

Southwest Division
Naval Facilities Engineering Command
Contracts Department
1220 Pacific Highway, Building 127, Room 112
San Diego, CA 92132-5187

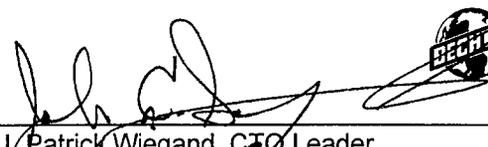
Contract No. N68711-92-D-4670

**COMPREHENSIVE LONG-TERM ENVIRONMENTAL
ACTION NAVY
CLEAN II**

**FINAL
QUALITY ASSURANCE PROJECT PLAN
FOR GROUNDWATER MONITORING
OF PERCHLORATE
MCAS EL TORO, CALIFORNIA
CTO-0171/0032
September 1998**

Prepared by:

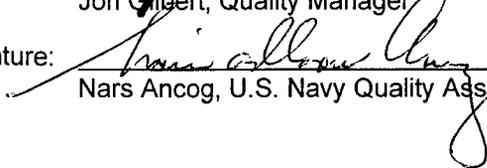
BECHTEL NATIONAL, INC.
401 West A Street, Suite 1000
San Diego, CA 92101-7905

Signature:   for _____
J Patrick Wiegand, CTO Leader

Date: 16 Sept. 1998

Signature:  _____
Jon Gilbert, Quality Manager

Date: 16 Sept 98

Signature:  _____
Nars Ancog, U.S. Navy Quality Assurance Officer

Date: 16 SEP 98



BECHTEL NATIONAL INC.

2287

CLEAN II TRANSMITTAL/DELIVERABLE RECEIPT

Contract No. N-68711-92-D-4670

Document Control No.: CTO-0171/0032

File Code: 0210

TO: Contracting Officer
Naval Facilities Engineering Command
Southwest Division
Mr. Richard Selby, Code 57CS1.RS
Building 127, Room 112
1220 Pacific Highway
San Diego, CA. 92132-5190

DATE: September 18, 1998

CTO #: 0171

LOCATION: MCAS El Toro

FROM:

[Signature]
D. J. Tedaldi, Ph.D., P.E., Project Manager

DESCRIPTION: Final Quality Assurance Project Plan for Groundwater Monitoring of
Perchlorate - DTD September 1998

TYPE: Contract Deliverable X CTO Deliverable Other
(Cost) (Technical)

VERSION: Final REVISION #: NA

ADMIN RECORD: Yes X No Category Confidential
(PM to Identify)

SCHEDULED DELIVERY DATE: 9/21/98 ACTUAL DELIVERY DATE: 9/18/98

NUMBER OF COPIES SUBMITTED: 10/5C/5E

COPIES TO (Include Name, Navy Mail Code, and No. of Copies):

SWDIV:

- G. Steinway, Code 56MC.GS (O)
- J. Rogers, Code 57CS3.JR (1C/1E)*
- D. DeMars, Code 56MC.DBD (1C/1E)
- A. Piszkin, Code 56MC.AP (1C/1E)
- M. Pound, Code 5722.MP (1C/1E)
- N. Ancog, Code 5722.NA (1C/1E)

BECHTEL (Distributed by Bechtel):

- K. Kapur (1C)
- D. Tedaldi (1C/1E)
- P. Wiegand (1C/1E)
- B. Coleman (2E AR, and 1E IR)
- El Toro File (1C)
- BNI Document Control (1C/1E)

OTHER (Distributed by Bechtel):

- J. Joyce, El Toro (BEC) (1C/1E)
- G. Kistner, US EPA (1C/2E)
- P. Hannon, CRWQCB (1C/1E)
- T. Mahmoud, Cal EPA (1C/2E)
- F. Seto, Cal EPA (1C/1E)
- R. Herndon, OCWD (1C/1E)
- R. Bell, IRWD (1C/1E)

O = Original Transmittal Sheet
C = Copy Transmittal Sheet
E = Enclosure
* = Unbound

Date/Time Received

Bechtel

401 West A Street
Suite 1000
San Diego, CA 92101-7905

CLEAN II Program
Bechtel Job No. 22214
Contract No. N68711-92-D-4670
File Code: 0210
IN REPLY REFERENCE: CTO-00171/0032

September 18, 1998

Contracting Officer
Naval Facilities Engineering Command
Southwest Division
Mr. Richard Selby, Code 57CS1.RS
Building 127, Room 112
1220 Pacific Highway
San Diego, CA 92132-5190

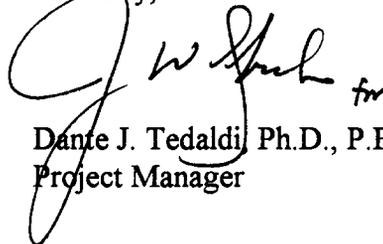
Subject: Final Quality Assurance Project Plan for Groundwater Monitoring of Perchlorate
Marine Corps Air Station, El Toro, California

Dear Mr. Selby:

It is our pleasure to submit this copy of the Final Quality Assurance Project Plan for Groundwater Monitoring of Perchlorate, Marine Corps Air Station, El Toro, California, prepared under Contract Task Order (CTO) 0171 and Contract No. N68711-92-D-4670. We gratefully acknowledge the high level of cooperation and team work demonstrated by personnel from Southwest Division during the execution of this project.

We appreciate the opportunity to be of service to you on this project. If you have any questions or would like further information, please contact CTOL, Pat Wiegand, at (619) 687-8850 or me at (619) 687-8780.

Sincerely,



Dante J. Tedaldi, Ph.D., P.E.
Project Manager

DJT/sp

Enclosure: Final Quality Assurance Project Plan for Groundwater Monitoring of Perchlorate



Bechtel National, Inc. Systems Engineers-Constructors

TABLE OF CONTENTS

Section	Page
ACRONYMS/ABBREVIATIONS	iv
1 INTRODUCTION	
1.1 Purpose.....	1-1
1.2 Data Usage.....	1-1
1.3 Project Description.....	1-1
2 PROJECT ORGANIZATION	
2.1 Project Team Organization.....	2-1
2.2 Base Closure Team.....	2-3
2.3 Navy Project Organization.....	2-3
2.4 Regulatory Oversight.....	2-4
3 QUALITY ASSURANCE OBJECTIVES FOR MEASUREMENT	
3.1 Summary of Data Quality Objectives.....	3-1
3.2 Data Measurement Objectives.....	3-1
3.2.1 Quality Assurance Guidance.....	3-1
3.2.2 PARCC Criteria.....	3-3
3.2.3 Field Measurements.....	3-4
3.2.4 Laboratory Analytical Levels.....	3-5
3.2.4.1 Analytical Methods and Detection Limits.....	3-6
3.2.4.2 Quality Control Analyses.....	3-6
3.2.4.3 Quality Control Acceptance Criteria.....	3-6
3.3 Standard Operating Procedures.....	3-6
4 SAMPLE COLLECTION	
4.1 Sampling Design.....	4-1
4.2 Sampling Equipment and Preparation.....	4-1
4.3 Sample Containers.....	4-1
4.4 Sample Collection.....	4-2
4.5 Sample Handling and Shipment.....	4-2
5 SAMPLE CUSTODY/DOCUMENTATION	
5.1 Field Sample Custody and Documentation.....	5-1

TABLE OF CONTENTS (continued)

Section	Page
5.1.1	Field Logbooks and Records..... 5-1
5.1.2	Sample Labeling..... 5-1
5.1.3	Chain-of-Custody Records..... 5-2
5.1.4	Custody Seals..... 5-2
5.1.5	Photographs..... 5-2
5.1.6	Sample Transport..... 5-3
5.2	Laboratory Sample Custody and Documentation..... 5-3
5.3	Corrections to Documentation..... 5-3
6	ANALYTICAL QUALITY CONTROL PROCEDURES
6.1	Laboratory Quality Assurance Program..... 6-1
6.2	Laboratory Standard Operating Procedures..... 6-1
6.3	Field and Laboratory Quality Control Samples..... 6-1
6.3.1	Duplicates..... 6-2
6.3.2	Blanks..... 6-2
6.3.3	Spikes..... 6-2
6.4	Laboratory Quality Control Checks..... 6-3
6.4.1	Control Charts..... 6-3
6.4.2	Performance Evaluation Samples..... 6-4
6.5	Instrument Calibration..... 6-4
6.6	Preventive Maintenance..... 6-5
6.7	Laboratory Internal Quality Control and Corrective Action..... 6-5
6.8	Data Calculation and Reporting Units..... 6-6
6.9	Documentation and Deliverables..... 6-6
7	DATA QUALITY MANAGEMENT
7.1	Data Management..... 7-1
7.2	Data Quality Assessment..... 7-1
7.2.1	Data Review..... 7-1
7.2.2	Data Verification..... 7-2
7.2.3	Data Validation..... 7-2
7.2.4	PARCC Criteria Evaluation..... 7-3
7.2.4.1	Precision and Accuracy..... 7-3
7.2.4.2	Spikes..... 7-3
7.2.4.3	Blanks..... 7-4
7.2.4.4	Duplicates..... 7-4

TABLE OF CONTENTS (continued)

Section	Page
7.2.4.5 Completeness	7-5
7.3 Corrective Actions	7-5
8 QUALITY ASSURANCE OVERSIGHT	
8.1 Performance and System Audits	8-1
8.2 Corrective Actions	8-1
8.3 Quality Assurance Reports to Management.....	8-2
8.4 QAPP Implementation	8-2
8.5 QAPP Revision or Amendment.....	8-2

9 REFERENCES

FIGURES

Figure	Page
2-1 Project Organization	2-2

TABLES

Table	Page
3-1 Data Quality Objectives for Groundwater Monitoring of Perchlorate.....	3-2
3-2 Tolerance Limits for Field Measurements.....	3-5

ACRONYMS/ABBREVIATIONS

BCT	BRAC Cleanup Team
BEC	BRAC Environmental Coordinator
bgs	below ground surface
BNI	Bechtel National, Inc.
BRAC	Base Realignment and Closure
Cal-EPA	California Environmental Protection Agency
CLEAN	Comprehensive Long-Term Environmental Action Navy
CLP	(U.S. EPA) Contract Laboratory Program
COC	chain of custody
CTO	contract task order
DBPE	double-blind performance evaluation
DHS	(California) Department of Health Services
DQO	data quality objective
DTSC	(Cal-EPA) Department of Toxic Substances Control
°F	degrees Fahrenheit
FSP	Field Sampling Plan
IDW	investigation-derived waste
LCS	laboratory control sample
MCAS	Marine Corps Air Station
MD	matrix duplicate
µg/L	micrograms per liter
mg/L	milligrams per liter
µmhos/cm	micromhos per centimeter
MS	matrix spike
MSD	matrix spike duplicate
mV	millivolts
NEESA	Naval Energy and Environmental Support Activity
NFESC	Naval Facilities Engineering Service Center
OCWD	Orange County Water District
PARCC	precision, accuracy, representativeness, completeness, and comparability
PE	performance evaluation

ACRONYMS/ABBREVIATIONS (continued)

QA	quality assurance
QAO	quality assurance officer
QAPP	quality assurance project plan
QC	quality control
RPD	relative percent difference
RPM	remedial project manager
RWQCB	(California) Regional Water Quality Control Board
SOP	standard operating procedure
SWDIV	Southwest Division Naval Facilities Engineering Command
U.S. EPA	United States Environmental Protection Agency
VOC	volatile organic compound

Section 1 INTRODUCTION

This Quality Assurance Project Plan (QAPP) for groundwater monitoring of perchlorate at Marine Corps Air Station (MCAS) El Toro, California, has been prepared by Bechtel National, Inc. (BNI) on behalf of the United States Department of the Navy, Southwest Division Naval Facilities Engineering Command (SWDIV), in accordance with Contract Task Order (CTO)-0171 issued under the Comprehensive Long-Term Environmental Action Navy (CLEAN) II Program, contract No. N68711-92-D-4670.

1.1 PURPOSE

This QAPP has been prepared to assure that the data collected during groundwater monitoring for perchlorate at MCAS El Toro are precise, accurate, representative, complete, and comparable to actual site conditions and that the data meet the criteria of technical project procedures during sample collection, sample analysis, and data evaluation. The goal of groundwater monitoring for perchlorate is to determine the concentrations and distribution of perchlorate in the shallow groundwater unit and the principal aquifer at on-Station, downgradient off-Station, and background sampling locations.

A discussion of the perchlorate sample locations and rationale is included in Section 4 of the Field Sampling Plan (FSP) for Groundwater Monitoring of Perchlorate at MCAS El Toro (BNI 1998a). This QAPP and FSP constitute the fieldwork plans for groundwater monitoring of perchlorate as stipulated by United States Environmental Protection Agency (U.S. EPA) guidelines.

1.2 DATA USAGE

Data collected during performance of groundwater monitoring for perchlorate at MCAS El Toro will be used to:

- document perchlorate concentrations on- and off-Station in the shallow groundwater unit and the principal aquifer;
- evaluate whether MCAS El Toro appears to be a probable source of perchlorate in groundwater or whether perchlorate concentrations appear to reflect ambient groundwater quality conditions; and
- prepare a brief summary report documenting the results of perchlorate sampling.

1.3 PROJECT DESCRIPTION

This project will involve the collection of hydrogeologic and groundwater analytical data to assess the presence and general distribution of perchlorate concentrations in groundwater at MCAS El Toro. These data will be used to evaluate whether MCAS El Toro may be a source of perchlorate that has been identified in shallow groundwater near

Section 1 Introduction

the western corner of the Station and in a monitoring well located about 100 feet downgradient from the Station boundary in that area.

Perchlorate was first identified in groundwater near MCAS El Toro during sampling conducted by the Orange County Water District (OCWD) in December 1997. OCWD collected groundwater samples from Westbay Multiport monitoring well sample ports 18_MCAS03-1, 18_MCAS03-2, and 18_MCAS03-3 located at depths of 89, 164, and 224 feet below ground surface (bgs) respectively (OCWD 1998). This monitoring well is located approximately 100 feet west of the west Station boundary. The samples were sent to the California Department of Health Services (DHS)-approved Montgomery Watson analytical laboratory and a split sample from 164 feet bgs was sent to the DHS-approved Weck Laboratories for analysis of perchlorate using U.S. EPA Method 300-M. The Montgomery Watson laboratory did not detect perchlorate in the 89-foot-bgs sample (detection limit of 4.0 micrograms per liter [$\mu\text{g/L}$]) but detected 7.6 $\mu\text{g/L}$ in the 164-foot-bgs sample and 4.3 $\mu\text{g/L}$ in the 224-foot-bgs sample. Weck Laboratory did not detect perchlorate in the sample from 164 feet bgs. These concentrations are all below the California provisional action level of 18 $\mu\text{g/L}$.

Between 26 January 1998 and 09 March 1998, groundwater samples were collected with a HydroPunch[®] sampling device attached to a cone penetrometer test (CPT) direct-push truck near the west corner of MCAS El Toro. While the primary objective of this sampling activity was to refine the extent of the TCE plume in this area of the Station, samples were also collected and submitted for analyses of perchlorate using California DHS Method CL04METH.SRL. Twenty-eight HydroPunch samples were collected for analyses of perchlorate at depths ranging from 123 to 209.5 feet bgs at seven locations in an area approximately 500 to 2,000 feet east of off-Station OCWD monitoring well 18_MCAS03. Perchlorate was reported in 27 of the 28 samples at concentrations ranging from 4 to 23 $\mu\text{g/L}$ (detection limit 10 $\mu\text{g/L}$). All but one of the reported perchlorate concentrations were 12 $\mu\text{g/L}$ or less.

Documentation of perchlorate concentrations in groundwater will be accomplished by conducting a single round of sampling at 50 single or cluster wells and Westbay multiport well sample ports. These wells are located on-Station near areas that may have been potential sources of perchlorate, along the critical groundwater migration path(s) including off-Station downgradient areas, and at on- and off-Station background locations. Water level measurements will also be collected at each sampling location.

Section 2 **PROJECT ORGANIZATION**

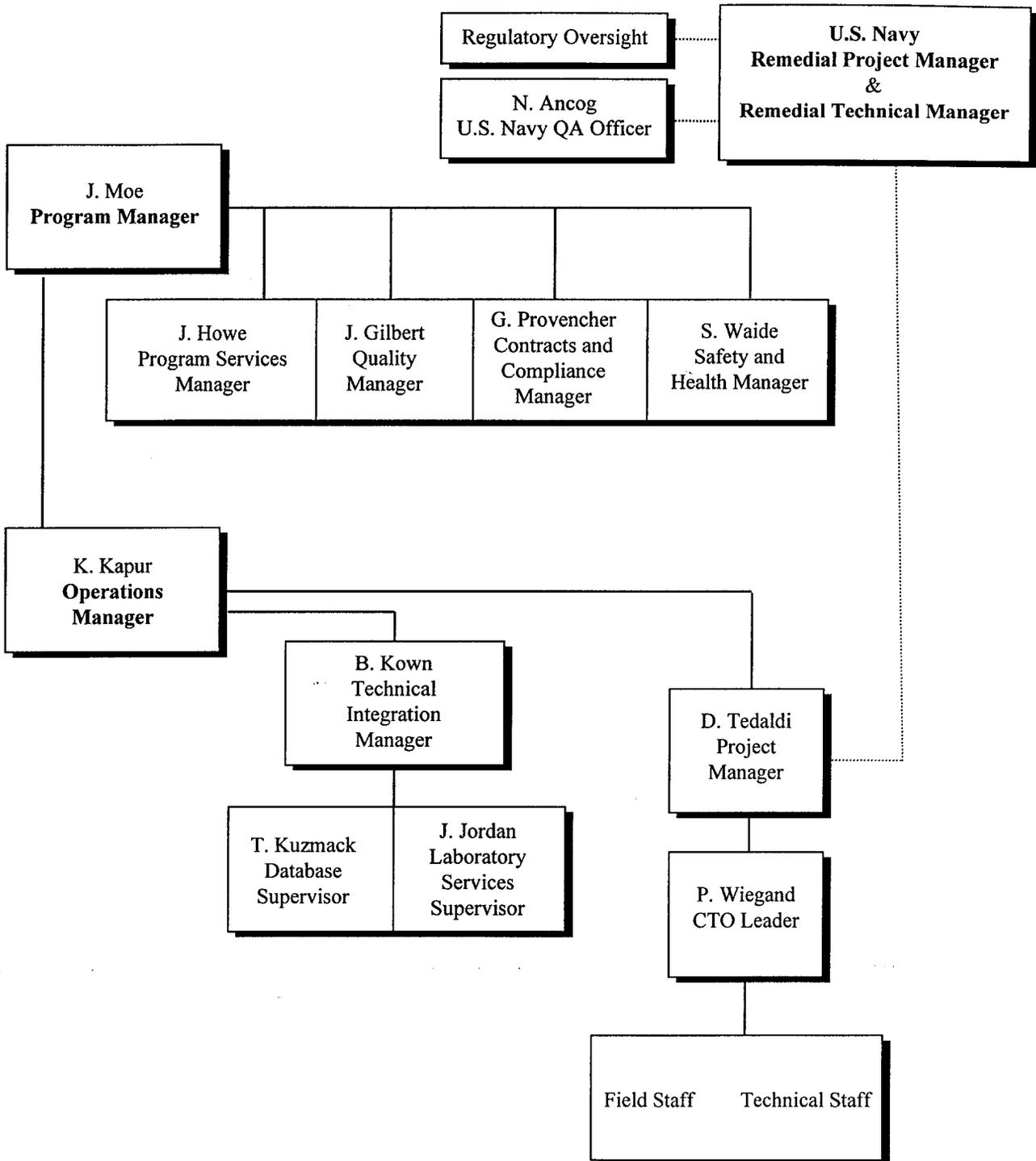
The project organization for groundwater monitoring of perchlorate at MCAS El Toro comprises representatives from the Navy, the Base Realignment and Closure Cleanup Team, and the CLEAN Program Team. The overall organization and relationships of these representatives are illustrated on Figure 2-1.

2.1 PROJECT TEAM ORGANIZATION

The specific responsibilities for the CLEAN II Program staff members are described below.

- Program Manager is responsible for all aspects of the CLEAN II Program.
- Operations Manager assigns adequate resources to complete the work, conduct technical reviews of deliverables, and perform field operations.
- Project Manager supervises all work performed at the base under the CLEAN II Program contract. Responsibilities include project planning, scheduling, staffing, executing tasks and subcontracts, and managing deliverables.
- CTO Leader is responsible for day-to-day supervision of staff and coordination of tasks for CTO project completion. Responsible for deliverables production, oversight of data review and management, and quality assurance (QA).
- Quality Manager is responsible for developing the QA process and supervising audits of projects for compliance with program procedures and specifications. The Quality Manager has authority to suspend site or project activities if quality standards are not maintained.
- Technical Integration Manager provides oversight of the technical quality of the project deliverables.
- Safety and Health Manager is responsible for development and implementation of the Program Health and Safety Plan and project- or CTO-specific modifications and amendments.
- Program Services Manager assists the CTO Leader and the Project Manager by providing reports on project tracking, scheduling, estimating, and trending.
- Contracts and Compliance Manager is responsible for solicitation, selection, and management of subcontracts for services and materials required for the project.
- Laboratory Services Supervisor is responsible for selection, coordination, technical oversight, and management of analytical laboratory and data validation subcontracts and services.
- Database Supervisor has oversight responsibility for management of the database, which is the repository of data gathered in the course of the project.

Section 2 Project Organization



**Figure 2-1
 Project Organization**

Section 2 Project Organization

Field Staff and Technical Staff consist of CTO staff members who are responsible for completing all elements of the perchlorate sampling activity, including field investigation, subcontract management, data gathering, data evaluation, and preparation of reports.

2.2 BASE CLOSURE TEAM

The Base Realignment and Closure (BRAC) Cleanup Team (BCT) consists of:

- BRAC Environmental Coordinator (BEC)

The BEC chairs the BCT and is responsible for coordinating environmental restoration and compliance programs and updating the BRAC Cleanup Plan at MCAS El Toro.

- U.S. EPA Remedial Project Manager (RPM), California Environmental Protection Agency (Cal-EPA) Department of Toxic Substances (DTSC) RPM, and California Regional Water Quality Control Board (RWQCB) Santa Ana Region RPM

These agency RPMs are responsible for overseeing and monitoring the progress of groundwater monitoring for perchlorate at MCAS El Toro and its conformance with the requirements of the Federal Facilities Agreement.

2.3 NAVY PROJECT ORGANIZATION

The responsibilities of Navy personnel assigned to CLEAN Program projects are as follows:

- U.S. Navy QA Officer (QAO) provides government oversight of the QA program, including review and sign-off on QAPPs and field sampling plans. The QAO provides quality-related direction through the Contract Technical Representative to the Quality Manager. The QAO has authority to suspend affected project or site activities if Southwest Division-approved quality requirements are not maintained.
- RPM is the Navy manager directly responsible for project execution and coordination with base representatives, regulatory agencies, and the SWDIV management team.
- Remedial Technical Manager is the Navy manager directly responsible for project technical issues, including review of all relevant documents for the Navy Installation Restoration Program.

Section 2 Project Organization

2.4 REGULATORY OVERSIGHT

Regulatory agency personnel, in conjunction with the Navy, approve the findings and any recommendations presented in the report on perchlorate sampling at MCAS El Toro. The agency RPMs are responsible for overseeing and monitoring the progress of work at the Station.

Regulatory RPMs providing oversight are the U.S. EPA RPM, Cal-EPA DTSC RPM, and the RWQCB Santa Ana Region RPM.

Section 3

QUALITY ASSURANCE OBJECTIVES FOR MEASUREMENT

This section describes the overall objectives for data that will be collected during the groundwater monitoring for perchlorate at MCAS El Toro. These objectives have determined the types of sampling and analytical methods and QA/quality control (QC) procedures that will be followed. The data collected and used shall meet the overall data measurement objectives of this QAPP, including procedures for the collection and assessment of data that are within acceptable tolerances of precision, accuracy, representativeness, completeness, and comparability (PARCC) criteria.

3.1 SUMMARY OF DATA QUALITY OBJECTIVES

The data quality objectives (DQOs) for groundwater monitoring were developed in general accordance with the seven-step DQO process outlined in the Guidance for the Data Quality Objectives Process (U.S. EPA 1994a). The DQOs for perchlorate sampling are summarized in Table 3-1.

3.2 DATA MEASUREMENT OBJECTIVES

Data measurement objectives define data quality requirements to be met in order to support the project DQOs. Data measurement objectives are the determinants of the quality of the data needed to support specific decisions or regulatory actions. To assure attainment of the DQOs, the following data measurement objectives are to be considered:

- the specification of particular analytical method and reporting detection limit requirements;
- the identification of the appropriate laboratory analytical QC requirements;
- the selection of the appropriate levels of other PARCC criteria for the data; and
- any specific sample-handling issues or other project-specific issues.

The overall objectives of this QAPP are to assure that the collected data are of sufficient quality to support their intended use. This section presents considerations for the DQO process that are applicable to objectives of data measurement.

3.2.1 Quality Assurance Guidance

Analytical QA/QC will be performed in accordance with this QAPP, as supported by the following guidance and technical specifications:

- CLEAN Program Technical Specification for Analytical Laboratory Services 22214-TS-002 (Laboratory Technical Specification) (BNI 1998b);
- CLEAN Program Technical Specification for Data Review. 22214-TS-004 (Technical Specification) (BNI 1996a); and
- Navy Installation Restoration Laboratory Quality Assurance Guide (NFESC 1996).

Section 3 Quality Assurance Objectives for Measurement

**Table 3-1
 Data Quality Objectives for Groundwater Monitoring of Perchlorate**

Step	Process	Response
1	State the problem.	Perchlorate has been detected at trace levels in shallow groundwater at MCAS ^a El Toro.
2	Identify decisions that address the problem.	If perchlorate is reported in groundwater at MCAS El Toro at concentrations exceeding the California provisional action level of 18 µg/L ^b in any well, then the need for further action will be evaluated. If perchlorate is not reported above the California provisional action level of 18 µg/L, no further action will be proposed.
3	Identify inputs that affect the decision.	Fifty monitoring wells/ports located on-Station near areas that may have been potential sources of perchlorate, along the critical migration path(s) including off-Station downgradient areas, and at on- and off-Station background locations. Water levels from the monitoring wells. Concentrations of perchlorate in groundwater based on analysis using the California Department of Health Services method – “Determination of Perchlorate by Ion Chromatography.”
4	What are the study boundaries?	Spatial boundaries: the shallow groundwater unit and principal aquifer on-Station and off-Station downgradient to the west of MCAS El Toro. Sample locations are presented on Figure 3-2 of the FSP ^c (BNI 1998a). Temporal boundaries: a single sampling event conducted over a 1-month duration.
5	Identify decision rules.	If perchlorate is reported in groundwater at MCAS El Toro at concentrations exceeding the California provisional action level of 18 µg/L, then recommendations for further evaluation of perchlorate will be proposed and submitted to the regulatory agencies within 90 days following receipt of validated analytical results. If perchlorate is not reported above the California provisional action level of 18 µg/L, perchlorate will be dropped as a contaminant of concern and no further monitoring will be conducted.
6	Limits on uncertainty.	Sampling strategy is based on a review of historical Station information and on known hydrogeologic conditions at MCAS El Toro, and is judgmentally designed to obtain the required information. The analytical results may be subjected to statistical testing to assess the significance of any data exceeding the California provisional action level.
7	Optimize the design.	The proposed sampling strategy of sampling 50 wells located near potential sources of perchlorate, along critical migration path(s) and background locations, will evaluate the presence of perchlorate in groundwater at MCAS El Toro. The proposed strategy may be modified based on Navy and regulatory comments as well as other information.

Notes:

- ^a MCAS – Marine Corps Air Station
- ^b µg/L – micrograms per liter
- ^c FSP – Field Sampling Plan

Section 3 Quality Assurance Objectives for Measurement

QA/QC procedures, documentation, and standards are consistent with U.S. EPA requirements published in the referenced methods and guidance.

3.2.2 PARCC Criteria

PARCC criteria are the qualitative and quantitative indicators of data quality. An objective of this QAPP is to assure that collected data are precise, accurate, representative, complete, and comparable to actual site conditions. PARCC criteria are defined as follows.

Precision is a measure of mutual agreement among individual measurements of the same property, usually under prescribed similar conditions. Precision is determined for analytical results using field and laboratory duplicates and duplicate matrix spike samples. It is expressed in terms of the relative percent difference (RPD) as shown below:

$$RPD = \frac{|C_1 - C_2|}{(C_1 + C_2)/2} \times 100$$

where:

C_1 = concentration of sample or matrix spike (MS)
 C_2 = concentration of duplicate or matrix spike duplicate (MSD)

Accuracy is the degree of agreement of a measurement (or an average of the same measurement type), with an accepted reference or true value. Accuracy of analytical determinations will be measured using laboratory QC analyses such as laboratory control samples (LCSs), MSs, and surrogate spikes. Accuracy is typically measured by evaluating the QC result against the concentration known to have been added, expressed as percent recovery, as shown below:

$$\%R = \frac{S - U}{C_{sa}} \times 100$$

where:

S = measured concentration of spiked aliquot
 U = measured concentration of unspiked aliquot
 C_{sa} = concentration of spike added

Representativeness is the reliability with which a measurement or measurement system reflects the true conditions under investigation. Representativeness is influenced by the number and location of the sampling points, the sampling timing and frequency of the monitoring efforts, and the field and laboratory procedures.

Completeness is a measure of the amount of valid data obtained from a measurement system compared to the amount that was expected to be obtained under correct normal conditions. Data validation and data quality assessment will determine which data are valid and which data are rejected. Percent completeness is defined as:

Section 3 Quality Assurance Objectives for Measurement

$$\text{Percent Completeness} = \frac{V}{T} \times 100$$

where:

V = number of valid (not rejected) measurements over a given time

T = total number of planned measurements

The overall completeness goal for this project will be 90 percent for all validated project data.

Comparability expresses the confidence with which one data set can be compared to another based on using U.S. EPA-defined procedures where available. If U.S. EPA procedures are not available, the procedures have been defined or referenced in this document. Section 7 further summarizes the QC evaluation procedures.

The comparability of data will be established through well-documented methods and procedures, standard reference materials, QC samples and surrogates, and performance evaluation (PE) study results, as well as by reporting each data type in consistent units. Analytical methods employed will be the same or equivalent for all rounds of sampling.

A further discussion of QA/QC samples to be analyzed is presented in Section 6 and in the Laboratory Technical Specifications (BNI 1998b). Procedures for assessing precision, accuracy, and completeness are presented in Section 7.

Audits, internal QA/QC checks, preventive maintenance, and corrective action, as described in other sections of the document and in the Laboratory Technical Specifications (BNI 1998b), will be implemented toward maintaining the stated QA/QC objectives.

3.2.3 Field Measurements

Field measurements characterize field conditions during sampling events and are determined in type by the circumstances surrounding a specific sampling event, the nature and anticipated concentrations of the contaminants, and the media to be sampled. Field data will be reported in units consistent with those of other agencies and organizations to allow comparability of databases. Standardized field measurement protocols will be used to the extent possible to maintain consistency and to obtain results that can be verified or validated. Calibration and maintenance of field equipment and instrumentation will be in accordance with manufacturers' specifications or applicable test specifications and the current version of CLEAN Program Standard Operating Procedure (SOP) 6, Instrument Calibration and Use. Calibration and maintenance activities will be documented.

Groundwater depths will be measured using an electronic water-level indicator, a Westbay well pressure transducer, or a dedicated QED water-level measurement probe as applicable to each well or sample port. Conductivity, pH, temperature, dissolved oxygen, oxidation/reduction potential, and turbidity will be measured to evaluate stability during

Section 3 Quality Assurance Objectives for Measurement

purging prior to collecting groundwater samples. An organic vapor meter, a photoionization detector, or a flame ionization detector will be used to monitor for potential organic vapors in both the breathing zone of the workers and at the source of potential vapor generations (the wellhead).

The physical measurements will be recorded with the greatest precision allowable by the instrument used. Although detection limits will not be specified for these measurements, limits for measurement tolerance will be specified. Detection limits for volatile organic compound (VOC) screening will be determined by the equipment used. Tolerance limits for field instruments are presented in Table 3-2.

**Table 3-2
 Tolerance Limits for Field Measurements**

Measurement	Tolerance Limit
pH	± 0.1 unit
Electrical conductance	± 10 $\mu\text{mhos/cm}^a$
Temperature	$\pm 0.1^\circ\text{F}^b$
Dissolved oxygen	± 0.1 mg/L ^c
Oxidation-reduction potential	± 0.5 mV ^d
Turbidity	$\pm 3\%$ of full scale
Depth to water	± 0.01 foot

Notes:

- ^a $\mu\text{mhos/cm}$ – micromhos per centimeter
- ^b $^\circ\text{F}$ – degrees Fahrenheit
- ^c mg/L – milligrams per liter
- ^d mV – millivolt

3.2.4 Laboratory Analytical Levels

Fixed-base laboratory analysis provides sample-specific data according to U.S. EPA and Naval Facilities Engineering Service Center (NFESC) requirements. The level of concern or cleanup level selected for the site directly affects data measurement requirements. Therefore, the analytical technique chosen should have a method reporting detection limit at or below the level of concern (to the extent practicable). Regardless of the specified method reporting detection limit, the actual detection limit reported may be sample-specific, especially in the case of samples containing numerous analytes at widely different concentration ranges. The data measurement objective is to obtain data with reporting detection limits adequate to assess perchlorate concentrations versus the California provisional action level for perchlorate using the most appropriate methodology.

Section 3 Quality Assurance Objectives for Measurement

3.2.4.1 ANALYTICAL METHODS AND DETECTION LIMITS

Groundwater samples will be submitted to the laboratory for determination of perchlorate concentrations using the California DHS Sanitation and Radiation Laboratory Branch method – “Determination of Perchlorate by Ion Chromatography,” Revision 0.0. Perchlorate is the only target analyte addressed by this QAPP. The reporting detection limit (the lowest level that can be reliably achieved within the specified limits of precision and accuracy during routine laboratory operating conditions) for perchlorate is 4 µg/L and the California provisional action level is 18 µg/L.

3.2.4.2 QUALITY CONTROL ANALYSES

An LCS or method blank spike sample and a method blank will be analyzed with each analytical/QC batch containing a total of 20 project samples or fewer. An MS and a matrix duplicate (MD) will be analyzed for perchlorate at a frequency of 1 set per 20 environmental samples.

3.2.4.3 QUALITY CONTROL ACCEPTANCE CRITERIA

At a minimum, the laboratory will maintain control charts for LCS analyses and will generate acceptance limits based on historical recoveries in accordance with the Laboratory Technical Specifications (BNI 1998b). The acceptance limits for the method blank will be the detection limit. The laboratory will comply with limits for MS recoveries and duplicate and MSD precision in accordance with the Laboratory Technical Specification programmatic analytical DQOs or the California DHS method for perchlorate analysis. The accuracy and precision criteria for the perchlorate analytical method to be used on this project are:

- MS/MSD accuracy criteria is 75 – 125 percent recovery;
- LCS accuracy criteria is 75 – 125 percent recovery; and
- precision (RPD) is 15 percent.

The laboratory will take corrective action as required in the Laboratory Technical Specifications (BNI 1998b) to correct or address out-of-control events. Such actions may include sample reextraction and/or reanalysis. Noncompliant QC results attributed to sample matrix effects will be documented and noted in the laboratory reports.

3.3 STANDARD OPERATING PROCEDURES

The CLEAN Program SOPs that will be followed during groundwater monitoring for perchlorate at MCAS El Toro are listed below.

- SOP 6, Instrument Calibration and Use
- SOP 7, Water and Free-Product Level Measurement in Wells
- SOP 8, Groundwater Sampling

Section 3 Quality Assurance Objectives for Measurement

- SOP 9, Sample Containers, Preservation, and Handling
- SOP 10, Sample Custody, Transfer, and Shipment
- SOP 11, Decontamination of Equipment
- SOP 17, Logbook Protocols
- SOP 25, Preparing Quality Assurance Project Plans

SOP 6, Instrument Calibration and Use, describes the general procedures to be employed for the calibration and use of equipment and instruments commonly used for field measurements and sample screening. The procedure is intended for use with instruments and equipment outside of safety, health physics, or industrial hygiene monitoring purposes.

SOP 7, Water and Free-Product Level Measurement in Wells, identifies the methods to be used for the measurement of water and free-product levels in wells and provides standardized reporting formats for documentation of data.

SOP 8, Groundwater Sampling, provides direction to assure that a groundwater sampling event obtains accurate water-quality data that are representative of the groundwater being monitored at the time of the collection. The procedure also promotes the proper collection of groundwater samples through adherence to a site-specific field sampling plan and implementation of QA/QC measures. The procedure is intended for use by geologists and environmental engineers in association with hydrogeologic/hazardous waste investigations. It applies to the collection and handling of groundwater samples from existing or newly installed wells.

SOP 9, Sample Containers, Preservation, and Handling, assures that the integrity of samples is maintained for analysis. The procedure applies to all environmental samples collected by CLEAN II environmental engineers and geologists. It describes the various container types and preservatives available for the collection of samples, and provides guidelines for the appropriate handling of these samples.

SOP 10, Sample Custody, Transfer, and Shipment, assures that the integrity of samples is maintained throughout the sample transfer process. The procedures describe protocols for the custody, transfer, and shipment of environmental and industrial samples from the point of collection to analysis and disposal by a designated analytical laboratory. The procedure applies to all environmental and industrial hygiene samples collected and submitted for archiving or analysis by CLEAN II personnel.

SOP 11, Decontamination of Equipment, assures correct equipment decontamination procedures are followed to prevent cross-contamination of samples.

SOP 17, Logbook Protocols, provides procedures and guidance for the labeling, use, and control of logbooks used to document CLEAN II field data-collection activities.

SOP 25, Preparing Quality Assurance Project Plans, provides procedures and guidance for the preparation, revision, control, and approval of CLEAN II QAPPs.

Section 3 Quality Assurance Objectives for Measurement

These SOPs are supplemented by procedures presented in the FSP (BNI 1998a). These supplemental procedures include low-flow purging and sampling. Controlled copies of all CLEAN Program SOPs have been provided to SWDIV, DTSC, and U.S. EPA Region IX by the CLEAN Program Quality Manager.

Section 4

SAMPLE COLLECTION

An objective of the sampling procedures outlined in this project plan is to obtain representative samples that yield results of consistent quality. The use of proper sampling techniques, sampling equipment, strict sampling controls in the field, and appropriate chain-of-custody (COC) procedures will reduce the potential for nonrepresentative samples and unreliable analytical data. QA/QC objectives pertinent to proper sampling procedures are outlined in this section.

4.1 SAMPLING DESIGN

A summary and rationale for the proposed sampling locations, sample types, and sample analysis are presented in Section 4 of the FSP (BNI 1998a). Background information and previous perchlorate sampling results, which led to development of this perchlorate sampling program, are presented in Section 2 of the FSP.

4.2 SAMPLING EQUIPMENT AND PREPARATION

All nondisposable sampling equipment and material, tools, and field-measurement devices will be decontaminated before and after each sample collection or use at each location to prevent accidental sample contamination or flawed field measurements. Decontamination procedures for sampling equipment and measurement devices are presented in Section 6.7 of the FSP and in CLEAN Program SOP 11, Decontamination of Equipment. Disposal and management of all investigation-derived waste (IDW) will be the responsibility of MCAS El Toro waste management personnel, as specified in Section 1.5 of the Update to the Final IDW Management Plan (BNI 1998c). The CTO Leader will coordinate all IDW disposal with the MCAS El Toro resident officer in charge of construction, who will be the on-Station point of contact.

4.3 SAMPLE CONTAINERS

All sample containers are to be supplied by the subcontract laboratory designated for analytical services. The sample containers will be cleaned and QC-tested by procedures appropriate to the specific analyses to be performed. Sample containment will follow the prescribed U.S. EPA Contract Laboratory Program (CLP) Sample Bottle Repository Program (U.S. EPA 1990) procedures to assure that containers are free of contaminants. This QC testing will be verified or performed by the laboratory prior to shipping the containers to the field sampling team. The sample containers (polyethylene bottles) with caps will be shipped to the user with sample coolers in protective cardboard cartons or other wrapping. All polyethylene containers will be provided with polypropylene closures. No preservatives will be introduced into these containers. The analytical method "Determination of Perchlorate by Ion Chromatography" does not require any sample preservative.

Section 4 Sample Collection

The analytical method, sample containers, and holding time associated with laboratory analyses of groundwater samples collected at MCAS El Toro are as follows:

- Analytical method – Determination of Perchlorate by Ion Chromatography, Revision 0.0, June 3, 1997, Sanitation and Radiation Laboratory Branch, Department of Health Services, State of California.
- Sample containers – 250-milliliter polyethylene bottles.
- Holding time – 14 days

4.4 SAMPLE COLLECTION

Field methods and procedures for sample collection will be conducted as described in Section 6 of the FSP (BNI 1998a) and will be in accordance with the current applicable CLEAN Program SOPs.

4.5 SAMPLE HANDLING AND SHIPMENT

Samples will be transported and stored according to procedures outlined in Section 6 of the FSP (BNI 1998a). Documentation for sampling activities is detailed in the FSP and discussed in Section 5 of this QAPP.

Sample packaging and shipping procedures are based on U.S. EPA specifications as well as U.S. Department of Transportation regulations (*49 Code of Federal Regulations*). Wet ice will be included in coolers containing samples that require temperature control as specified in the FSP. To assure that the specified analytical holding time is met, all samples will be delivered to the laboratory by CLEAN II personnel, transported by a laboratory courier, or shipped to the laboratory via an express mail service within 48 hours of sample collection. The FSP and CLEAN II SOP 10, Sample Custody, Transfer, and Shipment, describe packing and shipment of samples.

Upon receipt by the laboratory, samples will be stored in accordance with procedures established by the U.S. EPA in the CLP Statement of Work, CLEAN Program Technical Specification for Analytical Laboratory Services (BNI 1998b), and the Navy Installation Restoration Program Laboratory Quality Assurance Guide (NFESC 1996).

Section 5

SAMPLE CUSTODY/DOCUMENTATION

Sample custody and documentation are important elements of generating acceptable and defensible data. Each sample or field measurement must be properly documented to facilitate timely, correct, and complete analysis and to support use of field and laboratory data. The documentation system provides the means to identify, track, and monitor each sample from the point of collection through final data reporting. Specific documentation requirements are described in the following sections.

5.1 FIELD SAMPLE CUSTODY AND DOCUMENTATION

Sample custody and documentation methods that will be used are described in CLEAN Program SOP 10, Sample Custody, Transfer, and Shipment and CLEAN Program SOP 17, Logbook Protocols. These SOPs address field logbooks, sample labels, custody seals, and COC forms.

5.1.1 Field Logbooks and Records

Controlled, prepaginated, and permanently bound logbooks will be used to record field observations and measurements to provide a permanent record of daily field activities. The logbooks will contain various forms for this purpose, including daily field reports, geologic drill logs, well-sampling records, groundwater-level records, contractor production reports, and photo-documentation.

Entries will be legible and written in indelible ink. Corrections will consist of line-out deletions that will be initialed and dated by the person making the correction. All entries will be signed and dated, and the remaining space on each page will be crossed out. Completed field logbooks will be delivered to the CLEAN Program Document Control Center in San Diego. Other forms used to record field safety and health-related data will not be bound into field logbooks, but will instead be maintained in project files and folders. Logbook procedures are described in CLEAN Program SOP 17.

5.1.2 Sample Labeling

Sample labels will be attached to each sample container just before or at the time of sampling. The labels will be made of waterproof paper or plastic with gummed backs and will be completed with indelible ink. Any errors made on the sample label will be corrected using a single line through the error (initialed) followed by the entry of the correct information. Sample labels will clearly indicate the project name and number, the sampling location identifier, the nine-digit sample number (container identification number), the sampling date and time (using 24-hour notation), the analysis to be performed, and the field sampler's name or initials as described in Section 6.9.2 of the FSP; CLEAN Program SOP 9, Sample Containers, Preservation, and Handling; and SOP 10, Sample Custody, Transfer, and Shipment.

Section 5 Sample Custody/Documentation

All environmental samples collected to support CTO-0171 will be identified by a unique nine-digit sample numbering system as described in the FSP and CLEAN Program Procedure T2.2.

5.1.3 Chain-of-Custody Records

The COC record documents the transfer of sample custody from the sample collection through receipt by the laboratory. CLEAN Program SOP 10 contains a description of COC procedures. COC forms will be completed by the sampler and will accompany the samples from the field to the analytical laboratory.

The custody record will be completed using waterproof ink. All corrections will be made by drawing a line through the error, initialing and dating the error, and then entering the correct information. Erasures are not permitted. All applicable information on the COC record, including signatures, will be filled out completely and legibly. Unused space (rows) for sample/analysis information will be crossed out, initialed, and dated. Samples requiring different turnaround times will not be included together on the same COC record. If samples are to be delivered to the laboratory by an overnight carrier, the airbill number will be recorded, and the COC record(s) will be placed in a waterproof plastic bag that is taped to the lid inside the sample cooler prior to sealing.

5.1.4 Custody Seals

After samples are collected, custody seals are placed on the sample containers. Custody seals are used to detect tampering between sample collection and analysis. The seal is placed so that it must be broken in order to open the sample container. Two or more custody seals will also be placed on the outside of the shipping container or cooler prior to shipment via an overnight carrier. Each custody seal affixed to sample containers and sample coolers will be signed and dated by the field sampler. Custody seals are described in CLEAN Program SOP 10.

5.1.5 Photographs

Photographs may be taken of the sample locations to show the surrounding area and objects used to locate the site. The photographs will be used to provide backup documentation for procedures and unusual conditions encountered as well as general sampling locations. Photographs will be taken at each sampling location and will be described in the field logbook in accordance with all SWDIV (and MCAS El Toro) rules regarding photographs. Photographs should include two or more reference points to allow relocation of the sampling point at a later time. The film roll number will be identified by taking a photograph of an informational sign on the first frame of the roll. This sign will display the site name, initials of photographer, film roll number, and date. After the photographs are developed, they will be labeled for cross-referencing with other field data.

Section 5 Sample Custody/Documentation

5.1.6 Sample Transport

The sample transport procedures will be conducted following CLEAN Program SOP 9, Sample Containers, Preservation, and Handling; and CLEAN Program SOP 10, Sample Custody, Transfer, and Shipment, consistent with applicable U.S. EPA guidance and requirements.

5.2 LABORATORY SAMPLE CUSTODY AND DOCUMENTATION

The subcontract laboratory used during groundwater monitoring for perchlorate will be required to establish custody procedures that conform to those required by the CLP, as outlined in the CLP user's guide (U.S. EPA 1991). These procedures include:

- designation of a sample custodian;
- completion by the custodian of the COC record, any sample tags, and laboratory request sheets, including documentation of sample condition upon receipt;
- laboratory sample tracking and documentation procedures;
- secure sample storage with the appropriate environment (e.g., refrigerated, dry); and
- proper data logging and documentation procedures, including custody of all original laboratory records.

A designated sample custodian will take custody of all samples upon their arrival at the laboratory. The custodian will inspect all sample labels and custody forms to assure correspondence between information on the labels and forms. The custodian will also inspect all samples and document any signs of damage or tampering and temperature discrepancies. The custodian will then assign a unique laboratory number to each sample and will distribute the samples to the appropriate analysts or to secured storage areas. All sample transfers in the laboratory will be recorded.

5.3 CORRECTIONS TO DOCUMENTATION

All original recorded data shall be written in waterproof ink. No accountable serialized documents will be destroyed or thrown away, even if they are illegible or contain inaccuracies that require a replacement document. If an error is made on an accountable document assigned to an individual, that individual shall make corrections by making a line through the error, initialing the error, and entering the correct information. The erroneous information shall not be obliterated. Any subsequent error discovered on an accountable document shall be corrected, initialed, and dated by the person who made the entry.

Section 6

ANALYTICAL QUALITY CONTROL PROCEDURES

Analytical QA/QC procedures encompass the requirements established by the Navy Installation Restoration Laboratory Quality Assurance Guide (NFESC 1996), the Analytical Laboratory Technical Specifications (BNI 1998b), and California DHS method-specific criteria. These procedures will be provided for by the laboratory QA program and supported by SOPs; they will address QC samples, instrument calibration, preventive maintenance, internal QC checks and corrective action, and data review and reporting.

Both field and laboratory QA/QC checks will be employed to evaluate the performance of field and laboratory analytical procedures. QA/QC checks will take the form of samples introduced into the sampling, sample transport, and analytical stream to enable evaluation of analytical accuracy and precision, as well as representativeness.

6.1 LABORATORY QUALITY ASSURANCE PROGRAM

Analytical laboratories will maintain a written quality assurance plan in accordance with the Laboratory Technical Specification, Section 4.11 (BNI 1998b) and Navy requirements (NFESC 1996). All subcontractor laboratories (fixed-base and mobile) shall have the appropriate current state certifications, such as the California State Environmental Laboratory Accreditation Program certification. Fixed-base laboratories shall have undergone the NFESC evaluation process and must maintain current approval.

6.2 LABORATORY STANDARD OPERATING PROCEDURES

The subcontract laboratory shall maintain a controlled set of SOPs that meet the requirements established in the Laboratory Technical Specification, Section 4.1 (BNI 1998b) and Navy requirements (NFESC 1996). SOPs shall serve as the implementing procedures for the laboratory QA program and must be clear, comprehensive, up to date, and sufficiently detailed to permit duplication of analytical results by qualified analysts. The laboratory must have an SOP for each of the reference methods performed on the project before work begins. Controlled revision to SOPs must be provided for in the laboratory QA program.

6.3 FIELD AND LABORATORY QUALITY CONTROL SAMPLES

QC samples are used to assess data quality in terms of precision and accuracy and verify that sampling procedures, decontamination, packaging, and shipping are not introducing variables that could compromise the validity of sample data into the sampling chain. Such QC samples are regularly prepared in the field and laboratory so that all phases of the sampling process are monitored. The types of QC samples to be collected during the project are discussed below.

Section 6 Analytical Quality Control Procedures

6.3.1 Duplicates

Field duplicates are two samples of the same matrix, collected at the same location and time (to the extent possible), with an assumed level of overall homogeneity within the sample matrix. The same sampling techniques and analytical methods are performed on both samples. Analysis of field duplicates provides a quantitative measure of the precision of the overall sampling and analysis process as the sum of contributions from sample heterogeneity, the precision of the sampling process, and the analytical method(s). Laboratory duplicates are not a substitute for field duplicates. One duplicate sample will be taken for every ten groundwater samples collected during each sampling event.

6.3.2 Blanks

A variety of QC blank samples will be used to assess the potential for sample contamination during the sampling and analysis processes. Laboratory QC samples used for assessing the impact of contamination on sample results include method blanks, calibration blanks, instrument blanks, and refrigerator storage blanks. The laboratory will use these QC sample types in accordance with U.S. EPA method-specific requirements, the Laboratory Technical Specification, Section 4.11 (BNI 1998b), and Navy requirements (NFESC 1996). In addition, two kinds of field QC blanks will be used: equipment rinsate blanks and source water blanks.

An equipment rinsate blank is a sample of contaminant-free water that has been passed through or over recently decontaminated field sampling equipment. The equipment blank is used to assess the adequacy of the equipment decontamination process, as well as contaminant effects from handling, storage, shipment, and analysis. Equipment rinsate blanks will be prepared by the sampling team at a minimum of one blank (for perchlorate) per set of decontaminated groundwater sampling equipment per day during each sampling event.

Source water blanks are used to assess the potential for sample contamination from the final rinsewater of the decontamination process. One blank from each source water location will be collected and analyzed for perchlorate during each month that a sampling event is in progress.

6.3.3 Spikes

The types of QC spike samples to be employed by the fixed-base laboratory include LCSs (or method blank spikes) and MSs. An LCS is a clean matrix (i.e., same used for a method blank) spiked with known concentration(s) of target analyte(s). The LCS is carried through the entire analytical procedure to assess the overall accuracy of the method. An MS is an aliquot of a parent sample spiked with target analyte(s) of known concentration(s) prior to sample preparation. The impact of a sample matrix on target analyte recovery (i.e., accuracy) and precision is assessed by MS, MSD, and unspiked MD QC samples.

Section 6 Analytical Quality Control Procedures

For this project, the acceptance limits for precision and accuracy for MS percent recovery are listed in the Analytical Laboratory Technical Specification (BNI 1998b) and are presented in Section 3.2.4.3 (Quality Control Acceptance Criteria). Each perchlorate analytical preparation batch must contain two matrix QC samples: an MS and an MD.

6.4 LABORATORY QUALITY CONTROL CHECKS

Laboratory checks will include the procedures detailed below.

- The reagents, gases, and standards required to analyze samples by the specified method will be of the highest quality available. Materials and procedures will be recorded in a logbook to document complete traceability to a certified reference standard and source such as the National Institute of Standards and Technology.
- Instruments will be calibrated according to the manufacturers' instructions and as required by the California DHS analytical method for perchlorate. Where there are no specifications, a five-point calibration curve will be implemented.
- Calibration of instruments will be documented in a bound logbook, and records will be maintained in accordance with Section 4.6 of the Laboratory Technical Specification (BNI 1998b).
- During sample analysis, continuing calibration standards will be analyzed and documented in a logbook as required for each analytical method.
- The percent recovery and percent difference criteria for inorganics and organics continuing calibration shall be within the QC criteria of the requested method.
- Laboratory method blanks will be included in every preparation batch or analytical batch at a frequency of at least 1 per 20 samples.
- An analysis of 1 MS sample will be made for every 20 samples and will be fortified with representative compounds for each analytical method performed.
- An analysis of 1 MSD or MD sample will be made for every 20 samples analyzed, or 1 per batch, whichever is greater.

The term "matrix" refers to the use of the actual sample media collected in the field. Laboratory QC samples are derived from an aliquot (subset) of the field samples. The groundwater samples collected for analysis of perchlorate will contain sufficient volume for analysis of the parent sample, MS, and MSD or MD.

6.4.1 Control Charts

Control charts will be used by the fixed-base laboratory to assess variability in QC parameters over time. At a minimum, the laboratory shall control chart LCS results for each method of analysis. The laboratory will include in its QA plan a description of the methodology used in control charting. Section 4.3 of the Laboratory Technical Specification (BNI 1998b) details the requirements for control charting and criteria for out-of-control conditions.

Section 6 Analytical Quality Control Procedures

6.4.2 Performance Evaluation Samples

PE samples will be submitted to the fixed-base laboratory as part of the routine NFESC evaluation process according to NFESC (NFESC 1996). The perchlorate sampling will include the collection of QC samples including field duplicate samples, equipment rinsate samples, source water blanks, and double-blind PE (DBPE) samples. A total of 5 field duplicate samples (10 percent of the groundwater samples), an estimated 20 to 25 equipment rinsate samples (1 per day per sampling team), 1 or 2 source water blanks (1 during each month the field sampling activities are in progress), and 5 DBPE samples (10 percent of the groundwater samples) will be submitted to the laboratory for perchlorate analysis.

The DBPE samples will be submitted to monitor the laboratory's performance of the perchlorate analyses. The DBPE samples will consist of five unmarked spiked perchlorate samples prepared by U.S. EPA and provided to the field teams. The sealed DBPE samples will be transferred to the field team leader under COC protocols to ensure sample integrity from preparation through analysis by the designated laboratory.

The U.S. EPA will provide these spiked samples to the field team leader in the same sample containers used for collection of the groundwater samples so that they are indistinguishable from the other samples being submitted to the laboratory. The DBPE samples will also be assigned dummy well identification numbers and labeled in the field consistent with the groundwater samples being collected. One DBPE sample will be submitted to the laboratory for every ten groundwater samples collected for perchlorate analysis.

The reporting detection limit for the perchlorate analyses is 4 µg/L and the California provisional action level is 18 µg/L. The accuracy and precision criteria for the perchlorate analytical method to be used on this project are:

- MS/MSD accuracy criterion is 75 – 125 percent recovery;
- LCS accuracy criterion is 75 – 125 percent recovery; and
- precision (RPD) is 15 percent.

QC samples (except DBPE) will be evaluated to determine if these acceptance criteria are met. Due to the extra handling of DBPE samples, the recovery accuracy criterion of 65 to 135 percent will be used. In addition, these performance criteria will also be evaluated via review of the laboratory and data validation reports in conjunction with the DQOs. If acceptance criteria are not met, corrective actions will be evaluated (Section 8.2).

6.5 INSTRUMENT CALIBRATION

The laboratories are required to document calibration procedures according to Section 4.6 of the Laboratory Technical Specification (BNI 1998b), and are subject to review by CLEAN II Program auditors under the direction of the Program Quality Manager. Calibration procedures will be consistent with specified method requirements.

Section 6 Analytical Quality Control Procedures

Calibration of field equipment and instrumentation will be in accordance with the relevant SOPs.

6.6 PREVENTIVE MAINTENANCE

The laboratory will perform and maintain records of preventive maintenance on instruments used for analysis of project samples. Preventive maintenance documentation is incorporated into California laboratory certification requirements and is an element of the laboratory QA plan.

6.7 LABORATORY INTERNAL QUALITY CONTROL AND CORRECTIVE ACTION

A method blank will be analyzed with every batch of 20 or fewer samples to measure laboratory contamination. The method blank will consist of analyte-free water and will be carried through the entire preparation and analysis procedure. Acceptance criteria for method blanks must conform to reference method requirements when specified. Generally, corrective action is required if target compound concentrations in the method blank are greater than the method detection limit. Corrective action, including data flagging, is required when method blank concentrations are greater than the reporting detection limit, and the samples must be reprocessed if sample target compound/analyte concentrations are not greater than ten times the method blank concentrations.

An LCS will be analyzed with every batch containing 20 or fewer samples to measure accuracy. The LCS will consist of a method blank spiked with a known amount of analyte, and it will be carried through the entire preparation and analysis procedure. The standards source will be separate from that used to prepare calibration standards. The recoveries will be plotted on control charts, and control limits will be calculated based upon historical data. The guidance limits for the LCS presented in Section 3.2.4.3 (Quality Control Acceptance Criteria) will be used until the laboratory has enough LCS data to develop a control chart (BNI 1998b). If control limits are exceeded, the analysis will be stopped and the problem will be corrected. Samples associated with the out-of-control LCS will be reanalyzed in another batch, unless documented evidence is presented to show that associated samples were not affected.

An MS will be analyzed for 1 out of every 20 or fewer samples to measure matrix effects on accuracy. MS samples will consist of additional aliquots of a sample spiked with a known amount of analyte. If a valid spike recovery is outside acceptance limits, but the LCS is in control, matrix interference may be indicated. Acceptance limits for MS presented in Section 3.2.4.3 (Quality Control Acceptance Criteria) will be used.

To measure precision, a duplicate or MSD will be analyzed for 1 out of every 20 samples for inorganics and organics, respectively. For any batch of samples that does not contain a duplicate or MSD, two LCS samples (LCS and LCS duplicate) will be separately prepared and analyzed. If the RPD does not meet the required acceptance limits, the

Section 6 Analytical Quality Control Procedures

problem will be investigated and corrected. Any affected samples will be reanalyzed in a separate batch. Acceptance limits for precision in Section 3.2.4.3 (Quality Control Acceptance Criteria) will be used.

6.8 DATA CALCULATION AND REPORTING UNITS

Calculations of results will be documented in the laboratory SOPs and must be consistent with the reference method. Reporting units will be consistent with applicable regulatory and decision thresholds.

6.9 DOCUMENTATION AND DELIVERABLES

Requirements for hard copy and electronic data deliverables are detailed in the Laboratory Technical Specifications (BNI 1998b). Electronic deliverables to be loaded into the Bechtel Environmental Integrated Data Management System will also be submitted.

The laboratory is responsible for maintaining supporting documentation in the form of sample preparation logs, instrument run logs, maintenance logs, standards receipt and preparation logs, instrument printouts, and chromatograms. Calculations should be clearly identified in the sample analysis records or in laboratory SOPs.

Section 7

DATA QUALITY MANAGEMENT

Data quality management includes data management, data verification and validation, preventive maintenance, data assessment, and corrective actions as described below.

7.1 DATA MANAGEMENT

Project data will consist of various types of information, ranging from field measurements to laboratory analyses. Site data requirements for this project will be governed by the specific type of data being collected and the DQOs. Unique data type combinations will be available to accommodate specific data collection and reporting needs for this project.

Primary data management activities include the establishment of sampling design; collecting, encoding, verifying, and validating data; the performance of QA/QC evaluation of data; and the generation of output. The data management staff shares responsibility for high-quality products with the project staff.

Data management procedures are established by the CLEAN Program Data Management Plan (BNI 1996b). Project-specific modifications are incorporated into the update to the Final Amended Data Management Plan (BNI 1998d).

7.2 DATA QUALITY ASSESSMENT

The data QA process includes analytical data review by the project chemist, data verification of hard copy and electronic results, independent data validation, and evaluation of overall data in terms of the PARCC criteria. Data evaluation will include an assessment of the results from field QC samples such as field blanks, equipment rinsate blanks, and trip blanks.

7.2.1 Data Review

Data will be reviewed by project staff for internal and external consistency in accordance with CLEAN Program Data Review Technical Specification (BNI 1996a). CLEAN Program Procedures (BNI 1998e) for performance, system audits, and corrective action oversight will be used. The CLEAN Program Quality Control Management Plan (BNI 1994) defines the requirements and responsibilities required of all CLEAN Program personnel and subcontractors in order to attain the desired level of quality.

The requirements for performance of analytical laboratory analysis are specified in the subcontract for technical services under which the work is performed. The subcontract specifies deliverables, turnaround time, and performance standards. Receipt of required deliverables will be verified in the course of the contract-compliance screening. Each data package will be reviewed against a deliverables requirements checklist prepared based on the subcontract and the project-specific needs, and the completed checklist will

Section 7 Data Quality Management

be filed with the data package. Outstanding items will be resolved before the project is closed.

7.2.2 Data Verification

Field and laboratory data will be managed using manual and electronic systems. Data stored, evaluated, and reported electronically will be subject to 100 percent manual verification against hard copy data reports. Discrepancies will be corrected and documented following the CLEAN Program Data Management Plan (BNI 1996b).

7.2.3 Data Validation

Laboratory data will be validated in accordance with the CLEAN Program Technical Specification for Data Review (BNI 1996a). The data validation process consists of a systematic assessment and verification of data quality through an independent review. Validation must be performed by individuals who are not associated with the collection or analysis of samples, interpretation of sample data, or with any decision-making process within the scope of the particular investigation. For the CLEAN Program, this is accomplished through the use of independent third-party data validation subcontractors. Data validation procedures will be in accordance with U.S. EPA guidance for the CLP, modified as necessary to accommodate non-CLP methods.

The terminology for levels of data validation has changed because the previous Naval Energy and Environmental Support Activity guidance (NEESA 1988) has been replaced by the Navy Installation Restoration Laboratory Quality Assurance Guide (NFESC 1996), which does not define levels of data validation. For the CLEAN Program, the former Level C data validation process (NEESA 1990) will be referenced as Level III data validation, and the former Level D process (NEESA 1990) will be referenced as Level IV data validation. Level III and Level IV data validation requirements and criteria are described in the Technical Specification for Data Review (BNI 1996a) and the Navy SWDIV Policy Memorandum No. 13 (SWDIV 1996).

Level IV data validation follows the U.S. EPA protocols and CLP criteria set forth in the functional guidelines for evaluating organic and inorganic analyses (U.S. EPA 1994b,c). These guidelines apply to analytical data packages that include the raw data (e.g., spectra and chromatograms) and backup documentation for calibration standards, analysis run logs, LCS, dilution factors, and other types of information. This additional information is utilized in the Level IV data validation process for checking calculations of quantified analytical data. Calculations are checked for QC samples (e.g., MS/MSD and LCS data) and routine field samples (including field duplicates, field and equipment rinsate blanks, and VOC trip blanks). To assure that detection limit and data values are appropriate, an evaluation is made of instrument performance, method of calibration, and the original data for calibration standards.

For a Level III data validation effort, the data values for routine and QC samples are generally assumed to be correctly reported by the laboratory. Data quality is assessed by

Section 7 Data Quality Management

comparing the QC parameters listed above to the appropriate criteria (or limits) as specified in the project QAPP, by CLP requirements, or by method-specific requirements (e.g., California DHS, CLP, SW-846). If calculations for quantitation are verified, it is done on a limited basis and may require raw data in addition to the standard data forms normally present in a data package.

The fixed-base laboratory data will be subjected to a data validation strategy appropriate to the intended use of the data. An independent third-party subcontractor will perform a Level III data validation on 80 percent of laboratory data. The remaining 20 percent of the data will receive a Level IV data validation. The sample data that receive Level IV validation will be selected randomly to obtain a representative data set unless a review of the first round of sampling data suggests focused data validation of specific parameters or specific sample locations.

7.2.4 PARCC Criteria Evaluation

The data QA process encompasses data validation and internal technical data review to evaluate the entire data set for the project. The assessment should consider each type of data, the relationship to the entire data set, and the adequacy of the data to fulfill the DQOs of the sampling event or project. Data sets are assessed for completeness and compliance to method-specific or project-specific QA/QC requirements, including the results of the independent data validation process. Data validation compares the DQOs to the actual level of data quality obtained through evaluation of the PARCC criteria and other method performance requirements. The assessment process also evaluates data quality in terms of the PARCC criteria and determines data usability for the intended purpose(s). The procedures used to assess data precision, accuracy, and completeness are described below.

7.2.4.1 PRECISION AND ACCURACY

The assessment procedures in this section are designed to review QC data for the three types of controlled samples: spikes, blanks, and duplicates.

7.2.4.2 SPIKES

The procedure for assessing spikes will be as follows:

1. Calculate the percent recovery as shown below for each sample:

$$\text{percent recovery} = [(t-x)/a] \times 100 \text{ percent}$$

where:

t = total concentration found in the spiked sample
 x = original concentration in sample prior to spiking
 a = actual spike concentration added to the sample

2. Qualitatively evaluate the significance of data that fall outside the recovery limits along with associated sample data (per data validation process).

Section 7 Data Quality Management

7.2.4.3 BLANKS

The evaluation procedure for blanks may involve a qualitative review of the chemical analysis data reported by the laboratory. The procedure for assessing blank samples will be as follows:

1. If chemicals are detected in blank samples, the laboratory will determine the nature and source of the contamination problem.
2. If any chemicals are found in blank samples, the compound(s) and concentration(s) detected will be reported, and the data will be assessed for potential misinterpretation or high bias (per the data validation process).

Laboratory method blank data will be quantitatively evaluated during the data validation process. Field blank data will be evaluated using the Risk Assessment Guidance for Superfund (U.S. EPA 1989). This guidance provides specific rules on data evaluation and editing data sets with regard to the presence of laboratory and field-based contamination. Field blanks will be evaluated during the internal data evaluation process, and data qualifiers will be applied where appropriate.

7.2.4.4 DUPLICATES

The procedure for assessing duplicate samples will be as follows:

1. Calculate the RPD and percent ratio as shown below for each duplicate pair:

$$\text{RPD} = [(x_1 - x_2) / x_1] \times 100 \text{ percent}$$

where:

x_1 = concentration of sample 1 of pair

x_2 = concentration of sample 2 of pair

x = average of sample 1 and sample 2

$$\text{percent ratio} = (x_1 / x_2) \times 100 \text{ percent}$$

Additional evaluation may include:

2. Calculate the average RPD for all duplicate pairs.
3. Calculate the standard deviation of the RPDs using the formula shown below:

$$\text{standard deviation}(s) = \{[\sum(x_i - x)^2] / (n-1)\}^{1/2}$$

where:

x_i = individual observed or calculated values

x = average of all observed or calculated values

n = number of observed or calculated values

4. Compare the RPDs with the precision objectives identified in Section 3 of this plan and identify any duplicates that do not meet these objectives.

Section 7 Data Quality Management

7.2.4.5 COMPLETENESS

The completeness of the data is measured by an estimate of the amount of data expected from the field program versus the amount of data actually entered into the database that is available for interpretation. The data validation process and data quality assessment will determine which data will not be usable as a result of being rejected. Rejected data will not be eliminated from the database; however, valid data must constitute 90 percent of the total data collected. The procedure for assessing completeness will be as follows:

$$\text{percent complete} = (v/t) \times 100 \text{ percent}$$

where:

v = number of valid measurements

t = total number of planned measurements

7.3 Corrective Actions

If QA/QC audits or reviews of data indicate unacceptable data, samples should be reanalyzed if holding-time criteria permit. Should the requirements not be met following reanalysis, the Laboratory Services Supervisor will be responsible for developing and initiating corrective action. The Quality Manager will be responsible for assessing whether the selected corrective action is adequate.

Corrective action may include reanalyzing samples (if holding-time criteria permit); resampling and analyzing; evaluating and amending established sampling and analytical procedures; or reevaluating DQOs and data validation requirements.

Section 8

QUALITY ASSURANCE OVERSIGHT

Quality assurance oversight, management for performance and system audits, and corrective action performance will follow the CLEAN Program Quality Control Management Plan (BNI 1994). The Quality Control Management Plan provides the requirements and responsibilities that will be carried out by all CLEAN II personnel and subcontractors to attain the designed level of quality. Personnel are to be qualified and trained in the work that they are assigned.

The Navy is responsible for evaluation of the laboratory QA programs. Laboratory QA programs will be evaluated using the NFESC process (NFESC 1996). Oversight will include internal and external audits, documentation of findings, and reports of corrective action.

8.1 PERFORMANCE AND SYSTEM AUDITS

Audits and surveillance of activities will be conducted to assure that work is accomplished by trained personnel using approved procedures. These verification activities will be conducted by the Quality Manager, assisted by various technical experts who are not directly responsible for accomplishing the work being reviewed. Audits of field sampling activities, laboratories, and administrative activities will be conducted. Analytical laboratories will be audited by BNI or the Navy following the NFESC process conducted annually (approximately) and reports will be provided to BNI and Navy management. Verification activities will be accomplished to evaluate the conduct of such activities as sample location, identification and control, COC protocol, field documentation, and calibration of instruments. Verification activities may be scheduled or unscheduled, and will be conducted commensurate and in coordination with work activities.

8.2 CORRECTIVE ACTIONS

Corrective actions will be identified, tracked, and closed out in a timely manner. Project activities that are found to be in noncompliance with quality requirements and cannot be resolved in the normal course of verification activities will be appropriately documented in accordance with approved procedures. Corrective Action Requests will be used to document noncompliance, corrective action commitments, and resolutions.

Corrective action is not complete until the problem has been solved effectively and permanently. Follow-up action to assure that the problem remains corrected is an important step in the corrective action process.

The need for corrective actions will be evaluated based on the results of field activities, laboratory results of the groundwater samples, QC samples (including DBPE samples), data validation reports, and the DQOs. Should the evaluation of these data indicate that acceptance criteria are not met, possible corrective action will be evaluated. The corrective actions will be agreed upon by the Navy and regulatory agencies. Input for decision making will be obtained from appropriate representatives of the Navy and regulatory agencies.

Section 8 Quality Assurance Oversight

8.3 QUALITY ASSURANCE REPORTS TO MANAGEMENT

QA reports will be made to the program management on a monthly basis. These reports will contain a discussion of the current status of the project, including the results of performance and system audits, the results of any data quality assessments, any problems, and methods to resolve these problems. In addition, the data quality assessment results for the project shall be summarized and reported in the QA section of the monitoring report on perchlorate in groundwater at MCAS El Toro.

8.4 QAPP IMPLEMENTATION

The Quality Manager will assist the Navy QAO in the documentation of QAPP implementation. Documentation will provide evidence of compliance with specific QA activities required by this QAPP, such as conduct of field and laboratory audits.

8.5 QAPP REVISION OR AMENDMENT

When circumstances arise such as a significant change in work scope that impact the original project DQOs, the QAPP document will be revised or amended. The modification process will be based upon U.S. EPA guidelines and direction from the Navy RPM and QAO and will be conducted in accordance with CLEAN Program SOP 25, Preparing Quality Assurance Project Plans.

Section 9 REFERENCES

- Bechtel National, Inc. 1994. CLEAN Program Quality Control Management Plan. 15 March.
- . 1996a. CLEAN II Technical Specifications for Data Review, Contract Technical Specifications, 22214-TS-004, Revision 2. October (or latest revision in effect at the time of data review).
- . 1996b. CLEAN Program Data Management Plan. September.
- . 1998a. Field Sampling Plan for Groundwater Monitoring of Perchlorate, MCAS El Toro, California. July.
- . 1998b. CLEAN Program Technical Specifications for Analytical Laboratory Services, Contract Technical Specifications, 22214-TS-002, Revision 5. 25 March (or latest revision in effect at the time of analysis).
- . 1998c. Update to the Final Investigation-Derived Waste Management Plan for Groundwater Monitoring, MCAS El Toro, California. July.
- . 1998d. Update to the Final Amended Data Management Plan for Groundwater Monitoring, MCAS El Toro, California. July.
- . 1998e. Navy CLEAN Program Procedures Manual, Volume 3: Quality Assurance and Technical. Revision 41. March.
- BNI. *See* Bechtel National, Inc.
- Naval Energy and Environmental Support Activity. 1988. Sampling and Chemical Analysis Quality Assurance Requirements for the Navy Installation Restoration Program. NEESA 20.2-047B. June.
- . 1990. Quality Assurance in Environmental Analysis. Prepared for NEESA by the Analytical Support Group, Sampling and Environmental Support Department, Martin Marietta Energy Systems, Inc. October.
- Naval Facilities Engineering Service Center. 1996. Navy Installation Restoration Program Laboratory Quality Assurance Guide. Interim Guidance Document. February.
- NEESA. *See* Naval Energy and Support Activity.
- NFESC. *See* Naval Facilities Engineering Service Center.
- Southwest Division Naval Facilities Engineering Command. 1996. Policy Memorandum #13. 09 April.
- United States Environmental Protection Agency. 1989. Risk Assessment Guidance for Superfund. Volume I: Human Health Evaluation Manual, Interim Final. Office of Emergency and Remedial Response. September.
- . 1990. Sampler's Guide for the Contract Laboratory Program, First Edition. Office of Solid Waste and Emergency Response. December.

Section 9 References

- . 1991. User's Guide to the Contract Laboratory Program. Office of Emergency and Remedial Response. EPA/540/P-91/002. January.
- . 1994a. Guidance for Data Quality Objectives Process.
- . 1994b. Laboratory Data Validation Functional Guidelines for Evaluating Inorganics Analysis. Hazardous Site Evaluation Division, U.S. EPA, prepared by U.S. EPA Data Review Work Group. 01 February.
- . 1994c. Laboratory Data Validation Functional Guidelines for Evaluating Organics Analysis. Hazardous Site Evaluating Division, U.S. EPA, prepared by U.S. EPA Data Review Work Group. 01 February.

U.S. EPA. *See* United States Environmental Protection Agency.