FOSTER WHEELER ENVIRONMENTAL CORPORATION

SWDIV CONTRACT NO. N44255-95-D-6030
DO NO. 0090

FINAL

SAMPLING AND ANALYSIS PLAN

Revision 0
September 7, 2001

WEST-SIDE AQUIFERS TREATMENT SYSTEM
AND EAST-SIDE AQUIFER TREATMENT SYSTEM
MOFFETT FEDERAL AIRFIELD
MOFFETT FIELD, CALIFORNIA

DCN: FWSD-RACII-01-0335

Southwest Division
Naval Facilities Engineering Command
Contracts Department
1220 Pacific Highway, Building 127, Room 112
San Diego, California 92132-5190

CONTRACT NO. N44255-95-D-6030
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DCN: FWSD-RACII-01-0335

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ABBREVIATIONS AND ACRONYMS

°C	degree Celsius
CCV	continuing calibration verification
COC	Chain-of-Custody
DHS	Department of Health Services
DO	Delivery Order
DoN	Department of the Navy
EATS	East-Side Aquifer Treatment System
EDD	electronic data deliverable
EPA	United States Environmental Protection Agency
EWI	Environmental Work Instruction
FWENC	Foster Wheeler Environmental Corporation
FSP	Field Sampling Plan
GAC	granular activated carbon
GC/MS	gas chromatograph/mass spectrometer
HCl	hydrochloric acid
HDPE	high-density polyethylene
HNO_3	nitric acid
ICAL	initial calibration
LCS	laboratory control sample
MCAWW	Method for the Chemical Analysis of Water and Wastes
MFA	Moffett Federal Airfield
µg/L	micrograms per liter
mg/L	milligrams per liter
mL	milliliter
MS/MSD	matrix spike/matrix spike duplicate
NA	not applicable
NAVFAC	Naval Facilities Engineering Command
NFESC	Naval Facilities Engineering Service Center
NPDES	National Pollution Discharge Elimination System
%R	percent recovery

ABBREVIATIONS AND ACRONYMS
(Continued)

QA	quality assurance
QAPP	Quality Assurance Project Plan
QC	quality control
RAC	Remedial Action Contract
RL	reporting limit
ROICC	Resident Officer in Charge of Construction
RPD	relative percent difference
SAP	Sampling and Analysis Plan
SM	Standard Method
SOP	standard operating procedure
SWDIV	Southwest Division Naval Facilities Engineering Command
TPH-extractable	total extractable petroleum hydrocarbons
TPH-purgeable	total purgeable petroleum hydrocarbons
VOA	volatile organic analysis
VOC	volatile organic compound
WATS	West-Side Aquifers Treatment System

1.0 INTRODUCTION

This Sampling and Analysis Plan (SAP) was prepared by Foster Wheeler Environmental Corporation (FWENC) to support sampling activities at the East-Side Aquifer Treatment System (EATS) and West-Side Aquifers Treatment System (WATS) at Moffett Federal Airfield (MFA) (Formerly Naval Air Station Moffett Field) in Moffett Field, California. This SAP was prepared on behalf of the United States Department of the Navy (DoN), Southwest Division Naval Facilities Engineering Command (SWDIV) under Delivery Order (DO) No. 0090, issued under Remedial Action Contract (RAC) No. N44255-95-D-6030. This SAP describes field sampling procedures, data gathering methods, and quality control (QC) requirements for this project.

1.1 OBJECTIVE

The objective of this project is to conduct performance monitoring in accordance with the National Pollution Discharge Elimination System (NPDES) permit for EATS and WATS.

2.0 BACKGROUND

Site location and background, including a site description, are presented in the *EATS/WATS Final Operation and Maintenance Manual* (Tetra Tech EM, Inc., 2000). Information presented in this manual will not be duplicated here.

3.0 MAPS

Figures showing the locations of the site project area are included in the *EATS/WATS Final Operation and Maintenance Manual* (Tetra Tech EM, Inc., 2000) and will not be duplicated here.

4.0 SAMPLING STRATEGY

This section discusses the collection and analysis of samples to meet the project objectives during field activities.

4.1 EATS SAMPLING

Performance monitoring samples will be collected as described below:

Analysis	SP1 System Influent	SP2 Air Stripper Effluent	SP3 Bag Filter Effluent	SP4 Lead GAC Unit Effluent	SP5 System Effluent	R1/R2
VOC	Monthly	Quarterly	--	Quarterly	**Monthly**	**Variable**
TPH-purgeable	Monthly	--	--	--	**Monthly**	**Variable**
TPH-extractable	Monthly	--	--	--	**Monthly**	**Variable**
Hardness	Annually	--	--	--	**Annually**	**Annually**
Bioassay	--	--	--	--	**Annually**	--
Metals	Annually	--	--	--	**Annually**	--
FIELD PARAMETERS						
pH	**Monthly**	--	--	--	**Monthly**	--
Dissolved Oxygen	--	--	--	--	--	**Annually**
Temperature	Monthly	--	--	--	**Monthly**	--
Turbidity	Annually	--	--	--	**Annually**	--

Notes:

- GAC – granular activated carbon
- SP – sample port
- TPH-extractable – total extractable petroleum hydrocarbons
- TPH-purgeable – total purgeable petroleum hydrocarbons
- VOC – volatile organic compound
- "- -" – indicates analysis not performed
- **BOLD** denotes NPDES permit-required samples and analysis.
- Normal font denotes sampling and analysis to monitor system component performance.
- Field parameters (pH and temperature) to be collected at each sampling point.
- "VARIABLE" denotes sample collected within 24 hours after an exceedence is identified in the system effluent.
- "R1/R2" denotes receiving water samples. R1 will be collected from the Northern Channel, immediately downstream of Building 191. R2 will be collected from the Northern Channel adjacent to the bridge to the fuel pier.

4.2 WATS SAMPLING

Performance monitoring samples will be collected as described below:

Analysis	SP1 System Influent	SP2 Tank T-101 Effluent	SP3 Tank T-102 Effluent	SP4 AOP Effluent	SP5 Air Stripper Effluent	SP307 GAC Effluent	SP308 GAC Effluent	SP309 GAC Effluent	SP310 GAC Effluent	SP6 System Effluent	R1/RD2
VOC	Monthly	Quarterly	Quarterly	Monthly	Monthly	Monthly	Monthly	Monthly	Monthly	**Monthly**	**Variable**
TPH-purgeable	Monthly	--	--	Quarterly	Quarterly	Quarterly	Quarterly	Quarterly	Quarterly	**Monthly**	**Variable**
TPH-extractable	Monthly	--	--	Quarterly	Quarterly	Quarterly	Quarterly	Quarterly	Quarterly	**Monthly**	**Variable**
Hardness	Annually	--	--	--	--	--	--	--	--	**Annually**	**Annually**
Bioassay	--	--	--	--	--	--	--	--	--	**Annually**	--
Metals	Annually	--	--	--	--	--	--	--	--	**Annually**	--
FIELD PARAMETERS											
pH	**Monthly**	Quarterly	Quarterly	**Monthly**	**Monthly**	**Monthly**	**Monthly**	**Monthly**	**Monthly**	**Monthly**	**Q/V**
Dissolved Oxygen	--	--	--	--	--	--	--	--	--	--	Annually
Temperature	Monthly	Quarterly	Quarterly	Quarterly	Quarterly	Quarterly	Quarterly	Quarterly	Quarterly	Monthly	Annually
Turbidity	--	--	--	--	--	--	--	--	--	**Annually**	--

Notes:

- AOP – advanced oxidation process
- GAC – granular activated carbon
- Q/V – denotes quarterly and within 24 hours after an exceedence is identified in the system effluent.
- SP – sample port
- TPH-extractable – total extractable petroleum hydrocarbons
- TPH-purgeable – total purgeable petroleum hydrocarbons
- VOC – volatile organic compound
- "- - "– indicates analysis not performed
- ***BOLD*** *denotes NPDES permit-required samples and analysis.*
- Normal font denotes sampling and analysis to monitor system component performance.
- "VARIABLE" denotes sample collected within 24 hours after an exceedence is identified in the system effluent.
- "R1/RD2" denotes receiving water samples. R1 will be collected from the Northern Channel, immediately downstream of Building 191. RD2 will be collected from the Northern Channel adjacent to the bridge to the fuel pier.

5.0 REQUEST FOR ANALYSIS

This section describes analytical methods, containers, preservative requirements, and field and laboratory quality control samples.

5.1 ANALYTICAL METHODS

The following analytical methods will be used for this project in conjunction with *Test Methods for Evaluating Solid Waste, Physical Chemical Methods, SW-846* [United States Environmental Protection Agency (EPA), 1994].

- Volatile organic compounds (VOCs) by EPA Method 8260B
- Total purgeable petroleum hydrocarbons (TPH-purgeable) by EPA Method 8015B
- Total extractable petroleum hydrocarbons (TPH-extractable) by EPA Method 8015B
- Hardness by EPA Method 130.2, Method for the Chemical Analysis of Water and Wastes (MCAWW) or Standard Method (SM) 2340B
- Bioassay by 96-hour static fish toxicity using rainbow trout
- Metals by EPA Method 6010B/6020A/7000

5.2 SAMPLE CONTAINERS, PRESERVATIVES, AND HOLDING TIMES

Table 1 lists the sample containers, preservatives, and holding time requirements for samples.

5.3 FIELD QUALITY CONTROL SAMPLES

Field QC samples will be collected and analyzed during the project to assess the consistency and performance of the sampling program. Field QC samples for this project could include field duplicates and trip blanks.

5.3.1 Field Duplicates

Field duplicates consist of two samples (an original and a duplicate) of the same matrix collected at the same time and location to the most accurate extent possible and using the same sampling techniques. The purpose of field duplicate samples is to evaluate the precision of the overall sample collection and analysis process. Field duplicates will be collected at a frequency of one (1) per every 10 samples per matrix and will be analyzed for the same analytes as the original sample. Field duplicates receive unique sample numbers; therefore, the identity of the duplicate samples is "blind" to the analytical laboratory. Exact locations of duplicate samples and their identifications will be recorded in the field logbook.

5.3.2 Trip Blanks

Trip blanks are hydrochloric acid (HCl) preserved organic-free water prepared by the laboratory in 40-milliliter (mL) volatile organic analysis (VOA) vials that will be carried into the field, stored with the sample, and returned to the laboratory for VOC analysis. Trip blanks will be used to determine if samples have been cross-contaminated with VOCs during sample collection and transportation. Trip blanks will be provided and analyzed for each VOC sampling and shipping event.

5.4 LABORATORY QUALITY CONTROL SAMPLES

The laboratory will analyze one (1) matrix spike/matrix spike duplicate (MS/MSD) for every 20 project samples. In order for the laboratory to prepare a project-specific MS/MSD, field personnel will collect triple the sample volumes at a minimum of one (1) per sampling event, or one (1) per 20 samples collected per matrix. Field personnel will designate one (1) sample in 20 for MS/MSD analysis on the Chain-of-Custody (COC) form.

6.0 FIELD METHODS AND SAMPLING PROCEDURES

The following sections present sampling procedures and sample handling procedures to be used for this project.

6.1 EATS SAMPLING PROCEDURES

Samples will be collected starting at sample port (SP)5 and ending with SP1. SP5 will always be the system effluent, and SP4 will always be the lead granular activated carbon (GAC) bed effluent. Thus, if the GAC vessels are valved so that V-108 is the lead unit and V-109 is the polishing unit, the sample port on V-108 will be SP4 and the sample port on V-109 will be SP5.

Each sample port should be purged by filling a 1-liter container with purgewater. Field parameters such as pH, dissolved oxygen, temperature, or turbidity should be measured using the purgewater. This water then should be disposed of in the sump of the EATS secondary containment pad. Samples should be collected in the following order: VOCs, TPH-purgeable, TPH-extractable, hardness, bioassay, and metals (Table 1).

Due to previous problems in collecting headspace-free samples for VOA and TPH-purgeable analysis, the 40-mL vials used for these samples should be unpreserved. Lack of preservative reduces the holding times for the samples from 14 to 7 days.

All field equipment shall be calibrated prior to use and decontaminated in accordance with Section 6.3. Samples will be numbered, labeled, and packaged in accordance with Sections 6.4 through 6.6. Field documentation including field logbooks and COCs will be filled out in accordance with Section 6.7.

6.2 WATS SAMPLING PROCEDURES

Samples will be collected starting at SP6 and ending with SP1 (Figure 2). Each sample port should be purged by filling a 1-liter container. Field parameters such as pH, dissolved oxygen, temperature, or turbidity should be measured using this water. This water then should be disposed of in the sump of the WATS secondary containment pad. Samples should be collected in the following order: VOCs, TPH-purgeable, TPH-extractable, hardness, bioassay, and metals (Table 1).

Due to previous problems in collecting headspace-free samples for volatile organic analysis and TPH-purgeable analysis, the 40-mL vials used for these samples should be unpreserved. Lack of preservative reduces the holding times for the samples from 14 to 7 days.

Samples will be numbered, labeled, and packaged in accordance with Sections 6.4 through 6.6. Field documentation including field logbooks and the COC will be filled out in accordance with Section 6.7.

6.3 DECONTAMINATION PROCEDURES

Decontamination of nondisposable sampling equipment will be performed to prevent the introduction of extraneous material into samples and to prevent cross-contamination between samples. All sampling equipment will be decontaminated by steam cleaning or by washing with a nonphosphate detergent, such as Liquinox™, or equivalent.

The following steps will be followed for decontamination of nondisposable sample equipment:

1. **Wash with nonphosphate detergent and water solution**—This step will remove all visible contamination from the equipment. Using a 5-gallon bucket approximately 75 percent full of solution and a long-handled brush is suggested for this step. Dilute nonphosphate detergent as directed by the manufacturer.
2. **Rinse with potable water**—This step will rinse all the detergent solution away from equipment. Using a 5-gallon bucket approximately 75 percent full of water and a long-handled brush is suggested for this step. Periodic changing of this water is required.
3. **Rinse with deionized/laboratory reagent-grade water**—This step will rinse any detergent solution and potable water residues. Rinsing is most effective when water is applied using a stainless steel Hudson-type sprayer or Nalgene® squeeze bottle while holding equipment over a 5-gallon bucket.
4. **Rinse with deionized/laboratory reagent-grade water**—This step will be a final rinse to remove any contaminants. Rinsing is most effective when water is applied using a stainless steel Hudson-type sprayer or Nalgene® squeeze bottle while holding equipment over a 5-gallon bucket.

6.4 SAMPLE NUMBER

All samples submitted to an analytical laboratory will be uniquely numbered according to the following format:

0090-WATS-YYY or 0090-EATS-YYY

Where, 0090, is the four-digit DO number, WATS/EATS is the treatment system, and YYY is a sequential number for this project. The sample number will be recorded in the field logbook and on the COC form at the time of sample collection. A complete description of the sample and sampling circumstances will be recorded in the field logbook and referenced using the unique sample identification number.

6.5 SAMPLE LABELING

Sample labels will be filled out with indelible black ink and will be affixed to each sample container. Each sample label will be covered with clear tape. Each sample container will be labeled with the following, at a minimum:

- Sample identification number
- Sample collection date (month/day/year)
- Time of collection (24-hour clock)
- Sampler's initials
- Analyses to be performed
- Preservation (if any)

6.6 SAMPLE PACKAGING AND SHIPMENT

Immediately after sample labeling, custody seals will be affixed to each sample container. Each sample will be placed in double resealable plastic bags to keep the sample container and label dry. (For VOA containers, place the signed custody seal on the outside of the first resealable bag. Then place the container in another resealable bag. This will prevent any contact with the adhesive from the custody seal and the VOA containers.) All glass sample containers will be protected with bubble wrap if transported by a commercial carrier.

Each cooler will be shipped with a temperature blank. A temperature blank is a sample container filled with tap water and stored in the cooler during sample collection and transportation. The temperature of the temperature blank will be recorded by the laboratory on the COC form immediately upon receipt of the samples.

Sample cooler drain spouts will be taped from the inside and outside of the cooler to prevent any leakage.

Samples transported by a laboratory assigned courier will be packed in a sample cooler with ice in a sufficient quantity to keep the samples cooled. Two custody seals will be taped across the cooler lid: one seal in the front and one seal in the back. Clear tape will be applied to the custody seals to prevent accidental breakage during transport. The COC form will be completed and signed by the courier. The cooler and the top two copies (white and pink) of the COC form will then be released to the courier for transportation to the laboratory.

Samples shipped by a commercial carrier will be packed in a sample cooler lined with a plastic bag. Double-bagged ice will be added to the cooler in a sufficient quantity to keep the samples cool for the duration of the shipment to the laboratory. Saturday deliveries must be coordinated with the laboratory, and the airbill and cooler must be marked appropriately. The COC form will include the airbill number in the "transfers accepted by" column, and the top two copies of the

COC form will be sealed in a double resealable bag. The COC form will then be taped to the inside of the sample cooler lid. Two custody seals will be taped across the cooler lid: one seal in the front and one seal in the back. Clear tape will be applied to the custody seals to prevent accidental breakage during shipping. The cooler will be taped shut with strapping tape. The samples will then be shipped to the analytical laboratory. A copy of the courier airbill will be retained for documentation.

6.7 FIELD DOCUMENTATION

At a minimum, sampling information will be recorded on the COC form and in the field logbook. Both documents will be completed in the field at the time of sample collection. All entries will be legible and will be recorded in indelible black ink.

6.7.1 Chain-of-Custody

The following will be recorded on the COC form:

- Project name
- Project location
- Project number (FWENC)
- Purchase order number
- Sample ID
- Sampler's name
- Sampler's signature
- Project contact
- Airbill number (if applicable)
- Date (of sample collection)
- Time (of sample collection to the nearest minute, 24-hour clock)
- Sample type (matrix)
- Turn-around-time
- Sample location codes:

Examples:

EATS samples:
SP1-SYSTEM INFLUENT
SP2-AIR STR EFFLUENT
SP3-BAG FIL EFFLUENT
SP4-GAC EFFLUENT
SP5-SYSTEM EFFLUENT
R1
R2

WATS samples:

SP1-SYSTEM INFLUENT
SP2-TANK101 EFFLUENT
SP3-TANK102 EFFLUENT
SP4-AOP EFFLUENT
SP5-AIR STR EFFLUENT
SP307-GAC EFFLUENT
SP308-GAC EFFLUENT
SP309-GAC EFFLUENT
SP310-GAC EFFLUENT
SP6-SYSTEM EFFLUENT
R1
RD2

- Sample depth in feet (start, end)
- QC type:

  REG: regular sample
  TB: trip blank
  FD: field duplicate

- Laboratory name
- Number of sample containers
- Analyses required
- Comments
  - MS/MSD samples
  - Observations specific to sample
- Transfer signature (to relinquish samples)
  - The sampler will be the first person to relinquish sample possession
- Courier/laboratory representative's signature (for commercial carrier, record airbill number here)
- Date/time (of custody transfer)
- Laboratory instruction
- Data package requirement (Level III or IV)

6.7.2 Field Logbooks

A permanently bound field logbook with consecutively numbered pages, used for sampling activities only, will be assigned to this project. All entries will be recorded in indelible black ink. At the end of each workday, the logbook pages will be signed by the responsible sampler and any unused portions of logbook pages will be crossed out, signed, and dated.

If it is necessary to transfer the logbook to another person, the person relinquishing the logbook will sign and date the last page used, and the person receiving the logbook will sign and date the next page to be used.

At a minimum, the logbook will contain the following information:

- Project name and location
- Date and time
- Personnel in attendance
- General weather information
- Work performed
- Field observations
- Sampling performed, including specifics such as location, type of sample, type of analyses, and sample identification
- Field analyses performed, including results, instrument checks, problems, and calibration records for field instruments
- Descriptions of deviations from the Sampling and Analysis Plan
- Problems encountered and corrective action taken
- Identification of field QC samples
- QC activities
- Verbal or written instructions
- Any other events that may affect the samples

6.7.3 Document Corrections

Changes or corrections on any project documentation will be made by crossing out the item with a single line, and initialing (by the person performing the correction) and dating the correction. The original item, although erroneous, must remain legible beneath the cross-out. The new information should be written clearly above the crossed-out item.

7.0 PROJECT ORGANIZATION

This section identifies the individuals who are responsible for the oversight and/or implementation of the proposed field activities. The Project Organization Chart is shown in Figure 1. The responsibilities of the team members associated with the sampling activities are presented in Table 2.

7.1 LIST OF POINTS OF CONTACT

The following is a list of the key contacts for the project:

Agency	Contact	Title
Southwest Division Naval Facilities Engineering Command 1220 Pacific Highway San Diego, CA 92132-5190	Art Tamayo (619) 532-0981 Mary Parker (619) 532-0945 Narciso A. Ancog (619) 532-2540	Base Environmental Coordinator (Interim) Remedial Project Manager Quality Assurance Officer
Moffett Federal Airfield ROICC Office Building 107 Moffett Federal Airfield, CA 94035	Gary Munekawa (650) 603-9834 David Smith (650) 603-9836	Project Engineer, ROICC Construction Management Technician, ROICC
NASA Ames Building 218, Duran Street Moffett Federal Airfield, CA 94035	Don Chuck (650) 604-0237	Environmental Restoration Specialist
Foster Wheeler Environmental 1230 Columbia Street, Suite 640 San Diego, CA 92101	Pete Everds (619) 234-8696, ext 204	Project Manager
Foster Wheeler Environmental c/o Naval Weapons Station Gardeners Road and Industrial Road 800 Seal Beach Boulevard Seal Beach, CA 90740	Terri Ryland (562) 936-5887 Mary Schneider (562) 936-5881 Lisa Bienkowski (562) 936-5889	Technical Lead Program Quality Control Manager Project Chemist

8.0 QUALITY ASSURANCE OBJECTIVES

The overall quality assurance (QA) objectives of this SAP are to outline procedures for the collection and assessment of data that are within acceptable ranges of precision and accuracy. The data quality associated with environmental data is a function of the sampling plan rationale and the procedures used to collect the samples as well as the analytical methods and instrumentation used. However, uncertainty cannot be eliminated entirely from environmental data.

8.1 DATA QUALITY OBJECTIVES

Data quality objectives are not applicable for this project.

8.2 ANALYTICAL DATA QUALITY OBJECTIVES

Analytical data will be obtained using standard methods in a state of California-certified and DoN-evaluated laboratory. The QC criteria are defined in this section. The analytical methods used, project required reporting limits, and project QC criteria are also described.

8.2.1 Quality Control Criteria

QC criteria definitions are as follows:

- **Precision**—A measure of the reproducibility of a set of replicate results or the agreement among repeat observations made under the same conditions. Analytical precision is the measurement of the variability associated with duplicate or replicate analyses. For this project, a laboratory control sample (LCS) will be used to determine the precision of the analytical method. Total precision is the measurement of the variability associated with the entire sampling and analysis process. It is determined by analysis of duplicate field samples and measures variability introduced by both the laboratory and field operations. Field duplicate and MSD samples will be used to assess field and analytical precision, and the precision measurement will be determined using the relative percent difference (RPD) between the duplicate sample results. The formula for calculating the RPD is as follows:

  $$RPD = 100 \times 2 \times (\text{result} - \text{duplicate result})/(\text{result} + \text{duplicate result})$$

- **Accuracy**—The nearness of a result or the mean of a set of results to the true or accepted value. Analytical accuracy is measured by comparing the percent recovery (%R) of analytes spiked into a LCS against a control limit. Surrogate compound recoveries are also used to assess accuracy and method performance for each sample analyzed. The formula for calculating accuracy uses the following equation to determine %R of specific analytes.

  $$\%R = 100 \times (\text{spiked sample result} - \text{unspiked sample result})/\text{amount of spike added}$$

- **Representativeness**—The degree to which sample data accurately and precisely represents a characteristic of a population, parameter variations at a sampling point, or an environmental condition. Representativeness is a qualitative parameter mostly concerned with the proper design of the sampling program.

8.2.2 Project Reporting Limits

The reporting limits established for this project are identified in Table 3.

8.2.3 Project Quality Control Limits

The precision and accuracy QC limits for each method are identified in Table 4.

8.3 LABORATORY SAMPLE CUSTODY AND DOCUMENTATION

The samples will be delivered to the person in the laboratory authorized to receive samples (referred to as the sample custodian). Upon receipt of a sample, the sample custodian will inspect the condition of the sample (including the temperature of the cooler) and the custody seal, reconcile the information on the sample label against that on the COC form, assign a laboratory number, log the sample in the laboratory logbook, and store it in a secured sample storage room.

The FWENC Project Chemist will be informed immediately of any inconsistencies between the COC form and the sample containers received. Any deviations from accepted sample-handling procedures will be documented, and the FWENC Project Chemist will be informed.

Changes or corrections on any project documentation will be made by crossing out the item with a single line and initialing (by the person performing the correction) and dating the correction. The original item, although erroneous, must remain legible beneath the cross-out. The new information will be written above the crossed-out item. Corrections must be written clearly and legibly with indelible black ink.

9.0 ANALYTICAL QUALITY CONTROL PROCEDURES

This section describes analytical quality control procedures, including laboratory qualification, QA program, and QC procedures associated with analytical methods.

9.1 LABORATORY QUALIFICATION

The analytical laboratories selected to analyze samples for this project will be certified by the California Department of Health Services (DHS) through the Environmental Laboratory Accreditation Program for all of the analytical methods required for the project. In addition, the laboratory must successfully complete the Naval Facilities Engineering Service Center (NFESC) Laboratory Evaluation Program prior to sampling activities and maintain that status throughout the project.

Laboratories selected for the project must be capable of providing the required turnaround times, project QC, and data deliverables required by this SAP.

9.2 LABORATORY QUALITY CONTROL PROCEDURES

The analytical laboratory must have written standard operating procedures (SOPs) defining the instrumentation, instrumentation maintenance, tuning, calibration, method detection limits, QC acceptance criteria, blank requirements, and stepwise procedures for each analytical method. The SOPs must be available to the analysts in the laboratory. The SOPs must meet or exceed the requirements of the methods cited in Section 8.2 of this SAP. The laboratory must maintain logs of all activities that have an impact on the quality of the laboratory results.

Any portion of the method that is subcontracted by the laboratory to another laboratory or sent to another facility of the same network of laboratories must have the prior approval of the FWENC Project Chemist.

The laboratory must maintain the instruments required by the methods specified for the analyses. Sufficient redundancy in equipment must be available in the laboratory to handle downtime situations.

Method substitution because of instrumental failure will not be permitted without specific approval from the FWENC Project Chemist.

9.3 LABORATORY QUALITY CONTROL SAMPLES

9.3.1 Calibration

All instruments and equipment must be calibrated in accordance with the specified methods, unless different instructions are included in this document.

Initial calibrations are performed when the method is first used and again whenever the continuing calibrations fail to meet their respective acceptance criteria. In addition, if the instrument undergoes significant maintenance, the initial calibration must be repeated.

Continuing calibrations are used to verify that the instrument performance has remained within the limits set at the time of the initial calibration. The frequency of continuing calibrations is method-dependent.

9.3.2 Instrument Blanks

Instrument blanks are run to ensure that analytes from previous runs are out of the system and do not contaminate succeeding runs. Instrument blanks must be run following calibration runs, before sample analyses are performed, and after samples that contain high concentrations of potentially interfering materials.

Target analytes must not appear in the instrument blanks at concentrations greater than the required quantitation limits. If the laboratory consistently observes contaminants in the instrument blanks, the laboratory must investigate the source of the contamination and eliminate it, if possible.

9.3.3 Method Blanks

Method blanks are prepared in the same manner as the samples, using the same reagents and glassware used for samples. The purpose of the method blank is to ensure that the equipment and reagents used in preparing the samples are free of contaminants that could interfere with the analysis.

The method blank must not exhibit analytes at concentrations greater than the required quantitation limits. If contaminants are found that either contribute to the apparent concentration of a particular target analyte or interfere with the analysis, the analysis sequence must be stopped, the source of contamination identified and corrected, and the analysis repeated. Contamination in the method blank above reporting limits will require that the entire associated batch of extracts or digestates be re-prepared. Hence, it is very important to make sure that no such contamination is present.

9.3.4 Laboratory Control Samples

LCSs are purchased samples containing known concentrations of specific target analytes. LCSs can also be prepared by spiking known amounts of target analytes into a well-characterized blank matrix. The matrix will be laboratory reagent water for water samples and clean sand for soil samples.

The LCS is prepared and run with the associated samples, using the same reagents. All analytes in the LCS must meet recovery criteria. If the criteria are not met, the entire batch of samples must be re-prepared, together with a new LCS, and reanalyzed.

9.3.5 Matrix Spike and Matrix Spike Duplicate

The MS/MSD serves to determine whether matrix effects are affecting recoveries. For inorganic analyses, only a single matrix spike is performed per batch. A MS/MSD is prepared by spiking a known amount of solution to two portions of a sample being run in a batch. Once the spike is added to the MS/MSD samples, these samples are carried through the complete sample preparation process along with the other samples in the batch. The MS/MSD recoveries are compared against each other and against the known amount of the spike. From this data, both accuracy and precision can be determined. The laboratory will perform a MS/MSD at a frequency of one (1) per 20 project samples per matrix.

9.3.6 Duplicates

Two types of duplicates, field and laboratory, will be performed. Field duplicates are two samples that are duplicates of each other. The purpose of field duplicates is to measure the consistency of field sampling. The field duplicate is treated the same as the other field samples and identification is withheld from the laboratory. Field duplicates will be collected at a frequency of one (1) for every 10 samples per site per matrix. Field duplicates will not be applicable to the collection of waste characterization samples.

The laboratory duplicate is created by the laboratory, where two aliquots are intentionally taken from the same sample and analyzed in parallel. This analysis serves to measure the precision of laboratory operations. Duplicate analyses will be applied only for inorganic analyses.

9.4 PREVENTIVE MAINTENANCE

All instruments must be maintained in accordance with the manufacturers' recommended procedures. The laboratory must define in its QA plan the frequency and type of maintenance for each instrument. The laboratory must also record all maintenance activities in an instrument logbook.

In addition to preventive maintenance, the laboratory must keep a sufficient supply of replacement parts on hand for those parts known to require frequent changes due to wear and tear or contamination.

Whenever preventive or corrective maintenance is applied to an instrument, the laboratory must demonstrate the instrument's return to operating conditions and must recalibrate the instrument prior to resumption of sample analyses.

9.5 DATA REVIEW

All data reported by the laboratory must be reviewed in accordance with the SOPs. At a minimum, the written guidelines must be in accordance with the *Navy Installation Restoration Chemical Data Quality Manual* [Naval Facilities Engineering Command (NAVFAC), 1999a] and the following requirements.

9.5.1 Analyst Review

Each analyst that generates a data set is responsible for ensuring that the data comply with the method and project-specific requirements, and that any deviations or failure to meet criteria are documented for the project file.

9.5.2 Peer Review

One hundred percent of all data sets must be reviewed by an independent peer analyst. Peer reviews must be performed by an analyst that is qualified to perform the subject analytical method. The peer review must be comprehensive and include documentation of the following:

- Check 100 percent of manual entries for transcription errors
- Check 100 percent of manual calculations for accuracy
- Spot check computer calculations to verify program validity
- Check for compliance with method- and project-specific QC requirements
- Check for completeness of raw data or supporting materials
- Confirm spectral assignments and identification of tentatively identified compounds
- Check descriptions of deviations from methods or requirements
- Check for appropriate use of significant figures and rounding
- Check reported values for dilutions
- Evaluate reasonableness of results

9.5.3 Technical Reviews

Technical reviews by the responsible supervisor or designated alternate must be performed on 100 percent of reported data. The same individual may not perform peer and technical reviews on the same data set. The technical review must include documentation of the following:

- Check for compliance with method and project-specific requirements
- Check the completeness of the reported information
- Check the information in the report narrative

- Evaluate the reasonableness of the results

If the responsible supervisor is the only qualified peer reviewer for a method, the requirement for the technical review is waived.

9.5.4 Management Review

One hundred percent of all data must receive management approval prior to release. The scope and content of management's review is at the laboratory's discretion. Authority to release data may be delegated to a technical supervisor or other party, if the term of the delegated authority is documented in the QA program file.

9.5.5 QA Review

QA reviews of data from each section of the laboratory must be conducted on a routine basis. Annually, at least 10 percent of data reports generated using each analytical method must be reviewed by a member of the QA staff. The QA reviews must include documentation of the following:

- Check for compliance with required QC practices
- Check for compliance with approved SOPs
- Check for compliance with method and project requirements

QA data reviews may be conducted after the subject data have been reported by FWENC.

9.6 DELIVERABLES

The following sections describe the deliverable documents that will be submitted to FWENC by the analytical laboratory.

9.6.1 Hardcopy Deliverables

Two copies of the hardcopy data will be submitted to FWENC by the laboratory. The report pages will be numbered. The report will contain a table of contents referencing individual sections in the data package, original COC forms, a copy of all corrective action reports, and a case narrative documenting the resolution of all corrective actions and noncompliance events. All FWENC samples will be cross-referenced to the associated QC samples. In order to perform validation, two types of data packages will be required. They will be referred to as EPA Level III packages.

For this project, FWENC will request that 100 percent of the data be submitted in an EPA Level III-equivalent data package. All data packages will be assembled in the following sequence:

- Cover page (with laboratory service identification number, FWENC project name, and FWENC project number)
- Original COC forms (including cooler temperature)
- Sample receipt forms
- Cross-reference table
- Case narrative
- Organic raw data sequence (by test):
  - Sample result forms, including method blanks
  - Surrogate summaries (surrogate results may appear on the sample result forms)
  - QC summaries
  - Tune data [gas chromatograph/mass spectrometer (GC/MS) only]
  - Initial calibration (ICAL)
  - Daily calibration checks, including related continuing calibration verifications (CCVs)
  - Resolution check standards (GC/MS and pesticides)
  - Instrument run log
  - Sample preparation log

  (*) = For EPA Level III, include a copy of chromatogram of each field sample for all TPH analyses

9.6.2 Electronic Deliverables

The electronic data deliverable (EDD) will be in ASCII format. This will be compatible with the DoN Environmental Data Transfer Standard. The laboratory will certify that the EDD and the hardcopy reports are identical. Both the EDD and the hardcopy will present results to one to three significant figures. For inorganic results, two (2) significant figures will be used for results less than 10, and three (3) significant figures will be used for results greater than 10. For organic results, one (1) significant figure will be used for results less than 10, and two (2) significant figures will be used for results greater than 10. The EDD for each sample delivery group is due at the same time as the hardcopy, 21 days after the last sample of the sample delivery group has been delivered to the laboratory.

10.0 DATA QUALITY MANAGEMENT

10.1 DATA MANAGEMENT

The following sections describe the requirements for the management of hardcopy data and electronic data.

10.1.1 Hardcopy

All relevant raw data and documentation, including, but not limited to, logbooks, data sheets, electronic files, and final reports, will be maintained by the laboratory for at least 7 years. FWENC will be notified 30 days before disposal of any relevant laboratory records.

FWENC will maintain copies of all COC forms. Laboratory reports will be logged in upon receipt and filed in chronological order. The second copy of the report will be sent for third-party data validation.

10.1.2 Electronic Data

Field information (date and time collected, sample identification, etc.) will be entered directly into the main database from the COC form or uploaded from electronic files generated in the field.

Upon receipt by the FWENC Management Information System Data Manager, electronic data will be uploaded into a Microsoft Access database. The uploaded data will be processed to compare the fields against a list of required values. If any errors are returned by the program, the file will be manually edited or regenerated by the laboratory. The laboratory database will be merged with the field database, and reports will be generated from the merged database.

10.2 DATA VALIDATION

Data validation is not required for compliance samples.

10.3 DATA REVIEW

Data will be reviewed by the FWENC Project Chemist. The evaluation of data will be based on the results of the QC samples, the level of contamination of samples indicated by the blank analysis, and the overall indication of interference due to contamination. The following data qualifiers will be used in the report:

J - Result is estimated
U - Analyte is not detected at or above the stated reporting limit

11.0 QUALITY ASSURANCE OVERSIGHT

QA oversight for this project will include system audits of field activities and of the laboratory subcontracted by the DoN to perform the analysis.

11.1 FIELD AUDITS

The FWENC and SWDIV QA Officers may schedule audits of field activities at any time to evaluate the execution of sample collection, identification, and control in the field. The audit will also include observations of COC procedures, field documentation, instrument calibrations, and field measurements.

Field documents and COC forms will be reviewed to ensure that all entries are printed or written in indelible black ink, dated, and signed.

Sampling operations will be reviewed and compared to the Field Sampling Plan (FSP), the Quality Assurance Project Plan (QAPP), and other applicable SOPs. The auditor will verify that the proper sample containers are used, the preservatives are added or are already present in the container, and the documentation of the sampling operation is adequate.

Field measurements will be reviewed by random spot-checking to determine that the instrument is within calibration, that the calibration is done at the appropriate frequency, and that the sensitivity range of the instrument is appropriate for the project.

11.1.1 Corrective Action

All nonconformance and corrective actions will be processed in accordance with FWENC Procedure QC-3. This procedure is presented in Attachment 5 of the Final Contractor Quality Control Plan (FWENC, 1999).

The FWENC Program Quality Control Manager will monitor corrective action documentation, verify implementation of corrective action, track and analyze corrective action, and closeout corrective action documentation upon completion of corrective action.

11.2 LABORATORY AUDITS

Laboratories selected to perform the analyses are required to have successful completion of NFESC and California DHS laboratory evaluation processes throughout the project. These processes consist of laboratory QA plan review, performance evaluation samples, data package review, and an on-site audit. Because of this requirement, FWENC will not perform an on-site audit or visit unless it is deemed necessary.

Laboratory oversight by FWENC will be through the review of the preliminary report and hardcopy data packages. The information that may be obtained from the data packages consists of the following:

- Correct chain-of-custody procedures
- Adherence to method or QAPP holding times
- Method detection limits and reporting limits
- Spiking levels, frequency, and recovery
- Accuracy of analytical operations through the LCS

11.2.1 Corrective Action

The laboratory will have a QA/QC and corrective action program that addresses all out-of-control situations. Following completion of analyses, laboratory personnel will verify compliance with the minimum QC requirements of the project and the laboratory QA/QC plan. If any of the parameters fall outside the control limits, corrective action will be implemented.

Initial corrective action is to verify that no obvious calculation errors have occurred. If appropriate, reanalysis will be performed. If the reanalysis confirms the initial out-of-control limits result, the chemist will notify the laboratory supervisor, who will initiate the corrective action process. Corrective actions may include, but are not limited to, the following:

- Verification of dilution factors
- Examination of sample for nonhomogeneity
- Verification of sample preparation
- Checking of standard preparation logbook
- Verification of instrument performance
- Checking of reagent water purity
- Monitoring chemist's method performance for procedure verification

Notification and prompt involvement of the FWENC Project Chemist in the corrective action process are absolutely necessary in determining an appropriate resolution. Corrective action records will document all steps taken in the corrective action process, beginning with a description of the problem and ending with a final resolution. A copy of the corrective action report will be sent to the FWENC Project Chemist immediately and will be maintained in the project files at the FWENC office.

All corrective action reports will be maintained by the laboratory in a project file and delivered to FWENC as part of the hardcopy deliverable.

12.0 REFERENCES

Foster Wheeler Environmental Corporation (FWENC). 1999. *Final Contractor Quality Control Plan.*

Tetra Tech EM, Inc. August 2000. *EATS/WATS Final Operation and Maintenance Manual.*

U.S. Environmental Protection Agency (EPA). 1994. *Test Methods for Evaluating Solid Waste, Physical Chemical Methods, SW-846,* Third Edition and Final Updates.

U.S Navy/Naval Facilities Engineering Command (NAVFAC), Southwest Division. 1999a. *Navy Installation Restoration Chemical Data Quality Manual.* September.

TABLES

TABLE 1

SAMPLE CONTAINERS, PRESERVATIVES, AND HOLDING TIME REQUIREMENTS

Analysis	Analytical Method	Container	Preservative	Holding Time
VOCs	EPA Method 8260B	3 40-mL VOA vials	Cool, 4±2°C	7 days
TPH-purgeable	EPA Method 8015B	3 40-mL VOA vials	Cool, 4±2°C	7 days
TPH-extractable	EPA Method 8015B	One 1-liter glass amber	Cool, 4±2°C	7 days to extract; 40 days to analyze
Hardness	EPA Method 130.2, MCAWW or SM2340B	250-mL HDPE container	Cool, 4±2°C	6 months
Bioassay	96-hour static fish toxicity using rainbow trout	5-gallon container	NA	36 hours
Metals	EPA Method 6010B/6020A/7000	500-mL HDPE container	pH ≤ 2 w/ HNO_3	6 months (except mercury which is 28 days)

Notes:

°C – degrees Celsius
EPA – United States Environmental Protection Agency
HDPE – high density polyethylene
HNO_3 – nitric acid
MCAWW – Methods for the Chemical Analysis of Water and Wastes
mL – milliliter
NA – not applicable
SM – Standard Method
TPH-extractable – total extractable petroleum hydrocarbons
TPH-purgeable – total purgeable petroleum hydrocarbons
VOA – volatile organic analysis
VOC – volatile organic compound

TABLE 2

PERSONNEL AND RESPONSIBILITIES

Key Position	Responsibility
SWDIV Quality Assurance Officer	• Provides governmental oversight of FWENC QA Program • Provides quality-related directives through Contracting Officer Representative • Provides technical and administrative oversight of FWENC surveillance audit activities • Point of contact for all matters concerning QA and the DoN Laboratory QA Program • Prepares governmental budget estimates for all QA functions included in FWENC contracts • Coordinates training on matters pertaining to generation and maintenance of quality of data • Authority to suspend project execution if QA requirements are not adequately followed
Project Chemist	• Develops sampling and analysis plan and QA project plan • Selects qualified subcontract laboratories • Implements chemical data QC procedures and performs auditing of field performance • Reviews laboratory data prior to use • Coordinates data validation of laboratory data • Reviews data validation report • Prepares and supports report preparation
Field Chemist/ Technician	• Performs all sampling in accordance with approved SAP • Ensures that field QA samples are collected as specified in the SAP • Completes sampling notes, forms, and sampling logs • Coordinates laboratory and field sampling activities • Implements corrective actions as required

TABLE 2

PERSONNEL AND RESPONSIBILITIES

Key Position	Responsibility
Remedial Project Manager	• Acts as project management from client perspective • Fulfills scope of work • Oversees cost and schedule • Is lead interface with Moffett Federal Airfield
Project Manager	• Executes all phases of a specific project and efficiently applies the full resources of the FWENC RAC Team • Manages all technical, quality, financial, and administrative aspects of the project • Identifies and completes documents appropriate to work assignments • Approves and maintains qualification records for all project personnel • Ensures and verifies that the project team completes all work tasks and QA/QC requirements of planning documents • Logs all variances to planning documents and ensures timely follow-up and approval by the DoN
Resident Officer in Charge of Construction	• Oversees the technical and QC of the field activities

Notes:

FWENC – Foster Wheeler Environmental Corporation
QA – Quality Assurance
QC – Quality Control
RAC – Remedial Action Contract
SAP – Sampling and Analysis Plan
SWDIV – Southwest Division Naval Facilities Engineering Command

TABLE 3

PROJECT REPORTING LIMITS

Parameter/Method	Analyte	Water RL	EATS Permit Limit	WATS Permit Limit	Units
VOCs	1,1,1-Trichloroethane	5	5	5	µg/L
EPA Method 8260B	1,1,2,2-Tetrachloroethane	5	5	5	µg/L
	1,1,2-Trichloroethane	5	5	5	µg/L
	1,1-Dichloroethane	5	5	5	µg/L
	1,1-Dichloroethene	5	5	5	µg/L
	1,2-Dichloroethane	0.5	0.5	0.5	µg/L
	1,2-Dichloropropane	5	5	5	µg/L
	2-Hexanone	5	5	5	µg/L
	Acetone	5	5	5	µg/L
	Benzene	1	1	1	µg/L
	Bromodichloromethane	5	5	5	µg/L
	Bromoform	5	5	5	µg/L
	Bromomethane	5	5	5	µg/L
	Carbon disulfide	5	5	5	µg/L
	Carbon tetrachloride	0.5	0.5	0.5	µg/L
	Chlorobenzene	5	5	5	µg/L
	Chloroethane	5	5	5	µg/L
	Chloroform	5	5	5	µg/L
	Chloromethane	5	5	5	µg/L
	cis-1,2-Dichloroethene	5	5	5	µg/L
	cis-1,3-Dichloropropene	5	5	5	µg/L
	Dibromochloromethane	5	5	5	µg/L
	Ethylbenzene	5	5	5	µg/L
	Methyl ethyl ketone	5	5	5	µg/L
	Methylene chloride	5	5	5	µg/L
	Methyl isobutyl ketone	5	5	5	µg/L
	Styrene	5	5	5	µg/L
	Tetrachloroethene	5	5	5	µg/L
	Toluene	5	5	5	µg/L
	trans-1,2-Dichloroethene	5	5	5	µg/L
	trans-1,3-Dichloropropene	5	5	5	µg/L
	Trichloroethene	5	5	5	µg/L
	Vinyl chloride	0.5	0.5	0.5	µg/L
	Xylenes (Total)	5	5	5	µg/L

TABLE 3

PROJECT REPORTING LIMITS

Parameter/Method	Analyte	Water RL	EATS Permit Limit	WATS Permit Limit	Units
TPH-purgeable EPA Method 8015B	C6-C12	50	50	50	µg/L
TPH-extractable EPA Method 8015B	C12-C24	50	50	50	µg/L
	C24-C36	500	NA	NA	
Hardness EPA 130.2, MCAWW or SM 2340B	Hardness	10	NA	NA	mg/L
Bioassay 96-hour static fish	Bioassay	NA	90% survival	90% survival	NA
Metals EPA Method 6010B/6020A/7000	Arsenic	5	17.2 [a]	7.9 [b]	µg/L
	Cadmium	2	11.5 [a]	5.2 [b]	µg/L
	Chromium	5	34.4 [a]	15.7 [b]	µg/L
	Copper	5	34.4 [a]	15.7 [b]	µg/L
	Lead	5	34.4 [a]	15.7 [b]	µg/L
	Mercury	0.2	0.57 [a]	0.3 [b]	µg/L
	Nickel	5	172 [a]	78.7 [b]	µg/L
	Selenium	5	115 [a]	52.4 [b]	µg/L
	Silver	5	17.2 [a]	7.9 [b]	µg/L
	Zinc	10	401 [a]	183.5 [b]	µg/L
pH/Field Measurement	pH	NA	6.5-8.5	6.5-8.5	NA

Notes:

EATS – East-Side Aquifer Treatment System
EPA – United States Environmental Protection Agency
MCAWW – Method for the Chemical Analysis of Water and Wastes
µg/L – micrograms per liter
mg/L – milligrams per liter
NA – not applicable
RL – reporting limit
SM – Standard Method
TPH-extractable – total extractable petroleum hydrocarbons
TPH-purgeable – total purgeable petroleum hydrocarbons
VOC – volatile organic compound
WATS – West-Side Aquifers Treatment System
[a] – based on 32 gallons per minute average flow rate
[b] – based on 70 gallons per minute average flow rate

TABLE 4

QUALITY CONTROL ACCEPTANCE CRITERIA

Method	Analyte	Accuracy Water (% R)	Precision Water (% RPD)	Accuracy Soil (% R)	Precision Soil (% RPD)
EPA Method 8260B	1,1-Dichloroethene	75-125	≤ 30	65-135	≤ 30
	Benzene	75-125	≤ 30	65-135	≤ 30
	Chlorobenzene	75-125	≤ 30	65-135	≤ 30
	Trichloroethene	71-125	≤ 30	61-135	≤ 30
	Toluene	74-125	≤ 30	64-135	≤ 30
	Surrogates:				
	Dibromofluoromethane	75-124	NA	70-130	NA
	Toluene-D_8	75-125	NA	65-135	NA
	4-Bromofluorobenzene	75-125	NA	65-135	NA
	1,2-Dichloroethane-D_4	62-139	NA	52-149	NA
TPH-Purgeable	TPH–Purgeable	65-135	≤ 35	55-145	≤ 30
	Surrogate:				
	4-Bromofluorbenzene	65-135	NA	65-135	NA
TPH-Extractable	TPH–Extractable	65-135	≤ 50	65-135	≤ 50
	Surrogate:				
	Hexacosane	65-135	NA	65-135	NA
EPA Method 6010B/6020A/7000	Arsenic	75-125	≤ 30	75-125	≤ 30
	Cadmium	75-125	≤ 30	75-125	≤ 30
	Chromium	75-125	≤ 30	75-125	≤ 30
	Copper	75-125	≤ 30	75-125	≤ 30
	Lead	75-125	≤ 30	75-125	≤ 30
	Mercury	75-125	≤ 30	75-125	≤ 30
	Nickel	75-125	≤ 30	75-125	≤ 30
	Selenium	75-125	≤ 30	75-125	≤ 30
	Silver	75-125	≤ 30	75-125	≤ 30
	Zinc	75-125	≤ 30	75-125	≤ 30

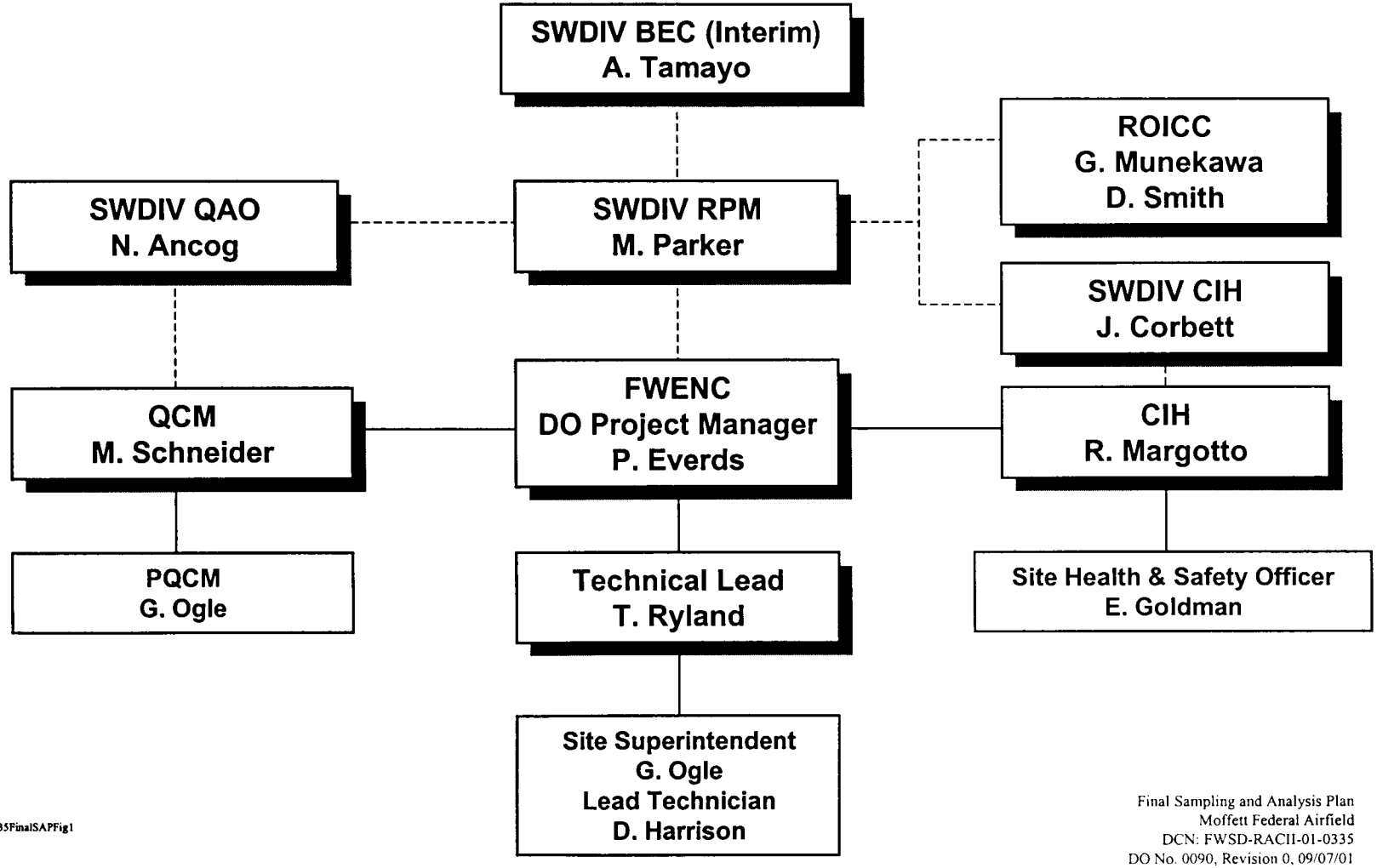
Notes:

EPA – United States Environmental Protection Agency
NA – not applicable
%R – percent recovery
RPD – relative percent difference
TPH-extractable – total extractable petroleum hydrocarbons
TPH-purgeable – total purgeable petroleum hydrocarbons

FIGURES

Figure 1

Project Organization Chart



010335FinalSAPFig1

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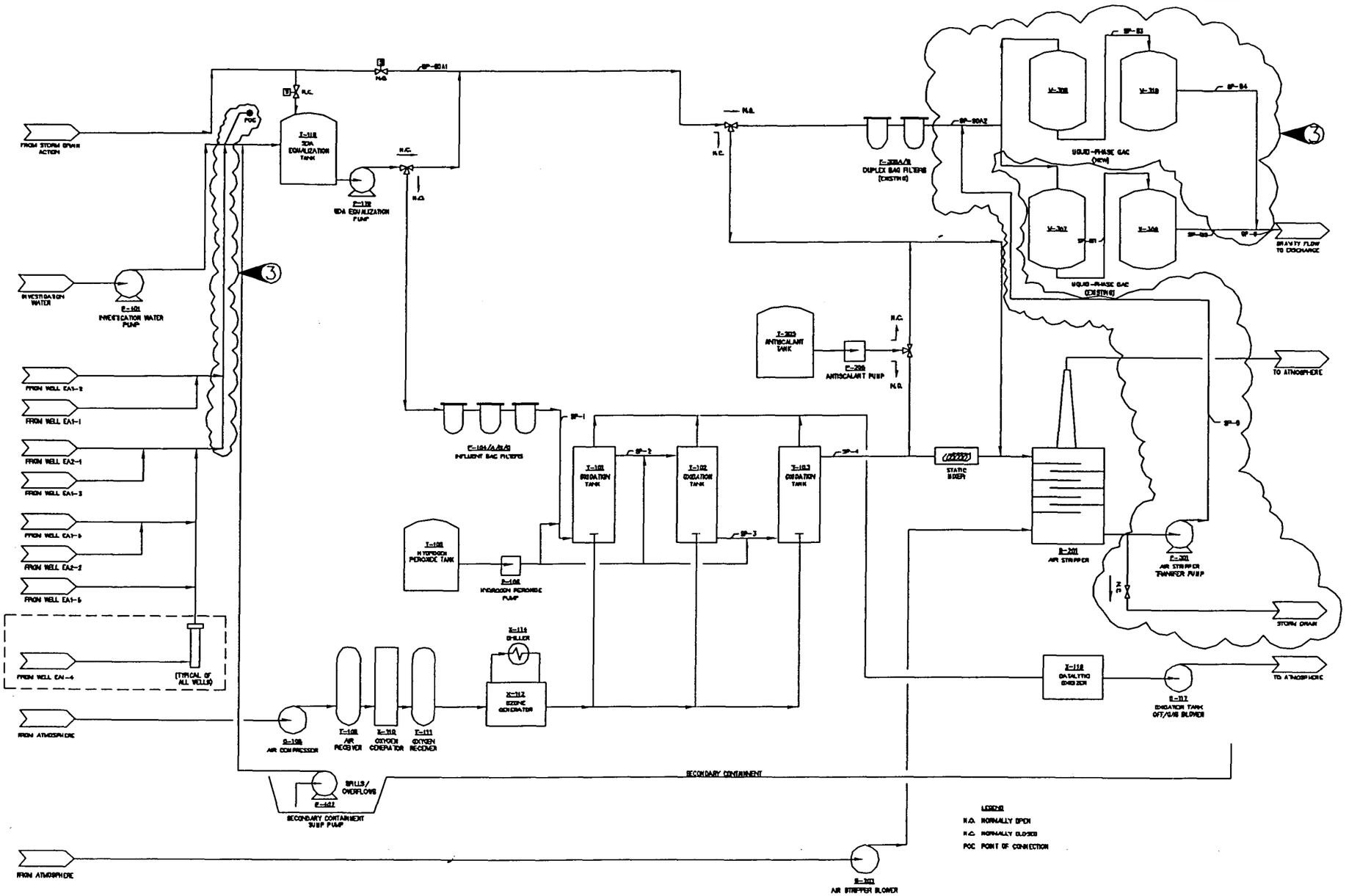

REV	DATE	BY	CHK'D	APRVD	DESCRIPTION / ISSUE
3	7/10/01	JY	CW	CW	REVISED PER FOSTER WHEELER DESIGN MODIFICATION
2	7/12/00	RB	ED	BH	REVISED PER TETRA TECH COMMENTS
1	5/8/00	TRS	ED	BH	AS-BUILT

NAVAL FACILITIES ENGINEERING COMMAND
SOUTHWEST DIVISION
SAN DIEGO, CA

FIGURE 2
PROCESS FLOW DIAGRAM WEST-SIDE AQUIFERS SYSTEM DESIGN MODIFICATION

MOFFETT FEDERAL AIRFIELD
MOFFETT FIELD, CA

FOSTER WHEELER ENVIRONMENTAL CORPORATION