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**FIELD SAMPLING PLAN
FOR
SITE AND LABORATORY ACTIVITIES
AT
MARINE CORPS BASE CAMP LEJEUNE, NORTH CAROLINA**

Prepared for:

DEPARTMENT OF THE NAVY

Contract No. N62470-03-D-4000



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Naval Facilities Engineering Command
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Contract Task Order 0010

November 2003

**FIELD SAMPLING PLAN
FOR
LONG TERM MONITORING AND OPERATION & MAINTENANCE
AT
MARINE CORPS BASE CAMP LEJEUNE, NORTH CAROLINA**

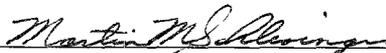
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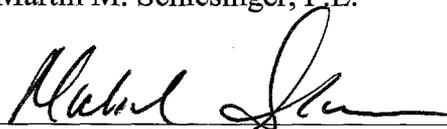
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We hereby certify that the Field Sampling Plan shown and marked in this submittal is proposed to be incorporated into Contract Number N62470-03-D-4000, is in compliance with the contract drawings and specifications, can be installed in the allocated spaces, and is submitted for Government approval.



Certified by Submittal Reviewer / Program Manager
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November 2003

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List of Acronyms

ASTM	American Society for Testing and Materials
°C	degrees Celsius
CAA	Clean Air Act
CAR	corrective action report
CCV	continuing calibration verification
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CFR	Code of Federal Regulations
CLEAN	Comprehensive Long-term Environmental Action Navy
CLJ	Marine Corps Base, Camp Lejeune, North Carolina
CLP	Contract Laboratory Program
CNO	Chief of Naval Operations
COC	Chain of Custody Form
CRM	certified reference material
CWA	Clean Water Act
DI	deionized
DOD	U.S. Department of Defense
DQO	data quality objectives
DRO	diesel range organics
EDD	electronic data deliverables
EPA	U.S. Environmental Protection Agency
ER,N	Environmental Restoration, Navy
FFA	Federal Facilities Agreement
FID	flame ionization detector
FS	feasibility study
FSP	Field Sampling Plan
G	glass
GC	gas chromatography
GC/MS	gas chromatography/mass spectroscopy
GRO	gasoline range organics
GW	groundwater
H ₂ SO ₄	sulfuric acid
HASP	Health and Safety Plan
HCl	hydrochloric acid
HDPE	high-density polyethylene
HNO ₃	nitric acid

List of Acronyms (Continued)

HPLC	high-performance liquid chromatography
ICB	initial calibration blank
ICP	inductively coupled plasma
ICS	interference check standard
ID	identification
IDW	investigation-derived waste
IR	Installation Restoration
IS	internal standards
LANTDIV	Department of the Navy, Atlantic Division
LCS	laboratory control sample
LIMS	Laboratory Information Management System
MB	method blank
MDL	method detection limit
mg/Kg	milligram per kilogram
mg/L	milligram per liter
MS/MSD	matrix spike/matrix spike duplicate
N/A	not applicable
NaOH	sodium hydroxide
Na ₂ S ₂ O ₃	sodium thiosulfate
NELAP	National Environmental Laboratory Accreditation Program
NEPA	National Environmental Policy Act
NFESC	Naval Facilities Engineering Service Center
NIOSH	National Institute of Occupational Safety and Health
NIST	National Institute of Standards and Technology
NPDES	National Pollutant Discharge Elimination System
OSHA	Occupational Safety and Health Administration
OVM	organic vapor monitor
P	polyethylene
PA	preliminary assessment
PAH	polynuclear aromatic hydrocarbon
PARCC	precision, accuracy, representativeness, comparability, and completeness
PC	project chemist
PCB	polychlorinated biphenyls
PDS	post digestion spike

List of Acronyms (Continued)

PE	performance evaluation
PM	project manager
ppb	parts per billion
ppm	parts per million
QA	quality assurance
QAM	laboratory quality assurance manual
QAO	quality assurance objectives
QAPP	quality assurance project plan
QC	quality control
QMS	quality management system
R	recovery
RA	remedial action
RCRA	Resource Conservation and Recovery Act
RD	remedial design
RI	remedial investigation
RL	reporting limits
RPD	relative percent difference
SAP	sampling and analysis plan
SARA	Superfund Amendments and Reauthorization Act
SCS	Soil Conservation Survey
SI	site inspection
SOP	standard operating procedure
SOW	statement of work
SRM	standard reference material
SVOC	semi-volatile organic compound
SW-846	Test Methods for Evaluating Solid Waste, Physical/Chemical Methods
SWMU	solid waste management unit
TCLP	toxicity characteristic leaching procedure
TIC	tentatively identified compounds
ug/Kg	microgram per kilogram
ug/L	microgram per liter
USGS	U.S. Geological Survey
USACE	U.S. Army Corps of Engineers
UST	underground storage tank
VOC	volatile organic compound

Preface

Engineering & Environment (EEI) has been tasked by the Naval Facilities Engineering Command (NAVFACENGCOM) in support of Environmental Remediation Services under the cognizance of the Atlantic Division (LANTDIV) for Marine Corp Base, Camp Lejeune (CLJ), North Carolina. This Basewide Field Sampling Plan (FSP) has been prepared as a deliverable under Contract No. N62470-03-D-4000, Contract Task Order 0010. The Sampling and Analysis Plan (SAP), by definition, is comprised of a Field Sampling Plan (FSP) and a Quality Assurance Project Plan (QAPP). This Basewide FSP will apply to all site and laboratory activities performed under contract for CLJ. It establishes protocols to allow for comparability and defensibility of sampling and analytical data. It is intended to provide detailed documentation for procedures merely referenced in each task-specific SAP. The task-specific SAPs will provide all remedial and quality control limits to be used in data validation. Contract personnel should defer to the task-specific SAPs in cases where differences from this Basewide SAP in field or laboratory procedure are observed.

This Basewide Field Sampling Plan has been prepared in accordance with the scope of services necessary to support Prime Contract No. N62470-03-D-4000,. This contract was issued by the Naval Facilities Engineering Command (NAVFACENGCOM) in support of Environmental Remediation Services under the cognizance of the Atlantic Division (LANTDIV) for Marine Corp Base, Camp Lejeune, North Carolina.

1.0 Introduction

This Basewide Field Sampling Plan (FSP) presents the procedures designed to achieve comparability and defensibility regarding sampling techniques for different sites and events on the Marine Corps Base, Camp Lejeune (CLJ), North Carolina. It is to be used in conjunction with task-specific SAPs, which define the remediation goals for each site. This FSP, along with a Quality Assurance Project Plan (QAPP), make up the Basewide Sampling and Analysis Plan (SAP). The SAP provides assurance that data are collected, analyzed, reviewed, and reported in a consistent and representative manner. This FSP is required reading for all field personnel involved in remedial activity efforts and is available to the field teams collecting samples. All subcontractors are also required to comply with the procedures documented in this FSP.

2.0 Project Description

This Basewide Field Sampling Plan (FSP) for the Marine Corps Base (MCB), Camp Lejeune (CLJ), North Carolina has been prepared by Engineering & Environment INC. (EEI) for the Department of the Navy, Atlantic Division (LANTDIV) under Contract No. N62470-03-D-4000. It is relevant to all CLJ site and analytical activities performed by EEI or EEI-subcontracted personnel. The following sections of this FSP describe the general scope of the project, current remedial and monitoring activities, and procedures involved in sample collection. The associated QAPP addresses policies to be used by the fixed-base laboratory for delivering usable and legally defensible data.

2.1 Facility Location and Background

MCB Camp Lejeune is a training base of the Marine Corps, located in Onslow County, North Carolina. The base covers approximately 236 square miles. Its southeastern boundary is State Route 24, and its western boundary is U.S. Route 17. The town of Jacksonville, North Carolina is north of the base.

MCB Camp Lejeune was placed on the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) National Priorities List in October 1989. A Federal Facilities Agreement (FFA) was established to ensure that environmental impacts associated with past and present activities at CLJ were thoroughly investigated and that appropriate corrective action alternatives were developed and implemented as necessary to protect public health and the environment.

2.2 Scope of Work

The rationale and approach for mobilizing and conducting field activities are addressed in various Work Plans that have been written by EEI for MCB Camp Lejeune. Data quality objectives specific to each remedial and/or monitoring activity can be found in task-specific SAPs. This Basewide FSP gives detailed procedures for proper and representative sampling associated with the different proposed remedial activities to be performed at MCB Camp Lejeune. Sampling of soil, sediment, surface water, ground water, air, and waste are addressed herein. There are also specific procedures to maintain consistency of documentation, sample shipment, field instrument calibration, and decontamination of equipment.

3.0 Project Organization and Responsibilities

All project personnel, including field, laboratory, and subcontractor personnel are subject to the requirements of the SAP. The key positions and identities are described in detail in the task-specific FSPs. Following is an overview of responsibilities provided for this scope of work.

3.1 Regulatory Requirements

The CERCLA National Priorities List status requires that activities at MCB Camp Lejeune be sanctioned by the United States Environmental Protection Agency (EPA), Region IV, the North Carolina Department of Environment, Health, and Natural Resources, and the United States Department of the Navy. The primary contractor reports directly to the Department of the Navy, Atlantic Division (LANTDIV). LANTDIV personnel will facilitate the project from beginning to end, ensuring that environmental impacts are investigated, and providing the necessary interface with the regulatory agencies and contractors selected to support the project efforts in meeting the projects objectives. CERCLA/Resource Conservation and Recovery Act (RCRA) corrective actions will be developed and implemented as necessary to protect public health and the environment.

3.2 Primary Contractor Tasks

The EEI project manager (PM) serves as the focal point for control of all project activities. The PM will be supported by the project team, which will provide reviews, guidance, and technical advice on project execution issues. The project team will consist of supervisory, health and safety, technical, and QA/QC staff members to ensure safe and compliant progress of the remediation goals. Individuals of the project team each have specific responsibilities involving adherence with the statement of work (SOW), QAPP, Health and Safety Plan (HASP), and FSP.

3.3 Subcontractor Activities

The selection of qualified subcontractors will be in accordance with EEI procurement and QA procedures. The bulk of the engineering work will be accomplished by EEI personnel, but a selection of environmental laboratories for LANTDIV work are procured and coordinated based on capacity and capability. EEI performs quality checks to determine that the subcontractors have fulfilled the procurement requirements necessary to perform site or off-site activities. All subcontractors will be required to follow the procedures of the SAP.

3.4 Qualifications and Training of Personnel

Personnel assigned to the project, including field personnel and subcontractors, will be qualified to perform the tasks to which they are assigned. Said personnel will meet requirements set forth in OPNAVINST 5090.1B 25-5.8. This includes but is not limited to basic sampling techniques, field-testing methodology, task-specific sampling methods, maintenance of environmental paperwork, and how to avoid cross contamination. In addition to education and experience, specific training may be required to qualify individuals to perform certain activities. Training will be documented appropriately and the forms placed in the project file as a record. Project personnel will receive an orientation to the full SAP and the HASP as appropriate to their responsibilities before participation in project activities. Training of field personnel will be provided by the Site Supervisor, the QA Officer, or by a qualified designee.

4.0 Sampling Procedures Overview

4.1 Purpose

The sampling events for this project may include, but are not limited, to the following:

- Soil Screening
- Off-site Borrow Sampling
- Post-excavation Confirmation Sampling
- Wastewater Treatment Plant Sampling
- Monitoring Well Installation Drill Cuttings
- Groundwater Monitoring
- Soil-vapor Extraction Stack Monitoring
- Disposal Characterization

Sampling procedures will be compliant with EPA, state, and applicable DOD specifications. This SAP meets or exceeds guidelines set forth by Naval Environmental compliance documentation OPNAVINST 5090.1B Chapter 25, NAVSEA T0300-AZ-PRO-010, and National Environmental Laboratory Accreditation Program (NELAP) quality system requirements. The matrix and required analytical method will determine which sample collection procedure(s) is appropriate. Sections 5.0 through 9.0 provide specific techniques to be used when collecting soil/sediment, surface water, ground water, air, and/or waste samples. The remainder of Section 4.0 of this FSP addresses information that is consistent for any type of field sampling.

4.2 Preparations for Field Sampling

The Site Supervisor will oversee procurement of all required sampling equipment (Table 4-1). Where feasible, single-use disposable equipment will be used to minimize decontamination time and effort. For events requiring bailers and tubing, Teflon[®] and/or silicone will be used. Where metal equipment is to be used for soil sample collection and/or compositing, the augers, bowls, spoons, etc. will be made of stainless steel.

Field measurement instruments may be used for health and safety purposes or to determine matrix stabilization prior to sampling. These field instruments will be calibrated and maintained in accordance with the manufacturer's specifications. Documentation provided by the manufacturer for any field instruments will be filed on site for easy reference. Details regarding the field screening data procedures are available in Section 10.0 of this FSP.

The Site Supervisor will ensure that all permits and authorizations have been acquired prior to the start of remedial and monitoring activities at MCB Camp Lejeune. The Project Chemist or appropriate representative will notify the chosen laboratory to provide EPA-approved sample bottles, preservative, and shipping containers. The laboratory may also be requested to provide deionized water for decontamination of equipment, prepared trip blanks, chains of custody, custody seals, and approved packing material to protect sample bottles during transit.

4.3 Health and Safety Program

A Health and Safety Officer will be assigned to oversee compliance of the remedial plans with OSHA regulations. This Health and Safety Officer may or may not be assigned solely to work at MCB Camp Lejeune and may or may

Table 4-1
Sampling Equipment and Analytical Instrumentation

Table 4-1 A: Sampling Equipment - Groundwater Equipment

Equipment	Construction	Use	Parameter Groups
Peristaltic Pump with foot-valve	SS, Teflon	Purging	All parameter groups
Peristaltic Pump with foot-valve	SS, Teflon	Sampling	All parameter groups except VOC
Peristaltic Pump with foot-valve and in line filter 1.0 um (on positive pressure side of pump)	SS, Teflon	Sampling	Dissolved Metals, only in Groundwater
Syringes	Polypropylene	Field filtration	Inorganic anions
Syringe filter holders	Stainless Steel	Field filtration	Inorganic anions
0.45 um membranes	Polyester	Field filtration	Inorganic anions

Table 4-1 B: Sampling Equipment - Surface Water Equipment

Equipment	Construction	Use	Parameter Groups
Dipper	SS	Sampling	All parameter groups
Surface bailer	Teflon	Sampling	All parameter groups
ISCO Autosampler	Teflon Tubing with ice chests	Sampling	Anions, Inorganic Parameters
Syringes	Polypropylene	Field filtration	Inorganic anions
Syringe filter holders	Stainless Steel	Field filtration	Inorganic anions
0.45 um membranes	Polyester	Field filtration	Inorganic anions

Table 4-1 C: Sampling Equipment - Miscellaneous Equipment

Equipment	Construction	Use	Parameter
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1. Decontamination equipment and supplies

a. 5 gallon bucket	PVC	Wash sampler	All parameter groups except metals and VOC
b. Brushes	N/A	Wash sampler	All parameter groups
c. Detergents "Liqui-Nox"	N/A	Wash sampler	All parameter groups
d. Waterproof bags	Plastic	To contain wastes	All parameter groups
e. Analyte free water rinser	Plastic	Wash sampler	All parameter groups
f. Paper towels	Paper	Decontamination	All parameter groups

g. Pesticide grade methanol	N/A	Clean Container	VOC
h 1:1 Nitric Acid Solution	N/A	Clean Container	Metals
i. 1:1 Hydrochloric Acid	N/A	Clean Container	Nutrients
k. Analyte free water	N/A	Clean Container	All parameter groups

2. Supplies and reagents for field measurement

a. pH buffers (4,7 and 10)	N/A	Calibration	Physical properties
b. Conductivity Standards 100 and 1000 uS/cm	KCl	Calibration	Physical properties
c. AEPA Turbidity Standards 80, 8.0, 0.8 NTU	Formazin	Calibration	Physical properties

3. Preservation supplies

a. Acid preservative	Sulfuric Acid, ACS grade	Sample preservation	Anions, Inorganic Parameters
b. Acid preservative	Nitric Acid, ACS grade	Sample preservation	Metals
c. Dropping Bottle	Glass	Sample preservation	Metals, Anions
d. Narrow range pH paper	N/A	Sample preservation	Metals, Anions

4. Sample transportation supplies

a. Ice chests	Ice	Transporting samples	All parameter groups
b. Sealing tape	Plastic	Transporting samples	All parameter groups
c. Shipping labels and forms	Paper	Transporting samples	All parameter groups
d. Ice	Ice	Transporting samples	All parameter groups
e. Sample container tags	Paper	Documentation	All parameter group

5. Protective clothing

a. Gloves	Latex	Sampling	All parameter groups
b. Clothing and goggles	N/A	Protection	All parameter groups

6. Documentation supplies

a. Notebooks/logs/field sheets	Paper	Documentation	All parameter groups
b. Pens, markers	N/A	Documentation	All parameter groups
c. Sample container labels	Paper	Documentation	All parameter groups
d. Custody labels/tags	Paper	Documentation	All parameter groups
e. Custody/transmittal forms	Paper	Documentation	All parameter groups

f. Camera	N/A	Documentation	All parameter groups
g. Calculator	N/A	Documentation	All parameter groups

7. Reference material:

a. Site maps	Paper	Locate positions	All parameter groups
b. SOPs	Paper	Documentation	All parameter groups

8. Other equipment

a. Water level indicator	N/A	Depth measurements	All parameter groups
b. Lanyards for bailers	Polypropylene	Sampling	All parameter groups
c. Bung wrench	Copper	Sampling	All parameter groups
d. Syringes	Polypropylene	Field filtration	Inorganic anions
e. Syringe filter holders	Stainless Steel	Field filtration	Inorganic anions
f. 0.45 um membranes	Polyester	Field filtration	Inorganic anions
g. Peristaltic Pump	Teflon	Field filtration	Metals
h. 1.0 um membranes	Polyester	Field filtration	Metals in GW
i. Protective sheeting for clean work areas and/or around well heads	PE	Protection from contamination	All parameter groups
j. Buckets to contain and measure purge water	PE	Protection from contamination	All parameter groups
k. Buckets to contain wastes	PE	Protection from contamination	All parameter groups
l. Container for wastes	PE	Protection from contamination	All parameter groups

9. Field Test Instruments

Dissolved oxygen meter	N/A	DO	Dissolved Oxygen
Ionalyzer	N/A	pH	Physical Properties
Thermometer	N/A	Temperature	Physical Properties
pH tester	N/A	pH, Temperature	Physical Properties
Digital TDS Meter	N/A	Conductivity	Physical Properties
Nephelometer	N/A	Turbidity	Physical Properties

not handle tasks for all sites undergoing remediation or monitoring. The Health and Safety Officer(s) is responsible for writing and maintaining a Health and Safety Plan (HASP). He/she will ensure that the HASP is available to all site personnel prior to beginning work at MCB Camp Lejeune. A sign-off form will be maintained with the site copy of the HASP to indicate that personnel have read the document and are aware of its implications.

4.4 Sample Custody and Documentation

Sample custody can be defined as physical possession of samples, having samples within visual range, or having samples located in a restricted access area. Sample possession during all sampling efforts must be traceable from the time of collection until the results are verified and reported. The sample custody procedures provide a mechanism for documentation of all information related to sample collection and handling. The primary piece of documentation to ensure sample custody is the Chain of Custody Form (COC). EEI personnel are responsible for providing evidence of sample custody from the time of collection until the laboratory receives the samples. The laboratory will be able to provide documentation of sample custody from that point to sample disposal.

As part of appropriate documentation, all sample bottles will be adequately labeled. The label will present sample identification and collection information. It will be pre-printed from the sample tracking system or completed with indelible ink. At a minimum, all sample labels will include the following sample information:

- Field sample location and unique sample identifier
- Project name and number
- Analysis requested for each bottle
- Method of preservation for each bottle
- Date and time of collection
- Initials of sample technician.

A sample numbering system will be utilized in the field to uniquely identify each sample collected at MCB Camp Lejeune. The sample number will be traceable to the site, location, and depth (where applicable). The sample identification and description will be recorded by the Site Supervisor or representative in the sample collection logs.

4.4.1 Field Custody Procedures

The sampling team with the Site Supervisor will maintain overall responsibility for the care and custody of the collected samples until they are transferred or properly dispatched to the laboratory. All shipping or sample transfer activities will be documented.

Transfer of custody and shipping procedures will include:

- The Site Supervisor instructing sampling team personnel in the proper COC procedures before sampling begins,
- A COC entry made in the field for each sample. This document will accompany the samples in shipment, and a copy will be maintained at the site for placement in the project files at the conclusion of field activities. The custody of individual sample containers will be documented by recording each sample identification and the number of bottles on the appropriate COC form,
- COC records initiated in the field will be placed in a plastic bag and taped to the underside of the top of the shipping cooler used for sample transport,
- Each time responsibility for custody of the sample changes, the new custodian will sign and date the record,

- All coolers must be secured at the site with two custody seals prior to transport. Custody seals should be signed and dated by the person relinquishing custody of the samples being shipped. They should be placed over the opening of each cooler so that the cooler cannot be opened without breaking the seal.

4.4.2 Laboratory Custody Procedures

All samples to be analyzed by the laboratory will be shipped via overnight courier service. Upon receipt, a representative of the laboratory shall check the integrity of the custody seals, then locate, sign, and date the COC. The laboratory is responsible for verifying that the COC and containers are in agreement. The COC, a Cooler Receipt Form, and information regarding any discrepancies between the COC and bottle labels will be faxed to the Project Chemist prior to preparation for analysis. The Laboratory Information Management System will provide evidence of sample custody from receipt by the laboratory until appropriate disposal.

4.5 Sample Containers, Preservation, and Holding Times

Samples must be placed in sample containers certified by the manufacturer to be pre-cleaned to EPA specifications. Containers provided by the laboratory will be compatible with the matrix and intended analysis, and properly prepared and preserved to maintain sample integrity. Table 4-2 specifies the types of containers needed for each analytical method and matrix.

Physical and chemical preservation includes techniques designed to stabilize the concentrations of analytes in the sample matrix during the time from sample collection through preparation and analysis. All samples shall be preserved by cooling to $4^{\circ}\text{C} \pm 2^{\circ}\text{C}$ immediately after sample collection. Whenever possible, chemical preservatives will come prepared from the laboratory. The final pH of the chemically preserved samples will be checked using pH paper and the result recorded. The pH paper will not be dipped into the sample container to measure pH, but an aliquot of sample shall be removed for pH testing and then properly disposed. If the pH check indicates pH adjustment is necessary, additional preservative will be added to attain the correct sample pH.

A sample holding time establishes the recommended maximum time that a sample may be held under preservation before extraction and analysis without compromising sample representativeness. Preservation techniques and holding times are standardized by the EPA according to analytical method. Table 4-2 summarizes the latest information on preservation techniques and holding times for the requested analyses.

Chemical preservation is not usually recommended for solid matrix samples. Unpreserved samples that require preservation by the laboratory should be indicated on the sample label and should be flagged on the COC to identify these samples to the laboratory receiving personnel as requiring special handling.

4.6 Sample Packaging and Shipment

Samples that are collected for off-site laboratory analysis that require overnight shipment will be generally prepared by:

- Sealing the container in an outer ziplock storage bag.
- Securely wrapping and taping each collected bottle in bubble wrap (or other similar shock-adsorbing material).

At least three sides of the container must be wrapped or surrounded with material when placing the samples into the shipping cooler. Adequate ice will be placed in doubled ziplock bags and added to the cooler around and over the

Table 4-2

Recommendation for Sampling and Preservation of Samples, Arranged According to Measurement

Extract from manual: U. S. Environmental Protection Agency. 1983. Sample preservation. pp.xv-xx. In Methods for Chemical Analysis of Water and Wastes, EPA-600/4-79-020. U.S.E.P.A., Cincinnati, Ohio, USA. (see note 1, below)

Measurement	Volume Required (ml)	Container (note 2)	Preservative (notes 3,4)	Holding Time (note 5)
100. Physical				
Color	50	P,G	Cool, 4 deg. C	48 Hrs.
Conductance	100	P,G	Cool, 4 deg. C	28 Days
Hardness	100	P,G	HNO ₃ - pH below 2	6 Mos.
Odor	200	G only	Cool, 4 deg. C	24 Hrs.
pH	25	P,G	None Required	Analyze Immediately
Residue				
Filterable	100	P,G	Cool, 4 deg. C	7 Days
Non-filterable	100	P,G	Cool, 4 deg. C	7 Days
Total	100	P,G	Cool, 4 deg. C	7 Days
Volatile	100	P,G	Cool, 4 deg. C	7 Days
Settleable Matter				
Settleable Matter	1000	P,G	Cool, 4 deg. C	48 Hrs.
Temperature	1000	P,G	None Required	Analyze Immediately
Turbidity	100	P,G	Cool, 4 deg. C	48 Hrs.

200. Metals

Dissolved	200	P,G	Filter on site, HNO ₃ - pH below 2	6 Mos.
Suspended	200	P,G	Filter on site	6 Mos. (8)
Total	100	P,G	HNO ₃ - pH below 2	6 Mos.
Chromium (6)	200	P,G	Cool, 4 deg. C	24 Hrs.
Mercury				
Dissolved	100	P,G	Filter on site, HNO ₃ - pH below 2	28 Days
Total	100	P,G	HNO ₃ - pH below 2	28 Days

300. Inorganics, Non-Metallics

Acidity	100	P,G	Cool, 4 deg. C	14 Days
Alkalinity	100	P,G	Cool, 4 deg. C	14 Days
Bromide	100	P,G	None Required	28 Days
Chloride	50	P,G	None Required	28 Days
Chlorine	200	P,G	None Required	Analyze Immediately
Cyanides	500	P,G	Cool, 4 deg. C, NaOH - pH over 12 0.6g ascorbic acid (6)	14 Days*(7)
Fluoride	300	P,G	None Required	28 Days
Iodide	100	P,G	Cool, 4 deg. C	24 Hrs.
Nitrogen				
Ammonia	400	P,G	Cool, 4 deg. C, H2SO4 - pH below 2	28 Days
Kjeldahl, Total	500	P,G	Cool, 4 deg. C, H2SO4 - pH below 2	28 Days
Nitrate + Nitrite	100	P,G	Cool, 4 deg. C, H2SO4 - pH below 2	28 Days
Nitrate (9)	100	P,G	Cool, 4 deg. C,	48 Hrs.
Nitrite	50	P,G	Cool, 4 deg. C,	48 Hrs.
Dissolved Oxygen				
Probe	300	G bottle + top	None Required	Analyze Immediately
Winkler	300	G bottle + top	Fix on site and store	8 Hours
Phosphorus				
Ortho-P,	50	P,G	Filter on site, Cool, 4 deg. C	48 Hrs.
Hydrolyzable	50	P,G	Cool, 4 deg. C, H2SO4 - pH below 2	28 Days
Total,	50	P,G	Cool, 4 deg. C, H2SO4 - pH below 2	28 Days
Total, dissolved	50	P,G	Filter on site, Cool, 4 deg. C, H2SO4 - pH below 2	24 Hrs.
Silica	50	P only	Cool, 4 deg. C	28 Days

Sulfate	50	P,G	Cool, 4 deg. C	28 Days
Sulfide	500	P,G	Cool, 4 deg. C, add 2 ml zinc acetate plus NaOH - pH over 9	7 Days
Sulfite	50	P,G	None Required	Analyze Immediately

400. Organics

BOD	1000	P,G	Cool, 4 deg. C	48 Hrs.
COD	50	P,G	Cool, 4 deg. C, H ₂ SO ₄ - pH below 2	28 Days
Oil & Grease	1000	G only	Cool, 4 deg. C, H ₂ SO ₄ - pH below 2	28 Days
Organic carbon	25	P,G	Cool, 4 deg. C, H ₂ SO ₄ or HCl to pH below 2	28 Days
Phenolics	500	G only	Cool, 4 deg. C, H ₂ SO ₄ - pH below 2	28 Days
MBAS	250	P,G	Cool, 4 deg. C	48 Hrs.
NTA	50	P,G	Cool, 4 deg. C	24 Hrs.

1. More specific instructions for preservation and sampling are found with each procedure as detailed in this manual. A general discussion on sampling water and industrial wastewater may be found in ASTM, Part 31, p. 72-82 (1976) Method D-3370.

2. Plastic (P) or Glass (G). For metals, polyethylene with a polypropylene cap (no liner) is preferred.

3. Sample preservation should be performed immediately upon sample collection. For composite samples each aliquot should be preserved at the time of collection. When use of an automated sampler makes it impossible to preserve each aliquot, then samples may be preserved by maintaining at 4 deg. C until compositing and sample splitting is completed.

4. When any sample is to be shipped by common carrier or sent through the United States Mails, it must comply with the Department of Transportation Hazardous Materials Regulations (49 CFR Part 172). The person offering such material for transportation is responsible for ensuring such compliance. For the preservation requirements of Table I the Office of Hazardous Materials, Materials Transportation Bureau, Department of Transportation has determined that the Hazardous Materials Regulations do not apply to the following materials: Hydrochloric acid (HCl) in water solutions at concentrations of 0.04% by weight or less (pH about 1.96 or greater); Nitric acid (HNO₃) in water solutions at concentrations of 0.15% by weight or less (pH about 1.62 or greater); Sulfuric acid (H₂SO₄) in water solutions at concentrations of 0.35% by weight or less (pH about 1.15 or greater); Sodium hydroxide (NaOH) in water solutions at concentrations of 0.080% by weight or less (pH about 12.30 or less).

5. Samples should be analyzed as soon as possible after collection. The times listed are the maximum times that samples may be held before analysis and still considered valid. Samples may be held for longer periods only if the permittee, or monitoring laboratory, has data on file to show that the specific types of sample under study are stable for the longer time, and has received a variance from the Regional Administrator. Some samples may not be stable for the maximum time period given in the table. A permittee, or monitoring laboratory, is obligated to hold the sample for a shorter time if knowledge exists to show this is necessary to maintain sample stability.

6. Should only be used in the presence of residual chlorine.

7. Maximum holding time is 24 hours when sulfide is present. Optionally, all samples may be tested with lead acetate paper before the pH adjustment in order to determine if sulfide is present. If sulfide is present, it can be removed by the addition of cadmium nitrate powder until a negative spot test is obtained. The sample is filtered and then NaOH is added to pH 12.

8. Samples should be filtered immediately on-site before adding preservative for dissolved metals.

9. For samples from non-chlorinated drinking water supplies conc. H_2SO_4 should be added to lower sample pH to less than 2. The sample should be analyzed before 14 days.

top of the sample containers to form a cooling layer to help ensure proper preservation during shipment. In addition, most samples will have been pre-cooled to the desired temperature prior to packing for shipment. Completed and signed COCs will be placed into the cooler in a protective ziplock bag and taped to the underside of the cooler lid. A minimum of 2 custody seals will be applied across the opening of the cooler and the lid secured by wrapping the cooler with clear plastic packing tape. The cooler will then be ready for shipment according to the methods required by the overnight delivery service. At a minimum, the laboratory address, telephone number, and contact name should be included on the original airbill and, if multiple packages are sent, on each sample cooler.

At all times from the point of sample collection in the field through storage, inventory, preparation, and shipment, the samples must remain sealed, protected from sources of contamination, and adequately preserved by chilling.

As shipping regulations are subject to frequent updates without notification, the sample technician should, at least quarterly, petition a set of applicable shipping regulations from the overnight shipper to be assured of regulatory compliance.

4.7 Decontamination

All reusable equipment that may directly or indirectly contact samples shall be cleaned in a designated decontamination area. In addition, EEI will take care to prevent the sample from coming into contact with potentially contaminating substances, such as tape, oil, engine exhaust, corroded surfaces, or dirt. To minimize the possible contribution of even trace levels of contamination from sampling equipment, adequate decontamination must be completed prior to each use of the equipment. Sampling and drilling devices shall be scrubbed with a solution of potable water and Alconox[®], or equivalent laboratory-grade detergent. The equipment will then be rinsed with copious quantities of potable water. If equipment has come in contact with oil or grease, it will be rinsed with pesticide-grade methanol followed by pesticide-grade hexane. The equipment will be air-dried on a clean surface. If the sampling device will not be used immediately after decontamination, it shall be wrapped in oil-free aluminum foil. Decontamination fluids shall be collected in appropriate storage containers. These will be sampled for characterization and disposal by an approved facility.

5.0 Ground Water Sampling

5.1 Purpose

This section describes the activities involved in ground water sample collection. Procedures are described in this section for proper well purging techniques and for obtaining a representative sample from a ground water monitoring well.

5.2 General Sampling Procedures

The single most important part of sampling monitoring wells is obtaining a representative sample of the ground water where the well has been screened. Therefore, evacuation of the water column in a monitoring well is required prior to sample collection. This removes the standing water column and induces ground water flow from the surrounding formation into the well. The exception to this standard procedure is if the objective of the sampling event is to determine the presence of non-aqueous phase liquids or freestanding product in the well. Access to monitoring wells may be difficult and the wells themselves hard to locate in the field. The sample technician must obtain information on the location, access, and permission required before visiting the site. Monitoring wells usually have a friction or screw cap and should be locked. Keys to unlock the caps and a complete set of tools are necessary before beginning a sampling event on monitoring wells.

If several wells are to be sampled, proper identification of the well is essential. The well permit or ID number should be known prior to the sampling event. If the well number is not known, a precise field description of each well location is needed to avoid confusion of reporting. Where sufficient history is available, sample the wells in the order of least contaminated to most contaminated to avoid cross contamination of the samples. If previous data is not available on the wells, the well headspace may be sampled with a photoionization or flame ionization detector (PID or FID) to determine the order of sampling.

Equipment used to sample monitoring wells generally fall into two categories: (a) that used to evacuate water in the well casing, and (b) that used to collect a discrete sample for analysis. However, in some instances the device used for evacuation may be the same as that used for sample collection. The individual performing sampling should consult the task-specific SAP to ascertain the proper well evacuation device. In addition to sampling for standard monitoring well parameters, the ground water at MCB Camp Lejeune is frequently sampled for natural attenuation parameters. The sample technician should check the task-specific SAP to ascertain if these parameters are applicable.

5.3 Monitoring Well Purging Procedures

The first step in sampling monitoring wells is to measure the standing water column in the well. This is done via the dual interface probe. The dual interface probe is capable of obtaining readings for both aqueous and non-aqueous liquids. Measure the aqueous and nonaqueous phase levels and record in the logbook. A measured thickness of non-aqueous phase liquid (NAPL) implies free product. Wells with free product are not generally sampled at MCB Camp Lejeune. The task-specific SAP should be consulted in cases where freestanding product is encountered to determine the need for sampling.

Once the measurements have been taken and recorded to the nearest 0.01 foot, the standing water column volume can then be calculated by the following formula: the amount of water within the well casing is calculated by

multiplying the linear feet of water by the volume per foot for the proper diameter casing. The capacity of common casing diameters are shown below:

Casing Diameter (ft.)	Gallons/Linear foot
2 inch (0.1667)	0.1632
4 inch (0.3333)	0.6528
6 inch (0.5000)	1.4688
8 inch (0.6667)	2.6112
10 inch (0.8333)	4.0800
12 inch (1.0000)	5.8752

Example:

Total depth of well casing	100 ft.
Depth to water	<u>-20 ft.</u>
Linear feet of water	80 ft.
2 inch casing	<u>x 0.1632</u>
Amount of water in casing	13 gal.

An alternate formula that can be used to determine the gallons in any diameter well is:

$$\text{Number of gallons} = 5.8752 \times C^2 \times H$$

Where C = casing diameter in feet and H = height of water column in feet.

The amount of water in the well should then be multiplied by five to determine the maximum volume to be purged from the well prior to sampling.

Low flow purging methods will be used, with target flow rates of approximately 0.25 to 0.50 gallons per minute (GPM). The flow rate will be held constant throughout the purge to the extent practical. During the purge, the pH, temperature, specific conductance, and turbidity will be measured repeatedly, with at least two minutes between successive measurements. Purging will be considered complete when the following stabilization criteria have been met: pH varies by no more than +/-0.1 standard unit and temperature, specific conductance, dissolved oxygen, and turbidity vary by no more than +/-5 percent over three consecutive readings. Additionally, turbidity readings of 5 or less nephelometric units (NTUs) are desirable. Purging will be discontinued if 5 well volumes have been evacuated or if the well is purged to dryness regardless of stabilization status. The time of day, cumulative purge volume, and measurement units will be recorded for each measurement of pH, temperature, specific conductance, and turbidity.

Purging of the well will be accomplished using either a low-flow Grundfos, a positive displacement bladder or similar pump. Polyethylene tubing will be used as a discharge line and will be discarded after use at a well. The sample technician should consult the task-specific SAP for the device to be used in a well purging event. Every effort must be made when using these devices to not over-pump the well. Fast pump rates can cause hydraulic turbulence in the well, which would effect the representativeness of the sample.

If a well has been pumped to near dryness at a flow rate of less than 0.5 gallons per minute, the well should be allowed a minimum twenty-minute recovery time and then sampled. If recovery time exceeds 24 hours, then project management should be notified and corrective action taken.

Sampling should be performed within two hours of purging the well; however, due to recharge rates, this is not always possible. All sampling must be performed within 24 hours of well purging. If this cannot be accomplished,

the Project Manager should be notified immediately, and corrective action should be taken. A newly installed well should not be sampled for at least two weeks after development unless otherwise specified by the Project Manager due to normally slow flow rates of the groundwater at MCB Camp Lejeune.

5.3.1 Before Purging

The following items should be performed and entered into a logbook before monitoring well purging:

- Record date, time, and weather conditions
- Document well number and permit number
- Screen PID or FID reading taken from the headspace immediately after the cap is removed. (If readings exceed background, safety precautions outlined in the HASP will be followed)
- Check for free product, measure thickness if present
- Gauge total depth from top of inner casing or surveyor's mark –if total depth data is not known
- Record depth from top of inner casing to water
- Calculate volume of water present in the well.

5.3.2 During After Purging

Record the following after purging information:

- Start and end time of purging
- Purge method
- Purge rate(s)
- Total volume purged and calculations for said volume
- Initial and final pH, dissolved oxygen, temperature, specific conductivity, and turbidity (parameters may be task-specific)
- Start and end time of sampling
- Sampling method.

5.4 Monitoring Well Sampling

After purging, sampling of a well should take place as soon as possible. Whenever possible, sampling should take place in the order of least contaminated well to highest contaminated well. All sampling and purging equipment will be decontaminated before use and before each successive use in accordance with the prescribed decontamination procedures. Collection of ground water samples will be documented on a sampling log.

The equipment required for ground water sampling includes a water level indicator, low-flow submersible pump with disposable (single use) polyethylene tubing, disposable (single use) polyethylene or dedicated Teflon[®] bailers of appropriate size for the monitoring wells, disposable (single use) nylon rope, meters for detecting field parameters (pH, turbidity, conductivity, etc.), appropriate sample bottles and temperature control cooler, plastic sheeting, and flame ionization detector (FID) or photoionization detector (PID). All equipment used to purge wells and collect samples will be protected from ground surface contact and contamination by use of clean plastic sheeting.

Sampling preferentially will be conducted using a Grundfos or other type of in-line sampling pump. The pump will be meticulously decontaminated between wells and the polyethylene discharge tubing will be discarded between

wells. If low discharge rates prohibit the use of inline sampling pumps, a single use disposable polyethylene bailer or dedicated Teflon[®] Bailer tethered with single use disposable nylon rope will be used to collect samples.

Volatile organic parameters are sampled first. Ideally the first bailer or aliquot from the in-line pump, before any other fraction is sampled, will be used when volatiles analysis is required. Care should be given, as in all volatile parameter sampling, that no air is entrained into the VOA vial. Vials should be checked for bubbles, and if any are present a new VOA vial will be used for recollected sample. Any short holding time parameters, such as nitrate, will be sampled next. Semi-volatile and metals parameters will be sampled last. Task-specific SAPs should be consulted for sampling methods and any on-site parameters to be tested.

Sample containers will be labeled with appropriate identifying information (location, date, time, condition, added preservatives, etc.). Pre-printed labels will be provided by the Site Supervisor or labels shall be filled out with indelible ink. Each sample will be logged in a field notebook at the time of collection. Sample containers of appropriate volume and composition will be provided by the laboratory in advance to ensure the collection of sufficient volumes for all specified analyses.

In general, samples for metals analysis shall not be filtered. Instead, analyses shall be performed on unfiltered samples and the results obtained will be representative of the total metals concentration present in the groundwater. Unless specified in the task-specific SAP. If there is a site-specific need for filtering samples and reporting dissolved metals, filtering will not be performed in the field due to the increased potential for sample contamination. Any necessary filtering will be conducted in the laboratory as soon as possible after sample receipt. Total metals samples will be pre-preserved with HNO₃ to a pH less than 2. Dissolved metals samples will be preserved by the laboratory after filtering.

All sample containers will be transferred to a cooler (kept at 4°C ± 2°C). All sample documentation and chain of custody procedures outlined in section 4.4 should then be followed. After proper documentation has been performed, sample packaging and shipping as outlined in section 4.6 of this document should be completed. Proper laboratory notification and planning must be taken so that parameters with short holding time requirements are not missed.

6.0 Field Parameters

6.1 Purpose

The purpose of this section is to establish criteria for field sampling methodologies. As a large number of field sampling parameters are used at MCB Camp Lejeune, the task-specific SAP should be consulted as to which parameters apply. Field-testing falls into two primary categories, (a) instrumentation used to obtain a direct readout of specific parameters, and (b) chemical test methods using chemical reactions to provide quantitative data. The number of such methods is so broad it is impossible to describe their procedures in a single document. Therefore, this section will describe general procedures that have wide applications in these methodologies.

6.2 General Sampling Procedures

Field equipment calibration will follow the protocols described by the equipment manufacturer, including calibration criteria and frequencies.

Field-testing and monitoring equipment will be inspected and calibrated before use. Testing and monitoring equipment includes PIDs and FIDs for monitoring soil vapor, HACH kits for specific ions, and flow-through cell meters for pH, temperature, specific conductivity, dissolved oxygen meters, and turbidity. Standards for these instruments will be kept on site and in good condition. Each day that an instrument is used, its calibration will be checked against standards. If an instrument is out of calibration, it will be recalibrated prior to use. Calibrated equipment will be identified using the manufacturer serial number or other unique identification.

Equipment that fails calibration or becomes inoperable during use will be removed from service and separated from serviceable equipment to prevent inadvertent use. Such equipment will be repaired and recalibrated or replaced, as appropriate. No equipment that has failed calibration will be used until the equipment has been repaired.

All equipment to be used during the field sampling will be examined to certify that it is in operating condition. This examination includes checking the manufacturer operating manuals and the instructions with each instrument to ensure that all maintenance items are being observed. Field notes from previous sampling trips will be reviewed to ensure that any prior equipment problems have been remedied.

All chemical test methods or kits should be inspected for damage prior to use. Each of these tests or kits often has an expiration date, which should be checked as well. No kit or method will be used that is past its expiration date under any circumstance. Methodology should be read and understood before it is actually used in the field. It is often prudent to perform "dry runs" inside before attempting the test in the field.

All data from chemical and instrumental methods should be recorded in the logbook, including calibration information as per Section 4.3 of the Basewide QAPP, all dilution and extraction data, weights of samples, and ambient air conditions.