FINAL
PHASE 1 REMEDIAL INVESTIGATION
QUALITY ASSURANCE PROJECT PLAN
MONTEREY APARTMENTS SITE

Contract No. C0089007

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Prepared By:

ECOLOGY AND ENVIRONMENT, INC.
101 Yesler Way
Suite 600
Seattle, Washington 98104

Prepared For:

WASHINGTON STATE DEPARTMENT OF ECOLOGY
Toxics Cleanup Program

ecology and environment, inc.
101 YESLER WAY, SEATTLE, WASHINGTON, 98104, TEL. 206/624-9537
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MONTEREY APARTMENTS PHASE 1 REMEDIAL INVESTIGATION
QUALITY ASSURANCE PROJECT PLAN

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1. INTRODUCTION

As a contractor to the Washington State Department of Ecology (Ecology), Ecology and Environment, Inc. (E & E) has the responsibility to implement minimum procedures to assure that the precision, accuracy, representativeness, comparability, and completeness (PARCC) of its data are known and documented. To ensure this responsibility is met uniformly, E & E must prepare a written analytical quality assurance (QA) plan for each remedial investigation (RI) sampling project E & E performs.

This quality assurance project plan (QAPjP) was prepared under Contract No. C0089007 for the Monterey Apartments Site Phase 1 RI under Work Assignment No. 1, Amendment No. 4.

The QAPjP provides specific QA policies, organization, objectives, functional activities, and QA/quality control (QC) procedures to be followed during the field, analytical, and testing Phase 1 RI activities. As subsequent sampling and QA plan task phases emerge for Phase 2 of the RI/feasibility study (FS), QAPjP deliverables will be prepared to supplement this plan to assure that the QA/QC requirements of the Ecology RI/FS system are satisfied.

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2. PROJECT DESCRIPTION

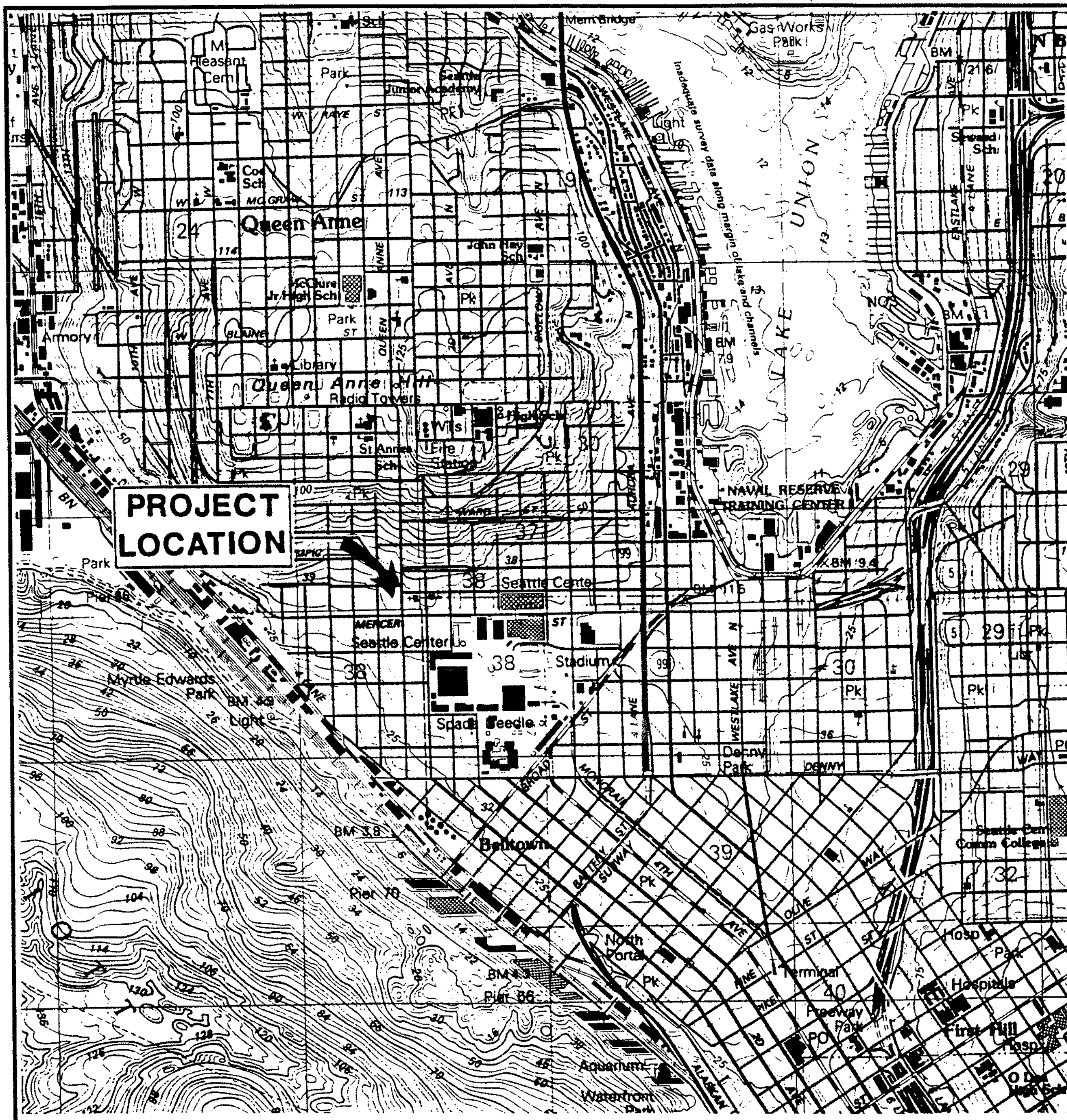
2.1 SITE DESCRIPTION

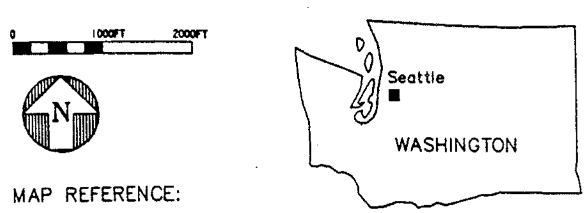
The Monterey Apartments site is located at 622 First Avenue West, near the intersection of Queen Anne Avenue North and West Roy Street, in the City of Seattle, Washington (Figure 2-1). The site is located in a residential and commercial neighborhood in the Queen Anne district of northwest Seattle in the SE1/4, section 25 of Township 25 N., Range 3 E. of King County (USGS 1983).

The apartment building basement living units have been impacted by free organic vapors originating from an underground storage tank (UST) petroleum release which was first identified in 1986 (GeoEngineers 1986). Petroleum product was released from a nearby service station tank(s) and migrated via a local, shallow, perched water-table aquifer toward the apartment building. The building's foundation construction and drain tile system apparently served as a gathering point for the free product.

Two active service stations have been isolated as the probable sources of the petroleum release: the Manhattan Express Texaco service station (Express), and the Unocal Counterbalance service station (Unocal) (Figure 2-2).

The Express, previously known as Arnold's, is located on the southwest corner of the Queen Anne Avenue North and West Roy Street intersection, less than 300 feet northeast of the Monterey Apartments property. At least one monitoring well (MW-6), positioned adjacent to the Express UST complex, contains petroleum product floating atop the shallow, water-table aquifer beneath the property (E & E 1990).





BASE MAP REFERENCE:

SEATTLE NORTH AND SEATTLE SOUTH – 1983
U.S. GEOLOGICAL SURVEY AND NATIONAL OCEAN SURVEY
7.5 X 15 MIN. QUAD
1:25,000 METRIC/TOPOGRAPHIC/BATHYMETRIC

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FIGURE 2–1
VICINITY MAP

MONTEREY APARTMENTS PHASE 1
REMEDIAL INVESTIGATION

DRAWN BY:	DATE:	PRJCT/JOB NO.	CAD DWG NO.
DCW	2–27–91	WB6120	0301LM.DWG

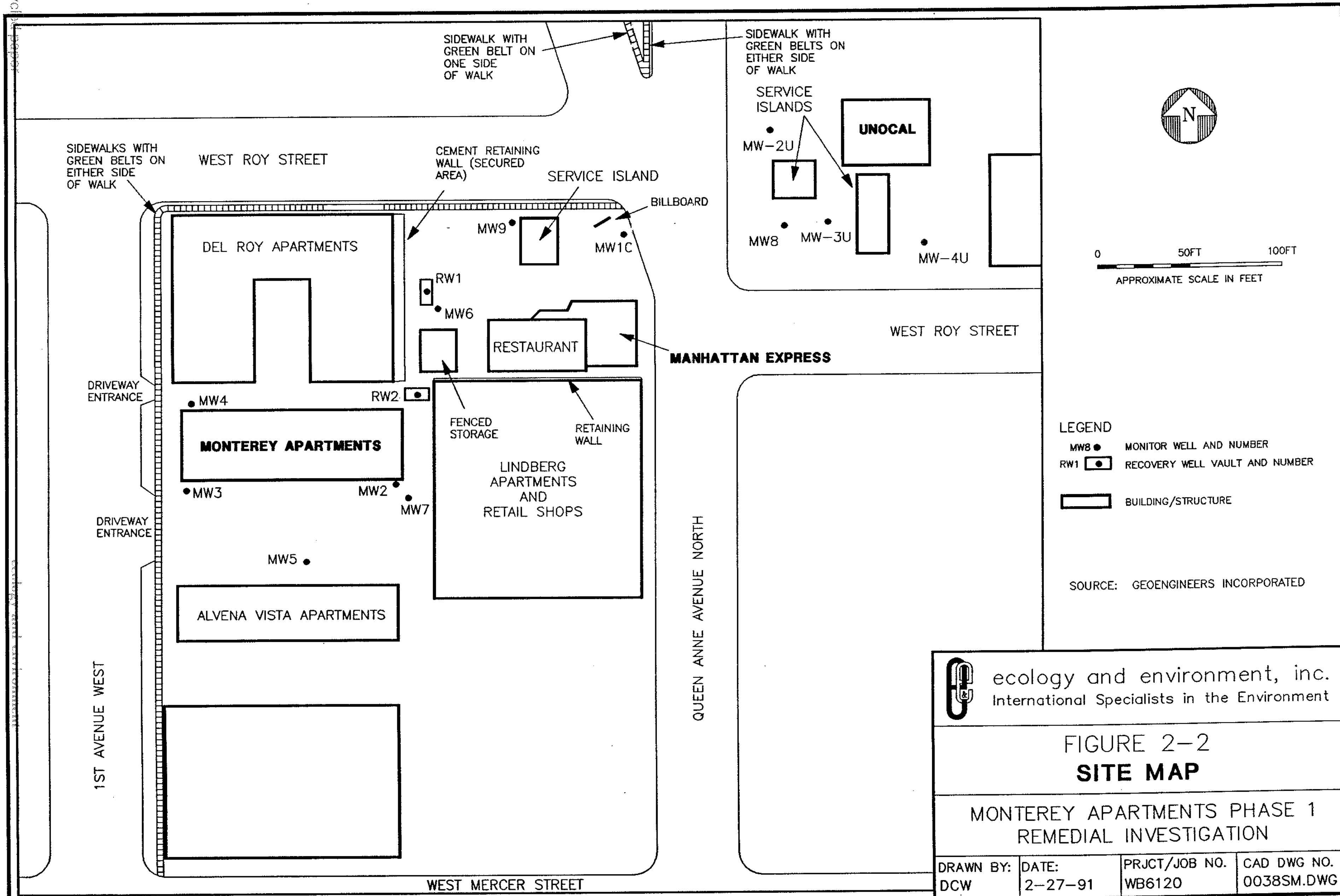

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FIGURE 2-2
SITE MAP

MONTEREY APARTMENTS PHASE 1
REMEDIAL INVESTIGATION

DRAWN BY:	DATE:	PRJCT/JOB NO.	CAD DWG NO.
DCW	2-27-91	WB6120	0038SM.DWG

The Unocal station is located on the northeast corner of the Queen Anne Avenue North and West Roy Street intersection. On-site monitoring wells and previous tank replacement activities at this station have demonstrated the presence of both soil and shallow water-table aquifer petroleum contamination beneath the property. The existence of mobile, relatively non-degraded floating petroleum similar to that documented at MW-6 has not been confirmed by previous investigations at this location of the Unocal facility (GeoEngineers 1989; E & E 1990).

2.2 OBJECTIVES AND SCOPE

The following four primary objectives for the Monterey Apartments RI were identified in the Monterey Apartments Site Phase 1 Remedial Investigation Work Plan (E & E 1991):

- Evaluate the extraction potential of petroleum product persisting atop the shallow water table beneath the Express station at MW-6.
- Define the concentration, distribution, and estimated volume of petroleum contamination caused by the release of automotive petroleum fuels at the Express;
- Define the distribution, potential contribution, and migration routes of the Unocal petroleum leaks, relative to the Express and Monterey properties; and
- Collect baseline data relevant to the FS, such as soil vadose zone impacts and groundwater quality parameters.

The field sampling activities planned for Phase 1 will include the chemical analysis of soil-gas samples collected at an anticipated 54 sampling stations, the analysis of groundwater samples collected from the existing site wells and from three temporary groundwater sampling stations to be installed using the soil-gas sample collection equipment. In addition to defining plume distribution, the data will determine existing water quality which will aid in cleanup standards selection, and provide baseline information appropriate to FS planning.

To meet the objectives established for this project, six primary field tasks will be performed during Phase 1:

Field Task 1: Aquifer Testing;
Field Task 2: Monitoring Well Groundwater Sampling;
Field Task 3: Soil-Gas Surveying and Groundwater Sampling;
Field Task 4: Terrain Conductivity Surveying;
Field Task 5: Sewer Line/Storm Drain Locating; and
Field Task 6: UST Tightness Testing.

The rationale locations, analytical requirements, and methodologies for these field tasks are discussed in detail in the Phase 1 RI, Sampling and Analysis Plan (SAP). These tasks will be referenced in tables and discussions throughout the later sections of this plan.

2.3 DATA USE

Sampling and testing data collected during the Phase 1 RI will be reduced, assimilated, and plotted to accurately characterize the site in terms of contaminant distribution and phases, concentrations, migration pathways, contaminant sources, and additional physical characteristics.

Field Task 1: Aquifer Testing. Data collected from a bail-down test at MW-6 will be used to estimate floating product recovery potential from that well to determine if a small borehole skimmer pump would be effective and appropriate to recover product at the site.

Field Task 2: Monitoring Well Groundwater Sampling. Analytical data for groundwater collected from the existing monitoring wells will be of sufficient quality to:

- o Support groundwater cleanup standards evaluation as per WAC 173-340-720;
- o Support human health risk assessment procedures, if appropriate; and
- o Provide baseline data relevant to FS and engineering design.

Field Task 3: Soil-Gas Survey and Groundwater Sampling. The soil-gas survey data will be used to access the location and extent of the vapor plume, and to support decision-making recommendations on the installation of additional groundwater monitoring wells and/or recovery wells. The task also will include installing temporary groundwater sampling stations to assess contaminant migration.

Field Task 4: Terrain Conductivity Surveying. The survey will be performed on the Express property to assist in locating shallow buried features, including tanks and pipes. The information will assist in determining where soil-gas drive point locations should be positioned on the property.

Field Task 5: Sewer Line/Storm Drain Locating. Buried features such as lateral sewer lines and storm drains on the Express property are potential vapor/fluid migration conduits. The location of these objects will be determined and integrated into the selection of soil-gas sampling stations during for investigation.

Field Task 6: UST Tightness Testing. Integrity testing of four USTs at the Express will be used to assist in determining if the active tanks and associated piping serving the station are releasing product into the environment. If leaks are detected, corrective measures, as defined under WAC 173-340-450, may be required.

Site Safety Considerations. Data collected while performing the field effort also will be used to monitor personal protection defined in the project Site Safety Plan. In addition, the data will be used to identify potential immediate health risks to local residents.

2.4 SAMPLE COLLECTION/ANALYSIS REQUIREMENTS

The soil-gas survey and groundwater sampling field tasks will involve collecting numerous samples to be submitted for laboratory analyses. A sample collection summary is presented in Table 2-1. The table identifies the type and number of samples to be collected, associated QC samples, and collection requirements. Sampling procedures are discussed in Section 5.

Data uses, QA objectives, and analytical method requirements for the samples to be collected are summarized in Section 4 and 8.

Table 2-1

**SAMPLE COLLECTION SUMMARY AND REQUIREMENTS
PHASE 1 REMEDIAL INVESTIGATION
MONTEREY APARTMENTS SITE
SEATTLE, WASHINGTON**

Field Task Number	Number of Samples (1)	Matrix	Analytical Parameters	Type of Sample Container	Sample Preservation	Technical Holding Time	Quality Control Samples
2	3	Groundwater	Color, Nitrite, Nitrate	1,000-mL polyethylene bottle with polyethylene lined cap (poly.)	4°C (± 2°)	24 hours (Color: 48 hours)	Field duplicate Field blank
2	3	Groundwater	Biochemical Oxygen Demand (BOD)	1,000-mL poly.	4°C (± 2°)	48 hours	Field duplicate Field blank
2	3	Groundwater	Bicarbonate, carbonate	1,000-mL poly.	4°C (± 2°)	14 days	Field duplicate Field blank
2	3	Groundwater	Sulfate	1,000-mL poly.	4°C (± 2°)	28 days	Field duplicate Field blank
2	3	Groundwater	Total Dissolved Solids (TDS)	1,000-mL poly.	4°C (± 2°)	7 days	Field duplicate Field blank
2	3	Groundwater	Chloride, fluoride	1,000-mL poly.	None required	28 days	Field duplicate Field blank
2	3	Groundwater	Chemical Oxygen Demand (COD)	1,000-mL poly.	H_2SO_4 to pH $\leq$ 2 4°C (± 2°)	28 days	Field duplicate Field blank
2	3	Groundwater	Total Hardness	1,000-mL poly.	HNO_3 to pH $\leq$ 2 4°C (± 2°)	6 months	Field duplicate Field blank
2	3	Groundwater	Turbidity	1,000-mL poly.	4°C (± 2°)	48 hours	Field duplicate Field blank
2	3	Groundwater	Ammonia-N	1,000-mL poly.	H_2SO_4 to pH $\leq$ 2 4°C (± 2°)	28 days	Field duplicate Field blank

Table 2-1 (cont.)

Field Task Number	Number of Samples(1)	Matrix	Analytical Parameters	Type of Sample Container	Sample Preservation	Technical Holding Time	Quality Control Samples
2	3	Groundwater	Total Phosphorus/ Organic Phosphorus	1,000-mL poly.	H_2SO_4 to pH $\leq$ 2 4°C ($\pm$ 2°)	28 days (Organic: 48: hours)	Field duplicate Field blank
2	3	Groundwater	Total Organic Carbon (TOC)	1,000-mL poly.	H_2SO_4 to pH $\leq$ 2 4°C ($\pm$ 2°)	28 days	Field duplicate Field blank
2	3	Groundwater	Total Coliform	Sterilized glass container supplied by ARI	None required	Analyze immediately	Field duplicate Field blank
2	3	Groundwater	Ethylene Dibromide (EDB)	40-mL glass vial with Teflon-lined septum	4 drops HCl 4°C ($\pm$ 2°)	14 days	Field duplicate Field blank
2	3	Groundwater	Inorganic Elements(2)	1,000-mL poly.	HNO_3 to pH $\leq$ 2	6 months	Field duplicate Field blank
2	3	Groundwater	Arsenic, Mercury, and Selenium	1,000-mL poly.	HNO_3 to pH $\leq$ 2	Mercury 28 days, others 6 months	Field duplicate Field blank
2	14	Groundwater	Volatile Organic Compounds (VOCs)(3)	40-mL glass vial with Teflon-lined septum	4 drops HCl 4°C ($\pm$ 2°)	14 days	Field duplicate Field blank
2	14	Groundwater	Total Recoverable Petroleum Hydrocarbons (TPH)	1000-mL glass container with Teflon lined lid	HCl to pH $\leq$ 2 4°C ($\pm$ 2°)	28 days	Field duplicate Field blank
2	14	Groundwater	Lead	1,000-mL poly.	HNO_3 to pH $\leq$ 2	6 months	Field duplicate Field blank

Table 2-1 (cont.)

Field Task Number	Number of Samples(1)	Matrix	Analytical Parameters	Type of Sample Container	Sample Preservation	Technical Holding Time	Quality Control Samples
3	52	Soil-gas	Volatile Aromatic Compounds and Volatile Total Petroleum Hydrocarbons (BTEX(4)/TPH)	Soil Gas Adsorbent Trap	4°C (± 2°)	14 days	4 Field blanks, 4 Trip blanks, and 12 base station reference samples (assuming 12 field days)
3	6	Groundwater	Volatile Aromatic Compounds and Volatile Total Petroleum Hydrocarbons (BTEX(4)/TPH)	40-mL glass vial with Teflon lined Septum	4 drops of HCl 4°C (± 2°)	14 days	Rinsate blank Field duplicate

(1) Number of samples does not include QC samples.

(2) Complete list of inorganic elements is provided in Appendix A.

(3) Complete list of VOCs is provided in Appendix A.

(4) Complete list of BTEX compounds is provided in Appendix A.

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3. PROJECT ORGANIZATION AND PLANNING

3.1 PROJECT MANAGEMENT

Project management and lines of authority for the Monterey Apartments Phase 1 RI are presented in this section and are illustrated in Figure 3-1. E & E QA contacts for the project include:

- o Peter Jowise
  Program Director
- o John L. Roland
  Project Manager
- o Carolyn O'Brien
  QA Officer
- o Lila Transue
  Data Specialist

These contacts can be reached at the address below:

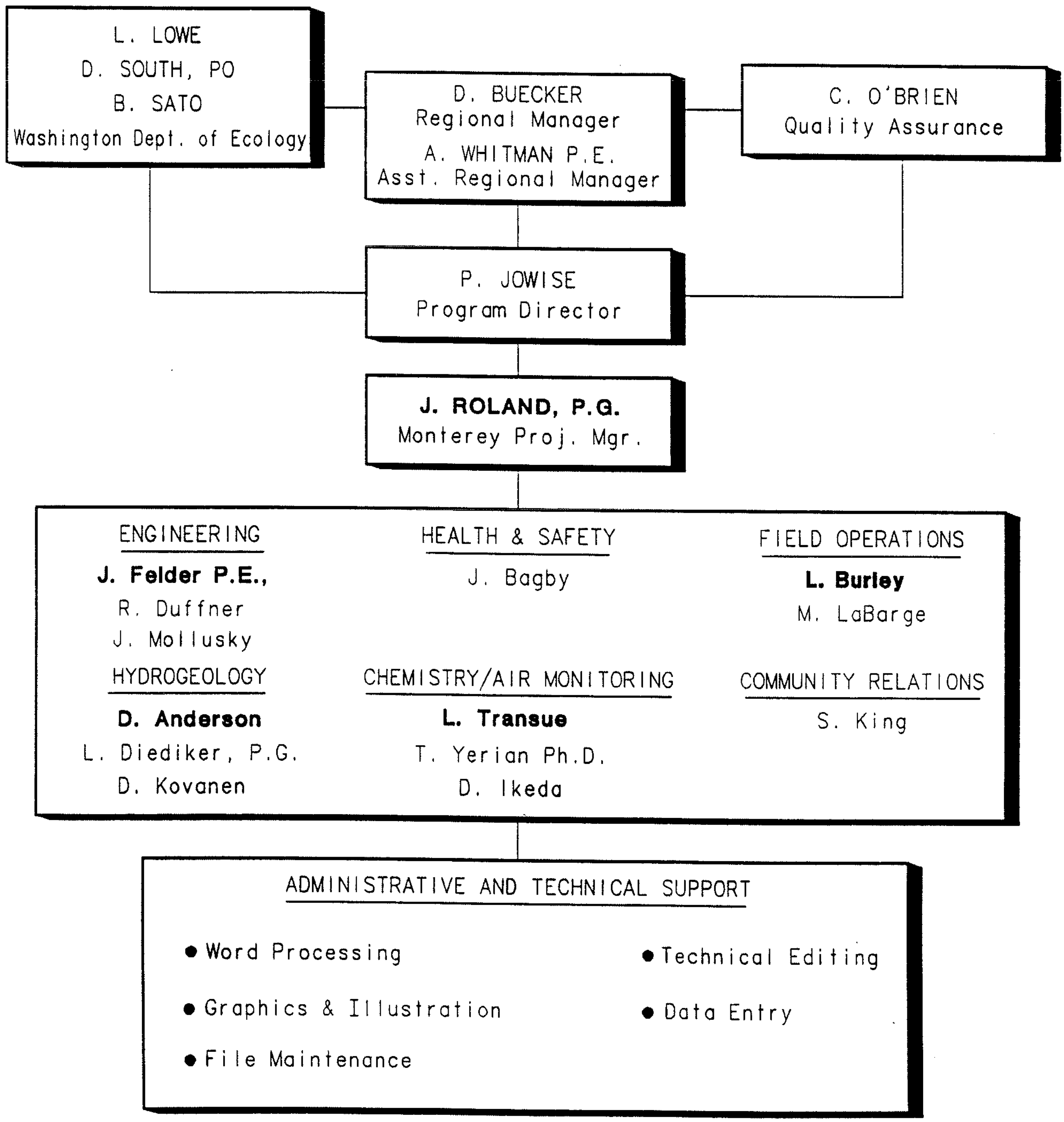
Ecology and Environment, Inc.
101 Yesler Way, Suite 600
Seattle, Washington 98104
206/624-9537

The various QA/QC functions are described below.

Program Director. The program director has overall responsibility for ensuring that work on the site meets client objectives and E & E quality standards. In addition, he is responsible for technical QC and project oversight, and provides the project manager with access to corporate management.

PHASE 1
REMEDIAL INVESTIGATION
MONTEREY APARTMENTS

FIGURE 3-1
Organizational Structure
and
Primary Resources



Bold type indicates project team personnel selected to provide support for field site activities

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Project Manager. The project manager is responsible for implementing the project and has the authority to commit the resources necessary to meet project objectives and requirements. The project manager's primary function is to ensure that technical, budgetary, and scheduling objectives are achieved successfully. The project manager reports directly to Ecology and provides the major point of contact and control for matters concerning the project. The project manager will perform the following tasks:

- Establish project policy and procedures to address the overall project goals, as well as the objectives of each task;
- Acquire and apply technical and corporate resources as needed to ensure performance within budget and schedule constraints;
- Monitor and direct the team leaders;
- Develop and meet ongoing project and/or task staffing requirements, including mechanisms to review and evaluate each task product;
- Ensure that E & E project personnel and subcontractors are aware of project QA objectives;
- Review the work performed on each task to ensure its quality, responsiveness, and timeliness;
- Review and analyze overall task performance with respect to planned requirements and authorizations;
- Approve all external reports (deliverables) before their submission to Ecology;
- Take responsiblity for the preparation and quality of interim and final reports; and
- Represent the project team at meetings and public hearings.

QA Officer. The QA officer is responsible for maintaining QA for the Ecology contract and all projects assigned to E & E under that contract. The QA officer will:

- Provide external, and thereby independent, QA oversight;

- o Coordinate with Ecology QA officers, and the E & E program director and project manager to ensure that appropriate QA project objectives are established;
- o Coordinate with project management and personnel to ensure that appropriate QC procedures to meet QA objectives are developed and in place;
- o Require and/or review actions to resolve QC issues, if necessary; and
- o Report non-conformance with QC criteria or QA objectives, if it occurs.

Data Specialist. Duties and responsibilities for the Monterey Apartments site data validation specialist include the following:

- o Review laboratory deliverables to determine the analytical performance of the sample sets and the associated QC analyses.
- o Assess and summarize the accuracy, precision, and reliability of data to determine its usability;
- o Document any factors affecting data usability for the historical record; and
- o Generate data validation reports.

Technical Staff. The technical staff (team members) for this project will be drawn from E & E's pool of corporate resources. Technical staff will be used to collect and analyze data, and to prepare various task reports and support materials. All of the technical staff members are experienced professionals who possess the degree of specialization and technical competence required to perform the required work effectively and efficiently.

3.2 PROJECT PLANNING

Described in this section are the primary planning requirements and activities necessary to initiate the Phase 1 RI for the Monterey Apartments site, including the preparation of plans and initial evaluation activities to define project scope. Project planning has been divided into four parts described below.

3.2.1 Initial Site Evaluation

Initial site evaluation was conducted to establish the RI scope of work. The site evaluation encompassed:

- o A review of the existing available data and information that described the current site situation;
- o A historical background search of the area, including two propery title searches;
- o The measurement of groundwater elevations and floating product thicknesses at the site's monitoring wells;
- o A gas chromatographic analysis of floating product samples collected from the monitoring wells to assess degradation characteristics;
- o The performance of a pilot soil-gas surey to establish the feasibility of performing a complete survey at the site (E & E 1990); and
- o Approval of the Monterey Apartments site Phase 1 Remedial Investigation Work Plan which defined the Phase 1 RI scope of work (E & E 1991).

3.2.2 Sampling and Analysis Plan

The Phase 1 RI SAP for the site presents the overall scoping and schedule of sampling and testing assignments, and includes a detailed description of the rationale for the groundwater and soil-gas sampling, and other primary testing and measurement tasks.

3.2.3 Quality Assurance Project Plan

This site-specific QAPjP has been prepared, and designed to ensure that Ecology receives the quality of measurement and analytical data mandated under the terms of the Work Assignment. Project procedures detailed in this plan include sample handling and custody, analytical procedures, measurement of data quality, data reduction, and internal QC checks. In addition, project activities will be reviewed independently and will include QC meetings, peer review leader activity, and internal deliverable review.

Analytical and Sample Management Services. Three analytical laboratories will be employed for analysis of samples collected during the Monterey Apartments Phase I RI. Soil gas and groundwater samples collected with the Geoprobe will be analyzed by Columbia Analytical Services (CAS) of Bothell, Washington (Ecology Laboratory Accreditation Number C001). Monitoring well analysis will be performed by both Analytical Resources, Incorporated (ARI) of Seattle, Washington (Ecology Laboratory Accreditation Number C038) and the E & E Analytical Services Center (ASC) of Buffalo, New York (Ecology interim accreditation status, pending on-site Ecology audit).

Data Validation. Site-specific QA/QC and a summary of analytical methods to be employed are addressed in this QAPjP. The QAPjP also outlines a QA program that will ensure that the technical data generated are accurate, representative, and if appropriate, legally defensible.

Analytical data will be evaluated by the E & E data validation specialist for precision, accuracy, and completeness. Procedures for data validation also are included herein.

3.2.4 Site Safety Plan

The site safety plan addresses such items as general description of work to be performed, hazards expected, personal protection levels, and medical emergency preparedness. At present, it is assumed that the work will be performed in Level D protection. Action levels are provided and discussed in the Phase 1 RI Site Safety Plan.

4. QUALITY ASSURANCE OBJECTIVES FOR DATA

4.1 QA OBJECTIVES AND TARGETS

Data quality objectives (DQOs) are statements regarding the level of certainty that a data user requires for data derived from environmental measurements. Data quality needs should be matched with the appropriate analytical methods and QC requirements so that the correct type, quality, and amount of data are collected.

Field tasks performed during the Monterey Apartments Phase 1 RI will obtain field measurements using standard, approved methods. Analytical sample data will be derived using EPA-approved methods, modified where necessary to accomplish the specific project goals. Section 7 of this document provides a description of the methodologies to be employed for the collection and analysis of all analytical data. Data use and DQOs for the field measurements are described in Table 4-1. Tables 4-2 and 4-3 summarize the data use, data quality, and QC criteria required for each analytical parameter to accomplish the project objectives.

Data quality requirements can be described according to EPA analytical data quality levels. Analytical data generated from the soil-gas and groundwater samples collected using the Geoprobe will achieve data quality Level III. The samples will be analyzed using standard EPA approved methods, with modifications as indicated in Table 4-3. Data generated from the monitoring well groundwater sampling also will achieve a data quality of Level III, requiring complete documentation and full (100%) validation of each analytical parameter. Discussion on data reduction, validation, and reporting procedures is located in Section 9.

Table 4-1

**SUMMARY OF DATA USE AND QUALITY OBJECTIVES FOR FIELD MEASUREMENTS
PHASE 1 REMEDIAL INVESTIGATION
MONTEREY APARTMENTS SITE
SEATTLE, WASHINGTON**

Field Task/ Measurements	Objective	Data Use	Data Description	Data Reporting Requirements
<u>Task 1 - Aquifer Testing</u>				
- Water Level Indicator	Depth to groundwater measurement	Aquifer test calculations	Measurement of depth to SWL from well measuring reference point	± 0.01 foot[1]
- Pressure Transducer	Monitor falling/rising hydraulic head in well	Aquifer test calculations	Record hydraulic head variation in well during bail-down test	± 0.1 foot[1]
<u>Task 2 - Monitoring Well Groundwater Sampling</u>				
- Product/Water Interface Probe	Measurement of depth to water/floating product	Gradient mapping and plume assessment	Depth measurements from well surface reference point	± 0.01 foot[1]
- pH/Temperature Meter	Monitoring of groundwater pH/temperature	Determination of aquifer characteristics	pH units and temperature in °C	± 0.1 pH units; ± 0.5° C[1,2]
- Conductivity Meter	Monitoring of groundwater conductivity	Deermination of geophysical aquifer characteristics	Specific conductance	± 1.0 umho/cm
<u>Task 3 - Soil-Gas Survey and Groundwater Sampling</u>				
- Rotometer	Quantify absorbant trap sample volume (liters)	Quantification of contaminant concentration	Record of volume (liters) of soil-gas drawn through sample medium (Carbotrap)	± 50 mL/min
- Photoionization Detector	Ambient air and soil-gas monitoring	Health and safety monitoring and soil-gas aquisition screening	Real-time organic vapor detection	± 1 ppm (isobutylene)
- Water Level Meter	Depth of groundwater measurement	Assure accurate placement of probe to collect groundwater	Measure depth from ground surface to watertable	± 0.01 foot[1]

Table 4-1 (cont.)

Field Task/ Measurements	Objective	Data Use	Data Description	Data Reporting Requirements
<u>Task 4 - Terrain Conductivity Surveying</u>				
- Geonics EM31-D	Measurement of terrain conductivity at Express property	Buried feature detection (cement tanks)	Apparent terrain conductivity measured to a maximum depth of approximately 6 meters bgs to survey for buried features	± 5% at 20 millimhos/ meter[1]
<u>Task 5 - Sewer Line/Storm Drain Locating</u>				
- Snooper Locator (radio transmitter/receiver instrument)	Sewer line/storm drain location	Assessment of potential contaminant migration routes	Instrumentation will locate concrete, ceramic tile, vitrified clay or plastic underground pipes	± 1 foot for horizontal positioning[1] ± 60% accuracy for depth positioning[1]
<u>Task 6 - UST Tightness Testing</u>				
- Vacutech Nonvolumeric test	Tank/piping integrity testing	Leak detection	Tightness tests will measure leakage. The results presented will have a threshold of 0.05 gals/hr	P(D) = 99%, for 0.10 gallon/hr leak[3] P(FA) = 1%, at 0.05 gallon/ hr threshold[3]

(1) Field measurement using factory calibrated equipment and checked for reliability in the field.

(2) Field analysis using portable instruments calibrated daily using required standards.

(3) Performance criteria based on test results using 10,000 gallon capacity tank. P(D) - Probability of Detection. P(FA) - Probability of False Alarm.

Table 4-2

SUMMARY OF DATA USE AND DATA QUALITY OBJECTIVES FOR LABORATORY ANALYTICAL DATA
PHASE 1 REMEDIAL INVESTIGATION
MONTEREY APARTMENTS SITE
SEATTLE, WASHINGTON

Field Task Number	Matrix	Objective	Data Use	Data Type/ Requirement[1]	Data Quality Requirement
2	Groundwater	Comprehensive petroleum contaminant survey of all on-site wells	Determination of the extent of groundwater contamination at the site	VOCs, TPH, lead	Full CLP-type[2] (Level III)
2	Groundwater	Characterize the aquifer for geochemical, nutrient, and and biological parameters	Site characterization and collection of relevant data for feasibility study evaluation	BOD, COD, nitrite-N, nitrate-N, ammonia-N, sulfate, total phosphorus, organic phosphorus, carbonate, bicarbonate, total hardness, chloride, fluoride, color, TDS, TOC, selected inorganic elements, total coliform, EDB, turbidity	Full CLP-type[2] (Level III)
3	Soil gas	Survey to assess distribution and magnitude of petroleum contaminant migration in the vadose zone	Deliniation of the plume of contamination from potential sources	BTEX, and volatile TPH	Screeening[3] (Level III)
3	Groundwater	Verification of contamination of groundwater at selected soil gas sampling locations	Assist in delineation of the contaminant plume	BTEX, and volatile TPH	Screening[3] (Level III)

(1) VOCs – Volatile organic compounds.
TPH – Total petroleum hydrocarbons.
BOD – Biochemical oxygen demand.
COD – Chemical oxygen demand.
TDS – Total dissolved solids.
TOC – Total organic carbon.
BTEX – Benzene, toulene, ethylbenzene, xylenes.
(2) Full deliverables package, including all raw data with 100 percent full data validation as defined in Section 9.
(3) Sample data and QC will be evaluated as defined in Section 9.

Table 4-3

**ANALYTICAL QUALITY ASSURANCE OBJECTIVES/REQUIREMENTS
PHASE 1 REMEDIAL INVESTIGATION
MONTEREY APARTMENTS SITE
SEATTLE, WASHINGTON**

Field Task Number	Parameter[1]	Matrix	Method Reference/Number	Practical Quantitation Limit[2]	Level	Method Accuracy[3] (percent)	Method Precision[4] (percent)
2	Volatile organic compounds (VOCs)	Groundwater	SW846/8240[7]	5-100 μg/L	Low	As per method[5]	As per method[6]
2	Total petroleum hydrocarbon (TPH)	Groundwater	EP1/418.1[9]	1.0 mg/L	Low	75-125%	± 15%
2	Lead	Groundwater	SW846/7421[7]	5.0 μg/L	Low	75-125%	± 20%
2	Ethylene dibromide	Groundwater	SW846/Mod 8010[7,10]	0.01 μg/L	Low	75-125%	± 15%
2	Metals	Groundwater	SW846/6010[7]	5-5,000 μg/L	Low	75-125%	± 20% (values > 5 x PQL)
2	Color	Groundwater	SM/2120B[11]	N/A	Low	N/A	N/A
2	Hardness, Total	Groundwater	EP1/130.2[9]	1 mg/L	Low	75-125%	± 15%
2	Total dissolved Solids (TDS)	Groundwater	EP1/160.1[9]	10 mg/L	Low	75-125%	± 15%
2	Chloride	Groundwater	EP1/325.3[9]	1.0 mg/L	Low	75-125%	± 15%
2	Fluoride	Groundwater	EP1/340.2[9]	0.1 mg/L	Low	75-125%	± 15%
2	Alkalinity (carbonate/ bicarbonate)	Groundwater	EP1/310.1[9]	0.5 mg/L	Low	75-125%	± 15%
2	Ammonia-N	Groundwater	EP1/350.2[9]	0.05 mg/L	Low	75-125%	± 15%
2	Nitrate-N	Groundwater	EP1/353.2[9]	0.1 mg/L	Low	75-125%	± 15%

Table 4-3 (cont.)

Field Task Number	Parameter[1]	Matrix	Method Reference/Number	Practical Quantitation Limit[2]	Level	Method[3] Accuracy (percent)	Method[4] Precision (percent)
2	Nitrite-N	Groundwater	EP1/354.1[9]	0.01 mg/L	Low	N/A	N/A
2	Total Phosphorus/Organic Phosphorus	Groundwater	EP1/365.2[9]	0.01 mg/L	Low	75-125%	± 15%
2	Sulfate	Groundwater	EP1/375.4[9]	1.0 mg/L	Low	75-125%	± 15%
2	Chemical oxygen demand (COD)	Groundwater	EP1/410.2[9]	5.0 mg/L	Low	75-125%	± 15%
2	Total organic carbon (TOC)	Groundwater	EP1/415.2[9]	1.0 mg/L	Low	75-125%	± 15%
2	Biochemical oxygen demand (BOD)	Groundwater	EP1/405.1[9]	N/A	Low	N/A	± 15%
2	Total Coliform	Groundwater	SM/9222B[11]	N/A	Low	N/A	N/A
2	Arsenic	Groundwater	SW846/7060[7]	5.0 µg/L	Low	75-125%	± 20%
2	Mercury	Groundwater	SW846/7470[7]	1.0 µg/L	Low	75-125%	± 20%
2	Selenium	Groundwater	SW846/7740[7]	5 µg/L	Low	75-125%	± 20%
2	Turbidity	Groundwater	EP1/180.1[9]	N/A	Low	N/A	N/A
3	Benzene, toulene, ethyl benzene, xylene (BTEX)	Soil-gas	SW846/8020[7]	20 - 40 ng	Low	N/A	N/A
3	Volatile TPH	Soil-gas	SW846/Mod 8015[7,8]	5.0 µg	Low	N/A	± 30%
3	BTEX	Groundwater	SW846/8020[7]	2 - 4 µg/L	Low	60-140%	± 30%
3	Volatile TPH	Groundwater	SW846/Mod 8015[7,8]	1.0 mg/L	Low	60-140%	± 30%

Table 4-3 (cont.)

N/A Not applicable.

(1) See Appendix A for complete list of analytes and respective practical quantitation limits (PQLs).

(2) Quantitation limit ranges reported for VOCs, BTEX, and inorganic elements are practical quantitation limits based in the listed method. Actual sample quantitation limits may be adjusted for sample volume, extraction volume, or sample dilution as appropriate.

(3) Method Accuracy, as it applies to the specific case, is determined by evaluating the matrix spike compound recoveries and the surrogate compound recoveries (surrogates are used for organic analyses only). Matrix spike compounds are selected compounds found in the associate methodologies, and reflect the behavior of those specific compounds in the given sample. Matrix spike data are used to determine long-term accuracy of the analytical method. Surrogate compounds are non-target analytes, and are used to evaluate laboratory performance on individual samples.

(4) The relative percent difference value (RPD) between the matrix spike and the matrix spike duplicate are used to determine long-term precision of the analytical method for organic analyses. The percent difference (%D) values calculated for duplicate analyses are indicators of laboratory precision based on each sample matrix for inorganic analyses.

(5) Refer to the listed method for acceptable percent recovery criteria for the matrix spike compounds associated with this analysis.

(6) Refer to the listed method for acceptable RPD for the matrix spike and matrix spike duplicate recoveries associated with this analysis.

(7) Methods are contained in USEPA "Test Methods for Evaluating Solid Wastes," SW-846, Revision 0, September 1986.

(8) Modifications are contained in the State of California Leaking Underground Fuel Tank (LUFT) Task Force Field Manual Appendix D (October 1989).

(9) Methods are contained in USEPA Methods for Chemical Analyses of Water and Wastes, Revised March 1983 (EPA-600/4-79-020).

(10) Modifications to SW846 Method 8010 for EDB analysis are described in Appendix B.

(11) Methods are contained in "Standard Methods for the Examination of Water and Wastewater," 17th Ed, 1989.

PARCC parameters are indicators of data quality. The end use of the measurement data defines the necessary PARCC parameter criteria to achieve the project DQOs. Numerical precision, accuracy, and completeness goals are established to aid in selecting appropriate test, measurement, sampling, and analytical methods.

4.2 PRECISION AND ACCURACY

Precision measures the reproducibility of measurements under a given set of conditions. It is a quantitative measure of the variability of a group of measurements compared to their average value. Accuracy measures the bias in a measurement system.

Target values for reporting of field tests and measurements for the Monterey Apartments Phase 1 RI are presented in Table 4-1. For field measurements, assurance of precision and accuracy will rely upon the routine calibration and instrument checks required for each of the instruments. Analytical and calibration procedural requirements for the field instruments quality are presented in Section 8 and Section 9, respectively. Laboratory analytical methods target values for practical quantitation limits, method accuracies (percent spike recovery) and precision (relative percent difference of matrix spike duplicates or duplicates) are provided in Table 4-3. Compound-specific objectives for target values not included in Table 4-3 can be obtained by directly referencing the indicated method. It also should be noted that high target analyte concentrations, sample nonhomogeneity, and matrix interferences can preclude achievement of analytical quantitation limits or other QC criteria designed to assess analytical accuracy and precision.

Measurements of precision and accuracy for soil gas screening sample collection are limited by the nature of the sample matrix, sample collection approach, and analytical methodology. Matrix spike and laboratory duplicate analyses will not be performed when analyzing sorbent tube media, due to consumption of the entire sample during the sample desorption process. For the soil-gas samples, replicate samples will not be collected as a measure for precision. Instead, a semi-quantitative assessment will be performed by collecting sorbent tube samples at a fixed base station on a daily basis to permit performance monitoring throughout the project duration. The base station collection requirements are described more fully in Section 5.3.2.

The project objectives will be met by collecting representative soil-gas samples which will delineate the subsurface contamination plume, and by consistently following the specified sample aquisition and analytical methodology. All sample results and relative trends in contaminant concentrations should be consistent with results from similarly collected samples. If sample results from key locations are inconsistent, or unsatisfactory, in comparison with the results observed from similar samples, resampling of that location may be performed to assess representativeness.

4.3 REPRESENTATIVENESS

Representativeness describes the degree to which the data accurately and precisely represent a characteristic of a population parameter, the variation of a physical or chemical characteristic at a sampling point, an operational parameter, or an environmental condition.

The representativeness of the field tests and measurements, and analytical data, to be produced at the Monterey Apartments site Phase 1 RI will be maximized through careful considerations of site conditions (i.e., soil homogeneity, geological structures, physical structures) and the location of sampling sites to account adequately for site variations. Field test and measurement techniques, and sampling and analytical techniques will be performed consistantly as defined in this document and will be repeatable during future investigations, if required. In the field, care will be taken in the collection of field measurements and samples to ensure that they are representative of the specific area of collection and the object or soil matrix which is being measured or analyzed. Within the laboratory, precautions will be taken to extract an aliquot representative of the whole sample.

Field representativeness will be achieved during the soil-gas sampling survey by selectively performing both biased and set-spaced sampling at locations which will best characterize the contaminant plume. Sample locations will be selected based on existing data, field observations and measurements, available sampling locations, and previous soil-gas sample location results. Due to the inherent uncertainties in soil-gas sampling, a flexible collection plan provides a better means for accurate delineation of the contaminant plume. Field representativeness will be optimized by performing vertical profiles in at least one location within the survey area. The profiling will involve the collection/measurement of sorbent tube and/or photoionization detector (PID) screening samples at depth intervals of 4 feet to a maximum of 12 feet below ground surface (bgs). By evaluating the profile, E & E can select the optimal sample collection depths relative to soil characteristic variabilities, including permeability variations, soil moisture, and soil texture.

4.4 COMPLETENESS

Completeness is defined as the percentage of measurements made that are judged to be valid measurements. Completeness goals are essentially the same for all data uses, namely, that a sufficient amount of valid data be generated to accomplish the objectives of the project. An overall target goal of 90 percent completeness has been set for the Monterey Apartments Phase 1 RI. The completeness goal for the collection and analysis of the groundwater monitoring well data (Field Task 2) has been established at 80 percent for the field water quality measurements, and 95 percent for the laboratory analyses. The completeness goal for the soil gas sampling and analysis (Field Task 3) is 80 percent due to the screening nature of the survey and the environmental uncerainties. Eighty percent completeness should be sufficient to allow enough valid data to be generated during the survey to permit adequate delineation and assessment of the vapor contaminant plume.

4.5 COMPARABILITY

Comparability expresses the confidence with which one data set can be compared with another. Data sets can be compared with confidence when: precision and accuracy are known, representative samples or measurements have been collected, and completeness goals have been met. Field measurements and analytical sample data to be obtained during the

5. SAMPLING AND TESTING PROCEDURES

5.1 AQUIFER TESTING

Prior to the commencement of the soil-gas survey and groundwater sampling events, an aquifer bail-down test will be conducted at MW-6. The bail-down test will be conducted to determine the feasibility of installing and operating a slim borehole floating petroleum skimmer system (e.g., Westinghouse Groundwater Recovery, Inc. Flexible Axial Peristaltic [FAP] Pump) at MW-6, and to determine extraction rates. The test will target the silty-sand perched aquifer at the site which is underlain by a clay layer unit. Subsoils at the site are known to be contaminated by hydrocarbons, and a floating product layer exists on top of the groundwater.

The test will encompass the following anticipated steps:

- Measuring of initial water elevation and well depth to determine the standing water volume, as well as the thickness of petroleum product, if any.
- Installing of a data logger/pressure transducer (In-Situ, Inc. Hermit 1000B) in MW-6 to help record changes in water level during the bail-down test. A water level indicator also will be available as a backup.
- Hand bailing MW-6 using a clear polyvinyl chloride acrylic (PVC) bailer. All liquids will be contained in new, 55-gallon 17-E drums and temporarily stored in a secured, fenced area on the Express property to await proper disposal.
- Bailing the floating layer phase until the layer is removed, or less than 0.5-inch in thickness. All recovered volumes will be documented.
- Allowing MW-6 to recover, following removal of the floating layer, for a period of not less than 1/2 hour. Any recharge will be monitored with the interface probe meter.

- o Repeat the petroleum layer removal procedure up to three times if a floating phase layer of at least 2 inches in thickness reappears following the standby recovery period.

- o Bailing at least 50 gallons of total fluids at a constant rate following the floating layer test phase. The rate and duration of withdrawl will be dependant on well performance, and will be adjusted accordingly.

- o Recording the drawdown with a transducer during the total fluids removal step. Well RW-1 (approximately 10 feet away) also will be monitored to detect any sympathetic drawdown.

- o Allowing MW-6 to recover after purging of an appropriate total liquids volume. The resulting rising head will be recorded for later data reduction.

- o Revisiting MW-6 at least 20 hours following completion of the previous steps to measure product thickness using the bailer. Any reintroduced floating layer present will be noted, and if greater than 2 inches in thickness, will be removed.

- o Revising MW-6 the following day to assess the presence of additional floating product.

- o Determining semiquantitive well recovery rates of petroleum product, aquifer transmissivity (T), and hydraulic conductivity (K) surrounding MW-6.

- o Entering all results from the test into a field logbook for later reference and well evaluation.

Measurement of well depth and water elevation will be used to determine the initial well volume of MW-6. The volume will be determined as described in Section 5.2.1.

The In-Situ Hermit 1000B is an electronic programmable data logger/transducer designed to record and transfer data to data processing equipment, or to the user, for later use. It measures and stores feet of water (hydraulic head) above the transducer and it provides a corresponding change in water level as the well is bailed. The data logger/transducer will be calibrated according to manufacturer specifications before the instrument goes into the field and before the bail-down test commences. Well drawdown also will be monitored simultaneously using a product/water level indicator for comparison.

Monterey Apartments Phase 1 RI will conform with the requirements defined by the QAPjP so as to be comparable within the data sets and to other data involving similar field measurements, analytical techniques, sample types, and sample conditions. Comparability also will be achieved by following standard, approved techniques and methods to collect the field measurements, analyze representative samples, perform data validation/evaluation; and by reporting the analytical results in appropriate units.