if appropriate. Calculate volume of standing water in casing.
3. Decontaminate purging and sampling equipment (see section DECONTAMINATION in this SOP)
4. Begin purging and if possible, adjust purge rate to expose as little of the screened interval as possible (subject to reasonable time constraints).

Record the following observations at the beginning of purge, periodically during purge, and during sampling:

- Purge volume and time
- pH, temperature, and specific conductivity
- Turbidity (clarity and color)
- Approximate drawdown and well yield during purge
- Whether well was purged dry
- Other observations (such as presence of product) as appropriate

5. Terminate purging when one of the following conditions is observed:

   Quick Recharge Wells: Well shows stabilized field parameters and at least 3 casing volumes of standing water have been removed - ready for sampling. If field parameters have not stabilized after removal of 5 casing volumes of standing water, terminate purging anyway. Wells should be allowed to recover to at least 1/2 the original standing water depth prior to sampling.

   Slow Recharge Wells: Wells that are initially purged dry, and do not recover to 1/2 the original standing water depth within 4 hours, should be purged dry again and then sampled when sufficient recovery has occurred to submerge the sampling bailer or pump. Generally, 3 feet of recovery may be considered sufficient recovery for normal bailer or pump submergence.

6. If recharge has submerged the entire screened interval, sample from mid-depth of screened interval. Otherwise, sample from mid-depth of water column at time of sampling.

7. If dissolved metals analyses are to be performed, filter sample. Also if dissolved metals analyses are to be performed and the sample is moderately turbid or very turbid, collect companion filtered and unfiltered samples.

8. For parameters other than dissolved metals, do not filter sample. Fill sample containers directly and preserve according to the requirements of Table 1. Containers should generally filled to capacity. 40 milliliter glass vials should be filled from the bottom using a sample discharge tube (bottom-emptying device for bailer or discharge tube of bladder pump). 40 milliliter vials should not have headspace.

9. Label sample containers, place in ziplock bag, and place on ice in cooler.

10. Log samples onto chain-of-custody form and maintain sample custody until shipped to laboratory.

11. Containerize purge water, excess sample, and decontamination wastewater in steel drum(s). Label drum(s) with hazardous waste label, contents, and well number from which waste originated.

## 4.0 QUALITY ASSURANCE AND QUALITY CONTROL

Quality control samples should consist of the following:

- Duplicate samples at a frequency of 1 per 10 natural samples
- Cross-contamination blank (also known as a sampler rinsate blank) at a frequency of 1 per 10 natural samples. Cross-contamination blanks are prepared by passing deionized water over and through decontaminated sampling equipment (including sample filter if used).
- If analyses require collection of samples in 40 milliliter vials, travel blanks should also be included at a frequency of 1 per day of sampling.
- Optional quality control samples include standard reference materials and natural matrix spikes.

Meters for measurement of field parameters should be calibrated at least once per day. Calibration standards should generally approximate or span natural groundwater characteristics. Recalibration may be appropriate if unusual measurements are noticed. Calibration activities should be documented on the instrument calibration log.

## 5.0 DOCUMENTATION

The following information should be collected prior to sampling and taken into the field for reference:

- Well completion schematic
- Summary of historic water level, total depth, and field parameter measurements

Observations, measurements, and other documentation of the purging and sampling effort should be recorded on the following:

- Daily Report
- Field Notebook
- Instrument Calibration Log
- Well Purge and Sample Log
- Chain-of-Custody

Documentation should include any deviations from this SOP, as well as documentation of the containerization and disposition/disposal of investigation-derived waste.

## 6.0 DECONTAMINATION

Prior to entering the site, purging and sampling equipment should be decontaminated by steam cleaning, pressure washing, or equivalent.

Prior to sampling each well, down-well equipment and equipment that will contact the sample (except sample containers) should be decontaminated according to the following procedure:

- Steam clean or pressure wash (optional unless oily contamination covers equipment)
- Wash with soap
- Rinse with tap water
- Double rinse with distilled water

If metals are included in the analytical parameters, the decontamination procedures should include:

- Steam clean or pressure wash (optional unless oily contamination covers equipment)
- Wash with soap
- Rinse with tap water
- Rinse with dilute nitric acid (skip for pumps containing metal parts)
- Rinse with tap water
- Double rinse with distilled water

Suction or discharge hoses from purge pumps need external decontamination only. Purge or sampling pumps should be decontaminated by filling the decontamination chamber with the aforementioned solutions and pumping the solutions from the chamber to the waste drum.

Prior to leaving the site, purging and sampling equipment should be steam cleaned, pressure washed, or equivalent.

## 7.0 INVESTIGATION-DERIVED WASTE

Purge water, excess sample, and decontamination wastewater should be containerized in steel drums. Drums should be labeled with hazardous waste labels, including: Generator's name and accumulation date. Wastes from different wells may be combined, but wastes that are anticipated to contain chemical should not be mixed with waste that are not thought to be contaminated.

## 8.0 SAFETY

Primary chemical hazards during well purging and sampling are associated with dermal exposure. Acids used for decontamination and sample preservation may also present chemical hazards. Primary protection against dermal exposure includes splash protection and gloves. Special chemical hazards may be associated with the presence of product, if discovered during sampling. Water quality samples are not generally considered representative in the presence of product. Accordingly, it may be appropriate to abandon sampling efforts if product is discovered.

Other specific site safety guidance is provided in the Site Safety Plan.

## 9.0 REFERENCES

Aller, L., T.W. Bennett, G. Hackett, R.J. Petty, J.H. Lehr, H. Sedoris, and D.M. Nielsen, 1989. Handbook of Suggested Practices for the Design and Installation of Ground-Water Monitoring Wells. National Water Well Association, Dublin, OH. 1989.

U.S. Environmental Protection Agency, 1989a. A Compendium of Superfund Field Operations Methods, EPA/540/P-87/001, OSWER Directive 9355.0-14. USEPA, Office of Emergency and Remedial Response, Washington, DC. December 1989.

U.S. Environmental Protection Agency, 1989b. USEPA Method Study #39, Method 504, 1,2-Dibromoethane (EDB) and 1,2-Dibromo-3-Chloropropane (DBCP) in Water, Pb 89-119 580/AS. National Technical Information Service, Springfield VA. 1989.

Table 1

Sampling and Preservation for Groundwater Samples

| Parameter | Analytical Method | Container | Preservation | Maximum Holding Time |
|---|---|---|---|---|
| Purgeable Halocarbons by GC | EPA 8010 | Two 40-ml glass vials | HCl to pH<2, cool to 4 degrees Celsius | 14 days after collection |
| Purgeable Aromatics by GC | EPA 8020 | Two 40-ml glass vials | HCl to pH<2, cool to 4 degrees Celsius | 14 days after collection |
| Organochlorine Pesticides and PCB's | EPA 8080 | Two 1-liter amber glass | Cool to 4 degrees Celsius | Extract 7 days after collection<br>Analyze 40 days after extraction |
| Organophosphorus Pesticides | EPA 8140 | Two 1-liter amber glass | Cool to 4 degrees Celsius | Extract 7 days after collection<br>Analyze 40 days after extraction |
| Chlorinated Herbicides (Phenoxy Herbicides) | EPA 8150 | Two 1-liter amber glass | Cool to 4 degrees Celsius | Extract 7 days after collection<br>Analyze 40 days after extraction |
| Volatile Organic Compounds by GC/MS | EPA 8240 | Two 40-ml glass vials | Cool to 4 degrees Celsius | 14 days after collection |
| Semi-Volatile Organic Compounds by GC/MS (Base/Neutral/Acid Extractable Organics) | EPA 8270 | Two 1-liter amber glass | Cool to 4 degrees Celsius | Extract 7 days after collection<br>Analyze 40 days after extraction |
| Dibromoethane (EDB) and 1,2-Dibromo-3-Chloropropane (DBCP) | EPA 504 | Two 1-liter amber glass | Cool to 4 degrees Celsius | Extract 7 days after collection<br>Analyze 40 days after extraction |
| Total Petroleum Hydrocarbons as Diesel | Extract by EPA 3550 and analyze by GCFID | Two 40-ml glass vials | HCl to pH<2, cool to 4 degrees Celsius | Extract 7 days after collection<br>Analyze 7 days after extraction |
| Oil & Grease | SM 503 | One 1-liter glass with aluminum foil-lined cap | $H_2SO_4$ to pH<2, cool to 4 degrees Celsius | 28 days after collection |
| Total Metals | EPA 7000 Series | One 1/2 liter poly | HNO3 to pH<2, cool to 4 degrees Celsius | 6 months after collection (28 days for mercury) |
| Dissolved Metals | EPA 7000 Series | One 1/2 liter poly | HNO3 to pH<2, cool to 4 degrees Celsius | 6 months after collection (28 days for mercury) |
| General Minerals | Various | Two 1-liter poly | Cool to 4 degrees Celsius | 7 days after collection |

# STANDARD OPERATING PROCEDURE (SOP) 5A
# DRIVE-POINT PIEZOMETERS

## 1.0 INTRODUCTION AND SUMMARY

This SOP describes the methods for installation of drive-point piezometers. Field activities covered in this SOP may be used to obtain soilgas samples, groundwater samples from shallow depths, and water level data. Drive-point piezometers may be used as an efficient and cost effective alternative to monitoring wells to allow contaminant detection and mapping in shallow aquifers. Drive-point piezometers may also be used as soilgas probes and as groundwater or soil vapor extraction points. Drive points are installed using hand held air-powered equipment, providing for installation in areas of restricted access.

Since the drive points are driven through the soil column, the potential for contamination of underlying strata (by material carried down from above) exists. Thus caution should be employed when applying this tool and interpreting analytical results.

Installation of drive-point piezometers generally consists of initial decontamination of tools and materials, pre-digging of the initial 1 to 2 feet, driving of the piezometer, collection of soilgas samples if appropriate, driving of the piezometer to total depth, and surface completion.

## 2.0 EQUIPMENT AND MATERIALS

- Air Compressor, 30-pound air hammer, pipe drive adapter, suitable length of air line
- Drive-point (perforated pipe or well point)
- Drive/riser pipe capable of attachment to drive-point, preferability flush threading
- Post hole digger for pilot hole
- Hand tools (pipe wrenches, hand level, adjustable wrench, etc.)
- Ear plugs, work gloves, steel toed boots
- Bristle brushes and buckets for decontamination
- Low residue, organic free soap such as Liquinox or Alconox
- Air pump, air tight adapters, flexible tubing, and Tedlar bags for soilgas sampling
- Peristaltic pump and tubing or small-diameter bailer for groundwater sampling
- Tape measure
- Water level sounder
- Cement for surface seal
- Construction log and field notebook

## 3.0 TYPICAL PROCEDURES

The following procedures are intended to facilitate installation of drive-point piezometers to shallow depths (generally less than 25 feet).

1. Obtain permits from local agency charged with regulation of wells City, County, and State agencies may all have regulations pertaining to installation of drive-point piezometers. Permitting may require negotiation of design features with, and inspection of installation by regulatory personnel.

2. Design the drive-point piezometer Determine soilgas sampling depth and total depth by comparison with on-site or nearby boring logs. Consider site specific soil properties relevant to driving the piezometer, and choose drive-point and drive/riser pipe accordingly. Determine the location of any underground utilities on the site.

3. Decontamination Inspect drive-point and piezometer drive/riser pipe for foreign material (oil, dirt, etc.) which may affect sample quality. All components of the drive-point piezometer should be thoroughly decontaminated prior to driving. Decontamination should consist of steam cleaning or scrubbing in hot water, scrubbing with a detergent solution, a tap water rinse, and a distilled or deionized water rinse. A long handled brush capable of running the entire length of the piezometer drive/riser pipe sections should be used to scrub the interior of the drive/riser pipe.

4. Dig a pilot hole at the desired location The pilot hole should be advanced at least 18 inches. The pilot hole provides a crude guide for the initial driving of the drive-point piezometer, as well as space for the surface seal. The pilot hole also permits evaluation of the presence of shallow utilities at the piezometer location.

5. Begin driving the piezometer Immediately prior to driving and approximately every 3 inches for the first 2 to 3 feet, the drive-point piezometer should be leveled. A hand level capable of measuring plumbness of vertical objects should be placed against the drive-point or riser pipe to assure a straight drive. Inclined piezometers may fail during driving due to uneven application of driving force at joints. Plumbness is checked by frequently placing the level on the sides of the drive-point or drive/riser pipe. Each plumbness check should include at least 2 measurements at 90 degrees to each other around the drive-point or drive/riser pipe.

   Driving is accomplished by attaching the pipe drive adapter to the air hammer, connecting the air hammer to the air supply, placing the pipe drive adapter onto the drive/riser pipe and then activating the air hammer. Care must be taken to maintain an evenly distributed downward force during driving to maintain plumbness. The integrity of the drive-point piezometer should be checked periodically during driving by running a flexible tape down the pipe annulus. This will verify that the drive-point has not collapsed, and provide assurance of the depth to which the point has been advanced.

6. Soilgas Sampling Upon reaching the desired sampling depth a soilgas sample may be collected. Soilgas samples are collected by removing the drive adapter from the riser pipe, attaching air tight adapter fittings including a nipple capable of providing an air tight seal to flexible tubing to the drive/riser pipe, connecting the sampling pump to the nipple with flexible tubing, and connecting the discharge of the sampling pump to a Tedlar bag.

The volume of each cycle of the sampling pump must be known to assure adequate purging of the annular volume of the piezometer. Hand pumps typically meet these requirements. A minimum of one annular volume of vapor should be purged from the piezometer prior to filling the Tedlar bag. This helps assure that the sample is not diluted by ambient air. Prior to filling the Tedlar bag the soilgas should be monitored using a PID to detect the presence of organic vapors. PID monitoring of the soilgas will provide a basis for a collection/no collection decision. After collection of the soilgas sample, driving may be continued or the drive-point may be completed as a soil vapor probe.

7. Document As-Driven Condition Upon reaching the total depth the drive-point piezometer should be measured using a flexible tape to verify the depth. The presence or absence of groundwater and drive-point depth should be recorded on the completion form, and in field notes. If groundwater is detected, the water level should be recorded. Water levels are measured by lowering a water level sounder probe into the piezometer.

8. Surface Seal Fill the annular space around the riser pipe with neat cement. Generally this space coincides with the pilot hole. The seal should be completed flush to existing grade. Care should be taken to assure that cement is mixed thick enough to prevent flow along the riser pipe to the subsurface. Clean sand may be placed in the bottom of the pilot hole after cessation of driving to prevent flow of cement if necessary.

9. Groundwater Sampling Groundwater samples may be obtained by bailing if the inside diameter of the drive-point and riser pipe permit it, or by use of a peristaltic pump and flexible tubing. An attempt should be made to purge 3 piezometer volumes prior to collecting the groundwater sample. However it may be prudent to collect the initial volume removed if a reasonable doubt exists as to whether sufficient flow to purge the piezometer will be obtained.

## 4.0 QUALITY ASSURANCE AND QUALITY CONTROL

Quality assurance checks for drive-point piezometer installation consist of verification and accurate measurement of length of drive-point, lengths of drive/riser pipe, depths to soilgas sampling points, and total depth. Inspection of the drive-point and drive/riser pipe for adequate decontamination provides another quality control check.

## 5.0 DOCUMENTATION

Observations, measurements, and other documentation of the well completion of the drive-point piezometer installation should be recorded on the following:

- Daily report
- Field Notebook
- Piezometer Completion Log

Documentation should include deviations from this SOP, including descriptions of problems encountered during installation and attempted/implemented remedies.

## 6.0 DECONTAMINATION

Materials used for construction of drive-point piezometers consist of threaded pipe, drive-point, and possibly pipe couplings. These items are typically contaminated with cutting oil and loose material which may interfere with sample integrity. Therefore great care should be taken to adequately decontaminate components of the drive-point piezometer. Decontamination should include steam cleaning and/or scrubbing in hot soapy water, scrubbing in a detergent solution, a tap water rinse, and a deionized or distilled water rinse.

Care should be taken to inspect and decontaminate sampling apparatus such as tubing, bailers, sounders, and flexible tapes which may be used inside the drive-point piezometer during sample collection.

Air hammers may occasionally discharge oil or grease, great care should be taken to prevent contact of discharged oil or grease with the drive-point or drive/riser pipe during driving. If oil or grease contacts the piezometer components, they should be decontaminated prior to further driving. Attempts to prevent such contact should be made by use of plastic sheeting or other suitable barrier material.

## 7.0 SAFETY

Primary safety concerns during installation of drive-point piezometers are associated with exposure to noise associated with use of the air hammer, and eye injuries due to fragments generated by pounding metal surfaces. Protection against hearing impairment includes use of ear plugs. Eye protection is afforded by use of safety glasses or a face shield.

# STANDARD OPERATING PROCEDURE (SOP) 9A
# VERIFICATION SOIL SAMPLING FOR UNDERGROUND STORAGE TANK REMOVAL

## 1.0 INTRODUCTION AND SUMMARY

This SOP describes procedures for verification soil sampling during the removal of underground storage tanks. The sampling protocols described herein are suitable for collecting soil samples for chemical analysis, limited physical testing, and visual classification. These procedures are intended to allow collection of verification samples which will provide the information necessary to evaluate whether a release has occurred and if a leak is suspected, what residual contaminant levels remain after initial excavation of contaminated soil.

This SOP has been developed for routine use within the San Francisco Bay area and should be closely examined and potentially modified if applied to other locations.

## 2.0 EQUIPMENT AND MATERIALS

- Backhoe or other piece of equipment capable of obtaining a grab soil sample from the base and sidewalls of the excavation (typically the same backhoe as that used to excavate for tank removal)
- Brass or stainless steel liners, 3- to 6-inch length and 2- or 2.5-inch diameter, fitted with plastic endcaps
- Hammer or other tool to drive liners into soil
- Teflon sheets, approximate 6-mil thickness, approximate 3-inch width
- Bottles and jars: 8-ounce wide-mouth glass jars, laboratory cleaned
- Kimwipes, clean silica sand, and/or deionized water (for blank sample preparation)
- Duct tape
- UST removal observation form, soil sampling form, sample labels, chain-of-custody forms, hazardous waste labels, field organic vapor monitor calibration form, field notebook, and marking pens
- Ziploc plastic bags of size to accommodate sample containers
- Stainless steel spatula, spoon, and bowl
- Steel shovel and trowel
- Cooler with ice
- Field organic vapor monitor: the make, model, and calibration information of the field organic vapor monitor (including compound and concentration of calibration gas) should be documented in the field notes
- Buckets (minimum 2) and brushes (minimum 2) for decontamination
- Low residue, organic free soap such as Liquinox or Alconox
- Distilled or deionized water (minimum 2 gallons)

- Garden hose and confirm availability of onsite tap water
- Visqueen
- Paper towels and garbage bag
- Camera and film
- Copy of current RWQCB Tri-Regional Recommendations and current county or city requirements (if available)
- Gloves: work, nitrile, and latex
- Half-face respirator with OV-HEPA cartridges
- Coveralls, steel-toed water-repellent boots, hardhat, earplugs
- Fire extinguisher and first-aid kit
- Measuring tapes and toolbox with standard tools

As specified in the Site Safety Plan, additional safety and personnel decontamination equipment and materials may be needed.

## 3.0 TYPICAL PROCEDURES

These sampling procedures are generally applicable. However local regulations should be researched prior to beginning a specific project, as they may require different procedures than described herein.

1. <u>Obtain grab sample of soil from tank excavation using backhoe bucket</u> Beneath each end of the former tank (fill/pump end only for tank volume <1000 gallons) obtain a backhoe bucket full of soil. The soil sample should be collected from the upper two feet of native soil or fill material below tank invert. If the water table is above the bottom of the excavation, verification samples should be collected immediately above the water table in the excavation side walls adjacent to the tank ends, and groundwater samples should be collected in accordance with SOP 10A - Verification Groundwater Sampling for Underground Storage Tank Removal. If staining, elevated organic vapor monitor readings, or other evidence of release are present in the excavation - then additional samples should be collected of the affected soil.
2. <u>Collect tank excavation soil samples</u> Trim the soil in the backhoe bucket as required to expose fresh unaerated material. Fill a liner by driving it into the soil in the backhoe bucket. Remove the liner (excavate with trowel if necessary) and cap each end with pre-cut teflon sheeting and plastic end cap, seal with Duct tape (do not use electrical tape). Label the liner, enter onto chain-of-custody form, and place in a zip-lock bag on ice in a cooler. Measure cavity created by liner removal from soil with field organic vapor monitor and record result.
3. <u>Classify soil exposed in excavation</u> Visually describe soil encountered in the excavation according to ASTM D 2488-Standard Practice for Description and Identification of Soils (Visual-Manual Procedure).

4. Collect piping soil samples If product or vent piping was removed outside the limits of the tank excavation, collect one soil sample for each 20 linear feet of such piping. Because of shallow depth, soil samples from beneath piping may generally be collected by directly driving the liner into freshly exposed soil (without the aid of a backhoe).

5. Collect extent -of-soil-contamination or soil remediation verification samples If excavation was performed to determine the extent of a suspected release or to remove contaminated soil, collect one verification sample along every 15 to 20 lineal feet of the excavation perimeter and base to characterize the vertical and horizontal extent of (former) contamination. Use methods described in 1 and 2 above.

7. Document locations Measure horizontal and vertical dimensions necessary to reconstruct sampling locations. The depths of all samples should be measured and recorded in field notes. The excavation, tank, and piping should be located relative to prominent site features such as buildings, intersections, fence lines, and a sketch showing the site features, tank and piping location, excavation perimeter, and sample locations should be prepared in the field.

8. Request Laboratory Analyses Analytical requirements vary with the substances reportedly stored in each tank. Suggested minimum analytical requirements are presented in Table 1. A laboratory certified by the State of California should be contracted to perform the analyses.

## 4.0 QUALITY ASSURANCE AND QUALITY CONTROL

Field quality control samples are not normally collected during soil sampling.

Optional quality control soil samples may include collection of replicates, at an approximate frequency of 1 replicate for every 10 natural samples. Replicates are collected by driving two liners adjacent to each other. Each sample is labeled according to normal requirements. The replicate samples obtained in such a manner are suitable for assessing the reproducibility of both chemical and physical parameters. Interpretation of the reproducibility of data should recognize the potential for significant changes in soil type over even a 6-inch interval. Accordingly, replicates do not supply the same information as normally encountered duplicate or split samples. Duplicate or split samples are better represented by the laboratory performing replicate analyses on adjacent subsamples of soil from the same liner.

Optional quality control samples may be collected to check for cross-contamination using field blanks. Field blanks may be prepared by (1) swipe sampling decontaminated liners and split-spoon with kimwipes, (2) pouring clean silica sand into a decontaminated liner, or (3) pouring deionized water over the decontaminated liner and collecting the water that contacts the sampling implements for aqueous analysis. Field blanks may be prepared at the discretion of the field staff given reasonable doubt regarding the efficacy of the decontamination procedures.

## 5.0 DOCUMENTATION

Observations, measurements, and other documentation should be recorded on the following:

- Field Notebook

- Underground Storage Tank Sampling Form
- Underground Storage Tank Observation Form
- Excavation Log Form
- Field Organic Vapor Calibration Form
- Sample Label
- Chain-of-Custody Form

In addition to the standardized entries, notations of unusual or unexpected conditions as well as deviations from this SOP should be recorded.

## 6.0 DECONTAMINATION

Prior to entering the site, the backhoe and appurtenant items (bucket, tracks, shovels, troughs and buckets, etc.) should be decontaminated by steam cleaning, pressure washing, or soap washing and rinsing.

Between each tank excavation (if more than one), appurtenant items that contacted soil should be decontaminated by steam cleaning, pressure washing, or soap washing and rinsing. Prior to leaving a site where contamination was encountered, the backhoe and appurtenant items should be decontaminated by steam cleaning, pressure washing, or soap washing and rinsing. If contamination is encountered, onsite decontamination of materials and equipment that contacted the contaminated soil should be contained (lined pit or drum). Decontamination of materials and equipment contacting uncontaminated soil may occur upon open ground or areas discharging to a sanitary sewer (discharge to a storm sewer may be acceptable if only minor amounts of solids and soap are discharged).

Prior to sample collection; the liners, end caps, trowel, liner driving equipment, and other equipment or materials that may directly contact the sample should be decontaminated. Decontamination for these items should consist of a soap wash, followed by a tap water rinse, followed by a distilled water rinse.

If decontamination solutions and brushes are used to clean materials and equipment that previously contacted contaminated soil, the solutions should be changed between tank excavations. Otherwise, the solutions and brushes may be reused.

## 7.0 WASTE HANDLING AND DISPOSAL

Wastes resulting from the activities of this SOP may include excess soil sample, decontamination wastewaters, and miscellaneous waste (paper, plastic, gloves, jars, aluminum foil, etc.) Unless otherwise prohibited by the Site Safety Plan, excess soil sample may be returned to the excavation of origin or soil stockpile, and miscellaneous waste may be disposed of as municipal waste.

Decontamination wastewaters may be discharged to sanitary sewers, subject to sewer district restrictions.

## 8.0 SAFETY

Normal and special safety precautions are described in the Site Safety plan. Physical hazards typically prevail because the backhoe or excavator contains exposed moving parts constructed of heavy material with sharp edges.

Chemical hazards are typically discovered upon removal of the tank from the excavation. Opportune monitoring for volatile chemicals may be conducted at this time.

## 9.0 REFERENCES

American Society for Testing and Materials, 1990. 1990 Annual Book of ASTM Standards, Section 4 - Construction, Volume 4.08 - Soil and Rock, Building Stones; Geotextiles. ASTM, Philadelphia, PA. 1990.

Regional Water Quality Control Board, 1990. Tri-Regional Board Staff Recommendations for Preliminary Evaluation and Investigation of Underground Tank Sites. California Regional Water Quality Control Board, San Francisco Bay Region, Oakland CA. 10 August 1990.

U.S. Environmental Protection Agency, 1989a. A Compendium of Superfund Field Operations Methods, EPA/540/P-87/001, OSWER Directive 9355.0-14. USEPA, Office of Emergency and Remedial Response, Washington, DC. December 1989.

U.S. Environmental Protection Agency, 1989b. Soil Sampling Quality Assurance User's Guide - Second Edition. National Technical Information Service, PB 89-189 864/AS, Springfield, VA. 1989.

# STANDARD OPERATING PROCEDURE (SOP) 10

# ANALYSIS OF SOIL AND WATER USING THE POLYETHYLENE BAG SAMPLING SYSTEM

## 1.0 INTRODUCTION AND SUMMARY

The polyethylene bag sampling system (PBSS) involves collecting a soil or water sample, placing it in a recloseable bag, agitating the sample to release vapor from the sample to the headspace of the bag, and measuring the headspace vapor concentration using an analytical field instrument. Distilled water is added to soil samples to facilitate partitioning of volatile organics from the soil sample into the bag headspace.

This SOP has been developed to define an effective procedure for screening soil and groundwater samples for contamination. The applications of this procedure include:

- A screening tool to select soil and groundwater samples for laboratory analyses.
- An approximation of the extent of soil contamination for remedial actions.
- Detection of the presence of contamination to develop effective field investigation planning.

## 2.0 EQUIPMENT AND MATERIALS

Soil Sampling

- Hand auger, trowel, split spoon sampler, backhoe, or other device for the collection of soil samples.
- 25 grams (g) of soil sample.
- 100 to 300 milliliters (ml) distilled water.

Water Sampling

- Bailer
- Glass container
- 100 to 300 ml sample water

Sample Container

- One-quart recloseable bag (Ziplock baggie)
- Three-way valve attached to pre-made hole and sealed using Buna-N gaskets and nuts 2 inches down from the recloseable end of the bag.
- Hand pump (used for inflating bag through three-way valve)

## 3.0 SAMPLE PREPARATION AND ANALYSIS

The container used for the preparation and analysis of both soil and water samples is a one-quart, recloseable, polyethylene, freezer bag. A hole is made in one side of the bag, about 2 inches down from the recloseable end and sealed using Buna-N gaskets and lamp nuts on both sides of the hole. Before the sample is collected, the bag seal should be leak tested by inflating the bag with ambient air (using a hand pump attached to the valve system) until taut, and then sealing off the air space within the bag by closing the valve. If leakage is observed, discard the bag.

Soil Sampling Approximately 100 ml of distilled water is placed into a leak-tight freezer bag. Weigh out 25 g of soil sample and place into a sealed polyethylene freezer bag with an attached valve system. The exact amount of sample collected is not as important as assuring that the amount collected is consistent for all analyses conducted at a site. The soil sample should be collected and sealed as quickly as possible to avoid loss of volatile constituents.

Water Sampling A recommended sample volume of 100 to 300 ml of water sample is introduced into the sample bag using a graduated container. Sample volumes of 300 ml tend to yield more consistent results than 100 ml samples. Samples larger than 300 ml may prove difficult to agitate. The sample volume used should be consistent for all samples analyzed at a site to ensure comparable results.

Soil and Water Sampling Immediately after sample introduction, the bag is inflated using an air pump until the bag is taut. The air inside of the bag is then sealed-off by closing the valve. The bag is then manually agitated with a rocking motion. Following agitation, a calibrated field instrument such as a PID, FID, or GC that detects total organic volatiles (TOV) is attached to the bag valve system using polyethylene tubing. The valve is then opened and the headspace vapor concentration is measured. Securing the bag and valve in an upright position prevents accidental introduction of water into the detector. The sample bag and its contents should be properly disposed of following each analysis. Buna-N gaskets may be reused many times without cross-contamination from one sample to another; however, the valve system should be purged before reuse by pumping air through the system. The valve system is then checked with the organic vapor monitor to determine the effectiveness of the purging. In the event of residual contamination, the tubing attached to the valve should be replaced.

## 4.0 CALIBRATION

Field instruments are calibrated prior to taking sample measurements. Calibration curves for field standards can be developed by one of four methods:

- A single component standard is used to develop a calibration curve; results are reported for other petroleum components as an equivalent to the standard.
- Serial dilution of a water sample that is spiked with a field standard. A relative concentration calibration curve is developed by plotting the results of the serial dilution analyses which can later be semi-quantified by a laboratory analysis of the same samples.
- A third alternative specifies that a multi-component standard with the same constituents in proportions similar to those of the contaminated water may be used to generate a calibration curve.
- Generation of a calibration curve based on headspace readings from water samples obtained from several wells where the concentrations

of contaminants have been previously determined by laboratory analysis.

## 5.0 QUALITY ASSURANCE AND QUALITY CONTROL

Prior to using the headspace test, all reusable equipment which are used for the collection and testing of field samples should be properly decontaminated according to the applicable guidelines.

Field standards can be affected by the salinity and dissolved organic content of water samples, resulting in the development of misleading calibration curves. Also, when an unknown mixture of multiple constituents is analyzed, non-linear responses result from concentration variations of different components in the mixture. Variations in the organic content of the soil can also result in lower total readings due to sorption and dissolution effects.

## 6.0 DOCUMENTATION

Information regarding samples analyzed by the headspace test should be recorded in a field notebook at the time of the analysis. Information which should be included in the field notebook are the sample number and location (approximate horizontal and vertical coordinates), time of analysis, weight of sample, volume of distilled water mixed with sample, any natural or man-made conditions which may affect the normal test results (i.e. the presence of other compounds in the sample which may affect the calibration curve for the target analyte), sample color, odor, and viscosity before analysis, concentration values obtained from the field instrument, and observations of instrument performance during the analyses.

## 7.0 DECONTAMINATION

Prior to the analysis of the field samples by the headspace test, all of the reusable equipment involved in the collection and testing of the the field samples should be properly decontaminated. Decontamination for items such as augers, split spoon samplers, trowels, and bailers should consist of a soap wash, followed by a tap water rinse, and then followed by a distilled water rinse.

Special care should be taken in decontaminating the valve system and tubing. The Buna-N gaskets which hold the valve system in place may be reused many times without cross-contamination from one sample to another; however, the valve system used in the analysis should be purged before reuse by pumping air through the system. The valve system is then checked with the field instrument (i.e. PID) to determine the effectiveness of the purging. In the event of residual contamination, the tubing attached to the valve should be replaced.

## 8.0 WASTE HANDLING AND DISPOSAL

Wastes resulting from the activities of this SOP may include excess soil sample, headspace test and decontamination waste water, test waste such as the plastic bags used to hold the samples, and miscellaneous waste (paper, plastic, protective clothing such as surgical gloves, boots, and tyvek, jars, etc.). Unless otherwise prohibited in the Site Safety Plan, excess soil sample may be returned to the original excavation, soil boring, or stockpile from which it was derived.

Headspace test and decontamination waste water may be discharged to sanitary sewers, subject to sewer district regulations. The waste water may also be temporarily stored onsite in Department Of Transportation (DOT) approved containers, pending test results of the waste water from a certified California Department Of Health Services (DHS) laboratory. Upon receipt of the laboratory data, the proper disposal method for the wastewater can be determined.

## 9.0 SAFETY

Tests should be performed under level D protection unless field instrument readings indicate a higher action level for the site is necessary.

## 10.0 REFERENCES

U.S. Environmental Protection Agency, 1990. Field Measurements - Dependable Data When You Need It, EPA/530/UST-90/003. USEPA, Office of Underground Storage Tanks, Washington D.C., September 1990.

# STANDARD OPERATING PROCEDURE (SOP) 11
# HANBY METHOD FOR ANALYSIS OF SOIL AND WATER

## 1.0 INTRODUCTION AND SUMMARY

This SOP describes procedures for the analysis of petroleum aromatic hydrocarbons in soil and groundwater using the Hanby Method. The Hanby Method provides a colorimetric indication of the presence of aromatic hydrocarbons such as benzene, toluene, ethylbenzene, and xylenes (BTEX), gasoline, diesel, etc.

This SOP has been developed to quantify levels of soil and groundwater contamination related to tank removals, but can also be applied to indicate the presence and define the extent of soil and groundwater contamination along pipelines, determine the contaminant limits for soil excavation, determine groundwater monitoring well locations, measure progress of soil and groundwater remediation, and as a screening tool to select field samples for further laboratory analysis.

## 2.0 EQUIPMENT AND MATERIALS

<u>Soil Sampling</u>

- Hand auger, trowel, split spoon sampler, backhoe or other piece of equipment capable of obtaining a grab or composite soil sample
- Spatula or knife
- Jars with lids for the collection and storage of soil samples
- 1-quart jars for extraction of soil samples
- Analytical scale (OHAUS triple-beam balance (Model #710-00)
  ACCULAB scale (Model 333))

<u>Water Sampling</u>

- Bailer or pump, and 750 ml sample bottles for collection of water samples

<u>Soil and Groundwater</u>

- Deionized water or distilled water
- Bristle brushes and organic free soap (i.e. Liquinox or Alconox) for decontamination of reusable equipment
- Hanby Analytical Laboratory Test Kit for Aromatics
  - extraction reagent
  - catalyst
  - 10 ml graduated cylinder
  - 50-ml beaker
  - 500-ml separatory jar
  - ring stand for separatory funnel

- test tubes and test tube caps
- colorimetric chart for water samples
- colorimetric photographs for soil samples
- waste bottle
- safety glasses
- surgical gloves

## 3.0 TYPICAL PROCEDURES

The following procedures are intended to cover the majority of sampling conditions. However, normal field practice requires re-evaluation of these procedures and implementation of alternate procedures upon encountering unusual or unexpected conditions. Deviations should be documented.

<u>Soil Samples (Direct Extraction Method)</u>

1. Place beaker on an analytical balance and tare.

2. Quickly add 5 grams of soil sample to beaker.

3. Chop sample with clean spatula or knife blade until soil is < 3mm pieces.

4. Hold 10 ml ampule of extraction reagent upright firmly with one hand on a flat surface and with the other hand quickly snap off the top of the ampule and pour into beaker covering soil. AVOID FUMES BY KEEPING EXTRACTION REAGENT AT ARMS LENGTH. Stir soil in extraction reagent for 3 minutes.

5. Pour solvent from the beaker into one of the screw top test tubes up to the black line (4.2 ml) of the test tube. Cover the remaining extractant reagent solution in the beaker with aluminum foil and secure with rubber band.

6. Add one catalyst vial to the test tube, screw on the test tube cap firmly, and shake well for 2 minutes. CAUTION: AVOID CONTACT WITH SKIN, EYES, AND WATER.

7. Compare color of catalysts at bottom of tube to photograph of standard results, i.e. gasoline in soil, diesel in soil, etc.

8. If color in test tube is black, go back to step 6 and make a (10:1) dilution of extractant reagent solution. Mix 1 ml of extractant reagent solution derived in step 6, with 9 ml of extractant reagent from a new ampule (use graduated cylinder). Pour the new solution into another capped test tube up to the black line. Add another vial of color reagent. If color in test tube is still black, go back to step 6, or quit and send soil sample to laboratory for further analysis. If sample color (other than black) is present, match sample color in test tube to compound concentration color on photograph, and then multiply concentration by a factor of 10. If color in test tube is between compound concentration colors on photograph, interpolate an approximate concentration value and then multiply by a factor of 10.

9. Pour excess solvent from beaker into waste solvent bottle (if not needed for dilution in the case of high concentration samples.)

10. Place beakers in a well ventilated area until solvent has evaporated. Place soil into a waste soil container.

11. Place used screw-cap test tubes into a protective wrapping. (Note: while doing this procedure keep the beakers well below breathing zone level (i.e. at waist level while standing)

<u>Water Samples</u>

1. Pour 500 ml of water sample into separatory funnel

2. Snap the top off one of the 5 ml ampules of extraction reagent and pour it into a separatory funnel. CAUTION: WEAR GLOVES AND AVOID BREATHING VAPORS OF EXTRACTION REAGENT.

3. Shake vigorously with inversion of funnel, for two minutes. CAUTION: RELEASE PRESSURE ON FUNNEL, after first few shakes by pointing stopcock side of the bottle upwards and opening stopcock. Note: if the water sample is clear, then shake with a vigorous motion; however, if the water sample is turbid, then shake with a swirling motion. Vigorous shaking of a turbid sample will cause an emulsion layer to form which may inhibit the drainage of the extractant reagent solution from the separatory funnel.

4. Place separatory funnel on ring stand and let sit for 5 minutes.

5. Withdraw extraction layer (bottom) into test tube up to the black line (4.2 ml), being careful to stop before water layer enters stopcock.

6. Carefully shake catalyst powder in small vial (color development reagent) into test tube. CAUTION: REAGENT REACTS VIOLENTLY WITH MOISTURE; WILL BURN SKIN

7. Shake tube vigorously for thirty seconds and compare color on the colorimetric chart.

8. If solution color is black, then prepare another water sample as described in steps 1 through 5. Then prepare a 10:1 dilution of extractant reagent/water sample solution. Add the catalyst powder from the small vial, shake for 30 seconds, and match the color in the test tube to the compound concentration color on the colorimetric chart. Then multiply the color chart concentration by a factor of 10 to obtain the actual approximate concentration. If the color in the test tube is still black, then either prepare a weaker dilution or send the water sample to a laboratory for further analysis.

## 4.0 QUALITY ASSURANCE AND QUALITY CONTROL

Prior to testing by the Hanby Method, all equipment which is used for the collection and testing of field samples should be properly decontaminated according to the applicable guidelines. The presence of aromatic contaminants in field samples which are additional to the presence of the aromatic compound to be analyzed, may interfere with the test results. Therefor, prior to performing analyses by the Hanby Method, existing laboratory and historical chemical information pertaining to the site and the surrounding area should be evaluated.

To ensure proper results with the Hanby Field Test Kit, a background sample of either soil or groundwater should be collected from a source with either proven absence of contamination, or from a source where the contaminant concentration is known.

## 5.0 DOCUMENTATION

Information regarding samples tested by the Hanby Method should be recorded in a field notebook at the time of the analysis. Information which should be included in the field notebook are the sample number and location (approximate horizontal and vertical coordinates), time of analysis, any natural or man-made conditions which may affect normal test results (i.e. rain, drainage of water from the separatory funnel), sample color before analysis, approximate concentration of compound derived from colorimetric charts, a record of sample dilutions, and any evidence suggesting the presence of other contaminants which would affect the results (i.e. the presence of other aromatics in the sample may affect the test results).

## 6.0 DECONTAMINATION

Prior to the analysis of field samples by the Hanby Method, all equipment involved in the collection and testing of field samples should be properly decontaminated. Decontamination for these items should consist of a soap wash, followed by a tap water rinse, and then followed by a distilled water rinse. If decontamination solutions and brushes are used to clean sample collection and analysis equipment that previously contacted contaminated soil, then the solutions should be changed between sample analyses.

## 7.0 WASTE HANDLING AND DISPOSAL

Wastes resulting from the activities of this SOP may include excess soil sample, decontamination wastewaters, test wastes such as excess extractant reagent and used test tubes containing reagents and analytes, and miscellaneous waste (paper, plastic, gloves, jars, aluminum foil, etc.). Unless otherwise prohibited in the Site Safety Plan, excess soil sample may be returned to the original excavation, soil boring, or stockpile from which it was derived.

Decontamination wastewater may be discharged to sanitary sewers , subject to sewer district restrictions. The waste water may also be temporarily stored onsite in Department Of Transportation (DOT) approved containers, pending test results of the waste water from a certified California Department Of Health Services (DHS) laboratory. Upon receipt of the laboratory data, the proper disposal method can be determined.

Field test wastes (i.e. excess extractant reagent, soil sample contaminated with reagents, used test tube containing reagents and analytes) can be sent back to the manufacturer of the Hanby Field Test Kit in approved DOT mailing containers. Miscellaneous wastes may be disposed of as municipal waste.

## 8.0 SAFETY

The Hanby Method should always be performed in a well ventilated area. Surgical gloves and safety glasses should always be worn when handling the test kit reagents and performing the filed tests. Tests should always be performed below the breathing zone, preferably at waist level while in a standing position. The Material Safety Data (MSDS) sheets which are included in the test kit should be read thoroughly before attempting a field test and should always be taken to the field with the kit.

The color development reagent which is contained in the small plastic vials reacts violently with water and therefore should never be mixed directly with water. The color reagent should always be kept in a dry, cool place. The extractant reagent is incompatible with chemically active metals such as sodium, magnesium, and potassium, and should be stored below 80 degrees Fahrenheit.

## 9.0 REFERENCES

Environmental Analytical Laboratories, Field Test Procedures for Aromatics in Groundwater and Soils, 1991.

# APPENDIX B

Site Safety Plan

Site Safety Plan
AutoPro Facility
5200 Telegraph Avenue
Oakland CA

Anticipated Field Work The field work anticipated during preparation of this plan includes: installation of drive-point piezometer in uncontaminated areas, water level monitoring, in-pit bioremediation, excavation of contaminated soil, confirmation soil sampling, drilling and soil sampling for well installation, well installation, well development, well sampling, and surveying.

Chemical Hazard Evaluation Chemical compounds detected during previous sampling at the facility, as well as hazard criteria, are summarized in Table 1.

Physical Hazard Evaluation Physical hazards which may be encountered include: heavy machinery, heavy lifting, slip-trip-fall, loud noise, and heat exposure.

Health and Safety Responsibilities This site safety plan will be implemented by the site safety officer under the supervision of the project manager, and in coordination with appropriate client representatives. Safety personnel and their responsibilities are presented in Table 2.

Work Zone A work zone will be established around the area of work. The work zone is an area of sufficient size to allow safe completion of the work while maintaining control of access to the work area. The work zone will be restricted by requesting people not directly involved in the work to stay out of the immediate work area, and/or by restricting access by other suitable means, such as traffic cones and blockades.

No smoking, chewing of tobacco or gum, eating, or drinking will be allowed in the work zone.

Personal Protective Equipment Field work will begin in modified Level-D personal protection (Table 3). If air monitoring results of the work zone exceed the action levels specified below, then personal protective equipment will be upgraded as necessary to modified Level-C (Table 3).

Monitoring Visual monitoring should be routinely conducted by the workers. Workers should evaluate themselves for signs of fatigue as the work progresses. Work breaks should be taken as reasonably required to maintain safety and efficiency.

The work area atmosphere will be monitored using a field organic vapor monitor (Thermo Environmental Instruments Model 580B, 10.0 eV photoionization detector, calibrated to 100 ppm v/v isobutylene). Atmospheric monitoring will focus on the breathing zone of workers within the work zone. If continual readings greater than 5 ppm above background are detected in the breathing zone, personal protection should be upgraded to modified Level-C from modified Level-D. 5 ppm was selected as a conservative upgrade criteria as this is one-half the 8-hour time weighted average exposure limit for benzene (Table 1). If continual readings greater than 50 ppm above background are recorded in the breathing zone, work should stop. Work should be resumed after consultation with the project manager and possibly the client, and may include additional safety precautions.

Emergency Procedures. These procedures are designed to allow rapid treatment of workers for injuries or exposure to hazardous substances occurring on the worksite. A secondary purpose of these procedures is to allow documentation of emergencies.

Emergency information is summarized in Table 4. The location of the nearest hospital is shown on Figure 1.

If required, first aid should be provided for the injured worker. The site safety officer should be notified immediately of an emergency. It is the site safety officer's responsibility to document the emergency and report it to the project manager and client in a timely manner.

Documentation Documentation specific to the Site Safety Plan consists of the tail gate safety meeting form (attached). Health and safety issues not addressed on the tailgate safety meeting form should be recorded in the field notebook.

Decontamination Decontamination refers to removal of possible chemicals from workers and health and safety monitoring equipment. In many instances, removal and thorough cleaning of work clothing is adequate for worker decontamination. However, if skin contact with chemical containing material occurs during field work, the affected area should be scrubbed thoroughly with soap and water.

Monitoring equipment should be kept clean by wiping as required with a paper towel or other suitable material.

Health and Safety Wastes Wastes generated by health and safety practices include disposable protective equipment such as gloves, tyvek-coveralls, and boot covers, as well as used paper towels. These items may be disposed of with normal municipal refuse.

Liquid wastes from washing may be disposed of in the sanitary sewer.

Table 1

Chemical Hazard Evaluation

| Chemical | Measured in Soil (mg/kg) | Measured in Groundwater (mg/l) | Odor Threshold (ppm v/v) | Lower Explosive Limit (ppm v/v) | Permissible Exposure Limit (ppm v/v) | Time Weighted Average (ppm v/v) | Immediately Dangerous to Life and Health (ppm v/v) |
|---|---|---|---|---|---|---|---|
| Oil & Grease | 240 to 12,000 | NM | NA | NA | 5 $mg/m^3$ | 5 $mg/m^3$ | NA |
| Total Petroleum Hydrocarbons as Gasoline | <1 to 2,900 | 110 | NA | NA | 300 | 300 | NA |
| Total Petroleum Hydrocarbons as Diesel | <1 to 4,500 | 68 | NA | 6,000 | NA | NA | NA |
| Benzene | <0.005 to 4.5 | 0.13 | 12 | 13,000 | 1 | 10 | NA |
| Toluene | <0.005 to 2.4 | 0.071 | 2.9 | 13,000 | 100 | 100 | 2,000 |
| Ethylbenzene | <0.005 to 2.7 | 0.19 | 2.3 | 10,000 | 100 | 100 | 2,000 |
| Xylenes | <0.005 to 4.9 | 0.18 | 1.1 | 10,000 | 100 | 100 | 10,000 |
| Lead | 47.1 | 1.61 | NA | Not flammable or explosive | 0.05 $mg/m^3$ | 0.15 $mg/m^3$ | NA |

General Notes

(a) Exposure criteria from: (1) American Conference of Governmental Industrial Hygienists, *1990-1991 Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices,* (2) National Institute for Occupational Safety and Health, *Pocket Guide to Chemical Hazards*, 1985, (3) American Conference of Governmental Industrial Hygienists, *Guide to Occupational Exposure Values,* Undated (circa 1990), and (4) Amoore, J. E. and Hautala, E., *Odor as an Aid to Chemical Safety: Odor Thresholds Compared with Threshold Limit Values and Volatilities for 214 Industrial Chemicals in Air and Water Dilution*, Journal of Applied Toxicology, Volume 3, Number 6, 1983.

(b) NA = no applicable value listed in cited references

(c) NM = not measured

(d) < indicates parameter reported below detection limits

Table 2

Safety Personnel and Responsibilities

| Personnel | Responsibilities |
|---|---|
| Project Manager<br><br>(Doug Lovell) | Development and overall implementation of Site Safety Plan, provide properly trained onsite personnel to complete the work, coordination of safety issues with client. |
| Site Safety Officer<br><br>(Noah Heller or Mark Buscheck) | Onsite implementation of Site Safety Plan, coordination and documentation of field safety procedures, communication of safety issues to project manager, delineate work zone, atmospheric monitoring, review site safety procedures with subcontractors, conduct tailgate site safety meeting, contact Underground Service Alert, clear underground utilities, maintain adequate supply of safety equipment onsite for Streamborn personnel. |
| Subcontractor's Site Safety Officer<br><br>(to be determined) | Understand and obtain subcontracting crews' compliance with Site Safety Plan, maintain onsite supply of safety equipment for subcontractor's personnel, relay safety concerns to Site Safety Officer. |

Table 3

Personnel Protective and Monitoring Equipment

| Item | Requirement |
|---|---|
| Modified Level-D Personal Protective Equipment | Hardhat, dedicated work clothing (cotton coveralls or tyveks), water repellent steel-toed boots, work gloves, latex gloves (as appropriate), nitrile gloves (as appropriate), first aid kit, fire extinguisher, warning tape, optional eye and hearing protection. |
| Modified Level-C Personal Protective Equipment | Add Half-face respirator with OV-HEPA cartridges and mandatory tyveks to modified Level-D protective equipment. Change respirator cartridges upon detection of breakthrough (by smell), increase in breathing resistance, or daily (whichever is more frequent). |
| Atmospheric Monitoring | Field organic vapor monitor capable of detecting organic vapor concentrations of 1 ppm (v/v). Field organic vapor monitor to be calibrated to known reference gas daily.<br><br>Action levels (measurement in the breathing zone of work area):<br>>5 ppm for 10 minutes: upgrade to modified Level C<br>>50 ppm for 10 minutes: stop work, consult with project manager |
| Visual Monitoring | Evaluate co-workers for signs of fatigue and visual signs of distress due to physical labor and possible chemical exposure. |

Table 4

Emergency Information

| Emergency Service or Contact | Telephone | Address and Directions |
|---|---|---|
| Hospital | (415) 428-3240 | Children's Hospital<br>747 52nd Street<br>Oakland CA<br><br>Between Shattuck Ave. and Martin Luther King Way<br><br>• Leave the site and turn left onto Telegraph Ave. and immediate right onto 52nd Street<br><br>• Follow 52nd St. west under Highway 24 overpass; cross Shattuck Ave., Children's Hospital on the left side<br><br>• Refer to Figure 1 |
| Ambulance | 911 | |
| Fire Department | 911 | |
| Police Department | 911 | |
| On-site Telephone | 415/653-8646 | |
| Streamborn Site Safety Officer | Noah Heller<br>415/528-4234 (work)<br>415/771-4435 (home)<br><br>or<br><br>Mark Buscheck<br>415/528-4234 (work)<br>415/994-3127 (home) | |
| Streamborn Project Manager | Doug Lovell<br>415/528-4234 (work)<br>415/527-4180 (home) | |
| Pacific Excavators | Joe Madison<br>415/370-8783 (work) | |
| Subcontractors | To be determined | |

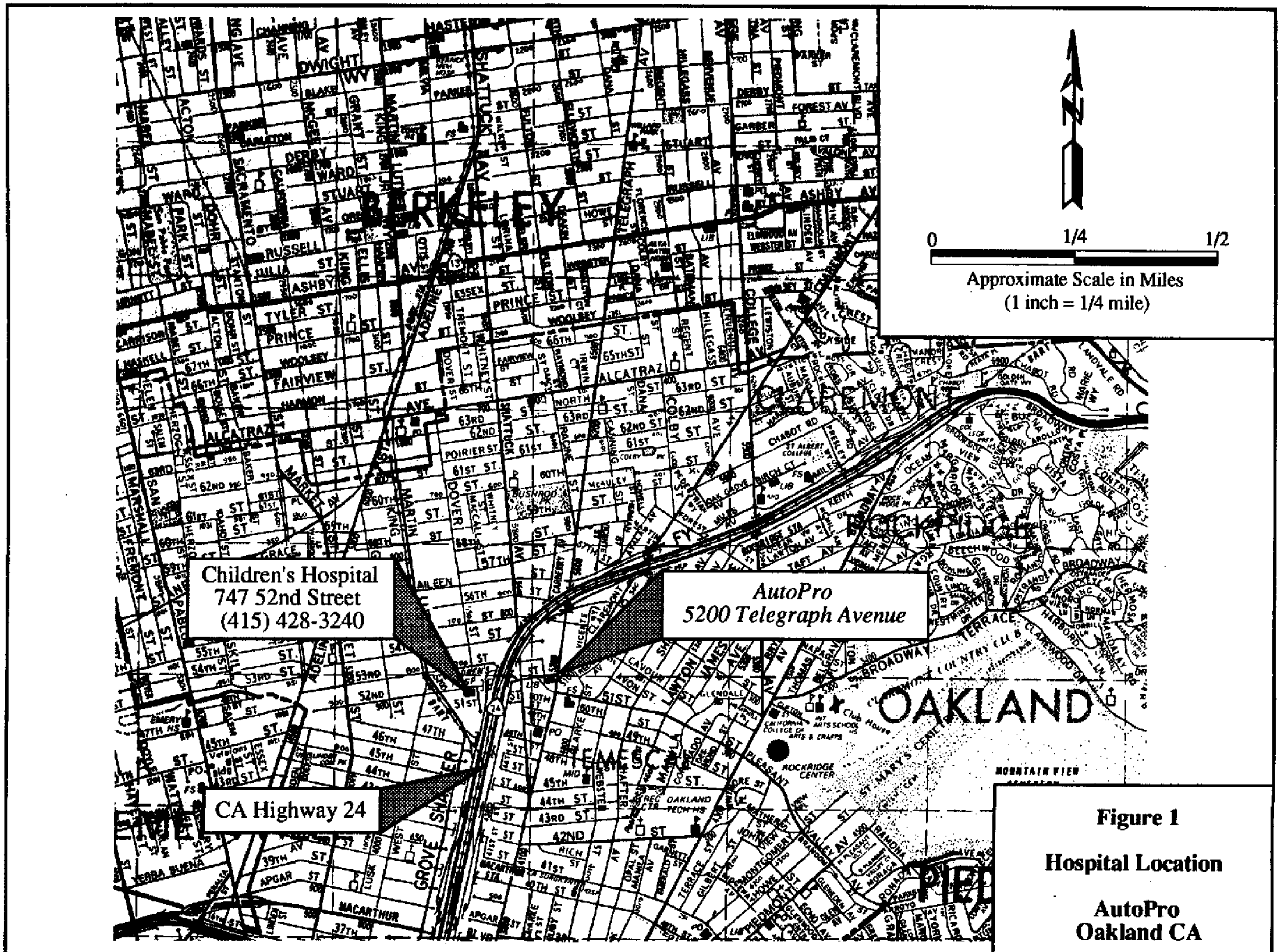


**Figure 1**

**Hospital Location**

**AutoPro**
**Oakland CA**

## Tailgate Safety Meeting

Client: ______________________ Date: ______________

Work Location: ______________________ Time: ______________

______________________ Conducted By: ______________

______________________

Work Description: ______________________________________________

______________________________________________

Potential Chemical Hazards: ______________________________________________

______________________________________________

Physical Hazards: ______________________________________________

______________________________________________

______________________________________________

Protective Clothing/Equipment: ______________________________________________

______________________________________________

Conditions for Upgrade of Protective Equipment: ______________________________

______________________________________________

Nearest Emergency Hospital: ______________________ Telephone: ______________

Route To Hospital: ______________________________________________

______________________________________________

______________________________________________

Attendees

| Printed Name | Signature |
| --- | --- |
| | |
| | |
| | |