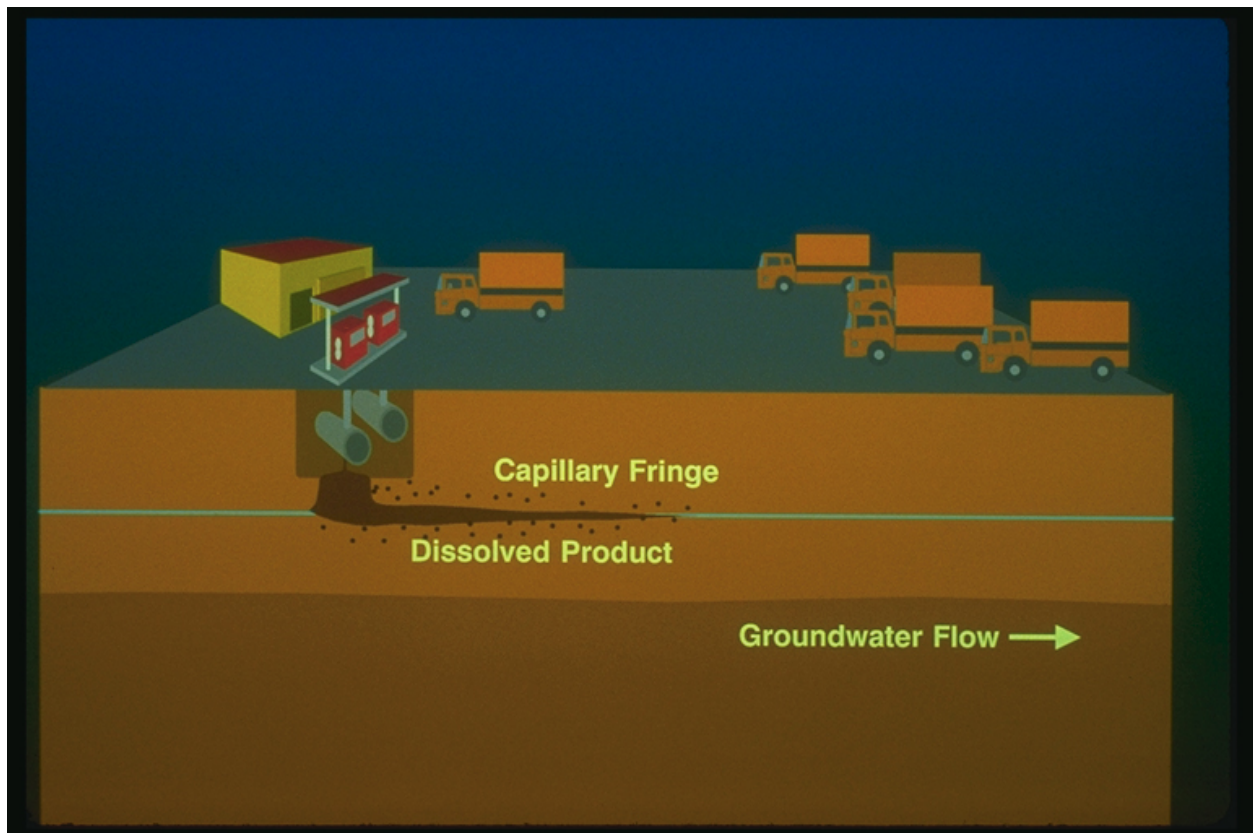


# SITE CHARACTERIZATION AND REMEDIATION



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# INTRODUCTION

This handbook has been prepared to assist Responsible Party(ies) comply with the regulations and laws that address contamination from releases of hazardous substances. The Kern County Environmental Health Services Department (KCEHSD), Hazardous Materials Management Program (HMMP) has prepared this document in an effort to describe methods to assess the real or potential damage that contamination presents to the environment, public health, and safety. By better understanding these principles, the responsible parties may cost-effectively reduce their risk and liability.

This document consists of the following parts:

**Definition of Terms and Glossary** -- an explanation of terms commonly used in environmental assessments/remediation.

**Contractor Selection** -- provides guidelines for the underground storage tank owner and/or operator, land owner or other responsible party to choose the appropriate type of contractor for each specific task, such as preliminary assessment, site characterization, or complex groundwater investigation. Each task requires specific expertise before work will be approved by state and local agencies.

**Notification & Report Submittals** -- describes the notification process and schedule for submittal of all required reports.

**Site Characterization Workplan/Reports** -- provides in an outline the information that needs to be included for determination of the extent of contamination.

**Remedial Action Workplan/Report** -- provides in an outline the information that needs to be included to evaluate the most appropriate corrective action to be taken, its implementation and operation, and verification of site remediation. An explanation of currently available remedial technologies is also included.

**Risk Assessment** -- provides in an outline the information that needs to be presented in order to evaluate the possibility of leaving significant contamination in place or to justify a proposed cleanup level.

**Permit Requirements** -- describes the permits that are required by the HMMP during an investigation. Other permits that various agencies may require are also listed.

**Appendix** -- provides sample drawings to illustrate the information required to perform a proper subsurface investigation as well as some common questions asked and their answers. Guidelines on field sampling and laboratory analysis as well as quality control/quality assurance (QA/QC) guidelines are also provided.

## DEFINITION OF TERMS & GLOSSARY

**Aquifer:** An underground formation composed of materials such as sand, or gravel that can store and produce water to wells or springs in a usable quantity.

**Aeration:** A remediation method that may be acceptable to treat gasoline contaminated soil. The requirements for this method are detailed in the Kern County Environmental Health Services Department's Policy on Aeration and Rule 4651 of the San Joaquin Valley Unified Air Pollution Control District (SJVUAPCD).

**Air Sparging:** A groundwater remediation method that involves the introduction of air into the saturated zone under controlled conditions to enhance volatilization and aerobic degradation of volatile organic contaminants.

**Bioremediation:** A remediation method that involves the process of biodegradation to remove or reduce the toxic characteristics or components of chemicals from soil and groundwater with the controlled use of scientific and engineering principles.

**BTX & E:** Benzene, Toluene, Xylene, and Ethylbenzene; chemicals commonly found in gasoline that are used as indicators of gasoline contamination in soil or water.

**C-57 Contractors License:** License issued by the State Contractor's Board which authorizes a person to drill, construct, and destroy water wells, monitoring wells or cathodic protection wells.

**Chain of Custody:** Method of tracking the possession of a sample from the time it is retrieved in the field until it is analyzed in a lab; it assures the accountability and integrity of the sample.

**Contaminant Plume:** A three-dimensional underground zone containing contaminants in various concentrations.

**Contamination:** The presence of hazardous substances in an amount that is greater than that which occurs naturally in soil, air, or water and may degrade the environment or have a possible adverse impact on human health.

**Environmental Contractor:** A person who meets the qualifications identified in the Environmental Contractor section of this handbook (page 5).

**Environmentally Sensitive:** An area within the county meeting any of the following criteria: 1) highest historic groundwater is within 50-100 feet of ground surface, or 2) nearest surface water in unlined conveyance is within 75 feet of tank(s), or 3) nearest agricultural or domestic well within 75 feet of tank(s), or 4) facility is located in a designated aquifer recharge area, or 5) Permitting Authority determines possible adverse environmental impact due to facility proximity to unique wildlife habitat areas.

**Extremely Environmentally Sensitive:** Area where the highest historic groundwater is within 50 feet of ground surface.

**Groundwater:** Underground water that fills pores between particles of soil, sand and gravel or openings in rocks, to the point of saturation. Where groundwater occurs in significant quantity, it can be used as a source of water supply.

**Groundwater Gradient:** The slope of the water table, generally coinciding with the direction of groundwater flow.

**Hazardous Substances:** Liquid, solid and gaseous substances that can adversely affect human health or the environment and are defined in either Federal, State or local regulations.

**Hydrogeology:** The branch of geology that deals with occurrence, distribution and movement of surface and groundwater.

**Monitoring Wells:** Special wells drilled at specific locations on a site for sampling of groundwater or vapors at selected depths and determining information such as direction of groundwater flow, types and concentration of contaminants, etc. The construction or destruction of a monitoring well is prohibited without first obtaining a Permit from the KCEHSD Hazardous Materials Management Program. Other monitoring well requirements are found in KCEHSD Handbook UT-50.

**Non-Environmentally Sensitive:** Area where the highest historic groundwater is greater than 100 feet of the ground surface.

**Perched Groundwater:** Water that is collected above a layer of impermeable material and is isolated from the underlying main groundwater body.

**Preliminary Assessment (Tank Removal):** The initial site investigation involving retrieval of soil samples to determine whether contaminants are present and further studies are needed in accordance with a "Site Characterization Workplan." Minimum specifications for preliminary assessments are provided in KCEHSD Handbook UT-30.

**Quality Assurance/Quality Control (QA/QC):** Assures that samples and test results are of optimum quality by following standards for laboratory handling and analyzing as specified in US EPA publication entitled "Test Methods for Evaluating Solid Waste" commonly known as SW-846.

**Remedial Action Options:** Options for corrective action which assure that public health and the environment are protected from the effects of contamination.

**Remedial Action Plan:** A plan for implementing the selected corrective action which is required to minimize, mitigate, or clean-up the effects of contamination.

**Risk Assessment:** An evaluation of the potential for the contaminant to adversely impact public health and the environment.

**Sampling:** The process of obtaining a representative segment of soil, air, or water to be analyzed for contaminants; must be performed in accordance with SW-846.

**SW-846:** EPA publication entitled "Test Methods for Evaluating Solid Waste" that was designed as a source of information to achieve uniform sampling and analysis of wastes. It includes a description of sampling container selection, chain of custody requirements, quality assurance/quality control, and methods for obtaining representative samples, etc.

**Site Characterization:** A study or investigation of a site to fully assess the lateral and vertical extent of contamination and threat to groundwater resources, the environment, and public health and safety.

**Test Hole:** A hole excavated or drilled in the ground for gathering data such as groundwater depth and quality, soil type and properties.

**TPH:** Total Petroleum Hydrocarbon

**UT-30:** Handbook developed by the Kern County Environmental Health Services Department, Hazardous Materials Management Program specifying requirements for permanent closure of underground hazardous substance storage tanks.

**UT-50:** Handbook developed by the Kern County Environmental Health Services Department, Hazardous Materials Management Program specifying requirements for construction and destruction of all monitoring wells.

**Unified Soil Classification System:** A system for classifying soils in accordance with ASTM standards.

**Vadose Zone:** The zone that overlies the water table; includes the soil zone, the intermediate zone and the capillary fringe.

**Vapor Extraction:** A remediation method engineered to remove volatile contaminants from the soil through the use of one or more vacuum wells. Contaminated vapors that are extracted are treated before they are released into the atmosphere.

**Well Log:** A systematic and sequential record of geologic data obtained from a well during drilling. A well log may be in narrative, tabular, graphic and symbolic form. It generally includes information on the thickness and lithologic composition of the rocks in the order in which they were penetrated, as well as the presence of water, unusual odor, or other subsurface peculiarity.

## **ENVIRONMENTAL CONTRACTOR SELECTION**

The work associated with the investigation of hazardous chemicals releases requires a professional level of expertise. Specifically, preliminary assessments must be performed by contractors knowledgeable in proper sampling procedures. More complex investigations, such as site characterizations, require the knowledge of contaminant transport mechanisms, and laws associated with hazardous waste management including regulations and ordinances. Other aspects associated with subsurface investigation such as the application of specific permit conditions, risk assessments, and implementation of different remedial action alternatives must be acquired.

### **FOR PRELIMINARY ASSESSMENTS (TANK REMOVAL)**

All contractors retrieving samples for preliminary assessment after removal of underground tanks must submit to KCEHSD for approval written sampling procedures which address the following:

1. Types of sample containers and their preservation.
2. Sample preservation methods.
3. Equipment used and method of sample retrieval.
4. Health and safety considerations.
5. Familiarity with sampling specifications provided in KCEHSD UT-30 and EPA SW 846.

### **FOR SITE CHARACTERIZATION AND REMEDIATION**

#### **1. In Soil Only:**

- a. Workplans and reports must be prepared by or under the supervision of an appropriately registered professional in the state of California with at least 3 years full time experience in performing environmental assessments associated with hazardous chemical releases into the environment.
- b. Boring logs must be prepared by or under the direct supervision of a California registered geologist (RG), certified engineering geologist (CEG), registered civil engineer (RCE) or registered geotechnical engineer (RGE). The report that contains the boring logs and/or other geologic interpretations must be signed by one of the above registered professionals.

## 2. Involving Groundwater:

- a. Workplans and reports must be signed by an appropriately registered professional in the state of California with at least 5 years full time experience in hydrogeology and in performing environmental assessments associated with hazardous chemical releases into the environment.
- b. Wells must be designed and installed by or under the direct supervision of a California RG, CEG, RCE or RGE. Report of the well logs and/or other geologic interpretations must be signed by one of these registered professionals.

## 3. Remediation System Design

The remediation treatment system for contaminated soil and/or groundwater must be designed by or under the direct supervision of an appropriately registered professional in the State of California with at least 3 years experience in the proposed remediation system. All calculations, specifications and/or assumptions must be verified by the registered professional.

## 4. Other Reports

**Risk Assessment:** Must be prepared by a professional, knowledgeable in contaminant transport mechanisms and risk assessment evaluations (qualitative/ quantitative) using federal, state and local guidelines.

**Health & Safety Plan:** Must be prepared by a professional familiar with health and safety requirements on hazardous materials/wastes and/or industrial operations.

## NOTES:

1. **The contractor must provide to KCEHSD a resume of the individual who will be preparing and/or signing workplans and reports. KCEHSD reserves the right to reject workplans or reports not meeting the minimum requirements.**
2. **KCEHSD recommends that multiple bids be obtained before selecting a contractor.**

## **NOTIFICATION AND REPORT SUBMITTALS**

After removal of underground storage tanks(s) and review of preliminary the analytical data, a determination is made whether further investigation is necessary, or closure is appropriate.

### **RESPONSIBLE PARTY NOTIFICATION**

A responsible party (RP) as defined in Title 23, CCR, Section 2720 is notified by mail of an unauthorized release from underground storage tank(s). The RP for sites that are classified as non-environmentally sensitive (NES) by this Department have 10 days to determine whether local agency oversight costs will be paid directly to the County (Local Option) or through the State/Federal Fund (State Option). If the local option is chosen, an initial deposit of \$1000 is required for oversight costs. Contracts for the local option may be renewed when the initial or subsequent deposits are exhausted.

Sites classified as environmentally sensitive (ES) or extremely environmentally sensitive (EES) are automatically enrolled by the Department into the State Option.

### **REPORTS REQUIRED & SCHEDULE FOR SUBMITTALS**

- 1. Site Characterization Workplan**
  - a. Workplan: Within 30 days from the date of notification by KCEHSD that a site characterization is required at the facility.
  - b. Field Investigation: Within 30 days after approval of workplan by KCEHSD.
- 2. Site Characterization Final Report:** Within 60 days of completion of field investigation.
- 3. Remedial Action Plan:** Within 60 days of KCEHSD approval of remediation method.
- 4. Progress Report:** Within 1 month after actual remediation is started and quarterly thereafter.
- 5. Remedial Action Report:** Within 30 days of completion of the remediation.

**NOTE: Failure to abide by the above time schedule may result in legal actions being initiated.**

## **GENERAL REQUIREMENTS FOR PLANS/REPORTS**

1. All workplans and reports must include the facility name, location, contact person (representing owner), address, telephone number, and facility permit number.
2. All workplans and reports must be signed, stamped and dated by the qualified personnel as described in the "Environmental Contractor Selection" section. Registered professionals must provide the expiration date of their registration.
3. All workplans and reports must be properly bound. Except for cover letters loose sheets are not acceptable.
4. For groundwater cases a copy of all workplans and reports must also be submitted to:

Central Valley Regional Water Quality Control Board  
3614 E. Ashlan Avenue  
Fresno, CA 93726  
ATTN:

OR

Lahontan Regional Water Quality Control Board  
15428 Civic Drive, Suite 100  
Victorville, CA 92392-2383  
ATTN:

# **SITE CHARACTERIZATION WORKPLANS/REPORTS**

## **SITE CHARACTERIZATION WORKPLAN**

### **A. SITE CHARACTERIZATION WORKPLAN INVOLVING SOIL ONLY**

A site characterization workplan must be approved by KCEHSD prior to beginning work. The Workplan **must** include the following information:

#### **1. Site Background**

- a. History of site and tank use.
- b. Historical information regarding discrepancies or reportable variations on inventory monitoring, results of tank tests, repairs to tanks or piping.
- c. Estimates of liquid quantity and composition leaked into the environment and how quantified.
- d. Information on local topography, geology, sumps, dry wells, nearby waterways, and groundwater depth and its current designated beneficial use including references.

#### **2. Area and Site Specific Maps/Plot Plans**

- a. Area map showing site location relative to nearby landmarks such as water courses, highways, urban or industrial areas, etc. (see sample illustrations).
- b. Scale drawing of the site showing nearby cross streets (include street names), buildings, septic tanks and leachfields, water wells, underground and overhead utility lines, canopies and any other obstacles which may present a hazard during drilling (see sample illustrations).
- c. A diagram of all removed and/or existing tanks and piping systems on the property. Each tank must be labeled with corresponding past and present contents and volumes.
- d. A north arrow pointing towards the top of the paper shall be included on all maps/plot plans.

### **3. Preliminary Site Assessment Results**

- a. Analytical results of the preliminary site assessment.
- b. Summary of all other environmental site work performed on sumps, dry wells or underground tank closures.

### **4. Soil Sampling Plan**

- a. Proposed sampling locations and depths including rationale for their selection. To define the vertical extent of contamination, the soil boring shall be advanced until field observations and instrumentation readings are "none detected" for a minimum of two consecutive (10 feet) soil samples.
- b. The number of samples to be sent to the lab for analysis must be adequate to obtain a representative profile of the contamination.
- c. Proposed methodology for completion and destruction of all borings.
- d. Plan for management of drilling spoils.
- e. Contaminants to be analyzed, the name of the laboratory that will perform the analyses, analytical methods, field investigation procedures, and Quality Assurance and Quality Control (QA/QC) plans.
- f. Equipment and procedures for sample retrieval.

### **5. Health and Safety Considerations**

- a. Hazard identification and abatement.
- b. Personnel training.
- c. Chemicals of concern including exposure limits.
- d. On site monitoring and required safety equipment.
- e. Emergency information.
- f. Personnel protective equipment.

## **B. SITE CHARACTERIZATION INVOLVING GROUNDWATER**

In addition to all of the requirements for a site characterization workplan involving soil only, the following information must also be submitted to KCEHSD for review and approval for sites where groundwater is threatened or affected:

### **1. Site Background**

- a. Proximity of private, municipal, domestic and irrigation wells on site or within 500 feet of the contamination.
- b. Tables summarizing preliminary soil and groundwater data.
- c. Information on ground water quality including the present designated beneficial use.

### **2. Sampling Plan**

- a. Site map showing location and depth of all proposed groundwater monitoring wells.
- b. Details of proposed monitoring well construction.
- c. Proposed groundwater sampling methodology to include purging, testing for stability, frequency of sampling, number of samples, and equipment for obtaining groundwater samples and floating product.
- d. Rationale for monitoring well locations, construction, and sampling frequency.
- e. Name of the laboratory that will perform the analyses, contaminants to be analyzed, analytical methods and QA/QC.

### **3. Determination of Aquifer Characteristics**

- a. Method of determining groundwater gradient and direction.
- b. Proposed method and rationale for determining other hydrogeologic characteristics such as hydraulic conductivity, transmissivity, storage capacity, and aquifer thickness.

## **SITE CHARACTERIZATION REPORT**

### **A. SITE CHARACTERIZATION REPORT INVOLVING SOIL ONLY**

If the site characterization study indicates that only soil is contaminated and no threat to groundwater exists, a site characterization report with a minimum of three remedial action options must be submitted to KCEHSD for review and approval. The report shall include but not be limited to the following:

**1. Brief discussion of the problem and findings from the preliminary site assessment or other studies.**

**2. Site Characterization findings shall include:**

- a. The vertical and lateral extent of the contamination plume accurately delineated on overview and cross section diagrams drawn to scale. Cross sections must include soil stratigraphy based on boreholes, trenches, monitoring wells, or any other supporting information (see sample illustrations).
- b. Results and interpretations of all data collected.
- c. Tables summarizing analytical data, and discussion of methodologies used to collect and analyze the samples.
- d. All borings shall be described using Uniform Soil Classification System and logged by a professional geologist, civil engineer or engineering geologist who is registered in the State of California and experienced in the Unified Soil Classification System. A technician trained and experienced in the use of the Unified Soil Classification system working under the direct supervision of one of the aforementioned professionals shall be deemed qualified to log borings provided the aforementioned professional reviews the logs and assumes responsibility for the accuracy and completeness of the logs. All reports, plans, or other analysis must be signed by the above aforementioned registered professionals.
- e. Estimated volume of substance released.

**3. Remedial Action Options (appropriate for the site) shall include:**

- a. Evaluation of at least three remediation alternatives including the "no action" alternative. The justification for "no action" must be supported by either passing the general risk appraisal contained in **Appendix B** or providing a more detailed risk assessment. In the event that the site fails the general risk appraisal contained in **Appendix B**, the permittee may submit a more detailed risk assessment as outlined in **pages 21 - 23** if "no action" is still desired as the final remediation activity.

- b. A brief description, feasibility study, and cost analysis of each alternative.
- c. Risks associated with the implementation of each alternative such as compromising the integrity of a building, exposing biological receptors, etc.
- d. The alternatives may be presented in a form that ranks these alternatives based on the above criteria. The contractor must recommend one option that is best suited for the site.
- e. Expected ranges of concentrations of contaminants that each remediation alternative is capable of treating.
- f. An evaluation of the need for any monitoring wells and analysis during or after remediation.

**NOTES:**

- 1. Hazardous Materials Management Program Staff are available for consultations during this selection period.**
- 2. Appendix B may be copied and used as worksheet for the general risk appraisal.**

**B. SITE CHARACTERIZATION REPORT INVOLVING GROUNDWATER.**

In addition to the items required for the site characterization report involving soils only, the groundwater site characterization must also include at a minimum the following for review and approval by this Department.

**1. Groundwater Investigation Results shall include:**

- a. Details of monitoring well installation such as number, depth, location and construction. Any changes or deviations from the workplan must be indicated.
- b. Well development data such as volume purged, conductivity, pH, and temperature readings of the water.
- c. Vertical and horizontal extent of groundwater contamination.
- d. Depth and extent of floating product.
- e. Contaminated aquifer gradient and regional gradient based upon the most recent data on depth to groundwater.

- f. Extent of vapor plume.
- g. Interpretation of groundwater analysis results and analytical data summarized in a table.
- h. Estimates of liquid leaked and how it was determined.
- i. All other aquifer data used to evaluate groundwater remedial actions.
- j. The results obtained from the site characterization must be presented in figures and tables when appropriate.

**2. Remedial Action Alternatives shall include:**

- a. Evaluation of feasible remediation options. These options may also be presented in a matrix highlighting the cost, time frames for completion, advantages and disadvantages specific to the site.
- b. Field laboratory or pilot studies on the remediation process.
- c. Past experience with the selected remediation method on sites with similar conditions if available.

## **REMEDIAL ACTION WORKPLANS/REPORTS**

### **REMEDIAL ACTION PLAN**

A remedial action plan shall be proposed based upon the site characterization results. In addition, there may be added requirements or reviews for a specific project by other agencies such as:

1. Regional Water Quality Control Board, if the contamination threatens or affects groundwater.
2. California Environmental Protection Agency, Department of Toxic Substances Control, if treatment, storage, disposal or transportation of a hazardous waste is required.
3. Kern County Air Pollution Control District or San Joaquin Valley Unified Air Pollution Control District if the plan involves any chemical emissions into the atmosphere.

#### **The remedial action plan shall include the following:**

1. Results of field and/or laboratory studies or proposed pilot study.
2. A detailed description of the approved remediation method including schematics and calculations for the entire remediation system.
3. Remedial activity details such as number, placement and construction design of recovery wells, pumping rate, soil to be excavated, layout of vent wells, biodegradation rates, etc...
4. Expected concentrations of contaminants after remediation.
5. Sampling and analysis plan to monitor performance of the remediation system and to verify remediation effectiveness.
6. Disposition of treated soil and/or water.
7. Health and Safety plan during remediation activities.
8. Discussion of implementation schedule including phases if appropriate.
9. The primary contractor and any subcontractors who will be involved in the remediation.

## **PROGRESS REPORT**

A Progress Report must be submitted for remediation projects continuing over three months. The report shall include the following:

1. Changes or deviations from the approved remedial action plan and justification for any changes.
2. Data gathered during remediation activities.
3. Estimated time and concentrations remaining to be remediated, and basis for the estimations.
4. Problems encountered and corrective measures taken.

## **REMEDIAL ACTION REPORT**

The remedial action report is prepared when it has been determined that the site has been remediated. This report shall include the following:

1. Brief summary of the project.
2. All data collected to verify that the site has been remediated.
3. A discussion and interpretation of the verification data, and the rationale for determining that the site has been remediated.

## **REMEDIAL ACTION ALTERNATIVES**

The following is a list of currently available technologies that are used in remediating petroleum contaminated soil and groundwater. By providing the recommended information described below, KCEHSD's review time frame will be minimized and enhance the transfer of information.

### **A. NO ACTION**

The "NO ACTION" may be proposed if the contamination found at the site is not significant. At sites where the levels are significant, the feasibility of leaving the contamination in place may be evaluated by first performing a general risk appraisal as shown in Appendix B of this handbook, then a detailed risk assessment, if necessary. The risk assessment shall address at a minimum, the potential migration routes, and the short and long term effects to public health and the environment.

## **B. CONTAINMENT**

The containment of contamination in place will be approved after being determined through a risk assessment that migration of existing contamination will not be significant.

The site shall be graded and a base of Class II aggregate with a cap of asphalt concrete shall be applied. The cap shall extend well beyond the area of contamination, and sloped to prevent pooling of water or liquids on the surface. The cap shall also be adequately sealed after application and the integrity maintained. All potholes or cracks must be repaired immediately.

A qualified paving contractor must grade and apply the cap. It is recommended that a 4-inch asphalt concrete and an 8-inch aggregate base for heavy duty truck use be applied.

## **C. EXCAVATION**

Excavation may be approved if demonstrated that removal of impacted soil is the most appropriate method to remediate the contamination based on economic and risk analysis results. The proposal must include the following information but not be limited to:

1. Excavation procedures including equipment to be used.
2. Area to be excavated and quantity of soil to be excavated.
3. Confirmatory sampling and analysis procedures.
4. Disposition of excavated soil such as:

Off-site Disposal/Treatment: Provide name and address of the disposal site or treatment company, type of treatment, name and address of the transporter and record of shipment (manifests).

Aeration: Refer to KCEHSD's Aeration Policy of Petroleum Contaminated Soil and Rule 4651 of the SJVUAPCD.

Enhanced Bioremediation (Landfarming Method): Provide location where soil will be landfarmed and the details of the bioremediation system (refer to page 18 for bioremediation reporting requirements).

#### **D. VAPOR EXTRACTION**

Vapor extraction may be approved if it can be demonstrated that subsurface soil conditions and contaminant properties are conducive to the method. The information that must be provided in the proposal shall include, but not be limited to:

1. Pilot study results or proposal to determine pertinent parameters such as radius of influence, hydraulic conductivity, pressure at well heads, etc.
2. Number of wells, their location, and construction design.
3. Detailed description and specifications of extraction and vapor treatment system.
4. Estimated time of cleanup and method of determination.
5. Method and frequency of monitoring the performance of the entire system.

#### **E. ENHANCED BIOREMEDIATION**

Enhanced bioremediation through landfarming or above ground application may be approved if it is determined by risk and cost analysis that this alternative is the most appropriate remediation technique for the site. The information that must be provided shall include, but not be limited to:

1. Site specific feasibility study results that demonstrate the applicability and efficiency of this method by either using indigenous or commercially available biocultures.
2. Information on commercial biocultures such as chemical additives, case histories, and manufacturer's brochures.
3. Details of the bioremediation system operation to include construction design, method of introducing biocultures or nutrients, method of aeration, mixing/tilling, and frequency of these activities.
4. Monitoring and verification sampling and analysis procedures.

**NOTE: In situ bioremediation will be considered only at sites where extensive data on the hydrogeology, physical, chemical properties of the contaminants, and any additives (nutrients, etc) that will be introduced have been determined. This method is not encouraged for mitigation of groundwater contamination applications because of several factors such as uncontrolled migration of contaminants, possible chemical transformations and hydrogeologic complexities which may result in further deterioration of groundwater quality.**

## **F. PUMP & TREAT**

Pump & treat involves the pumping of contaminated water to the surface for treatment. The treated water may be discharged back to the aquifer or to the sewer after obtaining the appropriate discharge permits. When designing the groundwater pumping and discharge system, the extent of contamination, the hydrogeological, and chemical and biological characteristics of the area must be adequately assessed. The information that must be provided in the proposal shall include, but not be limited to:

1. Site specific data such as hydraulic conductivity, transmissivity, specific yield, porosity, aquifer thickness, and expected pumping rates. A pump test must be performed to determine relevant aquifer characteristics.
2. Details of the groundwater extraction system need to include pump specifications and performance data.
3. Details of the groundwater treatment method that will be used e.g., air stripping, bioremediation (reactors), carbon adsorption, etc.
4. Radius of influence, flow line arrival times, drawdown in extraction well, number of pore volumes to be flushed, and estimated cleanup time. Mathematical calculations performed manually or by computer models must be provided.
5. Disposition of the treated water.
6. Sampling plan to monitor compliance with discharge requirements and to evaluate the performance of the remediation system.

## **G. AIR SPARGING**

In situ air sparging is a technique for remediating sites where groundwater is contaminated with volatile organic compounds. Air is injected into the saturated zone to enhance volatilization and aerobic biodegradation of the contaminants. It is usually used in conjunction with soil vapor extraction to capture the vapors and prevent off site migration.

When designing the in situ air sparging system, the extent of contamination, hydrogeologic, chemical and biological characteristics of the area must be adequately assessed. The following information that must be included in the proposal shall include, but not limited to:

1. Details of the air sparging system to include the number of wells, pump specifications, and air source.
2. Well locations, construction design, and casing materials.
3. Air flow rates including an estimation of the radius of influence.

4. Monitoring plan including an estimated cleanup time.
5. Remediation plan for the vadose zone that will be implemented in conjunction with air sparging such as soil vapor extraction or excavation.

Prior to initiating air sparging, groundwater needs to be tested for pH, total dissolved solids, and dissolved constituents such as iron, manganese, calcium, magnesium, and oxygen.

## **RISK ASSESSMENT GUIDELINES FOR CONTAMINATED SITES**

This section was developed to help responsible parties (**RP**) and consultants comply with the Kern County Environmental Health Services Department's (**KCEHSD**) requirements for risk assessment (**RA**) at contaminated sites. It is intended to provide guidance in preparation of an acceptable risk assessment for determination of risks to human health (carcinogenic and non-carcinogenic risks) and the environment.

In order to provide a uniform format for the KCEHSD's review of the environmental fate, transport and risks, the following information must be provided in a risk assessment.

### **GENERAL REQUIREMENTS**

1. The name and location of the site, the name, address and phone number of the company or individual preparing the RA must be included in the document.
2. The RA must be dated and bound.
3. The reason for performing a risk assessment.
4. The site characterization must be completed before preparing a RA.
5. If certain site specific parameters such as permeability, organic and moisture content, etc have not been determined, worst case or conservative values may be assumed. References and rationale for all assumptions must be provided.
6. All assumptions, sample calculations and final computer printouts must be submitted. Computer printouts must be limited to the input and output data for the initial and final year or "time interval". Computer printouts must be bound.

### **IDENTIFICATION AND EVALUATION OF RISK**

#### **1. Site Assessment Results**

- a. Analytical results tabulated and illustrated in plan and cross-sectional views.
- b. Contaminants of concern.
- c. Average and highest concentration of contaminants.
- d. Soil and/or groundwater properties determined during assessment that are necessary for the environmental fate, transport and risk calculations such as hydraulic conductivity, porosity, organic and moisture content, etc.

## **2. Contamination Migration Routes and Receptors**

- a. Identification and description of receptors, areas and environmental media (groundwater, atmosphere, surface water) that may be impacted.
- b. Description of potential migration routes or mechanisms including natural and man-made factors that may influence contaminant transport.
- c. Potential interaction of contaminants.
- d. Identification of exposure pathways (inhalation, ingestion, etc.) if a receptor may be involved.

## **3. Estimation of Risks**

- a. Estimation of transport time of contaminants to a receptor and/or to the environment as determined by computer modeling or manual calculations.
- b. Concentration of contaminants that may potentially reach a receptor and/or the environment.
- c. Estimation or quantification of risk or exposure levels (noncancer and carcinogenic risk).
- d. Regulatory standards or guidelines on acceptable exposure levels, potency/slope factors (include references).
- e. Evaluation of the quantified risks (comparison between acceptable levels and calculated levels).

## **4. Assumptions and Calculations**

- a. Description of the transport mechanism (diffusion, advection, etc.) and discussion of its applicability. Formulas used in manual or computer calculations must be included.
- b. Chemical properties of contaminants such as Henry's Law constant, diffusivity coefficients, molecular weight, vapor pressures, and water solubility.
- c. Atmospheric conditions such as temperature, and wind velocity.
- d. Soil parameters such as porosity, organic, and moisture content.
- e. Groundwater parameters such as hydraulic conductivity, permeability, depth, and gradient.

- f. All parameters and scenarios that are utilized in the modeling or manual calculations must be summarized in drawings, figures or tables as appropriate. Rationale for all assumptions must also be presented.
- g. For proprietary solutions or codes, sufficient information must be provided in order that the results may be reproduced using similar solutions. Uncommon abbreviations used in the computer program must be defined.

## **5. Conclusion and Recommendation**

- a. Discussion of the risk assessment results.
- b. Discussion of the strengths and limitations of the risk assessment.
- c. Conclusions and recommendations.

**NOTE: Performing a risk assessment does not assure the approval of the "NO ACTION" alternative or any proposed cleanup level. KCEHSD recommends that all applicable factors such as cost of each alternative be considered before selecting a remedial method.**

## **PERMIT REQUIREMENTS**

### **PERMITS REQUIRED BY THE HAZARDOUS MATERIALS MANAGEMENT PROGRAM**

A permit is required for:

1. groundwater monitoring wells
2. borings (test holes) that are drilled to groundwater

The number of wells and/or test holes, locations, and construction design associated with site assessment and remediation must be approved by HMMP-Enforcement prior to submitting the permit application. Permit applications can be obtained from KCEHSD and must be submitted at least 10 working days before the scheduled drilling date.

### **PERMITS REQUIRED BY OTHER AGENCIES**

Other agencies that may require permits or authorizations (especially in the remediation phase) include, but are not limited to:

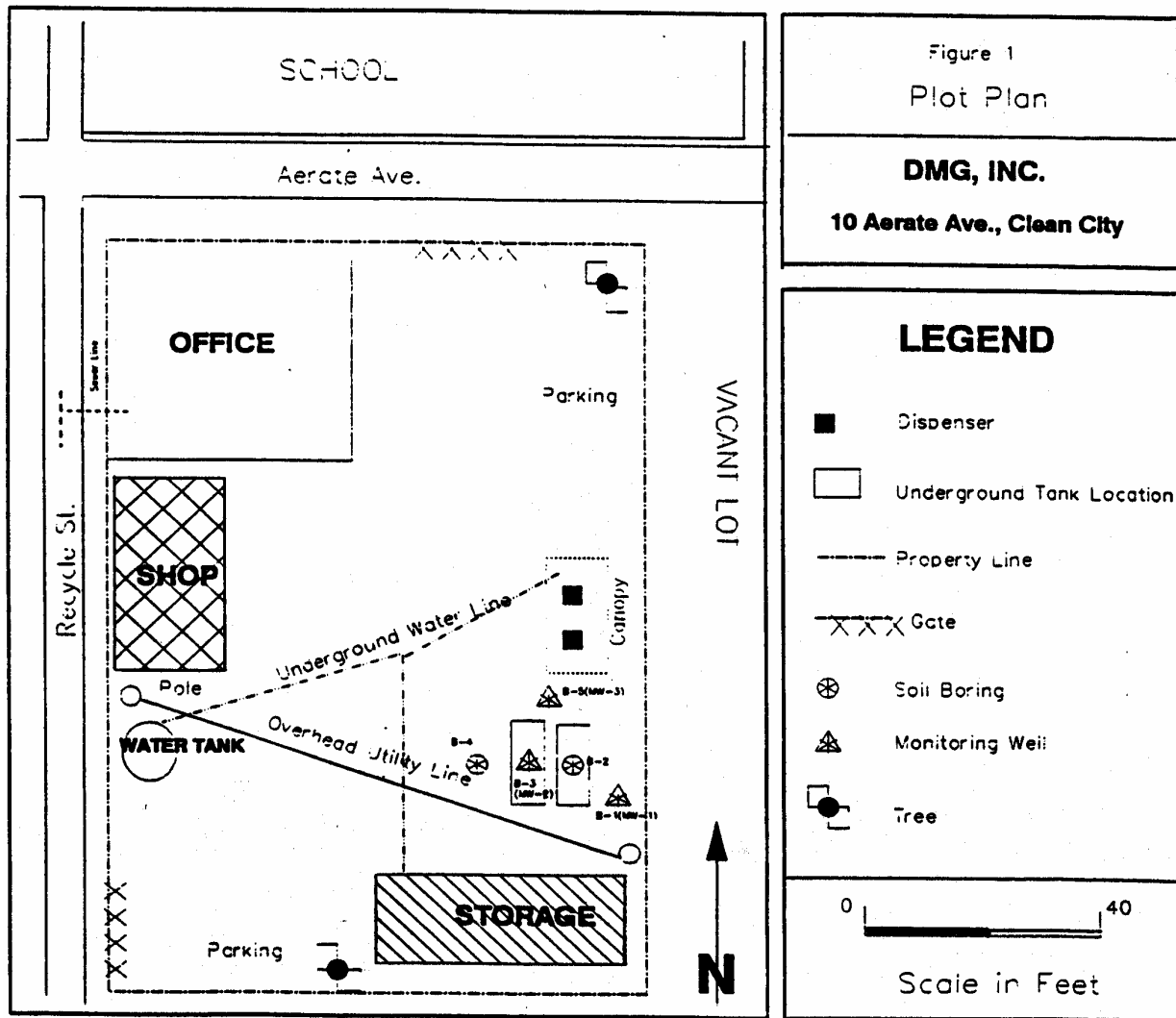
1. Cal-EPA Dept. of Toxic Substances Control for treatment of a hazardous waste.
2. Regional Water Quality Control Board for discharge of water or waste.
3. Air Pollution Control District for releases of chemicals into the atmosphere.
4. Public Works or Planning for grading permits, right-of-way, etc.

It is the responsibility of the responsible party and/or his contractor to obtain all necessary permits prior to beginning work.

## APPENDIX A - SAMPLE DRAWINGS

### SITE PLOT PLAN

The site plot plan must be drawn to scale and include all items listed in the **Site Characterization Workplan** requirements on **page 9**. Below is an example of a plot plan drawing.



## "PLAN" AND "VERTICAL CROSS-SECTION" VIEWS OF THE CONTAMINATION PLUME

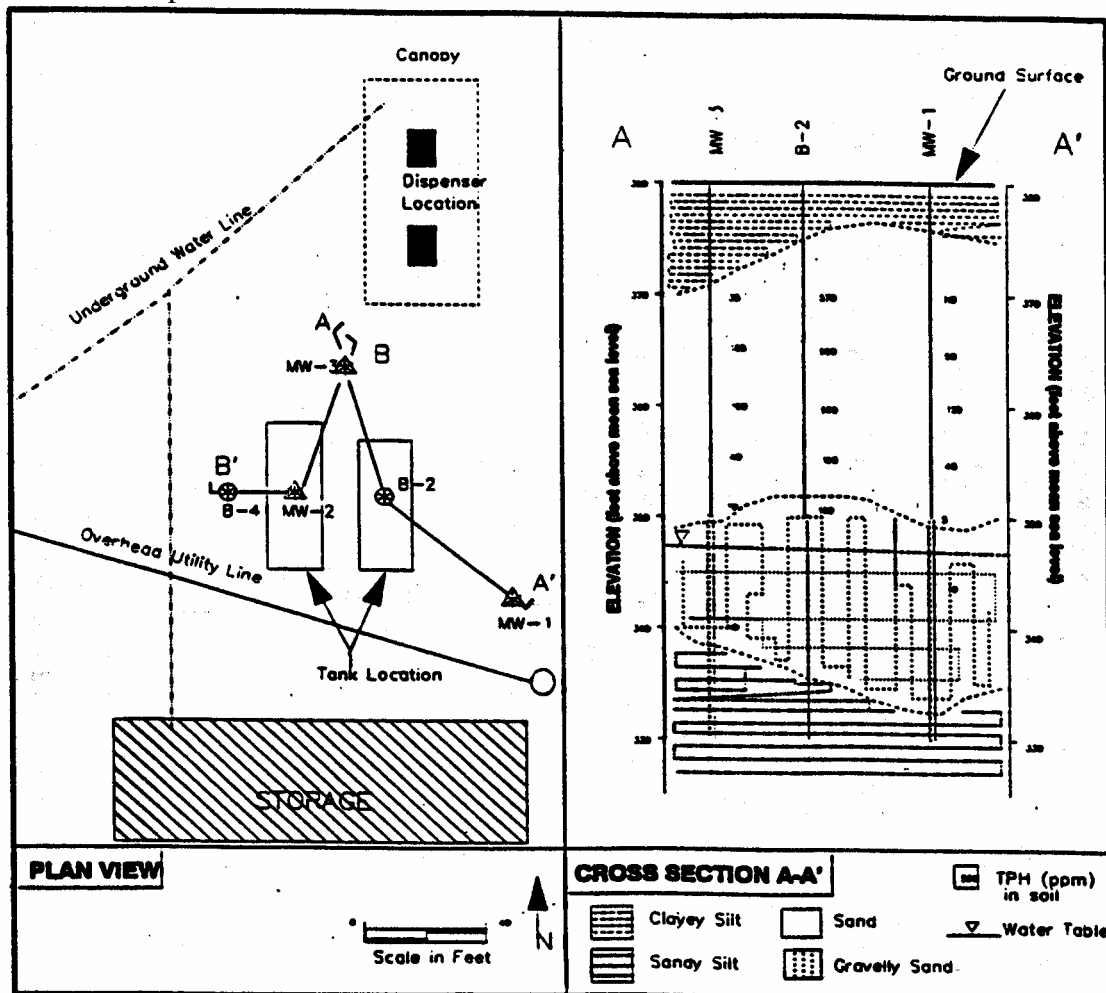
A "plan view" of the contamination plume is an overhead view of the lateral extent of the contamination plume.

A "vertical cross-sectional" view of the contamination plume is the cutaway view of the vertical and lateral extent of the contamination plume through the soil.

Both views must include all of the following:

- ❖ scale, north arrow, legend
- ❖ tank, piping, and dispenser location, buildings and structures
- ❖ lateral and vertical (on x-sectional view) extent of plume
- ❖ sample locations and contaminant concentrations shown
- ❖ significant soil changes with depth, groundwater depth

Below are simplified, basic examples of "plan" and "vertical cross-sectional" views of a contaminant plume.



## APPENDIX B - GENERAL RISK APPRAISAL

### A. VAPOR MIGRATION TO THE SURFACE

Table 1 VAPOR MIGRATION TO THE SURFACE		
	YES	NO
1. Is part or the entire contamination plume beneath or within 25 feet to a building?		
2. Is the contamination plume within 25 feet to ground surface?		
3. Is the contamination plume near potential subsurface confined spaces such as basements, sewers etc.?		
4. Are there subsurface conduits that will increase vapor migration to the surface?		
5. If "YES" to any of the above, are the concentrations (in soil) of: TPH(g) = or > 100 ppm TPH(d) = or > 1000 ppm BENZENE = or > 3 ppm TOLUENE, XYLENES or ETHYLBENZENE = or > 20 ppm	_____ _____ _____ _____	_____ _____ _____ _____
<p>If "NO" to all of #5, proceed to Table 2 (Leaching Potential Analysis).</p> <p>If "YES" to any of #5, the risks associated with possible vapor migration to the surface must be addressed. Both noncancer and cancer risks must be evaluated. If BENZENE was not detected, the excess cancer risk is not needed.</p> <p>Regardless of whether #5 is "YES" or "NO", Table 2 (Leaching Potential Analysis) has to be completed.</p>		

B. LEACHING POTENTIAL ANALYSIS (Table 2-1 from LUFT manual)

Site Feature	S C O R E	Score 10 points if condition is met	S C O R E	Score 9 points if condition is met	S C O R E	Score 5 points if condition is met
Minimum depth to groundwater from the soil sample (in feet)		> 100		51-100		25-50 <sup>1</sup>
Fractures in the subsurface (applies to foothills or mountain areas)		None		Unknown		Present
Average annual precipitation (in inches)		<10		10-25		26-40 <sup>2</sup>
Man-made conduits which increase vertical migration of leachate		None		Unknown		Present
Unique site features: recharge area, coarse soil, nearby wells, etc.		None		Unknown		Present
Column total points		+		+		=
Range of total points		49 points or more		41-48 points		40 points or less
Maximum allowable B/T/X/E levels (ppm)		1/50/50/50		.3/.3/1/1		NA <sup>3</sup>
Maximum allowable TPH levels (ppm)	Gasoline	1,000		100		10
	Diesel	10,000		1,000		100

1. If depth is greater than 5 feet and less than 25 feet, score 0 points. If the depth is 5 feet or less, this table should not be used.
2. If precipitation is over 40 inches, score 0 points.
3. Levels for BTX & E are not applicable at a TPH concentration of 10 ppm (gasoline) or 100 ppm (diesel) (For explanation see step 6, page 27.)

Source: October 1089 Version of Leaking Underground Fuel Tank Field Manual

If the BTXE & TPH levels are exceeded, the potential threat to groundwater may be further evaluated by performing a risk assessment.

NOTE: Guidelines on a detailed risk assessment are outlined in pages 21-23.

## **APPENDIX C - SAMPLING AND ANALYSIS GUIDELINES**

In addition to sampling and analysis protocols describe in the EPA SW-846 and other approved publications, the following describes acceptable procedures for the type of investigation described in this booklet:

### **SOIL SAMPLING**

#### **A. CORE SAMPLES:**

1. Collect undisturbed soil samples by using a split-barrel core sampler (California split spoon sampler) with stainless steel or brass tubes/cylinders.
2. There must be no headspace in the tubes. Cover with an acceptable material such as Teflon, then cap with the plastic lid.
3. The samples must be labeled and placed into a cooler immediately for delivery to the laboratory. A temperature of 4° C. (37° F.) must be maintained in the cooler at all times until delivery to the lab.
4. Follow the proper chain-of-custody procedures.
5. All sampling equipment must be properly decontaminated between samples.
6. Precautions should be taken to prevent cross contamination of equipment by site personnel.

#### **B. SAMPLING SOIL PILES/EXCAVATION:**

1. The collection of samples by inserting the sampling tube or glass jar into the soil pile should be performed to minimize the disturbance of the soil. Hand augers that can be fitted with sampling tubes may also be used.
2. There must be no headspace in the sampling containers.
3. Follow items #3 to 6 as described above in the core sampling.
4. The number of confirmatory samples to be retrieved from an excavation is determined based on site specific conditions. For soil stockpiles, one composite sample per 50 cubic yards is recommended.

## **GROUNDWATER SAMPLING**

1. Wells must be developed/purged prior to sampling. The purging process must ensure that all stagnant water is replaced by fresh formation water.

**For low yield wells (yield less than 3 casing volumes):** After evacuation of water to dryness, retrieval of a water sample should be based on the recovery rate.

**For high yield wells (yield over 3 casing volumes):** Evacuate at least 3 casing volumes of water prior to sampling. The water stability must also be determined by measuring the pH, conductivity and temperature.

**For domestic wells:** Site specific sampling requirements will be determined when required.

2. Groundwater samples must be retrieved within 24 hours after development.
3. The use of dedicated sampler for each well is preferred.
4. Acceptable protocols for field sampling such as labeling, preservation, and chain-of-custody procedures must be followed.

## LABORATORY ANALYSIS

The following table summarizes the methods of analysis that may be used as a reference in the investigation.

**Table 3**

**Table of U.S. EPA Test Methods for Petroleum Hydrocarbons**

SW-846 Method	Water/ Waste Water Method	Analytes	Primary Equipment	Sample Preparation <sup>1</sup>
4030 <sup>2</sup>		TPHs	Immunoassay	Included in kit
4035 <sup>2</sup>		PAHs	Immunoassay	Included in kit
8015 <sup>3</sup>		Aliphatic and Aromatic Hydrocarbons; Nonhalogenated VOCs	GC/FID	Extraction (SVOCs) <sup>4</sup> ; Purgeand-Trap and Headspace (VOCs) <sup>4</sup> ; Azeotropic Distillation (Nonhalogenated VOCs) <sup>3, 4</sup>
8021 <sup>3, 5</sup>	502.2/602	Aromatic VOCs	GC/PID	Purge-and-Trap <sup>4</sup>
8100		PAHs	GC/FID	Extraction <sup>4</sup>
8260 <sup>6</sup>	524.2/624	VOCs	GC/MS	Purge-and-Trap, Headspace, Azeotropic Distillation <sup>4</sup>
8270	525/625	SVOCs	GC/MS	Extraction <sup>4</sup>
8310	610	PAHs	High Performance Liquid Chromatography	Extraction <sup>4</sup>
8440 <sup>7</sup>	418.1 <sup>8</sup>	TPH	IR Spectrophotometer	Supercritical Fluid Extraction from soils <sup>4</sup>

<sup>1</sup> These are the standard methods of preparation for the corresponding method. They may vary depending on specific analytical needs.

<sup>2</sup> Screening method for soils

<sup>3</sup> MTBE can be analyzed with U.S. EPA SW-846 Method 8015 or 8021, however, 8021 has lower detection limits, is subject to less

interference in highly contaminated samples, and tends to be more economical by providing BTEX data in the same analysis. Concerns

about coelution with some alkanes requires at least one confirmatory analysis with SW-846 Method 8260 per site.

<sup>4</sup> See Chap. 4 of SW-846 for specific appropriate methods.

<sup>5</sup> 8021 replaces 8010 and 8020.

<sup>6</sup> The old method, 8240, is replaced by 8260.

<sup>7</sup> This method is similar to 418.1, however, perchlorethane (PCE) is used as an IR solvent instead of Freon-113.

<sup>8</sup> 418.1 is used extensively although it is not on the list of promulgated methods.

## QUALITY ASSURANCE/QUALITY CONTROL (QA/QC)

All sampling activities must have a quality assurance program to verify data credibility. This program must be for field and laboratory work.

### **FIELD QA/QC**

For QA/QC purposes, blank samples are prepared and analyzed to check for cross-contamination during sample collection, shipment, and in the laboratory. Blank samples are usually prepared for liquid samples and recommended for soil samples if cross-contamination is suspected. The following types of blanks may be used depending on the situation:

1. **Equipment Blank:** This sample is used to assess the caliber of field contamination procedures.
2. **Field Blank:** This sample is prepared when there is no need to decontaminate sampling equipment or use a sample collection vessel. This sample provides information on possible contamination of chemical preservatives, or contamination introduced during shipment or in the laboratory.
3. **Trip Blank:** This sample is used to detect any contamination that may have occurred during sampling and/or transportation. This sample is prepared only when no other type of blanks are available.

The following samples are also utilized for field quality control:

1. **Replicate Sample:** This sample determines the consistency of sampling procedures and analytical methods. One (1) replicate sample is usually obtained out of every ten (10) sampling points. At sites where there are fewer than ten (10) sampling points, at least one (1) replicate sample must be taken. The laboratory must not know the identity of the replicate sample.
2. **Split Sample:** This sample is obtained by dividing a sample and placing them into two containers for analysis by separate laboratories.
3. **Background Sample:** If necessary, a background sample is collected in an area not affected by site activities to establish background concentration levels. This sample is retrieved, sealed, labeled, packaged, and transported to the laboratory in the same manner as all the field samples.

A record of all sample identification numbers and chain of custody shall be maintained in the field notebook/log. All significant events, site conditions, and revisions during the field investigation shall also be recorded. All field procedures must be conducted by properly trained individuals.

## **LABORATORY QA/QC**

All analyses must be performed by state certified laboratories. The laboratory quality control program shall include, but not limited to:

1. Daily checkout of the instrument.
2. Daily verification of instrument operational parameters.
3. Preparation of standard calibration curves.
4. Analysis of reagent blanks.
5. Analysis of duplicates and verification of repeatability of duplicate analysis.
6. Spiked sample recovery.
7. Preparation of control charts for determining warning and control units.

All analytical results must specify reporting units, detection levels, sample matrix, solids or moisture content (if applicable) and basis of analysis (wet-dry). In addition, all data validation must be submitted with the analytical results.

## APPENDIX D - COMMON QUESTIONS AND ANSWERS

1. **How much will all this work cost?**

There are many factors that influence the cost of this type of investigation. These factors include whether contamination threatens or has reached groundwater, public health and environmental risk at the site, appropriate remedial action options approved by regulatory agencies, and the scope of work required, i.e. number of reports/samples and type of equipment necessary.

2. **Am I going to be required to remove all of the contamination?**

Not necessarily. There are several other remedial action options that are available depending on site conditions. All options for remediation must be submitted to Kern County Environmental Health Services Department following the guidelines described in this handbook.

3. **Does the Environmental Health Services Department maintain a pre-approved list of environmental contractors?**

No. Since it is prohibitively burdensome to keep a current list, it would be unfair to new companies doing business in this area not to be included. For this reason, we suggest you call the state licensing boards for registered professionals and/or consult advertising sources such as the telephone book, newspaper, or trade publications for contractor contacts. Environmental Health Services does review the qualifications of the contractor you select when proposals, reports, or studies are provided for review.

4. **What is the Environmental Health Services Department's cleanup level in soil and groundwater?**

The cleanup levels are site specific. These levels are determined through the incorporation of federal, state and local agency standards. If the proposed cleanup levels are higher than regulatory standards, a risk assessment must be performed using expected and worst case assumptions.