Final

H-3 Landfill (Site 0001) Work Plan/Sampling and Analysis Plan

MARINE CORPS BASE HAWAII, OAHU, HAWAII

September 2015

Department of the Navy
Naval Facilities Engineering Command, Hawaii
400 Marshall Road
JBPHH HI 96860-3139

Naval Facilities Engineering Command
NAVFAC HAWAII

Comprehensive Long-Term Environmental Action Navy
Contract Number N62742-03-D-1837, CTO HC31

1. Title and Approval Page

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Prepared for:

Department of the Navy
Naval Facilities Engineering Command, Hawaii
400 Marshall Road
JBPHH HI 96860-3139

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Prepared under:
Comprehensive Long-Term Environmental Action Navy
Contract Number N62742-03-D-1837, CTO HC31

AECOM CTO Manager:	Ed Sloan	9/9/2015 Date
AECOM QA Program Manager:	Scott Lewis	9/9/2015 Date
NAVFAC Hawaii RPM:	Joel Narusawa	Date

EXECUTIVE SUMMARY

This work plan (WP) documents the proposed sampling and analysis program for additional groundwater monitoring and completion of the baseline ecological risk assessment (BERA). The purpose of the additional investigation is to confirm the recommendations of the Decision Document (DD) and ensure that the recommended alternative of land use controls (LUCs) (in combination with the side slope stabilization implemented under the removal action) for the H-3 Landfill will continue to be protective of the environment in the future. The H-3 Landfill is located at Marine Corps Base Hawaii (MCB Hawaii), Kaneohe Bay, Oahu, Hawaii (Figure 1).

This WP incorporates a Tier II Sampling and Analysis Plan (SAP) format. This format utilizes the flexibilities in Uniform Federal Policy for Quality Assurance Project Plans policy (DoD 2005) to provide an effective and efficient process for smaller and less complex sites, while ensuring that the quality assurance (QA) process effectively and efficiently reflects the goals of the project and intended use of the data (DON 2011). The Naval Facilities Engineering Command, Pacific QA Officer approved the use of the Tier II SAP format for this contract task order.

The former H-3 Landfill is an approximately 20-acre site located at the main entrance to MCB Hawaii at the end of the H-3 Freeway (ATT 1988). MCB Hawaii occupies the entire Mokapu Peninsula in Kaneohe Bay on the windward (northeast) coast of Oahu. The landfill is located on the southwest side of the peninsula (Figure 1). The landfill, closed and covered by 1976, served as the main waste disposal facility for MCB Hawaii, Kaneohe Bay, Oahu, Hawaii. All wastes generated from MCB Hawaii, except those from the housing area and waste generated by contractors, were reportedly disposed of in the landfill. These wastes are reported to include lead, mercury, pesticides, paints, solvents, thinners, waste petroleum oils and lubricants, waste fuels, corrosive liquids, transformer oils, and tear gas.

In May 2009, MCB Hawaii personnel discovered that a portion of the landfill fronting the shoreline had receded, which exposed construction and demolition debris. A time critical removal action (TCRA) was then completed in 2009 to provide temporary remedial slope stabilization (AECOM 2011). The TCRA was followed by a removal action to provide side slope stabilization for the entire landfill. Installation of a sheet pile wall, geotextile fabric, sand bags and armor stone to provide side slope stabilization was initiated in January 2013 and completed in March 2014. A remedial investigation and feasibility study (RI/FS) was completed in 2011 and 2012, which recommended LUCs (in combination with the side slope stabilization implemented under the removal action) as the final remedy for the site. The DD presenting the final remedy for this site was signed in June 2014 (DON 2014).

Results of an ecological risk assessment prepared during the RI/FS show the potential risk to ecological receptors at the site exceeds the no-observed-adverse-effect-level (NOAEL), but is below the lowest-observed-adverse-effect-level (LOAEL) which is protective of wildlife populations but may pose risk to individual receptors. The United States Fish and Wildlife Service (USFWS) disagrees with the conclusions of the RI/FS because endangered species have been observed at the site or surrounding area. The USFWS recommends that risk be below the NOAEL when assessing risk to endangered species to protect individual birds. The objectives of this investigation are to confirm the findings of the RI/FS and the recommendations of the DD and ensure that the recommended alternative of LUCs (in combination with the side slope stabilization implemented under the removal action) will continue to be protective of the environment in the future. The objectives of this document are to summarize the available historical information for the site, present a preliminary conceptual site model, and describe the investigation approach.

The investigation approach includes the following:

- Conduct additional groundwater and surface water monitoring to confirm that concentrations are either stable or decreasing, and do not pose unacceptable risk to the environment.
- Collect surface water, pore water, bulk sediment, and biota data to complete the BERA and to evaluate site specific risks to ecological receptors.

The trends in concentrations of chemicals of potential concern in groundwater generated from the analytical data will be summarized in a groundwater sampling summary report, and to the findings of the BERA will be summarized in a BERA summary report.

CONTENTS

ACRONYMS AND ABBREVIATIONS

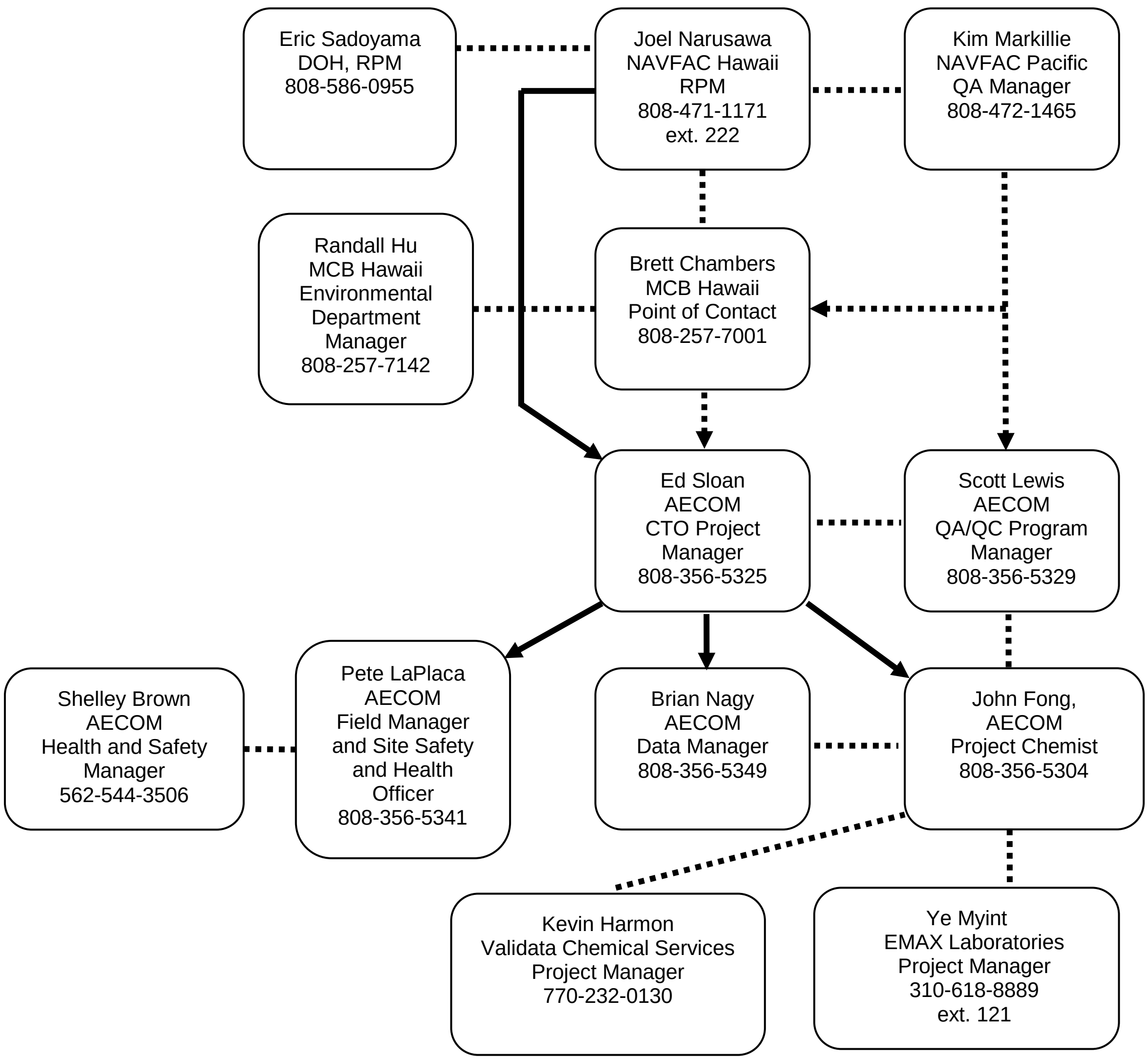
µg/kg	microgram per kilogram
µg/L	microgram per liter
AECOM	AECOM Technical Services, Inc.
amu	atomic mass unit
ASTM	American Society for Testing and Materials
AVS/SEM	acid volatile sulfides and simultaneously extracted metals
BERA	baseline ecological risk assessment
bgs	below ground surface
btoc	below top of casing
CCV	continuing calibration verification
CLEAN	Comprehensive Long-Term Environmental Action Navy
COC	chain-of-custody
COPC	chemical of potential concern
CS	confirmation study
CSM	conceptual site model
CTO	contract task order
CVAA	cold vapor atomic absorption
DD	Decision Document
DDD	dichlorodiphenyldichloroethane
DDE	dichlorodiphenyldichloroethylene
DDT	dichlorodiphenyltrichloroethane
DL	detection limit
DoD	Department of Defense
DOH	Department of Health, State of Hawaii
DQA	data quality assessment
DQI	data quality indicator
EAL	environmental action level
EDD	electronic data deliverable
EML	estimated maximum level
EMPC	estimated maximum possible concentration
EPA	Environmental Protection Agency, United States
ER	Environment Restoration
ERA	ecological risk assessment
ERAGS	Ecological Risk Assessment Guidance for Superfund
FS	feasibility study
ft^2	square foot
GC	gas chromatography
GC-ECD	gas chromatography-electron capture detection
GC-HRMS	gas chromatograph-high resolution mass spectrometry
GC-MS	gas chromatography-mass spectrometry
GRO	gasoline range organics
HHRA	human health risk assessment
HI	hazard index
HRGC	high resolution gas chromatography
HRMS	high resolution mass spectrometry
HSP	Health and Safety Plan

IAS	initial assessment study
ICAL	initial calibration
ICP	inductively coupled plasma
ICP-AES	inductively coupled plasma-atomic emission spectroscopy
ICP-MS	inductively coupled plasma–mass spectroscopy
ID	identification
IDW	investigation-derived waste
IS	internal standard
LCS	laboratory control sample
LOAEL	lowest-observed-adverse-effect level
LOD	limits of detection
LOQ	limit of quantitation
LUC	land use control
MB	method blank
MCB	Marine Corps Base
MDL	method detection limit
mg/kg	milligram per kilogram
MS	matrix spike
MSA	method of standard addition
MSD	matrix spike duplicate
msl	mean sea level
MW	monitoring well
NAVFAC	Naval Facilities Engineering Command
No.	number
NOAA	National Oceanic and Atmospheric Administration
NOAEL	no-observed-adverse-effects level
N-HQ	NOAEL-based hazard quotients
PAH	polynuclear aromatic hydrocarbon
PAL	project action level
PCB	polychlorinated biphenyl
PDS	post-digestion spike
PFK	perfluorokerosene
POC	point of contact
PQL	project quantitation limit
PQO	project quality objectives
PSQ	principal study questions
QA	quality assurance
QC	quality control
QSM	Quality Systems Manual
RF	response factor
RI	remedial investigation
RPD	relative percent difference
RPM	remedial project manager
RSL	regional screening levels
RT	retention time

S/N	signal-to-noise ratio
SAP	Sampling and Analysis Plan
SIM	selective ion monitoring
SOP	standard operating procedure
SSHO	site safety and health officer
SQV	sediment quality values
SRA	Screening Risk Assessment
SVOC	semivolatile organic compound
TCRA	time-critical removal action
TLF	temporary lodging facility
TOC	total organic carbon
U.S.	United States
USFWS	U.S. Fish and Wildlife Service
VOC	volatile organic compound
VSI	visual site inspection
WP	work plan

2. Project Organizational Chart

Lines of Authority ——— Lines of Communication ················



3. Communication Pathways

The communication pathways for the WP/SAP are shown below.

Communication Driver	Responsible Entity	Name	Phone Number	Procedure
Regulatory Agency Interface	Navy RPM	Joel Narusawa	808-471-1171 ext. 222	All project documentation will be forwarded by the Navy RPM. The Navy will be responsible for notifying DOH when significant corrective actions or changes occur. Corrective actions will be communicated within 24 hours.
Project Management	AECOM CTO Project Manager	Ed Sloan	808-356-5325	The AECOM CTO project manager will direct and approve all communication to the Navy's RPM and provide monthly status reports to the NAVFAC contracting officer. The AECOM CTO manager will notify the Navy RPM of field changes or modifications by close of business the following day.
QA/QC Management	AECOM QA Program Manager	Scott Lewis	808-356-5329	The AECOM QA program manager will designate responsible project quality personnel to perform specified QA and QC activities and report to project and program management. Issues and non-conformances, and corrective actions will be reported to NAVFAC Pacific QA manager within 1 day of non-conformance issuance.
Field Progress Reports	AECOM Field Manager	Pete LaPlaca	808-356-5341	The AECOM field manager will communicate relevant field information to the CTO project manager and AECOM project chemist daily during field activities, by phone or e-mail.
Stop Work Due to Safety Issues	AECOM SSHO (onsite) or AECOM Field Manager	Pete LaPlaca	808-356-5341	The AECOM SSHO will communicate with the AECOM field manager and both will have the authority to stop work by field subcontractors or field sampling personnel. Field work will then restart upon satisfactory implementation of the appropriate corrective actions.
WP/SAP Changes Prior to Field/Laboratory Work	AECOM CTO Manager	Ed Sloan	808-356-5325	Substantial changes to the planning documents will require the AECOM CTO project manager prepare amended worksheets before the activities begin.
WP/SAP Changes in the Field	AECOM Field Manager	Pete LaPlaca	808-356-5341	The AECOM field manager will notify the project manager of changes to the procedures specified in the WP/SAP during field activities. The AECOM CTO project manager will determine the appropriate course of action and document these changes in the remedial investigation report.
Field Corrective Actions	AECOM Field Manager	Pete LaPlaca	808-356-5341	The AECOM field manager will have the authority to stop work and issue corrective response actions to field sampling personnel. Modes of communications will be by telephone or e-mail within 24 hours.
Daily COC Reports and Shipping Documentation	AECOM Field QC Coordinator/SSHO	Pete LaPlaca	808-356-5341	COCs and shipping records will be submitted via fax or e-mail to the AECOM project chemist at the end of each day that samples are collected.
Sample Receipt Variances	Laboratory Project Manager	Ye Myint	310-618-8889 ext. 121	All variances in sample receipt will be reported to the AECOM project chemist by the laboratory(s) within 24 hours of variance. A signed copy of the COCs and a completed Sample Condition Report will be provided to the project chemist within 24 hours of sample receipt.

Communication Driver	Responsible Entity	Name	Phone Number	Procedure
Reporting Laboratory Data Quality Issues	Laboratory Project Manager	Ye Myint	310-618-8889 ext. 121	QA/QC issues that potentially affect data usability will be reported by the laboratory project manager(s) to the project chemist by e-mail within 1 business day. If significant problems are identified from the laboratory that impacts the usability of the data, the project chemist will inform the Navy Project Manager within 1 day of notification.
	Navy Project Manager	Joel Narusawa	808-471-1171 ext. 222	If significant problems with the laboratory(s) are identified, the Navy project manager will inform the Navy Quality Assurance Manager for evaluation to determine what corrective actions will be taken with respect to the accreditation process.
Reporting Lab Quality Variances	Laboratory Project Manager	Ye Myint	310-618-8889 ext. 121	All laboratory QA/QC variance issues will be reported to AECOM project chemist by the laboratory(s) within 1 day of variance. The variance(s) will be reported to the AECOM CTO project manager the same business day and to the Navy within 2 business days.
Analytical Corrective Actions	AECOM Project Chemist	John Fong	808-356-5304	The AECOM project chemist will immediately notify the AECOM CTO project manager and the laboratory project manager(s) by e-mail of field or analytical procedures that were not performed in accordance with the planning documents. The AECOM project chemist will document the non-conformance and issue the corrective actions to be taken and will verify implementation of the corrective actions by the laboratory.
Reporting Data Validation Issues	Data Validation Project Manager	Kevin Harmon	770-232-0130	All data validation issues will be reported to the AECOM project chemist by the data validators by telephone or e-mail. The validators will generate memos to the laboratory in regards to incomplete deliverables or discrepancies. The issue(s) will also be reported to the AECOM CTO project manager or the project chemist within 1 business day by telephone or e-mail.
Data Validation Corrective Actions	AECOM Analytical & Data Validation Advisor	Brian Nagy	808-356-5349	The AECOM analytical and data validation advisor will have the authority to issue corrective response actions to laboratory and data validation firms. Corrective actions may be issued to the laboratory as a result of data validation results. Modes of communications will be by telephone or e-mail within 24 hours after audit.

AECOM AECOM Technical Services, Inc.
COC chain-of-custody
CTO contract task order
DOH Department of Health, State of Hawaii
NAVFAC Naval Facilities Engineering Command
QA quality assurance
QC quality control
RPM remedial project manager
SAP sampling and analyses plan
SSHO site safety and health officer
WP work plan

4. Project Planning Session Participants Sheet

Project Name: H-3 Landfill additional groundwater sampling and ecological risk evaluation
Projected Date(s) of Sampling: September 21-30, 2015 and November 9-20, 2015
Project Manager: Laura Newman

Site Name: H-3 Landfill (Site 0001)
Site Location: MCB Hawaii, Oahu, Hawaii

Date of Session: March 26, 2015
Scoping Session Purpose: To discuss technical approach for further sampling at the site.

Name	Project Role	Affiliation	Phone #	E-mail Address
Michael Fry	Regulator	USFWS	808-792-9461	michael_fry@fws.gov
Joel Narusawa	Navy Project Manager	NAVFAC Hawaii	808-471-1171 ext. 222	joel.narusawa@navy.mil
Lance Bookless	MCB Hawaii POC	MCB Hawaii	808-257-7000	lance.bookless1@usmc.mil
Brett Chambers	MCB Hawaii POC	MCB Hawaii	808-257-7001	brett.chambers1@usmc.mil
Todd Russell	MCB Hawaii POC	MCB Hawaii	808-216-7135	todd.russell@usmc.mil
Laura Newman	CLEAN CTO Project Manager	AECOM	303-740-3808	laura.newman@aecom.com
Jeff Briggs	Senior Ecological Risk Assessor	AECOM	518-951-2280	jeff.briggs@aecom.com
Jeff Johnson	Deputy Program Manager	AECOM	808-356-5340	jeff.johnson@aecom.com

AECOM	AECOM Technical Services, Inc.
CLEAN	Comprehensive Long-Term Environmental Action Navy
CTO	contract task order
MCB	Marine Corps Base
NAVFAC	Naval Facilities Engineering Command
POC	point of contact
USFWS	U.S. Fish and Wildlife Service

Several meetings and conference calls were conducted prior to this meeting to discuss comments received from the United States (U.S.) Fish and Wildlife Service (USFWS) on the findings of the ecological risk assessment and the recommended response action for the H-3 Landfill (AECOM 2012b, DON 2014). On March 26, 2015, a final meeting was attended by representatives of the Navy, Marine Corps Base (MCB) Hawaii, USFWS and AECOM Technical Services, Inc. (AECOM) to discuss the final agreed-upon approach to confirm or re-evaluate the findings for this site.

At this meeting, the USFWS representative confirmed he reviewed the recommendations previously sent by the Navy and his understanding is that Naval Facilities Engineering Command, Hawaii (NAVFAC Hawaii) is proposing continued groundwater monitoring at the site, along with extending the Baseline Ecological Risk Assessment (BERA) to complete Steps 3B to 8. NAVFAC Hawaii agreed that additional groundwater data would be beneficial to confirm that groundwater concentrations are either stable or decreasing. NAVFAC Hawaii proposed to complete seven additional groundwater monitoring events to provide data, in addition to the one existing round of data that will be sufficient for evaluating groundwater trends.

The USFWS representative stated that he is not sure how beneficial the additional risk assessment would be, because the previous risk evaluation showed that this site represents a risk to sensitive and endangered species. AECOM clarified that the risk assessment would be further refined, to reduce uncertainties by evaluating the specific benthic community and fish at this site through the collection of tissue samples. The actual bioavailability of the chemicals could then be evaluated. The measured tissue concentrations of chemicals of potential concern (COPCs) in benthic organisms and fish would be used in place of estimated (modeled) tissue concentrations to model potential exposure and risk to endangered bird species using the area for feeding. The USFWS representative stated he was comfortable with the continuation of the BERA, but is concerned about COPCs in groundwater leaking into the drainage channel. NAVFAC Hawaii clarified that the additional evaluation of groundwater will also include a measurement of background concentrations to help identify if cleanup is required. If site concentrations are at or below the background concentrations, then cleanup will not be conducted because the detected concentrations at the site will be considered representative of naturally occurring conditions.

5. Conceptual Site Model

This work plan (WP) documents the proposed sampling and analysis program for the H-3 Landfill located at Marine Corps Base Hawaii (MCB Hawaii), Kaneohe Bay, Oahu, Hawaii (Figure 1). The additional sampling will include seven quarterly rounds of groundwater monitoring to evaluate groundwater trends at the site, along with field sampling to support completion of a baseline ecological risk assessment (BERA).

This WP incorporates a Tier II Sampling and Analysis Plan (SAP) format. This format utilizes the flexibilities in Uniform Federal Policy for Quality Assurance Project Plans policy (DoD 2005) to provide an effective and efficient process for smaller and less complex sites while ensuring that the quality assurance (QA) process effectively and efficiently reflects the goals of the project and intended use of the data (DON 2011). The Tier II format is appropriate for this site because several field investigations have been conducted at this site, and the previously prepared WPs include detailed information that is still applicable for this investigation. The Naval Facilities Engineering Command, Pacific QA Officer approved the use of the Tier II SAP format for this contract task order.

5.1 Overview

The former H-3 Landfill, Site 0001, is located at the main entrance to MCB Hawaii at the end of the H-3 Freeway (ATT 1988) A Remedial Investigation/Feasibility Study (RI/FS) prepared for this site in 2012 (AECOM 2012b) concluded that concentrations of chemicals of potential concern (COPCs) from the landfill do not pose unacceptable risk to human health or the environment (the risks were within risk management ranges) and recommended land use controls (LUCs) (in combination with the side slope stabilization implemented under a removal action [AECOM 2011]) for the site. The Decision Document (DD) presenting the final remedy for this site was signed in June 2014 (DON 2014). The final remedy does not include long-term groundwater monitoring. However, as the result of concerns expressed by the United States (U.S.) Fish and Wildlife Service (USFWS), MCB Hawaii has agreed to conduct seven additional rounds of groundwater and surface water sampling and to complete the BERA in support of the Comprehensive Environmental Response, Compensation, and Liability Act (CERLCA) five-year review process to ensure that the LUCs will continue to protect human health and the environment in the future.

5.2 Site Description, History, and Environmental Setting

This section describes the physical characteristics of the site, the environmental setting, and previous investigation results.

5.2.1 Site Description and History

The H-3 Landfill is an approximately 20-acre site located at the main entrance to MCB Hawaii at the end of the H-3 Freeway (ATT 1988). MCB Hawaii occupies the entire Mokapu Peninsula in Kaneohe Bay on the windward (northeast) coast of Oahu. The landfill is located on the southwest side of the peninsula (Figure 1). The former H-3 Landfill served as the main waste disposal facility for MCB Hawaii, Kaneohe Bay, Oahu, Hawaii from 1940 to 1972, pre-dating the roadway that currently bisects the parcel in a north/south direction. All wastes generated from MCB Hawaii, except those from the housing area and waste generated by contractors, were reportedly disposed of in the landfill. These wastes are reported to include lead, mercury, pesticides, paints, solvents, thinners, waste petroleum oils and lubricants, waste fuels, corrosive liquids, transformer oils, and tear gas. The portion of the landfill west of the H-3 Freeway was closed and covered in late 1971 or early 1972. The eastern portion of the landfill was closed between 1972 and 1976 (AECOM 2012b). Currently, the site is a grassy, open area that houses the base pass and identification (ID) office and several static displays, and the southeast portion of the site is covered with a shrub-scrub habitat dominated by Koa haole and guinea grass. The land use is considered industrial; no land use changes are proposed for this site.

5.2.2 Topography and Surface Water Drainage Patterns

The topography of the site and surrounding area is characterized by flat coastal plains. The soil surface of the landfill ranges from 5 to 15 feet in elevation above mean sea level (msl). The landfill primarily comprises land reclaimed from Kaneohe Bay. The surface soil comprises fill material and debris and is underlain by unconsolidated calcareous sands containing abundant coral fragments (ATT 1988).

The Hawaiian climate is temperate oceanic. There are two defined seasons: summer (from May through September) and winter (from October through April). Summer is characterized by northeast trade winds, partly cloudy skies, and scattered light showers. Winter has slightly cooler temperatures and higher rainfall. Tropical storms are likely once every year or two. The seasonal temperature variation on Mokapu Peninsula is 6 degrees. The average daily temperature variation is 9 degrees. Daily temperatures vary from the high 60s (degrees Fahrenheit) or low 70s to the high 70s or low 80s. The mean annual rainfall at the Mokapu Peninsula weather station is 38 inches. Approximately 75 percent of the annual rainfall occurs from October through April, with January typically being the wettest month (average rainfall is 1.3 inches per month). The daily relative humidity ranges from about 69 percent to about 80 percent. Relative humidity is fairly constant throughout the year (ATT 1988).

5.2.2.1 Surface Water

Surface runoff from the portion of the landfill west of H-3 Freeway likely flows directly into Kaneohe Bay. Surface water runoff from the eastern portion of the landfill discharges either directly into the Mokapu Central Drainage Channel or to the Temporary Lodging Facility (TLF) wetland, in the northeastern portion of the landfill. The TLF wetland contains water the majority of the time. When the pond reaches capacity, water from the pond likely discharges east to the Mokapu Central Drainage Channel, which is a large drainage channel that surrounds the eastern and southern portions of the landfill and discharges to Kaneohe Bay. In the eastern portion of the landfill and Halekou Pond, shallow groundwater and surface water are likely hydraulically continuous, and the shallow groundwater may mix with the waters of Mokapu Central Drainage Channel and Halekou Pond. This mixing may be augmented by tidal action (ATT 1988).

5.2.3 Geology and Soils

A detailed description of the geology and soil at the site and surrounding area is provided in the RI/FS report (AECOM 2012b). Shallow soil boring conducted from 6 to 8 December 2010 indicated the landfill cover material is composed primarily of silty and sandy materials from 1 to 3 feet below ground surface. Based on a review of monitoring well (MW) and soil borings, and visual observations of the exposed areas of the landfill side slopes, the surface soils are underlain by a sequence of intermixed soil and waste debris (concrete rubble, metal, glass, wood, plastic, and household debris) with an average thickness of approximately 6.5 feet. The soil waste debris is underlain by dense silty and clayey coralline sand and gravel with occasional layers of soft/loose silty clay.

5.2.4 Groundwater Hydrogeology

A detailed description of the hydrogeology and soil at the site and surrounding area is provided in the RI/FS report (AECOM 2012b). Groundwater elevations collected on 9 December 2010 during the RI/FS ranged from 6.81 feet below top of casing (btoc) (1.35 feet above msl) to 14.08 feet btoc (1.42 feet above msl). Groundwater depths and elevations are presented in Table 5-1. Based on the 9 December 2010 gauging data, the groundwater gradient was generally flat, showing a slight groundwater gradient toward Kaneohe Bay and the Mokapu Central Drainage Channel (Figure 3-2 from the RI/FS [AECOM 2012b]). However, the predominant flow direction for the site is estimated to be toward Kaneohe Bay, as previously determined.

Table 5-1: Groundwater Elevation

Well	Date	Time	Depth to Groundwater from Top of Casing (ft)	TOC Elevation (ft above msl)	Water Level Elevation (ft above msl)
MW-1	12-9-10	1518	7.85	9.24	1.39
MW-3	12-9-10	1521	6.81	8.16	1.35
MW-4	12-9-10	1506	14.08	15.50	1.42
MW-7	12-9-10	1512	10.24	11.82	1.58
MW-8	12-9-10	1450	13.59	14.93	1.34
MW-9	12-9-10	1456	11.89	13.31	1.42

The salinity of the shallow groundwater encountered at the perimeter of the landfill ranged from 2 to 32 parts per thousand, indicating that the groundwater is under tidal influence from Kaneohe Bay and the adjacent fish ponds. Because of the salinity of the shallow groundwater, it is not considered a source of potable water (ATT 1988).

5.2.5 Vegetation and Wildlife

5.2.5.1 VEGETATION

The site includes both upland and wetland areas. Portions of the upland area exist as maintained (mowed) lawn. Dominant vegetation includes Koa haole (*Leucaena leucocephala*) and guinea grass (*Panicum maximum*). Additional vegetation identified on site includes coconut palms (*Cocos nucifera*), hala (*Pandanus tectorius*), ironwood (*Casuarina equisetifolia*), California grass (*Brachiaria mutica*), and Bermuda grass (*Cynodon dactylon*). The shoreline vegetation is dominated by pickleweed (*Batis maritima*), with scattered red mangrove (*Rhizophora mangle*) extending into the water, and Indian fleabane (*Pluchea indica*), and Hau (*Hibiscus tiliaceus*) above the normal high tide elevation. Fauna known to inhabit the site is identified in Table 5-2.

Table 5-2: Potential Fauna of the H-3 Landfill

Scientific Name	Common Name	Relative Abundance and Habitat		
		Shrub/Scrub [a]	Mowed Grasses [b]	Canal and fish ponds
Mammals				
Felis cattus	Feral cat	U	—	—
Herpestes auropunctatus	Mongoose	U	—	—
Mus musculus	House mouse	U	U	—
Rattus norvegicus	Norway rat	U	U	—

Scientific Name	Common Name	Relative Abundance and Habitat		
		Shrub/Scrub [a]	Mowed Grasses [b]	Canal and fish ponds
Rattus rattus	Black rat	U	U	—
Birds				
Acridotheres tristis	Common mynah	C	U	—
Anas wyvilliana	Hawaiian duck [c]	—	—	C
Arenaria interpres	Ruddy turnstone	—	—	C (winter)
Bubulcus ibis	Cattle egret	C	C	C
Calidris alba	Sanderling	—	—	C (winter)
Cardinalis cardinalis	Northern cardinal	C	U	—
Carpodacus mexicanus	House finch	C	U	—
Fulica alai	Hawaiian coot [c]	—	—	C
Gallinula chloropus sandvicensis	Moorhen [c]	—	—	C
Geopelia striata	Zebra dove	A	C	—
Heteroscelus incanus	Wandering tattler	—	—	C (winter)
Himantopus mexicanus knudseni	Black-necked stilt [c]	—	—	C
Nycticorax nycticorax hoactli	Black-crowned night heron	U	—	C
Pluvialis fulva	Pacific golden plover	—	C	C (winter)
Padda oryzivora	Java sparrow	C	U	—
Paroaria coronata	Red-crested cardinal	U	U	—
Passer domesticus	House sparrow	A	U	—
Streptopelia chinensis	Spotted dove	U	U	—
Zosterops japonicus	Japanese white-eye	C	U	—

Note: List based on survey of similar habitats on former Barbers Point NAS (Earth Tech 1998).
— not present
A abundant
C common
O occasional
U uncommon
[a] Shrub/scrub habitat includes trees, shrubs and other vegetation on the H-3 Landfill where areas of *Leucaena* and *Prosopis* have developed.
[b] Mowed grass habitat includes areas ranging from frequently cut lawns to areas of planted grasses and invasive, weedy, herbaceous vegetation that are maintained by mowing once or twice a year.
[c] Listed species are either endangered species or surrogates for endangered species (Section 5.2.5.3).

5.2.5.2 Sensitive Habitats

The landfill is bordered by Heleloa Pond on the southwest, and by Halekou Pond on the east and southeast (Figure 1). These ponds are part of an eight-member Nuupia Ponds complex connecting the narrow neck of Mokapu Peninsula to the main island of Oahu. The shallow waters of the ponds are interconnected with each other and Kaneohe Bay through a series of culverts. This former early Hawaiian fish pond complex is now Marine Corps-owned and -managed as a protected wetland/endangered species habitat eligible for listing in the National Register of Historic Places and is known as the Nuupia Ponds Wildlife Management area (ATT 1988). In addition, a protected jurisdictional wetland (TLF wetland) is located adjacent to the landfill, to the northeast. The TLF wetland is also considered a habitat for protected species. These wetlands are part of the Koʻolaupoko ecosystem, an inter-related patchwork of small, but essential, habitat fragments for endangered Hawaiian water birds and migratory waterfowl. MCB Hawaii wetlands represent a significant piece of this network and the wetland management activities provide important regional benefits for these bird populations. Studies have confirmed that individual water birds (e.g., Hawaiian stilt) move around the regional wetlands to various nesting and feeding sites based on variables such as water quality, food availability, time of year, and human and predator disturbance.

5.2.5.3 WILDLIFE

The MCB Hawaii wildlife management area hosts 10 percent of the endangered Hawaiian stilt's population. The Hawaii stilt and three other endangered water birds (Hawaiian coot, moorhen, and duck) and over 60 species of native and migratory birds have been recorded here. Regular surveys, such as the bi-annual State of Hawaii-sponsored water bird survey and the Hawaii Audubon-sponsored Christmas Bird Count, continue to be conducted at MCB Hawaii, Kaneohe Bay and provide valuable data on species presence and population trends. One example is the noticeable increase in the number of koloa and hybrid koloa (Hawaiian ducks) present over the past 10 years (MCB Hawaii and SRG 2011). In addition, exhibit C5-1 of the *Marine Corps Base Hawaii Integrated Natural Resources Management Plan Update* (MCB Hawaii and SRG 2011), indicates that (although the counts can vary from year to year) the Hawaiian stilt population has been steadily increasing since counting began in 1947. A survey of endangered water bird utilization of available habitat on MCB Hawaii, Kaneohe Bay was conducted in 2006–2007. The survey documents the cumulative results of wetland and watershed improvement projects, documents Hawaiian stilt productivity, and records foraging and nesting use by other Hawaiian birds in the study areas (e.g., the wetlands located in the Nuupia Ponds). The survey results, which are supported by several decades of State and Hawaii Audubon-sponsored bird counts, indicate that MCB Hawaii wetlands continue to serve an important function in supporting seasonal visits by a wide diversity of migratory waterfowl and resident water birds (MCB Hawaii and SRG 2011).

5.3 RESULTS OF PREVIOUS INVESTIGATIONS

The following sections provide discussion of previous investigations conducted at the project site. Historical data tables summarizing the data collected during these investigations are discussed in detail in the RI/FS (AECOM 2012b).

5.3.1 Initial Assessment Study

An initial assessment study (IAS) was completed in 1984 (NEESA 1984). The IAS report recommended further assessment for the landfill site.

5.3.2 Confirmation Study

A follow-up confirmation study (CS) was completed in 1988, which comprised groundwater, sediment, and tissue sampling and analysis (ATT 1988). Based on the results of the investigation, the CS recommended no further action for the H-3 Landfill site, provided that the site usage remains the same (ATT 1988).

5.3.3 Time-Critical Removal Action

A time-critical removal action (TCRA) was conducted in May 2009 when MCB Hawaii personnel discovered that a portion of the landfill fronting the shoreline had receded, which exposed construction and demolition debris. The purpose of the TCRA was to provide temporary remedial slope stabilization. The temporary remedial slope stabilization was to remain in place until completion of follow-on design analysis. Approximately 510 square feet (ft^2) of the landfill side slope was temporarily stabilized as part of the TCRA (AECOM 2011). In addition, other portions of the landfill side slopes, including the portion that fronts the drainage channel/fish ponds, were observed to be steep with evidence of erosion or scour at the toe. The observation of erosion indicated that a study of the entire landfill cover would be necessary to evaluate whether the presumptive remedy at the H-3 Landfill site is still protective and if the site conditions are stable.

5.3.4 Engineering Evaluation/Cost Analysis

In 2012, an engineering evaluation/cost analysis was prepared to initiate a removal action to repair the additional landfill slopes identified as needing repair and prevent the further exposure of landfill debris to the adjacent sediments and surface water (AECOM 2012a). The recommended removal action alternative for the H-3 Landfill site was slope stabilization with rock rip-rap to prevent further erosion and exposure of the wastes on the landfill side-slopes, and thus mitigate potentially unacceptable risks associated with direct exposure to the wastes and potential migration of waste materials and constituent chemicals.

5.3.5 Remedial Investigation/Feasibility Study

A RI/FS was conducted from 2011 to 2012 to further investigate the site and to evaluate remedial action alternatives for the H-3 Landfill (AECOM 2012b). The sampling strategy for the RI incorporated various field techniques and methodologies for sampling groundwater, surface water, and sediment at the site; conducting a visual site inspection (VSI); completing a surface scan; and visually observing the extent of the landfill by digging shallow test pits (AECOM 2012b). The VSI found sections of the landfill side slope with significant erosion or debris. The surface scan did not detect any vapors, confirming the expectation of no gas generation concerns. Furthermore, the results of the geotechnical sampling and slope stability analysis indicate the landfill is stable and has no issues related to landfill gas. Vegetation is well-established, and the slope of the cover facilitates run-off of the majority of the site. The cover vegetation will minimize erosion and surface water infiltration. The cover thickness and soil type provide adequate separation to prevent human and terrestrial ecological receptor contact with the waste.

Sampling at the site showed that metals concentrations exceeded project action levels (PALs) in sediment. Sediment PAL exceedances for various metals were documented in multiple locations in the TLF wetland and Mokapu Central Drainage Channel (both adjacent to the landfill and upgradient), with arsenic and nickel being fairly prevalent throughout the landfill (AECOM 2012b). Metals and polychlorinated biphenyls (PCBs) were the only COPCs detected in groundwater from the site. Concentrations of copper, lead, and zinc in the upgradient MW (MW-7) were similar to or higher than concentrations of COPCs detected from the onsite MWs. While the groundwater at the site is also subject to tidal influences, MW-7 is located more than 800 feet inland, which suggests that concentrations of copper lead, and zinc in groundwater may not be solely attributable to the H-3 Landfill. Metals (arsenic and mercury) and PCBs were the only COPCs detected in surface water from the TLF wetland at concentrations that exceeded PALs.

Results of a human health risk assessment (HHRA) conducted during the RI indicate that the potential incremental lifetime excess cancer risk for all human receptors from exposure to groundwater, surface water, and sediment at the H-3 Landfill are below or within the U.S. Environmental Protection Agency (EPA) target cancer risk management range of 1×10^{-6} to 1×10^{-4}. In addition, the total hazard indices (HIs) for all human receptors are either below or equal to the EPA target HI of 1. The results of an ecological risk assessment (ERA) showed that COPCs in surface sediment, surface water, and groundwater could pose potential risk to benthic organisms and individual wildlife receptors, but are unlikely to cause adverse effects to wildlife populations (indeterminate risk) and are subject to risk management consideration.

RI results were used to evaluate various remedial alternatives in the FS. Based on the screening of remedial action technologies, remedial action alternatives, the evaluation and comparative analysis of retained alternatives, and the appropriate components of the *Presumptive Remedy for CERCLA Municipal Landfill Sites* (EPA 1993), the recommended remedial action alternative was LUCs (in combination with the side slope stabilization implemented under the removal action). The DD presenting the final remedy for this site was signed in June 2014 (DON 2014).

5.4 PRELIMINARY EXPOSURE ASSESSMENT

The findings of a HHRA show risk to receptors are within risk management ranges, and LUCs have been recommended for this site. While the findings of the ERA also show risk to be within acceptable levels for wildlife populations, the Navy is addressing concerns expressed by the USFWS about the endangered species at the site, and the potential for risk to sensitive receptors, by conducting additional groundwater monitoring and completing the BERA. Therefore, the exposure assessment identifies ecological receptors that currently, or in the future, are likely to use the property and, as a result, may come in contact with the COPCs identified in the RI/FS (AECOM 2012b). It addresses the potential populations that may be exposed, the routes or pathways in which exposure could occur, and the magnitude, frequency, and duration of potential exposures. Potential populations or receptors that are evaluated, and the pathways by which they may be exposed, are displayed in the conceptual site model (CSM) (Figure 2) for ecological receptors.

5.4.1 Land Use and Receptors

Current and future ecological receptors include benthic and aquatic organisms located on site, in the TLF wetland, and off site (east or south of the H-3 Landfill in the drainage channel associated with the Heleloa and Halekou Fish Ponds).

5.4.2 Summary of Sources and Exposure Pathways

A description of exposure pathways reasonably anticipated for each impacted medium at the H-3 Landfill is presented in the CSM (Figure 2). Receptors may be exposed to chemicals present in groundwater at the H-3 Landfill via seepage of groundwater to surface water in the TLF wetland or drainage channel. Shore birds that feed on benthic organisms and incidentally ingest sediment also may be exposed to site-related chemicals in the sediment pore water. Therefore, the exposure pathway to these current and future ecological receptors is considered potentially complete.

6. Project Quality Objectives/Systematic Planning Process Statements

The project quality objectives (PQOs) for this investigation were developed in accordance with *Guidance on Systematic Planning Using the Data Quality Objectives Process (EPA QA/G-4)* (EPA 2006) and are presented below.

6.1 Step 1: State the Problem

The results of the ecological risk assessment (ERA) show that chemicals of potential concern (COPCs) in surface sediment, surface water, and groundwater could pose potential risk to benthic organisms and individual wildlife receptors (i.e., potential risks are above the no-observed-adverse-effects level [NOAEL]), but are unlikely to cause adverse effects to wildlife populations (are below the lowest-observed-adverse-effects level [LOAEL]) and are subject to risk management consideration. Because of the endangered species observed at the site or surrounding area, and because the risk exceeds the NOAEL, the United States (U.S.) Fish and Wildlife Service (USFWS) disagrees with the conclusions of the remedial investigation/feasibility study (RI/FS). U.S. Environmental Protection Agency (EPA) guidance (EPA 2005) defines the NOAEL as the highest dose that does not cause a statistically significant adverse effect and states that the threshold for adverse effect lies between the NOAEL and the LOAEL. The USFWS recommends that the risk be below the NOAEL when assessing risk to endangered species, as the loss of individual birds must be prevented. While the conservatism built into the ERA strongly suggests that actual risk to any ecological receptors is below the NOAEL, a scientifically defensible, site-specific investigation will reduce the conservatism of the ERA and address the risk questions and risk hypotheses previously developed for this site.

In addition, following a proposal to decommission the monitoring wells at this site, the USFWS expressed concerns that decommissioning the wells will prevent the public and federal agencies from assessing the potential migration of COPCs into the Nuupia Pond Complex and Kaneohe Bay.

The project stakeholders are the State of Hawaii Department of Health (DOH), the U.S. Army Corps of Engineers, USFWS, Navy, Marine Corps Base (MCB) Hawaii, and AECOM Technical Services, Inc. as the consultant for the Navy. The decision makers for the project will be the Navy, MCB Hawaii, and DOH.

6.2 Step 2: Identify the Goals of the Study

The goal of this investigation is to confirm the findings of the RI/FS and the recommendations of the DD and ensure that the recommended alternative of land use controls (LUCs) (in combination with the side slope stabilization implemented under the removal action) will continue to be protective of the environment in the future.

6.2.1 Principle Study Questions and Alternative Actions

The following principal study questions (PSQs) have been identified for the site:

PSQ #1:

- "Are the NOAEL-based hazard quotients (N-HQs), derived for COPCs from site-specific data and biota samples for representative species, less than 1, either directly or through potential leachate, such that they do not present a risk to individual wildlife receptors?"

Depending on the outcome of the field activities, the alternative actions will be as follows:

- No additional ecological risk evaluation will be conducted at the site.
- The remedy will be re-evaluated to determine the need for an alternative remedial action.

PSQ #2:

- "Do COPC concentrations in groundwater at the site exceed the project action levels (PALs) or the background concentrations?"

Depending on the outcome of the field activities, the alternative actions will be as follows:

- Discontinue sampling after seven rounds and no additional action will be taken.
- Evaluate groundwater trends to determine if additional sampling is needed.

PSQ #3:

- "Are COPC concentrations in the groundwater not stable or decreasing, such that they may pose a risk to the environment in the future?"

Depending on the outcome of the field activities, the alternative actions will be as follows:

- Groundwater and surface water sampling will be discontinued if groundwater trends are either stable or decreasing.
- Groundwater sampling will continue in increments of two rounds of sampling to evaluate groundwater trends, or an alternate action (such as an evaluation of the cause of any increasing trends) will be taken.

6.3 STEP 3: IDENTIFY INFORMATION INPUTS

Decisions regarding the potential risk to individual wildlife receptors, or the potential for groundwater concentrations to pose a future risk to the environment, will be based on evaluation of the following data:

- Previous reports, aerial photographs and images, site figures, and data related to the site will be reviewed to establish existing conditions at the landfill.
- Past and future land use scenarios, and regulatory requirements and environmental compliance issues will be evaluated.
- Seven rounds of quarterly groundwater/surface water sampling will be performed from the existing six monitoring wells (MWs) (including a background well) and four surface water

locations (two from the TLF wetland and two from the Mokapu Central Drainage Channel). Samples will be analyzed for polychlorinated biphenyls (PCBs) as Congeners (NOAA 18), total organic carbon (TOC), and total and dissolved metals.

- Groundwater and surface water data collected quarterly will be compared to PALs. In this case, the PALs are developed from risk-based screening criteria including:
  - DOH Environmental Action Levels (EALs) (DOH 2011): Table D-1c, Groundwater Action Level (potentially impacted groundwater is not a current or potential drinking water resource; surface water body is located within 150 meters of release site) (screening criteria used for human health risk assessment)
  - DOH EALs (DOH 2011): Table D-1c, Groundwater protection of aquatic habitat impacts (chronic) (screening criteria used for ecological risk assessment)
- After seven quarterly sampling events are completed, trends for each COPC will be evaluated using the Akritas-Sen-Theil slope with Kendall tau. Trends will be evaluated within each well and at each surface water location for the seven rounds of data, as well as one round of existing data collected during the RI.
- Background concentrations (i.e., prediction limits) will be statistically-derived using Pro UCL for all of the groundwater analytical parameters following the seven sampling events. Concentrations detected at the site will be compared to the derived background concentrations to evaluate if they are representative of naturally occurring conditions.
- During each sampling event, four surface water samples will be collected from the TLF wetland, and four surface water samples will be collected from the Mokapu Central Drainage Channel, adjacent to the landfill. Samples will be analyzed for polynuclear aromatic hydrocarbons (PAHs), organochlorine pesticides, PCBs as Congeners, total metals and mercury, and dissolved metals and mercury.
- During each sampling event, four bulk sediment grab samples will be collected from the TLF wetland, and four bulk sediment grab samples will be collected from the Mokapu Central Drainage Channel, adjacent to the landfill. In addition, two bulk sediment replicate samples will be collected from the TLF wetland, two bulk sediment replicate samples will be collected from the Mokapu Central Drainage Channel, and one bulk sediment replicate sample will be collected from a background location. The method for collecting sediment grab samples may vary depending on field conditions. Possible methods include disposable scoops, an Ekman Sampler, a Ponar Sampler, or similar, as field conditions warrant. Samples will be analyzed for PAHs, organochlorine pesticides, PCBs as Congeners, and total metals and mercury. The background sample will also be analyzed for acid volatile sulfides and simultaneously extracted metals, bioaccumulation, and TOC.
- During each sampling event, four pore water samples will be collected from pore water piezometers installed in the TLF wetland and eight pore water samples will be collected from pore water piezometers installed in the Mokapu Central Drainage Channel adjacent to the landfill. Samples will be analyzed for PAHs, organochlorine pesticides, PCBs as Congeners, and dissolved metals and mercury.
- During each sampling event, fifteen biota samples (five plant, five invertebrate [snail, crustaceans, marine worms], and five fish tissue samples) will be collected from the TLF Wetland and the Mokapu Central Drainage Channel and analyzed for PAHs, organochlorine pesticides, PCBs as Congeners, metals, and lipids. If insufficient invertebrate tissue is

available for laboratory analysis, three site and one reference sediment sample(s) will be collected for laboratory bioaccumulation testing to derive tissue COPC concentrations.

- Quality control (QC) data will be collected to evaluate the quality of the analytical data. This will include the collection and analysis of field QC sediment samples and the use of laboratory QC samples.

6.4 STEP 4: DEFINE THE BOUNDARIES OF THE STUDY

The horizontal study boundary for the study will be the limits of the landfill plus an additional 5 feet beyond the landfill limits (out from the shoreline) to include sediments in the Mokapu Drainage Channel.

The vertical study boundary will be to a maximum depth of three feet for the piezometers. The vertical extent for groundwater sampling will consist of the elevation of the groundwater within the monitoring wells following purging. Sediment samples will be collected from the surface and only during low tide to ensure sediments are accessible to foraging endangered birds.

The temporal boundaries for the study include the time-frame required for the proposed field activities. The field activities for this project are scheduled to begin in September 2015, and are anticipated to last until March 2017.

6.5 STEP 5: DEVELOP THE ANALYTIC APPROACH

The analytic approach is comprised of a series of "if…then…" decision statements. The following decision rules will be applied in the investigation, or to further action, if proposed for this project:

- If the findings of the baseline ecological risk assessment (BERA) indicate chemical concentrations result in N-HQs less than 1, such that they do not present a risk to individual wildlife receptors, then no additional actions will be taken.
- If the findings of the BERA indicate chemical concentrations result in N-HQs exceeding 1, such that they could present a risk to individual wildlife receptors, the remedy will be re-evaluated to determine the need for an alternative remedial action.
- If COPC concentrations are consistently below the PALs or background concentrations for metals (such that they are representative of naturally occurring site conditions) for at least the final four consecutive rounds of sampling, sampling will be discontinued after seven rounds and no additional action taken.
- If groundwater trends for each individual COPC (within each well) show concentrations are not stable or decreasing for one or more analytes, the data and remedy will be further evaluated to ensure protectiveness.
- If groundwater trends for each individual COPC (within each well) show concentrations are stable or decreasing (even if concentrations are above PALs), then groundwater and surface water sampling will be discontinued. COPC concentrations will also be compared to the derived background concentrations as additional support to discontinue monitoring. If the concentrations are at or below the background concentrations, then they are considered representative of naturally occurring conditions.
- If, after seven rounds of sampling, stable or decreasing trends are not observed, then sampling will continue in increments of two rounds of sampling. Following each two sampling round increments, the trends will be reevaluated. Sampling and evaluation would

continue in this manner until stable or decreasing trends are observed, or until an alternate action (such as an evaluation of the cause of any increasing trends) is taken.

6.6 Step 6: Specify Performance or Acceptance Criteria

The purpose of Step 6 is to identify potential sources of study errors and describe how these potential errors will be minimized throughout the investigation. The objective of this section is to complete the following:

- Identify potential sources of study error (i.e., field error, analytical error).
- Establish and identify methods for reducing potential sources of errors.
- Determine how decision errors will be managed during the project.

6.6.1 Sources of Error

Sources of error in an investigation may be divided into two main categories: sampling errors and measurement errors. A sampling error occurs when a sampling design and implementation does not capture the range of heterogeneity at the site. A measurement error occurs as a result of performance variance from laboratory instrumentation, analytical methods, and operator error. The EPA identifies the combination of all these errors as a "total study error" (EPA 2006). One objective of the investigation is to reduce the total study error so that decision makers can be confident that the data collected accurately represents the chemical characteristics of the site.

6.6.2 Managing Decision Error

The investigation will use decision error minimization techniques in sampling design, sampling methodologies, and laboratory measurement of chemicals of concern. Possible decision errors will be minimized during the field investigation by using the following methods:

- Application of standardized field sampling methodologies (Section 10). Sampling activities will be performed in accordance with the *Project Procedures Manual, U.S. Navy Environmental Restoration Program, NAVFAC Pacific* (DON 2015).
- Use of applicable analytical methods (Section 12) for sample analysis by a competent analytical laboratory certified by the Department of Defense Environmental Laboratory Accreditation Program to reduce measurement errors.
- Confirmation of analytical data to identify and control potential laboratory error and sampling error through the use of spikes, duplicates, blanks, etc.

The following sections discuss the methodologies proposed to reduce decision errors.

6.6.2.1 Implementation of Judgmental Sampling Design

The purpose of a judgmental sampling design is to provide answers to specific questions where information on parameters of a population already exists. The judgmental sampling design for the landfill augments the previously collected samples and provides additional information to evaluate groundwater trends at the site and complete the BERA. Confidence and power limits associated with statistically based sampling designs do not apply directly to judgmentally located samples. Decision errors are considered for judgmental samples; however, they are not evaluated statistically. Decision errors associated with judgmental sampling are based on sampling design and measurement errors. Assuming the best possible professional judgment was used to develop the judgmental sampling plan (i.e., position sampling locations), the most important decision errors will be associated with field and laboratory techniques involved in the data collection and analysis. However, these potential errors are greatly reduced due to the following:

- Reviewing historical aerial photographs, analytical data, and site reconnaissance
- Conducting sampling activities in accordance with the *Project Procedures Manual* (DON 2007)

6.6.2.2 Sampling Methodologies and Procedures

Possible decision errors generated by sampling errors will be minimized during the field investigation by applying standardized field sampling methodologies and conducting sampling activities in accordance with the *Project Procedures Manual* (DON 2007).

6.6.2.3 Laboratory Measurement of COPCs

Possible decision errors generated by laboratory measurement errors will be minimized by using applicable analytical methods for sample analysis by a competent analytical laboratory evaluated by the DoD ELAP.

6.7 Step 7: Developing the Plan for Obtaining Data

The sampling design was developed to provide the data required to confirm that COPC concentrations in groundwater are either stable or decreasing, and that COPC concentrations do not pose a risk to individual wildlife receptors.

Details of the sampling design and supporting rationale are presented in Section 8. The Navy will use the data to identify potentially unacceptable risks to individual wildlife receptors, or verify if the remedy selected in the DD is protective. The sampling design for each site was developed to optimize resources and generate data to satisfy the PQOs.

7. Field Quality Control Samples

Measurement Performance Criteria Table – Sediment Field QC Samples

QC Sample	Analytical Group [a]	Frequency [b]	DQI	Measurement Performance Criteria
Field duplicate	PAHs, Organochlorine Pesticides, PCBs, AVS-SEM, TOC, Metals, and Mercury	10% of primary samples collected per matrix per analytical method	Precision	RPD ≤100% sediment [c]
Field blank	PAHs, Organochlorine Pesticides, PCBs, Metals, and Mercury	Once per source of decontamination water per sampling event	Adequacy of the decontamination water quality	≤1/2 of LOQ
Equipment Blank	PAHs, Organochlorine Pesticides, PCBs, Metals, and Mercury	5% of primary samples collected per matrix per analytical method	Adequacy of the decontamination process	≤1/2 of LOQ

Measurement Performance Criteria Table – Groundwater, Surface, and Pore Water Field QC Samples

QC Sample	Analytical Group [a]	Frequency [b]	DQI	Measurement Performance Criteria
Field duplicate	All	10% of primary samples collected per matrix per analytical method	Precision	RPD ≤50% water [c]
Field blank	All	Once per source of decontamination water per sampling event	Adequacy of the decontamination water quality	≤1/2 of LOQ
Equipment Blank	All	5% of primary samples collected per matrix per analytical method	Adequacy of the decontamination process	≤1/2 of LOQ

Measurement Performance Criteria Table – Biota Samples Field QC Samples

QC Sample	Analytical Group [a]	Frequency [b]	DQI	Measurement Performance Criteria
Field duplicate	All	10% of primary samples collected per matrix per analytical method	Precision	RPD ≤100% Tissue [c]
Field blank	All	Once per source of decontamination water per sampling event	Adequacy of the decontamination water quality	≤1/2 of LOQ
Equipment Blank	All	5% of primary samples collected per matrix per analytical method	Adequacy of the decontamination process	≤1/2 of LOQ

% percent
DQI data quality indicator
LOQ limit of quantitation
QC quality control
RPD relative percent difference
[a] Refer to Worksheets #11 for a list of all analytical groups.
[b] Per Procedure III-B, Field QC Samples (DON 2015); refer to Worksheet #14 for a summary of QC samples by project location, matrix, and analytical group.
[c] Per Section II, Data Validation Procedures (DON 2015).

8. Sampling Design and Rationale

8.1 GROUNDWATER AND SURFACE WATER SAMPLING

This portion of the site investigation will consist of seven rounds of quarterly groundwater and surface water sampling. Quarterly groundwater samples will be collected from six existing groundwater monitoring wells (including one background well) and four surface water sampling locations (two from the temporary lodging facility [TLF] wetland and two from the Mokapu Central Drainage Channel) (Figure 3). The groundwater and surface water data will be used to confirm that chemical of potential concern (COPC) concentrations are either stable or decreasing, and pose no future risk to the environment. This section summarizes the sampling and analysis program proposed for seven rounds of groundwater and surface water monitoring. The proposed sample quantities, laboratory analyses, and quality control (QC) requirements for groundwater are summarized in Table 8-1.

Table 8-1: Sampling and Analysis Program, Quarterly Monitoring of Groundwater and Surface Water

		No. of Samples					
Analytical Method	Analytical Parameter	Analytical Samples	Duplicate Samples	MS/MSD	Equipment Rinsate [a]	Field Blanks [b]	Total [c]
Water							
8082A	PCBs as Congeners	10	1	2	1	1	15
9060A	TOC	10	1	2	1	1	15
7470A	Dissolved Mercury	10	1	2	1	1	15
6020A	Dissolved Metals	10	1	2	1	1	15
6010C	RCRA 8 Metals [d]	2	0	0	0	0	2

MS/MSD matrix spike/matrix spike duplicate
No. number
PCB polychlorinated biphenyl
RCRA Resource Conservation and Recovery Act
TOC total organic carbon
[a] The final analyte-free rinse water from equipment decontamination. These samples will be collected after the individual sampling event.
[b] One field blank per water source.
[c] Total number of analyses includes QC samples.
[d] Included for characterization of IDW for disposal.

8.2 GROUNDWATER AND SURFACE WATER DATA EVALUATION

Analytical results will be compared to the project action levels (PALs) to evaluate whether COPC concentrations in groundwater or surface water pose potential risks to ecological receptors. Groundwater data for landfill wells will also be compared to background levels to evaluate if COPC concentrations in groundwater may be attributed to impacts from the landfill or other sources (i.e., surface water), or if they are representative of natural occurring conditions at the site. Pro UCL will be used to calculate the background concentrations (i.e., prediction limits). The concentrations from each surface water sampling location will also be compared to each other to evaluate if concentrations observed are the result of impacts from the landfill or other potential sources.

Statistical analyses will be conducted by comparing the analytical results for landfill wells to prediction limits (interwell comparison) to determine whether the background level has been exceeded. The background level has been exceeded if the resulting groundwater concentration at a landfill monitoring well for a constituent is greater than the 95 percent upper prediction limit calculated for the background monitoring well or surface water analytical data for that constituent.

The trends of COPC concentrations at all sampling locations will also be analyzed to evaluate changes in concentrations over time at each sampling location. Analytical results from each monitoring event will be added to the data set to assess increases or decreases in COPC concentrations. Trends will be analyzed using the Akritas-Sen-Theil slope with Kendall tau.

Decisions regarding the groundwater monitoring program will be based on the results of interwell analyses and trend analyses using an intrawell evaluation and other statistical methods. If the concentrations of COPCs in groundwater exceed the screening criteria or background concentration, then the results of the intrawell evaluation and statistical analyses will be used to evaluate whether there are changes from the historical and current conditions (i.e., stable or decreasing trends are not observed, concentrations inconsistent with historical results). If it is determined that changes from the current and historical concentrations are occurring, then further evaluation of potential risks to human and/or ecological receptors will be evaluated to determine whether continued monitoring or corrective action is warranted. If changes from historical or current conditions are not observed after seven rounds of sampling, then the monitoring will be discontinued.

8.3 BERA SAMPLING

This portion of the site investigation will consist of one round of surface water, pore water, and bulk sediment sampling, as well as plant, benthic invertebrate, and fish biota tissue sampling. Four surface water and four bulk sediment samples will be collected from four locations in the TLF wetland (Figure 3). Four surface water and four bulk sediment samples will be collected from four locations in the Mokapu Central Drainage Channel (Figure 3). In addition, four pore water samples will be collected from the TLF wetland from pore water piezometers and eight pore water samples will be collected from the Mokapu Central Drainage Channel from eight pore water piezometers (Figure 3). Finally, fifteen biota samples (five plant, five invertebrate [snail, crustaceans, marine worms], and five fish tissue samples) will be collected from the TLF Wetland and the Mokapu Central Drainage Channel (Figure 3). If insufficient invertebrate tissue is available, site sediment will be collected for laboratory bioaccumulation testing to derive invertebrate tissue COPC concentrations. The surface water, pore water, sediment, and biota sampling (plant, benthic invertebrate, and fish biota tissue) will be used to complete the BERA and to evaluate site specific risks to ecological receptors.

This section summarizes the sampling and analysis program proposed to evaluate surface water, pore water, sediment, and biota to further evaluate risk to the environment at the landfill site. The proposed sample quantities, laboratory analyses, and QC requirements for sediment and groundwater are summarized in Table 8-2.

Table 8-2: Sampling and Analysis Program, Ecological Risk Evaluation

Analytical Method	Analytical Parameter	No. of Samples					
		Analytical Samples	Duplicate Samples	MS/MSD	Equipment Rinsate [a]	Field Blanks [b]	Total [c]
Surface Water							
8270D	SVOCs	8	1	2	1	1	13
8270D SIM	PAHs	8	1	2	1	1	13
8081B	Organo. Pesticides	8	1	2	1	1	13
1668C	PCBs as Congeners	8	1	2	1	1	13

Analytical Method	Analytical Parameter	No. of Samples					
		Analytical Samples	Duplicate Samples	MS/MSD	Equipment Rinsate [a]	Field Blanks [b]	Total [c]
6020A	Total Metals	8	1	2	1	1	13
6020A	Dissolved Metals	8	1	2	1	1	13
1631E	Total Mercury	8	1	2	1	1	13
1631E	Dissolved Mercury	8	1	2	1	1	13
Pore Water							
8270D	SVOCs	12	2	2	1	1	18
8270D SIM	PAHs	12	2	2	1	1	18
8081B	Organo. Pesticides	12	2	2	1	1	18
1668C	PCBs as Congeners	12	2	2	1	1	18
6020A	Dissolved Metals	12	2	2	1	1	18
1631E	Dissolved Mercury	12	2	2	1	1	18
Sediment							
8270D	SVOCs	8	1	2	1	1	13
8270D SIM	PAHs	8	1	2	1	1	13
8081B	Organo. Pesticides	8	1	2	1	1	13
1668C	PCBs as Congeners	8	1	2	1	1	13
ASTM 1688-10	Bioaccumulation	5	1	NA	NA	NA	6
ASTM 1688-10	Bioaccumulation (Water quality and Ammonia monitoring) [d]	28	NA	NA	NA	NA	28
821-R-91-100	AVS-SEM	5	1	NA	NA	NA	6
Lloyd Kahn	TOC	5	1	NA	NA	NA	6
6020A	Metals	8	1	2	1	1	13
7471B	Mercury	8	1	2	1	1	13
Biota Samples (tissue)							
8270D	SVOCs	15	2	2	1	1	21
8270D SIM	PAHs	15	2	2	1	1	21
8081B	Organo. Pesticides	15	2	2	1	1	21
1668C	PCBs as Congeners	15	2	2	1	1	21
Bligh and Dryer 1959	Lipids	15	2	2	1	1	21
6020A	Metals	15	2	2	1	1	21
7471B	Mercury	15	2	2	1	1	21

ASTM American Society for Testing and Materials
AVS-SEM acid volatile sulfides and simultaneously extracted metals
NA not applicable
PAH polynuclear aromatic hydrocarbon
SIM selective ion monitoring
SVOC semivolatile organic compound

[a] The final analyte-free rinse water from equipment decontamination. These samples will be collected after the individual sampling event.
[b] One field blank per water source.
[c] Total number of analyses includes QC samples. A MS/MSD pair includes two samples.
[d] Daily monitoring that is completed at the laboratory during the bioaccumulation testing.

8.4 BASELINE ECOLOGICAL RISK ASSESSMENT

The ecological risk assessment (ERA) methodology follows the guidance provided by the Navy (DON 2003), which relies heavily upon the eight-step process outlined in the Ecological Risk Assessment Guidance for Superfund (ERAGS) (EPA 1997). An assessment begins with a Tier 1 Ecological Screening Risk Assessment (SRA) (Steps 1 and 2 of the eight-step process), designed to "provide a scientific basis for deciding whether a site may be eliminated from concern, to identify risk situations that may require immediate attention (in the form of an interim response action), and to determine whether additional ERA…is warranted" (DON 2003, Section 2.1.1).

If the ecological SRA proceeds to a BERA, the assessment process continues to Tier 2 (Steps 3a through 8). Steps 1 through 3a have been completed for the H-3 Landfill. Step 3a included a re-evaluation of conservative assumptions used in the previous ecological SRAs and a refinement of the COPCs at the H-3 Landfill to determine whether COPCs identified in the ecological SRAs could be eliminated from further consideration. Step 3a results provide the basis for the collection of additional site-specific data for the BERA.

8.4.1 Step 3b—Problem Formulation

Step 3b, Problem Formulation, focuses on the scope and magnitude of the BERA and provides the basis for the study design. The intent of Step 3b initially is to ensure that the assessment (and associated study design and data collection activities) focus on the important (i.e., the most at risk) ecological and contaminant concerns for the site, and ultimately to provide for a scientifically defensible risk assessment that will support risk management decisions.

Representatives from the United States (U.S.) Fish and Wildlife Service (USFWS), the Navy, AECOM, and Marine Corps Base (MCB) Hawaii met on December 17, 2014, and again on March 26, 2015, to discuss the USFWS concerns. During those meetings, the group discussed and identified the most important ecological concerns, clarified the COPCs, and determined what actions are needed at the site.

During the December 17, 2014 meeting, the USFWS clarified that their primary concern is the potential risk to the four endangered species that use the wetland as a breeding ground. The risks are protective of wildlife populations, but this may result in potential risk to individual receptors, and the USFWS wants endangered species protected at the individual level. In addition, there was no factor of safety used in the risk assessment to account for exposure of juvenile birds or embryos. The risk assessment did not evaluate additive and other potential synergistic effects of exposure to multiple COPCs. In addition, the USFWS did not feel the Navy could do an adequate assessment and five-year review of the landfill without additional groundwater monitoring data. The Navy agreed that there was limited data, and that to address the USFWS concerns, additional groundwater data would be beneficial.

During the March 26, 2015 meeting, the Navy recommended that the risk assessment be further refined, to reduce the uncertainties, by evaluating the specific benthic community at this site by collecting additional surface water, pore water, sediment, and tissue samples. The actual bioavailability of the chemicals could then be evaluated to identify the true state (and potential risks) at the site. All evaluations to date at this site have been based on screening data and default values, and the decisions made have been largely based on conservative risk estimates with a level of uncertainty. USFWS was concerned there will still be uncertainty regarding the cumulative effects of the metals. The objective of the BERA will be to evaluate exposure, and the collection of tissue samples will reduce uncertainty associated with chemicals in food. However, the risk assessment will also incorporate measurement of acid volatile sulfides and simultaneously extracted metals (acid volatile sulfides and simultaneously extracted metals [AVS/SEM] method) to reduce other uncertainties (such as the cumulative effects of the metals).

During the March 26, 2015, it was agreed that the Navy would prepare a work plan for the proposed groundwater sampling and extension of the BERA.

8.4.2 Step 4—Study Design and Data Quality Objectives

This Work Plan (WP) and Sampling and Analysis Plan (SAP), are being prepared as part of Step 4 of the Navy (DON 2003) ERA process. This WP and SAP discuss the identification and design of the scientifically defensible site-specific investigations necessary to address the risk questions and risk hypotheses previously developed. Specific data needs are identified, assessment and measurement endpoints are presented, the kind and amount of data needed is determined and discussed herein, the methods for collecting the data are identified, the appropriate risk characterization approach is selected, and the specific study methods (i.e., toxicity text, field surveys, tissue analyses) are selected.

8.4.3 Step 5—Verification of Field Sampling Design

Verification of the field sampling design is Step 5 of the eight-step ERAGS process (EPA 1997) as well as the Navy ERA guidance (DON 2003). A site visit by the ERA team will form the basis for the sampling proposed in the WP. Discussion with the regulatory agencies (e.g., the United States Fish and Wildlife Service [USFWS]) will verify the feasibility and practicality of the proposed sampling design.

8.4.4 Step 6—Site Investigation and Data Analysis

Step 6 of the eight-step ERAGS process (EPA 1997, DON 2003) is comprised of site investigation and data analysis. The proposed data to be collected during the site investigation is discussed in Section 8.3.

8.4.5 Step 7—Risk Characterization

Risk characterization is Step 7 of the eight-step ERAGS process (EPA 1997), as well as the Navy ERA guidance (DON 2003). The risk characterization will contain a refined evaluation of site surface water, pore water, sediment, and groundwater background COPC concentrations, as well as an evaluation of site fish, crustaceans, marine worms, and terrestrial plant tissue COPC concentrations. Tissue COPC concentrations of representative food species will be used in food chain models to estimate exposure to four representative special status species (Hawaiian black-necked stilt, Hawaiian coot, Hawaiian duck, and Hawaiian moorhen), and the piscivorous black-crowned night heron. Ecological hazards will be revised using more realistic exposure parameters and site-specific information obtained during the BERA field investigations to allow the risk management decisions to properly allow consideration of the special status species.

8.4.6 Step 8—Risk Management

Risk management is Step 8 of the eight-step ERAGS process. The goal of risk management is to provide sufficient information to the risk managers to proceed with management decisions regarding the site. Scientific judgments will be made as to whether a potential remedial alternative would be more detrimental to the environment than leaving chemically impacted media on site. For example, dredging impacted sediment may adversely affect the ecosystem more than the no-action alternative. This type of information will help support risk management decisions.

8.5 ANALYTICAL DESIGN

The analytical laboratory will be required to achieve reporting limits below the PALs or screening criteria, and must verify, reduce, and report analytical data as specified in their laboratory quality assurance (QA) plan and in accordance with the *Department of Defense Quality Systems Manual for Environmental Laboratories* (DoD 2010). The proposed analytical methods are listed in Table 8-2.

Analytical data from the laboratory will be submitted to a subcontractor for data validation. Validator deliverables will include validated data, validation reports as described in Naval Facilities Engineering Command (NAVFAC) Pacific Environmental Restoration (ER) Program Procedure II-A, *Data Validation* (DON 2015), and a data quality assessment (DQA) report described in Procedure II-S, *Data Quality Assessment Report Procedure* (DON 2015). Validated data will consist of Contract Laboratory Program-like forms with associated qualifiers and qualification codes. Hard copy validation reports will include a case narrative describing discrepancies or anomalies in the data and the validated data. The DQA report will document all QC analyses, present results of comparison to established standards, and provide an estimate of the potential effect of out-of-control events on the usability of the data.

9. Field Project Implementation (Field Project Instructions)

9.1 Project Planning

The project team will communicate with the Navy/Marine Corps Base (MCB) Hawaii to discuss technical and administrative matters, and to ensure the project objectives are accomplished in a timely and efficient manner. The project team has prepared this work plan (WP) to address the project objectives and associated data needs required to achieve those objectives. This WP includes a site-specific health and safety plan (HSP) (Appendix C) to address site hazards, protective measures, and contingency plans.

9.2 Site Preparation

The locations of temporary storage and fieldwork areas will be prepared. AECOM Technical Services, Inc. (AECOM) will mark the proposed locations of all sampling and monitoring well locations prior to commencing field activities.

9.3 Utility Clearance

Prior to the initiation of intrusive activities, AECOM will submit a Digging Work Clearance Request to MCB Hawaii and will coordinate with MCB Hawaii personnel to locate any utilities in the area where the soil borings will be advanced. AECOM will obtain a Dig Permit from the Facilities Department prior to the start of work. The procedures described in Naval Facilities Engineering Command (NAVFAC) Pacific Environment Restoration (ER) Program Procedure I-A-5, *Utility Clearance* (DON 2015) will also be utilized as applicable.

9.4 Quarterly Groundwater and Surface Water Sampling

Seven rounds of groundwater/surface water sampling will be performed from the existing six monitoring wells and four surface water locations (Figure 3) to confirm that site conditions are stable and will remain protective of the environment. Groundwater and surface water physical parameters of temperature, pH, conductivity, and turbidity will be monitored during purging. Once these parameters have stabilized, groundwater samples will be collected in accordance with NAVFAC Pacific ER Program Procedure I-C-3, *Monitoring Well Sampling* (DON 2015) and I-B-5, *Surface Water Sampling* (DON 2015). AECOM will collect groundwater samples from each well using a portable submersible or bladder pump. Surface water samples will be collected by submerging a sample container to just below the surface and filling with water. Collected groundwater and surface water samples (filtered for metals analysis), will be transferred directly into laboratory-supplied, pre-cleaned vials and bottles that will then be sealed, labeled, and placed in a chilled insulated receptacle, and shipped to the designated analytical laboratory under standard chain-of-custody (COC) protocol. Samples will be analyzed for polychlorinated biphenyls (PCBs) as Congeners (NOAA 18), total organic carbon (TOC), and total and dissolved metals and mercury. Quality assurance/quality control (QA/QC) samples will include duplicates, matrix spike (MS)/matrix spike duplicate (MSD) pairs, field blanks, and equipment blanks.

Surface water samples will be filtered using a 0.45-micron membrane pressure filter attached to a disposable, pressurized bailer. Surface water samples will be collected in a container and then transferred to the bailer. The bailer will then be pressurized so that the sample passes through the filter and into the sample container.

9.5 SOIL BORINGS AND PIEZOMETERS

Shallow hand auger boreholes will be excavated at 12 locations throughout the site and 12 pore water piezometers will be installed within the borings in accordance with Procedure I-C-1, *Monitoring Well Installation and Abandonment* (DON 2015). The piezometers are 2-inch diameter, pre-manufactured piezometers completed with 12-inches of sand pack, a 7-inch foam bridge, and 6-inches of bentonite. Piezometers will be installed with a 4-inch diameter hand auger to a depth of approximately two feet below the sediment surface.

9.6 SAMPLING FOR ECOLOGICAL RISK EVALUATION

The investigation will consist of the following: surface water and pore water samples, additional bulk sediment samples, and plant, benthic invertebrate, and fish biota tissue samples as shown in Table 9-1. If insufficient invertebrate tissue is available, site sediment will be collected for laboratory bioaccumulation testing to derive invertebrate tissue chemical of potential concern (COPC) concentrations. Four co-located surface water, bulk sediment, and pore water samples will be collected from the TLF wetland. Four surface water, four bulk sediment, and eight pore water samples will be collected from the Mokapu Central Drainage Channel and Kaneohe Bay adjacent to the landfill. The sediment samples will be collected in accordance with Procedure I-B-6, *Subaqueous Sediment Sampling* (DON 2015). Discrete sediment samples will be obtained using disposable scoops during low tide when these sediments are exposed. Surface water samples will be collected with a disposable bailer in accordance with Procedure I-B-5, *Surface Water Sampling* (DON 2015). Pore water samples will be collected from pre-installed piezometers (installed during an initial site visit) using disposable bailers or a peristaltic pump in accordance with Procedure I-C-3, *Monitoring Well Sampling* (DON 2015). Collected sediment, pore water (filtered for metals analyses), and surface water (both filtered and unfiltered for metals analysis) samples will be transferred directly into laboratory-supplied, pre-cleaned jars, vials, or bottles that will then be sealed, labeled, and placed in a chilled insulated receptacle, and shipped to the designated analytical laboratory under standard COC protocol. Surface water, pore water, and sediment samples will be analyzed for polynuclear aromatic hydrocarbons (PAHs), organochlorine pesticides, PCBs as Congeners, total metals and mercury (except pore water samples), and dissolved metals and mercury (surface water and pore water samples only). QA/QC samples will include duplicates, MS/MSD pairs, field blanks, and equipment blanks. In addition, two bulk sediment replicate samples will be collected from the TLF wetland, two bulk sediment replicate samples will be collected from the Mokapu Central Drainage Channel, and one bulk sediment replicate sample will be collected from a background location to be analyzed for acid volatile sulfides and simultaneously extracted metals (AVS/SEM) and TOC.

Fifteen biota samples (five plant, five invertebrate [snail, crustaceans, marine worms], and five fish tissue samples) will be collected from the TLF wetland and the Mokapu Central Drainage Channel and analyzed for PAHs, organochlorine pesticides, PCBs as Congeners, metals, and lipids. Invertebrate, plant, and fish tissue samples will be collected using nets, traps, and hand gathering. Tissue samples will be collected daily. If sufficient tissue volume is not collected on the first day, then tissue collection will continue at the location with each day's catch frozen until sufficient quantity is obtained for the location. Each aggregated tissue sample will be dated with the first and last day of included tissue. Frozen samples will be shipped to the offsite analytical laboratory on bagged ice by an overnight courier. Tissue samples will be maintained at 4°C, or lower, during shipping. If insufficient invertebrate tissue is available for laboratory analysis, three site and one reference sediment sample(s) will be collected for laboratory bioaccumulation testing to derive tissue

COPC concentrations. The field schedule must be coordinated so that the sampling described above is conducted when the pond has water, likely during the rainy season.

9.7 PROTECTION OF WETLAND AND ECOLOGICAL RESOURCES

The work will be conducted in a protected wetland, known to be used by several endangered species, and may be used as a nesting ground for several waterbirds, including the Hawaiian moorhen (gallinule), black-necked stilt, coot, and duck. Therefore, conservation measures are needed to ensure no bird species that use the wetland are disturbed. The following measures will be implemented at the project site to avoid and minimize effects to the Hawaiian waterbirds:

- Given that waterbirds in Hawaii have been known to nest year round, nest searches will be conducted by a qualified MCB Hawaii wildlife biologist prior to any work being conducted and after any subsequent delay of three or more days (during which time birds may attempt nesting).
- If a nest with eggs is discovered, work will cease in the vicinity for a minimum of seventy days (10 weeks); if a nest with chicks is discovered, work will cease for a minimum of 49 days (7 weeks). These guidelines are intended to protect chicks, and may be shortened if monitoring is conducted often enough to note when chicks have fledged (usually five to six weeks after hatching).
- If a previously undiscovered nest is found after work begins, all work will cease within a minimum radius of 100 feet of the nest and the United States (U.S.) Fish and Wildlife Service (USFWS) will be contacted within 48 hours.
- All workers associated with this project (e.g., employee, contractor, etc.) will be fully briefed on these best management practices and the requirement to adhere to them for the duration of their involvement in this project.
- All project-related materials and equipment placed in the water will be free of pollutants.

9.8 FIELD QUALITY ASSURANCE/QUALITY CONTROL

The AECOM QA program manager or designee will visit the site and observe field activities to assess conformance to the WP and NAVFAC Pacific Standard Operating Procedures (SOPs) (DON 2015). The contract task order (CTO) manager and support staff will respond in writing to audit findings.

9.9 FIELD HEALTH AND SAFETY AUDIT

The health and safety professional or designee will visit the site to observe field health and safety practices to assess conformance with the project-specific HSP. The CTO manager and support staff will respond in writing to audit findings.

9.10 EQUIPMENT DECONTAMINATION

Non-disposable field equipment, including, but not limited to, the hand auger, sediment sampling equipment, and purging equipment will be decontaminated in accordance with Procedure I-F, *Equipment Decontamination* (DON 2015).

9.11 IDW Sampling, Evaluation, and Disposal

The investigation-derived waste (IDW) will be evaluated based on the corresponding groundwater, surface water, and sediment sampling data to select appropriate disposal methods. The IDW will be handled, stored, and labeled in accordance with Procedure I-A-6, *IDW Management* (DON 2007). IDW will be disposed of within 90 calendar days of generation of the IDW.

9.12 Sample Location Survey

Experienced field personnel will use a commercially available, consumer-grade global positioning system (GPS) system unit to document the sample locations at the site, in accordance with Procedure I-I, *Land Surveying* (DON 2015).

9.13 Quality Control Tasks

AECOM will implement NAVFAC ER program procedures (DON 2015) for sediment, surface water, pore water, and groundwater sampling.

9.14 Data Management Tasks

9.14.1 Documentation and Records

All field observations and measurements will be recorded in a field notebook and project-specific field data sheets. All samples will have global positioning system locations. Chains-of-custodies, air bills, and sampling logs will be prepared and retained for each sample, in accordance with Procedure III-D, *Logbooks* (DON 2015) and Procedure III-E, *Record Keeping, Sample Labeling, and Chain-of-Custody Procedures* (DON 2015).

All data derived from the field investigation will be incorporated into the Risk Assessment and groundwater monitoring summary report.

9.14.2 Analytical Data Reporting

Laboratories will verify, reduce, and report soil data as specified in their Department of Defense (DoD) Environmental Laboratory Accreditation Program-evaluated laboratory QA plan and in accordance with their subcontract. Laboratory sample and QC data will be reported as full deliverables and presented as both printed and electronic data deliverable (EDD) copies. The hard copy, printed report will be delivered in Contract Laboratory Program-like format, along with a case narrative and table of contents. Laboratory hard copy data deliverable format will be consistent with Appendix E of the DoD *Quality Systems Manual for Environmental Laboratories* (QSM) (DoD 2010). The format for the EDDs is also specified in Appendix D of the QSM. Portable document format copies of all analytical data packages will be stored on CD-ROM diskettes and archived with the project report at NAVFAC Pacific in the Administrative Record. All other data generated in the field and reports generated for the project will be stored in both hard copy and electronic data file forms by AECOM. All data generated for this project will be maintained for a period of no less than 5 years, as specified in Section 4.12, Control of Records of the DoD QSM (DoD 2010).

Both laboratory sample data and QC data will be reported in the printed deliverables. Turnaround time for deliverables will be 21 days from date of sample receipt.

9.14.3 Assessment/Audit Tasks

The project chemist, QA program manager, and field manager will be responsible for assessment and audit tasks (Section 2). The CTO project manager will be responsible for coordinating the field audit.

9.14.4 Data Review Tasks

All analytical data, field notes, data sheets, and other data necessary to support the project will be maintained in an AECOM electronic database. All hard copies of analytical data, field notes, data sheets, and other data necessary to support the project will be maintained in the AECOM Honolulu office.

All project analytical data will be validated by a third-party data validation firm in accordance with the following Data Validation Procedures (DON 2015):

- Third-party data validation will consist of standard validation (90 percent) and full validation (10 percent). The first 10 percent of project field data generated by the laboratory will be validated at full validation to establish a baseline, ensuring the laboratory has complied with the requirements outlined in both the analytical methods and the DoD QSM (DoD 2010). In addition, data quality checks (i.e., evaluating the precision and accuracy) will be performed once the analytical data are received from the laboratory. AECOM will verify the data against the specified limits of quantitation (LOQs) and limits of detection (LODs) in Section 11. All documents produced for the project will be kept in a secured facility for the life of the project. Upon closure of the project, laboratory documents will be archived with the project report in the administrative record file at NAVFAC Pacific.

Table 9-1: Sample Details Table

<table>
<tr><td colspan="4" rowspan="4">CLEAN III HC60 [a] – H-3 Landfill (Site 0001)
Marine Corps Base Hawaii, Oahu, Hawaii
NCTAMS PAC/PHNC National Priorities List Site</td><td>Matrix</td><td>Groundwater, Surface Water, and Pore Water</td><td>Sediment</td><td>Biota</td></tr>
<tr><td>Analysis Group</td><td>1) SVOCs and PAHs,
2) Pesticides, 3) PCBs, 4)TOC,
5) Metals, 6) Mercury</td><td>1) SVOCs and PAHs, 2) Pesticides, 3) PCBs, 4)TOC, 5)AVS-SEM 6) Metals, 7) Mercury</td><td>1) SVOCs and PAHs, 2) Pesticides, 3) PCBs, 4)Lipid, 5) Metals, 6) Mercury</td></tr>
<tr><td>Preparation and Analytical Method</td><td>1) 3510C/8270DSIM,
2) 3510C/8081B,
3) 3510C/1668C/8082
4) 9060A
5) 3010A/6010C/6020A
6) 7470A</td><td>1) 3510C/8270DSIM,
2) 3510C/8081B,
3) 3510C//1668C
4) Lloyd Kahn
5)AVS/SEM/6020A/7471B
6) 3010A/6010C/6020A
7) 7471B</td><td>1) 3510C/8270DSIM,
2) 3510C/8081B,
3) 3510C/1668C/8082A
4) Bligh and Dyer 1959
5) 3010A/6010C/6020A
6) 7471B</td></tr>
<tr><td>Analytical Laboratory/ Analytical SOP Reference</td><td>EMAX Laboratories
1) EMAX-3520/EMAX-8270SIM/ EMAX-8270
2) EMAX-3520/EMAX-8081
3) a-Congener (Low Resolution) EMAX-3520/EMAX-8082Con
3) b-Congener (High Resolution) – HMS-1668C
4) EMAX-9060
5) EMAX-6020
6) EMAX-7470</td><td>EMAX Laboratories
1) EMAX-3550/EMAX-8270SIM/ EMAX-8270
2) EMAX-3550/EMAX-8081
3) Congener (High Resolution) – HMS-1668C
4) GEN-ASTM r.9
5) GEN-AVS r.7/MET-ICP r.25
6) EMAX-6020
7) EMAX-7470</td><td>EMAX Laboratories
1) EXT-3541 r.10/SVM-8270L r.9
2) SOC-8081 r.18
3)HMS-1668C
4) EXT-LIPID r.5
5) MET-3010A r.12/MET-ICP r.25/MET-6020 r.16
6) MET-7471 r.17</td></tr>
<tr><td colspan="4" rowspan="4">Laboratory: EMAX Laboratories, Inc.
Ye Myint
1835 W. 205th Street
Torrance, CA 90501
310-618-8889 ext. 121</td><td>Data Package Turnaround Time</td><td>21 calendar days</td><td>21 calendar days</td><td>21 calendar days</td></tr>
<tr><td>Container Type</td><td>1,2, 3) 1L Amber Glass (None)
4) 250 mL Amber Glass (H_2SO_4)
5, 6) 1L Polyethylene (HNO_3)</td><td>250 mL wide-mouth glass (All samples)</td><td>250 mL wide-mouth glass (All samples)</td></tr>
<tr><td>Preservative</td><td>See above</td><td>None</td><td>None</td></tr>
<tr><td>Holding Time (Preparation/ Analysis)</td><td>1, 2) 7 days / 40 days,
3) None,
4) 28 days,
5) 6 months,
6) 28 days</td><td>1, 2) 14 days / 40 days,
3) None,
4) 14 days,
5) 28 days,
6) 6 months,
7) 28 days</td><td>1 year (for frozen samples)</td></tr>
<tr><td>Site</td><td>Matrix</td><td>Station ID</td><td>Sample ID</td><td>Depth/Sampling Interval</td><td>Groundwater, Surface Water, and Pore Water</td><td>Sediment</td><td>Biota</td></tr>
<tr><td>H-3</td><td>GW</td><td>NA</td><td>1-18</td><td>20-30 ft bgs</td><td>—</td><td>—</td><td>—</td></tr>
<tr><td>H-3</td><td>Surface Water</td><td>NA</td><td>1-14</td><td>NA</td><td>—</td><td>—</td><td>—</td></tr>
</table>

	Matrix	Groundwater, Surface Water, and Pore Water	Sediment	Biota
CLEAN III HC60 [a] – H-3 Landfill (Site 0001) Marine Corps Base Hawaii, Oahu, Hawaii NCTAMS PAC/PHNC National Priorities List Site	Analysis Group	1) SVOCs and PAHs, 2) Pesticides, 3) PCBs, 4)TOC, 5) Metals, 6) Mercury	1) SVOCs and PAHs, 2) Pesticides, 3) PCBs, 4)TOC, 5)AVS-SEM 6) Metals, 7) Mercury	1) SVOCs and PAHs, 2) Pesticides, 3) PCBs, 4)Lipid, 5) Metals, 6) Mercury
	Preparation and Analytical Method	1) 3510C/8270DSIM, 2) 3510C/8081B, 3) 3510C/1668C/8082 4) 9060A 5) 3010A/6010C/6020A 6) 7470A	1) 3510C/8270DSIM, 2) 3510C/8081B, 3) 3510C//1668C 4) Lloyd Kahn 5)AVS/SEM/6020A/7471B 6) 3010A/6010C/6020A 7) 7471B	1) 3510C/8270DSIM, 2) 3510C/8081B, 3) 3510C/1668C/8082A 4) Bligh and Dyer 1959 5) 3010A/6010C/6020A 6) 7471B
	Analytical Laboratory/ Analytical SOP Reference	EMAX Laboratories 1) EMAX-3520/EMAX-8270SIM/ EMAX-8270 2) EMAX-3520/EMAX-8081 3) a-Congener (Low Resolution) EMAX-3520/EMAX-8082Con 3) b-Congener (High Resolution) – HMS-1668C 4) EMAX-9060 5) EMAX-6020 6) EMAX-7470	EMAX Laboratories 1) EMAX-3550/EMAX-8270SIM/ EMAX-8270 2) EMAX-3550/EMAX-8081 3) Congener (High Resolution) – HMS-1668C 4) GEN-ASTM r.9 5) GEN-AVS r.7/MET-ICP r.25 6) EMAX-6020 7) EMAX-7470	EMAX Laboratories 1) EXT-3541 r.10/SVM-8270L r.9 2) SOC-8081 r.18 3)HMS-1668C 4) EXT-LIPID r.5 5) MET-3010A r.12/MET-ICP r.25/MET-6020 r.16 6) MET-7471 r.17
Laboratory: EMAX Laboratories, Inc. Ye Myint 1835 W. 205th Street Torrance, CA 90501 310-618-8889 ext. 121	Data Package Turnaround Time	21 calendar days	21 calendar days	21 calendar days
	Container Type	1,2, 3) 1L Amber Glass (None) 4) 250 mL Amber Glass (H_2SO_4) 5, 6) 1L Polyethylene (HNO_3)	250 mL wide-mouth glass (All samples)	250 mL wide-mouth glass (All samples)
	Preservative	See above	None	None
	Holding Time (Preparation/ Analysis)	1, 2) 7 days / 40 days, 3) None, 4) 28 days, 5) 6 months, 6) 28 days	1, 2) 14 days / 40 days, 3) None, 4) 14 days, 5) 28 days, 6) 6 months, 7) 28 days	1 year (for frozen samples)

Site	Matrix	Station ID	Sample ID	Depth/Sampling Interval	Groundwater, Surface Water, and Pore Water	Sediment	Biota
H-3	Pore Water	NA	1-14	2 ft bgs	—	—	—
H-3	Sediment	NA	1-10	NA	—	—	—
H-3	Biota	NA	1-17	NA	—	—	—

	Matrix	Groundwater, Surface Water, and Pore Water	Sediment	Biota
CLEAN III HC60 [a] – H-3 Landfill (Site 0001) Marine Corps Base Hawaii, Oahu, Hawaii NCTAMS PAC/PHNC National Priorities List Site	Analysis Group	1) SVOCs and PAHs, 2) Pesticides, 3) PCBs, 4)TOC, 5) Metals, 6) Mercury	1) SVOCs and PAHs, 2) Pesticides, 3) PCBs, 4)TOC, 5)AVS-SEM 6) Metals, 7) Mercury	1) SVOCs and PAHs, 2) Pesticides, 3) PCBs, 4)Lipid, 5) Metals, 6) Mercury
	Preparation and Analytical Method	1) 3510C/8270DSIM, 2) 3510C/8081B, 3) 3510C/1668C/8082 4) 9060A 5) 3010A/6010C/6020A 6) 7470A	1) 3510C/8270DSIM, 2) 3510C/8081B, 3) 3510C//1668C 4) Lloyd Kahn 5)AVS/SEM/6020A/7471B 6) 3010A/6010C/6020A 7) 7471B	1) 3510C/8270DSIM, 2) 3510C/8081B, 3) 3510C/1668C/8082A 4) Bligh and Dyer 1959 5) 3010A/6010C/6020A 6) 7471B
	Analytical Laboratory/ Analytical SOP Reference	EMAX Laboratories 1) EMAX-3520/EMAX-8270SIM/ EMAX-8270 2) EMAX-3520/EMAX-8081 3) a-Congener (Low Resolution) EMAX-3520/EMAX-8082Con 3) b-Congener (High Resolution) – HMS-1668C 4) EMAX-9060 5) EMAX-6020 6) EMAX-7470	EMAX Laboratories 1) EMAX-3550/EMAX-8270SIM/ EMAX-8270 2) EMAX-3550/EMAX-8081 3) Congener (High Resolution) – HMS-1668C 4) GEN-ASTM r.9 5) GEN-AVS r.7/MET-ICP r.25 6) EMAX-6020 7) EMAX-7470	EMAX Laboratories 1) EXT-3541 r.10/SVM-8270L r.9 2) SOC-8081 r.18 3)HMS-1668C 4) EXT-LIPID r.5 5) MET-3010A r.12/MET-ICP r.25/MET-6020 r.16 6) MET-7471 r.17
Laboratory: EMAX Laboratories, Inc. Ye Myint 1835 W. 205th Street Torrance, CA 90501 310-618-8889 ext. 121	Data Package Turnaround Time	21 calendar days	21 calendar days	21 calendar days
	Container Type	1,2, 3) 1L Amber Glass (None) 4) 250 mL Amber Glass (H_2SO_4) 5, 6) 1L Polyethylene (HNO_3)	250 mL wide-mouth glass (All samples)	250 mL wide-mouth glass (All samples)
	Preservative	See above	None	None
	Holding Time (Preparation/ Analysis)	1, 2) 7 days / 40 days, 3) None, 4) 28 days, 5) 6 months, 6) 28 days	1, 2) 14 days / 40 days, 3) None, 4) 14 days, 5) 28 days, 6) 6 months, 7) 28 days	1 year (for frozen samples)

Site	Matrix	Station ID	Sample ID	Depth/Sampling Interval	Groundwater, Surface Water, and Pore Water	Sediment	Biota
Field QC Samples							
H-3	Field Duplicate	NA	All	NA	—	—	—

	Matrix	Groundwater, Surface Water, and Pore Water	Sediment	Biota
CLEAN III HC60 [a] – H-3 Landfill (Site 0001) Marine Corps Base Hawaii, Oahu, Hawaii NCTAMS PAC/PHNC National Priorities List Site	Analysis Group	1) SVOCs and PAHs, 2) Pesticides, 3) PCBs, 4)TOC, 5) Metals, 6) Mercury	1) SVOCs and PAHs, 2) Pesticides, 3) PCBs, 4)TOC, 5)AVS-SEM 6) Metals, 7) Mercury	1) SVOCs and PAHs, 2) Pesticides, 3) PCBs, 4)Lipid, 5) Metals, 6) Mercury
	Preparation and Analytical Method	1) 3510C/8270DSIM, 2) 3510C/8081B, 3) 3510C/1668C/8082 4) 9060A 5) 3010A/6010C/6020A 6) 7470A	1) 3510C/8270DSIM, 2) 3510C/8081B, 3) 3510C//1668C 4) Lloyd Kahn 5)AVS/SEM/6020A/7471B 6) 3010A/6010C/6020A 7) 7471B	1) 3510C/8270DSIM, 2) 3510C/8081B, 3) 3510C/1668C/8082A 4) Bligh and Dyer 1959 5) 3010A/6010C/6020A 6) 7471B
	Analytical Laboratory/ Analytical SOP Reference	<u>EMAX Laboratories</u> 1) EMAX-3520/EMAX-8270SIM/ EMAX-8270 2) EMAX-3520/EMAX-8081 3) a-Congener (Low Resolution) EMAX-3520/EMAX-8082Con 3) b-Congener (High Resolution) – HMS-1668C 4) EMAX-9060 5) EMAX-6020 6) EMAX-7470	<u>EMAX Laboratories</u> 1) EMAX-3550/EMAX-8270SIM/ EMAX-8270 2) EMAX-3550/EMAX-8081 3) Congener (High Resolution) – HMS-1668C 4) GEN-ASTM r.9 5) GEN-AVS r.7/MET-ICP r.25 6) EMAX-6020 7) EMAX-7470	<u>EMAX Laboratories</u> 1) EXT-3541 r.10/SVM-8270L r.9 2) SOC-8081 r.18 3)HMS-1668C 4) EXT-LIPID r.5 5) MET-3010A r.12/MET-ICP r.25/MET-6020 r.16 6) MET-7471 r.17
Laboratory: EMAX Laboratories, Inc. Ye Myint 1835 W. 205th Street Torrance, CA 90501 310-618-8889 ext. 121	Data Package Turnaround Time	21 calendar days	21 calendar days	21 calendar days
	Container Type	1,2, 3) 1L Amber Glass (None) 4) 250 mL Amber Glass (H_2SO_4) 5, 6) 1L Polyethylene (HNO_3)	250 mL wide-mouth glass (All samples)	250 mL wide-mouth glass (All samples)
	Preservative	See above	None	None
	Holding Time (Preparation/ Analysis)	1, 2) 7 days / 40 days, 3) None, 4) 28 days, 5) 6 months, 6) 28 days	1, 2) 14 days / 40 days, 3) None, 4) 14 days, 5) 28 days, 6) 6 months, 7) 28 days	1 year (for frozen samples)

Site	Matrix	Station ID	Sample ID	Depth/Sampling Interval	Groundwater, Surface Water, and Pore Water	Sediment	Biota
H-3	Matrix Spike/Matrix Spike Duplicate	NA	All	NA	—	—	—

	Matrix	Groundwater, Surface Water, and Pore Water	Sediment	Biota
CLEAN III HC60 [a] – H-3 Landfill (Site 0001) Marine Corps Base Hawaii, Oahu, Hawaii NCTAMS PAC/PHNC National Priorities List Site	Analysis Group	1) SVOCs and PAHs, 2) Pesticides, 3) PCBs, 4)TOC, 5) Metals, 6) Mercury	1) SVOCs and PAHs, 2) Pesticides, 3) PCBs, 4)TOC, 5)AVS-SEM 6) Metals, 7) Mercury	1) SVOCs and PAHs, 2) Pesticides, 3) PCBs, 4)Lipid, 5) Metals, 6) Mercury
	Preparation and Analytical Method	1) 3510C/8270DSIM, 2) 3510C/8081B, 3) 3510C/1668C/8082 4) 9060A 5) 3010A/6010C/6020A 6) 7470A	1) 3510C/8270DSIM, 2) 3510C/8081B, 3) 3510C//1668C 4) Lloyd Kahn 5)AVS/SEM/6020A/7471B 6) 3010A/6010C/6020A 7) 7471B	1) 3510C/8270DSIM, 2) 3510C/8081B, 3) 3510C/1668C/8082A 4) Bligh and Dyer 1959 5) 3010A/6010C/6020A 6) 7471B
	Analytical Laboratory/ Analytical SOP Reference	EMAX Laboratories 1) EMAX-3520/EMAX-8270SIM/ EMAX-8270 2) EMAX-3520/EMAX-8081 3) a-Congener (Low Resolution) EMAX-3520/EMAX-8082Con 3) b-Congener (High Resolution) – HMS-1668C 4) EMAX-9060 5) EMAX-6020 6) EMAX-7470	EMAX Laboratories 1) EMAX-3550/EMAX-8270SIM/ EMAX-8270 2) EMAX-3550/EMAX-8081 3) Congener (High Resolution) – HMS-1668C 4) GEN-ASTM r.9 5) GEN-AVS r.7/MET-ICP r.25 6) EMAX-6020 7) EMAX-7470	EMAX Laboratories 1) EXT-3541 r.10/SVM-8270L r.9 2) SOC-8081 r.18 3)HMS-1668C 4) EXT-LIPID r.5 5) MET-3010A r.12/MET-ICP r.25/MET-6020 r.16 6) MET-7471 r.17
Laboratory: EMAX Laboratories, Inc. Ye Myint 1835 W. 205th Street Torrance, CA 90501 310-618-8889 ext. 121	Data Package Turnaround Time	21 calendar days	21 calendar days	21 calendar days
	Container Type	1,2, 3) 1L Amber Glass (None) 4) 250 mL Amber Glass (H_2SO_4) 5, 6) 1L Polyethylene (HNO_3)	250 mL wide-mouth glass (All samples)	250 mL wide-mouth glass (All samples)
	Preservative	See above	None	None
	Holding Time (Preparation/ Analysis)	1, 2) 7 days / 40 days, 3) None, 4) 28 days, 5) 6 months, 6) 28 days	1, 2) 14 days / 40 days, 3) None, 4) 14 days, 5) 28 days, 6) 6 months, 7) 28 days	1 year (for frozen samples)

Site	Matrix	Station ID	Sample ID	Depth/Sampling Interval	Groundwater, Surface Water, and Pore Water	Sediment	Biota
H-3	Equipment Blank	NA	All	NA	—	—	—
H-3	Field Blank	NA	All	NA	—	—	—

— Not relevant to this category

ASTM	American Society for Testing and Materials
bgs	below ground surface
CLEAN	Comprehensive Long-Term Environmental Action Navy
ID	identification
NA	not applicable
VOC	volatile organic compound

[a] Work conducted at this site may be continued or completed under a separate CTO or under another contract.

10. Project Sampling SOP References Table

Reference Number	Title, Revision Date and/or Number [a]	Originating Organization of Sampling SOP	Equipment Type	Comments
I-A-6	IDW Management (DON 2015)	NAVFAC Pacific	N/A	No
I-A-7	*Analytical Data Validation Planning and Coordination* (DON 2015)	NAVFAC Pacific	N/A	No
I-A-8	Sample Naming (DON 2015)	NAVFAC Pacific	N/A	No
I-B-5	Surface Water Sampling (DON 2015) [b]	NAVFAC Pacific	Peristaltic pump	No
I-B-6	Subaqueous Sediment Sampling (DON 2015)	NAVFAC Pacific	Thin-wall tube auger, core samplers, Ponar or Eckman dredge, vibracore sampler	No
I-C-3	Monitoring Well Sampling (DON 2015)	NAVFAC Pacific	Bladder Pump	No
I-D-3	Biological Tissue Sample Collection (DON 2015)	NAVFAC Pacific	Refer to laboratory SOP for sample type	No
I-E	*Soil (Sediment) and Rock Classification* (DON 2015)	NAVFAC Pacific	N/A	No
I-F	Equipment Decontamination (DON 2015)	NAVFAC Pacific	N/A	No
III-A	Laboratory QC Samples (Water, Soil/sediment) (DON 2015)	NAVFAC Pacific	N/A	No
III-B	Field QC Samples (Water, Soil/sediment) (DON 2015)	NAVFAC Pacific	N/A	No
III-D	Logbooks (DON 2015)	NAVFAC Pacific	N/A	No
III-E	Record Keeping, Sample Labeling, and Chain of Custody Procedures (DON 2015)	NAVFAC Pacific	N/A	No
III-F	Sample Handling, Storage and Shipping (DON 2015)	NAVFAC Pacific	N/A	No

IDW investigation-derived waste
N/A not applicable
NAVFAC Naval Facilities Engineering Command
QC quality control
SOP standard operating procedure
[a] Applicable procedures from the Project Procedures Manual (DON 2015).
[b] SOP will be applied to collection of perched groundwater.

11. Reference Limits and Evaluation Table

This worksheet lists the sample matrices, analytical groups, analytes, project action levels, and project quantitation limit goals. Agriculture & Priority Pollutants Laboratory's laboratory-specific limits of quantitation, limits of detection, and method detection limits are also provided for this project.

The sediment, biota, surface water, pore water, and groundwater analytical data will be screened against conservative values from the current State of Hawaii Department of Health Environmental Action Limits (DOH 2011), United States Environmental Protection Agency (EPA) Regional Screening Levels (EPA, June 2015), and EPA Region 3 Biological Technical Assistance Group ecological marine sediment quality values (EPA Region 3 2006).

11.1 SEDIMENT

Matrix: **Sediment**
Analytical Group: **Total Metals and Mercury (Method 6020A and 7471B)**

Analyte	CAS No.	DOH EAL [a] (mg/kg)	EPA RSL [b] (mg/kg)	Ecological Freshwater SQVs [c] (mg/kg)	Ecological Marine SQVs [d] (mg/kg)	Project Action Level (mg/kg)	PQL Goal (mg/kg) [e]	Laboratory-Specific Limits (mg/kg) [f]		
								LOQs	LODs	DLs
Aluminum	7429-90-5	—	7700	—	—	7700	770	100	10	5
Antimony	7440-36-0	2.4	3.1	2	—	2	0.2	0.5	0.2	0.1
Arsenic	7440-38-2	24	0.68	9.8	7.24	0.67	0.6	0.5	0.1	0.05
Barium	7440-39-3	1000	1500	—	—	1000	100	0.5	0.1	0.072
Beryllium	7440-41-7	31	16	—	—	16	1.6	0.5	0.1	0.05
Cadmium	7440-43-9	14	7	0.99	0.68	0.68	0.68	0.5	0.1	0.057
Chromium (Total)	7440-47-3	1,145	—	43.4	52.3	43.4	4.34	0.5	0.1	0.05
Cobalt	7440-48-4	80	2.3	50	—	2.3	0.23	0.5	0.1	0.05
Copper	7440-50-8	626	310	31.6	18.7	18.7	1.87	0.5	0.2	0.1
Iron	7439-89-6	—	5500	20,000	—	550	55	100	10	5
Lead	7439-92-1	200	400	35.8	30.2	30.2	3.02	0.5	0.1	0.05
Manganese	7439-96-5	—	180	460	—	180	18	0.5	0.2	0.153
Mercury	7439-97-6	4.69	0.94	0.18	0.13	0.13	0.13	0.1	0.02	0.01
Molybdenum	7439-98-7	78	39	—	—	39	3.9	0.5	0.2	0.1
Nickel	7440-02-0	761	150	22.7	15.9	15.9	1.6	0.5	0.1	0.063
Selenium	7782-49-2	78	39	2	—	2	2	0.5	0.1	0.05
Silver	7440-22-4	78	39	1	0.73	0.73	0.73	0.5	0.1	0.05
Thallium	7440-28-0	0.78	0.078	—	—	0.078	0.078	0.5	0.1	0.05
Vanadium	7440-62-2	770	39	—	—	39	3.9	0.5	0.25	0.19
Zinc	7440-66-6	1,000	2300	121	124	121	12.1	2	1	0.683

— Information is not available.

DL method detection limit
DOH Department of Health, State of Hawaii
EAL environmental action level
LOD limit of detection
LOQ limit of quantitation
mg/kg milligram per kilogram
No. number
PQL project quantitation limit
RSL regional screening levels
SQV sediment quality values
[a] DOH EALs (DOH 2011): Table B-2, Soil Action Level (Potentially impacted groundwater is not a current or potential drinking water resource; surface water body is located within 150 meters of release site).
[b] EPA Region 9 RSLs (EPA, June 2015): Residential Soil.
[c] Ecological freshwater Sediment Quality Values (SQVs) from EPA Region 3 BTAG (EPA Region 3 2006).
[d] Ecological marine SQVs from EPA Region 3 BTAG (EPA Region 3 2006).
[e] For a specific chemical where screening criteria is lower than the reporting limit (LOQ for this project), LOD will be used as an alternative action level (DOH 2011).
[f] Laboratory-specific LOQs, LODs, and DLs are limits that an individual laboratory can achieve when performing a specific analytical method, and the results are based on dry weight.

Matrix: **Sediment**
Analytical Group: **SVOCs (Method 8270D)**

Analyte	CAS No.	DOH EAL [a] (µg/kg)	EPA RSL [b] (µg/kg)	Ecological Freshwater SQVs [c] (µg/kg)	Ecological Marine SQVs [d] (µg/kg)	Project Action Level (µg/kg)	PQL Goal (µg/kg)	Laboratory-Specific Limits (µg/kg) [e]		
								LOQs	LODs	DLs
2,4-Dimethylphenol	105-67-9	8,985	130,000	29	—	29	29	20	5	2.5
Hexachlorobenzene	118-74-1	303	210	20	—	20	20	20	5	2.5

— Information is not available.
µg/kg microgram per kilogram
[a] DOH EALs (DOH 2011): Table B-2, Soil Action Level (Potentially impacted groundwater is not a current or potential drinking water resource; surface water body is located within 150 meters of release site).
[b] EPA Region 9 RSLs (EPA, June 2015): Residential Soil.
[c] Ecological freshwater Sediment Quality Values (SQVs) from EPA Region 3 BTAG (EPA Region 3 2006).
[d] Ecological marine Sediment Quality Values (SQVs) from EPA Region 3 BTAG (EPA Region 3 2006).
[e] The current laboratory-specific LOQs, LODs, and DLs are from the standard method, but the laboratory will modify the procedure to lower the reporting limits to meet project action levels for this project.

Matrix: **Sediment**
Analytical Group: **PCBs (Method 8082A)**

Analyte	CAS No.	DOH EAL [a] (µg/kg)	EPA RSL [b] (µg/kg)	Ecological Freshwater SQVs [c] (µg/kg)	Ecological Marine SQVs [d] (µg/kg)	Project Action Level (µg/kg)	PQL Goal (µg/kg)	Laboratory-Specific Limits (µg/kg) [e]		
								LOQs	LODs	DLs
PCB-8	34883-43-7	—	—	—	—	—	—	0.5	0.25	0.112
PCB-18	37680-65-2	—	—	—	—	—	—	0.5	0.25	0.100
PCB-28	7012-37-5	—	—	—	—	—	—	0.5	0.25	0.100
PCB-44	41464-39-5	—	—	—	—	—	—	0.5	0.25	0.113
PCB-52	35693-99-3	—	—	—	—	—	—	0.5	0.25	0.100
PCB-66	32598-10-0	—	—	—	—	—	—	0.5	0.25	0.100
PCB-101	37680-73-2	—	—	—	—	—	—	0.5	0.25	0.100
PCB-105	32598-14-4	—	120	—	—	120	12	0.5	0.25	0.100
PCB-118	31508-00-6	—	120	—	—	120	12	0.5	0.25	0.100
PCB-128	38380-07-3	—	—	—	—	—	—	0.5	0.25	0.100
PCB-138	35065-28-2	—	—	—	—	—	—	0.5	0.25	0.100
PCB-153	35065-27-1	—	—	—	—	—	—	0.5	0.25	0.100
PCB-170	35065-30-6	—	—	—	—	—	—	0.5	0.25	0.100
PCB-180	35065-29-3	—	—	—	—	—	—	0.5	0.25	0.100
PCB-187	52663-68-0	—	—	—	—	—	—	0.5	0.25	0.100
PCB-195	52663-78-2	—	—	—	—	—	—	0.5	0.25	0.100
PCB-206	40186-72-9	—	—	—	—	—	—	0.5	0.25	0.100
PCB-209	2051-24-3	—	—	—	—	—	—	0.5	0.25	0.100
Total PCBs [f]	1336-36-3	1,120	230	59.8	40	40	4	0.5	0.25	0.100

— Information is not available.
[a] DOH EALs (DOH 2011): Table B-2, Soil Action Level (Potentially impacted groundwater is not a current or potential drinking water resource; surface water body is located within 150 meters of release site).
[b] EPA Region 9 RSLs (EPA, June 2015): Residential Soil.
[c] Ecological freshwater Sediment Quality Values (SQVs) from EPA Region 3 BTAG (EPA Region 3 2006).
[d] Ecological marine Sediment Quality Values (SQVs) from EPA Region 3 BTAG (EPA Region 3 2006).
[e] Laboratory-specific LOQs, LODs, and DLs are limits that an individual laboratory can achieve when performing a specific analytical method, and the results are based on dry weight.
[f] Total PCBs as congeners = 2 * (PCB-8 + PCB-18 + PCB-28 + PCB-44 + PCB-52 + PCB-66 + PCB-101 + PCB-105 + PCB-118 + PCB-128 + PCB-138 + PCB-153 + PCB-170 + PCB-180 + PCB-187 + PCB-195 + PCB-206 + PCB-209).

Matrix: **Sediment**
Analytical Group: **Organochlorine Pesticides (Method 8081B)**

Analyte	CAS No.	DOH EAL [a] (µg/kg)	EPA RSL [b] (µg/kg)	Ecological Freshwater SQVs [c] (µg/kg)	Ecological Marine SQVs [d] (µg/kg)	Project Action Level [e] (µg/kg)	PQL Goal (µg/kg)	Laboratory-Specific Limits (µg/kg) [f]		
								LOQs	LODs	DLs
4,4'-DDD	72-54-8	2,300	2,200	4.88	1.22	1.22	1.22	2	0.4	0.2
4,4'-DDE	72-55-9	2,000	1,600	3.16	2.07	2.07	2.07	2	0.4	0.2
4,4'-DDT	50-29-3	1,900	1,900	4.16	1.19	1.19	1.19	2	0.4	0.2
Aldrin	309-00-2	39	31	2	—	2	2	2	0.4	0.2
Chlordane (technical)	12789-03-6	1,700	1,800	—	—	1,800	180	50	20	10
Dieldrin	60-57-1	34	33	1.9	0.72	0.72	0.72	2	0.4	0.2
Endosulfan (total)	115-29-7	47,000	37,000	2.14	0.107	0.107	0.107	2	0.4	0.2
Endosulfan I	959-98-8	—	—	2.9	—	2.9	2.9	2	0.4	0.2
Endosulfan sulfate	1031-07-8	—	—	5.4	0.357	0.357	0.357	2	0.4	0.2
Endrin	72-20-8	1,900	1800	2.22	2.67	2.22	2.22	2	0.4	0.2
gamma-BHC	58-89-9	570	560	2.37	0.32	0.32	0.32	2	0.4	0.2
Heptachlor	76-44-8	130	120	68	—	68	6.8	2	0.4	0.2
Heptachlor epoxide	1024-57-3	70	59	2.47	0.6	0.6	0.6	2	0.4	0.2

— Information is not available.
DDD dichlorodiphenyldichloroethane
DDE dichlorodiphenyldichloroethylene
DDT dichlorodiphenyltrichloroethane
[a] DOH EALs (DOH 2011): Table B-2, Soil Action Level (Potentially impacted groundwater is not a current or potential drinking water resource; surface water body is located within 150 meters of release site).
[b] EPA Region 9 RSLs (EPA, June 2015): Residential Soil.
[c] Ecological freshwater Sediment Quality Values (SQVs) from EPA Region 3 BTAG (EPA Region 3 2006).
[d] Ecological marine Sediment Quality Values (SQVs) from EPA Region 3 BTAG (EPA Region 3 2006).
[e] For a specific chemical where screening criteria is lower than the reporting limit (LOQ for this project), LOD will be used as an alternative action level (DOH 2011).
[f] Laboratory-specific LOQs, LODs, and DLs are limits that an individual laboratory can achieve when performing a specific analytical method, and the results are based on dry weight. The current laboratory-specific LOQs, LODs, and DLs are from the standard method, but the laboratory will modify the procedure to lower the reporting limits to meet project action levels for this project.

Matrix: **Sediment**
Analytical Group: **PAH**

Analyte	CAS No.	DOH EAL [a] (µg/kg)	EPA RSL [b] (µg/kg)	Ecological Freshwater SQVs [c] (µg/kg)	Ecological Marine SQVs [d] (µg/kg)	Project Action Level (µg/kg)	PQL Goal (µg/kg)	Laboratory-Specific Limits (µg/kg) [e]		
								LOQs	LODs	DLs
Benzo[a]Anthracene	56-55-3	1,476	160	108	75	75	7.5	10	2.5	2.45
Benzo(k)fluoranthene	207-08-9	14,760	1,600	27	—	27	2.7	10	2.5	1.25

Analyte	CAS No.	DOH EAL [a] (µg/kg)	EPA RSL [b] (µg/kg)	Ecological Freshwater SQVs [c] (µg/kg)	Ecological Marine SQVs [d] (µg/kg)	Project Action Level (µg/kg)	PQL Goal (µg/kg)	Laboratory-Specific Limits (µg/kg) [e]		
								LOQs	LODs	DLs
Chrysene	218-01-9	10,487	16,000	166	108	108	10.8	10	2.5	2.2
Indeno[1,2,3-Cd]Pyrene	193-39-5	1476	160	17	—	17	5.0	10	2.5	1.25
Pyrene	129-00-0	44,029	180,000	195	153	153	15.3	10	2.5	1.25

— Information is not available.
[a] DOH EALs (DOH 2011): Table B-2, Soil Action Level (Potentially impacted groundwater is not a current or potential drinking water resource; surface water body is located within 150 meters of release site).
[b] EPA Region 9 RSLs (EPA, June 2015): Residential Soil.
[c] Ecological freshwater Sediment Quality Values (SQVs) from EPA Region 3 BTAG (EPA Region 3 2006).
[d] Ecological marine Sediment Quality Values (SQVs) from EPA Region 3 BTAG (EPA Region 3 2006).
[e] Laboratory-specific LOQs, LODs, and DLs are limits that an individual laboratory can achieve when performing a specific analytical method, and the results are based on dry weight.

11.2 GROUNDWATER

Matrix: **Groundwater**
Analytical Group: **PCBs (Method 8082A)**

Analyte	CAS No.	DOH EAL [a] (µg/L)	DOH EAL Aquatic Habitat [b] (µg/L)	Project Action Level (µg/L)	PQL Goal (µg/L)	Laboratory-Specific Limits (µg/L) [c]		
						LOQs	LODs	DLs
PCB-8	34883-43-7	—	—	—	—	0.1	0.01	0.008
PCB-18	37680-65-2	—	—	—	—	0.1	0.01	0.005
PCB-28	7012-37-5	—	—	—	—	0.1	0.01	0.013
PCB-44	41464-39-5	—	—	—	—	0.1	0.01	0.006
PCB-52	35693-99-3	—	—	—	—	0.1	0.01	0.005
PCB-66	32598-10-0	—	—	—	—	0.1	0.01	0.005
PCB-101	37680-73-2	—	—	—	—	0.1	0.01	0.005
PCB-105	32598-14-4	—	—	—	—	0.1	0.01	0.005
PCB-118	31508-00-6	—	—	—	—	0.1	0.01	0.005
PCB-128	38380-07-3	—	—	—	—	0.1	0.01	0.006
PCB-138	35065-28-2	—	—	—	—	0.1	0.01	0.005
PCB-153	35065-27-1	—	—	—	—	0.1	0.01	0.005
PCB-170	35065-30-6	—	—	—	—	0.1	0.01	0.005
PCB-180	35065-29-3	—	—	—	—	0.1	0.01	0.005
PCB-187	52663-68-0	—	—	—	—	0.1	0.01	0.005
PCB-195	52663-78-2	—	—	—	—	0.1	0.01	0.005
PCB-206	40186-72-9	—	—	—	—	0.1	0.01	0.005
PCB-209	2051-24-3	—	—	—	—	0.1	0.01	0.005
Total PCBs [d]	1336-36-3	0.014	0.014	0.014	0.014	0.1	0.01	0.005

— Information is not available.
µg/L microgram per liter
N/A LOD is not applicable for this method.
[a] DOH EALs (DOH 2011): Table D-1c, Groundwater Action Level (Potentially impacted groundwater is not a current or potential drinking water resource; Surface water body is located within 150m of release site). Screening criteria are used for human health.
[b] DOH EALs (DOH 2011): Table D-1c, Groundwater-protection of aquatic habitat impacts (chronic). Screening criteria are used for ecological risk assessment.
[c] Laboratory-specific LOQs, LODs, and DLs are limits that an individual laboratory can achieve when performing a specific analytical method.
[d] Total PCBs as congeners = 2 * (PCB-8 + PCB-18 + PCB-28 + PCB-44 + PCB-52 + PCB-66 + PCB-101 + PCB-105 + PCB-118 + PCB-128 + PCB-138 + PCB-153 + PCB-170 + PCB-180 + PCB-187 + PCB-195 + PCB-206 + PCB-209).

Matrix: **Groundwater**
Analytical Group: **Dissolved Metals & Dissolved Mercury (Methods 6020A and 7470A)**

Analyte	CAS No.	DOH EAL [a] (µg/L)	DOH EAL Aquatic Habitat [b] (µg/L)	Project Action Level [c] (µg/L)	PQL Goal (µg/L)	Laboratory-Specific Limits (µg/L) [d]		
						LOQs	LODs	DLs
Aluminum	7429-90-5	—	—	—	—	100	20	10
Antimony	7440-36-0	30	30	30	3	1	0.5	0.25
Arsenic	7440-38-2	36	36	36	3.6	1	0.2	0.1
Barium	7440-39-3	2,000	2,000	2,000	200	1	0.5	0.25
Beryllium	7440-41-7	2.7	2.7	2.7	0.27	1	0.1	0.05
Cadmium	7440-43-9	3.0	3.0	3	0.3	1	0.2	0.1
Chromium	18540-29-9	74	74	74	7.4	1	0.2	0.1
Cobalt	7440-48-4	3.0	3.0	3.0	3.0	1	0.2	0.1
Copper	7440-50-8	2.9	2.9	2.9	2.9	1	0.5	0.25
Iron	7439-89-6	—	—	—	—	100	10	5
Lead	7439-92-1	5.6	5.6	5.6	0.56	1	0.1	0.05
Manganese	7439-96-5	—	—	—	—	1	0.2	0.1
Molybdenum	7439-98-7	240	240	240	24	2	0.5	0.25
Mercury	7487-94-7	0.025	0.025	0.025	0.025	0.5 [d]	0.1 [d]	0.054
Nickel	7440-02-0	5.0	5.0	5.0	5	1	0.2	0.1
Selenium	7782-49-2	5.0	5.0	5.0	0.5	1	0.3	0.15
Silver	7440-22-4	1.0	1.0	1.0	1	1	0.2	0.1
Thallium	7440-28-0	20	20	20	20	1	0.2	0.1
Vanadium	7440-62-2	19	19	19	19	1	0.5	0.25
Zinc	7440-66-6	22	22	22	2.2	20	10	5

— Information is not available.
[a] DOH EALs (DOH 2011): Table D-1c, Groundwater Action Level (Potentially impacted groundwater is not a current or potential drinking water resource; Surface water body is located within 150 meters of release site). Screening criteria are used for human health.
[b] DOH EALs (DOH 2011): Table D-1c, Groundwater-protection of aquatic habitat impacts (chronic). Screening criteria are used for ecological risk assessment.
[c] For a specific chemical where screening criteria is lower than the reporting limit (LOQ for this project), LOD will be used as an alternative action level (DOH 2011).
[d] Laboratory-specific LOQs, LODs, and DLs are limits that an individual laboratory can achieve when performing a specific analytical method.

11.3 SURFACE WATER AND PORE WATER

Matrix: **Surface Water and Pore Water**
Analytical Group: **PAHs (Method 8270D SIM)**

Analyte	CAS No.	DOH EAL Marine Habitat [a] (µg/L)	Project Action Level [b] (µg/L)	PQL Goal (µg/L)	Laboratory-Specific Limits (µg/L) [c]		
					LOQs	LODs	DLs
Benz[a]Anthracene	56-55-3	0.027	0.027	0.027	0.02	0.01	0.005
Benzo[a]Pyrene	50-32-8	0.014	0.014	0.014	0.02	0.01	0.005
Benzo[b]Fluoranthene	205-99-2	9.1	9.1	0.91	0.02	0.01	0.005
Benzo(g,h,I)Perylene	191-24-2	0.1	0.1	0.1	0.02	0.01	0.005
Indeno[1,2,3-Cd]Pyrene	193-39-5	4.3	4.3	0.43	0.02	0.01	0.005

— Information is not available.
SIM selective ion monitoring
[a] DOH EALs (DOH 2011): Table D-4a, Surface Water Action Level of Marine Habitats Chronic aquatic habitat goals.
[b] For a specific chemical where screening criteria is lower than the reporting limit (LOQ for this project), LOD will be used as an alternative action level pending regulatory approval (DOH 2011).
[c] Laboratory-specific LOQs, LODs, and DLs are limits that an individual laboratory can achieve when performing a specific analytical method. The current laboratory-specific LOQs, LODs, and DLs are from the standard method, but the laboratory will modify the procedure to lower the reporting limits to meet project action levels for this project.

Matrix: **Surface Water and Pore Water**
Analytical Group: **PCBs (Method 1668C)**

Analyte	CAS No	DOH EAL Marine Habitat [a] (µg/L)	Project Action Level (µg/L)	PQL Goal (µg/L)	Laboratory-Specific Limits (µg/L) [b]		
					LOQs	LODs	DLs
PCB-8	34883-43-7	—	—	—	0.005	0.0025	NA
PCB-18	37680-65-2	—	—	—	0.005	0.0025	NA
PCB-28	7012-37-5	—	—	—	0.005	0.0025	NA
PCB-44	41464-39-5	—	—	—	0.005	0.0025	NA
PCB-52	35693-99-3	—	—	—	0.005	0.0025	NA
PCB-66	32598-10-0	—	—	—	0.005	0.0025	NA
PCB-101	37680-73-2	—	—	—	0.005	0.0025	NA
PCB-105	32598-14-4	—	—	—	0.005	0.0025	NA
PCB-118	31508-00-6	—	—	—	0.005	0.0025	NA
PCB-128	38380-07-3	—	—	—	0.005	0.0025	NA
PCB-138	35065-28-2	—	—	—	0.005	0.0025	NA
PCB-153	35065-27-1	—	—	—	0.005	0.0025	NA
PCB-170	35065-30-6	—	—	—	0.005	0.0025	NA
PCB-180	35065-29-3	—	—	—	0.005	0.0025	NA

Analyte	CAS No	DOH EAL Marine Habitat [a] (µg/L)	Project Action Level (µg/L)	PQL Goal (µg/L)	Laboratory-Specific Limits (µg/L) [b]		
					LOQs	LODs	DLs
PCB-187	52663-68-0	—	—	—	0.005	0.0025	NA
PCB-195	52663-78-2	—	—	—	0.005	0.0025	NA
PCB-206	40186-72-9	—	—	—	0.005	0.0025	NA
PCB-209	2051-24-3	—	—	—	0.005	0.0025	NA
Total PCBs [c]	1336-36-3	0.003	0.003	0.003	0.005	0.0025	NA

— Information is not available.
N/A DLs and LOD are not applicable for this method.
[a] DOH EALs (DOH 2011): Table D-4a, Surface Water Action Level of Marine Habitats. Chronic aquatic habitat goals.
[b] Laboratory-specific LOQs, LODs and DLs are limits that an individual laboratory can achieve when performing a specific analytical method.
[c] Total PCBs as congeners = 2 * (NOAA 18).

Matrix: **Surface Water and Pore Water**
Analytical Group: **SVOCs (Method 8270D)**

Analyte	CAS No	DOH EAL Marine Habitat [a] (µg/L)	Project Action Level (µg/L)	PQL Goal (µg/L)	Laboratory-Specific Limits (µg/L) [b]		
					LOQs	LODs	MDLs
4-Chloroaniline (p-chloroaniline)	106-47-8	5.0	5.0	5.0	10	5	4.2
Diethylphthalate	84-66-2	1.7	1.7	1.7	1	0.5	0.25
Dimethylphthalate	131-11-3	1.7	1.7	1.7	1	0.5	0.25

— Information is not available.
[a] DOH EALs (DOH 2011): Table D-4a, Surface Water Action Level of Marine Habitats. Chronic aquatic habitat goals.
[b] Laboratory-specific LOQs, LODs, and DLs are limits that an individual laboratory can achieve when performing a specific analytical method. The current laboratory-specific LOQs, LODs, and DLs are from the standard method, but the laboratory will modify the procedure to lower the reporting limits to meet project action levels for this project.

Matrix: **Surface Water and Pore Water**
Analytical Group: **Organochlorine Pesticides (Method 8081B)**

Analyte	CAS No	DOH EAL Marine Habitat [a] (µg/L)	Project Action Level (µg/L)	PQL Goal (µg/L)	Laboratory-Specific Limits (µg/L) [b]		
					LOQs	LODs	DLs
4,4'-DDD	72-54-8	0.001	0.001	0.001	0.0005	0.00028	0.0001
4,4'-DDE	72-55-9	0.001	0.001	0.001	0.0005	0.00028	0.000075
4,4'-DDT	50-29-3	0.001	0.001	0.001	0.0005	0.00028	0.000088
Aldrin	309-00-2	0.13	0.13	0.13	0.001	0.001	0.00046
Chlordane (technical)	12789-03-6	0.004	0.004	0.004	1	0.25	0.125

Analyte	CAS No	DOH EAL Marine Habitat [a] (µg/L)	Project Action Level (µg/L)	PQL Goal (µg/L)	Laboratory-Specific Limits (µg/L) [b]		
					LOQs	LODs	DLs
Dieldrin	60-57-1	0.0019	0.0019	0.0019	0.005	0.001	0.00074
Endosulfan (total)	115-29-7	0.0087	0.0087	0.0087	—	—	—
Endosulfan I	959-98-8	—	—	—	0.002	0.002	0.0008
Endosulfan sulfate	1031-07-8	—	—	—	0.0005	0.00028	0.00008
Endrin	72-20-8	0.0023	0.0023	0.0023	0.002	0.001	0.00063
gamma-BHC	58-89-9	0.08	0.08	0.08	0.0005	0.0004	0.0003
Heptachlor	76-44-8	0.0036	0.0036	0.0036	0.001	0.00028	0.00012
Heptachlor epoxide	1024-57-3	0.0036	0.0036	0.0036	0.001	0.00028	0.00016

— Information is not available.
[a] DOH EALs (DOH 2011): Table D-4a, Surface Water Action Level of Marine Habitats. Chronic aquatic habitat goals.
[b] Laboratory-specific LOQs, LODs, and DLs are limits that an individual laboratory can achieve when performing a specific analytical method. The current laboratory-specific LOQs, LODs, and DLs are from the standard method, but the laboratory will modify the procedure to lower the reporting limits to meet project action levels for this project.

Matrix: **Surface Water and Pore Water**

Analytical Group: **Total and Dissolved Metals & Mercury (Methods 6020A and 7470A)**

Analyte	CAS No	DOH EAL Marine Habitat [a] (µg/L)	Project Action Level [b] (µg/L)	PQL Goal (µg/L)	Laboratory-Specific Limits (µg/L) [c]		
					LOQs	LODs	DLs
Aluminum	7429-90-5	—	—	—	100	20	10
Antimony	7440-36-0	500	500	50	1	0.5	0.25
Arsenic	7440-38-2	36	36	3.6	1	0.2	0.1
Barium	7440-39-3	200	200	20	1	0.5	0.25
Beryllium	7440-41-7	2.7	2.7	0.27	1	0.1	0.05
Cadmium	7440-43-9	9.3	9.3	0.93	1	0.2	0.1
Chromium (Total)	7440-47-3	10,300	10,300	1,030	1	0.2	0.1
Cobalt	7440-48-4	3	3	1	1	0.2	0.1
Copper	7440-50-8	2.9	2.9	2.0	1	0.5	0.25
Iron	7439-89-6	—	—	—	100	10	5
Lead	7439-92-1	5.6	5.6		1	0.1	0.05
Manganese	7439-96-5	—	—	—	1	0.2	0.1
Molybdenum	7439-98-7	240	240	24	2	0.5	0.25
Mercury	7439-97-6	0.025	0.025	0.025	0.001	0.00015	0.00006
Nickel	7440-02-0	8.3	8.3	3.0	1	0.2	0.1

Matrix: **Surface Water and Pore Water**

Analytical Group: **Total and Dissolved Metals & Mercury (Methods 6020A and 7470A)**

Analyte	CAS No	DOH EAL Marine Habitat [a] (µg/L)	Project Action Level [b] (µg/L)	PQL Goal (µg/L)	Laboratory-Specific Limits (µg/L) [c]		
					LOQs	LODs	DLs
Selenium	7782-49-2	71	71	7.1	1	0.3	0.15
Silver	7440-22-4	1	1	1	1	0.2	0.1
Thallium	7440-28-0	20	20	2	1	0.2	0.1
Vanadium	7440-62-2	19	19	1.9	1	0.5	0.25
Zinc	7440-66-6	86	86	20	20	10	5

— Information is not available.
[a] DOH EALs (DOH 2011): Table D-4a, Surface Water Action Level of Marine Habitats. Chronic aquatic habitat goals.
[b] For a specific chemical where screening criteria is lower than the reporting limit (LOQ for this project), LOD will be used as an alternative action level pending regulatory approval (DOH 2011).
[c] Laboratory-specific LOQs, LODs, and DLs are limits that an individual laboratory can achieve when performing a specific analytical method.

11.4 BIOTA (TISSUE)

Matrix: **Biota**
Analytical Group: **PAHs (Method 8270D SIM)**

Analyte	CAS No.	Invertebrates-Crustacea	Fish	Plant Tissue Screening Value	Laboratory-Specific Limits (µg/kg)		
					LOQs	LODs	DLs
Benz[a]Anthracene	56-55-3	12740	1050	—	0.5	0.1	0.038
Benzo(a)pyrene	50-32-8	12740	1050	—	0.5	0.1	0.073
Benzo[b]Fluoranthene	205-99-2	12740	1050	—	0.5	0.1	0.066
Benzo(g,h,I)Perylene	191-24-2	12740	1050	—	0.5	0.1	0.095
Benzo(k)Fluoranthene	207-08-9	12740	1050	—	0.5	0.1	0.057
Chrysene	218-01-9	12740	1050	—	0.5	0.1	0.055
Indeno(1,2,3-cd)pyrene	193-39-5	12740	1050	—	0.5	0.1	0.096
Pyrene	129-00-0	12740	1050	—	0.5	0.1	0.05

Notes: All units are in microgram per kilogram.
Plant tissue screening value refers to Plant Tissue Reference.
— Information is not available.
Crustacea Criteria for crustacea were developed of the Pearl Harbor Sediment Study
Fish Criteria for fish were developed of the Pearl Harbor Sediment Study

Matrix: **Biota**
Analytical Group: **PCBs (Method 1668C)**

Analyte	CAS No.	Invertebrates-Crustacea	Fish	Plant Tissue Screening Value	Laboratory-Specific Limits (µg/kg)		
					LOQs	LODs	DLs
PCB-8	34883-43-7	—	—	—	0.05	0.02	0.01
PCB-18	37680-65-2	—	—	—	0.05	0.02	0.01
PCB-28	7012-37-5	—	—	—	0.05	0.02	0.01
PCB-44	41464-39-5	—	—	—	0.05	0.02	0.01
PCB-52	35693-99-3	—	—	—	0.05	0.02	0.01
PCB-66	32598-10-0	—	—	—	0.05	0.02	0.01
PCB-101	37680-73-2	—	—	—	0.05	0.02	0.01
PCB-105	32598-14-4	—	125000	—	0.05	0.02	0.01
PCB-118	31508-00-6	—	125000	—	0.05	0.02	0.01
PCB-128	38380-07-3	—	—	—	0.05	0.02	0.01
PCB-138	35065-28-2	—	—	—	0.05	0.02	0.01
PCB-153	35065-27-1	—	—	—	0.05	0.02	0.01

Analyte	CAS No.	Invertebrates-Crustacea	Fish	Plant Tissue Screening Value	Laboratory-Specific Limits (µg/kg)		
					LOQs	LODs	DLs
PCB-170	35065-30-6	—	—	—	0.05	0.02	0.01
PCB-180	35065-29-3	—	—	—	0.05	0.02	0.01
PCB-187	52663-68-0	—	—	—	0.05	0.02	0.01
PCB-195	52663-78-2	—	—	—	0.05	0.02	0.01
PCB-206	40186-72-9	—	—	—	0.05	0.02	0.01
PCB-209	2051-24-3	—	—	—	0.05	0.02	0.01
PCBs (total)	—	200	2800	—	0.05	0.02	0.01

Notes: All units are in microgram per kilogram.
Plant tissue screening value refers to Plant Tissue Reference.
Total PCBs as congeners = 2 * (NOAA 18).
— Information is not available.
Crustacea CBR Criteria for crustacea were developed of the Pearl Harbor Sediment Study
Fish CBR Criteria for fish were developed of the Pearl Harbor Sediment Study
NA DLs and LODs are not applicable for this method.

Matrix: **Biota**
Analytical Group: **SVOCs**

Analyte	CAS No.	Invertebrates-Crustacea	Fish	Plant Tissue Screening Value	Laboratory-Specific Limits (µg/kg) [e]		
					LOQs	LODs	DLs
2,4-Dimethylphenol	105-67-9	2500	—	—	—	—	—
4-Chloroaniline (p-chloroaniline)	106-47-8	3300	1000	134000	—	—	—
Diethylphthalate	84-66-2	3300	1000	—	200	140	140
Dimethylphthalate	131-11-3	800	—	—	100	8	6
Hexachlorobenzene	118-74-1	2500	—	—	40	8	5

Notes: All units are in microgram per kilogram.
Plant tissue screening value refers to Plant Tissue Reference.
— Information is not available.
Crustacea Criteria for crustacea were developed of the Pearl Harbor Sediment Study
Fish Criteria for fish were developed of the Pearl Harbor Sediment Study

Matrix: **Biota**
Analytical Group: **Organochlorine Pesticides (Method 8081B)**

					Laboratory-Specific Limits (µg/kg)		
Analyte	CAS No.	Invertebrates-Crustacea	Fish	Plant Tissue Screening Value	LOQs	LODs	DLs
4,4'-DDD	72-54-8	300	45	—	1	0.98	0.41
4,4'-DDE	72-55-9	300	45	—	1	0.58	0.45
4,4'-DDT	50-29-3	300	45	—	1	0.58	0.49
Aldrin	309-00-2	2400	785	—	1	1	0.19
Chlordane (technical)	12789-03-6	—	—	—	6	6	2
Dieldrin	60-57-1	50	600	—	1	1	0.23
Endosulfan (total)	115-29-7	—	—	—	1	1	0.3
Endosulfan I	959-98-8	328	15.5	10000000	1	1	0.3
Endosulfan sulfate	1031-07-8	328	15.5	—	1	1	0.3
Endrin	72-20-8	25	95	—	1	1	0.2
gamma-BHC (Lindane)	58-89-9	1.075	2685	10000000	1	1	0.2
Heptachlor	76-44-8	150	50	—	1	1	0.2
Heptachlor epoxide	1024-57-3	150	50	—	1	1	0.2

Notes: All units are in microgram per kilogram.
Plant tissue screening value refers to Plant Tissue Reference.
— Information is not available.
Crustacea Criteria for crustacea were developed of the Pearl Harbor Sediment Study
Fish Criteria for fish were developed of the Pearl Harbor Sediment Study

Matrix: **Biota**
Analytical Group: **Metals and Mercury (Methods 6020A and 7471B)**

Analyte	CAS No.	Invertebrates-Crustacea	Fish	Plant Tissue Screening Value	Laboratory-Specific Limits (mg/kg)		
					LOQs	LODs	DLs
Aluminum	7429-90-5	—	40	—	2	0.4	0.2
Antimony	7440-36-0	—	25	—	0.05	0.005	0.002
Arsenic	7440-38-2	6.4	2.6	0.1	0.5	0.05	0.02
Barium	7440-39-3	—	0.075	50	0.05	0.02	0.005
Beryllium	7440-41-7	—	25.65	1.7	0.02	0.008	0.003
Cadmium	7440-43-9	0.4	0.18	0.7	0.02	0.008	0.002
Chromium	7440-47-3	—	—	5	0.2	0.08	0.02
Cobalt	7440-48-4	22.6	—	1.1	0.02	0.008	0.003
Copper	7440-50-8	10	19.6	3.4	0.1	0.04	0.02
Lead	7439-92-1	2.46	12.7	11.8	0.02	0.002	0.005
Iron	7439-89-6	—	—	—	1	0.4	0.2
Manganese	7439-96-5	—	—	16	0.05	0.02	0.008
Mercury	7487-94-7	—	—	27	0.02	0.02	0.002
Nickel	7440-02-0	99.2	—	39	0.2	0.08	0.02
Selenium	7782-49-2	0.11	0.6	146	1	0.4	0.2
Silver	7440-22-4	—	0.3	0.56	0.02	0.02	0.006
Thallium	7440-28-0	6.03	0.135	0.2	0.02	0.002	0.0009
Vanadium	7440-62-2	2.9	2.85	—	0.2	0.02	0.0007
Zinc	7440-66-6	63.5	96.5	170	0.5	0.2	0.06

Notes: All units are in milligram per kilogram.
Plant tissue screening value refers to Plant Tissue Reference.
— Information is not available.
Crustacea Criteria for crustacea were developed of the Pearl Harbor Sediment Study
Fish Criteria for fish were developed of the Pearl Harbor Sediment Study

12. Analytical SOP References Table

Lab SOP Number	Title, Revision Date, and/or Number	Definitive or Screening Data	Matrix and Analytical Group	Instrument	Variance to QSM (Yes/No)	Modified for Project Work? (Yes/No)
Preparatory Methods – EMAX Laboratories						
EMAX-3550	Extraction, Sonication, Revision 4	Definitive	PAHs, Pesticides, PCB Congeners (Sediment)	Preparation	No	No
EMAX-7471	Mercury, Revision 8	Definitive	Metals (Sediment)	Preparation	No	No
EMAX-6020	Trace Metals By ICP-Ms, Revision 9	Definitive	Metals (Water)	Preparation	No	No
EMAX-7470	Mercury, Revision 7	Definitive	Mercury (Water)	Preparation	No	No
EMAX-3520	Extraction, Continuous Liquid Liquid, Revision 4	Definitive	SVOC, PAHs, Pesticides, PCB Congener (low resolution) (Water)	Preparation	No	No
EXT-3541	Automated Soxhlet Extraction, r.10	Definitive	PAHs, Pesticides (Tissue)	Preparation	No	No
MET-TISP/MET-TDIG	Tissue Sample Preparation, r.9/Sample Preparation of Biological Tissues for Metals Analysis by GFAA, ICP-OES, and ICP-MS, r.4	Definitive	Metals (Tissue)	Preparation	No	No
MET-7471	Mercury in Solid or Semisolid Waste, r.17	Definitive	Mercury (Tissue)	Preparation	No	No
GEN-AVS	Sulfides, Acids Volatile r.7	Definitive	AVS-SEM (Sediment)	Preparation	No	No
HMS-1668C	Chlorinated Biphenyl Congeners in Water, Soil, Sediment, Biosolid, and Tissue by Isotope Dilution, Revision 00.0	Definitive	PCB High Resolution Congeners (Water/Tissue)	Preparation	No	No
Analytical Methods – EMAX Laboratories						
EMAX-8270	Semivolatile Organics By GC/MS, Revision 6	Definitive	SVOC (Water, Sediment)	GC-MS	No	No
EMAX-8270SIM	Semivolatile Organics By GC/MS SIM, Revision 2	Definitive	PAHs (Water, Sediment)	GC-MS	No	No
EMAX-8081	Organochlorine Pesticides By Gas Chromatography, Revision 8	Definitive	Pesticides (Water, Sediment)	GC-ECD	No	No
EMAX-8082CON	Polychlorinated Biphenyls (PCB) Congeners By Gas Chromatography, Revision 1	Definitive	PCB Congeners (Low resolution) (Water, Sediment)	GC-ECD	No	No

Lab SOP Number	Title, Revision Date, and/or Number	Definitive or Screening Data	Matrix and Analytical Group	Instrument	Variance to QSM (Yes/No)	Modified for Project Work? (Yes/No)
EMAX-6020	Trace Metals By ICP-MS, Revision 9	Definitive	Metals (Water, Sediment)	ICP-MS	No	No
EMAX-7471	Mercury, Revision 8	Definitive	Mercury (Sediment)	CVAA	No	No
EMAX-7470	Mercury, Revision 7	Definitive	Mercury (Water)	CVAA	No	No
EMAX-9060	Total Organic Carbon, Revision 3	Definitive	TOC (Water)	TOC analyzer	No	No
EXT-LIPID	Percent Lipids in Tissue	Definitive	Lipids (Tissue)	Yamato Convection Oven DKN600/MSE GT2 Centrifuge/Mettler AT200 balance	No	No
SVM-8270P	Polynuclear Aromatic Hydrocarbons by GC/MS SIM, r.9	Definitive	PAHs (Tissue)	GC-MS	No	No
SOC-8081	Organochlorine Pesticides by Gas Chromatography: Capillary Column Technique, r.18	Definitive	Pesticides (Tissue)	GC-ECD	No	No
MET-ICP/MET-6020	Determination of metals and trace elements by ICP/AES, r.25/Determination Of Metals & Trace Elements By Inductively Coupled Plasma-MS (METHOD 6020), r.16	Definitive	Metals (Tissue)	ICP-MS	No	No
MET-7471	Mercury in Solid or Semisolid Waste, r.17	Definitive	Mercury (Tissue)	CVAA	No	No
GEN-ASTM	Total Carbon In Soil, r.9	Definitive	TOC (sediment)	Analyzer	No	No
GEN-AVS/GEN-ICP	Sulfides, Acids Volatile, r.7/Determination of Metals and Trace Elements by ICP/AES, r.25	Definitive	AVS-Metals (Sediment)	ICP	No	No
HMS-1668C	Chlorinated Biphenyl Congeners in Water, Soil, Sediment, Biosolid, and Tissue by Isotope Dilution, Revision 00.0	Definitive	PCB High Resolution Congeners (Water/Tissue)	GC-HRMS	No	No

Note: The laboratory SOPs listed in Worksheet #12 are the most current revisions at the time of publication of this WP. AECOM will review the laboratory SOPs immediately prior to sample submittal to ensure that the laboratory uses SOPs that are in compliance with the DoD QSM annual review requirement.

ASTM	American Society for Testing and Materials
BNA	base neutrals and acids
CLP	Contract Laboratory Program
CVAA	cold vapor atomic absorption
DL	detection limit
EPA	Environmental Protection Agency, United States
GC-ECD	gas chromatography-electron capture detection
GC-FID	gas chromatography-flame ionization detector
GC-HRMS	gas chromatograph-high resolution mass spectrometry
GC-MS	gas chromatography-mass spectrometry

GRO	gasoline range organics
HRGC	high resolution gas chromatography
HRMS	high resolution mass spectrometry
ICP-AES	inductively coupled plasma-atomic emission spectroscopy
ICP-MS	inductively coupled plasma–mass spectroscopy
N/A	not applicable
no.	number
NOAA	National Oceanic and Atmospheric Administration
PAH	polynuclear aromatic hydrocarbon
PCB	polychlorinated biphenyl
QSM	Quality Systems Manual
SIM	selective ion monitoring
SOP	standard operating procedure
TOC	total organic carbon

13. Sample Custody Requirements

Each sample will be assigned a chain-of-custody (COC) sample identification (ID) number and a descriptive ID number in accordance with Naval Facilities Engineering Command (NAVFAC) Pacific Environment Restoration (ER) Program Procedure I-A-8, *Sample Naming* (DON 2015). All sample ID numbers will be recorded in the field logbook in accordance with Procedure III-D, *Logbooks* (DON 2015). The COC sample ID number (the only ID number submitted to the analytical laboratory) is used to facilitate data tracking and storage. The COC sample ID number allows all samples to be submitted to the laboratory without providing information on the sample type or source. The descriptive ID number is linked to the COC sample ID number, which provides information regarding sample type, origin, and source.

13.1 COC Sample Identification Number

A COC sample ID number will be assigned to each sample as follows, to facilitate data tracking and storage:

FDzzz

Where:

F	Designating the sampling team's home office (e.g., Honolulu office)
D	Designating contract task order (CTO) HC31 Site (former H-3 Landfill)
zzz	Chronological number starting with 057 (following the previous sampling from CTO HC31)

Quality control samples will be included in the chronological sequence.

13.2 Descriptive Identification Number

A descriptive ID number (for internal use only) will identify the sampling location, type, sequence, matrix, and depth. The descriptive ID number is used to provide sample-specific information (e.g., location, sequence, and matrix). The descriptive identifier is not revealed to the analytical laboratory. The descriptive ID number for all samples is assigned as follows:

AA-bbcc-dee-Dff.f

Where:

AA	=	Site area (Table 13-1)
bb	=	Sample type and matrix (Table 13-2)
cc	=	Location number (e.g., MW-01)
d	=	Field quality control (QC) sample type (Table 13-3)
ee	=	Chronological sample number from a particular sampling location (e.g., 01, 02)
D	=	The letter "D" denoting depth

ff.f = Depth of sample in feet below ground surface (bgs) (measured to the tenth of a foot). For field blanks, trip blanks, and equipment blanks, the depth field will contain the month and date of collection.

For example, the sample number FD-SS01-S01-D0.0 would indicate that the sample is the first sediment sample collected from the H-3 Landfill at location SS01. The duplicate sample would be designated as FD-SS01-D01-D0.0. These characters will establish a unique descriptive identifier that will be used during data evaluation.

Table 13-1: Area Identifiers

Identifier	Site Area
FD	H-3 Landfill

Table 13-2: Sample Type and Matrix Identifiers

Identifier	Sample Type	Matrix
SS	Surface Sediment	Sediment
GW	Groundwater	Water
SW	Surface Water	Water
PW	Pore Water	Water
Bio	Biota	Biota
WQ	Water Blanks	Water

Table 13-3: Field QC Sample Type Identifiers

Identifier	Field or QC Sample Type	Description
S	Primary Sample	All field samples, except QC samples
D	Duplicate	Co-located for soil (adjacent liners)/replicate for water
E	Equipment Blank	Water
B	Field Blank	Water

13.3 HANDLING, SHIPPING, AND CUSTODY

All samples collected for analysis will be recorded in the field logbook in accordance with Procedure III-D, *Logbooks* (DON 2015). All samples will be labeled and recorded on COC forms in accordance with Procedure III-E, *Record Keeping, Sample Labeling, and Chain-of-Custody Procedures* (DON 2015). Samples will be handled, stored, and shipped in accordance with Procedure III-F, *Sample Handling, Storage, and Shipping* (DON 2015). All samples collected on this project will be shipped to the analytical laboratory via overnight airfreight.

All samples received at the analytical laboratory will be managed in accordance with laboratory standard operating procedures for receiving samples, archiving data, and sample disposal and waste collection, as well as, storage and disposal per Section 5.8, “Handling of Samples” of the Department of Defense Quality Systems Manual (DoD 2013).

14. Laboratory QC Samples Table

Matrix	**Groundwater**
Analytical Group	**PCB Congeners**
Analytical Method/SOP Reference	Analytical Method: EPA Method 1668C Preparation Method: EPA 1668C Laboratory SOPs: HMS-1668C
Analytical Organization	EMAX LABORATORIES

QC Sample	Frequency & Number	Method/SOP QC Acceptance Limits	Corrective Action	Personnel Responsible for Corrective Action	DQI	Measurement Performance Criteria
Resolving power (tuning)	Prior to initial calibration and at the beginning and end of each 12-hour period.	Using PFK and a molecular leak, static resolving power must be ≥10,000 (10% valley) for identified masses.	Retune instrument and verify. No samples will be run without a passing tune check. Rerun affected samples since the last acceptable check.	Analyst Lab QA Officer	Accuracy	QC acceptance criteria as specified by Lab SOP ANA1668 and at least as stringent as specified by DoD QSM 5.0 (DoD 2013).
EMPC	Every sample with a response S/N ≥2.5 for both quantitation ions.	Identification criteria per method must be met, and the S/N of response for both quantitation ions must be ≥2.5.	N/A	Analyst Lab QA Officer	Accuracy	QC acceptance criteria as specified by Lab SOP ANA1668 and at least as stringent as specified by DoD QSM 5.0 (DoD 2013).
CCV	Before sample analysis of each 12-hour period, and at the end of the analysis sequence.	Ion abundance specified in the method must be met. For unlabeled standards, RF within ± 20% D of RF established in ICAL; and for labeled standards, RF within ± 30% D of RF established in ICAL.	Immediately analyze two additional consecutive CCVs. If both pass, samples may be reported without reanalysis. If either fails, take corrective action(s) and re-calibrate; then reanalyze all affected samples since the last acceptable CCV. End-of-run CCV: If the RF for unlabeled standards ≤25% RPD and the RF for labeled standards ≤35% RPD (relative to the RF established in the ICAL), the mean RF from the two daily CCVs must be used for quantitation of impacted samples instead of the ICAL mean RF value. If the starting and ending CCV RFs differ by more than 25% RPD for unlabeled compounds or 35% RPD for labeled compounds, the sample may be quantitated against a new initial calibration if it is analyzed within two hours. Otherwise, analyze samples with positive detections, if necessary.	Analyst Lab QA Officer Project Chemist	Accuracy/Precision	Results may not be reported without a valid CCV. If reanalysis cannot be performed, data must be qualified and explained in the case narrative.

QC Sample	Frequency & Number	Method/SOP QC Acceptance Limits	Corrective Action	Personnel Responsible for Corrective Action	DQI	Measurement Performance Criteria
MB	Each time samples are extracted and one per matrix per analytical method for each batch of at most 20 samples.	No analytes detected above the EML listed in Table 2 of the method or 1/3 the regulatory limit, whichever is greater.	Correct problem, then re-prep and reanalyze the MB and all samples in the associated batch for failed analytes in all samples in the associated batch, if sufficient material is available.	Analyst Lab QA Officer Project Chemist	Sensitivity	No analytes detected above the EML or 1/3 the regulatory limit, whichever is greater.
LCS	One per batch of at most 20 samples analyzed of similar matrix per analytical method.	Per DoD QSM Appendix C Limits, Method 1668C and Lab SOP HMS-1668C.	Correct problem, then re-prep and reanalyze the LCS and all samples in the associated batch for failed analytes in all samples in the associated batch, if sufficient material is available.	Analyst Lab QA Officer Project Chemist	Accuracy	QC acceptance criteria at least as stringent as specified by DoD QSM 5.0 (DoD 2013).
MS/MSD	1 per 20 samples or less, or 1 per location depending on sample matrix.	Per DoD QSM Appendix C Limits, Method 1668C and Lab SOP HMS-1668C MSD or Matrix Duplicate: RPD of all analytes ≤30%.	Examine the PQOs. Notify lab QA officer and project chemist about additional measures to be taken.	Analyst Lab QA Officer Project Chemist	Accuracy/Precision	For matrix evaluation, use QC acceptance criteria at least as stringent as specified by DoD QSM 5.0 (DoD 2013).

% percent
CCV continuing calibration verification
D difference
DoD Department of Defense
DQI data quality indicator
EML estimated maximum level
EMPC estimated maximum possible concentration
EPA Environmental Protection Agency, United States
ICAL initial calibration
LCS laboratory control sample
MB method blank
MS matrix spike
MSD matrix spike duplicate
N/A not applicable
PCB polychlorinated biphenyl
PFK perfluorokerosene
PQO project quality objectives
QA quality assurance
QC quality control
QSM Quality Systems Manual
RF response factor
RPD relative percent difference
S/N signal-to-noise ratio
SOP standard operating procedure

Matrix	**Groundwater**
Analytical Group	**Metals and Mercury**
Analytical Method/SOP Reference	Analytical Methods: EPA Method 6010C/6020A/7470A Preparation Methods: EPA 3010A/7470A Laboratory SOPs: EMAX-6020/ EMAX-7471
Analytical Organization	EMAX LABORATORIES

QC Sample	Frequency & Number	Method/SOP QC Acceptance Limits	Corrective Action	Personnel Responsible for Corrective Action	DQI	Measurement Performance Criteria
LOD determination and verification	At initial set-up and verified quarterly. If a laboratory uses multiple instruments for a given method, the LOD must be verified on each.	The apparent signal to noise ratio must be at least 3 and the results must meet all method requirements for analyte identification.	If the LOD verification fails, the laboratory must: 1) Repeat the detection limit determination and LOD verification at a higher concentration; or 2) Perform and pass two consecutive LOD verifications at a higher concentration. The LOD is set at the higher concentration.	Analyst Lab QA Officer Project Chemist	Bias/ Representativeness	QC acceptance criteria as specified by Lab SOPs (ANA6010C/ANA6020A/ANA7470 A).
LOQ establishment and verification	At initial setup: 1) Verify LOQ; and 2) Determine precision and bias at the LOQ. Subsequently, verify LOQ quarterly. If a laboratory uses multiple instruments for a given method, the LOQ must be verified on each.	1) The LOQ and associated precision and bias must meet client requirements and must be reported; or 2) In the absence of client requirements, must meet control limits of the LCS. 3) If the method is modified, precision and bias at the new LOQ must be demonstrated and reported. See Volume 1, Module 4, Section 1.5.2 of the DoD QSM 5.0 (DoD 2013).	If the LOQ verification fails, the laboratory must either establish a higher LOQ or modify method to meet the client-required precision and bias.	Analyst Lab QA Officer Project Chemist	Sensitivity/Bias	QC acceptance criteria as specified by Lab SOPs (ANA6010C/ANA6020A/ANA7470 A), and at least as stringent as specified by DoD QSM 5.0 (DoD 2013).
Initial and continuing calibration blank (ICB/CCB)	Before beginning a sample run, after every 10 field samples, and at the end of the analysis sequence.	No analytes detected >LOD.	Correct problem and repeat ICAL. All samples following the last acceptable calibration blank must be reanalyzed.	Analyst Lab QA Officer Project Chemist	Sensitivity/Bias	QC acceptance criteria as specified by Lab SOP (ANA6010C/ANA6020A/ANA7470 A), and at least as stringent as specified by DoD QSM 5.0 (DoD 2013).
CCV	Before sample analysis, after every 10 field samples, and at the end of the analysis sequence.	All reported analytes and surrogates within ± 10% of true value.	Immediately analyze two additional consecutive CCVs. If both pass, samples may be reported without reanalysis. If either fails, take corrective action(s) and re-calibrate; then reanalyze all affected samples since the last acceptable CCV.	Analyst Lab QA Officer Project Chemist	Accuracy/Precision	Results may not be reported without a valid CCV. If reanalysis cannot be performed, data must be qualified and explained in the case narrative.

QC Sample	Frequency & Number	Method/SOP QC Acceptance Limits	Corrective Action	Personnel Responsible for Corrective Action	DQI	Measurement Performance Criteria
MB	One per matrix per analytical method for each batch of at most 20 samples.	No analytes detected >1/2 LOQ or >1/10 the amount measured in any sample or 1/10 the regulatory limit, whichever is higher.	Correct problem. If required, re-prep and reanalyze MB and all samples processed with the contaminated blank.	Analyst Lab QA Officer Project Chemist	Sensitivity/Bias	No analytes detected >1/2 LOQ or >1/10 the amount measured in any sample or 1/10 the regulatory limit, whichever is higher.
LCS	One per batch of at most 20 samples analyzed of similar matrix per analytical method.	Per DoD QSM Appendix C Limits, Methods SW-846 6010C/7470A and Lab SOPs (EMAX-6020/ EMAX-7471).	Correct problem. If required, re-prep and reanalyze the LCS and all samples processed in the associated preparatory batch for the failed analytes.	Analyst Lab QA Officer Project Chemist	Accuracy	QC acceptance criteria at least as stringent as specified by DoD QSM 5.0 (DoD 2013).
MS/MSD pair	One per MS pair per analytical method for each batch of at most 20 samples.	Per DoD QSM Appendix C Limits, Methods SW-846 6010C/7470A and Lab SOPs (EMAX-6020/ EMAX-7471). MSD or Matrix Duplicate: RPD of all analytes ≤20%.	Examine the PQOs. Notify Lab QA officer and project chemist about additional measures to be taken.	Analyst Lab QA Officer Project Chemist	Accuracy/Precision	For matrix evaluation, use QC acceptance criteria at least as stringent as specified by DoD QSM 5.0 (DoD 2013).
Dilution test	One per preparatory batch if MS or MSD fails. Only applicable to samples with concentrations >50× the LOQ prior to dilution.	Five-fold dilution must agree within ±10% of the original measurement.	Perform PDS addition.	Analyst Lab QA Officer Project Chemist	Accuracy/ Representativeness	QC acceptance criteria specified by DoD QSM 5.0 (DoD 2013). Diluted result is within ±10% of the original measurement.
PDS (ICP only)	One per preparatory batch when dilution test fails or analyte concentration in all samples <50 x LOQ prior to dilution. Use the same sample as used for the MS/MSD, if possible.	Recovery within 80–120%.	Run all associate samples in the preparatory batch by MSA.	Analyst Lab QA Officer Project Chemist	Accuracy/ Representativeness	QC acceptance criteria specified by DoD QSM 5.0 (DoD 2013). Recovery within 80–120%.
MSA	When dilution test or post digestion spike fails.	N/A	N/A	Analyst Lab QA Officer Project Chemist	confirmation	N/A

CCB continuing calibration blank
ICB initial calibration blank
ICP inductively coupled plasma
LOD limit of detection
LOQ limit of quantitation
MSA method of standard addition
N/A not applicable
PDS post-digestion spike

Matrix	**Water, Sediments, and Tissue**
Analytical Group	**SVOCs and PAHs**
Analytical Method/SOP Reference	Analytical Method: EPA Method 8270D/SIM Preparation Method: EPA 3550C Laboratory SOPs: EMAX-8270/SIM
Analytical Organization	EMAX LABORATORIES

QC Sample	Frequency & Number	Method/SOP QC Acceptance Limits	Corrective Action	Personnel Responsible for Corrective Action	DQI	Measurement Performance Criteria
LOD determination and verification	At initial set-up and verified quarterly. If a laboratory uses multiple instruments for a given method, the LOD must be verified on each.	The apparent signal to noise ratio must be at least 3 and the results must meet all method requirements for analyte identification.	If the LOD verification fails, the laboratory must: 1) Repeat the detection limit determination and LOD verification at a higher concentration; or 2) Perform and pass two consecutive LOD verifications at a higher concentration. The LOD is set at the higher concentration.	Analyst Lab QA Officer Project Chemist	Bias/ Representativeness	QC acceptance criteria as specified by Lab SOP ANA8270DSIM.
LOQ establishment and verification	At initial setup: 1) Verify LOQ; and 2) Determine precision and bias at the LOQ. Subsequently, verify LOQ quarterly. If a laboratory uses multiple instruments for a given method, the LOQ must be verified on each.	1) The LOQ and associated precision and bias must meet client requirements and must be reported; or 2) In the absence of client requirements, must meet control limits of the LCS. 3) If the method is modified, precision and bias at the new LOQ must be demonstrated and reported. See Volume 1, Module 4, Section 1.5.2 of the DoD QSM 5.0 (DoD 2013).	If the LOQ verification fails, the laboratory must either establish a higher LOQ or modify method to meet the client-required precision and bias.	Analyst Lab QA Officer Project Chemist	Sensitivity/Bias	QC acceptance criteria as specified by Lab SOP ANA8270DSIM and at least as stringent as specified by DoD QSM 5.0 (DoD 2013).
Tune Check	Prior to the initial calibration and prior to each 12-hour period of sample analysis.	Specific ion abundance criteria of DFTPP or BFB from method.	Retune instrument and verify	Analyst Lab QA Officer Project Chemist	Sensitivity/Bias	Samples may not be analyzed without a passing tune.
Performance check	Before initial calibration and sample analysis, and at the beginning of each 12-hour shift.	Degradation of DDT must be ≤20%. Benzidine and pentachlorophenol will be present at their normal responses, and will not exceed a tailing factor of 2.	Correct problem, then repeat performance checks.	Analyst Lab QA Officer Project Chemist	Sensitivity/Bias	Degradation of DDT must be ≤20%; and benzidine and pentachlorophenol must be present at normal responses and tailing factor is ≤2. No samples must be analyzed until performance check is within criteria.

QC Sample	Frequency & Number	Method/SOP QC Acceptance Limits	Corrective Action	Personnel Responsible for Corrective Action	DQI	Measurement Performance Criteria
CCV	Before sample analysis, after every 10 field samples, and at the end of the analysis sequence.	All reported analytes and surrogates within established RT windows. All reported analytes and surrogates within ± 20% of true value.	Immediately analyze two additional consecutive CCVs. If both pass, samples may be reported without reanalysis. If either fails, take corrective action(s) and re-calibrate; then reanalyze all affected samples since the last acceptable CCV.	Analyst Lab QA Officer Project Chemist	Accuracy/Precision	Results may not be reported without a valid CCV. If reanalysis cannot be performed, data must be qualified and explained in the case narrative.
MB	Each time samples are extracted and one per matrix per analytical method for each batch of at most 20 samples.	No analytes detected >1/2 LOQ or >1/10 the amount measured in any sample or 1/10 the regulatory limit, whichever is higher. For common lab contaminants, no analytes detected >LOQ.	Correct problem. If required, re-prep and reanalyze MB and all samples processed with the contaminated blank.	Analyst Lab QA Officer Project Chemist	Sensitivity/Bias	No analytes detected >1/2 LOQ or >1/10 the amount measured in any sample or 1/10 the regulatory limit, whichever is higher. For common laboratory contaminants, no analytes detected >LOQ.
LCS	One per batch of at most 20 samples analyzed of similar matrix per analytical method.	Per DoD QSM Appendix C Limits, Method 8270DSIM and Lab SOP EMAX-8270/SIM.	Correct problem. If required, re-prep and reanalyze the LCS and all samples processed in the associated preparatory batch for the failed analytes.	Analyst Lab QA Officer Project Chemist	Accuracy	QC acceptance criteria at least as stringent as specified by DoD QSM 5.0 (DoD 2013).
Internal standards verification	Every field sample, standard, and QC sample.	Retention time ± 10 seconds from retention time of the midpoint standard in the ICAL; EICP area within -50% to +100% of ICAL midpoint standard.	Inspect mass spectrometer and GC for malfunctions. Reanalysis of samples analyzed while system was malfunctioning is mandatory.	Analyst Lab QA Officer Project Chemist	Accuracy/Precision/ Representativeness	Laboratory in-house method manual to be followed for acceptance criteria.
Surrogate spike	All field and QC samples.	Per DoD QSM Appendix C Limits, Method 8270DSIM and Lab SOP EMAX-8270/SIM.	For QC and field samples, correct problem then re-prep and reanalyze all failed samples for failed surrogates in the associated preparatory batch, if sufficient sample material is available. If obvious chromatographic interference with surrogate is present, reanalysis may not be necessary.	Analyst Lab QA Officer Project Chemist	Accuracy/Precision/ Representativeness	QC acceptance criteria at least as stringent as specified by DoD QSM 5.0 (DoD 2013).

QC Sample	Frequency & Number	Method/SOP QC Acceptance Limits	Corrective Action	Personnel Responsible for Corrective Action	DQI	Measurement Performance Criteria
MS/MSD pair	One per analytical method for each batch of at most 20 samples.	Per DoD QSM Appendix C Limits, Method 8270DSIM and Lab SOP EMAX-8270/SIM. MSD or Matrix Duplicate: RPD of all analytes ≤20%.	Examine the PQOs. Notify Lab QA officer and project chemist about additional measures to be taken.	Analyst Lab QA Officer Project Chemist	Accuracy/Precision	For matrix evaluation, use QC acceptance criteria at least as stringent as specified by DoD QSM 5.0 (DoD 2013).

BFB 4-bromofluorobenzene
DDT dichlorodiphenyltrichloroethane
DFTPP decafluorotriphenylphosphine
EICP extracted ion current profile
GC gas chromatography
PAH polynuclear aromatic hydrocarbon
RT retention time
SIM selected ion monitoring
SVOC semivolatile organic compound

Matrix	**Water, Sediments, and Tissue**
Analytical Group	**Organochlorine Pesticides**
Analytical Method/SOP Reference	Analytical Method: EPA Method 8081B Preparation Method: EPA 3540 Laboratory SOPs: EMAX-8081
Analytical Organization	EMAX LABORATORIES

QC Sample	Frequency & Number	Method/SOP QC Acceptance Limits	Corrective Action	Personnel Responsible for Corrective Action	DQI	Measurement Performance Criteria
LOD determination and verification	At initial set-up and verified quarterly. If a laboratory uses multiple instruments for a given method, the LOD must be verified on each.	The apparent signal to noise ratio must be at least 3 and the results must meet all method requirements for analyte identification.	If the LOD verification fails, the laboratory must: 1) Repeat the detection limit determination and LOD verification at a higher concentration; or 2) Perform and pass two consecutive LOD verifications at a higher concentration. The LOD is set at the higher concentration.	Analyst Lab QA Officer Project Chemist	Bias/ Representativeness	QC acceptance criteria as specified by Lab SOP ANA8081B.
LOQ establishment and verification	At initial setup: 1) Verify LOQ; and 2) determine precision and bias at the LOQ. Subsequently, verify LOQ quarterly. If a laboratory uses multiple instruments for a given method, the LOQ must be verified on each.	1) The LOQ and associated precision and bias must meet client requirements and must be reported; or 2) In the absence of client requirements, must meet control limits of the LCS. 3) If the method is modified, precision and bias at the new LOQ must be demonstrated and reported. See Volume 1, Module 4, Section 1.5.2 of the DoD QSM 5.0 (DoD 2013).	If the LOQ verification fails, the laboratory must either establish a higher LOQ or modify method to meet the client-required precision and bias.	Analyst Lab QA Officer Project Chemist	Sensitivity/Bias	QC acceptance criteria as specified by Lab SOP ANA8081B and at least as stringent as specified by DoD QSM 5.0 (DoD 2013).
Breakdown Check	Before sample analysis and at the beginning of each 12-hour shift.	Degradation of DDT and Endrin each must be ≤15%.	Correct problem, then repeat breakdown check.	Analyst Lab QA Officer Project Chemist	Sensitivity/Bias	No samples will be run until DDT and Endrin breakdown is each ≤15%.
CCV	Before sample analysis, after every 10 field samples, and at the end of the analysis sequence.	All reported analytes and surrogates within established RT windows. All reported analytes and surrogates within ± 20% of true value.	Immediately analyze two additional consecutive CCVs. If both pass, samples may be reported without reanalysis. If either fails, take corrective action(s) and re-calibrate; then reanalyze all affected samples since the last acceptable CCV.	Analyst Lab QA Officer Project Chemist	Accuracy/Precision	Results may not be reported without a valid CCV. If reanalysis cannot be performed, data must be qualified and explained in the case narrative.

QC Sample	Frequency & Number	Method/SOP QC Acceptance Limits	Corrective Action	Personnel Responsible for Corrective Action	DQI	Measurement Performance Criteria
MB	Each time samples are extracted.	No analytes detected >1/2 LOQ or >1/10 the amount measured in any sample or 1/10 the regulatory limit, whichever is higher. For common laboratory contaminants, no analytes detected ≥LOQ as shown in Worksheet #15.	Correct problem, then re-prep and reanalyze the MB and all samples in the associated batch for failed analytes in all samples in the associated batch, if sufficient material is available.	Analyst Lab QA Officer Project Chemist	Sensitivity	No analytes detected >1/2 LOQ. For common laboratory contaminants, no analytes detected >LOQ.
LCS	Each group of 20 or less prior or analysis of samples.	Per DoD QSM Appendix C Limits, Method 8081B and Lab SOP EMAX-8081.	Correct problem, then re-prep and reanalyze the LCS and all samples in the associated batch for failed analytes in all samples in the associated batch, if sufficient material is available.	Analyst Lab QA Officer Project Chemist	Accuracy	QC acceptance criteria at least as stringent as specified by DoD QSM 5.0 (DoD 2013).
Surrogate Spike	All field and QC samples.	QC acceptance criteria specified by DoD QSM Appendix C Limits, if available. Otherwise, use in-house control limits.	For QC and field samples, correct problem then re-prep and reanalyze all failed samples for failed surrogates in the associated preparatory batch, if sufficient sample material is available. If obvious chromatographic interference with surrogate is present, reanalysis may not be necessary.	Analyst Lab QA Officer Project Chemist	Accuracy/Precision/ Representativeness	QC acceptance criteria at least as stringent as specified by DoD QSM 5.0 (DoD 2013).
MS/MSD pair	One per matrix per analytical method for each batch of at most 20 samples per site.	Per DoD QSM Appendix C Limits, Method 8081B and Lab SOP EMAX-8081. MSD or Matrix Duplicate: RPD of all analytes ≤30%.	Examine the PQOs. Notify lab QA officer and project chemist about additional measures to be taken.	Analyst Lab QA Officer Project Chemist	Accuracy/Precision	For matrix evaluation, use QC acceptance criteria at least as stringent as specified by DoD QSM 5.0 (DoD 2013).
Confirmation of positive results (second column or second detector)	All positive results must be confirmed.	Calibration and QC criteria same as for initial or primary column analysis. RPD between primary and secondary column ≤40%.	Report from both columns.	Analyst	Precision/ Representativeness	QC acceptance criteria specified by DoD QSM 5.0 (DoD 2013). RPD between primary and secondary column ≤40%. Use project-specific reporting requirements if available; otherwise, use method reporting requirements; otherwise, report the result from the primary column.

N/A not applicable

Matrix	**Sediment**
Analytical Group	**PCB Congeners**
Analytical Method/SOP Reference	Analytical Method: EPA Method 1668 Preparation Method: EPA 1668B Laboratory SOPs: HMS-1668C
Analytical Organization	EMAX LABORATORIES

QC Sample	Frequency & Number	Method/SOP QC Acceptance Limits	Corrective Action	Personnel Responsible for Corrective Action	DQI	Measurement Performance Criteria
Resolving power (tuning)	Prior to initial calibration and at the beginning and end of each 12-hour period.	Using PFK and a molecular leak, static resolving power must be ≥10,000 (10% valley) for identified masses.	Retune instrument and verify. No samples will be run without a passing tune check. Rerun affected samples since the last acceptable check.	Analyst Lab QA Officer	Sensitivity	QC acceptance criteria as specified by Lab SOP ANA1668 and at least as stringent as specified by DoD QSM 5.0 (DoD 2013).
EMPC	Every sample with a response S/N ≥2.5 for both quantitation ions.	Identification criteria per method must be met, and the S/N of response for both quantitation ions must be ≥2.5.	N/A	Analyst Lab QA Officer	Accuracy	QC acceptance criteria as specified by Lab SOP ANA1668 and at least as stringent as specified by DoD QSM 5.0 (DoD 2013).
CCV	Before sample analysis of each 12-hour period, and at the end of the analysis sequence.	Ion abundance specified in the method must be met. For unlabeled standards, RF within ± 20% D of RF established in ICAL; and for labeled standards, RF within ± 30% D of RF established in ICAL.	Immediately analyze two additional consecutive CCVs. If both pass, samples may be reported without reanalysis. If either fails, take corrective action(s) and re-calibrate; then reanalyze all affected samples since the last acceptable CCV. End-of-run CCV: If the RF for unlabeled standards ≤25% RPD and the RF for labeled standards ≤35% RPD (relative to the RF established in the ICAL), the mean RF from the two daily CCVs must be used for quantitation of impacted samples instead of the ICAL mean RF value. If the starting and ending CCV RFs differ by more than 25% RPD for unlabeled compounds or 35% RPD for labeled compounds, the sample may be quantitated against a new initial calibration if it is analyzed within two hours. Otherwise, analyze samples with positive detections, if necessary.	Analyst Lab QA Officer Project Chemist	Accuracy/Precision	Results may not be reported without a valid CCV. If reanalysis cannot be performed, data must be qualified and explained in the case narrative.

QC Sample	Frequency & Number	Method/SOP QC Acceptance Limits	Corrective Action	Personnel Responsible for Corrective Action	DQI	Measurement Performance Criteria
MB	Each time samples are extracted and one per matrix per analytical method for each batch of at most 20 samples.	No analytes detected above the EML listed in Table 2 of the method or 1/3 the regulatory limit, whichever is greater.	Correct problem, then re-prep and reanalyze the MB and all samples in the associated batch for failed analytes in all samples in the associated batch, if sufficient material is available.	Analyst Lab QA Officer Project Chemist	Sensitivity	No analytes detected above the EML or 1/3 the regulatory limit, whichever is greater.
LCS	One per batch of at most 20 samples analyzed of similar matrix per analytical method.	Per DoD QSM Appendix C Limits, Method 1668B and Lab SOP HMS-1668C.	Correct problem, then re-prep and reanalyze the LCS and all samples in the associated batch for failed analytes in all samples in the associated batch, if sufficient material is available.	Analyst Lab QA Officer Project Chemist	Accuracy	QC acceptance criteria at least as stringent as specified by DoD QSM 5.0 (DoD 2013).
MS/MSD	1 per 20 samples or less, or 1 per location depending on sample matrix.	Per DoD QSM Appendix C Limits, Method 1668B and Lab SOP HMS-1668C MSD or Matrix Duplicate: RPD of all analytes ≤20%.	Examine the PQOs. Notify lab QA officer and project chemist about additional measures to be taken.	Analyst Lab QA Officer Project Chemist	Accuracy/Precision	For matrix evaluation, use QC acceptance criteria at least as stringent as specified by DoD QSM 5.0 (DoD 2013) for LCS.

Matrix	**Sediment and Tissue**
Analytical Group	**Metals by ICP-MS & Mercury**
Analytical Method/SOP Reference	Analytical Methods: EPA Methods 6020A/7471B Preparation Methods: EPA 3050B/7471B Laboratory SOPs: MET-ICP/MET-6020 and MET-7471
Analytical Organization	EMAX LABORATORIES

QC Sample	Frequency & Number	Method/SOP QC Acceptance Limits	Corrective Action	Personnel Responsible for Corrective Action	DQI	Measurement Performance Criteria
LOD determination and verification	At initial set-up and verified quarterly. If a laboratory uses multiple instruments for a given method, the LOD must be verified on each.	The apparent signal to noise ratio must be at least 3 and the results must meet all method requirements for analyte identification.	If the LOD verification fails, the laboratory must: 1) Repeat the detection limit determination and LOD verification at a higher concentration; or 2) Perform and pass two consecutive LOD verifications at a higher concentration. The LOD is set at the higher concentration.	Analyst Lab QA Officer Project Chemist	Bias/ Representativeness	QC acceptance criteria as specified by Lab SOPs (ANA6020A and ANA7471B).
LOQ establishment and verification	At initial setup: 1) Verify LOQ; and 2) Determine precision and bias at the LOQ. Subsequently, verify LOQ quarterly. If a laboratory uses multiple instruments for a given method, the LOQ must be verified on each.	1) The LOQ and associated precision and bias must meet client requirements and must be reported; or 2) In the absence of client requirements, must meet control limits of the LCS. 3) If the method is modified, precision and bias at the new LOQ must be demonstrated and reported. See Volume 1, Module 4, Section 1.5.2 of the DoD QSM 5.0 (DoD 2013).	If the LOQ verification fails, the laboratory must either establish a higher LOQ or modify method to meet the client-required precision and bias.	Analyst Lab QA Officer Project Chemist	Sensitivity/Bias	QC acceptance criteria as specified by Lab SOPs (ANA6020A and ANA7471B), and at least as stringent as specified by DoD QSM 5.0 (DoD 2013).
Tuning	Prior to ICAL.	Mass calibration ≤0.1 amu from the true value. Resolution <0.9 amu full width at 10% peak height.	Retune instrument and verify. No samples will be analyzed without a passing tune.	Analyst Lab QA Officer Project Chemist	Sensitivity/Bias	No samples will be run without a valid tune.
CCV	Before sample analysis, after every 10 field samples, and at the end of the analysis sequence.	All reported analytes and surrogates within ± 10% of true value.	Immediately analyze two additional consecutive CCVs. If both pass, samples may be reported without reanalysis. If either fails, take corrective action(s) and re-calibrate; then reanalyze all affected samples since the last acceptable CCV.	Analyst Lab QA Officer Project Chemist	Accuracy/Precision	Results may not be reported without a valid CCV. If reanalysis cannot be performed, data must be qualified and explained in the case narrative.
Internal standards verification	Every field sample, standard, and QC sample.	IS intensity in the samples within 30-120% of intensity of the IS in the ICAL blank.	Reanalyze field sample at 5× dilution until criteria is met. For failed QC samples, correct problem, and rerun all associated failed field samples.	Analyst Lab QA Officer Project Chemist	Accuracy/Precision/ Representativeness	QC acceptance criteria at least as stringent as specified by DoD QSM 5.0 (DoD 2013).

QC Sample	Frequency & Number	Method/SOP QC Acceptance Limits	Corrective Action	Personnel Responsible for Corrective Action	DQI	Measurement Performance Criteria
MB	Each time samples are extracted and one per matrix per analytical method for each batch of at most 20 samples.	No analytes detected >1/2 LOQ or >1/10 the amount measured in any sample or 1/10 the regulatory limit, whichever is higher. For common lab contaminants, no analytes detected >LOQ.	Correct problem. If required, re-prep and reanalyze MB and all samples processed with the contaminated blank.	Analyst Lab QA Officer Project Chemist	Sensitivity/Bias	No analytes detected >1/2 LOQ or >1/10 the amount measured in any sample or 1/10 the regulatory limit, whichever is higher. For common laboratory contaminants, no analytes detected >LOQ.
LCS	One per batch of at most 20 samples analyzed of similar matrix per analytical method.	Per DoD QSM Appendix C Limits, Methods SW-846 6020A/7471B and Lab SOPs (MET-ICP/MET-6020 and MET-7471).	Correct problem. If required, re-prep and reanalyze the LCS and all samples processed in the associated preparatory batch for the failed analytes.	Analyst Lab QA Officer Project Chemist	Accuracy	QC acceptance criteria at least as stringent as specified by DoD QSM 5.0 (DoD 2013).
MS/MSD pair	One per analytical method for each batch of at most 20 samples.	Per DoD QSM Appendix C Limits, Methods SW-846 6020A/7471B and Lab SOPs (MET-ICP/MET-6020 and MET-7471).	Examine the PQOs. Notify Lab QA officer and project chemist about additional measures to be taken.	Analyst Lab QA Officer Project Chemist	Accuracy/Precision	For matrix evaluation, use QC acceptance criteria at least as stringent as specified by DoD QSM 5.0 (DoD 2013).
Dilution test	One per preparatory batch if MS or MSD fails. Only applicable to samples with concentrations >50× the LOQ prior to dilution.	Five-fold dilution must agree within ±10% of the original measurement.	Perform PDS addition.	Analyst Lab QA Officer Project Chemist	Accuracy/ Representativeness	QC acceptance criteria specified by DoD QSM 5.0 (DoD 2013). Diluted result is within ±10% of the original measurement.
PDS (ICP only)	One per preparatory batch when dilution test fails or analyte concentration in all samples <50× LOQ prior to dilution. Use the same sample as used for the MS/MSD, if possible.	Recovery within 80–120%.	Run all associate samples in the preparatory batch by MSA.	Analyst Lab QA Officer Project Chemist	Accuracy/ Representativeness	QC acceptance criteria specified by DoD QSM 5.0 (DoD 2013). Recovery within 80–120%.
MSA	When dilution test or post digestion spike fails.	N/A	N/A	Analyst Lab QA Officer Project Chemist	Confirmation	N/A

amu atomic mass unit
ICP-MS inductively coupled plasma–mass spectrometry
IS internal standard
N/A not applicable

Matrix	**Sediment**
Analytical Group	**TOC**
Analytical Method/SOP Reference	Analytical Method: Lloyd Kahn Method (EPA Region 2 1998) Preparation Method: Lloyd Kahn Method Laboratory SOPs: GEN-ASTM
Analytical Organization	EMAX LABORATORIES

QC Sample	Frequency & Number	Method/SOP QC Acceptance Limits	Corrective Action	Personnel Responsible for Corrective Action	DQI	Measurement Performance Criteria
LOD determination and verification	At initial set-up and verified quarterly. If a laboratory uses multiple instruments for a given method, the LOD must be verified on each.	The apparent signal to noise ratio must be at least 3 and the results must meet all method requirements for analyte identification.	If the LOD verification fails, the laboratory must: 1) Repeat the detection limit determination and LOD verification at a higher concentration; or 2) Perform and pass two consecutive LOD verifications at a higher concentration. The LOD is set at the higher concentration.	Analyst Lab QA Officer Project Chemist	Bias/ Representativeness	QC acceptance criteria as specified by Lab SOP GEN-ASTM.
LOQ establishment and verification	At initial setup: 1) Verify LOQ; and 2) Determine precision and bias at the LOQ. Subsequently, verify LOQ quarterly. If a laboratory uses multiple instruments for a given method, the LOQ must be verified on each.	1) The LOQ and associated precision and bias must meet client requirements and must be reported; or 2) In the absence of client requirements, must meet control limits of the LCS. 3) If the method is modified, precision and bias at the new LOQ must be demonstrated and reported. See Volume 1, Module 4, Section 1.5.2 of the DoD QSM 5.0 (DoD 2013).	If the LOQ verification fails, the laboratory must either establish a higher LOQ or modify method to meet the client-required precision and bias.	Analyst Lab QA Officer Project Chemist	Sensitivity/Bias	QC acceptance criteria as specified by Lab SOP GEN-ASTM, and at least as stringent as specified by DoD QSM 5.0 (DoD 2013).
MB	Each time samples are extracted.	No analytes detected >1/2 lab LOQ.	Correct problem, then re-prep and reanalyze the MB and all samples in the associated batch for failed analytes in all samples in the associated batch, if sufficient material is available.	Analyst Lab QA Officer Project Chemist	Sensitivity	QC acceptance criteria specified by lab and this project.
LCS	Each group of 20 or less.	QC acceptance criteria specified by lab.	Correct problem, then re-prep and reanalyze the LCS and all samples in the associated batch for failed analytes in all samples in the associated batch, if sufficient material is available.	Analyst Lab QA Officer Project Chemist	Accuracy	QC acceptance criteria specified by lab and this project.

QC Sample	Frequency & Number	Method/SOP QC Acceptance Limits	Corrective Action	Personnel Responsible for Corrective Action	DQI	Measurement Performance Criteria
Matrix quadruplicate	One per analytical method for each batch of at most 20 samples.	Per method and Lab SOP GEN-ASTM, quadruplicate sample must not exceed the 3 standard deviation limit.	Reanalyze quadruplicate samples and all samples in that preparation batch.	Analyst Lab QA Officer Project Chemist	Accuracy/Precision	Per method and Lab SOP GEN-ASTM, quadruplicate sample must not exceed the 3 standard deviation limit.

ASTM American Society for Testing and Materials
TOC total organic carbon

15. Data Verification and Validation (Steps I and IIa/IIb) Process Table

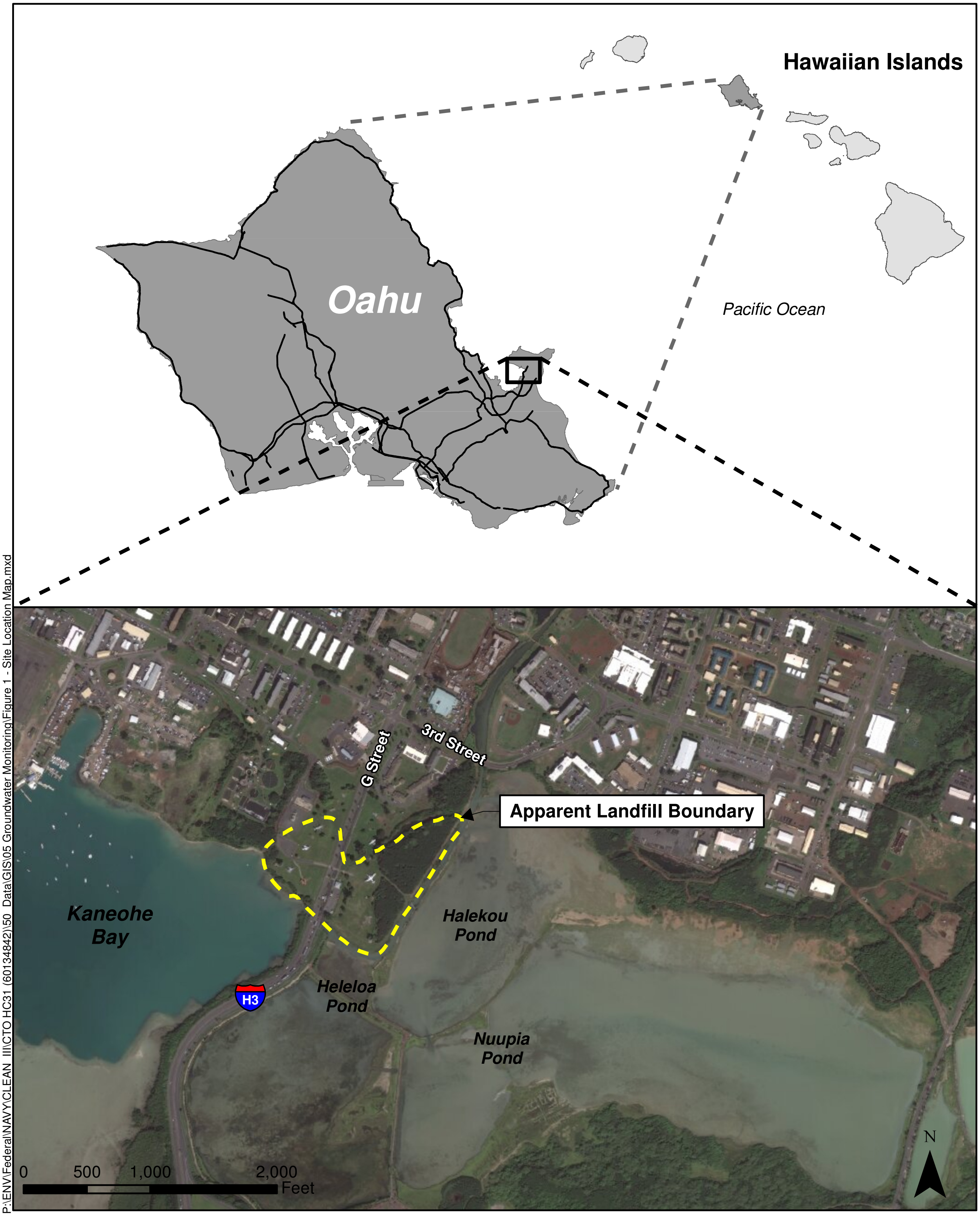
Data Review Input	Description	Responsible for Verification (name, organization)	Step I/IIa/IIb [a]	Internal/External
Laboratory system audits	Determine whether the laboratory holds a current DoD ELAP certification for all analyses to be performed for the project.	Project Chemist (John Fong, AECOM)	Step I	Internal
Field procedures	Determine whether field procedures are performed in accordance with this WP/SAP and prescribed procedures.	QA Program Manager (Scott Lewis, AECOM)	Step I	Internal
Field logbook and notes	Review the field logbook and any field notes on a weekly basis and place them in the project file. Copies of the field logbook and field notes will be provided to the CTO manager and included in the Field Audit Report.	Field Manager (Pete LaPlaca, AECOM)	Step I	Internal
Instrument calibration sheets	Determine whether instruments are calibrated and used in accordance with manufacturer's' requirements.	Project Chemist (John Fong, AECOM) & Data Validator (Kevin Harmon, Validata Chemical Services)	Step I	Internal & External
COC forms	Review COC completed forms and verify them against the corresponding packed sample coolers. A copy of each COC will be placed in the project file. The original COC will be taped inside the cooler for shipment to the analytical laboratory.	Project Chemist (John Fong, AECOM)	Step I	Internal
Sampling analytical data package	Verify all analytical data packages for completeness prior to submittal of the data to the data validator.	Project Manager (Ye Myint, EMAX Laboratories)	Step I	External
Analytes	Determine whether all analytes specified in Worksheet #15 were analyzed and reported on by the laboratory.	Project Chemist (John Fong, AECOM)	Step IIa	Internal
COC and field QC logbook	Examine data traceability from sample collection to project data generation.	Project Chemist (John Fong, AECOM)	Step IIa	Internal
Laboratory data and WP/SAP requirements	Assess and document the performance of the analytical process. A summary of all QC samples and results will be verified for measurement performance criteria and completeness. Full Validation will be performed on 10% of the data and Standard Validation will be performed on 90% of the data. A report will be prepared within 21 days of receipt.	Data Validator (Kevin Harmon, Validata Chemical Services) & Project Chemist (John Fong, AECOM)	Steps IIa & IIb	Internal & External
SVOCs and PAHs	Complete Procedure II-C, *Standard and Full data Validation Procedure for GC/MS Semivolatile Organics by SW-846 8270C (Full Scan and SIM)* (DON 2015).	Data Validator (Kevin Harmon, Validata Chemical Services)	Step IIa	External

Data Review Input	Description	Responsible for Verification (name, organization)	Step I/IIa/IIb [a]	Internal/External
Organochlorine Pesticides	Complete Procedure II-E, *Standard and Full Data Validation Procedure for Organochlorine Pesticides by SW-846 8081A* (DON 2015).	Data Validator (Kevin Harmon, Validata Chemical Services)	Step IIa	External
PCBs as Congeners	Complete Procedure II-G, *Standard and Full Data Validation Procedure for Polychlorinated Biphenyls as Congeners by SW-846 8082* (DON 2015).	Data Validator (Kevin Harmon, Validata Chemical Services)	Step IIa	External
Metals and Mercury	Complete Procedure II-Q, *Standard and Full Validation Procedure for Metals by SW-846 6000/7000* (DON 2015).	Data Validator (Kevin Harmon, Validata Chemical Services)	Step IIa	External
Sampling plan	Determine whether the number and type of soil and groundwater samples specified in Worksheet #20 were collected and analyzed.	Project Chemist (John Fong, AECOM) & Field Manager (Pete LaPlaca, AECOM)	Step IIb	Internal
Field QC samples	Establish that the number of QC samples specified in Worksheet #20 were collected and analyzed.	Project Chemist (John Fong, AECOM)	Step IIb	Internal
Project quantitation limits and data qualifiers	Establish that sample results met the project quantitation limits and qualify the data in accordance with Procedure II-A, *Data Validation Procedure* (DON 2015).	Data Validator (Kevin Harmon, Validata Chemical Services) & Project Chemist (John Fong, AECOM)	Step IIb	Internal & External
Validation report	Summarize outcome of data comparison to MPC in the WP/SAP. Include qualified data and an explanation of all data qualifiers.	Data Validator (Kevin Harmon, Validata Chemical Services)	Step IIa	External

% percent
AECOM AECOM Technical Services, Inc.
COC chain of custody
CTO contract task order
DoD Department of Defense
ELAP Environmental Laboratory Accreditation Program
GC/MS gas chromatography/mass spectrometry
MPC measurement performance criteria
PAH polynuclear aromatic hydrocarbon
PCB polychlorinated biphenyl
QA quality assurance
QC quality control
SAP Sampling and Analysis Plan
SIM selective ion monitoring
SVOC semivolatile organic compound
WP work plan

[a] IIa Compliance with methods, procedures, and contracts. See Table 10, page 117, UFP-QAPP manual, V.1 (DoD 2005).
IIb Comparison with measurement performance criteria in the WP/SAP. See Table 11, page 118, UFP-QAPP manual, V.1 (DoD 2005).

Appendix A:
Figures



P:\ENV\Federal\NAVY\CLEAN III\CTO HC31 (60134842)\50 Data\GIS\05 Groundwater Monitoring\Figure 1 - Site Location Map.mxd

Figure 1
Site Location Map
Groundwater Monitoring and BERA Sampling Work Plan
H-3 Landfill (Site 0001)
Marine Corps Base Hawaii
Oahu, Hawaii

Contributing Source	Affected Media	Exposure Route	Terrestrial Receptors: Plants	Terrestrial Receptors: Soil Invertebrates	Terrestrial Receptors: Herbivores/Invertivores/ Omnivores
H3 Landfill Material	Surface Soil	Direct Contact:	Incomplete	Incomplete	Incomplete
		Incidental Ingestion:	N/A	Incomplete	Incomplete
		Food Web Transfer:	N/A	N/A	Incomplete

Rationale: Surface soil on the landfill is not anticipated to be contaminated due to a clean protective cover already in place. Available information indicates fill soil was utilized to cover the landfill in accordance with general solid waste landfill industry standards at the time of closure. This fill material is free of landfill debris or contaminants. Therefore, direct contact with Landfill COPC is not expected to occur through the surface soil exposure and the pathway is incomplete.

Affected Media	Exposure Route	Plants	Soil Invertebrates	Herbivores/Invertivores/ Omnivores
Subsurface Soil	Incidental Ingestion: Direct contact: Inhalation:	Incomplete	Incomplete	Incomplete

Rationale: Ecological receptors are not expected to come into significant contact with subsurface soils. While burrowing animals may access deeper soils, exposure to subsurface soil is considered negligible compared to that for surface soil. There are no known burrowing birds (no identified seabird nesting colonies) or mammals on site. The majority of bird and mammal exposure comes from the ingestion of food (plants and invertebrates). The majority of plant and invertebrate chemical exposure occurs in the upper 2 feet, or less, of soil. Plants may send roots into subsurface soil and some invertebrates burrow into deeper soil but most nutrient uptake by plants and most foraging by invertebrates is assumed to occur within the upper bioactive layer of soil. Less than 3 percent of exposure is from incidental soil ingestion. Therefore, all exposure pathways are incomplete for subsurface soil.

Affected Media	Exposure Route	Aquatic Receptors: Aquatic Life (incl. Plankton)	Aquatic Receptors: Sediment Biota	Aquatic Receptors: Fish (all Trophic Levels)	Aquatic Receptors: Invertivorous/ Piscivorous Birds
Groundwater Discharge/ Transition Zone	Direct Contact:	Potentially Complete	Potentially Complete	Potentially Complete	Potentially Complete

Rationale: Aquatic organisms and birds foraging in areas where groundwater discharges may come into contact with groundwater as it discharges to water bodies adjacent to the H3 Landfill site.

Affected Media	Exposure Route	Aquatic Life (incl. Plankton)	Sediment Biota	Fish (all Trophic Levels)	Invertivorous/ Piscivorous Birds
Freshwater/Marine Surface Water	Direct Contact: Ingestion:	Potentially Complete	N/A	Potentially Complete	Potentially Complete
	Food Web Transfer:	N/A	N/A	Potentially Complete	Potentially Complete

Rationale: Aquatic organisms are directly exposed to surface water in the pond or shoreline areas that may be contaminated by groundwater discharge. Waterbirds may ingest surface water as well as invertebrates and fish that have taken-up COPC from surface water into their body tissues. This pathway is considered complete. While sediment invertebrates are exposed to overlying water, the majority of their exposure is to sediment and porewater.

Affected Media	Exposure Route	Aquatic Life (incl. Plankton)	Sediment Biota	Fish (all Trophic Levels)	Invertivorous/ Piscivorous Birds
Freshwater/Marine Sediment (and/or Porewater)	Direct Contact: Ingestion:	N/A	Potentially Complete	Potentially Complete	Potentially Complete
	Food Web Transfer:	N/A	N/A	Potentially Complete	Potentially Complete

Rationale: Sediment invertebrates and fish may be directly exposed to COPC in sediment in the pond or shoreline areas. Waterbirds may ingest sediment as well as invertebrates and fish that have taken-up COPC from sediments into their body tissues. This pathway is considered complete. While aquatic life (surface water organisms) are potentially exposed to sediment, the majority of their exposure is to surface water.

N/A not applicable: Exposure route does not exist, or is not normally evaluated as such in ecological risk assessment.
COPC Chemical of potential concern

Figure 2
Ecological Receptors Exposure Pathway Evaluation
Groundwater Monitoring and BERA Sampling Work Plan
H-3 Landfill (Site 0001)
Marine Corps Base Hawaii
Oahu, Hawaii

LOCATION MAP

LEGEND

BERA Sample Type

- Sediment/Surface Water
- Piezometer
- Sediment
- Sediment/Surface Water/AVS
- Fish
- Invertebrate
- Groundwater Monitoring Well Location
- Former Monitoring Well
- Surface Water Sampling Location
- Apparent Landfill Boundary
- Surveyed Elevation Contour (2-ft Interval)
- Land Use Control Area
- Temporary Lodging Facility Wetland
- Nuupia Ponds Wildlife Management Area Boundary

NOTES

1. Map projection: Hawaii State Plane Zone 3, NAD83.
2. Base map source: USGS 2006.
3. Apparent landfill boundary was derived from aerial photo evaluations and visual observations of test pits advanced throughout the site.

Figure 3
Proposed Sampling Locations for Groundwater Monitoring and Ecological Risk Evaluation
Groundwater Monitoring and BERA Sampling Work Plan
H-3 Landfill (Site 0001)
Marine Corps Base Hawaii
Oahu, Hawaii

Path: \\Honolulu\Honolulu\Projects_Legacy\ENV\Federal\NAVY\CLEAN_III\CTO HC31 (60134842)\50_Data\GIS\05 Groundwater Monitoring\Fig3_SampLocs_rev2.mxd

Appendix B:
NAVFAC Pacific ER Program SOPs
(on CD-ROM at end of document)

I. Field Procedures

II. Data Validation Procedures

III. QC Procedures

Utility Clearance

1. Purpose

This standard operating procedure describes the process for determining the presence of subsurface utilities and other cultural features at locations where planned site activities involve the physical disturbance of subsurface materials. The procedure applies to the following activities: soil gas surveying, excavating, trenching, drilling of borings and installation of monitoring and extraction wells, use of soil recovery or slide-hammer hand augers, and all other intrusive sampling activities. The primary purpose of the procedure is to minimize the potential for damage to underground utilities and other subsurface features, which could result in physical injury, disruption of utility service, or disturbance of other subsurface cultural features.

2. Scope

This procedure applies to all United States Navy Environmental Restoration (ER) Program projects performed in the Naval Facilities Engineering Command, Pacific Area of Responsibility.

This procedure shall serve as management-approved professional guidance for the ER Program and is consistent with protocol in the Uniform Federal Policy-Quality Assurance Project Plan (DoD 2005). As professional guidance for specific activities, this procedure is not intended to obviate the need for professional judgment during unforeseen circumstances. Deviations from this procedure while planning or executing planned activities must be approved and documented by the following prime contractor representatives: the CTO Manager and the Quality Assurance (QA) Manager or Technical Director. A Navy project representative (i.e., Remedial Project Manager or QA Manager) shall also concur with any deviations.

3. Definitions

3.1 Utility

For this procedure, a utility is defined as a manmade underground line or conduit, cable, pipe, vault or tank that is, or was, used for the transmission of material or energy (e.g., gas, electrical, telephone, steam, water or sewage, product transfer lines, or underground storage tanks).

3.2 As-Built Plans

As-built plans are plans or blueprints depicting the locations of structures and associated utilities on a property.

3.3 One-Call

The Utility Notification Center is the one-call agency for Oregon, Washington, Montana, and Hawaii. The Utility Notification Center is open 24 hours a day, and accepts calls from anyone planning to dig in. The phone number for the Hawaii One Call Center is 1-866-423-7287 (or 811). Additional information can be found at http://www.callbeforeyoudig.org/hawaii/index.asp.

Calling before you dig ensures that any publicly owned underground lines will be marked, so that you can dig around them safely. Having the utility lines marked not only prevents accidental damage to the lines, but prevents property damage and personal injuries that could result in breaking a line.

The following information will need to be provided when a request is placed to One-Call:

- Your name, phone number, company name (if applicable), and mailing address.
- What type or work is being done. This should be a description of the specific reason for the work, not the method used.
- Who the work is being done for.
- The county and city the work is taking place in.
- The address or the street where the work is taking place.
- Marking instructions, (specific instructions as to where the work is taking place).

Under normal circumstances it takes between 2 days to 5 days from the time you call (not counting weekends or holidays) to have the underground lines marked. Because these laws vary from state to state, exactly how long it will take depends on where your worksite is located. You will be given an exact start time and date when your locate request is completed, which will comply with the laws in your area.

In the event of an emergency (any situation causing damage to life or property, or a service outage), lines can be marked sooner than the original given time if requested, but must be handled via voice contact with One-Call.

3.4 TONING

Toning is the process of surveying an area utilizing one or more surface geophysical methods to determine the presence or absence of underground utilities. Typically, toning is conducted after identifying the general location of utilities and carefully examining all available site utility plans. Each location is marked according to the type of utility being identified. In addition, areas cleared by toning are flagged or staked to indicate that all identified utilities in a given area have been toned.

4. Responsibilities

The prime contractor CTO Manager is responsible for verifying that these utility locating procedures are performed prior to the initiation of active subsurface exploration. The CTO Manager is responsible for ensuring that all personnel involved in sampling and/or testing shall have the appropriate education, experience, and training to perform their assigned tasks as specified in Chief of Naval Operations Instruction 5090.1, under *Specific Training Requirements* (DON 2014).

The prime contractor QA Manager or Technical Director is responsible for ensuring overall compliance with this procedure.

The onsite Field Manager (FM) and Site Safety and Health Officer (SSHO) are responsible for planning utility clearance and for locating and marking underground utilities according to this procedure.

Field personnel are responsible for the implementation of this procedure.

5. Procedures

Follow the following steps at all sites where subsurface exploration will include excavations, drilling, or any other subsurface investigative method that could damage utilities at a site. In addition to the steps outlined below, always exercise caution while conducting subsurface exploratory work.

5.1 PREPARE PRELIMINARY SITE PLAN

Prepare a preliminary, scaled site plan depicting the proposed exploratory locations as part of the work plan. Include as many of the cultural and natural features as practical in this plan.

5.2 REVIEW BACKGROUND INFORMATION

Search existing plan files to review the as-built plans and available geographic information system databases to identify the known location of utilities at the site. In addition, the contractor should contact the Navy RPM to obtain the most updated GIS layers. Plot the locations of utilities identified onto a preliminary, scaled site plan. Inform the CTO Manager if utilities lie within close proximity to a proposed exploration or excavation location. The CTO Manager will determine if it is necessary to relocate proposed sampling or excavation locations.

Include the utility location information gathered during investigation (e.g., remedial investigation or remedial site evaluation) work in the project design documents for removal or remedial actions. In this manner, information regarding utility locations collected during implementation of a CTO can be shared with the other contractors during implementation of a particular task order. In many instances, this will help to reduce the amount of additional geophysical surveying work the other contractor may have to perform.

Conduct interviews with onsite and facility personnel familiar with the site to obtain additional information regarding the known and suspected locations of underground utilities. In addition, if appropriate, contact shall be made with local utility companies to request their help in locating underground lines. Pencil in the dimensions, orientation, and depth of utilities, other than those identified on the as-built plans, at their approximate locations on the preliminary plans. Enter the type of utility, the personnel who provided the information, and the date the information was provided into the field log.

During the pre-fieldwork interviewing process, the interviewer will determine which site personnel should be notified in the event of an incident involving damage to existing utilities. Record this information in the field logbook with the corresponding telephone numbers and addresses.

5.3 DIG PERMIT

Prior to all activities requiring excavation work that may disrupt utility services, vehicular or aircraft traffic flow, protection provided by fire and intrusion alarm systems, or routine activities at Navy bases (including Joint Base Pearl Harbor-Hickam and Naval Base Guam), as well as intrusive work at Marine Corps Base Hawaii, current procedures shall be followed. The dig permit process tries to identify, as much as practical, any known, potentially hazardous work condition related to excavation activities and is intended to prevent accidents. It also informs key Navy personnel of the digging work and coordinates the required work with these activities to minimize inconveniences (JBPHH 2013).

5.4 Site Visit – Locate Utilities – Toning

Prior to the initiation of field activities, the field task manager or similarly qualified staff personnel shall visit the site and note existing structures and evidence of associated utilities, such as fire hydrants, irrigation systems, manhole and vault box covers, standpipes, telephone switch boxes, free-standing light poles, gas or electric meters, pavement cuts, and linear depression. Compare notes of the actual site configuration to the preliminary site plan. Note deviations in the field logbook and on the preliminary site plan. Accurately locate or survey and clearly mark with stakes, pins, flags, paint, or other suitable devices all areas where subsurface exploration is proposed. These areas shall correspond with the locations drawn on the preliminary site plan.

Following the initial site visit by the FM, a trained utility locator will locate, identify, and tone all utilities depicted on the preliminary site plan. The locator should use appropriate sensing equipment to attempt to locate utilities that might not have appeared on the as-built plans. This may involve the use of surface geophysical methods (Procedure I-B-2, *Geophysical Testing*). At a minimum, use a utility locator, metal detector, and/or magnetometer; however, it is important to consider the possibility that non-metallic utilities or tanks might be present at the site. Use other appropriate surface geophysical methods, such as Ground Penetrating Radar, if non-metallic cultural features are likely to be present at the site. Clear proposed exploration areas of all utilities in the immediate area where subsurface exploration is proposed. Clearly tone all anomalous areas. Clearly identify all toned areas on the preliminary site plan. After toning the site and plotting all known or suspected buried utilities on the preliminary site plan, the utility locator shall provide the FM with a copy of the completed preliminary site plan. Alternatively, the FM or designee shall document the results of the survey on the preliminary site plan.

Report to the FM anomalous areas detected and toned that are in close proximity to the exploration or excavation areas. The FM shall determine the safe distance to maintain from the known or suspected utility. It may be necessary to relocate proposed exploration or excavation areas. If this is required, the FM or a similarly qualified individual shall relocate them and clearly mark them using the methods described above. Completely remove the markings at the prior location. Plot the new locations on the site plan and delete the prior locations from the plan. In some instances, such as in areas extremely congested with subsurface utilities, it may be necessary to dig by hand to determine the location of the utilities.

5.5 Prepare Site Plan

Prior to the initiation of field activities, draft a final site plan that indicates the location of subsurface exploration areas and all known or suspected utilities present at the site. Provide copies of this site plan to the Contracting Officer’s Representative (COR), the CTO Manager, and the subcontractor who is to conduct the subsurface exploration/excavation work. Review the site plan with the COR to verify its accuracy prior to initiating subsurface sampling activities.

6. Records

Keep a bound field logbook detailing all activities conducted during the utility locating procedure. The logbook will describe any changes and modifications made to the original exploration plan. The trained utility locator shall prepare a report and keep it in the project file. Also keep a copy of the final site plan on file.

7. Health and Safety

Field personnel shall perform work in accordance with the current (or as contractually obligated) United States Army Corps of Engineers Safety and Health Requirements Manual EM-385-1-1 (USACE 2008) and site-specific health and safety plan.

8. References

Department of Defense, United States (DoD). 2005. *Uniform Federal Policy for Quality Assurance Project Plans, Part 1: UFP-QAPP Manual*. Final Version 1. DoD: DTIC ADA 427785, EPA-505-B-04-900A. In conjunction with the U. S. Environmental Protection Agency and the Department of Energy. Washington: Intergovernmental Data Quality Task Force. March. On-line updates available at: http://www.epa.gov/fedfac/pdf/ufp_qapp_v1_0305.pdf.

Department of the Navy (DON). 2014. *Environmental Readiness Program Manual*. OPNAV Instruction 5090.1D. 10 January.

Joint Base Pearl Harbor-Hickam (JBPHH). 2013. *Dig Permit Requests.* JBPHH Instruction 11013.1. 15 March 2013.

United States Army Corps of Engineers (USACE). 2008. *Consolidated Safety and Health Requirements Manual*. EM-385-1-1. Includes Changes 1–7. 13 July 2012.

Procedure I-B-2, *Geophysical Testing.*

9. Attachments

None.

Investigation-Derived Waste Management

1. Purpose

This standard operating procedure describes the activities and responsibilities of the United States (U.S.) Navy Environmental Restoration (ER) Program, Naval Facilities Engineering Command (NAVFAC), Pacific with regard to management of investigation-derived waste (IDW). The purpose of this procedure is to provide guidance for the minimization, handling, labeling, temporary storage, inventory, classification, and disposal of IDW generated under the ER Program. This procedure will also apply to personal protective equipment (PPE), sampling equipment, decontamination fluids, non-IDW trash, non-indigenous IDW, and hazardous waste generated during implementation of removal or remedial actions. The information presented will be used to prepare and implement work plans (WPs) for IDW-related field activities. The results from implementation of WPs will then be used to develop and implement final IDW disposal plans.

2. Scope

This procedure applies to all Navy ER projects performed in the NAVFAC Pacific Area of Responsibility.

This procedure shall serve as management-approved professional guidance for the ER Program and is consistent with protocol in the Uniform Federal Policy-Quality Assurance Project Plan (DoD 2005). As professional guidance for specific activities, this procedure is not intended to obviate the need for professional judgment during unforeseen circumstances. Deviations from this procedure while planning or executing planned activities must be approved and documented by the following prime contractor representatives: the CTO Manager and the Quality Assurance (QA) Manager or Technical Director. A Navy project representative (i.e., Remedial Project Manager or QA Manager) shall also concur with any deviations.

This procedure focuses on the requirements for minimizing, segregating, handling, labeling, storing, and inventorying IDW in the field. Certain drum inventory requirements related to the screening, sampling, classification, and disposal of IDW are also noted in this procedure.

3. Definitions

3.1 IDW

IDW consists of all materials generated during site investigations that might be contaminated with chemicals of concern. IDW might consist of many types of potentially contaminated materials, including but not limited to, PPE, disposable sampling and decontamination equipment, investigation-derived soil, sludge, and sediment, well development and purge water, and decontamination fluids.

3.2 PPE

PPE, as defined in this procedure, refers to all disposable materials used to protect personnel from contact with potentially contaminated site media, such as inner and outer gloves, Tyvek suits and overboots, and disposable respirator cartridges. Non-consumable items, such as steel-toe boots, respirators, and hard hats are not included in this procedure.

3.3 DISPOSABLE SAMPLING EQUIPMENT

Disposable sampling equipment consists of all single-use equipment that might have come in contact with potentially contaminated site media, including sample bailers, Draeger air monitoring tubes, used soil sampling trowels and spatulas, plastic drop cloths, plastic bags and bucket liners, and sample containers from field analytical test kits.

3.4 INVESTIGATION-DERIVED SOIL, SLUDGE, AND SEDIMENT

Investigation-derived soil consists of all potentially contaminated soil that is disturbed as part of site investigation activities. The most commonly encountered form of IDW soil is drill cuttings brought to the ground surface by drilling. Other forms of disturbed soil, including trenching spoils and excess soil remaining from surface sampling, should not be stored as IDW. Excavated soil should be returned to its source if site conditions permit.

Investigation-derived sludge consists of all potentially contaminated sludge materials generated or disturbed during site investigation activities. Generated sludge might consist of drilling mud used or created during intrusive activities. Other sludge might include solvents or petroleum-based materials encountered at the bottom of storage tanks and grease traps.

Investigation-derived sediment consists of all potentially contaminated sediments that are generated or disturbed during site investigation activities. Generated sediments might include solids that settle out of suspension from well development, purge, or decontamination water (see Definitions 3.5 and 3.6) while stored in 55-gallon drums or during sample filtration. Disturbed sediments might also consist of catch basin sediments or excess sediment from surface water activities.

3.5 WELL DEVELOPMENT AND PURGE WATER

Development water consists of groundwater withdrawn from newly installed monitoring wells in preparation for well purging or pump testing. Monitoring well development methods are discussed in Procedure I-C-2, *Monitoring Well Development*.

Purge water consists of groundwater that is removed from monitoring wells immediately prior to sampling. Well purging methods are discussed in Procedure I-C-3, *Monitoring Well Sampling*. Groundwater derived during aquifer testing shall be addressed on a site-specific basis. Procedures for handling groundwater generated during aquifer testing shall be included in the WP or equivalent document for the CTO.

3.6 DECONTAMINATION FLUIDS

Decontamination fluids consist of all fluids used in decontamination procedures conducted during site investigation activities. These fluids consist of wash water, rinse water, and solvents used for the decontamination of non-consumable PPE, sampling equipment, and drilling equipment. Decontamination procedures are discussed in Procedure I-F, *Equipment Decontamination*.

3.7 NON-IDW TRASH

Non-IDW trash is all waste materials, such as waste paper, drink containers, food, and packaging, generated in the support zone that have not come in contact with potentially contaminated site media.

3.8 Non-Indigenous IDW

Non-indigenous IDW consists of all waste materials from offsite sources that are generated in the transition or contamination reduction zones and have not come in contact with potentially contaminated site media. Non-indigenous IDW includes materials, such as PPE from "clean" field activities (e.g., field blank generation, water sampling events) and refuse from monitoring well installation (e.g., unused sections of well casing, used bentonite buckets, sand bags, and cement bags).

Non-indigenous waste does not include material/waste that is abandoned at the ER site (including the IDW waste storage area) by other parties not associated with the ER work. Disposal of abandoned material/waste in the vicinity of IDW is the responsibility of the property owner (e.g., Navy Region Hawaii) or party responsible for abandoning the material/waste. The ER contractor shall notify the Contracting Officer's Representative (COR) of the situation as soon as possible so that recovery actions can be coordinated by the Government.

3.9 Resource Conservation and Recovery Act (RCRA) Hazardous Waste

Under the RCRA, a solid waste that is not excluded from regulation is defined as hazardous if it:

- Is "listed" as a hazardous waste in Chapter 40, Code of Federal Regulations (CFR), Parts 261.31 through 261.33
- Exhibits any of four hazardous "characteristics"—ignitability, corrosivity, reactivity, or toxicity (as determined using the Toxicity Characteristic Leachate Procedure [TCLP]) (40 CFR 261.20-24)
- Is subject to certain "mixture" or "derived-from" rules (40 CFR 261.3).

Under certain circumstances, petroleum- or polychlorinated biphenyl (PCB)-contaminated wastes are not considered RCRA hazardous when they only exhibit toxicity characteristic (40 CFR 261.4(b)(10) and 261.8). If IDW is determined to be RCRA hazardous waste, then RCRA storage, transport, and disposal requirements shall apply unless exempt.

3.10 RCRA Land Disposal Restrictions (LDR)

Land disposal, as defined in RCRA, is any placement of RCRA hazardous waste on the land in a waste pile, landfill, impoundment, well, land treatment area, etc. LDRs are regulatory restrictions placed on land disposal, including pre-treatment standards, engineered containment, capacity constraints, and reporting and permitting requirements.

3.11 Area of Contamination (AOC)

The U.S. Environmental Protection Agency (EPA) considers the RCRA AOC to be a single land-based disposal unit, usually a "landfill," and includes non-discrete land areas in which there is generally dispersed contamination. Storing IDW in a container (i.e., portable storage devices, such as drums and tanks) within the AOC and returning it to its source, whether RCRA hazardous or not, does not trigger RCRA LDRs. In addition, sampling and direct replacement of wastes within an AOC do *not* constitute land disposal.

3.12 CERCLA Hazardous Substances

The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) hazardous substances are listed in 40 CFR Table 302.4 and include substances regulated by the RCRA Subtitle C, Clean Water Act (CWA), Clean Air Act (CAA), and Toxic Substances Control Act (TSCA). The CFR is updated annually; therefore, the most recent CFR should be referenced for the CERCLA hazardous waste list.

CERCLA hazardous substances are defined independent of their concentration level (i.e., any detection of a listed CERCLA constituent is considered a “CERCLA hazardous substance”). “Reportable quantities” identified for chemicals in 40 CFR Table 302.4 concern only CERCLA and RCRA requirements for notification to EPA when a release has occurred; they do not dictate whether a chemical is a hazardous substance.

The definition of CERCLA hazardous substances excludes “petroleum, including crude oil or any fraction thereof;” natural gas; natural gas liquids; liquefied natural gas; and synthetic gas usable for fuel, unless specifically listed or designated under the act. Excluded fractions of crude oil contain hazardous substances, such as benzene, that are indigenous in those petroleum substances or that are normally mixed with or added to petroleum during the refining process. However, hazardous substances that are (1) added to petroleum after the refining process, (2) increase in concentration as a result of contamination of the petroleum during use, or (3) commingled with petroleum after a release to the environment, are not considered part of the petroleum exclusion provision, and therefore, are regulated under CERCLA. In addition, some waste oils are regulated under CERCLA because they are specifically listed.

The scope of CERCLA hazardous substances includes the smaller subsets of RCRA hazardous wastes, PCB Aroclors, and other constituents. Therefore, a RCRA hazardous waste is always considered a CERCLA hazardous substance for a CERCLA-driven response action; however, a CERCLA hazardous substance is not always a RCRA hazardous waste.

CERCLA only regulates releases or threats of releases of hazardous substances into the environment. If there is no evidence that (1) a release has occurred (based on site history, visual observations, background metals evaluation), (2) there is a threat of release (as from abandoned, discarded, or non-maintained chemical receptacles), or (3) the release has entered the environment (as defined below), then CERCLA does not regulate the constituent even though it is identified on the CERCLA hazardous substance list.

3.12.1 CERCLA Hazardous Substances: TSCA/PCBs

PCBs are a CERCLA hazardous substance. PCBs belong to a broad family of man-made organic chemicals known as chlorinated hydrocarbons. PCBs were domestically manufactured from 1929 until their manufacture was banned in 1979. They have a range of toxicity and vary in consistency from thin, light-colored liquids to yellow or black waxy solids. Due to their non-flammability, chemical stability, high boiling point, and electrical insulating properties, PCBs were used in hundreds of industrial and commercial applications including electrical, heat transfer, and hydraulic equipment; as plasticizers in paints, plastics, and rubber products; in pigments, dyes, and carbonless copy paper; and many other industrial applications. Although no longer commercially produced in the United States, PCBs may be present in products and materials produced before the 1979 PCB ban.

If PCBs are detected at concentrations equal to or greater than 50 parts per million (ppm), the sample is considered TSCA-regulated. Current PCB regulations can be found in the CFR at 40 761. The EPA Q and A Manual (EPA 2009), referring to CFR 761.61 explains PCB remediation waste must be managed and disposed of based on the concentration at which the PCBs are found. It is unacceptable to dilute the as-found concentration of the contaminated soil by mixing it with clean soil during excavation or other IDW management activities.

3.13 ENVIRONMENT

Environment means navigable waters, ocean waters, surface water, groundwater, drinking water supply, land surface or subsurface strata, and ambient air, within the U.S. or under federal jurisdiction (see Section 101(8) of CERCLA or 40 CFR 300.5 for complete definition).

3.14 ONSITE AREA

The CERCLA onsite area is defined in 40 CFR 300.400(e)(1) as an area that includes:

- AOC
- All suitable areas in very close proximity to the contamination that are necessary for the implementation of the response action

The delineation of the onsite area is further discussed in Volume 55 Federal Register (FR) Page 8688 and EPA guidance.

Neither CERCLA, the National Oil and Hazardous Substances Pollution Contingency Plan, nor RCRA define the terms “area of contamination” or “contamination.” However, the area of contamination is interpreted as containing “varying types and concentrations of contaminants” (55 FR 8760) that may or may not pose a risk to human health or the environment.

The onsite area may also include several noncontiguous aerial extents of contaminations if they share a common nexus (55 FR 8690).

3.15 OFFSITE AREA

The offsite area consists of all areas outside the onsite area.

3.16 CERCLA OFFSITE RULE

The CERCLA offsite rule (400 CFR 300.440) states that IDW containing CERCLA hazardous substances (at any concentration) must be stored, treated, or disposed of offsite only at facilities having current EPA approval to accept such CERCLA wastes. RCRA-permitted facilities (Subtitle C and D) must also have specific EPA approval to accept waste generated at a CERCLA site (even if the waste is RCRA hazardous).

With some restrictions, the offsite rule does not apply to the following:

- Wastes generated during non-CERCLA actions
- Treatability study samples

- Wastes generated during emergency response actions
- Laboratory samples

CERCLA allows IDW to be managed, stored, and disposed of onsite within or near the AOC without the need for EPA approval (i.e., CERCLA facility approval) or RCRA permits. If IDW is to be stored or disposed of on site, the onsite area (and the AOC) should be delineated on a figure in the project field book and revised, based on best professional judgment, as site data become available.

4. Responsibilities

The prime contractor CTO Manager is responsible for preparing WPs and IDW disposal plans and reports in compliance with this procedure, and is responsible for documenting instances of noncompliance. The CTO Manager is responsible for ensuring that all personnel involved in sampling and/or testing shall have the appropriate education, experience, and training to perform their assigned tasks as specified in Chief of Naval Operations Instruction 5090.1, under *Specific Training Requirements* (DON 2014).

The prime contractor QA Manager or Technical Director is responsible for ensuring overall compliance with this procedure.

The Field Manager is responsible for implementing this IDW procedure and ensuring that all project field staff follow these procedures.

Field personnel are responsible for the implementation of this procedure.

5. IDW Management Procedures

The procedures for IDW management in the field are described below.

5.1 Planning for IDW Management

The project team should begin planning for IDW issues early in the site investigation planning stage. The proper management of IDW involves all of the following tasks:

- Obtain Navy approval for a designated IDW storage area prior to commencement of field work
  - Complete Navy form, including IDW Tracking Sheet and provide to remedial project manager (RPM) for processing
- Waste generation and minimization
- Chemical screening and characterization of the waste
- Waste handling, storage, and associated maintenance in compliance with all regulations (prepare an IDW drum inventory, ensure storage areas are compliant with type of waste [double containment, TSCA requirements, etc.] maintain condition of drum and labeling, maintain safety and assess controls, comply with permit requirements [for offsite storage])
- Waste transport and disposal within required holding times
- Waste tracking, documentation, record keeping, and reporting

As part of IDW planning, the CTO Manager should consult with the COR and environmental regulatory agencies to clearly identify the primary federal or state regulatory authority that is driving the site investigation. This authority may be CERCLA, RCRA (Subtitle C), RCRA (subtitle I), TSCA, CWA, or an equivalent state program. The primary investigation authority and regulations promulgated under this authority set forth requirements for IDW management. These requirements may differ under the various response authorities. For CERCLA-driven actions, IDW storage and disposal should comply with all applicable or relevant and appropriate requirements (ARARs) and to-be-considered (TBC) criteria to the extent practicable.

Lastly, the CTO Manager should consider the disposal criteria of the anticipated disposal facility when developing the sampling and analysis plan (SAP). Some offsite facilities do not accept waste that is characterized by association with samples collected from the investigation site or they may require analytical data for chemicals that are not of potential concern at the site. Facility disposal criteria may dictate laboratory reporting limits.

If unknown waste is observed onsite, notify the project RPM and COR for further instructions.

5.2 IDW MINIMIZATION

Field managers (FMs) and their designates shall minimize the generation of onsite IDW to reduce the need for special storage or disposal requirements that might result in substantial additional costs and provide little or no reduction in site risks (EPA 1992b). Reduce the volume of IDW by applying minimization practices throughout the course of site investigation activities. These minimization strategies include substitution of biodegradable raw materials; using low-volume IDW-generating drilling techniques; where possible, returning excess material to the source location; using disposable sampling equipment versus generating more decontamination fluids from reusable sampling equipment; using bucket and drum liners; and separating trash from IDW.

Material substitution consists of selecting materials that degrade readily or have reduced potential for chemical impacts to the site and the environment. An example of this practice is the use of biodegradable detergents (e.g., Alconox or non-phosphate detergents) for decontamination of non-consumable PPE and sampling equipment. In addition, field equipment decontamination can be conducted using isopropyl alcohol rather than hexane or other solvents (for most analytes of concern) to reduce the potential onsite chemical impacts of the decontamination solvent. Select decontamination solvents carefully so that the solvents, and their known decomposition products, are *not* potentially RCRA hazardous waste, unless absolutely necessary.

Give priority to drilling methods that minimize potential IDW generation. Select hollow-stem auger and air rotary methods, where feasible, over mud rotary methods. Mud rotary drilling produces waste drilling mud, while hollow stem and air rotary drilling methods produce relatively low volumes of soil waste. Use small-diameter borings and cores when soil is the only matrix to be sampled at the boring location; however, the installation of monitoring wells requires the use of larger-diameter borings.

If possible, return soil, sludge, or sediment removed from borings, containment areas, and shallow test trenches to the source immediately after sampling and/or geological logging of the soils (EPA 1991, 1992b). Immediate replacement of solid waste in the source location during investigation activities avoids RCRA LDRs, which permit movement of IDW within the same AOC without considering land disposal to have occurred, even if the IDW is later determined to contain RCRA hazardous material (EPA 1991). Place soil IDW from borings and trenches on polyethylene sheeting (e.g., Visqueen) during excavation and segregate it by approximate depth and any apparent contamination (i.e., visible staining). Following excavation, replace the soil IDW from above the saturated layer into the boring or trench and compact it, if possible. Efforts should be made to return the waste to the approximate depth from which it was generated. Soil and sludge IDW generated at or below the saturated layer of a boring or trench should be placed in drums and not returned to the source area. Suspected contaminated soil and sludge IDW generated above the saturated layer of a boring or trench should not be returned below the saturated layer."

Often monitoring wells are constructed outside the area of concern for soil contamination to sample for potential groundwater contamination or collect characteristic background data. At these locations, soil cuttings generated from above the saturation zone may be immediately disposed of near the wellhead in a shallow pit covered with natural topsoil from the site, and compacted. Contain soil and sludge IDW generated at or below the saturated layer in drums.

Reduce the quantity of decontamination rinse water generated by using dedicated and disposable sampling equipment, such as plastic bailers, trowels, and drum thieves that do not require decontamination. In general, decontamination fluids, and well development and purge water should not be minimized because the integrity of the associated analytical data might be affected.

Minimize the storage of visibly soiled PPE and disposable sampling equipment IDW by implementing decontamination procedures. If, based upon the best professional judgment of the FM, the PPE and disposable sampling equipment can be rendered non-contaminated after decontamination, then double-bag the PPE and disposable sampling equipment and dispose of it off site at a (RCRA Subtitle D) municipal solid waste disposal facility at the end of each work day (EPA 1991, 1992b). Since the decontaminated waste does not contain CERCLA hazardous substances, it need not be disposed of at a CERCLA-approved disposal facility in accordance with the CERCLA offsite rule.

Bucket liners can be used in the decontamination program to reduce the volume of solid IDW generated, and reduce costs on larger projects. The plastic bucket liners can be crushed into a smaller volume than the buckets, and only a small number of plastic decontamination buckets are required for the entire project. The larger, heavy-duty, 55-gallon drum liners can be used for heavily contaminated IDW to provide secondary containment, and reduce the costs of disposal and drum recycling. Drum liners may extend the containment life of the drums in severe climates and will reduce the costs of cleaning out the drums prior to recycling.

All waste materials generated in the support zone are considered non-IDW trash. To minimize the total volume of IDW, separate all trash from IDW, seal it in garbage bags, and properly dispose of it off site as municipal waste at the end of each work day.

Keep excess cement, sand, and bentonite grout prepared for monitoring well construction to a minimum. FMs shall observe well construction to ensure that a sufficient, but not excessive, volume of grout is prepared. Some excess grout may be produced. Unused grout (that should not come in contact with potentially contaminated soil or groundwater) shall be considered non-hazardous trash, and the drilling subcontractor shall dispose of it off site. Surplus materials from monitoring well installation, such as scrap plastic sections, used bentonite buckets, and cement/sand bags that do not come in contact with potentially contaminated soil, shall be considered non-IDW trash, the drilling subcontractor shall dispose of it off site.

Following proper segregation procedures, as discussed in the next section, can minimize the quantity of contaminated IDW generated.

5.3 SEGREGATION OF IDW BY MATRIX AND LOCATION

It is necessary to properly segregate IDW in order to:

- Avoid commingling contaminated waste with clean waste, thereby creating a larger volume of waste that must be treated as contaminated
- Facilitate the sampling, screening, classification, and disposal of waste that may require different management methods

Take efforts to segregate IDW even when these activities will increase storage container and storage space requirements. These efforts will drastically reduce the sampling and documentation required for characterizing the waste and their associated costs.

In general, segregate IDW by matrix and source location and depth at the time it is generated. IDW from only one matrix shall be stored in a single drum (e.g., soil, sediment, water or PPE shall *not* be mixed in one drum). Groundwater and decontamination water should not be commingled; however, development and purge water from the same well may be stored together.

In general, IDW from separate sources should not be combined in a single drum or stockpile. Take efforts to segregate waste by increments of depth below ground surface. Most importantly, segregate soil IDW generated at or from below the saturated zone from soil generated above this zone (soil below this zone might be impacted by contaminated groundwater, whereas soil above the zone may be “clean”). Similarly, segregate soil above and below an underground storage tank (UST). Label each drum of soil to indicate the approximate depth range from which it was generated; this task may require cuttings to be segregated on plastic sheeting as they are generated or drums to be filled during the trenching or boring operation if this can be done in a safe manner.

It is possible that monitoring well development and purge water will contain suspended solids, which will settle to the bottom of the storage drum as sediment. Include significant observations on the turbidity or sediment load of the development or purge water in the logbook see Procedure III-D, *Logbooks* and Section 5.5). To avoid mixed matrices in a single drum (i.e., sediment and water), it may be necessary to decant the liquids into a separate drum after the sediments have settled out. This segregation may be accomplished during subsequent IDW sampling activities or during consolidation in a holding tank prior to disposal.

Place potentially contaminated well construction materials in a separate drum. No soil, sediment, sludge, or liquid IDW shall be placed in drums with potentially contaminated waste well construction materials. In addition, potentially contaminated well construction materials from separate monitoring wells shall not be commingled.

Store potentially contaminated PPE and disposable sampling equipment in drums separate from other IDW. Segregate PPE from generally clean field activities, such as water sampling, from visibly soiled PPE, double-bag it, and dispose of it off site as municipal waste. Disposable sampling equipment from activities, such as soil, sediment, and sludge sampling, includes plastic sheeting used as liner material in containment areas around drilling rigs and waste storage areas, disposable sampling equipment, and soiled decontamination equipment. If, according to the Field Manager's best professional judgment, the visibly soiled PPE can be decontaminated and rendered non-hazardous, then double-bag the decontaminated PPE and disposed of it off site as municipal waste (EPA 1991, 1992b). PPE and disposable sampling equipment generated on separate days in the field may be combined in a single drum, provided clean and visibly soiled IDW are segregated as discussed above.

IDW generated from the use of field analytical test kits consists of those parts of the kit that have come into contact with potentially contaminated site media, and used or excess extracting solvents and other reagents. Contain potentially contaminated solid test kit IDW in plastic bags and store it with contaminated PPE or disposable sampling equipment IDW from the same source area as soil material used for the analyses. Segregate the small volumes of waste solvents, reagents, and water samples used in field test kits, and dispose of it accordingly (based upon the characteristics of the solvents as described in this procedure). Most other test kit materials should be considered non-IDW trash, and be disposed of as municipal waste.

Store decontamination fluids in drums separate from groundwater and other IDW. If practical, decontamination fluids generated from different sources should not be stored in the same drum. If decontamination fluids generated over several days or from different sources are stored in a single drum, record information about the dates and IDW sources represented in the drum. Note this information in the field notebook, on the drum label (Section 5.4.3), and in the drum inventory (Section 5.5).

The FM and designated personnel should separate the liquid and sediment portions of the equipment decontamination fluid present in the containment unit used by the drilling or excavation field crew. The contents of this unit normally consist of turbid decontamination fluid above a layer of predominantly coarse-grained sediment. When the contents of the containment unit are to be removed for storage in IDW drums, the FM shall instruct the field crew to place as much of the liquid into drums as possible and transfer the remaining solids into separate drums. Note observations of the turbidity and sediment load of the liquid IDW in the field notebook, on the drum label (Section 5.4.3), and in attachments to the drum inventory (Section 5.5). It is likely that decontamination fluids will contain minor amounts of suspended solids that will settle out of suspension to become sediment at the bottom of IDW storage drums. As noted above, it may be necessary to segregate the drummed water from sediment during subsequent IDW sampling or disposal activities.

Documentation for waste storage containers should include IDW source and segregation information and be maintained as follows:

1. Field logbook should be updated, at least weekly, with all IDW drum additions – update storage area location map to include new drum position and drum number.

2. External drum log (hard copy and electronic copy) should be updated with each IDW drum addition (drum numbers, source, and generation date) and closure of drum (fill date).

5.4 DRUM FILLING, HANDLING, AND LABELING, AND INVENTORYING

Drum handling consists of those actions necessary to prepare an IDW drum for labeling. Drum labeling consists of those actions required to legibly and permanently identify the contents of an IDW drum.

5.4.1 Drum Filling

Each drum of solid IDW shall be completely filled, when possible. For liquid IDW, drums should be left with headspace of approximately 5 percent by volume to allow for expansion of the liquid and potential volatile contaminants.

5.4.2 Drum Handling

IDW shall be containerized using U.S. Department of Transportation-(DOT) approved drums. The drums shall be made of steel or plastic, have a 55-gallon capacity, be completely painted or opaque, and have removable lids (i.e., United Nations Code 1A2 or 1H2). Drums having removable lids with bung holes are preferred to facilitate verification of drum contents. Typically 55-gallon drums are used, however small drums may be used depending on the amount of waste generated. New steel drums are preferred over recycled drums. Recycled drums should not be used for hazardous waste, PCBs or other regulated shipments. For short-term storage of liquid IDW prior to discharge, double-walled bulk steel or plastic storage tanks may be used. For this scenario, consider the scheduling and cost-effectiveness of this type of bulk storage, treatment, and discharge system versus longer-term drum storage.

The Guam Environmental Protection Agency may require double-walled drums or other secondary containment for the storage of liquid IDW. For long-term IDW storage at other project locations, the DOT-approved drums with removable lids are recommended. Verify the integrity of the foam or rubber sealing ring located on the underside of some drum lids prior to sealing drums containing IDW liquids. If the ring is only partially attached to the drum lid, or if a portion of the ring is missing, select another drum lid with a sealing ring that is in sound condition.

To prepare IDW drums for labeling, wipe clean the outer wall surfaces and drum lids of all material that might prevent legible and permanent labeling. If potentially contaminated material adheres to the outer surface of a drum, wipe that material from the drum, and segregate the paper towel or rag used to remove the material with visibly soiled PPE and disposable sampling equipment. Label all IDW drums and place them on appropriate pallets prior to storage.

5.4.3 Drum Labeling

Proper labeling of IDW drums is essential to the success and cost-effectiveness of subsequent waste screening and disposal activities (see Attachment I-A-6-1 and Attachment I-A-6-2). Labels shall be permanent and descriptive to facilitate correlation of field analytical data with the contents of individual IDW drums. Label all IDW drums using the **three distinct labeling methods** described below to ensure durability of the information. These three methods are completing and affixing preprinted NAVFAC Pacific ER Program labels; marking information on drum surfaces with paint; and, affixing aluminum tags to the drum. **Use of the preprinted labels, painted labeling, and aluminum tags is *mandatory***. These methods are described below.

5.4.3.1 Preprinted Labels

Complete **two** preprinted NAVFAC Pacific ER Program drum labels as described below and presented in Attachment I-A-6-1. Seal both labels in separate heavy-duty, clear plastic bags, or use permanent markers on weatherproof stickers, to prevent moisture damage.

1. Place one label on the outside of the drum with the label data facing outward. Affix the bag/sticker to the drum at the midpoint of the drum height using a sufficient quantity of adhesive tape (e.g., duct tape, packing/strapping tape) so the bag will remain on the drum as long as possible during storage.

2. Affix the second label (sealed as mentioned above) to the underside of the drum lid, sealing it inside the drum when the lid is replaced.

The use of two or more preprinted labels for outer IDW drum identification purposes should be considered as a short-term backup to the information on the aluminum tags discussed below.

Print the requested information legibly on the drum labels in black, indelible ink. Instructions for entering the required drum-specific information for each label field are presented below:

CTO: Enter the four-digit number of the CTO for the project during which the IDW was generated. Include any initial zeroes in the CTO number (e.g., CTO 0047).

Activity-Site: Enter the name of the Navy activity responsible for the project site (e.g., Naval Supply Center, Naval Facilities Engineering Command Hawaii) and the name of the site where the project is taking place (e.g., Orote, Landfill, Building [Bldg.] 18).

Drum#: Enter the drum identification number according to the convention described below.

(xxxx-AA-DMzzz);

Where:

xxxx	represents the four-digit CTO number
AA	represents the unique site identifier assigned by the CTO Manager for multiple site CTOs (e.g., for CTO 0047, OW denotes Old Westpac, OR denotes Orote)
DM	represents a *drum* identification number
zzz	the sequential drum number for the site, beginning with 001

Date Collected: Enter the date the IDW was generated and placed in the drum. If IDW was generated over a number of days, enter the start and end dates for the period.

Contents: Record the source identification number on the label. Enter a "√" in the box corresponding to the type of IDW placed in the drum. For "Soil" and "Water," use the line provided to record observations on the condition of the drum contents (e.g., diesel odor, high turbidity, specific liquid IDW type). Check "Solid Waste" for PPE and indicate that PPE is present in the drum. Check

“Other” for disposable sampling equipment and potentially contaminated monitoring well construction materials, and indicate the type of waste on the line provided.

Project Type: Enter a “√” in the box corresponding to the type of investigation. Choices are Remedial Investigation, RCRA Facility Inspection, UST, and Other. If “Other” is specified, indicate the type of project in the “Comments” area, as described below.

Comments: Enter any additional information regarding the drum contents that will assist individuals who will characterize and dispose of the contents of the drum. “Other” project types include Site Inspection, Feasibility Study, Removal/Remedial Action, and Emergency Response activity. In addition, use this space on the label to complete any descriptions that were too large to fit in preceding label fields, such as the turbidity of decontamination water or the site activities from which the PPE was generated.

For Information Contact: Enter the project COR activity / code, address, and phone number.

It is essential that all relevant information recorded on individual drum labels be repeated in the field notebook for later development of the drum inventory database (see Section 5.5 and Procedure III-D, *Logbooks*).

5.4.3.2 Painted Labels

The second method for labeling drums is to paint label information directly on the outer surface of the drum. At a minimum, the information placed on the drum shall include the CTO number, the drum number (following the numbering convention given above), the source identification number and type, the generation date(s), and the telephone number provided at the bottom of the preprinted label appropriate for the project location. The drum surface shall be dry and free of material that could prevent legible labeling. Confine label information to the upper two-thirds of the total drum height. The top surface of the drum lid may be used as an additional labeling area, but this area should only be used *in addition* to the upper two-thirds of the sides of the drum. The printing on the drum shall be large enough to be easily legible. Yellow, white, black, or red paint markers (oil-based enamel paint) that are non-photodegradable are recommended to provide maximum durability and contrast with the drum surface.

5.4.3.3 Aluminum Tags

The third method for labeling drums is to affix an aluminum tag to the drum with neatly printed information that shall consist of the **CTO number**, the **drum identification number**, the **type of contents**, the **generation date(s)**, the **source** identification number and type, and the **telephone number** provided at the bottom of the appropriate preprinted label. Attachment I-A-6-2 to this procedure presents an example of the aluminum tag, which shall measure approximately 1 inch by 3 inches, or larger. When a ballpoint pen is used to fill out the aluminum tag, the information is permanently recorded as indentations on the tag. A fine ballpoint pen shall be used, and block-printed lettering is required for legibility. Indentations on the tag shall be sufficiently deep to be legible after the label has been exposed to weathering for an extended period.

Complete aluminum tags after the drum has been sealed. Affix the tags to the drum using a wire, which passes through predrilled holes in the label and shall be wrapped around the bolt used to seal the drum lid. The wire is the most likely part of the aluminum tag to decay during exposure. Use of plastic insulated, copper-core electrical wire of appropriate diameter is recommended if long-term exposure to severe weathering is anticipated.

5.4.3.4 WASTE LABELS

Standard green and white non-hazardous and/or other hazardous waste stickers may be used in conjunction with, but not in lieu of, the above labeling procedures.

5.5 DRUM INVENTORY

Accurate preparation of an IDW drum inventory is essential to all subsequent activities associated with IDW drum tracking and disposal. Prepare an inventory for each project in which IDW is generated, stored, and disposed of. This information provided in the inventory report constitutes the results of preparing and implementing an IDW sampling, screening, characterization, and disposal program for each site.

The drum inventory information shall include 10 elements that identify drum contents and indicate their outcome. These elements are discussed in Sections 5.5.1 through 5.5.10.

5.5.1 Navy Activity (Generator)/Site Name

Inventory data shall include the Navy activity and the site name where the IDW was generated (e.g., Fleet Industrial Supply Center Pearl/Red Hill, Naval Magazine Headquarters/USTs).

5.5.2 CTO Number

Inventory data shall include the four-digit CTO number associated with each drum (e.g., 0089) and contract number as necessary.

5.5.3 Drum Number

Include the drum number assigned to each drum in the inventory database. Drum numbers shall adhere to the numbering convention presented in Section 5.4.3.1 (e.g., 0091-LF-DM006).

5.5.4 Storage Location Prior to Disposal

Include the storage location of each drum prior to disposal in the inventory database (e.g., Bldg. 394 Battery Disassembly Area, or Adjacent to West end of Bldg. 54). As part of the weekly inventory, a site visit to the IDW storage location shall be performed to observe the condition of the drums and covers. Drums and covers are considered acceptable when the integrity of the drums and covers are structurally intact, drum identification is legible, and the location of the drum storage is secure. An unacceptable classification will require recommendations to remedy the unacceptable classification.

5.5.5 Origin of Contents

Specify the source identification of the contents of each IDW drum in the inventory database (e.g., soil boring number, monitoring well number, sediment sampling location, or the multiple sources for PPE- or rinse water-generating activities).

5.5.6 IDW Type

Inventory data shall include the type of IDW in each drum (e.g., soil, PPE, disposable sampling equipment, sludge, sediment, development water, steam cleaning water, decontamination rinse water).

5.5.7 Waste Volume

Specify the amount of waste in each drum in the inventory database as a percentage of the total drum volume or an estimated percentage-filled level (e.g., 95 percent maximum for liquid IDW).

5.5.8 Generation Date

Inventory data shall include the date IDW was placed in each drum. If a drum contains IDW generated over more than one day, the start date for the period shall be specified in dd-mmm-yy format. This date is *not* to be confused with a RCRA hazardous waste accumulation date (40 CFR 262).

5.5.9 Expected Disposal Date

Specify the date each drum is expected to be disposed of as part of the inventory in mmm-yy format. This date is for the Navy's information only and shall not be considered contractually binding.

5.5.10 Actual Disposal Date

The actual drum disposal date occurs at the time of onsite disposal, or acceptance by the offsite treatment or disposal facility. Enter this date in the drum inventory data base only when such a date is available in dd-mmm-yy format.

Information required to complete all 10 of the inventory elements for the monthly inventory report described above and summarized in Attachment I-A-6-3, will be located on the IDW labels or provided by the CTO Manager.

Actual disposition of the IDW drum contents will be provided to the Navy.

5.6 IDW CLASSIFICATION

In general, the CTO Manager should follow IDW classification guidance contained in the *Generic IDW Disposal Plans* for Hawaii and Guam (Ogden 1994, 1995) and EPA guidance (EPA 1991, 1992a). The IDW classification process consists of chemical screening and characterization of the waste.

Various federal and state laws and guidance contain requirements for IDW management (handling, storage, transport, disposal, and recordkeeping) based on the type(s) and concentrations of chemicals present in the waste. To ensure that IDW is managed in compliance with these requirements and to evaluate disposal options, the CTO Manager should

- Directly sample and analyze the IDW or associate it with historical data, observed site conditions, and/or samples collected on site at the source of the waste
- Screen the waste to identify the maximum concentrations of individual chemicals in, or associated with, the waste

- Screen waste constituents against chemical background data, if available
- Characterize the waste based on regulated groups of chemical constituents present in the waste
- Screen waste constituents against risk-based health criteria, ARARs, and TBC criteria for onsite disposal, or disposal facility criteria for offsite disposal

Each of the above steps is distinct and should be performed separately to avoid potential mistakes in the IDW classification process. The following subsections discuss these steps in greater detail.

5.6.1 IDW Sampling and Chemical Screening

IDW should be screened to identify chemicals present in the waste and their maximum concentrations. Screening may be facilitated by (1) directly sampling the waste, (2) associating the waste with analytical results from samples collected at the source of the IDW (e.g., a well boring), (3) visual observation of the waste, (4) historical activity data from the site, or (5) a combination of these methods (e.g., association with limited sampling). Composite sampling may be required if the unit volume of IDW is non-homogeneous. Data from samples collected directly from the IDW should take precedence over associated site sample data when making waste management decisions. Procedure I-D-1, *Drum Sampling* discusses methods for drum sampling.

Typically, IDW is screened for chemicals of potential concern at the site and against background data if available. If IDW is generated from outside the suspected AOC (e.g., soil cuttings from the installation of a background monitoring well), assume it is clean, and dispose of it accordingly.

The CTO Manager should consider the disposal criteria of any offsite disposal facility anticipated to be used when developing the SAP. Some offsite facilities do not accept waste that is characterized by association with samples collected from the investigation site or they may require analytical data for chemicals that are not of potential concern at the site. Direct sampling and analysis of the waste may be required for these other constituents. Some disposal facilities prefer to collect and analyze the samples themselves. In addition, disposal facility criteria may dictate laboratory reporting limits. When possible, the CTO Manager should coordinate sampling and data requirements with the disposal subcontractor and anticipated disposal facility. Such efforts may allow IDW sampling to be conducted while the field team is mobilized for the site investigation, rather than conducting a separate IDW sampling event later.

5.6.2 IDW Characterization

Various federal and state laws and guidance contain requirements for IDW management (handling, storage, transport, disposal, and recordkeeping) based on the particular constituent or *group(s) of chemical constituents* present in the waste. Therefore, to ensure that IDW is managed in compliance with these requirements, characterize IDW based on the chemical screening results to determine whether any of the following regulated constituents are present in the waste:

- Petroleum hydrocarbons (regulated by RCRA Subtitle I when released from a UST; see 40 CFR Part 280)
- Hazardous wastes (regulated by RCRA Subtitle C; see 40 CFR 261-299)
- Non-hazardous, solid wastes (regulated by RCRA Subtitle D; see 40 CFR 257-258)

- Hazardous substances and commingled petroleum (regulated by CERCLA; see 40 CFR 300.400 and 302.4)
- PCBs (regulated by TSCA; see 40 CFR 700)
- Asbestos (regulated by CAA for disposal; see 40 CFR 61, Subpart M)
- Radioactive wastes (regulated by the Nuclear Regulatory Commission; see 10 CFR [various parts], 40 CFR, Subchapter F, and other applicable laws)

EPA regulations and guidance do not require IDW to be tested to properly characterize it. Instead waste may be characterized based on historical site data, site observations, analytical data from the source of the IDW, and professional judgment (EPA 1991). Specifically, the EPA has indicated that IDW may be assumed not to be “listed” wastes under RCRA unless available information about the site suggests otherwise (53 FR 51444). Similarly, RCRA procedures for determining whether waste exhibits RCRA hazardous characteristics do not require testing if the decision can be made by “applying knowledge of the hazard characteristic in light of the materials or process used” (40 CFR 262.11(c); EPA 1991). If applicable, the disposal plans and reports should state, “there is no evidence based on site data and observations that the IDW contains listed RCRA wastes or exhibits RCRA characteristics.”

For soil IDW, the potential for exhibiting toxicity may be determined by comparing constituent concentrations in the waste against screening values that are 20 times the TCLP criteria as specified in Section 1.2 of EPA Method Solid Waste-846 1311 *Toxicity Characteristic Leaching Procedure* (EPA 2007). Otherwise, samples associated with the soil can be tested using the TCLP.

5.7 IDW STORAGE

In general, the CTO Manager should follow IDW storage guidance contained in the *Generic IDW Disposal Plans* for Hawaii and Guam (Ogden 1994, 1995) and EPA guidance (EPA 1990, 1991, 1992a).

Always store IDW in a manner that is secure, protected from weather, and protective of human health and the environment. It is preferable to store IDW within the AOC(s) or on site; however, the Navy may assign a specific IDW storage area away from the project site.

If the IDW is determined to be RCRA hazardous, then RCRA storage, transport, and disposal requirements may apply, including a limited **90-day** storage permit exemption period prior to required disposal. If onsite disposal is an option, store RCRA waste within the AOC so that RCRA LDRs will not apply in the future. LDRs may be triggered if the waste is stored within the onsite area, but outside of the AOC or if the waste is removed from and later returned to the AOC for disposal. The AOC concept does not affect the approach for managing IDW that did not come from the AOC, such as PPE, decontamination equipment and fluids, and groundwater. If RCRA hazardous, these wastes must be managed under RCRA and drummed and disposed of off site (EPA 1991).

RCRA waste should not be stored within the AOC prior to disposal when professional judgment suggests the IDW might pose an immediate or permanent public endangerment (EPA 1991b).

Offsite storage of CERCLA waste must comply with the CERCLA offsite rule (40 CFR 300.440).

If the IDW is determined to be TSCA-regulated, then TSCA storage requirements as described in CFR 764.65, transport, and disposal requirements apply, including a limited **30-day** storage period prior to required disposal. Storage requirements are as follows:

1. Storage facilities must provide an adequate roof and walls to prevent rain water from reaching the stored PCBs.

2. Storage facilities must provide an adequate floor that has continuous curbing with a minimum 6-inch-high curb.

3. Storage facilities must contain no drain valves, floor drains, expansion joints, sewer lines, or other openings that would permit liquids to flow from the curbed area.

4. Storage facilities must provide floors and curbing constructed of continuous smooth and impervious materials to minimize penetration of PCBs.

5. Storage facilities must not be located at a site that is below the 100-year flood water elevation.

6. PCBs in concentrations of 50 ppm or greater must be disposed of within 1 year after being placed in storage.

PCB waste can also be stored in a RCRA-approved waste storage area for 30 days from date of generation.

NAVFAC Pacific requires that all CERCLA, RCRA, and other types of waste be removed from JBPHH areas within 90 days of its generation, particularly within the shipyard area, and 30 days of generation for TSCA waste. Efforts should also be made to dispose of IDW within the 30- and 90-day periods at other Navy installations, unless the IDW will be managed with remediation waste to be generated during a cleanup action in the near future. The Navy may approve extensions of the storage time limit for wastes that are non-hazardous on a project-specific basis.

5.7.1 Drum Storage

Implement drum storage procedures to minimize potential human contact with the stored IDW and prevent extreme weathering of the stored drums. Place all IDW drums upright on pallets before the drums are stored. RCRA storage requirements include the following: containers shall be in good condition and closed during storage; wastes shall be compatible with containers; storage areas shall have a containment system; and spills or leaks shall be removed as necessary.

Place all IDW drums generated during field activities at a single AOC or designated IDW storage area together in a secure, fenced onsite area to prevent access to the drums by unauthorized personnel. When a secure area is not available, place drums in an area of the site with the least volume of human traffic. At a minimum, place plastic sheeting (or individual drum covers) around the stored drums. Post signage at the IDW storage area stating that drums should not be removed from the area without first contacting the Navy COR.

Liquid IDW drums must be stored under secondary containment (either secondary containment pallets or handmade plastic sheeting/polyvinyl chloride frame containment) and all IDW drums (soil and water) must utilize secondary containment when stored within 15 feet of a surface water body or storm drain inlet.

Drums from projects involving multiple AOCs shall remain at the respective source areas where the IDW was generated. IDW should not be transferred off site for storage elsewhere, except under rare circumstances, such as the lack of a secure onsite storage area.

Implement proper drum storage practices to minimize damage to the drums from weathering and possible human exposure to the environment. When possible, store drums in dry, shaded areas and cover them with impervious plastic sheeting or tarpaulin material. Make every effort to protect the preprinted drum labels from direct exposure to sunlight, which causes ink on the labels to fade. In addition, store drums in areas that are not prone to flooding. Secure the impervious drum covers appropriately to prevent dislodging by the wind. It may be possible to obtain impervious plastic covers designed to fit over individual drums; nonetheless, repeat the labeling information on the outside of these opaque covers.

Drums in storage shall be placed with sufficient space between rows of drum pallets and shall not be stacked, such that authorized personnel may access all drums for inspection. Proper placement will also render subsequent IDW screening, sampling, and disposal more efficient when individual drum removal is necessary. It is recommended that IDW drums be segregated in separate rows/areas by matrix (i.e., soil, liquid or PPE/other).

If repeated visits are made to the project site, inspect the IDW drums to clear encroaching vegetation, check the condition and integrity of each drum, secondary containment if applicable, check and replace aluminum tags as necessary, and replace or restore the tarpaulin covers.

5.7.2 IDW Stockpiles

Consider IDW stockpiling only when a very large quantity of IDW will be generated. Segregate stockpiled IDW, and inventory it by source location and depth to the extent practicable. Stockpiling and media mixing should not be used as methods to dilute chemical concentrations in the waste. Line stockpiles on the bottom, cover it with sturdy plastic, and locate it in areas where weather elements (e.g., wind, rainfall runoff) will not cause migration of the waste. Never dispose of liquid IDW on a stockpile; drum or store liquid waste in other appropriate containers. Follow applicable regulation and guidance when sampling stockpiled waste for characterization purposes.

5.8 IDW DISPOSAL

Various methods and requirements for onsite and offsite disposal of IDW are discussed in the *Generic IDW Disposal Plans* for Hawaii and Guam (Ogden 1994, 1995) and EPA guidance (EPA 1990, 1991, 1992b). This section explains the disposal evaluation process and highlights some of the more important requirements for onsite and offsite IDW disposal options.

IDW sampling, characterization, and disposal analysis, particularly for onsite disposal, can be unexpectedly complex and require compliance with many different laws (that act as ARARs for IDW management and disposal). Before preparing the IDW disposal plan, compare estimated costs for onsite vs. offsite disposal. Offsite disposal may be more cost effective than devising and documenting the justification for onsite disposal when the quantity of IDW is small (less than 10 drums) and/or the waste fails the initial conservative screening against conservative risk-based criteria. Also weigh cost savings against the policy preference of the EPA and State of Hawaii Department of Health to manage and dispose of IDW on site, when possible.

5.8.1 Onsite Disposal

In general, the EPA preference is to dispose of IDW on site when the disposal action:

- Does not pose an unacceptable long-term risk to human health and the environment
- Is in accordance with chemical-, location- and action-specific ARARs “to the extent practicable” (40 CFR 300.415(i); 55 FR 8756)
- Does not introduce contaminants into clean soil or other site media
- Does not mobilize or significantly increase concentrations of any hazardous constituents already present in the environment
- Is consistent with the final remedy planned for the site
- Takes into account any community concerns regarding waste storage and the disposal method

Base onsite disposal options on best professional judgment and available site-specific data. For some projects, it may be prudent to store the waste temporarily until additional site data become available (e.g., sample analytical data, preliminary risk-assessment results, AOC delineation, and establishment of background values). Factors to consider include, but are not limited to the following:

- The detected or suspected contaminants, their concentrations, and total volume of IDW
- Media potentially affected (e.g., groundwater drinking source)
- Background metals data for site media
- Site access, conditions, and potential receptors
- Current and future land use
- Public perceptions (especially if drum storage and/or disposal takes place in open view)
- Time limits for IDW storage
- Potential requirements to treat waste before disposing of it on site
- Lack of unpaved areas to disposed of waste on site
- Potential wind, erosion, runoff, or flood conditions that might cause offsite migration of disposed waste
- Proximity to the ocean, surface water, or environmentally sensitive habitats
- Natural attenuation processes
- Need for additional utility survey before excavating to backfill waste
- Need for land use controls required to limit exposure pathways (e.g., backfill waste, provide permanent security around site, replant site to prevent erosion)

Protection of human health can be evaluated by comparing chemical concentrations in the waste to the more conservative of EPA residential regional screening levels), environmental action levels, and chemical-specific ARARs and TBC criteria. Ecological receptors can be protected by screening the IDW against EPA ecological soil screening levels. Onsite disposal of surface and groundwater IDW can be evaluated by initially screening against EPA tap-water PRGs, State Safe Drinking Water Standards (maximum contaminant levels and non-zero maximum contaminant level goals), and/or State Surface Water Quality Standards. These criteria are not always ARARs for the disposal method or site conditions; however, they may be useful to affirmatively show that the disposal is protective. Alternatively, the IDW may be associated with human-health and eco-risk assessment results for the site if the onsite placement of IDW is consistent with exposure pathway assumptions made during the risk assessment (e.g., contaminated soil might not present an unacceptable health risk at depth, but could pose such a risk if disposed of at the ground surface).

In general, return IDW consisting of environmental media to or near its source, and return waste generated from depth to its original depth, if possible and approved by NAVFAC in advance. Bury all contaminated soil and water IDW to be disposed of on site below grade at a depth of at least 3 feet and cover it with clean soil to reduce the potential for future exposure to human and ecological receptors.

Dispose of non-indigenous IDW and contaminated decontamination fluids off site. The cleaning detergent Alconox, often used in the decontamination process, is itself non-hazardous and biodegradable. Small quantities of clean decontamination water containing Alconox may be disposed of to clean areas on site. If onsite disposal is appropriate for RCRA IDW, this waste should be disposed of within the AOC to avoid the need to comply with LDRs.

IDW from several non-contiguous onsite areas may be consolidated and disposed of at one of the areas, provided a nexus exists between the wastes generated and response projects (55 FR 8690-8691).

IDW may also be temporarily disposed of back to the AOC without detailed analysis or documentation if the waste will be addressed with other site contamination during a future response action and will not present a significant short-term threat to human health and the environment.

5.8.2 Offsite Disposal

If onsite disposal is not a viable option, dispose of the IDW at an appropriate offsite treatment and/or disposal facility. Offsite transport and disposal of IDW must comply with all applicable laws and criteria specific to the chosen disposal facility. These requirements may include, but are not limited to the following:

- RCRA LDRs
- RCRA waste storage permits and time limits
- National Pollutant Discharge Elimination System and sewer disposal criteria
- CERCLA offsite rule
- TSCA treatment requirements
- DOT hazardous material transport packaging, manifesting, and security provisions

- International Maritime Organization ocean transport rules
- Certifications and training for waste transport contractors
- State notification requirements when importing certain types of waste

The CERCLA offsite rule (40 CFR 300.440) requires that CERCLA waste be disposed of only at facilities specifically approved by the EPA to receive such waste for treatment, storage, or disposal. The acceptability status of a disposal facility can change quickly (e.g., if there is a release at the facility); therefore, the CTO Manager should contact the EPA Region 9 CERCLA Offsite Rule Coordinator no more than 60 days prior to disposal of the IDW to verify the facility's approval status. The offsite rule applies to any CERCLA-driven remedial or removal action involving the offsite transfer of waste containing hazardous substances regardless of the concentrations present.

RCRA hazardous waste manifests must always be signed by authorized Navy personnel. In some cases, the Navy may authorize contractors to sign non-hazardous manifests. Navy authorization to allow contractor signature of non-hazardous manifests shall be based upon a Navy review of the contractor's RCRA and DOT training records. In addition, the Navy shall always be allowed the opportunity to review/approve non-hazardous manifests and waste profiles prior to waste disposal efforts.

Disposal of liquid IDW into the Navy sanitary sewer shall occur only if first approved by the Navy. Requests for disposal to Navy facilities should be coordinated through the COR. Discharge to the public sewer system is discouraged and should occur only if approved by state and local government agencies.

5.9 RECORDS

The CTO Manager is responsible for completing and updating the site-specific IDW drum inventory spreadsheet and submitting it as needed, and reviewing the IDW disposal plan (IDW disposal paperwork).

FMs and designates are responsible for documenting all IDW-related field activities in the field notebook including most elements of the IDW drum inventory spreadsheet. The correct methods for developing and maintaining a field notebook are presented in Procedure III-D, *Logbooks*.

Guidance related to preparing an IDW disposal plan (if required) is presented in the *Generic IDW Disposal Plans* for Hawaii and Guam (Ogden 1994, 1995).

5.9.1 IDW Disposal Documentation

Upon receipt of analytical data from the investigation or from IDW-specific analytical data, the generator information request form will be completed and provided to the IDW subcontractor to begin IDW characterization. Completed IDW disposal paperwork received from the IDW subcontractor should be reviewed for accuracy prior to submitting for Navy review.

The CTO Manager is responsible for submitting backup documentation (actual site or drum sampling results) along with the IDW disposal paperwork to the Navy.

Navy-approved contractor personnel may sign non-hazardous waste IDW documentation. Hazardous waste IDW documentation must be signed by an authorized Navy Environmental Coordinator.

All manifests (non-hazardous and hazardous) must be tracked, and if completed manifests (signed by disposal facility) are not received within 30 days of initial transportation, then contractor must notify the RPM weekly of the shipping status (e-mail is acceptable). Hazardous waste must be disposed of within 45 days of initial transportation. If not, specific IDW transportation details must be supplied to the Navy in order to prepare and file an exception report.

TSCA-regulated waste must be physically destroyed and or buried within 1 year of generation (date placed in IDW drum). Disposal certificates should be provided by the waste facility to the IDW subcontractor and Navy contractor.

Following disposal of IDW, the CTO Manager should prepare a short IDW disposal report summarizing the disposal operation and appending any associated records (e.g., final drum log, waste profiles, transport manifests, bills of lading, disposal facility certifications). Minimal topics to include in the report:

- IDW inventory and storage
- IDW chemical screening and characterization
- IDW transport and disposal
- Manifests
- Drum storage photographs
- Site figure

6. Health and Safety

Field Personnel shall perform work in accordance with the current (or as contractually obligated) United States Army Corps of Engineers Safety and Health Requirements Manual EM-385-1-1 (USACE 2008) and site-specific health and safety plan.

7. References

Department of Defense, United States (DoD). 2005. *Uniform Federal Policy for Quality Assurance Project Plans, Part 1: UFP-QAPP Manual*. Final Version 1. DoD: DTIC ADA 427785, EPA-505-B-04-900A. In conjunction with the U. S. Environmental Protection Agency and the Department of Energy. Washington: Intergovernmental Data Quality Task Force. March. On-line updates available at: http://www.epa.gov/fedfac/pdf/ufp_qapp_v1_0305.pdf.

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Procedure I-C-2, *Monitoring Well Development*.

Procedure I-C-3, *Monitoring Well Sampling*.

Procedure I-D-1, *Drum Sampling.*

Procedure I-F, *Equipment Decontamination.*

Procedure III-D, *Logbooks.*

8. Attachments

Attachment I-A-6-1: IDW Drum Label

Attachment I-A-6-2: Drum Label – Aluminum Tag

Attachment I-A-6-3: Monthly IDW Drum Inventory Updates

Attachment I-A-6-1
IDW Drum Label

IDW Drum Label

Contract #:

CTO #:

ACTIVITY SITE:

(_ _ _ _ - _ _ - D M _ _ _)

DRUM #

DATE COLLECTED

CONTENTS: (please ✓ and explain)

☐ Soil

☐ Water

☐ Solid Waste

☐ Other

PROJECT TYPE

☐ RI ☐ RFI ☐ UST ☐ Other

COMMENTS:

FOR INFORMATION CONTACT:

COR Activity/ Code:

Address:

Telephone:

Attachment I-A-6-2
Drum Label - Aluminum Tag

Drum Label - Aluminum Tag

Attachment I-A-6-3
Monthly IDW Drum Inventory Updates

Table I-A-6-1: Monthly IDW Drum Inventory Updates

Navy Activity / Site Name (Generator Site)	CTO Number (0bbb)	Drum Number (xxxx-AA-DMzzz)	Drum Storage Location	Origin of Contents (Source ID #)	IDW Type	Waste Volume (Fill level %)	Waste Generation Date (dd-Mon-yy)	Expected Disposal Date (Mon-yy)	Actual Disposal Date (dd-Mon-yy)
Inspector:									
Date of Inspection:									
NSC Pearl Harbor/ Landfill	0068	0068-LF-DM001	NSC, Bldg 7	SB-1	Soil Cuttings	100	16-Dec-92	Dec-93	N/A
		0068-LF-DM002	N/A	MW-1 MW-2 MW-3	Purge Water	75	20-Dec-92	Jul 93	26-Jul-93
		0068-LF-DM003	N/A	MW-1 MW-2 MW-3	Decon. Water	95	20-Dec-92	Jul-93	26-Jul-93
		0068-LF-DM004	NSC, Bldg.16	SB-1 SB-2 SB-3 SB-4 MW-1 MW-2 MW-3	PPE	50	16-Dec-92	Oct-93	N/A
NAVSTA Guam/ Drum Storage	0047	0047-DS-DM001	Hazmat Storage Area	SB-1 SB-2	Soil Cuttings	100	18-Feb-93	Sep-93	N/A

N/A Not Applicable

Analytical Data Validation Planning and Coordination

1. Purpose

This standard operating procedure describes data validation planning and coordination for all United States Navy Environmental Restoration (ER) Program, Naval Facilities Engineering Command (NAVFAC), Pacific sampling projects involving data validation.

2. Scope

This procedure applies to all Navy ER projects performed in the NAVFAC Pacific Area of Responsibility.

This procedure shall serve as management-approved professional guidance for the ER Program and is consistent with protocol in the Uniform Federal Policy-Quality Assurance Project Plan (DoD 2005). As professional guidance for specific activities, this procedure is not intended to obviate the need for professional judgment during unforeseen circumstances. Deviations from this procedure while planning or executing planned activities must be approved and documented by the following prime contractor representatives: the CTO Manager and the Quality Assurance (QA) Manager or Technical Director. A Navy project representative (i.e., Remedial Project Manager or QA Manager) shall also concur with any deviations.

3. Definitions

3.1 Critical Samples

Critical samples are samples that are especially important for assessing exposure and/or risk at a particular site, or are key in identifying remedial options.

3.2 Data Quality Assessment Report

The data quality assessment report summarizes the QA/quality control (QC) evaluation of the data according to precision, accuracy, representativeness, completeness, and comparability relative to the Project Quality Objectives (PQOs). The report provides a quantitative and qualitative assessment of the data and identifies potential sources of error, uncertainty, and bias that may affect the overall usability.

3.3 Data Validation

Data validation is a process that determines the technical usability of analytical data by comparison with a set of performance criteria. The performance criteria are designed in a manner that will enable the data user to know if the set of data will meet the intended purpose.

3.4 Data Validation Strategy

The data validation strategy includes the percentage of data to be validated (e.g., 100 percent or a smaller percentage), all samples from an entire sample delivery group (SDG) versus selected samples from various SDGs, and whether samples for Level D validation will be identified in advance or only after critical or risk-driving results for the risk assessment have been identified.

3.5 Data Validation Levels

The level of data validation possible for a given set of samples is based on the level of data package provided by the laboratory. The three levels of data validation considered are Level B (requires a Level 2 data package), Level C (requires a Level 3 data package), and Level D (requires a Level 4 data package). These levels have been identified in previous standard operating procedures as Cursory (Level B), Standard (Level C), and Full (Level D). Description for the extent of each level of data validation is presented below and further in Procedure II-A, *Data Validation*.

3.6 Raw Data

Raw data is information that has not been processed, formatted, or reduced for end use. Examples of raw data include gas chromatographs, instrument printouts, copies of log books, chemist worksheets, etc.

3.7 Sample Delivery Group (SDG)

A SDG, or analytical batch, typically includes up to 20 field samples plus associated batch QC samples.

4. Responsibilities

The prime contractor CTO Manager shall ensure coordination between data validators and appropriate project personnel. The CTO Manager is responsible for critical sample selection. The project chemist, laboratory coordinator, or other designated person, shall coordinate with the data validation task leader.

The prime contractor QA Manager or Technical Director is responsible for ensuring overall compliance with this procedure.

5. Procedures

An independent party who is not responsible for the generation of the data shall perform data validation. Section 5.1 discusses guidelines for selecting a data validation strategy, while Section 5.2 presents planning and coordination guidelines.

5.1 Data Validation Strategy Selection

Consult the Contracting Officer’s Representative, any appropriate regulatory agencies, and any Federal Facilities Agreements when choosing a data validation strategy. Clearly define the proposed level of effort for data validation in the project work plan. Based on the data validation requirements identified in the project planning documents, the analytical data may undergo “Level B,” “Level C,” or “Level D” data validation or some combination of these validation levels.

Guidelines for the required level of effort for data validation is described below and further in Procedure II-A, *Data Validation*.

5.1.1 Amount of Raw Data Acquired

It is recommended to request and obtain from the laboratory all raw data generated for the project sample analyses. While not all of the raw data will likely be reviewed, it is more time-efficient and cost-effective to obtain the data at the time of analysis than to request the laboratory to provide them at a later date. In addition, project chemists and risk assessors may use portions of the raw data to more fully evaluate analytical data. Attachment I-A-7-1 presents the laboratory analytical data reporting requirements that shall be followed for the NAVFAC Pacific Area of Responsibility.

For projects with quick turnaround time (TAT) requirements, one option is to receive results only for the quick TAT, while receiving the remaining data at the normal TAT. This will allow the laboratory more time to compile the entire data package. Consult project-specific PQOs to determine if this approach is feasible.

5.1.2 Level B Validation

Level B validation is the least intensive of the three levels of data validation and is appropriate for non-critical data. Level B validation consists of evaluating factors such as holding times, spike analyses, blank analyses, and field QC samples. Examples of analytical results evaluated under data review include data generated during compliance monitoring, field analytical testing, or investigation derived waste sampling.

5.1.3 Level C Validation

Level C validation is the intermediary of the three levels of data validation and is appropriate for critical samples used in decision making. Level C validation consists of evaluating factors such as holding times, instrument calibration, spike and blank analyses, and field QC samples. Level C validation may be performed on a percentage or all of the project data. The exact percentage of data to undergo Level C validation will depend on the project objectives. Examples of analytical results evaluated under Level C validation include data generated for risk assessments, removal action verification, remedial designs, etc.

5.1.4 Level D Validation

Level D validation is the most rigorous of the three levels of data validation and is appropriate for critical samples used in decision making. Level D validation consists of evaluating factors such as holding times, instrument calibration, spike and blank analyses, field QC samples, and raw data. Level D validation may be performed on a percentage or all of the project data. The exact percentage of data to undergo Level D validation will depend on the project objectives. Examples of analytical results evaluated under Level D validation include data generated for risk assessments, removal action verification, remedial designs, etc.

Depending on the objectives of the project, a representative portion of data shall be chosen for Level D validation by selecting random samples and analyses, or more practically, be selected by identifying certain representative SDGs. This may include selecting all samples and analyses from one of the first SDGs of field samples for Level D data validation, and also for SDGs with different matrices, subsequent phases of work/mobilizations, and for each laboratory if more than one is used.

Larger projects typically require lower frequencies of Level D validation than smaller projects. For example, a project with one SDG may require 100 percent Level D validation. For a CTO with five SDGs, the first SDG may require Level D validation with the remaining four SDGs validated at Level C.

If significant issues, as defined in the data validation procedures presented in Section II of this procedures manual, are noted during Level D validation, additional Level D validation above the originally planned percentage may be warranted and should be proposed. Additionally, the first several SDGs validated should be evaluated and corrective actions taken immediately if issues are identified.

5.2 PLANNING AND COORDINATION

During the planning and cost estimating stage of a project, contact the data validation task leader. Discuss the level of quality control, data validation strategy, number of samples per method, number of SDGs, schedule, and due dates. Copy all planning documents to the data validation task leader when they are completed (draft and final).

Hardcopy data validation reports are typically required and electronic entry of data qualifiers and qualification codes may be required if an analytical database is used for data interpretation.

Continuing coordination is critical. Notify the data validation task leader of any changes to the sampling schedule, analytical plan, or number of samples. Inform the data validators as well as the laboratory of every change from the chain of custody/analytical request form in sample numbers and/or requested analyses. Communicate changes to analytical methods agreed upon with the laboratory to the data validation task leader.

A schedule, which is updated as needed, is necessary to track the status of data validation activities. The prime contractor QA Manager or Technical Director shall coordinate and set priorities between CTOs. Attachment I-A-7-2 is an example of a form that may be used by CTO personnel to track the data validation status of hardcopy data.

A cross-reference list of field QC samples associated with site samples is required to validate data. This list must be provided by field personnel or from the chain-of-custody logbook (Procedure III–E, *Record Keeping, Sample Labeling, and Chain-of-Custody*).

6. Records

Data validation reports generated by data validators shall include content discussed in Procedure II-A, *Data Validation* and be included as an appendix in the report and summarized in the report. Changes in the schedule, number of samples, or analytical plan shall be sent to the data validators verbally and in writing.

The data validation effort shall be summarized for inclusion as a section of the report. It may also be helpful to summarize the data validation results in the form of a data quality assessment report (DQAR). The DQAR should summarize the net results of data validation for each QC parameter evaluated. It is recommended that precision, accuracy, and percent completeness objectives also be presented in the report. This task could be conducted by the data validators, or by project staff more familiar with the PQOs. The content and format of the DQAR is discussed in Procedure II-S, *Data Quality Assessment Report*.

As part of the summary, the project personnel shall ensure that all data requested for analysis and validation were actually analyzed and validated. Identification of rejected data (and the reasons) may be the most critical results. Data that have been qualified from detections to nondetections, or data for which numerical values have changed significantly, are also important. The summary may focus on the analytes and samples that are considered most critical for each project and include a summary of field QC results by field QC type.

7. Health and Safety

Not applicable.

8. References

Department of Defense, United States (DoD). 2005. *Uniform Federal Policy for Quality Assurance Project Plans, Part 1: UFP-QAPP Manual*. Final Version 1. DoD: DTIC ADA 427785, EPA-505-B-04-900A. In conjunction with the U. S. Environmental Protection Agency and the Department of Energy. Washington: Intergovernmental Data Quality Task Force. March. On-line updates available at: http://www.epa.gov/fedfac/pdf/ufp_qapp_v1_0305.pdf.

Procedure II-A, *Data Validation*.

Procedure II-S, *Data Quality Assessment Report*.

Procedure III–E, *Record Keeping, Sample Labeling, and Chain-of-Custody*.

9. Attachments

Attachment I-A-7-1: DoD QSM Appendix DoD A Reporting Requirements

Attachment I-A-7-2: Example Hardcopy Data Validation Status Tracking Form

Attachment I-A-7-1
DoD Quality Systems Manual Appendix DoD A Reporting Requirements

APPENDIX DOD-A – REPORTING REQUIREMENTS

In the absence of client specified reporting criteria, the reporting requirements outlined below shall be used for hard-copy data reports or electronic versions of hard-copy data (such as pdf). They include mandatory requirements for all printed data reports, and requirements for data reports requiring third party data review or validation. Optional reporting requirements are those that may be required by a specific project, depending upon their needs. The following elements are required: cover sheet, table of contents, case narrative, analytical results, sample management records, and Quality Assessment/Quality Control (QA/QC) information. Information for third-party review may be required depending on project-specific requirements or the method being used.

1.0 Cover Sheet

The cover sheet shall specify the following information:

- Title of report (i.e., test report, test certificate);
- Name and location of laboratory (to include a point of contact, phone and facsimile numbers, and e-mail address);
- Name and location of any subcontractor laboratories, and appropriate test method performed (information can also be located in the case narrative as an alternative);
- Unique identification of the report (such as serial number);
- Client name and address;
- Project name and site location;
- Statement of data authenticity and official signature and title of person authorizing report release;
- Amendments to previously released reports that clearly identify the serial number for the previous report and state the reason(s) for reissuance of the report; and
- Total number of pages.

2.0 Table of Contents

Laboratory data packages shall be organized in a format that allows for easy identification and retrieval of information. An index or table of contents shall be included for this purpose.

3.0 Case Narrative

A case narrative shall be included in each report. The purpose of the case narrative is to:

- Describe any abnormalities and deviations that may affect the analytical results;
- Summarize any issues in the data package that need to be highlighted for the data user to help them assess the usability of the data; and
- Provide a summary of samples included in the report with the methods employed in order to assist the user in interpretation.

The case narrative shall provide (Information need not be repeated if noted elsewhere in the data package):

- A table(s) summarizing samples received, providing a correlation between field sample numbers and laboratory sample numbers, and identifying which analytical, preparation, and clean-up methods were performed. If multiple laboratories performed analyses, the name and location of each laboratory **shall** be associated with each sample;
- A list of samples that were received but not analyzed;
- Date of samples received;
- Sample preservation or condition at receipt;
- A description of extractions or analyses that are performed out of holding times;
- A definition of all data qualifiers or flags used;
- Identification of deviations of any calibration standards or QC sample results from appropriate acceptance limits and a discussion of the associated corrective actions taken by the laboratory;
- Identification of multiple sample runs with reason(s) identified (e.g., dilutions or multiple cleanups);
- Identification of samples and analytes for which manual integration was necessary; and
- Appropriate notation of any other factors that could affect the sample results (e.g., air bubbles in volatile organic compounds (VOC) sample vials, excess headspace in soil VOC containers, the presence of multiple phases, sample temperature or pH excursions, and container type or volume).

4.0 Analytical Results

The results for each sample shall contain the following information at a minimum: (Information need not be repeated if noted elsewhere in the data package):

- Project name and site location;
- Field sample ID number as written on custody form;
- Laboratory sample ID number;
- Preparation batch number(s);
- Matrix (soil, water, oil, air, etc.);
- Date and time sample collected;
- Date and time sample prepared;
- Date and time sample analyzed;
- Method numbers for all preparation, cleanup, and analysis procedures employed;
- Analyte or parameter with the Chemical Abstracts Service (CAS) Registry Number if available;

- Sample aliquot analyzed;
- Final extract volume;
- Identification of analytes in which manual integration occurred, including the cause and justification;
- Analytical results with correct number of significant figures;
- Detection Limit, Limit of Detection, and Limit of Quantitation associated with sample results and adjusted for sample-specific factors (e.g., aliquot size, dilution/concentration factors, and moisture content);
- Any data qualifiers assigned;
- Concentration units;
- Dilution factors;
- All multiple sample run results shall be reported;
- Percent moisture or percent solids (all soils are to be reported on a dry weight basis); and
- Statements of the estimated uncertainty of test results (optional).

5.0 Sample Management Records

Sample Management records shall include the documentation accompanying the samples, such as:

- Chain-of-custody records;
- Shipping documents;
- Records generated by the laboratory which detail the condition of the samples upon receipt at the laboratory (e.g., sample cooler receipt forms, cooler temperature, and sample pH);
- Telephone conversation or e-mail records associated with actions taken or quality issues; and
- Records of sample compositing done by the laboratory.

6.0 QA/QC Information

The minimum laboratory internal QC data package shall include:

- Method blank results;
- Percent recoveries for Laboratory Control Sample (LCS), Laboratory Control Sample Duplicates (LCSD), Matrix spike (MS), and Matrix Spike Duplicates (MSD);
- MSD or matrix duplicate Relative percent differences (RPD);
- Surrogate percent recoveries;
- Tracer recoveries;
- Spike concentrations for LCS, MS, surrogates;
- QC acceptance criteria for LCS, MS, surrogates;
- Post-Digestion Spike (PDS) recoveries;

- In-house or project specified LCS control limits, as applicable;
- Serial dilutions (SD) percent difference; and
- Batch numbers (preparation, analysis, and cleanup).

7.0 Data Reports for Third Party Review or Validation

When third party review or data validation is to be performed, the extent (stage) of data validation that can be performed is dependent upon the type (level) of data report delivered by the laboratory. The data report level and data validation stage required to meet project data quality objectives should be specifically defined in the QAPP.

The minimum reporting requirements for each level of data report are outlined below.

- A cover sheet, table of contents, and case narrative including all of the information specified in the above sections are required for all levels of data reports.
- **Level 1**: Analytical results, Sample Management Records.
- **Level 2**: **Level 1** reporting requirements plus QA/QC Information, Instrument QA/QC Information, Instrument and Preparation logs.
- **Level 3**: **Level 2** reporting requirements plus Instrument Quantitation Reports.
- **Level 4**: **Level 3** reporting requirements plus Instrument Chromatograms and Spectra.
- In addition, Standards traceability should be included in Levels 3 and 4 if a legal chain of custody is required.

The data validation guidelines established in other Department of Defense guidance or project-specific guidelines may have distinct reporting formats. The appropriate QAPP should be consulted to determine what type of data package is required.

Attachment I-A-7-2
Example Data Validation Status Tracking Form

Table I-A-7-2-1: CTO xxxx Data Validation Report Status Tracking Form

SDG	Due Date	VOCs Rec'd	PCBs Rec'd	TPH Rec'd	Metals Rec'd	Cr+6 Rec'd	Otin Rec'd	TOC Rec'd
DB360	7/30	7/21	8/21	8/21	8/7	X	8/23	5/25
DB383	7/30	7/21	8/21	8/21		X	8/23	5/25
DB401	6/15	6/9	6/9	6/9	6/9	X	7/7	6/9
DC160	8/15	7/21	8/21	8/21			X	8/7
DC180	8/15	7/21	8/21	7/23		7/21	8/23	8/21
CK0693	7/30	X	X	X	X	7/20	X	X
CK0694	7/30	X	X	X	X	7/20	X	X
CK0732	7/30	X	X	X	X	7/20	X	X
DC205	9/15		X			X	X	
DC209	9/15		X			X	X	
DB429	9/15		X			X	X	
DB439	9/15		X			X	X	X
DB458	9/15		X			X	X	X

PCB polychlorinated biphenyl
TOC total organic carbon
TPH total petroleum hydrocarbons
VOC volatile organic compound
7/21 date data validation report was received
X no analysis for that method for that SDG
blank data validation report not yet received

Sample Naming

1. Purpose

This standard operating procedure describes the naming convention for samples collected and analyzed, and whose resulting data will be stored in the database for the United States Navy Environmental Restoration (ER) Program, Naval Facilities Engineering Command (NAVFAC), Pacific projects. Unique sample names are used to facilitate tracking by laboratory personnel and project personnel, and for purposes of storing, sorting, and querying data in the database.

2. Scope

This procedure applies to all Navy ER projects performed in the NAVFAC Pacific Area of Responsibility.

This procedure shall serve as management-approved professional guidance for the ER Program and is consistent with protocol in the Uniform Federal Policy-Quality Assurance Project Plan (DoD 2005). As professional guidance for specific activities, this procedure is not intended to obviate the need for professional judgment during unforeseen circumstances. Deviations from this procedure while planning or executing planned activities must be approved and documented by the following prime contractor representatives: the CTO Manager and the Quality Assurance (QA) Manager or Technical Director. A Navy project representative (i.e., Remedial Project Manager or QA Manager) shall also concur with any deviations.

3. Definitions

3.1 Chain of Custody Sample Number

The chain of custody (COC) sample number is a five-character identification number that is used by the laboratory and project personnel for tracking purposes. A unique COC sample number must be used for each sample collected from a particular location at a particular time. It is useful for the first two characters to be letters unique to a particular site or project, while the remaining three characters may be digits from 001 to 999 (e.g., AA001). The COC sample number is the only identifier that should be presented to the laboratory.

3.2 Sample Identification Number

The sample identification number is a unique multi-alpha, multi-numeric identifier that is used by the field team to associate sampling results to the particular sampling location, sample type, number of times the location has been sampled, and depth. To avoid potential bias in sample analysis, the sample identifier is not provided to the laboratory. The sample identification number shall be recorded in the field logbook concurrently with the COC sample number.

4. Responsibilities

The prime contractor CTO Manager shall ensure that a proper sample naming convention is identified in the field sampling plan. The Field Quality Control (QC) Supervisor or other field-sampling leader shall ensure that the sample naming convention is implemented. The laboratory coordinator, CTO Manager, and/or other designated personnel shall ensure on a daily basis that unique, appropriate COC sample numbers and sample identifiers have been assigned. The prime contractor QA Manager or Technical Director is responsible for ensuring overall compliance with this procedure.

The prime contractor Technical Director will designate one person in each office (e.g., the laboratory coordinator) to track site designations used in the COC sample number.

5. Procedures

A COC sample number and sample identifier shall be assigned as described below. It is critical that each sample name have a unique COC sample number and sample identifier; otherwise, data cannot be properly stored and tracked in the database.

5.1 COC Sample Number

Use the following format for the COC sample number:

abccc

Where:

a = A letter indicating the office managing the CTO

b = A letter indicating the project or site, for example

A = first site

B = second site

C = third site, etc.

ccc = Chronological number, for example

001 = first sample from the site

002 = second sample from the site

105 = 105th sample from the site

Field QC samples should be included in this chronological sequence

For example, the 23rd sample from the Carpentry Shop Dip Tank site (assigned project "A" for b above; the office will be assigned "D") being investigated would be referred to as "DA023." This might be a soil sample, water sample, trip blank, equipment blank, field duplicate, or other sample type. Using this COC sample number, the samples will be submitted to the laboratory "blind," that is, the laboratory should not know whether each sample received is a site or field QC sample.

If a sample is lost during shipping, the replacement sample must be assigned a new COC sample number. If different containers for the same sample are shipped on different days, a new COC sample number must be assigned.

When numbering reaches the letter Z, the 26th site, it may begin with a new first letter "a," which must be coordinated with the prime contractor QA Manager or Technical Director and Coordinator or designee to ensure that it has not been used by another CTO.

Alternatively, the "ab" designators can serve to identify a unique project field, such as "RH" for the Red Hill site.

5.2 SAMPLE IDENTIFICATION NUMBER

The following format is provided as a suggested guidance. Individual site objectives may necessitate variations to the suggested guidance. Coordinate with the prime contractor QA Manager or Technical Director when considering deviating from this guidance.

AA-bbcc-dee-Dff.f

Where:

AA = Designates the site identification

bb = Sample type and matrix (see Table I-A-8-1)

cc = Location number (e.g., 01, 02, 03)

d = Field QC sample type (see Table I-A-8-2)

ee = Chronological sample number from a particular sampling location (e.g., 01, 02, 03)

D = The letter "D" denoting depth

ff.f = Depth of sample in feet bgs (to the measured decimal place). For field blanks, trip blanks and equipment blanks, the depth field will contain the month and date of collection.

For example, the first subsurface soil sample collected from the Foundry Building (FB) borehole location four at a depth of 10 feet would be designated "FB-BS04-S01-D10.0." These characters will establish a unique sample identifier that can be used when evaluating data.

Table I-A-8-1 presents the character identifiers to be used in the sample and matrix portion of the sample identification number. In all cases, the second letter indicates the sample matrix. Note grab, composite, and undisturbed sample designations in the field logbook.

Table I-A-8-1: Sample Type and Matrix Identifiers

Identifier	Sample Type	Matrix
SS	Surface Soil	Soil
IS	Surface Soil (ISM)	Soil
IB	Subsurface Soil (ISM)	Soil
BS	Subsurface Soil	Soil
BG	Subsurface Soil (Geotechnical)	Soil
SD	Sediment	Sediment
GW	Groundwater	Water
SW	Surface Water	Water
FP	Free Product	Oil
WQ	Water Blanks	Water
SG	Soil Gas	Soil gas
CC	Concrete Chips	Concrete

Identifier	Sample Type	Matrix
WS	Waste (IDW)	Soil
WW	Waste (IDW)	Water

IDW investigation-derived waste
ISM incremental sampling methodology

Table I-A-8-2 describes the field QC designator types. These field QC designators clarify the type of sample collected.

Table I-A-8-2: Field QC Sample Type Identifiers

Identifier	QC Sample Type	Description
S	Normal (Primary) Sample	All non-field QC samples
D	Duplicate	Collocate (adjacent liners)
R	Triplicate	Replicate
E	Equipment Rinsate	Water
B	Field Blank	Water
T	Trip Blank	Analytical-laboratory-prepared sample -Water
M	Trip Blank	Analytical-laboratory-prepared sample – Methanol
L	Batch Test Sample	Batch Test Leaching Model Sample
P	Blind Spike	Performance testing sample

6. Records

Sample identifiers (and COC sample numbers, if appropriate) shall be identified in advance if the exact numbers of samples to be collected are known; these numbers may be listed on a spreadsheet along with requested analyses to be used as a reference by field sampling personnel.

The COC/analytical request form must be used to track all sample names. Copies of each COC form shall be sent daily to the CTO Laboratory Coordinator and with the samples to the analytical laboratory. An example of a COC form is included as Attachment III-E-2 of Procedure III-E, *Record Keeping, Sample Labeling, and Chain-of-Custody*.

In the field, personnel shall record in the field logbook the COC sample number of each sample collected, as well as additional information, such as the sampling, date, time, and pertinent comments.

7. Health and Safety

Not applicable.

8. References

Department of Defense, United States (DoD). 2005. *Uniform Federal Policy for Quality Assurance Project Plans, Part 1: UFP-QAPP Manual*. Final Version 1. DoD: DTIC ADA 427785, EPA-505-B-04-900A. In conjunction with the U. S. Environmental Protection Agency and the Department of Energy. Washington: Intergovernmental Data Quality Task Force. March. On-line updates available at: http://www.epa.gov/fedfac/pdf/ufp_qapp_v1_0305.pdf.

Procedure III-E, *Record Keeping, Sample Labeling, and Chain-of-Custody*.

9. Attachments

None.

Surface Water Sampling

1. Purpose

The purpose of this standard operating procedure is to establish standard protocols for use in sampling surface water by all United States Navy Environmental Restoration (ER) Program, Naval Facilities Engineering Command (NAVFAC), Pacific personnel.

2. Scope

This procedure applies to all Navy ER projects performed in the NAVFAC Pacific Area of Responsibility.

This procedure shall serve as management-approved professional guidance for the ER Program and is consistent with protocol in the most current version of the Uniform Federal Policy-Quality Assurance Project Plan (DoD 2005). As professional guidance for specific activities, this procedure is not intended to obviate the need for professional judgment during unforeseen circumstances. Deviations from this procedure while planning or executing planned activities must be approved and documented by the following prime contractor representatives: the CTO Manager and the Quality Assurance (QA) Manager or Technical Director. A Navy project representative (i.e. Remedial Project Manager or QA manager) shall also concur with any deviations.

3. Definitions

None.

4. Responsibilities

The prime contractor CTO Manager is responsible for ensuring that all project field personnel follow these procedures when sampling surface water. The CTO Manager is responsible for ensuring that all personnel involved in sampling and/or testing shall have the appropriate education, experience, and training to perform their assigned tasks as specified in Chief of Naval Operations Instruction 5090.1, under *Specific Training Requirements* (DON 2014).

The prime contractor QA Manager or Technical Director is responsible for ensuring overall compliance with this procedure.

The Field Manager is responsible for ensuring that all project field staff follow these procedures.

Field sampling personnel are responsible for the implementation of this procedure.

5. Procedures

Surface water bodies that could be affected by a release from an investigation site may be selected for sampling. This procedure describes sample collection methods for a surface water sampling program.

5.1 SELECTION OF SAMPLING TECHNIQUES

Proper selection of sampling points and collection methodology are essential to meeting the objectives of a surface water sampling program. The data quality objectives and the conceptual site model should be used to determine all sampling methods and parameters. Sampling points should be selected for collection of surface water samples on the basis of characteristics of the surface water body to be monitored, the location of the body of surface water, and its hydrologic boundaries with respect to the site. Other considerations include the contaminants of concern, logistical considerations, such as access to the surface water body, the direction of flow, and determination of a background location.

Methods of collecting surface water samples vary from hand sampling procedures at a single point to sophisticated, multipoint sampling techniques. The number and type of samples to be collected depends on the characteristics of the body of water, the amount of suspended sediment that a moving body carries, the size of the discharge area at the site, and other factors. Multipoint sampling techniques apply to larger bodies of water; the samples are composited to provide a more representative sample.

Whenever possible, the sampling device, either disposable or constructed of a nonreactive material, should hold at least 500 milliliters to minimize the number of times the liquid must be disturbed, thus reducing agitation of any sediment layers. A 1-liter polypropylene or stainless steel beaker with a pour spout and handle works well. Any sampling device might contribute contaminants to a sample. The correct sampling device will not compromise the integrity of the sample and will give the desired analytical results.

5.1.1 Shallow Water Body Surface Water Sample Collection

A dip or grab sample is appropriate for a small body of water, or for collecting near-surface samples in a larger surface water body. The sampling method involves filling a sample container by submerging it either just below the surface, or by lowering the container to a desired depth by using a weighted holder. For shallow bodies of surface water, hold the sample container carefully just beneath the water surface to avoid disturbing the streambed and stirring the sediment. Position the container’s mouth so that it faces upstream, while the sampling personnel are standing downstream. Any preservative added to the sample should be added after sample collection to avoid loss of preservative. Alternatively, a transfer device may be dipped into the water, and then the contents transferred to the appropriate container containing the preservative. For near-surface sample collection in a large surface water body, a pond sampler may be used if an extended reach is required to collect a representative sample. A pond sampler consists of a single use sample container attached to a telescoping, heavy-duty, aluminum pole via an adjustable clamp attached to the end. The collection technique for shallow surface water samples can be used for near-surface samples in a large surface water body.

5.1.2 Deep Surface Water Sample Collection

For deeper surface water bodies, either sample containers or transfer devices may be used to collect a sample. A weighted holder that allows either a sample transfer device or a sample container to be lowered, opened for filling, closed, and returned to the surface is suggested for sampling deeper surface water bodies. This is because concentrations of constituents near the surface of a deeper body of surface water might differ from the total concentration distributed throughout the water column cross section and thus a surface sample would not be representative of the water body. An open container that is lowered and raised to the surface at a uniform rate so that the bottle is just filled on reaching the surface is appropriate for deeper stagnant water bodies, however this method does not collect a truly representative sample in deeper flowing surface water bodies.

Kemmerer Samplers. Collect samples near the shore unless sampling from a boat is feasible and permitted. If a boat is used, the body of water should be cross-sectioned, and samples should be collected at various depths across the water in accordance with the specified work plan. For this type of sampling, use a weighted-bottle sampler to collect samples at any predetermined depth. The sampler consists of a glass bottle, a weighted sinker, a bottle stopper, and a line that is used to open the bottle and to lower and raise the sampler during sampling. The sampler can be either fabricated or purchased. The general procedure for using the sampler is as follows:

1. Assemble the weighted bottle sampler.
2. Gently lower the sampler to the desired depth so as not to remove the stopper prematurely.
3. Pull out the stopper with a sharp jerk of the sampler line.
4. Allow the bottle to fill completely, as evidenced by the cessation of air bubbles.
5. Raise the sampler and cap the bottle.
6. Wipe the bottle clean. The bottle can also be used as the sample container.

Teflon Bailers: Teflon bailers have also been used to collect samples in deep bodies of water. When the use of Teflon bailers is deemed appropriate for sampling water from a specific depth, the bailers shall be equipped with a check valve that closes during sample retrieval.

Peristaltic Pump: Another method of extending the reach of sampling efforts is to use a small peristaltic pump. In this method, the sample is drawn through heavy-wall Teflon tubing and pumped directly into the sample container. This system allows the operator to reach into the liquid body, sample from depth, or sweep the width of narrow streams. However, use of the peristaltic pump is restricted to a maximum depth of 20 to 24 feet due to the physical constraints associated with vacuum pumps.

If medical-grade silicon tubing is used in the peristaltic pump, the system is suitable for sampling almost any analyte, including most organics. Some volatile stripping may occur; due to the relatively high flow rate of the pump. Therefore, avoid pumping methods for sampling volatile organics. Battery-operated peristaltic pumps are available and can be easily carried by hand or with a shoulder sling, as needed. It is necessary in most situations to change both the Teflon suction line and the silicon pump tubing between sampling locations to avoid cross contamination. This action requires maintaining a sufficiently large stock of material to avoid having to clean the tubing in the field.

Peristaltic pumps work especially well for sampling large bodies of water when a near-surface sample will not sufficiently characterize the body as a whole. It is capable of lifting water from depths in excess (but not much in excess) of 21 feet. This lift ability decreases somewhat with higher-density fluids and with increased wear on the silicone pump tubing. Similarly, increases in altitude will decrease the pump’s ability to lift from depth. When sampling a liquid stream that exhibits a considerable flow rate, it may be necessary to weight the bottom of the suction line.

Use the following procedures for collecting samples using peristaltic pumps:

1. Install clean, medical-grade silicone tubing in the pump head, per the manufacturer's instructions. Allow sufficient tubing on the discharge side to facilitate convenient dispensation of liquid into sample bottles but only enough on the suction end for attachment to the intake line. This practice will minimize sample contact with the silicone pump tubing. (Some types of thinner Teflon tubing may be used.)
2. Select the length of suction intake tubing necessary to reach the required sample depth and attach it to the tubing on the intake side of the pump. If necessary, a small weight composed of relatively inert material, which will not react with anticipated chemicals, may be used to weight the intake tubing. Heavy-wall Teflon of a diameter equal to the required pump tubing will suit most applications. (A heavier wall will allow for a slightly greater lateral reach.)
3. If possible, allow several liters of sample to pass through the system before actual sample collection. Collect this purge volume, and then return it to the source (i.e., surface water) after the sample aliquot has been collected.
4. Fill necessary sample bottles by allowing pump discharge to flow gently down the side of bottle with minimal entry turbulence. Cap each bottle as it is filled.
5. Preserve the sample, if necessary, following guidelines in the work plan. In most cases, place preservatives in sample containers before sample collection to avoid overexposure of samples and overfilling of bottles during collection.
6. Check that a Teflon liner is present in the cap, if required. Secure the cap tightly. Tape the cap to the bottle, and then date and initial the tape. The tape will serve as a custody seal.
7. Label the sample bottle with an appropriate tag using a solvent-free marker. Be sure to label the tag carefully and clearly, addressing all the categories or parameters. Record the information in the field logbook, and complete the chain-of-custody documents.
8. Place the properly labeled sample bottle in an appropriate carrying container.
9. Allow the system to drain thoroughly, and then disassemble and decontaminate it.

5.2 TRANSFER DEVICES

Samples from various locations and depths can be composited if project quality objectives indicate that it is appropriate; otherwise, collect separate samples. Identify approximate sampling points on a sketch of the water body. Use the following procedures for collecting samples using transfer devices:

1. Submerge a stainless steel dipper or other suitable device, causing minimal disturbance to the surface of the water. Note the approximate depth and location of the sample source (e.g., 1 foot up from bottom or just below the surface).
2. Allow the device to fill slowly and continuously.
3. Retrieve the dipper or device from the surface water with minimal disturbance.
4. Remove the cap from the sample bottle and slightly tilt the mouth of the bottle below the dipper or device edge.
5. Empty the dipper or device slowly, allowing the sample stream to flow gently down the side of the bottle with minimal entry turbulence.

6. Continue delivery of the sample until the bottle is almost filled. Check all procedures for recommended headspace for expansion.
7. If necessary, preserve the sample according to guidelines in the work plan. In most cases, place preservatives in sample containers before sample collection to avoid overexposure of samples and overfilling of bottles during collection.
8. Check that a Teflon liner is present in the cap, if required. Secure the cap tightly. Tape the cap to the bottle using solvent-free tape, and then date and initial the tape. The tape will serve as a custody seal.
9. Label the sample bottle with an appropriate sample tag using a solvent-free marker. Be sure to label the tag carefully and clearly, addressing all the categories or parameters. Record the information in the field logbook, and complete the chain-of-custody form.
7. Dismantle the sampler, wipe the parts with terry towels or rags, and store them in plastic bags for subsequent disposal. Follow all instructions for proper decontamination of equipment and personnel.

Use the following procedures for collecting samples using peristaltic pumps:

1. Install clean, medical-grade silicone tubing in the pump head, per the manufacturer's instructions. Allow sufficient tubing on the discharge side to facilitate convenient dispensation of liquid into sample bottles but only enough on the suction end for attachment to the intake line. This practice will minimize sample contact with the silicone pump tubing. (Some types of thinner Teflon tubing may be used.)
2. Select the length of suction intake tubing necessary to reach the required sample depth and attach it to the tubing on the intake side of the pump. If necessary, a small weight composed of relatively inert material, which will not react with anticipated chemicals, may be used to weight the intake tubing. Heavy-wall Teflon of a diameter equal to the required pump tubing will suit most applications. (A heavier wall will allow for a slightly greater lateral reach.)
3. If possible, allow several liters of sample to pass through the system before actual sample collection. Collect this purge volume, and then return it to the source (i.e., surface water) after the sample aliquot has been collected.
4. Fill necessary sample bottles by allowing pump discharge to flow gently down the side of bottle with minimal entry turbulence. Cap each bottle as it is filled.
5. Preserve the sample, if necessary, following guidelines in the work plan. In most cases, place preservatives in sample containers before sample collection to avoid overexposure of samples and overfilling of bottles during collection.
6. Check that a Teflon liner is present in the cap, if required. Secure the cap tightly. Tape the cap to the bottle, and then date and initial the tape. The tape will serve as a custody seal.
7. Label the sample bottle with an appropriate tag using a solvent-free marker. Be sure to label the tag carefully and clearly, addressing all the categories or parameters. Record the information in the field logbook, and complete the chain-of-custody documents.
8. Place the properly labeled sample bottle in an appropriate carrying container.
9. Allow the system to drain thoroughly, and then disassemble and decontaminate it.

Multipoint sampling techniques that represent both dissolved and suspended constituents and both vertical and horizontal distributions are applicable to larger bodies of water. Subsequent to sample collection, multipoint sampling techniques may require a compositing and sub-sampling process to homogenize all the individual samples into the number of subsamples required to perform the analyses of interest. Homogenizing samples is discouraged for samples collected for volatile organic analysis, because aeration causes a loss of volatile compounds. If collection of composite samples is required, then include the procedure for compositing in the project-specific work plan.

The sampling devices selected must not compromise sample integrity. Collect samples with either disposable devices, or devices constructed of a nonreactive material, such as glass, stainless steel, or Teflon. The device must have adequate capacity to minimize the number of times the liquid must be disturbed, reducing agitation of any sediment layers. Further, the device must be able to transfer the water sample into the sample container without loss of volatile compounds. A single- or double-check valve or stainless steel bailer made of Teflon equipped with a bottom discharging device may be used.

All equipment used for sample collection must be decontaminated before and after use in accordance with Procedure I-F, *Equipment Decontamination*.

5.3 TYPICAL FIELD SAMPLING SUPPLIES AND EQUIPMENT/APPARATUS

Sampling supplies

- Work Plan
- Maps/Plot plan
- Tape measure
- Survey stakes, flags, or buoys
- Camera
- Stainless steel, plastic, or other appropriate composition (e.g., Teflon) bucket
- Laboratory supplied sampling containers
- Ziploc plastic bags for samples, and sample jars
- Logbook
- Labels
- Chain of Custody forms
- Site description forms
- Cooler(s)
- Ice

Equipment/Apparatus

- Decontamination supplies/equipment
- Spade or shovel

- Spatula
- Scoop
- Trowel
- Task-specific surface water sampling equipment

6. Records

During the completion of sampling activities, fill out the sample logbook and transmit forms to the CTO Manager for storage in project files.

7. Health and Safety

Field Personnel shall perform work in accordance with the current (or as contractually obligated) United States Army Corps of Engineers Safety and Health Requirements Manual EM-385-1-1 (USACE 2008) and site-specific health and safety plan.

8. References

Department of Defense, United States (DoD). 2005. *Uniform Federal Policy for Quality Assurance Project Plans, Part 1: UFP-QAPP Manual*. Final Version 1. DoD: DTIC ADA 427785, EPA-505-B-04-900A. In conjunction with the U. S. Environmental Protection Agency and the Department of Energy. Washington: Intergovernmental Data Quality Task Force. March. On-line updates available at: http://www.epa.gov/fedfac/pdf/ufp_qapp_v1_0305.pdf.

Department of the Navy (DON). 2014. *Environmental Readiness Program Manual*. OPNAV Instruction 5090.1D. 10 January.

United States Army Corps of Engineers (USACE). 2008. *Consolidated Safety and Health Requirements Manual*. EM-385-1-1. Includes Changes 1–7. 13 July 2012.

Procedure I-F, *Equipment Decontamination.*

9. Attachments

None.

Subaqueous Sediment Sampling

1. Purpose

This standard operating procedure describes the methods by which United States Navy Environmental Restoration (ER) Program, Naval Facilities Engineering Command (NAVFAC), Pacific personnel will conduct subaqueous sediment sampling.

2. Scope

This procedure applies to all Navy ER projects performed in the NAVFAC Pacific Area of Responsibility.

This procedure shall serve as management-approved professional guidance for the ER Program and is consistent with protocol in the most current version of the Uniform Federal Policy-Quality Assurance Project Plan (DoD 2005). As professional guidance for specific activities, this procedure is not intended to obviate the need for professional judgment during unforeseen circumstances. Deviations from this procedure while planning or executing planned activities must be approved and documented by the following prime contractor representatives: the CTO Manager and the Quality Assurance (QA) Manager or Technical Director. A Navy project representative (i.e., Remedial Project Manager or QA Manager) shall also concur with any deviations.

3. Definitions

3.1 Sediment

Sediment is solid material that is moved and deposited in a new location. Sediment can consist of rocks and minerals, as well as the remains of plants and animals. It can be as small as a grain of sand or as large as a boulder. Sediment moves from one place to another through the process of erosion.

3.2 Subaqueous Sediment

Subaqueous sediment is sediment that is found under water.

3.3 Ponar Sampler

The Ponar sampler is an aluminum/steel device used in collecting sediment grab samples. The jaws of the Ponar sampler, which close on the bottom, provide a sharp cutting action similar to a dredge bucket. The wide jaws function to prevent stones from jamming the shutting mechanism. The Ponar sediment sampler will penetrate up to 8 to 10 inches into surface sediment. The screen and rubber flaps on the top serve to reduce the sediment loss due to the pressure-wave in front of the sampler upon descent and wash out loss during retrieval. The Ponar sampler can be used to collect samples from both soft-bottom (muck, mud, peats) and hard-bottom (gravel, sand, clay) areas. Sediment can be accessed by removing the top screens or by manually opening the sampler, releasing the sediment into a large container.

3.4 Ekman Sampler

The Ekman sampler is a light-weight aluminum/steel device used in collecting sediment grab samples. Due to its light weight, the Ekman sampler is recommended only for collection of samples from soft mud, silt, or sand. However, because it is small and light, it is best used for sampling where fine particles are likely to get disturbed by the force produced from objects moving through water. The Ekman sampler works by lowering the sampler to the sediment surface and triggering the two spring-loaded jaws at the bottom of the sample box.

3.5 VAN VEEN SAMPLER

The Van Veen sampler collects surface grab samples over a surface area of approximately 0.1 square meters with a penetration depth of approximately 8 to 10 inches. The Van Veen is lowered by a crane equipped with a cable in a controlled fall through the water column until it reaches the sediment surface. Tension on the cable is relaxed, and the mechanical jaws of the Van Veen close and dig into the sediment as tension is reapplied to the cable by upward motion for sample retrieval. The surface grab is then recovered aboard the operations vessel and placed onto a cradle to stabilize the Van Veen for inspection and processing, and to contain any spilled sediment. The Van Veen sampler is similar to the Ponar sampler, with screens and flaps on the top of the sampler to reduce sediment disturbance and limit washout.

3.6 PISTON CORER

Sediment cores from shallow depth locations are typically collected using a piston core sampler. The piston corer consists of a 3-inch-diameter, 15-foot-long food-grade polycarbonate tube attached to a stainless steel head. The piston corer is capable of collecting sediment cores up to 65 feet or more below the sediment water interface. A new tube is used for each sampling attempt and cut to appropriate size using a portable jigsaw with a clean blade, depending on water depth encountered and required penetration. Penetration of the core tube is achieved by manually forcing the tube into the sediment by pressing down on an aluminum extension attached to the piston core head. To prevent compaction of the core during penetration, a stopper is placed within the tube at the sediment–water interface, maintaining static pressure to ensure core integrity. To increase penetration, a hammering tool may be used under certain sediment conditions (e.g., high-plasticity clay inhibiting penetration) to drive the sampler deeper into the sediment column.

3.7 DIVER DEPLOYED CORES

Diver deployed sample cores are useful in areas that may not be accessible by vessel such as under-pier areas. Sediment cores can be deployed manually by divers in soft sediment areas. Divers push or hammer cores into sediment and seal the top of the open core with a cap or check valve to retain the sediment in the core. The core is then extracted, the bottom is capped, and the sample is brought to the surface. Core depths are limited by sediment type generally for shallow cores from 12 to 36 inches. Rectangular cores can be used to obtain a relatively undisturbed core for sediment transport evaluation.

3.8 VIBRACORE

The Vibracore is an apparatus used to collect intact sediment core using a combination of gravity and vibration. The apparatus consists of a vibratory motor attached to a core tube, typically aluminum or polycarbonate, with a core catcher installed at the bottom of the core tube. The vibration of the core tube reduces friction along the inner and outer core tube wall to allow for penetration. A check valve at the top of the core and the core catcher at the bottom of the tube prevent sediment loss as the core tube is retrieved. Vibracore is typically operated from a sampling vessel equipped with a winch to lower and raise the apparatus and is capable of collecting samples as deep as 40 feet or more.

4. Responsibilities

CTO Managers are responsible for selecting the appropriate sampling procedures for use in specific situations. The CTO Manager is responsible for ensuring that all personnel involved in sampling or testing shall have the appropriate education, experience, and training to perform their assigned tasks as specified in Chief of Naval Operations Instruction 5090.1, under *Specific Training Requirements* (DON 2014).

The prime contractor QA Manager or Technical Director is responsible for ensuring overall compliance with this procedure.

The Field Manager is responsible for ensuring that all project field staff follow these procedures.

Field sampling personnel are responsible for the implementation of this procedure.

5. Procedure

5.1 Considerations For Munitions and Explosives of Concern

Potential Munitions and Explosives of Concern (MEC) hazards may be encountered in any area formerly or currently occupied or used by the Department of Defense (DoD). MEC hazards may occur on the ground surface, in the subsurface, and within bodies of water, and may not always be readily observable, or identifiable. As a result, whether or not munitions-related activities ever occurred on the specific work area or within waters in which Navy operations/activities will take place, special care should always be taken when conducting field operations, especially intrusive activities, in the event that MEC may be encountered.

If the site is currently recognized as belonging in the Military Munitions Response Program and has a current, Naval Ordnance Safety and Security-accepted, site-specific Explosives Safety Submission (ESS) (per DON 2010), then field activities, especially intrusive activities, shall adhere to the safety procedures outlined within the ESS.

If suspected MEC is encountered on an active DoD installation, immediately notify your supervisor, DoD Point of Contact, and installation Point of Contact, who will contact and facilitate military Explosive Ordnance Disposal response.

5.2 Method Survey

Subaqueous sediment samples may be recovered using a variety of methods and equipment, depending on the depth of the aqueous layer, the portion and depth of the sediment profile required (surface vs. subsurface), the type of sample required (disturbed vs. undisturbed), and the sediment type (soft vs. hard).

Sediment is collected from beneath an aqueous layer either directly, using a hand-held device such as a shovel, trowel, or auger, or indirectly, using a remotely actuated device such as an Ekman, Ponar, Van Veen, piston corer, or Vibracore sampler. Following collection, the sediment is placed into appropriate sample containers.

5.3 SAMPLE PRESERVATION, CONTAINERS, HANDLING, AND STORAGE

Chemical preservation of solids is generally not recommended. Refrigeration is usually the best approach, followed by analysis within holding time. The holding time of sediment samples is a function of contaminants analyzed and the temperature of sample storage and shall be specified in the project-specific work plan.

Wide-mouth glass containers with Teflon-lined caps are utilized for sediment samples. Other sample containers may be utilized depending on the objectives of the investigation. The sample volume is a function of the analytical requirements and will be specified in the work plan. A sufficient volume should be collected to allow for a portion of the sample to be retained and examined visually.

5.4 TYPICAL FIELD SAMPLING SUPPLIES AND EQUIPMENT/APPARATUS

Sampling supplies

- Work Plan
- Maps/plot plan
- Tape measure
- Survey stakes, flags, or buoys
- Camera
- Stainless steel, plastic, or other appropriate composition (e.g., Teflon) bucket
- One-quart jars w/Teflon-lined lids
- Eight or sixteen-ounce wide-mouth jars with Teflon-lined lids
- Ziploc plastic bags for samples, and sample jars
- Logbook
- Labels
- Chain-of-Custody (COC) forms
- Site description forms
- Cooler(s)
- Ice

Equipment/Apparatus

- Sampling vessel
- Differential global positioning system (dGPS) receiver
- Decontamination supplies/equipment
- Spade or shovel
- Spatula
- Scoop
- Trowel

- Homogenization container (e.g., stainless steel bowl)
- Bucket auger
- Thin wall auger
- Extension rods
- T handle
- Sampling trier
- Sediment coring device:
  - Tubes
  - Points
  - Drive head
  - Drop hammer
  - Eggshell check valve devices
  - Acetate cores
  - Ponar Sampler
  - Ekman Sampler
  - Van Veen Sampler
  - Piston Corer
  - Vibracore apparatus, liner, core catcher
  - Nylon rope

5.5 SAMPLING PROCEDURE

5.5.1 Preparation and Logging

The rationale for the selection of sampling device shall be documented and explained in the work plan.

- Decontaminate all equipment before sediment sampling.
- Perform a general site survey prior to site entry, in accordance with the health and safety plan.
- Evaluate the selection of the sampling device contingent upon the following factors:
  - Depth of water at the sampling location
  - Depth of sediment sampling
  - Physical characteristics of the medium to be sampled

The sediment sample shall be cataloged by a geologist or site-specific trained scientist with previous experience in cataloging sediment cores in accordance with Procedure I-E, *Soil and Rock Classification*.

5.5.2 Sample Collection

5.5.2.1 Sampling Surface Sediments with Trowels or Scoops from Beneath a Shallow Aqueous Layer

Tools, such as spades, shovels, and scoops, can be used to collect sediment from beneath shallow aqueous layers.

This method can be used to collect consolidated sediments, but is limited somewhat by the depth of the aqueous layer; typically less than 3 feet. Depending on the care and precision demonstrated, the sampling technician can collect accurate, representative samples with this procedure. A stainless steel or plastic scoop or lab spoon will suffice in most applications. Care should be exercised to avoid the use of devices plated with chrome or other materials. Plating is particularly common with garden implements such as plotting trowels.

The following procedure will be used to collect the sediment samples with trowels or scoops:

1. Using a pre-cleaned stainless steel scoop or trowel, remove the desired thickness of sediment from the sampling area.
2. Transfer the sample into an appropriate sample container or homogenization container.

5.5.2.2 Sampling Surface Sediments with a Thin-Wall Tube Auger from Beneath a Shallow Aqueous Layer

This system consists of an auger, a series of extensions, and a T handle. The auger is driven into the surface sediment and used to extract a core. A sample of the core is taken from the appropriate depth; typically less than 3 feet.

The following procedure will be used for collecting sediment with a thin-walled auger:

1. Insert the auger into the material to be sampled at a 90 degree to 45 degree angle from horizontal. This orientation minimizes the spillage of sample from the sampler. Extraction of samples may require tilting of the containers.
2. Rotate the trier once or twice to cut a core of material.
3. Slowly withdraw the trier, ensuring that the slot is facing upward.
4. An acetate core may be inserted into the auger prior to sampling if characteristics of the sediments or body of water warrant it. An intact core can be extracted by using this technique.
5. Transfer the sample into an appropriate sample or homogenization container.

5.5.2.3 Sampling Subsurface Sediments with Augers and Thin-Wall Tube Samplers from Beneath a Shallow Aqueous Layer

This system consists of an auger, a series of extensions and a T handle, and a thin-wall tube sampler. The auger is used to bore a hole to a desired sampling depth and then withdrawn. Next, the auger tip is replaced with a tube core sampler, lowered down the borehole, and driven into the sediment at the completion depth. The core is withdrawn and the sample is collected. This method can be used to collect consolidated sediments, but is somewhat limited by the depth of the aqueous layer; typically less than 3 feet.

Several augers are available, including bucket and posthole augers. Bucket-type augers are better for direct sample recovery, easy to use, and provide a large volume of sample. Posthole augers have limited utility for sample collection because they are designed to cut through fibrous, rooted materials.

The following procedures will be used for collecting sediment samples with the hand auger:

1. Attach the auger bit to a drill rod extension, and then attach the T handle to the drill rod.
2. Clear the area to be sampled of any surface debris (e.g., twigs, rocks, litter).
3. During drilling, periodically remove any accumulated sediment from the auger bucket.
4. After reaching the desired depth, slowly and carefully remove the auger from the boring. When sampling directly from the auger, collect the sample after the auger is removed from the boring and proceed to the last step.
5. Remove the auger tip from the drill rods and replace it with a clean thin-wall tube sampler. Install the proper cutting tip.
6. Carefully lower the tube sampler down the borehole. Gradually force the tube sampler into the sediment. Care should be taken to avoid scraping the sides of the borehole. Avoid hammering the drill rods to facilitate coring because the vibrations might cause the boring walls to collapse.
7. Remove the tube sampler and unscrew the drill rods.
8. Remove the cutting tip and remove the core from the device.
9. Discard the top of core (approximately 1 inch), as it represents material collected by the tube sampler before penetration of the layer in question.
10. Transfer the sample into an appropriate sample container or homogenization container.

If the borehole will not stay open, sampling techniques detailed in Section 5.4.2.5 may be used.

5.5.2.4 SAMPLING SUBSURFACE SEDIMENTS FROM BENEATH A SHALLOW AQUEOUS LAYER USING A CORE SAMPLER

This methodology describes the use of a core sampler to collect subsurface sediments. It consists of a coring device, handle, and acetate or stainless steel core. Use the following procedures for collecting sediments with a core sampler:

1. Measure the depth of water using appropriate means, such as a sounding line, marked pole, or fathometer.
2. Assemble the coring device by inserting the acetate core into the sampling tube.
3. Insert the “egg shell” check valve mechanisms into the tip of the sampling tube with the convex surface positioned inside the acetate core.
4. Screw the coring point onto the tip of the sampling tube.
5. Screw the handle onto the upper end of the sampling tube and add extension as needed.

6. This sampler may be used with either a drive hammer for firm, consolidated sediments or a T handle for soft sediments.
7. Place the sampler in a perpendicular position on the material to be sampled.
8. If the T handle is used, place downward pressure on the device until the desired depth is reached. Rotate the sampler to shear off the core of the bottom and proceed to Step 15.
9. If the drive hammer is selected, insert the tapered handle (drive head) of the drive hammer through the drive head.
10. With the left hand holding the tube, drive the sampler into the material to the desired depth. Do not drive the tube further than the tip of the hammer's guide.
11. Record the length of the tube that penetrated the sample material, and the number of blows required to attain this depth.
12. Remove the drive hammer and fit the keyhole-like opening on the flat side of the hammer onto the drive head. In this position, the hammer serves as a handle for the sampler.
13. Rotate the sampler at least two revolutions to shear off the sample at the bottom.
14. Lower the sampler handle (hammer) until it just clears the two ear-like protrusions on the drive head, and rotate 90 degrees.
15. Withdraw the sampler by pulling the handle (hammer) upwards and dislodging the hammer from the sampler.
16. Unscrew the coring point, and remove the eggshell check valve.
17. Slide the acetate core out of the sampler tube. The acetate core may be capped at both ends. The sample may be used in this fashion, or the contents may be transferred to a stainless steel or plastic bucket.
18. Collect samples for volatile organic analysis directly from the core to minimize volatilization of contaminants.

5.5.2.5 Sampling Surface Sediments from Beneath a Deep Aqueous Layer

This technique consists of lowering a remote sampling mechanism to the sediment by a rope, cable, or extended handle. The mechanism is triggered, and the device entraps sediment in spring-loaded jaws, or within lever-operated jaws. The hoisting process can be project specific, but deep samples would typically use an electric winch.

The following procedures will be used for collecting sediments with an Ekman Sampler:

1. Attach a sturdy nylon or stainless steel cable to the hook provided or secure the extended handle to the bracket with machine bolts.
2. Arrange the Ekman dredge sampler so that the jaws are in the open position and the trip cables are positioned over the release studs.
3. Lower the sampler to the sediment surface.
4. Trigger the jaw release mechanism by lowering a messenger down the line or by depressing the bottom on the upper end of the extended handle.

5. Raise the sampler, and slowly decant any free liquid through the top of the sampler by slowly inclining the sampler and collecting the escaping water in a bucket or other suitable container.
6. Open the sampler, and transfer the sediment into a stainless steel or plastic bucket. Continue to collect additional sediment until sufficient material has been secured. Transfer the sediment to an appropriate sample or homogenization container.
7. Collect samples for volatile organic analysis directly from the bucket to minimize volatilization of contaminants.

The following procedures will be used for collecting sediments with a Van Veen or Ponar sampler:

1. Attach a sturdy nylon rope (Ponar only) or steel cable to the hook provided on top of the sampler.
2. Arrange the Van Veen or Ponar sampler in the open position, setting the trip bar so the sampler remains open when lifted from the top.
3. Slowly lower the sampler to the sediment surface to limit disturbance.
4. The weight of the sampler will release the spring-loaded pin, thus releasing the trip bar and closing the jaws upon extraction.
5. Raise the sampler to the surface and slowly decant any free liquid through the screens on top of the sampler.
6. Open the sampler and transfer the sediment to a stainless steel or plastic bucket. Continue to collect additional sediment until sufficient material has been secured. Transfer the sediment to an appropriate sample or homogenization container.
7. Collect samples for volatile organic analysis directly from the bucket to minimize volatilization of contaminants.

Immediately after recovery, each grab sample is inspected to determine its acceptability, according to the following criteria:

- The Van Veen or Ponar sampler jaws were completely closed.
- The material surface was intact and there was no evidence that the material had been disturbed (e.g., partially or completely washed out, no evidence of a grab from the same hole).
- The material did not overflow through the vents on top of the Van Veen or Ponar.
- Sufficient sediment materials were obtained by the Van Veen or Ponar.
- A layer of clean water overlaid the surface of the sediment in the sampler.
- The sediment was fairly evenly distributed in the sampler.

In conditions where these criteria were met, the grab is considered acceptable, and the water overlaying the surface of the sediment is removed by allowing the water to percolate and drain into the cradle used to stabilize the sampler prior to processing. After removal of the overlying water, a clean plastic ruler is inserted into the center of the grab material to measure the amount of recovery.

5.5.2.6 SAMPLING SURFACE AND SUBSURFACE SEDIMENTS FROM BENEATH A DEEP AQUEOUS LAYER USING A PISTON CORER OR VIBRACORE SAMPLER

This methodology describes the general use of samplers to collect subsurface sediments. The methodology consists of a Vibracore or sediment corer apparatus, aluminum core tube, core sleeve (clear acetate), food-grade polycarbonate tube, and sampling vessel (as applicable). The piston corer uses designated polycarbonate tubes only.

The following procedures will be used for collecting sediments with a Vibracore Sampler:

1. Measure the depth of water using appropriate means, such as a sounding line, marked pole, or fathometer.
2. Verify the Vibracore head is securely attached to the winch cable and the aluminum core tube.
3. Insert core sleeve into the aluminum core tube and attach core catcher at the end of the tube.
4. Using a winch, suspend and lower the Vibracore slowly until the core tube contacts the bottom using the depth of water determination in Step 1.
5. Initiate vibration and continue penetration until the core tube is completely buried or refusal occurs. If refusal occurs, relocate sample position as close to the original location as possible. Turn off the vibration when penetration is completed and log the depth of penetration.
6. Raise the core tube slowly by winch. Vibration may be used if extracting the core tube is very difficult.
7. Remove core catcher and slide core sleeve out of the core tube. Inspect sediment core for signs of compaction or sediment loss (e.g., length of recovered sediment significantly less than penetration depth, gaps in the sediment core).
8. The core shall be cataloged by a geologist or site-specific trained scientist with previous experience in cataloging sediment cores in accordance with Procedure I-E, *Soil and Rock Classification.*
9. Collect sample from required depth intervals. Transfer the sediment to an appropriate sample or homogenization container.

The following procedures will be used for collecting sediments with a piston core sampler:

1. Measure the depth of water using appropriate means, such as a sounding line, marked pole, or fathometer.

1. Verify the polycarbonate tube is securely attached to the piston corer and the rope or push pole is attached to the top of the sampler.
2. Lower the piston corer slowly (by rope or push pole) until the core tube contacts the bottom using the depth of water determination in Step 1.
3. Push the sampler into the sediment by push pole or weighting system. Continue penetration until the core tube is completely buried or refusal occurs. If refusal occurs, relocate sample position as close to the original location as possible. Log the depth of penetration.

4. Raise the core tube slowly by rope or pole.
5. Cap the bottom of the polycarbonate tube, remove core tube from the sampler head, and cap the top of the sample tube. Inspect sediment core for signs of compaction or sediment loss (e.g., length of recovered sediment significantly less than penetration depth, gaps in the sediment core).
6. The core shall be cataloged by a geologist or site-specific trained scientist with previous experience in cataloging sediment cores in accordance with Procedure I-E, *Soil and Rock Classification.*
7. Collect sample from required depth intervals. Transfer the sediment to an appropriate sample or homogenization container.

Following retrieval, a Teflon cap is placed on each end of the tube and labeled to indicate the top and bottom of the core. Onboard the operations vessel, the piston core will be placed upright and secured until the suspended sediments settle in the upper part of the core. The following criteria were used to determine core acceptability:

- The material surface was intact and there was no evidence that the material had been disturbed (e.g., partially or completely washed out).
- The material was evenly distributed with no sectional gaps along the length of the core.
- Sufficient material was present in the core to obtain analytical samples.
- A layer of clean water overlaid the top of the core.

5.5.3 Sample Acceptability

Only sediments correctly collected with a grab or core sampling device shall be used for subsequent physicochemical, biological, or toxicity testing. If samples do not meet the criteria specified below, the sample shall be rejected and the location re-sampled.

5.5.3.1 Grab Sample Acceptability

Acceptability of grab samples can generally be ascertained by:

- Noting that the samplers were closed when retrieved, are relatively full of sediment (not overfilled), and do not appear to have lost surficial fines.
- Overlying water should be present and not excessively turbid
- The sediment-water interface is intact and relatively flat, with no sign of channeling or sample washout.
- The desired depth of penetration has been achieved.
- There is no evidence of significant sediment loss (incomplete closure of the sampler, penetration at an angle, or tilting upon retrieval).

5.5.3.2 CORE SAMPLE ACCEPTABILITY

Acceptability of core samples can be ascertained by:

- Ensuring that the core sampler was not inserted at an angle or tilted upon retrieval.
- Ensuring that the sediment core sample is continuous with no observed gaps.
- The core collected the required depth to meet the study objectives, with no significant loss of sediment.

5.5.4 Subsampling and Composite Samples

The decision to subsample or composite sediment samples depends on the purpose and objectives of the investigation, the nature and heterogeneity of the sediments, the volume of sediment required for analytical or toxicity assessment, and the degree of statistical resolution that is acceptable. The work plan shall discuss the rationale and protocol for subsampling or compositing to ensure the project objectives are met.

6. Records

Keep records of all sampling activities in the field notebook. Sample custody should be documented on the COC forms.

7. Health & Safety

Field Personnel shall perform work in accordance with the current (or as contractually obligated) United States Army Corps of Engineers Safety and Health Requirements Manual EM-385-1-1 (USACE 2008) and site-specific health and safety plan. In addition, during sediment sampling, anomaly avoidance conducted by an unexploded ordinance (UXO) qualified technician may be required to prevent disturbance of munitions and explosives of concern (MEC) or material potentially presenting an explosive hazard (MPPEH).

8. References

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Procedure I-E, *Soil and Rock Classification.*

Procedure I-F, *Equipment Decontamination.*

9. Attachments

None.

Monitoring Well Installation and Abandonment

1. Purpose

This standard operating procedure describes the methods to be used by the United States (U.S.) Navy Environmental Restoration (ER) Program, Naval Facilities Engineering Command (NAVFAC), Pacific personnel during the installation of groundwater monitoring wells. It describes the components of monitoring well design and installation and sets forth the rationale for use of various well installation techniques in specific situations.

2. Scope

This procedure applies to all Navy ER projects performed in the NAVFAC Pacific Area of Responsibility.

This procedure shall serve as management-approved professional guidance for the ER Program and is consistent with protocol in the Uniform Federal Policy-Quality Assurance Project Plan (DoD 2005). As professional guidance for specific activities, this procedure is not intended to obviate the need for professional judgment during unforeseen circumstances. Deviations from this procedure while planning or executing planned activities must be approved and documented by the following prime contractor representatives: the CTO Manager and the Quality Assurance (QA) Manager or Technical Director. A Navy project representative (i.e., Remedial Project Manager or QA Manager) shall also concur with any deviations.

3. Definitions

3.1 FILTER PACK

Filter pack is sand or gravel that is smooth, uniform, clean, well-rounded, and siliceous. It is placed in the annulus of the well between the borehole wall and the well screen to prevent formation materials from entering the well and to stabilize the adjacent formation.

3.2 ANNULUS

The annulus is the downhole space between the borehole wall and the well casing and screen.

3.3 BRIDGE

An obstruction in the drill hole or annulus. A bridge is usually formed by caving of the wall of the well bore, by the intrusion of a large boulder, or by filter pack materials during well completion. Bridging can also occur in the formation during well development.

3.4 GROUT

Grout is a fluid mixture of cement and water that can be forced through a pipe and emplaced in the annular space between the borehole and casing to form an impermeable seal. Various additives, such as sand, bentonite, and polymers, may be included in the mixture to meet certain requirements.

3.5 SIEVE ANALYSIS

Sieve analysis is the evaluation of the particle-size distribution of a soil, sediment, or rock by measuring the percentage of the particles that will pass through standard sieves of various sizes.

4. Responsibilities

CTO Managers are responsible for issuing WPs that reflect the procedures and specifications presented in this procedure. Individual municipalities, county agencies, and, possibly, state regulatory agencies enforce regulations that may include well construction and installation requirements. The CTO Manager shall be familiar with current local and state regulations, and ensure that these regulations are followed. Regulations are subject to constant revision. Every effort should be made to stay informed of these changes through contact with the agencies that oversee work in specific project areas, prior to initiation of field activities. The CTO Manager or designee shall review all well construction logs on a minimum monthly basis. The CTO Manager is responsible for ensuring that all personnel involved in monitoring well installation and abandonment have the appropriate education, experience, and training to perform their assigned tasks as specified in Chief of Naval Operations Instruction 5090.1, under *Specific Training Requirements* (DON 2014).

The prime contractor QA Manager or Technical Director is responsible for ensuring overall compliance with this procedure.

The Field Manager (FM) is responsible for direct supervision of the installation of monitoring wells and ensuring that procedures and specifications are implemented in the field. The qualifications for the FM include a degree in geology, hydrogeology, civil/geotechnical/environmental engineering, or equivalent with at least 2 years of field experience in the installation of monitoring wells.

Field sampling personnel are responsible for the implementation of this procedure.

The onsite geologist/hydrogeologist/engineer is expected to obtain a description of the lithologic samples obtained during the excavation and construction of a monitoring well. These data are often required to provide guidance regarding the installation of specific components of the monitoring well. Guidance for lithologic sample collection and sample description is contained within Procedure I-B-1, *Soil Sampling.*

5. Procedures

5.1 CONSIDERATIONS FOR MUNITIONS AND EXPLOSIVES OF CONCERN

Potential Munitions and Explosives of Concern (MEC) hazards may be encountered in any area formerly or currently occupied or used by the Department of Defense (DoD). MEC hazards may occur on the ground surface, in the subsurface, and within bodies of water, and may not always be readily observable, or identifiable. As a result, whether or not munitions-related activities ever occurred on the specific work area or within waters in which Navy operations/activities will take place, special care should always be taken when conducting field operations, especially intrusive activities, in the event that MEC may be encountered.

If the site is currently recognized as belonging in the Military Munitions Response Program and has a current, Naval Ordnance Safety and Security-accepted, site-specific Explosives Safety Submission

(ESS) (per DON 2010), then field activities, especially intrusive activities, shall adhere to the safety procedures outlined within the ESS.

If suspected MEC is encountered on an active DoD installation, immediately notify your supervisor, DoD Point of Contact, and installation Point of Contact, who will contact and facilitate military Explosive Ordnance Disposal response.

5.2 BACKGROUND INFORMATION

The primary objectives of installing a monitoring well at a site are: to observe groundwater levels and flow conditions; to obtain samples for determining groundwater quality; and to evaluate the hydraulic properties of water-bearing strata. To achieve these objectives, it is necessary to satisfy the following criteria:

- Construct the well with minimum disturbance to the formation.
- Construct the well with materials that are compatible with the anticipated geochemical environment.
- Properly complete the well in the desired zone.
- Adequately seal the well with materials that will not interfere with the collection of representative water samples.
- Sufficiently develop the well to remove drilling fluids or other additives or conditions associated with drilling, and provide unobstructed flow to the well.

The proper design and construction of monitoring wells requires an understanding of site geology and hydrogeology, and knowledge of contaminant transport in subsurface materials.

A significant difference between monitoring wells and production or “water” wells is that the intake section of monitoring wells is often purposely completed in a zone of poor water quality and/or poor yield. The quality of water entering a monitoring well can vary from drinking water to a hazardous waste or leachate. In contrast, production wells are normally designed to efficiently obtain water from highly productive zones containing good quality water. The screen of a monitoring well often extends only a short length (typically 10 feet or less) to monitor hydraulic conditions within, and obtain water samples from, selected water-bearing intervals. In contrast, water wells are often designed to obtain economic quantities of water from multiple zones of water-bearing strata.

5.3 MONITORING WELL DESIGN CONSIDERATIONS

The following information was compiled from a number of technical references. For additional information related to monitoring well installation, consult the references listed in Section 8.

5.3.1 Well Placement

Select the location of a monitoring well according to the purpose of the monitoring program, which will vary among different sites and may include detection of contaminants in groundwater, verification of contaminant migration predictions, the monitoring of leachate at a landfill site, or remediation of a contaminated site. Each of these purposes will require a specialized array of monitoring locations and completion intervals, and a specific sampling program. Therefore, design the monitoring well network to satisfy the needs of the particular situation.

Determine the position of a monitoring well in a contaminant flow path for a monitoring effort based on the interpretation of preliminary data. These data shall be sufficient to facilitate identification of potential contaminant sources. Also consider site history, topography, climate, surface hydrology, and the location of nearby pumping wells.

Design the layout of the groundwater monitoring network following preliminary evaluation of the approximate direction of groundwater flow. A minimum of three wells is necessary to estimate local hydraulic gradients. Ideally, at least one well will be located hydraulically upgradient, and two or more wells strategically located hydraulically downgradient of each potential contaminant source. Determination of the horizontal and vertical extent of a contaminant plume is often an iterative process requiring the installation and sampling of wells in several phases.

Install monitoring wells hydraulically downgradient and as close as physically possible to the areas of suspected contamination in order to immediately detect releases from a hazardous waste site. Locate additional monitoring wells based on the interception of potential groundwater flow paths and direction of contaminant migration.

The placement of groundwater monitoring wells shall also consider the three-dimensional nature of groundwater flow. Significant vertical gradients and heterogeneous and/or anisotropic hydraulic conditions may exist at a site. Thus, the direction of groundwater flow may not necessarily coincide with the apparent horizontal gradient observed by the triangulation provided by three monitoring wells. Determine the completion intervals of existing wells prior to the calculation of groundwater gradient directions. Consider temporal/seasonal groundwater flow conditions if the monitoring well network is located near existing active well fields, near tidal zones, or near ephemeral surface water (e.g., canals, dry river beds).

5.3.2 Well Depth and Screened Interval

A detailed understanding of the site stratigraphy, including both horizontal and vertical extent of geologic formations, is necessary to identify zones of different permeabilities, and discontinuities, such as bedding planes, fractures, or solution channels. Groundwater flow and/or contaminant transport beneath the site preferentially occur in the more permeable zones. Equally important is the identification of relatively low permeability zones that may impede migration of contaminants. The occurrence and movement of groundwater in the subsurface is closely related to lithology. Thus, geologic conditions will influence the location, design, and methods used to locate and install monitoring wells.

The depth of a monitoring well is determined by the depth of one or more water-bearing zones that are to be monitored. For example, if preliminary soil borings indicate that multiple water-bearing zones are present at a site, and it is believed that zones other than the uppermost zone may be impacted by surface contamination, a well should be completed in each individual water-bearing zone encountered. Where two or more saturated zones occur beneath a site, and the intent of the monitoring program is to monitor water quality in the lower zone, the monitoring well will generally require surface casing to isolate the upper water-bearing zone from the deeper zone prior to drilling into the deeper zone.

In multiple aquifer systems, highly variable conditions may occur. For example, an overlying unconfined aquifer may be contaminated, whereas the underlying confined aquifer may not contain contaminants. Exercise extreme care to ensure that the installation/completion of monitoring wells does not cause cross-contamination of the aquifers. In these cases, it may be preferable to install surface casing through the contaminated aquifer to minimize the possibility of cross-contamination to the lower aquifer system.

Characteristics of lithologic materials encountered at the site, such as the degree of consolidation and grain size, also influence the type of well completion. In unconsolidated alluvial deposits, screened well intakes are typically used. An emplaced filter pack, consisting of well-sorted, clean, inert silica sand with a grain size and well screen slot size appropriate for the formation, typically is used to filter out fine-grained materials present within formations encountered in the borehole. Where permeable, consolidated formations are present, casing may be extended through overlying unconsolidated deposits and the well may be completed with a section of open borehole in the consolidated water-bearing zone. Even in these cases, however, fine-grained materials may enter the well through fractures, and if severe enough, an artificial filter pack and screened intake may be required. Also, many regulatory agencies require a screened interval installed with filter pack for all well completions.

Placement of the screened interval depends primarily on two factors: the interval to be monitored and the type of contaminants. The desired interval to be monitored shall dictate the interval to be screened. Determine which stratigraphic horizons represent potential pathways for contaminant migration by the site characterization. Short screened sections provide more specific data on the vertical distribution of contaminants and hydraulic head, while long screen intervals can result in a cumulative dilution of contamination in one zone with uncontaminated groundwater in another zone, as well as less specific information on hydraulic head. In addition, a long screened interval could potentially create vertical conduits that might result in cross-contamination.

Consider the type of contaminants involved prior to well installation. Contaminants that have a density less than water migrate differently than contaminants with a density equal to or greater than water. For example, if the contaminant in an unconfined aquifer has a density lower than water, such as diesel or gasoline, it is important to ensure that the screened interval of the well extends above the maximum seasonal elevation of the water table. Doing so facilitates an accurate determination of apparent thickness of free product in a monitoring well. In general, the screen shall extend 3 to 5 feet above the highest anticipated level of the water table when monitoring the upper portions of an unconfined aquifer.

Conversely, if the contaminant of concern has a density higher than water, such as trichloroethene (TCE), the screened interval of one or more monitoring wells should be installed just above the lower confining bed of a potentially impacted aquifer. TCE may be transported at high concentrations as a dense, nonaqueous phase liquid (DNAPL) near the source area, and migrate along the top of a confining bed at the base of an impacted aquifer.

Give special attention to interpretation of site stratigraphy when assessing DNAPL, particularly with respect to dipping beds, as it is possible for DNAPLs to effectively move hydraulically upgradient if low permeability perching horizons dip in a direction opposite the hydraulic gradient. This type of situation is important to consider when selecting monitoring well locations.

If time and budget allow, correlate conventional borehole geophysical methods and continuous cores of soil samples to yield a more complete stratigraphic characterization. A continuous profile of borehole conditions is compared to field observations and is used to select screened intervals.

5.3.3 Well Permitting

All wells shall be permitted in accordance with the regulations of the jurisdiction where well installation is occurring, if this is Navy policy for the region of activity. Contact local authorities prior to establishing well construction requirements for the project.

The permit procedure may require permit fees, site inspections, and an application signed by a registered professional geologist or engineer. Permit requirements may impact field schedules and budgets. The driller may also be required by law to be licensed and bonded. Provide documentation that all legal requirements have been met to the appropriate agencies prior to the installation of a monitoring well.

5.4 SELECTION OF DRILLING METHOD

Monitoring well installation at hazardous waste sites may involve drilling through or near hazardous materials, in areas where the extent of contamination is unknown, or through more than one geologic material or aquifer. Use of any drilling method at a hazardous waste site involves an element of risk related to the potential spread of contamination or creation of a pathway through which contaminants can migrate. Selection of a method most appropriate for site-specific conditions is essential to minimize these risks. Table I-C-1-1 provides an interpretation of how geologic conditions may influence the selection of a particular drilling method.

Most drill rigs use gasoline or diesel fuel, as well as hydraulic fluid during operation. Because these fluids are all potential contaminants, it is important to protect the drill hole and immediate area from these substances. Whenever leaking fluid from the drill rig is detected, drilling operations shall cease as soon as practical following stabilization of the drill stem, and the rig shall be moved to a safe area to be repaired.

Table I-C-1-1: Relative Performance of Different Drilling Methods in Various Types of Geologic Formations; Commonly Utilized Drilling Methods

Type of Formation	Auger-Hollow Stem	Rotary Bucket Auger*	Rotary with Fluids (foam, mud)*	Air Rotary	Air Rotary with Casing Hammer	Down the Hole Air Hammer	Dual Tube/ Casing Hammer	Coring	Reverse Rotary with Fluids*	Reverse Rotary with Dual Tube	Direct Push **
Loose sand and gravel	G	P	P-G	NR	E	NR	E	NR	P-E	E	E
Loose boulders in alluvium	P	P-G	G	NR	E	NR	P	NR	P	G	NR
Clay, silt	E	G	E	NR	E	NR	E	P-G	E	E	G
Shale	P	NR	E	P	E	NR	NR	E	E	E	NR
Sandstone	P	NR	G	E	NR	NR	NR	E	G	E	P
Limestone with chert	NR	NR	G	E	NR	E	NR	E	G	G	NR
Limestone with and without fractures	NR	NR	G-E	E	NR	E	NR	E	P-E	E	P
Limestone, cavernous	NR	NR	P-G	P-G	NR	E	NR	E	NR	E	NR

Type of Formation	Auger-Hollow Stem	Rotary Bucket Auger*	Rotary with Fluids (foam, mud)*	Air Rotary	Air Rotary with Casing Hammer	Down the Hole Air Hammer	Dual Tube/ Casing Hammer	Coring	Reverse Rotary with Fluids*	Reverse Rotary with Dual Tube	Direct Push **
Dolomite	NR	NR	E	E	NR	E	NR	E	E	E	NR
Basalts-thin layers in sedimentary rocks	P	NR	G	E	NR	NR	NR	E	G	E	P
Tuff	P	NR	G	E	NR	E	NR	E	G	G	NR
Basalts-thick layers	NR	NR	P	G	NR	E	NR	E	G	G	NR
Basalts-highly fractured	NR	NR	NR	P	NR	G	NR	E	NR	G	NR
Metamorphic rocks	NR	NR	NR-P	G	NR	E	NR	E	G	G	NR
Granite	NR	NR	NR-P	E	NR	E	NR	E	G	G	NR

E Excellent
G Good
NR Not Recommended
P Poor
* Cannot be used for analytical soil sampling
** Procedure I-H, *Direct-Push Sampling Techniques* discusses protocol associated with direct push applications.

The following sections discuss commonly used drilling methods and their applicability to installation of monitoring wells. Regardless of the drilling method selected, decontaminate all drilling equipment using Procedure I-F, *Equipment Decontamination*. Follow these procedures before use and between borehole locations to prevent cross-contamination. In addition to selecting the proper drilling technique, take other precautions to prevent distribution of any existing contaminants throughout the borehole.

5.4.1 Hollow-stem Continuous-flight Auger

Hollow-stem continuous-flight auger (HSA) is the most frequently employed method used in the environmental industry for the drilling and installation of shallow monitoring wells in unconsolidated materials. Drilling with HSA is possible in loose sand and gravel, loose boulders in alluvium, clay, silt, shale, and sandstone. HSA drilling is usually limited to unconsolidated materials and depths of approximately 150 to 200 feet. HSA drill rigs are mobile, relatively inexpensive to operate, generally cause minimal disturbance to the subsurface materials, and have the additional advantage of not introducing drilling fluids (e.g., air, mud, or foam) to the formation.

Another advantage of the HSA method is that undisturbed samples are obtained by driving a split-spoon sampler below the lead auger. Soil samples can usually be easily collected in this manner with a minimum of tripping sampling tools into and out of the hole.

Moreover, in the HSA drilling method, the well is constructed inside the HSAs as the augers are gradually removed from the ground. This method decreases the possibility of the borehole collapsing before the well is installed. HSAs shall have a nominal outside auger-flight diameter of 10 to 12 inches and a minimum inside diameter of 8 inches. Larger inside diameter auger flights are sometimes available. Well casing diameter is usually limited to 4 inches or less when using the HSA method. The difference between the inner diameter (I.D.) of the auger and the outer diameter (O.D.) of the well casing shall be at least 4 inches (i.e., a minimum 2-inch annular space) to permit effective placement of filter pack, bentonite seal, and grout without bridging.

5.4.2 Rotary Bucket Auger

Rotary bucket auger drilling, or bucket auger drilling (BAD), utilizes a large-diameter bucket auger to excavate earth materials. Excavated material is collected in a cylindrical bucket that has auger-type cutting blades on the bottom of the bucket. The bucket is attached to the lower end of a kelly bar that passes through, and is rotated by, a large ring gear that serves as a rotary table.

The kelly bar is square in cross-section and consists of two or more lengths of square steel tubing, with each successive length of tubing telescoped inside the previous length. This design permits boring to a depth several times the collapsed length of the kelly bar before having to add a length of drill rod between the kelly and the bucket. In drilling with the telescoping kelly, the bucket is typically lifted and dumped without disconnecting, thereby speeding up the process when drilling deep holes. Depths of 75 to 100 feet are achievable with most telescoping kellys. It is possible to construct wells more than 250 feet deep by this method, although depths of 50 to 150 feet are more typical.

The BAD technique is most effective in semi-consolidated or clayey formations that stand open without caving. Drilling through unconsolidated materials within the saturated zone is difficult, but not impossible if the hole is kept full of water or mud (see direct rotary methods with foam or mud). Drilling mud may be necessary, particularly in loose formations consisting of unconsolidated fine- to medium-grained sands and silts. In the right conditions, a bucket auger bit will remove a cylinder of material 12 to 24 inches deep with each run. Therefore, samples obtained by the BAD method are representative of the formation being drilled, unless sloughing or caving of the borehole walls occurs.

Boreholes drilled with the BAD technique generally range from 18 to 48 inches in diameter. Because of the large diameter of the borehole drilled with this technique, and the common need to add either water or mud to maintain the borehole in unconsolidated, near-surface deposits, it is recommended to use this method only for the installation of surface casing through the first water-bearing unit at a hazardous waste site.

5.4.3 Direct Rotary with Foam or Mud

Direct rotary drilling (DRD) techniques involve the use of various types of drilling fluids, which typically include air, foam, and mud. In each of the DRD methods, drilling fluids are circulated down through the inside of the drilling pipe into the borehole, and then up through the annulus between the drilling pipe and the borehole wall to carry drill cuttings up to the surface. The drilling fluids may also be used for stabilizing the borehole wall, which may be especially useful in unconsolidated, caving formations. In this section, the DRD method and its use with either foam or mud are discussed.

A variety of bit types may be used with each of these drilling fluids, depending on the type of formational material encountered; however, typically, the tri-cone or roller bit is used. The drilling bit is attached directly to a heavy section of drill pipe called a drill collar, which is attached to help keep the borehole straight. The drill collar is in turn attached to the drill pipe and the kelly.

General types of drilling fluids available for use with the DRD method include water with clay additives, water with polymeric additives, water with clay and polymeric additives, and foams (comprised of air or water, surfactants, and occasionally clays or polymers). The drilling fluid density may be adjusted during drilling to improve or resume circulation within the borehole, or to attempt to stabilize the borehole wall. A major problem with the addition of these fluids is that it is almost impossible to estimate the amount introduced into the formation through the saturated and unsaturated zones. Additionally, it is also very difficult to estimate the magnitude and duration of the impact to groundwater quality by the use of these fluids.

The drilling fluids and associated cuttings shall not be allowed to flow over the site unrestricted. A downhole circulation system, or fluid diversion system shall be used to keep the fluids and cuttings contained in a reasonable manner, yet still allow the collection of grab samples for lithologic identification.

While in some geologic situations DRD may be the most efficient method of drilling a borehole, potential problems associated with the drilling fluids usually make DRD a last-resort drilling technique for environmental purposes; one that should be avoided whenever possible.

Potential Problems of DRD with Foam or Mud

- The chemistry of the drilling fluid could adversely affect the chemistry of groundwater samples, soil samples, or the efficiency of the well (when using mud).
- Bentonite mud reduces the effective porosity of the formation around the well, thereby compromising the estimates of well recovery. Bentonite may also affect groundwater pH. Additives to adjust viscosity and density may introduce contaminants to the system or force irrecoverable quantities of mud into the formation.
- Some organic polymers and compounds provide an environment for bacterial growth, which in turn, reduces the reliability of sampling results.
- Uncontained drilling foam and/or mud may create unsafe working conditions at the surface around the rig.

Solutions

- DRD should only be utilized as a last resort.
- The hydrogeologist should ensure that the fluids used will not affect the chemistry of the soil samples and groundwater samples. One possibility is to collect samples of the drilling fluid for laboratory analysis.
- The hydrogeologist shall keep track of the amount of water and fluids introduced to the borehole in order to purge this quantity during well development.
- Provisions to contain drilling mud and foam shall be discussed in the drilling contractor scope of work.

5.4.4 Air Rotary and Air Rotary with Casing Hammer

Air rotary drilling (ARD) and air rotary with casing hammer (ARCH) force air down the drill pipe and back up the borehole and remove drill cuttings in the same manner as DRD with foam or mud. Without a casing hammer, the use of ARD techniques is best suited to hard-rock formations where the borehole will stand open on its own and circulation loss is not a major concern. ARCH is most useful in unconsolidated sediments of all types due to the use of a hardened steel casing that is driven behind the bit with a pneumatic casing hammer to keep the hole open. A combination of these two drilling techniques is very useful where unconsolidated overburden overlies consolidated rock. In this case, the casing hammer attachment would be used to set the surface casing at the top of the consolidated formation while continuing with ARD. As a well is being installed or the hole is being abandoned, the casing can be retrieved for use on another hole, or left in place to serve as surface casing.

Air from the compressor shall be filtered to ensure that oil or hydraulic fluid is not introduced into the soils and/or groundwater system to be monitored. In addition, foam or hydrocarbon-based lubricating joint compounds for the drill rods shall not be used with any rotary drilling method due to the potential for introduction of contaminants into the native materials and/or groundwater. Teflon-based joint lubricating compounds that are typically mixed with vegetable oil are available for this purpose.

Potential Problems of ARD and ARCH

- In the case of sampling with a split-spoon sampler to collect soil samples for laboratory analysis, the high-pressure air from inside the drill pipe can cause volatilization of contaminants from the soils beneath the bit in unconsolidated sediments. If installing deep wells or boreholes, this problem may not be avoidable.
- Fine-grained saturated materials that may cause surging and heaving problems are common in many coastal areas. Heaving sediments may cause problems during sampling and well installation when drilling with ARD.
- Rocks and other drill cuttings may be ejected from the borehole at high velocities, creating a secondary hazard around the rig.

Solutions

- ARD and ARCH should not be used for soil sampling in shallow, unconsolidated situations where a HSA rig could be used as effectively.
- One method to compensate for heaving and surging aquifer materials is to over drill the borehole by 5 or 10 feet to provide space for heaving sediments to fill in while well completion is being performed.
- Another method to control heaving sands is to add clean water to a level above the water table to create a downward pressure on the heaving materials. This additional volume of water should also be extracted during well development.
- Drill rigs shall be equipped with cyclones or equivalent devices designed to contain formation projectiles.

5.4.5 Dual Tube Casing Hammer with Reverse Air Circulation

Dual tube casing hammer with reverse air circulation (DTCH) is useful in unconsolidated sediments, but is most effective as a method for drilling through thick sequences of materials, such as coarse-grained sands and gravels. The DTCH system operates by simultaneously driving a pair of heavy gauge steel pipes into the ground while using high pressure reverse air circulation to blow air down the annulus of the two pipes and bring air and unconsolidated lithologic materials out through the inside of the inner pipe. The method does not employ a typical bit in that the formational materials are not ground up, sliced, nor cut into pieces. Instead, the bit consists of a special shoe that is used to funnel materials either into, or away from, the inner pipe, depending on whether the formational material is fine- or coarse-grained, respectively.

Typically, the method can drill through 200 feet of gravel in a day with relative ease. The inside diameter of the inner pipe is about 6 inches, with the borehole diameter being about 10 inches. Cobbles with long axes of up to 6 inches come up through the inner pipe easily. Larger conglomerate clasts must be either pushed aside or broken up using the pneumatic hammer to drive the heavy shoe down onto the clast.

Conversely, the method works poorly in clay-rich materials. The shoe acts as a large cookie cutter, forcing a plug of clay into the inner pipe, which then must be forced to the surface and physically removed from the diverter/shoe assembly with the hammer. This method should probably be avoided where large thicknesses of clay are expected to be encountered in the subsurface.

Typically, the DTCH method can drill to approximately 200 feet with standard equipment. Deeper holes will likely require a larger air volume for circulation via an additional compressor hooked up to the drilling rig. Additionally, a variation of the DTCH called “triple tube” can be used to install larger-diameter wells to depths of about 200 feet depending upon the site. This method can also be used to supply a temporary surface casing to avoid cross-contamination of deeper zones while extending the boring to greater depths.

Potential Problems of DTCH

- In the case of soil sampling with a split-spoon sampler to collect samples for laboratory analysis, the high-pressure air from inside the drill pipe can cause volatilization of contaminants from the soils beneath the bit in unconsolidated sediments. If installing deep wells or boreholes, this problem may not be avoidable.

Solutions

- DTCH should not be used for sampling soil in shallow, unconsolidated situations where a HSA rig could be used as effectively.

5.5 MONITORING WELL DESIGN PROCEDURES

The designs of typical groundwater monitoring wells are depicted in Figure I-C-1-1 and Figure I-C-1-2. A discussion of the design of the individual components of a typical monitoring well is given in the following subsections.

5.5.1 Pre-installation Design Drawing

Develop a pre-installation design drawing after the borehole for the well has been completed and well-specific lithologic and hydrologic information are available. The pre-design drawing shall identify the anticipated depth of the well, the locations of the top and bottom of the screened interval, the anticipated top of the filter pack, the anticipated top of the bentonite seal, and the locations of centralizers (if applicable). In addition, calculate the volumes of sand, bentonite, and grout anticipated to be placed in the annular space of the well. Maintain the drawing as documentation of the well design.

5.5.2 Casing Selection

The cased section of a monitoring well is a pipe without slots or openings, which is installed to prevent the well from directly accessing formations above the screened interval. The casing isolates the screened interval.

The selection of appropriate casing materials must take into account several site-specific factors, such as: (1) geology, (2) geochemistry, (3) well depth, (4) size and type of equipment to be used in the well, and (5) the types and concentrations of suspected contaminants. In addition, consider several other logistical factors, including drilling method, cost, and availability.

Typical casing materials comprise polyvinyl chloride (PVC), chlorinated PVC, fiberglass reinforced plastic, Teflon, galvanized steel, carbon steel, Type 304 stainless steel, and Type 316 stainless steel. Casing materials must be compatible with the environment into which they will be placed. Metallic casings are most subject to corrosion, while thermoplastic casings are most subject to chemical degradation. Some thermoplastic materials are susceptible to sorption and desorption of chemicals. The extent to which these processes occur is related to water quality, the concentration of contaminants, and the type of casing materials. Choose casing material with knowledge of the existing or anticipated groundwater chemistry. If non-aqueous phase liquids (light non-aqueous-phase liquid or DNAPL) are potentially present at a site, careful consideration of the concentrations and types of chemicals that may come into contact with the casing must be made to insure the casing will not degrade over time. Table I-C-1-2 presents the relative compatibilities of some typical casing materials.Table I-C-1-2: Relative Chemical Compatibility of Rigid Well-Casing Material

	PVC [a] 1	Galvanized Steel	Carbon Steel	Low-Carbon Steel	Stainless [b] Steel 304	Stainless [b] Steel 316	Teflon [c]
Buffered weak acid	100	56	51	59	97	100	100
Weak acid	98	59	43	47	96	100	100
Mineral acid/high solids	100	48	57	60	80	82	100
Aqueous/organic mixtures	64	69	73	73	98	100	100
Percent overall rating [d]	91	58	56	59	93	96	100

[a] PVC casing shall not be installed in a groundwater environment containing chlorinated solvent or other destructive contaminants where the concentration of organics is greater than 1 part per million, and where the desired detection limit is less than 25 part per billion.
[b] Type 316 stainless steel screen and/or casing shall be used rather than type 304 when conditions are unknown and the lifespan of the monitoring well is to be greater than 5 years, or where the pH (indicates the hydrogen ion concentration – acidity or basicity) is less than 4.5, or where chloride concentration is greater than 1,000 part per million.
[c] Trademark of E.I. DuPont de Nemours
[d] Overall rating based on scale of 0 to 100 with 0 being the least compatible and 100 being the most compatible.

Besides chemical compatibility, a second consideration for specification of casing materials is the depth of the monitoring well. Well installations greater than 150 feet deep require casing materials of greater structural strength. In the case of PVC casing, Schedule 80 PVC rather than Schedule 40 may be required to prevent over-stressing of the casing couplings. The build-up of heat during grout setup might adversely affect some thermo-plastic materials.

Regardless of the type of casing materials, use only flush-threaded couplings. Flush-threaded couplings ensure that no screws, mechanical adapters, glues, or solvents are necessary to join individual sections. Steel conductor casing shall be welded at the joints, and the joint shall be at least as thick as the thickness of the casing wall. The weld shall be fully penetrating and shall meet the standards of the American Welding Society. Outside steel collars may be used to increase the strength of the welded joint. Do not use Teflon tape on PVC or stainless steel casing joints because it reduces the tensile strength of the joints.

The selection of an appropriate casing diameter is also important. The I.D. shall be 4 inches or greater to allow better access to the well and more rigorous well development than is commonly possible with smaller-diameter wells. Wells with casing smaller than 4-inch I.D. shall only be installed with the approval of the QA Manager or Technical Director. Wells greater than 150 feet in depth may require diameters larger than 4 inches to ensure that development and sampling equipment can be moved easily through the well. In addition, wells designed for groundwater extraction shall have a casing diameter large enough to accommodate a pump capable of achieving the appropriate pumping rate. The borehole in which the well is to be installed shall be a minimum of 4 inches larger in diameter than the O.D. of the well casing.

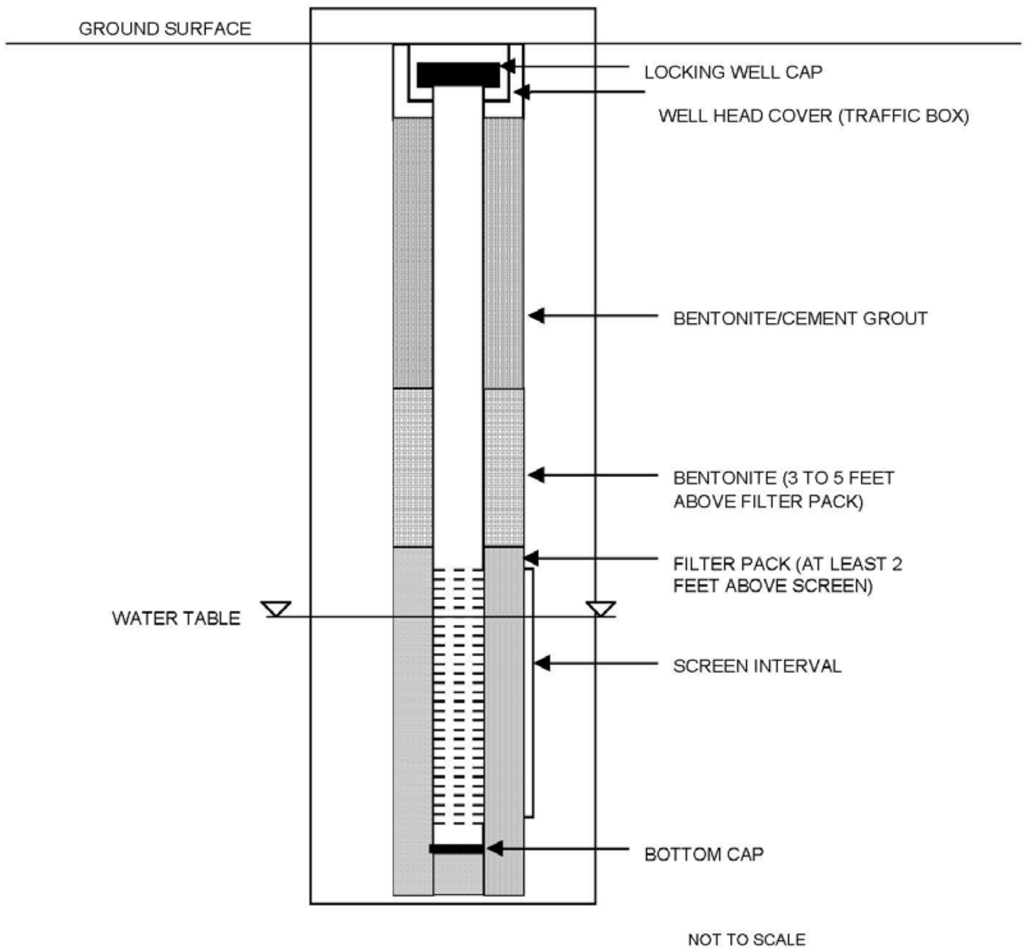


Figure I-C-1-1: General Cross Section of Monitoring Well, Unconfined Water Bearing Zone

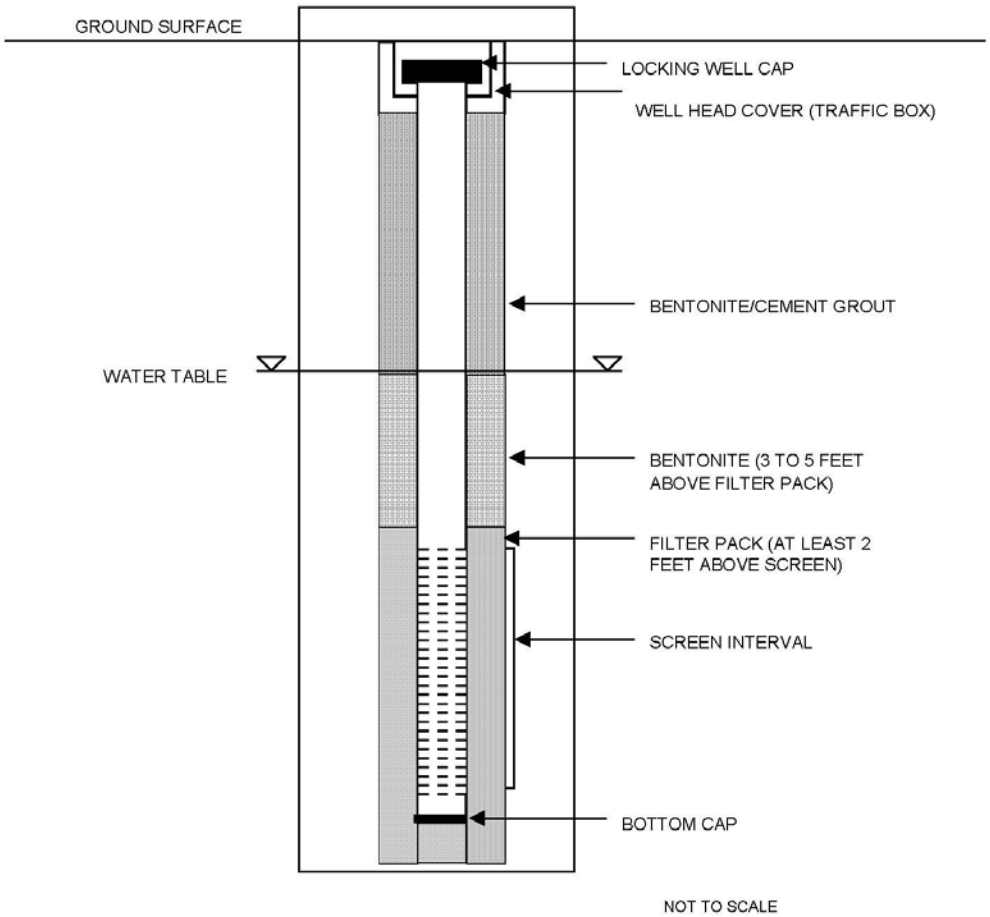


Figure I-C-1-2: General Cross Section of Monitoring Well, Confined Water Bearing Zone

5.5.3 Well Screen Selection

The screened section of the monitoring well allows groundwater to flow freely into the well, while retarding movement of fine-grained lithologic materials into the well. When designing a well screen, consider important factors, such as type of well screen material, length of the screened section, location of the screened section, the intake opening (slot) size, the type of intake opening, and size of filter pack to be utilized.

Five factors directly affect the performance of the monitoring well and are evaluated in the selection of an appropriate screen: (1) chemical resistance/interference, (2) screen length, (3) screen placement, (4) intended use of well (e.g., long-term groundwater extracted); and (5) intake opening size.

Selection of a screen material that provides chemical resistance and minimizes interference follows the same basic procedures as the selection of an appropriate casing material (see Table I-C-1-2). Some typical screen materials consist of PVC, Teflon, Type 304 stainless steel, and Type 316 stainless steel. Again, use only flush-threaded couplings. Screen sections constructed of different metals in the same well may cause electrochemical reactions that could rapidly degrade the casing or screen; therefore, do not use this type of composite well construction. In addition, construct wells intended for long-term groundwater extraction with well screen rather than slotted casing for facilitating redevelopment.

Selection of the screen length depends on its primary use(s). Most monitoring wells function as both groundwater sampling points and piezometers. Shorter-screened sections provide more specific data on vertically distributed contaminants, hydraulic head, and flow, and are generally preferred to longer-screened lengths. Saturated sections in groundwater monitoring wells shall be limited to between 5 and 10 feet in length; however, longer intervals may be justified in certain circumstances with approval of the QA Manager or Technical Director.

Placement of the screened interval within a groundwater monitoring well depends primarily upon two factors: the discrete interval and the type of contaminants to be monitored. The location of the discrete interval to be monitored will dictate the location of the screened interval within a monitoring well; however, also consider the characteristics of the contaminants to be monitored (i.e., light, non-aqueous phase liquid; dense, non-aqueous phase liquid) when choosing placement of the screened interval.

An additional consideration in the design of the screened section of the well is the hydraulic characteristics of the water-bearing zone that is to be monitored (i.e., confined or unconfined). If an unconfined zone is being monitored for contaminants that are less dense than water (e.g., gasoline, diesel, waste oil), place 3 to 5 feet of screened interval above the highest level of the water table to allow for evaluation of fluctuations in water level and to ensure that contaminant phases less dense than water can be observed. Conversely, if an unconfined zone is being monitored for contaminants that are denser than water (e.g., chlorinated solvents), place approximately 5 feet of screened interval (maximum) just above the confining unit at the base of the water-bearing zone to facilitate detection of the dense-phase contaminants. In the case of a confined water-bearing zone, use a maximum-screened interval of approximately 5 feet.

Selection of an appropriate intake opening size is critical to the performance of the monitoring well and to the integrity of groundwater samples obtained from the well. The size of the intake openings can only be determined following the selection of an appropriate filter pack, which itself is selected based upon the grain-size of the formation. An intake size is generally designed to hold back between 85 to 100 percent of the filter pack material. Figure I-C-1-3 can be used to select appropriate intake opening sizes. The screen slots shall be factory-made (or formed).

5.5.4 Filter Pack Design

Filter pack material shall be clean and chemically stable within the monitoring well environment to minimize addition to, or sorption from, the groundwater. Filter pack shall meet the following minimum specifications:

- Filter pack material shall be at least 95 percent silica, consisting of hard, durable grains that have been washed until free of dust and contamination, and graded.
- Filter pack material shall not be angular and non-uniform such that it will bridge in the annular space, leaving a void or poorly packed materials that can consolidate or settle after construction.
- Select filter pack to meet the grading specification determined from sieve analysis of the geologic formation to be screened, if available.
- Filter pack material shall be commercially packaged in bags that prevent the entrance of contaminants, and allow proper handling, delivery, and storage at the monitoring well site. Do not use material delivered in broken bags for monitoring well construction.

In investigations where there are limited data on site conditions prior to monitoring well installation, select the filter pack size prior to field activities based on available lithologic data. Use finer filter pack sizes if fine-grained formations are anticipated to be present, and use coarser-grained filter packs in coarser lithologies and consolidated formations.

In investigations where sieve analysis data exist for a site prior to field activities, base selection of a proper filter pack upon the grain size of the formation materials to be monitored. Use the sieve data for the finest lithology identified in the interval to be monitored for establishing filter pack size. The U.S. Environmental Protection Agency recommends that filter pack grain size be selected by multiplying the 70 percent retained grain size of the formation materials by a factor between 4 and 6. Use a factor of 4 if the formation materials are fine-grained and uniform, and use a factor of 6 if the formation materials are coarse-grained and non-uniform. In any case, the actual filter pack used should fall within the area defined by these two curves. An example of this technique is presented in Figure I-C-1-4.

5.5.5 Annular Seal

The annular seal is placed directly above the filter pack in the annulus between the borehole and the well casing. The annular space must be sealed to prevent the migration of water and contaminants through the annulus. The annular seal is also intended to hydraulically and chemically isolate discrete water-bearing zones.

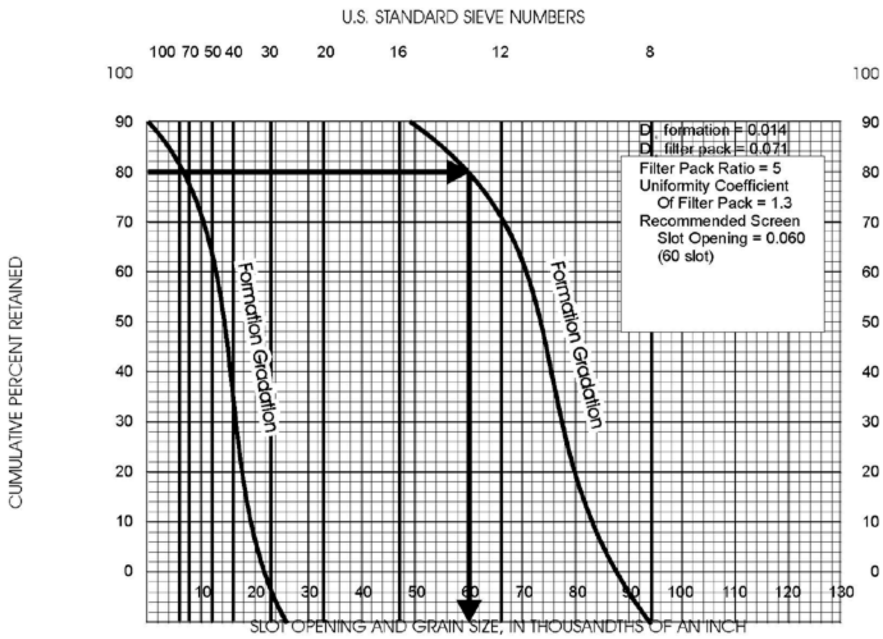


Figure I-C-1-3: Selecting Well Intake Slot Size Based on Filter Pack Grain Size

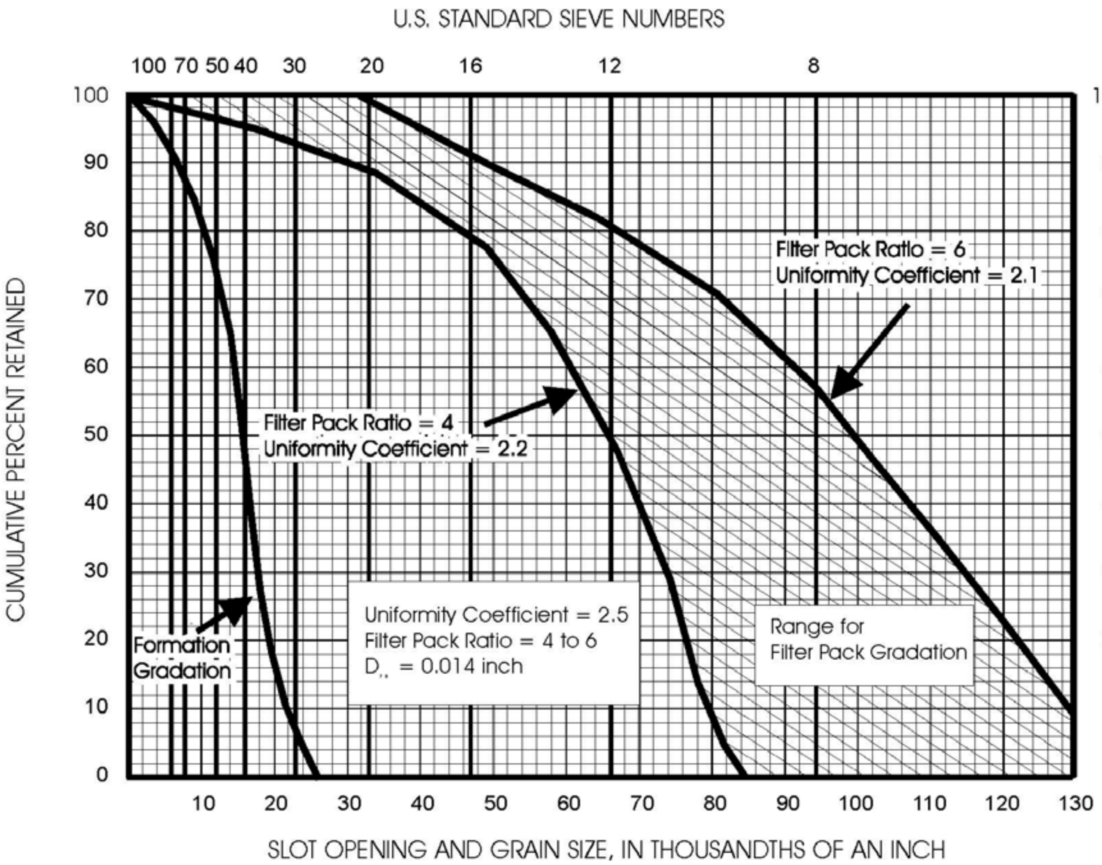


Figure I-C-1-4: Filter Pack Design Criteria

Typically, annular seals consist of two discrete sections. The first section, known as the bentonite seal, consists of a pure sodium bentonite seal. To be effective, the bentonite seal should be emplaced directly over the top of the filter pack and extend approximately 3 to 5 feet (no less than 3 feet thick). Typical materials for the seal consist of granular sodium bentonite, or sodium bentonite pellets or chips.

The second section of the annular seal typically contains grout slurry, which completely fills the remaining annular space from the bentonite seal to just below the ground surface. Grout consists of either sodium bentonite and Portland cement slurry or neat cement slurry. Give special consideration to the selection of annular seal material for wells installed in coastal areas where groundwater may contain elevated concentrations of sulfates. In this situation, use a sulfate resistant grout to prolong the usefulness of the well.

5.5.6 Surface Completion

The surface of the well shall be completed using either an above-grade (monument) style, or a flush-to-grade (traffic box) style. In either case, the protection of the wellhead at land surface is accomplished by means of a surface seal of concrete and a metal completion box surrounding the well casing. The surface seal serves to prevent infiltration of surface water and unauthorized entry, and where necessary, to provide protection from vehicular traffic.

5.6 MONITORING WELL INSTALLATION TECHNIQUES

The following general procedures describe the installation of groundwater monitoring wells.

5.6.1 General Casing and Screen Installation Techniques

Following completion of the borehole, the FM or designate will first measure the total depth of the hole to ensure that the desired depth has been attained. The lengths of casing and screen shall also be measured. These measurements shall be made with an accuracy of 0.01 feet using either a fiberglass or steel tape measure.

Installation of the casing and screen is normally accomplished by emplacing them into the well as an integral unit. Prior to installation, decontaminate individual lengths of the well casing and screen according to Procedure I-F, *Equipment Decontamination*, unless the casing and screen were certified by the manufacturer to have been properly pre-cleaned at the factory and sealed in plastic. Following decontamination, inspect each length to ensure that damaged or otherwise unsuitable sections are not used.

To ensure even distribution of filter pack, bentonite seal, and grout materials around the well within the borehole, suspend the casing and screen with a threaded hoisting plug and do not allow them to rest on the bottom of the boring unless the installation is less than 30 feet deep.

5.6.2 Centralizers

Install centralizers at the top and bottom of screened sections when using the air or mud rotary techniques for well installation. Also place centralizers at 20- to 40-foot intervals on blank casing; the FM will determine the spacing according to the depth of the well. Align the centralizers from top to bottom of the casing so that they do not interfere with the insertion and removal of the tremie pipe. All devices used to affix centralizers to the casing shall not puncture the casing or contaminate the groundwater with which they come in contact. Centralizers shall be constructed of stainless steel.

5.6.3 Filter Pack Installation

Prior to the addition of any filter pack material, cover the top of the well casing to prevent filter pack material from entering it.

The filter pack is usually installed through HSAs, conductor casing, or a tremie pipe depending on the drilling technique used; however, if the depth to the bottom of the screened interval is less than 10 feet, and lithologic materials are sufficiently consolidated to preclude the possibility of hole collapse, the filter pack may be poured into the annular space of the well from the ground surface. This procedure applies to any drilling method.

During installation, measure the level of the top of the filter pack periodically to ensure that no bridging has occurred, and to determine the depth to the top of the filter pack. Be sure that the filter pack encloses the entire length of the screened section. For wells less than 100 feet in total depth, the filter pack shall generally extend to 2 feet above the top of the screened section of the well. For wells greater than 100 feet in total depth, an additional 1 foot of filter pack may be emplaced above the screen for each 100 feet of well depth.

An alternative to conventional monitoring well construction and installation is through the use of small diameter pre-fabricated monitoring wells, commonly referred to as “pre-pack” wells. Pre-pack wells typically consist of a well screen (slotted PVC) surrounded by sand (filter-pack) held in place by a stainless steel or polyethylene mesh. The pre-pack well assembly is commonly used in conjunction with direct-push drilling methodologies, which allows a relatively quick installation of these small diameter wells. Having the filter pack around the slotted PVC before the well screen is installed ensures that the filter pack is located directly around the well screen and minimizes the effort required for the filter pack installation.

The filter pack is normally an inert (e.g., siliceous) granular material that has a grain-size distribution chosen to retain formation materials. A sleeved screen consists of a slotted pipe base over which a sleeve of stainless steel mesh filled with selected filter media is installed. Pre-packed or sleeved screens may be used for any formation conditions, but they are most often used where heaving, running or blowing sands make placement of conventional well screens and filter packs difficult, or where predominantly fine-grained formation materials are encountered (ASTM 2010). During installation, the boring is advanced using hollow drive rods with an expendable drive point. Upon reaching the desired monitoring well installation depth, the entire well assembly (i.e., pre-pack well) is lowered to the desired depth within the hollow drive rods. At the desired depth, the hollow drive rods are retracted to a point above the screen. At this step a barrier is placed directly above the screen to prevent grout or material from entering the screened interval as the hollow drive rods are extracted from the boring. This barrier can be created either by natural formation collapse (occurring during the initial rod retraction), by gravity installation of fine-grade sand through the rod annulus, or as part of the pre-pack monitoring well components (e.g. expanding foam bridge). With the barrier in place, granular bentonite or bentonite slurry is then installed in the annulus to form a well seal. When installing pre-pack screens additional sand must be used to fill in the annular space between the pre-pack and the edge of the borehole. Furthermore, filter sand should be installed to at least 2 feet above the top of the pre-packed well screen.

Vendors offer pre-pack monitoring well components with varying outer diameters, which is typically based on the inner diameter of the hollow drill rods. These types of wells may be sampled by several methods including peristaltic pump, mini-bailer, or bladder pump to yield data of similar quality to that of conventional monitoring wells.

Following the installation of the filter pack, a surge block or large bailer shall be placed into and removed from the casing for approximately 10 minutes to set and compact the filter pack and to begin well development. Then, check the level of the filter pack again. Add more filter pack material according to the procedures described above if any settling of the filter pack has occurred. After emplacement, note the volume of filter pack material placed in the well, record it in the well completion record (Figure I-C-1-5), and compare it to the calculated volume of filter pack that was expected to have been used.

5.6.4 Annular Seal Installation

The sodium bentonite seal shall have a minimum thickness of 3 feet. Generally, to be effective the bentonite seal should extend above the filter pack approximately 3 to 5 feet. It may be constructed of powdered, granular, or pelletized bentonite, and may be emplaced as a dry solid, powder, or slurry. Use only sodium bentonite manufactured specifically for use in the drilling and construction of water wells. Typically, granular or pelletized bentonite is emplaced dry. Powdered bentonite is usually mixed with potable water to produce a slurry. Depending on the type of installation method, the bentonite may be emplaced through the HSAs, conductor casing, or tremie pipe.

In dry form, place the bentonite directly on the top of the filter pack. After emplacing each 1-foot-thick layer of dry bentonite in the well, add approximately 5 gallons of water of known chemical quality to hydrate the bentonite. Allow a minimum of 15 minutes for hydration of the bentonite seal once it is completely installed.

When emplacing the bentonite in slurry form, take care to ensure that the bentonite is thoroughly mixed, with no visible lumps to ensure the proper consistency. Then place a 1-foot layer of fine-grained silica sand over the top of the filter pack. This fine-grained sand layer will prevent infiltration of the filter pack by the bentonite slurry.

Emplace the remaining annular seal following the installation of the bentonite seal. The annular seal shall be a slurry consisting of 7 to 9 gallons of water per 94-pound bag of Portland cement Type I or II and a minimum of 3 to 5 percent bentonite (1/4 to 1/2 bags of bentonite powder per five bags of Portland cement). The slurry may be emplaced through a HSA, conductor casing, or tremie pipe, depending on the method of installation. Thoroughly mix the grout to ensure the proper consistency with no visible lumps of dehydrated powder. The rates at which the augers or pipe are withdrawn and the slurry added will be such that the level of the grout within the well annulus is just below the lowermost auger or pipe.

If a tremie pipe is used, emplace the annular grout seal by pumping through a pipe with a minimum 1-inch I.D., in one continuous pour, from the top of the transition seal to the ground surface. Place the bottom of the tremie pipe about 5 to 10 feet above the transition seal, depending on the stability of the hole and impact velocity of the grout.

A tremie pipe is not required for annular seals less than 10 feet from the ground surface to the top of the transition seal or for grouting within dual wall drill strings or HSAs. Measure the volume of grout seal material placed in the well, record it in the well construction log, and compare it with the calculated volume. The slurry shall extend from the top of the bentonite seal to a depth of approximately 2 feet below ground surface (bgs).

5.6.5 Annular Seal "Set Time" and Setting

Let the annular grout seal set at least 12 hours before disturbing the casing or well so that separations or breaks do not occur between the seal and the casing, or between the seal and the borehole. Development of the well is prohibited until the grout seal has set. Likewise, the concrete slab, traffic box, and/or casing riser of the surface completion shall not be poured and constructed until the grout seal has set. Top off any settlement of the grout seal as soon as possible after it sets. Record all pertinent data on the well construction log.

5.6.6 Surface Completion

The surface of a groundwater monitoring well shall be either an above-ground completion or as a flush-to-ground completion. Regardless of the method, each monitoring well shall have, at a minimum, a casing cap, concrete slab and annular seal, and a locking protective casing or locking vault. Although wellheads vary in size, effort should be made to use a consistent size wellhead or similar completion per site.

In an above-ground completion, the protective casing or monument is installed around the top of the well casing within a cement surface seal. A 2-foot-long by 2-foot-wide cement pad with a minimum thickness of 3 inches is constructed around the protective casing. Type 1 Portland cement, which meets the requirements of CLASS A standards, is used for the surface seal. Inspect the monument prior to installation to ensure that no oils, coatings, or chemicals are present. Once installed, maintain the monument in a plumb position with 2 to 3 inches of clearance between the top of the well casing and the lid of the monument. The monument shall extend at least 18 inches above grade and at least 12 inches below grade. Construct a minimum of three concrete-filled posts around the well to protect it from vehicular damage.

Inside the monument, cut or scribe two permanent survey marks, approximately 0.25 inches apart, into the top of the well casing, and also permanently mark the well with its identification number. Permanent marks may include painting, marking, or engraving on the protective casing or surface completion. An alternate option may be to attach a non-corroding, imprinted metal tag to part of the well. Cover the top of the well casing with a slip cap or locking cap to prevent debris from entering the well. Fit the monument with a casehardened lock to prevent unauthorized entry.

In a flush-to-ground completion, the protective casing or traffic box is installed around the top of the well casing, which has been cut off slightly below grade. The traffic box has a lid that is held firmly in place by bolts and has a flexible O-ring or rubber gasket to prevent water from entering the box. Whenever possible, wells with flush completions should not be placed in low spots where surface water can accumulate. If this is unavoidable, consider an aboveground completion. The traffic box is set within a cement surface seal slightly above grade to deflect surface water flow away from the well. The surface seal must form an apron at ground surface that is at least 2 feet wide and 4 inches thick. The concrete apron must slope away from the well (a minimum of 1 percent) to prevent surface water leakage into the well head (DOH 2009). An effort should be made to standardize the appearance of the well completions at a particular site. Type 1 Portland cement, which meets the requirements of CLASS A standard, is used for the surface seal. Where monitoring well protection must be installed flush with the ground, an internal cap should be fitted on top of the riser within the manhole or vault. This cap should be leak-proof so that if the vault or manhole fills with water, the water will not enter the well casing. The cap should also be able to lock to prevent unwanted access or tampering with the well. Ideally, the manhole cover cap should also be leak-proof (ASTM 2010). Inspect the traffic box prior to installation to ensure that no oils, coatings, or chemicals are present. Once installed, maintain the traffic box in a level position that leaves 2 to 3 inches of clearance between the top of the well casing and the lid of the traffic box. Regular maintenance may be necessary to maintain the integrity of the seals and pads protecting the wells.

Cut two permanent survey marks into the top of the well casing, approximately 0.25 inches apart, and also permanently mark the well with its identification number. Cover the top of the well casing with a lockable cap to prevent debris from entering the well. Also fit the lockable cap with a casehardened lock to prevent unauthorized entry.

In areas where there is a high probability of damaging the well (high traffic, heavy equipment, poor visibility), it may be necessary to enhance the normal protection of the monitoring well through the use of posts, markers, signs, or other means. The level of protection should meet the damage threat posed by the location of the well (ASTM 2010).

5.6.7 Installation of Surface Casing

The use of surface casing may be required to minimize the potential for cross-contamination of different hydrogeologic zones within the subsurface of a site. The depth of placement of the surface casing shall be based on site-specific geologic knowledge obtained from lithologic samples collected in situ during the drilling of the well boring.

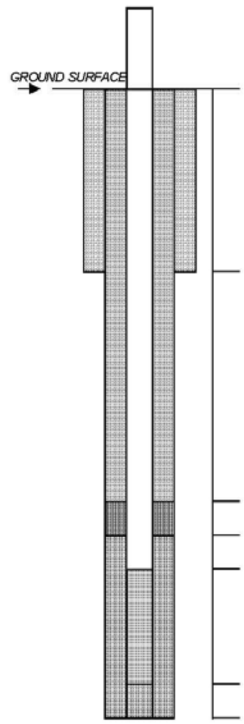
If a surface casing is to be installed permanently along with the well, grout it in place. The borehole shall be of sufficient diameter that a tremie or grout pipe can be easily placed between the borehole wall and the outside of the surface casing. After the desired placement depth is reached and the drilling tools are removed from the borehole, lower the casing into the borehole and center it. The bottom of the surface casing may be plugged or driven into the sediment at the base of the borehole to keep grout from entering the casing, if necessary.

Install grout through the tremie pipe and pump it from the bottom of the casing to ground surface. As the grout is being placed, raise the tremie pipe slowly to avoid excessive backpressure and potential clogging of the tremie pipe. After the grout has been allowed to set for at least 24 hours, drilling and subsequent well installation can continue. The required time for grout to set before drilling can continue depends on the volume of grout emplaced; the more grout used, the longer the delay time.

JOB NO.: ____________ WELL NO. ____________ HYDROGEOLOGIST: ____________

CLIENT: ____________ DRILLER: ____________

WELL LOCATION: ____________ DATE/TIME: ____________



DETAILS OF CONSTRUCTION

Date Completed ____________

Borehole Diameter (in.) ____________

Type and Size of Casing (in.) ____________

Type and Size of Screen (in.) ____________

Screen Perforation Diameter (in.) ____________

Screen Length (ft.) ____________

Centralizer Depths (ft.) ____________

Completion Technique

1. Type of Filter Pack and Placement Method ____________

2. Type of Bentonite and Placement Method ____________

3. Type of Grout Mixture and Placement Method ____________

Description of Potential Problems With Well:

____

____

____

____

Development Technique

____

Well Head Elevation ____________

Ground Surface Elev. ____________

Well Head Completion Method ____________

Drilling Method/Rig Type ____________

Surface Casing: Type ____________

Diameter ____________

Length ____________

MATERIALS

Cement (sks.) ____________

Filter Pack Material ($ft.^3$) ____________

Casing Material (ft.) ____________

Bentonite ($ft.^3$) ____________

Top of Bentonite Seal ____________ ft.

Top of Filter Pack ____________ ft.

Top of Screen ____________ ft.

Bottom of Screen ____________ ft.

Bottom of Hole ____________ ft.

GROUT

BENTONITE

FILTER PACK

NOTE: ALL DEPTHS ARE REFERENCED TO GROUND SURFACE

Figure I-C-1-5: Well Completion Record

5.6.8 Shallow Well Completion

Due to the occurrence of shallow groundwater in some areas, there are instances when the top of the screened interval must be placed at a depth so shallow that it is impossible to install the well using the typical design for annular materials (i.e., 2 feet above the screen for filter pack followed by a 3-foot thickness of bentonite seal). In cases where the top of the screen must be placed between 4 and 6 feet bgs, use the following design alteration:

- Place the filter pack 1 foot above the top of the screened interval.
- Place a minimum of 3 feet of bentonite seal above the filter pack.
- Fill the remainder of annular space with a 3 percent to 5 percent bentonite-cement grout.

In no case shall the top of the screen be brought higher than 4 feet bgs because it is difficult to install a reliable annular seal at these shallow depths.

5.6.9 Method-specific Well Installation Techniques

The following sections describe well installation techniques for groundwater monitoring at hazardous waste sites. Sections on troubleshooting common problems encountered when using each technique and potential solutions to the problems are included.

5.6.9.1 HSA

General methods of well installation using the HSA technique are listed below:

- Complete a pre-installation design drawing in accordance with Section 5.4.1.
- Prior to well installation, properly decontaminate and measure the well screen, cap, and casing to ensure accurate placement of well casing and screen. Mark the well casing near the ground surface to signal to the drillers where the casing should be placed.
- Remember that wells are constructed within the augers as the augers are removed from the ground.
- The diameter of the well casing constructed within an HSA is limited to 4 inches. *Note:* The difference between the I.D. of the HSA and O.D. of the well casing must be at least 4 inches to permit effective placement of filter pack, bentonite seal, and grout.
- Remove the inner rod and hammer quickly, measure the depth of the borehole, and place the well screen and casing quickly into the auger to the desired depth. *Note:* the well screen and casing shall be suspended in hole by the use of a hoisting bail in order to ensure proper depth and plumb construction. This may not be necessary for wells less than 30 feet in depth.
- Prior to adding filter pack, cover the top of the well casing to prevent filter pack material from entering it.
- The HSA acts as tremie pipe for placement of filter pack, bentonite, and grout.
- Slowly pour filter pack between the inside of the auger and the outside of the well casing.
- While the filter pack material is being poured, incrementally withdraw the auger. The rate of auger withdrawal and filter pack placement shall allow for the top of the filter pack level to be just below the lead auger. In general, the augers should be withdrawn in increments of

2 to 3 feet. *Note:* The level of the top of the filter pack shall be constantly tagged with a measuring tape during emplacement of the filter pack.

- Surge the well to consolidate the filter pack; add more if settlement occurs.
- Emplace bentonite pellets or chips through the HSA. Tag the level of the bentonite periodically to ensure accurate placement. For each foot of bentonite seal installed in an unsaturated completion, pour 5 gallons of water of known chemical quality into the well to hydrate the bentonite. If the bentonite seal is less than 10 feet bgs and the borehole is stable, the bentonite may be emplaced directly from the top of the borehole rather than through the HSA.
- After allowing 15 minutes for the bentonite seal to hydrate, emplace a grout seal through the HSA from the top of the bentonite seal to within 2 feet of ground surface. The grout shall be emplaced from bottom to top in one continuous pour. If the top of the bentonite seal is less than 10 feet bgs and the borehole is not subject to collapse, the grout may be emplaced directly from the top of the borehole. If the top of the bentonite seal is greater than 10 feet bgs, a tremie tube shall be used to emplace the grout. The composition of the grout is detailed in Section 5.4.5.
- Construct an above- or below-ground wellhead.

Potential Problems and Solutions

Bridging Filter Pack or Bentonite Seal

Bridging filter pack or bentonite can create unwanted void spaces or lock the well casing within the HSA.

Avoidance of Locked Well Casing

- Carefully tag the filter pack level and keep it just below the lead auger while the auger is inched up and sand is slowly added.
- Use an auger with a larger I.D.
- Use filter pack materials with a larger grain size.
- Add water of known chemical quality while pouring the sand filter pack. Try this only in cases where the filter pack is very fine.

Solutions for Unlocking Well Casing from Augers

- Gently hold the casing in place while lifting and twisting the auger (do not force).
- Insert the surge block into the casing and gently surge the water column if bridge is below water table.
- Add water between the well and auger if the sand bridge is above the water table.
- Attach an air compressor to a tremie pipe, and then gently blow the bridge away.
- Completely remove the casing and screen, and reinstall the well.
- Never drive the casing out of the auger with a hammer because this will break the casing.

Heaving, Surging Materials

Fine-grained saturated materials that might cause surging problems are common in coastal areas. Heaving sediments might cause problems when drilling with HSA.

Solutions for Heaving Sediments

- Over-drill the borehole by 5 or 10 feet to provide space for heaving sediments to fill in while well installation begins. Begin placement of filter pack as soon possible. Add it quickly until over-drilled space is filled.
- Add clean water to a level above the water table to create a downward pressure on the heaving materials. The volume of water added shall be recorded on the well installation log and extracted during well development.
- Drill an initial pilot borehole and sample with a 6-inch-diameter auger. The 6-inch auger may be fitted with plastic or metal core catcher on the lead auger, which will allow for soil sampling and prevent sediments from entering augers. After the total sampling depth is reached, the 6-inch auger is removed and 10-inch-diameter augers are substituted to ream out the borehole. Fit the lead auger with a tapered stainless steel plug. At a depth below the desired total depth of the well, use the sampling hammer and center rod to knock out the stainless steel plug. Then complete well installation.

5.6.9.2 Direct Rotary with Foam or Mud

General well installation techniques using direct rotary with foam or mud are listed below:

- Complete a pre-installation design drawing in accordance with Section 5.4.1.
- Prior to well installation, measure the well screen, cap, and casing to ensure accurate placement of well casing and screen. Place mark on the portion of the well casing near ground surface to identify to the drillers where the casing should be placed. Place centralizers on the well casing and screen as discussed in Section 5.5.2.
- With DRD techniques, wells are constructed in the borehole after the bit and drill pipe are removed from the hole. For mud rotary drilling, first thin the mud sufficiently prior to removing the bit and drill pipe from the hole. Thinning the mud allows faster and more accurate placement of the annular materials within the borehole, which balances the density of the borehole fluids so they more closely match the density of the fluids used to install the filter pack and bentonite seal. It also reduces the potential for annular materials to be washed out of the borehole through the tremie.
- After the bit and drill pipe are retrieved from the hole as smoothly and quickly as possible, measure the total depth of the hole to verify its depth and to check its stability.
- Suspend the well screen and casing in the hole by the use of hoisting bail in order to ensure proper depth and a plumb construction. This may be unnecessary for wells less than 30 feet in depth. Place the casing and screen in the hole as fast as is safely possible to minimize the time that the borehole stays open.
- Prior to the addition of filter pack, cover the top of the well casing to prevent filter pack material from entering the well casing.

- Use a tremie pipe for placement of filter pack, bentonite, and grout. Also emplace the filter pack and bentonite seal as soon as possible to avoid potential collapse of the hole.
- Slowly pour the filter pack into the tremie pipe to avoid bridging within the tremie pipe at the water table. The level of the top of the filter pack shall be constantly tagged with measuring tape as the filter pack is being emplaced.
- Make the bentonite seal at least 3 feet thick. It should consist of bentonite pellets or chips emplaced through the tremie pipe. Tag the level of the bentonite periodically to ensure accurate placement. If the bentonite seal is less than 10 feet bgs and the borehole is stable, the bentonite may be placed directly from the top of the borehole rather than through the tremie pipe.
- After allowing 15 minutes for the bentonite seal to hydrate, emplace a grout seal through the tremie pipe from the top of the bentonite seal to within 2 feet of ground surface. The grout shall be placed from bottom to top in one continuous pour. If the top of the bentonite seal is less than 10 feet bgs, and the borehole is not subject to collapse and is not filled with drilling fluid, the grout may be placed directly from the top of the borehole. The composition of the grout is detailed in Section 5.4.5.
- Construct an above- or below-ground wellhead.

Potential Problems and Solutions

Bridging Filter Pack or Bentonite Seal

Bridging filter pack or bentonite can create unwanted void spaces that might collapse in the future.

Solution

Controlled pouring of the annular materials is the best solution for bridging. In the case of mud rotary, however, it may be necessary to perform emplacement of the filter pack and bentonite chips or pellets through the borehole without the aid of a tremie pipe. For wells greater than 10 feet deep, obtain the approval of the QA Manager or Technical Director.

5.6.9.3 Air Rotary and Air Rotary With Casing Hammer

General well installation techniques using ARD or ARCH are listed below:

- Prepare a pre-installation design drawing in accordance with Section 5.4.1.
- Prior to well installation, properly decontaminate and measure the well screen, cap, and casing to ensure the accurate placement of well casing and screen.
- Remember that with ARD techniques, wells are constructed in the borehole after the bit and drill pipe are removed from the hole. With ARCH, the driven casing remains in the ground and is slowly withdrawn as well installation proceeds.
- After the bit and drill pipe are retrieved from the hole as smoothly and quickly as possible, measure the total depth of the hole to verify its depth and to check its borehole stability.
- To ensure proper depth and a plumb construction, suspend the well screen and casing in the hole using a hoisting bail. Place the casing and screen in the borehole as fast as is safely possible to minimize the time that the hole stays open, particularly for ARD.

- Before adding filter pack, cover the top of the well casing to prevent filter pack material from entering it.
- For ARD, use a tremie pipe for placement of filter pack, bentonite, and grout. Emplace the filter pack and bentonite seal as soon as possible to avoid potential collapse of the hole. For ARCH, the annular materials can in most cases be placed directly between the driven casing and the well casing. A tremie pipe is advisable if exacting placement is required.
- For ARD, place the tremie pipe within 2 feet of the interval where the filter pack is to be placed. Slowly pour the filter pack into the tremie pipe to avoid bridging within the tremie pipe at the water table. The tremie pipe shall be slowly withdrawn during placement.
- Periodically tag the level of the top of the filter pack with measuring tape while the filter pack is being emplaced. Install bentonite in a similar manner.
- For ARCH, pour the filter pack slowly between the well casing and driven casing. The driven casing shall be withdrawn periodically while the filter pack is being emplaced. Withdraw the driven casing in increments no greater than 2 to 3 feet.
- For ARD, emplace bentonite pellets or chips through the tremie pipe to a minimum thickness of 3 feet. Tag the level of the bentonite periodically to ensure accurate placement. For each foot of bentonite seal installed in an unsaturated completion, add 5 gallons of water of known chemical quality into the well to hydrate the bentonite. If the bentonite seal is less than 10 feet bgs and the borehole is stable, the bentonite may be emplaced directly from the top of the borehole rather than through the tremie pipe. For ARCH, emplace the bentonite between the well casing and the driven casing while the driven casing is being withdrawn.
- Emplace a grout seal through the tremie pipe for the ARD method or through the driven casing for the ARCH method. Emplace the grout from the top of the bentonite seal to within 2 feet of ground surface. The driven casing or tremie pipe shall be withdrawn as the grout is placed. Emplace the grout from bottom to top in one continuous pour following placement of the bentonite seal. If the top of the bentonite seal is less than 10 feet bgs and the borehole is not subject to collapse, emplace the grout directly from the top of the borehole. The composition of the grout is detailed in Section 5.4.5.
- Construct an above- or below-ground wellhead.

Potential Drilling Problems

Bridging Filter Pack or Bentonite Seal

Bridging filter pack or bentonite can create unwanted void spaces that might collapse in the future.

Solutions

Controlled pouring of the annular materials is the best solution against bridging.

Heaving Sediment

Fine-grained saturated materials that might cause heaving problems are common in coastal areas. Difficulties caused by heaving sediments might create problems when drilling with ARCH. Heaving sediments cannot be drilled using ARD techniques.

Solutions for Heaving Sediments

- Over-drill the borehole by 5 or 10 feet to provide space for heaving sediments to fill in while well completion is begun.
- Add clean water to a level above the water table to create a downward pressure on the heaving materials. The volume of water added should be extracted during well development.
- Heaving sands may also be controlled by first removing the drill pipe from the hole, and then constructing an airlift line made from the tremie pipe. If there is sufficient water above the heaving sands, an air line connected approximately 10 feet from the bottom of the tremie pipe can be used to air lift out the fine-grained sediments at the base of the casing.
- Begin placement of filter pack as soon as possible and add it quickly until the over-drilled space is filled.

5.6.9.4 DTCH

General well installation techniques using DTCH are listed below:

- Prepare a pre-installation design drawing in accordance with Section 5.4.1.
- Prior to well installation, measure the well screen, cap, and casing to ensure accurate depth placement of well casing and screen. Place a mark near the top of the casing to identify to the drillers the proper position to place the casing and screen.
- Like HSA drilling techniques, wells are constructed within the dual tube pipe as the pipe is removed from the ground.
- Prior to setting the casing and screen in the hole, verify total depth of the hole by measuring it and check for surging materials. Suspend the well screen and casing in the hole using a hoisting bail in order to ensure proper depth and plumb construction.
- Prior to addition of filter pack, cover the top of the well casing to prevent filter pack material from entering the well casing.
- The inner pipe of the dual tube assembly shall act as tremie pipe for placement of filter pack, bentonite, and grout.
- Slowly pour the filter pack between the inside of the augers and the outside of the well casing to avoid potential bridging of the annular materials. While the filter pack material is being poured, the dual tube pipe shall be incrementally withdrawn. The rate of pipe withdrawal and filter pack emplacement shall allow for the top of the filter pack level to be just below the shoe of the dual tube assembly. The level of the top of the filter pack shall be constantly tagged with measuring tape.
- Use bentonite pellets or chips to construct the well seal, which shall be a minimum of 3-feet thick, and shall also be emplaced through the dual tube assembly. For each foot of bentonite seal installed in an unsaturated completion, 5 gallons of water of known chemical quality shall be poured into the well to hydrate the bentonite. Tag the level of the bentonite periodically to ensure accurate emplacement. If the bentonite seal is less than 10 feet bgs and the borehole is stable, the bentonite may be emplaced directly from the top of the borehole rather than through the tremie pipe.

- Emplace a grout seal through the dual tube assembly from the top of the bentonite seal to within 2 feet of ground surface. Emplace the grout from bottom to top in one continuous pour immediately following emplacement of the bentonite seal. If the top of the bentonite seal is less than 10 feet bgs, the grout may be emplaced directly from the top of the borehole. The composition of the grout is detailed in Section 5.4.5.
- Construct an above- or below-ground wellhead.

Potential Problems and Solutions

Bridging Filter Pack or Bentonite Seal

Bridging filter pack or bentonite can create unwanted void spaces or lock the well casing and dual tube pipe together.

Avoidance of Locked Well Casing

- Tag carefully and always keep the filter pack just below the shoe while inching the dual tube assembly up and slowly adding sand.
- Use a smaller-diameter well casing.
- Use a filter pack with a larger grain size.
- Add water while pouring the sand filter pack. Avoid this unless absolutely necessary.

Solutions for Unlocking Well Casing from Dual Tube Pipe

- Insert a surge block into casing and gently surge the water column if the bridge is below water table.
- Add water between the well and piping if the sand bridge is above the water table.
- Attach an air compressor to a tremie pipe, and gently blow the bridge away.

Heaving, Surging Materials

Fine-grained saturated materials that might cause surging problems are common in coastal areas. Heaving sediments might cause problems when drilling with DTCH.

Solutions for Heaving Sediments

- Over-drill the borehole by 5 or 10 feet to provide space for heaving sediments to fill in while well completion begins.
- Add clean water to a level above the water table to create a downward pressure on the heaving materials. The volume of water added should be extracted during well development.
- Remove the drill pipe from the hole, and then construct an airlift line made from the tremie pipe. If there is sufficient water above the heaving sands, an air line connected approximately 10 feet from the bottom of the tremie pipe can be used to air lift out the fine-grained sediments at the base of the casing.
- Begin emplacement of the filter pack as soon as possible, and add it quickly until the over-drilled space is filled.

5.6.10 Well Construction Record Keeping Procedures

A written well completion record (Figure I-C-1-5) detailing the timing, amount of materials, and methods of installation/construction for each step of monitoring well construction shall be prepared during construction of each monitoring well by the FM or designate. Construction records shall be kept in a hard-bound field notebook dedicated to the CTO. An "as-built" drawing illustrating the placement location and amounts of all materials used in construction of each monitoring well shall be prepared in the field at the time of construction. The well construction record shall be filled out with indelible ink. Construction records shall include the date/time and quantities of materials used at each of the following stages of monitoring well construction, including:

- Drilling
  - Drill rig type
  - Drilling method/coring method
  - Drill bit/core barrel diameter (hole diameter)
  - Drill company, driller, helper(s)
  - Field geologist, supervising geologist
  - Dates/times start and finish drilling hole, interval drilling rates
  - Total depth of hole
  - Drilling location, surveyed ground elevation
  - Inclination of hole from horizontal
- Borehole abandonment – type, volume, and surface seal
- Casing material – type
- Casing decontamination – document process and equipment used
- Casing diameter – nominal I.D. of casing
- Screen material
  - Type
  - Top and bottom of section as actually installed
  - Length
  - Slot type, size, shape
  - Type of bottom plug and/or cap used
- Filter pack material
  - Composition and size gradation
  - Manufacturer
  - Actual volume and depth of top and bottom of filter pack
  - Calculated volume versus actual volume used and explanation of discrepancies
- Transition seal

  - Composition and depth of top and bottom of seal
  - Size (or gradation) or material used (e.g., pellets, granulated, or powdered)
  - Time allowed for hydration prior to emplacement of annular grout slurry seal
- Annular slurry seal
  - Date and time of beginning and completion of annular seal
  - Type and actual volume of seal
  - Calculated volume versus actual volume and explanation of discrepancies
  - Set time allowed prior to commencement of additional work
- Surface completion
  - Type of construction
  - Nature of materials used for surface completion
  - Date/time of completion

5.6.11 Well Location

A registered land surveyor shall survey each monitoring well location for exact horizontal location to the nearest 0.5 foot, and exact vertical location to the nearest 0.01 foot, referenced to mean sea level or mean low low water. The vertical elevation shall be surveyed between the two notches cut in the top of the well casing, which is the point from which all water level measurements shall be made. The elevation of the ground or top of the concrete slab adjacent to the monitoring well shall also be surveyed, to the nearest 0.01 foot.

5.7 WELL ABANDONMENT/DESTRUCTION

Once a monitoring well is no longer needed as part of an investigation, or has been damaged to the extent that it cannot be repaired, it is essential that it be properly abandoned. The proper abandonment of a monitoring well ensures that the underlying groundwater supply is protected and preserved. In addition, proper well abandonment eliminates a potential physical hazard and liability. An additional permit and/or inspection may be required for abandonment, depending on state or local regulations.

The standard procedures for the abandonment of a groundwater monitoring well apply to the HSA drilling method. This type of installation was chosen because it is the primary method of abandoning groundwater monitoring wells. For wells abandoned on Guam, the current Guam Environmental Protection Agency Well Abandonment Procedures shall be followed (Attachment I-C-1-1).

The first step in abandoning a groundwater monitoring well is to remove the surface completion from around the top of the well casing. This is normally accomplished using a jackhammer to break the surface cement seal, and then removing the monument or traffic box. When the surface seal and the wellhead cover have been removed, over-drill the well to its total depth using HSAs. Once the total depth of the well has been reached, remove the casing and screen from the borehole. Then completely backfill the borehole with a grout seal. Typically, the grout seal is emplaced as slurry of Portland cement grout, which contains a minimum of 3 to 5 percent bentonite as described in

Section 5.4.5. When mixing the slurry, take care that the bentonite is mixed according to the manufacturer's specifications to ensure the proper consistency.

Emplace the slurry through the HSAs. The rates at which the augers are withdrawn and the slurry is added shall be such that the level of the slurry within the borehole is just below the lead auger. The borehole seal shall extend from the total depth of the borehole to a depth of approximately 1 foot bgs. Then repair the surface to prior conditions and grade.

If the monitoring well casing cannot be pulled or drilled out, perforate the well casing adjacent to the saturated zones so that the annular space and any nearby voids can be filled with sealing material. Fill the perforated well or borehole from the bottom up with an appropriate sealing material, such as neat cement. Inject the neat cement under pressure to force it into the annular space, nearby voids, and filter pack. Apply pressure for a sufficient time to allow the cementing mixture to set. After the cement has hardened, excavate a hole around the well (use a backhoe if necessary) to the depth specified in the Monitoring Well Abandonment Work Plan (WP) and ensure the excavation depth is in accordance with local regulatory agency guidelines (Attachment 1 for *Guam Monitoring Well Abandonment Procedure*) (GEPA 2006). Remove the uppermost portion of the casing, (if still in place), and pour a cement cap on top of the abandoned well, and backfill the remaining portion of the excavation with sealing material. Note, if personnel are required to enter the excavation to remove the upper portion of the casing, then proper sloping and shoring are required as per Section 25, *Excavations* of The Safety and Health Requirements Manual EM 385-1-1 (USACE 2008).

The State of Hawaii Department of Health Hazard Evaluation and Emergency Response must be notified at least 1 week prior to any well abandonment activities conducted in Hawaii (DOH 2009, Section 6.2.5.1). Additionally, an Abandonment of Monitoring Well Summary Report should be prepared using the form presented in Attachment 1-C-1-2. The record should include the following information:

- Well construction information:
  - Date of installation
  - Drilling company
  - Total depth
  - Casing material/length
  - Screen material/length
  - Annular material
- General abandonment information:
  - Drilling firm (contact, mailing address, and phone number).
  - Consulting firm (contact, mailing address, and phone number).
- Well abandonment information
  - Date of abandonment
  - Reason for abandonment

- Details of how the casing/screen was removed drilled out or perforated.
- Sealing material (weight/volume/bags/mix ratio)

5.8 Vapor Extraction/Monitoring Wells

Vapor extraction/monitoring wells have most of the same design and installation considerations and procedures as groundwater-monitoring wells, with the exception that they are screened in the unsaturated zone. Vapor extraction/monitoring wells generally shall not be screened over an interval greater than 20 feet and shall not be screened over two or more lithologies that have air permeabilities that differ by more than one order of magnitude. Vapor extraction/monitoring wells shall be installed using drilling techniques that do not require drilling fluids other than filtered air. Vapor monitoring wells may have casing I.D.s of 2 inches or less while extraction wells shall generally have casing I.D.s of at least 4 inches. The design of vapor extraction/monitoring wells is dependent upon many site-specific factors, such as the depth of contamination, soil conditions, geology, and depth to groundwater. As a result, specifics related to the design of these wells shall be included in the CTO WP, field sampling plan, or plans and specifications.

5.9 Drive Points

An alternative to conventional monitoring well construction is, under limited conditions, the use of drive points. These consist of slotted steel pipe that is pushed, hammered, or hydraulically jetted into the ground. A filter pack is not constructed around the screen, so the width of the screen openings must be sufficiently small to prevent the passage of significant quantities of sediment into the well during the withdrawal of water for sampling. In some instances, the drive points are used only as piezometers.

Drive points are commonly used in hazardous waste investigations to sample ambient soil gases in the vadose zone. It is often possible to extend the drive point below the water table to collect water samples. In some instances, permits may be required because the drive points are considered in some jurisdictions to be equivalent to a temporary monitoring well.

5.10 Discrete Depth Groundwater Sampling

Another alternative to conventional monitoring well construction is the use of a discrete groundwater sampling device such as a Hydropunch. The Hydropunch tool can be used in conjunction with a standard drill rig, a cone penetrometer rig, or possibly a vehicle capable of driving vapor probes to sample groundwater and non-aqueous phase liquid in unconsolidated formations. The Hydropunch tool is constructed of a stainless steel drive point, a perforated section of Teflon pipe for a sample intake, and a stainless steel sample chamber. The tool is 55.5 inches long, 2 inches in O.D., and weighs approximately 24 pounds.

Ideally, a standard HSA drilling rig is used to drill a pilot hole to a depth just above the desired sampling depth. The Hydropunch tool is then hydraulically pushed or driven 4 to 5 feet through the saturated zone at each sampling location. As the tool is advanced, the sample intake screen remains pristine within the watertight stainless steel chamber. When the desired sampling interval is reached, the steel sampling chamber is unscrewed and withdrawn 1 foot to several feet, depending on how long a sampling interval is needed. This exposes the intake screen to the groundwater. Under hydrostatic pressure, groundwater flows through the intake screen and fills the sample chamber, without aeration or agitation occurring. The drive cone, which is attached to the base of the screen, will remain in place by soil friction.

The pointed shape of the sampler and its smooth exterior surface prevent downward transport of surrounding soil and groundwater as the tool is advanced. Once in place, the intake screen will be sealed from groundwater above and below the interval being sampled, because the exterior of the Hydropunch tool is flush against the surrounding soil wall. Additionally, as the tool is advanced, the sample intake screen is retained within the steel watertight sample chamber.

A stainless steel or Teflon bailer with a bottom check valve is lowered into the sample chamber to collect the groundwater sample. Groundwater is then decanted at ground surface from the bailer into the appropriate sample containers.

6. Records

Monitoring well location, design, and construction shall be recorded in the field notebook for the CTO and on a well completion record form (Figure I-C-1-5). The field operations manager should provide a copy of this form to the CTO Manager for the project files.

7. Health and Safety

Field personnel shall perform work in accordance with the current (or as contractually obligated) United States Army Corps of Engineers Safety and Health Requirements Manual EM-385-1-1 (USACE 2008) and site-specific health and safety plan.

8. References

ASTM International (ASTM) 2010. *Standard Practice for Design and Installation of Ground Water Monitoring Wells*. D5092-04^{e1}(Reapproved 2010). West Conshohocken, PA.

Department of Defense, United States (DoD). 2005. *Uniform Federal Policy for Quality Assurance Project Plans, Part 1: UFP-QAPP Manual*. Final Version 1. DoD: DTIC ADA 427785, EPA-505-B-04-900A. In conjunction with the U. S. Environmental Protection Agency and the Department of Energy. Washington: Intergovernmental Data Quality Task Force. March. On-line updates available at: http://www.epa.gov/fedfac/pdf/ufp_qapp_v1_0305.pdf.

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———.2014. *Environmental Readiness Program Manual*. OPNAV Instruction 5090.1D. 10 January.

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United States Army Corps of Engineers (USACE). 2008. *Consolidated Safety and Health Requirements Manual*. EM-385-1-1. Includes Changes 1–7. 13 July 2012.

Procedure I-A-5, Utility Clearance.

Procedure I-B-1, Soil Sampling.

Procedure I-B-5, Surface Water Sampling.

Procedure I-F, Equipment Decontamination.

9. Attachments

Attachment I-C-1-1, Guam Monitoring Well Abandonment Procedure

Attachment I-C-1-2, DOH Abandonment of Monitoring Well Summary Report Form

Attachment I-C-1-1

Guam Well Abandonment Procedure

Well Abandonment Procedure

Guam Environmental Protection Agency
Water Resources Management Program

I. Abandonment procedure for cased wells that ***will not*** have its casing removed

1. Remove the well pedestal and concrete pad if applicable.
2. Excavate down to six (6) feet and cut the casing.
3. If the well extends into the water table, measure the depth to the water table(DWT) and fill the well with 3/8 to 3/4 inch clean washed aggregate to three (3) feet above the water table. If the well is completely within the vadose zone, proceed to item "I.4."
4. Provide a two-foot (2) a bentonite plug by placing 3/4 inch bentonite chip in six (6) inch lifts and hydrating with potable water.
5. Fill the casing with clean cement up to six (6) below the ground surface which will form a mushroom cap.
6. Fill the final six (6) feet with native soil.

Note:
a. For wells with a depth to the water table greater than eleven (11) feet, the total depth of fill for item "I.5" will be equal to DWT less eleven feet.
b. For shallow wells with a depth to the water table greater than nine (9) feet, but less than eleven (11) feet above the water table, item "I.5" will not be included.
c. For shallow wells with a depth to the water table greater than three (3) feet, but less than nine (9) feet, items "I.4" and "I.5" will not be included.

II. Abandonment procedure for wells that ***will*** have its casing removed and open boreholes.

1. Remove the old pedestal and concrete pad if applicable.
2. Remove the casing if not an open borehole.
3. If the well extends into the water table, measure the depth to the water table(DWT) and fill the well with 3/8 to 3/4 inch clean washed aggregate to three (3) feet above the measured water table. If the well is completely within the vadose zone, proceed to item "II.4."
4. Provide a two-foot (2) bentonite plug by placing 3/4 inch bentonite chips in six (6) inch lifts and hydrating with potable water.
5. Fill the remaining portion with bentonite/cement slurry (30% of bentonite by volume) in 10-foot lifts up to twenty-six (26) feet below the ground surface.
   a. After each 10-foot lift, the hole shall be sounded to determine if ten (10) feet of the hole is actually filled with the bentonite/cement slurry by at least eight (8) feet. If the depth of the fill is greater than eight (8) feet, continue with the next ten-foot (10) lift of bentonite/cement slurry. If the depth of the fill is less than eight (8) feet (an indication that there is a cavity), go to "II.5.b." Otherwise, continue with item "II.5.a." When the bentonite/cement fill reaches a height of twenty-six (26) feet below the ground surface, go to item "II.6."
   b. Fill the next ten (10) feet with 3/8 to 3/4 inch clean washed aggregate. Sound the hole to ensure that at least nine (9) feet has been filled with clean aggregate. If less than nine (9) feet is filled, repeat another ten-foot (10) lift of 3/8 to 3/4 inch clean washed aggregate until the sounding of the well/borehole reveals a rise of nine (9) feet or greater. Go to item "II.5.c."

   c. Provide a two-foot (2) bentonite plug above the clean aggregate by placing 3/4 inch bentonite chips in six (6) inch lifts and hydrating with potable water. Continue with item "II.5.a."

6. Fill the next twenty (20) feet above the bentonite/cement fill with neat cement.
7. The remaining six (6) feet shall be filled with native soil.

Note:
   a. For wells with a depth to the water table greater than thirty-one (31) feet, the total depth of fill for item "II.5" will be equal to DWT less thirty-one (31) feet.
   b. For shallow wells with a depth to the water table greater than eleven (11) feet, but less than thirty-one (31) feet above the water table, item "II.5" will not be included.
   c. For shallow wells with a depth to the water table greater than nine (9) feet, but less than eleven (11) feet above the water table, items "II.5" and "II.6" will not be included.
   d. For shallow wells with a depth to the water table greater than three (3) feet, but less than nine (9) feet, items "II.4", "II.5" and "II.6" will not be included.

General Notes:

a. The driller shall submit a well abandonment plan following the above procedure to Guam EPA for review/approval.
b. The driller shall notify Guam EPA administrator 48 hours prior to starting date of the the approved abandonment plan.
c. All above-ground materials shall be removed from the well site and disposed in a manner that conforms to the Guam EPA's solid waste regulations.
d. If a well is in an area that is covered with asphalt or concrete that is not to be removed (such as a parking lot or a driveway/street), the native soil fill may be excluded and the well may be filled to the top with neat cement and then covered with new asphalt or concrete.

Attachment I-C-1-2
DOH Abandonment of Monitoring Well Summary Report Form

Abandonment of Monitoring Well Summary Report

____________________ (Monitoring Well ID)

Submit form within 30 days of well abandonment or within 90 days if included in a site closure, monitoring, or investigation report. In addition, submit copies of the original boring log and well construction diagram for the monitoring well, a site map showing the location of the abandoned monitoring well, and the disposal documentation for wastes generated during the abandonment process. Submit all documentation to: Hawaii Department of Health, Hazard Evaluation and Emergency Response Office, Attention: SDAR, 919 Ala Moana Blvd, Rm. 206, Honolulu Hawaii 96814.

Location Information	**Owner Information**
Facility Name:	Well Owner:
Facility Address:	Contact Person:
	Mailing Address:
Latitude:	
Longitude:	Phone Number: Fax Number:
TMK:	Land Owner:
Location Description:	Contact Person:
	Mailing Address:
Monitoring Well Location Map Attached: Y N	Phone Number: Fax Number:

Well Construction Information	
Date of Installation:	Casing Material: Casing Diameter:
Drilling Company:	Casing Length: Casing Depth:
Total Depth:	Screen Material: Slot Size:
Depth to Water:	Screen Length: Screen Depth:
Was the Well Set in an Aquifer that is a Current or Potential	Annular Material: Depth:
Drinking Water Source: Y N	Annular Material: Depth:
Boring Log/Well Construction Diagram Attached: Y N	Annular Material: Depth:

General Abandonment Information	
Drilling Firm:	Consulting Firm:
Contact Person:	Contact Person:
Mailing Address:	Mailing Address:
Phone Number: Fax Number:	Phone Number: Fax Number:

Well Abandonment Information	
Date of Abandonment:	Sealing Material: Depth:
Reason for Abandonment:	Volume/Weight/Bags Mixing Ratio:
Casing/Screen Removed: Y N	Sealing Material: Depth:
If Yes, was annular material removed?: Y N	Volume/Weight/Bags Mixing Ratio:
If No, was casing cut off below the surface?: Y N	Method of Sealing Material Placement:
Comments:	
Driller's Signature:	Date:
Consultant's Signature:	Date:

Monitoring Well Development

1. Purpose

This section describes the standard operating procedures for monitoring well development to be used by United States Navy Environmental Restoration (ER) Program, Naval Facilities Engineering Command (NAVFAC), Pacific personnel.

2. Scope

This procedure applies to all Navy ER projects performed in the NAVFAC Pacific Area of Responsibility.

This procedure shall serve as management-approved professional guidance for the ER Program and is consistent with protocol in the Uniform Federal Policy-Quality Assurance Project Plan (DoD 2005). As professional guidance for specific activities, this procedure is not intended to obviate the need for professional judgment during unforeseen circumstances. Deviations from this procedure while planning or executing planned activities must be approved and documented by the following prime contractor representatives: the CTO Manager and the Quality Assurance (QA) Manager or Technical Director. A Navy project representative (i.e., Remedial Project Manager or QA Manager) shall also concur with any deviations.

3. Definitions

None.

4. Responsibilities

The prime contractor CTO Manager is responsible for ensuring that these monitoring well development procedures are followed during projects conducted under the NAVFAC Pacific ER Program. The CTO Manager is responsible for ensuring that all personnel involved in monitoring well development shall have the appropriate education, experience, and training to perform their assigned tasks as specified in Chief of Naval Operations Instruction 5090.1, under *Specific Training Requirements* (DON 2014).

The prime contractor QA Manager or Technical Director is responsible for ensuring overall compliance with this procedure.

The Field Manager is responsible for ensuring that all project field staff follow these procedures.

Field personnel are responsible for the implementation of this procedure.

5. Procedure

5.1 INTRODUCTION

Well development procedures are crucial in preparing a well for sampling. They enhance the flow of groundwater from the formation into the well and remove the clay, silt, and other fines from the formation so that produced water will not be turbid or contain suspended matter that can interfere with chemical analyses. A monitoring well should be a “transparent” window into the aquifer from which samples can be collected that are truly representative of the quality of water that is moving through the formation.

The goal of well development is to restore the area adjacent to a well to its natural condition by correcting damage to the formation during the drilling process. Well development shall accomplish the following tasks:

- Remove a filter cake or any drilling fluid within the borehole that invades the formation.
- Remove fine-grained material from the filter pack.
- Increase the porosity and permeability of the native formation immediately adjacent to the filter pack.

Well development shall not occur until 24 hours after the completion of well installation to allow the annular seal to fully set up.

5.2 FACTORS AFFECTING MONITORING WELL DEVELOPMENT

5.2.1 Type of Geologic Materials

Different types of geologic materials are developed more effectively by using certain development methods. Where permeability is greater, water moves more easily into and out of the formation and development is accomplished more quickly. Highly stratified deposits are effectively developed by methods that concentrate on distinct portions of the formation. If development is performed unevenly, a groundwater sample will likely be more representative of the permeable zones. In uniform deposits, development methods that apply powerful surging forces over the entire screened interval will produce satisfactory results.

5.2.2 Design and Completion of the Well

Because the filter pack reduces the amount of energy reaching the borehole wall, it must be as thin as possible if the development procedures are to be effective in removing fine particulate material from the interface between the filter pack and natural formation. Conversely, the filter pack must be thick enough to ensure a good distribution of the filter pack material during emplacement. The general rule is that filter pack material must be at least 2 inches thick.

The screen slot size must be appropriate for the geologic material and filter pack material in order for development to be effective. If slot size is too large, the removal of too much sediment may cause settlement of overlying materials and sediment accumulation in the casing. When screen openings are too small, full development may not be possible and well yield will be below the potential of the formation. Additionally, incomplete development coupled with a narrow slot size can lead to blockage of the screen openings.

5.2.3 Drilling Method

The drilling method influences development procedure. Typical problems associated with specific drilling methods include the following:

- If a mud rotary method is used, mud cake builds up on the borehole wall and must be removed during the development process.

- If drilling fluid additives have been used, the development process must include an attempt to remove all fluids that have infiltrated into the native formation.
- If driven casing or hollow-stem auger methods have been used, the interface between the casing or auger flights and the natural formation may have been smeared with fine particulate matter that must be removed during the development process.
- If an air rotary method has been used in rock formations, fine particulate matter is likely to build up on the borehole walls and may plug pore spaces, bedding planes, and other permeable zones. These openings must be restored during the development process.

5.3 PREPARATION

In preparing for monitoring well development, development logs for any other monitoring wells in the vicinity should be reviewed to determine the general permeability of the water-bearing formation and the appropriate development method.

Depth to groundwater and information from the well construction log should be used in calculating the required quantity of water to be removed. The distance between the equilibrated water level and the bottom of the screen is the saturated section. The saturated section (feet) multiplied by the unit well volume per foot (gallons/linear foot) equals the gallons required to remove one total well volume of water. The unit well volume is the sum of the casing volume and the filter pack pore volume, both of which depend upon casing and borehole diameter and the porosity of the filter pack material. Well volume can be calculated using Table I-C-2-1, Table I-C-2-2, or Table 1-C-2-3.

Table I-C-2-1: Casing Volume*

Casing Diameter (inches)	Volume (gallon/linear foot)
2	0.16
4	0.65
6	1.47

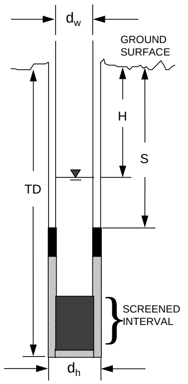
Table I-C-2-2: Filter Pack Pore Volume

Casing Diameter (inches)	Borehole Diameter (inches)	Volume [a] (gallon/linear foot)
2	6	0.52
2	8	0.98
4	10	1.37
4	12	2.09
6	12	1.76

* The above two volumes must be added together to obtain one unit well volume.
[a] Assumes a porosity of 40% for filter pack.

Table I-C-2-3: Well Volume Calculation

HOLE DIAMETER	d_h	=	
WELL CASING INSIDE DIAMETER	$d_w ID$	=	
OUTSIDE DIAMETER	$d_w OD$	=	_____
DEPTH TO: WATER LEVEL	H	=	
BASE OF SEAL	S	=	_____
BASE OF WELL	TD	=	
EST. FILTER PACK POROSITY	P	=	_____



WELL VOLUME CALCULATION:

$$\text{CASING VOLUME} = V_c = \Pi\left(\frac{d_w ID}{2}\right)^2 (TD - H) = 3.14\left(\frac{\_\_}{2}\right)^2 (\_\_\_\_ - \_\_\_\_) = \_\_\_\_\_\_$$

$$\text{FILTER PACK PORE VOLUME} = V_f = \Pi\left[\left(\frac{d_h}{2}\right)^2 - \left(\frac{d_w OD}{2}\right)^2\right](TD - (S \text{ or } H^*)(P) = \_\_\_\_\_\_$$

$$(\text{* if } S > H, \text{ use } S; \text{ if } S < H, \text{ use } H)$$

$$= 3.14\left[\left(\frac{\_\_\_\_}{2}\right)^2 - \left(\frac{\_\_\_\_}{2}\right)^2\right](\_\_\_\_ - \_\_\_\_)(\_\_\_\_) = \_\_\_\_\_\_$$

TOTAL WELL VOLUME = VT = Vc + Vf = ____ + ____ = ______ ft.^{3} x 7.48 = ______ gal.

5.4 DECONTAMINATION

The purpose of decontamination of development equipment is to prevent cross-contamination between monitoring wells. Use disposable equipment where appropriate. Use a steam-cleaner, if available, to decontaminate development equipment. Clean the equipment away from the monitoring well in such a fashion that decontamination effluent can be intercepted and drummed.

A triple rinse decontamination procedure is acceptable for equipment, such as bailers, or if access to a steam cleaner is not possible (Procedure I-F, *Equipment Decontamination*).

During well development, place visqueen around the well to prevent contamination at ground surface. Properly dispose of this sheeting after each use.

5.5 WELL DEVELOPMENT MONITORING

Throughout the well development process, maintain a development record using the form presented in Attachment I-C-2-1. The record should include the following information:

- General:
  - Project name and number
  - Well name/number and location
  - Date, time, and weather conditions
  - Names of personnel involved
- Development volume:
  - Initial and final water level
  - Casing total depth and diameter
  - Borehole diameter
  - Casing volume, filter pack pore volume, total well volume
  - Volume of water to be evacuated
  - Method and rate of removal
  - Appearance of water before and after development
- Monitoring data for each sample point:
  - Date, time, elapsed time
  - Cumulative gallons removed, removal method, removal rate
  - Temperature, pH (indicates the hydrogen ion concentration – acidity or basicity), specific conductivity, turbidity, dissolved oxygen, redox potential, and salinity

Part of the well development procedure shall consist of acquisition and analysis of water samples at appropriate intervals considering the total quantity of water to be removed. Measure conductivity, pH, temperature, dissolved oxygen, redox potential, turbidity, and salinity in each sample using a multi-parameter meter and flow-through cell. Collect readings on a periodic basis (approximately every 3 to 5 minutes) during development and obtain at least one reading after removal of each well volume. At the time each sample is analyzed, record the cumulative water removed, the time, the time elapsed during development, and calculated flow rate. Continue development until at least 3 borehole volumes have been removed, turbidity stabilizes at or below 5 nephelometric turbidity units, and three successive readings of the parameters have stabilized (values within 10 percent of each other). If stabilization has not been attained, if turbidity remains high, or if the well does not readily yield water, allow the water level in the well to recover, conduct an additional 15 minutes of mechanical surging and/or bailing, then continue development until stabilization can be achieved or for a reasonable time.

Section 5.7 describes well development in special situations, such as low yield formations and 2-inch wells.

5.6 METHODS OF MONITORING WELL DEVELOPMENT

The methods available for the development of monitoring wells have been inherited from production well practices. Methods include: (1) mechanical surging with a surge block or swab, and (2) surge pumping. Development methods using air or jetting of water into the well are generally inappropriate for development of monitoring wells due to the potential for affecting water quality.

Containerize and appropriately label all development water (unless it is permissible to discharge it on site). All development efforts must utilize mechanical surging or surge pumping, followed by bailing or groundwater removal with a pump. More detailed descriptions of appropriate development methods are presented below.

5.6.1 Mechanical Surging and Bailing

For mechanical surging and bailing, a surge block or swab is operated either manually or by a drill rig. The surge block or swab should be vented and be of sufficient weight to free-fall through the water in the well and create a vigorous outward surge. The equipment lifting the tool must be strong enough to extract it rapidly. A bailer is then used to remove fine-grained sediment and groundwater from the well.

Procedures:

1. Properly decontaminate all equipment entering the well.
2. Record the static water level and the total well depth.
3. Lower the surge block or swab to the top of the screened interval.
4. Operate in a pumping action with a typical stroke of approximately 3 feet.
5. Gradually work the surging downward through the screened interval during each cycle.
6. Surge for approximately 10 to 15 minutes per cycle.
7. Remove the surge block and attach the bailer in its place.
8. Bail to remove fines loosened by surging until the water appears clear.

9. Repeat the cycle of surging and bailing at least three times or until turbidity is reduced and stabilization of water quality parameters occurs.
10. The surging shall initially be gentle and the energy of the action should gradually increase during the development process.

The advantages (+) and disadvantages (–) of this method are listed below:

+ Reversing the direction of flow reduces bridging between large particles, and the inflow then moves the fine material into the well for withdrawal.
+ It affects the entire screened interval.
+ It effectively removes fines from the formation and the filter pack.
– It might cause upward movement of water in the filter pack that could disrupt the seal.
– Potential exists for damaging a screen with a tight-fitting surge block or with long surge strokes.

5.6.2 Surge Pumping

Procedures:

1. Properly decontaminate all equipment entering the well.
2. Record the static water level and the total well depth.
3. Lower a submersible pump or airlift pump without a check valve to a depth within 1 to 2 feet of the bottom of the screened section.
4. Start pumping and increase discharge rate to maximum capacity (overpumping), causing rapid drawdown of water in the well.
5. Periodically stop and start the pump, allowing the water in the drop pipe to fall back into the well and surge the formation (backwashing), thus loosening particulates.
6. The pump intake shall be moved up the screened interval in increments appropriate to the total screen length.
7. At each pump position, the well shall be pumped, overpumped, and backwashed alternately until satisfactory development has been attained as demonstrated by reduction in turbidity and stabilization of water quality parameters.

The advantages (+) and disadvantages (–) of this method are listed below:

+ Reversing the direction of flow reduces bridging between large particles, and the inflow then moves the fine material into the well for withdrawal.
+ It effectively removes fines from the formation and filter pack.
– The pump position or suction line must be changed to cover the entire screen length.

- Submersible pumps suitable to perform these operations may not be available for small diameter (1 inch or less) monitoring wells.
- It is not possible to remove sediment from the well unless particle size is small enough to move through the pump.

For additional information on well development, consult the references included in Section 8 of this procedure.

5.7 Special Situations

5.7.1 Development of Low Yield Wells

Development procedures for monitoring wells in low-yield (<0.25 gallons per minute), water-bearing zones are somewhat limited. Due to the low hydraulic conductivity of the materials, surging of water in and out of the well casing is difficult. Also, the entry rate of water is inadequate to remove fines from the well bore and the gravel pack when the well is pumped. Additionally, the process may be lengthy because the well can be easily pumped dry and the water level is very slow to recover.

Follow the procedures for mechanical surging and bailing for low yield wells. During surging and bailing, wells in low yield formations should be drawn down to total depth twice, if possible. Development can be terminated, however, if the well does not exhibit 80 percent recovery after 3 hours.

5.7.2 Development of 2-inch Wells

It is easier to develop monitoring wells that are large in diameter than small diameter wells. Mechanical surging or bailing techniques that are effective in large diameter wells are much less effective when used in wells 2 inches or less in diameter. Mechanical surge blocks and bailers have a high potential for damaging a small diameter well. As a result, the CTO Manager shall obtain approval from the QA Manager or Technical Director prior to installing groundwater monitoring wells with inside diameters of 2 inches or less.

Develop two-inch or smaller diameter wells by surging with a specially designed, hand-operated surge block or by pumping with a bladder or airlift pump. Information related to development of wells 2 inches or less in diameter shall be included in the CTO work plan.

6. Records

Well development information should be documented in indelible ink on well development monitoring forms (Attachment I-C-2-1). Copies of this information shall be sent to the CTO Manager and to the project files. The CTO Manager shall review all well development logs on a minimum monthly basis.

7. Health and Safety

Field personnel shall perform work in accordance with the current (or as contractually obligated) United States Army Corps of Engineers Safety and Health Requirements Manual EM-385-1-1 (USACE 2008) and site-specific health and safety plan.

8. References

Department of Defense, United States (DoD). 2005. *Uniform Federal Policy for Quality Assurance Project Plans, Part 1: UFP-QAPP Manual*. Final Version 1. DoD: DTIC ADA 427785, EPA-505-B-04-900A. In conjunction with the U. S. Environmental Protection Agency and the Department of Energy. Washington: Intergovernmental Data Quality Task Force. March. On-line updates available at: http://www.epa.gov/fedfac/pdf/ufp_qapp_v1_0305.pdf.

Department of the Navy (DON). 2014. *Environmental Readiness Program Manual*. OPNAV Instruction 5090.1D. 10 January.

United States Army Corps of Engineers (USACE). 2008. *Consolidated Safety and Health Requirements Manual.* EM-385-1-1. Includes Changes 1–7. 13 July 2012.

Procedure I-F, *Equipment Decontamination.*

9. Attachments

Attachment I-C-2-1: Well Development Record

Attachment I-C-2-1
Well Development Record

WELL DEVELOPMENT LOG

PROJECT	WELL ID	SITE	PREPARED BY

METHOD
OVERPUMPAGE ☐
BAILER ☐
SURGE BLOCK ☐
AIR LIFT ☐
OTHER __________

INITIAL WATER LEVEL:
INITIAL TOTAL DEPTH:

FINAL WATER LEVEL:
FINAL TOTAL DEPTH:

REMARKS:

*CAPACITY OF CASING (GALLONS/LINEAR FOOT)

1" - 0.012
2" - 0.16
4" - 0.65
6" - 0.1.47

*VOLUME BETWEEN CASING AND HOLE
(GALLONS/LINEAR FOOT)
(ASSUMING 40% POROSITY)

1" CASING AND 2" HOLE - 0.013
2" CASING AND 6" HOLE - 0.52
2" CASING AND 8" HOLE - 0.98
4" CASING AND 10" HOLE - 1.37
4" CASING AND 12" HOLE - 2.09

*The two volumes for the saturated portion of the well must be added together to obtain one unit well volume.

DEVELOPMENT LOG:					CUMULATIVE WATER REMOVED	WATER QUALITY							COMMENTS
DATE	TIME	METHOD	ELAPSED TIME	FLOW RATE (gpm)	GALLONS	pH	TEMP (°C)	SP. COND (mS/cm)	DO (mg/L)	ORP (mV)	TURBIDITY (ntu)	SALINITY (ppt)	

DO dissolved oxygen
ORP oxidation-reduction potential

Monitoring Well Sampling

1. Purpose

This standard operating procedure describes the monitoring well sampling procedures to be used by United States (U.S.) Navy Environmental Restoration (ER) Program, Naval Facilities Engineering Command (NAVFAC), Pacific personnel.

2. Scope

This procedure applies to all Navy ER projects performed in the NAVFAC Pacific Area of Responsibility.

This procedure shall serve as management-approved professional guidance for the ER Program and is consistent with protocol in the Uniform Federal Policy-Quality Assurance Project Plan (DoD 2005). As professional guidance for specific activities, this procedure is not intended to obviate the need for professional judgment during unforeseen circumstances. Deviations from this procedure while planning or executing planned activities must be approved and documented by the following prime contractor representatives: the CTO Manager and the Quality Assurance (QA) Manager or Technical Director. A Navy project representative (i.e., Remedial Project Manager or QA Manager) shall also concur with any deviations.

3. Definitions

None.

4. Responsibilities

The prime contractor CTO Manager is responsible for ensuring that these standard groundwater sampling activities are followed during projects conducted under the NAVFAC Pacific ER Program. The CTO Manager or designee shall review all groundwater sampling forms on a minimum monthly basis. The CTO Manager is responsible for ensuring that all personnel involved in monitoring well sampling shall have the appropriate education, experience, and training to perform their assigned tasks as specified in Chief of Naval Operations Instruction 5090.1, under *Specific Training Requirements* (DON 2014).

The prime contractor QA Manager or Technical Director is responsible for ensuring overall compliance with this procedure.

The Field Manager is responsible for ensuring that all project field staff follow these procedures.

Field sampling personnel are responsible for the implementation of this procedure.

Minimum qualifications for sampling personnel require that one individual on the field team shall have a minimum of 1 year experience with sampling monitoring wells.

The field sampler and/or task manager is responsible for directly supervising the groundwater sampling procedures to ensure that they are conducted according to this procedure, and for recording all pertinent data collected during sampling. If deviations from the procedure are required because of anomalous field conditions, they must first be approved by the QA Manager or Technical Director and then documented in the field logbook and associated report or equivalent document.

5. Procedures

5.1 PURPOSE

This procedure establishes the method for sampling groundwater monitoring wells for water-borne contaminants and general groundwater chemistry. The objective is to obtain groundwater samples of aquifer conditions with as little alteration of water chemistry as possible.

5.2 PREPARATION

5.2.1 Site Background Information

Establish a thorough understanding of the purposes of the sampling event prior to field activities. Conduct a review of all available data obtained from the site and pertinent to the water sampling. Review well history data including, but not limited to, well locations, sampling history, purging rates, turbidity problems, previously used purging methods, well installation methods, well completion records (including depth of screened interval), well development methods, previous analytical results, presence of an immiscible phase, historical water levels, and general hydrogeologic conditions.

Previous groundwater development and sampling logs give a good indication of well purging rates and the types of problems that might be encountered during sampling, such as excessive turbidity and low well yield. They may also indicate where dedicated pumps are placed in the water column. To help minimize the potential for cross-contamination, well purging and sampling, and water level measurement collection shall proceed from the least contaminated to the most contaminated as indicated in previous analytical results. This order may be changed in the field if conditions warrant it, particularly if dedicated sampling equipment is used. A review of prior sampling procedures and results may also identify which purging and sampling techniques are appropriate for the parameters to be tested under a given set of field conditions.

5.2.2 Groundwater Analysis Selection

Establish the requisite field and laboratory analyses prior to water sampling. Decide on the types and numbers of QA/quality control (QC) samples to be collected (Procedure III-B, *Field QC Samples [Water, Soil]*), as well as the type and volume of sample preservatives, the number of sample containers (e.g., coolers), and the quantity of ice or other chilling materials. The sampling personnel shall ensure that the appropriate number and size sample containers are brought to the site, including extras in case of breakage or unexpected field conditions. Document the analytical requirements for groundwater analysis in the project-specific work plan.

5.3 GROUNDWATER SAMPLING PROCEDURES

Groundwater sampling procedures at a site shall include: (1) measurement of well depth to groundwater; (2) assessment of the presence or absence of an immiscible phase; (3) assessment of purge parameter stabilization; (4) purging of static water within the well and well bore; and (5) obtaining a groundwater sample. Each step is discussed in sequence below. Depending upon specific field conditions, additional steps may be necessary. As a rule, at least 24 hours should separate well development and well sampling events.

5.3.1 Measurement of Static Water Level Elevation

Measure the depth to standing water and the total depth of the well to the nearest 0.01 foot to provide baseline hydrologic data, to calculate the volume of water in the well, and to provide information on the integrity of the well (e.g., identification of siltation problems). Mark each well with a permanent, easily identified reference point for water level measurements whose location and elevation have been surveyed.

Before purging the well, measure water levels in all of the wells within the zone of influence of the well being purged. Measure water levels twice in quick succession and record each measurement. This will provide a water level database that describes water levels across the site at one time (a synoptic sampling). Measure the water level in each well immediately prior to purging the well.

The device used to measure the water level surface and depth of the well shall be sufficiently sensitive and accurate in order to obtain a measurement to the nearest 0.01 foot reliably. An electronic water level meter will usually be appropriate for this measurement; however, when the groundwater within a particular well is highly contaminated, an inexpensive weighted tape measure can be used to determine well depth to prevent adsorption of contaminants onto the meter tape. The presence of light, non-aqueous phase liquids (LNAPLs) and/or dense, non-aqueous phase liquids (DNAPLs) in a well requires measurement of the elevation of the top and the bottom of the product, generally using an interface probe. Water levels in such wells must then be corrected for density effects to accurately determine the elevation of the water table.

5.3.2 Decontamination of Equipment

Establish a decontamination station before beginning sampling. The station shall consist of an area of at least 4 feet by 2 feet covered with plastic sheeting and be located upwind of the well being sampled and far enough from potential contaminant sources to avoid contamination of clean equipment. The station shall be large enough to fit the appropriate number of wash and rinse buckets, and have sufficient room to place equipment after decontamination. One central cleaning area may be used throughout the entire sampling event. The area around the well being sampled shall also be covered with plastic sheeting to prevent spillage. Further details are presented in Procedure I-F, *Equipment Decontamination*.

Decontaminate each piece of equipment prior to entering the well. Also conduct decontamination prior to sampling at a site, even if the equipment has been decontaminated subsequent to its last usage. This precaution is taken to minimize the potential for cross-contamination. Additionally, decontaminate each piece of equipment used at the site prior to leaving the site. It is only necessary to decontaminate dedicated sampling equipment prior to installation within the well. Do not place clean sampling equipment directly on the ground or other contaminated surfaces prior to insertion into the well. Dedicated sampling equipment that has been certified by the manufacturer as being decontaminated can be placed in the well without onsite decontamination.

5.3.3 Detection of Immiscible Phase Layers

Complete the following steps for detecting the presence of LNAPL and DNAPL, as necessary, before the well is evacuated for conventional sampling:

1. Sample the headspace in the wellhead immediately after the well is opened for organic vapors using either a photoionization detector or an organic vapor analyzer (flame ionization detector), and record the measurements.

2. Lower an interface probe into the well to determine the existence of any immiscible layer(s), LNAPL and/or DNAPL, and record the measurements.
3. Confirm the presence or absence of an immiscible phase by slowly lowering a clear bailer to the appropriate depth, then visually observing the results after sample recovery.
4. In rare instances, such as when very viscous product is present, it may be necessary to utilize hydrocarbon- and water-sensitive pastes for measurement of LNAPL thickness. This is accomplished by smearing adjacent, thin layers of both hydrocarbon- and water-sensitive pastes along a steel measuring tape and inserting the tape into the well. An engineering tape showing tenths and hundredths of feet is required. Record depth to water, as shown by the mark on the water-sensitive paste, and depth to product, as shown by the mark on the product-sensitive paste. In wells where the approximate depth to water and product thickness are not known, it is best to apply both pastes to the tape over a fairly long interval (5 feet or more). Under these conditions, measurements are obtained by trial and error, and may require several insertions and retrievals of the tape before the paste-covered interval of the tape encounters product and water. In wells where approximate depths of air-product and product-water interfaces are known, pastes may be applied over shorter intervals. Water depth measurements should not be used in preparation of water-table contour maps until they are corrected for depression by the product.

If the well contains an immiscible phase, it may be desirable to sample this phase separately. Sections 5.3.5.1 and 5.3.5.2 present immiscible phase sampling procedures. It may not be meaningful to conduct water sample analysis of water obtained from a well containing LNAPLs or DNAPLs. Consult the CTO Manager and QA Manager or Technical Director if this situation is encountered.

5.3.4 Purging Equipment and Use

The water present in a well prior to sampling may not be representative of *in situ* groundwater quality and shall be removed prior to sampling. Handle all groundwater removed from potentially contaminated wells in accordance with the investigation-derived waste (IDW) handling procedures in Procedure I-A-6, *Investigation-Derived Waste Management*.

Purging shall be accomplished by removing groundwater from the well at low flow rates using a pump. According to the U.S. Environmental Protection Agency (EPA) (EPA 1996), the rate at which groundwater is removed from the well during purging ideally should be less than 0.2 to 0.3 liters/min. The EPA further states that wells should be purged at rates below those used to develop the well to prevent further development of the well, to prevent damage to the well, and to avoid disturbing accumulated corrosion or reaction products in the well. The EPA also indicates that wells should be purged at or below their recovery rate so that migration of water in the formation above the well screen does not occur.

Realistically, the purge rate should be low enough that substantial drawdown in the well does not occur during purging. The goal is minimal drawdown (less than 0.1 meter) during purging (EPA 1996). The amount of drawdown during purging should be recorded at the same time the other water parameters are measured. Also, a low purge rate will reduce the possibility of stripping volatile organic compounds (VOCs) from the water, and will reduce the likelihood of mobilizing colloids in the subsurface that are immobile under natural flow conditions.

The sampler shall ensure that purging does not cause formation water to cascade down the sides of the well screen. Wells shall not be purged to dryness if recharge causes the formation water to cascade down the sides of the screen, as this will cause an accelerated loss of volatiles. This problem should be anticipated. Water shall be purged from the well at a rate that does not cause recharge water to be excessively agitated unless an extremely slow recharging well is encountered where complete evacuation is unavoidable.

In high yield wells (wells that exhibit 80 percent recovery in less than 2 hours), purging shall be conducted at relatively low flow rates and shall remove water from the entire screened interval of the well to ensure that fresh water from the formation is present throughout the entire saturated interval. In general, place the intake of the purge pump 2 to 3 feet below the air-water interface within the well to allow purging and at the same time minimize disturbance/overdevelopment of the screened interval in the well. During the well purging procedure, collect water level and/or product level measurements to assess the hydraulic effects of purging. Sample the well when it recovers sufficiently to provide enough water for the analytical parameters specified.

Low yield wells (those that exhibit less than 80 percent recovery in less than 2 hours) require one borehole volume of water to be removed. Allow the well to recover sufficiently to provide enough water for the specified analytical parameters, and then sample it.

Evaluate water samples on a regular basis (approximately every 5 minutes) during well evacuation and analyze them in the field preferably using a multi-parameter meter and flow-through cell for temperature, pH (indicates the hydrogen ion concentration – acidity or basicity), specific conductivity, dissolved oxygen (DO), oxidation reduction potential (ORP), turbidity, salinity, and total dissolved solids (TDS). Take at least five readings during the purging process. These parameters are measured to demonstrate that the natural character of the formation water has been pumped into the well. Purging shall be considered complete when three consecutive sets of field parameter measurements stabilize within approximately 10 percent (EPA 2006). However, suggested ranges are ±0.2 degrees Celsius for temperature, ±0.1 standard units for pH, ±3 percent for specific conductance, ±10 percent for DO, and ±10 millivolts for redox potential (ASTM 2001). This criterion may not be applicable to temperature if a submersible pump is used during purging due to the heating of the water by the pump motor. Enter all information obtained during the purging and sampling process including drawdown, into a groundwater sampling log (Figure I-C-3-1). Complete all blanks on this field log during sampling.

In cases where an LNAPL has been detected in the monitoring well, insert a stilling tube of a minimum diameter of 2 inches into the well prior to well purging. The stilling tube shall be composed of a material that meets the performance guidelines for sampling devices. Insert the stilling tube into the well to a depth that allows groundwater from the screened interval to be purged and sampled, but that is below the upper portion of the screened interval where the LNAPL is entering the well screen. The goal is to sample the aqueous phase (groundwater) while preventing the LNAPL from entering the sampling device. To achieve this goal, insert the stilling tube into the well in a manner that prevents the LNAPL from entering the stilling tube. However, sampling groundwater beneath a NAPL layer is not generally recommended due to the fact that the interval with residual NAPL saturation is often unknown and the NAPL can be mobilized into the well from intervals below the water table.

One method of doing this is to cover the end of the stilling tube with a membrane or material that will be ruptured by the weight of the pump. A piece of aluminum foil can be placed over the end of the stilling tube. Slowly lower the stilling tube into the well to the appropriate depth and then attach it firmly to the top of the well casing. When the pump is inserted, the weight of the pump breaks the foil covering the end of the tube, and the well can be purged and sampled from below the LNAPL layer. Firmly fasten the membrane or material that is used to cover the end of the stilling tube so that it remains attached to the stilling tube when ruptured. Moreover, the membrane or material must retain its integrity after it is ruptured. Pieces of the membrane or material must not fall off of the stilling tube into the well. Although aluminum foil is mentioned in this discussion as an example of a material that can be used to cover the end of the tube, a more chemically inert material may be required, based on the site-specific situation. Thoroughly decontaminate stilling tubes prior to each use. Collect groundwater removed during purging, and store it on site until its disposition is determined based upon laboratory analytical results. Storage shall be in secured containers, such as U.S. Department of Transportation-approved drums. Label containers of purge water with the standard NAVFAC Pacific ER Program IDW label.

The following paragraphs list available purging equipment and methods for their use.

5.3.4.1 BAILERS AND PUMPS

Submersible Pump: A stainless steel submersible pump may be utilized for purging both shallow and deep wells prior to sampling groundwater for volatile, semivolatile, and non-volatile constituents. For wells over 200 feet deep, the submersible pump is one of the few technologies available to feasibly accomplish purging under any yield conditions. For shallow wells with low yields, submersible pumps are generally inappropriate due to over stressing of the wells (<1 gallon per minute), which causes increased aeration of the water within the well.

Steam clean or otherwise decontaminate the pump and discharge tubing prior to the placing the pump in the well. The submersible pump shall be equipped with an anti-backflow check valve to keep water from flowing back down the drop pipe into the well. Place the pump intake approximately 2 to 3 feet below the air-water interface within the well and maintain it in that position during purging. Additionally, when pulling the pump out of the well subsequent to purging, take care to avoid dumping water within the drop pipe and pump stages back into the well.

Bladder Pump: A stainless steel and/or Teflon bladder pump can be utilized for purging and sampling wells up to 200 feet in depth for volatile, semivolatile, and non-volatile constituents. Additionally, the bladder pump can be used for purging and obtaining groundwater samples overlain by a LNAPL layer as long as care is taken not to draw the product layer into the bladder pump. Use of the bladder pump is most effective in low to moderate yield wells.

Either a battery powered compressor, compressed dry nitrogen, or compressed dry air, depending upon availability, can operate the bladder pump. The driving gas utilized must be dry to avoid damage to the bladder pump control box. Decontaminate the bladder pump prior to use. Once purging is complete, collect the samples directly from the bladder pump.

Centrifugal or Diaphragm Pump: A centrifugal, or diaphragm, pump may be used to purge a well if the water level is within 20 feet of ground surface. A new, or properly decontaminated, hose is lowered into the well and water withdrawn at a rate that does not cause excessive well drawdown.

GROUNDWATER SAMPLING LOG

WELL NO. ______ LOCATION: ______ PROJECT NO. ______

DATE: TIME: ______ CLIMATIC CONDITIONS: ______

TIDAL CONDITIONS: Rising ☐ Falling ☐ HIGH TIDE: LOW TIDE: CURRENT TIDE:

STATIC WATER LEVEL (FT.) and TIME: ______ TOTAL DEPTH (FT.): ______

WELL PURGING: LENGTH OF SATURATED ZONE: ______ LINEAR FT.

a VOLUME OF WATER TO BE EVACUATED: ______ GALS. (Gals/Linear ft. X linear feet of saturation X 3-casing volumes)

METHOD OF REMOVAL: ______ PUMPING RATE: ______ mL/min

WELL PURGE DATA:

DATE/ TIME	DTW	GALLONS REMOVED	TDS (g/L)	pH	SP. COND. (mS/cm)	D.O. (mg/L)	TURB. (NTU)	TEMP. (°C)	ORP (mV)	SAL (ppt)

SAMPLE WITHDRAWAL METHOD: ______

APPEARANCE OF SAMPLE: COLOR: ______

SEDIMENT: ______

OTHER: ______

LABORATORY ANALYSIS PARAMETERS AND PRESERVATIVES ______

NUMBER AND TYPES OF SAMPLE CONTAINERS USED: ______

SAMPLE IDENTIFICATION NUMBER(S) ______

DECONTAMINATION PROCEDURES: ______

NOTES: ______

SAMPLED BY: ______

SAMPLES DELIVERED TO: ______ TRANSPORTER: ______

DATE: ______ TIME: ______

CAPACITY OF CASING (GALLONS/LINEAR FOOT)

2"-0.16•4"-0.65•6"-1.47•8"-2.61•10"-4.08•12"-5.87

Figure I-C-3-1: Groundwater Sampling Log

Place the hose bottom approximately 2 to 3 feet below the air-water interface and maintain it in that position during purging.

Air Lift Pump: Airlift pumps are not appropriate for purging or sampling.

Bailer: Avoid using a bailer to purge a well because it can result in aeration of the water in the well and possibly cause excessive purge rates. If a bailer must be used, decontaminate the bailer, bailer wire, and reel as described in Section 5.3.2 prior to its use. Teflon-coated cable mounted on a reel is recommended for lowering the bailer in and out of the well.

Lower the bailer below the water level of the well with as little disturbance of the water as possible to minimize aeration of the water in the well. One way to gauge the depth of water on the reel is to mark the depth to water on the bailer wire with a stainless steel clip. In this manner, less time is spent trying to identify the water level in the well. The QA Manager or Technical Director shall approve use of bailers for purging monitoring wells in advance.

5.3.5 Monitoring Well Sampling Methodologies

5.3.5.1 Sampling Light, Non-Aqueous Phase Liquids (LNAPL)

Collect LNAPL, if present, prior to any purging activities. The sampling device shall generally consist of a dedicated or disposable bailer equipped with a bottom-discharging device. Lower the bailer slowly until contact is made with the surface of the LNAPL, and to a depth less than that of the immiscible fluid/water interface depth as determined by measurement with the interface probe. Allow the bailer to fill with the LNAPL and retrieve it.

When sampling LNAPLs, never drop bailers into a well, and always remove them from the well in a manner that causes as little agitation of the sample as possible. For example, the bailer should not be removed in a jerky fashion or be allowed to continually bang against the well casing as it is raised. When using bailers to collect LNAPL samples for inorganic analyses, the bailer shall be composed of fluorocarbon resin. Bailers used to collect LNAPL samples for organic analyses shall be constructed of stainless steel. The cable used to raise and lower the bailer shall be composed of an inert material (e.g., stainless steel) or coated with an inert material (e.g., Teflon).

5.3.5.2 Sampling Dense, Non-Aqueous Phase Liquids (DNAPL)

Collect DNAPL prior to any purging activities. The best method for collecting DNAPL is to use a double-check valve, stainless steel bailer, or a Kemmerer (discrete interval) sampler. The sample shall be collected by slow, controlled lowering of the bailer to the bottom of the well, activation of the closing device, and retrieval.

5.3.5.3 Groundwater Sampling Methodology

The well shall be sampled when groundwater within it is representative of aquifer conditions and after it has recovered sufficiently to provide enough volume for the groundwater sampling parameters. A period of no more than 2 hours shall elapse between purging and sampling to prevent groundwater interaction with the casing and atmosphere. This may not be possible with a slowly recharging well. Measure and record the water level prior to sampling to demonstrate the degree of recovery of the well. Sampling equipment (e.g., especially bailers) shall never be dropped into the well, as this could cause aeration of the water upon impact. Additionally, the sampling methodology utilized shall allow for the collection of a groundwater sample in as undisturbed a condition as possible, minimizing the potential for volatilization or aeration. This includes minimizing agitation and aeration during transfer to sample containers.

Sampling equipment shall be constructed of inert material. Equipment with neoprene fittings, polyvinyl chloride bailers, tygon tubing, silicon rubber bladders, neoprene impellers, polyethylene, and viton is not acceptable. If bailers are used, an inert cable/chain (e.g., fluorocarbon resin-coated wire or single strand stainless steel wire) shall be used to raise and lower the bailer. Generally, bladder and submersible pumps are acceptable sampling devices for all analytical parameters. Dedicated equipment is highly recommended for all sampling programs. The following text describes sampling methods utilizing submersible pumps, bladder pumps, and bailers.

Submersible Pumps: When operated under low-flow rate conditions (100 to 300 milliliters [mL]/minute or less), submersible pumps are as effective as bladder pumps in acquiring samples for volatile organic analysis as well as other analytes. The submersible pump must be specifically designed for groundwater sampling (i.e., pump composed of stainless steel and Teflon, sample discharge lines composed of Teflon) and must have a controller mechanism allowing the required low flow rate. Adjust the pump rate so that flow is continuous and does not pulsate to avoid aeration and agitation within the sample discharge lines. Run the pump for several minutes at the low flow rate used for sampling to ensure that the groundwater in the lines was obtained at the low flow rate. Higher pumping rates than 100 to 300 mL/minute may be used when collecting samples to be analyzed for non-volatile constituents, if significant drawdown does not occur.

Bladder Pumps: A gas-operated Teflon or stainless steel bladder pump with adjustable flow control and equipped with Teflon-lined tubing can be effectively utilized to collect a groundwater sample and is considered to be the best overall device for sampling inorganic and organic constituents. Operate positive gas displacement bladder pumps in a continuous manner so that they minimize discharge pulsation that can aerate samples in the return tube or upon discharge. If a bladder pump is utilized for the well purging process, the same bladder pump can also be utilized for sample collection after purging is complete.

Most models of bladder pumps can be operated with a battery powered compressor and control box. The compressor can be powered with either a rechargeable battery pack (provided with the compressor), by running directly off of a vehicle battery (via alligator clips), or by plugging into the vehicle’s direct current connector (cigarette lighter receptacle). When using a vehicle to power a compressor, several precautions should be taken. First, position the vehicle downwind of the well. Second, ensure the purge water exiting the well is collected into a drum or bucket. Finally, connect the compression hose from the well cap to the control box. Do not connect the compression hose from the compressor to the control box until after the engine has been started.

When all precautions are completed and the engine has been started, connect the compression hose to the control box. Slowly adjust the control knobs so as to discharge water at a flow rate (purge rate) that minimizes drawdown in the well, usually around 100 to 300 mL/minute. The compressor should not be set as to discharge the water as hard as possible. The optimal setting is one that produces the required purge rate per minute (not per purge cycle) while maintaining a minimal drawdown.

Prior to sampling volatiles constituents, turn off the vehicle engine, and obtain a flow rate of 100 mL/minute so as not to cause fluctuation in pH, pH-sensitive analytes, the loss of volatile constituents, or draw down of the groundwater table. If necessary (when sampling wells that require a large sample volume) the vehicle engine may be turned back on after sampling volatile constituents. Higher flow rates (100 to 300 mL/minute) can be used once the samples for the analysis of volatile components have been collected, but should not allow for increased draw down in the well. At no time shall the sample flow rate exceed the flow rate used while purging. Preserve the natural conditions of the groundwater, as defined by pH, DO, specific conductivity, and reduction/oxidation (redox).

For those samples requiring filtration, it is recommended to use in-line high capacity filters after all nonfiltered samples have been collected.

Bailers: A single- or double-check valve Teflon or stainless steel bailer equipped with a bottom discharging device can be utilized to collect groundwater samples. Bailers have a number of disadvantages, however, including a tendency to alter the chemistry of groundwater samples due to degassing, volatilization, and aeration; the possibility of creating high groundwater entrance velocities; differences in operator techniques resulting in variable samples; and difficulty in determining where in the water column the sample was collected. Therefore, use bailers for groundwater sampling only when other types of sampling devices cannot be utilized for technical or logistical reasons. The QA Manager or Technical Director must approve the use of bailers for groundwater sampling in advance.

Thoroughly decontaminate the bailer before being lowering it into the well if it is not a disposable bailer sealed in plastic. Collect two to three rinse samples and discharge them prior to acquisition of the actual sample. Each time the bailer is lowered to the water table, lower it in such a way as to minimize disturbance and aeration of the water column within the well.

The preferred alternative when using bailers for sampling is to use disposable Teflon bailers equipped with bottom-discharging devices. Use of disposable bailers reduces decontamination time and limits the potential for cross-contamination.

Passive Sampling: Passive samplers include passive diffusion bags, HydraSleeve, Snap Sampler, Gore Sorbers, and rigid porous polyethylene samplers. Passive samplers generate minimal waste and purge water, if any. Passive samplers depend on ambient equilibrium with formation water. These are relatively inexpensive, simple to deploy and work well for low-yield wells. However, passive samplers have volume and or analyte limitations and may require consideration of contaminant stratification. Passive samplers should be handled in accordance with the manufacturer's instructions, Army guidance (USACE 2002), or ITRC guidance (ITRC 2007).

5.3.6 Sample Handling and Preservation

Many of the chemical constituents and physiochemical parameters to be measured or evaluated during groundwater monitoring programs are chemically unstable; therefore, preserve samples. The EPA document entitled, *Test Methods for Evaluating Solid Waste – Physical/Chemical Methods, SW-846* (EPA 2007), includes a discussion of appropriate sample preservation procedures. In addition, SW-846 specifies the sample containers to use for each constituent or common set of parameters. In general, check with specific laboratory requirements prior to obtaining field samples. In many cases, the laboratory will supply the necessary sample bottles and required preservatives. In some cases, the field team may add preservatives in the field. Sample containers should be labeled in accordance with Procedure III-E, *Record Keeping, Sample Labeling, and Chain of Custody*.

Improper sample handling may alter the analytical results of the sample. Therefore, transfer samples in the field from the sampling equipment directly into the container that has been prepared specifically for that analysis or set of compatible parameters as described in the CTO-specific work plan. It is not an acceptable practice for samples to be composited in a common container in the field and then split in the laboratory, or poured first into a wide mouth container and then transferred into smaller containers.

Collect groundwater samples and place them in their proper containers in the order of decreasing volatility and increasing stability. A preferred collection order for some common groundwater parameters is:

1. VOCs and total organic halogens (TOX)
2. Dissolved gases, total organic carbon (TOC), total fuel hydrocarbons
3. Semivolatile organics, pesticides
4. Total metals, general minerals (unfiltered)
5. Dissolved metals, general minerals (filtered)
6. Phenols
7. Cyanide
8. Sulfate and chloride
9. Turbidity
10. Nitrate and ammonia
11. Radionuclides

When sampling for VOCs, collect water samples in vials or containers specifically designed to prevent loss of VOCs from the sample. An analytical laboratory shall provide these vials, preferably by the laboratory that will perform the analysis. Collect groundwater from the sampling device in vials by allowing the groundwater to slowly flow along the sides of the vial. Sampling equipment shall not touch the interior of the vial. Fill the vial above the top of the vial to form a positive meniscus with no overflow. No headspace shall be present in the sample container once the container has been capped. This can be checked by inverting the bottle once the sample is collected and tapping the side of the vial to dislodge air bubbles. Sometimes it is not possible to collect a sample without air bubbles, particularly water that is aerated. In these cases, the investigator shall note the problem to account for possible error. Cooling samples may also produce headspace, but this will typically disappear once the sample is warmed prior to analysis. In addition, if the samples are shipped by air, air bubbles form most of the time. Field logs and laboratory analysis reports shall note any headspace in the sample container(s) at the time of receipt by the laboratory, as well as at the time the sample was first transferred to the sample container at the wellhead.

5.3.6.1 Special Handling Considerations

Samples requiring analysis for organics shall not be filtered. Samples shall not be transferred from one container to another because this could cause aeration or a loss of organic material onto the walls of the container. TOX and TOC samples shall be handled and analyzed in the same manner as VOC samples.

Obtain groundwater samples to be analyzed for metals sequentially. One sample shall be obtained directly from the pump and be unfiltered. The second sample shall be filtered through a 0.45-micron membrane in-line filter. Both filtered and unfiltered samples shall be transferred to a container, preserved with nitric acid to a pH less than 2, and analyzed for dissolved metals. Remember to include a filter blank for each lot of filters used and always record the lot number of the filters. In addition, allow at least 500 mL of effluent to flow through the filter prior to sampling. Any difference in concentration between the total and dissolved fractions may be attributed to the original metallic ion content of the particles and adsorption of ions onto the particles.

5.3.6.2 FIELD SAMPLING PRESERVATION

Preserve samples immediately upon collection. Ideally, sampling containers will be pre-preserved with a known concentration and volume of preservative. For example, metals require storage in aqueous media at pH of 2 or less. Typically, 0.5 mL of 1:1 nitric acid added to 500 mL of groundwater will produce a pH less than 2. Certain matrices that have alkaline pH (greater than 7) may require more preservative than is typically required. An early assessment of preservation techniques, such as the use of pH strips after initial preservation, may therefore be appropriate. The introduction of preservatives will dilute samples, and may require normalization of results. Guidance for the preservation of environmental samples can be found in the EPA *Handbook for Sampling and Sample Preservation of Water and Wastewater* (EPA 1982). Additional guidance can be found in other EPA documents (EPA 1992, 1996).

5.3.6.3 FIELD SAMPLING LOG

A groundwater sampling log (Figure I-C-3-1) shall document the following:

- Identification of well
- Well depth
- Static water level depth and measurement technique
- Presence of immiscible layers and detection method
- Well yield
- Purge volume and pumping rate
- Time that the well was purged
- Collection method for immiscible layers
- Sample identification numbers
- Well evacuation procedure/equipment
- Sample withdrawal procedure/equipment
- Date and time of collection
- Well sampling sequence
- Types of sample containers used and sample identification numbers
- Preservative(s) used
- Parameters requested for analysis

- Field analysis data
- Sample distribution and transporter
- Field observations on sampling event
- Name of collector
- Climatic conditions including air temperature

6. Records

Document information collected during groundwater sampling on the groundwater sampling log form in indelible ink (Figure I-C-3-1). Send copies of this information to the CTO Manager and to the project files.

7. Health and Safety

Field personnel shall perform work in accordance with the current (or as contractually obligated) United States Army Corps of Engineers Safety and Health Requirements Manual EM-385-1-1 (USACE 2008) and site-specific health and safety plan.

8. References

ASTM International (ASTM). 2001. *Standard Guide for Sampling Ground-Water Monitoring Wells*. D4448). Reapproved in 2013). West Conshohocken, PA.

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Interstate Technology and Regulatory Council (ITRC). 2007. *Protocol for Use of Five Passive Samplers to Sample for a Variety of Contaminants in Groundwater*. February.

United States Army Corps of Engineers (USACE). 2002. *Study of Five Discrete Interval-Type Groundwater Sampling Devices*. Cold Regions Research and Engineering Laboratory. Hanover, NH. August.

———. 2008. *Consolidated Safety and Health Requirements Manual*. EM-385-1-1. Includes Changes 1–7. 13 July 2012.

Procedure I-A-6, *Investigation-Derived Waste Management.*

Procedure I-F, *Equipment Decontamination.*

Procedure III-B, *Field QC Samples (Water, Soil).*

Procedure III-E, *Record Keeping, Sample Labeling, and Chain of Custody.*

9. Attachments

None.

Biological Tissue Sample Collection

1. Purpose

This standard operating procedure describes the collection of biological tissue samples to be used by United States (U.S.) Navy Environmental Restoration (ER) Program, Naval Facilities Engineering Command (NAVFAC), Pacific personnel.

2. Scope

This procedure applies to all Navy ER projects performed in the NAVFAC Pacific Area of Responsibility.

This procedure shall serve as management-approved professional guidance for the ER Program and is consistent with protocol in the Uniform Federal Policy-Quality Assurance Project Plan (DoD 2005). As professional guidance for specific activities, this procedure is not intended to obviate the need for professional judgment during unforeseen circumstances. Deviations from this procedure while planning or executing planned activities must be approved and documented by the following prime contractor representatives: the CTO Manager and the Quality Assurance (QA) Manager or Technical Director. A Navy project representative (i.e., Remedial Project Manager or QA Manager) shall also concur with any deviations.

3. Definitions

None.

4. Responsibilities

The prime contractor QA Manager or Technical Director is responsible for ensuring that all biological tissue samples are collected according to this procedure. The CTO Manager is responsible for ensuring that all personnel involved in biological tissue sample collection have the appropriate education, experience, and training to perform their assigned tasks as specified in Chief of Naval Operations Instruction 5090.1, under *Specific Training Requirements* (DON 2014).

The prime contractor QA Manager or Technical Director is responsible for ensuring overall compliance with this procedure.

The Field Manager (FM) is responsible for field oversight to ensure that all biological tissue samples are collected according to this procedure.

Field sampling personnel are responsible for the implementation of this procedure.

5. Procedures

Collect samples as described below. Ship samples according to Procedure III-F, *Sample Handling, Storage, and Shipping*, and in time to meet analytical method holding times. Decontaminate sampling equipment in accordance with Procedure I-F, *Equipment Decontamination*, and the CTO work plan (WP).

Field personnel shall be experienced in field collection techniques, and the Field Manager (FM) and/or the Senior Field Biologist shall supervise all field activities. The Site Manager or FM shall ensure that all collection methods are in accordance with local, state, and federal regulatory requirements and if required, shall obtain the appropriate collecting permits. Prior to selecting species to be collected for tissue samples, the Site Manager or FM shall conduct a document/record review; consult with the appropriate local, state, federal, and private wildlife/forestry/conservation agencies; and conduct a preliminary site survey to identify appropriate species, sampling locations, and times. Field personnel shall be aware of the analytical methods to be conducted, ensuring that the manner in which the organisms are handled does not compromise the analyses and that an adequate amount of tissue is collected.

Collect tissues of selected resident organisms to evaluate contaminant loading only after assessing a site-specific food web. Determine the selection of species on a site-specific basis depending on the following:

- Their relevance to assessment and measurement endpoints
- Their position in the food web
- The exposure pathway under consideration
- The importance of various species to the ecosystem and abundance or availability in the field

Collect selected organisms for tissue analysis to measure the potential bioaccumulation of contaminants of potential ecological concern. Procedures for the collection of animals and plants are described below.

5.1 ANIMALS

The WP will specify the tissue collection requirements. In general, use whole organisms, unless otherwise specified. If animals are collected by hand, wear gloves during handling. If necessary, rinse organisms with analyte-free water to remove dirt. Do not rinse animals, such as rodents, whose body weight measurement will be distorted when they are wet. When appropriate (particularly for terrestrial vertebrates), record the sex, total body weight, reproductive status, weight of particular organs (liver, spleen, and kidneys) and weight of testes. Handle animals according to Procedure III-F, *Sample Handling, Storage, and Shipping*. An appropriate mass, as determined by the laboratory, of each species shall be placed in new food-grade re-sealable bags, weighed, and frozen. Animals will not be allowed to depurate (flush out) their guts before freezing. Use similar methods when collecting the same species at the reference sites.

Consider the organism, site-specific variables, and analytical needs when deciding on a particular collection technique. Select a method on a case-by-case basis, and maintain the flexibility to change methods. Techniques used in the collection of animals can vary considerably, depending on their environment, habitat, defense strategies, and mobility. Because of this, methods for the collection of animals are discussed from a more general perspective. Include additional information, as necessary, in the CTO WP.

5.1.1 Terrestrial Animals

5.1.1.1 VERTEBRATES

Although many terrestrial animals are swift moving or have potentially dangerous defense mechanisms, many reptiles, such as turtles and lizards along with amphibians and very young mammals and birds, may be easily collected by hand. Collecting by hand entails searching the site for the habitat of the desired species, and then carefully searching for organisms.

Other, less accommodating species may be collected by using non-lethal traps (refraining from using lethal traps will avoid potential conflicts with local laws and animal-rights groups, and prevent injury to domestic animals). Carefully follow operating instructions for the specific type of equipment being used. Spring-loaded traps that close a door are preferable for mammals. These types of traps enclose the animal in a safe container where it cannot hurt itself or be attacked from the outside. Pit traps may be used when collecting reptiles, and mist nets may be used for collecting birds. Set the traps suited for the targeted species in the appropriate habitat on the site. Collected organisms can be examined, and if suitable, humanely sacrificed, bagged, and frozen.

5.1.1.2 INVERTEBRATES

Many of the invertebrates can be collected by hand. Although search times may vary, once located, most can be easily picked up by hand and bagged. Searching may entail turning over rocks and woody debris, digging into logs, or other actions, to expose organisms. After collecting, return the environment to as natural a state as possible by replacing the rocks and taking other relevant actions.

Soil-dwelling invertebrates can be collected by digging up soil, then screening it through sieves with progressively smaller mesh sizes. Desired organisms can then be picked out by hand or with forceps, depending on defense capabilities. Flying, biting, or stinging invertebrates, such as some insects, can be collected using nets, varying the size and mesh as appropriate for the particular organism sought. In circumstances where relatively large numbers of non-abundant organisms are needed, traps may be most efficient.

5.1.2 Aquatic Animals

5.1.2.1 VERTEBRATES

Fish can be collected with a variety of techniques, depending on factors, such as species, abundance, habitat, and territoriality and environmental conditions. Fish traps and trawls are effective for bottom dwelling or schooling fish and areas free of bottom obstructions. Because this method requires a boat and covers a large area, it is unsuitable for small sites or areas with highly constrained boundaries.

Where allowed, electrofishing can be highly effective, but is non-selective and restricted to shallow, clear, fresh waters. All fish in the immediate area are affected, and stunned fish are often lodged in hiding places or simply not seen because of poor visibility. Carefully follow the operating procedures for the specific electroshock unit being used.

In many cases, diving for fish by divers is most effective because it can be very selective and site specific. Divers can set up wall nets, and drive the desired fish into them. When a fish hits the net, it can be scooped into hand nets and placed into a holding container. Another effective method is the use of spears, although care must be taken when collecting small species. Spear fishing does not allow for the collection of live specimens, and those that are collected have varying amounts of damage from being speared.

5.1.2.2 INVERTEBRATES

Sessile invertebrates can be collected by hand using simple devices, such as a hammer/chisel or a pry bar/knife. Make a search for the organism in the appropriate habitat within the site. Depending on the site and organism, suitable habitat may occur in areas accessible from shore, such as rocks or pilings, or in the intertidal region during low tides. Often, organisms may occur in areas that require collection by divers. In either case, attached organisms are collected by removing them from the substrate with a hammer/chisel, prybar/knife, or other suitable device.

Other methods include trawls, dredges, and sediment grab samplers. These methods are less reliable because the area being sampled cannot be seen. Trawls and dredges are dragged along the bottom for a predetermined time, then hauled to the surface and examined for contents. Desired organisms are selected and the rest are discarded. Because these methods require a boat and cover a large area, they are unsuitable for small sites or areas with highly constrained boundaries. Sediment grab samplers may be used since they are not dragged, can be used without a boat, and can be used in small, constrained sites.

Divers may collect mobile invertebrates by hand, or in the case of small, swift organisms, such as some crustaceans, with nets. Spears may be used to collect certain hard-to-catch organisms, such as octopi.

5.2 PLANTS

The FM and/or the Senior Field Biologist must carefully select plant sampling locations to account for variation in soil characteristics at different areas of the site. Collect stems, shoots, and/or leaves, depending on the following:

- The exposure pathway under evaluation
- The measurement endpoint selected for these pathways
- The particular plant species

For example, there may be a need to differentiate between contaminants of potential concern accumulated in roots versus those accumulated in leaves versus those deposited on leaves as aerosols or dust, depending on which receptors are eating a given part of a plant.

Collect whole plants or plant parts by hand, or by using a variety of tools, such as a shovel, a knife, or pruning shears. Leaves typically can be pulled from the plant by hand, while more woody parts will probably require a knife or shears for removal. Roots of small plants can be exposed by uprooting the plant by hand, while the roots of larger plants will usually need to be exposed with a shovel. The specific technique and tools utilized will be project-specific and depend on the type of plant and plant part being collected.

Collect an appropriate mass, as determined by the laboratory, of each species by hand and rinse it with analyte-free water to remove dirt unless it is important to assess an aerial deposition pathway. The samples shall be placed in new, food-grade re-sealable bags; weighed; frozen; and sent to the laboratory for chemical analysis. Handle samples according to Procedure III-F, *Sample Handling, Storage, and Shipping*. Use the same methods when collecting similar species at the reference sites.

6. Records

Maintain sample collection records in field logbooks and on chain-of-custody/analytical request forms in accordance with Procedures III-D, *Logbooks*; and III-E, *Record Keeping, Sample Labeling, and Chain-of-Custody*, respectively.

7. Health and Safety

Field Personnel shall perform work in accordance with the current (or as contractually obligated) United States Army Corps of Engineers Safety and Health Requirements Manual EM-385-1-1 (USACE 2008) and site-specific health and safety plan.

8. References

Department of Defense, United States (DoD). 2005. *Uniform Federal Policy for Quality Assurance Project Plans, Part 1: UFP-QAPP Manual*. Final Version 1. DoD: DTIC ADA 427785, EPA-505-B-04-900A. In conjunction with the U. S. Environmental Protection Agency and the Department of Energy. Washington: Intergovernmental Data Quality Task Force. March. On-line updates available at: http://www.epa.gov/fedfac/pdf/ufp_qapp_v1_0305.pdf.

Department of the Navy (DON). 2014. *Environmental Readiness Program Manual*. OPNAV Instruction 5090.1D. 10 January.

United States Army Corps of Engineers (USACE). 2008. *Consolidated Safety and Health Requirements Manual*. EM-385-1-1. Includes Changes 1–7. 13 July 2012.

Procedure I-F, *Equipment Decontamination.*

Procedure III-D, *Logbooks.*

Procedure III-E, *Record Keeping, Sample Labeling, and Chain-of-Custody.*

Procedure III-F, *Sample Handling, Storage, and Shipping.*

9. Attachments

None.

Soil and Rock Classification

1. Purpose

This section sets forth standard operating procedures for soil and rock classification for use by United States Navy Environmental Restoration (ER) Program, Naval Facilities Engineering Command (NAVFAC), Pacific personnel.

2. Scope

This procedure applies to all Navy ER projects performed in the NAVFAC Pacific Area of Responsibility.

This procedure shall serve as management-approved professional guidance for the ER Program and is consistent with protocol in the Uniform Federal Policy-Quality Assurance Project Plan (DoD 2005). As professional guidance for specific activities, this procedure is not intended to obviate the need for professional judgment during unforeseen circumstances. Deviations from this procedure while planning or executing planned activities must be approved and documented by the following prime contractor representatives: the CTO Manager and the Quality Assurance (QA) Manager or Technical Director. A Navy project representative (i.e., Remedial Project Manager or QA Manager) shall also concur with any deviations.

3. Definitions

None.

4. Responsibilities

The prime contractor CTO Manager is responsible for ensuring that these standard soil and rock classification procedures are followed during projects conducted under the ER Program and that a qualified individual conducts or supervises the projects. A qualified individual is defined as a person with a degree in geology, hydrogeology, soil science, or geotechnical/civil engineering with at least 1 year of experience classifying soil. Supervision is defined as onsite and continuous monitoring of the individual conducting soil classification. The CTO Manager is responsible for ensuring that all personnel involved in soil and rock classification have the appropriate education, experience, and training to perform their assigned tasks as specified in Chief of Naval Operations Instruction 5090.1, under *Specific Training Requirements* (DON 2014).

The CTO Manager is responsible for reviewing copies of the field boring log forms on a monthly basis at a minimum. However, it is recommended that initially boring logs are reviewed daily to ensure accuracy.

The prime contractor QA Manager or Technical Director is responsible for ensuring overall compliance with this procedure.

The Field Manager is responsible for field oversight to ensure that all project field staff follow these procedures.

Field personnel are responsible for the implementation of this procedure.

5. Procedures

5.1 Soil Classification

The basic purpose of the classification of soil is to thoroughly describe the physical characteristics of the sample and to classify it according to an appropriate soil classification system for the NAVFAC Pacific ER Program. The Unified Soil Classification System (USCS) was developed so that soils could be described on a common basis by different investigators and serve as a "shorthand" description of soil. A classification of a soil in accordance with the USCS includes not only a group symbol and name, but also a complete word description.

Describing soil on a common basis is essential so that soil described by different site qualified personnel is comparable. Site individuals describing soil as part of site activities *must* use the classification system described herein to provide the most useful geologic database for all present and future subsurface investigations and remedial activities at NAVFAC Pacific ER Program sites.

The site geologist or other qualified individual shall describe the soil and record the description in a boring log or logbook. The essential items in any written soil description are as follows:

- Classification group name (e.g., silty sand)
- Color, moisture, and odor
- Range of particle sizes
- Approximate percentage of boulders, cobbles, gravel, sand, and fines
- Plasticity characteristics of the fines
- In-place conditions, such as density/consistency, compaction, amount of induration/cementation or weathering, retention of the parent rock fabric, and structure
- USCS classification symbol

The USCS serves as “shorthand” for classifying soil into 15 basic groups:

GW[1] Well graded (poorly sorted) gravel (>50 percent gravel, <5percent fines)

GP[1] Poorly graded (well sorted) gravel (>50percent gravel, <5percent fines)

GM[1] Silty gravel (>50 percent gravel, >15 percent silt)

GC[1] Clayey gravel (>50 percent gravel, >15 percent clay)

SW[1] Well graded (poorly sorted) sand (>50 percent sand, <5 percent fines)

SP[1] Poorly graded (well sorted) sand (>50 percent sand, <5 percent fines)

SM[1] Silty sand (>50 percent sand, >15 percent silt)

SC[1] Clayey sand (>50 percent sand, >15 percent clay)

[1] If percentage of fine is 5 percent to 15 percent, a dual identification shall be given (e.g., a soil with more than 50 percent poorly sorted gravel and 10 percent clay is designated GW-GC.

ML[2] Inorganic, low plasticity silt (slow to rapid dilatancy, low toughness, and plasticity)

CL[2] Inorganic, low plasticity (lean) clay (no or slow dilatancy, medium toughness and plasticity)

MH[2] Inorganic elastic silt (no to slow dilatancy, low to medium toughness and plasticity)

CH[2] Inorganic, high plasticity (fat) clay (no dilatancy, high toughness, and plasticity)

OL Organic low plasticity silt or organic silty clay

OH Organic high plasticity clay or silt

PT Peat and other highly organic soil

Figure I-E-1 defines the terminology of the USCS. Flow charts presented in Figure I-E-2 and Figure I-E-3 indicate the process for describing soil. The particle size distribution and the plasticity of the fines are the two properties of soil used for classification. In some cases, it may be appropriate to use a borderline classification (e.g., SC/CL) if the soil has been identified as having properties that do not distinctly place the soil into one group.

5.1.1 Estimation of Particle Size Distribution

One of the most important factors in classifying a soil is the estimated percentage of soil constituents in each particle size range. Being proficient in estimating this factor requires extensive practice and frequent checking. The steps involved in determining particle size distribution are listed below:

1. Select a representative sample (approximately 1/2 of a 6-inch long by 2.5-inch diameter sample liner).
2. Remove all particles larger than 3 inches from the sample. Estimate and record the percent by volume of these particles. Only the fraction of the sample smaller than 3 inches is classified.
3. Estimate and record the percentage of dry mass of gravel (less than 3 inches and greater than 1/4 inch).
4. Considering the rest of the sample, estimate, and record the percentage of dry mass of sand particles (about the smallest particle visible to the unaided eye).
5. Estimate and record the percentage of dry mass of fines in the sample (do not attempt to separate silts from clays).
6. Estimate percentages to the nearest 5 percent. If one of the components is present in a quantity considered less than 5 percent, indicate its presence by the term “trace.”
7. The percentages of gravel, sand, and fines must add up to 100 percent. “Trace” is not included in the 100 percent total.

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[2] If the soil is estimated to have 15 percent to 25 percent sand or gravel, or both, the words “with sand” or “with gravel” (whichever predominates) shall be added to the group name (e.g., clay with sand, CL; or silt with gravel, ML). If the soil is estimated to have 30 percent or more sand or gravel, or both, the words “sandy” or “gravely” (whichever predominates) shall be added to the group name (e.g., sandy clay, CL). If the percentage of sand is equal to the percent gravel, use “sandy.”

5.1.2 Soil Dilatancy, Toughness, and Plasticity

5.1.2.1 Dilatancy

To evaluate dilatancy, follow these procedures:

1. From the specimen, select enough material to mold into a ball about 1/2 inch (12 millimeters [mm]) in diameter. Mold the material, adding water if necessary, until it has a soft, but not sticky, consistency.
2. Smooth the soil ball in the palm of one hand with the blade of a knife or small spatula. Shake horizontally, striking the side of the hand vigorously against the other hand several times. Note the reaction of water appearing on the surface of the soil. Squeeze the sample by closing the hand or pinching the soil between the fingers, and note the reaction as none, slow, or rapid in accordance with the criteria in Table I-E-1. The reaction is the speed with which water appears while shaking, and disappears while squeezing.

Table I-E-1: Criteria for Describing Dilatancy

Description	Criteria
None	No visible change in specimen.
Slow	Water appears slowly on the surface of the specimen during shaking and does not disappear or disappears slowly upon squeezing.
Rapid	Water appears quickly on the surface of the specimen during shaking and disappears quickly upon squeezing.

5.1.2.2 Toughness

Following the completion of the dilatancy test, shape the test specimen into an elongated pat and roll it by hand on a smooth surface or between the palms into a thread about 1/8 inch (3 mm) in diameter. (If the sample is too wet to roll easily, spread it into a thin layer and allow it to lose some water by evaporation.) Fold the sample threads and re-roll repeatedly until the thread crumbles at a diameter of about 1/8 inch. The thread will crumble at a diameter of 1/8 inch when the soil is near the plastic limit. Note the pressure required to roll the thread near the plastic limit. Also, note the strength of the thread. After the thread crumbles, lump the pieces together and knead it until the lump crumbles. Note the toughness of the material during kneading. Describe the toughness of the thread and lump as low, medium, or high in accordance with the criteria in Table I-E-2.

Table I-E-2: Criteria for Describing Toughness

Description	Criteria
Low	Only slight pressure is required to roll the thread near the plastic limit. The thread and the lump are weak and soft.
Medium	Medium pressure is required to roll the thread near the plastic limit. The thread and the lump have medium stiffness.
High	Considerable pressure is required to roll the thread near the plastic limit. The thread and the lump have very high stiffness.

DEFINITION OF TERMS

MAJOR DIVISIONS			SYMBOLS	TYPICAL DESCRIPTIONS
COARSE GRAINED SOILS More Than Half of Material is Larger Than No. 200 Sieve Size	**GRAVELS** More Than Half of Coarse Fraction is Smaller Than No. 4 Sieve	**CLEAN GRAVELS** (Less than 6% Fines)	**GW**	Well graded gravels, gravel-sand mixtures, little or no fines
			GP	Poorly graded gravels, gravel-sand mixtures, little or no fines
		GRAVELS With Fines	**GM**	Silty gravels, gravel-sand-silt mixtures, non-plastic fines
			GC	Clayey gravels, gravel-sand-clay mixtures, plastic fines
	SANDS More Than Half of Coarse Fraction is Smaller Than No. 4 Sieve	**CLEAN SANDS** (Less than 6% Fines)	**SW**	Well graded sands, gravelly sands, little or no fines
			SP	Poorly graded sands, gravelly sands, little or no fines
		SANDS With Fines	**SM**	Silty sands, sand-silt mixtures, non-plastic fines
			SC	Clayey sands, sand-clay mixtures, plastic fines
FINE GRAINED SOILS More Than Half of Material is Smaller Than No. 200 Sieve Size	**SILTS AND CLAYS** Liquid Limit is Less Than 50%		**ML**	Inorganic silts, rock flour, fine sandy silts or clays, and clayey silts with non- or slightly-plastic fines
			CL	Inorganic clays of low to medium plasticity, gravelly clays, silty clays, sandy clays, lean clays
			OL	Organic silts and organic silty clays of low plasticity
	SILTS AND CLAYS Liquid Limit is Greater Than 50%		**MH**	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts, clayey silt
			CH	inorganic clays of high plasticity, fat clays
			OH	Organic clays of medium to high plasticity, organic silts
HIGHLY ORGANIC SOILS			**PT**	Peat and other highly organic soils

GRAIN SIZES

SILTS AND CLAYS	SAND			GRAVEL		COBBLES	BOULDERS
	FINE	MEDIUM	COARSE	FINE	COARSE		
200	40	10	4	3/4"	3"	12"	
	U.S. STANDARD SERIES SIEVE			CLEAR SQUARE SIEVE OPENINGS			

Figure I-E-1: Unclassified Soil Classification System (USCS)

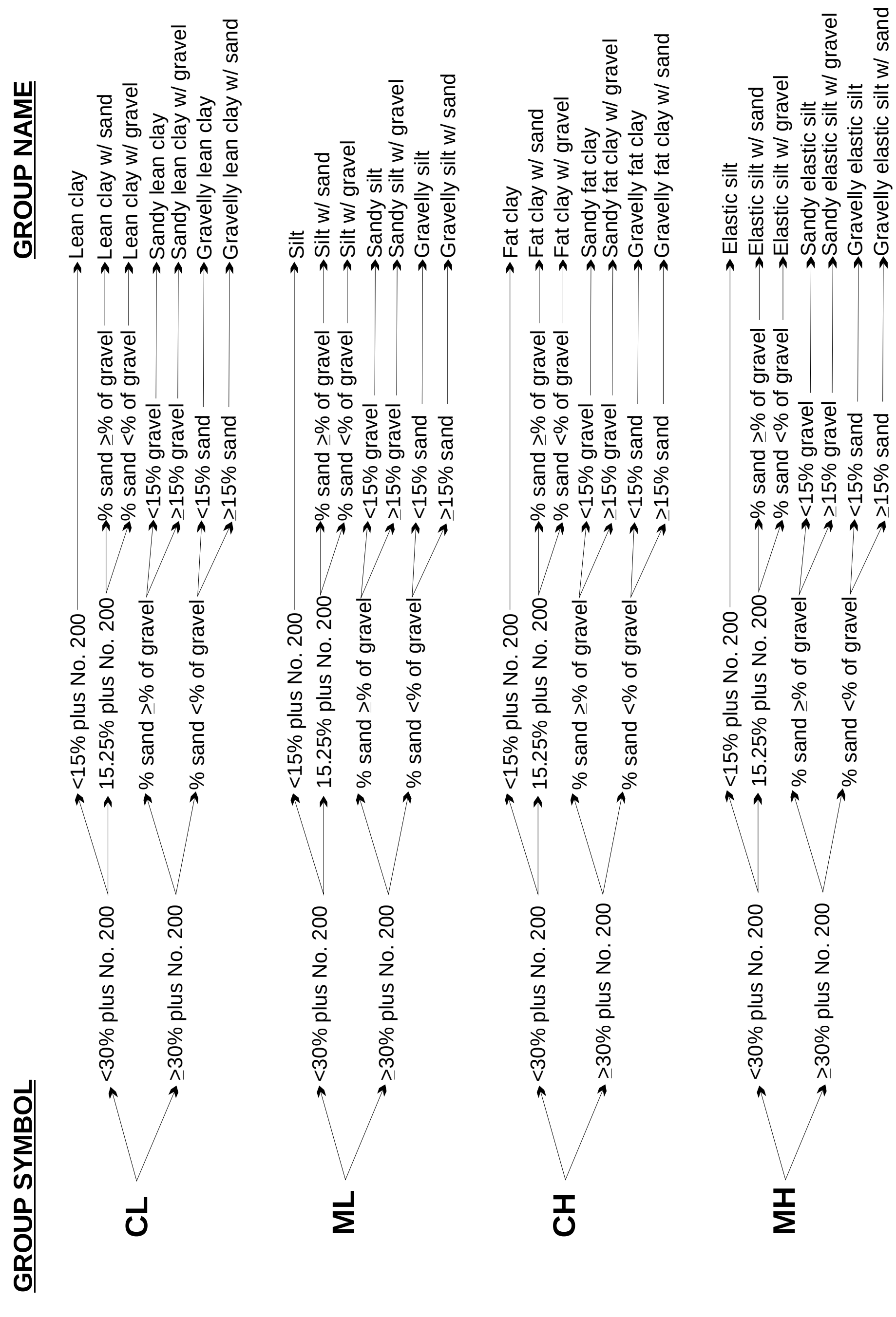

Figure I-E-2: Flow Chart for Fine Grain Soil Classification

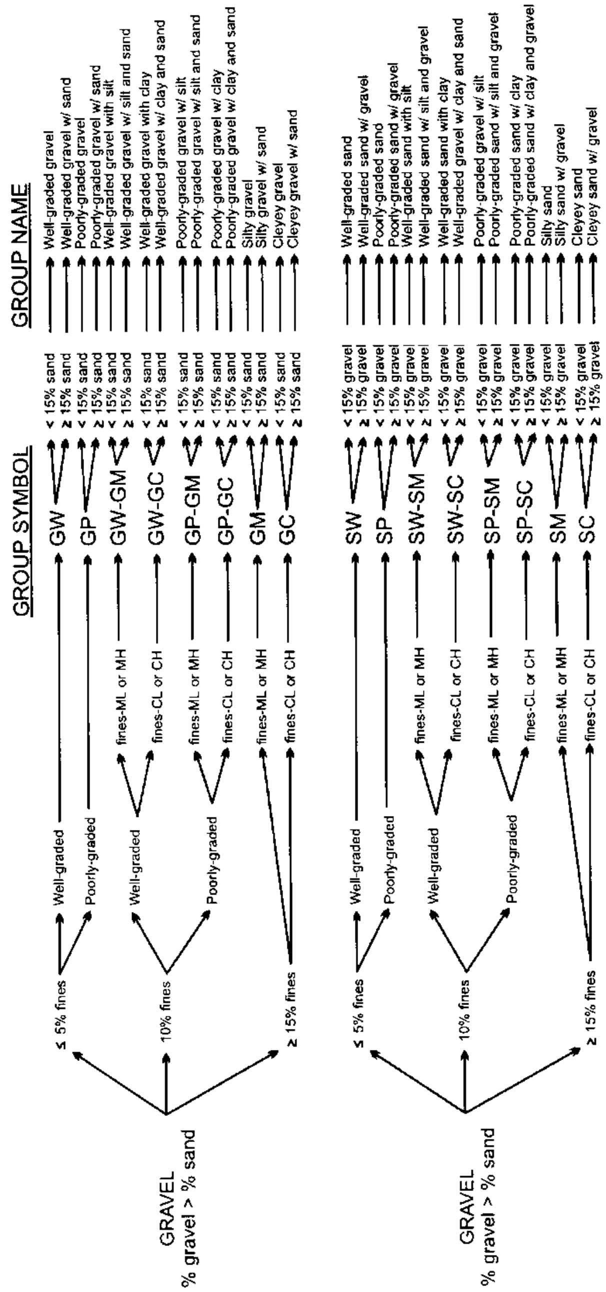

Figure I-E-3: Flow Chart for Soil with Gravel

5.1.2.3 PLASTICITY

The plasticity of a soil is defined by the ability of the soil to deform without cracking, the range of moisture content over which the soil remains in a plastic state, and the degree of cohesiveness at the plastic limit. The plasticity characteristic of clays and other cohesive materials is defined by the liquid limit and plastic limit. The liquid limit is defined as the soil moisture content at which soil passes from the liquid to the plastic state as moisture is removed. The test for the liquid limit is a laboratory, not a field, analysis.

The plastic limit is the soil moisture content at which a soil passes from the plastic to the semi-solid state as moisture is removed. The plastic limit test can be performed in the field and is indicated by the ability to roll a 1/8-inch (0.125-inch) diameter thread of fines, the time required to roll the thread, and the number of times the thread can be re-rolled when approaching the plastic limit.

The plasticity tests are not based on natural soil moisture content, but on soil that has been thoroughly mixed with water. If a soil sample is too dry in the field, add water prior to performing classification. If a soil sample is too sticky, spread the sample thin and allow it to lose some soil moisture.

Table I-E-3 presents the criteria for describing plasticity in the field using the rolled thread method.

Table I-E-3: Criteria for Describing Plasticity

Description	Criteria
Non-Plastic	A 1/8-inch thread cannot be rolled.
Low Plasticity	The thread can barely be rolled.
Medium Plasticity	The thread is easy to roll and not much time is required to reach the plastic limit.
High Plasticity	It takes considerable time rolling the thread to reach the plastic limit.

5.1.3 Angularity

The following criteria describe the angularity of the coarse sand and gravel particles:

- *Rounded* particles have smoothly-curved sides and no edges.
- *Subrounded* particles have nearly plane sides, but have well-rounded corners and edges.
- *Subangular* particles are similar to angular, but have somewhat rounded or smooth edgesand.
- *Angular* particles have sharp edges and relatively plane sides with unpolished surfaces. Freshly broken or crushed rock would be described as angular.

5.1.4 Color, Moisture, and Odor

The natural moisture content of soil is very important. Table I-E-4 shows the terms for describing the moisture condition and the criteria for each.

Table I-E-4: Soil Moisture Content Qualifiers

Qualifier	Criteria
Dry	Absence of moisture, dry to the touch
Moist	Damp but no visible water
Wet	Visible water, usually soil is below water table

Color is described by hue and chroma using the Munsell Soil Color Chart (Munsell 2000). For uniformity, all site geologists shall use this chart for soil classification. Doing so will facilitate correlation of geologic units between boreholes logged by different geologists The Munsell Color Chart is a small booklet of numbered color chips with names like “5YR 5/6, yellowish-red.” Note mottling or banding of colors. It is particularly important to note and describe staining because it may indicate contamination.

In general, wear a respirator if strong organic odors are present. If odors are noted, describe them if they are unusual or suspected to result from contamination. An organic odor may have the distinctive smell of decaying vegetation. Unusual odors may be related to hydrocarbons, solvents, or other chemicals in the subsurface. An organic vapor analyzer may be used to detect the presence of volatile organic contaminants.

5.1.5 In-Place Conditions

Describe the conditions of undisturbed soil samples in terms of their density/consistency (i.e., compactness), cementation, and structure utilizing the following guidelines:

5.1.5.1 Density/Consistency

Density and consistency describe a physical property that reflects the relative resistance of a soil to penetration. The term “density” is commonly applied to coarse to medium-grained sediments (i.e., gravels, sands), whereas the term “consistency” is normally applied to fine-grained sediments (i.e., silts, clays). There are separate standards of measure for both density and consistency that are used to describe the properties of a soil.

The density or consistency of a soil is determined by observing the number of blows required to drive a 1 3/8-inch (35 mm) diameter split barrel sampler 18 inches using a drive hammer weighing 140 pounds (63.5 kilograms) dropped over a distance of 30 inches (0.76 meters). Record the number of blows required to penetrate each 6 inches of soil in the field boring log during sampling. The first 6 inches of penetration is considered to be a seating drive; therefore, the blow count associated with this seating drive is recorded, but not used in determining the soil density/consistency. The sum of the number of blows required for the second and third 6 inches of penetration is termed the “standard penetration resistance,” or the “N-value.” The observed number of blow counts must be corrected by an appropriate factor if a different type of sampling device (e.g., Modified California Sampler with liners) is used. For a 2 3/8-inch inner diameter Modified California Sampler equipped with brass or stainless steel liners and penetrating a cohesionless soil (sand/gravel), the N-value from the Modified California Sampler must be divided by 1.43 to provide data that can be compared to the 1 3/8-inch diameter sampler data.

For a cohesive soil (silt/clay), the N-value for the Modified California Sampler should be divided by a factor of 1.13 for comparison with 1 3/8-inch diameter sampler data.

Drive the sampler and record blow counts for each 6-inch increment of penetration until one of the following occurs:

- A total of 50 blows have been applied during any one of the three 6-inch increments; a 50-blow count occurrence shall be termed “refusal” and noted as such on the boring log.
- A total of 150 blows have been applied.
- The sampler is advanced the complete 18 inches without the limiting blow counts occurring, as described above.

If the sampler is driven less than 18 inches, record the number of blows per partial increment on the boring log. If refusal occurs during the first 6 inches of penetration, the number of blows will represent the N-value for this sampling interval. Table I-E-5 and Table I-E-6 present representative descriptions of soil density/consistency vs. N-values.

Table I-E-5: Measuring Soil Density with a California Sample – Relative Density (Sands, Gravels)

	Field Criteria (N-Value)	
Description	1 3/8 in. ID Sampler	2 in. ID Sampler using 1.43 factor
Very Loose	0–4	0–6
Loose	4–10	6–14
Medium Dense	10–30	14–43
Dense	30–50	43–71
Very Dense	>50	>71

Table I-E-6: Measuring Soil Density with a California Sampler – Fine Grained Cohesive Soil

	Field Criteria (N-Value)	
Description	1 3/8 in. ID Sampler	2 in. ID Sampler using 1.13 factor
Very Soft	0–2	0–2
Soft	2–4	2–4
Medium Stiff	4–8	4–9
Stiff	8–16	9–18
Very Stiff	16–32	18–36
Hard	>32	>36

For undisturbed fine-grained soil samples, it is also possible to measure consistency with a hand-held penetrometer. The measurement is made by placing the tip of the penetrometer against the surface of the soil contained within the sampling liner or shelby tube, pushing the penetrometer into the soil a distance specified by the penetrometer manufacturer, and recording the pressure resistance reading in pounds per square foot. The values are as follows (Table I-E-7):

Table I-E-7: Measuring Soil Consistency with a Hand-Held Penetrometer

Description	Pocket Penetrometer Reading (psf)
Very Soft	0–250
Soft	250–500
Medium Stiff	500–1,000
Stiff	1,000–2,000
Very Stiff	2,000–4,000
Hard	>4,000

Consistency can also be estimated using thumb pressure using Table I-E-8.

Table I-E-8: Measuring Soil Consistency Using Thumb Pressure

Description	Criteria
Very Soft	Thumb will penetrate soil more than 1 inch (25 mm)
Soft	Thumb will penetrate soil about 1 inch (25 mm)
Firm	Thumb will penetrate soil about 1/4 inch (6 mm)
Hard	Thumb will not indent soil but readily indented with thumbnail
Very Hard	Thumbnail will not indent soil

5.1.5.2 CEMENTATION

Cementation is used to describe the friability of a soil. Cements are chemical precipitates that provide important information as to conditions that prevailed at the time of deposition, or conversely, diagenetic effects that occurred following deposition. Seven types of chemical cements are recognized by Folk (1980). They are as follows:

1. Quartz – siliceous
2. Chert – chert-cemented or chalcedonic
3. Opal – opaline
4. Carbonate – calcitic, dolomitic, sideritic (if in doubt, calcareous should be used)
5. Iron oxides – hematitic, limonitic (if in doubt, ferruginous should be used)
6. Clay minerals – if the clay minerals are detrital or have formed by recrystallization of a previous clay matrix, they are not considered to be a cement. Only if they are chemical precipitates, filling previous pore space (usually in the form of accordion-like stacks or fringing radial crusts) should they be included as “kaolin-cemented,” “chlorite-cemented,” etc.
7. Miscellaneous minerals – pyritic, collophane-cemented, glauconite-cemented, gypsiferous, anhydrite-cemented, baritic, feldspar-cemented, etc.

The degree of cementation of a soil is determined qualitatively by utilizing finger pressure on the soil in one of the sample liners to disrupt the gross soil fabric. The three cementation descriptors are as follows:

1. Weak – friable; crumbles or breaks with handling or slight finger pressure
2. Moderate – friable; crumbles or breaks with considerable finger pressure
3. Strong – not friable; will not crumble or break with finger pressure

5.1.5.3 STRUCTURE

This variable is used to qualitatively describe physical characteristics of soil that are important to incorporate into hydrogeological and/or geotechnical descriptions of soil at a site. Appropriate soil structure descriptors are as follows:

- *Granular:* Spherically shaped aggregates with faces that do not accommodate adjoining faces
- *Stratified:* Alternating layers of varying material or color with layers at least 6 mm (1/4 inch) thick; note thickness
- *Laminated:* Alternating layers of varying material or color with layers less than 6 mm (1/4 inch) thick; note thickness
- Blocky: Cohesive soil that can be broken down into small angular or subangular lumps that resist further breakdown
- *Lensed:* Inclusion of a small pocket of different soil, such as small lenses of sand, should be described as homogeneous if it is not stratified, laminated, fissured, or blocky. If lenses of different soil are present, the soil being described can be termed homogeneous if the description of the lenses is included
- *Prismatic or Columnar:* Particles arranged about a vertical line, ped is bounded by planar, vertical faces that accommodate adjoining faces; prismatic has a flat top; columnar has a rounded top
- *Platy:* Particles are arranged about a horizontal plane

5.1.5.4 OTHER FEATURES

- *Mottled:* Soil that appears to consist of material of two or more colors in blotchy distribution
- *Fissured:* Breaks along definite planes of fracture with little resistance to fracturing (determined by applying moderate pressure to sample using thumb and index finger)
- *Slickensided:* Fracture planes appear polished or glossy, sometimes striated (parallel grooves or scratches)

5.1.6 Development of Soil Description

Develop standard soil descriptions according to the following examples. There are three principal categories under which all soil can be classified. They are described below.

5.1.6.1 COARSE-GRAINED SOIL

Coarse-grained soil is divided into sands and gravels. A soil is classified as a sand if over 50 percent of the coarse fraction is “sand-sized.” It is classified as a gravel if over 50 percent of the coarse fraction is composed of “gravel-sized” particles.

The written description of a coarse-grained soil shall contain, in order of appearance: Typical name including the second highest percentage constituent as an adjective, if applicable (underlined); grain size of coarse fraction; Munsell color and color number; moisture content; relative density; sorting; angularity; other features, such as stratification (sedimentary structures) and cementation, possible formational name, primary USCS classification, secondary USCS classification (when necessary), and approximate percentages of minor constituents (i.e., sand, gravel, shell fragments, rip-up clasts) in parentheses.

Example: POORLY SORTED SAND WITH SILT, medium- to coarse-grained, light olive gray, 5Y 6/2, saturated, loose, poorly sorted, subrounded clasts, SW/SM (minor silt with approximately 20 percent coarse-grained sand-sized shell fragments, and 80 percent medium-grained quartz sand, and 5 percent to 15 percent ML).

5.1.6.2 *Fine-grained Soil*

Fine-grained soil is further subdivided into clays and silts according to its plasticity. Clays are rather plastic, while silts have little or no plasticity.

The written description of a fine-grained soil should contain, in order of appearance: Typical name including the second highest percentage constituent as an adjective, if applicable (underlined); Munsell color; moisture content; consistency; plasticity; other features, such as stratification, possible formation name, primary USCS classification, secondary USCS classification (when necessary), and the percentage of minor constituents in parentheses.

Example: SANDY LEAN CLAY, dusky red, 2.5 YR 3/2, moist, firm, moderately plastic, thinly laminated, CL (70 percent fines, 30 percent sand, with minor amounts of disarticulated bivalves [about 5 percent]).

5.1.6.3 *Organic Soil*

For highly organic soil, describe the types of organic materials present as well as the type of soil constituents present using the methods described above. Identify the soil as an organic soil, OL/OH, if the soil contains enough organic particles to influence the soil properties. Organic soil usually has a dark brown to black color and may have an organic odor. Often, organic soils will change color, (e.g., from black to brown) when exposed to air. Some organic soils will lighten in color significantly when air-dried. Organic soils normally will not have a high toughness or plasticity. The thread for the toughness test will be spongy.

Example: ORGANIC CLAY, black, 2.5Y, 2.5/1, wet, soft, low plasticity, organic odor, OL (100 percent fines), weak reaction to HCl.

5.2 Rock Classification

The purpose of rock classification is to thoroughly describe the physical and mineralogical characteristics of a specimen and to classify it according to an established system. The generalized rock classification system described below was developed for the NAVFAC Pacific ER Program because, unlike the USCS for soils, there is no universally accepted rock classification system. In some instances, a more detailed and thorough rock classification system may be appropriate. Any modifications to this classification system, or the use of an alternate classification system should be considered during preparation of the site work plan. Both the CTO Manager and the QA Manager or

Technical Director must approve any modifications to this classification system, or the use of another classification system.

Describing rock specimens on a common basis is essential so that rocks described by different site geologists are comparable. Site geologists describing rock specimens as a part of investigative activities must use the classification system described herein, or if necessary, another more detailed classification system. Use of a common classification system provides the most useful geologic database for all present and future subsurface investigations and remedial activities at NAVFAC Pacific ER Program sites.

A rock classification template has been designated as shown in Figure I-E-4 to provide a more consistent rock classification between geologists. The template includes the classification of rocks by origin and mineralogical composition. When classifying rocks, all site geologists shall use this template.

The site geologist shall describe the rock specimen and record the description in a borehole log or logbook. The items essential for classification include:

- Classification Name (i.e., schist)
- Color
- Mineralogical composition and percent
- Texture/Grain size (i.e., fine-grained, pegmatitic, aphanitic, glassy)
- Structure (i.e., foliated, fractured, lenticular)
- Rock Quality Designation (sum of all core pieces greater than two times the diameter of the core divided by the total length of the core run, expressed as a percentage)
- Classification symbol (i.e., MF)

Example: Metamorphic foliated schist: Olive gray, 5Y, 3/2, Garnet 25 percent, Quartz 45 percent, Chlorite 15 percent, Tourmaline 15 percent, Fine-grained with Pegmatite garnet, highly foliated, slightly wavy, MF.

6. Records

Document soil classification information collected during soil sampling onto the field boring logs, field trench logs, and into the field notebook. Procedure I-B-1, *Soil Sampling* presents copies of the field boring log form. Copies of this information shall be placed in the project files.

7. Health and Safety

Field Personnel shall perform work in accordance with the current (or as contractually obligated) United States Army Corps of Engineers Safety and Health Requirements Manual EM-385-1-1 (USACE 2008) and site-specific health and safety plan.

8. References

Department of Defense, United States (DoD). 2005. *Uniform Federal Policy for Quality Assurance Project Plans, Part 1: UFP-QAPP Manual*. Final Version 1. DoD: DTIC ADA 427785, EPA-505-B-04-900A. In conjunction with the U. S. Environmental Protection Agency and the Department of Energy. Washington: Intergovernmental Data Quality Task Force. March. On-line updates available at: http://www.epa.gov/fedfac/pdf/ufp_qapp_v1_0305.pdf.

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Folk, Robert L. 1980. *Petrology of Sedimentary Rocks*. Austin, TX: Hemphill Publishing Company.

Munsell Color Company (Munsell). 2009. *Munsell Soil Color Chart*, (Revised). Baltimore.

United States Army Corps of Engineers (USACE). 2008. *Consolidated Safety and Health Requirements Manual*. EM-385-1-1. Includes Changes 1–7. 13 July 2012.

Procedure I-B-1, *Soil Sampling*.

9. Attachments

None.

DEFINITION OF TERMS				
PRIMARY DIVISIONS			SYMBOLS	SECONDARY DIVISIONS
SEDIMENTARY ROCKS	Clastic Sediments	CONGLOMERATE	CG	Coarse-grained Clastic Sedimentary Rock types including: Conglomerates and Breccias
		SANDSTONE	SS	Clastic Sedimentary Rock types including: Sandstone, Arkose and Greywacke
		SHALE	SH	Fine-grained Clastic Sedimentary Rock types including: Shale, Siltstone, Mudstone and Claystone
	Chemical Precipitates	CARBONATES	LS	Chemical Precipitates including: Limestone, Crystalline Limestone, Fossiliferous Limestone Micrite and Dolomite
		EVAPORITES	EV	Evaporites including: Anhydrite, Gypsum, Halite, Travertine and Caliche
IGNEOUS ROCKS		EXTRUSIVE (Volcanic)	IE	Volcanic Rock types including: Basalt, Andesite, Rhyolite, Volcanic Tuff, and Volcanic Breccia
		INTRUSIVE (Plutonic)	II	Plutonic Rock types including: Granite, Diorite and Gabbro
METAMORPHIC ROCKS		FOLIATED	MF	Foliated Rock types including: Slate, Phyllite, Schist and Gneiss
		NON-FOLIATED	MN	Non-foliated Rock types including: Metaconglomerate, Quartzite and Marble

Figure I-E-4: Rock Classification System

Equipment Decontamination

1. Purpose

This standard operating procedure describes methods of equipment decontamination for use during site activities by United States (U.S.) Navy Environmental Restoration (ER) Program, Naval Facilities Engineering Command (NAVFAC), Pacific personnel.

2. Scope

This procedure applies to all Navy ER projects performed in the NAVFAC Pacific Area of Responsibility.

This procedure shall serve as management-approved professional guidance for the ER Program and is consistent with protocol in the Uniform Federal Policy-Quality Assurance Project Plan (DoD 2005). As professional guidance for specific activities, this procedure is not intended to obviate the need for professional judgment during unforeseen circumstances. Deviations from this procedure while planning or executing planned activities must be approved and documented by the following prime contractor representatives: the CTO Manager and the Quality Assurance (QA) Manager or Technical Director. A Navy project representative (i.e., Remedial Project Manager or QA Manager) shall also concur with any deviations.

3. Definitions

None.

4. Responsibilities

The prime contractor CTO Manager is responsible for identifying instances of non-compliance with this procedure and ensuring that decontamination activities comply with this procedure. The CTO Manager is responsible for ensuring that all personnel involved in equipment decontamination have the appropriate education, experience, and training to perform their assigned tasks as specified in Chief of Naval Operations Instruction 5090.1, under *Specific Training Requirements* (DON 2014).

The prime contractor QA Manager or Technical Director is responsible for ensuring overall compliance with this procedure.

The Field Manager is responsible for field oversight to ensure that all project field staff follow these procedures.

Field personnel are responsible for the implementation of this procedure.

5. Procedures

Decontamination of equipment used in sampling of various media, groundwater monitoring, and well drilling and development is necessary to prevent cross-contamination and to maintain the highest integrity possible in collected samples. Planning a decontamination program requires consideration of the following factors:

- The location where the decontamination procedures will be conducted
- The types of equipment requiring decontamination
- The frequency of equipment decontamination
- The cleaning technique and types of cleaning solutions appropriate for the contaminants of concern
- The method for containing the residual contaminants and wash water from the decontamination process
- The use of a quality control measure to determine the effectiveness of the decontamination procedure

The following subsection describes standards for decontamination, including the frequency of decontamination, cleaning solutions and techniques, containment of residual contaminants and cleaning solutions, and effectiveness.

5.1 DECONTAMINATION AREA

Select an appropriate location for the decontamination area at a site based on the ability to control access to the area, the ability to control residual material removed from equipment, the need to store clean equipment, and the ability to restrict access to the area being investigated. Locate the decontamination area an adequate distance away and upwind from potential contaminant sources to avoid contamination of clean equipment.

It is the responsibility of the site safety and health officer (SSHO) to set up the site zones (i.e., exclusion, transition, and clean) and decontamination areas. Generally, the decontamination area is located within the transition zone, upwind of intrusive activities, and serves as the washing area for both personnel and equipment to minimize the spread of contamination into the clean zone. For equipment, a series of buckets are set up on a visqueen-lined bermed area. Separate spray bottles containing laboratory-grade isopropyl alcohol (or alternative cleaning solvent as described in the CTO work plan [WP]) and distilled water are used for final rinsing of equipment. Depending on the nature of the hazards and the site location, decontamination of heavy equipment, such as augers, pump drop pipe, and vehicles, may be accomplished using a variety of techniques.

5.2 TYPES OF EQUIPMENT

Drilling equipment that must be decontaminated includes drill bits, auger sections, drill-string tools, drill rods, split barrel samplers, tremie pipes, clamps, hand tools, and steel cable. Decontamination of monitoring well development and groundwater sampling equipment includes submersible pumps, bailers, interface probes, water level meters, bladder pumps, airlift pumps, peristaltic pumps, and lysimeters. Other sampling equipment that requires decontamination includes, but is not limited to, hand trowels, hand augers, slide hammer samplers, shovels, stainless-steel spoons and bowls, soil sample liners and caps, wipe sampling templates, composite liquid waste samplers, and dippers. However, equipment that is shipped pre-packaged from the vendor should not have to be decontaminated prior to first use. Equipment with a porous surface, such as rope, cloth hoses, and wooden blocks, cannot be thoroughly decontaminated and shall be properly disposed of after one use.

5.3 FREQUENCY OF EQUIPMENT DECONTAMINATION

Decontaminate down-hole drilling equipment and equipment used in monitoring well development and purging prior to initial use and between each borehole or well. Down-hole drilling equipment, however, may require more frequent cleaning to prevent cross-contamination between vertical zones within a single borehole. When drilling through a shallow contaminated zone and installing a surface casing to seal off the contaminated zone, decontaminate the drilling tools prior to drilling deeper. Initiate groundwater sampling by sampling groundwater from the monitoring well where the least contamination is suspected. Decontaminate groundwater, surface water, and soil sampling devices prior to initial use and between collection of each sample to prevent the possible introduction of contaminants into successive samples.

5.4 CLEANING SOLUTIONS AND TECHNIQUES

Decontamination can be accomplished using a variety of techniques and fluids. The preferred method of decontaminating major equipment, such as drill bits, augers, drill string, and pump drop-pipe, is steam cleaning. To steam clean, use a portable, high-pressure steam cleaner equipped with a pressure hose and fittings. For this method, thoroughly steam wash equipment, and rinse it with potable tap water to remove particulates and contaminants.

Where appropriate, disposable materials are recommended. A rinse decontamination procedure is acceptable for equipment, such as bailers, water level meters, new and re-used soil sample liners, and hand tools. The decontamination procedure shall consist of the following: (1) wash with a non-phosphate detergent (alconox, liquinox, or other suitable detergent) and potable water solution; (2) rinse in a bath with potable water; (3) spray with laboratory-grade isopropyl alcohol; (4) rinse in a bath with deionized or distilled water; and (5) spray with deionized or distilled water. If possible, disassemble equipment prior to cleaning. Add a second wash at the beginning of the process if equipment is very soiled.

Decontaminating submersible pumps requires additional effort because internal surfaces become contaminated during usage. Decontaminate these pumps by washing and rinsing the outside surfaces using the procedure described for small equipment or by steam cleaning. Decontaminate the internal surfaces by recirculating fluids through the pump while it is operating. This recirculation may be done using a relatively long (typically 4 feet) large-diameter pipe (4-inch or greater) equipped with a bottom cap. Fill the pipe with the decontamination fluids, place the pump within the capped pipe, and operate the pump while recirculating the fluids back into the pipe. The decontamination sequence shall include: (1) detergent and potable water; (2) potable water rinse; (3) potable water rinse; and (4) deionized water rinse. Change the decontamination fluids after each decontamination cycle.

Solvents other than isopropyl alcohol may be used, depending upon the contaminants involved. For example, if polychlorinated biphenyls or chlorinated pesticides are contaminants of concern, hexane may be used as the decontamination solvent. However, if samples are also to be analyzed for volatile organics, hexane shall not be used. In addition, some decontamination solvents have health effects that must be considered. Decontamination water shall consist of distilled or deionized water. Steam-distilled water shall not be used in the decontamination process as this type of water usually contains elevated concentrations of metals. Decontamination solvents to be used during field activities will be specified in CTO WP and site-specific health and safety plan.

Rinse equipment used for measuring field parameters, such as pH, temperature, specific conductivity, and turbidity with deionized or distilled water after each measurement. Also wash new, unused soil sample liners and caps with a fresh detergent solution and rinse them with potable water followed by distilled or deionized water to remove any dirt or cutting oils that might be on them prior to use.

5.5 CONTAINMENT OF RESIDUAL CONTAMINANTS AND CLEANING SOLUTIONS

A decontamination program for equipment exposed to potentially hazardous materials requires a provision for catchment and disposal of the contaminated material, cleaning solution, and wash water.

When contaminated material and cleaning fluids must be contained from heavy equipment, such as drilling rigs and support vehicles, the area must be properly floored, preferably with a concrete pad that slopes toward a sump pit. If a concrete pad is impractical, planking can be used to construct solid flooring that is then covered by a nonporous surface and sloped toward a collection sump. If the decontamination area lacks a collection sump, use plastic sheeting and blocks or other objects to create a bermed area for collection of equipment decontamination water. Situate items, such as auger flights, which can be placed on metal stands or other similar equipment, on this equipment during decontamination to prevent contact with fluids generated by previous equipment decontamination. Store clean equipment in a separate location to prevent recontamination. Collect decontamination fluids contained within the bermed area and store them in secured containers as described below.

Use wash buckets or tubs to catch fluids from the decontamination of lighter-weight drilling equipment and hand-held sampling devices. Collect the decontamination fluids and store them on site in secured containers, such as U.S. Department of Transportation-approved drums, until their disposition is determined by laboratory analytical results. Label containers in accordance with Procedure I-A-6, *Investigation-Derived Waste Management*.

5.6 EFFECTIVENESS OF DECONTAMINATION PROCEDURES

A decontamination program must incorporate quality control measures to determine the effectiveness of cleaning methods. Quality control measures typically include collection of equipment blank samples or wipe testing. Equipment blanks consist of analyte-free water that has been poured over or through the sample collection equipment after its final decontamination rinse. Wipe testing is performed by wiping a cloth over the surface of the equipment after cleaning. Procedure III-B, *Field QC Samples (Water, Soil)* provides further descriptions of these samples and their required frequency of collection. These quality control measures provide "after-the fact" information that may be useful in determining whether or not cleaning methods were effective in removing the contaminants of concern.

6. Records

Describe the decontamination process in the field logbook.

7. Health and Safety

Field Personnel shall perform work in accordance with the current (or as contractually obligated) United States Army Corps of Engineers Safety and Health Requirements Manual EM-385-1-1 (USACE 2008) and site-specific health and safety plan.

8. References

Department of Defense, United States (DoD). 2005. *Uniform Federal Policy for Quality Assurance Project Plans, Part 1: UFP-QAPP Manual*. Final Version 1. DoD: DTIC ADA 427785, EPA-505-B-04-900A. In conjunction with the U. S. Environmental Protection Agency and the Department of Energy. Washington: Intergovernmental Data Quality Task Force. March. On-line updates available at: http://www.epa.gov/fedfac/pdf/ufp_qapp_v1_0305.pdf.

Department of the Navy (DON). 2014. *Environmental Readiness Program Manual*. OPNAV Instruction 5090.1D. 10 January.

United States Army Corps of Engineers (USACE). 2008. *Consolidated Safety and Health Requirements Manual*. EM-385-1-1. Includes Changes 1–7. 13 July 2012.

Procedure I-A-6, *Investigation-Derived Waste Management.*

Procedure III-B, *Field QC Samples (Water, Soil).*

9. Attachments

None.

Data Validation

1. Purpose

This procedure describes the presentation format and information provided in the data validation reports under the United States (U.S.) Navy Environmental Restoration (ER) Program for Naval Facilities Engineering Command (NAVFAC), Pacific. The objective of data validation is to provide data of known quality to the end user. This procedure also establishes the method by which a Contract Task Order (CTO) Manager selects and confirms the content of data validation reports and is consistent with protocol in the *Department of Defense Quality Systems Manual (QSM) for Environmental Laboratories* (DoD QSM) (DoD 2013).

2. Scope

This procedure applies to all Navy ER projects performed in the NAVFAC Pacific Area of Responsibility.

This procedure shall serve as management-approved professional guidance for the ER Program and is consistent with protocol in the most recent version of the Uniform Federal Policy-Quality Assurance Project Plan (UFP QAPP) Part 1 (DoD 2005a), 2A (DoD 2012) and 2B (2005b) as well as the DoD Quality Systems Manual (DoD 2013). As professional guidance for specific activities, this procedure is not intended to obviate the need for professional judgment during unforeseen circumstances. Deviations from this procedure while planning or executing planned activities must be approved and documented by the following prime contractor representatives: the CTO Manager and the Quality Assurance (QA) Manager or Technical Director. A Navy project representative (i.e., Remedial Project Manager or QA manager) shall also concur with any deviations.

3. Definitions

Acronyms and abbreviations used in all data validation procedures and reports are defined in Attachment II-A-1. Commonly used terms are defined in Attachment II-A-2.

4. Responsibilities

The CTO Manager, the QA Manager or Technical Director, and the CTO QA Coordinator are responsible for ensuring that this procedure is implemented by data validation personnel.

Data validation personnel are responsible for implementing this procedure for all data validation reports.

5. Procedure

5.1 INTRODUCTION

This procedure addresses the validation of data obtained under the NAVFAC Pacific ER Program using primarily U.S. Environmental Protection Agency (EPA) Solid Waste (SW)-846 methods (EPA 2007). Based on the data validation requirements identified in the CTO project planning documents, the analytical data may undergo “Level B,” “Level C,” or “Level D” data validation or some combination of these validation levels. This procedure establishes the required format and content of the various validation reports.

5.1.1 Confirmation of Data Validation Reports

Prior to shipment of all completed data validation reports to the CTO Manager, a single draft report for one sample delivery group (SDG) should be submitted. The CTO Manager shall review the draft report to confirm that the report contains the requested information, and respond to the Data Validation Project Manager in a timely manner. Once the requested contents are confirmed, the complete data validation packages should be delivered to the CTO Manager.

5.2 CONTENT AND FORMAT OF THE DATA VALIDATION REPORT

The data validation report will consist of the following four major components:

1. Cover letter
2. Data validation reference package comprising:
    a. Cover page
    b. Acronyms and abbreviations list
    c. Data qualifier reference table
    d. Qualification code reference table
3. Individual data validation reports by SDG:
    e. Cover page
    f. Introduction
    g. Data validation findings
    h. Appendix of laboratory reports with applied data qualifiers

A discussion of the contents and format of these components is provided in the following sections.

5.2.1 Cover Letter

The cover letter will contain the generation date of the cover letter, the address of the CTO office, the CTO number, and the CTO Manager's name or designee. The cover letter will list the specific reports being sent under that cover letter. A senior data reviewer must review the report and sign the cover letter to denote approval. Attachment II-A-3 is an example of the cover letter.

5.2.2 Data Validation Reference Package

One data validation reference package shall be provided per CTO and shall contain the reference information needed for interpretation of the individual data validation reports. The following sections shall be included:

5.2.2.1 COVER PAGE

The cover page shall indicate the CTO title and number to which the reference package applies.

5.2.2.2 *Acronyms and Abbreviations List*

This list shall present all acronyms and abbreviations used in the individual data validation reports. Attachment II-A-1 is an example of the acronyms and abbreviations list.

5.2.2.3 *Data Qualifier Reference Table*

Data qualifiers are applied in cases where the data do not meet the required quality control (QC) criteria or where special consideration by the data user is required.

The data qualifier reference table lists the data qualifiers used in the validation of the analytical data. Attachment II-A-4 is an example of this table.

5.2.2.4 *Qualification Code Reference Table*

Qualification codes explain why data qualifiers have been applied and identify possible limitations of data use. Attachment II-A-5 provides the qualification codes used by the NAVFAC Pacific ER Program. Qualification codes are to be provided by data validation personnel on the annotated laboratory reports discussed in Section 5.2.3.4.

5.2.3 Individual Data Validation Reports by SDG

For all analyses, each SDG shall have a unique data validation report. The procedures used to generate the reports are discussed in the following sub-sections.

5.2.3.1 *Cover Page*

The cover page shall indicate the CTO title and number, analysis type, and the SDG(s), which the report addresses.

5.2.3.2 *Introduction*

This section will contain a brief description of the CTO information that is pertinent to data validation. This information includes the CTO title and number, CTO Manager, the sample matrices and analyses performed on the samples, the data validation level for the project, and a brief discussion of the methodologies used for data validation. This section will also contain a Sample Identification Table which lists the identification of each sample identification number cross referenced with its associated internal laboratory identification number and COC sample number. Each sample will be listed under every analytical method for which data was validated. Attachment II-A-6 is an example of the sample identification table.

5.2.3.3 *Data Validation Findings*

This section shall present the data validation findings of the data reviewer for the CTO data package. The findings shall be determined on the basis of validation criteria established for each analytical method[1] in the DoD QSM (DoD 2013) or the CTO planning document and Procedure II-B through Procedure II-X. For all data validation levels, the data validation findings are divided into the following analytical categories:

- II-B GC/MS Volatile Organics by SW-846 Method 8260

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[1] Other methods may be included with approval of the CTO and Data Validation Managers.

- II-C GC/MS Semivolatile Organics by SW-846 8270 (full scan and SIM)
- II-D HRGC/HRMS Polychlorinated Dibenzodioxins (PCDDs) and Polychlorinated Dibenzofurans (PCDFs) by SW-846 8290
- II-E Organochlorine Pesticides by SW-846 8081
- II-F Polychlorinated Biphenyls as Aroclors by SW-846 8082
- II-G Polychlorinated Biphenyls as Congeners by SW-846 8082
- II-H Total Petroleum Hydrocarbons by SW-846 8015
- II-I Chlorinated Herbicides by SW-846 8151
- II-J Organophosphorus Pesticides by SW-846 8141
- II-K Halogenated and Aromatic Volatiles by SW-846 8021
- II-L Phenols by SW-846 8041
- II-M Ethylene Dibromide/Dibromochloropropane by SW-846 8011
- II-N Polynuclear Aromatic Hydrocarbons by SW-846 8310
- II-O Explosives by SW-846 8330
- II-P Carbamate and Urea Pesticides by EPA Method 632
- II-Q Metals by EPA Method SW-846 6000/7000
- II-R Wet Chemistry Analyses
- II-S Data Quality Assessment Report
- II-T HRGC/HRMS Polychlorinated Biphenyls as Congeners by EPA Method 1668
- II-U Carbamate and Urea Pesticides by SW-846 8321
- II-V Perchlorate by SW-846 6850
- II-W GC/FID/ECD Volatile Organics and Fixed Gases in Soil Gas/Vapor by EPA Method TO-3 and ASTM D1946
- II-X GC/MS Volatile Organics and Fixed Gases in Soil Gas/Vapor by EPA Method TO-14, TO-15, and TO-17

GC/MS	gas chromatography/mass spectrometry
ECD	electron capture detector
FID	flame ionization detector
HRGC/HRMS	high resolution gas chromatograph/high resolution mass spectrometer
SIM	selective ion monitoring

Level C and Level D Data Validation

Data obtained using any analytical methods in the above categories will be validated in terms of meeting criteria for specific QA/QC factors such as holding times, instrument calibration, and blank analyses. A separate discussion of each QA/QC factor under each analytical method will be presented in the CTO data validation report. The QA/QC factors used to validate data for Level C and Level D validation are presented below for each analytical category.

Volatile Organics by Gas Chromatography/Mass Spectrometry (GC/MS)

1. Sample management (sample preservation, handling, and transport, chain-of-custody, and holding times)
2. GC/MS instrument performance check
3. Calibration (initial calibration, initial calibration verification, and continuing calibration)
4. Method blanks
5. Blank spikes and laboratory control samples (LCSs)
6. Surrogate recovery
7. Matrix spike/matrix spike duplicate (MS/MSD)
8. Field QC samples (trip blanks, equipment blanks, field blanks, field duplicates, and field triplicates)
9. Internal standards performance
10. Target compound identification (Level D only*)
11. Compound quantitation and reporting limits (RLs) (Level D only*)
12. Tentatively identified compounds (Level D only*)
13. System performance (Level D only*)

Semivolatile Organics by Full Scan and SIM GC/MS

1. Sample management (sample preservation, handling, and transport; chain-of-custody; holding times)
2. GC/MS instrument performance check (full scan)
3. Calibration (initial calibration, initial calibration verification, and continuing calibration)
4. Method blanks
5. Blank spikes and LCSs
6. Surrogate recovery
7. MS/MSD
8. Field QC samples (equipment blanks, field blanks, and field duplicates)
9. Internal standards performance
10. Target Compound identification (Level D only*)
11. Compound quantitation and RLs (Level D only*)
12. Tentatively identified compounds (Level D only*)

13. System performance (Level D only*)

Dioxins/Dibenzofurans by HRGC/HRMS

1. Sample management (sample preservation, handling, and transport; chain-of-custody; holding times)
2. HRGC/HRMS instrument performance check
3. Calibration (initial calibration, initial calibration verification, and continuing calibration)
4. Method blanks
5. Blank spikes and LCSs
6. MS/MSD
7. Field QC samples (equipment blanks, field blanks, field duplicates, and field triplicates)
8. Internal standards performance
9. Target compound identification (Level D only*)
10. Compound quantitation and RLs (Level D only*)
11. System performance (Level D only*)

Organochlorine Pesticides by GC

1. Sample management (sample preservation, handling, and transport; chain-of-custody; holding times)
2. Pesticides instrument performance (retention time evaluation, 4,4'-DDT/Endrin breakdown evaluation)
3. Calibration (analytical sequence, initial calibration, initial calibration verification, continuing calibration)
4. Method blanks
5. Blank spikes and LCSs
6. Surrogate recovery
7. MS/MSD
8. Sample cleanup performance
9. Field QC samples (equipment blanks, field blanks, field duplicates, and field triplicates)
10. Target compound identification (Level D only*)
11. Compound quantitation and RLs (Level D only*)

Organic Analyses by GC (QA/QC factors may vary depending on analysis type)

1. Sample management (sample preservation, handling, and transport; chain-of-custody; holding times)

2. Instrument performance
3. Calibration (initial calibration, initial calibration verification and continuing calibration)
4. Method blanks
5. Blank spikes and LCS
6. Surrogate recovery
7. MS/MSD
8. Field QC samples (trip blanks [volatile organic compounds], equipment blanks, field blanks, field duplicates, and field triplicates)
9. Target compound identification (Level D only*)
10. Compound quantitation and RLs (Level D only*)

Organic Analyses by High-Performance Liquid Chromatography (QA/QC factors may vary depending on analysis type)

1. Sample management (sample preservation, handling, and transport; chain-of-custody; holding times)
2. Instrument performance
3. Calibration (initial calibration, initial calibration verification and continuing calibration)
4. Method blanks
5. Blank spikes and LCSs
6. Surrogate recovery
7. MS/MSD
8. Field QC samples (equipment blanks, field blanks, field duplicates, and field triplicates)
9. Target compound identification (Level D only*)
10. Compound quantitation and reporting limits (RLs) (Level D only*)

Organic Analyses by Liquid Chromatography–Mass Spectrometry (QA/QC factors may vary depending on analysis type)

1. Sample management (sample preservation, handling, and transport; chain-of-custody; holding times)
2. Instrument performance
3. Calibration (initial calibration, initial calibration verification, and continuing calibration)
4. Method blanks
5. Blank spikes and LCSs
6. MS/MSD
7. Field QC samples (equipment blanks, field blanks, field duplicates, and field triplicates)

8. Internal standards performance
9. Target compound identification (Level D only*)
10. Compound quantitation and RLs (Level D only*)

Metals

1. Sample management (sample preservation, handling, and transport; chain-of-custody; holding times)
2. Calibration (initial and continuing)
3. Blanks (Calibration blanks and Method [preparation] blanks)
4. Inductively coupled (argon) plasma (spectroscopy) (ICP) interference check sample
5. Blank spikes and LCSs
6. MS/MSD and Matrix duplicates
7. Furnace atomic absorption QC
8. Internal standards performance (MS methods only)
9. ICP serial dilution
10. Sample result verification (Level D only*)
11. Field QC samples (equipment blanks, field blanks, field duplicates, and field triplicates)

Inorganic Analyses by Wet Chemical Methods, (QA/QC factors may vary depending on analysis type)

1. Sample management (sample preservation, handling, and transport; chain-of-custody; and holding times)
2. Calibration (initial and continuing)
3. Method blanks
4. Blank spikes and LCSs
5. MS/MSD and Matrix duplicates
6. Sample result verification (Level D only*)
7. Field QC samples (equipment blanks, field blanks, field duplicates, and field triplicates)

* Sections applicable to Level D validation only will also appear in Level C validation reports with the notation "not applicable for Level C validation."

Level B Data Validation

Data obtained using any analytical methods in the Level B Validation analytical categories will be validated in terms of meeting criteria for specific QA/QC factors such as holding times, blank spike analyses, and blank analyses. A separate discussion of each QA/QC factor under each analytical method will be presented in the CTO data validation report. The QA/QC factors used to validate data for QA/QC “Level B Validation” are presented below for each analytical category.

Organic Analyses

1. Sample management (sample preservation, handling, and transport; chain-of-custody; and holding times)
2. Method blanks
3. Blank spikes and laboratory control samples
4. Field QC samples (trip blanks (volatile organic compounds), equipment blanks, field blanks, field duplicates, and field triplicates)
5. Surrogate recovery
6. MS/MSD

Inorganic Analyses

1. Sample management (sample preservation, handling, and transport; chain-of-custody; and holding times)
2. Blanks (Calibration and Method blanks)
3. Blank spikes and LCSs
4. Field QC samples (equipment blanks, field blanks, field duplicates, and field triplicates)
5. MS/MSD and Laboratory Duplicates
6. ICP serial dilution

5.2.3.4 LABORATORY REPORTS

Annotated laboratory reports with the appropriate data qualifiers and qualification codes as specified in the NAVFAC Pacific ER Program data validation procedures will be submitted as an appendix to the data validation report. An example is provided as Attachment II-A-7. Records

Copies of all documents generated by data validation personnel will be stored for no less than 10 years. The original validated laboratory data shall be archived to the Federal Records Center at project completion.

6. References

Department of Defense, United States (DoD). 2005a. *Uniform Federal Policy for Quality Assurance Project Plans, Part 1: UFP-QAPP Manual*. Final Version 1. DoD: DTIC ADA 427785, EPA-505-B-04-900A. In conjunction with the U. S. Environmental Protection Agency and the Department of Energy. Washington: Intergovernmental Data Quality Task Force. March. On-line updates available at: http://www.epa.gov/fedfac/pdf/ufp_qapp_v1_0305.pdf.

———. 2005b. *Uniform Federal Policy for Quality Assurance Project Plans, Part 2B: Quality Assurance/quality Control Compendium: Minimum QA/QC Activities*. Final Version 1. DoD: DTIC ADA 426957, EPA-505-B-04-900B. In conjunction with the U. S. Environmental Protection Agency and the Department of Energy. Washington: Intergovernmental Data Quality Task Force. March. On-line updates available at: http://www.epa.gov/swerffrr/pdf/-qaqc_v1_0305.pdf.

———. 2012. *Uniform Federal Policy for Quality Assurance Project Plans, Part 2A: Optimized UFP-QAPP Worksheets*. Revision 1. March.

———. 2013. *Department of Defense Quality Systems Manual for Environmental Laboratories.* Version 5.0. Draft Final. Prepared by DoD Environmental Data Quality Workgroup and Department of Energy Consolidated Audit Program Operations Team. July.

Environmental Protection Agency, United States (EPA). 2007. *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW-846.* 3rd ed., Final Update IV. Office of Solid Waste. On-line updates at: www.epa.gov/epaoswer/hazwaste/test/new-meth.htm.

7. Attachments

Attachment II-A-1: Acronyms and Abbreviations

Attachment II-A-2: Definition of Terms

Attachment II-A-3: Sample Cover Letter

Attachment II-A-4: Data Qualifier Reference Table

Attachment II-A-5: Qualification Code Reference Table

Attachment II-A-6: Sample Identification Table

Attachment II-A-7: Example Annotated Laboratory Report Volatile Organics Analysis Data Sheet

Attachment II-A-1
Acronyms and Abbreviations

ACRONYMS AND ABBREVIATIONS

Following is a list of acronyms and abbreviations that may be used in NAVFAC Pacific ER Program data validation reports and the data quality assessment reports.

%D	percent difference
%R	percent recovery
µg/kg	microgram per kilogram
µg/L	microgram per liter
4,4'-DDD	4,4'-dichlorodiphenyldichloroethane
4,4'-DDE	4,4'-dichlorodiphenyldichloroethylene
4,4'-DDT	4,4'-dichlorodiphenyltrichloroethane
AA	atomic absorption
ARRF	average relative response factor
BFB	bromofluorobenzene
BNA	base/neutral/acid
CCB	continuing calibration blank
CCC	calibration check compound
CCV	continuing calibration verification
CF	calibration factor
CLP	Contract Laboratory Program
COC	chain-of-custody
COD	chemical oxygen demand
CTO	contract task order
CVAA	cold vapor atomic absorption
DBCP	Dibromochloropropane
DCB	decachlorobiphenyl
DFTPP	decafluorotriphenylphosphine
DL	detection limit
DoD	Department of Defense
DOE	Department of Energy
DQAR	data quality assessment report
DUP	laboratory duplicate
DVP	data validation procedure
EB	equipment blank
EDB	ethylene dibromide
EDL	estimated detection limit
EICP	extracted ion current profile
EPA	Environmental Protection Agency, United States
FB	field blank
GC	gas chromatography
GC/ECD	gas chromatography/electron capture detector
GC/ELCD	gas chromatography/electrolytic conductivity detector (Hall detector)
GC/FPD	gas chromatography/flame photometric detector
GC/MS	gas chromatography/mass spectrometry

GC/PID	gas chromatography/photoionization detector
GFAA	graphite furnace atomic absorption
GPC	gel permeation chromatography
Hg	mercury
HPLC	high-performance liquid chromatography
HRGC/HRMS	high resolution gas chromatography/high resolution mass spectrometry
HT	holding time
ICB	initial calibration blank
ICP	inductively coupled plasma
ICS	interference check sample
ICV	initial calibration verification
IDL	instrument detection limit
IR	infrared spectroscopy
IRP	installation restoration program
IS	internal standards
LCS	laboratory control sample
LOD	limit of detection
LOQ	limit of quantitation
m/z	mass to charge ratio
MBAS	methyl blue active substance
mg/kg	milligram per kilogram
mg/L	milligram per liter
MS	matrix spike
MSA	method of standard addition
MSD	matrix spike duplicate
NFESC	Naval Facilities Engineering Services Center
ng/kg	nanogram per kilogram
OP	organophosphorus
PAH	polynuclear aromatic hydrocarbon
PARCC	precision, accuracy, representativeness, comparability, completeness
PCB	polychlorinated biphenyl
PCDD	polychlorinated dibenzodioxin
PCDF	polychlorinated dibenzofuran
PE	performance evaluation
PEM	performance evaluation mixture
PFK	perfluorokerosene
pg/g	picogram per gram
pg/L	picogram per liter
PQO	project quality objective
QA	quality assurance
QAC	quality assurance coordinator
QAPP	quality assurance project plan
QC	quality control
QSM	quality system manual

r	correlation coefficient
r^2	coefficient of determination
RF	response factor
RIC	reconstructed ion chromatogram
RL	reporting limit
RPD	relative percent difference
RRF	relative response factor
RRT	relative retention time
RSD	relative standard deviation
RT	retention time
s/n	signal to noise ratio
SDG	sample delivery group
SICP	selected ion current profiles
SOP	standard operating procedure
SOW	statement of work
SPCC	system performance check compound
SRM	standard reference material
SVOC	semivolatile organic compound
TB	trip blank
TCDD	tetrachlorodibenzodioxin
TCX	tetrachloro-m-xylene
TDS	total dissolved solids
TIC	tentatively identified compound
TOC	total organic carbon
TOX	total organic halides
TPHE	total petroleum hydrocarbons as extractables
UV/VIS	ultraviolet/visible
VOA	volatile organic analysis
VOC	volatile organic compound
VTSR	validated time of sample receipt
WDM	window defining mixture

Attachment II-A-2
Definition of Terms

DEFINITION OF TERMS

Calibration Curve	–	A plot of response versus concentration of standards.
CCB	–	Continuing Calibration Blank – a deionized water sample run every 10 samples designed to detect any carryover contamination.
CCV	–	Continuing Calibration Verification – a standard run every 10 samples to test instrument performance.
EDL	–	Estimated Detection Limit – The sample specific EDL is the concentration of a given analyte required to produce a signal with a peak height of at least 2.5 times the background signal level.
Field Blank	–	Field blanks are intended to identify contaminants that may have been introduced in the field through source water.
Field Duplicate	–	A duplicate sample generated in the field, not in the laboratory.
Findings	–	Any out-of-control, unacceptable, or out of criteria event which may impact the quality of the data or require corrective action.
GPC	–	Gel Permeation Chromatography – A sample clean-up technique that separates compounds by size and molecular weight. Generally used to remove oily materials from sample extracts.
Holding Time	–	The time from sample collection to sample analysis.
ICB	–	Initial Calibration Blank – the first blank standard run to confirm the calibration curve.
ICV	–	Initial Calibration Verification – the first standard run to confirm the calibration curve.
Initial Calibration	–	The establishment of a calibration curve with the appropriate number of standards and concentration range. The calibration curve plots instrument response versus concentration of standards.
IR	–	Infrared Spectroscopy.
IS	–	Internal Standards – compounds added to every VOA and BNA standard, blank, matrix spike duplicate, and sample extract at a known concentration, prior to instrumental analysis. Internal standards are used as the basis for quantitation of the target compounds.
Laboratory Duplicate	–	A duplicate sample generated in the laboratory.
MDL	–	Method Detection Limit – minimum concentration of a substance that can be measured and reported with 99% confidence that the analyte concentration is greater than zero.
MS	–	Matrix Spike – introduction of a known concentration of analyte into a sample to provide information about the effect of the sample matrix on the extraction or digestion and measurement methodology.
m/z	–	The ratio of mass (m) to charge (z) of ions measured by GC/MS.

Post Digestion Spike	–	The addition of a known amount of standard after digestion. (Also identified as analytical spike or spike for furnace analysis).
Primary Analysis	–	One of two types of pesticide/PCB analysis by GC/EC techniques, the other being confirmation analysis. The primary analysis is used to establish the tentative identification of any pesticides/PCBs detected. The identification is confirmed in the confirmation analysis. If the two analyses are done simultaneously, either may be considered the primary analysis. Either may be used for quantitation if contract criteria are met.
QA	–	Quality Assurance – total program for assuring the reliability of data
QC	–	Quality Control – routine application of procedures for controlling the monitoring process.
RL	–	Reporting Limit – value specified by the client based on sensitivity requirements from project-specific action levels.
RPD	–	Relative Percent Difference (between matrix spike and matrix spike duplicate, duplicate laboratory control samples, or blank spikes)
Serial Dilution	–	A sample run at a specific dilution to determine whether any significant chemical or physical interferences exist due to sample matrix effects (ICP only).
SDG	–	Sample Delivery Group – defined by one of the following, whichever occurs first: • Case of field samples • Each 20 field samples within a case • Each 14-day calendar period during which field samples in a case are received, beginning with receipt of the first sample in the SDG
Level B Validation	–	Data validation is performed using sample results and QA/QC summaries (i.e., method blanks, LCS, MS/MSDs, surrogates, and serial dilutions). This level of data validation was previously identified as "Standard."
Level C Data Validation	–	Data validation is performed using sample results and QA/QC summaries (including instrument performance, calibration, and internal standard data). This level of data validation was previously identified as "Cursory."
Level D Data Validation	–	Data validation is performed using sample results, QA/QC summaries (including instrument performance, calibration, and internal standard data) and raw data associated to the sample results and QA/QC summaries. This level of data validation was previously identified as "Full."

Attachment II-A-3
Sample Cover Letter

SAMPLE COVER LETTER

(Date)

(CTO Manager or designee) (company address) Dear ( ): Enclosed is Revision __ of the data validation reports for CTO (number) as follows: Semi-volatiles SDG S0221 SDG S0350 Pesticides/PCBs SDG S0201 Metals SDG S0221 SDG S0201 The specific sample identifications are listed in the Sample Identification Table(s). The data packages were reviewed according to the data validation procedures referenced in the introduction to each report.

Sincerely,

(Signature)

Data Validation Project Manager

Attachment II-A-4
Data Qualifier Reference Table

Table II-A-4-1: Data Qualifier Reference Table

Qualifier	Organics	Inorganics
U	The analyte was analyzed for, but was not detected above the method detection limit.	The analyte was analyzed for, but was not detected above the method detection limit.
J	The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.	The result is an estimated quantity. The associated numerical value is the approximate concentration of the analyte in the sample.
N	The analysis indicates the presence of an analyte for which there is presumptive evidence to make a "tentative identification."	Not applicable.
NJ	The analysis indicates the presence of an analyte that has been "tentatively identified" and the associated numerical value represents its approximate concentration.	Not applicable.
UJ	The analyte was not detected above the method detection limit. However, the associated value is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample.	The analyte was analyzed for, but was not detected. The associated value is an estimate and may be inaccurate or imprecise.
R	The sample results are rejected due to serious deficiencies in the ability to analyze the sample and to meet quality control criteria. The presence or absence of the analyte cannot be verified.	The data are unusable. The sample results are rejected due to serious deficiencies in meeting the Quality Control (QC) criteria. The analyte may or may not be present in the sample.

Attachment II-A-5
Qualification Code Reference Table

Table II-A-5-1: Qualification Code Reference Table

Qualifier	Organics	Inorganics
H	Holding times were exceeded.	Holding times were exceeded.
S	Surrogate recovery was outside QC limits.	The sequence or number of standards used for the calibration was incorrect.
C	Calibration %RSD, r, r^2 or %D were noncompliant	Correlation coefficient is <0.995.
R	Calibration RRF was <0.05.	%R for calibration is not within control limits
B	Presumed contamination from preparation (method blank)	Presumed contamination from preparation (method) blank or calibration blank
L	Laboratory Control Sample/Laboratory Control Sample Duplicate %R or RPD was not within control limits	Laboratory Control Sample/Laboratory Control Sample Duplicate %R or RPD was not within control limits
Q	MS/MSD recovery was poor	MS/MSD recovery was poor.
E	MS/MSD or Duplicate RPD was high.	MS/MSD or Duplicate RPD or difference was high.
I	Internal standard performance was unsatisfactory	ICP ICS results were unsatisfactory.
A	Not applicable.	ICP Serial Dilution %D were not within control limits
M	Instrument Performance Check (BFB or DFTPP) was noncompliant	Not applicable.
T	Presumed contamination from trip blank.	Not applicable.
F	Presumed contamination from FB or ER.	Presumed contamination from FB or ER.
D	The analysis with this flag should not be used because another more technically sound analysis is available.	The analysis with this flag should not be used because another more technically sound analysis is available.
P	Instrument performance for pesticides was poor	Post Digestion Spike recovery was not within control limits
V	Unusual problems found with the data that have been described in the validation report where a description of the problem can be found.	Unusual problems found with the data that have been described in where a description of the problem can be found.

Attachment II-A-6
Sample Identification Table

Table II-A-6-1: Sample Identification Table

EPA Identification	Sample Identification	Lab Identification Number	COC Sample Number	Matrix
FB001	FB-BS04-E01-D10.0	2720-1	DA001	water
FB002	FB-BS04-B01-D10.0	2720-2	DA002	water
FB003	FB-BS04-B02-D10.0	2720-3	DA003	water
FB004	FB-SS01-S01-D0.5	2720-4	DA004	soil
FB005	FB-BS01-S01-D10.0	2720-5	DA005	soil
FB006	FB-SS02-S01-D0.5	2720-6	DA006	soil
FB007	FB-BS02-S01-D10.0	2720-7	DA007	soil
FB008	FB-BS02-D01-D10.0	2720-8	DA008	soil
FB009	FB-SS03-S01-D0.5	2720-9	DA009	soil
FB010	FB-BS03-S01-D10.0	2720-10	DA010	soil

Attachment II-A-7
Example Annotated Laboratory Report
Volatile Organics Analysis Data Sheet

EXAMPLE ANNOTATED LABORATORY REPORT
VOLATILE ORGANICS ANALYSIS DATA SHEET

1A
VOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.: CA145

Lab Name: COLUMBIA ANALYTICAL SERVI Contract: EARTH TECH

Lab Code: COLUMB Case No.: SAS No.: SDG No.: K9804746

Matrix: (soil/water) SOIL Lab Sample ID: K9804746-013

Sample wt/vol: 5.1 (g/mL) G Lab File ID: 0727F009

Level: (low/med) LOW Date Received: 07/17/98

% Moisture: not dec. 11 Date Analyzed: 07/27/98

GC Column: RTX-624 ID: 0.32 (mm) Dilution Factor: 1.0

Soil Extract Volume:________(uL) Soil Aliquot Volume: ________(uL)

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q	
74-87-3	Chloromethane	11	U	U
74-83-9	Bromomethane	11	U	
75-01-4	Vinyl Chloride	11	U	
75-00-3	Chloroethane	11	U	
75-09-2	Methylene Chloride	0.8	JB	11U (B)
67-64-1	Acetone	2	JB	
75-15-0	Carbon Disulfide	11	U	U
75-35-4	1,1-Dichloroethene	11	U	
75-34-3	1,1-Dichloroethane	11	U	
540-59-0	1,2-Dichloroethene (total)	11	U	
67-66-3	Chloroform	11	U	
107-06-2	1,2-Dichloroethane	11	U	
78-93-3	2-Butanone	11	U	
71-55-6	1,1,1-Trichloroethane	11	U	
56-23-5	Carbon Tetrachloride	11	U	
75-27-4	Bromodichloromethane	11	U	
78-87-5	1,2-Dichloropropane	11	U	
10061-01-5	cis-1,3-Dichloropropene	11	U	
79-01-6	Trichloroethene	11	U	
124-48-1	Dibromochloromethane	11	U	
79-00-5	1,1,2-Trichloroethane	11	U	
71-43-2	Benzene	11	U	
10061-02-6	trans-1,3-Dichloropropene	11	U	
75-25-2	Bromoform	11	U	
108-10-1	4-Methyl-2-Pentonone	11	U	
591-78-6	2-Hexanone	11	U	
127-18-4	Tetrachloroethene	0.2	J	J
79-34-5	1,1,2,2-Tetrachloroethane	11	U	U
108-88-3	Toluene	0.2	JB	11U (B)
108-90-7	Chlorobenzene	11	U	U
100-41-4	Ethylbenzene	11	U	U
100-42-5	Styrene	0.4	JB	11U (B)
1330-20-7	Xylene (Total)	0.2	JB	11U (B)

FORM I VOA OLM03.0

ug 6/6/98

01513
"U.S. NAVY PACDIV IRP VALIDATED"

Level C and Level D Data Validation for GC/MS Semivolatile Organics by SW-846 8270 (Full Scan and SIM)

1. Purpose

This data validation procedure sets forth the standard operating procedure for performance of Level C and Level D data validation of semivolatile organic data obtained under the United States (U.S.) Navy Environmental Restoration (ER) Program for Naval Facilities Engineering Command (NAVFAC), Pacific and is consistent with protocol in the *Department of Defense Quality Systems Manual (QSM) for Environmental Laboratorie*s (DoD QSM) (DoD 2013). Level B validation is addressed separately in Procedure II-A, *Data Validation*.

2. Scope

This procedure applies to all Navy ER projects performed in the NAVFAC Pacific Area of Responsibility.

This procedure shall serve as management-approved professional guidance for the ER Program and is consistent with protocol in the most recent version of the Uniform Federal Policy-Quality Assurance Project Plan (UFP QAPP) Part 1 (DoD 2005a), 2A (DoD 2012), and 2B (2005b), as well as the DoD Quality Systems Manual (DoD 2013). As professional guidance for specific activities, this procedure is not intended to obviate the need for professional judgment during unforeseen circumstances. Deviations from this procedure while planning or executing planned activities must be approved and documented by the following prime contractor representatives: the CTO Manager and the Quality Assurance (QA) Manager or Technical Director. A Navy project representative (i.e., Remedial Project Manager or QA Manager) shall also concur with any deviations.

3. Responsibilities

The CTO Manager, the QA Manager or Technical Director, and the CTO QA Coordinator are responsible for ensuring that this procedure is implemented by data validation personnel.

Data validation personnel are responsible for implementing this procedure for validation of all gas chromatography/mass spectrometry (GC/MS) semivolatile data.

4. Procedure

This procedure addresses the validation of semivolatile organic data obtained using U.S. Environmental Protection Agency (EPA) Method Solid Waste (SW)-846 8270 (EPA 2007). The quality control (QC) criteria identified in this procedure are those specified in the analytical method and the DoD QSM (DoD 2013). Where project specific criteria are identified in the CTO work plan, they will supersede the QC criteria identified in this procedure.

- Form I: Sample Results Summary Form
- Form II: Surrogate Recovery Summary Form
- Form III: Matrix Spike/Matrix Spike Duplicate or Blank Spike/Blank Spike Duplicate Recovery Summary Form

- Form IV: Method Blank Summary Form
- Form V: Instrument Performance Check Summary Form
- Form VI: Initial Calibration Summary Form
- Form VII: Continuing Calibration Summary Form
- Form VIII: Internal Standard Summary Form

Level C data validation consists of review of summary forms only while Level D data validation requires review of both summary forms and all associated raw data. Data review guidelines and how they apply to the different validation levels are indicated in the following text.

4.1 SAMPLE MANAGEMENT

QA/QC criteria included under sample management are sample preservation, handling, and transport; chain of custody (COC); and holding times.

4.1.1 Sample Preservation, Handling, and Transport

Level C and Level D:

Evaluate sample collection, handling, transport, and laboratory receipt from COC and laboratory receipt checklists to ensure that the samples have been properly preserved and handled.

1. Samples are to be shipped in coolers that are maintained at above freezing to 6 degrees Celsius (°C). If the temperature exceeds 6°C but is less than or equal to 10°C, note this in the data validation report. If the temperature of receipt is greater than or equal to 11°C, positive values shall be flagged as estimated "J" and nondetects as estimated "UJ." If the temperature is below 0°C, special note should be made that the samples were frozen and no qualification shall be required. In the event that both a cooler temperature and a temperature blank were measured, the temperature blank shall be evaluated for temperature compliance as it best assimilates the condition of the samples; however, both temperatures shall be noted in the data validation report.
2. If the temperature of the cooler upon receipt at the laboratory was not recorded, document that the laboratory is noncompliant.
3. If the receiving laboratory transferred the samples to another laboratory for analysis, apply the same temperature criteria to both the transfer COC and the original COC.

4.1.2 Chain of Custody

Level C and Level D:

Examine the COC for legibility and check that all semivolatile analyses requested on the COC have been performed by the laboratory. Ensure that the COC Sample Number on the laboratory Form I matches the Sample Identification on the COC. Read the laboratory case narrative for additional information.

1. Any samples received for analysis that were not analyzed shall be noted in the data validation report, along with the reason(s) for failure to analyze the samples, if the reason(s)

can be determined. Conversely, samples that were analyzed for semivolatiles, but were not requested should also be noted.

2. Any discrepancies in sample naming between the COC and sample results form shall be noted in the data validation report with the correct sample name being identified if the correct sample name can be determined.

3. If the receiving laboratory transferred the samples to another laboratory for analysis, both the original COCs and transfer COCs shall be present. Document in the data validation report if the transfer COCs are not present.

4. Internal COC is required for all samples, extracts, and digestates from receipt to disposal. Verify the internal COC forms for completeness. Document in the data validation report if the internal COC forms are not present.

5. Each individual cooler shall have an individual COC that lists only samples contained within that cooler. Document in the data validation report if multiple coolers appear on one COC.

4.1.3 Holding Times

Level C and Level D:

Holding times for semivolatile organics are measured from the time of collection (as shown on the COC) to the time of sample extraction and from the time of sample extraction to the time of sample analysis (as shown on the Form I). Samples and extracts must be stored and refrigerated at above freezing to 6°C until the time of analysis.

Water samples shall be unpreserved and refrigerated at above freezing to 6°C and shall be extracted within 7 days of collection and analyzed within 40 days of extraction.

Soil samples shall be unpreserved and refrigerated at above freezing to 6°C and shall be extracted within 14 days of collection and analyzed within 40 days of extraction.

1. If the holding time is exceeded, flag all associated positive results as estimated "J" and all associated limits of detection (LODs) (nondetects) as estimated "UJ," and document that holding times were exceeded.

2. If holding times are grossly exceeded by greater than a factor of 2.0 (e.g., a non-water sample has a holding time of more than 14 days), detects will be qualified as estimated "J" and nondetects as unusable "R."

4.2 GC/MS Instrument Performance Check (Full Scan)

Level C and Level D:

GC/MS instrument performance checks or tune checks are performed for the Full scan analyses to ensure mass resolution, identification, and to some degree, sensitivity. Instrument performance checks are not required for samples analyzed by selected ion monitoring (SIM). These criteria are not sample specific. Conformance is determined using standard materials; therefore, these criteria should be met in all circumstances.

The analysis of the instrument performance check solution must be performed at the beginning of each 12-hour period during which samples or standards are analyzed. The instrument performance check, decafluorotriphenylphosphine (DFTPP) for semivolatile analysis, must meet the ion abundance criteria given below.

Table II-C-1: Ion Abundance Criteria – DFTPP (SW-846 8270C)

m/z	Ion Abundance Criteria
51	30.0–60.0% of m/z 198
68	Less than 2.0% of m/z 69
70	Less than 2.0% of m/z 69
127	40.0–60.0% of m/z 198
197	Less than 1.0% of m/z 198
198	Base peak, 100% relative abundance
199	5.0–9.0% of m/z 198
275	10.0–30.0% of m/z 198
365	Greater than 1.0% of m/z 198
441	Present, but less than m/z 443
442	Greater than 40.0% of m/z 198
443	17.0–23.0% of m/z 442

% percent
m/z mass-to-charge ratio

Table C-II-2: Ion Abundance Criteria – DFTPP (SW-846 8270D)

m/z	Ion Abundance Criteria
51	10.0–80.0% of m/z 198
68	Less than 2.0% of m/z 69
70	Less than 2.0% of m/z 69
127	10.0–80.0% of m/z 198
197	Less than 2.0% of m/z 198
198	Base peak, 100% relative abundance
199	5.0–9.0% of m/z 198
275	10.0–60.0% of m/z 198
365	Greater than 1.0% of m/z 198
441	Present, but less than 24.0% m/z 442
442	Greater than 50.0% of m/z 198
443	15.0–24.0% of m/z 442

Check that all sample runs are associated with an injection. Make certain that a DFTPP performance check is present for each 12-hour period samples are analyzed (Form V [or equivalent]). Verify that all samples were analyzed within 12 hours of DFTPP injection.

If ion abundance criteria are not met, professional judgment may be applied to determine to what extent the data may be utilized. The most important factors to consider are the empirical results that are relatively insensitive to location on the chromatographic profile and type of instrumentation; therefore, the critical ion abundance criteria for DFTPP are the mass to charge (m/z) ratios for 198/199 and 442/443. The relative abundances for m/z 68, 70, 197, and 441 are also very important.

The relative abundances of m/z 51, 127, 275, and 365 are of lesser importance. For example, if the relative abundance of m/z 365 is zero, minimum detection limits may be affected. However, if m/z 365 is present, but less than the 1.0 percent minimum abundance criteria, the deficiency is not as serious. Use professional judgment when samples are analyzed beyond the 12-hour time limit.

DFTPP should also be used to assess GC column performance and injection port inertness. Degradation of 4,4'-dichlorodiphenyltrichloroethane to 4,4'-dichlorodiphenyldichloroethane and 4,4'-dichlorodiphenyldichloroethylene should not exceed 20 percent. Benzidine and pentachlorophenol should be present at their normal responses and should not exceed a tailing factor of 2 using the equation presented in EPA SW-846 8270D (or most current version). Decisions to use analytical data associated with DFTPP instrument performance checks not meeting requirements should be noted in the data validation report.

Level D:

Verify by recalculating from the raw data (mass spectral listing) that the mass assignment is correct and that the mass listing is normalized to the specified m/z. If transcription or rounding errors are discovered on the Form V (or equivalent), request a resubmittal from the laboratory. Validate the data using the criteria outlined above.

4.3 Calibration

Compliance requirements for satisfactory instrument calibration are established to ensure that the instrument is capable of producing acceptable qualitative and quantitative data for compounds on the semivolatile target compound list for both Full Scan and SIM analyses.

4.3.1 Initial Calibration

Initial calibration demonstrates that the instrument is capable of acceptable performance in the beginning of the analytical run and of producing an acceptable calibration curve for both Full Scan and SIM analyses.

Level C and Level D:

1. Evaluate the average relative response factors (RRFs) for all target compounds by checking Form VI (or equivalent).
2. If any of the semivolatile target compounds listed in Table C-II-3below has an average RRF of less than 0.01 or any other semivolatile target compound has an average RRF of less than 0.05, flag positive results for that compound as estimated “J” and nondetects as unusable “R” in associated samples.

Table C-II-3: Semivolatile Compounds Exhibiting Poor Response

2,2’-Oxybis-(1-chloropropane)	Benzaldehyde
4-Chloroaniline	4-Nitroaniline
Hexachlorobutadiene	4,6-Dinitro-2-methylphenol
Hexachlorocyclopentadiene	N-Nitrosodiphenylamine
2-Nitroaniline	3,3’-Dichlorobenzidine
3-Nitroaniline	1,1’-Biphenyl
2,4-Dinitrophenol	Dimethylphthalate
4-Nitrophenol	Diethylphthalate

Acetophenone	1,2,4,5-Tetrachlorobenzene
Caprolactam	Carbazole
Atrazine	Butylbenzylphthalate
Di-n-butylphthalate	Di-n-octylphthalate
Bis(2-ethylhexyl)phthalate	

3. Check Form VI (or equivalent) and evaluate the percent relative standard deviation (%RSD) for all target compounds. If any semivolatile target compound has a %RSD of greater than 15 percent, flag detects for the affected compounds as “J” and nondetects as “UJ” in the associated samples that correspond to that initial calibration.

Level D:

1. Verify the files reported on Form VI (or equivalent) against the quantitation reports, mass spectra, and chromatograms. If the files do not match, the RRFs reported are likely to be from another initial calibration and will have to be changed. Request a resubmittal from the laboratory.
2. Recalculate the average RRFs and %RSDs reported on Form VI (or equivalent) for one compound per internal standard from the raw data (preferably compounds which were identified in the samples) on the low-point calibration standard and one additional calibration standard. If errors are discovered, request a resubmittal from the laboratory. Validate the data according to the criteria outlined above.

4.3.2 Initial Calibration Verification

The initial calibration curve must be verified with a standard that has been purchased or prepared from an independent source each time initial calibration is performed. A standard from the same manufacturer but independently prepared from different source materials may also be used as an independent source. This initial calibration verification (ICV) must contain all of the method target compounds.

Level C and Level D:

1. Verify the ICV was analyzed following the initial calibration and contained all method target compounds.
2. If any target analyte has a percent difference (%D) greater than 20 percent, flag detects for the affected compounds as estimated “J” and nondetects as estimated “UJ” in all samples associated with the initial calibration.

Level D:

Verify from the raw data that there were no calculation or transcription errors by recalculating a percentage of the ICV calculations.

4.3.3 Continuing Calibration

The continuing calibration checks document satisfactory maintenance and adjustment of the instrument on a day-to-day basis for both Full Scan and SIM analyses.

Level C and Level D:

1. Continuing calibration standards containing both target compounds and system monitoring compounds must be analyzed every 12 hours during operation. Evaluate the continuing RRFs on Form VII (or equivalent).
2. Ensure that the average RRFs reported on Form VII (or equivalent) correspond to the average RRFs reported on Form VI (or equivalent) for the corresponding initial calibration.
3. If any of the semivolatile target compounds listed in Table C-II-3 has an average RRF of less than 0.01 or any other semivolatile target compound has an average RRF of less than 0.05, flag positive results for that compound as estimated “J” and nondetects as unusable “R” in associated samples.
4. If any semivolatile target compound has a %D between the initial calibration average RRF and continuing calibration RRFs outside 20 percent, flag all detects as “J” and all nondetects as “UJ” in all associated samples that correspond to that continuing calibration.
5. An ending continuing calibration is required by DoD QSM Appendix B (an ending continuing calibration is not required by the method) and professional judgment should be used in qualifying associated data when the %D is outside 50 percent.

Level D:

1. Verify the file reported on Form VII (or equivalent) against the raw data for the continuing calibration. If the file does not match, the RRFs reported are likely to be from another continuing calibration and will have to be changed. Request a resubmittal from the laboratory.
2. Recalculate the reported RRFs and %Ds reported on Form VII (or equivalent) for one compound per internal standard. If errors are discovered, request a resubmittal from the laboratory. Validate the data according to the criteria outlined above.

4.4 BLANKS

Method blank analytical results are assessed to determine the existence and magnitude of contamination problems. If problems with any method blank exist, all associated data must be carefully evaluated to determine whether there is any bias on the data, or if the problem is an isolated occurrence not affecting other data. Results may not be corrected by subtracting any blank values.

Level C and Level D:

1. The reviewer should identify samples associated with each method blank using Form IV (or equivalent). Verify that method blank analysis has been reported per matrix and concentration level for each set of samples. Each sample must have an associated method blank. Qualify positive results in samples with no method blank as unusable “R.” Nondetects do not require qualification.
2. Compare the results of each method blank with the associated sample results. The reviewer should note that the blank analyses may not involve the same weights, volumes, percent moistures, or dilution factors as the associated samples. These factors must be taken into consideration when applying the criteria discussed below, such that a comparison of the total amount of contamination is actually made.

3. If a compound is found in the blank, but not in the associated sample, no action is taken.

4. Compounds that are detected in both the sample and the associated blank with the exception of bis(2-ethylhexylphthalate) shall be qualified when the sample concentration is less than the limit of quantitation (LOQ) and the blank concentration is less than, greater than, or equal to the LOQ. Bis(2-ethylhexylphthalate) shall be qualified when the sample concentration is less than five times (5×) the LOQ and the blank concentration is less than, greater than, or equal to 5× LOQ. Care should be taken to factor in the percent moisture when comparing detects in the sample and the method blank. The applicable review qualifier(s) are summarized in Table C-II-4.

Table C-II-4: Blank Qualifications

Sample Result	Sample Value	Reviewer Qualifier(s)
Less than LOQ* and blank result is <, > or = LOQ*	Leave as reported	U
≥ LOQ*, blank result is < LOQ*	Leave as reported	None
≥ LOQ*, blank result is > LOQ* and sample result < blank result	Leave as reported	Use professional judgment
≥ LOQ*, blank result is > LOQ* and sample result ≥ blank result	Leave as reported	Use professional judgment
≥ LOQ* and blank result is = LOQ*	Leave as reported	Use professional judgment

*5x LOQ for bis(2-ethylhexylphthalate)

In the case wherein both the sample concentration and the blank concentration are greater than or equal to the LOQ, previously approved criteria as identified in the project planning documents may be applied to qualify associated sample results. Otherwise, qualify sample results as non-detect “U” when the sample concentration is less than or equal to 10 times the blank concentration (10× rule) for the phthalates listed in Table C-II-5 and tentatively identified compounds (TICs). For all other compounds, qualify sample results as non-detect “U” when the sample concentration is less than or equal to 5× the blank concentration (5× rule).

Table C-II-5: Phthalates

Dimethylphthalate
Diethylphthalate
Di-n-butylphthalate
Butylbenzylphthalate
Bis(2-ethylhexylphthalate)
Di-n-octylphthalate

5. If gross contamination exists in the blanks (i.e., saturated peaks by GC/MS), all compounds affected shall be flagged as unusable “R” due to interference in all samples affected and this shall be noted in the data validation comments.

6. If target compounds other than common laboratory contaminants are found at low levels in the blank(s), it may be indicative of a problem at the laboratory and shall be noted in the data validation report.

7. Additionally, there may be instances where little or no contamination was present in the associated blanks, but qualification of the sample was deemed necessary. Contamination

introduced through dilution water is one example. Although it is not always possible to determine, instances of this occurring can be detected when contaminants are found in the diluted sample result, but are absent in the undiluted sample result. It may be impossible to verify this source of contamination; however, if the reviewer determines that the contamination is from a source other than the sample, the data should be qualified. The sample value shall be reported as a nondetect and the reason shall be documented in the data validation report.

Level D:

1. Verify all target compound and TIC detects found in the method blanks against the raw data.
2. Verify that the target compound detects have valid spectra, as defined in Section 4.10 and the tentative identity of any TICs against the raw data, as defined in Section 4.12. If the spectra are not valid or the tentative identity is in error, request for a corrected Form I for the method blank from the laboratory.
3. Verify detected concentrations of target compounds and TICs from the raw data, as defined in Section 4.11. After the validity of the target compounds and TICs is verified, validate the corresponding data using the criteria outlined above.

4.5 BLANK SPIKES AND LABORATORY CONTROL SAMPLES

Blank spike/laboratory control sample (LCS) recoveries must be within the QC limits specified in the DoD QSM Appendix C unless project-specific control limits are established for a given sample matrix. Use in-house limits if compounds are not listed in Appendix C or project limits are not specified.

Level C and Level D:

1. If the blank spike/LCS results are 0 percent, only the spiked compounds that showed low recovery in all associated samples shall be flagged as unusable “R” for nondetects and estimated “J” for detects.
2. If blank spike/LCS results are below the control limits (but above 0 percent), spiked compounds which showed low recovery in all associated samples shall be flagged as estimated “UJ” or “J.”
3. If blank spike/LCS results are above the control limits, detects for only the spiked compounds which showed high recovery in all associated samples shall be flagged as estimated “J.”
4. If the laboratory analyzes a blank spike duplicate/LCS duplicate (LCSD), evaluate and qualify the LCSD results using the criteria noted above.
5. If the relative percent difference (RPDs) between LCS and LCSD results are above the control limits (use the MS/MSD RPD control limits identified in DoD QSM Appendix B, if none are available use laboratory in-house limits), spiked compounds which showed high RPD in all associated samples shall be flagged as estimated “UJ” or “J.”

Level D:

To check that the spike percent recovery was calculated and reported correctly using the following equation, recalculate one or more spike recoveries per matrix (and any spike that would result in the qualification of a sample).

$$\%Recovery = \frac{Q_d}{Q_a} \times 100$$

Where:

Q_d = Quantity determined by analysis

Q_a = Quantity added to samples/blanks

If transcription errors are discovered on Form III (or equivalent), request a resubmittal from the laboratory. Validate the data according to the criteria outlined above.

4.6 SYSTEM MONITORING COMPOUNDS (SURROGATE SPIKES)

Laboratory performance on individual samples is established by means of surrogate spiking activities. All samples are spiked with surrogate compounds prior to sample preparation. The evaluation of the results of these surrogate spikes is not necessarily straightforward. The sample itself may produce effects because of factors such as interferences and high concentrations of compounds. Since the effects of the sample matrix are frequently outside the control of the laboratory and may present relatively unique problems, the review and validation of data based on specific sample results is frequently subjective and demands analytical experience and professional judgment. The following procedures shall be followed:

Level C and Level D:

1. Sample and blank surrogate recoveries for semivolatiles must be within the QC limits specified in the DoD QSM Appendix C unless project-specific control limits are established. Use in-house limits if surrogates are not listed in Appendix C or project limits are not specified. Verify that no samples or blanks have surrogates outside the criteria from Form II (or equivalent).
2. If two or more surrogates in a base/neutral fraction or two or more surrogates in an acid fraction are out of specification, or if at least one surrogate has a recovery of less than 10 percent, then the sample should be re-analyzed though surrogate results still could be outside the criteria. (Note: When unacceptable surrogate recoveries are followed by successful re-analyses, the laboratories are required to report only the successful run unless the re-analyses were performed outside the holding times. Laboratories do not have to perform a re-analysis if a matrix spike/matrix spike duplicate was performed on the sample with out-of-control surrogate results showing the same matrix effects.)
3. The laboratory has failed to perform satisfactorily if surrogate recoveries are out of specification with no evidence of re-analysis. The non-surrogate recoveries shall be documented in the data validation report.

4. If two or more surrogates in the base/neutral fraction or two or more surrogates in the acid fraction are less than lower acceptance limit, but have a recovery greater than or equal to 10 percent, qualify positive results for that fraction as estimated "J" and nondetects as estimated "UJ." (Note that all phenols pertain to the acid fraction; all remaining compounds correspond to the base neutral fraction.)
5. If any surrogate in a fraction shows less than 10 percent recovery, qualify positive results for that fraction as estimated "J," and nondetects for the fraction as unusable "R."
6. If two or more surrogates in either base/neutral or acid-faction have a recovery greater than the upper acceptance limit, detected compounds in that fraction are qualified "J." Nondetects should not be qualified.
7. No qualification with respect to surrogate recovery is placed on data unless at least two surrogates in the semivolatile fraction are out of specification or unless any surrogate has less than 10 percent recovery.
8. In the special case of blank analysis with surrogates out of specification, the reviewer must give special consideration to the validity of associated sample data. The basic concern is whether the blank problems represent an isolated problem with the blank alone, or whether there is a fundamental problem with the analytical process. For example, if the samples in the batch show acceptable surrogate recoveries, the reviewer may determine the blank problem to be an isolated occurrence for which no qualification of the data is required.
9. Surrogates may be reported as "diluted out" (D); if dilution is such that the surrogate can no longer be detected. If this is the case, note in the data validation report that surrogate evaluation could not be performed due to a high dilution factor. A full evaluation of the sample chromatogram and quantitation report may be necessary to determine that surrogates are truly "diluted out."

Level D:

Verify that the surrogate percent recovery was calculated and reported correctly using the following equation. Recalculate all surrogate recoveries for one sample per matrix:

$$\%Recovery = \frac{Q_d}{Q_a} \times 100$$

Where:

Q_d	=	Quantity determined by analysis
Q_a	=	Quantity added to samples/blanks

If transcription errors are discovered on Form II (or equivalent), request a resubmittal from the laboratory. Validate the data according to the criteria outlined above.

4.7 MATRIX SPIKE/MATRIX SPIKE DUPLICATE

Matrix Spike/Matrix Spike Duplicate (MS/MSD) data are used to determine the effect of the matrix on a method's recovery efficiency and precision for a specific sample matrix.

No action is taken on MS/MSD data alone to qualify an entire data package. Using informed professional judgment; however, the data reviewer may use the MS/MSD results in conjunction with other QC criteria (i.e., surrogates and LCS) and determine the need for some qualification of the data.

The data reviewer should first try to determine the extent to which the results of the MS/MSD affect the associated data. This determination should be made with regard to the MS/MSD sample itself, as well as specific compounds for all samples associated with the MS/MSD.

In those instances where it can be determined that the results of the MS/MSD affect only the sample spiked, then qualification should be limited to this sample alone. It may be determined through the MS/MSD results, however, that a laboratory is having a systematic problem in the analysis of one or more compounds, which affects all associated samples.

Note: If a field blank was used for the MS/MSD, the information must be included in the data validation summary. Sample matrix effects have not been observed with field blanks therefore the recoveries and precision do not reflect the analytical impact of the site matrix.

Level C and Level D:

The laboratory must spike and analyze an MS/MSD from the specific project site as required for each matrix type and analytical batch.

1. MS/MSD data should be reported on a MS/MSD summary form similar to Form III (or equivalent).
2. Compare the percent recovery (%R) and relative percent difference (RPD) for each spiked compound with the QC limits specified in the DoD QSM Appendix C unless project-specific control limits are established. Use in-house limits if spiked compounds are not listed in Appendix C or project limits are not specified.
3. If MS/MSD results are 0 percent, only the spiked compounds that showed low recovery in the parent sample shall be flagged as unusable “R” for nondetects and estimated “J” for detects.
4. If MS/MSD results are below the control limits (but above 0 percent), spiked compounds which showed low recovery in the parent sample shall be flagged as estimated “UJ” or “J.”
5. If MS/MSD results are above the control limits, detects for only the spiked compounds which showed high recovery in the parent sample shall be flagged as “J.”
6. If the RPDs between MS and MSD results are greater than 20 percent, detects for only the spiked compounds which showed high RPD in the parent sample shall be flagged as estimated “J.”
7. Failure of MS/MSD due to the presence of a target compound in the parent sample at greater than two times the spike concentration or diluted by more than a factor of two should not result in any qualifications. Note the incident in the data validation report.

Level D:

Check the raw data and recalculate one or more percent recoveries (%Rs) and RPDs, especially %Rs and RPDs that resulted in the qualification of data, using the following equations to verify that results on Form III (or equivalent) are correct.

$$\%R = \frac{(SSR - SR)}{SA} \times 100$$

$$RPD = \frac{ABS|SSR - SDR|}{(SSR + SDR)/2} \times 100$$

Where:

SA	=	spike added
SR	=	sample result
SSR	=	spiked sample result
SDR	=	spiked duplicate result
ABS	=	absolute value

If transcription errors are discovered on Form III (or equivalent), request a resubmittal from the laboratory. Validate the data according to the criteria outlined above.

4.8 FIELD QC SAMPLES

Field QC samples discussed in this section of the procedures are equipment blanks, field blanks, field duplicates, and field triplicates.

4.8.1 Equipment Blanks and Field Blanks

Compounds detected in equipment blanks indicate the possibility of cross-contamination between samples due to improper equipment decontamination.

A field blank sample may be collected from each source of water used during each sampling event. The field blank may be analyzed to assess whether the chemical nature of the water used in decontamination may have affected the analytical results of site samples.

If semivolatile organic compounds are detected in the equipment blanks and/or field blanks, the procedure for the qualification of associated sample results is identical to the criteria outlined in Section 4.4 of this procedure.

Level C and Level D:

1. Determine which field QC samples apply to samples in the sample delivery group (SDG).

2. Ensure that units are correct when applying field QC blank qualifications. If samples are soil matrix, results must first be converted to microgram per liter from microgram per kilogram (µg/kg) to make correct comparisons.
3. Because of the way in which the field blanks and equipment blanks are sampled, equipment blanks are not qualified because of field blank contamination. The affected samples are qualified, however, by either the field blank or equipment blank results, whichever has the higher contaminant concentration.
4. Equipment blanks and field blanks are only qualified with method blank results in order to account for laboratory contamination.

Level D:

1. Verify all target compound and TIC detects found in the equipment blanks and field blanks against the raw data.
2. Verify that the target compound detects have valid spectra, as defined in Section 4.10 and verify the tentative identity of any TICs against the raw data, as defined in Section 4.12. If the spectra are not valid, or the tentative identity is in error, request for a corrected Form I (or equivalent) for the equipment blank or field blank from the laboratory.
3. Verify detected concentrations of target compounds and TICs from the raw data, as defined in Section 4.11. After the validity of the target compounds and TICs is verified, validate the corresponding data using the criteria outlined above.

4.8.2 Field Duplicates and Field Triplicates

Field duplicates consist of either collocated or subsampled samples. Field duplicates for ground water and surface water samples are generally considered to be collocates. Soil duplicate samples may be homogenized and subsampled in the field (or at the laboratory) to form an original and duplicate sample, or may be an additional volume of sample collected in a separate sample container to form a collocate sample. Field duplicate results are an indication of both field and laboratory precision; the results may be used to evaluate the consistency of sampling practices.

Field triplicates are collected from different, randomly selected locations to verify that an incremental sample truly represents a decision unit. Field triplicate results are more useful than field duplicates to statistically evaluate sampling precision.

Level C and Level D:

1. Check to ensure that field duplicates and/or field triplicates were collected and analyzed as specified in the project planning documents. If the sampling frequency is less than the frequency stated in the planning documents, no qualification of the associated sample results is necessary but the incident shall be discussed in the data validation report.
2. For field duplicate results, if the RPDs are greater than 50 percent for water or 100 percent for soil or as stated in the planning document if more conservative, no qualification of the associated sample results is necessary, but the differences should be noted in the data validation summary.

3. For field triplicate results, if the RSDs are greater than the QC limits stated in the planning document, no qualification of the associated sample results is necessary, but the differences should be noted in the data validation summary.

Level D:

1. Verify all target compound and TIC detects found in the field duplicates and/or field triplicates against the raw data.
2. Verify that the target compound detects have valid spectra, as defined in Section 4.10 and the tentative identity of any TICs against the raw data, as defined in Section 4.12. If the spectra are not valid, or the tentative identity is in error, request for a corrected Form I (or equivalent) for the sample or field duplicate from the laboratory.
3. Verify detected concentrations of target compounds and TICs from the raw data, as defined in Section 4.11. After the validity of the target compounds and TICs is verified, validate the corresponding data using the criteria outlined above.

4.9 INTERNAL STANDARDS PERFORMANCE

Internal standards performance criteria ensure that GC/MS sensitivity and response are stable during every analytical run.

Level C and Level D:

1. If an internal standards area count for a sample is outside –50 percent or +100 percent of the area the initial calibration midpoint standard:
2. Positive results for compounds quantitated using an internal standards area count greater than 100 percent should be qualified as estimated "J." Nondetected compounds should not be qualified.
3. Compounds quantitated using an internal standards area count less than 50 percent should be qualified as estimated "J" for detects and estimated "UJ" for nondetects.
4. If extremely low area counts are reported (less than 20 percent of the area for associated standards), detected compounds should be qualified as estimated "J" and nondetected target compounds should then be qualified as unusable "R."
5. If an internal standards retention time varies by more than 10 seconds from the retention time of the initial calibration midpoint standard, the nondetected target compounds should be qualified as unusable "R" for Level C validation. A Level D validation examination of the raw data should be recommended to the CTO Manager. The chromatographic profile for that sample must be examined to determine if any false positives or negatives exist. For shifts of a large magnitude, the reviewer may consider partial or total rejection of the data for that sample fraction. Positive results should be qualified as "NJ" if the mass spectral criteria are met.

Level D:

Verify the internal standard areas reported on Form VIII (or equivalent) from the raw data for at least one sample per SDG, and verify internal standard areas for samples that were qualified due to out-of-control internal standard areas. If errors are discovered between the raw data and the Form VIII (or equivalent), request a resubmittal from the laboratory. Validate the data according to the criteria outlined above.

4.10 TARGET COMPOUND IDENTIFICATION

The objective of the criteria for GC/MS qualitative analysis is to minimize the number of erroneous identifications of target compounds. An erroneous identification can either be false positive (reporting a compound present when it is not) or a false negative (not reporting a compound that is present).

The identification criteria can be applied more easily in detecting false positives than false negatives. More information is available for false positives because of the requirement for submittal of data supporting positive identifications. However, negatives, or nondetected compounds, represent an absence of data and are, therefore, more difficult to assess. One example of detecting false negatives is the not reporting of a target compound that is reported as a TIC.

Level C:

Target compound identification is not evaluated for Level C validation because it requires the interpretation of mass spectral raw data.

Level D:

The following criteria should be followed when evaluating raw data.

1. The relative retention times (RRTs) must be within ±0.06 RRT units of the standard RRT.
2. Mass spectra of the sample compound and a current laboratory-generated standard (i.e., the mass spectrum from the associated calibration standard) must match according to the following criteria:
3. All ions present in the standard mass spectrum at a relative intensity greater than 10 percent must be present in the sample spectrum.
4. The relative intensities of these ions must agree within ± 20 percent between the standard and sample spectra. (Example: For an ion with an abundance of 50 percent in the standard spectrum, the corresponding sample ion abundance must be between 30 percent and 70 percent.)
5. Ions present at greater than 10 percent in the sample mass spectrum, but not present in the standard spectrum, must be considered and accounted for.
6. The application of qualitative criteria for GC/MS analysis of target compounds requires professional judgment. It is up to the reviewer’s discretion to obtain additional information from the laboratory and CTO Manager. If it is determined that incorrect identifications were made, all such data should be qualified as not detected “U” or unusable “R.”
7. Professional judgment must be used to qualify the data if it is determined that cross-contamination has occurred. Any changes made to the reported compounds or concerns regarding target compound identifications should be clearly indicated in the data validation report.

4.11 COMPOUND QUANTITATION AND REPORTING LIMITS

The objective is to ensure that the reported quantitation results and reporting limits (i.e., LOQ, LOD, detection limit [DL]) are accurate. All soil sample results are reported on a dry weight basis.

Level C and Level D:

1. Verify that the reporting limits for nondetects are equal to the LOD. Verify that an annual DL study was performed or quarterly LOD/LOQ verification checks were performed in accordance with the DoD QSM. The LOD/LOQ verification check must be evaluated to determine whether the laboratory can reliably detect and identify all target analytes at a spike concentration of approximately two times but not more than four times the current reported DL. Qualify nondetects as unusable “R.”
2. Check that reported nondetects and positive values have been adjusted to reflect sample dilutions (including clean-up) and for soil samples, sample moisture. When a sample is analyzed at more than one dilution, the lowest LODs are used unless a QC criterion has been exceeded. In this case, the higher LODs from the diluted analysis are used. The least technically sound data will be flagged “R” with a qualification code “D.”
3. Verify that LOQs/LODs for soils and sediments were calculated based on dry weight. If the LOQs/LODs were reported based on wet weight, the percent moisture must be factored in and the LOQs/LODs must be adjusted accordingly.
4. Verify that no results exceed the highest calibration standard without being diluted. If a result has exceeded the highest calibration standard, verify that a dilution was performed. If not, qualify the detected compound that required dilution as “J” and document the event in the data validation report.

Level D:

The compound quantitation must be evaluated for all detects by evaluating the raw data. Compound concentrations must be calculated based on the internal standards associated with that compound, as listed in the following equation. Quantitation must be based on the quantitation ion (m/z) specified in the method or project planning document for both the internal standards and target compounds. The compound quantitation must be based on the RRF from the appropriate initial calibration standard.

Water

$$\mu g/L = \frac{A_x \times I_s \times D_f \times V_t}{A_{is} \times ARRF \times V_o \times V_i}$$

Where:

A_x	=	area of characteristic ion (extracted ion current profile) for compound being measured
A_{is}	=	area of characteristic ion for the internal standard
I_s	=	amount of internal standard added (nanograms)
ARRF	=	average relative response factor for compound being measured

V_o = volume of water extracted (milliliter)

D_f = dilution factor

V_t = volume of extract injected (microliter [µL])

V_i = volume of concentrated extract (µL)

Soil/Sediment

$$\text{Concentration } \mu g/kg \text{ (Dry weight basis)} = \frac{A_x \times I_s \times D_f \times V_t \times 2.0_t}{A_{is} \times ARRF \times Ws \times D \times V_i}$$

Where:

A_x, I_s, RRF, A_{is}, $V_{i,}$ V_t are as given for water, above.

D = $\dfrac{100 - \%\text{ moisture}}{100}$

W_s = Weight of sample extracted, in grams (g)

The factor of 2.0 in the numerator is used to account for the amount of extract that is not recovered from gel permeation chromatography clean up.

If discrepancies are discovered in the quantitation, request a resubmittal from the laboratory. Validate the data according to the criteria outlined above.

4.12 TENTATIVELY IDENTIFIED COMPOUNDS

For each sample analyzed by Full Scan, the laboratory may conduct a mass spectral search of the spectral library and report the possible identity for up to 30 largest semivolatile fraction peaks which are not system monitoring compounds (surrogates), internal standards, or target compounds, but which have area or height greater than 10 percent of the area or height of the nearest internal standard. TIC results are reported for each sample on the Organic Analyses Data Sheet (Form I SV-TIC [or equivalent]). TICs are not reported for SIM analysis.

Level C and Level D:

1. All TIC results should be qualified "NJ," tentatively identified with approximated concentrations.
2. The reviewer should be aware of common laboratory artifacts and their sources such as siloxane compounds, which indicate capillary column degradation, and carbon dioxide, which indicates a possible air leak in the system. These may be qualified as unusable "R."
3. If a target compound is identified as a TIC by non-target library search procedures, the reviewer should request that the laboratory recalculate the result using the proper quantitation ion.
4. TIC results that are not above the 10× level in the blank should be qualified as unusable, "R." (Dilutions and sample size must be taken into account when comparing the amounts present in blanks and samples.)

5. The reviewer may elect to report all similar compounds as a total (e.g., all alkanes may be summarized and reported as total hydrocarbons).

Level D:

1. Check each TIC for each sample using the following criteria.
2. Major ions (greater than 10 percent relative intensity) in the reference spectrum should be present in the sample spectrum.
3. The relative intensities of the major ions should agree within ±20 percent between the sample and the reference spectra.
4. Molecular ions present in the reference spectrum should be present in the sample spectrum.
5. Ions present in the sample spectrum but not in the reference spectrum should be reviewed for possible background contamination, interference, or co-elution of additional TIC or target compounds.
6. When the above criteria are not met, but in the technical judgment of the data reviewer or mass spectral interpretation specialist, the identification is correct, the data validator may report the identification.
7. Since TIC library searches often yield several candidate compounds having a close matching score, all reasonable choices must be considered. The reviewer may use judgment to change the reported tentative identity.

5. Records

A Form I that has been validated and verified, and has been determined by the data validator to accurately represent the appropriate sample results to be utilized, shall be stamped "NAVFAC PACIFIC VALIDATED." Additionally, sample result forms for which the data has been validated at the Level D validation level shall be stamped or noted "Level D."

Copies of all documents generated by the data validation personnel will be stored for no less than 10 years. The original validated laboratory data shall be archived to the Federal Records Center at project completion.

6. References

Department of Defense, United States (DoD). 2005a. *Uniform Federal Policy for Quality Assurance Project Plans, Part 1: UFP-QAPP Manual*. Final Version 1. DoD: DTIC ADA 427785, EPA-505-B-04-900A. In conjunction with the U. S. Environmental Protection Agency and the Department of Energy. Washington: Intergovernmental Data Quality Task Force. March. On-line updates available at: http://www.epa.gov/fedfac/pdf/ufp_qapp_v1_0305.pdf.

———. 2005b. *Uniform Federal Policy for Quality Assurance Project Plans, Part 2B: Quality Assurance/quality Control Compendium: Minimum QA/QC Activities*. Final Version 1. DoD: DTIC ADA 426957, EPA-505-B-04-900B. In conjunction with the U. S. Environmental Protection Agency and the Department of Energy. Washington: Intergovernmental Data Quality Task Force. March. On-line updates available at: http://www2.epa.gov/sites/production/files/documents/qaqc_v1_0305.pdf.

———. 2012. *Uniform Federal Policy for Quality Assurance Project Plans, Part 2A: Optimized UFP-QAPP Worksheets*. Revision 1. March.

———. 2013. *Department of Defense Quality Systems Manual for Environmental Laboratories.* Version 5.0. Draft Final. Prepared by DoD Environmental Data Quality Workgroup and Department of Energy Consolidated Audit Program Operations Team. July.

Environmental Protection Agency, United States (EPA). 2007. *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW-846.* 3rd ed., Final Update IV. Office of Solid Waste. Updates available: www.epa.gov/epaoswer/hazwaste/test/new-meth.htm.

Procedure II-A, *Data Validation.*

7. Attachments

None.

Level C and Level D Data Validation for Organochlorine Pesticides by SW-846 8081

1. Purpose

This data validation procedure sets forth the standard operating procedure for performance of Level C and Level D data validation of organochlorine pesticide data obtained under the United States (U.S.) Navy Environmental Restoration (ER) Program for Naval Facilities Engineering Command (NAVFAC), Pacific and is consistent with protocol in the *Department of Defense Quality Systems Manual (QSM) for Environmental Laboratories* (DoD QSM) (DoD 2013). Level B validation is addressed separately in Procedure II-A, *Data Validation*.

2. Scope

This procedure applies to all Navy ER projects performed in the NAVFAC Pacific Area of Responsibility.

This procedure shall serve as management-approved professional guidance for the ER Program and is consistent with protocol in the most recent version of the Uniform Federal Policy-Quality Assurance Project Plan (UFP QAPP) Part 1 (DoD 2005a), 2A (DoD 2012), and 2B (2005b), as well as the DoD Quality Systems Manual (DoD 2013). As professional guidance for specific activities, this procedure is not intended to obviate the need for professional judgment during unforeseen circumstances. Deviations from this procedure while planning or executing planned activities must be approved and documented by the following prime contractor representatives: the CTO Manager and the Quality Assurance (QA) Manager or Technical Director. A Navy project representative (i.e., Remedial Project Manager or QA Manager) shall also concur with any deviations.

3. Responsibilities

The CTO Manager, the QA Manager or Technical Director, and the CTO QA Coordinator are responsible for ensuring that this procedure is implemented by data validation personnel.

Data validation personnel are responsible for implementing this procedure for validation of all gas chromatography (GC) organochlorine pesticide data.

4. Procedure

This procedure addresses the validation of organochlorine pesticide data obtained using U.S. Environmental Protection Agency (EPA) Method SW-846 8081 (EPA 2007). The quality control (QC) criteria identified in this procedure are those specified in the analytical method and the DoD QSM (DoD 2013). Where project specific criteria are identified in the CTO work plan, they will supersede the QC criteria identified in this procedure.

- Form I: Sample Results Summary Form
- Form II: Surrogate Recovery Summary Form
- Form III: Matrix Spike/Matrix Spike Duplicate or Blank Spike/Blank Spike Duplicate Recovery Summary Form

- Form IV: Method Blank Summary Form
- Form V: Instrument Performance Check Summary Form
- Form VI: Initial Calibration Summary Form
- Form VII: Continuing Calibration Summary Form
- Form VIII: Pesticide Analytical Sequence Form
- Form X: Pesticide Identification Summary Form

Level C data validation consists of review of summary forms only while Level D data validation requires review of both summary forms and all associated raw data. Data review guidelines and how they apply to the different validation levels are indicated in the following text.

4.1 SAMPLE MANAGEMENT

QA/QC criteria included under sample management are sample preservation, handling, and transport; chain of custody (COC); and holding times.

4.1.1 Sample Preservation, Handling, and Transport

Level C and Level D:

Evaluate sample collection, handling, transport, and laboratory receipt from COC and laboratory receipt checklists to ensure that the samples have been properly preserved and handled.

Samples are to be shipped in coolers that are maintained at above freezing to 6 degrees Celsius (°C). If the temperature exceeds 6°C but is less than or equal to 10°C, note this in the data validation report. If the temperature of receipt is greater than or equal to 11°C, positive values shall be flagged as estimated “J” and nondetects as estimated “UJ.” If the temperature is below 0°C, special note should be made that the samples were frozen and no qualification shall be required. In the event that both a cooler temperature and a temperature blank were measured, the temperature blank shall be evaluated for temperature compliance as it best assimilates the condition of the samples; however, both temperatures shall be noted in the data validation report.

If the temperature of the cooler upon receipt at the laboratory was not recorded, document that the laboratory is noncompliant.

Water samples shall not be preserved; they shall only be kept cool. If the water samples were inappropriately preserved with acid, the samples should not be analyzed. Analysis of an inappropriately preserved sample by the laboratory may require that all results be reported as unusable “R.”

1. If the receiving laboratory transferred the samples to another laboratory for analysis, apply the same temperature criteria to both the transfer COC and the original COC.

4.1.2 Chain of Custody

Level C and Level D:

1. Examine the COC for legibility and check that all pesticide analyses requested on the COC have been performed by the laboratory. Ensure that the COC Sample Number on the laboratory Form I (or equivalent) matches the Sample Identification on the COC. Read the laboratory case narrative for additional information.
2. Any samples received for analysis that were not analyzed shall be noted in the data validation report, along with the reason(s) for failure to analyze the samples, if the reason(s) can be determined. Conversely, samples that were analyzed for pesticides but were not requested should also be noted.
3. Any discrepancies in sample naming between the COC and Form I (or equivalent) form shall be noted in the data validation report with the correct sample name being identified if the correct sample name can be determined.
4. If the receiving laboratory transferred the samples to another laboratory for analysis, both the original COCs and transfer COCs shall be present. Document in the data validation report if the transfer COCs are not present.
5. Internal COC is required for all samples, extracts, and digestates from receipt to disposal. Verify the internal COC forms for completeness. Document in the data validation report if the internal COC forms are not present.
6. Each individual cooler shall have an individual COC that lists only samples contained within that cooler. Document in the data validation report if multiple coolers appear on one COC.

4.1.3 Holding Times

Level C and Level D:

Holding times for organochlorine pesticides are measured from the time of collection (as shown on the COC) to the time of sample extraction and from the time of sample extraction to the time of sample analysis (as shown on the Form I [or equivalent]). Samples and extracts must be stored and refrigerated at above freezing to 6°C until the time of analysis.

Water samples shall be unpreserved and refrigerated at above freezing to 6°C and shall be extracted within 7 days of collection and analyzed within 40 days of extraction.

Soil samples shall be unpreserved and refrigerated at above freezing to 6°C and shall be extracted within 14 days of collection and analyzed within 40 days of extraction.

1. If the holding time is exceeded, flag all associated positive results as estimated “J” and all associated limits of detection (LODs) (nondetects) as estimated “UJ,” and document that holding times were exceeded.

2. If holding times are grossly exceeded by greater than a factor of 2.0 (e.g., a non-preserved water sample has an extraction holding time of more than 14 days), detects will be qualified as estimated “J” and nondetects as unusable “R.”

4.2 PESTICIDES INSTRUMENT PERFORMANCE

Level C and Level D:

The objective is to ensure that adequate chromatographic resolution and instrument sensitivity are achieved by the chromatographic system. These criteria are not sample specific; conformance is determined using standard materials. These criteria should therefore be met in all circumstances.

4.2.1 Retention Time Evaluation

4.2.1.1 SURROGATE RETENTION TIMES

Level C and Level D:

Check Form VIII (or equivalent) to verify that the surrogate compounds throughout the sequence are within the absolute retention time windows.

Level C:

If the retention times for the surrogate compounds are outside the retention time windows, the nondetects for that sample shall be qualified as unusable “R” and the detects shall be qualified “N.” A recommendation for Level D validation should be made to potentially salvage usable data.

Level D:

Verify from the raw data that the laboratory reported the surrogate retention times accurately on Form VIII (or equivalent). If the retention times for the surrogate compounds are outside the retention time windows, the reviewer should evaluate the chromatogram for that sample to ensure that there were no false positives or false negatives. Professional judgment should be utilized in the qualification of data.

4.2.1.2 CALIBRATION RETENTION TIMES

Level C and Level D:

During the initial calibration sequence, absolute retention times are determined for all single response pesticides, the surrogates, and at least three major peaks of each multi-component compound. Check Form VII (or equivalent) for retention time shift in the continuing calibration verification standards. Check for possible transcription errors by comparing retention time windows reported on Form VI and Form VII (or equivalent). Verify that all compounds in continuing calibration standards are within the established retention time windows.

Level C:

If the standards do not fall within the retention windows, a recommendation for Level D validation should be made to potentially salvage usable data. The samples injected after the last out of control standard are potentially affected and should be qualified as unusable “R” for nondetects and “N” for detects.

Level D:

Verify from the raw data that the reported retention time windows are calculated and reported correctly. If the continuing calibration standards fall outside the retention windows, the sample chromatograms must be carefully evaluated to ensure there are no false negatives or false positives.

The reviewer should examine the raw data based on expanded retention time. If the identification of the target compound is questionable, the detect may be qualified as a tentative identification “N.”

4.2.2 4,4′-DDT/Endrin Breakdown Evaluation

Level C and Level D:

4,4'-dichlorodiphenyltrichloroethane (DDT) and endrin are easily degraded to 4,4'-dichlorodiphenyldichloroethylene (DDE) and 4,4'-dichlorodiphenyldichloroethane (DDD), and endrin aldehyde and endrin ketone, respectively. Degradation problems are checked with the Performance Evaluation Mixture (PEM). Check Form VII Pest-1 (or equivalent) and verify that the percent breakdowns do not exceed 15 percent for either endrin and 4,4-DDT on both gas chromatography (GC) columns. The combined degradation should not exceed 30 percent.

1. If 4,4'-DDT breakdown is greater than 15 percent, beginning with the samples following the last out of control standard:

   a. Flag all positive results for 4,4′-DDT, 4,4'-DDD, and 4,4'-DDE as estimated “J.”

   b. If 4,4'-DDT was not detected, but 4,4'-DDD and 4,4'-DDE are detected, then flag the LOD for 4,4'-DDT as unusable “R” and flag 4,4'-DDD and 4,4'-DDE detects as presumptively present at an estimated quantity “NJ.”

   c. Use professional judgment where 4,4'-DDT is present on one column but not confirmed on the other column that has greater than 15 percent breakdown. In this case, the reviewer may determine that the compound needs to be reported as tentative “N.”

2. If endrin breakdown is greater than 15 percent:

   a. Flag all positive results for endrin, endrin aldehyde, and endrin ketone as estimated “J.”

   b. If endrin was not detected but endrin aldehyde and endrin ketone are detected, then flag the limit of detection (LOD) for endrin as unusable “R” and flag endrin ketone and endrin aldehyde detects as presumptively present at an estimated quantity “NJ.”

   c. Use professional judgment where endrin is present on one column but not confirmed on the other column that has greater than 15 percent breakdown. In this case, the reviewer may determine that the compound needs to be reported as tentative “N.”

3. If the combined 4,4'-DDT and endrin breakdown is greater than 30 percent:

   a. The reviewer shall consider the degree of individual breakdown of 4,4'-DDT and endrin and apply qualifiers as described above.

Level D:

Verify from the raw data that the 4,4'-DDT/Endrin breakdowns reported on Form VII-Pest-1 (or equivalent) are calculated correctly.

4.3 CALIBRATION

Compliance requirements for satisfactory instrument calibration are established to ensure that the instrument is capable of producing acceptable quantitative data. Initial calibration demonstrates that the instrument is capable of acceptable performance in the beginning, and continuing calibration checks document satisfactory maintenance and adjustment of the instrument on a day-to-day basis.

4.3.1 Analytical Sequence

The proper analytical sequence should be employed as specified in EPA SW-846 Method 8081 (EPA 2007). Instrument blank/PEM or instrument blank/Individual Standard Mixtures A and B must be present every 12 hours. All samples must be associated with a proper initial calibration sequence. The sequence must end with either the instrument blank/PEM or the instrument blank/Individual Standard Mixtures A and B. Professional judgment should be utilized to determine if the data quality is compromised due to inappropriate analytical sequence.

4.3.2 Initial Calibration

The GC system can be calibrated using the external standard technique or internal standard technique. Because of the difficulty in selecting suitable internal standards, the external standard technique will often be the method of choice.

At the beginning of the analysis sequence, calibration standards must be run at minimum five concentration levels for each parameter of interest to establish the calibration curve and expected retention time windows for the compounds of interest. A separate minimum five concentration level calibration is required for multi-component parameters, such as toxaphene and technical chlordane. One of the standards should be at a concentration at or just above the limit of quantitation (LOQ), and the other concentrations should correspond to the expected range of concentrations found in real samples or should define the working range of the detector.

Level C and Level D:

Check Form VI (or equivalent) and verify that reported percent relative standard deviations (%RSDs) are less than or equal to 20 percent. If %RSD is greater than 20 percent, the affected compound shall be qualified as estimated “J” for detects and “UJ” for nondetects.

Level D:

The calibration factors and %RSDs reported on Form VI (or equivalent) must be verified from the raw data to ensure that the calibration factors and %RSDs were calculated correctly and there were no transcription errors. Recalculate the average relative response factors and %RSDs reported on Form VI (or equivalent) for one compound from the raw data (preferably compounds which were identified in the samples) on the low-point calibration standard and one additional calibration standard.

4.3.3 Initial Calibration Verification

The initial calibration curve must be verified with a standard that has been purchased or prepared from an independent source each time initial calibration is performed. A standard from the same manufacturer but independently prepared from different source materials may also be used as an independent source. This initial calibration verification (ICV) must contain all of the method target compounds.

Level C and Level D:

1. Verify the ICV was analyzed following the initial calibration and contained all method target compounds.

2. If any target analyte has a percent difference (%D) greater than 20 percent, flag detects for the affected compounds as estimated “J” and nondetects as estimated “UJ” in all samples associated with the initial calibration.

Level D:

Verify from the raw data that there were no calculation or transcription errors by recalculating a percentage of the ICV calculations.

4.3.4 Continuing Calibration

The working calibration factor must be verified every 12 hours by the injection of PEM and Individual Standard Mixtures A and B prior to sample analysis. The standard mixtures must also be analyzed after every 10 samples and at the end of the analysis sequence to ensure that system performance has not degraded. A continuing calibration standard for multi-component analytes (i.e., toxaphene, chlordane) is required before sample analysis only. If calibration standards for multi-component analytes (i.e., toxaphene, chlordane) were not analyzed prior to sample analysis and if any of the multi-component compounds are detected in any of the samples, the sequence must incorporate a standard for that compound within 72 hours from when the sample was analyzed. If a standard was not analyzed within 72 hours, qualify the detects as estimated “J” in all the samples.

Level C and Level D:

Check Form VII (or equivalent) and verify that all %Ds are less than or equal to 20 percent. If %Ds are outside 20 percent for any target compound, qualify the compound as estimated “UJ” for nondetects and “J” for detects in all samples analyzed after the last out of control standard.

Level D:

Verify from the raw data that there were no calculation or transcription errors on the Form VII (or equivalent).

4.4 BLANKS

Method blank analytical results are assessed to determine the existence and magnitude of contamination problems. If problems with any method blank exist, all associated data must be carefully evaluated to determine whether there is any inherent variability in the data, or if the problem is an isolated occurrence not affecting other data. No contaminants should be present in the method blank(s). The method blank should be analyzed on each GC system used to analyze site samples.

1. The reviewer should identify samples associated with each method blank using Form IV (or equivalent). Verify that method blank analysis has been reported per matrix and concentration level for each set of samples. Each sample must have an associated method blank. Qualify positive results in samples with no method blank as unusable “R.” Nondetects do not require qualification.

2. If the method blank was not analyzed on a GC used to analyze site samples, note the deficiency in the data validation report. Professional judgment shall be used for subsequent qualification of the data.
3. Compare the results of each method blank with the associated sample results. The reviewer should note that the blank analyses may not involve the same weights, volumes, percent moistures, or dilution factors as the associated samples. These factors must be taken into consideration when applying the criteria discussed below, such that a comparison of the total amount of contamination is actually made.
4. If a compound is found in the blank, but not in the associated sample, no action is taken.
5. Any compound, detected in both the sample and the associated blank shall be qualified when the sample concentration is less than the LOQ and the blank concentration is less than, greater than, or equal to the LOQ. Care should be taken to factor in the percent moisture when comparing detects in the sample and the method blank. The applicable review qualifier(s) are summarized in Table II-E-1.

Table II-E-1: Blank Qualifications

Sample Result	Sample Value	Reviewer Qualifier(s)
Less than LOQ and blank result is <, >or = LOQ	Leave as reported	U
≥LOQ, blank result is < LOQ	Leave as reported	None
≥LOQ, blank result is > LOQ and sample result < blank result	Leave as reported	Use professional judgment
≥LOQ, blank result is > LOQ and sample result ≥ blank result	Leave as reported	Use professional judgment
≥LOQ and blank result is = LOQ	Leave as reported	Use professional judgment

6. In the case wherein both the sample concentration and the blank concentration are greater than or equal to the LOQ, previously approved criteria as identified in the project planning documents may be applied to qualify associated sample results. Otherwise, qualify sample results as non-detect "U" when the sample concentration is less than or equal to 5 times the blank concentration (5× rule).
7. Instances of contamination can be attributable to the dilution process. These occurrences are difficult to determine; however, the reviewers should qualify the sample data as nondetects, "U," when the reviewer determines the contamination to be from a source other than the sample.
8. In the event of gross contamination (i.e., saturated peaks) in the blanks, the associated samples must be evaluated for gross contamination. If gross contamination exists in the samples, the affected compounds should be qualified as unusable, "R."

Level D:

1. Verify from the preparation log that the information recorded on Form IV (or equivalent) is correct.
2. Review the results of all blank raw data and Form I (or equivalent) to ensure that there were no false negatives or false positives.

3. Verify all target compound detects found in the method blanks against the raw data. Follow the guidelines specified in Sections 4.9 and 4.10 of this procedure. After the validity of the target compounds are verified, validate the corresponding data using the criteria outlined above for Level C and Level D validation.

4.5 BLANK SPIKES AND LABORATORY CONTROL SAMPLES

Blank spike/laboratory control sample (LCS) recoveries must be within the QC limits specified in the DoD QSM Appendix C unless project-specific control limits are established for a given sample matrix. Use in-house limits if compounds are not listed in Appendix C or project limits are not specified.

Level C and Level D:

1. If the blank spike/LCS results are 0 percent, only the spiked compounds that showed low recovery in all associated samples shall be flagged as unusable "R" for nondetects and estimated "J" for detects.

2. If blank spike/LCS results are below the control limits (but above 0 percent), spiked compounds which showed low recovery in all associated samples shall be flagged as estimated "UJ" or "J."

3. If blank spike/LCS results are above the control limits, detects for only the spiked compounds which showed high recovery in all associated samples shall be flagged as estimated "J."

4. If the laboratory analyzes a blank spike duplicate/LCS duplicate (LCSD), evaluate and qualify the LCSD results using the criteria noted above.

5. If the relative percent differences (RPDs) between LCS and LCSD results are above the control limits (use the matrix spike [MS]/matrix spike duplicate [MSD] RPD control limits identified in DoD QSM Appendix B, if none are available use laboratory in-house limits), spiked compounds which showed high RPD in all associated samples shall be flagged as estimated "UJ" or "J."

Level D:

To check that the spike percent recovery was calculated and reported correctly using the following equation, recalculate one spike recovery per matrix (and any spike that would result in the qualification of a sample).

$$\%\text{Recovery} = \frac{Q_d}{Q_a} \times 100$$

Where:

Q_d	=	Quantity determined by analysis
Q_a	=	Quantity added to samples/blanks

If transcription errors are discovered on Form III (or equivalent), request a resubmittal from the laboratory. Validate the data according to the criteria outlined above.

4.6 SURROGATE RECOVERY

Laboratory performance on individual samples is established by means of surrogate spiking activities. All samples are spiked with two surrogate compounds prior to sample preparation. The evaluation of the results of these surrogate spikes is not necessarily straightforward. The sample itself may produce effects because of factors such as interferences and high concentrations of compounds. Since the effects of the sample matrix are frequently outside the control of the laboratory and may present relatively unique problems, the review and validation of data based on specific sample results is frequently subjective and demands analytical experience and professional judgment. The following procedures shall be followed:

Level C and Level D:

Sample and blank surrogate recoveries for pesticides must be within the QC limits specified in the DoD QSM Appendix C unless project-specific control limits are established. Use in-house limits if surrogates are not listed in Appendix C or project limits are not specified. Verify that no samples or blanks have surrogates outside the criteria from Form II (or equivalent).

1. If recovery is below the QC limits for either one of the surrogates, but is above or equal to 10 percent, flag associated positive results as estimated “J” and nondetects as “UJ.”
2. If any surrogate recovery is less than 10 percent, flag all nondetects as unusable “R” and detects as estimated “J.” No qualification is applied if surrogates are diluted beyond detection but note in the data validation report that surrogate evaluation could not be performed due to the high dilution factor.
3. If any surrogate recovery is above the upper QC limit, flag associated positive results as estimated “J.” No qualification of nondetects is necessary in the case of high recoveries.
4. Surrogates may be reported as “diluted out” (D); if dilution is such that the surrogate can no longer be detected. If this is the case, note in the data validation report that surrogate evaluation could not be performed due to a high dilution factor. A full evaluation of the sample chromatogram may be necessary to determine that surrogates are truly "diluted out."

Level D:

The reported surrogate recoveries on Form II should be verified from the raw data for a representative number of samples.

4.7 MATRIX SPIKE/MATRIX SPIKE DUPLICATE

MS/MSD data are used to determine the effect of the matrix on a method’s recovery efficiency and precision for a specific sample matrix.

No action is taken on MS/MSD data alone to qualify an entire data package. Using informed professional judgment; however, the data reviewer may use the MS/MSD results in conjunction with other QC criteria (i.e., surrogates and LCS) and determine the need for some qualification of the data.

The data reviewer should first try to determine the extent to which the results of the MS/MSD affect the associated data. This determination should be made with regard to the MS/MSD sample itself, as well as specific compounds for all samples associated with the MS/MSD.

In those instances where it can be determined that the results of the MS/MSD affect only the sample spiked, then qualification should be limited to this sample alone. It may be determined through the MS/MSD results, however, that a laboratory is having a systematic problem in the analysis of one or more compounds, which affects all associated samples.

Note: If a field blank was used for the MS/MSD, the information must be included in the data validation summary. Sample matrix effects have not been observed with field blanks therefore the recoveries and precision do not reflect the analytical impact of the site matrix.

Level C and Level D:

The laboratory must spike and analyze a MS/MSD from the specific project site as required for each matrix type and analytical batch.

1. MS/MSD data should be reported on a MS/MSD summary form similar to Form III (or equivalent).
2. Compare the percent recovery (%R) and relative percent difference (RPD) for each spiked compound with the QC limits specified in the DoD QSM Appendix C unless project-specific control limits are established. Use in-house limits if spiked compounds are not listed in Appendix C or project limits are not specified.
3. If MS/MSD results are 0 percent, only the spiked compounds that showed low recovery in the parent sample shall be flagged as unusable “R” for nondetects and estimated “J” for detects.
4. If MS/MSD results are below the control limits (but above 0 percent), spiked compounds which showed low recovery in the parent sample shall be flagged as estimated “UJ” or “J.”
5. If MS/MSD results are above the control limits, detects for only the spiked compounds which showed high recovery in the parent sample shall be flagged as “J.”
6. If the RPDs between MS and MSD results are greater than 30 percent, detects for only the spiked compounds which showed high RPD in the parent sample shall be flagged as estimated (J).
7. Failure of MS/MSD due to the presence of a target compound in the parent sample at greater than two times the spike concentration or diluted by more than a factor of two should not result in any qualifications. Note the incident in the data validation report.

Level D:

Check the raw data and recalculate one or more percent recoveries (%Rs) and RPDs, especially %Rs and RPDs that resulted in the qualification of data, using the following equations to verify that results on Form III (or equivalent) are correct.

$$\%R = \frac{(SSR - SR)}{SA} \times 100$$

$$RPD = \frac{ABS|SSR - SDR|}{(SSR + SDR)/2} \times 100$$

Where:

SA	=	spike added
SR	=	sample result
SSR	=	spiked sample result
SDR	=	spiked duplicate result
ABS	=	absolute value

If transcription errors are discovered on Form III (or equivalent), request a resubmittal from the laboratory. Validate the data according to the criteria outlined above.

4.8 FIELD QC SAMPLES

Field QC samples discussed in this section of the procedures are equipment blanks, field blanks, field duplicates, and field triplicates.

4.8.1 Equipment Blanks and Field Blanks

Compounds detected in equipment blanks indicate the possibility of cross-contamination between samples due to improper equipment decontamination.

A field blank sample may be collected from each source of water used during each sampling event. The field blank may be analyzed to assess whether the chemical nature of the water used in decontamination may have affected the analytical results of site samples.

If pesticide compounds are detected in the equipment blanks and/or field blanks, the procedure for the qualification of associated sample results is identical to the criteria outlined in Section 4.4 of this procedure.

Level C and Level D:

1. Determine which field QC samples apply to samples in the sample delivery group.
2. Ensure that units are correct when applying field QC blank qualifications. If samples are soil matrix, results must first be converted to micrograms per liter from micrograms per kilogram to make correct comparisons.
3. Because of the way in which the field blanks and equipment blanks are sampled, equipment blanks are not qualified because of field blank contamination. The affected samples are qualified, however, by either the field blank or equipment blank results, whichever has the higher contaminant concentration.

4. Equipment blanks and field blanks are only qualified with method blank results in order to account for laboratory contamination.

Level D:

Compound identification and quantification of field blank and equipment blank samples must be verified. Follow the guidelines specified in Sections 4.9 and 4.10 of this procedure.

4.8.2 Field Duplicates and Field Triplicates

Field duplicates consist of either collocated or subsampled samples. Field duplicates for ground water and surface water samples are generally considered to be collocates. Soil duplicate samples may be homogenized and subsampled in the field (or at the laboratory) to form an original and duplicate sample, or may be an additional volume of sample collected in a separate sample container to form a collocate sample. Field duplicate results are an indication of both field and laboratory precision; the results may be used to evaluate the consistency of sampling practices.

Field triplicates are collected from different, randomly selected locations to verify that an incremental sample truly represents a decision unit. Field triplicate results are more useful than field duplicates to statistically evaluate sampling precision.

Level C and Level D:

1. Check to ensure that field duplicates and/or field triplicates were collected and analyzed as specified in the project planning documents. If the sampling frequency is less than the frequency stated in the planning documents, no qualification of the associated sample results is necessary but the incident shall be discussed in the data validation report.
2. For field duplicate results, if the RPDs are greater than 50 percent for water or 100 percent for soil or as stated in the planning document if more conservative, no qualification of the associated sample results is necessary, but the differences should be noted in the data validation summary.
3. For field triplicate results, if the RSDs are greater than the QC limits stated in the planning document no qualification of the associated sample results is necessary, but the differences should be noted in the data validation summary.

Level D:

Before comparison of duplicates and/or triplicates, the compound identification and quantification must be verified. Follow the guidelines specified in Sections 4.9 and 4.10 of this procedure.

4.9 TARGET COMPOUND IDENTIFICATION

Qualitative criteria for compound identification have been established to minimize the number of erroneous identifications of compounds. An erroneous identification can be either a false positive (reporting a compound present when it is not) or a false negative (not reporting a compound that is present).

The laboratory must report retention time window data for each compound on each column used to analyze the samples. The retention time windows are used for qualitative identification. Retention times of reported compounds must fall within the calculated window for both chromatographic columns. Second column confirmation must be performed for all GC work. Sample chromatograms for both columns must be provided.

Level C and Level D:

1. Review Form I and Form X (or equivalent). Check for errors.
2. Verify that the retention times of sample compounds reported on the Form X (or equivalent) fall within the calculated retention time windows for both columns. If the qualitative criteria for two-column confirmation were not met, all reported positive detects should be considered nondetect "U."
3. Any compounds confirmed by two columns must be confirmed by gas chromatography/mass spectrometry (GC/MS) if the concentration is sufficient for detection by GC/MS as determined by the laboratory LOQs. The GC/MS would normally require a minimum concentration of 10 nanograms per microliter in the final extract for each single-component. If results indicate that sufficient concentration of compound was present to perform GC/MS but GC/MS was not performed, note this in the data validation report.
4. If second column confirmation is not performed, qualify any reported detect as presumptive and estimated, "NJ."

Level D:

1. Verify from the raw data that the retention time of the detected compound and the retention time windows are correct.
2. Evaluate all sample chromatograms to ensure that there were no peaks present which were not reported (false negatives) or the reported detects did not meet identification criteria (false positives). Presence of a large interfering peak may result in false positives or false negatives. The reviewer should use professional judgment in evaluating the effect of interference.

4.10 COMPOUND QUANTITATION AND REPORTING LIMITS

The objective is to ensure that the reported quantitation results and reporting limits (i.e., LOQ, LOD, detection limit [DL]) are accurate. All soil sample results are reported on a dry weight basis.

Level C:

Specific compound quantitation is not verified for Level C validation.

Level C and Level D:

1. Verify that the reporting limits for nondetects are equal to the LODs. Verify that an annual DL study was performed or quarterly LOD/LOQ verification checks were performed in accordance with the DoD QSM. The LOD/LOQ verification check must be evaluated to determine whether the laboratory can reliably detect and identify all target analytes at a spike concentration of approximately two times but not more than four times the current reported DL. Qualify nondetects as unusable "R."
2. Check that reported nondetects and positive values have been adjusted to reflect sample dilutions (including clean-up) and for soil samples, sample moisture. When a sample is

analyzed at more than one dilution, the lowest LODs are used unless a QC criterion has been exceeded. In this case, the higher LODs from the diluted analysis are used. The least technically sound data will be flagged "R" with a qualification code "D."

3. Verify that reported limits for soils and sediments were calculated based on dry weight. If the LOQs/LODs were reported based on wet weight, the percent moisture must be factored in and the LOQs/LODs must be adjusted accordingly.
4. Single-peak pesticide results can be checked for agreement between quantitative results obtained on the two GC columns. Check Form X (or equivalent) for RPDs between the two column quantitation results. RPD should be less than or equal to 40 percent. If RPD exceeded 40 percent, the affected compound shall be qualified as estimated "J." The higher result should be reported unless overlapping peaks are causing erroneously high results, then the lower result may be reported.
5. If a sample requiring a dilution analysis due to a target compound detect exceeding the calibration linear range was not re-analyzed at a dilution, the compound exceeding calibration range shall be qualified as estimated "J."
6. If the laboratory re-analyzed a sample and submitted both sample results, the reviewer must determine which of the two analyses has better data quality. Only one analysis should be reported and the other is rejected.

Level D:

1. Compound quantification should be verified by recalculation from the raw data for a representative number of samples.
2. Verify from the standard chromatograms that the instrument sensitivity is adequate to support the LODs. Poor sensitivity may result in elevated LODs.
3. Verify from the raw data that the reported RPDs between the two column quantitation results are calculated correctly and there are no transcription errors. The reviewer should be aware that the retention time of the target compound may have shifted due to the interference.

5. Records

A Form I that has been validated and verified, and has been determined by the data validator to accurately represent the appropriate sample results to be utilized, shall be stamped "NAVFAC PACIFIC VALIDATED." Additionally, sample result forms for which the data have been validated at the Level D validation level shall be stamped or noted "Level D."

Copies of all documents generated by the data validation personnel will be stored for no less than 10 years. The original validated laboratory data shall be archived to the Federal Records Center at project completion.

6. References

Department of Defense, United States (DoD). 2005a. *Uniform Federal Policy for Quality Assurance Project Plans, Part 1: UFP-QAPP Manual*. Final Version 1. DoD: DTIC ADA 427785, EPA-505-B-04-900A. In conjunction with the U. S. Environmental Protection Agency and the

Department of Energy. Washington: Intergovernmental Data Quality Task Force. March. On-line updates available at: http://www.epa.gov/fedfac/pdf/ufp_qapp_v1_0305.pdf.

———. 2005b. *Uniform Federal Policy for Quality Assurance Project Plans, Part 2B: Quality Assurance/quality Control Compendium: Minimum QA/QC Activities*. Final Version 1. DoD: DTIC ADA 426957, EPA-505-B-04-900B. In conjunction with the U. S. Environmental Protection Agency and the Department of Energy. Washington: Intergovernmental Data Quality Task Force. March. On-line updates available at: http://www2.epa.gov/sites/production/files/documents/qaqc_v1_0305.pdf.

———. 2012. *Uniform Federal Policy for Quality Assurance Project Plans, Part 2A: Optimized UFP-QAPP Worksheets*. Revision 1. March.

———. 2013. *Department of Defense Quality Systems Manual for Environmental Laboratories.* Version 5.0. Draft Final. Prepared by DoD Environmental Data Quality Workgroup and Department of Energy Consolidated Audit Program Operations Team. July.

Environmental Protection Agency, United States (EPA). 2007. *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW-846*. 3rd ed., Final Update IV. Office of Solid Waste. Updates available: www.epa.gov/epaoswer/hazwaste/test/new-meth.htm.

Procedure II-A, *Data Validation*.

7. Attachments

None.

Level C and Level D Data Validation for Polychlorinated Biphenyls as Congeners by SW-846 8082

1. Purpose

This data validation procedure sets forth the standard operating procedure for performance of Level C and Level D data validation of polychlorinated biphenyl (PCB) as Congeners data obtained under the United States (U.S.) Navy Environmental Restoration (ER) Program for Naval Facilities Engineering Command (NAVFAC), Pacific and is consistent with protocol in the *Department of Defense Quality Systems Manual (QSM) for Environmental Laboratories* (DoD QSM) (DoD 2013). Level B validation is addressed separately in Procedure II-A, *Data Validation*.

2. Scope

This procedure applies to all Navy ER projects performed in the NAVFAC Pacific Area of Responsibility.

This procedure shall serve as management-approved professional guidance for the ER Program and is consistent with protocol in the most recent version of the Uniform Federal Policy-Quality Assurance Project Plan (UFP QAPP) Part 1 (DoD 2005a), 2A (DoD 2012), and 2B (2005b), as well as the DoD Quality Systems Manual (DoD 2013). As professional guidance for specific activities, this procedure is not intended to obviate the need for professional judgment during unforeseen circumstances. Deviations from this procedure while planning or executing planned activities must be approved and documented by the following prime contractor representatives: the CTO Manager and the Quality Assurance (QA) Manager or Technical Director. A Navy project representative (i.e., Remedial Project Manager or QA Manager) shall also concur with any deviations.

3. Responsibilities

The CTO Manager, the QA Manager or Technical Director, and the CTO QA Coordinator are responsible for ensuring that this procedure is implemented by data validation personnel.

Data validation personnel are responsible for implementing this procedure for validation of all gas chromatography (GC) PCB as Congener data.

4. Procedure

This procedure addresses the validation of PCB as Congeners data obtained using U.S. Environmental Protection Agency (EPA) Method Solid Waste (SW)-846 8082 (EPA 2007). The quality control (QC) criteria identified in this procedure are those specified in the analytical method and the DoD QSM (DoD 2013). Where project specific criteria are identified in the CTO work plan, they will supersede the QC criteria identified in this procedure.

- Form I: Sample Results Summary Form
- Form II: Surrogate Recovery Summary Form
- Form III: Matrix Spike/Matrix Spike Duplicate or Blank Spike/Blank Spike Duplicate Recovery Summary Form

- Form IV: Method Blank Summary Form
- Form VI: Initial Calibration Summary Form
- Form VII: Continuing Calibration Summary Form
- Form VIII: PCBs as Congeners Analytical Sequence Form
- Form X: PCBs as Congeners Identification Summary Form

Level C data validation consists of review of summary forms only while Level D data validation requires review of both summary forms and all associated raw data. Data review guidelines and how they apply to the different validation levels are indicated in the following text.

4.1 SAMPLE MANAGEMENT

QA/QC criteria included under sample management are sample preservation, handling, and transport; chain of custody (COC); and holding times.

4.1.1 Sample Preservation, Handling, and Transport

Level C and Level D:

Evaluate sample collection, handling, transport, and laboratory receipt from COC and laboratory receipt checklists to ensure that the samples have been properly preserved and handled.

1. Samples are to be shipped in coolers that are maintained at above freezing to 6 degrees Celsius (°C). If the temperature exceeds 6°C, note this in the data validation report and no data qualification shall be required. PCBs are environmentally stable and are not expected to degrade significantly during transit or storage. If the temperature is below 0°C, special note should be made that the samples were frozen and no qualification shall be required. In the event that both a cooler temperature and a temperature blank were measured, the temperature blank shall be evaluated for temperature compliance as it best assimilates the condition of the samples; however, both temperatures shall be noted in the data validation report.
2. If the temperature of the cooler upon receipt at the laboratory was not recorded, document that the laboratory is noncompliant.
3. Water samples shall not be preserved; they shall only be kept cool. If the water samples were inappropriately preserved with acid, the samples should not be analyzed. Analysis of an inappropriately preserved sample by the laboratory may require that all results be reported as unusable "R."
4. If the receiving laboratory transferred the samples to another laboratory for analysis, apply the same temperature criteria to both the transfer COC and the original COC.

4.1.2 Chain of Custody

Level C and Level D:

Examine the COC for legibility and check that all PCB as Congener analyses requested on the COC have been performed by the laboratory. Ensure that the COC Sample Number on the laboratory Form I (or equivalent) matches the Sample Identification on the COC. Read the laboratory case narrative for additional information.

1. Any samples received for analysis that were not analyzed shall be noted in the data validation report, along with the reason(s) for failure to analyze the samples, if the reason(s) can be determined. Conversely, samples that were analyzed for PCBs as Congeners but were not requested should also be noted.
2. Any discrepancies in sample naming between the COC and Form I (or equivalent) shall be noted in the data validation report with the correct sample name being identified if the correct sample name can be determined.
3. If the receiving laboratory transferred the samples to another laboratory for analysis, both the original COCs and transfer COCs shall be present. Document in the data validation report if the transfer COCs are not present.
4. Internal COC is required for all samples, extracts, and digestates from receipt to disposal. Verify the internal COC forms for completeness. Document in the data validation report if the internal COC forms are not present.
5. Each individual cooler shall have an individual COC that lists only samples contained within that cooler. Document in the data validation report if multiple coolers appear on one COC.

4.1.3 Holding Times

Level C and Level D:

There is no holding time for PCBs as Congeners per Chapter 2 of EPA SW-846 (EPA 2007). If the recommended holding time criteria below are not met, data will not be qualified.

Water samples shall be unpreserved and refrigerated at above freezing to 6°C and shall be extracted within 7 days of collection and analyzed within 40 days of extraction.

Soil samples shall be unpreserved and refrigerated at above freezing to 6°C and shall be extracted within 14 days of collection and analyzed within 40 days of extraction.

4.2 CALIBRATION

Compliance requirements for satisfactory instrument calibration are established to ensure that the instrument is capable of producing acceptable quantitative data. Initial calibration demonstrates that the instrument is capable of acceptable performance in the beginning, and continuing calibration checks document satisfactory maintenance and adjustment of the instrument on a day-to-day basis.

4.2.1 Initial Calibration

The GC system can be calibrated using the external standard technique or internal standard technique. Because of the difficulty in selecting suitable internal standards, the external standard technique will often be the method of choice.

At the beginning of the analysis sequence, calibration standards must be run at five concentration levels for each parameter of interest to establish the calibration curve and expected retention time windows for the compounds of interest. One of the standards should be at a concentration at or just above the limit of quantitation (LOQ), and the other concentrations should correspond to the expected range of concentrations found in real samples or should define the working range of the detector.

Level C and Level D:

Check Form VI (or equivalent) and verify that reported percent relative standard deviations (%RSDs) are less than or equal to 20 percent. If %RSD is greater than 20 percent, the affected compound shall be qualified as estimated “J” for detects and “UJ” for nondetects.

Level D:

The calibration factors and %RSDs reported on Form VI (or equivalent) must be verified from the raw data to ensure that the calibration factors and %RSDs were calculated correctly and there were no transcription errors. Recalculate the average relative response factors and %RSDs reported on Form VI (or equivalent) for one compound from the raw data (preferably compounds which were identified in the samples) on the low-point calibration standard and one additional calibration standard.

4.2.2 Initial Calibration Verification

The initial calibration curve must be verified with a standard that has been purchased or prepared from an independent source each time initial calibration is performed. A standard from the same manufacturer but independently prepared from different source materials may also be used as an independent source. This initial calibration verification (ICV) must contain all of the method target compounds.

Level C and Level D:

1. Verify the ICV was analyzed following the initial calibration and contained all method target compounds.
2. If any target analyte has a percent difference (%D) greater than 20 percent, flag detects for the affected compounds as estimated “J” and nondetects as estimated “UJ” in all samples associated with the initial calibration.

Level D:

Verify from the raw data that there were no calculation or transcription errors by recalculating a percentage of the ICV calculations.

4.2.3 Continuing Calibration

The working calibration factor must be verified every 12 hours by the injection of a continuing calibration standard prior to sample analysis. A continuing calibration standard must also be analyzed after every 10 samples and at the end of the analysis sequence to ensure that system performance has not degraded. The continuing calibration standard shall be the mid-level standard or the standard with a contaminant concentration level that is potentially the most representative of contaminant concentrations in the next 10 samples.

Level C and Level D:

Check Form VII (or equivalent) and verify that all %Ds are less than or equal to 20 percent. If %Ds are outside 20 percent for any target compound, qualify the compound as estimated “UJ” for nondetects and “J” for detects in all samples analyzed after the last out of control Level C.

Level D:

Verify from the raw data that there were no calculation or transcription errors on the Form VII (or equivalent).

4.3 BLANKS

Method blank analytical results are assessed to determine the existence and magnitude of contamination problems. If problems with any method blank exist, all associated data must be carefully evaluated to determine whether there is any bias on the data, or if the problem is an isolated occurrence not affecting other data. No contaminants should be present in the method blank(s). The method blank should be analyzed on each GC system used to analyze site samples.

1. The reviewer should identify samples associated with each method blank using Form IV (or equivalent). Verify that method blank analysis has been reported per matrix and concentration level for each set of samples. Each sample must have an associated method blank. Qualify positive results in samples with no method blank as unusable “R.” Nondetects do not require qualification.
2. If the method blank was not analyzed on a GC used to analyze site samples, note the deficiency in the data validation report. Professional judgment shall be used for subsequent qualification of the data.
3. Compare the results of each method blank with the associated sample results. The reviewer should note that the blank analyses may not involve the same weights, volumes, percent moistures, or dilution factors as the associated samples. These factors must be taken into consideration when applying the criteria discussed below, such that a comparison of the total amount of contamination is actually made.
4. If a compound is found in the blank, but not in the associated sample, no action is taken.
5. Any compound, detected in both the sample and the associated blank shall be qualified when the sample concentration is less than the LOQ and the blank concentration is less than, greater than, or equal to the LOQ. Care should be taken to factor in the percent moisture when comparing detects in the sample and the method blank. The applicable review qualifier(s) are summarized in Table II-G-1.

Table II-G-1: Blank Qualifications

Sample Result	Sample Value	Reviewer Qualifier(s)
Less than LOQ and blank result is <, > or = LOQ	Leave as reported	U
≥LOQ, blank result is <LOQ	Leave as reported	None
≥LOQ, blank result is >LOQ and sample result <blank result	Leave as reported	Use professional judgment
≥LOQ, blank result is >LOQ and sample result ≥blank result	Leave as reported	Use professional judgment
≥LOQ and blank result is = LOQ	Leave as reported	Use professional judgment

6. In the case wherein both the sample concentration and the blank concentration are greater than or equal to the LOQ, previously approved criteria as identified in the project planning

documents may be applied to qualify associated sample results. Otherwise, qualify sample results as non-detect "U" when the sample concentration is less than or equal to 5 times the blank concentration (5× rule).

7. Instances of contamination can be attributable to the dilution process. These occurrences are difficult to determine; however, the reviewers should qualify the sample data as nondetects, "U," when the reviewer determines the contamination to be from a source other than the sample.
8. In the event of gross contamination (i.e., saturated peaks) in the blanks, the associated samples must be evaluated for gross contamination. If gross contamination exists in the samples, the affected compounds should be qualified as unusable, "R."

Level D:

1. Verify from the preparation log that the information recorded on Form IV (or equivalent) is correct.
2. Review the results of all blank raw data and Form I (or equivalent) to ensure that there were no false negatives or false positives.
3. Verify all target compound detects found in the method blanks against the raw data. Follow the guidelines specified in Sections 4.8 and 4.9 of this procedure. After the validity of the target compounds are verified, validate the corresponding data using the criteria outlined above for Level C and Level D validation.

4.4 BLANK SPIKES AND LABORATORY CONTROL SAMPLES

Blank spike/laboratory control sample (LCS) recoveries must be within the project-specific control limits established for a given sample matrix. Use in-house limits if project limits are not specified.

Level C and Level D:

1. If the blank spike/LCS results are 0 percent, only the spiked compounds that showed low recovery in all associated samples shall be flagged as unusable "R" for nondetects and estimated "J" for detects.
2. If blank spike/LCS results are below the control limits (but above 0 percent), spiked compounds which showed low recovery in all associated samples shall be flagged as estimated "UJ" or "J."
3. If blank spike/LCS results are above the control limits, detects for only the spiked compounds which showed high recovery in all associated samples shall be flagged as estimated "J."
4. If the laboratory analyzes a blank spike duplicate/LCS duplicate (LCSD), evaluate and qualify the LCSD results using the criteria noted above.
5. If the relative percent differences (RPDs) between LCS and LCSD results are above the control limits (use the matrix spike [MS]/matrix spike duplicate [MSD] RPD control limits identified in DoD QSM Appendix B, if none are available use laboratory in-house limits), spiked compounds which showed high RPD in all associated samples shall be flagged as estimated "UJ" or "J."

Level D:

To check that the spike percent recovery was calculated and reported correctly using the following equation, recalculate one spike recovery per matrix (and any spike that would result in the qualification of a sample).

$$\%\text{Recovery} = \frac{Q_d}{Q_a} \times 100$$

Where:

Q_d = Quantity determined by analysis

Q_a = Quantity added to samples/blanks

If transcription errors are discovered on Form III (or equivalent), request a resubmittal from the laboratory. Validate the data according to the criteria outlined above.

4.5 SURROGATE RECOVERY

Laboratory performance on individual samples is established by means of surrogate spiking activities. All samples are spiked with surrogate compounds prior to sample preparation. The evaluation of the results of these surrogate spikes is not necessarily straightforward. The sample itself may produce effects because of factors such as interferences and high concentrations of compounds. Since the effects of the sample matrix are frequently outside the control of the laboratory and may present relatively unique problems, the review and validation of data based on specific sample results is frequently subjective and demands analytical experience and professional judgment. The following procedures shall be followed:

Level C and Level D:

Sample and blank surrogate recoveries for PCBs as congeners must be within the project-specific control limits. Use in-house limits if project limits are not specified. Verify that no samples or blanks have surrogates outside the criteria from Form II (or equivalent).

1. If recovery is below the QC limits for any of the surrogates, but above or equal to 10 percent, flag associated positive results as estimated “J” and nondetects as “UJ.”
2. If any of the surrogate recovery is less than 10 percent, flag all nondetects as unusable “R” and detects as estimated “J.” No qualification is applied if surrogates are diluted beyond detection but note in the data validation report that surrogate evaluation could not be performed due to the high dilution factor.
3. If any surrogate recovery is above the upper QC limit, flag associated positive results as estimated “J.” No qualification of nondetects is necessary in the case of high recoveries.
4. Surrogates may be reported as “diluted out” (D); if dilution is such that the surrogate can no longer be detected. If this is the case, note in the data validation report that surrogate evaluation could not be performed due to a high dilution factor. A Level D evaluation of the sample chromatogram may be necessary to determine that surrogates are truly “diluted out.”

Level D:

The reported surrogate recoveries on Form II should be verified from the raw data for a representative number of samples.

4.6 MATRIX SPIKE/MATRIX SPIKE DUPLICATE

MS/MSD data are used to determine the effect of the matrix on a method's recovery efficiency and precision for a specific sample matrix.

No action is taken on MS/MSD data alone to qualify an entire data package. Using informed professional judgment; however, the data reviewer may use the MS/MSD results in conjunction with other QC criteria (i.e., surrogates and LCS) and determine the need for some qualification of the data.

The data reviewer should first try to determine the extent to which the results of the MS/MSD affect the associated data. This determination should be made with regard to the MS/MSD sample itself, as well as specific compounds for all samples associated with the MS/MSD.

In those instances where it can be determined that the results of the MS/MSD affect only the sample spiked, then qualification should be limited to this sample alone. It may be determined through the MS/MSD results, however, that a laboratory is having a systematic problem in the analysis of one or more compounds, which affects all associated samples.

Note: If a field blank was used for the MS/MSD, the information must be included in the data validation summary. Sample matrix effects have not been observed with field blanks therefore the recoveries and precision do not reflect the analytical impact of the site matrix.

Level C and Level D:

The laboratory must spike and analyze a MS/MSD from the specific project site as required for each matrix type and analytical batch.

1. MS/MSD data should be reported on a MS/MSD summary form similar to Form III (or equivalent).
2. Compare the percent recovery (%R) and RPD for each spiked compound with the project-specific control limits. Use in-house limits if project limits are not specified.
3. If MS/MSD results are 0 percent, only the spiked compounds that showed low recovery in the parent sample shall be flagged as unusable "R" for nondetects and estimated "J" for detects.
4. If MS/MSD results are below the control limits (but above 0 percent), spiked compounds which showed low recovery in the parent sample shall be flagged as estimated "UJ" or "J."
5. If MS/MSD results are above the control limits, detects for only the spiked compounds which showed high recovery in the parent sample shall be flagged as "J."
6. If the RPDs between MS and MSD results are greater than 30 percent, detects for only the spiked compounds which showed high RPD in the parent sample shall be flagged as estimated "J."

7. Failure of MS/MSD due to the presence of a target compound in the parent sample at greater than two times the spike concentration or diluted by more than a factor of two should not result in any qualifications. Note the incident in the data validation report.

Level D:

Check the raw data and recalculate one or more %Rs and RPDs, especially %Rs and RPDs that resulted in the qualification of data, using the following equations to verify that results on Form III (or equivalent) are correct.

$$\%R = \frac{(SSR - SR)}{SA} \times 100$$

$$RPD = \frac{ABS|SSR - SDR|}{(SSR + SDR)/2} \times 100$$

Where:

SA	=	spike added
SR	=	sample result
SSR	=	spiked sample result
SDR	=	spiked duplicate result
ABS	=	absolute value

If transcription errors are discovered on Form III (or equivalent), request a resubmittal from the laboratory. Validate the data according to the criteria outlined above.

4.7 FIELD QC SAMPLES

Field QC samples discussed in this section of the procedures are equipment blanks, field blanks, field duplicates, and field triplicates.

4.7.1 Equipment Blanks and Field Blanks

Compounds detected in equipment blanks indicate the possibility of cross-contamination between samples due to improper equipment decontamination.

A field blank sample may be collected from each source of water used during each sampling event. The field blank may be analyzed to assess whether the chemical nature of the water used in decontamination may have affected the analytical results of site samples.

If PCBs as congener compounds are detected in the equipment blanks and/or field blanks, the procedure for the qualification of associated sample results is identical to the criteria outlined in Section 4.3 of this procedure.

Level C and Level D:

1. Determine which field QC samples apply to samples in the sample delivery group.
2. Ensure that units are correct when applying field QC blank qualifications. If samples are soil matrix, results must first be converted to micrograms per liter from micrograms per kilogram to make correct comparisons.
3. Because of the way in which the field blanks and equipment blanks are sampled, equipment blanks are not qualified because of field blank contamination. The affected samples are qualified, however, by either the field blank or equipment blank results, whichever has the higher contaminant concentration.
4. Equipment blanks and field blanks are only qualified with method blank results in order to account for laboratory contamination.

Level D:

Compound identification and quantification of field blank and equipment blank samples must be verified. Follow the guidelines specified in Sections 4.8 and 4.9 of this procedure.

4.7.2 Field Duplicates and Field Triplicates

Field duplicates consist of either collocated or subsampled samples. Field duplicates for ground water and surface water samples are generally considered to be collocates. Soil duplicate samples may be homogenized and subsampled in the field (or at the laboratory) to form an original and duplicate sample, or may be an additional volume of sample collected in a separate sample container to form a collocate sample. Field duplicate results are an indication of both field and laboratory precision; the results may be used to evaluate the consistency of sampling practices.

Field triplicates are collected from different, randomly selected locations to verify that an incremental sample truly represents a decision unit. Field triplicate results are more useful than field duplicates to statistically evaluate sampling precision.

Level C and Level D:

1. Check to ensure that field duplicates and/or field triplicates were collected and analyzed as specified in the project planning documents. If the sampling frequency is less than the frequency stated in the planning documents, no qualification of the associated sample results is necessary but the incident shall be discussed in the data validation report.
2. For field duplicate results, if the RPDs are greater than 50 percent for water or 100 percent for soil or as stated in the planning document if more conservative, no qualification of the associated sample results is necessary, but the differences should be noted in the data validation summary.
3. For field triplicate results, if the RSDs are greater than the QC limits stated in the planning document, no qualification of the associated sample results is necessary, but the differences should be noted in the data validation summary.

Level D:

Before comparison of duplicates and/or triplicates, the compound identification and quantification must be verified. Follow the guidelines specified in Sections 4.8 and 4.9 of this procedure.

4.8 TARGET COMPOUND IDENTIFICATION

Qualitative criteria for compound identification have been established to minimize the number of erroneous identifications of compounds. An erroneous identification can be either a false positive (reporting a compound present when it is not) or a false negative (not reporting a compound that is present).

The laboratory must report retention time window data for each compound on each column used to analyze the samples. The retention time windows are used for qualitative identification. Retention times of reported compounds must fall within the calculated window for both chromatographic columns. Second column confirmation must be performed for all GC work. Sample chromatograms for both columns must be provided.

Level C and Level D:

1. Review Form I and Form X (or equivalent). Check for errors.
2. Verify that the retention times of sample compounds reported on the Form X (or equivalent) fall within the calculated retention time windows for both columns. If the qualitative criteria for two-column confirmation were not met, all reported positive detects should be considered nondetect “U.”
3. Any compounds confirmed by two columns must be confirmed by gas chromatography/mass spectrometry (GC/MS) if the concentration is sufficient for detection by GC/MS as determined by the laboratory LOQs. The GC/MS would normally require a minimum concentration of 10 nanograms per microliter in the final extract for each single-component. If results indicate that sufficient concentration of compound was present to perform GC/MS but GC/MS was not performed, note this in the data validation report.
4. If second column confirmation is not performed, qualify any reported detect as presumptive and estimated, “NJ.”

Level D:

1. Verify from the raw data that the retention time of the detected compound and the retention time windows are correct.
2. Evaluate all sample chromatograms to ensure that there were no peaks present which were not reported (false negatives) or the reported detects did not meet identification criteria (false positives). Presence of a large interfering peak may result in false positives or false negatives. The reviewer should use professional judgment in evaluating the effect of interference.

4.9 COMPOUND QUANTITATION AND REPORTING LIMITS

The objective is to ensure that the reported quantitation results and reporting limits (i.e., LOQ, limit of detection [LOD], detection limit [DL]) are accurate. All soil sample results are reported on a dry weight basis.

Level C:

Specific compound quantitation is not verified for Level C validation.

Level C and Level D:

1. Verify that the reporting limits for nondetects are equal to the LODs. Verify that an annual DL study was performed or quarterly LOQ/LOD verification checks were performed in accordance with the DoD QSM. The LOQ/LOD verification check must be evaluated to determine whether the laboratory can reliably detect and identify all target analytes at a spike concentration of approximately two times but not more than four times the current reported DL. Qualify nondetects as unusable “R.”
2. Check that reported nondetects and positive values have been adjusted to reflect sample dilutions (including clean-up) and for soil samples, sample moisture. When a sample is analyzed at more than one dilution, the lowest LODs are used unless a QC criterion has been exceeded. In this case, the higher LODs from the diluted analysis are used. The least technically sound data will be flagged “R” with a qualification code “D.”
3. Verify that reported limits for soils and sediments were calculated based on dry weight. If the LOQs/LODs were reported based on wet weight, the percent moisture must be factored in and the LOQs/LODs must be adjusted accordingly.
4. PCBs as congener results can be checked for agreement between quantitative results obtained on the two GC columns. Check Form X (or equivalent) for RPDs between the two column quantitation results. RPD should be less than or equal to 40 percent. If RPD exceeded 40 percent, the affected compound shall be qualified as estimated “J.” The higher result should be reported unless overlapping peaks are causing erroneously high results, then the lower result may be reported.
5. If a sample requiring a dilution analysis due to a target compound detect exceeding the calibration linear range was not re-analyzed at a dilution, the compound exceeding calibration range shall be qualified as estimated “J.”
6. If the laboratory re-analyzed a sample and submitted both sample results, the reviewer must determine which of the two analyses has better data quality. Only one analysis should be reported and the other is rejected.

Level D:

1. Compound quantification should be verified by recalculation from the raw data for a representative number of samples.
2. Verify from the standard chromatograms that the instrument sensitivity is adequate to support the LODs. Poor sensitivity may result in elevated LODs.

3. Verify from the raw data that the reported RPDs between the two column quantitation results are calculated correctly and there are no transcription errors. The reviewer should be aware that the retention time of the target compound may have shifted due to the interference.

5. Records

A Form I that has been validated and verified, and has been determined by the data validator to accurately represent the appropriate sample results to be utilized, shall be stamped "NAVFAC PACIFIC VALIDATED." Additionally, sample result forms for which the data have been validated at the Level D validation level shall be stamped or noted "Level D."

Copies of all documents generated by the data validation personnel will be stored for no less than 10 years. The original validated laboratory data shall be archived to the Federal Records Center at project completion.

6. References

Department of Defense, United States (DoD). 2005a. *Uniform Federal Policy for Quality Assurance Project Plans, Part 1: UFP-QAPP Manual*. Final Version 1. DoD: DTIC ADA 427785, EPA-505-B-04-900A. In conjunction with the U. S. Environmental Protection Agency and the Department of Energy. Washington: Intergovernmental Data Quality Task Force. March. On-line updates available at: http://www.epa.gov/fedfac/pdf/ufp_qapp_v1_0305.pdf.

———. 2005b. *Uniform Federal Policy for Quality Assurance Project Plans, Part 2B: Quality Assurance/quality Control Compendium: Minimum QA/QC Activities*. Final Version 1. DoD: DTIC ADA 426957, EPA-505-B-04-900B. In conjunction with the U. S. Environmental Protection Agency and the Department of Energy. Washington: Intergovernmental Data Quality Task Force. March. On-line updates available at: http://www2.epa.gov/sites/production/files/documents/qaqc_v1_0305.pdf.

———. 2012. *Uniform Federal Policy for Quality Assurance Project Plans, Part 2A: Optimized UFP-QAPP Worksheets*. Revision 1. March.

———. 2013. *Department of Defense Quality Systems Manual for Environmental Laboratories.* Version 5.0. Draft Final. Prepared by DoD Environmental Data Quality Workgroup and Department of Energy Consolidated Audit Program Operations Team. July.

Environmental Protection Agency, United States (EPA). 2007. *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW-846.* 3rd ed., Final Update IV. Office of Solid Waste. Updates available: www.epa.gov/epaoswer/hazwaste/test/new-meth.htm.

Procedure II-A, *Data Validation*.

7. Attachments

None.

Level C and Level D Data Validation for Metals by SW-846 6000/7000

1. Purpose

This data validation procedure sets forth the standard operating procedure for performance of Level C and Level D data validation of metals data obtained under the United States (U.S.) Navy Environmental Restoration (ER) Program for Naval Facilities Engineering Command, Pacific (NAVFAC Pacific) and is consistent with protocol in the *Department of Defense Quality Systems Manual (QSM) for Environmental Laboratories* (DoD QSM) (DoD 2013). Cursory validation is addressed separately in Procedure II-A, *Data Validation*.

2. Scope

This procedure applies to all Navy ER projects performed in the NAVFAC Pacific Area of Responsibility.

This procedure shall serve as management-approved professional guidance for the ER Program and is consistent with protocol in the most recent version of the Uniform Federal Policy-Quality Assurance Project Plan (UFP QAPP) Part 1 (DoD 2005a), 2A (DoD 2012), and 2B (2005b), as well as the DoD Quality Systems Manual (DoD 2013). As professional guidance for specific activities, this procedure is not intended to obviate the need for professional judgment during unforeseen circumstances. Deviations from this procedure while planning or executing planned activities must be approved and documented by the following prime contractor representatives: the CTO Manager and the Quality Assurance (QA) Manager or Technical Director. A Navy project representative (i.e., Remedial Project Manager or QA Manager) shall also concur with any deviations.

3. Responsibilities

The CTO Manager, the QA Manager or Technical Director, and the CTO QA Coordinator are responsible for ensuring that this procedure is implemented by data validation personnel.

Data validation personnel are responsible for implementing this procedure for validation of all metals data.

4. Procedure

This procedure addresses the validation of metals data obtained using U.S. Environmental Protection Agency (EPA) Method Solid Waste (SW)-846 6000/7000 (EPA 2007). The quality control (QC) criteria identified in this procedure are those specified in the analytical method and the DoD QSM (DoD 2013). Where project specific criteria are identified in the CTO work plan, they will supersede the QC criteria identified in this procedure.

- Form I: Sample Results Summary Form
- Form II: Initial and Continuing Calibration Verification Form
- Form III: Blanks Form
- Form IV: ICP Interference Check Sample Form

- Form VA: Spike Sample Recovery Form
- Form VB: Post Digest Spike Sample Recovery Form
- Form VI: Duplicates Form
- Form VII: Laboratory Control Sample Form
- Form VIII: Standard Addition Results Form
- Form IX: ICP Serial Dilutions Form
- Form X: Instrument Detection Limits Form
- Form XI: ICP Inter-element Correction Factors Form
- Form XII: ICP Linear Ranges Form
- Form XIII: Preparation Log Form
- Form XIV: Analysis Run Log Form
- Form XV: ICP-MS Internal Standards

Level C data validation consists of review of summary forms only while Level D data validation requires review of both summary forms and all associated raw data. Data review guidelines and how they apply to the different validation levels are indicated in the following text.

4.1 Sample Management

QA/QC criteria included under sample management are sample preservation, handling, and transport; chain of custody (COC); and holding times.

4.1.1 Sample Preservation, Handling, and Transport

Level C and Level D:

Evaluate sample collection, handling, transport, and laboratory receipt from COC and laboratory receipt checklists to ensure that the samples have been properly preserved and handled.

1. Metals and Mercury - Samples must be preserved with nitric acid to a pH less than 2. If analyses for dissolved metals are requested, samples should be filtered before adding preservatives. If total metals are requested, unfiltered samples should be used. Document these occurrences in the data validation report.
2. Soil samples must be refrigerated at above freezing to 6 degrees Celsius (˚C).
3. Organic Lead samples should be collected without headspace and stored at above freezing to 6°C.
4. Based upon professional judgment, analysis of an inappropriately preserved sample by the laboratory may result in qualification of the sample results as estimated “J” or “UJ.” In extreme cases of a destructive preservative, the sample data may be qualified as unusable, “R.”
5. If the temperature of the cooler upon receipt at the laboratory was not recorded, document that the laboratory is noncompliant.

6. If the receiving laboratory transferred the samples to another laboratory for analysis, apply the same temperature criteria to both the transfer COC and the original COC.

4.1.2 Chain of Custody

Level C and Level D:

Examine the COC for legibility and check that all metal analyses requested on the COC have been performed by the laboratory. Ensure that the COC Sample Number on the laboratory Form I matches the Sample Identification on the COC. Read the laboratory case narrative for additional information.

1. Verify collect dates, sampling times, and time zones. This is critical to evaluating parameters with short holding times.
2. Any samples received for analysis that were not analyzed shall be noted in the data validation report, along with the reason(s) for failure to analyze the samples, if the reason(s) can be determined. Conversely, samples that were analyzed for metals but were not requested should also be noted.
3. Any discrepancies in sample naming between the COC and sample results form shall be noted in the data validation report with the correct sample name being identified if the correct sample name can be determined.
4. If the receiving laboratory transferred the samples to another laboratory for analysis, both the original COCs and transfer COCs shall be present. Document in the data validation report if the transfer COCs are not present.
5. Internal chain of custody is required for all samples, extracts, and digestates from receipt to disposal. Verify the internal COC forms for completeness. Document in the data validation report if the internal COC forms are not present.
7. Each individual cooler shall have an individual COC that lists only samples contained within that cooler. Document in the data validation report if multiple coolers appear on one COC.

4.1.3 Holding Times

Level C and Level D:

Holding times are determined from the time of sample collection to the time of sample analysis. Holding times are as follows:

- Metals – 6 months for soil and water
- Mercury – 28 days for both soil and water
- Organic Lead – 14 days to extraction and 40 days from extraction to analysis for soil samples; 7 days to extraction and 40 days from extraction to analysis for water samples

If holding times are exceeded, flag all results greater than the detection limit (DL) as estimated “J” and all results less than the DL as estimated “UJ.” If holding times are grossly exceeded, the reviewer may determine that the data reported as nondetects are unusable “R.” Data will not be qualified unusable “R” unless the holding time was grossly exceeded by more than a factor of 2.

4.2 CALIBRATION

Compliance requirements for satisfactory instrument calibration are established to ensure that the instrument is capable of producing acceptable quantitative data. Initial calibration demonstrates that the instrument is capable of acceptable performance at the beginning of the analysis run and of producing a linear calibration curve. Continuing calibration documents that the initial calibration is still valid and that maintenance and adjustment of the instrument on a day-to-day basis is satisfactory.

4.2.1 Initial Calibration

Level C and Level D:

Instruments must be calibrated daily prior to sample analysis and each time the instrument is set up.

1. Inductively Coupled Plasma (ICP) Analysis: A blank and at least one high standard must be used in establishing the analytical curve. If more than one standard is used, r^2 must be 0.99 or greater.
2. Graphite Furnace Atomic Absorption (GFAA) Analysis: A blank and at least three standards must be used in establishing the analytical curve. Linearity is determined using linear regression analysis. The correlation coefficient, r must be 0.995 or greater.
3. Cold Vapor Atomic Absorption (CVAA), Mercury Analysis: A blank and at least five standards must be used in establishing the analytical curve. Linearity is determined using linear regression analysis. The correlation coefficient must be 0.995 or greater.

If the correlation coefficient is below 0.995, qualify all associated detects as estimated “J” and all nondetects as “UJ.” If the correlation coefficient is significantly lower than 0.995, professional judgment may be used to reject, “R,” the analytes associated with the initial calibration.

Level D:

Recalculate the correlation coefficient for all initial calibrations. Verify from the raw data that appropriate concentration and number of standards were utilized to establish analytical curves and the associated correlation coefficients.

4.2.2 Initial and Continuing Calibration Verification (ICV and CCV)

Level C and Level D:

1. Review Form II (Part I) for ICV and CCV percent recovery (%R) values.
2. Analysis results for Method 6000 ICV and CCV must fall within the control limits of 90-110 percent recovery of the true value for all analytes.
3. Analysis results for Method 7000 ICV and CCV must fall within the control limits of 90-110 percent recovery.
4. If after a failing CCV, two additional consecutive CCVs are analyzed immediately, and both additional CCVs are within the control limits, the data is acceptable. If either of the additional CCVs is not within control limits, then the associated data will need qualification. See below for the recommended qualification guidelines.

5. Because of rounding discrepancies, let the results fall within 1 percent of the acceptance windows (e.g., 89–111 percent).
6. If the ICV or CCV %R falls outside the acceptance windows, use professional judgment to qualify all associated data. The following guidelines are recommended:
   a. If the ICV or CCV %R falls outside the acceptance windows but within the ranges of 75-89 percent or 111–125 percent, qualify results greater than the DL as estimated “J.”
   b. If the ICV or CCV %R is within the range of 111–125 percent, results less than the DL are acceptable.
   c. If the ICV or CCV %R is 75–89 percent, qualify results less than the DL as nondetected and estimated “UJ.”
   d. If the ICV or CCV %R is less than 75 percent, qualify results greater than the DL as estimated “J” and results less than the MDL as unusable “R.”
   e. If the ICV or CCV percent recovery is greater than 125 percent, qualify results greater than the DL as unusable “R”; results less than the DL are acceptable.
   f. Because no raw data is evaluated at Level C, it is unnecessary to evaluate the correlation coefficient for the initial calibrations for the graphite furnace analyses.

Note: Level C data validation does not encompass reviews of the raw data; therefore, the concentration and number of standards utilized to establish analytical curves and the associated correlation coefficients are not verified. The reviewer should note in the data validation summary that this information was not reviewed.

Level D:

1. Recalculate and verify one or more of the ICV and CCV %Rs per type of analysis using the following equation for %R. Once again, due to possible rounding discrepancies, allow the results to fall within 1 percent of the acceptance windows (e.g., 89–111 percent)

$$\%\text{Recovery} = \frac{Q_d}{Q_a} \times 100$$

   Where:

   Q_d = Concentration (in micrograms per liter [μg/L]) of each analyte measured in the analysis of the ICV or CCV solution.

   Q_a = Concentration (in μg/L) of each analyte in the ICV or CCV source.

2. If discrepancies are discovered on any Form II, request a resubmittal from the laboratory and validate according to the criteria outlined above.

4.3 BLANKS

Method (preparation) and calibration blank analyses results are assessed to determine the existence and magnitude of laboratory contamination problems. If problems with any blank exist, all data associated with the blank must be carefully evaluated to determine whether there is a bias on the data, or if the problem is an isolated occurrence not affecting data.

4.3.1 Calibration Blanks

Level C and Level D:

1. If the blank is less than the LOQ and the samples results are greater than the DL but less than the LOQ, then qualify "U" at the result.
2. If the blank is less than the LOQ and the sample results are greater than the LOQ or nondetect, the data is acceptable.
3. If the blank is greater than the LOQ, then samples less than 5× the blank will be qualified as "U" at the concentration. Samples greater than 5× the blank are acceptable.
4. For negative blanks where the absolute value of the blank is greater than the LOQ, sample results that are less than 10x the absolute value of the negative blank qualify "J" for detect and 'UJ" for nondetect results. Results that are greater than 10× the absolute value of the negative blank are acceptable.

Ensure that units are correct when applying calibration blank qualifications. If samples are soil matrix, results must first be converted to µg/L from milligrams per kilogram to make correct comparisons.

Level D:

Verify one or more of the calibration blank results per type of analysis by comparing the Form III to the raw data. After the validity of the target analytes are verified, validate the corresponding data using the criteria outlined above for Level C and Level D validation.

4.3.2 Method (Preparation) Blanks

Level C and Level D:

At least one method blank must be prepared with each batch of samples. If a method blank was not prepared and analyzed as required, the reviewer may qualify associated sample results less than the DL as nondetected and estimated "UJ," and sample results greater than the DL as estimated "J." Professional judgment should be utilized, however, taking into account the results of other associated blanks (e.g., initial calibration blank, continuing calibration blank).

If metals are detected in the method blanks, the procedure for the qualification of associated sample results is identical to the rules outlined in Section 4.3.1 of this procedure.

Level D:

Verify out-of-control method blanks that result in the qualification of numerous analytes against the raw data. Verify the results reported on Form III. After the validity of the target analytes are verified, validate the corresponding data using the criteria outlined above for Level C and Level D validation.

4.4 ICP Interference Check Sample (ICP ICS)

The ICP ICS verifies the inter-element and background correction factors. An ICS must be run at the beginning of each sample analysis run.

Level C and Level D:

Review Form IV for the ICP ICS solution A and solution AB sample results and percent recovery values. Results for the ICP ICS solution AB analysis must fall within the control limits of ±20 percent of the true value. Aluminum (Al), calcium (Ca), iron (Fe), and magnesium (Mg) must be reported on the Form IV for solution A and solution AB to properly evaluate the ICP ICS. For samples with concentrations of Al, Ca, Fe, and Mg which are comparable to or greater than their respective levels in the ICS:

1. If the ICS AB recovery for an analyte is greater than 120 percent and the sample results are less than the DL, this data is acceptable for use.
2. If the ICS AB recovery for an analyte is greater than 120 percent and the sample results are greater than the DL, qualify the affected data as estimated "J."
3. If the ICS AB recovery for an analyte is between 50 percent and 79 percent and the sample results are greater than the DL, qualify the affected data as estimated "J."
4. If sample results are less than the DL and the ICS AB recovery for that analyte is within the range of 50–79 percent, the possibility of false negatives may exist. Qualify the data for these samples as nondetected and estimated "UJ."
5. If ICS AB recovery results for an analyte are less than 50 percent, qualify the affected data as unusable "R."
6. If the absolute value of the ICS A is greater than the limit of detection (LOD) and the sample result is greater than the DL but less than 10× the ICS A finding, qualify as estimated "J."
7. If the absolute value of the ICS A is greater than the LOD and the sample result is greater than 10× the ICS A finding, this data is acceptable.
8. If the positive value of the ICS A is greater than the LOD and the sample results are less than the DL, this data is acceptable for use.
9. If the absolute value of the negative ICS A is greater than the LOD and the sample results are less than the DL, this data is estimated "UJ."

Level D:

Recalculate and verify one or more ICS percent recoveries for the initial and final ICS analyses using the following equation. Verify the results reported on Form IV (or equivalent). If discrepancies are discovered, request a resubmittal from the laboratory and validate the associated data accordingly using the criteria outlined above.

$$\%\text{Recovery} = \frac{Q_d}{Q_a} \times 100$$

Where:

Q_d = Concentration (in µg/L) of each analyte measured in the analysis of the ICS solution.

Q_a = Concentration (in µg/L) of each analyte in the ICS source.

4.5 BLANK SPIKES AND LABORATORY CONTROL SAMPLES

Blank spike/laboratory control sample (LCS) recoveries must be within the QC limits specified in the DoD QSM Appendix C unless project-specific control limits are established for a given sample matrix. Use in-house limits if compounds are not listed in Appendix C or project limits are not specified.

Level C and Level D:

1. If the blank spike/LCS results are less than 50 percent, only the spiked analytes that showed low recovery in all associated samples shall be flagged as “R” for nondetects and “J” for detects.
2. If blank spike/LCS results are below the control limits (but above 50 percent), spiked analytes that showed low recovery in all associated samples shall be flagged as estimated “UJ” or “J.”
3. If blank spike/LCS results are above the control limits, detects for only the spiked analytes that showed high recovery in all associated samples shall be flagged as “J.”
4. If the laboratory analyzes a blank spike duplicate/LCS duplicate (LCSD), evaluate and qualify the LCSD results using the criteria noted above.
5. If the relative percent differences (RPDs) between LCS and LCSD results are above the control limits (use the matrix spike [MS]/matrix spike duplicate (MSD) RPD control limits identified in DoD QSM Appendix B, if none are available use laboratory in-house limits), spiked analytes which showed high RPD in all associated samples shall be flagged as estimated “UJ” or “J.”

Level D:

To check that the spike percent recovery was calculated and reported correctly using the following equation, recalculate one spike recovery per matrix (and any spike that would result in the qualification of a sample).

$$\%\text{Recovery} = \frac{Q_d}{Q_a} \times 100$$

Where:

Q_d = Quantity determined by analysis

Q_a = Quantity added to samples/blanks

If transcription errors are discovered on Form VII (or equivalent), request a resubmittal from the laboratory. Validate the data according to the criteria outlined above.

4.6 MATRIX SPIKE/MATRIX SPIKE DUPLICATE AND MATRIX DUPLICATE

MS/MSD and matrix duplicate (MD) data are used to determine the effect of the matrix on a method’s recovery efficiency and precision for a specific sample matrix. MD analyses are also performed to demonstrate acceptable method precision by the laboratory at the time of analysis.

MS/MSD results should be within the QC limits specified in the DoD QSM Appendix C unless project-specific control limits are established for a given sample matrix. Use in-house limits if spiked analytes are not listed in Appendix C or project limits are not specified.

For the MD RPD, for sample results greater than 5× the LOQ, use RPD to evaluate. For sample results less than 5× the LOQ, use the difference between the MD and the sample unless project limits are specified. For difference use 1× the LOQ as the control limit for water samples and 2× the LOQ as the control limit for soil samples unless project limits are specified.

If the MS/MSD percent recovery results do not meet the control limits, further action shall be evaluated to determine the source of difference. For sample analytes greater than 50× the LOQ, a five-fold dilution test can be performed. For samples analytes less than 50× the LOQ, a post digestion spike (PDS) can be performed.

Level C and Level D:

The laboratory must spike and analyze a MS/MSD or MD from the specific project site as required for each matrix type and analytical batch.

1. MS/MSD data should be reported on a MS/MSD summary form similar to Form VA. MD data should be reported on a MD summary form similar to Form VI. PDS data should be reported on a summary form similar to Form VB. The serial dilution results should be reported on a summary form similar to Form IX.
2. If the MS/MSD results are outside of the control limits and the sample results are greater than 50× LOQ and a five-fold serial dilution test was performed and the dilution results were within 10 percent difference of the original measurement, then the data is acceptable.
3. If the MS/MSD results are outside of the control limits and the sample results are less than 50x LOQ and a PDS was performed and within 80–120 percent recovery, then the data is acceptable.
4. If the MS/MSD results are not within the control limits and the secondary actions (serial dilution test and/or PDS) are outside of the control limits or not performed, the source sample requires qualification. The following guidelines are recommended:
6. If MS/MSD results are below the control limits, spiked analytes that showed low recovery shall be flagged as estimated “UJ” or “J.”
   a. If MS/MSD results are above the control limits, detects for only the spiked analytes that showed high recovery shall be flagged as “J.”
   b. If the RPD or difference between MS and MSD or between the MD and sample are greater than 20 percent, qualify the sample as estimated “UJ” or “J.” RPD results are not affected by the serial dilution test or the PDS.
   c. Failure of MS/MSD due to the presence of a target analyte in the parent sample at greater than four times the spike concentration should not result in any qualifications. Note the incident in the data validation report.

Level D:

For the MS/MSD, check the raw data and recalculate one or more %Rs and RPDs, especially %Rs and RPDs that resulted in the qualification of data, using the following equations to verify that results on Forms VA and VB (or equivalent) are correct.

$$\%R = \frac{(SSR - SR)}{SA} \times 100$$

$$RPD = \frac{ABS|SSR - SDR|}{(SSR + SDR)/2} \times 100$$

Where:

SA	=	spike added
SR	=	sample result
SSR	=	spiked sample result
SDR	=	spiked duplicate result
ABS	=	absolute value

For the ICP serial dilution, recalculate one or more percent difference (%Ds) from the information supplied in the raw data and compare the results to those reported on Form IX using the following equation. If discrepancies are discovered, correct Form IX and validate the associated data accordingly using the criteria outlined above.

$$\%D = \frac{(I - S)}{I} \times 100$$

Where:

I	=	initial sample result
S	=	serial dilution result (instrument reading × 5)

If transcription errors are discovered on Forms VA or VB (or equivalent), request a resubmittal from the laboratory. Validate the data according to the criteria outlined above.

4.7 FURNACE ATOMIC ABSORPTION QC

Duplicate injections and furnace analytical spikes establish the precision and accuracy of the individual analytical determinations. For analyses, graphite furnace analysis is usually performed on arsenic, lead, selenium, and thallium.

Level C and Level D:

1. Prepare and analyze the sample and one spike at 2× the limit of quantitation (LOQ). If after analysis within the calibration range the spike recovery is less than 80 percent or greater than 120 percent and the sample absorbance or concentration is greater than 50 percent of the spike amount; the sample quantitation must be performed by the Method of Standard Addition (MSA). Review Form XIV. The graphite furnace atomic absorption analytical spikes should be reported for each analyte in the column labeled %R.
2. Spike recovery must be greater than or equal to 80 percent and less than or equal to 120 percent.
   a. If the analytical spike recovery is less than 80 percent, qualify results as estimated “J” or “UJ” in all associated samples.
   b. If the analytical spike recovery is less than 10 percent, qualify nondetected results as unusable “R” and detected results as estimated “J” in all associated samples.
   c. If the analytical spike recovery is greater than 120 percent, all detected data for the specific analyte will be qualified as estimated “J,” in all associated samples.
3. If MSA is required, review Form VIII.
   a. If the MSA is required and has not been done, qualify the data as estimated “J.”
   b. If any of the samples have not been spiked at the appropriate levels, qualify the data as estimated “J.”
   c. If the MSA correlation coefficient is less than 0.995, qualify the data as estimated “J.”

Note: Level C validation does not encompass the review of raw data; therefore, for sample concentrations greater than the RL, relative standard deviation (RSD), (or coefficient of variation for duplicate injections) is not evaluated. The reviewer should note in the data validation summary that this information was not reviewed.

Level D:

1. Verify by recalculating at least one analytical spike recovery per graphite furnace analyte reported on Form XIV. Also recalculate any analytical spike recovery that resulted in qualification of an analyte during Level C validation. If any transcription errors are discovered, request a resubmittal from the laboratory and validate the associated data accordingly using the criteria outlined above.
2. Verify by recalculating all graphite furnace results reported from a MSA determination, especially if the MSA was unsuccessful and resulted in qualification of the data. If any transcription errors are discovered, request a resubmittal from the laboratory and validate the associated data accordingly using the criteria outlined above.

4.8 INDUCTIVELY COUPLED PLASMA-MASS SPECTROMETRY INTERNAL STANDARDS

The analysis of inductively coupled plasma-mass spectrometry internal standards determines the existence and magnitude of instrument drift and physical interferences. The criteria for evaluation of internal standard results apply to all analytical samples and method blanks analyzed during the run.

Level C and Level D:

1. Review Form XV (or equivalent) for the internal standard %R values.
2. If no internal standards were analyzed with the run, the sample data should be qualified as unusable (R).
3. If the %R is not within the 30-120 percent limit, qualify positive results as estimated “J” and nondetects as estimated “UJ.”

Level D:

Verify the internal standard %R reported on Form XV (or equivalent) from the raw data for at least one sample per sample delivery group (SDG), and verify internal standard results for samples that were qualified due to out-of-control internal standard results. If errors are discovered between the raw data and the Form XV (or equivalent), request a resubmittal from the laboratory. Validate the data according to the criteria outlined above.

4.9 SAMPLE RESULT VERIFICATION

Level C:

Level C validation does not require the evaluation of raw data; sample result verification is not required. All soil sample results are reported on a dry weight basis.

Level D:

Verify by recalculating at least one ICP, GFAA, and CVAA result against the raw data for each Form I (or equivalent). Verify that the target analyte was reported from the correct run and the correct dilution factor was used. Review the laboratory preparation logs and instrument run logs to insure the accurate reporting of the data. If transcription errors are discovered, request a resubmittal from the laboratory and validate the data according the criteria outlined above.

4.10 FIELD QC SAMPLES

Field QC samples discussed in this section of the procedure are equipment blanks, field blanks, field duplicates, and field triplicates. Analytical results for field QC samples are utilized to qualify associated sample results.

4.10.1 Equipment Blanks and Field Blanks

Analytes detected in equipment blanks indicate the possibility of cross-contamination between samples due to improper equipment decontamination.

A field blank sample may be collected from each source of water used during each sampling event. The field blank may be analyzed to assess whether the chemical nature of the water used in decontamination may have affected the analytical results of site samples.

If metals are detected in the equipment blanks and/or field blanks, the procedure for the qualification of associated sample results is identical to the criteria outlined in Section 4.3.1 of this procedure.

Level C and Level D:

1. Determine which field QC samples apply to samples in the SDG.

2. Ensure that units are correct when applying field QC blank qualifications. If samples are soil matrix, results must first be converted to µg/L from micrograms per kilogram to make correct comparisons.
3. Because of the way in which the field blanks and equipment blanks are sampled, equipment blanks are not qualified because of field blank contamination. The affected samples are qualified, however, by either the field blank or equipment blank results, whichever has the higher contaminant concentration.
4. Equipment blanks and field blanks are only qualified with method blank results in order to account for laboratory contamination.

Level D:

1. Verify all target analytes found in the equipment blanks and field blanks against the raw data.
2. After the validity of the target analytes are verified, validate the corresponding data using the criteria outlined above for Level C and Level D validation.

4.10.2 Field Duplicates and Field Triplicates

Field duplicates consist of either collocated or subsampled samples. Field duplicates for ground water and surface water samples are generally considered to be collocates. Soil duplicate samples may be homogenized and subsampled in the field (or at the laboratory) to form an original and duplicate sample, or may be an additional volume of sample collected in a separate sample container to form a collocate sample. Field duplicate results are an indication of both field and laboratory precision; the results may be used to evaluate the consistency of sampling practices.

Field triplicates are collected from different, randomly selected locations to verify that an incremental sample truly represents a decision unit. Field triplicate results are more useful than field duplicates to statistically evaluate sampling precision.

Level C and Level D:

1. Check to ensure that field duplicates and/or field triplicates were collected and analyzed as specified in the project planning documents. If the sampling frequency is less than the frequency stated in the planning documents, no qualification of the associated sample results is necessary but the incident shall be discussed in the data validation report.
2. For field duplicate results, if the RPDs are greater than 50 percent for water or 100 percent for soil or as stated in the planning document if more conservative, no qualification of the associated sample results is necessary, but the differences should be noted in the data validation summary.
3. For field triplicate results, if the RSDs are greater than the QC limits stated in the planning document, no qualification of the associated sample results is necessary, but the differences should be noted in the data validation summary.

Level D:

Verify by recalculating at least two detects common between the sample and its field duplicate and/or field triplicate. If discrepancies are discovered, request a resubmittal from the laboratory.

5. Records

A Form I that has been validated and verified, and has been determined by the data validator to accurately represent the appropriate sample results to be utilized, shall be stamped “NAVFAC PACIFIC VALIDATED.” Additionally, sample result forms for which the data has been validated at the Level D validation level shall be stamped or noted “Level D.”

Copies of all documents generated by the data validation personnel will be stored for no less than 10 years. The original validated laboratory data shall be archived to the Federal Records Center at project completion.

6. References

Department of Defense, United States (DoD). 2005a. *Uniform Federal Policy for Quality Assurance Project Plans, Part 1: UFP-QAPP Manual*. Final Version 1. DoD: DTIC ADA 427785, EPA-505-B-04-900A. In conjunction with the U. S. Environmental Protection Agency and the Department of Energy. Washington: Intergovernmental Data Quality Task Force. March. On-line updates available at: http://www.epa.gov/fedfac/pdf/ufp_qapp_v1_0305.pdf.

———. 2005b. *Uniform Federal Policy for Quality Assurance Project Plans, Part 2B: Quality Assurance/quality Control Compendium: Minimum QA/QC Activities*. Final Version 1. DoD: DTIC ADA 426957, EPA-505-B-04-900B. In conjunction with the U. S. Environmental Protection Agency and the Department of Energy. Washington: Intergovernmental Data Quality Task Force. March. On-line updates available at: http://www2.epa.gov/sites/production/files/documents/qaqc_v1_0305.pdf.

———. 2012. *Uniform Federal Policy for Quality Assurance Project Plans, Part 2A: Optimized UFP-QAPP Worksheets*. Revision 1. March.

———. 2013. *Department of Defense Quality Systems Manual for Environmental Laboratories.* Version 5.0. Draft Final. Prepared by DoD Environmental Data Quality Workgroup and Department of Energy Consolidated Audit Program Operations Team. July.

Environmental Protection Agency, United States (EPA). 2007. *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW-846.* 3rd ed., Revision 6. Office of Solid Waste. November. On-line updates at: http://www.epa.gov/epawaste/hazard/testmethods/sw846/online/index.htm.

Procedure II-A, *Data Validation*.

7. Attachments

None.

Data Quality Assessment Report

1. Purpose

This procedure describes the presentation format and information provided in the data quality assessment report (DQAR) under the United States (U.S.) Navy Environmental Restoration (ER) Program for Naval Facilities Engineering Command (NAVFAC), Pacific and is consistent with protocol in the *Department of Defense Quality Systems Manual (QSM) for Environmental Laboratories* (DoD QSM) (DoD 2013). The objective of DQAR is to summarize the validated data to the end user. This procedure also establishes the method by which a Contract task Order (CTO) Manager selects and confirms the content of the DQAR. Data validation is addressed separately in Procedure II-A, *Data Validation*.

2. Scope

This procedure applies to all Navy ER projects performed in the NAVFAC Pacific Area of Responsibility.

This procedure shall serve as management-approved professional guidance for the ER Program and is consistent with protocol in the most recent version of the Uniform Federal Policy-Quality Assurance Project Plan (UFP QAPP) Part 1 (DoD 2005a), 2A (DoD 2012), and 2B (2005b), as well as the DoD Quality Systems Manual (DoD 2013). As professional guidance for specific activities, this procedure is not intended to obviate the need for professional judgment during unforeseen circumstances. Deviations from this procedure while planning or executing planned activities must be approved and documented by the following prime contractor representatives: the CTO Manager and the Quality Assurance (QA) Manager or Technical Director. A Navy project representative (i.e., Remedial Project Manager or QA Manager) shall also concur with any deviations.

3. Responsibilities

The CTO Manager, the QA Manager or Technical Director, and the CTO QA Coordinator are responsible for ensuring that this procedure is implemented by data validation personnel.

Data validation personnel (unless otherwise stated) are responsible for implementing this procedure for all DQARs.

4. Procedure

4.1 Introduction

The DQAR summarizes the QA/quality control (QC) evaluation of the data according to precision, accuracy, representativeness, completeness, comparability, and sensitivity relative to the project quality objectives (PQOs). The report provides a quantitative and qualitative assessment of the data and identifies potential sources of error, uncertainty, and bias that may affect the overall usability.

The DQAR summary report identifies the level of data validation for each sample and evaluates and summarizes the results of QA/QC data validation for the entire sampling program. Each analytical fraction has a separate section for each of the criteria. These sections interpret specific QC deviations and their effects on both individual data points and the analyses as a whole. The last section presents a summary of the precision, accuracy, representativeness, completeness, comparability, and sensitivity criteria by comparing quantitative parameters with acceptability criteria defined in the PQOs. Qualitative criteria are also summarized in this section. A DQAR example is provided as Attachment II-S-1.

4.2 PRECISION AND ACCURACY OF ENVIRONMENTAL DATA

Environmental data quality depends on sample collection procedures, analytical methods and instrumentation, documentation, and sample matrix properties. Both sampling procedures and laboratory analyses contain potential sources of uncertainty, error, and/or bias, which affect the overall quality of a measurement. Errors in sample data may result from incomplete equipment decontamination, inappropriate sampling techniques, sample heterogeneity, improper filtering, and improper preservation. The accuracy of analytical results is dependent on selecting appropriate analytical methods, maintaining equipment properly, and complying with QC requirements. The sample matrix also is an important factor in the ability to obtain precise and accurate results within a given media.

Environmental and laboratory QC samples assess the effects of sampling procedures and evaluate laboratory contamination, laboratory performance, and matrix effects. QC samples include: trip blanks, equipment blanks, field blanks, field duplicates, field triplicates, method blanks, laboratory control samples (LCSs), surrogate spikes, matrix spike/matrix spike duplicates (MS/MSDs), laboratory duplicates, and laboratory triplicates.

Before producing the DQAR, the analytical data should be validated according to the NAVFAC Pacific data validation procedures. Samples not meeting the NAVFAC ER Program validation criteria are qualified with a flag, an abbreviation indicating a deficiency with the data. The following are flags used in data validation.

J Estimated. The associated numerical value is an estimated quantity. The analyte was detected but the reported value may not be accurate or precise. The “J” qualification indicates the data fell outside the QC limits, but the exceedance was not sufficient to cause rejection of the data.

R Rejected. The data is unusable (the compound or analyte may or may not be present). Use of the “R” qualifier indicates a significant variance from functional guideline acceptance criteria. Either resampling or re-analysis is necessary to determine the presence or absence of the rejected analyte.

U Nondetected. Analyses were performed for the compound or analyte, but it was not detected. The “U” designation is also applied to suspected blank contamination. The “U” flag is used to qualify any result detected in an environmental sample at a concentration less than 10 times the value of the concentration in any associated blank for common laboratory contaminants and less than 5 times the concentration in any associated blank for all other contaminants.

UJ Estimated/Nondetected. Analyses were performed for the compound or analyte, but it was not detected and the limit of detection (LOD) is an estimated quantity due to poor accuracy or precision. This qualification is also used to flag possible false negative results in the case where low bias in the analytical system is indicated by low calibration response, surrogate, internal standard, or other spike recovery.

Once the data are reviewed and qualified according to the NAVFAC Pacific data validation procedures, the data set is then evaluated using precision, accuracy, representativeness, completeness, comparability, and sensitivity criteria that provide an evaluation of overall data usability. The following is a discussion of the precision, accuracy, representativeness, completeness, and comparability criteria as related to the PQOs.

4.2.1 Precision

Precision is a measure of the agreement or reproducibility of analytical results under a given set of conditions. It is a quantity that cannot be measured directly but is calculated from reported concentrations. Precision is expressed as the relative percent difference (RPD) or percent relative standard deviation (%RSD):

$$RPD = (D1–D2)/\{1/2(D1+D2)\} \times 100$$

$$\%RSD = SD/\{1/3(D1+D2+D3)\} \times 100$$

Where:

D1	=	the reported concentration for primary sample analyses
D2	=	the reported concentrations for duplicate analyses
D3	=	the reported concentrations for triplicate analyses
SD	=	the standard deviation for sample, duplicate and triplicate analyses

Precision is primarily assessed by calculating a RPD from the reported concentrations of the spiked compounds for each sample in the MS/MSD pair. In the absence of a MS/MSD pair, a laboratory duplicate or LCS/laboratory control sample duplicate (LCSD) pair can be analyzed as an alternative means of assessing precision. In some cases, samples from multiple sample delivery groups (SDGs) are within one QC batch and therefore are associated with the same laboratory QC samples. An additional measure of sampling precision may be obtained by collecting and analyzing field duplicate samples, which are compared using the RPD result as the evaluation criteria.

MS and MSD samples are field samples spiked by the laboratory with target analytes prior to preparation and analysis. These samples measure the overall efficiency of the analytical method in recovering target analytes from an environmental matrix. A LCS is similar to a MS/MSD sample in that the LCS is spiked with the same target analytes prior to preparation and analysis. However, the LCS is prepared using a controlled interference-free matrix instead of a field sample aliquot. Laboratory reagent water is used to prepare aqueous LCS. Non-aqueous LCSs are prepared using solid media approved by the American Society for Testing and Materials for their homogeneity. The LCS measures laboratory efficiency in recovering target analytes from either a solid or aqueous matrix in the absence of matrix interferences.

For inorganic analysis, one primary sample is analyzed and accompanied by an unspiked laboratory duplicate. The data reviewer compares the reported results of the primary analysis and the laboratory duplicate and calculates RPDs to assess laboratory precision.

Laboratory and field sampling precision are further evaluated by calculating RPDs for field sample duplicate pairs. The sampler collects two field samples at the same location and under identically controlled conditions. The laboratory then analyzes the samples under identical conditions.

If incremental sampling is performed, laboratory and field sampling precision are evaluated by calculating RSDs for laboratory triplicates and field triplicates. At the subsampling step, one sample is prepared in triplicate per batch. Laboratory triplicate data are used to determine that the samples are being reduced to sufficiently small particle sizes during the grinding process. Field triplicates are collected from different, randomly selected locations to verify that an incremental sample truly represents a decision unit. Field triplicate results are more useful than field duplicates to statistically evaluate sampling precision.

An RPD outside the numerical QC limit in either MS/MSD samples or LCS/LCSD or a %RSD outside the numerical QC limit in the laboratory triplicate indicates imprecision. Imprecision is the variance in the consistency with which the laboratory arrives at a particular reported result. Thus, the actual analyte concentration may be higher or lower than the reported result.

Possible causes of poor precision include sample matrix interference, improper sample collection or handling, inconsistent sample preparation, and poor instrument stability. In some duplicates and/or triplicates, results may be reported in the primary, duplicate, or triplicate samples at levels below the limit of quantitation (LOQ) or non-detected. Since these values are considered to be estimates, RPD exceedances from duplicates or %RSD exceedances from triplicates do not suggest a significant impact on the data quality.

4.2.2 Accuracy

Accuracy is a measure of the agreement of an experimental determination and the true value of the parameter being measured. It is used to identify bias in a given measurement system. Recoveries outside acceptable QC limits may be caused by factors such as instrumentation, analyst error, or matrix interference. Accuracy is assessed through the analysis of MS, MSD, LCS, and samples containing surrogate spikes. In some cases, samples from multiple SDGs are within one QC batch and therefore are associated with the same laboratory QC samples. Surrogate spikes are either isotopically labeled compounds or compounds that are not typically detected in the samples. Surrogate spikes are added to every blank, environmental sample, MS/MSD, and standard, for applicable organic analyses. Accuracy of inorganic analyses is determined using the percent recoveries of MS and LCS analyses.

Percent recovery (%R) is calculated using the following equation:

$$\%R = (A - B)/C \times 100$$

Where:

A	=	measured concentration in the spiked sample
B	=	measured concentration of the spike compound in the unspiked sample
C	=	concentration of the spike

The percent recovery of each analyte spiked in MS/MSD samples, LCS, and surrogate compounds added to environmental samples is evaluated against the acceptance criteria specified by the previously noted documents. Spike recoveries outside the acceptable QC accuracy limits provide an indication of bias, where the reported data may overestimate or underestimate the actual concentration of compounds detected or quantitation limits reported for environmental samples.

4.3 REPRESENTATIVENESS

Representativeness is a qualitative parameter that expresses the degree to which the sample data are characteristic of a population and is evaluated by reviewing the QC results of blank samples and holding times. Positive detects of compounds in the blank samples identify compounds that may have been introduced into the samples during sample collection, transport, preparation, or analysis. The various types of blanks evaluated are discussed below.

A method blank is a laboratory grade water or solid matrix that contains the method reagents and has undergone the same preparation and analysis as the environmental samples. The method blank provides a measure of the combined contamination derived from the laboratory source water, glassware, instruments, reagents, and sample preparation steps. Method blanks are prepared for each sample of a similar matrix extracted by the same method at a similar concentration level.

For inorganic analyses, initial and continuing calibration blanks consist of acidified laboratory grade water, which are injected at the beginning and at a regular frequency during each 12-hour sample analysis run. These blanks estimate residual contaminants from the previous sample or standards analysis and measure baseline shifts that commonly occur in emission and absorption spectroscopy.

Trip blanks are used to identify possible volatile organic contamination introduced into the sample during transport. A trip blank is a sample volatile organics analysis vial filled in the laboratory with reagent-grade water and preserved to a pH less than 2 with hydrochloric acid. It is transported to the site, stored with the sample containers, and returned unopened to the laboratory for analysis.

Equipment blanks consist of analyte-free water poured over or through the sample collection equipment. The water is collected in a sample container for laboratory analysis. These blanks are collected after the sampling equipment is decontaminated and measure efficiency of the decontamination procedure.

Field blanks consist of analyte-free source water stored at the sample collection site. The water is collected from each source water used during each sampling event.

If sample grinding is performed, grinding blanks, which consist of clean solid matrix (such as Ottawa sand), must be prepared (e.g., ground and subsampled) and analyzed in the same manner as a field sample. Grinding equipment must be thoroughly cleaned between the processing of samples and grinding blanks must be processed and analyzed to prevent cross-contamination.

Contaminants found in both the environmental sample and a blank sample are assumed to be laboratory artifacts if the concentration in the environmental sample is less than 10 times the blank value for common laboratory contaminants (methylene chloride, acetone, 2-butanone, and phthalate esters) or 5 times the blank value for other laboratory contaminants.

Holding times are evaluated to assure that the sample integrity is intact for accurate sample preparation and analysis. Holding times will be specific for each method and matrix analyzed. Holding time exceedances can cause loss of sample constituents due to biodegradation, precipitation, volatization, and chemical degradation.

4.4 COMPARABILITY

Comparability is a qualitative expression of the confidence with which one data set may be compared to another. It provides an assessment of the equivalence of the analytical results to data obtained from other analyses. It is important that data sets be comparable if they are used in conjunction with other data sets. The factors affecting comparability include the following: sample collection and handling techniques, matrix type, and analytical method. If these aspects of sampling and analysis are carried out according to standard analytical procedures, the data are considered comparable. Comparability can only be compared with confidence when precision, accuracy, and representativeness are known.

4.5 COMPLETENESS

Completeness is defined as the percentage of acceptable sample results compared to the total number of sample results. Completeness is evaluated to determine if an acceptable amount of usable data were obtained so that a valid scientific site assessment can be completed. Completeness equals the total number of sample results for each fraction minus the total number of rejected sample results divided by the total number of sample results multiplied by 100. The goal for completeness for target analytes in each analytical fraction should be specified in the DoD QSM (DoD 2013) or project planning document.

Percent completeness is calculated using the following equation:

$$\%C = (T - R)/T \times 100$$

Where:

%C	=	percent completeness
T	=	total number of sample results
R	=	total number of rejected sample results

Completeness is also determined by comparing the planned number of samples per method and matrix as specified in the project planning document, with the number determined above.

4.6 SENSITIVITY

Sensitivity is the ability of an analytical method or instrument to discriminate between measurement responses representing different concentrations. This capability is established during the planning phase to meet the data quality objectives (DQOs). It is important that calibration requirements, detection limits (DLs), and project-specific LODs and LOQs presented in the work plan are achieved and that target analytes can be detected at concentrations necessary to support the DQOs. In addition, sample results are compared to method blank and field blank results to identify potential effects of laboratory background and field procedures on sensitivity.

5. References

Department of Defense, United States (DoD). 2013. *Department of Defense Quality Systems Manual (QSM) for Environmental Laboratories.* Final version 5.0. Prepared by Department of Defense Environmental Data Quality Workgroup and the Department of Energy Consolidated Audit Program Operations Team. March.

Procedure II-A, *Data Validation*.

6. Attachments

II-S-1: Data Quality Assessment Report Example

Attachment II-S-1
Data Quality Assessment Report Example

DATA QUALITY ASSESSMENT REPORT

SITE INVESTIGATION BUILDING E-13
PEARL HARBOR, CTO XXX

12/1/03

Table of Contents

Glossary

µg/kg	microgram per kilogram
µg/L	microgram per liter
BTEX	benzene, toluene, ethylbenzene, xylenes
DL	detection limit
DQO	data quality objectives
EPA	Environmental Protection Agency, United States
IDL	instrument detection limit
LCS/LCSD	laboratory control sample/laboratory control sample duplicate
LOD	limit of detection
LOQ	limit of quantitation
mg/kg	milligram per kilogram
MS/MSD	matrix spike/matrix spike duplicate
NAS	Naval Air Station
PARCCS	Precision, Accuracy, Representativeness, Comparability, Completeness, Sensitivity
PAH	polynuclear aromatic hydrocarbon
PCB	polychlorinated biphenyl
QA/QC	quality assurance/quality control
RPD	relative percent difference
RRF	relative response factor
RL	reporting limit
SDG	sample delivery group
%D	percent difference
%R	percent recovery
%RSD	percent relative standard deviation

1. Introduction

A remediation and closure was conducted at Building E-13 at Pearl Harbor, Oahu, Hawaii. This part of the site investigation included the collection and analyses of 141 environmental and quality control (QC) samples. The analyses were performed by the following methods:

- Polynuclear aromatic hydrocarbons (PAHs) by United States Environmental Protection Agency (EPA) SW-846 8270C-SIM
- Polychlorinated biphenyls (PCBs) by EPA SW-846 Method 8082
- Metals by EPA SW-846 Method 6010B/6020/7471A

Analytical services were provided by ZZZZ Laboratories whom performed analyses on the water and soil samples. The samples were grouped into sample delivery groups (SDGs) of up to 20 field samples received by each laboratory. The environmental samples are associated with QA/QC samples designed to document the data quality of the entire SDG or a sub-group of samples within a SDG. Table I is a cross-reference table listing each sample, analysis, SDG, collection date, laboratory sample number, and matrix. All shaded samples in Table I were reviewed under Level D validation guidelines.

One hundred percent of the analytical data were validated according to NAVFAC Pacific Level D data validation procedures. The analytical data were evaluated for quality assurance and quality control (QA/QC) based on the *Department of the Navy Environmental Restoration Program (NERP) Manual* (2006).

This data quality assessment report (DQAR) summarizes the QA/QC evaluation of the data according to precision, accuracy, representativeness, completeness, comparability, and sensitivity (PARCCS) relative to the project quality objectives (PQOs). This report provides a quantitative and qualitative assessment of the data and identifies potential sources of error, uncertainty, and bias that may affect the overall usability.

The DQAR evaluates and summarizes the results of QA/QC data validation for the entire sampling program. Each analytical fraction has a separate section for each of the PARCC criteria. These sections interpret specific QC deviations and their effects on both individual data points and the analyses as a whole. Section 6 presents a summary of the PARCC criteria by comparing quantitative parameters with acceptability criteria defined in the PQOs. Qualitative PARCC criteria are also summarized in this section.

Precision and Accuracy of Environmental Data

Environmental data quality depends on sample collection procedures, analytical methods and instrumentation, documentation, and sample matrix properties. Both sampling procedures and laboratory analyses contain potential sources of uncertainty, error, and/or bias, which affect the overall quality of a measurement. Errors in sample data may result from incomplete equipment decontamination, inappropriate sampling techniques, sample heterogeneity, improper filtering, and improper preservation. The accuracy of analytical results is dependent on selecting appropriate analytical methods, maintaining equipment properly, and complying with QC requirements. The sample matrix also is an important factor in the ability to obtain precise and accurate results within a given media.

Environmental and laboratory QA/QC samples assess the effects of sampling procedures and evaluate laboratory contamination, laboratory performance, and matrix effects. QA/QC samples include: equipment blanks, field duplicates, method blanks, laboratory control samples (LCSs), surrogate spikes, matrix spike/matrix spike duplicates (MS/MSDs), and laboratory duplicates.

Before conducting the PARCC evaluation, the analytical data were validated according to the *Department of the Navy Environmental Restoration Program (NERP) Manual* [2006]). Samples not meeting the Project Procedures Manual acceptance criteria were qualified with a flag, an abbreviation indicating a deficiency with the data. The following are flags used in data validation.

J Estimated: The associated numerical value is an estimated quantity. The analyte was detected but the reported value may not be accurate or precise. The "J" qualification indicates the data fell outside the QC limits, but the exceedance was not sufficient to cause rejection of the data.

R Rejected: The data is unusable (the compound or analyte may or may not be present). Use of the "R" qualifier indicates a significant variance from functional guideline acceptance criteria. Either resampling or re-analysis is necessary to determine the presence or absence of the rejected analyte.

U Nondetected: Analyses were performed for the compound or analyte, but it was not detected. The "U" designation is also applied to suspected blank contamination. The "U" flag is used to qualify any result detected in an environmental sample at a concentration less than 10 times the value of the concentration in any associated blank for common laboratory contaminants and less than 5 times the concentration in any associated blank for all other contaminants.

UJ Estimated/Nondetected: Analyses were performed for the compound or analyte, but it was not detected and the limit of detection (LOD) is an estimated quantity due to poor accuracy or precision. This qualification is also used to flag possible false negative results in the case where low bias in the analytical system is indicated by low calibration response, surrogate, internal standard, or other spike recovery.

Once the data are reviewed and qualified according to the *Department of the Navy Environmental Restoration Program (NERP) Manual* (2006), the data set is then evaluated using PARCCS criteria. PARCCS criteria provide an evaluation of overall data usability. The following is a discussion of PARCCS criteria as related to the PQOs.

Precision is a measure of the agreement or reproducibility of analytical results under a given set of conditions. It is a quantity that cannot be measured directly but is calculated from reported concentrations. Precision is expressed as the relative percent difference (RPD):

$$RPD = (D1–D2)/\{1/2(D1+D2)\} \times 100$$

Where:

D1 and D2 = the reported concentrations for sample and duplicate analyses.

Precision is primarily assessed by calculating a RPD from the reported concentrations of the spiked compounds for each sample in the MS/MSD pair. In the absence of a MS/MSD pair, a laboratory duplicate or LCS/LCSD pair can be analyzed as an alternative means of assessing precision. In some cases, samples from multiple SDGs were within one QC batch and therefore are associated with the same laboratory QC samples. An additional measure of sampling precision was obtained by collecting and analyzing field duplicate samples, which were compared using the RPD result as the evaluation criteria.

MS and MSD samples are field samples spiked by the laboratory with target analytes prior to preparation and analysis. These samples measure the overall efficiency of the analytical method in recovering target analytes from an environmental matrix. A LCS is similar to a MS/MSD sample in that the LCS is spiked with the same target analytes prior to preparation and analysis. However, the LCS is prepared using a controlled interference-free matrix instead of a field sample aliquot. Laboratory reagent water is used to prepare aqueous LCS. Non-aqueous LCSs are prepared using solid media approved by the American Society for Testing and Materials (ASTM) for their homogeneity. The LCS measures laboratory efficiency in recovering target analytes from either a solid or aqueous matrix in the absence of matrix interferences.

For inorganics analysis, one primary sample is analyzed and accompanied by an unspiked laboratory duplicate. The data reviewer compares the reported results of the primary analysis and the laboratory duplicate, then calculates RPDs, which are used to assess laboratory precision.

Laboratory and field sampling precision are further evaluated by calculating RPDs for aqueous field sample duplicate pairs. The sampler collects two field samples at the same location and under identically controlled conditions. The laboratory then analyzes the samples under identical conditions.

An RPD outside the numerical QC limit in either MS/MSD samples or LCS/LCSD indicates imprecision. Imprecision is the variance in the consistency with which the laboratory arrives at a particular reported result. Thus, the actual analyte concentration may be higher or lower than the reported result.

Possible causes of poor precision include sample matrix interference, improper sample collection or handling, inconsistent sample preparation, and poor instrument stability. In some duplicate pairs, results maybe reported in either the primary or duplicate samples at levels below the limit of quantitation (LOQ) or non-detected. Since these values are considered to be estimates, RPD exceedances from these duplicate pairs do not suggest a significant impact on the data quality.

Accuracy is a measure of the agreement of an experimental determination and the true value of the parameter being measured. It is used to identify bias in a given measurement system. Recoveries outside acceptable QC limits may be caused by factors such as instrumentation, analyst error, or matrix interference. Accuracy is assessed through the analysis of MS, MSD, LCS, and samples containing surrogate spikes. In some cases, samples from multiple SDGs were within one QC batch and therefore are associated with the same laboratory QC samples. Surrogate spikes are either isotopically labeled compounds or compounds that are not typically detected in the samples. Surrogate spikes are added to every blank, environmental sample, MS/MSD, and standard, for all applicable organic analyses. Accuracy of inorganic analyses is determined using the percent recoveries of MS and LCS analyses.

%R is calculated using the following equation:

$$\%R = (A–B)/C \times 100$$

Where:

A	=	measured concentration in the spiked sample
B	=	measured concentration of the spike compound in the unspiked sample
C	=	concentration of the spike

The percent recovery of each analyte spiked in MS/MSD samples, LCS, and surrogate compounds added to environmental samples is evaluated against the acceptance criteria specified by the previously noted documents. Spike recoveries outside the acceptable QC accuracy limits provide an indication of bias, where the reported data may overestimate or underestimate the actual concentration of compounds detected or quantitation limits reported for environmental samples.

Representativeness is a qualitative parameter that expresses the degree to which the sample data are characteristic of a population and is evaluated by reviewing the QC results of blank samples and holding times. Positive detects of compounds in the blank samples identify compounds that may have been introduced into the samples during sample collection, transport, preparation, or analysis. The QA/QC blanks collected and analyzed are method blanks.

A method blank is a laboratory grade water or solid matrix that contains the method reagents and has undergone the same preparation and analysis as the environmental samples. The method blank provides a measure of the combined contamination derived from the laboratory source water, glassware, instruments, reagents, and sample preparation steps. Method blanks are prepared for each sample of a similar matrix extracted by the same method at a similar concentration level.

For inorganic analyses, initial and continuing calibration blanks consist of acidified laboratory grade water, which are injected at the beginning and at a regular frequency during each 12 - hour sample analysis run. These blanks estimate residual contaminants from the previous sample or standards analysis and measure baseline shifts that commonly occur in emission and absorption spectroscopy.

Trip blanks are used to identify possible volatile organic contamination introduced into the sample during transport. A trip blank is a sample bottle filled in the laboratory with reagent-grade water and preserved to a pH less than 2 with hydrochloric acid. It is transported to the site, stored with the sample containers, and returned unopened to the laboratory for analysis.

Equipment blanks consist of analyte-free water poured over or through the sample collection equipment. The water is collected in a sample container for laboratory analysis. These blanks are collected after the sampling equipment is decontaminated and measure efficiency of the decontamination procedure. Equipment blanks were collected and analyzed for all target analytes.

Field blanks consist of analyte-free source water stored at the sample collection site. The water is collected from each source water used during each sampling event. Field blanks were collected and analyzed for all target analytes.

Contaminants found in both the environmental sample and a blank sample are assumed to be laboratory artifacts if the concentration in the environmental sample is less than 10 times the blank value for common laboratory contaminants; methylene chloride, acetone, 2-butanone, and phthalate esters or 5 times the blank value for other laboratory contaminants.

Holding times are evaluated to assure that the sample integrity is intact for accurate sample preparation and analysis. Holding times will be specific for each method and matrix analyzed. Holding time exceedances can cause loss of sample constituents due to biodegradation, precipitation, volatization, and chemical degradation.

Comparability is a qualitative expression of the confidence with which one data set may be compared to another. It provides an assessment of the equivalence of the analytical results to data obtained from other analyses. It is important that data sets be comparable if they are used in conjunction with other data sets. The factors affecting comparability include the following: sample collection and handling techniques, matrix type, and analytical method. If these aspects of sampling and analysis are carried out according to standard analytical procedures, the data are considered comparable. Comparability is also dependent upon other PARCC criteria, because only when precision, accuracy, and representativeness are known can data sets be compared with confidence.

Completeness is defined as the percentage of acceptable sample results compared to the total number of sample results. Completeness is evaluated to determine if an acceptable amount of usable data were obtained so that a valid scientific site assessment can be completed. Completeness equals the total number of sample results for each fraction minus the total number of rejected sample results divided by the total number of sample results multiplied by 100. As specified in the PQOs, the goal for completeness for target analytes in each analytical fraction is 90 percent.

Percent completeness is calculated using the following equation:

$$\%C = (T - R)/T \times 100$$

Where:

%C	=	percent completeness
T	=	total number of sample results
R	=	total number of rejected sample results

Completeness is also determined by comparing the planned number of samples per method and matrix as specified in the project planning document, with the number determined above.

Sensitivity is the ability of an analytical method or instrument to discriminate between measurement responses representing different concentrations. This capability is established during the planning phase to meet the DQOs. It is important that calibration requirements, detection limits (DLs), and project-specific LODs and LOQs presented in the work plan are achieved and that target analytes can be detected at concentrations necessary to support the DQOs. In addition, sample results are compared to method blank and field blank results to identify potential effects of laboratory background and field procedures on sensitivity.

The following sections present a review of QC data for each analytical method.

2. Polynuclear Aromatic Hydrocarbons

A total of 58 soil samples were analyzed for PAH by EPA SW-846 Method 8270C-SIM. All PAH data were assessed to be valid with the exception of 17 of the 986 total results, which were rejected based on QC exceedances. This section discusses the QA/QC supporting documentation as defined by the PARCC criteria and evaluated based on the PQOs.

2.1 Precision and Accuracy

2.1.1 Instrument Calibration

Initial and continuing calibration results provide a means of evaluating accuracy within a particular SDG. Relative response factor (RRF), percent relative standard deviation (%RSD), and percent difference (%D) are the three major parameters used to measure the effectiveness of instrument calibration. RRF is a measure of the relative spectral response of an analyte compared to its internal standard. %RSD is an expression of the linearity of instrument response. %D is a comparison of a continuing calibration instrumental response with its initial response. %RSD and %D exceedances suggest routine instrumental anomalies, which typically impact all sample results for the affected compounds.

The relative response factors met the acceptance criteria of 0.05 in the initial and continuing calibration standards.

The relative standard deviation in the initial calibrations and/or %D between the initial calibration mean relative response factors and the continuing calibration relative response factors were within the acceptance criteria of 15 and 20 percent, respectively.

The %Ds in the initial calibration verification were within the acceptance criteria of 20 percent.

2.1.2 Surrogates

As a result of non-compliant surrogate recoveries, 17 non-detected results in sample BA368 were qualified as unusable (R). Additionally, 136 results in samples BA267, BA338, BA341, BA363, BA364, BA367, BA368, and BA369 were qualified as detected estimated (J) and non-detected estimated (UJ) due to non-compliant surrogate recoveries. The details regarding the qualification of results are provided in the data validation reports.

2.1.3 MS/MSD Samples

As a result of non-compliant MS/MSDs, five results for non-compliant RPDs and 32 results for non-compliant %Rs were qualified as detected estimated (J) and non-detected estimated (UJ). The affected compounds were 2-methylnapthalene, acenaphthene, acenaphthylene, anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, chrysene, dibenz(a,h)anthracene, fluorene, naphthalene, phenanthrene, and pyrene. The details regarding the qualification of results are provided in the data validation reports.

2.1.4 LCS Samples

As a result of non-compliant LCS/LCSD recoveries, 139 results were qualified as detected estimated (J) and non-detected estimated (UJ). The affected compounds were acenaphthene, benzo(a)anthracene, benzo(a)pyrene, dibenz(a,h)anthracene, fluorene, and pyrene. The details regarding the qualification of results are provided in the data validation reports.

2.1.5 Internal Standards

No data were qualified based on internal standard nonconformances. The recoveries and retention times were evaluated against the acceptance criteria.

2.1.6 Field Duplicate Samples

The field duplicate samples were evaluated for acceptable precision with RPDs for the compounds. The associated data validation narratives provided details regarding criteria exceeded. Sample data were not qualified on the basis of field duplicate precision.

2.1.7 Proficiency Testing Samples

Proficiency testing samples were not performed for the sampling event.

2.1.8 Compound Quantitation and Target Identification

Due to compound quantitation nonconformances (i.e., co-elution of peaks), 29 benzo(b)fluoranthene and benzo(k)fluoranthene detected results in several samples were qualified as detected estimated (J). The details regarding the qualification of results are provided in the data validation reports.

All target compound identifications were found to be acceptable

2.2 REPRESENTATIVENESS

2.2.1 Holding Times

The evaluation of holding times to verify compliance with the method was conducted. All holding times were met.

2.2.2 Blanks

Method blanks were analyzed to evaluate representativeness. The concentration for an individual target compounds in any of the three types of QA/QC blanks were used for data qualification.

If contaminants were detected in a blank, corrective actions were made for the chemical analytical data during data validation. The corrective action consisted of amending the laboratory reported results for organic compounds based on the following criteria. The validation qualifier codes used in the blank summary tables are described below.

- *Results Below or Above the LOQ:* If a sample result for the blank contaminant was less than the LOQ or greater than the sample LOQ and less than 5× the blank value, the sample result for the blank contaminant was amended as a non-detect at the concentration reported in the sample results.
- *No Action:* If a sample result for the blank contaminant was greater than 10× the blank value for common contaminants or 5× the blank value for other contaminants, the result was not amended.

2.2.2.1 Method Blanks

As a result of method blank contamination, one benzo(a)anthracene result was qualified as non-detected (U). The details regarding the qualification of results are provided in the data validation reports.

2.3 Comparability

The laboratory used standard analytical methods for all of the analyses. In all cases, the method detection limits attained were at or below the reporting limit. Target compounds detected below the reporting limits flagged (J) by the laboratory should be considered estimated. The comparability of the data is regarded as acceptable.

2.4 Completeness

The completeness level attained for PAH field samples was 98.3 percent. This percentage was calculated as the total number of accepted sample results divided by the total number of sample results multiplied by 100.

2.5 Sensitivity

The calibration was evaluated for instrument sensitivity and was determined to be technically acceptable. All laboratory reporting limits met the specified requirements described in the work plan although LOD was elevated for benzo(a)anthracene for one sample due to method blank contamination.

3. Polychlorinated Biphenyls

A total of 20 soil samples were analyzed for PCB as Aroclors by EPA SW-846 Method 8082. All PCB data were assessed to be valid since none of the 140 total results were rejected based on QC exceedances. This section discusses the QA/QC supporting documentation as defined by the PARCC criteria and evaluated based on the PQOs.

3.1 Precision and Accuracy

3.1.1 Instrument Calibration

Initial and continuing calibration results provide a means of evaluating accuracy within a particular SDG. Percent relative standard deviation (%RSD) and percent difference (%D) are the two major parameters used to measure the effectiveness of instrument calibration. %RSD is an expression of the linearity of instrument response. %D is a comparison of a continuing calibration instrumental response with its initial response. %RSD and %D exceedances suggest more routine instrumental anomalies, which typically impact all sample results for the affected compounds.

Six results were qualified detected estimated (J) and non-detected estimated (UJ). The relative standard deviations in the initial calibrations and/or percent difference between the initial calibration and the continuing calibration concentrations for Aroclor 1016, Aroclor 1221, and Aroclor 1232 were outside the acceptance criteria of 20 and 15 percent, respectively. The affected samples are identified in the data validation reports.

3.1.2 Surrogates

No data were qualified based on surrogate recovery nonconformances. In cases where individual recoveries exceeded criteria, the QC exceedance was judged to have no impact on the data quality and no qualifications were made.

3.1.3 MS/MSD Samples

No data were qualified based on MS/MSD nonconformances. For those SDGs with MS/MSD results, the recoveries were evaluated against the acceptance criteria. In cases where recoveries exceeded criteria, the QC exceedance was judged to have no impact on the data quality and no qualifications were made.

3.1.4 LCS Samples

No data were qualified based on LCS nonconformances. For those SDGs with LCS results, the recoveries were evaluated against the acceptance criteria.

3.1.5 Field Duplicate Samples

The field duplicate samples were evaluated for acceptable precision with RPDs for the compounds. The associated data validation narratives provided details regarding criteria exceeded. Sample data were not qualified on the basis of field duplicate precision.

3.1.6 Proficiency Testing Samples

Proficiency testing samples were not performed for the sampling event.

3.1.7 Compound Quantitation and Target Identification

Due to compound quantitation nonconformances (i.e., %Ds between columns), one Aroclor 1260 result in sample BA245 was qualified as detected estimated (J). The details regarding the qualification of results are provided in the data validation reports.

All target compound identifications were found to be acceptable.

3.2 Representativeness

3.2.1 Holding Times

The evaluation of holding times to verify compliance with the method was conducted. All holding times were met.

3.2.2 Blanks

As previously discussed in Section 2.2.2, method blanks were analyzed to evaluate representativeness.

3.2.2.1 Method Blanks

No QC issues were associated with the method blanks for this analysis.

3.3 Comparability

The laboratory used standard analytical methods for all of the analyses. In all cases, the method detection limits attained were at or below the reporting limit. Target compounds detected below the reporting limits flagged (J) by the laboratory should be considered estimated. The comparability of the data is regarded as acceptable.

3.4 Completeness

The completeness level attained for PCB field samples was 100 percent. This percentage was calculated as the total number of accepted sample results divided by the total number of sample results multiplied by 100.

3.5 Sensitivity

The calibration was evaluated for instrument sensitivity and was determined to be technically acceptable. All laboratory LODs and LOQs met the project requirements described in the work plan.

4. Metals

A total of 48 soil samples were analyzed for metals by EPA SW-846 Method 6010B/6020/7471A. All metals data were assessed to be valid since none of the 465 total results were rejected based on QC exceedances. This section discusses the QA/QC supporting documentation as defined by the PARCC criteria and evaluated based on the PQOs.

4.1 Precision and Accuracy

4.1.1 Instrument Calibration

Initial and continuing calibration verification results provide a means of evaluating accuracy within a particular SDG. Correlation coefficient (r) and percent recovery (%R) are the two major parameters used to measure the effectiveness of instrument calibration. The correlation coefficient indicates the linearity of the calibration curve. %R is used to verify the ongoing calibration acceptability of the analytical system. The most critical of the two calibration parameters, r, has the potential to affect data accuracy across a SDG when it is outside the acceptable QC limits. %R exceedances suggest more routine instrumental anomalies, which typically impact all sample results for the affected analytes.

The correlation coefficients in the initial calibrations and/or percent recoveries in the continuing calibration verifications were within the acceptance criteria of $\geq$ 0.995 and 90-110 percent, respectively.

4.1.2 MS Samples

As a result of non-compliant MS recoveries, 21 results were qualified as detected estimated (J) and non-detected estimated (UJ). The analytes affected were barium, cadmium, and chromium. The details regarding the qualification of results are provided in the data validation reports.

4.1.3 Duplicate (DUP) Samples

No data were qualified based on duplicate nonconformances. For those SDGs with DUP results, the relative percent differences/differences were evaluated against the acceptance criteria. In cases where

RPDs or differences exceeded criteria, the QC exceedance was judged to have no impact on the data quality and no qualifications were made.

4.1.4 LCS Samples

No data were qualified based on LCS nonconformances. For those SDGs with LCS results, the recoveries were evaluated against the acceptance criteria.

4.1.5 ICP Serial Dilution

No data were qualified based on ICP serial dilution nonconformances. All recoveries were evaluated against the acceptance criteria.

4.1.6 ICP Interference Check Sample

As a result of ICP interference check sample exceedances, 16 results were qualified as detected estimated (J) and non-detected estimated (UJ). The analytes affected were arsenic, cadmium, chromium, and silver. The details regarding the qualification of results are provided in the data validation reports.

4.1.7 Field Duplicate Samples

The field duplicate samples were evaluated for acceptable precision with RPDs for the analytes. The associated data validation narratives provided details regarding criteria exceeded. Sample data were not qualified on the basis of field duplicate precision.

4.1.8 Proficiency Testing Samples

Proficiency testing samples were not performed for the sampling event.

4.1.9 Sample Result Verification

All sample results were found to be acceptable.

4.2 REPRESENTATIVENESS

4.2.1 Holding Times

The evaluation of holding times to verify compliance with the method was conducted. All holding times were met.

4.2.2 Blanks

Method blanks were analyzed to evaluate representativeness. The concentration for an individual target compounds in any of the three types of QA/QC blanks were used for data qualification.

If contaminants were detected in a blank, corrective actions were made for the chemical analytical data during data validation. The corrective action consisted of amending the laboratory reported results for organic analytes based on the following criteria. The validation qualifier codes are described below.

- *Results Below or Above the LOQ:* If a sample result for the blank contaminant was less than the LOQ or greater than the sample LOQ and less 5× the method blank value or the highest applicable calibration blank value, the sample result for the blank contaminant was amended as a non-detect at the concentration reported in the sample results.

- *No Action:* If a sample result for the blank contaminant was greater than 5× the blank value, the result was not amended.

4.2.2.1 Method Blanks

No QC issues were associated with the method blanks for this analysis.

4.3 Comparability

The laboratory used standard analytical methods for all of the analyses. In all cases, the method detection limits attained were at or below the reporting limit. Target analytes detected below the reporting limits flagged (J) by the laboratory should be considered estimated. The comparability of the data is regarded as acceptable.

4.4 Completeness

The completeness level attained for metal field samples was 100 percent. This percentage was calculated as the total number of accepted sample results divided by the total number of sample results multiplied by 100.

4.5 Sensitivity

The calibration was evaluated for instrument sensitivity and was determined to be technically acceptable. All laboratory LODs and LOQs met the project requirements described in the work plan.

5.0 Variances in Analytical Performance

The laboratory used standard analytical methods for all of the analyses throughout the project. No systematic variances in analytical performance were noted according to the laboratory SOW.

6.0 Summary of PARCC criteria

The validation reports present the PARCC results for all SDGs. Each PARCC criterion is discussed in detail in the following sections.

6.1 Precision and Accuracy

Precision and accuracy were evaluated using data quality indicators such as MS/MSD, LCS, and surrogates. The precision and accuracy of the data set were considered acceptable after integration of qualification of estimated results as specifically noted in the data validation reports.

6.2 Representativeness

All samples for each method and matrix were evaluated for holding time compliance. All samples were associated with a method blank in each individual SDG. The representativeness of the project data is considered acceptable after qualification for blank contamination.

6.3 COMPARABILITY

Sampling frequency requirements were met in obtaining duplicates and necessary field blanks. The laboratory used standard analytical methods for their analyses. The analytical results were reported in correct standard units. Holding times, sample preservation, and sample integrity were within QC criteria. The overall comparability is considered acceptable.

6.4 COMPLETENESS

Of the 1591 total analytes reported, 17 of the sample results were rejected. The completeness for all SDGs is as follows:

Parameter/Method	Total Analytes	No. of Rejects	%Completeness
PAHs	986	17	98.3
PCBs	140	0	100
Metals	465	0	100
Total	**1,591**	**17**	**98.9**

The completeness percentage based on rejected data met the 90 percent DQO goal. A less quantifiable loss of data occurred in the application of blank qualifications.

6.5 SENSITIVITY

Sensitivity was achieved by the laboratory to support the DQOs. Calibration concentrations and reporting limits met the project requirements and low level PAH contamination in the method blanks did not affect sensitivity.

Table 1: Validation Sample Table, SDG 42300

Client ID #	Lab ID #	QC Type	Matrix	Date Collected	Mercury (7470A)	PAH (8270C-SIM)	PCBs (8082)
BA268	AP55206		soil	7-30-03	X		
BA269	AP55207		soil	7-30-03	X		
BA270	AP55208		soil	7-30-03	X		
BA271	AP55209		soil	7-30-03	X		
BA272	AP55210		soil	7-30-03	X		
BA273	AP55211		soil	7-30-03	X		
BA274	AP55212		soil	7-30-03	X		
BA275	AP55213		soil	7-30-03	X		
BA276	AP55214		soil	7-30-03	X		
BA277	AP55215		soil	7-30-03	X		
BA278	AP55216		soil	7-31-03	X		
BA279	AP55217		soil	7-31-03	X		
BA280	AP55218		soil	7-31-03	X		
BA281	AP55219		soil	7-31-03	X		
BA282	AP55220		soil	7-31-03	X		
BA283	AP55221		soil	7-31-03	X		
BA284	AP55222		soil	7-31-03	X		
BA285	AP55223		soil	7-31-03	X		
BA286	AP55224		soil	7-31-03	X		
BA287	AP55225		soil	7-31-03	X		
BA245	AP54789		soil	7-25-03			X
BA246	AP54790		soil	7-25-03			X
BA247	AP54791		soil	7-25-03			X
BA248	AP54792		soil	7-25-03			X
BA249	AP54793		soil	7-25-03			X
BA250	AP54794		soil	7-25-03			X
BA251	AP54795		soil	7-25-03			X
BA252	AP54796		soil	7-25-03			X
BA253	AP54797		soil	7-25-03			X
BA254	AP54798		soil	7-25-03			X
BA255	AP54799		soil	7-25-03			X
BA256	AP54800		soil	7-25-03			X
BA257	AP54801		soil	7-25-03			X
BA258	AP54802		soil	7-25-03			X
BA259	AP54803		soil	7-25-03			X
BA260	AP54804		soil	7-25-03			X
BA261	AP54805		soil	7-25-03			X
BA262	AP54806		soil	7-25-03			X
BA263	AP54807		soil	7-25-03			X
BA264	AP54808		soil	7-25-03			X
BA265	AP54809		soil	7-26-03		X	
BA265DL	AP54809DL	DL	soil	7-26-03		X	

Client ID #	Lab ID #	QC Type	Matrix	Date Collected	Mercury (7470A)	PAH (8270C-SIM)	PCBs (8082)
BA266	AP54810		soil	7-26-03		X	
BA266DL	AP54810DL	DL	soil	7-26-03		X	
BA266DL2	AP54810DL2	DL2	soil	7-26-03		X	
BA267	AP54811		soil	7-26-03		X	
BA245MS	AP54789MS	MS	soil	7-25-03			X

Laboratory QC Samples (Water, Soil)

1. Purpose

This section sets forth the standard operating procedure for identifying the number and type of laboratory quality control (QC) samples that will be analyzed during each contract task order (CTO) associated with the United States Navy Environmental Restoration (ER) Program, Naval Facilities Engineering Command (NAVFAC), Pacific. Laboratory QC analyses serve as a check on the precision and accuracy of analytical methods and instrumentation, and the potential contamination that might occur during laboratory sample preparation and analyses. Laboratory QC analyses include blank, surrogate, blank spike, laboratory control sample (LCS), and matrix spike (MS)/matrix spike duplicate (MSD) analyses. These laboratory QC analyses are discussed in general below.

2. Scope

This procedure applies to all Navy ER projects performed in the NAVFAC Pacific Area of Responsibility.

This procedure shall serve as management-approved professional guidance for the ER Program and is consistent with protocol in the most recent version of the Uniform Federal Policy-Quality Assurance Project Plan (UFP QAPP) Part 1 (DoD 2005a), 2A (DoD 2012), and 2B (2005b), as well as the DoD Quality Systems Manual (DoD 2013). As professional guidance for specific activities, this procedure is not intended to obviate the need for professional judgment during unforeseen circumstances. Deviations from this procedure while planning or executing planned activities must be approved and documented by the following prime contractor representatives: the CTO Manager and the Quality Assurance (QA) Manager or Technical Director. A Navy project representative (i.e., Remedial Project Manager or QA Manager) shall also concur with any deviations.

3. Definitions

3.1 PRECISION

Precision is the degree to which a set of observations or measurements of the same property, obtained under similar conditions, conform to themselves. Precision is usually expressed as a standard deviation, variance, or range, in either absolute or relative terms. Examples of QC measures for precision include laboratory duplicates, laboratory triplicates, and matrix spike/matrix spike duplicates.

3.2 ACCURACY

Accuracy is the degree of agreement between an observed value and an accepted reference value. Accuracy includes a combination of random error (precision) and systematic error (bias), components which are due to sampling and analytical operations. Examples of QC measures for accuracy include performance evaluation samples, matrix spikes, LCSs, and equipment blanks.

3.3 MATRIX

A specific type of medium (e.g., surface water, drinking water), in which the analyte of interest may be contained. Medium is a substance (e.g., air, water, soil), which serves as a carrier of the analytes of interest (EPA 2010).

3.4 Method Blank

An analyte-free matrix (water, soil, etc.) subjected to the entire analytical process to demonstrate that the analytical system itself does not introduce contamination.

3.5 Matrix Spike

A sample prepared by adding a known concentration of a target analyte to an aliquot of a specific homogenized environmental sample for which an independent estimate of the target analyte concentration is available. The MS is accompanied by an independent analysis of the unspiked aliquot of the environmental sample. Spiked samples are used to determine the effect of the matrix on a method's recovery efficiency.

3.6 Laboratory Control Samples and Blank Spikes

A sample of known composition prepared using reagent-free water or an inert solid that is spiked with analytes of interest at the midpoint of the calibration curve or at the level of concern. It is analyzed using the sample preparation, reagents, and analytical methods employed for regular samples.

3.7 Surrogates

A pure substance with properties that mimic the analyte of interest (organics only). Surrogates are typically brominated, fluorinated, or isotopically labeled compounds unlikely to be found in environmental samples. These analytes are added to samples to evaluate analytical efficiency by measuring recovery.

3.8 Internal Standards

A pure substance added to both samples and laboratory standards at a known concentration with the purpose of providing a basis of comparison in the quantitation of analytes of interest. Internal standards are primarily used to increase the accuracy and precision of analytical methods where the primary source of variability is in sample preparation or sample injection on instrument.

4. Responsibilities

The prime contractor's QA Manager or Technical Director, as well as QC coordinators are responsible for ensuring that sample analytical activities during all CTOs are in compliance with this procedure.

The CTO QC Coordinators and the Laboratory Manager are responsible for identifying instances of non-compliance with this procedure and ensuring that future laboratory analytical activities are in compliance with it.

5. Procedures

Laboratory QC checks include all types of samples specified in the requested analytical methods, such as the analysis of laboratory blank, duplicate, and MS samples. QC requirements are specified in each analytical method and in Appendix B, *Quality Control Requirements*, and Appendix C, *Laboratory Control Sample (LCS) Control Limits and Requirements*, of the *Department of Defense Quality Systems Manual for Environmental Laboratories* Version 5.0 (or most current version)

(DoD QSM). Types of QC samples are discussed in general below. Detailed discussion and minimum QA/QC requirements are presented in the DoD QSM (DoD 2013).

A comprehensive discussion of the minimum number of laboratory QC samples can be found in the *Uniform Federal Policy for Quality Assurance Project Plans, Part 2B, Quality Assurance/Quality Control Compendium: Minimum QA/QC Activities* (DoD 2005b). However, additional QA/QC samples may be necessary based on the project quality objectives. Information pertaining to laboratory QC samples shall be documented in Worksheet 28 Laboratory QC Samples Table of the project UFP QAPP-style planning document.

5.1 LABORATORY BLANKS

Laboratory blank samples are analyzed to assess the degree to which laboratory contamination by reagent or method preparation may have affected sample analytical results. At a minimum, one laboratory blank will be analyzed per matrix per analytical method for each batch of at most 20 samples. In evaluating the blank results, all blank data are reviewed to identify any compounds detected in the blanks. The laboratory shall be contacted to discuss detection of analytes in blank samples only in the event of unusual contamination, but not for common laboratory contaminants at low levels. The following compounds are considered to be common laboratory contaminants: acetone, methylene chloride, 2-butanone, and common phthalate esters. The data for samples analyzed during the same time period as the blank are then evaluated to identify the presence of any contaminants found in the blanks. The presence of the blank contaminants found in associated samples is then evaluated to avoid potential misinterpretation of actual sample constituents. Briefly, as discussed in the data validation procedures, any analyte detected above the LOQ in both the sample and the associated blank is qualified as not detected if the sample concentration is less than five times the blank concentration (5× rule). For common laboratory contaminants (methylene chloride, acetone, 2-butanone, and common phthalate esters), a 10× rule applies.

5.2 LABORATORY REPLICATES (DUPLICATES AND TRIPLICATES)

Replicates are analyzed to evaluate the reproducibility, or precision, of the analytical procedures for a given sample. A replicate is two (duplicates) or three (triplicates) representative portions taken from one homogeneous sample by the laboratory and analyzed in the same laboratory (DoD 2005a). One duplicate sample is analyzed for each batch of twenty samples analyzed in a given matrix. Lab triplicates are assigned by the field team and identified on the chain of custody. The identification of a sample for lab triplicate analysis is typically selected from one of the field triplicates to allow for the evaluation of total study error of the sampling and analysis process. Duplicate analyses are normally performed on sample portions analyzed for inorganic constituents. For organic analyses, duplicate analyses are performed on MS samples (Section 5.5 of this procedure).

5.3 SURROGATES

Surrogate compounds must be added to all samples, standards, and blanks for all organic chromatography methods except when the matrix precludes its use or when a surrogate is not available. Poor surrogate recovery may indicate a problem with the sample composition and shall be reported to the client whose sample produced the poor recovery. Surrogate compounds to be included for organic analysis are specified in each analytical method.

5.4 Laboratory Control Samples and Blank Spikes

LCSs are used to demonstrate that the laboratory process for sample preparation and analysis is under control.

Analytes selected for spiking of LCSs are usually the same compounds used to spike MS/MSD samples and are representative target compounds. Control limits for LCS recoveries are provided in Appendix C of DoD QSM. If no control limits for LCS recoveries are listed in Appendix C of the DoD QSM for a given analyte, the laboratory's in-house derived control limits should be used.

For wet chemistry methods, a single spike of an appropriate control for each method may be used for LCS analyses (i.e., cyanide, a control standard of sodium cyanide from a source other than that used for calibration may be spiked into water samples and analyzed with the water samples). LCSs should be analyzed at a frequency of one per batch of at most twenty samples analyzed of similar matrix.

5.5 Matrix Spikes/Matrix Spike Duplicates

MS analyses are conducted by the laboratory to assess the accuracy of specific analytical methods and to provide information on the effect of the sample matrix on the analytical methodology. Spike analyses are performed by adding compounds of known concentration to a sample, an unspiked portion of which has previously been analyzed or is concurrently analyzed. The spiked analytes are representative target compounds for each analytical method performed. The spiked sample results are evaluated with the original sample results to evaluate any effects the matrix has on the analysis. One MS is analyzed for each batch of at most 20 samples of similar matrix. Since MS samples only provide information about the specific sample matrix used for the spike, MS analyses should be performed for each type of matrix collected.

For the MSD, a separate aliquot of the sample is separately spiked and analyzed. As discussed in Section 5.2, results of MSD analyses are expressed as a relative percent difference, which is calculated by dividing the difference in concentration between the MSD and the MS sample analyses by the arithmetic mean of their concentrations. One MSD analysis is required for at most each 20 samples of similar matrix.

Acceptance criteria for both the MS and the MSD are based on historic laboratory performance and are laboratory-specific. As a general rule, the acceptance criteria should be no more stringent than the LCS acceptance criteria.

It is important to note that the UFP QAPP Part 2B, QA/QC Compendium: Minimum QA/QC Activities (DoD 2005b) states that for organic analysis, MS and MSDs are not considered a minimum QC activity as long as surrogate spikes properly mimic the analytes of concern and can identify matrix effects. Project quality objectives should be evaluated to determine if organic MS/MSDs are useful for individual projects.

6. Records

Records of QC samples analyzed during ER Program CTO activities will be maintained on laboratory bench sheets, raw data sheets, in the laboratory computerized data system, and on QC summary forms, as requested. Analytical laboratories maintain records in accordance with their quality assurance manual (QAM) as part of performing environmental analytical work under DoD.

Records shall be maintained in accordance with the analytical laboratory subcontract agreement specifications or the laboratory-specific QAM, whichever is more stringent.

7. Health and Safety

Applicable to laboratory personnel only.

8. References

Department of Defense, United States (DoD). 2005a. *Uniform Federal Policy for Quality Assurance Project Plans, Part 1: UFP-QAPP Manual*. Final Version 1. DoD: DTIC ADA 427785, EPA-505-B-04-900A. In conjunction with the U. S. Environmental Protection Agency and the Department of Energy. Washington: Intergovernmental Data Quality Task Force. March. On-line updates available at: http://www.epa.gov/fedfac/pdf/ufp_qapp_v1_0305.pdf.

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———. 2013. *Department of Defense Quality Systems Manual for Environmental Laboratories.* Version 5.0. Final. Prepared by DoD Environmental Data Quality Workgroup and Department of Energy Consolidated Audit Program Operations Team. July.

Environmental Protection Agency, United States (EPA). 2010. Environmental Monitoring and Assessment Program: QA Glossary. November 8. On-line updates available at: http://www.epa.gov/emfjulte/html/pubs/docs/resdocs/qa_terms.html#mm. Accessed 2015.

Procedure I-A-7, *Analytical Data Validation Planning and Coordination.*

9. Attachments

None.

Field QC Samples (Water, Soil)

1. Purpose

This standard operating procedure describes the number and types of field quality control (QC) samples that will be collected during United States Navy Environmental Restoration (ER) Program, Naval Facilities Engineering Command (NAVFAC), Pacific site field work.

2. Scope

This procedure applies to all Navy ER projects performed in the NAVFAC Pacific Area of Responsibility.

This procedure shall serve as management-approved professional guidance for the ER Program and is consistent with protocol in the most recent version of the Uniform Federal Policy-Quality Assurance Project Plan Part 1 (DoD 2005a), 2A (DoD 2012), and 2B (2005b), as well as the DoD Quality Systems Manual (DoD 2013). As professional guidance for specific activities, this procedure is not intended to obviate the need for professional judgment during unforeseen circumstances. Deviations from this procedure while planning or executing planned activities must be approved and documented by the following prime contractor representatives: the Contract Task Order (CTO) Manager and the Quality Assurance (QA) Manager or Technical Director, as well as QC coordinators responsible for compliance with the procedure. A Navy project representative (i.e., Remedial Project Manager or QA Manager) shall also concur with any deviations.

3. Definitions

3.1 Trip Blank

Trip blanks are samples that originate from organic-free water (e.g., ASTM Type II water, high performance liquid chromatography grade water, etc.) prepared by the laboratory, shipped to the sampling site, and returned to the laboratory with samples to be analyzed for volatile organic compounds (VOCs). Trip blanks are analyzed to assess whether contamination was introduced during sample shipment (DoD 2005a). Trip blanks are prepared using the same sample container (typically a 40 ml VOA vial) as that used to collect field samples.

3.2 Equipment Blank Samples

An equipment blank (i.e., "decontamination rinsate," or "equipment rinsate") sample consists of a sample of water free of measurable contaminants poured over or through decontaminated field sampling equipment that is considered ready to collect or process an additional sample. Equipment blanks are to be collected from non-dedicated sampling equipment to assess the adequacy of the decontamination process.

3.3 Field Blanks

A blank used to provide information about contaminants that may be introduced during sample collection, storage, and transport. It can also be a clean sample carried to the sampling site, exposed to sampling conditions, transported to the laboratory, and treated as an environmental sample.

3.4 Field Duplicate

A generic term for two field samples taken at the same time in approximately the same location is referred to as a field duplicate. The location of the duplicate (distance and direction from primary sample) should be specified in the project planning documents. They are intended to represent the same population and are taken through all steps of the analytical procedure in an identical manner and provide precision information for the data collection activity. There are two categories of field duplicate samples defined by the collection method: co-located field duplicates and subsample field duplicates. Co-located field duplicates are two or more independent samples collected from side-by-side locations at the same point in time and space so as to be considered identical. Co-located samples are collected from adjacent locations or liners (e.g., laterally or vertically, in separate containers), or water samples collected from the same well at the same time that have not been homogenized. Subsample field duplicates samples are obtained from one sample collection at one sample location.

3.5 Field Replicates

Two or more field replicates are used with incremental sampling approaches to statistically evaluate the sampling precision or error for each decision unit (DU). The location of the replicates (distance and direction from primary sample) and the number of DUs with replicates should be specified in the project planning documents. Increments for replicate samples are collected from completely separate locations (i.e., separate systematic random or stratified random grid). Triplicate samples (i.e., primary incremental sample plus two replicates) are required for incremental sampling and are more useful than just duplicates for statistical evaluation. The replicate samples are collected, prepared, and analyzed in the same manner as carried out for the primary sample.

3.6 Temperature Indicators (Blanks)

A temperature indicator sample is often referred to as a temperature blank, but it is not analyzed nor does it measure introduced contamination. It may be a small sample bottle or VOA vial filled with distilled water that is placed in each shipping container to evaluate if samples were adequately cooled during sample shipment.

3.7 Source Water

Source water is water free from measurable contaminants that is used as the final decontamination rinse water.

4. Responsibilities

The prime contractor CTO Manager and QA Manager or Technical Director are responsible for ensuring that field QC samples are collected and analyzed according to this procedure. The CTO Manager is responsible for ensuring that all personnel involved in sampling or testing shall have the appropriate education, experience, and training to perform their assigned tasks as specified in Chief of Naval Operations Instruction 5090.1, under *Specific Training Requirements* (DON 2014).

The prime contractor QC Coordinator is responsible for determining the QC sample requirements.

The Laboratory Manager is responsible for ensuring that field QC samples are analyzed according to the specifications of the project statement of work and the analytical methods used.

The Field Manager is responsible for ensuring that all project field staff follow these procedures.

Field sampling personnel are responsible for the implementation of this procedure.

5. Procedures

Field QC checks may include submission of trip blank, equipment blank, field blank, duplicate, triplicate, and temperature indicator (blank) samples to the laboratory. Types of field QC samples are discussed in general below. Table III-B-1 identifies the minimum frequency at which field QC samples should be collected, with the actual frequency to be determined by the individual project needs. For additional information on field QC frequency, see the State of Hawaii Department of Health 2009 *Technical Guidance Manual for the Implementation of the Hawaii State Contingency Plan*.

A comprehensive discussion of the minimum types and numbers of field QC samples can be found in the *Uniform Federal Policy for Quality Assurance Project Plans, Part 2B, Quality Assurance/Quality Control Compendium: Minimum QA/QC Activities* (DoD 2005).

Table III-B-1: Field QC Samples per Sampling Event

	Minimum QC Sample Frequency	
Type of Sample	Metals	Organic
Trip blank (for volatiles only)	N/A	1/analytical method/cooler
Equipment blank	5%	5%
Field blank	1/decontamination water source/event [a]/for all analytes	
Field replicates [b]	10%	10%
Temperature Indicator (blank)	1/shipping container	

% percent
N/A not applicable
[a] A sampling event is considered to be from the time sampling personnel arrive at a site until they leave for more than a week. The use of controlled-lot source water makes one sample per lot, rather than per event, an option.
[b] To the extent practical, field replicates should be collected from the same locations as the samples designated for a laboratory matrix spike/matrix spike duplicate (organic analysis) where applicable, or from the sample used as a laboratory duplicate (inorganic analysis).

5.1 TRIP BLANKS

The laboratory prepares trip blanks using organic-free water, and then sends them to the field. The laboratory shall place trip blanks in sample coolers prior to transport to the site so that they accompany the samples throughout the sample collection/handling/transport process. Once prepared, trip blanks should not be opened until they reach the laboratory. One set of two 40-milliliter vials per volatile analysis forms a trip blank and accompanies each cooler containing samples to be analyzed for volatiles. Trip blanks are only analyzed for volatiles. Results of trip blank analyses are used to assess whether samples have been contaminated by volatiles during sample handling and transport to the laboratory.

Trip blanks are not typically associated with tissue samples; however, project-specific quality objectives shall determine if trip blanks for tissue samples are required.

5.2 EQUIPMENT BLANK SAMPLES

Collect equipment blank samples by pumping the source water over and/or through the decontaminated sampling equipment. Collect this runoff water into the sample containers directly or with the use of a funnel, if necessary. The source water may be pumped or poured by tipping the jug of water upside down over the equipment. Results of equipment blank samples are used to evaluate whether equipment decontamination was effective.

At a minimum, equipment blank samples should be collected at a rate of 5 percent of the total samples planned for collection for each sampling technique used. This rate may be adjusted depending on the nature of the investigation (site inspection, remedial investigation, remedial site evaluation, long-term monitoring) and the associated project quality objectives (PQOs). Equipment blank samples will be analyzed for the same parameters as the samples collected with that particular equipment. If analytes pertinent to the project are found in the equipment blanks, the frequency of equipment blank samples may be increased after decontamination procedures have been modified to further evaluate the effectiveness of the decontamination procedure.

When disposable or dedicated sampling equipment is used, equipment blank samples do not need to be collected.

Sampling devices (e.g., gloved hands, dip nets, or traps) used for collection of tissue samples are generally non-intrusive into the organisms collected, so equipment blank samples will not be collected as long as the devices have been properly cleaned following Procedure I-F, *Equipment Decontamination*, and appear clean.

5.3 FIELD BLANKS

Field blanks, consisting of samples of the source water used as the final decontamination rinse water, will be collected on site by field personnel by pouring the source water into sample containers and then analyzed to assess whether contaminants may have been introduced during sample collection, storage, and transport.

The final decontamination rinse water source (the field blank source water) and equipment blank source water should all be from the same purified water source. Tap water used for steam cleaning augers or used in the initial decontamination buckets need not be collected and analyzed as a field blank since augers typically do not touch the actual samples and the final decontamination rinse water should be from a purified source.

Field blanks should be collected at a minimum frequency of one per sampling event per each source of water. A sampling event is considered to be from the time sampling personnel arrive at a site until they leave for more than a week. Field blanks will be analyzed for the same parameters as the samples collected during the period that the water sources are being used for decontamination. Additional field blanks may be required based on PQOs.

5.4 FIELD DUPLICATES

Field duplicates consist of either co-located or subsampled samples. Field duplicates for ground water and surface water samples are generally considered to be co-located samples. Soil duplicate samples may be homogenized and subsampled in the field (or at the laboratory) to form an original and duplicate sample, or may be an additional volume of sample collected in a separate sample container to form a co-located sample.

The interpretation of co-located duplicate data may be more complex than subsample duplicate data because of the number of variables associated with the results of this type of duplicate sample. Duplicate soil samples for VOC analysis shall always be co-located (i.e., not homogenized or otherwise processed or subsampled). Duplicates will be analyzed for the same analytical parameters as their associated original sample. Collection of both co-located and subsampled versions of the same sample may be performed to aid in approximating sampling and analysis error.

Field duplicates for biological tissue samples will consist of subsamples of the original sample. Twice the required volume of organisms for one sample will be collected and placed into one food-grade, self-sealing bag. The sample will later be homogenized in the laboratory and subsampled, producing an original and a duplicate sample. Tissue duplicate samples will be analyzed for the same analytical parameters as their associated original samples.

5.5 Field Replicates

Field replicates are completely separate incremental replicate samples (collected from a set of systematic random or stratified random locations within the DU that are different from those used for the primary incremental samples). A different random starting location is determined for each replicate collected in the selected DU. Field replicates are typically collected in sets of three (the primary sample and two replicate samples) to produce a triplicate.

Replicate sample increments are collected from the same sampling grid established through the DU for the primary incremental sample, though at different systematic random locations than initially used. The replicate increments should not be collected from the same points or co-located with those used for the primary incremental sample. Replicate samples are sent to the laboratory as “blind” samples, meaning the laboratory does not know they represent replicate samples of the primary incremental sample.

5.6 Temperature Indicators (Blanks)

Temperature indicators (blanks) may be prepared in the lab or field by filling a small sample bottle or VOA vial with distilled water and sealing the container. One temperature indicator sample should be placed in each sample cooler or shipping container. Upon arrival at the laboratory, the temperature of the bottle is measured to determine if samples were adequately cooled during the shipment.

6. Records

Records of QC samples analyzed during ER Program CTO activities will be maintained on laboratory bench sheets, raw data sheets, in the laboratory computerized data system, and on QC summary forms, as requested. Analytical laboratories maintain records in accordance with their quality assurance manual (QAM) as part of performing environmental analytical work under DoD. Records shall be maintained in accordance with the analytical laboratory subcontract agreement specifications or the laboratory-specific QAM, whichever is more stringent.

7. Health and Safety

Field personnel shall perform work in accordance with the current (or as contractually obligated) United States Army Corps of Engineers Safety and Health Requirements Manual EM-385-1-1 (USACE 2008) and site-specific health and safety plan.

8. References

Department of Defense, United States (DoD). 2005a. *Uniform Federal Policy for Quality Assurance Project Plans, Part 1: UFP-QAPP Manual*. Final Version 1. DoD: DTIC ADA 427785, EPA-505-B-04-900A. In conjunction with the U. S. Environmental Protection Agency and the Department of Energy. Washington: Intergovernmental Data Quality Task Force. March. On-line updates available at: http://www.epa.gov/fedfac/pdf/ufp_qapp_v1_0305.pdf.

———. 2005b. *Uniform Federal Policy for Quality Assurance Project Plans, Part 2B: Quality Assurance/quality Control Compendium: Minimum QA/QC Activities*. Final Version 1. DoD: DTIC ADA 426957, EPA-505-B-04-900B. In conjunction with the U. S. Environmental Protection Agency and the Department of Energy. Washington: Intergovernmental Data Quality Task Force. March. On-line updates available at: http://www.epa.gov/swerffrr/pdf/-qaqc_v1_0305.pdf.

———. 2012. *Uniform Federal Policy for Quality Assurance Project Plans, Part 2A: Optimized UFP-QAPP Worksheets*. Revision 1. March.

———. 2013. *Department of Defense Quality Systems Manual for Environmental Laboratories.* Version 5.0. Draft Final. Prepared by DoD Environmental Data Quality Workgroup and Department of Energy Consolidated Audit Program Operations Team. July.

Department of the Navy (DON). 2014. *Environmental Readiness Program Manual*. OPNAV Instruction 5090.1D. 10 January.

United States Army Corps of Engineers (USACE). 2008. *Consolidated Safety and Health Requirements Manual.* EM-385-1-1. Includes Changes 1–7. 13 July 2012.

Procedure I-F, *Equipment Decontamination.*

Procedure III-E, *Record Keeping, Sample Labeling, and Chain-of-Custody*.

9. Attachments

None.

Logbooks

1. Purpose

This standard operating procedure describes the activities and responsibilities pertaining to the identification, use, and control of logbooks and associated field data records for use by United States Navy Environmental Restoration (ER) Program, Naval Facilities Engineering Command (NAVFAC), Pacific personnel.

2. Scope

This procedure applies to all Navy ER projects performed in the NAVFAC Pacific Area of Responsibility.

This procedure shall serve as management approved professional guidance for the ER Program and is consistent with protocol in the most recent version of the Uniform Federal Policy-Quality Assurance Project Plan Appendix A. Section 1.4 *Field Documentation SOPs* (DoD 2005). As professional guidance for specific activities, this procedure is not intended to obviate the need for professional judgment during unforeseen circumstances. Deviations from this procedure while planning or executing planned activities must be approved and documented by the following prime contractor representatives: the Contract Task Order (CTO) Manager and the Quality Assurance Manager or Technical Director. A Navy project representative (i.e., Remedial Project Manager or QA Manager) shall also concur with any deviations.

3. Definitions

3.1 Logbook

A logbook is a bound field notebook with consecutively numbered, water-repellent pages that is clearly identified with the name of the relevant activity, the person assigned responsibility for maintenance of the logbook, and the beginning and ending dates of the entries.

3.2 Data Form

A data form is a predetermined format used for recording field data that may become, by reference, a part of the logbook (e.g., soil boring logs, trenching logs, surface soil sampling logs, groundwater sample logs, and well construction logs are data forms).

4. Responsibilities

The prime contractor CTO Manager or delegate is responsible for determining which team members shall record information in field logbooks and for obtaining and maintaining control of the required logbooks. The CTO Manager shall review the field logbook on at least a monthly basis. The CTO Manager or designee is responsible for reviewing logbook entries to determine compliance with this procedure and to ensure that the entries meet the project requirements.

A knowledgeable individual such as the Field Manager, CTO Manager, or quality control (QC) Supervisor shall perform a technical review of each logbook at a frequency commensurate with the level of activity (weekly is suggested, or, at a minimum, monthly). Document these reviews by the dated signature of the reviewer on the last page or page immediately following the material reviewed.

The Field Manager is responsible for ensuring that all project field staff follow these procedures and that the logbook is completed properly and daily. The Field Manager is also responsible for submitting copies to the CTO Manager, who is responsible for filing them and submitting a copy to the Navy (if required by the CTO Statement of Work).

The logbook user is responsible for recording pertinent data into the logbook to satisfy project requirements and for attesting to the accuracy of the entries by dated signature. The logbook user is also responsible for safeguarding the logbook while having custody of it.

Field personnel are responsible for the implementation of this procedure.

All NAVFAC Pacific ER Program field personnel are responsible for complying with Chief of Naval Operations Instruction 5090.1, under *Specific Training Requirements* (DON 2014).

5. Procedure

The field logbook serves as the primary record of field activities. Make entries chronologically and in sufficient detail to allow the writer or a knowledgeable reviewer to reconstruct the applicable events. Store the logbook in a clean location and use it only when outer gloves used for personal protective equipment (PPE) have been removed.

Individual data forms may be generated to provide systematic data collection documentation. Entries on these forms shall meet the same requirements as entries in the logbook and shall be referenced in the applicable logbook entry. Individual data forms shall reference the applicable logbook and page number. At a minimum, include names of all samples collected in the logbook even if they are recorded elsewhere.

Enter field descriptions and observations into the logbook, as described in Attachment III-D-1, using indelible black ink.

Typical information to be entered includes the following:

- Dates (month/day/year) and times (military) of all onsite activities and entries made in logbooks/forms
- Site name, and description
- Site location by longitude and latitude, if known
- Weather conditions, including estimated temperature and relative humidity
- Fieldwork documentation, including site entry and exit times
- Descriptions of, and rationale for, approved deviations from the work plan or field sampling plan
- Field instrumentation readings
- Names, job functions, and organizational affiliations of personnel on-site

- Photograph references
- Site sketches and diagrams made on-site
- Identification and description of sample morphology, collection locations and sample numbers as described in Procedure I-A-8, *Sample Naming*
- Sample collection information, including dates (month/day/year) and times (military) of sample collections, sample collection methods and devices, station location numbers, sample collection depths/heights, sample preservation information, sample pH (if applicable), analysis requested (analytical groups), etc., as well as chain-of-custody (COC) information such as sample identification numbers cross-referenced to COC sample numbers
- Sample naming convention
- Field QC sample information
- Site observations, field descriptions, equipment used, and field activities accomplished to reconstruct field operations
- Meeting information
- Important times and dates of telephone conversations, correspondence, or deliverables
- Field calculations
- PPE level
- Calibration records
- Contractor and subcontractor information (address, names of personnel, job functions, organizational affiliations, contract number, contract name, and work assignment number)
- Equipment decontamination procedures and effectiveness
- Laboratories receiving samples and shipping information, such as carrier, shipment time, number of sample containers shipped, and analyses requested
- User signatures

The logbook shall reference data maintained in other logs, forms, etc. Correct entry errors by drawing a single line through the incorrect entry, then initialing and dating this change. Enter an explanation for the correction if the correction is more than for a mistake.

At least at the end of each day, the person making the entry shall sign or initial each entry or group of entries.

Enter logbook page numbers on each page to facilitate identification of photocopies.

If a person’s initials are used for identification, or if uncommon acronyms are used, identify these on a page at the beginning of the logbook.

At least weekly and preferably daily, the preparer shall photocopy (or scan) and retain the pages completed during that session for backup. This will prevent loss of a large amount of information if the logbook is lost.

6. Records

Retain the field logbook as a permanent project record. If a particular CTO requires submittal of photocopies of logbooks, perform this as required.

7. Health and Safety

Store the logbook in a clean location to keep it clean and use it only when outer gloves used for PPE have been removed.

8. References

Department of Defense, United States (DoD). 2005a. *Uniform Federal Policy for Quality Assurance Project Plans, Part 1: UFP-QAPP Manual*. Final Version 1. DoD: DTIC ADA 427785, EPA-505-B-04-900A. In conjunction with the U. S. Environmental Protection Agency and the Department of Energy. Washington: Intergovernmental Data Quality Task Force. March. On-line updates available at: http://www.epa.gov/fedfac/pdf/ufp_qapp_v1_0305.pdf.

Department of the Navy (DON). 2014. *Environmental Readiness Program Manual*. OPNAV Instruction 5090.1D. 10 January.

Procedure I-A-8, *Sample Naming.*

9. Attachments

Attachment III-D-1: Description of Logbook Entries

Attachment III-D-1
Description of Logbook Entries

Logbook entries shall be consistent with Section A.1.4 *Field Documentation SOPs* of the UFP-QAPP Manual (DoD 2005) and contain the following information, as applicable, for each activity recorded. Some of these details may be entered on data forms, as described previously.

Name of Activity	For example, Asbestos Bulk Sampling, Charcoal Canister Sampling, Aquifer Testing.
Task Team Members and Equipment	Name all members on the field team involved in the specified activity. List equipment used by serial number or other unique identification, including calibration information.
Activity Location	Indicate location of sampling area as indicated in the field sampling plan.
Weather	Indicate general weather and precipitation conditions.
Level of PPE	Record the level of PPE (e.g., Level D).
Methods	Indicate method or procedure number employed for the activity.
Sample Numbers	Indicate the unique numbers associated with the physical samples. Identify QC samples.
Sample Type and Volume	Indicate the medium, container type, preservative, and the volume for each sample.
Time and Date	Record the time and date when the activity was performed (e.g., 0830/08/OCT/89). Use the 24-hour clock for recording the time and two digits for recording the day of the month and the year.
Analyses	Indicate the appropriate code for analyses to be performed on each sample, as specified in the WP.
Field Measurements	Indicate measurements and field instrument readings taken during the activity.
Chain of Custody and Distribution	Indicate chain-of-custody for each sample collected and indicate to whom the samples are transferred and the destination.
References	If appropriate, indicate references to other logs or forms, drawings, or photographs employed in the activity.
Narrative (including time and location)	Create a factual, chronological record of the team's activities throughout the day including the time and location of each activity. Include descriptions of general problems encountered and their resolution. Provide the names and affiliations of non-field team personnel who visit the site, request changes in activity, impact the work schedule, request information, or observe team activities. Record any visual or other observations relevant to the activity, the contamination source, or the sample itself. It should be emphasized that logbook entries are for recording data and chronologies of events. The logbook author must include observations and descriptive notations, taking care to be objective and recording no opinions or subjective comments unless appropriate.
Recorded by	Include the signature of the individual responsible for the entries contained in the logbook and referenced forms.
Checked by	Include the signature of the individual who performs the review of the completed entries.

Record Keeping, Sample Labeling, and Chain-Of-Custody

1. Purpose

The purpose of this standard operating procedure is to establish standard protocols for all United States (U.S.) Navy Environmental Restoration (ER) Program, Naval Facilities Engineering Command (NAVFAC), Pacific field personnel for use in maintaining field and sampling activity records, writing sample logs, labeling samples, ensuring that proper sample custody procedures are used, and completing chain-of-custody/analytical request forms.

2. Scope

This procedure applies to all Navy ER projects performed in the NAVFAC Pacific Area of Responsibility.

This procedure shall serve as management-approved professional guidance for the ER Program and is consistent with protocol in the most recent version of the Uniform Federal Policy-Quality Assurance Project Plan (UFP QAPP) Part 1 (DoD 2005a), 2A (DoD 2012), and 2B (2005b), as well as the DoD Quality Systems Manual (DoD 2013). As professional guidance for specific activities, this procedure is not intended to obviate the need for professional judgment during unforeseen circumstances. Deviations from this procedure while planning or executing planned activities must be approved and documented by the following prime contractor representatives: the CTO Manager and the Quality Assurance (QA) Manager or Technical Director. A Navy project representative (i.e., Remedial Project Manager or QA Manager) shall also concur with any deviations.

3. Definitions

3.1 LOGBOOK

A logbook is a bound field notebook with consecutively numbered, water-repellent pages that is clearly identified with the name of the relevant activity, the person responsible for maintenance of the logbook, and the beginning and ending dates of the entries.

3.2 CHAIN-OF-CUSTODY

Chain-of-custody (COC) is documentation of the process of custody control. Custody control includes possession of a sample from the time of its collection in the field to its receipt by the analytical laboratory, and through analysis and storage prior to disposal.

4. Responsibilities

The prime contractor CTO Manager is responsible for determining which team members shall record information in the field logbook and for checking sample logbooks and COC forms to ensure compliance with these procedures. The CTO Manager shall review COC forms on a monthly basis at a minimum.

The prime contractor CTO Manager and QA Manager or Technical Director are responsible for evaluating project compliance with the Project Procedures Manual. The QA Manager or Technical Director is responsible for ensuring overall compliance with this procedure.

The Laboratory Project Manager or Sample Control Department Manager is responsible for reporting any sample documentation or COC problems to the CTO Manager or CTO Laboratory Coordinator within 24 hours of sample receipt.

The Field Manager is responsible for ensuring that all field personnel follow these procedures. The CTO Laboratory Coordinator is responsible for verifying that the COC/analytical request forms have been completed properly and match the sampling and analytical plan. The CTO Manager or CTO Laboratory Coordinator is responsible for notifying the laboratory, data managers, and data validators in writing if analytical request changes are required as a corrective action. These small changes are different from change orders, which involve changes to the scope of the subcontract with the laboratory and must be made in accordance with a respective contract (e.g., Comprehensive Long-Term Environmental Action Navy, remedial action contract).

NAVFAC Pacific ER Program field personnel are responsible for following these procedures while conducting sampling activities. Field personnel are responsible for recording pertinent data into the logbook to satisfy project requirements and for attesting to the accuracy of the entries by dated signature. All NAVFAC Pacific ER Program field personnel are responsible for complying with Chief of Naval Operations Instruction 5090.1, under *Specific Training Requirements* (DON 2014).

5. Procedures

This procedure provides standards for documenting field activities, labeling the samples, documenting sample custody, and completing COC/analytical request forms. The standards presented in this section shall be followed to ensure that samples collected are maintained for their intended purpose and that the conditions encountered during field activities are documented.

5.1 RECORD KEEPING

The field logbook serves as the primary record of field activities. Make entries chronologically and in sufficient detail to allow the writer or a knowledgeable reviewer to reconstruct each day’s events. Field logs such as soil boring logs and groundwater sampling logs will also be used. These procedures are described in Procedure III-D, *Logbooks*.

5.2 SAMPLE LABELING

Affix a sample label with adhesive backing to each individual sample container with the exception of pre-tared containers. Record the following information with a waterproof marker (ballpoint pen for containers for volatile analyses) on each label:

- Project name or number (optional)
- COC sample number
- Date and time of collection
- Sampler's initials
- Matrix (optional)
- Sample preservatives (if applicable)

- Analysis to be performed on sample (This shall be identified by the method number or name identified in the subcontract with the laboratory)
- Indicate if sample is to be used as the matrix spike (MS)/matrix spike duplicate (MSD) or laboratory triplicate sample

With the exception of sample containers with pre-tared labels, place clear tape over each label (preferably prior to sampling) to prevent the labels from tearing off, falling off, or being smeared, and to prevent loss of information on the label.

These labels may be obtained from the analytical laboratory or printed from a computer file onto adhesive labels.

For volatile soil organic analyses (VOA), labels are not to be affixed to vials that are pre-tared by the laboratory. Instead, on each of the VOA vials in the sample set (typically three per sample), mark the sample COC Sample identification (ID) on the vial in ballpoint pen. Then wrap the vials together in bubble wrap and place one sample label on the bubble wrap and cover with tape. It is imperative that the COC Sample ID be clearly marked on each vial as this will help prevent laboratory error if the vials are inadvertently separated after removal from the bubble wrap.

5.3 Custody Procedures

For samples intended for chemical analysis, sample custody procedures shall be followed through collection, transfer, analysis, and disposal to ensure that the integrity of the samples is maintained. Maintain custody of samples in accordance with the U.S. Environmental Protection Agency (EPA) COC guidelines prescribed in U.S. Environmental Protection Agency (EPA) *NEIC Policies and Procedures*, National Enforcement Investigations Center, Denver, Colorado, revised August 1991 (EPA 1978); EPA *RCRA Ground Water Monitoring Technical Enforcement Guidance Document* (TEGD), *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA* (EPA OSWER Directive 9355 3-01) (EPA 1988, Appendix 2 of the *Technical Guidance Manual for Solid Waste Water Quality Assessment Test (SWAT) Proposals and Reports* (Cal/EPA 1988), and *Test Methods for Evaluating Solid Waste* (EPA 2007). A description of sample custody procedures is provided below.

5.3.1 Sample Collection Custody Procedures

According to the EPA guidelines, a sample is considered to be in custody if one of the following conditions is met:

- It is in one’s actual physical possession or view
- It is in one’s physical possession and has not been tampered with (i.e., it is under lock or official seal)
- It is retained in a secured area with restricted access
- It is placed in a container and secured with an official seal such that the sample cannot be reached without breaking the seal

Place custody seals on sample containers (on bubble wrap for pre-tared containers) immediately after sample collection and on shipping coolers if the cooler is to be removed from the sampler's custody.

Place custody seals in such a manner that they must be broken to open the containers or coolers. Label the custody seals with the following information:

- Sampler's name or initials
- Date and time that the sample/cooler was sealed

These seals are designed to enable detection of sample tampering. An example of a custody seal is shown in Attachment III-E-1.

Field personnel shall also log individual samples onto COC forms (carbon copy or computer generated) when a sample is collected or just prior to shipping. These forms may also serve as the request for analyses. Procedures for completing these forms are discussed in Section 5.4, indicating sample identification number, matrix, date and time of collection, number of containers, analytical methods to be performed on the sample, and preservatives added (if any). The samplers will also sign the COC form signifying that they were the personnel who collected the samples. The COC form shall accompany the samples from the field to the laboratory. When a cooler is ready for shipment to the analytical laboratory, the person delivering the samples for transport will sign and indicate the date and time on the accompanying COC form. One copy of the COC form will be retained by the sampler and the remaining copies of the COC form shall be placed inside a self-sealing bag and taped to the inside of the cooler. Each cooler must be associated with a unique COC form. Whenever a transfer of custody takes place, both parties shall sign and date the accompanying carbon copy COC forms, and the individual relinquishing the samples shall retain a copy of each form. One exception is when the samples are shipped; the delivery service personnel will not sign or receive a copy because they do not open the coolers. The laboratory shall attach copies of the completed COC forms to the reports containing the results of the analytical tests. An example COC form is provided in Attachment III-E-2.

5.3.2 Laboratory Custody Procedures

The following custody procedures are to be followed by an independent laboratory receiving samples for chemical analysis; the procedures in their Naval Facilities Engineering and Expeditionary Warfare Center-evaluated Laboratory Quality Assurance Plan must follow these same procedures. A designated sample custodian shall take custody of all samples upon their arrival at the analytical laboratory. The custodian shall inspect all sample labels and COC forms to ensure that the information is consistent, and that each is properly completed. The custodian will also measure the temperature of the temperature blank in the coolers upon arrival using either a National Institute for Standards and Technology calibrated thermometer or an infra-red temperature gun. The custodian shall note the condition of the samples including:

- If the samples show signs of damage or tampering
- If the containers are broken or leaking
- If headspace is present in sample vials
- Proper preservation of samples (made by pH measurement, except volatile organic compounds (VOCs) and purgeable total petroleum hydrocarbons (TPH) and temperature). The pH of VOC and purgeable TPH samples will be checked by the laboratory analyst after the sample aliquot has been removed from the vial for analysis.

- If any sample holding times have been exceeded

All of the above information shall be documented on a sample receipt sheet by the custodian.

Discrepancies or improper preservation shall be noted by the laboratory as an out-of-control event and shall be documented on an out-of-control form with corrective action taken. The out-of-control form shall be signed and dated by the sample control custodian and any other persons responsible for corrective action. An example of an out-of-control form is included as Attachment III-E-4.

The custodian shall then assign a unique laboratory number to each sample and distribute the samples to secured storage areas maintained at 4 degrees Celsius (soil samples for VOC analysis are to be stored in a frozen state until analysis). The unique laboratory number for each sample, the COC sample number, the client name, date and time received, analysis due date, and storage shall also be manually logged onto a sample receipt record and later entered into the laboratory's computerized data management system. The custodian shall sign the shipping bill and maintain a copy.

Laboratory personnel shall be responsible for the care and custody of samples from the time of their receipt at the laboratory through their exhaustion or disposal. Samples should be logged in and out on internal laboratory COC forms each time they are removed from storage for extraction or analysis.

5.4 COMPLETING COC/ANALYTICAL REQUEST FORMS

COC form/analytical request form completion procedures are crucial in properly transferring the custody and responsibility of samples from field personnel to the laboratory. This form is important for accurately and concisely requesting analyses for each sample; it is essentially a release order from the analysis subcontract.

Attachment III-E-2 is an example of a generic COC/analytical request form that may be used by field personnel. Multiple copies may be tailored to each project so that much of the information described below need not be handwritten each time. Attachment III-E-3 is an example of a completed site-specific COC/analytical request form, with box numbers identified and discussed in text below.

Box 1 *Project Manager:* This name shall be the name that will appear on the report. Do not write the name of the Project Coordinator or point of contact for the project instead of the CTO manager.

Project Name: Write the project name as it is to appear on the report.

Project Number: Write the project number as it is to appear on the report. It shall include the project number and task number. Also include the laboratory subcontract number.

Box 2 *Bill to:* List the name and address of the person/company to bill only if it is not in the subcontract with the laboratory.

Box 3 *Sample Disposal Instructions:* These instructions will be stated in the Master Service Agreement or each CTO statement of work with each laboratory.

Shipment Method: State the method of shipment (e.g., hand carry; air courier via FED EX, AIR BORNE, or DHL).

Comment: This area shall be used by the field team to communicate observations, potential hazards, or limitations that may have occurred in the field or additional information regarding analysis (e.g., a specific metals list, samples expected to contain high analyte concentrations).

Box 4 *Cooler Number:* This will be written on the inside or outside of the cooler and shall be included on the COC. Some laboratories attach this number to the trip blank identification, which helps track volatile organic analysis samples. If a number is not on the cooler, field personnel shall assign a number, write it on the cooler, and write it on the COC.

QC Level: Enter the reporting/QC requirements (e.g., Full Data Package, Summary Data Package).

Turn around time (TAT): TAT will be determined by a sample delivery group (SDG), which may be formed over a 14-day period, not to exceed 20 samples. Once the SDG has been completed, standard TAT is 21 calendar days from receipt of the last sample in the SDG. Entering NORMAL or STANDARD in this field will be acceptable. If quicker TAT is required, it shall be in the subcontract with the laboratory and reiterated on each COC to remind the laboratory.

Box 5 *Type of containers:* Write the type of container used (e.g., 1 liter glass amber, for a given parameter in that column).

Preservatives: Field personnel must indicate on the COC the correct preservative used for the analysis requested. Indicate the pH of the sample (if tested) in case there are buffering conditions found in the sample matrix.

Box 6 *COC sample number:* This is typically a five-character alpha-numeric identifier used by the contractor to identify samples. The use of this identifier is important since the labs are restricted to the number of characters they are able to use. See Procedure I-A-8, *Sample Naming*.

Description (sample identification): This name will be determined by the location and description of the sample, as described in Procedure I-A-8, *Sample Naming*. This sample identification should not be submitted to the laboratory, but should be left blank. If a computer COC version is used, the sample identification can be input, but printed with this block black. A cross-referenced list of COC Sample Number and sample identification must be maintained separately.

Identify if sample requires laboratory subsampling.

Date Collected: Record the collection date to track the holding time of the sample. Note: For trip blanks, record the date it was placed in company with samples.

Time Collected: When collecting samples, record the time the sample is first collected. Use of the 24-hour military clock will avoid a.m. or p.m. designations (e.g., 1815 instead of 6:15 p.m.). Record local time; the laboratory is responsible for calculating holding times to local time.

Lab Identification: This is for laboratory use only.

Box 7 *Matrix and QC:* Identify the matrix (e.g., water, soil, air, tissue, fresh water sediment, marine sediment, or product). If a sample is expected to contain high analyte concentrations (e.g., a tank bottom sludge or distinct product layer), notify the laboratory in the comment section. Mark an "X" for the sample(s) that have extra volume for laboratory QC matrix spike/matrix spike duplicate (MS/MSD) or laboratory triplicate purposes. The sample provided for MS/MSD purposes is usually a field duplicate.

Box 8 *Analytical Parameters:* Enter the parameter by descriptor and the method number desired (e.g. benzene, toluene, ethylbenzene, and xylenes 8260B, polynuclear aromatic hydrocarbons 8270C, etc.). Whenever practicable, list the parameters as they appear in the laboratory subcontract to maintain consistency and avoid confusion.

If the COC does not have a specific box for number of sample containers, use the boxes below the analytical parameter, to indicate the number of containers collected for each parameter.

Box 9 *Sampler's Signature:* The person who collected samples must sign here.

Relinquished By: The person who turned over the custody of the samples to a second party other than an express mail carrier, such as FEDEX, must sign here.

Received By: Typically, a representative of the receiving laboratory signs here. Or, a field crew member who delivered the samples in person from the field to the laboratory might sign here. A courier, such as Federal Express, does not sign here because they do not open the coolers. It must also be used by the prime contracting laboratory when samples are to be sent to a subcontractor.

Relinquished By: In the case of subcontracting, the primary laboratory will sign the Relinquished By space and fill out an additional COC to accompany the samples being subcontracted.

Received By (Laboratory): This space is for the final destination (e.g., at a subcontracted laboratory).

Box 10 *Lab Number and Questions:* This box is to be filled in by the laboratory only.

Box 11 *Control Number:* This number is the "COC" followed by the first contractor identification number in that cooler, or contained on that COC. This control number must be unique (i.e., never used twice). Record the date the COC is completed. It should be the same date the samples are collected.

Box 12 *Total No. of Containers/row:* Sum the number of containers in that row.

Box 13 *Total No. of Containers/column:* Sum the number of containers in that column. Because COC forms contain different formats depending on who produced the form, not all of the information listed in items 1 to 13 may be recorded; however, as much of this information as possible shall be included.

COC forms tailored to each CTO can be drafted and printed onto multi-ply forms. This eliminates the need to rewrite the analytical methods column headers each time. It also eliminates the need to write the project manager, name, and number; QC Level; TAT; and the same general comments each time.

Complete one COC form per cooler. Whenever possible, place all volatile organic analyte vials into one cooler in order to reduce the number of trip blanks. Complete all sections and be sure to sign and date the COC form. One copy of the COC form must remain with the field personnel.

6. Records

The COC/analytical request form shall be faxed or e-mailed to the CTO Laboratory Coordinator for verification of accuracy. Following the completion of sampling activities, the sample logbook and COC forms will be transmitted to the CTO Manager for storage in project files. The data validators shall receive a copy also. The original COC/analytical request form shall be submitted by the laboratory along with the data delivered. Any changes to the analytical requests that are required shall be made in writing to the laboratory. A copy of this written change shall be sent to the data validators and placed in the project files. The reason for the change shall be included in the project files so that recurring problems can be easily identified.

7. Health and Safety

Not applicable.

8. References

California Environmental Protection Agency (Cal/EPA). 1988. *Technical Guidance Manual, Solid Waste Water Quality Assessment Test (SWAT) Proposals and Reports.* Solid Waste Disposal Program, Hydrogeology Section, Land Disposal Branch, Division of Water Quality, State Water Resources Control Board. August.

Department of Defense, United States (DoD). 2005a. Uniform Federal Policy for Quality Assurance Project Plans, Part 1: UFP-QAPP Manual. Final Version 1. DoD: DTIC ADA 427785, EPA-505-B-04-900A. In conjunction with the U. S. Environmental Protection Agency and the Department of Energy. Washington: Intergovernmental Data Quality Task Force. March. On-line updates available at: http://www.epa.gov/fedfac/pdf/ufp_qapp_v1_0305.pdf.

———. 2005b. Uniform Federal Policy for Quality Assurance Project Plans, Part 2B: Quality Assurance/quality Control Compendium: Minimum QA/QC Activities. Final Version 1. DoD: DTIC ADA 426957, EPA-505-B-04-900B. In conjunction with the U. S. Environmental Protection Agency and the Department of Energy. Washington: Intergovernmental Data Quality Task Force. March. On-line updates available at: http://www.epa.gov/swerffrr/pdf/-qaqc_v1_0305.pdf.

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Department of the Navy (DON). 2014. *Environmental Readiness Program Manual*. OPNAV Instruction 5090.1D. 10 January.

Environmental Protection Agency, United States (EPA). 1978. *NEIC Policies and Procedures.* EPA-330/9-78-001-R. Revised August 1991. National Enforcement Investigation Center. Denver. May.

———. 1988. *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA.* Interim Final. EPA/540/G-89/004. Office of Emergency and Remedial Response. October.

———. 2007. *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW-846.* 3rd ed., Revision 6. Office of Solid Waste. November. On-line updates at: http://www.epa.gov/epawaste/hazard/testmethods/sw846/online/index.htm.

Procedure I-A-8, *Sample Naming.*

Procedure III-D, *Logbooks.*

9. Attachments

Attachment III-E-1, Chain-of-Custody Seal

Attachment III-E-2, Generic Chain-of-Custody/Analytical Request Form

Attachment III-E-3, Sample Completed Chain-of-Custody

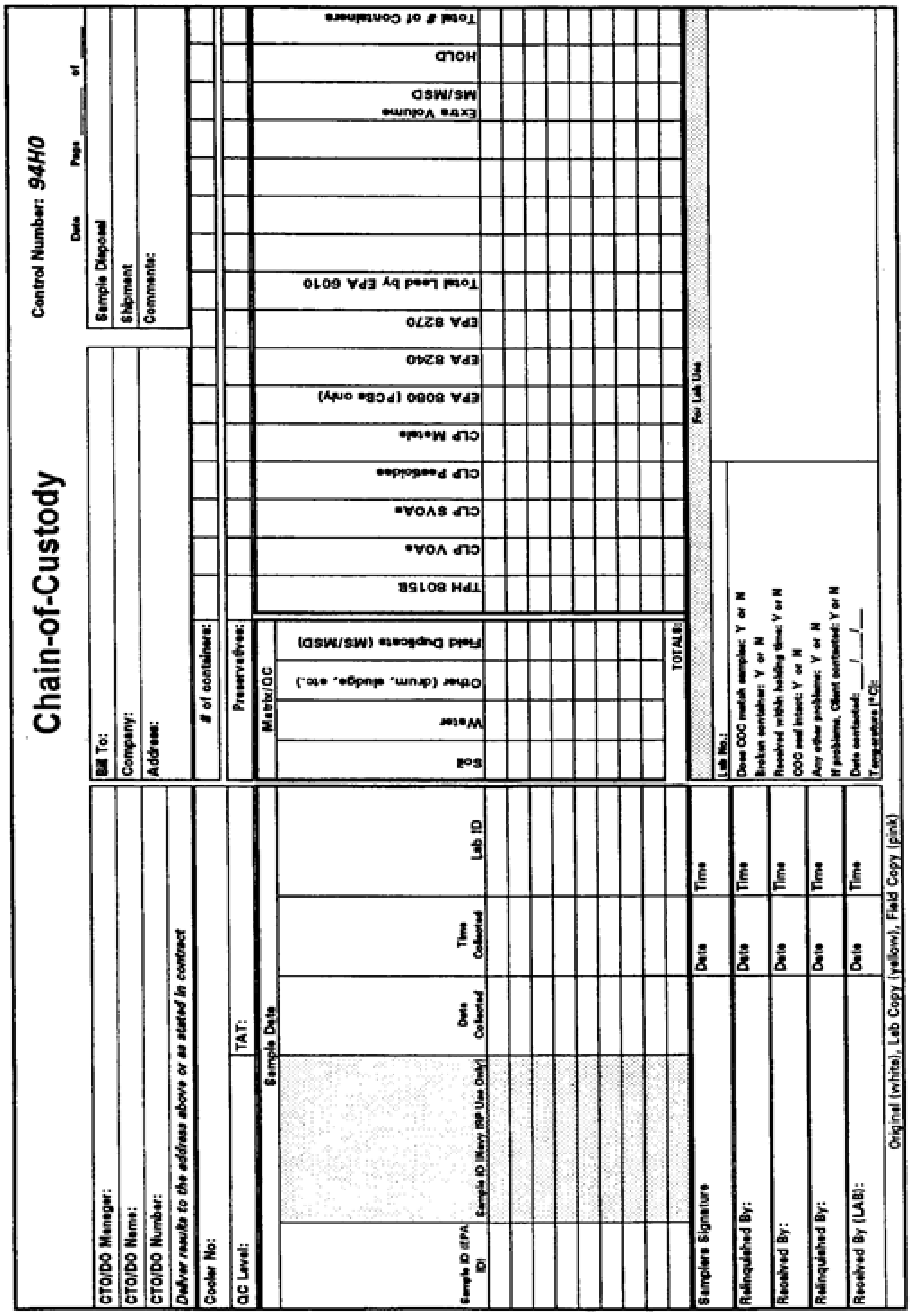
Attachment III-E-4, Sample Out-of-Control Form

Attachment III-E-1
Chain-of-Custody Seal

CHAIN-OF-CUSTODY SEAL

CUSTODY SEAL	
Company Name (808) XXX-XXXX	
Sampler's Name/Initials:____________________	Date: _____________ Time: _____________

Attachment III-E-2
Generic Chain-of-Custody/Analytical Request Form



Chain-of-Custody

Control Number: 94H0

Date ____ Page ____ of ____

CTO/DO Manager:
CTO/DO Name:
CTO/DO Number:
Deliver results to the address above or as stated in contract
Cooler No:
QC Level: | TAT:

Bill To:
Company:
Address:

Sample Disposal
Shipment
Comments:

\# of containers:
Preservatives:

Sample ID (EPA ID)	Sample ID (Navy IRP Use Only)	Date Collected	Time Collected	Lab ID	Soil	Water	Other (drum, sludge, etc.)	Field Duplicate (MS/MSD)	TPH 8015B	CLP VOAs	CLP SVOAs	CLP Pesticides	CLP Metals	EPA 8080 (PCBs only)	EPA 8240	EPA 8270	Total Lead by EPA 6010				Extra Volume MS/MSD	HOLD	Total # of Containers
								TOTALS:															

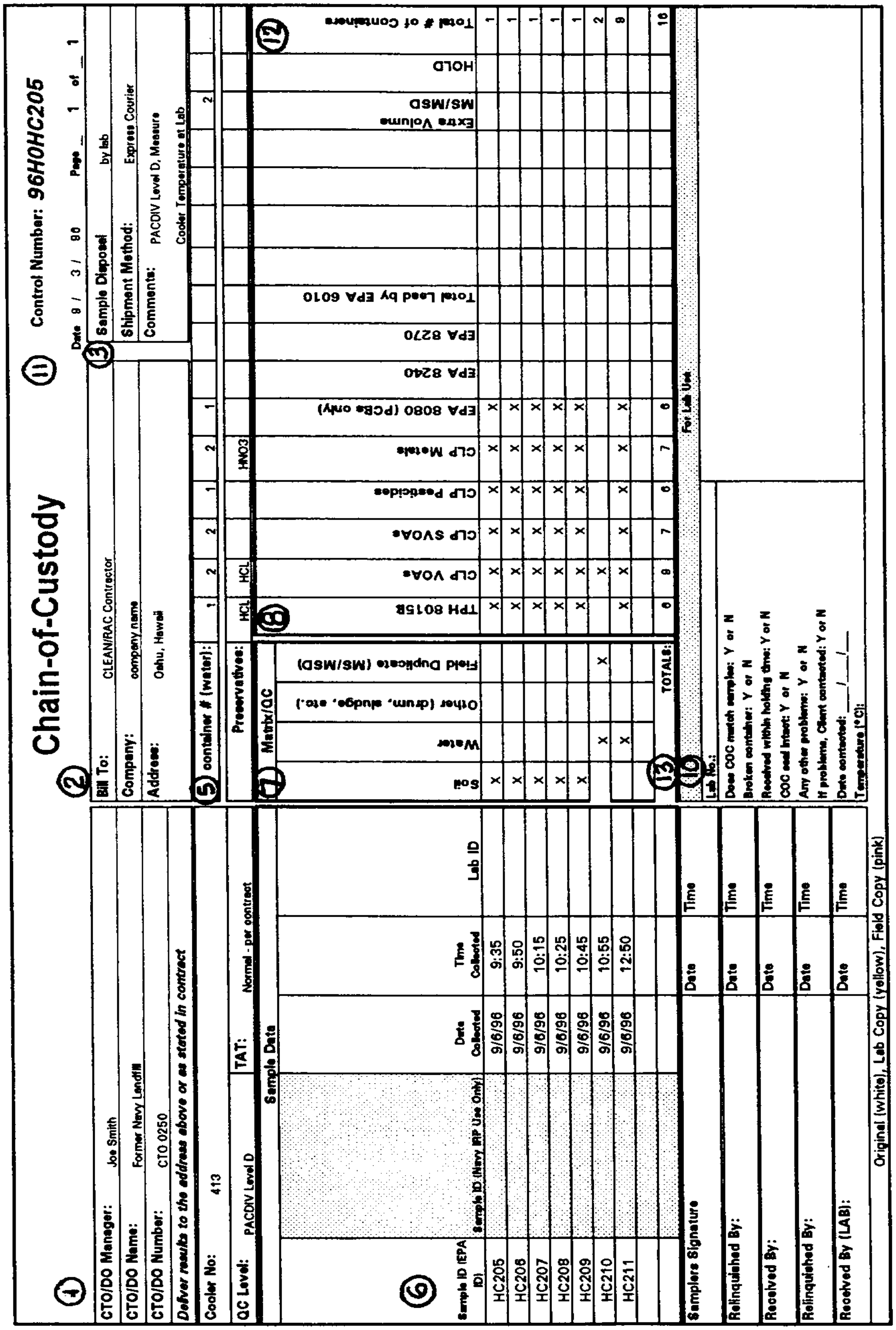
Samplers Signature | Date | Time
Relinquished By: | Date | Time
Received By: | Date | Time
Relinquished By: | Date | Time
Received By (LAB): | Date | Time

For Lab Use
Lab No.:
Does COC match samples: Y or N
Broken container: Y or N
Received within holding time: Y or N
COC seal intact: Y or N
Any other problems: Y or N
If problems, Client contacted: Y or N
Date contacted: ___/___/___
Temperature (°C):

Original (white), Lab Copy (yellow), Field Copy (pink)

Generic Chain-of-Custody/Analytical Request Form

Attachment III-E-3
Sample Completed Chain-of-Custody



Chain-of-Custody

(11) Control Number: **96H0HC205**

Date 9 / 3 / 96 Page 1 of 1

(1)

CTO/DO Manager: Joe Smith
CTO/DO Name: Former Navy Landfill
CTO/DO Number: CTO 0250
Deliver results to the address above or as stated in contract

(2)

Bill To: CLEAN/RAC Contractor
Company: company name
Address: Oahu, Hawaii

(3)

Sample Disposal: by lab
Shipment Method: Express Courier
Comments: PACDIV Level D, Measure Cooler Temperature at Lab

(4)

Cooler No: 413
QC Level: PACDIV Level D
TAT: Normal - per contract

(5) container # (water): TPH 8015B 1; CLP VOAs 2; CLP SVOAs 2; CLP Pesticides 1; CLP Metals 2; EPA 8080 1; Extra Volume MS/MSD 2

Preservatives: TPH 8015B HCL; CLP VOAs HCL; CLP Metals HNO3

Sample Data (6) — Matrix/QC (7) — Analyses (8) — (12)

Sample ID (EPA ID)	Sample ID (Navy IRP Use Only)	Date Collected	Time Collected	Lab ID	Soil	Water	Other (drum, sludge, etc.)	Field Duplicate (MS/MSD)	TPH 8015B	CLP VOAs	CLP SVOAs	CLP Pesticides	CLP Metals	EPA 8080 (PCBs only)	EPA 8240	EPA 8270	Total Lead by EPA 6010				Extra Volume MS/MSD	HOLD	Total # of Containers
HC205		9/6/96	9:35		X				X	X	X	X	X	X									1
HC206		9/6/96	9:50		X				X	X	X	X	X	X									1
HC207		9/6/96	10:15		X				X	X	X	X	X	X									1
HC208		9/6/96	10:25		X				X	X	X	X	X	X									1
HC209		9/6/96	10:45		X				X	X	X	X	X	X									1
HC210		9/6/96	10:55			X		X		X													2
HC211		9/6/96	12:50			X			X	X	X	X	X	X									9
					(13)			TOTALS:	6	9	7	6	7	6									16

(9)

Samplers Signature	Date	Time
Relinquished By:	Date	Time
Received By:	Date	Time
Relinquished By:	Date	Time
Received By (LAB):	Date	Time

(10) For Lab Use

Lab No.:
Does COC match samples: Y or N
Broken container: Y or N
Received within holding time: Y or N
COC seal intact: Y or N
Any other problems: Y or N
If problems, Client contacted: Y or N
Date contacted: ___/___/___
Temperature (°C):

Original (white), Lab Copy (yellow), Field Copy (pink)

Sample Completed Chain-of-Custody

Attachment III-E-4
Sample Out-of-Control Form

	Status	Date	Initial
OUT OF CONTROL FORM	Noted OOC		
	Submit for CA*		
	Resubmit for CA*		
	Completed		

Date Recognized:		By:	
Dated Occurred:		Matrix	
Parameter (Test Code):		Method:	
Analyst:		Supervisor:	
1. Type of Event (Check all that apply)		2. Corrective Action (CA)* (Check all that apply)	
	Calibration Corr. Coefficient <0.995		Repeat calibration
	%RSD>20%		Made new standards
	Blank >MDL		Reran analysis
	Does not meet criteria:		Sample(s) redigested and rerun
	Spike		Sample(s) reextracted and rerun
	Duplicate		Recalculated
	LCS		Cleaned system
	Calibration Verification		Ran standard additions
	Standard Additions		Notified
	MS/MSD		Other (please explain)
	BS/BSD		
	Surrogate Recovery		
	Calculations Error		

Samples Affected (List by Accession AND Sample No.)

	Holding Times Missed	
	Other (Please explain	Comments:

3. Results of Corrective Action	
	Return to Control (indicated with)
	Corrective Actions Not Successful - DATA IS TO BE FLAGGED with _____________.

Analyst:	Date:
Supervisor:	Date:
QA Department:	Date:

Sample Handling, Storage, and Shipping

1. Purpose

This standard operating procedure sets forth the methods for use by the United States (U.S.) Navy Environmental Restoration (ER) Program, Naval Facilities Engineering Command (NAVFAC), Pacific personnel engaged in handling, storing, and transporting samples.

2. Scope

This procedure applies to all Navy ER projects performed in the NAVFAC Pacific Area of Responsibility.

This procedure shall serve as management-approved professional guidance for the ER Program and is consistent with protocol in the most recent version of the Uniform Federal Policy-Quality Assurance Project Plan (UFP QAPP) Part 1 (DoD 2005a), 2A (DoD 2012), and 2B (2005b), as well as the DoD Quality Systems Manual (DoD 2013). As professional guidance for specific activities, this procedure is not intended to obviate the need for professional judgment during unforeseen circumstances. Deviations from this procedure while planning or executing planned activities must be approved and documented by the following prime contractor representatives: the CTO Manager and the Quality Assurance (QA) Manager or Technical Director. A Navy project representative (i.e., Remedial Project Manager or QA Manager) shall also concur with any deviations.

3. Definitions

None.

4. Responsibilities

The prime contractor CTO Manager and the Laboratory Project Manager are responsible for identifying instances of non-compliance with this procedure and ensuring that future sample transport activities are in compliance with this procedure.

The Field Manager is responsible for ensuring that all samples are shipped according to this procedure.

Field personnel are responsible for the implementation of this procedure.

The QA Manager or Technical Director is responsible for ensuring that sample handling, storage, and transport activities conducted during all CTOs are in compliance with this procedure.

All field personnel are responsible for complying with Chief of Naval Operations Instruction 5090.1, under *Specific Training Requirements* (DON 2014).

5. Procedures

5.1 HANDLING AND STORAGE

Immediately following collection, label all samples according to Procedure III-E, *Record Keeping, Sample Labeling, and Chain-of-Custody*. In addition, when more than one volatile organic analyte

(VOA) vial is used to collect one sample, the chain-of-custody (COC) identification (ID) will be written on the VOA vials (even pre-tared vials) with a ball point pen for that sample. The lids of the containers shall not be sealed with duct tape, but should be covered with custody seals (except pre-tared containers which should have the custody seal placed on the outside of the protective bubble wrap). Wrap glass sample containers on the sides, tops, and bottoms with bubble wrap or other appropriate padding to prevent breakage during transport. When collecting three VOA vials per sample, it is acceptable to wrap all three vials together and store in one plastic bag. Store all glass containers for water samples in an upright position, never stacked or placed on their sides. Samples will be maintained as close to 4 degrees Celsius (°C) as possible from the time of collection through transport to the analytical laboratory, using refrigerators and/or freezers when appropriate. Place all containers into self-sealing bags and into an insulated cooler with wet ice while still in the field. Samples should occupy the lower portion of the cooler, while the ice should occupy the upper portion. Place an absorbent material (e.g., proper absorbent cloth material) on the bottom of the cooler to contain liquids in case of spillage. Ship samples as soon after collection as possible to allow the laboratory to meet holding times for analyses. Check with the laboratory for operating/sample receipt hours prior to all traditional and non-traditional holidays to ensure sample shipment will be received. When not shipping samples directly upon field collection, store samples in a refrigerator or freezer (never freeze water samples) until shipped to the laboratory.

5.2 PACKING

Each cooler must contain a temperature blank (small plastic bottle with sterile water) to confirm cooler temperature upon receipt at the laboratory. Water samples can be used as such, but it is best to include a designated temperature blank bottle, typically supplied by the laboratory with the coolers.

One trip blank must be included in each cooler containing samples for volatile analysis (e.g., volatile organic compounds, total petroleum hydrocarbons-gasoline range organics.

Cooler must be lined completely in ice at the bottom and all four sides. After confirming all project samples are accounted for and labeled correctly, place samples in cooler. Record sample IDs on cooler-specific COC(s). Pack glass containers for water samples in an upright position, never stacked or placed on their sides. Fill all empty space between sample containers with bubble wrap or other appropriate material (not Styrofoam). Place a layer of ice on top of samples and fill all empty space between ice and cooler lid with bubble wrap or other appropriate material.

Place laboratory copies of completed COC(s), and soil permit if applicable, into resealable bag and tape to underside of cooler lid.

5.3 SHIPPING

Follow all appropriate U.S. Department of Transportation regulations (e.g., 49 Code of Federal Regulations [CFR], Parts 171-179) for shipment of air, soil, water, and other samples. Elements of these procedures are summarized below.

5.3.1 Hazardous Materials Shipment

Field personnel must state whether any sample is suspected to be a hazardous material. A sample should be assumed to be hazardous unless enough evidence exists to indicate it is non-hazardous. If not suspected to be hazardous, shipments may be made as described in the Section 5.3.3 for non-hazardous materials. If hazardous, follow the procedures summarized below.

Any substance or material that is capable of posing an unreasonable risk to life, health, or property when transported is classified as hazardous. Perform hazardous materials identification by checking the list of dangerous goods for that particular mode of transportation. If not on that list, materials can be classified by checking the Hazardous Materials Table (49 CFR 172.102 including Appendix A) or by determining if the material meets the definition of any hazard class or division (49 CFR Part 173), as listed in Attachment III-F-2.

All persons shipping hazardous materials must be properly trained in the appropriate regulations, as required by HM-126F, Training for Safe Transportation of Hazardous Materials (49 CFR HM-126F Subpart H). The training covers loading, unloading, handling, storing, and transporting of hazardous materials, as well as emergency preparedness in the case of accidents. Carriers, such as commercial couriers, must also be trained. Modes of shipment include air, highway, rail, and water.

When shipping hazardous materials, including bulk chemicals or samples suspected of being hazardous, the proper shipping papers (49 CFR 172 Subpart C), package marking (49 CFR 172 Subpart D), labeling (49 CFR 172 Subpart E), placarding (49 CFR 172 Subpart F, generally for carriers), and packaging must be used. Attachment III-F-1 shows an example of proper package markings. Refer to a copy of 49 CFR each time hazardous materials/potentially hazardous samples are shipped.

According to Section 2.7 of the International Air Transport Association Dangerous Goods Regulations publication, very small quantities of certain dangerous goods may be transported without certain marking and documentation requirements as described in 49 CFR Part 172. However, other labeling and packing requirements must still be followed. Attachment III-F-2 shows the volume or weight for different classes of substances. A “Dangerous Goods in Excepted Quantities” label must be completed and attached to the associated shipping cooler (Attachment III-F-3). Certain dangerous goods are not allowed on certain airlines in any quantity.

As stated in item 4 of Attachment III-F-4, the Hazardous Materials Regulations do not apply to hydrochloric acid (HCl), nitric acid (HNO_3), sulfuric acid (H_2SO_4), and sodium hydroxide (NaOH) added to water samples if their pH or percentage by weight criteria are met. Hazardous Materials Regulations also do not apply to methanol (MeOH) for soil samples if the percentage by weight criterion is met. These samples may be shipped as non-hazardous materials as discussed below.

5.3.2 Non-hazardous Materials Shipment

If the samples are suspected to be non-hazardous based on previous site sample results, field screening results, or visual observations, if applicable, then samples may be shipped as non-hazardous.

If preservatives (HCl, HNO_3, H_2SO_4, NaOH, or MeOH) are used, ensure their individual pH or percentage by weight criteria, as shown in item 4 of Attachment III-F-4, are met to continue shipping as non-hazardous samples.

When a cooler is ready for shipment to the laboratory, place the receiving laboratory address on the top of the cooler, place chain-of-custody seals on the coolers as discussed in Procedure III-E, *Record Keeping, Sample Labeling, and Chain-of-Custody*, place soil permit labels on top if applicable, and seal the cooler with waterproof tape.

5.3.3 Shipments from Outside the Continental United States

Shipment of sample coolers to the continental U.S. from locations outside the continental U.S. is controlled by the U.S. Department of Agriculture (USDA) and is subject to their inspection and regulation. A "USDA Soil Import Permit" is required to prove that the receiving analytical laboratory is certified by the USDA to receive and properly dispose of soil. In addition, all sample coolers must be inspected by a USDA representative, affixed with a label indicating that the coolers contain environmental samples, and accompanied by shipping forms stamped by the USDA inspector prior to shipment. In addition, the U.S. Customs Service must clear samples shipped from U.S. territorial possessions or foreign countries upon entry into the U.S. As long as the commercial invoice is properly completed (see below), shipments typically pass through U.S. Customs Service without the need to open coolers for inspection.

In Hawaii, soil sample shipments are typically brought to the courier at the airport where the courier contacts a USDA representative to make an inspection. Alternatively, the contractor may enter into an agreement with the USDA to ship soil samples. In this way, the USDA does not need to inspect each soil sample shipment. If the contractor maintains a Domestic Soil Permit, place the permit label and the soil origination label (Attachment III-F-9) on the top of the cooler. Place a copy of the receiving laboratory's soil permit with the COC inside the cooler. Confirm custody seals were placed on each container (Section 5.1) to ensure proper chain-of-custody control in the event coolers are opened for inspection.

In Guam, shipments can be dropped off directly to the Federal Express branch or to the courier at the airport. Alternatively, the courier can pick up shipments at each site provided that arrangements have been made regarding pickup time and location. USDA inspections occur outside of Guam. The laboratory's soil permit shall be placed with the COC inside the cooler, and the soil origination label (see Attachment III-F-9) should be placed on top of the cooler.

The USDA does not need to inspect water sample shipments.

Completion and use of proper paperwork will, in most cases, minimize or eliminate the need for the USDA and U.S. Customs Service to inspect the contents. Attachment III-F-5 shows an example of how paperwork may be placed on the outside of coolers for non-hazardous materials. For hazardous materials, refer to Section 5.3.1.

In summary, tape the paperwork listed below to the outside of the coolers to assist sample shipments. If a shipment is made up of multiple pieces (e.g., more than one cooler), the paperwork need only be attached to one cooler, provided that the courier agrees. All other coolers in the shipment need only be taped and have address and COC seals affixed.

1. **Courier Shipping Form & Commercial Invoice**. See Attachment III-F-6, and Attachment III-F-7 for examples of the information to be included on the commercial invoice for soil and water. Place the courier shipping form and commercial invoice inside a clear, plastic, adhesive-backed pouch that adheres to the package (typically supplied by the courier) and place it on the cooler lid as shown in Attachment III-F-5.
2. **Soil Import Permit (soil only)**. See Attachment III-F-8 and Attachment III-F-9 for examples of the soil import permit and soil samples restricted entry labels. The laboratory shall supply these documents prior to mobilization. The USDA in Hawaii often does stop

shipments of soil without these documents. Staple together the 2 inch × 2 inch USDA label (described below), and soil import permit, and place them inside a clear plastic pouch. The courier typically supplies the clear, plastic, adhesive-backed pouches that adhere to the package.

Placing one restricted entry label as shown in Attachment III-F-5 (covered with clear packing tape) and one stapled to the actual permit is suggested.

The USDA does not control water samples, so the requirements for soil listed above do not apply.

3. **Chain-of-Custody Seals**. The laboratory should supply the seals. CTO personnel must sign and date these. At least two seals should be placed in such a manner that they stick to both the cooler lid and body. Placing the seals over the tape (as shown in Attachment III-F-5), then covering it with clear packing tape is suggested. This prevents the seal from coming loose and enables detection of tampering.
4. **Address Label**. Affix a label stating the destination (laboratory address) of each cooler.
5. **Special Requirements for Hazardous Materials**. See Section 5.3.1.

Upon receipt of sample coolers at the laboratory, the sample custodian shall inspect the sample containers as discussed in Procedure III-E, *Record Keeping, Sample Labeling, and Chain-of-Custody*. The samples shall then be either immediately extracted and/or analyzed, or stored in a refrigerated storage area until they are removed for extraction and/or analysis. Whenever the samples are not being extracted or analyzed, they shall be returned to refrigerated storage.

6. Records

Maintain records as required by implementing these procedures.

7. Health and Safety

Personnel shall perform work in accordance with the current (or as contractually obligated) United States Army Corps of Engineers Safety and Health Requirements Manual EM-385-1-1 (USACE 2012) and site-specific health and safety plan.

8. References

Department of Defense, United States (DoD). 2005a. *Uniform Federal Policy for Quality Assurance Project Plans, Part 1: UFP-QAPP Manual*. Final Version 1. DoD: DTIC ADA 427785, EPA-505-B-04-900A. In conjunction with the U. S. Environmental Protection Agency and the Department of Energy. Washington: Intergovernmental Data Quality Task Force. March. On-line updates available at: http://www.epa.gov/fedfac/pdf/ufp_qapp_v1_0305.pdf.

———. 2005b. *Uniform Federal Policy for Quality Assurance Project Plans, Part 2B: Quality Assurance/quality Control Compendium: Minimum QA/QC Activities*. Final Version 1. DoD: DTIC ADA 426957, EPA-505-B-04-900B. In conjunction with the U. S. Environmental Protection Agency and the Department of Energy. Washington: Intergovernmental Data Quality Task Force. March. On-line updates available at: http://www.epa.gov/swerffrr/pdf/-qaqc_v1_0305.pdf.

———. 2012. *Uniform Federal Policy for Quality Assurance Project Plans, Part 2A: Optimized UFP-QAPP Worksheets*. Revision 1. March.

———. 2013. *Department of Defense Quality Systems Manual for Environmental Laboratories.* Version 5.0. Draft Final. Prepared by DoD Environmental Data Quality Workgroup and Department of Energy Consolidated Audit Program Operations Team. July.

Department of the Navy (DON). 2014. *Environmental Readiness Program Manual*. OPNAV Instruction 5090.1D. 10 January.

United States Army Corps of Engineers (USACE). 2008. *Consolidated Safety and Health Requirements Manual.* EM-385-1-1. Includes Changes 1–7. 13 July 2012.

Procedure III-E, *Record Keeping, Sample Labeling, and Chain-of-Custody*.

9. Attachments

Attachment III-F-1: Example Hazardous Materials Package Marking

Attachment III-F-2: Packing Groups

Attachment III-F-3: Label for Dangerous Goods in Excepted Quantities

Attachment III-F-4: SW-846 Preservative Exception

Attachment III-F-5: Non-Hazardous Material Cooler Marking Figure for Shipment From Outside The Continental United States

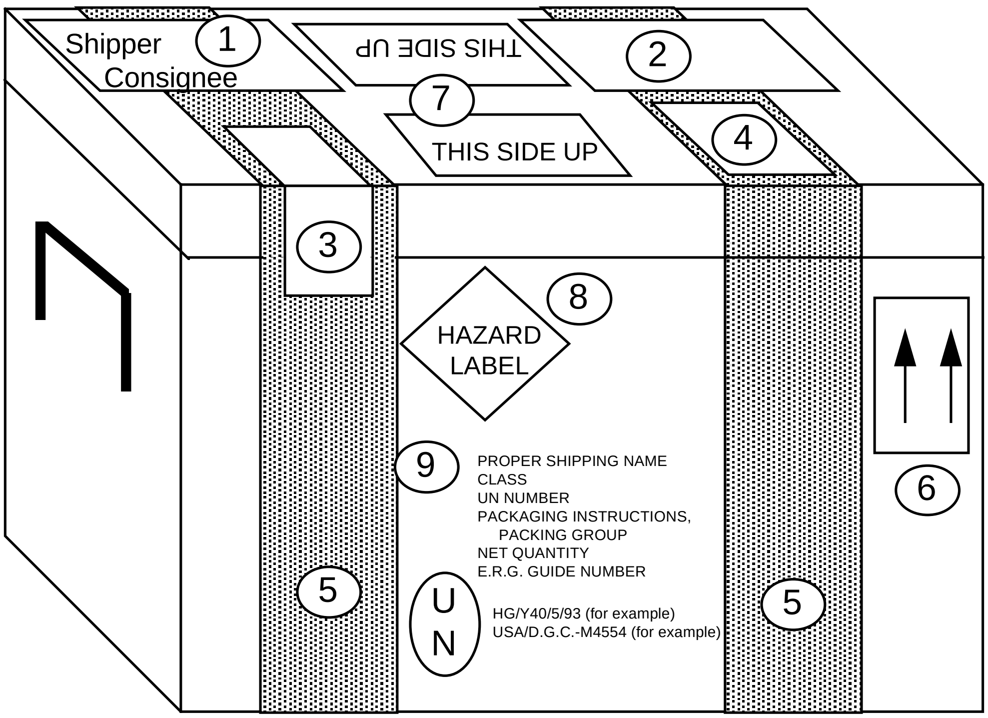
Attachment III-F-6: Commercial Invoice – Soil

Attachment III-F-7: Commercial Invoice – Water

Attachment III-F-8: Soil Import Permit

Attachment III-F-9: Soil Samples Restricted Entry Labels

Attachment III-F-1
Example Hazardous Material Package Marking



1	**AIR BILL/COMMERCIAL INVOICE**	6	**DIRECTION ARROWS STICKER - TWO REQUIRED**
2	**USDA PERMIT (Letter to Laboratory from USDA)**	7	**THIS SIDE UP STICKERS**
3	**CUSTODY SEAL**	8	**HAZARD LABEL**
4	**USDA 2" X 2" SOIL IMPORT PERMIT**	9	**HAZARDOUS MATERIAL INFORMATION**
5	**WATERPROOF STRAPPING TAPE**	10	**PACKAGE SPECIFICATIONS**

Attachment III-F-2
Packing Groups

PACKING GROUP OF THE SUBSTANCE	**PACKING GROUP 1**		**PACKING GROUP II**		**PACKING GROUP III**	
CLASS or DIVISION of PRIMARY or SUBSIDIARY RISK	Packagings		Packagings		Packagings	
	Inner	Outer	Inner	Outer	Inner	Outer
1: Explosives	---------------------------- Forbidden (Note A) ----------------------------------					
2.1: Flammable Gas	---------------------------- Forbidden (Note B) ----------------------------------					
2.2: Non-Flammable, non-toxic gas	---------------------------- See Notes A and B ----------------------------------					
2.3: Toxic gas	---------------------------- Forbidden (Note A) ----------------------------------					
3. Flammable liquid	30 mL	300 mL	30 mL	500 mL	30 mL	1 L
4.1 Self-reactive substances	Forbidden		Forbidden		Forbidden	
4.1: Other flammable solids	Forbidden		30 g	500 g	30 g	1 kg
4.2: Pyrophoric substances	Forbidden		Not Applicable		Not Applicable	
4.2 Spontaneously combustible substances	Not Applicable		30 g	500 g	30 g	1 kg
4.3: Water reactive substances	Forbidden		30 g or 30 mL	500 g or 500 mL	30 g or 30 mL	1 kg or 1 L
5.1: Oxidizers	Forbidden		30 g or 30 mL	500 g or 500 mL	30 g or 30 mL	1 kg or 1 L
5.2: Organic peroxides (Note C)	See Note A		30 g or 30 mL	500 g or 250 mL	Not Applicable	
6.1: Poisons - Inhalation toxicity	Forbidden		1 g or 1 mL	500 g or 500 mL	30 g or 30 mL	1 kg or 1 L
6.1: Poisons - oral toxicity	1 g or 1 mL	300 g or 300 mL	1 g or 1 mL	500 g or 500 mL	30 g or 30 mL	1 kg or 1 L
6.1: Poisons - dermal toxicity	1 g or 1 mL	300 g or 300 mL	1 g or 1 mL	500 g or 500 mL	30 g or 30 mL	1 kg or 1 L
6.2: Infectious substances	---------------------------- Forbidden (Note A) ----------------------------------					
7: Radioactive material (Note D)	---------------------------- Forbidden (Note A) ----------------------------------					
8: Corrosive materials	Forbidden		30 g or 30 mL	500 g or 500 mL	30 g or 30 mL	1 kg or 1 L
9: Magnetized materials	---------------------------- Forbidden (Note A) ----------------------------------					
9: Other miscellaneous materials (Note E)	Forbidden		30 g or 30 mL	500 g or 500 mL	30 g or 30 mL	1 kg or 1 L

Note A: *Packing groups are not used for this class or division.*
Note B: *For inner packagings, the quantity contained in receptacle with a water capacity of 30 mL. For outer packagings, the sum of the water capacities of all the inner packagings contained must not exceed 1 L.*
Note C: *Applies only to Organic Peroxides when contained in a chemical kit, first aid kit or polyester resin kit.*
Note D: *See 6.1.4.1, 6.1.4.2 and 6.2.1.1 through 6.2.1.7, radioactive material in excepted packages.*
Note E: *For substances in Class 9 for which no packing group is indicated in the List of Dangerous Goods, Packing Group II quantities must be used.*

Attachment III-F-3
Label for Dangerous Goods in Excepted Quantities

Attachment III-F-4
SW-846 Preservative Exception

Measurement	Vol. Req. (mL)	Container[2]	Preservative [3,4]	Holding Time[5]
MBAS	250	P,G	Cool, 4ºC	48 Hours
NTA	50	P,G	Cool, 4ºC	24 Hours

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.

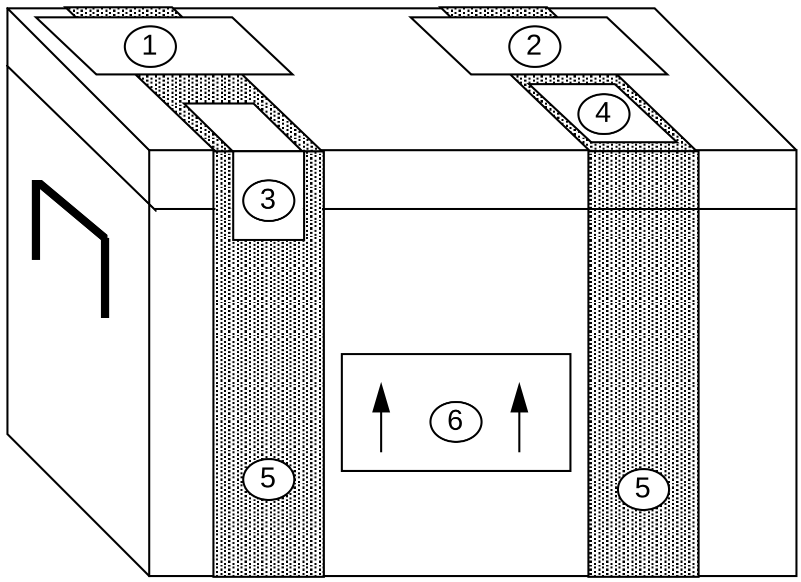
3. Sample preservation should be performed immediately upon sample collection. For composite samples each aliquot should be preserved at the time of collection. When use of an automated sampler makes it impossible to preserve each aliquot, then samples may be preserved by maintaining at 4ºC until compositing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

4. When any sample is to be shipped by common carrier or sent through the United States Mail, 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 1, 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 concentration of 0.04% by weight or less (pH about 1.96 or greater); Nitric acid (HNO_3) in water solutions at concentrations of 0.15% by weight or less (pH about 1.62 or greater); Sulfuric acid (H_2SO_4) 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.

Attachment III-F-5
Non-Hazardous Material Cooler Marking Figure for Shipment from outside the Continental United States



1 **AIR BILL/COMMERCIAL INVOICE**

2 **USDA PERMIT (Letter to Laboratory from USDA)**

3 **CUSTODY SEAL**

4 **USDA 2" X 2" SOIL IMPORT PERMIT**

5 **WATERPROOF STRAPPING TAPE**

6 **DIRECTION ARROWS STICKER - TWO REQUIRED**

Attachment III-F-6
Commercial Invoice – Soil

DATE OF EXPORTATION 1/1/94	EXPORT REFERENCES (i.e., order no., invoice no., etc.) <CTO #>
SHIPPER/EXPORTER (complete name and address) Joe Smith Ogden c/o <hotel name> <hotel address>	CONSIGNEE Sample Receipt <Lab Name> <Lab Address>
COUNTRY OF EXPORT Guam, USA	IMPORTER - IF OTHER THAN CONSIGNEE
COUNTRY OF ORIGIN OF GOODS Guam, USA	
COUNTRY OF ULTIMATE DESTINATION USA	

INTERNATIONAL AIR WAYBILL NO.

(NOTE: All shipments must be accompanied by a Federal Express International Air Waybill)

MARKS/NOS	NO. OF PKGS	TYPE OF PACKAGING	FULL DESCRIPTION OF GOODS	QTY	UNIT OF MEASURE	WEIGHT	UNIT VALUE	TOTAL VALUE
	3	coolers	Soil samples for labora analysis only				$1.00	$3.00
	TOTAL NO. OF PKGS.					TOTAL WEIGHT		TOTAL INVOICE VALUE
	3							$3.00

Check one
☐ F.O.B.
☐ C&F
☐ C.I.F.

THESE COMMODITIES ARE LICENSED FOR THE ULTIMATE DESTINATION SHOWN.

DIVERSION CONTRARY TO UNITED STATES LAW IS PROHIBITED.

I DECLARE ALL THE INFORMATION CONTAINED IN THIS INVOICE TO BE TRUE AND CORRECT

SIGNATURE OF SHIPPER/EXPORTER (Type name and title and sign)

Joe Smith, Ogden	Joe Smith	1/1/94
Name/Title	Signature	Date

Attachment III-F-7
Commercial Invoice – Water

DATE OF EXPORTATION 1/1/94	EXPORT REFERENCES (i.e., order no., invoice no., etc.) <CTO #>
SHIPPER/EXPORTER (complete name and address) Joe Smith Ogden c/o <hotel name> <hotel address>	CONSIGNEE Sample Rece <Lab Name> <Lab Address>
COUNTRY OF EXPORT Guam, USA	IMPORTER - IF OTHER THAN CONSIGNEE
COUNTRY OF ORIGIN OF GOODS Guam, USA	
COUNTRY OF ULTIMATE DESTINATION USA	

INTERNATIONAL AIR WAYBILL NO.

(NOTE: All shipments must be accompanied by a Federal Express International Air Waybill)

MARKS/NOS	NO. OF PKGS	TYPE OF PACKAGING	FULL DESCRIPTION OF GOODS	QTY	UNIT OF MEASURE	WEIGHT	UNIT VALUE	TOTAL VALUE
	3	coolers	Water samples for labo analysis only				$1.00	$3.00
	TOTAL NO. OF PKGS.					TOTAL WEIGHT		TOTAL INVOICE VALUE
	3							$3.00

Check one
☐ F.O.B.
☐ C&F
☐ C.I.F.

THESE COMMODITIES ARE LICENSED FOR THE ULTIMATE DESTINATION SHOWN.

DIVERSION CONTRARY TO UNITED STATES LAW IS PROHIBITED.

I DECLARE ALL THE INFORMATION CONTAINED IN THIS INVOICE TO BE TRUE AND CORRECT

SIGNATURE OF SHIPPER/EXPORTER (Type name and title and sign)

Name/Title	Signature	Date
Joe Smith, Ogden	Joe Smith	1/1/94

Attachment III-F-8
Soil Import Permit

UNITED STATES
DEPARTMENT OF
AGRICULTURE

Animal and Plant Health Inspection Service

Plant Protection and Quarantine

Soil Permit

Permit Number: S-52299

Issued To: Columbia Analytical Services
(Lee Wolf)
1317 S. 13th Avenue
Kelso, Washington 98626

TELEPHONE: (360) 577-7222

Under the authority of the Federal Plant Pest Act of May 23, 1957, permission is hereby granted to the facility/individual named above subject to the following conditions:

1. Valid for shipments of soil not heat treated at the port of entry, only if a compliance agreement (PPQ Form 519) has been completed and signed. Compliance Agreements and Soil permits are non-transferable. If you hold a Soil Permit and you leave your present employer or company, you must notify your local USDA office promptly.
2. To be shipped in sturdy, leakproof, containers.
3. To be released without treatment at the port of entry.
4. To be used only for analysis and only in the facility of the permittee at Columbia Analytical Services, located in Kelso, Washington.
5. No use of soil for growing purposes is authorized, including the isolation or culture of organisms imported in soil.
6. All unconsumed soil, containers, and effluent is to be autoclaved, incinerated, or heat treated by the permittee at the conclusion of the project as approved and prescribed by Plant Protection and Quarantine.
7. This permit authorizes shipments from all foreign sources, including Guam, Hawaii, Puerto Rico, and the U.S. Virgin Islands through any U.S. port of entry.

JUNE 30, 2006
Expiration Date

Deborah M. Knott
Approving Official DEBORAH M. KNOTT

WARNING: Any alteration, forgery, or unauthorized use of this Federal form is subject to civil penalties of up to $250,000 (7 U.S.C. s 7734(b)) or punishable by a fine of not more than $10,000, or imprisonment of not more than 5 years, or both (18 U.S.C. s 1001).

PPQ FORM 525B (8/94)

Pt. 1 - PERMITTEE

Attachment III-F-9
Soil Samples Restricted Entry Label and Soil Origin Label

U.S. DEPARTMENT OF AGRICULTURE

ANIMAL AND PLANT HEALTH INSPECTION SERVICE

PLANT PROTECTION AND QUARANTINE

HYATTSVILLE, MARYLAND 20782

SOIL SAMPLES

RESTRICTED ENTRY

The material contained in this package is imported under authority of the Federal Plant Pest Act of May 23, 1957.

For release without treatment if addressee is currently listed as approved by Plant Protection and Quarantine.

PPQ FORM 550 *Edition of 12/77 may be used*

(JAN 83)

Soil Samples Restricted Entry Label

SOIL ENCLOSED

Origin of Soil ________________________

Soil Origin Label

Appendix C:
Health and Safety Plan

Final Health and Safety Plan

Groundwater Monitoring and Baseline Ecological Risk Assessment Sampling for H-3 Landfill (Site 0001)

MARINE CORPS BASE HAWAII, OAHU, HAWAII

September 2015

Department of the Navy
Naval Facilities Engineering Command, Hawaii
400 Marshall Road
JBPHH HI 96860-3139

NAVFAC
Naval Facilities Engineering Command
NAVFAC HAWAII

Comprehensive Long-Term Environmental Action Navy
Contract Number N62742-03-D-1837, CTO HC31

Final Health and Safety Plan

Groundwater Monitoring and Baseline Ecological Risk Assessment Sampling for H-3 Landfill (Site 0001)

MARINE CORPS BASE HAWAII, OAHU, HAWAII

September 2015

Prepared for:

Department of the Navy
Naval Facilities Engineering Command, Hawaii
400 Marshall Road
JBPHH HI 96860-3139

Prepared by:

AECOM Technical Services, Inc.
1001 Bishop Street, Suite 1600
Honolulu, HI 96813-3698

Prepared under:

Comprehensive Long-Term Environmental Action Navy
Contract Number N62742-03-D-1837, CTO HC31

Final Health and Safety Plan for
Groundwater Monitoring and
Baseline Ecological Risk Assessment Sampling for
H-3 Landfill (Site 0001)
Marine Corps Base Hawaii, Oahu, Hawaii

Contract No. N62742-03-D-1837
Contract Task Order No. HC31

This health and safety plan (HSP) was prepared for employees performing a specific, limited scope of work. It was prepared based on the best available information regarding the physical and chemical hazards known or suspected to be present on the project site. While it is not possible to discover, evaluate, and protect in advance against all possible hazards that may be encountered during the completion of this project, adherence to the requirements of the HSP will significantly reduce the potential for occupational injury.

By signing below, I acknowledge that I have reviewed and hereby approve the Health and Safety Plan (HSP) for the groundwater monitoring and baseline ecological risk assessment (BERA) sampling at the former H-3 Landfill (Site 0001), Marine Corps Base Hawaii (MCB Hawaii), Kaneohe Bay, Oahu, Hawaii. This HSP has been written for the exclusive use of AECOM Technical Services, Inc., its employees, and subcontractors. The plan is written for the specified site conditions, dates, and personnel, and must be amended if these conditions change.

Plan Prepared By:

______________________________ Date: 9/10/2015

Danielle Coulombe
808-356-5303
Scientist III, Environmental
AECOM Technical Services, Inc., Honolulu, HI

Plan Approved By:

Shelley Brown

______________________________ Date: 9/10/2015

Ms. Shelley Brown, CIH
562-544-3506
CLEAN III Safety, Health and Environmental Professional
AECOM Technical Services, Inc., Honolulu, HI

Plan Concurrence By:

______________________________ Date: 9/10/2015

Ed Sloan
808-356-5325
CTO Manager
AECOM Technical Services, Inc., Honolulu, HI

SIGNATURE PAGE

By signing below, the undersigned acknowledges that he/she has read and reviewed the AECOM Technical Services, Inc., Health and Safety Plan for the groundwater monitoring and BERA sampling at the former H-3 Landfill (Site 0001), MCB Hawaii, Kaneohe Bay, Oahu, Hawaii. The undersigned also acknowledges that he/she has been instructed in the contents of this document and understands the information pertaining to the specified work, and will comply with the provisions contained therein.

Print Name	Signature	Organization	Date

CONTENTS

ATTACHMENTS

FIGURES

TABLES

ACRONYMS AND ABBREVIATIONS

°C	degree Celsius
°F	degree Fahrenheit
ACGIH	American Conference of Governmental Industrial Hygienists
AECOM	AECOM Technical Services, Inc.
AHA	activity hazard analysis
ANSI	American National Standards Institute
BERA	baseline ecological risk assessment
bpm	beat per minute
CFR	Code of Federal Regulations
CIH	certified industrial hygienist
CLEAN	Comprehensive Long-Term Environmental Action Navy
COPC	chemical of potential concern
CPC	chemical protective clothing
CPR	cardiopulmonary resuscitation
CRZ	contamination reduction zone
CS	confirmation study
CSIR	Contractor Significant Incident Report
CTO	contract task order
EZ	exclusion zone
FM	field manager
H&S	health and safety
H&SM	health and safety manager
H&SP	health and safety professional
HAZWOPER	Hazardous Waste Operations and Emergency Response
HSP	health and safety plan
IAS	initial assessment study
IDW	investigation-derived waste
MCB Hawaii	Marine Corps Base Hawaii
mph	mile per hour
NAVFAC Hawaii	Naval Facilities Engineering Command, Hawaii
NAVFAC Pacific	Naval Facilities Engineering Command, Pacific
no.	number
OHS	oil and hazardous substance
OSHA	Occupational Safety and Health Administration
PAL	project action level
PEL	permissible exposure limit
PFD	personal flotation device
PM	project manager
PPE	personal protective equipment
ppm	part per million
RPM	remedial project manager
SDS	safety data sheet
SH&E	safety, health, and environmental
SHM	safety and health manager
SOP	standard operating procedure
SSHO	site safety and health officer

TCRA	time-critical removal action
TLV	threshold limit value
TWA	time-weighted average
U.S.	United States
USCG	United States Coast Guard
UXO	unexploded ordnance

1. Introduction

The provisions of this site-specific Health and Safety Plan (HSP) are mandatory for all AECOM Technical Services, Inc. (AECOM) personnel involved in the groundwater monitoring and baseline ecological risk assessment (BERA) sampling activities at the former H-3 Landfill (Site 0001), Marine Corps Base Hawaii (MCB Hawaii), Kaneohe Bay, Oahu, Hawaii. This HSP also provides the specification for the minimum acceptable requirements for all subcontractor organizations, and notification of the chemical and physical hazards known to be associated with the AECOM-managed activities addressed in this document.

No operational changes to this HSP that could affect the health or safety of personnel, the community, or the environment will be made without prior approval of the AECOM contract task order (CTO) manager and the AECOM health and safety professional (H&SP). In the event of a conflict between this HSP and federal, state, or local regulations, the most stringent guidelines will apply.

These work activities were authorized by the United States (U.S.) Department of the Navy, Naval Facilities Engineering Command, Hawaii (NAVFAC Hawaii) as part of CTO number (No.) HC31 of the Comprehensive Long-Term Environmental Action Navy (CLEAN) contract no. N62742-03-D-1837.

1.1 Health and Safety Policy Statement

It is the policy of AECOM to provide a safe and healthful work environment for all its employees. AECOM considers no phase of operations or administration to be of greater importance than injury and illness prevention. Safety takes precedence over expediency or shortcuts. At AECOM, every accident and every injury is avoidable. Every reasonable step will be taken to reduce the possibility of injury, illness, or accident. AECOM's Safety, Health, and Environmental (SH&E) Policy Statement is included in Attachment A.

This HSP presents procedures to be employed during all onsite work activities. The practices and procedures presented in this HSP are mandatory for all AECOM employees (and subcontractors) while engaged in work operations at the site. AECOM also requires that all visitors to areas under its control abide by these procedures.

1.2 Classification of Activities

The planned groundwater monitoring and BERA sampling activities are considered to be Hazardous Waste Operations as defined in Title 29 of the Code of Federal Regulations (CFR) Part 1910, Section 120, subsection (a) [29 CFR 1910.120(a)].

1.3 Regulatory Requirements

This HSP meets the requirements and follows the guidelines established in the following documents:

- 29 CFR Part 1910, *Occupational Safety and Health Standards* (with specific attention to Section 120, Hazardous Waste Operations and Emergency Response [HAZWOPER])
- Hawaii Administrative Rules, Title 12, Subtitle 8, *Division of Occupational Safety and Health* (with specific attention to Chapter 99, *Hazardous Waste Operations and Emergency Response*)

- *Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities*, National Institute of Occupational Safety and Health 85-115 (NIOSH 1985)
- *Standard Operating Safety Guides* (EPA 2002)
- *Safety and Health Requirements Manual*, EM-385-1-1 (USACE 2008)
- *Department of the Navy Environmental Restoration Program Manual* (DON 2006)

The requirements specified in this HSP also conform to AECOM's Corporate SH&E Program requirements, copies of which will be maintained on site (Attachment C).

2. Management of Health and Safety Responsibilities

Project/field-level management of health and safety (H&S) requires that a management organization be established for each project. The organizational structure is standardized for each AECOM project and consists of the following positions and responsibilities.

2.1 CLEAN III Program Manager (Mr. Robin Cababa)

The program manager is responsible for ensuring that CTO managers are provided with adequate programmatic guidance, resources, and support to enable safe planning and performance of field operations. Programmatic management and technical support aspects of this responsibility are delegated to the CLEAN H&SP; however, the program manager will retain ultimate responsibility for ensuring that work activities are performed safely.

2.2 Health and Safety Professional (Ms. Shelley Brown, Certified Safety Professional)

The H&SP is a member of the AECOM SH&E Department assigned to oversee H&S requirements for the CTO and provide any needed technical support. The H&SP will serve as the CLEAN health and safety manager (H&SM). The H&SP will be the first point-of-contact for all of the CTO's H&S matters. Duties for the H&SP include the following:

- Review and approve of this HSP.
- Approve of the designated site safety and health officer (SSHO).
- Coordinate/delegate CTO SH&E duties to the SSHO.
- Visit the project site, as needed, to review the effectiveness of the HSP.
- Be available for project emergencies.
- Develop revisions to the HSP, as needed.
- Review of personal exposure monitoring results.
- Evaluate occupational exposure monitoring/air sampling data and adjust HSP requirements when necessary.
- Investigate reported unsafe acts or conditions.

2.3 CTO Manager (Mr. Ed Sloan)

The CTO project manager (PM) is responsible for coordinating with local Navy representatives, discipline managers, and subcontractors to complete the project in accordance with requirements set forth in this HSP and/or other project H&S documentation. The CTO manager has final responsibility for managing all aspects of the work operations, and is responsible to AECOM management for the safe performance and completion of the work activities. Specific safety-related duties include the following:

- Ensure that an approved HSP is prepared that addresses all aspects of the work to be performed.
- Ensure that all personnel assigned to perform onsite activities meet the required qualifications.
- Provide adequate resources and supplies to fulfill all work safety requirements.

- Assign the field manager (FM) and SSHO to provide onsite management of work activities.
- Contact the H&SP for guidance regarding any H&S related matters.

2.4 FIELD MANAGER (MR. PETE LAPLACA)

At the fieldwork site, a FM will be assigned to manage all AECOM and subcontractor activities at the site, and is responsible for field implementation of the specified H&S requirements. This includes communicating site requirements to all personnel, observing that field supervisors and subcontractors enforce all provisions of the HSP/other H&S documentation, working with the SSHO to implement all H&S performance elements, and consulting with the H&SP regarding any necessary changes to H&S requirements. Other responsibilities include the following:

- Read and become familiar with the HSP.
- Enforce the HSP and other safety regulations.
- Ensure that no work is performed that is not properly addressed in this HSP (or approved supplemental guidance).
- Maintaining the presence of at least two qualified cardiopulmonary resuscitation (CPR) and first aid providers on site at all times.
- Contacting the H&SP for guidance regarding any H&S related matters.

The FM is required, at a minimum, to have completed the 30-hour Occupational Safety and Health Administration (OSHA) construction safety class or, as an equivalent, 30 hours of formal construction safety and health training. In addition to being HAZWOPER-qualified and having completed the annual 8-hour HAZWOPER refresher training course in accordance with 29 CFR 1910.120(e)(8), the FM is also required to have completed an 8-hour HAZWOPER supervisor training course in compliance with 29 CFR 1910.120(e)(4). Supportive documentation of training will be maintained on site.

2.5 SITE SAFETY AND HEALTH OFFICER (MS. DANIELLE COULOMBE)

The SSHO will be responsible for the execution of the routine onsite duties for H&S, with assistance and direction from the designated H&SP. The responsibilities of the SSHO include the following:

- Be present during all investigation or cleanup operations to oversee implementation of HSP and conduct periodic safety reviews of the project site and project documentation. If not able to be present, a designated SSHO representative shall be present to take over all responsibilities.
- Perform daily site inspections to identify H&S issues, implement corrective measures, and observe employees at work.
- Stop work, as required, to maintain personal and environmental H&S.
- Act as emergency action coordinator (EC) and determine emergency evacuation routes, establish and post local emergency telephone numbers, and arrange emergency transportation.
- Ensure that all site personnel and visitors have received the proper training and medical clearance prior to entering the site in addition to maintaining proper documentation of all required training on site. Prior to the commencement of fieldwork, the SSHO will review

training records for all field employees to ensure that it is current and meets the necessary requirements.

- Establish any necessary controlled work areas (as designated in this HSP or other H&S documentation).
- Conduct project-specific training, including daily tailgate safety meetings, at the beginning of the work shift with all onsite personnel and subcontractors, and maintain attendance logs and records (S3NA-210-FM, *Tailgate Safety Meeting Log*).
- Discuss potential H&S hazards with the FM, H&SP, and the CTO manager, and coordinate changes/modifications to the HSP with the H&SM, FM, and CTO manager.
- Implement air monitoring according to directives in this HSP or other H&S documentation and forward all employee exposure monitoring information to the H&SP to enable the exposure notification (if applicable).
- Implement the field elements of SH&E standard operating procedure (SOP) S3NA-519-PR, *Respiratory Protection Program* (Attachment C).
- Maintain decontamination procedures that meet established criteria.
- Conduct daily tailgate safety briefings for AECOM and subcontractor field personnel with discussion of applicable SH&E standard operating procedures (SOPs) (Attachment C) and activity hazard analyses (AHAs) (Attachment E) for the site.

The SSHO or qualified alternate is required, at a minimum, to have completed the 30-hour OSHA construction safety class or as an equivalent possess 30 hours of formal construction safety and health training and 5 years of construction-industry safety experience as specified in the *Safety and Health Requirements Manual*, EM-385-1-1 (USACE 2008). In addition to being HAZWOPER-qualified and having completed the annual 8-hour HAZWOPER refresher training course in accordance with 29 CFR 1910.120(e)(8), the SSHO is also required to have completed an 8-hour HAZWOPER supervisor training course in accordance with 29 CFR 1910.120(e)(4). Supportive documentation of training will be maintained on site. For all emergency activities, the SSHO will be the primary contact and coordinator.

2.6 SUBCONTRACTORS

Services to be subcontracted include the following:

- Investigation-derived waste (IDW) disposal (Oasis Environmental Group, LLC)

Each AECOM subcontractor has been selected using a process that involves a review of their HSP and associated procedures. This review was completed using AECOM’s subport portal and the subcontractor procurement process. Each AECOM subcontractor is responsible for assigning specific work tasks to their employees. Each subcontractor’s management will provide qualified employees and allocate sufficient time, materials, and equipment to safely complete assigned tasks. In particular, each subcontractor is responsible for equipping its personnel with any required personal protective equipment (PPE).

AECOM considers each subcontractor to be an expert in all aspects of the work operations for which they are tasked, and each subcontractor is responsible for compliance with the regulatory requirements that pertain to those services. Each subcontractor is expected to perform its operations in accordance with its own unique safety policies and procedures, to ensure that hazards associated with the performance of the work activities are properly controlled. However, at a minimum, subcontractors will follow AECOM provided safety procedures (e.g., AECOM activity hazard analyses [AHAs], AECOM HSP). Additionally, SH&E SOP S3NA-001-PR, *Safe Work Standards and Rules* (Attachment C), provides AECOM's general subcontractor safety and health rules, which will be observed by all subcontractor organizations.

Subcontractors will have the opportunity to review and comment on AHAs to which they maintain expertise. Hazards not listed in this HSP, but known to any subcontractor, or known to be associated with a subcontractor's services, must be identified and addressed to the AECOM CTO manager or the FM prior to beginning work operations. The FM or authorized representative has the authority to halt any subcontractor operations, and to remove any subcontractor or subcontractor employee from the site for failure to comply with established H&S procedures or for operating in an unsafe manner.

2.7 ONSITE PERSONNEL AND VISITORS

Each person (AECOM or subcontractor employee) is responsible for his/her own H&S, for completing assigned tasks in a safe manner, and for reporting any unsafe acts or conditions to his/her supervisor and/or the FM/SSHO. All personnel are responsible for continuous adherence to the specified H&S procedures during the performance of their work. No person may work in a manner that conflicts with the letter or intent of safety and environmental precautions expressed in these procedures. After due warnings, AECOM will dismiss from the work site any person who violates safety procedures. AECOM employees are subject to progressive discipline and may be terminated for blatant or continued violations.

All personnel working for AECOM and its subcontractors are required to read and acknowledge their understanding of the HSP and any other applicable H&S documentation. All visitors to controlled work areas of any project site must likewise read and acknowledge their understanding of the applicable H&S requirements. All personnel are expected to abide by all written H&S requirements and any supplementary instructions communicated by the FM/SSHO, and cooperate with supervisory personnel to ensure a safe and healthful work site. Site personnel are required to report immediately any of the following to the FM:

- Accidents and injuries, no matter how minor
- Unexpected or uncontrolled releases of any hazardous substances
- Symptoms of exposure to a hazardous substance
- Unsafe or malfunctioning equipment
- Changes in site conditions that may affect the health or safety of project personnel

3. Summary of Site Conditions and Planned Work Activities

The following is a summary of information concerning conditions at the project site, and a description of work activities to be performed for the groundwater monitoring and BERA sampling. A more detailed accounting of this information is presented in the work plan.

3.1 Site History and Current Conditions

The former H-3 Landfill is an approximately 20-acre site located at the main entrance to MCB Hawaii at the end of the H-3 Freeway. It is located on the southeast side of the Mokapu Peninsula, which is entirely occupied by Marine Corps Base (MCB) Hawaii (Figure 3-1). The triangularly shaped former landfill was the MCB Hawaii main waste disposal area from 1940 to 1972, pre-dating the roadway that currently bisects the parcel in a north/south direction. A portion of the landfill west of H-3 Freeway was closed and covered with soil in late 1971 or early 1972. The eastern portion of the landfill was closed between 1972 and 1976.

All wastes generated on base, except those from the housing area and wastes from contractors, were reportedly disposed of in the landfill during the years of its operation. Wastes disposed of in the landfill were reported to include lead, mercury, pesticides, paints, solvents, thinners, waste petroleum oils and lubricants, waste fuels, corrosive liquids, transformer oils, and tear gas. A drainage channel and fish ponds border the south and eastern perimeter of the landfill, and the landfill side slopes are steep and have experienced erosion from either tidal and/or storm water runoff flows. The adjacent fish ponds are considered a sensitive ecological habitat and several endangered species frequent the area.

An initial assessment study (IAS) was completed in 1984 by Naval Energy and Environmental Support Activity (now known as Naval Facilities Engineering and Expeditionary Warfare Center) (NEESA 1984). The IAS report recommended further assessment for the landfill site. A follow-up confirmation study (CS) was completed in 1988 by Aqua Terra Technologies, Inc. The CS consisted of groundwater, sediment, and tissue sampling and analysis. Based on the results of the investigation, the CS recommended no further action for the former H-3 Landfill site, provided that the site usage remains the same (ATT 1988).

A time-critical removal action (TCRA) was conducted in May 2009 (AECOM 2011) when MCB Hawaii personnel discovered that a portion of the landfill fronting the shoreline had receded, which exposed construction and demolition debris. The purpose of the TCRA was to provide temporary remedial slope stabilization. The temporary remedial slope stabilization was to remain in place until completion of follow-on design analysis. Approximately 510 square feet of the landfill side slope was temporarily stabilized.

In 2012, an engineering evaluation/cost analysis was prepared to initiate a removal action to repair the additional landfill slopes identified as needing repair and prevent the further exposure of landfill debris to the adjacent sediments and surface water (AECOM 2012). The recommended removal action alternative for the H-3 Landfill site is slope stabilization with rock rip-rap to prevent further erosion and exposure of the wastes on the landfill side-slopes, and thus mitigate potentially unacceptable risks associated with direct exposure to the wastes, and potential migration of waste materials and constituent chemicals. Implementation of this selected removal action is being conducted under a separate project.

Remedial investigation activities reveal that chemicals of potential concern (COPCs) above the project action levels (PALs) are present in sediment, groundwater, and surface water at the site.

However, the risks posed to human health are within the risk management ranges for receptors (occupational workers, construction workers, and recreational visitors) and for all potential pathways (groundwater, surface water, and sediments in the wetland and drainage channel (AECOM 2012).

3.2 SCOPE OF WORK

The groundwater monitoring and BERA sampling activities include the following:

- Seven rounds of groundwater sampling at existing monitoring wells.
- Collect sediment, pore water, and surface water data.
- Collect biota samples.
- Management and disposal of purge water, decontamination water, materials, and IDW generated from sampling activities.

Field activities will be performed in accordance with the procedures described in the Tier II work plan. The sampling and design rationale is described in Worksheet #8 of the work plan.

3.2.1 Field Activities

The following activities involve possible exposure to contaminants; they are considered HAZWOPER operations.

3.2.1.1 BIOTA, SURFACE WATER, SEDIMENT, AND PORE WATER SAMPLING

The investigation will include pore water sampling, bulk sediment sampling, and plant, benthic invertebrate, and fish biota tissue sampling. AECOM will collect four co-located surface water, bulk sediment, and pore water samples from the TLF wetland. Four surface water, four bulk sediment, and eight pore water samples will be collected from the Mokapu Central Drainage Channel and Kaneohe Bay adjacent to the landfill. The sediment samples will be collected in accordance with Procedure I-B-6, *Subaqueous Sediment Sampling* (DON 2015). Discrete sediment samples will be obtained using disposable scoops during low tide when these sediments are exposed. Surface water samples will be collected with a disposable bailer in accordance with Procedure I-B-5, *Surface Water Sampling* (DON 2015). Pore water samples will be collected from pre-installed piezometers (installed during an initial site visit) using disposable bailers or a peristaltic pump in accordance with Procedure I-C-3, *Monitoring Well Sampling* (DON 2015). Collected sediment, pore water (filtered for metals analyses, and surface water (both filtered and unfiltered for metals analysis) samples will be transferred directly into laboratory-supplied, pre-cleaned jars, vials, or bottles that will then be sealed, labeled, and placed in a chilled insulated receptacle, and shipped to the designated analytical laboratory under standard COC protocol. Surface water, pore water, and sediment samples will be analyzed for polynuclear aromatic hydrocarbons (PAHs), organochlorine pesticides, PCBs as Congeners, total metals and mercury (except pore water samples), and dissolved metals and mercury (surface water and pore water samples only). QA/QC samples will include duplicates, MS/MSD pairs, field blanks, and equipment blanks. In addition two bulk sediment replicate samples will be collected from the TLF wetland, two bulk sediment replicate samples will be collected from the Mokapu Central Drainage Channel, and one bulk sediment replicate sample will be collected from a background location to be analyzed for acid volatile sulfides and simultaneously extracted metals (AVS/SEM) and TOC.

Fifteen biota samples (five plant, five invertebrate [snail, crustaceans, marine worms], and five fish tissue samples) will be collected from the TLF wetland and the Mokapu Central Drainage Channel and analyzed for PAHs, organochlorine pesticides, PCBs as Congeners, metals, and lipids. Invertebrate, plant, and fish tissue samples will be collected using nets, traps and hand gathering. Tissue samples will be collected daily. If sufficient tissue volume is not collected on the first day, then tissue collection will continue at the location with each day's catch frozen until sufficient quantity is obtained for the location. Each aggregated tissue sample will be dated with the first and last day of included tissue. Frozen samples will be shipped to the offsite analytical laboratory on bagged ice by an overnight courier. The field schedule must be coordinated so that the sampling describe above is conducted when the pond has water, likely during the rainy season.

3.2.1.2 Groundwater Sampling

Groundwater sampling will be performed from the existing six monitoring wells. Groundwater sampling will be conducted in accordance with NAVFAC Pacific ER Program Procedure I-C-3, *Monitoring Well Sampling* (DON 2015). AECOM will collect groundwater samples from each well using a portable submersible or bladder pump.

Surface water samples will be filtered using a 0.45-micron membrane pressure filter attached to a disposable, pressurized bailer. Surface water samples will be collected in a container and then transferred to the bailer. The bailer will then be pressurized so that the sample passes through the filter and into the sample container.

3.2.1.3 Investigation-Derived Waste (IDW) Management

IDW will be collected and categorized as non-hazardous or hazardous. All waste will be treated as hazardous until verified as non-hazardous. Potentially hazardous IDW (soil cuttings, purge water, and decontamination fluids) will be tested and disposed of within 90 calendar days of completing the field activities or as required. Potentially hazardous IDW waste will be staged on site, and then delivered to an IDW storage facility for processing. Non-hazardous IDW will be disposed of in a timely fashion following fieldwork, as required. All IDW work will be performed in accordance with Procedure I-A-6, *IDW Management* (DON 2015). Normal trash will be disposed of daily.

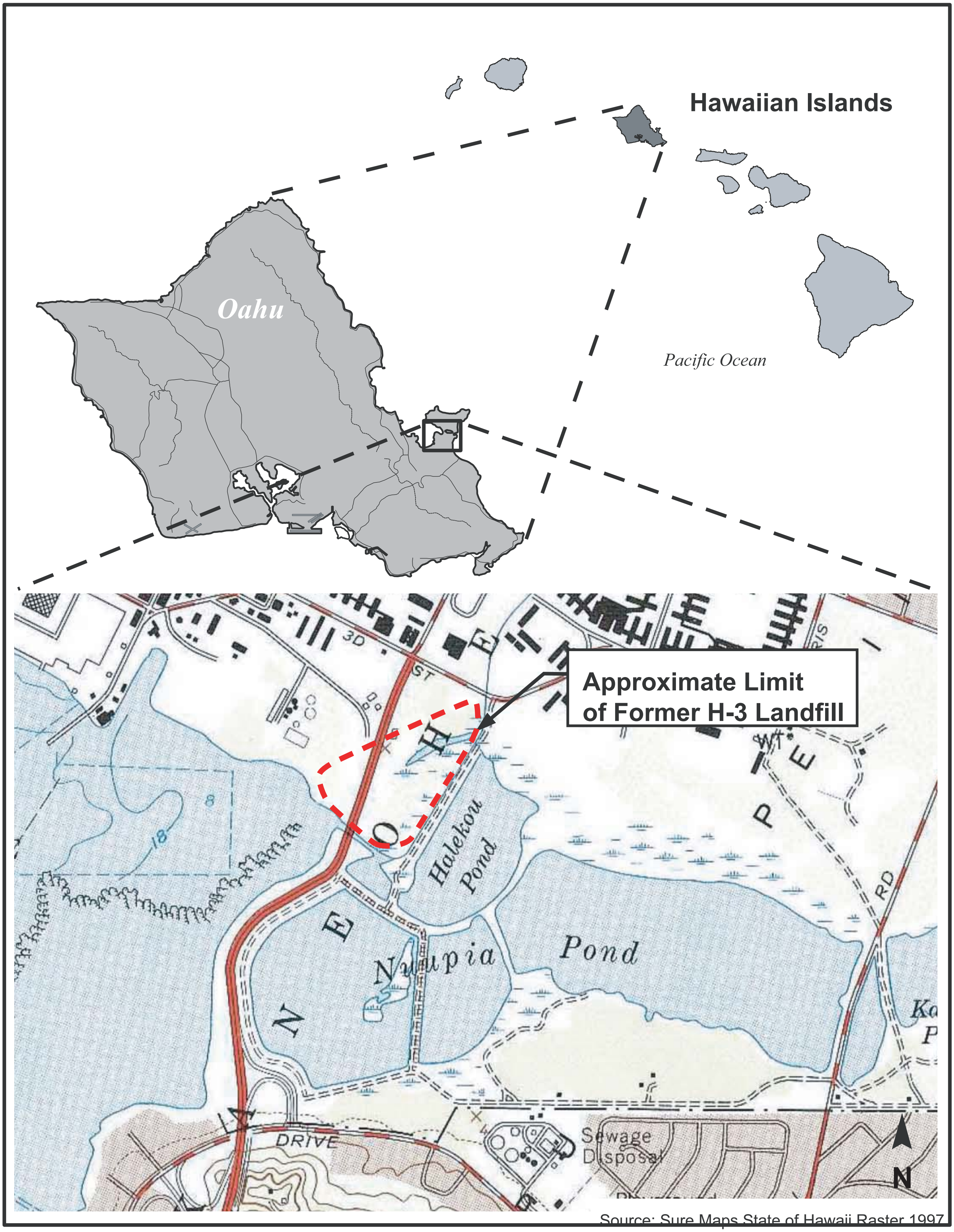


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Figure 3-1
Site Location Map
HSP, GW Monitoring and BERA Sampling,
H-3 Landfill (Site 0001), MCB Hawaii Oahu, Hawaii

4. General Health and Safety Procedures

SH&E SOP S3NA-001-PR, *Safe Work Standards and Rules* (Attachment C) and EM-385-1-1 Section 1A (USACE 2008) provide minimum safety requirements that will be observed by all personnel working on site. The following requirements apply to all work activities to be conducted during groundwater monitoring and BERA sampling activities at the former H-3 Landfill, located at MCB Hawaii, Oahu, Hawaii.

4.1 HAZWOPER REQUIREMENTS

All personnel assigned to the groundwater monitoring and BERA sampling activities must be HAZWOPER qualified by meeting the following training and medical monitoring requirements. These are duplicated in AECOM SH&E SOP S3NA-509-PR, *Hazardous Waste - HAZWOPER Activities*. This SH&E SOP and others are contained in Attachment C.

4.1.1 Medical Screening and Health Surveillance

All personnel regularly on site must have completed a physical exam in accordance with the requirements of 29 CFR 1910.120 (f). The medical surveillance program shall be performed by, or directly supervised by, a physician board certified in occupational medicine in accordance with 29 CFR 1910.129, 29 CFR 1926.65, and Naval Facilities Engineering Command, Pacific (NAVFAC Pacific) Environmental Restoration Program *Project Procedures Manual* (DON 2015). The examining physician will specify exam procedures and tests. Certification of participation in the medical surveillance program will be provided as necessary.

The results of medical examinations are to be evaluated by a physician board certified in occupational medicine. The medical evaluation must include a judgment of the employee’s ability to use respiratory protective equipment and to participate in hazardous waste site activities. The examining physician must document his evaluation/recommendations in writing. Restrictions of onsite activities may be required for personnel with certain medical conditions that could be aggravated by chemical exposure or physical demands at the site. Each employee is responsible for notifying the H&SP of physical or medical restrictions. The H&SP will then ensure that project management observes and enforces the restrictions. A copy of each person’s written medical evaluation will be made available for review following a request from the H&SP. Employees who have not received a medical examination within 12 months (365 days) of their previous medical exam will be required to immediately obtain an appropriate medical exam and provide a copy of the medical evaluation to the H&SP for review prior to starting work on the project.

4.1.2 HAZWOPER Training Requirements

All site personnel must have successfully completed all required training to meet the provisions established in 29 CFR 1910.120 (e)(2) and (e)(3) (40-hour or 24-hour initial training based on potential level of exposure). All personnel will also have received annual refresher training in accordance with 29 CFR 1910.120 (e)(8), and must have completed the most recent training course within the previous 365 days.

Work supervisors will also receive an additional required 8 hours of training, addressing supervisor responsibilities and obligations in maintaining an effective H&S program in accordance with 29 CFR 1910.120 (e)(4). In addition, the SSHO and/or designated representative are required to have completed a 30-hour OSHA Construction Safety course prior to the start of site work. Training documentation supporting the qualification of personnel will be maintained onsite. Prior to the commencement of fieldwork, the SSHO will review training records for all field employees to ensure that it is current and meets the necessary requirements.

4.1.3 Visitor Clearances

Visitors to any HAZWOPER-controlled work area must comply with the H&S requirements of this HSP, and demonstrate an acceptable need for entry into the work area. All visitors desiring to enter any controlled work area must observe the following procedures:

- A written confirmation must be received by AECOM documenting that each of the visitors has received the proper training and medical monitoring required by this HSP. Verbal confirmation can be considered acceptable, provided such confirmation is made by an officer or other authorized representative of the visitor's organization.
- Each visitor will be briefed on the hazards associated with the site activities being performed and acknowledge receipt of this briefing by signing the appropriate tailgate safety briefing form.

If a site visitor requires entry to any exclusion zone (EZ), but does not comply with the above requirements, all work activities within the EZ must be suspended, and monitoring using direct-reading instruments must indicate that no airborne contaminant concentrations are present that exceed the established background levels. Until these requirements have been met, entry will not be permitted.

4.2 ONSITE TRAINING PROCEDURES

The following training procedures will be accomplished at the work site. Additional training may be required according to the specific job task performed by the worker.

4.2.1 Initial Orientation Training

All onsite personnel will be trained about potential hazards at the work site, and prevention or control measures. Field personnel will be provided initial orientation training as follows during the initial orientation:

- Instructed on the contents of applicable portions of this HSP.
- Made aware of task-specific physical hazards and other hazards that may be encountered during site work (AHAs in Attachment E).
- Informed about precautionary measures and symptoms or signs of heat stress.
- Made aware of fire prevention measures, fire extinguishment methods, and evacuation procedures.

The FM will ensure that this training is provided to each person prior to his/her entry into any controlled area. All site-specific training should be documented on the *Tailgate Meeting Form*, a copy of which is included in SH&E SOP S3NA-210-PR, *Project Safety Meetings* (Attachment C).

4.2.2 Tailgate Safety Briefings

A tailgate safety briefing will be conducted at the start of each workday. The SSHO will conduct the tailgate safety briefings, and will review and discuss the H&S issues associated with the day's planned work activities, past problems encountered during similar work, and modifications to existing procedures. Documentation of the tailgate safety briefings will be accomplished by using the

Tailgate Meeting Form, a copy that is found in SH&E SOP S3NA-210-PR, *Project Safety Meetings* (Attachment C). The SSHO will maintain copies of all tailgate safety briefing sign-in logs in the project files. All field personnel associated with each day's project activities are required to attend these meetings.

4.2.3 Hazard Communication Training

Section 5.2 provides information concerning the materials that may be encountered as environmental contaminants during the work activities. In addition, a copy of the item's safety data sheet (SDS) must be provided to the SSHO for approval and filing (the SSHO will maintain copies of all SDSs on site) for hazardous materials/products brought onto the AECOM-controlled work site. For locally obtained products, SDSs may not be available, in which case some alternate form of product hazard documentation can be used, provided it is approved by the H&SP. In accordance with the requirements of SH&E SOP S3NA-507 PR, *Hazardous Materials Communication/WHMIS* (Attachment C), all personnel shall be briefed on the hazards of any chemical product they use (e.g., isopropanol used for decontamination) and shall be aware of and have access to all SDSs. The SDS will be maintained and stored on site.

All containers on site shall be properly labeled to indicate their contents. Labeling on any containers not intended for single-day, individual use shall also contain additional information indicating potential H&S hazards (e.g., flammability, reactivity).

4.3 General Site Safety Rules

All personnel must abide by the following general safety rule and as outlined in AECOM SH&E *SOP S3NA-001-PR, Safe Work Standards and Rules* and the guidelines provided in SH&E *SOP S3NA-005-PR, Vehicle and Driver Safety Program* (Attachment C).

4.3.1 Smoking, Eating, and Drinking

Smoking, eating, and drinking will not be permitted in controlled work areas. Field workers will first wash hands and face immediately after leaving controlled work areas (and always prior to eating or drinking). Consumption of alcoholic beverages is prohibited at any AECOM site.

4.3.2 Personal Hygiene

In accordance with EM-385-1-1 Section 2 (USACE 2008), the following will be observed:

4.3.2.1 Water Supply

A water supply meeting the following requirements will be utilized:

- *Potable Water*. An adequate supply of potable water will be available for field personnel consumption and use in cleaning activities. Potable water used for drinking can be provided in the form of water bottles, canteens, water coolers, or drinking fountains. Individual use cups will be provided as well as adequate disposal containers. Potable water containers will be properly identified in order to distinguish them from non-potable water sources.
- *Non-Potable Water*. Non-potable water cannot be used for drinking or washing purposes, but may be used for non-hygiene-related activities. All containers of non-potable water will be marked with a label stating:

Non-Potable Water
Not Intended for Drinking Water Consumption

4.3.2.2 Toilet Facilities

If access to permanent toilet facilities is not available, a portable toilet facility will be provided on the work site. Portable toilets must include hand-washing capabilities (hand wipes are adequate to meet this need).

4.3.2.3 Washing Facilities

Employees will be provided washing facilities (e.g., buckets with water and Alconox) at the work site. Personnel will be required to clean hands and face using water and hand soap (or similar substance) prior to breaks and at the end of daily work activities.

4.3.3 Buddy System

All field personnel shall use the buddy system when working within any controlled work area. Personnel belonging to another organization on site can serve as "buddies" for AECOM personnel. Under no circumstances shall an AECOM employee be alone in a controlled work area.

4.3.4 Lighting

At a minimum, all portions of the work area will be sufficiently lit so that all surfaces are illuminated at 10 foot-candles or greater. Since work will occur during daylight hours, the need for supplemental lighting is not anticipated in meeting this requirement.

4.3.5 General Housekeeping

All work areas will be kept clean and in dry condition to the extent practicable and that the nature of the work allows. Materials and supplies will be arranged in an orderly manner at locations that are convenient for ready use, but not so close that they encumber the immediate work areas. Excess debris and trash will be collected and stored in an appropriate container (e.g., plastic trash bags, garbage can, roll-off bin) prior to disposal. Collected refuse will be properly disposed of in a timely manner. Personnel will use a reasonable amount of effort to keep slip, trip, and fall hazards to a minimum.

4.4 Controlled Work Areas

The area surrounding each sampling location presents physical hazards associated with the work procedures. To minimize hazards to personnel not directly involved in sampling procedures, a controlled work area will be established. The extent of each area will be sufficient to ensure that personnel located at/beyond its boundaries will not be affected in any substantial way by hazards associated with sample-collection activities. To meet this requirement, the following minimum distances will be used:

- *Groundwater, Sediment, Pore water, Surface water, and Biota Sampling:* The area around the sampling location (i.e., groundwater monitoring well) will be sufficiently cleared to accommodate the sampling activities and the movement of the portable equipment to perform the activities.
- *Decontamination:* For personal and small parts decontamination conducted at the work location, decontamination activities will be kept within the applicable EZ or contamination reduction zone (CRZ) established for that operation.

All personnel will be alert to prevent unauthorized, accidental entrance into controlled-access areas such as the EZ, area of primary activities and CRZ, and area between the EZ and the support zone.

The support zone is an area where administrative and support activities occur and may accessible to the public (e.g., vendors, inspectors). If such an entry to the controlled-access areas occurs, then the trespasser must be immediately escorted outside the area or all HAZWOPER-related work must cease. If such an entry should occur, the trespasser shall be immediately escorted outside the area, or all HAZWOPER-related work must cease. All personnel, equipment, and supplies that enter controlled-access areas must be decontaminated or containerized as waste prior to leaving (through the CRZ only).

4.4.1 Work Area Control Records

The SSHO will record the identities of all personnel working in or entering the EZ each day. All site personnel or visitors working in or entering the EZ will be logged-in/logged-out on a daily basis.

5. Assessment of Chemical Hazards

For this project, AECOM will perform tasks associated with the groundwater monitoring and BERA sampling activities at the former H-3 Landfill and its surroundings. Performance of these tasks can expose personnel to a variety of hazards due to the operational activities, physical conditions of the work locations, and the potential presence of environmental contaminants (Section 5.2). This section focuses on the chemical hazards and physical hazards are addressed in Section 6.

5.1 SPECIFICATION OF WORK TASKS

Work tasks to be completed during this project are contained in Section 3.2.1 of this HSP. An AHA has been prepared for each task of this project (Attachment E). This AHA identifies the related hazards and applicable safety procedures, and specifies any additional requirements (e.g., monitoring procedures).

The AHA includes:

- Biota tissue sampling
- Sediment and pore water sampling
- Surface water sampling
- Groundwater sampling
- IDW management

5.1.1 Unanticipated Work Activities

Where work activities are identified that are not addressed in this HSP, appropriate safety documentation and procedures will be implemented. Prior to initiation of work activities, any subcontractor organization tasked with performance of such work will submit the required safety documentation for the subcontractor's work activities, as described in Section 2.6, which presents the appropriate safety procedures applicable to the specific work activities to be undertaken. Submitted safety procedures will be reviewed by the H&SP for adequacy and compliance with applicable regulatory requirements and the requirements presented in this HSP. Work will not be initiated until this review is completed and any identified deficiencies corrected to the satisfaction of the H&SP.

The H&SP may issue an exemption to this requirement based on the nature of the work activities to be undertaken.

5.2 SUSPECTED ENVIRONMENTAL CONTAMINANTS

The H-3 Landfill Decision Document (DON 2014) reported that there are COPCs above PALs in sediment, groundwater, and surface water at the site. However, the risks to human health are within the U.S. Environmental Protection Agency limits for receptors for all potential pathways. However, there is a potential for exposure to landfill-related gases during sampling.

The information presented below is intended to inform site personnel about the expected hazards associated with known or suspected environmental contaminants. Hazards associated with the use of commercially available hazardous materials are addressed as part of worker hazard communication requirements (Section 4.2.3 of this HSP).

Suspected environmental contaminants include the following:

- Methane
- Hydrogen sulfide

5.2.1 Landfill-Related Gases

5.2.1.1 METHANE

Methane is an odorless, colorless, highly flammable gas and is typically present in landfill soils as a biodegradation product. At room temperature, methane is a gas less dense than air. It is combustible and explosive in mixtures of about 5 to 15 percent in air. The most significant route of methane exposure is by inhalation, as it can produce asphyxiation due to the displacement of oxygen. Methane is not toxic when inhaled, and is not suspected of causing cancer or of having long-term health effects. A permissible exposure limit (PEL) has not been published by the OSHA for methane. Additionally, a threshold limit value (TLV) time-weighted average (TWA) concentration has not been recommended by the American Conference of Governmental Industrial Hygienists (ACGIH).

5.2.1.2 HYDROGEN SULFIDE

Hydrogen sulfide is a colorless, very poisonous flammable gas with a distinct foul odor of rotten eggs. Hydrogen sulfide is often the result of the bacterial breakdown of organic matter in the absence of oxygen, typically a landfill byproduct. Although very pungent at first, hydrogen sulfide quickly deadens the sense of smell, becoming very dangerous to potential victims exposed. At room temperature, hydrogen sulfide is slightly heavier than air. It is flammable and explosive containing a lower explosive limit of 4 percent in air and an upper explosive limit of 44 percent. The ACGIH TLV-TWA for hydrogen sulfide is 1 parts per million (ppm) and the short term exposure limit is 5 ppm (ACGIH 2014). OSHA has published a PEL of 20 ppm and this level is a ceiling limit requiring that it never be exceeded during the workday.

5.3 ASSESSMENT OF HAZARDS

There is the potential for occupational exposure to occur through inhalation. Descriptions of exposure hazards and protective measures for each contaminant type are presented in Section 5.2.

5.3.1.1 INHALATION

The groundwater, sediment, pore water, and surface water may contain residual methane and hydrogen sulfide. While sampling, personnel may be exposed via inhalation. Protection from methane and hydrogen sulfide will be provided by utilizing a multi-gas detector to assess potential inhalation and explosion hazards.

5.3.1.2 SKIN CONTACT

Contact with contaminated materials is likely during sediment sampling activities; therefore, protection against skin contact/adsorption can be accomplished by using protective gloves/clothing.

5.3.1.3 INCIDENTAL INGESTION

Incidental ingestion of contaminated materials is likely during sampling activities. Protection against exposure via ingestion can be accomplished by use of PPE, performing proper decontamination procedures when exiting contaminated work areas (Section 7.4), good personal hygiene practices, and the avoidance of eating food or drinking within the work zones.

6. Physical Hazards

AECOM will perform tasks associated with groundwater monitoring and baseline ecological risk assessment sampling activities at the former H-3 Landfill (Site 0001), Marine Corps Base Hawaii (MCB Hawaii), Kaneohe Bay, Oahu, Hawaii. Performance of these tasks can expose personnel to a variety of physical hazards. The physical hazards associated with these work activities are summarized below and detailed in the AHAs (Attachment E). An individual AHA has been prepared for each task, which cites the applicable SH&E SOPs. The SH&E SOPs are contained in Attachment C and the AHAs are in Attachment E.

6.1 Driving To and From Site

All vehicles driven to and from the project site will be properly maintained and inspected daily before use. Drivers will be appropriately licensed, trained, and medically fit to operate a vehicle. Only authorized drivers will operate a motor vehicle while conducting business for AECOM. Personnel must obey all traffic laws. Cell phone use is prohibited while driving, including hands-free device where permitted. All occupants must wear a seat belt while the vehicle is in motion. All loads will be secured properly. Drivers will be alert, drive defensively, and not allow themselves to become fatigued. In addition, personnel will follow the guidelines provided in SH&E SOP S3NA-005-PR, *Vehicle and Driver Safety Program* (Attachment C).

6.2 Slips, Trips, Falls, and Protruding Objects

Hazards from protruding objects, careless movements, or placement of materials on paths or foot traffic areas present a problem with regard to slips, trips, falls, and puncture wounds. Personnel will use a reasonable amount of effort to ensure the prevention of such injuries. SH&E S3NA-001-PR, *Safe Work Standards and Rules*, contains information relevant to slip and trips hazards. Maintaining three points of contact is the best way to prevent a fall when working/walking on uneven, rocky, or difficult terrain. This can be achieved by using a walking pole or placing one hand (gloved) on the ground when stability is compromised. Also, carrying equipment that causes the person's center of gravity to be unbalance should be avoided by packing and carrying loads closed to the body in backpacks or similar.

6.3 Heat Stress Prevention

Heat stress can be a significant field site hazard for field operations conducted in the hot, humid environment of Hawaii. Heat stress prevention will consist of the implementation of a work-rest schedule and a physiological monitoring program with modification to the work-rest schedule based on the results of the physiological monitoring program. Worker acclimatization and workloads will be assessed and work-rest schedules will be established in accordance to EM-385-1-1, Section 6, paragraph 06.I.04 (USACE 2008). In addition, personnel will follow the guidelines provided in SH&E SOP S3NA-511-PR, *Heat Stress* (Attachment C).

Additionally, site personnel will be instructed on the prevention of heat stress, in the identification of a heat-stress victim, and in the first-aid treatment procedures for heat stress casualties. To protect against heat stress, workers will observe the requirements detailed in the following sections.

6.3.1 Physiological Monitoring

Physiological monitoring will be performed to assess climatic, personnel, and working conditions that may contribute to heat stress. Site workers donning permeable, semi-permeable, or near-impermeable protective clothing and exposed to ambient temperatures above 70 degrees Fahrenheit (°F) will be monitored for heat stress in accordance with EM-385-1-1, Section 06.I.04

(USACE 2008) and as prescribed in SH&E SOP S3NA-511-PR, *Heat Stress* (Attachment C). Because temperatures on Oahu generally exceed 70°F, each site worker, regardless of task being performed or level of PPE donned, will be monitored for heat stress. The physiological monitoring identified for this field effort is heart rate monitoring, as described below.

6.3.1.1 Heart Rate Monitoring

At the start of the workday, each worker's baseline pulse rate measured in beats per minute (bpm) is determined by taking a pulse count for 15 seconds and multiplying the result by 4. Worker pulse rates can then be measured at the beginning and end of each break period to determine if the rest period allows adequate cooling by applying the following criteria:

- Each worker's maximum heart rate at the start of a break should be less than the difference of 180 and the worker's age in bpm. If this value is exceeded for a worker, then the duration of the following work period will be decreased by at least 10 minutes.
- At the beginning of each work period, all workers' heart rates must have returned to within +10 percent of the baseline pulse rate. If a worker's pulse rate exceeds this value, then the break period will be extended for at least 5 minutes, at the end of which pulse rates will be re-measured and the end-of-break criteria again applied.

In addition to heart rate monitoring, taking oral temperature readings may also be used as a monitoring control.

6.3.1.2 Oral Temperature

Use a clinical thermometer with a disposable probe cover (3 minutes under the tongue) or similar device to measure the oral temperature at the end of the work period (before drinking).

- If oral temperature exceeds 99.6°F or 37.6 degrees Celsius (°C), then shorten the next work cycle by one-third without changing the rest period.
- If oral temperature still exceeds 99.6°F (37.6°C) at the beginning of the next rest period, then shorten the following work cycle by one-third.
- A worker will not wear a semi-permeable or impermeable garment when their oral temperature exceeds 100.6°F (38.1°C).

6.3.2 Work-Rest Schedule

A work-rest schedule based on anticipated work rate (where light work corresponds to minimal physical activity besides standing/watching; very heavy work corresponds to significant, continuous physical labor) and the adjusted temperature (Table 6-1) will follow the work-rest schedule presented in Table 6-2.

The adjusted temperature method requires only that the ambient temperature (in °F) be known. Adjustment factors are applied to the ambient temperature to account for departures from ideal conditions (sunny conditions, light winds, moderate humidity, and a fully acclimated work force). The adjustments will be made by addition or subtraction to the ambient temperature reading, or changes in table position, as indicated in Table 6-1. Adjustments are independent and cumulative, all applicable adjustments will be applied. The result is the Adjusted Temperature, which can be compared with the values for the applicable work rate (where light work corresponds to minimal physical activity besides standing/watching, very heavy work corresponds to significant, continuous physical labor) to determine the work-rest frequency.

Table 6-1: Adjustment Factors to Calculate Adjusted Temperature

Factor	Adjustment
Time of Day	
Before daily temperature peak [a]	+2°F
10 a.m. – 2 p.m. (peak sunshine)	+2°F
Sunshine	
No clouds	+1°F
Partly cloudy (3/8 – 5/8 cloud cover)	–3°F
Mostly cloudy (5/8 – 7/8 cloud cover)	–5°F
Cloudy (>7/8 cloud cover)	–7°F
Indoor or nighttime work	–7°F
Wind (ignore if indoors or if wearing CPC)	
Gusts greater than 5 mph at least once per minute	–1°F
Gusts greater than 10 mph at least once per minute	–2°F
Sustained greater than 5 mph	–3°F
Sustained greater than 10 mph	–5°F
Humidity (ignore if wearing CPC)	
Relative humidity greater than 90 percent	+5°F
Relative humidity greater than 80 percent	+2°F
Relative humidity less than 50 percent	–4°F
CPC	
Modified Level D (coveralls, no respirator)	+5°F
Level C (coveralls w/o hood, full-face respirator)	+8°F
Level C (coveralls w/hood, full-face respirator)	+10°F
Level B w/airline	+9°F
Level B w/self-contained breathing apparatus	+9°F and right one column [b]
Level A	+14°F and right one column [b]
Miscellaneous	
Unacclimated work force	+5°F
Partially acclimated work force	+2°F
Working in shade	–3°F
Breaks taken in air-conditioned space	–3°F

°F degree Fahrenheit
CPC chemical protective clothing
mph mile per hour
[a] This adjustment accounts for temperature rise during the day. If the temperature has already reached its daytime peak, it can be ignored.
[b] Locate the proper column in Table 6-2 based on work rate, then move one column to the right (next-higher work rate) before locating the corresponding adjusted temperature.

Table 6-2: Work-Rest Schedule Based on Adjusted Temperature

Work-Rest Schedule	Adjusted Temperature (°F)			
	Light Work	Moderate Work	Heavy Work	Very Heavy Work
No specified requirements	<80	<75	<70	<65
15 minute break every 90 minutes of work	80–90	75–85	70–80	65–75
15 minute break every 60 minutes of work	>90–100	>85–95	>80–85	>75–80
15 minute break every 45 minutes of work	>100–110	>95–100	>85–90	>80–85

Work-Rest Schedule	Adjusted Temperature (°F)			
	Light Work	Moderate Work	Heavy Work	Very Heavy Work
15 minute break every 30 minutes of work	>110–115	>100–105	>90–95	>85–90
15 minute break every 15 minutes of work	>115–120	>105–110	>95–100	>90–95
Stop Work	>120	>110	>100	>95

Note: Time spent performing decontamination or donning/doffing CPC will not be included in calculating work or break time lengths.
Shaded cell indicates high-hazard conditions.

The SSHO or designee will determine the potential for heat stress based on planned activities, weather forecasts, and the field calculated adjusted temperature. Then the SSHO will determine the applicable work-rest schedule from Table 6-2 based on adjusted temperature and work intensity.

To read Table 6-2, determine the *Work Rate* at which the workers will be operating (where *Light Work* corresponds to minimal physical activity besides standing/watching, *Very Heavy Work* corresponds to significant, continuous physical labor), then read down the column to the temperature range corresponding to the *Adjusted Temperature* (derived from Table 6-2). The *Work-Rest Schedule* for that row indicates the appropriate work schedule.

Shaded areas in Table 6-2 indicate high hazard conditions. When such conditions are anticipated during a workday, the SSHO will include a discussion of heat stress as part of the daily tailgate safety meeting topics.

6.3.3 Evaluating the Work-Rest Schedule's Effectiveness

Once a work-rest schedule is established, the SSHO will continually evaluate its effectiveness through observation of workers for signs/symptoms of heat stress. Measurement of each worker's pulse can provide additional information in determining whether the schedule is adequate, and is accomplished as follows:

- At the start of the workday, each worker's baseline pulse rate (in bpm) is determined by taking a pulse count for 15 seconds and multiplying the result by 4. Worker pulse rates can then be measured at the beginning and end of each break period to determine if the rest period allows adequate cooling by applying the following criteria:
  - Each worker's maximum heart rate at the start of a break should be less than a bpm of 180 minus the worker's age. If this value is exceeded for a worker, then the duration of the following work period will be decreased by at least 10 minutes.
  - At the end of each work period, all workers' heart rates must have returned to within +10 percent of the baseline pulse rate. If a worker's pulse rate exceeds this value, then the break period will be extended for at least 5 minutes, at the end of which pulse rates will be re-measured and the end-of-break criteria again applied.

6.3.4 Heat Stress Monitoring and First Aid

In general, workers will be encouraged to immediately report difficulties or heat-related problems that they might experience or observe in fellow workers. Supervisors will use such information to alter the work-rest schedule to accommodate such problems. During breaks, workers will be encouraged to drink plenty of water or other liquids to replace lost fluids and to help cool off.

If a worker exhibit signs of severe heat distress, such as profuse sweating, extreme confusion and irritability, or pale, clammy skin, then that worker will be relieved of all duties at once and made to rest in a cool location and drink plenty of water. Anyone exhibiting symptoms of heat stroke (red, dry skin or unconsciousness) will be taken immediately to the nearest medical facility, taking steps to cool the person during transport (e.g., removing clothing, wetting the skin, using air conditioning). Severe heat stress (heat stroke) is a life-threatening condition that must be treated by competent medical authority.

Workers will be observed for heat stress during work activities. This section describes several potential heat related illnesses, first aid procedures, and heat-stress prevention guidelines. If workers exhibit signs of heat stress, then first aid will be provided and the work-rest schedule will be revised.

6.3.4.1 HEAT-RELATED ILLNESSES

The following guidance can be used in the identification and treatment of heat-related illness:

- *Mild Heat Strain* is the mildest form of heat-related illness. Victims exhibit irritability, lethargy, and significant sweating. The victim may complain of headache or nausea. This is the initial stage of overheating, and prompt action at this point may prevent more severe heat-related illness from occurring.
  - *First Aid:* Provide the victim with a work break during which he/she may relax, remove excess protective clothing, and drink cool fluids. An air-conditioned spot is an ideal break location. Once the victim shows improvement, he/she may resume working; however, the work pace will be moderated to prevent recurrence of the symptoms.
- *Heat Exhaustion* usually begins with muscular weakness and cramping, dizziness, staggering gait, and nausea. The victim will have pale, clammy, and moist skin and may perspire profusely. The pulse is weak and fast, and the victim may faint unless they lie down. The bowels may move involuntarily.
  - *First Aid:* Immediately remove the victim from the work area to a shady or cool area with good air circulation (avoid drafts or sudden chilling). Remove all protective outerwear. Treat the victim for shock. (Make the victim lie down and keep him or her cool by loosening all clothing). Raise the victim’s legs above the height of his or her head. If the victim is conscious, it may be helpful to give him or her sips of water. Transport victim to a medical facility as soon as possible.
- *Heat Stroke* is the most serious of heat illness, and represents the collapse of the body’s cooling mechanisms. As a result, body temperature may rise to 104°F or higher. As the victim progresses toward heat stroke, symptoms such as headache, dizziness, and nausea can be noted, and the skin is observed to be dry, red, and hot. Sudden collapse and loss of consciousness follows quickly, and death is imminent if exposure continues. Heat stroke can occur suddenly.
  - *First Aid:* Immediately evacuate the victim to a cool and shady area. Remove all protective outerwear and as much personal clothing as decency permits. Lay the victim on his/her back. Raise the victim’s legs above the height of his or her head. Apply cold, wet towels or ice bags to the head, armpits, and thighs. Sponge off the bare skin with cool water or rubbing alcohol, if available. The main objective is to cool without chilling the victim. Give no stimulants or hot drinks. Since heat stroke is a severe medical condition requiring professional medical attention, emergency medical help will be summoned immediately to provide onsite treatment of the victim and proper transport to

a medical facility. If a heat-related illness that requires medical attention occurs, per SH&E S3NA-605-PR, *Medical Surveillance Program* (Attachment C), the employee will receive an exposure-specific examination by the company occupational medicine physician prior to returning to work.

6.3.5 Recommended Heat Stress Prevention Guidelines

The guidelines discussed in this section are intended to be used only as a means for initial establishment of a work-rest schedule.

- The SSHO, in consultation with the AECOM SH&E Department, will evaluate the conditions at a specific operation and make final determinations of the work-rest schedule.
- Intake of fluid will be increased beyond that which satisfies thirst, and it is important to avoid “fluid debt,” which will not be made up as long as the individual is sweating.
- Two 8-ounce glasses of water will be taken prior to beginning work, then up to 32 ounces per hour during the work shift; fluid replacement at frequent intervals is most effective.
- The best fluid to drink is water; liquids like coffee or soda do not provide efficient hydration, and may increase loss of water.
  - If commercial electrolyte drinks (e.g., Gatorade) are used, the drink will be diluted with water, or 8 ounces of water will be taken with each 8 ounces of electrolyte beverage.
- Additional salt is usually not needed and salt tablets will not be taken.
- Replacement fluids will be cool, but not cold.
- Breaks will be taken in a cool, shaded location, and impermeable clothing will be removed.
- Dry clothing or towels will be available to minimize chills when taking breaks.
- Manual labor, other than paperwork or similar light tasks, will not be performed during breaks.
- Other controls that may be used include:
  - Scheduling work at night or during the cooler parts of the day (6 a.m. – 10 a.m. and after 3 p.m.)
  - Erecting a cover or partition to shade the work area
  - Use of cooling garments (this option is expensive and logistically difficult to implement)
- All site workers will be informed of the potential for heat stress during the daily safety meeting.
- The SSHO will determine whether workers are at particular risk for heat stress due to illness or other health factors.
- The SSHO will ensure that sufficient quantities of potable water and electrolyte drinks are available in the decontamination area and that a shaded rest area is available at or immediately outside the decontamination area.
- All workers will drink 16 ounces of water prior to beginning work and at least 16 ounces during each rest period.

6.3.6 Solar Protection

To protect against the extreme solar exposure at the project site and its surroundings, workers will observe the following requirements:

- Don tinted safety glasses at all times when working outdoors during daylight hours.
- Apply a commercial sun block with a minimum solar protection factor of 30 for Ultraviolet A and Ultraviolet B.

6.4 UNEXPLODED ORDNANCE SAFETY

An encounter with unexploded ordnance (UXO) of any kind is not anticipated, and the project site background does not indicate that UXO is likely present. Therefore, an Explosive Safety Submission is not required for this site. As a precaution and due to the proximity of potential UXO sites, information regarding UXO has been included in the HSP. UXO items present hazards when encountered in subsurface areas during excavating, trenching, or drilling. The basic policy to be observed regarding UXO is: **DO NOT TOUCH, HANDLE, OR OTHERWISE DISTURB ANY UXO ITEM**.

In addition, procedures identified in SH&E SOP S4NA-514-PR, *Munitions and Explosives of Concern/Unexploded Ordnance* (MEC/UXO) (Attachment C), as well as the following information, will be observed to minimize the hazards to personnel from UXO.

6.4.1 UXO in Surface Areas

All personnel must be briefed concerning the potential for UXO in surface areas and any known identifying characteristics of UXO items. When moving about the site, personnel should remain alert for any UXO items that might be present. Each work site should be thoroughly checked for the presence of UXO before any other activities commence. In the event that any UXO item is observed or expected, the following requirements will be observed:

- Personnel must note the location of the UXO item, and alert all other personnel in the area to its presence.
- Under no circumstances will any AECOM or subcontractor employee attempt to move or otherwise handle any suspected of known UXO item. COLLECTION OF “SOUVENIRS” IS PROHIBITED.
- Any AECOM work operations occurring within 20 feet of the item will cease. All AECOM and subcontractor employees will evacuate the area.

The installation representative will be alerted as to the location of the suspected item.

6.5 MANUAL LIFTING AND DRUM HANDLING

Most materials associated with investigation activities are moved by hand. The human body is subject to severe damage in the forms of back injury, muscle strains, and hernia if caution is not observed in the handling process. All personnel will observe the procedures identified in SH&E SOP S3NA-308-PR, *Manual Lifting, Field*, in Attachment C when performing manual lifting in excess of 10 pounds. Whenever possible, use at least two people to lift, or roll/lift with the arms as close to the body as possible. When manually lifting or handling materials, proper lifting techniques will be used. Workers should not over-push, over-pull, over-reach, and/or twist at the waist while carrying or handling a load. Their path of travel while transporting the load should be pre-determined and kept clear of any obstructions.

The handling of all containers used for storage of materials will be performed in accordance with the following:

- Where containers of capacity greater than 10 gallons are used for containerizing chemical products or waste materials, handling of the containers will be accomplished in accordance with the following:
  - When not in use, drums/containers will be covered with tight fitting lids.
  - At the conclusion of each work shift, all drums/containers will be placed in a NAVFAC Hawaii-designated waste storage area. This area will be properly marked and secured.
  - Mechanical or powered drum handling equipment will be used to move drums/containers. Manual handling of drums leads to musculoskeletal injuries and will be avoided to the maximum extent possible.

If sampling of IDW-containing drums for waste characterization purposes is required, it will be accomplished in a manner to minimize potential for skin contact. Handling of potentially contaminated soils and groundwater presents the risk of contact with hazardous substances. In order to provide protection against skin contact with contaminated materials, all sample collection activities will be performed using Modified Level D protective equipment ensembles. Specified personnel decontamination procedures will also be observed.

6.6 MANUAL/POWERED HAND TOOLS

Hand tools will be used to clear vegetation, open cans, close drum tops, etc., including machetes, rakes, mallets, hand wrenches, and impact (air) wrenches. All personnel will observe the procedures identified in SH&E SOP S3NA-305-PR, *Hand and Power Tools* (Attachment C), when using tools and equipment. Visual inspection of the hand tools will be done prior to its use, and any defective or damaged tool will be removed from the project and repaired or replaced.

6.7 LADDERS

Ladders will be used during surface sediment sampling to access sampling locations. All personnel will observe general procedures for the use of ladders identified in SH&E SOP S3NA-312-PR, *Stairways and Ladders*. Inspection and care of ladders will be specified at the beginning of each work day.

6.8 TRAFFIC SAFETY

Operations will not be taking place on streets; therefore, there should be minimal hazards to personnel from moving vehicles. Operators of vehicles and mobile equipment used during the field activity will obey all applicable traffic laws and operate the vehicles/equipment in a safe manner and not present a potential hazard to other workers (SH&E SOP S3NA-005-PR, *Vehicle and Driver Safety Program*). Vehicle/equipment operators will not offer or accept riders as passengers on vehicles/equipment that are not designed to carry passengers.

6.9 SEVERE WEATHER

The site is subject to effects of severe weather such as high wind, torrential rain, and electrical storms. Emergency action planning for severe weather is addressed in SH&E SOP S3NA-203-PR, *Emergency Response Planning, Field* (Attachment C). If severe weather that could threaten worker safety appears imminent, reschedule the work for another time. If work is already in progress, stop work, rally all personnel, secure the work area and evacuate to shelter. These response actions should be reviewed with site personnel during the tailgate safety meeting.

6.10 Biological Hazards (Poisonous Plants, Insect Stings/Bites)

Hazardous plants and animal wildlife may be present in and around the fieldwork activity areas. All personnel will observe the procedures identified in SH&E SOP S3NA-313-PR, *Wildlife, Plants and Insects* (Attachment C). Poisonous plants and wildlife (i.e., centipedes, spiders, etc.) may grow and/or live near or in the fieldwork activity areas. Insects such as bees and wasps may have colonized in or near the work areas. Field personnel should practice personal awareness of their surroundings at all times. Avoid areas of tall brush where contact with animal wildlife may occur. Do not place hands or feet in areas that cannot be observed and inspected. Prior to breaks and at the end of a shift, wash hands and face with soap and water to remove plant oils that may irritate the skin or cause a more severe reaction. Report insect-infested areas to the FM and identify workers who are allergic or capable of allergic reactions to bee, wasp, or ant stings or bites. Instruct insect- and/or plant-sensitive workers to have their prescribed antibiotic or medicine available in case of contact.

6.11 Working Near Water

Sediment sampling will be conducted along the edge of the drainage canal. SH&E SOP S3NA-315-PR, *Water, Working Around* (Attachment C) provides general requirements for working near water. Employees working near the water (i.e., along the base of the slope adjacent to the water's edge) shall utilize a U.S. Coast Guard (USCG)-approved personal flotation device (PFD) (life preserver). This shall be in addition to any other required PPE. At least one USCG-approved life ring, with at least 90 feet of line attached, shall be located on site.

6.12 Working Over Water

Sample collection will be conducted from a floating work platform. SH&E SOP S3NA-315-PR, *Water, Working Around* and SH&E SOP S3NA-419-PR, *Boat and Vessel Operations* provides general requirements for working over water. Because of the hazards associated with this work (man overboard, etc.), the following guidelines will be observed during all overwater work activities:

- Each person assigned to overwater work shall utilize a USCG-approved PFD (life preserver) certified to keep the user upright when in use. This shall be in addition to any other required PPE.
- The craft selected for use shall be rated to carry at least one person more than the required number of personnel in the sampling team. This craft shall possess side walls and other protection to help prevent personnel from falling into the water.
- Sampling shall be coordinated and conducted following receipt of approval from Port Operations. Additional requirements of Port Operations and Security shall be observed.
- The size of the work team assigned to any operation shall be kept to a minimum, consistent with work activity requirements.
- A float plan must be prepared and utilized in accordance with SH&E SOP S3NA-419-WI4, *Float Plan.*

7. Exposure Monitoring and Personal Protective Equipment

This section pertains to exposure monitoring procedures and PPE to be donned during site activities.

7.1 Chemical Exposure Monitoring Procedures

This section presents monitoring procedures that will be employed during groundwater monitoring and BERA sampling activities to assess employee exposure to chemical and physical hazards. Monitoring will consist primarily of onsite determination of various parameters (e.g., airborne contaminant concentrations and heat-stress effects), but may be supplemented by more sophisticated monitoring techniques, if necessary. The FM/SSHO will note the air monitoring results in the logbook, which is readily available for employees to review. Air monitoring results will be made available to the monitored employees at the end of the work day.

7.1.1 Monitoring Instrumentation

To assess the exposure potential to environmental contaminants during groundwater monitoring and BERA sampling activities, onsite monitoring will be performed using the type of real-time instrumentation as shown in Table 7-1.

Table 7-1: Monitoring Instrumentation

Instrument	Manufacturer/Model [a]	Substances Detected
Explosimeter	RAE Systems/QRAE II or equivalent	Methane and H_2S

[a] Or similar unit, as approved by H&SP.

All direct-reading air-monitoring equipment will be calibrated before and after each period of use in accordance with the manufacturer's written procedures for each device and standard industrial hygiene practice. Calibration information for each instrument will be recorded in the site log.

The following monitoring procedures and response action levels will be used for each of the site types to be sampled.

7.1.2 Monitoring Procedures –Sampling Activities

The monitoring procedures outlined in Table 7-2 will be followed during all sampling activities.

Table 7-2: Monitoring Procedures and Action Levels for Sampling Activities

Parameter	Zone Location and Monitoring Interval	Response Level (Above Background)	Response Activity
Methane	At or near the ground level, every 15 minutes during sampling activities	<10% LEL	Continue work activities. If significant changes exist in this acceptable range, contact the SSHO to investigate the potential for contributing factors.
		≥10% LEL	Cease work, exit the area or confined space, and contact the SSHO and SHM.
Hydrogen sulfide	Breathing Zone, every 15 minutes during sampling activities	<10 ppm	Continue work activities. If significant changes exist in this acceptable range, contact the SSHO to investigate the potential for contributing factors.
		≥10 ppm	Cease work, exit the area or confined space, and contact the SSHO and SHM.

LEL lower exposure limit
ppm parts per million
SHM safety and health manager
SSHO site safety and health officer

7.2 PERSONAL PROTECTIVE EQUIPMENT

The purpose of PPE is to provide a barrier that will shield or isolate individuals from the chemical and/or physical hazards that may be encountered during work activities. SH&E SOP S3NA-208-PR, *Personal Protective Equipment Program*, lists the general requirements for selection and usage of PPE. Table 7-3 lists the minimum PPE required during site operations and additional PPE that may be necessary. The specific PPE requirements for each work task are specified in the individual AHAs found in Attachment E.

Table 7-3: Personal Protective Equipment

Type	Material	Additional Information
Minimum PPE		
Safety Vest	High-visibility	ANSI/ISEA 107-2004 Approved, Class I where vehicular speed does not exceed 25 mph, Class II where vehicular speed is at or greater than 25 mph, Class III for enhanced visibility to arms and legs. Must have reflective tape and be visible from all sides.
Boots	Leather	ANSI-approved safety toe.
Safety Glasses		ANSI-approved, shaded/tinted safety glasses during daylight.
Hard Hat		ANSI-approved.
Work Uniform – Long pants, short or long-sleeve shirt or coveralls		No shorts/cutoff jeans or sleeveless shirts.
Additional PPE		
Gloves	Leather	If working with sharp objects or powered equipment.
Protective Chemical-Resistant Gloves	Nitrile	If collecting and handling contaminated materials.
Personal Flotation Device	Each PFD will have at least 31 square inches (200 square centimeters) of retroreflective material attached to its front side and at least 31 square inches (200 square centimeters) on its back side.	Type III or better and Coast Guard approved. All PFDs will be of a highly visible orange/reddish color. Must be worn when working near or over water.
Coveralls	Polyethylene-coated Tyvek or equivalent	If expecting muddy or overly dirty conditions.
Level C Respiratory Protection	MSA (Full Face or equivalent) equipped with GMA/P100	National Institute for Occupational Safety and Health-approved; use dependent upon air monitoring guidelines (Table 7-2); Current fit test required.

ANSI American National Standards Institute
ISEA Industrial Safety Equipment Association
MSA Mine Safety Appliances Company

By signing this HSP, each employee (AECOM and its subcontractors) certifies they have been properly trained in the use, limitations, care, and maintenance of the protective equipment used at this project. If they have not received training on the proper use, care, and limitations of the PPE required for this project, the CTO manager/SSHO shall be contacted immediately for the proper training prior to signing this HSP.

7.3 PPE Donning and Doffing Information

The following information provides field personnel with helpful hints that, when applied, make donning and doffing of PPE a safer and more manageable task:

- Never cut disposable booties from your feet using a basic utility knife. This has resulted in workers cutting through the booty and the underlying sturdy leather work boot, resulting in significant cuts to the legs/ankles. Instead, use an AECOM-approved cutting tool to start a cut in the edge of the booty, cutting above and parallel with the work boot, then proceed by manually tearing the material down to the sole of the booty for easy removal.
- When applying duct tape to PPE interfaces (e.g., wrist, lower leg, around respirator) and zippers, leave approximately 1 inch at the end of the tape to fold over onto itself. This will make it much easier to remove the tape by providing a small handle to grab while still wearing gloves. Without this fold, trying to pull up the tape end with multiple gloves on may be difficult and result in premature tearing of the PPE.
- Have a “buddy” check your ensemble to ensure proper donning before entering controlled work areas. Without mirrors, the most obvious discrepancies can go unnoticed and may result in a potential exposure situation.

7.4 Decontamination Activities

When possible, all necessary steps shall be taken to reduce or minimize contact with chemicals and impacted materials while performing field activities (e.g., avoid sitting or leaning on, walking through, dragging equipment over, tracking, or splashing potential or known impacted materials).

All personal decontamination activities shall be performed with an attendant (buddy) to provide assistance to personnel that are performing decontamination activities. Depending on specific site hazards, attendants may be required to wear a level of protection that is equal to the required level in the EZ. All persons and equipment entering the EZ shall be considered contaminated, and thus, must be properly decontaminated prior to entering the Support Zone. All requirements for performing personal and equipment decontamination are provided below.

7.4.1 Decontamination Equipment

The following equipment is commonly used for decontamination purposes:

- Soft-bristle scrub brushes or long-handled brushes to remove contaminants
- Hoses, buckets of water or garden sprayers for rinsing
- Large plastic/galvanized wash tubs or children’s wading pools for washing and rinsing solutions
- Large plastic garbage cans or similar containers lined with plastic bags for the storage of contaminated clothing and equipment
- Metal or plastic cans or drums for the temporary storage of contaminated liquids
- Paper or cloth towels for drying protective clothing and equipment

7.4.2 Personal Decontamination Steps

Modified Level D

In the Exclusion Zone:

1. Equipment drop on plastic sheet.
2. Remove the majority of gross contamination.
3. Wash boot covers and outer gloves.
4. Rinse boot covers and outer gloves.
5. Remove tape.
6. Remove boot covers and outer gloves.

In the CRZ (keep the most contaminated equipment near the EZ boundary):

1. Wash protective suits and safety boots.
2. Rinse protective suits and safety boots.
3. Safety boot removal.
4. Remove protective suit.
5. Wash inner gloves.
6. Rinse inner gloves.
7. Remove inner gloves.
8. Remove inner clothing (if necessary).

In the Support Zone:

1. Finish with personal decontamination/hygiene wash procedures.
2. Redress (if necessary).

Level C

In Exclusion Zone (near boundary of CRZ):

1. Equipment drop on plastic sheet.
2. Remove the majority of gross contamination.
3. Wash boot covers and outer gloves.
4. Rinse boot covers and outer gloves.
5. Remove tape.
6. Remove boot covers and outer gloves.

In the CRZ (keep the most contaminated equipment near the EZ boundary):

1. Wash protective suits and safety boots.
2. Rinse protective suits and safety boots.
3. Change out (if required): Filter/mask change and redress (boot covers and outer gloves).
4. Safety boot removal.
5. Remove protective suit.
6. Wash inner gloves.
7. Rinse inner gloves.
8. Remove respirator/mask and decontaminate.
9. Remove inner gloves.
10. Remove inner clothing (if necessary).

In the Support Zone:

1. Finish with personal decontamination/hygiene wash procedures.
2. Redress (if necessary).

7.4.3 Equipment Decontamination

Equipment that might require decontamination includes sampling equipment and tools. All employees performing equipment decontamination shall wear the appropriate PPE to protect against exposure to contaminants. The following is general guidance for use in determining equipment decontamination procedures:

- *Hand Tools:* Tools will be dropped into a plastic pail, tub, or other container at the work site. They will be brushed off, washed with a detergent solution, and rinsed with clean water.
- *Sampling Equipment:* Sampling equipment will be decontaminated before and between sampling to prevent cross-contamination, and before removal from the work site, following the same procedure as for hand tools.

7.4.4 Disposal of Decontamination Wastes

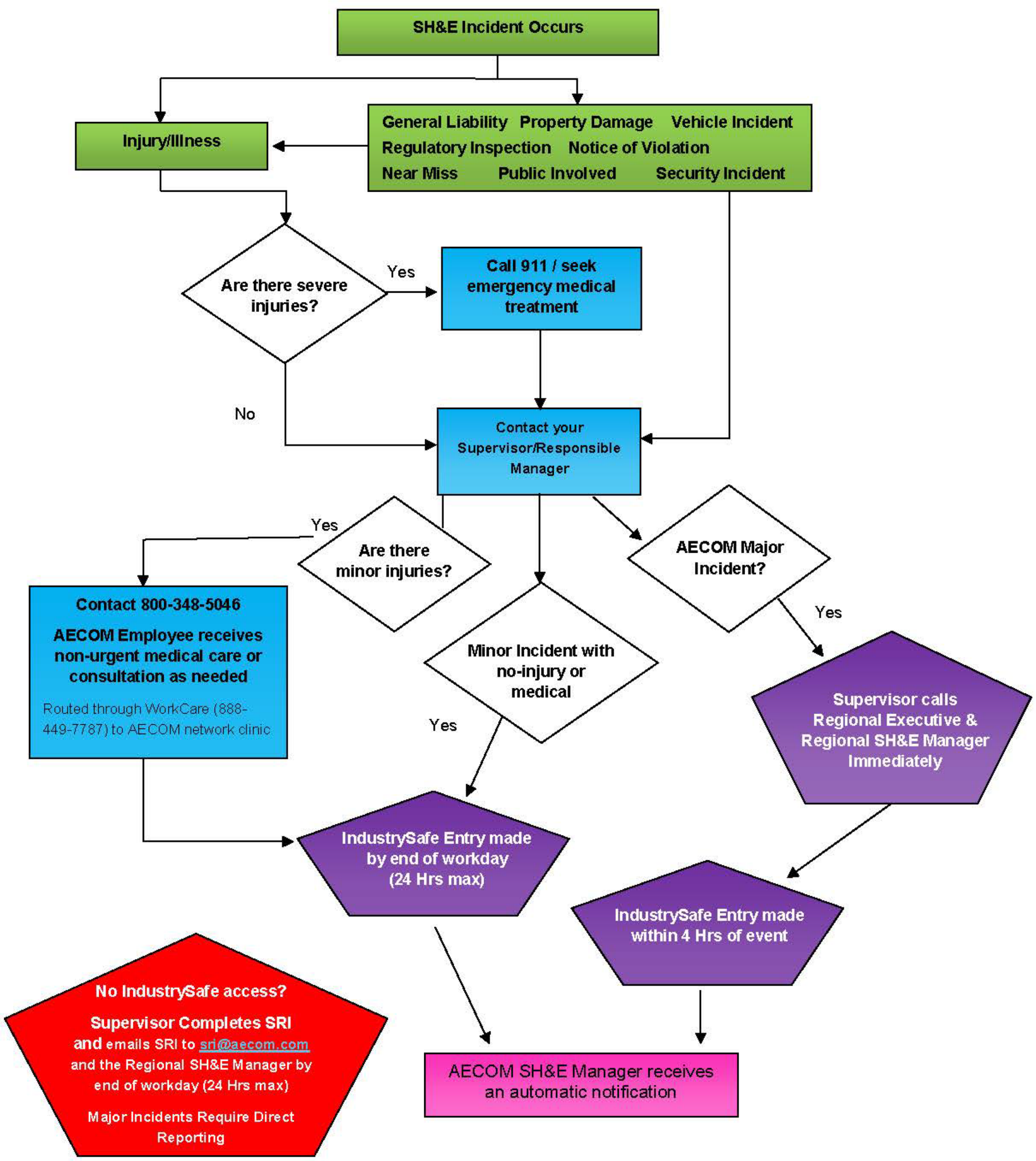
Solid and liquid decontamination waste should be containerized. Solids may be double-bagged, or placed in a sealed drum or similar container. Liquids will be collected during decontamination and placed in sealed containers. Containers must be clearly labeled for content, the operation from which they were filled, and the dates of accumulation.

8. Emergency Action Plan

8.1 GENERAL

An emergency action plan has been prepared for this project to provide a systematic process for responding to onsite emergencies. The emergency action plan will be reviewed and discussed prior to the start of work during daily safety tailgate meetings. An emergency action simulation will be conducted at the beginning of the field investigation. The simulation will be critiqued, and lessons learned will be identified by the field team. In the event an incident occurs, the AECOM Incident Reporting flowchart (Figure 8-1) should be consulted to assist with reporting procedures. Reporting procedures to meet the Navy CLEAN contract requirements are presented in Sections 8.7 and 8.8.

Figure 8-1: S3NA-004-WI1 Incident Reporting Flowchart



8.2 RESPONSIBILITIES

8.2.1 Site Safety and Health Officer

The SSHO will be the primary contact and coordinator of all emergency activities. The SSHO will be responsible for the following:

- Assuming full control of all work activities as the designated EC.
- Designating the evacuation assembly areas.
- Evaluating the severity of the emergency (SSHO will confirm procedure for summoning emergency responders prior to beginning work operations).
- Implementing the appropriate response action.
- Summoning appropriate emergency services (e.g., fire department, police, or ambulance).
- Notifying all site personnel, the H&SP, and concerned Navy authorities of the emergency situation.

The FM will act as an alternate point of contact for emergency action issues.

8.2.2 Other Onsite Personnel

Field personnel are required to inform the SSHO of all emergency situations and to abide by their issued response actions. Special medical problems of field personnel, such as allergies to insects, plants, or prescription medication, will be reported to the SSHO.

8.3 EMERGENCY EQUIPMENT

In accordance with 29 CFR 1910, Subpart K, the following emergency equipment will be available at the work site and in proper working condition.

8.3.1 First Aid Kit

A first-aid kit will be available that meets the following requirements:

- First-aid kits will be in weatherproof containers, meet all regulatory requirements, and be present at all locations where AECOM employees are working.
- Personnel permitted to use first-aid kits will possess a current first-aid card. A minimum of two trained first-aid/CPR providers who have also received bloodborne pathogens training will be present on site at all times.

8.3.2 Fire Extinguisher

A fire extinguisher with a minimum rating of 1-A; 10-BC will be available on site at all times. Site personnel will be trained in the use of the available fire extinguisher type(s), and will be kept aware of onsite locations where extinguishers are placed (for access in case of fire).

In addition, a fire extinguisher will be mounted on each piece of heavy equipment for use in an emergency. The minimum rating for each vehicle-mounted extinguisher will be 2-A; 10-BC.

8.3.3 Life Ring

At least one USCG-approved life ring, with at least 90 feet of line attached, shall be located on the boat, as well as on site at intervals of 200 feet.

8.3.4 Eyewash Units

An eyewash unit will be available at the work site at all times. The eyewash must meet the latest requirements of American National Standards Institute Standard Z358.1 (ANSI 2009), and will be capable of supplying hands-free irrigation for both eyes for at least 15 minutes at a flow rate of at least 0.4 gallon per minute.

8.4 RESPONSE ACTIONS – SAFETY EQUIPMENT PROBLEMS

A malfunction or other problem with any H&S equipment can potentially lead to a medical emergency. Examples include the following:

- Leaks or tears in protective clothing
- Failure of respiratory protective devices (i.e., self-contained breathing apparatus or air-purifying respirators)
- Encountering contaminants for which prescribed protective equipment may not be suitable

These equipment problems must be corrected before proceeding with field activities. Personnel affected by the equipment problem(s) must exit the work area until the problem has been corrected.

8.5 RESPONSE ACTION – FIRE

Activities to be conducted at the site may introduce the potential for accidental fire. A fire extinguisher meeting the minimum requirements of EM-385-1-1 will be on site at all times. In addition, all heavy equipment will have the appropriate fire extinguisher. All field personnel will be made aware of fire prevention measures, fire extinguishment methods, and evacuation procedures and be familiar with SH&E S3NA-206-PR, *Fire Protection, Field* (Attachment C). Field personnel will use a fire extinguisher to contain and extinguish small fires (area of 1 square foot). Fires of a larger size will require assistance from emergency responding agencies, such as the local fire department. All vehicles and heavy equipment on site will be required to carry a fire extinguisher.

8.6 RESPONSE ACTIONS – MEDICAL EMERGENCIES

A medical emergency is a situation that presents a significant threat to the health of personnel on site. Chemical exposure, heat stress, and poisonous insect bites can cause medical emergencies. Proper care must be initiated immediately. Proper care may be in the form of first-aid treatment or emergency hospitalization.

Response personnel will accompany victims to the medical facility, whenever possible, to advise them on decontamination procedures. Table 8-1 provides instructions to respond to general categories of medical emergencies.

Table 8-1: How to Respond to Medical Emergencies

Emergency	Response
Inhalation	1. Call for medical assistance. 2. Workers wearing proper respiratory protective equipment will remove the victim from the contaminated atmosphere. 3. For CPR and first-aid qualified field personnel: If the victim is not breathing, administer mouth-to-mouth resuscitation or CPR immediately.

Emergency	Response
Eye Contact	1. Do not rub eyes. 2. Flood eyes with emergency eyewash solution. Hold the eye open and flood so that all surfaces are thoroughly washed. 3. Continue washing for 15 minutes while calling for medical assistance.
Skin Exposure	1. Wash skin with soap and water for a minimum of 15 minutes. All contaminated areas on the body, including hair, will be thoroughly decontaminated. 2. If clothing is contaminated, it will be removed in a way to minimize further contact with the substance. 3. Seek medical assistance.
Heat Stress	1. Remove excess clothing. 2. Pour water on the victim. 3. If the victim is conscious, offer water or Gatorade. 4. Seek medical assistance. 5. Additional first aid measures are provided in Section 6.3.
Injury	6. Call for assistance (CPR/First Aid, WorkCare or EMS when appropriate) 7. Secure the area. 8. Assess injury and condition of in the injured party 9. Stabilize their position and provide first aid and comfort. 10. Seek further assistance.

CPR cardiopulmonary resuscitation

8.6.1 Medical Assistance

The SSHO will keep on site the list of emergency telephone numbers and locations of the local fire department, hospitals, ambulance service, and other emergency services (Table 8-2).

In the event of injury (other than serious/severe injury) where additional medical attention is needed, personnel will be transported to Castle Medical Center (Table 8-2 and Figure 8-2). In the event of severe injury, a call for medical assistance will be made.

At least two qualified first aid providers (FM and SSHO, or designee) who are trained in first aid and CPR as codified at 29 CFR 1910.1030 will be present on site at all times to provide immediate care in the event of accident or injury. The SSHO or designee will identify the first aid providers at the safety briefing prior to beginning work operations. The SSHO or designee will inform hospital personnel of any medical treatment administered to personnel for onsite injury, illness, or exposure to chemical contaminants.

8.6.2 Injury Reporting

All accidents and incidents that occur on site during field activities will be promptly reported to the SSHO and the FM in accordance with SH&E SOP S3NA-004-PR, *Incident Reporting*, S3NA-601-PR, *Recordkeeping*, and S3NA-603-PR, *Incident Investigation and Review* (Attachment C).

If an AECOM employee is injured and requires medical treatment, the FM will contact AECOM's **Incident Reporting Line at 800-348-5046 immediately**. The FM will initiate a written report, using the *SH&E Report of Incident* form (S3NA-004-FM1, Attachment D). The FM will complete the first two sections of this form and forward it to the CTO manager to complete. As an alternate, the CTO manager will input the necessary information into IndustrySafe. The report will then be provided to the SHM before the end of the following shift.

If an employee of a subcontractor is injured, documentation of the incident will be accomplished in accordance with the subcontractor's procedures; however, copies of all documentation (which at a minimum must include the OSHA Form 301 or equivalent) must be provided to the SSHO within 24 hours after the accident has occurred.

Additionally, injury reporting to meet the Navy CLEAN contract requirements needs to be completed and this information is contained within Sections 8.7 and 8.8.

8.7 Response Actions – Chemical Release or Other Significant Incident

Onsite personnel will implement the following procedure in response to any "incident" that results in an injury, causes damage to Navy or other property that could exceed $500, causes a stoppage in work of more than 2 hours, or requires response service from the Navy Public Works Center (PWC) or other offsite agency.

8.7.1 Incident Response Actions

- In the event of an incident, the SSHO (the FM will be the alternate) will assume full control of all work activities and be designated as the EC.
- The EC will assess the incident consequences and will order an immediate evacuation of the site if an uncontrolled hazard exists to site personnel. A headcount will be conducted to account for all personnel after the emergency evacuation has been completed. The location of the evacuation exit from the site and a rally point will be determined in the field by the SSHO near the work area. The SSHO will identify evacuation route and rally point during the daily tailgate briefing or more frequently as conditions change.
- Once the risk of worker injury is controlled, priority will be given to identifying and treating injuries, under the direction of the EC. First-aid procedures will be implemented immediately for all victims; emergency medical assistance will be contacted (in accordance with HSP procedures) if injuries warrant response by emergency medical technicians. As appropriate, less severely injured personnel will be transported to the designated hospital (as time/resources permit), sent home, or released to resume work.
- Once injury response activities are under control, the EC will perform an assessment of the site conditions and determine whether offsite support is required to implement control or corrective procedures. If no outside support is necessary, then the EC will direct worker recovery actions to allow resumption of normal activities. Once activities are restored, the EC will contact the CTO manager and SHM and provide a complete report of the incident occurrence, resulting injuries or damage, and the completed response actions. Additional directions issued by the CTO manager or SHM will be implemented by the EC. The CTO manager will be responsible for notifying the Navy remedial project manager (RPM) and the CLEAN program manager of the incident in as timely a manner as possible. Additional follow-up notifications will be performed as needed, in accordance with the follow-up activities discussed below.
- If outside support is required in response to the conditions of the incident, then the EC will contact an appropriate response agency in accordance with the HSP. The response agency will be provided with information concerning site location, the nature of the incident, the assessment of conditions, and what type of support is required. In addition, during the initial contact, the response agency must be informed that the work site is undergoing environmental investigation and that response actions may entail exposure to environmental contaminants. The Navy has an emergency notification procedure form, entitled *Oil and*

Hazardous Substance Spill Response & Notification Procedures – Contractors (the OHS form) in Attachment D of this HSP. In short, the responding actions are as follows:

- Call the Federal Fire Department for all emergent situations regarding hazardous chemical releases.
- If release of a hazardous substance is above the reportable quantity or is a petroleum substance that causes a sheen on the water, to notify additional agencies, including (a) the Navy On-Scene Coordinator, (b) the National Response Center, (c) the State Emergency Response Commission, and (d) the Local Emergency Planning Committee. The OHS form will be used in support of the incident response actions listed above.
- After notifying the response agency of the incident, the EC will *immediately* contact the CTO manager and HSP-designated SHM and provide a complete report of the incident occurrence, resulting injuries or damage, and the status of the ongoing response actions. Additional directions issued by the CTO manager or SHM will be implemented by the EC. The CTO manager will be responsible for notifying the RPM and the CLEAN program manager of the incident before close of business that day, if possible, or at the start of the next business day. Additional follow-up notifications will be performed as needed, in accordance with the follow-up activities discussed below.

- If response team support is immediate, then the EC will remain on site to meet the response team. If the response team is delayed, the EC will coordinate the response schedule until the response agency arrives[1]. The EC will provide the response team leader with a copy of the HSP, along with a concise briefing on site conditions, known physical/chemical hazards, and recommended safety procedures. The EC will attempt to answer questions the response team leader may have regarding the environmental conditions of the site or the circumstances of the incident.
- Once the status briefing is complete, the EC will relinquish operational control of the site to the response team. The EC will remain on site throughout the response team's work unless dismissed by the response team leader or relieved by an appropriate AECOM representative (e.g., the CTO manager); however, the EC will *not* direct response team actions. When the response team has completed its work, control of the site will return to the EC.
- Once response activities have been completed, the EC will notify the CTO manager and the SHM.

After all responding agencies have the situation under control and if outside support is required, the PWC may be notified to assist in post-emergency cleanup or as required by the HSP.

8.8 INJURY/INCIDENT FOLLOW-UP ACTIONS

Following any onsite incident or injury involving more than first aid treatment, a mishap report (Contractor Significant Incident Report [CSIR]) (Attachment C) must be prepared by the SHM and submitted to the CLEAN contracting officer according to the following schedule:

Serious Contractor Mishap: Any mishap involving a fatality or the hospitalization of three or more workers, or resulting in property damage exceeding $200,000 in value.

[1] If the response is not immediate, then the EC will ensure that the site is controlled and poses no health or safety hazard to persons or property before leaving it uncontrolled. If this cannot be ensured, then the EC or other designated personnel will stay on site to maintain control until the response team arrives.

- The SHM will provide immediate telephone notification to the contracting officer.
- The SHM will provide e-mail or written notification to the contracting officer within 4 hours of the incident. The SHM will provide a verbal notification to the contracting officer (written CSIR in 24 hours) and Hawaii Occupational Safety and Health Division, Department of Labor and Industrial Relations within 8 hours of death, hospitalization of 3 or more persons, or damage of $25,000 or more.
- A Preliminary CSIR must be submitted to the Contracting Officer within 24 hours of the mishap.
- The Final CSIR must be submitted to the Contracting Officer within 5 days of the mishap.

Non-serious Contractor Mishap: Any mishap that causes one or more OSHA-recordable injuries or that results in more than $5,000 in property damage, but does not qualify as serious.

- The SHM will provide telephone or e-mail notification to the contracting officer within 4 hours of the mishap.
- The CSIR must be submitted to the contracting officer within 5 days of the mishap.

Other Mishaps: All non-OSHA recordable injury or near-miss incidents (defined in SH&E SOP S3NA-004-PR, *Incident Reporting* [Attachment C]) and incidents involving less than $5,000 in damage.

The SHM will provide telephone or e-mail notification to the contracting officer within 3 working days of the mishap.

- No CSIR is required; however, a *SH&E Observation Report* form (S3NA-004-FM2 in Attachment D) will need to be completed and submitted to the SHM.
- AECOM will provide the contracting officer with a copy of its own investigation report once completed.

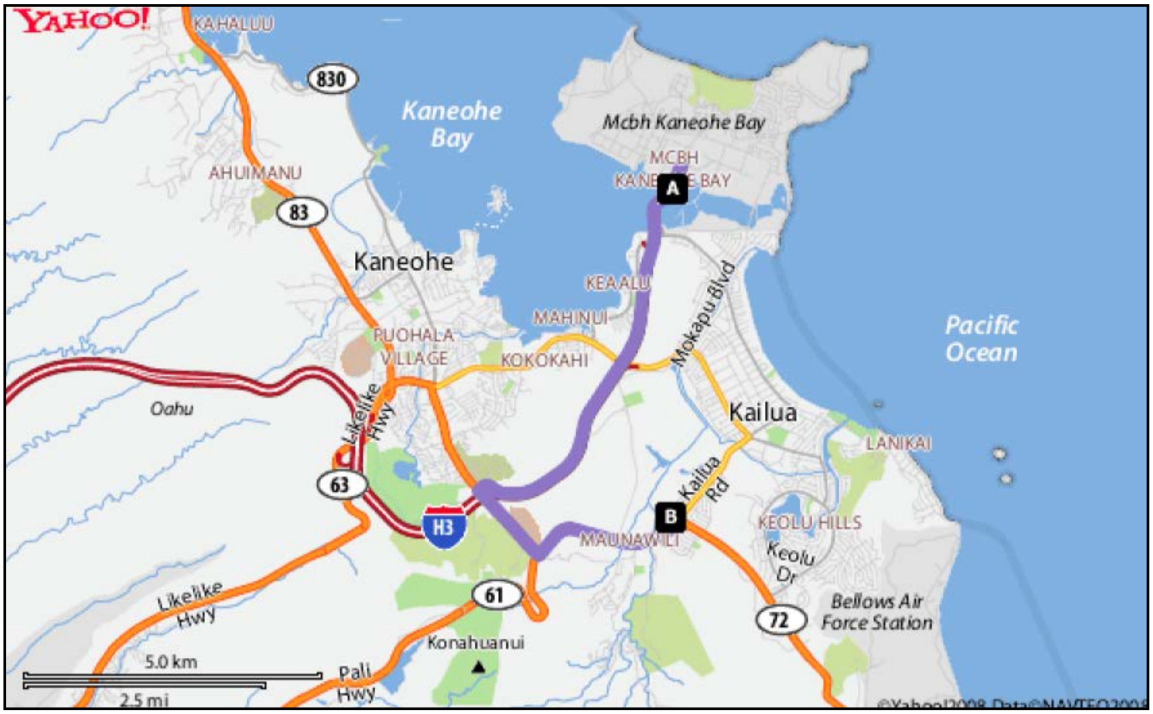
Follow-Up Investigations: The H&SP will investigate the circumstances of the incident/injury through review of the incident documentation, and will assist in the performance of any necessary accident investigation or other follow-up. A report detailing the investigation findings will be prepared, which will include identification of causative factors and recommendations concerning corrective actions. The CTO manager will ensure that the recommendations resulting from any investigation are implemented without delay.

- *Follow-Up Discussions:* Following an emergency action, the SSHO will address the action that was taken with the personnel on site to critique and evaluate the actions taken. Lessons learned from the emergency will be discussed with all personnel. A Preliminary CSIR must be submitted to the Contracting Officer within 24 hours of the mishap.
- The Final CSIR must be submitted to the Contracting Officer within 5 days of the mishap.

Table 8-2: Emergency Telephone Numbers

Emergency	**911**
Fire Department:	
Federal Fire Department (Regional Dispatch Center)	808-471-7117
Medical Care (Including Emergency Room):	
Castle Medical Center 640 Ulukahiki Street, Kailua, HI	808-263-5164
Non-Emergency Medical Care	
Acute Care Med Services Inc 660 Kailua Rd Kailua, HI 96734	808-266-3900
Fire/Regional Dispatch Center Emergency:	**808-449-2677**
Police:	
Military Police (Marine Corps Base Hawaii Security)	808-257-7114
Information and Response Organizations:	
Explosive Ordnance Disposal	808-474-3615
National Response Center (if spill over reportable quantity)	800-424-8802
State Emergency Response Commission (Hazard Evaluation and Emergency Response)	Days: 808-586-4249 24 Hrs.: 808-247-2191
Local Poison Control Center	800-222-1222
Navy Personnel:	
Remedial Project Manager, NAVFAC Hawaii, Mr. Joel Narusawa	808-471-1171 Ext. 222
MCB Hawaii Contact, Brett Chambers	808-257-7001
AECOM Personnel:	
CLEAN III H&SP, Shelley Brown	562-544-3506
CLEAN III Program Director, Robin Cababa	808-356-5354
CTO PM, Mr. Ed Sloan	808-356-5325 Mobile: 906-869-0579
SSHO, Danielle Coulombe	Mobile: 508-496-9249
AECOM Incident Reporting Line:	**800-348-5046**
Hawaii Occupational Safety and Health Division, Department of Labor and Industrial Relations (Email: dlir.director@hawaii.gov)	808-586-8844

Figure 8-2: Hospital Route Map



<u>Driving Directions to Castle Medical Center</u>

1. *Depart Site*
2. Make a U-Turn at 3rd Street onto G
3. Continue on John A Burns FWY (I-H3 W)
4. Take Exit #11/Kamehameha Highway (HI-83 S)
5. Turn Left on Kamehameha Highway (HI-83 S)
6. Turn Left onto Kalanianaole Highway (HI-61 N)
7. Turn Left on to Ulukahiki Street

Arrive at:

Castle Medical Center
640 Ulukahiki Street
Kailua HI, 96734

808-263-5164

9. References

29 Code of Federal Regulations (CFR) 1910. *Occupational Safety and Health Standards, Hazardous Materials, 1910.120, Hazardous Waste Operations and Emergency Response*.

29 CFR 1926. *Safety and Health Regulations for Construction, Occupational Health and Environmental Controls, 1926.65, Hazardous Waste Operations and Emergency Response*.

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Naval Energy and Environmental Support Activity (NEESA) 1984. *Initial Assessment Study of Marine Corps Air Station Kaneohe Bay, Hawaii*. April.

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Attachment A:
AECOM Corporate SH&E Policy Statement and Program Manual

Safety, Health and Environment Policy Statement

AECOM

PURPOSE

This policy establishes the framework to attain Best-In-Class Safety, Health and Environmental (SH&E) performance for AECOM's employees in the global marketplace.

COMMITMENT

AECOM is committed to exceptional levels of performance in protecting its people and the environment. As stated in our Core Values, keeping our people safe is our most important measure of success. We strive to be the beacon of safety excellence in the industries and global communities in which we work.

To advance our SH&E program, we are committed to:

- Zero work-related injuries and illnesses to AECOM employees and protection of the environment as a result of our activities.
- Providing a highly effective SH&E management system that drives continual review and improvement.
- Meeting all client requirements and properly incorporating all safety, health and environmental rules and regulations at the local, state, provincial and national levels.
- Developing an exceptional safety culture where our people embrace ownership for the safety of themselves and others.
- Substantial improvements against our goals of pollution prevention, resource conservation and environmental sustainability.
- Setting and meeting aggressive SH&E performance goals and Core Value Metrics to promote continual improvement.
- Working with employees and business partners in order to continuously improve SH&E performance.
- Recognizing and celebrating those who contribute to excellent SH&E performance.
- Striving to make AECOM the provider of choice for the safe execution of design, build, finance, operate and maintenance work globally.

The commitment to this policy by the leadership, management and employees of AECOM provides the foundation for a safe workplace, operational excellence and long-term business success.

EXPECTATIONS

Safety is a core value and a key to our success. We demand continual improvement in our journey towards a zero incident culture, where everyone is committed to safety, health and environmental excellence.

To that end, we demand that:

- Our leaders, managers, supervisors and employees demonstrate their commitment in their actions and decisions to assure that every person goes home safe every day.
- Our employees embrace safety a core value both on and off the job.
- We have an absolute commitment for our own safety and that of fellow employees.
- We will incorporate all Life-Preserving Principles into our work planning and execution.
- We proactively and aggressively identify, manage and eliminate hazards in the work place.
- We train and prepare our people to have the knowledge, skills, competency and equipment required to work safely.
- We stop our employees from working if the work cannot be executed safely or if conditions or behaviors on the work activity are unsafe.
- All employees immediately report safety, health and/or environmental incidents, near-misses, unsafe conditions, and at-risk behaviors to their supervisor; and that we diligently work to correct the problem.

Our SH&E expectations will be accomplished by the demonstrated leadership of management, implementation, and communications of industry recognized best practices and regulatory compliance.

COMMUNICATION

This Policy will be reviewed annually to ensure that it meets the needs of the company, and will be made available to all persons under the control of the company.

Sincerely,

M. Burke

Michael S. Burke
Chief Executive Officer

10/10/14
Date

Safety, Health, and Environment Manual

Americas

Preface

AECOM is a leading global provider of professional technical and management support services for government and commercial clients around the world. We provide our services through our global network of more than 45,000 employees in more than 100 countries to a broad range of end markets, including transportation, water, facilities, environmental management and energy.

AECOM believes that responsible stewardship of the built and natural environment as well as the safety and health of our employees is a critical element to business growth and success. AECOM demonstrates commitment to this fundamental responsibility by embracing Safety, Health and Environment as a Core Value.

The Americas Safety, Health and Environmental (SH&E) Program is an integral part of AECOM's overall Americas business plan. The SH&E Program is based on proven management principles and practices. It consists of an organized framework that is continually monitored and periodically reviewed in response to changing internal and external factors. The program establishes the minimum requirements for management involvement, responding to SH&E incidents, monitoring SH&E performance, and communicating with staff regarding their occupational health and safety obligations. It is meant to supplement the standards set by AECOM's clients and state, provincial, territorial, and federal regulatory agencies.

Through implementation of this SH&E Program Manual, AECOM has established a uniform, systematic and cost-effective approach to administrating SH&E issues and concerns associated with AECOM personnel and services. The SH&E Program Management System has been structured to align itself with the key elements of OHSAS 18001 (Occupational Health and Safety Assessment Series), ISO 14001 (the International Standard for Environmental Management Systems), CSA Z1000-06 (Canadian Standards Association OH&S Management System), COR (Provincial Certificate of Recognition programs in Canada) and Regulatory Agency Requirements.

All AECOM employees in the Americas are responsible for maintaining compliance with the SH&E Policy, Program Manual, and Standard Operating Procedures. Subject to the scope of a contract, elements of this SH&E Program may be applied to subcontractors and equipment suppliers to maintain an adequate level of SH&E awareness, control and cooperation with AECOM and with our clients' needs.

Where there is potential for criminal, civil or regulatory action against AECOM or any of its employees or subcontractors, all AECOM employees must notify AECOM's Americas Chief Legal Counsel before documenting an incident or conducting an investigation.

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1.0 Terms and Definitions

Acceptable Risk: A risk that has been reduced to a level that can be tolerated or effectively managed by the organization.

Audit: Systematic examination to determine whether activities and related results conform to established AECOM policies and whether such policies have been implemented and are being effectively followed.

Compliance: Meeting with statutory and AECOM procedural requirements.

Corrective Action: Action to eliminate the cause of a detected deviation from established policies and procedures.

Control Measures: Precautions and arrangements taken to eliminate or reduce the hazards.

Contractor: A company or organization that performs on-site activities that are, or will be, governed by a contract between the client (not AECOM) and that organization. In some cases, the contractor may also have the responsibility as the Prime Contractor, Construction Manager, Constructor, or other entity responsible for SH&E on-site.

Emergency: An unplanned situation or event requiring the involvement of public emergency services or regulatory authorities.

Environmental Impact: Any change to the environment, whether adverse or beneficial, wholly or partially resulting from AECOM's activities, products, or services.

Hazard: Any situation or condition that may be pose a risk of personal injury, environmental impact or damage to property.

Hazard Assessment: A process by which workplace hazards are identified and evaluated. Existing and potential hazards are identified through inspections and/or during the proposal or planning stage of a project or task.

Incident: A work-related event which is unplanned, potentially harmful or damaging, and which may result in personal injury, environmental impact, or loss or may impact the reputation of AECOM or its clients or may result in an investigation by a regulatory agency or insurer.

Near Miss: A near-miss or risk is the identified *potential* for an incident to occur, but which produces no visible injury or damage.

Non-conformance: Any deviation from work standards, practices, procedures, regulations, management system performance, etc., that could either directly or indirectly lead to injury or illness, property damage, damage to the workplace environment, or a combination of these.

Objectives: Goals, in terms of SH&E performance, that an organization or individual sets itself to achieve.

Personal Protective Equipment (PPE): Equipment or clothing worn by a person for protection from health or safety hazards associated with conditions at a work site.

Regulatory Agency: With respect to this document, a Government Agency with authority and jurisdiction over safety, health and/or environmental laws and regulations.

Regulatory Inspection: An inspection completed by a Regulatory Agency.

Risk: Combination of the likelihood and severity of the consequence(s) of a specified hazardous event.

Risk Assessment: Overall process of estimating the magnitude of risk and deciding whether or not the risk is tolerable.

Safety, Health & Environment (SH&E): Safety (Protection from unacceptable risk of harm). Health (Protection from occupational contaminants and diseases). Environment (Protection of the environment from AECOM's activities).

Safety, Health and Environmental (SH&E) Department: Support function within AECOM that assists management personnel in controlling conditions and factors that affect the well-being of employees.

Safety Inspections: Workplace, office or site inspections of work practices and controls as they apply to project or program specific SH&E requirements.

Senior Management: Employees with a title of Senior Vice President or above who are expressly authorized to make management decisions for AECOM's Americas Geography.

SH&E Management System (MS): Part of the overall SH&E Program that facilitates the management of the SH&E risks associated with the business of the organization. This includes the organizational structure, planning activities, responsibilities, practices, procedures, processes and resources for developing, implementing, achieving, reviewing and maintaining the organization's SH&E Policy.

SH&E Performance: Measurable results of the SH&E Management System related to the organization's control of safety and health risks, and environmental impacts based on its policies and objectives.

Safety, Health and Environmental Policy Statement: Overall intentions and direction of an organization related to its SH&E Program as formally expressed by Senior Management.

Significant: In this context, used to denote those SH&E aspects in relative terms that warrant action by Senior Management.

Site: Any location where AECOM employees perform work for AECOM, whether or not owned by AECOM, including, without limitation: offices, buildings, plant facilities, project sites or work sites.

Stakeholders: Individuals such as employees, client, suppliers, investors, and the public with a vested interest in the organization's achievements.

Stop Work Orders: A directive to cease work on a project, work site or office.

Subcontractors: On-site activities that are or will be governed by a contractual arrangement between AECOM (or its subsidiaries) and another entity involving hours worked by non-AECOM employees and not directly controlled or supervised by AECOM employees. This excludes office-based contract services (e.g. janitorial, copy machine, etc.) delivery/pickup services performed by mail, motor/rail/air freight carriers, and vendor vehicles. Subcontracted services include Subconsultant Services and Independent Contractors.

Supervisor or Project Manager: Management personnel who represent AECOM at any particular office, project or worksite and who are responsible for overseeing all aspects of the work performed while maintaining compliance with SH&E Policy and Procedures.

Target: A target is a detailed performance requirement derived from a goal or objective.

Temporary Employee: Individuals hired on a temporary basis to perform a limited task under the direction of an AECOM employee. All temporary employees must provide proof of workers' compensation coverage.

2.0 Introduction

This SH&E Program is based on the four-step problem solving process of “Plan-Do-Check-Act” methodology.

Plan: SH&E Management will establish the objectives and processes (SH&E Program) necessary to deliver results in accordance with the AECOM SH&E policy.

Do: AECOM operations management provides the resources, including human and financial, for implementing an effective SH&E Program.

Check: SH&E Management will monitor and measure processes against SH&E policy, objectives, legal and other requirements, and report the results.

Act: AECOM operations management and SH&E Management will take actions to continually improve the SH&E program and performance.

3.0 SH&E Policy and Guiding Principles

3.1 SH&E Policy Statement

3.1.1 A policy statement which outlines AECOM's commitment to SH&E has been developed and signed by AECOM's Chairman and CEO. This policy is communicated to all employees in the Americas and is posted at each permanent and temporary office site. An electronic version of this policy is also available on AECOM's intranet.

3.1.2 This policy will be formally reviewed and authorized annually as part of the Management Review process. However, if substantial changes occur in legislation, organization and/or other business drivers, changes may be made on an interim basis.

3.2 SH&E Guiding Principles

3.2.1 AECOM's Senior Executives have developed "SH&E Guiding Principles" to help employees understand and implement the SH&E Policy Statement and achieve the SH&E Core Values.

3.2.2 The SH&E Guiding Principles are:

- **Risk Management -** We will only undertake activities that we have evaluated thoroughly from an SH&E risk standpoint. Where risks are identified, we will develop and implement appropriate mitigation strategies to reduce the possibility of injuring people, damaging property, or impairing the environment**.**
- **Resources** - We will provide the necessary human, financial and material resources to implement, maintain and monitor the AECOM SH&E Program.
- **Leadership** - Management will be directly involved in the SH&E program. All supervisors will lead by example and through appropriate decision-making.
- **Compliance** - We will comply with all relevant and applicable rules and regulations pertaining to SH&E issues as well as those voluntary requirements to which we subscribe.
- **Involvemen**t - All employees will be encouraged to provide continual feedback on the effectiveness of our existing programs and to provide recommendations for the development of new ones that can advance our SH&E program.
- **Sustainability** - We will promote environmental sustainability through the efficient use of energy, conservation of natural resources, and prevention of pollution through reuse, recycling, and reduction whenever practical throughout our company.
- **Training** - We will provide thorough and effective training programs to employees. Our management teams will evaluate the training needs for all projects and only assign competent personnel. Industry Leaders We will work with clients, partners, suppliers, competitors and regulators to raise the SH&E standards of our industry.
- **Industry Leadership** - We will work with clients, partners, suppliers, competitors and regulators to raise the SH&E standards of our industry.
- **Work With Others** - We will assess the competencies and capabilities of our contractors, suppliers, vendors and partners prior to selecting them to perform work on our behalf. We will also monitor their implementation of SH&E programs during all phases of their activities.
- **Performance** - We will establish short and long-term performance targets relative to SH&E and regularly report on our progress toward these goals to our employees and other stakeholders.
- **Assessment** - We will routinely assess our programs at the corporate, business unit and individual project levels to enable continual improvement of our programs and systems.
- **Reporting** - Every employee is expected to report any occupational injury, illness, environmental release, near-miss incident and property damage incident in a timely, open and thorough manner. Information gained from this reporting will be communicated throughout the organization to enhance our ability to prevent future incidents.

4.0 Plan

4.1 Hazard Identification, Risk Assessment and Determining Controls

4.1.1 AECOM is committed to managing services and activities that pose a potential risk to our employees' safety and health or impact the environment.

4.1.2 The SH&E Management System evaluates, manages and controls these risks through the following safety hierarchy:

- Recognition
- Elimination
- Substitution
- Engineering Controls
- Administrative Controls
- Personal Protective Equipment

4.2 Project Delivery System

4.2.1 AECOM has established a detailed Project Delivery System that plans and delivers projects while effectively controlling risk. This delivery system requires significant involvement from most all levels of the organization and departments. A discussion of this process is as follows.

4.2.2 **Business Development (BD) -** The Region SH&E Managers participate in key regional marketing meetings, and coordinate with regional market segment managers to provide guidance on key SH&E issues associated with specific client needs and company pursuits, typically prior to the client's issuance of a request for proposal (RFP). In this way SH&E-related issues can be adequately incorporated into proposals, subcontractor agreements and equipment supplier purchases.

4.2.3 **Business Risk Assessment -** All projects are developed, planned and executed by Supervisors/ Project Managers within the AECOM "Delegation of Authority" and the "Sub-Delegations of Authority" for the Americas Geography (collectively the "DOA"). AECOM projects that have the potential for a specific risk, as identified in the DOA (e.g. working with hazardous materials, project safety responsibilities for non-AECOM employees) require that a "Request for Approval" and "Risk Analysis" be submitted to the AECOM "Hub" for senior management review, input, and approval. The Hub is managed by the Chief Risk Officer (CRO) and for issues involving safety, health and/or environmental compliance, is supported by the AECOM SH&E Vice-President. Once a project is approved by the Hub, the Chief Executive for Americas (CE) can instruct his/her organization to proceed with the proposal.

4.2.4 **Major Project Risk Assessment -** As part of AECOM's Major Project Business Development Guidelines and Project Approval process, certain projects that present a significant risk or involve a substantial long-term client commitment require an additional level of management assessment and approval by the Major Project Review Committee (MPRC). These projects require an extensive five-phase senior management review and approval process prior to moving forward. As part of this review process, the Americas SH&E Director and Region SH&E Managers are required to assist the business development team in identifying and evaluating unique SH&E risks and to propose appropriate mitigation strategies. This SH&E assessment is then evaluated by the MPRC as part of their overall project pursuit approval process. AECOM's Global SH&E VP participates as a key advisor on the Major Project Review Committee.

4.2.5 **Project Specific Hazard Analysis and Planning**

4.2.5.1 Every AECOM project with work outside of an AECOM office must have, at a minimum, a task hazard analysis (THA) in place that effectively deals with all known or anticipated hazards and provides for emergency response and evacuation as needed.

4.2.5.2 In addition, high risk activities, complex projects, or regulated sites must have a Safe Work Plan (SWP) or Health and Safety Plan (HASP) reviewed and approved by the Supervisor/Project Manager and the Region SH&E Manager (or designee) prior to the start of activities. All site employees involved in field work must read and acknowledge compliance with the THA, SWP or HASP as required, prior to performing work.

4.2.6 **Subcontractors Hazard Analysis and Planning Subcontractors** are responsible for generating their own project-specific hazard analysis that addresses their specific SH&E issues. Subcontractors are solely responsible for evaluating the hazards and potential hazards to their employees and shall adhere to their own hazard analysis. Additionally, subcontractors shall be required, at a minimum, to follow all SH&E requirements established in the AECOM project-specific hazard analysis.

4.2.7 **Contractors Hazard Analysis and Planning** Prior to the start of site activities, Supervisors/Project Managers are responsible for coordinating with other project site contractors to minimize the potential for conflicting plan elements. AECOM's project hazard analysis (and appropriate planning documents) will be distributed to other site contractors as appropriate.

4.2.8 **Continuous Risk Management Projects** that present a significant risk or impact to AECOM may require monthly management reviews for the life of the project. The Region SH&E Manager, or their designate, participate in this process and routinely review and evaluate project-specific risks and the effectiveness of the implemented control strategies. This is accomplished through reviewing the project-specific THAs, SWP and/or HASP, conducting project-specific SH&E audits, incident reviews and by reviewing additional SH&E data generated by the project.

4.3 Access to Applicable Codes, Regulations and Standards

4.3.1 AECOM is committed to remain current with, and endeavors to maintain access to, relevant national, state, provincial and local environmental, occupational health and safety laws, legislation and regulations and other requirements. In addition to regulations, many of our services require access to and knowledge of consensus standards established by many non-governmental agencies. Access to non-governmental and professional association and industrial standards is provided by AECOM's Information Handling Services (IHS) link in the United States. In Canada, access to government regulations and standards is provided through the CCOHS (Canadian Centre for Occupational Health and Safety).

4.3.2 Management procedures provide a practical means of identification and access to current legislation and information on proposed legislation. Information is communicated internally to provide an awareness of legal obligations. Responsibility and authorities are defined to achieve and maintain statutory and regulatory compliance.

4.4 Client Requirements

4.4.1 Many of AECOM's clients have additional SH&E requirements specific to their needs and operations that must be addressed. In order to comply with those requirements, AECOM may develop client specific manuals, programs, procedures, training and/or documentation to effectively implement and manage these special requirements. Identification of client SH&E requirements is accomplished during the project risk assessment phases and project teams are responsible for complying with client SH&E requirements where they exceed AECOM standards.

4.5 Objectives and Targets

4.5.1 SH&E objectives and targets are established for all relevant levels of management and are compatible with AECOM's overall business plan. Tracking of the objectives and targets are coordinated within the AECOM performance management program that defines responsibility and timeframes for completion.

4.5.2 At the Americas organizational level, AECOM will establish performance targets using numerous indicators, such as:

- Global SH&E Assessment Score Improvement
- SH&E Training Compliance
- regulatory citations and Notices of Violation
- Recordable Injury Rate (RIR)
- lost time incident rate, and
- days away from work

4.5.3 At the operations level, AECOM will establish targets using performance indicators and activity objectives such as:

- Direct involvement in SH&E-related activities
- project management reviews
- staff interviews
- Global SH&E Assessment Score Improvement
- SH&E Training Compliance
- regulatory citations and Notices of Violation

- Recordable Injury Rate (RIR)
- lost time incident rates, and
- days away from work

4.5.4 At the employee level, AECOM will establish targets using performance indicators and activity objectives such as:

- direct involvement in SH&E-related activities
- training needs assessment, and
- SH&E training compliance

5.0 Do

5.1 Resources, Roles, and Responsibilities

5.1.1 AECOM is committed to establishing an organizational structure that defines roles, responsibility, authority and accountability necessary to effectively manage the SH&E function and to define and provide the resources needed to implement and sustain the SH&E Management System.

5.1.2 Primary responsibility for SH&E performance belongs to the Chief Executive, Region Executives and District General Managers within operational management. Technical assistance, hands on support, guidance, and monitoring are provided to operations by the SH&E department.

5.1.3 The SH&E department consists of Region SH&E Managers, their support staff, the Americas SH&E Administrative Manager and the Americas SH&E Director.

5.2 SH&E Committees

5.2.1 AECOM and Occupational Safety and Health legislation in many jurisdictions require that a health and safety committee program be established to encourage the active participation of all employees in the prevention of incidents and the promotion of health and safety activities in the workplace.

5.2.2 AECOM will establish SH&E Committee programs in those states, provinces and territories where it is required by legislation or regulation.

5.2.3 In order to provide senior level guidance to the SH&E function, AECOM has established an Americas Executive SH&E Council. The council is co-chaired by two Region Executives and includes members representing both business lines and various organizational management levels. The council is charged with providing specific recommendations to the Americas SH&E Director and Chief Executive regarding all aspects of the program, including the contents of this manual.

5.2.4 AECOM encourages, but does not mandate, the formation of local SH&E Committees in all locations as an effective means to increase participation by all staff in the program.

5.3 Training

5.3.1 All AECOM employees shall receive training on AECOM's SH&E Policy, SH&E Guiding Principles, and Standard Operating Procedures applicable to their job assignments, as well as complying with applicable regulations, codes, and standards. All employees shall receive training in:

- Compliance with applicable SH&E regulations and AECOM specific requirements
- Fulfilling SH&E responsibilities
- Understanding how their actions can influence SH&E performance

5.3.2 In particular, employees shall be trained to recognize, evaluate and manage the risks associated with their current position.

5.3.3 All employees will be assessed for their job specific training. AECOM will provide training to meet SH&E program requirements and AECOM will track the completed training to confirm that staff are adequately trained for the duties they are required to perform.

5.3.4 Employees and their supervisor must review their SH&E Training Needs Assessment on an annual basis. This review must also occur any time an employee is reassigned to a task or work function that is substantially different in order to identify appropriate SH&E training. Upon completion of the Training Needs Assessment the employee will be required to request enrollment into the appropriate safety training program. Employees must not perform tasks without completing the appropriate training.

5.3.5 Project Managers/Supervisors are responsible for ensuring that employees are trained to perform specific work assignments and tasks in conformance with SH&E Policy and Standard Operating Procedures through one or more of the following:

- Formal and informal instruction
- On-the-job training
- Attendance at technical and professional seminars and conferences

5.4 Project Site Orientation

5.4.1 All AECOM employees assigned to a project site receive an initial Project Site Orientation that introduces the employee to the site, client specific requirements and the project hazard assessment.

5.4.2 Additionally, specific hazards of the project may be explained as well as the resources dedicated to mitigate the hazards.

5.5 Project/Employee Safety Meetings

5.5.1 All AECOM employees performing work at a project site are required to participate in routine safety meetings in accordance with the project hazard assessment.

5.5.2 A sign-off sheet recording the date, subject(s) covered, presenter and names of attendees is required to be generated after each project safety meeting. Office employees are also required to participate in routine employee safety meetings as appropriate.

5.6 Subcontractors

5.6.1 Subcontractors and suppliers involved with field work are provided with copies of the project hazard assessment for their projects.

5.6.2 Subcontractors are also encouraged to participate in Project Safety Meetings so that they may actively contribute to a safe working environment.

5.7 Communication and Participation

5.7.1 AECOM will maintain effective communications relevant to SH&E both internally and externally, and we will solicit and encourage input from employees and other interest parties.

5.7.2 AECOM's SH&E Department will communicate with employees to keep them informed, share lessons learned, hear about concerns, keep safety at the forefront of day to day actions and inspire a culture of safety within AECOM.

5.7.3 Communication bulletins as listed below will be issued by or from the senior management, local safety committee or SH&E management as appropriate and for the greatest impact. All leaders will be expected to regularly communicate to their teams about safety.

5.7.4 **Internal Communications -** Internal communications are established between all management levels to maintain awareness and understanding of SH&E Policy, Standard Operating Procedures and to provide a pathway for feedback of operational experience and SH&E performance. Internal SH&E communications will be maintained through direct, electronic and written media. All communications will be coordinated through the SH&E Department and, as appropriate and necessary, Americas Communications Department. Communications relevant to SH&E will include, but not be limited to: Lessons Learned, Safety Awareness programs, Incident Investigations, and revised and/or new SH&E Procedures.

5.7.5 **Employee Participation -** All AECOM employees are provided the opportunity to participate and have frequent and open SH&E communications at all levels of the organization. Employees are to be asked for their input at projects, meetings and during training sessions.

5.7.6 All AECOM employees will have the option to anonymously communicate any SH&E concern.

5.7.7 **External Communications – Stakeholders - AECOM's** internet web site provides general information such as the SH&E Policy statement, projects and services to external stakeholders. All communications related to the SH&E Policy received from stakeholders are forwarded to AECOM's Corporate Communications Department for recording, directing and response generation. Occasionally, these communications may be under the control of a client contract or regulatory requirement in which case they will also be involved in the communications process. Frequently projects will require a project-specific "Public Outreach Program" to maintain open and effective dialogue with stakeholders throughout a project.

5.8 Standard Operating Procedures

5.8.1 AECOM will establish and maintain a series of Standard Operating Procedures which guide operations in the safe work practices and safe job procedures in their daily functions.

5.8.2 SH&E Standard Operating Procedures (SOP) are considered administrative controls and are an integral part of the Safety, Health and Environment Program. The SOPs describe how operations are to be carried out, including responsibility, authority, planning, communications, work programs and methods. They are written for operations to maintain ongoing compliance with the SH&E Management System.

5.8.3 Where applicable, SH&E SOPs will be integrated into AECOM's Project Delivery System (PDS) to promote use and application of procedures during project delivery.

5.8.4 Forms and documents essential to the SH&E Management System are carefully generated, managed and catalogued. They demonstrate compliance with SH&E Policy, Standard Operating Procedures, legal and other requirements. Some examples of forms and documents include:

- SH&E Audit Reports
- Incident Investigation Reports
- Injury/Illness Records
- Medical Surveillance Records
- SH&E Training Records
- Respirator Fit Testing Records
- Exposure Monitoring Results

5.9 Document Control

5.9.1 AECOM will verify that all documentation associated with the SH&E Management System is under effective management control, and all document formats used are approved by the Americas SH&E Director prior to issuance. The prefix"S" will designate a safety, health, or environmental document that relates to an aspect of the Management System.

5.9.2 SH&E Standard Operating Procedures shall identify all documents required to be controlled and define authorization, generation, availability, approval, updating and storage of such documents. In addition, all SH&E documents shall be controlled in accordance with AECOM's Records Retention Policy and Quality Management System.

5.10 Operational Controls & Preventative Maintenance

5.10.1 Operational procedures are written for site and/or activity-specific operations, including equipment maintenance. Operational and control criteria are included in the Operational procedures to verify that the SH&E aspects of operations are managed appropriately.

5.10.2 Operational programs and procedures are provided to mitigate the risk of harming personnel, property, and the environment. Expectations for SH&E performance are communicated to subcontractors and equipment suppliers, mainly through the obligations set forth in our subcontract agreements with such parties. In addition to this, AECOM may, at its discretion, supply guidance notes to subcontractors and equipment suppliers to aid in compliance with this SH&E Management System. However, such general guidance does not relieve the subcontractors and suppliers from their primary responsibility for performing services and providing materials in a way that does not create SH&E risks.

5.11 Emergency Preparedness and Response

5.11.1 Each office and project site is to have a written site-specific emergency action plan which identifies potential emergency situations, alarm systems, external emergency response agencies, shut-down procedures, location of emergency equipment, personal protective equipment, how to obtain medical treatment, personal decontamination, accountability of personnel and temporary sheltering of employees.

5.11.2 Some project operations may also require AECOM employees to perform an actual response to an emergency situation, in which case more extensive emergency response training and equipment are provided. Emergency action plans for office locations are evaluated annually, and are reviewed prior to the start of all project site operations.

5.11.3 The Americas Business Continuity Team, along with individual Regional Business Continuity Teams, will coordinate appropriate actions and communications in the event of a natural or man-made situation that could have a significant impact on the safety of AECOM staff, property loss, or significant business interruption. Examples of these situations include, but are not limited to: hurricanes, severe wind/rain/snow events, earthquakes, potential pandemic outbreaks, civil disturbances, etc. SH&E Department members are integral members of the Americas and Regional Business Continuity Teams.

5.12 Modified Work Program

5.12.1 AECOM supports a Modified Work Program for all of its employees.

5.12.2 A Modified Work Program is a program designed to return injured employees to the workplace as quickly as possible by providing modified duties or meaningful alternative work for an injured employee, until such time as the employee can functionally return to their regular duties.

5.13 Medical Surveillance and Information

5.13.1 Employees who are assigned specific tasks may be required to enroll in AECOM's Medical Surveillance Program. Enrollment is based on regulatory or client requirements as well as potential for exposure to hazardous materials, substances, and/or conditions.

5.13.2 Employees have the right to accept or deny enrolment into this program, provided it was not a condition of their employment. An employee choosing not to participate in the program may be restricted from working in certain locations or on certain projects requiring medical surveillance.

5.14 Personal Protective Equipment

5.14.1 AECOM will provide personal protective equipment (PPE) where and when it is required by:

- Provincial, state or federal legislation
- analysis of workplace hazards as documented in a THA, SWP or HASP and/or
- Site specific rules of the controlling contractor or client

5.14.2 AECOM employees must wear and use all required PPE and are responsible for the inspection, care and maintenance of PPE assigned to them**.**

5.14.3 Employees must immediately correct or report any problems, damage or loss of this equipment. Supervisors must verify that employees have, know how to use and wear the appropriate PPE for each job, task and work site.

5.15 Incident Reporting

5.15.1 All work-related injuries, illnesses, and near-miss situations, including environmental impacts, vehicular incidents, instances of permit non-compliance, citation by a regulatory agency must be immediately reported by the employee, or their designee, to their Supervisor/Project Manager. If this initial reporting is done electronically (i.e. text, email, etc.) it must be confirmed verbally as soon as practical to ensure receipt and understanding between the employee and Supervisor/Project Manager.

5.15.2 The Supervisor/Project Manager shall immediately notify SH&E through the Americas SH&E Incident Reporting Line. When necessary based on the severity and/or nature of the incident, as defined in our Incident Reporting SOP, the Supervisor/Project Manager may also be required to notify AECOM Legal Counsel.

6.0 Check

The following section describes the programs that AECOM utilizes to continually check and assess the effectiveness of the SH&E Management System.

6.1 Performance Measurement, Monitoring & Statistics

6.1.1 SH&E Performance data is collected, reviewed and summarized to monitor conformance with SH&E Policy, Standard Operating Procedures, Objectives, and Targets and to confirm legal compliance.

6.1.2 AECOM has established methods to measure and monitor SH&E Management System performance and effectiveness on a regular basis. SH&E Management System performance is measured through a set of metrics of lagging and leading indicators. All AECOM Americas lagging and leading indicator metrics and targets are established on an annual basis and approved by the CE. Regions and Districts can also establish additional metrics as appropriate. An example of some of these indicators includes the following:

Lagging Indicators

- regulatory citations and Notices of Violation
- Recordable Injury Rate (RIR)
- lost time incident rate, and
- days away from work

Leading Indicators

- Exposure monitoring
- Completed Task Hazard Analyses
- Completed Project Review
- Completed office or site inspections
- Internal & External SH&E audits
- Near miss and safety observations reporting and investigation
- Employee surveys (generated by human resources)
- Completed Training Needs Assessment
- SH&E Training completed

6.1.3 The SH&E Department will identify trends and generate reports for both leading and lagging indicators across Regions, Districts and/or business lines. These reports will be distributed to the appropriate operations management levels for consideration.

6.2 Incident Investigation

6.2.1 The responsible AECOM manager must initiate an incident investigation, invite the appropriate participants to the investigation proceedings and coordinate an investigation review call in accordance with established SH&E SOP.

6.2.2 An incident investigation may also require attendance by AECOM Legal Counsel, SH&E Management, the SH&E Committee (or SH&E Representative), or by the AECOM Senior Management, Regional or Business Line manager of the staff who was involved in the incident.

6.2.3 Investigation results should have identified the systemic root causes and result in the development of corrective actions aimed at preventing a reoccurrence of the incident. Management must ensure corrective actions are completed in a timely manner, and complete the required internal and external reports.

6.3 Internal Audit Program

6.3.1 As part of the SH&E Management System AECOM has established procedures to continually monitor and measure the effectiveness of SH&E Policy and Standard Operating Procedures and determine when action is needed to improve upon the Objectives and Targets used to establish performance expectations.

6.3.2 Audits are an essential independent check on the effectiveness of the SH&E Management System. Formal and informal audits are performed at AECOM offices, sites and projects on a regular basis. Audits are performed to certify:

- Organizational conformance with SH&E Policy, Standard Operating Procedures, Objectives and Targets
- Effective functioning of the SH&E Management System

6.4 Management Audits

6.4.1 The Supervisor/Project Manager is responsible for conducting regular and ongoing audits of their projects. Corrective and preventative actions shall be taken when identified.

6.4.2 The SH&E Department conducts formal and informal audits of offices, sites and projects.

6.4.3 The results of audits are communicated to AECOM Americas senior management, supervisors/ project managers to confirm areas of non-conformance and to facilitate the implementation of corrective actions.

6.5 Inspections

6.5.1 Inspections are an integral part of the SH&E Program. They are used to identify and recommend controls for existing and potential hazards in the workplace.

6.5.2 Every office will coordinate office inspections on a regular basis in compliance with SH&E SOPs and applicable local legislation.

6.5.3 Project supervisors must conduct, at a minimum, formal monthly safety inspections on active construction sites, carry out ongoing informal visual inspections and correct any identified deficiencies in their assigned work areas.

6.6 Management Review

6.6.1 An annual Management Review is conducted to evaluate the performance results of the SH&E Management System and to approve program Objectives and Targets for the next fiscal year. The meeting is chaired by the Americas Chief Executive and attended by members of the Americas SH&E Executive Council.

6.6.2 The Americas SH&E Director generates and presents a summary report of the SH&E Management System performance results for the fiscal year. Americas senior management review data to determine the program's continuing suitability, adequacy and effectiveness, provide input, and come to consensus on any corrective actions.

6.6.3 The Management Review may consider all relevant SH&E issues to determine the need for change and continuous improvement. Any changes to SH&E Policy, Standard Operating Procedures, Objectives or Targets may arise due to circumstances, including:

- New or developing concerns of clients and stakeholders
- New or revised statutory/regulatory requirements
- Availability of improved technology to address SH&E risk

6.6.4 An additional Management Review may be held at any time if special circumstances arise. For example, major restructuring of operations or management responsibilities, new processes that introduce significantly new SH&E risks, major external concerns from stakeholders or statutory/ regulatory obligations.

7.0 Act

7.1 Corrective and Preventative Action

7.1.1 The SH&E Management System includes procedures to identify and control several types of non-conformance.

7.1.2 Responsibility and authorities are defined for taking corrective action to control non-conformance and for initiating and completing preventative actions to eliminate the causes of non-conformance.

7.1.3 The Region SH&E Managers work with supervisors and managers to identify and implement corrective and preventative actions on SH&E-related issues, including changes to practices and procedures.

7.1.4 Priority for the allocation of resources is related to the magnitude of the non-conformance and the need for mitigation.

8.0 Appendices

8.1 SH&E Standard Operating Procedures

000 Series - SH&E Essentials
S3NA-001-PR Safe Work Standards and Rules S3NA-002-PR Stop Work Authority for Unsafe Work S3NA-003-PR SH&E Training S3NA-004-PR Incident Reporting S3NA-005-PR Driver and Vehicle Safety Program S3NA-006-PR Safety Moments
100 Series - Office
S3NA-101-PR Emergency Response Planning, Office S3NA-102-PR Ergonomics, Office S3NA-103-PR Housekeeping, Office S3NA-104-PR Manual Lifting, Office S3NA-105-PR Office Safety Programs S3NA-106-PR Fire Protection, Office S3NA-107-PR Violence in the Workplace
200 Series - Project Management
S3NA-201-PR Client Site Requirements S3NA-202-PR Competent Person Designation S3NA-203-PR Emergency Response Planning, Field S3NA-204-PR Environmental Compliance S3NA-205-PR Equipment Inspections & Maintenance S3NA-206-PR Fire Protection, Field S3NA-207-PR Medical Services and First Aid S3NA-208-PR Personal Protective Equipment Program S3NA-209-PR Project Hazard Assessment and Planning S3NA-210-PR Project Safety Meetings S3NA-211-PR Regulatory Inspections S3NA-212-PR Site Inspections S3NA-213-PR Subcontractors S3NA-214-PR Site Safety Officer
300 Series - Field (Common)
S3NA-301-PR Confined Spaces S3NA-302-PR Electrical, General S3NA-303-PR Excavation and Trenching S3NA-304-PR Fall Protection S3NA-305-PR Hand and Power Tools S3NA-306-PR Highway and Road Work S3NA-307-PR Housekeeping, Worksite S3NA-308-PR Manual Lifting, Field S3NA-309-PR Mobile or Heavy Equipment S3NA-310-PR Rigging, Hoisting, Cranes and Lifting Devices S3NA-311-PR Scaffolding S3NA-312-PR Stairways and Ladders S3NA-313-PR Wildlife, Plants and Insects S3NA-314-PR Working Alone & Remote Travel S3NA-315-PR Water, Working Around

400 Series - Field (Uncommon)
S3NA-401-PR Aircraft Charters S3NA-402-PR All Terrain Vehicles (ATVs) S3NA-403-PR Avalanches S3NA(US)-404-PR Commercial Motor Vehicles S3NA-405-PR Drilling and Boring S3NA-406-PR Electrical Lines, Overhead S3NA-407-PR Electrofishing S3NA-408-PR Elevated Work Platforms and Aerial Lifts S3NA-409-PR Forklifts (operation of) S3NA-410-PR Hazardous Energy Control S3NA-411-PR Machine Guarding S3NA-412-PR Powder-Actuated Tools S3NA(US)-413-PR Process Safety Management S3NA-414-PR Railway Sites S3NA(US)-415-PR RCRA Regulated Facilities S3NA-416-PR Tunnel and Underground Work S3NA-417-PR Utilities, Underground S3NA-418-PR Welding, Cutting and Other Hot Work S3NA-419-PR Water, Marine Operations Boating S3-NA420-PR Water Underwater Diving
500 Series - Industrial Hygiene (Chemical, Biological, Radiological, Nuclear)
S3NA-501-PR Asbestos S3NA-502-PR Benzene S3NA-503-PR Blood borne Pathogen Program S3NA-504-PR Cadmium S3NA-505-PR Cold Stress Prevention S3NA-506-PR Compressed Gases S3NA-507 PR Hazardous Materials Communication / WHMIS S3NA-508-PR Hazardous Materials Handling and Shipping S3NA-509-PR Hazardous Waste Operations and Emergency Response S3NA-510-PR Hearing Conservation Program S3NA-511-PR Heat Stress Prevention S3NA-512-PR Laboratory Safety S3NA-513-PR Lead S3NA-514-PR Munitions and Explosives of Concern / Unexploded Ordnance (MEC-UXO) S3NA-515-PR Nanotechnology S3NA-516-PR Radiation Safety Programs S3NA-517-PR Radiation, Non-Ionizing S3NA-518-PR Radiation, Gauge Source Program S3NA-519-PR Respiratory Protection Program S3NA-520-PR Spill Response, Incidental
600 Series - Incident & Medical Management
S3NA-601-PR Recordkeeping S3NA-602-PR Exposure Monitoring S3NA-603-PR Incident Investigation and Review S3NA-604-PR Medical Records S3NA-605-PR Medical Surveillance Program S3NA-606-PR Modified Duty Program S3NA-606-FM4 Claims Management Record of Events S3NA-607-PR Post Incident Medical Management
700 Series - SH&E Program Management
S3NA-701-PR Rules and Regulatory Review S3NA-702-PR SH&E Organizational Reporting Structure & Supporting Roles S3NA-703-PR SH&E Manual and Procedures Review S3NA-704-PR SH&E Program Auditing S3NA-705-PR SH&E Program Monitoring and Reporting

Attachment B:
USACE/HSP Cross Reference Table

HSP/APP Cross Reference

The following cross-reference table provides information concerning the correspondence between the AECOM Technical Service, Inc. (AECOM) Health and Safety Plan (HSP) for the Groundwater Monitoring and BERA Sampling for Former H-3 Landfill (Site 0001), Marine Corps Base Hawaii, and the Accident Prevention Plan (APP) outline presented in Appendix A of the U.S. Army Corps of Engineers *Safety and Health Requirements Manual* EM 385-1-1 (USACE 2008). The format, content, procedures, and requirements in this HSP are directed solely to meet the onsite needs of the AECOM field workers and subcontractors who will be performing the work activities addressed in the HSP. Consequently, the document does not address any non-site-specific safety performance requirements or programs, except to specify site/task-level site implementation in the work force. Nor does the HSP attempt to duplicate or reproduce any of AECOM's Corporate Environmental, Health and Safety Program requirements, or information, except where specifying site-specific implementation needs[1]. The APP outlines elements, which are not site-specific, and are only addressed in AECOM's Corporate Environmental, Health and Safety Program (rather than the HSP), are so indicated.

USACE Accident Prevention Plan Requirement	AECOM Health and Safety Plan Section
1. SIGNATURE SHEET	An Approval page is located at the front of the HSP. The CLEAN CTO Manager and Health and Safety Manager provide signed approval of the HSP. Contact information is provided in HSP Table 8-2.
2. BACKGROUND INFORMATION. List the following:	
a. Contractor	HSP Title Page and Section 1.
b. Contract number	HSP Cover and Section 1.
c. Project name	HSP Cover and Section 1.
d. Brief project description, description of work to be performed, and location; phases of work anticipated (map)	HSP Section 3. Significant additional information is presented in the Work Plan prepared for each CTO and available on the work site at all times.
e. Contractor accident experience (provide information such as EMR, OSHA 200 Forms, corporate safety trend analyses)	This information is not site/project specific, and hence is not included as part of site-specific health and safety documents.
f. Listing of phases of work and hazardous activities requiring activity hazards analyses	HSP Section 3.2.
3. STATEMENT OF SAFETY AND HEALTH POLICY	HSP Section 1.1.
4. RESPONSIBILITIES AND LINES OF AUTHORITIES	
a. Identification and accountability of personnel responsible for safety – at both corporate and project level	HSP Section 2.
b. Lines of authority	HSP Section 2.
5. SUBCONTRACTORS AND SUPPLIERS. Provide the following:	
a. Identification of subcontractors and suppliers (if known)	HSP Section 2.6. Subcontractor procurement/selection is ongoing.
b. Means for controlling and coordinating subcontractors and suppliers	AECOM Corporate Safety, Health, and Environmental Program documentation.
c. Safety responsibilities of subcontractors and suppliers	HSP Sections 2.6 and 2.7.

[1] AECOM's Corporate Health and Safety Program documentation was provided to NAVFAC Pacific and accepted as part of the CLEAN Contract award process. Because these Programs are not site-specific, they are not included as part of the CTO's work planning document submittals.

USACE Accident Prevention Plan Requirement	AECOM Health and Safety Plan Section
6. TRAINING	
a. List subjects to be discussed with employees in safety indoctrination	HSP Section 4.2.1.
b. List mandatory training and certifications, which are applicable to this project and any requirements for periodic retraining/recertification	HSP Section 4.
c. Identify requirements for emergency response training	None required.
d. Outline requirements (who attends, when given, who will conduct etc.) for supervisory and employee safety meetings	HSP Section 4.
7. SAFETY AND HEALTH INSPECTIONS	
a. Who will conduct safety inspections, when inspections will be conducted, how the inspections will be recorded, deficiency tracking system, follow-up procedures, etc.	AECOM's site audit policies are part of its Corporate Safety, Health, and Environmental Program documentation and so are not included this HSP.
b. Any external inspections/certifications which may be required	HSP Section 4.
8. SAFETY AND HEALTH EXPECTATIONS, INCENTIVE PROGRAMS, AND COMPLIANCE	
a. The company's written safety program goals, objectives, and accident experience goals for this contract should be provided	This information is part of AECOM's Corporate Safety, Health, and Environmental Program and is not included in this HSP.
b. A brief description of the company's safety incentive programs (if any) should be provided	AECOM has no employee safety incentive program for the CLEAN Program.
c. Policies and procedures regarding noncompliance with safety requirements (to include disciplinary actions for violation of safety requirements) should be identified	AECOM's policies regarding worker noncompliance are part of its Corporate Safety, Health, and Environmental Program documentation and are not included in this HSP.
d. Provide written company procedures for holding managers and supervisors accountable for safety	AECOM's policies regarding manager accountability for safety performance are part of its Corporate Safety, Health, and Environmental Program documentation and are not included in this HSP.
9. ACCIDENT REPORTING. The contractor shall identify who shall complete the following, how, and when:	
a. Exposure data (man-hours worked)	Not applicable.
b. Accident investigations, reports and logs	HSP Section 8.6.
c. Immediate notification of major accidents	HSP Section 8.6.2.
10. MEDICAL SUPPORT. Outline on-site medical support and off-site medical arrangements	HSP Section 8.6.
11. PERSONAL PROTECTIVE EQUIPMENT. Outline procedures for conducting hazard assessments and written certifications for use of personal protective equipment	Hazard assessment information is presented in HSP Sections 5 and 6, and the Activity Hazard Analysis presented in Attachment D. PPE ensemble and equipment requirements are specified in Section 7.2. Task-specific PPE requirements are specified in the Activity Hazard Analysis presented in Attachment D.
12. PLANS (PROGRAMS, PROCEDURES) REQUIRED BY THE SAFETY MANUAL (as applicable)	
a. Hazard communication program (01.B.04)	AECOM's Hazard Communication policies are part of its Corporate Safety, Health, and Environmental Program documentation. Additional details are presented in HSP Section 4.
b. Emergency response plans:	
- Procedures and tests (01.E.01)	HSP Section 8.
- Spill plans (01.E.01, 06.A.02)	Not applicable.
- Firefighting plan (01.E.01, Section 19)	Not applicable. AECOM policy is to notify professional fire response agencies immediately in the event of fire. We do not perform fire-fighting activities.
- Posting of emergency telephone numbers (01.E.05)	HSP Section 8, Table 8-2.
- Wildfire prevention plan (09.K.01)	Not applicable.
- Man overboard/abandon ship (19.A.04)	Not applicable.

USACE Accident Prevention Plan Requirement	AECOM Health and Safety Plan Section
c. Layout plans (04.A.01)	Not applicable.
d. Respiratory protection plan (05.E.01)	Not applicable.
e. Health hazard control program (06.A.02)	Activity Hazard Analyses presented in Attachment D.
f. Lead abatement plan (06.B.05 & specifications)	Not applicable.
g. Asbestos abatement plan (06.B.05 & specifications)	Not applicable.
h. Abrasive blasting (06.H.01)	Not applicable.
i. Confined space (06.I)	Not applicable.
j. Hazardous energy control plan (12.A.07)	Not applicable.
k. Critical lift procedures (16.C.17)	Not applicable.
l. Contingency plan for severe weather (19.A.03)	Not applicable.
m. Access and haul road plan (22.I.10)	Not applicable.
n. Demolition plan (engineering and asbestos surveys) (23.A.01)	Not applicable.
o. Emergency rescue (tunneling) (26.A.05)	Not applicable.
p. Underground construction fire prevention and protection plan (26.D.01)	Not applicable.
q. Compressed air plan (26.I.01)	Not applicable.
r. Formwork and shoring erection and removal plans (27.B.02)	Not applicable.
s. Lift slab plans (27.D.01)	Not applicable.
t. Blasting plan (29.A.01)	Not applicable.
u. Diving plan (30.A.13)	Not applicable.
v. Plan for prevention of alcohol and drug abuse (Defense Federal Acquisition Regulation Supplement Subpart 252.223.7004, Drug-Free Force)	AECOM's Drug and Alcohol Abuse policies are part of its Corporate Human Resources and Safety, Health, and Environmental Program documentation. These requirements are not included in this HSP.

Accident Prevention Plan Requirements from: United States Army Corps of Engineers (USACE). 2008. *Safety and Health Requirements Manual.* EM 385-1-1. September.

Attachment C:
AECOM Corporate SH&E Procedures
(on CD-ROM at end of document)

000 SERIES - SH&E ESSENTIALS

S3NA-001-PR Safe Work Standards and Rules

S3NA-004-PR Incident Reporting

S3NA-005-PR Vehicle and Driver Safety Program

200 SERIES - PROJECT MANAGEMENT

S3NA-203-PR, Emergency Response Planning, Field S3NA-206-PR Fire Protection, Field

S3NA-206-PR, Fire Protection, Field

S3NA-208-PR Personal Protective Equipment Program

S3NA-210-PR Project Safety Meetings

300 SERIES - FIELD (COMMON)

S3NA-305-PR Hand and Power Tools

S3NA-308-PR Manual Lifting, Field

S3NA-313-PR Wildlife, Plants and Insects

S3NA-315-PR Water, Working Around

400 SERIES - FIELD (UNCOMMON)

S3NA-419-PR Boat and Vessel Operations

500 SERIES – INDUSTRIAL HYGIENE (CHEMICAL, BIOLOGICAL, RADIOLOGICAL, NUCLEAR)

S3NA-507 PR Hazardous Materials Communication / WHMIS

S3NA-509-PR Hazardous Waste Operations and Emergency Response Activities

S3NA-511-PR Heat Stress

S4NA-514-PR, Munitions and Explosives of Concern/Unexploded Ordnance (MEC/UXO)

S3NA-519-PR, Respiratory Protection Program

600 SERIES - INCIDENT & MEDICAL MANAGEMENT

S3NA-601-PR Recordkeeping

S3NA-603-PR Incident Investigation and Review

S3NA-605-PR Medical Surveillance Program

Americas

Safe Work Standards and Rules

S3NA-001-PR1

1.0 Purpose and Scope

1.1 Demonstrates AECOM's commitment to the establishment and maintenance of workplaces free from recognized hazards.

1.2 This procedure applies to all AECOM North America based employees and operations.

2.0 Terms and Definitions

2.1 **Safety Violation –** Not following verbal or written safety policies, rules and procedures (e.g., guidelines, rules, horse play, failure to wear selected PPE, abuse of selected PPE, etc.).

2.2 **Safe Work Practices** – The do's and don'ts about carrying out a task or use of equipment, informing the worker about the hazards present and providing direction on how to safeguard against the hazard. Safe Work Practices are generally guidelines only.

2.3 **Safe Job Procedures** – Written step-by-step set of instructions about completing a specific task safely including control measures and responding to emergency situations.

3.0 References

3.1 AECOM Employee Handbook

4.0 Procedure

4.1 Roles and Responsibilities

4.1.1 **Managers and Supervisors –** Responsible for compliance with all SOP's and governmental requirements, and will be held responsible to prevent or bring any violations to the attention of the appropriate level of Management for corrective actions as per AECOM HR policies.

4.1.2 **District, Office, and Project Managers** (Including field task managers, supervisors – Responsible for implementation of, and compliance with, this procedure.

4.1.3 **Region and District SH&E Managers –** Provide guidance as to safe work standards, rules, requirements and guidelines.

4.1.4 **Human Resource Managers –** Provide guidance and direction to managers and supervisors implementing the disciplinary process for safety violations (as defined in the Employee Handbook).

4.1.5 **Employees –** Responsible for adhering to all AECOM safe work standards, rules, requirements and instructions and to provide input as appropriate.

4.2 Standard Operating Procedures (SOPs)

4.2.1 Safe Work Practices and Safe Job Procedures are embodied in the SH&E Standard Operating Procedures and are available on AECOM's Americas SH&E website.

4.2.2 Specific Safe Work Practices and Safe Job Procedures have been developed in conjunction with employees and with particular input from those who have significant experience.

4.2.3 Standard Operating Procedures have been developed to provide clear instruction regarding the safety and reporting requirements of staff and operations.

4.3 Inspections and Audits

4.3.1 **Project Managers**, **Supervisors** and **Office Managers** shall conduct project audits and office inspections to identify safe work practices and potential safety violations.

4.4 Any employee who willfully disregards AECOM or client safety standards, rules or requirements is subject to disciplinary action.

5.0 Records

None

6.0 Attachments

6.1 S3NA-001-ST Safety Rules

Americas

Safety Rules

S3NA-001-ST

1.0 Rules for all Employees

1.1 Work in a manner that will not put oneself, other personnel or equipment or facilities at risk.

1.2 Identify hazardous conditions and activities in the work environment consistent with the job and training.

1.3 If a hazard cannot be eliminated, report it to the manager or supervisor promptly.

1.4 Implement established control methods consistent with project procedures and/or training.

1.5 Cooperate and comply with all AECOM Policies and Standard Operating Procedures.

1.6 Immediately report all acts of aggression, verbal or physical threats, assaults, sexual or other harassment to your supervisor, manager or the AECOM Hotline 1 888-299-9602.

1.7 Complete a Training Needs Assessment and take any safety training required for your job function or tasks.

1.8 Use or wear all personal protective equipment, devices or clothing required in accordance with manufacturers' instructions and AECOM training and/or procedures.

1.9 Do not perform any work task or activity which you believe is unsafe. Inform your supervisor immediately.

1.10 Immediately report all incidents (including near misses), injuries, property damage, spills, hazards, safety concerns and safety violations to your supervisor.

1.11 Report all observed unsafe acts, conditions, or behaviors that compromise the safety of AECOM employees, its clients, sub consultants, general contractors, or the public to your supervisor.

1.12 Keep all personal work areas clean from debris and tripping hazards.

1.13 Complete AECOM Vehicle and Driver Safety Program before operating any vehicle on AECOM business.

1.14 Operate all vehicles and mobile equipment in accordance with applicable regulations.

1.15 Do not use or operate any equipment, machine or device that may endanger you or another worker.

1.16 Do not remove damage, disable or make ineffective any protective safety, fire-fighting or first aid equipment or devices.

1.17 Use only vehicles, equipment and tools that are in safe operating condition and maintained in accordance with manufacturer's specifications. Report, remove from service, or have repaired, any tool or equipment that is damaged, not working properly or may otherwise be hazardous if used.

1.18 Do not use any hand-held wireless device while driving a vehicle or performing other safety critical tasks like working near traffic or working with power tools.

1.19 When travelling, working alone or working away from the AECOM office, particularly in remote areas, follow applicable call-in procedures.

1.20 Do not bring firearms onto AECOM property or allow them on AECOM projects unless expressed permission is provided by management for the use in wildlife protection.

1.21 Do not smoke in areas designated as "NO SMOKING" or in any AECOM facility.

1.22 Do not use, sell or distribute, be under the influence, or have in their possession any controlled substances, drugs, or alcohol while performing work duties.

2.0 Rules for Project or Field Work

2.1 Always report to site supervisor before performing work on site to determine specific requirements for the site or project. Follow all safety requirements, including AECOM's, or that of a client or prime contractor, as applicable.

2.2 Use only designated project entrances, parking areas and facilities.

2.3 Show or produce evidence of identification or required training if requested to gain entry to or while on a project.

2.4 Obey all warning signs (e.g., "Do Not Enter," "Eye, Hearing or Respiratory Protection Required," "Permit Required Confined Space," "Authorized Personnel Only").

2.5 Do not block, deface or remove any signage, barricade or fencing without approval.

2.6 Keep passageways clean and clear of debris, materials, hoses, cords, and tripping obstructions. Items should be moved to low activity areas or storage.

2.7 Verify with the **Project Manager** that all required Permits are in place prior to commencing work.

2.8 Be aware of work going on, around or above you including contractor activities and public motor vehicles.

2.9 Do not work alone when performing high risk or remote work. Examples of high risk work activities include, but are not limited to:

- 2.9.1 Entering trenches/excavations
- 2.9.2 Entering permit-required confined spaces
- 2.9.3 Working at-height (i.e., donning a full-body harness)
- 2.9.4 Operating an aerial lift
- 2.9.5 Working over water
- 2.9.6 Boating
- 2.9.7 Working in atmospheres that have the potential to contain highly hazardous chemicals (e.g. hydrogen sulphide, explosive atmospheres, etc.)
- 2.9.8 Working near operating mobile and heavy equipment
- 2.9.9 Working in or adjacent to work zones containing vehicular activity

2.10 Personal cameras, video recorders, and other photographic equipment shall not be permitted on site without the **Project Manager** and client's approval.

2.11 Plan work tasks before beginning work and consider any hazards that may exist and how to avoid them through safe work practices or safe work procedures.

Americas

Incident Reporting

S3NA-004-PR1

1.0 Purpose and Scope

1.1 To provide direction for timely reporting SH&E incidents.

1.2 This procedure applies to all AECOM Americas based employees and operations, as required per the *S2-001-PR1 Incident Reporting (Global Implementing Procedures).*

2.0 Terms and Definitions

2.1 **Fatality –** Loss of life of any AECOM employee, AECOM subcontractor personnel, client personnel or member of the general public that can be perceived to be related to work performed or controlled by AECOM.

2.2 **General Liability –** Incidents where AECOM could potentially be held liable.

2.3 **Lost Time Injury or Illness –** A work-related injury or illness that has caused a worker to be absent from his or her regular work following the day that the injury or illness occurred.

2.4 **Recordable Injury –** A work-related injury or illness that results in the following. (See *S3NA-601-PR1 Recordkeeping* for definitions).

- Fatality;
- Medical Treatment beyond first aid;
- Days away from work;
- Restricted work or transfer to another job;
- Loss of Consciousness; and/or
- A Significant injury or illness diagnosed by a medical professional.

2.5 **Restricted Work** (also called "**Modified Work**") – A work-related injury or illness that results in the employee being unable to perform one or more of the routine functions of their job. The restricted duties are done within the limitation of the injured person's abilities. (Documentation may be required per regulatory requirements).

2.6 **SH&E Incidents** – The following events or situations as applied to AECOM employees and/or AECOM-controlled operations are considered SH&E Incidents:

- Any injury or illness to an AECOM employee, that could be potentially work related or become aggravated by the work environment. This includes an AECOM subcontractor, temporary employee, or third-party contractor that performs work under the control of an AECOM operation.
- Any potentially work related abnormal condition to include pain and soreness shall be reported.
- Fire, explosion, or flash that is not an intended result of a remediation process, laboratory procedure, or other planned event.
- Any incident involving company-owned, rented, or leased vehicles (including personal vehicles used for company business).
- Any breach of a numeric limit attached to a governmental permit or consent.
- Any failure to perform the requirements of a non-numeric requirement contained in a government permit or consent.
- Any failure to obtain a government permit or consent when required (including failure to obtain revisions before an existing permit or consent expires).

- Any notice of violation or notice of non-compliance received from a regulatory authority with enforcement powers.
- Property damage resulting from any AECOM or subcontractor activity. This would include Motor Vehicle Accidents (MVA), buildings, equipment, and near miss events.
- Unexpected release or imminent release of a hazardous material.
- Unexpected chemical exposures to workers or the public.
- A safety, health or environmental related injury, damage, incident or complaint associated with the public as it relates to an AECOM activity.
- SH&E-related incidents that could result in adverse public media interest concerning AECOM or an AECOM project.
- Any inspection by a Federal, Provincial, or local safety, health, & environmental enforcement agency.

2.6.1 **Major SH&E Incident –** Any SH&E Incident that meets/involves the following criteria:

- Fatality;
- Amputation;
- Hospitalization for treatment for more than 24 hours (Admission);
- Absence from work for more than 30 calendar days due to work-related injury/illness;
- Any single event resulting in more than one employee requiring medical treatment or more than one employee being away from work more than three days;
- Any SH&E-related Consent Agreement/Order/Lawsuit or enforcement action seeking more than $10,000 or alleging criminal activity;
- Any spill or release of a hazardous material that is reportable to a regulatory agency;
- Any Notices of Violation resultant of not operating within a government permit/license or consent;
- Any incident resulting in property damage expected to exceed $2,500 US dollars;
- Any security related incident that could have caused harm to an AECOM employee; and/or
- Near Miss incidents that may have resulted in any of the above but because of “luck” did not happen.

2.6.2 **Near Miss Incidents –** This is defined as an incident having the potential to cause injury, health effects, environmental impairment, or property damage as described in the above categories – but did not. For example:

- A crane drops a 454 kilogram (1,000 pound) beam during a lift – and nobody is hurt, no equipment or property is damaged.
- A work crew is conducting a survey along the highway. A vehicle leaves the roadway and the vehicle enters the survey area at 80 kilmeters per hour (50 miles per hour). The vehicle misses an employee by 1 metre (3 feet); the driver recovers control of the vehicle and leaves the area.
- Awareness of a verified equipment recall or incident that occurs at another similar worksite.
- Unsafe conditions should not be reported as Near Misses but should be identified in Inspection and Observation Programs (such as LifeGuard and Office Inspections) and tracked until resolved/closed.

2.6.3 **Security Incident –** Any security related incident that could cause harm to or is associated with an AECOM employee in the course of duty.

2.7 **SH&E Incident Report (IR) –** Form used to document incidents which shall be completed when there is no internet access to IndustrySafe. Within 4 hours for a Major Incident and 24 hours for all others. IR's should be submitted to the **Supervisor** and **Region SH&E Manager**.

2.8 **SH&E Incident Reporting and Assistance Line –** 1-800-348-5046

- Email – sri@aecom.com (for locations that cannot access IndustrySafe)
- IndustrySafe on-line reporting link – https://www.industrysafe.com/AECOM

2.9 **WC Carrier/Claims –** Workers Compensation Third-Party Insurance Partner.

2.10 **Workers Compensation –** Analyst manages all Americas-based injury and illness claims.

2.11 **Workers Compensation Board** (Canada) – Known provincially by variations such as WCB, WSIB, CSST, WSCC, etc.).

3.0 References

3.1 S2-001-PR1 Incident Reporting (Global Implementing Procedures)

3.2 S3NA-601-PR1 Recordkeeping

3.3 S3NA-603-PR1 Incident Investigation and Review

3.4 S3NA-606-PR1 Modified Duty Program

4.0 Procedure

4.1 Roles and Responsibilities

4.1.1 **Employee**

- Contact the SH&E Incident Line at 1-800-348-5046 for work related non-emergency medical advice by Work Care and/or to obtain AECOM contact information.
- Notify his/her **Supervisor** immediately that an incident (including a Near Miss) has occurred, the circumstances involved, the nature and extent of the injuries/illness, and whether medical treatment may be required. Except for emergency situations, affected employees are required to discuss their injury/illness status with their **supervisor** and **Region SH&E Manager**, **District SH&E Manager**, and/or project SH&E Professional prior to obtaining medical treatment.
- Complete Industry Safe on-line reporting within four hours of incident. If injury/illness prevents input, **Supervisor** will be responsible for initial input. If employees lack internet access to IndustrySafe, a hardcopy Incident Report form shall be completed and submitted to the **Region** or **District SH&E Manager**. If incident is not major as defined above, IndustrySafe input by the end of workday (24 hours maximum) is required.

4.1.2 **Supervisor**

- In an emergency/life-threatening situation, use the appropriate local emergency phone numbers and seek immediate medical care for the employee.
- Address any immediate corrective actions required to make the scene safe. Consult with the **Region SH&E Manager** and leadership if guidance is required.
- For Major Incidents immediately contact leadership up to the **Regional Executive** and **Region SH&E Manager** by phone once the situation has stabilized.
- Complete an initial incident notification in the IndustrySafe on-line report if employee is not capable/incapacitated and any other applicable documentation .pdf and attach to the on-line report such as:

    a. Police Report

b. Photographs of incident scene

c. Witness statements

d. Federal/State/Province Specific Forms

e. Timeline

f. Root cause analysis

- As appropriate, initiate an Incident Investigation and Review per the requirements of *S3NA-603-PR1 Incident Investigation and Review*.
- Completion of any external reporting requirements. For example, the U.S. Coast Guard CG-3865, Recreational Boating Accident Report may be required if the incident involved a boat (contact the **Region SH&E Manager** for clarification). See *S3NA-004-WI2 Incident Response and Reporting* for further instruction.
- Where there is potential for criminal, civil or regulatory action against AECOM or any of its employees or subcontractors, a representative of AECOM Americas legal team (typically regional legal counsel) shall be contacted prior to any external communication, correspondence, or meeting concerning any incident, governmental investigation, or environment impact. AECOM's **Americas Chief Counsel**, or designee, may supplement this policy or require additional measures to protect the best interests of AECOM and its employees. The Office of Risk Management and Region Counsel should also be notified if the public is involved or a claim is anticipated.

4.1.3 **Region SH&E Manager**

- Monitor phone, messaging, and IndustrySafe for first report of incident and contact those involved for support as necessary.
- Upon receipt of an Incident Notification, contact the **Supervisor** to discuss the incident as well as short term and long term corrective actions.
- Coordinate case management with the AECOM **Workers Compensation Analyst**.
- Notify and coordinate with appropriate **Operations Manager** of the incident.
- As appropriate, assist an Incident Investigation and Review.
- Report all fatalities and/or Major SH&E incidents to the **Americas SH&E Director**, **Business Line Executive** and **Regional Executive** immediately by phone if not already notified by the **Supervisor**.

4.1.4 **District SH&E Managers**

- Inform appropriate personnel that have not already been notified of incidents that may affect them.
- Review electronic entry of incident information in IndustrySafe and coach **Supervisors** and **Employees** on completing investigations. Be responsible to manage open incidents until closure.
- Coordinate with **Region SH&E Manager** for management of medical support.
- Assist with Incident Investigation and Review per the requirements of *S3NA-603-PR1 Incident Investigation and Review*.
- Forward incident data as needed to SH&E Department, Legal, Human Resources and others as necessary for insurance claims.
- Enter Corrective Actions as a result of Incident Investigation and Executive Incident Review into IndustrySafe to monitor completion.

4.1.5 **Workers Compensation Analyst**

- Contact the employee and work with the Supervisor as needed to resolve a request for Workers Compensation coverage.
- Obtain from the employee medical clearance to return to work.

- Work with Human Resource or other third parties as needed to facilitate the requirements for the locality are met.

4.2 Workers Compensation Program

If an employee potentially requires support under Worker's Compensation, the employee will be contacted by the **Workers Compensation Analyst.** The employee's **Supervisor** shall also work with the **Workers Compensation Analyst** as needed in support of the employee. Prior to the employee returning to work after any treatment provided by a medical provider, a medical clearance is to be provided by the employee to the **Workers Compensation Analyst** and their **Supervisor**. The medical clearance will be scanned and added to the IndustrySafe incident by the **Employee** or **Supervisor**.

4.3 Modified Work Program

Every attempt will be made to accommodate reasonable restricted and modified duties to facilitate a safe return to work of the injured employee. The return to work program is based on the specific needs and circumstances to each case, refer to *S3NA-606-PR1 Modified Duty Program*. Each instance will be evaluated on a case-by-case basis. The resulting modified work program will be specific to the injured employee. In Canada, a third-party administrator works with the **Workers Compensation Analyst** or other designated Human Resource staff. The third-party administrator is familiar with the reporting requirements by province, which vary slightly between jurisdictions across Canada and completes filings and maintains correspondence with the appropriate board on the company's behalf.

4.4 Refer to the *S3NA-004-WI1 SH&E Reporting Flowchart* and *S3NA-004-WI2 Incident Response and Reporting Instructions* for specifics on the process and work flow for incident reporting.

5.0 Records

5.1 Incident reports and supporting documentation are maintained in the IndustrySafe database.

5.2 If a hardcopy Incident Report is generated it should ultimately be scanned and kept in the IndustrySafe database. All incident information must be retained by AECOM. Records relating to occupational injury and incidents must be kept for up to 30 years (or permanently in the Northwest Territories), depending on the classification of incident.

6.0 Attachments

6.1 S3NA-004-WI1 SH&E Reporting Flowchart

6.2 S3NA-004-WI2 Incident Response and Reporting Instructions

6.3 S3NA-004-FM1 SH&E Incident Report (IR)

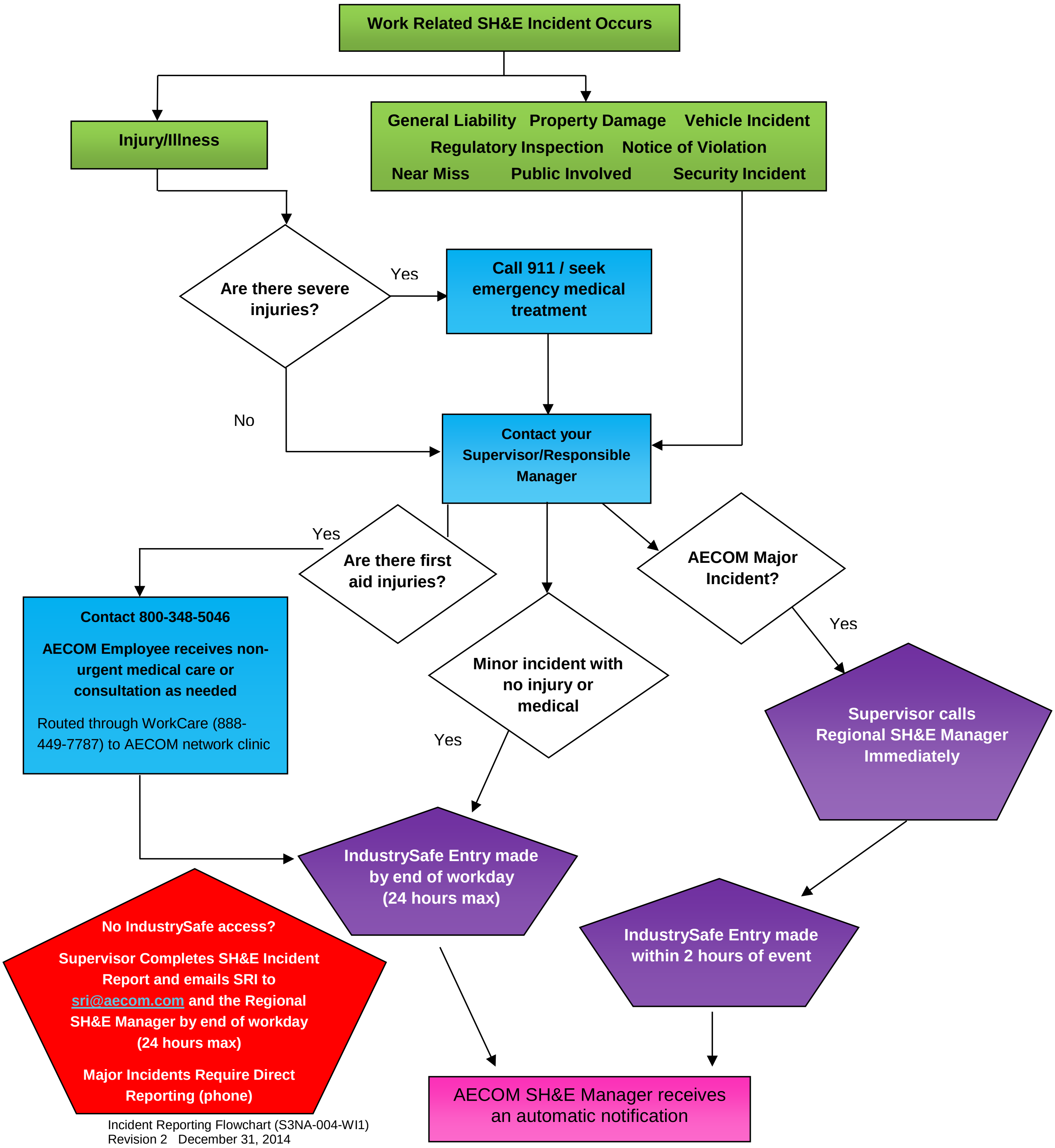
6.4 S3NA-004-FM2 Near-Miss Incident Report

AECOM

Americas

Incident Reporting Flowchart

S3NA-004-WI1



Incident Response and Reporting Instructions

S3NA-004-WI2

1.0 Steps for Initial Response

1.1 Take control of the scene (get everyone's attention and cooperation).

1.2 If necessary call for emergency services and provide first aid/CPR if individual(s) maintains current certification.

1.3 Control secondary incidents if safe to do so (ensure hazards are removed or controlled; issue a stop work order, if required).

1.4 Identify and preserve sources of evidence and evidence. In the event of a critical injury, the incident scene must be preserved for the potential site visit of a representative from the applicable government agency (if you are unsure, error on the side of caution and leave the site intact).

1.5 Report the incident to the immediate supervisor for implementing stop work orders or immediate corrective action as required.

1.6 Responsible employee/supervisor is to follow SHE Incident Reporting Procedure to initiate internal reporting and obtain guidance, as necessary. If a manager or supervisor is not available, any AECOM employee can initiate the reporting or make the call.

1.7 The employee / supervisor completes the entry into IndustrySafe.

2.0 Fatality or Serious SH&E Incident Notification

2.1 Any fatality or serious SH&E incident is to be directly reported via a verbal dialog as soon as practical (i.e. as soon as the site is secure and appropriate local emergency response is coordinated), but in no case more than 2 hours after the incident to the appropriate **Regional SH&E Manager** and **Regional Executive**.

2.2 Voicemail and/or email alone are not adequate to meet this requirement. The responsibility for this reporting belongs to the responsible manager (i.e. supervisor/office/branch/business line/project manager).

3.0 Internal Reporting Procedures

3.1 The call (from the scene of the incident, if possible) or entry into IndustrySafe initiates the reporting procedures.

3.2 For Emergency Injuries and Incidents

- Call Emergency Services e.g. 911
- **Managers** call their appropriate supervision and their Regional SH&E Manager immediately once the situation is safe and stabilized.
- The responsible manager, or delegate, must make initial notification into IndustrySafe within 4 hours of the event.

3.3 Non-emergency injuries or medical conditions

- Notify your responsible manager, supervisor/project manager.
- Call the Incident Reporting and Assistance Line at 1.800.348.5046 for connection with Work Care medical support

3.4 The **employee** or responsible manager must make initial notification into IndustrySafe within 4 hours of the event.

3.5 Property damage, environmental releases, and non-medical incidents

3.5.1 Immediate assistance circumstances

Contact your responsible manager, supervisor/project manager.

Call the Incident Reporting and Assistance Line at 1.800.348.5046 for situations that require immediate assistance (property damage estimated above $2,500, utility strikes, incidents involving the public, security-related incidents, etc.). The Assistance Line will connect you to the proper authorities within AECOM.

The employee or responsible manager must make initial notification into **IndustrySafe** within four hours of the event.

3.5.2 Non-critical and no-injury incidents

Examples include: Property damage less than $2,500, all near misses, etc.

Contact your responsible manager, supervisor/project manager.

The employee or responsible manager must make case entry into IndustrySafe within 24 hours of the event.

3.5.3 The employee involved in an incident shall complete incident reporting in IndustrySafe, or delegate to their responsible manager, within the required timeline for the category of event from 3.3 through 3.4 above.

- If the employee is unable to complete the report because of the severity of the injuries, the responsible manager, should start the IndustrySafe entry and notification process.

3.6 The **Project Manager/Supervisor** will:

- Confirm that on-site corrective actions were implemented,
- Determine the need for HR involvement (for medical aid incidents, WCB/WSIB/H&W/ WC reporting, and modified work cases),
- Determine the need for review by the District Manager,
- Identify and complete any other external reporting requirements (client, ministry responsible for labour, ministry responsible for environment), and
- Work with Regional Counsel or Media Communications as needed
- Conduct Executive Incident Review and implement at the project/office level corrective actions; dissmenate lessons learned.

3.7 The **Regional SH&E Manager** must:

- Support as requested an internal or external investigation of the incident (Regional Counsel may request/oversee an external investigation).
- Work with regional/business line leadership, Human Resources, and Regional Counsel or Media Communications, as requested.

4.0 External Reporting Procedures

4.1 Notification to external regulatory agencies (i.e. OSHA, ministry of labour/environment, WCB, WSIB, WC, H&W, etc) is to be done in accordance with *S3NA-601-PR1 Recordkeeping.*

4.2 The **Project Manager**, in conjunction with the Regional SH&E Manager, will determine what (if any) external reporting obligations must be met. For example:

4.2.1 Client. To a Client whom the employee was conducting work for at the time of the incident or accident. Health and safety requirements will vary for different clients, and therefore client reporting will be handled on an individual basis by the manager(s) involved.

4.2.2 State and OH&S Governing Agency. Reporting to the State, governing body of labour or OH&S (Canadian provincial/territorial ministry responsible for labour) by the employer (AECOM management/representative) will be done in accordance with regulatory requirements. Since reporting requirements vary slightly between jurisdictions throughout the Americas, the following can only be used as rough guidelines for determining whether or not a call should be made to the governing body:

- If a fatality or permanent injury is incurred;
- If the accident/incident involved a major structural failure or collapse of a building, bridge, tower, crane, hoist, temporary construction support system or excavation; or
- If the accident/incident involved the major release of a hazardous substance
- If required by OSHA (such as 1 or more hospitalized, etc.)

4.2.3 Environmental Governing Agency. To the governing body for the environment and spill reporting (provincial/territorial ministry responsible for environment) by the employer (AECOM management/representative). Reporting requirements vary slightly between jurisdictions:

- Spills, releases or other damage to the environment. (For minimum quantities for reporting based on the type of product spilled or released, refer to the applicable legislation.).

4.3 Medical Treatment Injury, Hazardous Material Spill/Release, Permit Condition Notification

4.3.1 Any SH&E incident involving medical treatment for an AECOM employee, release of a hazardous material/substance and/or breach of a numeric or non-numeric permit/consent limit is to be reported as soon as possible, to the Regional SH&E Manager, Regional/Business Line Manager and Group SH&E Director by using a direct communication method (face-to-face or phone call). Responsibility for this reporting belongs to the responsible project/location/department manager.

4.4 Worker's Compensation

4.4.1 AECOM's Workers Compensation Analyst will be responsible for working with the appropriate manager if the employee is off work for any length of time, if a modified work program will be created for the individual, or if there are any long-term implications from the accident.

4.4.2 Canada. Reporting to the WCB must be completed by both the employee(s) injured in the mishap and the employer (AECOM management/representative). Reporting requirements vary slightly between jurisdictions across Canada, therefore, the following can only be used as rough guidelines for determining whether or not a call should be made to the appropriate agency:

- If the employee requires medical treatment (by a medical practitioner, not just first aid);
- If the employee is off of work beyond the day of the accident;
- If the employee has to perform different or fewer work duties;
- If a fatality or permanent injury is incurred.

4.4.3 United States. Injured U.S. based employees will be referred to the Workers Compensation Analyst for potential claims processing. Workers Compensation regulations vary by State. The Workers Compensation Analyst and the RSH&E Manager will ensure that appropriate State reporting has been completed, as applicable. For property damage incidents with any potential resulting liability to the company will be referred to the Insurance group and liability carrier for claims processing.

Americas

SH&E Incident Report

S3NA-004-FM1

1. SEEK IMMEDIATE MEDICAL ATTENTION IF NECESSARY
2. EMPLOYEE MUST REPORT ALL INCIDENTS TO THEIR SUPERVISOR IMMEDIATELY
3. REPORT THE INCIDENT TO THE APPROPRIATE INCIDENT REPORTING LINE: **(800) 348-5046**

ORGANIZATION INFORMATION	
REGION: CANADA NORTH South	**DISTRICT:**
	PROJECT NUMBER:
BUSINESS LINE: AECOM CORP GROUP SERVICES CONSTRUCTION SERVICES (CS) ENERGY & POWER ENVIRONMENT B+P TRANSPORTATION WATER	
CLIENT NAME:	**PROJECT NAME:**
ADMINISTRATIVE	
EMPLOYEE NAME:	**EMPLOYEE NUMBER:**
WORK PHONE:	**CELL PHONE:**
EMPLOYEE STATUS FULL TIME PART TIME SUB TEMP AGENCY THIRD PARTY	**HOME OFFICE ADDRESS:**
	JOB TITLE:
DESCRIPTION OF EVENT	
TYPE OF OCCURRENCE: INJURY/ILLNESS PROPERTY DAMAGE ENV DAMAGE/SPILL REGULATORY INSPECTION MOTOR VEHICLE ACCIDENT BOATING INCIDENT NOV/CITATION OTHER BE SPECIFIC	
DATE OF INCIDENT:	**TIME OF INCIDENT:**
DATE REPORTED TO SUPERVISOR:	**TIME REPORTED TO SUPERVISOR:**
INCIDENT ADDRESS/LOCATION:	**CITY:**
STATE/PROVINCE/TERRITORY:	**ZIP/POSTAL CODE:**
WERE THERE ANY SUBCONTRACTORS, WITNESSES OR OTHER PERSONS INVOLVED: YES NO **IF YES, PLEASE PROVIDE DETAILS TO INCLUDE NAMES AND CONTACT INFORMATION**	
PERSONAL INJURY	
TYPE OF INJURY: FIRST AID (TREATED ON-SITE) MEDICAL AID (TREATED BY PROFESSIONAL) FATALITY	
DESCRIBE THE INJURY AND BODY PART AFFECTED: ***BE SPECIFIC STATEMENTS BELONG ON PAGE 2***	
WAS A DOCTOR OR HOSPITAL VISITED? YES NO	**IF YES, WHEN:**
MEDICAL RECEIVED:	**DOCTOR/HOSPITAL NAME:**
PROVIDER ADDRESS:	**PHONE NUMBER:**

1. **SEEK IMMEDIATE MEDICAL ATTENTION IF NECESSARY**
2. **EMPLOYEE MUST REPORT ALL INCIDENTS TO THEIR SUPERVISOR IMMEDIATELY**
3. **REPORT THE INCIDENT TO THE APPROPRIATE INCIDENT REPORTING LINE:** **(800) 348-5046**

Property Damage

TYPE OF DAMAGE: AECOM PROPERTY MOTOR VEHICLE (COMPLETE MVA REPORT PAGE 3)

SPILL OR RELEASE OF A HAZARDOUS SUBSTANCE MAJOR STRUCTURAL FAILURE CLIENT, SUBCONTRACTOR, OTHER:

DESCRIBE THE SPECIFIC DAMAGE, STRUCTURAL FAILURE OR HAZARDOUS RELEASE: RANK THE SEVERITY OF THE DAMAGE: MINOR SERIOUS MAJOR

WHERE CAN THE PROPERTY BE SEEN?

PROPERTY OWNER NAME: **CONTACT INFORMATION:**

IS THERE ANY POTENTIAL FOR CIVIL, CRIMINAL OR REGULATORY LIABILITY AGAINST AECOM OR AN EMPLOYEE? YES NO

IF YES, DISCUSS WITH AECOM REGIONAL COUNSEL BEFORE PROCEEDING WITH ANY FURTHER REPORTING.

INDICATE WHO HAS BEEN NOTIFIED OF THE EVENT (E.G., OWNER/OPERATOR, STATE (US) OR GOVERNING BODY OF LABOUR, ETC?

What, when, where, why, how? Attached notes/diagrams as required and list any machinery or equipment involved.

ON-SITE/CORRECTIVE ACTIONS

INCIDENT IMMEDIATELY REPORTED ON-SITE TO:

WHAT CORRECTIVE ACTIONS WERE IMMEDIATELY IMPLEMENTED ON-SITE?

WHAT LONG-TERM OR PERMANENT CORRECTIVE ACTIONS ARE RECOMMENDED?

ACKNOWLEDGEMENTS

EMPLOYEE DESCRIPTION OF INCIDENT:

What, when, where, why, how? Attached notes/diagrams as required and list any machinery or equipment involved

EMPLOYEE PRINTED NAME AND PHONE	SIGNATURE AND DATE

SUPERVISOR REVIEW OF INCIDENT:

SUPERVISORS PRINTED NAME, EMPLOYEE Number, AND PHONE	SIGNATURE AND DATE

MANAGER COMMENTS:

MANAGER PRINTED NAME AND PHONE	SIGNATURE AND DATE

1. **SEEK IMMEDIATE MEDICAL ATTENTION IF NECESSARY**
2. **EMPLOYEE MUST REPORT ALL INCIDENTS TO THEIR SUPERVISOR IMMEDIATELY**
3. **REPORT THE INCIDENT TO THE APPROPRIATE INCIDENT REPORTING LINE:** **(800) 348-5046**

FOR REGIONAL SH&E MANAGER USE ONLY:

NAME AND SIGNATURE:	**DATE:**

RECORDABILITY DETERMINATION FIRST AID RECORDABLE RECORDABILITY UNDETERMINED NON WORK

PROPERTY DAMAGE GENERAL LIABILITY VANDALISM

COMMENTS:

ATTENTION:

FOR MINOR INCIDENTS, THIS FORM MUST BE COMPLETED AND EMAILED TO SRI@AECOM.COM OR FORWARDED TO THE REGIONAL SH&E MANAGER BY THE END OF THE WORKDAY IN WHICH THE INCIDENT OCCURRED, OR A MAXIMUIM OF 24 HOURS FOLLOWING THE OCCURRENCE OF THE INCIDENT. MAJOR INCIDENTS MUST BE REPORTED IMMEDIATELY.

Submit Form

MOTOR VEHICLE ACCIDENT (MVA) REPORT

ONLY COMPLETE THIS PAGE FOR VEHICLE INCIDENTS

ADMINISTRATIVE				
AECOM VEHICLE:	FLEET	RENTAL	PERSONAL	JOB ACTIVITY AT TIME OF MVA:
DATE OF MVA:	TIME OF MVA:			LOCATION OF MVA:
MANAGER:				NUMBER OF VEHICLES INVOLVED:

REMEMBER: **STAY CALM.**
Do not admit liability, agree to pay for any damage or sign any document except as required by law.

AECOM DRIVER INFORMATION		
DRIVER/Employee Number	AECOM PASSENGERS:	OTHER PASSENGERS:
DRIVER'S LICENSE:	PROVINCE/STATE ISSUED:	EXPIRATION DATE:
INJURIES TO DRIVER:		
INJURIES TO PASSENGERS:		

AECOM VEHICLE INFORMATION					
YEAR:	MAKE:		MODEL:		
SERIAL/VIN #:	LICENSE PLATE #:		REGISTRATION #:		
OWNER:	INSURANCE COMPANY:		POLICY #:		
COMMERICIAL MOTOR VEHICLE :	I F RENTED OR PERSONAL, CONTACT INFORMATION OF OWNER:				
RANK THE SEVERITY OF THE DAMAGE TO THE VEHICLE:	0 - $500	$500 - $1000	$1000 - $4000	>$4000	
DESCRIPTION OF DAMAGE TO THE BODY OF THE VEHICLE:					

OTHER DRIVER/VEHICLE INFORMATION		
YEAR:	MAKE:	MODEL:
SERIAL/VIN #	LICENSE PLATE #:	REGISTRATION #:
DRIVER'S NAME:	CONTACT INFO:	LICENSE #:
OWNER:	INSURANCE COMPANY:	POLICY #:
IF RENTED OR PERSONAL, CONTACT INFORMATION OF OWNER:		
DESCRIPTION OF DAMAGE TO THE BODY OF THE OTHER VEHICLE:		

MOTOR VEHICLE ACCIDENT (MVA) REPORT

ONLY COMPLETE THIS PAGE FOR VEHICLE INCIDENTS

ACCIDENT DESCRIPTION	
EXACT LOCATION OF MVA (HIGHWAY KM, INTERSECTION, EXACT ADDRESS, ETC.)?	
OTHER PROPERTY DAMAGED:	
DESCRIBE THE EVENTS LEADING UP TO AND THE INCIDENT (REPORT FACTS ONLY: SPEED OF VEHICLES, DIRECTION TRAVELING, WEATHER CONDITIONS, ETC. DO NOT GIVE OPINIONS REGARDING CAUSE OF ACCIDENT OR LOSS.):	
DID THE POLICE ATTEND THE SCENE: YES NO CITATION ISSUED: YES NO TO WHO:	
POLICE :	CONTACT INFO:
WITNESS:	CONTACT INFO:
WITNESS:	CONTACT INFO:
SUBMIT THIS MVA REPORT WITH A COMPLETED SUPERVISORS REPORT OF INCIDENT TO THE APPROPRIATE MANAGER	
HAS A SUPERVISOR'S REPORT OF INCIDENT BEEN COMPLETED? YES NO	
COMPLETED BY:	SIGNATURE:

DRIVER

Americas

Near Miss Report

S3NA-004-FM2

If unable to access IndustrySafe. Please use this form to report any near-misses, you encounter as a part of your work. This may include office or field locations.

ADMINISTRATIVE	
PROJECT NAME & NUMBER: ☐ **N/A**	**LOCATION:**
EMPLOYEE NAME:	**EMPLOYEE NUMBER:**
EMPLOYEE TYPE: ☐ AECOM EMPLOYEE ☐ CONTRACTOR ☐ SUBCONTRACTOR ☐ JV PARTNER ☐ 3RD PARTY/PUBLIC	**SUPERVISOR:**
HOME OFFICE:	**DEPARTMENT NUMBER:**
JOB NUMBER/PROJECT LOCATION/PROJECT DESCRIPTION:	
DATE AND TIME OF NEAR MISS:	**DATE AND TIME REPORTED:**

Work Activity	☐ Office	☐Driving	☐Field	☐Lab	☐Other: __________________

REMEMBER: IDENTIFYING A NEAR MISS DOES NOT IMPLY GUILT BUT ASSISTS IN PREVENTING INCIDENTS OR INJURIES.

OBSERVATION, RISK OR NEAR MISS DETAILS

NEAR MISS POTENTIAL OUTCOME: ☐ INJURY/ILLNESS ☐ PROPERTY DAMAGE ☐ ENVIRONMENTAL DAMAGE

POTENTIAL SEVERITY: ☐ NEGLIGABLE ☐ MARGINAL ☐ CRITICAL ☐ CATASTROPHIC

PROBABILITY: ☐ FREQUENT ☐ IMPROBABLE ☐ OCCASIONAL ☐ PROBABLE ☐ REMOTE

DESCRIPTION OF NEAR MISS:

AECOM

If unable to access IndustrySafe. Please use this form to report any near-misses, you encounter as a part of your work. This may include office or field locations.

POTENTIAL IMMEDIATE CAUSES

- ☐ Procedures not followed
- ☐ Use of tools or equipment
- ☐ Use of protective measures
- ☐ Inattention/Lack of awareness
- ☐ Protective systems
- ☐ Tools, equipment, & vehicles
- ☐ Work exposures to…
- ☐ Work place environmental/layout

POTENTIAL SYSTEM CAUSES

- ☐ Physical capacity
- ☒ Physical condition
- ☐ Mental state
- ☐ Behavior
- ☐ Skill level
- ☐ Training/Knowledge transfer
- ☐ Mngmt/Supervision/Employee leadership
- ☐ Contractor selection & design
- ☐ Engineering/Design
- ☐ Work planning
- ☐ Purchasing, material handling/controls
- ☐ Tools & equipment
- ☐ Work rules/policies/stds/procedures
- ☐ Communication
- ☐ Other:___________________________

CORRECTIVE ACTIONS

Corrective Action Category Identified to Prevent Future Reoccurrence

(*Identify relevant issues in checkboxes and provide detail below, as applicable*)

- ☐ Different/New PPE needed
- ☐ New tool(s)/equipment needed
- ☐ Additional/proper personnel needed
- ☐ Change in working procedure
- ☐ New STOP WORK trigger identified
- ☐ Additional training/skills needed
- ☐ Improved housekeeping efforts
- ☐ Modified working behaviors
- ☐ Improved work planning
- ☐ Other:___________________________

WERE IMMEDIATE CORRECTIVE ACTIONS IMPLEMENTED? ☐ **YES** ☐ **NO** IF YES, PLEASE DESCRIBE:

WHAT LONG-TERM CORRECTIVE ACTIONS ARE RECOMMENDED?

FOR SH&E DEPARTMENT USE ONLY:	
CORRECTIVE ACTIONS REQUIRING IMPLEMENTATION:	**RATIONALE:**
COMMUNICATED BACK TO EMPLOYEE: ☐	**COMMUNICATED BACK TO MANAGER:** ☐
COMPLETED BY:	**DATE:**

Americas

Vehicle and Driver Safety Program

S3NA-005-PR1

1.0 Purpose and Scope

1.1 This procedure applies to employees who operate motor vehicles that are owned, rented, or leased by AECOM and to employees who use personal, client or government-supplied vehicles while conducting AECOM business. This Vehicle and Driver Safety Program applies to AECOM Americas operations. Policies and procedures related to the operation of commercial motor vehicles are in addition to this procedure, see *S3NA-404-PR1 Commercial Motor Vehicles.* Operational procedures related to the use of AECOM owned vehicles are addressed in the *Americas Fleet Vehicle Operations Policy*.

1.2 Vehicle and transportation related death is among the leading causes of death in the United States. In the occupational setting, motor vehicle crashes are the number one cause of death.

1.3 Vehicle damage and damage to property by vehicles are generally avoidable incidents that can result in injuries and added costs for repairs and replacements.

2.0 Terms and Definitions

2.1 **Americas Fleet Vehicle Managemen**t – The team of AECOM employees who oversee the operations, safety, and performance of the Americas Fleet.

2.2 **Authorized Driver** – AECOM employees who have provided proof of a current driver's license, proof of insurance and completed AECOM Driver & Vehicle Safety Training. Employees authorized to operate an AECOM Fleet Vehicle must receive additional approval by Region Fleet Vehicle Coordinators. Refer to *Americas Fleet Vehicle Operations Policy*.

2.3 **Commercial Motor Vehicle (CMV)** – For AECOM operations, a CMV is defined as a vehicle used for AECOM business that:

- ≥10,001 lbs gross vehicle weight rating (GVWR); and/or
- Carries a quantity of hazardous material (quantities ≥ 1001 lbs. combined total weight) at any time beyond the criteria in 49 CFR 173.6 (Materials of Trade).

2.4 **Company Busines**s – Any activity that is performed in the name of the company. This includes vehicle travel between work locations, client sites, meeting locations as well as driving performed as a part of work related travel (driving to and from airports, hotels, train stations). Company business does not include driving that is a part of a routine commute from home to an office location.

2.5 **Distracted Driving** – An activity that takes the driver's attention away from the primary task of driving.

2.6 **Driving Under the Influence (DUI)/Driving While Intoxicated (DWI)** – DUI is the operation of a vehicle on company business under the influence of alcohol, drugs, medications, or other substances capable of inducing an altered mental state and/or impairing physical and mental judgments such that the influence of said substances produces impairment in violation of governmental laws for the location of the impairment.

2.7 **Fatigue** – A general term used to describe the experience of being "sleepy", "tired" or "exhausted". The effect of fatigue is both a physiological and a psychological and can severely impair a driver's judgement. Fatigue can cause lapses in concentration which could prove fatal. Fatigue is not just a problem for drivers on long trips as a drivers can also suffer from fatigue even on short trips.

2.8 **Fleet Vehicle** – A motorized vehicle owned or leased by AECOM. These vehicles may be assigned to a specific driver or may be part of an office vehicle pool.

2.9 **IndustrySafe** – AECOM's internal database for the management of safety, health and environmental incidents. IndustrySafe is accessible to all AECOM employees, and maintains confidentiality for protected information.

2.10 **Journey Management** – A process for planning and executing necessary journeys safely.

2.11 **Local Laws** – Signs, postings, laws, regulations, ordinances and codes applicable for the jurisdiction in which the motor vehicle is being operated.

2.12 **Managers/Management** – All AECOM company personnel with supervisory responsibilities or direct reports.

2.13 **Mobile Communication Device** – A mobile electronic device that is used to receive or communicate voice, email, internet, and/or public media. The device requires user interaction (typing, dialing, reading, keying, etc.) that distracts the motor vehicle operator. Example devices include, but are not limited to:

- Mobile/Cellular phones
- Personal Data Assistant (PDA)
- iPads, iPods, or other tablet models
- Computers
- Global Positioning System receivers

2.14 **Motor Vehicle Report (MVR)** – A listing of the tickets (violations), incidents collision for an individual driver over a period of time (e.g. 3 years, 5 years) provided by a state or provincial authority such as the Department of Motor Vehicles.

2.15 **Personal Vehicle** – A motorized vehicle owned or leased by an employee.

2.16 **Spotters –** Extra personnel that may provide guidance when maneuvering in close and/or complex situations in order to avoid the occurrence of an incident.

2.17 **Task Hazard Analysis (THA)** – A process for planning and evaluating tasks, such as driving, for hazards and control measures to reduce and eliminate the risk of a harmful event.

2.18 **Vehicle Incident** – An incident, for the purposes of this procedure, is a vehicle collision or other vehicle related event where personal injury or property damage occurs. This includes theft, vandalism, and criminal mischief. Citations are considered incidents when the citation is received during the course of business and results in a restricted or suspended license, a governmental motor vehicle agency assigning points to the employee's license, or the employee provides AECOM's insurance as proof of insurance at the time of incident.

3.0 References

3.1 AECOM US, Canada and South America Employee Handbook (HR Department)

3.2 Americas Fleet Vehicle Operations Policy

3.3 AECOM Global Travel Policy

3.4 National Safety Council

3.5 Smith Systems

3.6 WP-001-PR Firearms Standard

3.7 S2-032-PR1 Weapons Safety

3.8 S3NA-003-PR1 SH&E Training

3.9 S3NA-004-PR1 Incident Reporting

3.10 S3NA-209-PR1 Project Hazard Assessment and Planning

3.11 S3NA-404-PR1 Commercial Motor Vehicles

3.12 S3NA-603-PR1 Incident Investigation and Review

4.0 Procedure

4.1 Roles and Responsibilities

4.1.1 **Regional Executive**

- Supports the implementation of the *Americas Fleet Vehicle Operations Policy*, including preventative maintenance, vehicle disposition and insurance.
- Providing necessary resources to manage vehicles and drivers to the extent their operation requires.

4.1.2 **Supervisor**

- Confirming employees are informed of the provisions of this procedure and related vehicle procedures.
- Providing a copy of this procedure to an employee who will be driving an AECOM owned, leased or personal vehicle for company business.
- Verifying that each employee has completed *S3NA-005-FM1 Driver's Authorization* per the instructions on the form.
- Allowing employees to designate time to complete required driving safety training, vehicle inspections and related activities.
- Assigning driving tasks to authorized employees only.
- Selecting and providing vehicles for use by authorized employees that are appropriate for the planned working conditions and environment.
- Supporting employees in the reporting of vehicle incidents per *S3NA-004-PR1 Incident Reporting,* including the entry of the incident into IndustrySafe.

4.1.3 **Employee**

- Following this procedure and applicable laws while operating a vehicle.
- Completing required training consistent with the training needs assessment and requirements per the *S3NA-003-PR1 SH&E Training*.
- Reporting to their supervisor if the vehicle selected is not appropriate for working conditions and environment.
- Reporting to their supervisor if they are inexperienced in operating the type of vehicle they are assigned.
- Reporting to their supervisor if they are inexperienced driving in the type of working conditions and environment they are assigned.
- Review the Driving THA and prepare a Journey Management Plan by completing the *S3NA-005-TP1 Journey Management Plan.*
- Immediately reporting vehicle incidents per *S3NA-004-PR1 Incident Reporting*, including the entry of the incident into IndustrySafe.
- Notifying their Supervisor, Region SH&E Manager, and Region Counsel upon receipt of a legal summons associated with a moving violation related to the use of a company vehicle.
- Immediately reporting a change or limitation(s) to his or her Driver's License to his or her Supervisor.
- Conducting a pre-operational inspection of the vehicle for damage or deficiencies and reporting discovered deficiencies affecting the safe operation of the motor vehicle to the appropriate authority (Region Fleet Vehicle Coordinator, Rental Car Agency or other).

4.1.4 **Region SH&E Manager / SH&E Department**

- Maintaining and updating resources for Driver Safety Training
- Maintaining this procedure and updating it when regulatory or company policies dictate.
- Assisting operational leaders with determining the risk incurred by the use of motor vehicles.
- Participating in the incident investigation and review process.

4.1.5 **Region Fleet Vehicle Coordinator (in their assigned regions)**

- Escalating safety issues related to fleet vehicles for resolution through the Fleet Management Company.
- Disposing of fleet vehicles per the guidance in the *Americas Fleet Vehicle Operations Policy*.
- Refer to the Region SH&E Manager for Fleet Vehicle driver training verification and risk assessment.

4.1.6 **Region Human Resources Manager**

- Responsible for verifying license and proof of personal vehicle insurance at the time of hire and upon verification of the Driver Authorization Form.

4.2 General Procedures and Practices

- Only Authorized Drivers are to operate a motor vehicle (rental, personal, or AECOM owned/leased) while on AECOM business, refer to *S3NA-005-WI1 Authorized Driver Safety Practices*.
- Drivers must comply with *AECOM's Global Travel Policy*, *Americas Fleet Vehicle Operations Policy*, and the applicable laws. (NOTE: *Individual state, provincial, and local laws vary*.)
- AECOM Fleet Vehicles and Rentals Cars should not be operated if the age or mileage on that vehicle exceeds the following:
    - Light/Medium Duty Trucks: 72 months/150,000 miles
    - Sedans: 36 months/80,000
    - Sport Utility Vehicles/Vans: 60 months/100,000 miles
- Seat belts are to be worn by the occupants. The number of passengers shall not exceed the manufacturer's specifications for the vehicle.
- Motorcycles may not be operated on company business unless:
    - Specific approval is provided by the **Supervisor** with concurrence from the **Region SH&E Manager.**
    - A hazard analysis is completed.
    - Required training and license is in place.
    - Headlights or daytime running lights will be used when the vehicle is in operation. Class 2 or 3 safety vest worn while operating a motorcycle.
- Fire arms and weapons are not permitted in AECOM Fleet Vehicles or rental vehicles insured by AECOM. Firearms and weapons in personal vehicles are subject to the laws and regulations of the respective local, provincial, state, territory, federal and region and/or country. In accordance with the Global Safety Department standards, no firearms or weapons are allowed to be used without express permission by the **Region Executive** and **Chief Security Officer**, refer to the *WP-001-PR Global Firearms Standard*. Exceptions can be made in writing from the **Region Executive** and **Chief Security Officer** if knives or weapons are required as part of the work activity or for third party protection and planned for appropriate hazard control measures and training, refer to the *S2-032-PR1 Weapons Safety*. Vehicles are to be selected based on the nature of planned use. In some working conditions, four-wheel drive and higher clearance vehicles may be required to ensure safe travel. Vehicle requirements/specifications must be identified in the project specific safety plan or THA.

- Vehicles are to be outfitted with the appropriate support equipment based on the THA or client vehicle specifications. Support equipment may include cones, rotating waning lights, warning flags, vehicle identification (magnetic door signs or similar,), wheel chocks, cargo nets, rollover protection.
- Drivers are to operate vehicles in a manner that avoids situations where backing is necessary. Reverse parking of all vehicles while on business is required. Backing of trucks and heavy equipment requires then a spotter to assist the driver in avoiding collisions.
- Non-AECOM drivers (subcontractors, joint venture partners, clients) are prohibited from operating an AECOM leased or owned vehicle unless the activity is specifically agreed to in the applicable contract and only if the use of the vehicle is consistent with the terms of the contract.

4.3 Distracted Driving

The use of all mobile communication devices (MCDs) while driving is strictly prohibited. MCDs include all hand-held or hands-free devices, including all mobile phones and other portable electronic devices that cause driver distraction such as tablets (e.g., iPads), PDAs, pagers, iPods, MP3s, GPS, DVD players, laptops, etc. Employees shall not use a personal or company MCD while driving a company vehicle; use a company MCD while driving a personal vehicle; or use a personal MCD while driving a personal vehicle on company business. Driving includes the time spent in traffic or while stopped at red lights or stop signs.

GPS units and GPS units on smart phones may only be used if factory installed or secured to the vehicle with a bracket that allows the driver to view the image without having to take their eyes off the road. Electronic devices shall be setup for operation prior to commencing driving activities.

4.4 Impairment

- Impairment can take many forms ranging from fatigue, to the use of prescription medication or alcohol (even small amounts), to the abuse use of illegal and legal drugs and alcohol. AECOM **Employees** are not to drive in an impaired condition.
- AECOM **employees** are prohibited from being under the influence of alcohol or drugs or improperly using medication in a way that could diminish, or raise questions concerning, an employee's ability to perform at his or her best while performing services for or on behalf of AECOM.
- AECOM **Employees** are prohibited from operating a vehicle if they are experiencing signs and symptoms of fatigue. **Employees** should stop work and rest before driving. No **Employee** should operate a vehicle if they have worked 14 consecutive hours within a 24 hour period.

4.5 Task Hazard Analysis (THA)

All **Employees** are to review a Driving THA prior to driving for company business, refer to *S3NA-209-PR1 Project Hazard Assessment and Planning*.

4.6 Journey Management

Journey Management is a process for planning and executing necessary journeys safely. Journey Management includes the following steps:

- Determining if the trip is necessary;
- Evaluating alternative safer modes of transport;
- Evaluating the potential to combine journeys with others.

Trips in excess of 100 miles (160 kms) (each way), or into remote or hazardous areas, or when otherwise deemed necessary, shall have a Journey Management Plan (JMP). This plan typically includes the route, location of route hazards, timing, rest periods and locations, communications, emergency response and security arrangements.

A sample Journey Management Plan has been provided in *S3NA-005-TP1 Journey Management Plan.*

Drivers are responsible for developing the Journey Management Plan in coordination with their **Supervisor**, **Project Manage**r and **Region SH&E Manager** (as appropriate).

4.7 Driver Safety Training

- Driver safety training is to be assigned based on the risks posed with the work environment and vehicle type, using the training needs assessment process, refer to *S3NA-003-PR1 SH&E Training*. A determination of training type is at the discretion of the **Supervisor**, the following guidance will be applied:
- Driver Safety Awareness – is appropriate for Authorized Drivers who periodically use their personal vehicle, AECOM Fleet Vehicle or rental car for AECOM business. Driver Safety Awareness training is an eLearning module approximately 1 Hour in length.
- Defensive Driver (online) – is appropriate for authorized drivers who are assigned an AECOM Fleet Vehicle or rental vehicle for a significant period of time with the expectation that the **Employee** utilizes the vehicle on a regular basis for AECOM business. Defensive Driver training is provided online through one of the following AECOM-approved training resources:
  - The National Safety Council
  - Alert Driving
- Defensive Driver (hands-on) – is appropriate for Authorized Drivers who drive in remote locations, hazardous environments (such as refineries, ports, terminals etc.), at-risk drivers, and as required by clients. Defensive Driver hands-on training is provided through one of the following AECOM-approved training resources such as Smith Systems. Hands on defensive driver training may also be required as a result of an incident or negative Motor Vehicle Report.
- Driver Retraining – Drivers involved in repeated motor vehicle incidents, incidents of sufficient severity or concern, or drivers identified as at-risk through AECOM's Motor Vehicle Report/Driver Abstract process shall be subject to a driver retraining program that may include any of the above programs or other training programs appropriate for the type of driving the employees performs. Retraining programs will be implemented at the discretion of the **Supervisor** and **Region SH&E Manager** Depending on the severity of the incident, the **Employee** may be subject to disciplinary and refused the right to drive on behalf of AECOM.
- Special Vehicles and Driving Conditions – Vehicles such as All-Terrain Vehicles (ATVs), four wheel drive vehicles, motorized carts, box vans and trailers (towing) require specialized training and supervision. Use of these types of vehicles is limited to AECOM projects, therefore training and qualification programs for drivers will be project specific. The **Project Manager** shall work with the **Region SH&E Manager** to tailor training to the specific needs of the project.

4.8 AECOM Fleet Vehicles (additional requirements)

- The requirements of this procedure apply to the use of AECOM Owned or Leased Vehicle, and additional requirements are set forth in the Americas Fleet Vehicle Operations Policy.
- Fleet Vehicles are to be parked on project sites in a manner that prevents the driver from backing (reversing) upon departure. For example, the vehicle should be backed into a parking spot or drivers should select a parking spot that allows them to "pull" through" so that the vehicle is facing the direction of departure.
- Fleet Vehicles are to have a "Safety Kit" that contains a first-aid kit, portable fire extinguisher, safety triangle, and two reflective safety vests. If not available, contact the **Region Fleet Vehicle Coordinator** about how to obtain one through the procurement system.

4.9 Personal Vehicles (additional requirements)

The requirements of this procedure apply to the use of a personal vehicle for company business. Additional requirements are set forth in the *AECOM Global Travel Policy*.

4.10 Rental Vehicles (additional requirements)

The requirements of this procedure apply to the use of a rental vehicle for company business. Additional requirements are set forth in the *AECOM Global Travel Policy*.

4.11 Requirements for Authorized Drivers

- Review the *S3NA-005-WI1 Authorized Driver Safety Practices* for more specifics.
- Perform pre-operation vehicle inspections, a sample vehicle inspection checklist is provided in *S3NA-005-FM2 Vehicle Inspection Checklist*.
- Arrange for preventive maintenance services for the vehicle and maintain it in sound mechanical condition, per manufacturer's recommendations.
- Drivers are not to permit unauthorized persons to operate an AECOM owned/leased/rented vehicle.
- Do not operate the vehicle if unsafe maintenance conditions exist that would likely result in vehicle damage or personal injury. This applies to vehicles owned or leased by AECOM and to personally-owned vehicles used for company business. Escalate other maintenance issues for correction to appropriate authority (**Region Fleet Vehicle Coordinator**, Rental Car Agency, **Supervisor** etc.).
- Use AECOM owned or leased vehicles for business only. Exceptions to use the vehicle as transportation to and from work, parking at residences overnight, may be permitted only if written approval is obtained from the **Regional Executive**.
- Transport only persons on AECOM related business or those persons receiving transportation as a prescribed service. Only drive vehicles in conditions for which the driver has the appropriate training and experience.
- No smoking by the driver or passengers in the vehicle.
- Drivers are responsible for damage caused by abuse of the vehicle.
- Secure the vehicle when left unattended.
- Securing loads in the inside and outside compartments of the vehicle. Do not rely on weight/shape of load alone. Always use a cargo net, straps, containers or other mechanical device when necessary to ensure load is secure. Mark loads that extend the beyond the end of truck, trailer or similar edge with a red warning flag of at least 16 square inches.
- Refrain from modifying existing equipment (warning sounds, backing alarms etc.) and from installing aftermarket equipment including toolboxes, truck caps, specialty lights, or towing equipment) without approval from the **Regional Executive, Region Fleet Vehicle Coordinator**, and AECOM Procurement Department.
- Shut the engine off when refuelling the vehicle.

4.12 Emergency Preparedness

- The following suggested items should be kept in vehicles used for company business in remote project locations:
  - First Aid kit, appropriate to the work and crew size, or per regulations.
  - Fire extinguisher, safety triangle, and safety vest
  - Emergency equipment (e.g., flares, flashlight, blanket, drinking water, etc.) based on conditions.
  - Means of communication (cell phone, radio or satellite phone), extra batteries or a charger.
- To the extent possible, **Employees** should refrain from changing tires or making repairs to vehicles in the field. A road side assistance service should be identified for vehicles used for company business in advance travel.
- Specific emergency procedures are to be identified in the Journey Management Plan or the THA.

4.13 Vehicle Incidents

- Vehicle incidents are to be managed consistent with *S3NA-004-PR1 Incident Reporting*.
- For vehicle incidents that involve non-emergency injuries or potential injuries, **Employees** must call the Incident Reporting and Assistance Line at 1.800.348.5046 for connection with Work Care medical support. The **Employee** or **Supervisor** is responsible for making the initial notification into IndustrySafe within 4 hours of the event.
- For vehicle incidents that involve property damage greater than $2,500, **Employees** are to call the Incident Reporting and Assistance Line at 1.800.348.5046 for connection with appropriate resources within AECOM, The **Employee** or **Supervisor** is responsible for making the initial notification into IndustrySafe within 4 business hours of the event.
- Non-critical and no-injury incidents (property damage less than $2,500, near misses, etc.), the **Employee** or **Supervisor** is responsible for making the case entry into IndustrySafe by the end of the work shift (at least within 24 hours of the event).
- For Fleet Vehicles, employees must contact the AECOM Fleet Management Company (Wheels: 800-477-2211) to report the incident. Refer to the Americas Fleet Vehicle Operations Policy for further information. Vehicle incidents that result in property damage or loss greater than $2,500 or cause injuries to AECOM **Employees** that result in medical treatment are to be investigated using the AECOM Incident Investigation Process in *S3NA-603-PR1 Incident Investigation and Review*.
- The **Employee(s)** involved in the incident are advised to:
  - Provide (if requested) to police and the other driver(s) their liability insurance information.
  - Not operate a damaged vehicle if its safety is questionable, its operating condition is illegal by applicable laws or its condition is such that further damage would likely result from its operation.
  - Cooperate with **Region Counsel** if the incident results in unresolved risks or third party claims, or if the **Employee** receives a Summons, Complaint or other legal documents relating to a traffic incident.
  - NOT ADMIT LIABILITY, AGREE TO PAY FOR DAMAGE OR SIGN A DOCUMENT RELATED TO AN INCIDENT EXCEPT AS REQUIRED BY LAW. Statements made in haste or anger may be legally damaging.
  - **Employees** must report the incident to AECOM's Global Travel Department. If the incident involved a third party, the driver is responsible for obtaining a copy of the police report and providing to global travel

4.14 Drug and Alcohol Testing

- Testing for Alcohol and/or Drugs procedures are specified in the *US and Canadian Employee Handbook* and administered through the AECOM **Human Resources Department**.
- In the event that a police/regulatory officer responding to a vehicle incident administers field and/or laboratory impairment testing AECOM reserves the right to obtain copies of such testing results for inclusion in the incident report and consideration in a subsequent incident investigation.

4.15 Citations and Violations

- Citations and violations which occur while driving for company business are to be reported as a Vehicle incident, using *S3NA-004-PR1 Incident Reporting* within 24-hours.
- The **Employee** is personally responsible for payment of fines for moving violations and parking citations incurred while driving a vehicle on AECOM business and for reporting such Incidents to his/her **Supervisor**, **Region SH&E Manager**, and **Region Counsel**.
- If an Authorized Driver receives a citation for DUI/DWI/Operating Under the Influence, is suspended from driving or has his/her driver's license revoked, he/she is required to notify his/her **Supervisor** and

Region Fleet Vehicle Coordinator within 8 hours of the action. Failure to do this may result in disciplinary action up to and including termination.

5.0 Records

5.1 None

6.0 Attachments

6.1 S3NA-005-WI1 Authorized Driver Safety Practices

6.2 S3NA-005-FM1 Driver Authorization

6.3 S3NA-005-FM2 Vehicle Inspection Checklist

6.4 S3NA-005-TP1 Journey Management Plan

Americas

Authorized Driver Safety Practices

S3NA-005-WI1

1.0 Before Vehicle Operation

1.1 Conduct a Pre-Trip *Vehicle Inspection, S3NA-005-FM2*.

1.2 Be familiar with applicable client rules and regulations when on the client's sites. The employee may, for example, be required to leave their keys in the ignition with the vehicle turned off or to display a vehicle pass. When parking, it is recommended that employees back the vehicle into the parkingspace.

1.3 Plan your travel to avoid being in a rush, traveling during peak traffic hours, and traveling through high traffic volume areas. Utilize the *S3NA-005-TP1 Journey Management Plan* as appropriate.

2.0 During Vehicle Operation

2.1 The Driver and all passengers must wear seatbelts at all times.

2.2 Maintain a safe distance when travelling behind other vehicles.

2.3 Confirm the area behind your vehicle is clear prior to and while reversing a vehicle.

2.4 When parking the vehicle on the edge of a roadway, turn on the four-way indicators (hazard lights) prior to leaving the vehicle. Use cones or other warning devices, and wear a high visibility traffic vest.

2.5 Observe extra caution in and around emergency and construction zones.

2.6 Avoid unattended rest areas, when possible, and especially at night.

2.7 If the vehicle breaks down, attempt to get to a secured location. Call police or roadside assistance as appropriate. Do not leave the vehicle.

2.8 Contact the police to help those with car trouble instead of stopping to assist.When possible, staff should have a car mechanic or roadside assistance change or repair a flat tire. If the Driver or passenger must change a tire, the Driver and passenger must adhere to the manufacturer's specifications and observe the proper lifting technique and safety procedures. Proper lifing is addressed in *S3NA-308-PR1 Manual Lifting, Field*.

3.0 24 – Hour Roadside Assistance, AECOM Fleet Vehicles only: Wheels: 800-477-2211

3.1 Authorized Drivers are to park Vehicles are to on project sites in a manner that prevents the driver from backing (reversing) upon departure. For example, the vehicle should be backed into a parking spot or the driver should select a parking spot that allows them to "pull" through" so that the vehicle is facing the direction of departure.

3.2 Authorized Drivers should use the "Get Out And Look" (GOAL) method before placing a vehicle in motion. Drivers are to make a 360-degree (360°) walk around of the vehicle immediately before placing vehicle into motionin order to determinewhether there are hazards or possible obstructions in the proposed path of travel. Drivers are to clear the area of people and objects before placing the vehicle in motion. A check will also be performed to ensure overhead and side clearances are adequate. The following are recommended best practices:

- Placement of cones on the right side of the front and rear of vehicle upon parking and retrieved during the 360° GOAL walk-around.
- In lieu of cones, place GOAL magnets on the right side of the hood and truck/tailgate of the vehicle upon parking. The GOAL magnets should then be retrieved during the 360° GOAL walk around just prior to moving the vehicle again.

- Place a GOAL sticker on the driver side door window as a reminder to get out and look.

4.0 If Vehicle is to be Left Unattended

4.1 Turn the ignition off, remove the key and set the emergency brake (if parked on an incline).

4.2 Lock and secure the vehicle.

4.3 Secure equipment and property in a locked trunk or tool chest.

4.4 Do not leave keys in an unattended vehicle.

5.0 Staff shall Drive Defensively

5.1 Look aheadtaking at least 15 seconds to visually identify if there is slowing traffic or another type of road hazard ahead or to your side. Don't drive behind vehicles that block your view.

5.2 Get the big pictureand look for hazards (other motorists, pedestrians, cyclists, road debris, etc.)

5.3 Scan your mirrorsevery 5 – 8 seconds to look for hazards. Don't stare or fix your eyes on any one item for too long.

5.4 Leave yourself an outby monitoring your space in front, behind and to each side of the vehicle, leaving enough are as a cushion so that you can take evasive action if needed.

5.5 Be seen by all other drivers, pedestrians, cyclists and others using or crossing the road. Use your headlights and avoid driving in the blind spot of other vehicles. Make sure your horn works and use it to warn others.

6.0 Road Rage

6.1 Road rage is a dangerous driving situation that can occur and should be avoided whenever possible, but NEVER instigated. Do not get drawn into a confrontation. Avoid any confrontational eye contact or gestures.

6.2 The driver should be aware of the vehicles around them, paying frequent attention to the vehicle's mirrors.

6.3 Get out of the way.even if the other motorist is speeding, it is safest not to make a point by staying in your lane. The other driver may be dealing with an emergency situation.

6.4 Unless it is necessary to use the horn as an alert, do so sparingly.

6.5 If someone is following you after an on-the-road encounter, drive to a public place or to the nearest police station and seek assistance.

6.6 Attempt to note the offender's license plate number and write it down as soon as it is safe to do so and the vehicle is not in motion.

6.7 Report any aggressive driving to the police immediately. This action may aid in preventing further occurrences by the same driver.

7.0 Work Trucks

7.1 When accessing any pickup truck box, staff will: step up into the box to avoid excess reaching and strain and; use three point contact getting in and out of the truck box (i.e., avoid jumping off the tailgate).

7.2 Be vigilant of differences between trucks and small cars related to blind spots, turning radius, and required overhead and undercarriage clearances.

8.0 Winter Driving

8.1 Clear snow from exterior vehicle surfaces.

8.2 Avoid using cruise control on icy roads.

8.3 Accelerate and brake gently to reduce skids or spinouts.

8.4 Wear winter clothing that does not restrict movement, vision or hearing.

8.5 Where required, have snow chains for the vehicle and be familiar with their installation.

8.6 Use extra caution while driving during hazardous winter conditions.

8.7 Avoid sudden changes of speed or direction to reduce possibility of skidding.

8.8 Drivers should leave extra distance between their vehicle and the vehicle ahead of them. Stopping on ice takes about eight times the distance that it takes on dry pavement.

8.9 Carry suitable warm clothing and emergency equipment during the winter months. Temperatures can plunge rapidly.

8.10 Be aware of icy patches on the road bridges and intersections that are especially prone to ice patches.

8.11 Be familiar with the skid control procedures for the type of vehicle being driven (i.e., front, rear or four-wheel drive).

9.0 Gravel Roads and Remote Locations

9.1 Prior to driving on a road with an assigned radio frequency, the passenger will test the two-way radio to confirm that the proper radio frequency is set, and that the transmission is being received clearly by other traffic. The passenger will operate the two-way radio.

9.2 Drivers will maintain appropriate speed for the road conditions.

9.3 Headlights will be used when operating the vehicle.

9.4 Drivers will respect the understood road protocol, drive defensively and respect intersections.

9.5 4WD options will be utilized at the discretion and comfort level of the driver. If road conditions are questionable even for 4WD use, the road will not be traveled and either another route found or the job postponed until road conditions improve.

10.0 Off-road

10.1 If inexperienced, seek supervisory advice and training.

10.2 Vehicles should only be driven off roads after other available options (e.g., use of ATV's, etc.) have been considered.

10.3 Prior to driving off-road, check to see that the vehicle is in good operating condition and your tires are properly inflated.

10.4 Realize the limitations of your vehicle and do not become over confident.

10.5 Seat belts should be kept fastened and loose objects in the vehicle securely fastened to prevent them from becoming projectiles in the event of a sudden stop.

10.6 Drive according to the ground conditions.

10.7 Speed and power are normally not required in rough off-road driving.

10.8 Learn to read the surrounding terrain. Monitor the ground conditions ahead of the vehicle -- it is essential to know what to expect in light of the road conditions.

10.9 When slowly traversing difficult areas of soft ground, try to keep the vehicle in motion. Once stopped it will be far more difficult to get the vehicle going again. If the vehicle becomes stuck, do not spin the wheels, as it will only dig in further or deeper until the vehicle chassis rests on the ground. Try to go slowly backwards in the vehicle's own tracks, as these have been previously compressed by the vehicle. In most cases this will be successful. If not, place appropriate material (e.g., wooden planks, mats, branches, etc.) under the wheel to improve traction.

10.10 Before driving over rough terrain, the terrain should be inspected on foot first.

10.11 When climbing hills in the vehicle go straight up or down. It is also smart to know what is on the other side of the hill before going up. At the base of the hill the driver should apply more power. Ease up on the power while approaching the top and before going over the crest. If the vehicle stalls on the ascent, back straight down the hill in reverse. For downhill travel in a vehicle with manual transmission, always use the lowest appropriate gear, and do not disengage the clutch to allow the vehicle to coast. If the vehicle is equipped with an automatic transmission, use low range and the lowest drive setting. DO NOT drive a hill at an angle this increases the risk for a roll-over incident. If the hill is very steep and you do not feel confident that your vehicle can make it up, then do not attempt it.

10.12 When driving through water, consider the maximum wading depth of the vehicle. The air intake must always be kept clear of water. Driving through water should always be done slowly to keep the bow wave low. In addition, slow speed prevents a hot engine from suffering tension cracks by sudden contact with cold water. Check the brakes after leaving the water.

10.13 Prior to returning to the road, do a vehicle inspection to confirm the vehicle is road worthy.

Americas

Driver Authorization

S3NA-005-FM1

Employee Name :	**Employee Number:**	**Office or Project Location:**	**Date:**

NOTE: It is not a requirement to provide copies of your driver license or proof of insurance as an attachment to this form. Supervisors are responsible for validating these documents are accurately represented in this form.

Employee

Driver's License Expirations Date	
Driver's License Number	
Proof of valid automobile insurance (for personal vehicle use only)	Check if Confirmed ☐

I acknowledge that I have read S3NA-005-Driver and Vehicle Safety and understand that it contains important information about AECOM's procedures regarding employee use of AECOM fleet, rental and personal vehicles. I agree to adhere to the requirements of the Procedure. _______ (Initial)

As a condition of driving a vehicle on AECOM business I will present my driver's license and proof of insurance (personal vehicle only) for validation by my Supervisor. _______ (Initial)

I understand as a condition to operating an AECOM fleet vehicle, AECOM may run a Motor Vehicle Driving Record report and provide this report to my Supervisor. _______ (Initial)

I understand I must notify supervisor immediately of any change to the status of my Driver's License, any citation or violation I receive driving for company business, and any incident that occurs while driving for company business. _______ (Initial)

I understand that AECOM reserves the right to terminate my driving privileges and associated benefits at any time, for any reason, in its sole discretion. _______ (Initial)

I understand that I am required to participate in a defensive driving course at AECOM's expense and may be required to participate in more advance training. _______ (Initial)

This procedure and my signed acknowledgement supplement the terms of my employment relationship with AECOM. _______ (Initial)

Date:	**Signature:**

Supervisor

I confirm that the Driver's License Number, Expiration Date and Proof of Insurance designated above are consistent with the employee's Driver's License and Proof on Insurance.

Date:	**Signature:**

Distribution

When the *Authorization* is completed email a copy to hrrecords@aecom.com (for inclusion in the employee's file). Additional copies must be provided to the following:

1) The employee
2) The supervisor (if the employee is assigned to an office location)
3) Project record (if the employee is assigned to a project location)

Americas

Vehicle Inspection Checklist

S3NA-005-FM2

Vehicle Tag No :	Date:	Time:	Mileage:	Driver Name:	Location:

Inspection Checklist: This Pre-Trip Vehicle Inspection Checklist is intended to be completed by the vehicle driver prior to departing on a trip. Checking boxes means that item is present and functioning. Deficiencies increase risk of an incident and should be repaired or corrected prior to departure. This checklist should only be used in addition to an on-going vehicle maintenance program. For AECOM Fleet Vehicles, report defiencies to: 800-477-2211 (Wheels)

Item	Yes	No	N/A
1. General			
1-1. Proof of insurance and registration available and current?	☐	☐	☐
1-2. Is the date of the last regular maintenance known, or is the mileage/date of next scheduled maintenance known?	☐	☐	☐
1-3. Have any safety recalls issued for this vehicle been addressed?	☐	☐	☐
1-4. Is the overall condition of the vehicle good (no leaks , body damage, unusual sounds when started)?	☐	☐	☐
2. Tires			
2-1. Do all four tires have sufficient tread for driving conditions? Legal limit: 2/32” (for rain/snow: > 4/32”)	☐	☐	☐
2-2. Are tires sufficiently inflated for driving conditions?	☐	☐	☐
2-3. Are the lug nuts and stem capspresent and tight for each tire?	☐	☐	☐
2-4. Is the spare tire and jack present and in good condition?	☐	☐	☐
3. Driver’s and Passenger’s Seat			
3-1. Are the pedal pads in good condition?	☐	☐	☐
3-2. Are the floor mats in good condition and not interfering with the pedals?	☐	☐	☐
3-3. Is the seat properly adjusted (including the headrest)?	☐	☐	☐
3-4. Is the seatbelt in good condition?	☐	☐	☐
3-5. Are the mirrors is good condition (not broken, dirty)?	☐	☐	☐
3-6. Is the dashboard free of warning lights and do the gauges appear to work when the car is started?	☐	☐	☐
3-7. Does the horn work?	☐	☐	☐
3-8. Are distractions such as cell phones and gps units secured so they do not encourage?	☐	☐	☐
4. Lights and Signals			
4 -1. Do the headlights and high beams work?	☐	☐	☐
4-2. Do the turn signals work (front and rear)?	☐	☐	☐
4-3. Do the brake lights work, including the high light in the rear window?	☐	☐	☐
4-4. Do the hazard lights (emergency flashers) work?	☐	☐	☐
4-5. Do backing lights work?	☐	☐	☐
5. Windows and Windshield			
5-1. Is the windshield clean and unbroken?	☐	☐	☐
5-2. Are the wiper blades in good condition (front and rear)?	☐	☐	☐
5-3. Are all the windows clean and unbroken and windshield fluid available and operational?	☐	☐	☐
6. Emergency Equipment (as needed per conditions/project requirements)			
6-1. Is there a “Safety Kit” (fire extinguisher, first aid, safety triangle and 2 reflective vests)?	☐	☐	☐
6-2. Is there a first aid kit, has it been inspected recently?	☐	☐	☐
6-3. Is a means for emergency communication available?	☐	☐	☐

7. Other Equipment (as needed per conditions/project requirements)			
7-1. Is there a means to secured loads (cargo next, container)?	☐	☐	☐
7-2. Are cones or other warning devices available?	☐	☐	☐
7-3. Is weather specific equipment (snow chains, tired etc.)?	☐	☐	☐

Americas

Journey Management Plan

S3NA-005-TP1

Journey Management Plan – required for trips > 100 miles (one way)
1. Driver and Passenger Information
Driver Name:
Driver Training Completed:
Passengers:
2. Vehicle Information
Vehicle Type/Description:
3. Trip Information
What is the purpose of the trip?
Single Trip: ☐ Reoccurring Trip: ☐ / / to / /
Is traveling for this purpose necessary?
Have alternate modes of travel (telepresence, public transportation, air,) been evaluated? ☐ YES ☐ NO
Departure Location:
Departure Date: Time:
Arrival Location:
Arrival Date: Estimated Time:
What is the weather forecast:
What is the route of travel: (okay to insert map)
4. Special Conditions

Check all that may apply:

- ☐ Night Driving
- ☐ Weather
- ☐ Long Driving (Over 2 hours)
- ☐ Fatigue
- ☐ Potential for distraction
- ☐ Other ___________________
- ☐ Other ___________________
- ☐ Rugged Terrain (4 x 4)
- ☐ Large Vehicles/Farm Equipment
- ☐ Animals
- ☐ Rush Hour/Heavy Traffic
- ☐ Towing
- ☐ Other ___________________
- ☐ Other ___________________

5. Site Arrival/Departure Procedure
1) Notify supervisor of safe arrival.
6. Site Arrival/Departure Procedure
1) Notify supervisor of safe arrival.
7. Emergency Planning
AECOM Supervisor (Name and Phone):
AECOM Project Manager (Name and Phone):
Roadside Service: For AECOM Fleet Vehicles Use: 800-477-2211 (Wheels)
AECOM Incident Reporting Line: 800-348-5046
AECOM Fleet Management: 800-477-2211
8. Approvals: all JMPs shall be reviewed and acknowledged by the driver and the driver's supervisor. A copy of the form shall remain with the driver and the supervisor for the duration of the journey. (Electronic copies are acceptable).
Driver's Signature:
Project Manager or Supervisor Name and Signature:

Emergency Response Planning, Field

S3NA-203-PR1

1.0 Purpose and Scope

1.1 Providing the requirements for preparation and planning for potential emergencies that may occur while AECOM staff are working in the field.

1.2 Applies to all AECOM Americas-based staff working outside of an AECOM office in a field environment.

1.3 The intent of this plan is to:

- Promote the safety of workers, visitors, and responders.
- Reduce the potential for destruction of goods and other property.
- Reduce the magnitude of environmental and other impacts.
- Help first responders quickly determine and initiate proper remedial actions.
- Reduce recovery times and costs.
- Make workers, visitors, and first responders more confident that emergencies will be properly managed.

2.0 Terms and Definitions

2.1 **Emergency –** An unplanned situation or event (including natural disasters) resulting in involvement of the public emergency services, police, fire, paramedic, or the environmental regulatory authorities.

2.2 **Voluntary First Aid Provider –** A general work force employee who is trained to render first aid, CPR, or use an Automatic Electronic Defibrillator (AED) on a voluntary basis. If Voluntary First Aid Provider were to render aid, they would do so as "Good Samaritans" and not as an occupational duty assigned by AECOM.

2.3 **Voluntary First Responder –** An individual who uses a limited amount of equipment to perform initial assessment and intervention and is trained to assist other emergency medical services.

3.0 References

3.1 S3NA-004-PR1 Incident Reporting

3.2 S3NA-101-FM1 Emergency Response Drill Report

3.3 S3NA-206-PR1 Fire Protection, Field

4.0 Procedure

4.1 Roles and Responsibilities

4.1.1 **Project Managers** are responsible for developing and implementing emergency response plans for their field staff and projects. They are responsible for confirming that an emergency drill is completed annually or more frequently as required by legislation, to confirm the effectiveness of the procedure and, as is needed, take corrective action. The *S3NA-101-FM1 Emergency Response Drill Report* will be used to confirm the completion and effectiveness of the drill.

4.1.2 **Site Supervisors** are responsible for confirming that crews have access to communication devices that are in good working order.

4.2 Emergency Response Plan (ERP)

4.2.1 **Project Managers** will establish and implement the ERP, including communicating the plan to all employees.

4.2.2 Emergency contact lists and procedures that includes fire, police, ambulance, poison control, first aiders on site, security, Site Safety Officer, SH&E reporting number for reporting all AECOM incidents, and other required emergency contacts will be available.

4.2.3 The site specific Emergency Response Plan (ERP) will comply with all governing regulations.

4.2.4 If the hazard assessment for the project indicates a need for planned evacuation or rescue, appropriate written procedures will be developed and implemented.

4.2.5 Staff will be trained for involvement in an emergency evacuation or rescue; however, all evacuations may require special preparation in the following circumstances :

- work at high angles,
- work in confined spaces or where there is a risk of entrapment,
- work with hazardous substances,
- underground work,
- work on or over water,
- work in remote isolation, and
- workplaces where there are persons who require physical assistance to be moved.

4.2.6 The ERP will address a clear path of travel to and from a working area, as applicable:

- The access will be made obvious and most direct with adequate illumination.
- The access will remain clear and unobstructed at all times.
- No material or equipment may be stored or temporarily left in path of egress.
- A traffic barrier will be used for facilitating vehicle and pedestrian traffic.
- The access route will have a clear line of vision into oncoming traffic lanes.

4.2.7 All staff will be advised of the location of first aid services, equipment, and supplies. Emergency contact information will be posted by all entrances on a worksite and left on the dash of the vehicle (mobile site office).

4.2.8 The ERP shall be tested for deficiencies through emergency response drills annually or more frequently as required by legislation.

4.2.9 The ERP shall be reviewed annually or more frequently as required by legislation.

4.3 First Aid

4.3.1 An assessment shall be made for each project or site visit to determine the response time and availability of Emergency Medical Services (EMS).

- If the assessment identifies reasonable risks that are life threatening and EMS response is greater than 4 minutes, at least two people on site shall be trained in first aid and CPR.
- If no life threatening risks exist on site and EMS response is greater than 30 minutes, at least one person shall be trained in first aid and CPR.
- **Project Manager** shall review local legislation for additional first aid requirements.

4.3.2 All AECOM site offices or trucks (mobile worksites) will maintain adequate first aid kits in convenient and accessible locations as appropriate for the specific location.

4.3.3 In addition, training of employees in basic first aid and adult CPR is required to meet legislative requirements. First aid certification shall be renewed every third year (or as dictated by legislation). Additional training may be required for personnel who have access to AEDs.

4.3.4 First aid attendants and all other persons authorized to call for transportation for injured workers will be made aware of the emergency evacuation procedures specific to their project site.

4.3.5 First aid supplies and facilities that meet the applicable federal, state, provincial, or territorial legislation will be made available on site. All first aid supplies and facilities will be maintained in accordance with the local legislation and inspected at least once per month.

4.4 Other Emergency Response Equipment

4.4.1 Provide portable fire extinguishers of appropriate class, size, and number of extinguishers in accordance with local legislation and *S3NA-206-PR1 Fire Protection, Field*.

4.4.2 Provide eye wash stations (where appropriate to hazards).

4.4.3 Maintain an ERP and emergency kit appropriate to the hazards associated with the location (e.g., earthquakes, tornadoes, hurricanes, etc.).

4.5 Communications

4.5.1 **Site Supervisors** are responsible for confirming that crews have access to communication devices that are in good working order, have reception in the area in which the crews will be working, and meet the needs of the planned check-in and emergency response procedures. This may include:

- 2-way radios,
- Cellular phones (or combination cell phone/2-way radio),
- Satellite phones,
- Car phones, or
- Personal Locator Beacons.

4.5.2 The **Project Manager** will be responsible for confirming that field crews have the appropriate means of communication before leaving for the field. The type of communication device will depend on the location and circumstances of the job task.

4.5.3 All staff is responsible for maintaining the communication devices in good working order before leaving for the field and for ensuring that battery-operated electronic devices have been recharged or have fresh batteries.

4.5.4 All staff is responsible for keeping communication devices clean and dry to facilitate their effective operation.

4.6 Visitors

4.6.1 All visitors to the site will review and acknowledge the safety plan or Task Hazard Analysis and associated Emergency Response Procedures.

4.7 Emergency Response

4.7.1 **Employees** responding to emergency situation should take no unnecessary risk. In the case of an emergency, the first aid attendant will promptly provide injured workers with a level of care within the scope of the attendant's training, objectively record observed or reported signs and symptoms of injuries and exposures to contaminants, secure medical treatment for workers with injuries considered by the first aid attendant as being serious or beyond the scope of the attendant's training.

4.7.2 All incidents will be reported in accordance with *S3NA-004-PR1 Incident Reporting*.

4.7.3 If emergency action is required to correct a condition that constitutes an immediate threat to workers, only those qualified and properly instructed workers necessary to correct the unsafe condition may be exposed to the hazard and every possible effort will be made to control the hazard while this is being done.

4.7.4 Emergency procedures are outlined in *S3NA-203-WI1 Emergency Response to Specific Hazards*; however, in situations where no specific procedures have been established, common sense and sound judgment should be followed to determine the safest course of action.

4.7.5 Upon evacuation or dismissal, no unauthorized or nonessential personnel are allowed access to the facility or project area during an emergency.

4.7.6 All accident and emergency sites will be immediately secured to prevent unauthorized access or the possibility of further risk to workers, property, or the public at large.

4.7.7 **Employees** should assist, as able to do so, and follow directions from a lead manager in any emergency operation.

4.7.8 **Employees** should render assistance in the safest possible manner, using appropriate personal protective equipment and precautions.

4.7.9 During an emergency, AECOM staff shall take direction from outside professional responders, as appropriate, who are in control of the situation.

4.8 Post-Emergency Follow Up

4.8.1 Prior to resuming operations, the work area will be inspected to confirm that conditions are under control and no longer pose a hazard to employees.

5.0 Records

5.1 The site-specific ERP will be filed in the project file.

5.2 ERPs shall be part of site SH&E audits.

5.3 Emergency Response Drill Reports shall be maintained in the project safety files.

6.0 Attachments

6.1 S3NA-203-WI1 Emergency Response to Specific Hazards

Emergency Response to Specific Hazards

S3NA-203-WI1

1.0 Injury or Health-Related Emergencies

1.1 In the event of serious illness or injury:

1.1.1 Do not move the victim or leave them alone unless absolutely necessary.

1.1.2 Call for emergency medical assistance.

1.1.3 Provide first aid to the level of qualification. Record the first aid given in the First Aid Treatment Record.

1.1.4 Request assistance from other first aiders as necessary.

1.1.5 Notify the immediate supervisor or manager.

1.1.6 If you are the injured or ill party, call for help and do not drive yourself to the hospital.

1.1.7 Arrange for hospital emergency service, medical practitioner's office emergency service, or medical practitioner's appointment, as needed.

1.1.8 Report the incident according to *S3NA-004-PR1 Incident Reporting*.

1.2 In the event of minor injuries:

1.2.1 If required, summon assistance.

1.2.2 Initiate first aid immediately as necessary.

1.2.3 Notify the immediate supervisor or manager.

1.2.4 Report the incident according to *S3NA-004-PR1 Incident Reporting*.

2.0 Fire

2.1 If you discover a fire:

2.1.1 If the fire is small and containable, use the appropriate fire extinguisher and/or fire fighting tools to extinguish the flames and cool the ashes.

2.1.2 Call emergency services to advise the operator of your location and provide as much detail as possible about the fire, its potential source, surrounding buildings or flammable materials, and number of people in the area.

2.1.3 If the fire is of moderate or large size, evacuate the area and do not return until emergency fire crews give the all-clear.

2.2 If you hear an alarm:

2.2.1 Go to designated muster point, if there is one, or evacuate the area to a safe distance.

2.2.2 Do not return to the area until officials provide the all-clear.

3.0 Electrical Storms

3.1 Guidelines

3.1.1 Lightning can strike several miles/kilometres from its source, so early precautions are crucial. If thunderstorms are in the forecast, reassess your plans for outdoor activities.

3.1.2 If you can hear thunder, then you are close enough to the storm to be at risk.

3.1.3 You are considered to be in the high danger zone if you are less than 6 miles/10 kilometres away. Use the 30/30 Rule to help you. If you can count 30 seconds or less between seeing lightning and hearing thunder, you should seek shelter immediately.

3.1.4 Do not resume any outdoor activities until you have waited at least 30 minutes after hearing the last clap of thunder. It is crucial to ensure that the risk of a lightning strike has passed completely.

3.2 Do:

3.2.1 Stay clear of high ground and open spaces.

3.2.2 Seek shelter in a house, large building or motor vehicle (if there is no other shelter). Keep windows and doors shut.

3.2.3 If you are riding a bicycle, motorcycle, or ATV, get off and seek shelter immediately. The rubber tires will not protect you.

3.2.4 If you are boating, head for shore. If caught on the water, crouch low in the boat.

3.2.5 If you are in a flat, open field, bend down and put your hand on your knees. Maintain minimum contact with the ground.

3.2.6 Avoid contact with metal. Stay at least 30 meters away from metal fences and take off shoes that have metal cleats.

3.2.7 Stay away from water, including lakes and puddles.

3.2.8 Stay sheltered until the storm is over.

3.3 Don’t:

3.3.1 Don’t seek shelter under a tree, in a shed, or in a small, open building.

3.3.2 Don’t lie down on the ground.

3.3.3 Don’t take a shower or bath. If lightning strikes the plumbing system it can be conducted into the tub or shower.

3.3.4 Don’t use the phone or electrical appliances unless absolutely necessary. Electricity travels through wires.

3.3.5 Don’t use a mobile phone outdoors.

3.3.6 Don’t hold a golf club, umbrella, or fishing rod.

3.3.7 Don't travel in a severe storm. If you are caught in your car, keep windows closed and park off the road away from power lines.

3.3.8 Don’t try to finish your activity; find shelter and wait out the storm.

3.3.9 Staff will not travel in areas where there is a severe thunderstorm warning.

4.0 Tornadoes

4.1 Guidelines

4.1.1 When a tornado approaches, anyone in its path should take shelter indoors—preferably in a basement or an interior first-floor room or hallway. Avoid basement or first-floor shelter areas with heavy equipment located on the floor directly above.

4.1.2 Make yourself as small as possible by crouching into a ball-like position, covering your head and neck.

4.1.3 Avoid windows and seek additional protection by getting underneath large, solid pieces of furniture.

4.1.4 Avoid automobiles and mobile homes, which provide almost no protection from tornadoes.

4.1.5 Those caught outside should lie flat in a depression or on other low ground and wait for the storm to pass.

5.0 Hurricanes

5.1 Guidelines

5.1.1 Coastal residents should form evacuation plans before a warning is issued to identify a safe shelter and a route to get there.

5.1.2 Stock up on emergency supplies including food, water, protective clothing, medications, batteries, flashlights, important documents, road maps, and a full tank of gasoline.

5.1.3 As a storm unfolds, evacuees should listen to local authorities on radio or television. Evacuation routes often close as a storm develops.

5.1.4 Dedicated professionals and improved technology have made hurricane forecasting more accurate than ever before, but it is far from precise.

5.1.5 If forced to weather a storm, get inside the most secure building possible and stay away from windows.

5.1.6 Remember that a lull often signifies the storm's eye—not its end. Anyone riding out a hurricane should wait for authorities to announce that the danger has passed.

6.0 Earthquakes

6.1.1 Drop down; take cover under a strong desk or table and hold on.

6.1.2 Stay indoors until the shaking stops and you are sure that it is safe to exit.

6.1.3 Stay away from bookcases or furniture that can fall on you.

6.1.4 Stay away from windows. In a high-rise building, expect the fire alarms and sprinklers to go off during a quake.

6.1.5 If you are in bed, hold on and stay there, protecting your head with a pillow.

6.1.6 If you are outdoors, find a clear spot away from buildings, trees, and power lines. Drop to the ground.

6.1.7 If you are in a car, slow down and drive to a clear place. Stay in the car until the shaking stops.

7.0 Gas Leak

7.1 Gas Odor

7.1.1 Leave the area immediately.

7.1.2 Notify the appropriate authorities and owner of the site.

7.1.3 Refrain from using ignition sources (cigarettes, electrical devices, etc. including cell phones).

7.1.4 Do not turn on vehicles or other electrical switches.

7.1.5 Warn others in the area.

7.1.6 Meet with responding personnel to identify the location of the odor.

7.2 Major Leak

7.2.1 Leave the area immediately.

7.2.2 Notify the appropriate authorities and owner of the site.

7.2.3 Secure area and warn others.

7.2.4 Meet with responding personnel to provide additional information.

7.2.5 Refrain from using ignition sources (cigarettes, electrical devices, etc. including cell phones).

7.2.6 Do not turn on vehicles or other electrical switches.

8.0 Violence or Potential for Violence

8.1.1 Remain calm.

8.1.2 Do not put yourself at increased risk.

8.1.3 Speak in a soft, non-threatening manner.

8.1.4 Do not touch the person or try to disarm them.

8.1.5 Avoid hostile actions or interactions, except to maintain personal safety.

8.1.6 Try to leave the area.

8.1.7 Report the incident as soon as possible.

9.0 Records

9.1 IndustrySafe

9.2 S3NA-004-PR1 Incident Reporting

9.3 S3NA-207-FM1 First Aid Treatment Record

Americas

Fire Protection, Field

S3NA-206-PR1

1.0 Purpose and Scope

1.1 This procedure establishes the AECOM requirements for the selection, placement, use, and inspection of fire extinguishing and fire detection equipment.

1.2 This procedure applies to all AECOM Americas field work.

2.0 Terms and Definitions

2.1 **Combustible liquid** – Liquid that must be heated to a temperature of 100 degrees Fahrenheit (°F) or 37.8 degrees Celsius (°C) to emit sufficient vapors to form an ignitable mixture with the air.

2.2 **Flammable liquid** – Liquid that gives off enough vapors to form an ignitable mixture with air at ambient temperatures (less than 100°F or 37.8°C).

3.0 References

3.1 S3NA-004-PR1 Incident Reporting

4.0 Procedure

4.1 Roles and Responsibilities

4.1.1 The **Project Manager** shall confirm that fire protection equipment is available at all field sites or in vehicles as required.

4.1.2 The **Project Manager** shall confirm that any fire extinguishing and detection equipment established at AECOM temporary worksites (and vehicles) are appropriately maintained and inspected in accordance with local fire codes.

4.1.3 The **Project Manager** shall confirm that all field staff who may have to use a portable fire extinguisher or other fire protection equipment are adequately trained in their use.

4.1.4 **Employees** shall maintain required training and familiarize themselves with the fire response and protection procedures that apply to the site on which they are working.

4.2 Planning

4.2.1 All field sites (including vehicles) will be equipped with a fire extinguisher and/or fire protection equipment appropriate to the number of staff, location of the work, and job task, as dictated by legislation or client requirements.

4.2.2 Fire protection equipment may include:

- Fire extinguishers, of the appropriate size, class, and type for the hazard; and/or
- Round-nosed shovel, as required

4.2.3 All **employees** shall be constantly on the alert for conditions that might contribute to a fire and shall remove or report the hazard.

4.2.4 All **employees** shall know the location of fire protection equipment in their work area.

4.2.5 Access to fire protection equipment must never be blocked by material, equipment, or vehicles.

4.2.6 A schedule for inspecting fire protection equipment shall be developed to confirm that it is in place, accessible, and fully charged. Inspection and maintenance shall be conducted in accordance with the manufacturer's instructions.

4.3 In the Event of a Fire

4.3.1 Activate the nearest fire alarm or call for help, if available, before attempting to extinguish a fire. If the fire is too big to control with the equipment at hand, retreat.

4.3.2 Never turn your back on a fire. Always back away until you are at a safe distance.

4.3.3 Never use water on an electrical fire.

4.3.4 All fire extinguisher contents shall be applied from upwind and shall be directed at the base or outer edge of the fire with a sweeping motion.

4.3.5 Never return a discharged fire extinguisher to its normal location. Take it out of service for recharging and replace it with a fully charged unit.

4.4 Fire Extinguishers

4.4.1 Vehicles and mobile equipment used for field work may be required to carry fire extinguishers, depending on client and/or industry standards. These fire extinguishers must be secured to the vehicle and never carried loose the cab. It is the responsibility of all field staff to confirm that these fire extinguishers are kept charged, secured, and available in good working condition.

4.4.2 Fire extinguishers shall be readily available wherever the potential for fire exists (e.g., during welding, grinding, or open flame operations).

4.4.3 Fire extinguishers shall be available in locations where flammable or combustible materials are stored, handled, or used.

4.4.4 Fire extinguishers shall be readily accessible, properly maintained, regularly inspected, and promptly refilled immediately after use.

4.4.5 Only trained personnel shall use a fire extinguisher. In the event of a fire, follow the site or project-specific emergency procedures for contacting the local fire department.

4.5 Location and Identification of Fire Extinguishers

4.5.1 Fire extinguishers shall be located and installed as follows:

- Mount fire extinguishers in compliance with local legislation.
- Located where they are readily seen. If an obstruction is unavoidable, then a sign indicating the location of the extinguisher and/or color symbol (e.g., red markings) will be used.
- Fire extinguishers shall always be positioned with the label visible.
- If extinguishers of different classes (e.g., one Class A and one Class B) are stored together, then they shall be marked using stencils or signs clearly indicating the type of fire for which each should be used.
- If an extinguisher contains an electrically conductive agent (e.g., water), it shall be clearly labeled with a sign that states “Not for Electrical Fires” with letters visible from at least 3 feet away.
- Extinguishers shall not be left on the floor, but shall be hung on a wall, column, or other appropriate support or shall be of the wheeled or cart type. Extinguishers of not more than 40 pounds shall be hung so that the top is not more than 5 feet above the floor. Extinguishers greater than 40 pounds shall be hung so that the top is not more than 3-½ feet from the floor. The bottom of the extinguisher shall not be less than 4 inches from the floor.
- Extinguishers shall be suitable for use at temperatures of 40°F to 120°F. The mounting locations shall allow the fire extinguishers to be kept within this temperature range.

4.6 Inspection of Fire Equipment

4.6.1 Inspection, Maintenance, and Testing of Portable Extinguishers

- The use or discharge of any fire extinguisher by an AECOM employee shall be immediately reported to the Supervisor. All use shall be reported in accordance with *S3NA-004-PR1 Incident Reporting.*

- Extinguishers shall be inspected monthly to ensure they are still in the proper location, have not been used or tampered with, are still properly charged, and that they have no obvious external damage. The initials of the inspector and the date of inspection shall be noted on the tag attached to the extinguisher.
- Any extinguisher showing damage shall be replaced.
- A thorough inspection shall be performed annually by personnel specifically trained in the inspection (e.g., extinguisher supplier).
- Extinguishers shall be tested and recharged by qualified contractors as required by the applicable regulations and standards.

4.7 Wildfire Fires

4.7.1 If a crew discovers an uncontrolled, wildfire, they will:

- Notify the appropriate authorities;
- If possible, use the fire protection equipment at their disposal to suppress the fire; or
- Evacuate the area; and
- Immediately notify their project manager and other AECOM personnel in the area.

4.7.2 If a crew is to be working in an area where a known wildfire is burning or a wildfire starts, they will:

- Reschedule work where practicable;
- Monitor the current status of the fire using radios and contact with the local authorities;
- Evacuate the area if an evacuation alert is given; and
- **Immediately notify their project manager and other personnel in the area if the hazard or circumstances change.** If crews must start or monitor a fire for any reason, they will:
  - Obtain the appropriate permits;
  - Monitor any fire bans in the area;
  - Design a containment area; and
  - Take every precaution to keep the fire in control.

4.8 Fire Prevention

4.8.1 During dry weather and wildfire seasons, the below steps to prevent wildfires from starting and spreading will be implemented.

- Defensible Space – A buffer zone or defensible space shall be established, around the work area of at least 50 feet. This defensible space is created by clearing flammable materials away from the work area and buildings.
- Remove flash fuels such as dead grass or vegetation that is down on the ground. (Do not remove live native plants from the natural area open space.)
- Consistently monitor defensible space for maximum fire prevention.
- Smoking – During conditions that present a high risk for fire, smoking will be limited to a fire safe area (smoking pen) established by the Safety Supervisor. The pen will contain a water-filled butt can and fire bucket. At instruction of the Safety Supervisor, smoking may be prohibited during dry weather and wildfire season.
- Hot Work – During conditions that present a high risk for fire, all outdoors field hot work (welding, cutting or use of spark producing tools) will be suspended. If hot work must be performed, it will be done in a fire safe area and only after a hot work permit has been issued by the safety officer. For 60 minutes after the completion of the hot work a fire watch will be maintained.
- Equipment – During dry weather and wildfire season, spark arrestors should be considered for use on mechanical equipment such as generators, chain saws, chop saws, string trimmers and

off road vehicles to prevent sparks form exiting trough the exhaust pipe. Spark arrestors should be in proper working order. Vehicles with under carriage exhaust/catalytic converters shall not be parked in grassy areas.

- Fires of any type are strictly prohibited, at all times.

5.0 Records

5.1 Fire extinguisher inspections shall be maintained in the appropriate office safety files.

6.0 Attachments

6.1 S3NA-206-WI1 Portable Fire Extinguishers

Portable Fire Extinguishers

1.0 Portable Fire Extinguishers

1.1 Selection Requirements

Portable extinguishers will be selected based on the following classifications:

Classification	Type of Fire
Class A	Combustible materials
Class B	Flammable liquid, gas, or grease
Class C	Electrical equipment
Class D	Combustible metal

In addition, portable fire extinguisher selection, placement, and fire protection systems designed for use on a project or in an AECOM office will be made in conjunction with an AECOM Safety, Health and Environment (SH&E) representative, the local fire department, or a professional fire protection systems contractor. Unless otherwise approved by an AECOM SH&E representative, fire extinguishers selected for use will be of the Type A, B, and/or C variety, typically charged with water, carbon dioxide, nitrogen, a dry chemical, or other approved extinguishing agent.

1.2 Class A Extinguishers

The number of Class A extinguishers will be based on the following:

	Light (low) Hazard Occupancy	Ordinary (moderate) Hazard Occupancy	Extra (high) Hazard Occupancy
Minimum rated single extinguisher	2-A	2-A	2-A
Maximum floor area per unit of A	3,000 square feet	1,500 square feet	1,000 square feet
Maximum floor area for extinguisher	11,250 square feet	11,250 square feet	11,250 square feet
Maximum travel distance to extinguisher	75 feet	75 feet	75 feet

The availability of Class A extinguishers can be satisfied with the use of extinguishers with multiple ratings (e.g., Class A, B, and C). In addition, where automatic sprinkler systems are present, the maximum floor area for each extinguisher does not apply; however, the 75-foot travel distance does.

1.3 Class B Extinguishers

Class B extinguishers will be provided according to the severity of the hazard as listed below:

Fire extinguishers labeled prior to June 1, 1969

Type of hazard	Basic minimum extinguisher rating
Light	4B
Ordinary	8B
Extra	12B

Fire extinguishers labeled after June 1, 1969

Type of hazard	Basic minimum extinguisher rating
Light	5B, 10B
Ordinary	10B, 20B
Extra	20B, 40B

An open tank in a building having flammable liquids in depth exceeding ¼ inch will be provided with sufficient extinguishers to provide one numerical unit of Class B for each square foot of tank surface area, the minimum extinguisher being a 5B (using labels after June 1, 1969). So, for example, a tank with a surface area of 50 square feet would require two Class 20B (or one 40B) and one Class 10B extinguisher. For tanks exceeding 100 square feet in surface area, a fixed extinguisher will be provided in addition to sufficient portable extinguishers for the numerical unit of Class to equal 100 (e.g., two Class 40B and one Class 20 B).

All Class B extinguishers will be located on the same floor as the hazard, with a travel distance of no more than 50 feet. For widely separated hazards (e.g., boiler rooms, paint storage areas, kitchens), a separate extinguisher for each class of hazard will be provided if the travel distance is more than 25 feet.

1.4 Class C Extinguishers

Class C extinguishers (one 15-pound carbon dioxide or equivalent) will be provided within 25 feet of a high hazard area containing an electrical distribution source such as a generator, transformer, or main switchgear. Also, the extinguisher size and locations will be determined based on the expected type of fire (combustible-Class A, or flammable-Class B) as noted above.

1.5 Class D Extinguishers

A Class D extinguisher for the specific type of combustible metal will be kept within 25 feet of the area where the metal is machined or processed.

Americas

Personal Protective Equipment Program

S3NA-208-PR1

1.0 Purpose and Scope

1.1 Provide an effective Personal Protective Equipment (PPE) Program to protect AECOM employees from potential workplace safety and health hazards.

1.2 This procedure applies to all AECOM Americas-based employees and operations.

1.3 The proper use of appropriate PPE, in combination with effective engineering and administrative controls, can provide AECOM employees with protection against potential workplace hazards and can reduce the potential for workplace injury and illness.

2.0 Terms and Definitions

2.1 **PPE** – Personal Protective Equipment

2.2 **CSA** – Canadian Standards Association

2.3 **ANSI** – American National Standards Institute

2.4 **SDSs** – Safety Data Sheets (previously Material SDSs)

3.0 References

3.1 Occupational Safety and Health Administration PPE standard (Title 29 of the Code of Federal Regulations 1910.132)

3.2 Canadian Standards Association (CSA)

3.3 Canada Labor Code, Part II

4.0 Procedure

4.1 Roles and Responsibilities

4.1.1 **Region SH&E Manager**

- Provide guidance to **Project Managers, Supervisors**, and field staff on the assessment of hazards and the selection of PPE.
- Provide training materials to **Project Managers** and **Supervisors** for **employee** training.

4.1.2 **Project Managers** or **Supervisors**

- Conduct Hazard Assessments to identify hazards present and to specify PPE appropriate for those hazards.
- Determine which staff requires employee-issued PPE.
- Approve the purchase of company-issued PPE.
- Verify that appropriate PPE is utilized by **employees** when required or necessary.

4.1.3 **Employee**

- In accordance with training and instructions, utilize appropriate PPE that has been issued when required or necessary.
- Inspect PPE prior to use to confirm that it is functional, and maintain PPE in a clean and functional condition.
- Follow instructions and manufacturers' guidance on the care, use, and storage of PPE.
- Review all relevant site hazard assessments prior to commencing work.

- Only work with materials for which the SDS have been reviewed.
- Refrain from wearing PPE outside of the work area for which it is required if doing so would constitute a hazard.

4.2 Hazard Assessment for Office Locations

4.2.1 *S3NA-208-FM1 PPE Hazard Analysis* will serve as the certificate of hazard assessment, as defined in local legislation for office activities that require PPE. This checklist will also be used to determine the PPE requirements for nonroutine maintenance tasks that may not be evaluated during the initial hazard assessments.

4.3 Hazard Assessment for Project Site Locations

4.3.1 HAZWOPER Locations

- Each Health and Safety Plan (HASP) that is prepared for waste site investigations/remediation includes a hazard assessment for each proposed field activity. Task-specific PPE requirements are listed in the HASP. Therefore, the HASP will serve as the certificate of hazard assessment for each project that involves off-site work activities that require the use of PPE.

4.3.2 All Other Project Site Locations

- The Task Hazard Analysis will serve as the certificate of hazard assessment for projects that involves off-site work activities that require the use of PPE. The checklist will be reviewed with the entire field team prior to arriving at the site.

4.4 Training

4.4.1 Staff will receive adequate instruction on the correct use, limitations, and assigned maintenance duties for the equipment to be used. The following information, at a minimum, will be covered during PPE training:

- What PPE is required.
- When it is required.
- Why it is required.
- How to properly don, doff, adjust, and wear the PPE described.
- The limitations of the PPE, including its expected useful life.
- How to properly care for, maintain, and dispose of the PPE.

4.4.2 Field staff is responsible for confirming that they have reviewed the operation manual for the PPE before work commences.

4.4.3 All staff will receive an orientation to the hazards on the job site as well as initial Field Safety orientation that outlines appropriate PPE requirements.

4.4.4 **Employees** who have participated in the 40-hour HAZWOPER training course are considered to have met the employee training requirements for the use of basic, non-specialized PPE. The training certificates that are issued as documentation of successful completion of the 40-hour HAZWOPER course will also serve as documentation of training as required by the PPE standard for basic PPE. **Employees** who have not participated in the HAZWOPER training will be provided PPE training specific to their assignment and/or location. The PPE Facts Sheets can serve as the basis for training.

4.5 Determining the Need for PPE

4.5.1 Using the Task Hazard Assessment, Safe Work Plan (SWP) or HASP, the need for the following types of PPE will be evaluated.

4.5.2 PPE will:

- Be selected and used in accordance with recognized standards and provide effective protection.

- Not in itself create a hazard to the wearer.
- Be compatible so that one item of PPE does not make another item ineffective.
- Be maintained in good working order and in a sanitary condition.

4.5.3 Prior to entering any regulated work area, employees shall confirm that they have access to or are equipped with the following ANSI/CSA-approved PPE, appropriate to the site hazards:

- Head Protection
- Eye & Face Protection
- Foot Protection
- Hi-Visibility Vests
- Hearing Protection

4.5.4 After the hazard assessments have been completed, the **Project Manager** will select the appropriate PPE for each job category or task, as necessary. The selected equipment will be indicated on the hazard assessment. PPE will be provided to each **employee** appropriate for the hazards present. All PPE selected and purchased by AECOM will meet or exceed the ANSI standards, CSA standards, or other standards as dictated by provincial, territorial, or state legislation.

4.6 Eye and Face Protection

4.6.1 AECOM **employees** must use appropriate eye and face protection when exposed to eye or face hazards from flying particles, molten metal, liquid chemicals, acid and caustic liquids, chemical gases or vapors, and injurious light radiation. Eye protection shall provide side protection when there is a hazard from flying objects.

4.7 Head Protection

4.7.1 Protective helmets (hard hats) are required when **employees** are working in areas where there is a potential for falling objects to cause injury to the head. When working near exposed electrical conductors that could contact the head, helmets designed to reduce electrical shock shall be worn.

4.8 Foot Protection

4.8.1 Protective footwear is required when **employees** are working in areas where there is a danger of foot injuries from falling and rolling objects or from objects piercing the sole and where an **employee's** feet are exposed to electrical hazards.

4.9 Hand Protection

4.9.1 Appropriate hand protection is required when **employee's** hands are exposed to hazards such as those from skin absorption of harmful substances, severe cuts and lacerations, severe abrasions, punctures, chemical burns, thermal burns, or harmful temperature extremes.

4.10 Chemically Resistant Clothing

4.10.1 Chemically resistant clothing is required when there is significant potential for the **employee** to come in direct contact with the chemicals he/she is handling. Tasks that involve chemical handling will be evaluated for the potential of splashing or spilling.

4.11 High-Visibility Apparel

4.11.1 High-visibility apparel with reflective banding (CSA/ANSI Class II and III garment) is required for all field activities in close proximity to moving traffic and other modes of transportation (transit, airlines, marine, etc.), in proximity to heavy equipment operations, or whenever otherwise specified in a project SWP or HASP. Color of apparel (orange or lime) may be client/project-specific.

4.11.2 Work conducted at night may require that the minimum level of apparel worn be, at minimum, CSA/ANSI Class III, as required by governing legislation.

4.12 Personal Clothing

4.12.1 **Employees** on a project site shall wear full length trousers and shirts that cover shoulders.

4.12.2 For personal safety on the job site, do not wear

- Loose or unsecured clothing or loose fitting cuffs;
- Greasy or oily clothing, gloves, or boots; or
- Torn or ragged clothing.

4.12.3 Neck chains shall not be worn when working with moving parts or where the risk of entanglement exists. For all other circumstances, they will be worn under clothing so that they do not hang out. Long hair will be tied back or otherwise confined.

4.12.4 Clothing made of synthetic fibres can be readily ignited and melted by electric flash or extreme heat sources. Cotton or wool fabrics are recommended for general use.

4.13 Specialized PPE

4.13.1 In addition to basic PPE, additional specialized PPE may be required to provide appropriate protection to the employee. Refer to applicable legislation and related Standard Operating Procedures for additional information on PPE requirements.

- Fall Protection – Only full-body harnesses with shock-absorbing lanyards will be used for personal fall arrest.
- Respiratory Protection – Respiratory protection shall be selected based on the contaminant and concentration to which the employee will be exposed. Refer to *S3NA-519-PR1 Respiratory Protection Program, the* task- or project-specific hazard assessments and the applicable SDSs for specific requirements.
- Fire Resistant Clothing – Approved fire-resistant outer clothing may be required at work locations with flammable or explosive materials or environments.
- Other Head Protection – Operators and passengers (if permitted) of all-terrain vehicles and snowmobiles will wear approved helmets.
- Chemical Protective Clothing – Approved chemical protection appropriate to the hazard will be worn. Review applicable SDSs for appropriate PPE.
- Protection from Drowning – **Employees** being transported by boat or exposed to any other drowning hazards are required to wear life jackets. Life jackets will have the proper regulatory approval.

4.14 PPE Supplies

4.14.1 Each AECOM office will maintain a supply of safety equipment including hard hats, high visibility vests, safety glasses, gloves, hearing protection and chemically resistant clothing based on the nature of their field activities. The **Office Manager (Operations)** or designee will be responsible for maintaining this inventory. PPE that is required for large field efforts will be ordered by the **Project Manager** or their designee.

4.14.2 At a minimum, operations will review its PPE program annually.

4.15 Obtaining Personalized Safety Gear

4.15.1 PPE for eyes, face, head, and extremities, protective clothing, and respiratory devices shall be provided to **employees** wherever necessary by reason of hazards.

4.15.2 **Employees** are not expected to provide their own general PPE. Certain personalized safety gear such as prescription safety glasses, safety-toed (capped) boots, and cotton coveralls will be ordered and sized specifically for the user.

4.15.3 Most PPE will be provided to the **employee** at no charge, with the exception of the above personalized safety equipment (prescription safety glasses, safety-toed boots, washable coveralls).

A partial cost reimbursement to the **employee** may be made based on company practice or project stipulations.

4.15.4 Prescription Safety Glasses

- Employees who are eligible will be allowed to obtain prescription safety glasses according to the specialized PPPE purchase program in their location.

4.15.5 Safety-Toed Boots/Shoes

- Employees who are eligible will be allowed to obtain safety work boots according to the specialized PPE purchase program in their location.

4.15.6 Reusable Coveralls

- Employees who are eligible will be allowed to obtain reusable coveralls according to the requirements of the project or location they are working at.

5.0 Records

5.1 Completed *S3NA-208-FM1 PPE Hazard Analysis* forms will be maintained in local office safety files.

6.0 Attachments

6.1 S3NA-208-WI1 PPE Selection

6.2 S3NA-208-WI2 Eye and Face Protection Fact Sheet

6.3 S3NA-208-WI3 Head Protection Fact Sheet

6.4 S3NA-208-WI4 Foot Protection Fact Sheet

6.5 S3NA-208-WI5 Hand Protection Fact Sheet

6.6 S3NA-208-WI6 Protective Clothing Fact Sheet

6.7 S3NA-208-FM1 PPE Hazard Analysis

PPE Selection

S3NA-208-WI1

1.0 Lists of Potential Hazards

	POTENTIAL HAZARDS
HEAD	Falling overhead objects
	Spark contact
	Chemical contamination
	Cold/heat
	Electrical (>600 volts)
HANDS	Cuts, punctures, abrasions
	Burns
	Dermatitis
	Chemical absorption
	Cold
FEET	Falling or rolling objects
	Chemical absorption
	Dermatitis
	Burns
	Cold
	Slips, trips
FACE	Burns (chemical, spark, UV radiation)
	Chemical splashing
	Flying particulates
	Abrasions, cuts
EYES	Burns (gas, liquid, spark)
	Abrasions-flying particulates
	Absorption
	Retinal/corneal damage (UV/IR radiation)
EARS	Noise
	Cold

BODY PROTECTION	**Chemical splashing**
	Burns (chemical, UV radiation)
	Absorption
	Spark contact
	Cuts/abrasions/punctures
	Heat/cold stress
	Moving vehicles/heavy equipment
MISCELLANEOUS	**Insects (ticks, spiders, mosquitoes, bees/wasps)**
	Animals (dogs, bears, wild boars, raccoons)
	Reptiles (snakes)
	Poison plants (poison ivy, poison sumac, poison oak)
	Biological (fungus, bacteria, fungus, viral)

2.0 Eye & Face Protection Selection Chart

		ASSESSMENT	PROTECTOR TYPE (see Table 3.0)	PROTECTOR	LIMITATIONS	NOT RECOMMENDED
IMPACT	Chipping, grinding, machining, masonry work, riveting, and sanding.	Flying fragments, objects, large chips, particles, sand, dirt, etc.	B, C, D, E, F, G, H, I, J, K, L, N	Spectacles, goggles, faceshields SEE NOTES (1) (3) (5) (6) (10) For severe exposure Add N	Protective devices do not provide unlimited protection. SEE NOTE (7)	Protectors that do not provide protection from side exposure. SEE NOTE (10) Filter or tinted lenses that restrict light transmittance, unless it is determined that a glare hazard exists. Refer to OPTICAL RADIATION.
HEAT	Furnace operation, pouring, casting, hot dipping, gas cutting, and welding.	Hot sparks	B, C, D, E, F, G, H, I, J, K, L, *N *N N	Faceshields, goggles, spectacles. *For severe exposure, add N SEE NOTE (2) (3) *Faceshields worn over goggles H, K SEE NOTE (2) (3) Screen faceshields. Reflective faceshields. SEE NOTE (2) (3)	Spectacles, cup and cover type goggles do not provide unlimited facial protection. SEE NOTE (2) SEE NOTE (3)	Protectors that do not provide protection from side exposure.
		Splash from molten metals				
		High temperature exposure				
CHEMICAL	Acid and chemicals handling, degreasing, plating	Splash	G, H, K *N	Goggle, eyecup and cover types. *For severe exposure, add N	Ventilation should be adequate but well protected from splash entry	Spectacles, welding helmets, handshields
		Irritating mists	G	Special purpose goggles	SEE NOTE (3)	
DUST	Woodworking, buffing, general dusty conditions.	Nuisance dust	G, H, K	Goggles, eyecup and cover types	Atmospheric conditions and the restricted ventilation of the protector can cause lenses to fog. Frequent cleaning may be required.	

	ASSESSMENT	PROTECTOR TYPE	PROTECTOR	LIMITATIONS	NOT RECOMMENDED
O P T I C A L R A D I A T I O N	WELDING: Electric Arc	O, P, Q	**TECTORS** **FILTER** **LENS PRO-** **SHADE** **TECTORS** SEE NOTE (9) 10-14 Welding Helmets or Welding Shields	Protection from optical radiation is directly related to filter lens density. SEE NOTE (4). Select the darkest shade that allows adequate task performance.	Protectors that do not provide protection from optical radiation. SEE NOTE (4)
	WELDING: Gas CUTTING TORCH BRAZING	J, K, L, M, N, O, P, Q	SEE NOTE (9) 4-8 Welding Goggles or Welding Faceshield 3-6 3-4	SEE NOTE (3)	
	TORCH SOLDERING	B, C, D, E, F, N	1.5-3 Spectacles or Welding Faceshield		
	GLARE	A, B	Spectacle SEE NOTE (9) (10)	Shaded or Special Purpose lenses, as suitable. SEE NOTE (8)	

NOTES

(1) Care shall be taken to recognize the possibility of multiple and simultaneous exposure to a variety of hazards. Adequate protection against the highest level of each of the hazards must be provided.
(2) Operations involving heat may also involve optical radiation. Protection from both hazards shall be provided.
(3) Faceshields shall only be worn over primary eye protection.
(4) Filter lenses shall meet the requirements for shade designations in Table 9-2.
(5) Persons whose vision requires the use of prescription (Rx) lenses shall wear either protective devices fitted with prescription (Rx) lenses or protective devices designated to be worn over regular prescription (Rx) eyewear.
(6) Wearers of contact lenses shall also be required to wear appropriate covering eye and face protection devices in a hazardous environment. It should be recognized that dusty and/or chemical environments may represent an additional hazard to contact lens wearers.
(7) Caution should be exercised in the use of metal frame protection devices in electrical hazard areas.
(8) Refer to Section 6.5, Special Purpose Lenses. (ANSI A87.1-1989)
(9) Welding helmets or handshields shall be used only over primary eye protection.
(10) Non-sideshield spectacles are available for frontal protection only.

3.0 Eye and Face Protector Selection Guide

A. SPECTACLE, No sideshield

B. CUP GOGGLE, Direct ventilation

C. CUP GOGGLE, Indirect ventilation

D. SPECTACLE, Headband temple

E. COVER WELDING-BURNING

F. GOGGLES, Indirect Ventilation

G. FACESHIELD

H. WELDING HELMET, Hand held

I. WELDING HELMET, Stationary window

J. WELDING HELMET, Lift front

K. COVER GOGGLE, Direct ventilation

L. SPECTACLE, Half sideshield

M. SPECTACLE, Full sideshield

N. SPECTACLE, Detachable sideshield

O. SPECTACLE, Non-removable lens

P. SPECTACLE, Lift front

Q. COVER GOGGLE, No ventilation

R. COVER GOGGLE, Indirect ventilation

4.0 Filter Lenses for Protection Against Radiant Energy

OPERATIONS	ELECTRODE SIZE 1/32 INCH	ARC CURRENT	MINIMUM PROTECTIVE SHADE
Shielded metal-arc welding	Less than 3 More than 3-5 More than 5-8 More than 8	Less than 60 60-160 161-250 251-550	7 8 10 11
Gas metal arc welding and flux cored arc welding		Less than 60 60-160 161-250 251-500	7 10 10 10
Gas tungsten arc welding		Less than 50 50-150 151-500	8 8 10
Air carbon	(Light)	Less than 500	10
Air cutting	(Heavy)	500-1000	11
Plasma arc welding		Less than 20 20-100 101-400 401-800	6 8 10 11
Torch brazing			3
Torch soldering			2
Carbon arc welding			14
OPERATIONS	**PLATE THICKNESS (INCHES)**	**(MM)**	**MINIMUM* PROTECTIVE SHADE**
Gas welding: Light Medium Heavy	 Under 1/8 1/8 to ½ Over 1/2	 Under 3.2 3.2 to 12.7 Over 12.7	 4 5 6
Oxygen cutting: Light Medium Heavy	 Under 1 1 to 6 Over 6	 Under 25 25 to 150 Over 151	 3 4 5

Americas

Eye and Face Protection Fact Sheet

S3NA-208-WI2

1.0 Introduction

1.1 Personal protective equipment (PPE) is designed to protect employees from health and safety hazards that cannot be removed from the work environment. PPE is designed to protect many parts of the body including eyes, face, head, hands, and feet. This fact sheet has been developed to inform employees about why eye and face protection is needed, when it should be worn, how to wear and adjust it properly, the limits of this type of PPE, and how to properly maintain and clean the eye and face protection issued.

2.0 Types of Eye and Face Protection

There are three major types of eye and face protection, including:

2.1 Primary Protectors

2.1.1 Safety glasses – The most widely used form of eye protection is safety glasses. To prevent lateral exposure to impact fragments, safety glasses are often equipped with side shields. Depending on the hazard, side shields can be either a cup-type or flat-folded. The cup-type provides more complete protection.

2.1.2 Safety goggles

- Vented goggles—impact only
- Indirectly vented—chemical splash and impact
- Non-vented—chemical fumes

2.1.3 Glasses offer excellent protection against impact; however, goggles form a tight-fitting seal to the skin around the entire eye and are more appropriate for chemical concerns.

2.2 Secondary Protectors

2.2.1 Faceshield

- Wear faceshields when there is a severe danger from impact or chemical splash. Faceshields are secondary protectors and must be worn over safety glasses or goggles.

2.2.2 Welding Helmet or Faceshield

- When welding, employees must use equipment with filter lenses that has a shade number appropriate for protection against injurious light radiation.

3.0 Cleaning and Maintaining Safety Eyewear

3.1 Clean lenses and frames regularly with soap and water. Store in a clean, dry area.

3.2 Replace scratched, pitted, cracked, or broken safety eyewear immediately.

4.0 Proper Fit/Adjusting Glasses

4.1 PPE that fits poorly will not afford the necessary protection. When fitting devices for eye protection against dust and chemical splashes, be sure that the devices are sealed to the face. If the temple bars of the glasses are too long, the glasses will have a tendency to fall forward and slide down your nose. Check with your SH&E coordinator if you need glasses with adjustable temple bars. Standard safety glasses are 58 millimeter; however, smaller sizes (54 millimeter) are also available.

WHEN TO WEAR PROTECTION

Hazard	Concern	Glasses	Goggles	Faceshield
Impact	Flying fragments from front/sides.	Safety glasses with sideshields.	Vented goggles.	Severe danger from impact. Wear with glasses/goggles.
Chemicals	Splash.		Indirectly vented.	Severe splash. Wear with goggles.
Chemicals	Fumes.		Non-vented.	
Injurious Light			Welding goggles with appropriate shaded lens.	Welding helmet with appropriate shaded lens.
Dust	Dust entering the eye.	Safety glasses with sideshields.	Vented goggles.	

5.0 Prescription Glasses/Contact Lenses

5.1 Prescription eyeglasses must not be substituted for safety eyeglasses. Regular eyeglasses do not offer the same impact resistance of the lens and frame assembly as safety glasses and are not Canadian Standards Association (CSA)/American National Standards Institute (ANSI) approved. Goggles can be worn over eyeglasses. If you wear corrective lenses, contact your SH&E coordinator for information about how to obtain prescription safety glasses.

5.2 Contact lenses are not recommended for any industrial job. Dust caught underneath the lens can cause painful abrasions. Some chemicals can react with your contacts to cause permanent injury.

6.0 Guidelines

6.1 Eye Protection – The following standards apply to eye and face protection:

Association	Standard
ANSI	Z87.1-2003, Practice for Occupational and Educational Eye and Face Protection Z87.1-1989, Practice for Occupational and Educational Eye and Face Protection
CSA	Z94.3-02, Eye and Face Protectors Z94.3.1-02, Protective Eyewear: A User's Guide Z94.3-99, Industrial Eye and Face Protectors CAN/CSA-Z94.3-92, Industrial Eye and Face Protectors

6.1.1 AECOM will offer safety glasses with permanently attached sideshields or directly vented goggles to all employees working in an area or at a process that involves flying particles.

6.1.2 Non-vented and indirectly vented goggles will be worn when employees are handling chemicals.

6.1.3 Faceshields, in combination with glasses or goggles, will be required where a severe splash or impact hazard has been identified.

6.1.4 When welding, employees must use equipment with filter lenses that have a shade number appropriate for protection against injurious light radiation.

6.1.5 **Supervisors** are responsible for ensuring that crews have access to the eye and face protection necessary to ensure their safety. This may include:

- Safety glasses with side shields,
- Safety goggles, or
- Face shield.

6.1.6 CSA/ANSI-approved eye and face protection shall be worn by all employees while engaged in activities where a risk of injury to the eyes or face may exist.

6.1.7 Face shields shall be worn when using grinding, drilling, buffing, or striking tools.

6.1.8 Eye protection shall be worn when handling liquid or powder chemicals and when draining or breaking joints on any pressure vessel, line, or equipment. In some situations, a face shield should be used in conjunction with goggles for additional eye and face protection.

6.1.9 Face shields shall be made available or installed whenever they may be required. Goggles shall be provided, as required.

6.1.10 Hardened glass prescription lenses and sport glasses are not an acceptable substitute for proper, required industrial safety eye protection.

6.1.11 Comfort and fit are very important in the selection of safety eyewear. Lens coatings, venting, or fittings may be needed to prevent fogging or to fit with regular prescription eyeglasses.

6.1.12 Sunglasses shall be worn when glare is a concern. Glare from sun and snow or water should be taken seriously as it can cause reduced vision and fatigue.

6.1.13 A combination of types of PPE may be necessary if more than one type of hazard exists. For example, where the potential hazards are chemical splashes and flying objects, chemical splash goggles used in combination with safety glasses may be required.

6.1.14 When contact lenses are worn (and where a hazard exists), extra precautions are required to reduce the potential for injury. As previously stated, contact lenses are not protective devices. PPE for contact lens wearers includes splash or dust-resistant goggles, and safety glasses. Other workers not wearing contact lenses would wear the same PPE when exposed to the same hazards.

6.1.15 Prescription eyewear may be worn if it is safety eyewear meeting CSA/ANSI standards and appropriate to the hazard or if it is worn behind equipment that meets the above requirements.

6.1.16 Personal eye and face protection is regulated for specific job tasks. For the most up-to-date information and for guidance, application or interpretation of these laws or guidelines, you should contact your local regulatory authority directly.

6.1.17 DO

- Replace pitted, scratched, bent, and poorly fitted PPE (damaged face/eye protection interferes with vision and will not provide the protection it was designed to deliver).
- Wear proper fitting eye protection (close to the face).
- Clean safety glasses daily, more often if needed.
- Store safety glasses in a safe, clean, dry place when not in use.

6.1.18 DON'T

- Modify eye/face protection.
- Use eye/face protection that does not have CSA/ANSI certification (a CSA stamp for safety glasses is usually on the frame inside the temple near the hinges of the glasses).

Americas

Head Protection Fact Sheet

S3NA-208-WI3

1.0 Introduction

1.1 Personal protective equipment (PPE) is designed to protect **employees** from health and safety hazards that cannot be removed from **the** work environment. PPE is designed to protect many parts of **the** body including eyes, face, head, hands, and feet. AECOM has evaluated each of the job tasks that are performed in the office. The purpose of these evaluations was to assess the hazards associated with a specific task and to determine what type or types of PPE will adequately protect **employees** from those hazards.

1.2 Because there is no potential for injury to the head from falling objects in the office, head protection is not required. However, some nonroutine maintenance tasks or construction activities may require such equipment. The need for this type of PPE while performing such nonroutine tasks will be evaluated by your project manager.

2.0 Types of Head Protection

2.1 The main type of head protector is the helmet. Helmets are designed to protect you from impact and penetration caused by objects hitting your head and from limited electrical shock or burns. The shell of the helmet is designed to absorb some of the impact. The suspension, which consists of a headband and strapping, not only holds the helmet in place but is critical for absorbing and distributing impact shock loads. AECOM recommends ratchet style suspension for rapid adjustment during changing site conditions.

3.0 Hard Hat Impact Types

3.1 Type I Hard Hats

3.1.1 Type I hard hats are intended to reduce the force of impact resulting for a blow only to the top of the head.

3.2 Type II Hard Hats

3.2.1 Type II hard hats are intended to reduce the force of impact resulting from a blow that may be received off center or to the top of the head. A Type II hard hat typically is lined on the inside with thick, high-density foam.

3.3 Electrical Classes

3.3.1 Class G (General) – Class G hard hats are intended to reduce the danger of contact exposure to low voltage conductors. Test samples are proof-tested at 2,200 volts (phase to ground). However, this voltage is not intended as an indication of the voltage at which the hard hat protects the wearer. Please note: Class G hard hats were formerly known as Class A.

3.3.2 Class E (Electrical) – Class E hard hats are intended to reduce the danger of exposure to high voltage conductors. Test samples are proof-tested at 20,000 volts (phase to ground). However, this voltage is not intended as an indication of the voltage at which the helmet protects the wearer. Please note: Class E hard hats were formerly known as Class B.

3.3.3 Class C (Conductive) – Class C hard hats are not intended to provide protection against contact with electrical conductors.

4.0 Proper Fit/Maintenance

4.1 The suspension of the hard hat must be adjusted to fit the wearer and to keep the shell a minimum distance of 1-1.5 inches (3 centimetres) above the wearer's head. Periodically inspect the suspension of your hard hat. Look for loose or torn cradle straps, loose rivets, broken sewing lines, or other defects. Replace the hat after a major impact.

5.0 Guidelines

5.1 Head Protection – The following standards apply to PPE for the head:

Association	Standard
American National Standard (ANSI)	Z89.1-2003, American National Standard for Industrial Head Protection Z89.1-1997, American National Standard for Industrial Head Protection
Canadian Standards Association (CSA)	CAN/CSA-Z94.1-92 (R1998), Industrial Protective Headwear CSA Standard Z94.1-05, Industrial Protective Headwear - Performance, Selection, Care and Use

5.1.1 On all construction projects and in the event that an overhead hazard exists, a four-point suspension Type II, Class G or E hard hat will be provided to affected employees.

5.1.2 Supervisors and staff are responsible for confirming that crews have the head protection necessary for their safety. This may include, as required by the specific job task:

- Hard hat, or
- Helmet

5.1.3 CSA/ANSI-approved industrial protective headwear that is appropriate to the hazards and meets applicable legislative requirements shall be worn by all personnel while engaged in construction, operation, maintenance, or other activities where there exists a foreseeable danger of injury to a worker's head at a work site and/or a significant possibility of lateral impact to the head.

5.1.4 Visitors to areas where the above activities are being conducted shall comply with the hard hat requirement.

5.1.5 Helmets, hard hats, and hard hat accessories (as required) shall be provided by AECOM.

5.1.6 Proper care is required for headgear to perform efficiently. The service life is affected by many factors including temperature, chemicals, sunlight, and ultraviolet radiation (welding). The usual maintenance for headgear is simply washing with a mild detergent and rinsing thoroughly.

5.1.7 DO

- Replace headgear that is pitted, holed, cracked, or brittle.
- Replace headgear that has been subjected to a blow even though damage cannot be seen.
- Remove from service any headgear if its serviceability is in doubt.
- Replace headgear and components according to manufacturers' instructions.
- Consult the Safety, Health and Environment team or your supplier for information on headgear.

5.1.8 DON'T

- Drill, remove peaks, or alter the shell or suspension in any way.
- Use solvents or paints on the shells.
- Put chin straps over the brims of Class B headgear.
- Use any liner that contains metal or conductive material.
- Apply any unnaproved stickers to the hard hat.
- Carry anything in the hard hat while wearing the hard hat.

Americas

Foot Protection Fact Sheet

S3NA-208-WI4

1.0 Introduction

1.1 Personal protective equipment (PPE) is designed to protect employees from health and safety hazards that cannot be removed from the work environment. PPE is designed to protect many parts of the body including the feet.

Foot injuries are most likely to occur:

- When heavy or sharp objects fall on your foot.
- When something rolls over your foot.
- When you step on an object that pierces the sole of your boot.
- When there is improper ankle support when walking on uneven surfaces.

2.0 Types of Foot Protection

2.1 Safety boots must meet the regulated standard. Safety boots are made with a steel-reinforced box toe to protect your foot from being pierced or crushed by a falling object. Safety boots with flexible steel insoles provide puncture resistance. They will stop or deflect nails or other objects that have penetrated the sole of the boot. Oil-resistant soles provide the added safety feature of preventing slips and trips on slippery work floors. Safety boots with tall upppers provide ankle support only when laced and tied appropriately.

3.0 Proper Fit

3.1 With most PPE, the more comfortable it is to use, the more likely you will be to use it. The fit of the safety boot is of the utmost importance. You must try on safety boots before purchasing them. When selecting boots, be sure that they are Canadian Standards Association (CSA)/American National Standard (ANSI) approved. Consult with your supervisor about how to obtain safety boots.

4.0 Guidelines

4.1 Foot Protection – The following standards apply to foot protection equipment:

Association	Standard
ANSI	Z41-1991, American National Standard for Personal Protection - Protective Footwear
CSA	Z195-02, Protective Footwear Z195.1-02, Guideline on Selection, Care, and Use of Protective Footwear Z195-M92 (R2000), Protective Footwear

4.1.1 Safety work boots shall have leather or rubber uppers, an oil-resistant sole, and a distinctive heel. When required by the regulations or the client, AECOM will provide affected employees with safety-toed boots that meet the requirements of the applicable ANSI or CSA standard.

4.1.2 **Supervisors** are responsible for confirming that employees have foot protection necessary to ensure their safety. This may include the following types as required by the specific job task:

- Steel-toed boots;
- Caulk boots;
- Chemical-resistant boot covers;
- Non-slip wading boots; or

- Rubber boots.

4.1.3 CSA/ANSI-approved safety-toed boots shall be worn by all **employees** while engaged in construction, operation, maintenance, or other activities where a risk of injury to the feet may exist.

4.1.4 The purchase of normal footwear for work is the responsibility of the **employee**.

4.1.5 **Employees** are responsible for confirming that the PPE they are provided with is in good working condition before work commences.

4.1.6 DO

- Choose a high-cut boot to provide ankle support.
- Choose footwear according to job hazard and CSA/ANSI standards.
- Lace up boot and tie laces securely. Boots do not protect if they are a tripping hazard or fall off.

4.1.7 DON'T

- Wear defective safety footwear (e.g., exposed steel-toe caps).
- Underprotect your feet or modify safety footwear.

Americas

Hand Protection Fact Sheet

S3NA-208-WI5

1.0 Introduction

1.1 Personal protective equipment (PPE) is designed to protect employees from health and safety hazards that cannot be removed from the work environment. PPE is designed to protect many parts of the body including eyes, face, head, hands, and feet. This fact sheet will inform employees about why and when hand protection is needed, the limits of gloves, and how to properly clean and dispose of gloves.

1.2 Gloves most commonly used in the construction industry are made from:

- Leather,
- Cotton,
- Rubber,
- Synthetic rubbers and other manmade materials, or
- Combinations of materials.

2.0 Types of Hand Protection

2.1 Hand protection is required when there is a potential for:

- Skin absorption of harmful substances,
- Severe cuts or lacerations, abrasions, or punctures,
- Vibration, or
- Temperature extremes.

2.2 Gloves are the most common protectors for the hands. Unfortunately, no one type of glove provides adequate protection against all potential hand hazards. Leather gloves provide good protection from cuts and lacerations but offer no protection against chemicals. Nitrile or neoprene rubber gloves offers good resistance to certain chemicals but they tear and rip easily when sharp objects are handled. The chemically resistant gloves used by AECOM shall be selected based on the manufacturer's chemical compatibility data, which indicates how each glove material performed in breakthrough time tests against certain chemicals. Do not substitute another type of glove for the chemically resistant gloves that have been selected. They may not offer adequate protection for the chemicals you handle.

3.0 Proper Fit/Cleaning Disposal

3.1 Gloves will deteriorate over time depending on the types and amount of chemicals with which they come into contact. Remove excessive chemical residue that builds up on the glove. Replace cracked, ripped, or torn gloves or when breakthrough occurs. Breakthrough is the time between initial contact of the chemical on the glove surface and the detection of the chemical on the inside of the glove. Tight-fitting gloves can cause fatigue while loose-fitting gloves can be hazardous. Measure the circumference of your hand around the palm area. This measurement, in inches, is closest to your actual glove size. For example, 7" is equal to a size 7 glove. Always select the right size glove. Dispose of chemically resistant gloves in accordance with the established protocols at the site or office. The product Safety Data Sheet (SDS) will need to be consulted if the glove is contaminated from chemical handling.

4.0 Guidelines

4.1 Hand Protection – Use performance characteristics as listed by the Manufacturer.

4.1.1 Leather or Kevlar gloves should be used as appropriate to prevent cuts, lacerations, abrasions, and punctures. Chemically resistant gloves such as neoprene or nitrile rubber will be issued to employees who are likely to come into direct contact with chemicals. When selecting chemically resistant gloves, AECOM will review the manufacturer's data tables regarding degradation of the glove material when exposed to the chemicals of concern, penetration of the chemicals of concern through imperfections in the gloves, and permeation (breakthrough times) of the chemicals of concern through the glove material.

- PPE must be provided to protect a worker’s skin from harmful substances that may injure the skin on contact or may adversely affect a worker’s health if it is absorbed through the skin.
- Employees shall wear appropriate gloves or mitts to protect their hands from workplace hazards, including hazardous material, heat, cold, abrasion, and sharp edges.
- Vinyl coated or leather gloves are good for providing protection while handling wood or metal objects.
- Inspect and maintain hand PPE regularly. If in doubt about the selection or need for glove or hand PPE, consult your safety supplier, Material SDSs, or local Safety, Health and Environment office.

4.1.2 DO

- Inspect hand PPE for defects before use.
- Wash all chemicals and fluids off gloves before removing hand PPE.
- Use gloves that fit properly.
- Use the proper hand PPE for the job.
- Follow manufacturer’s instructions on the care and use of the hand PPE you are using.
- Cover exposed skin (no gap between the sleeve and the hand).

4.1.3 DON’T

- Wear gloves when working with moving machinery (gloves can get tangled or caught).
- Wear hand PPE with metal parts near electrical equipment.

Americas

Protective Clothing Fact Sheet

S3NA-208-WI6

1.0 Introduction

1.1 Some projects require job tasks where there is a recognized hazard of injury to a person if protection is not provided to the legs or body of the individual. These hazards are effectively mitigated through the use of proper personal protection equipment (PPE).

1.2 Employees will dress appropriately for the climate & weather (cold, heat, wet, dry).

1.3 Supervisors are responsible for confirming that crews have the limb and body protection necessary to ensure their safety. This may include, as required by the specific job task:

- Leg chaps;
- Gloves (leather, cotton, latex, chemical-resistant, etc.);
- Fire-retardant overalls;
- High visibility vests;
- Retro-reflective strips; and/or
- Chemically resistant suits or overalls.

2.0 Chemically Resistant Clothing

2.1 Whenever there is a potential for chemical splashing, chemically resistant, disposable clothing, such as a coated-Tyvek coverall or apron, will be worn. Examples of when such clothing may be required include:

- Cleaning of small spills.
- Washing and rinsing of the printing presses.
- Non-routine tasks involving the use of chemicals.
- The transfer of large quantities of chemicals from large containers to smaller ones.

The process for selecting chemically resistant clothing will be similar to that described for the selection of chemically resistant gloves. The need for chemically resistant clothing will be determined by your Project Manager. The **Project Manager** will issue the required clothing to you.

3.0 Types of Chemically Resistant Clothing

Like gloves, the objective of whole body protection is to separate the person from a contaminating or hazardous material. Disposable garments, such as Tyvek coveralls or aprons, provide this type of barrier. Uncoated Tyvek coveralls are made of a porous fabric and are designed to prevent contact with particulates. Coated Tyvek coveralls provide a nonporous barrier to protect the worker from chemical splash and vapors. Protective aprons are made from nitrile or neoprene rubber like that used to make chemically resistant gloves.

4.0 Proper Fit/Cleaning/Disposal

Before donning a protective coverall, inspect it for rips or tears. Promptly remove any protective clothing that becomes ripped or torn during a particular task. Be sure the garment fits properly. The garment-to-glove seam will be taped when there is a potential for liquids to directly contact the skin if the arm of the suit shifts upward.

Single-use garments, such as Tyvek coveralls, will be disposed of in accordance with the environmental protocols at the site. Some clothing, such as rubber aprons, is meant for repeated use. Wipe down the apron using soap and water to remove any remaining liquids or residues.

5.0 Guidelines

5.1 "High visibility safety apparel" means personal protective safety clothing that is intended to provide conspicuity during both daytime and nighttime usage and that meets the Performance Class II or III requirements of the American National Standards Institute (ANSI) and Canadian Standards Association (CSA) standards.

5.2 The following standards apply to visibility protection:

Association	Standard
CSA	CAN/CSA-Z96-02, High-Visibility Safety Apparel
ANSI	ANSI/ISEA 107 - High-Visibility Safety Apparel

5.3 If there is a specific need to be visible to the passing public, to machine operators, or to other crew members, high visibility vests shall be worn (and retro-reflective striping on arms and legs at night).

5.4 Chemically Resistant Protective Clothing – use performance characteristics as listed by the Manufacturer

5.4.1 Whenever there is a potential for chemical splashing, disposable, chemically resistant clothing, such as a coated Tyvek coverall or apron will be worn. Examples of when such clothing may be required include the cleaning of small spills, nonroutine tasks involving the use of chemicals, and the transfer of large quantities of chemicals from large containers to smaller ones. The process for selecting chemically resistant clothing will be similar to that described for the selection of chemically resistant gloves.

5.5 All employees shall wear suitable clothing for the existing conditions and the work being performed.If there is a danger that a worker's hand, arm, leg, or torso may be injured, an employer ensure that the worker wears properly fitting hand, arm, leg, or body protective equipment that is appropriate to the work, the work site, and the hazards identified.

5.6 In the presence of a flash fire or electrical equipment flashover hazard, staff must wear flame resistant outerwear (overalls) and use other protective equipment appropriate to the hazard.

5.7 Where there is a risk of drowning, a personal flotation device or lifejacket must be worn, as per the applicable regulations.

5.8 Electrically rated rubber gloves and rubber boots must be worn when working around electricity (waders must also be worn for electro fishing where there is an electric current passing through the water).

5.9 When wearing flame resistant outerwear (coveralls), staff must not wear against their skin clothing that is made of a fabric or material that will melt when exposed to heat (e.g., fleece).

Americas

PPE Hazard Analysis

S3NA-208-FM1

This form will be used for office activities that require PPE. It will also be used to determine the PPE requirements for non-routine maintenance tasks that may not be evaluated during the initial hazard assessments.

1. **Job Title(s):** This hazard analysis describes the tasks and required personal protective equipment (PPE) for the following job titles:

2. **Description of Tasks:** The tasks performed by personnel in the above job titles include:

3. **Potential Hazards and PPE Selection** (see *S3NA-208-WI1 PPE Selection Guidelines* for assistance).

TASK	POTENTIAL HAZARDS (1)	PPE SELECTION

The signature of the certifying manager below verifies that the tasks are accurately described:

Signature Date

Print Date

Americas

Project Safety Meetings S3NA-210-PR1

1.0 Purpose and Scope

1.1 Establishes the requirements for conducting and documenting meetings on topics that are designed to promote Safety, Health and Environmental (SH&E) awareness and facilitate discussion regarding hazards and risks.

1.2 This procedure applies to all AECOM Americas-based employees and operations in the performance of services directed and controlled by AECOM.

2.0 Terms and Definitions

2.1 None

3.0 References

3.1 Q2-251-PR1 Project Meeting Procedure

3.2 Q2-381-PR1 Construction Phase Services Procedure

3.3 S3NA-003-PR1 SH&E Training

3.4 S3NA-004-PR1 Incident Reporting Procedure

3.5 S3NA-209-PR1 Project Hazard Assessment and Planning

4.0 Procedure

4.1 Roles and Responsibilities

4.1.1 **Project Managers** shall ensure that all employees and personnel under the control of AECOM, e.g. subcontractors, temporary agency employees, etc., assigned to projects within their areas of responsibility participate in project initiation/kick-off meetings, special situation meetings, task hazard analyses, on-site safety inspections, and supplemental training meetings.

4.1.2 **District SH&E Manager** shall provide assistance to Project Managers as required to carry out the requirements of this procedure, particularly in the area of making training materials available and providing spot- checks of proper documentation.

4.1.3 **Site Supervisor or Site Safety Officer** shall assist the Project Manager in running safety meetings, training or site inspections.

4.2 Construction Phase Initiation/Kick-off meeting for field operations

4.2.1 A construction phase initiation/kick-off safety meeting will be conducted prior to the start of field operations; refer to *Q2-381-PR1 Construction Phase Services Procedure* and *Q2-251-PR1 Project Meeting Procedure.* Discussion points for this meeting will come from the project-specific SH&E documentation (e.g., Health and Safety Plan [HASP], Safe Work Plan [SWP], Task Hazard Analysis [THA], etc.). The meeting will involve representatives from all organizations with a direct contractual relationship with AECOM on the project site. Topics for this meeting will include:

- Communication to all participants regarding on-site SH&E responsibilities and authority.
- Establishing safety points of contact for each organization and phase of work.
- Communication of organizational SH&E performance expectations.
- Identification of significant project SH&E issues, risks, and solutions.
- Coordination of organizational SH&E conflicts and interactions.

4.3 Meetings

4.3.1 Change in Scope/Activity – Conducted for all AECOM staff and site personnel with a direct contractual relationship with AECOM to discuss changes to scope or a new phase of work.

4.3.2 Periodic – Conducted at a regular, recurring frequency of not less than biweekly, but preferably once per week.

4.3.3 Daily – Daily safety discussions as part of daily routine project coordination meetings. Daily meetings are required for HAZWOPER activities and other activities as identified in the safety plan. Daily safety discussions will involve representatives from all organizations with a direct contractual relationship with AECOM on the job site.

4.3.4 Significant Personnel Turn-over – Conducted at the start of any workday where a new organization begins work on site or when more than 25 percent of the day's work force is new to the site.

4.3.5 Post-Incident – Conducted at the start of the work day following the occurrence of a serious incident as defined in *S3NA-004-PR1 Incident Reporting*. All project initiation/kick-off safety meetings will be documented using the *S3NA-210-FM1 Tailgate Safety Meeting Log*.

4.3.6 All special situation safety meetings listed above will include review of applicable THAs for the scope of services to be performed and be documented using the *S3NA-210-FM1 Tailgate Safety Meeting Log* or equivalent.

4.3.7 Daily safety discussions not otherwise required by HAZWOPER or the project safety plan will be documented.

4.4 Supplemental Training Meetings

4.4.1 The **Project Manager**, **Site Supervisor** or **Site Safety Officer** will implement worker training on general safety topics as part of routine on-site training activities. Where such training is conducted it will be documented on the *S3NA-210-FM1 Tailgate Safety Meeting Log*.

4.5 Safety Orientation

4.5.1 All project employees will attend a project-specific safety orientation and training session prior to the start of any project and/or task.

4.5.2 The **Project Manager**, **Site Supervisor**, or **Site Safety Officer** will conduct the meeting based on project specifics (e.g., location, unique hazards and risks, client requirements, etc.) and any mandatory topics required by *S3NA-003-PR1 SH&E Training*. The **Region SH&E Manager** can provide examples of project safety orientation material for reference.

4.5.3 The depth/level of training will be commensurate with the job function(s) to be performed. Site visitors will receive general orientation and task-specific training.

4.5.4 At a minimum, employee orientation and training will consist of the items listed below:

- Identification of hazards associated with the individual's job function and responsibilities.
- Specific safety procedural instruction needed to perform his or her required job function or task.
- Content of the HASP, SWP and any THA in accordance with *S3NA-209-PR1 Project Hazard Assessment and Planning*.

4.6 Periodic Safety Training Meetings

4.6.1 Safety training meetings will be scheduled and conducted throughout the duration of the project.

4.6.2 Meetings shall give project personnel an opportunity to maintain a high degree of safety awareness through timely and quality safety education. Meeting time will be used to discuss specific safety topics and obtain employee feedback.

4.6.3 Safety meetings will be conducted by the **Project Manager**, **Site Supervisor** or **Site Safety Officer** and supplemented by lead persons of the various crafts represented at the site (e.g., electrician, heavy equipment operator, foreman, inspector, resident engineer, etc.).

4.6.4 Topics for discussion will include SH&E hazards noted during routine and non-routine work situations and an explanation of job safety procedures unique to the project.

4.6.5 The **Project Manager** and **Site Safety Officer** will monitor safety meetings to ensure that subject matter is properly presented.

4.6.6 All periodic safety meetings will be documented using *S3NA-210-FM1 Tailgate Safety Meeting Log*. Sign-in of every meeting participant is required to ensure proper accountability and to meet AECOM project recordkeeping requirements.

4.6.7 SH&E considerations will be discussed at every project meeting. Once on site:

- All on-site personnel must review and acknowledge the form or plan at a “tailgate” or “toolbox” meeting.
- Any new or previously unidentified hazards must be documented on the form or plan as a revision and acknowledged with initials by all on-site staff.
- The HASP, SWP or THA must be reviewed regularly as required and documented on the plan.

5.0 Records

5.1 All signed copies of the field forms and project plans must be placed in the appropriate project folder.

6.0 Attachments

6.1 S3NA-210-FM1 Tailgate Safety Meeting Log

AECOM

Americas

Tailgate Safety Meeting Log

S3NA-210-FM1

This sign-in log documents the topics of the tailgate safety briefing and individual attendance at the briefing. Personnel who perform work operations on site are required to attend each safety briefing and acknowledge their ability to ask questions and receipt of such briefings daily. Please provide a brief narrative of the following topics as applicable to the Project.

Name of Meeting Leader	**Signature**

PROJECT NAME & LOCATION

PROJECT NUMBER	**DATE/TIME**	**WEATHER CONDITIONS**

TOPIC
Discussion – check all that apply

Today's Scope of Work (All tasks)	☐ yes	☐ n/a	Access / Egress / Slips, Trips, & Falls	☐ yes	☐ n/a
Schedule / New Work / Scope Changes	☐ yes	☐ n/a	Smoking, Eating, & Drinking	☐ yes	☐ n/a
Reviewed Procedures, Task Hazard Analysis, etc.	☐ yes	☐ n/a	Washroom / Facilities Location	☐ yes	☐ n/a
Emergency Action Plan & Procedures	☐ yes	☐ n/a	Heat/Cold Stress	☐ yes	☐ n/a
Communications Protocol	☐ yes	☐ n/a	Exclusion Areas Barricades / Cones	☐ yes	☐ n/a
Required Personal Protection Equipment	☐ yes	☐ n/a	Required Permits, Passes, Keys, etc.	☐ yes	☐ n/a
Required Monitoring / Instruments	☐ yes	☐ n/a	Decontamination Procedures / Investigation-Derived Waste Management	☐ yes	☐ n/a
Fitness for work / Fatigue	☐ yes	☐ n/a	Equipment Inspections/Safety Checklists	☐ yes	☐ n/a
Site Control / Work Zones / Security	☐ yes	☐ n/a			

COMMENTS / OTHER

Tailgate Meeting Attendees

Print Name	**Signature**

SIX QUESTIONS FOR SUCCESS – As your final preparedness, take two minutes to think through and answer these questions**:**

1. What are we about to do?
2. What equipment are we going to use?
3. Have I/we been trained to use this equipment?
4. Have I/we been trained to do this job?
5. How can I/we be hurt?
6. How can I/we prevent this incident?

If you and your team aren't prepared to do the assigned work, STOP WORK, and take time to properly prepare.

END OF DAY SIGN-OFF:

____

Site Safety Officer Signature

☐ No Incidents Occurred

☐ Number of Near Misses/Observations Reported

☐ All Incidents Reported the Incident Reporting Line

LESSONS LEARNED / COMMENTS / OTHER

Americas

Hand and Power Tools

S3NA-305-PR1

1.0 Purpose and Scope

1.1 Provides the AECOM requirements for all manually operated hand and power tools and equipment use, handling and storage.

1.2 This procedure applies to all AECOM Americas-based employees and operations.

2.0 Terms and Definitions

2.1 None

3.0 References

3.1 S3NA-003-PR1 SH&E Training

3.2 S3NA-205-PR1 Equipment Inspections & Maintenance

3.3 S3NA-208-PR1 Personal Protective Equipment Program

3.4 S3NA-302-PR1 Electrical, General

3.5 S3NA-410-PR1 Hazardous Energy Control

3.6 S3NA-510-PR1 Hearing Conservation Program

4.0 Procedure

4.1 Roles and Responsibilities

4.1.1 **Project Managers/Field Task Managers/Supervisors –** Ensure that all aspects of this procedure are followed and adhered to on all AECOM projects, sites and locations. If a specific tool is not included in the attachments, appropriate guidelines shall be established prior to work associated with that equipment, including following manufacturer's recommendations.

4.1.2 **Region Safety, Health and Environment (SH&E) Manager –** Provide technical guidance and support as to this procedure.

4.1.3 **Employees** – No work with any tool that they are not familiar with without first obtaining training associated with that equipment. In addition, **employees** must following manufacturer's recommendations for its use and must not modify the equipment without first obtaining authorization from the manufacturer.

4.2 Restrictions

4.2.1 No **employee** shall use any hand tool, unless they are familiar with the use and operation of the equipment or have received specific instruction on its use and operation.

4.2.2 All tools will be used in accordance with manufacturer's specifications.

4.3 Training

4.3.1 Instruction in the proper use, safe handling, and maintenance of tools will be provided to employees unfamiliar with the tool. Refer to the attachments section for specifics and ocncurrence in the employee's Training Needs Assessment (TNA) per the *S3NA-003-PR1 SH&E Training* procedure.

4.4 Personal Protective Equipment

4.4.1 Lockout devices (padlocks, multiple lock hasps, tags), gloves appropriate to the task, safety-toed boots, as required, hard hats and eye and face protection, as required and in accordance with the *S3NA-208-PR1 Personal Protective Equipment Program*.

4.5 Inspections

4.5.1 All tools must be inspected prior to each use. Any tool that is defective or has missing parts must not be used. Every broken or defective tool must be tagged 'out of service'. Tagged tools will be returned to the supervisor for repair or replacement. Tagged tools will be immediately removed from service.

4.5.2 All tools must be inspected to manufacture's specifications according to tool rests and guard adjustment tolerances. All tools will be inspected to ascertain that all safety devices are present and functioning properly in accordance with the *S3NA-205-PR1 Equipment Inspections & Maintenance* procedure.

5.0 Records

5.1 None

6.0 Attachments

6.1	S3NA-305-WI1	Chainsaw Safety Card
6.2	S3NA-305-WI2	Circular Saw Safety Card
6.3	S3NA-305-WI3	Cut Off Saw Safety Card
6.4	S3NA-305-WI4	Handheld Grinder Safety Card
6.5	S3NA-305-WI5	Impact Wrench Safety Card
6.6	S3NA-305-WI6	Nail Gun Safety Card
6.7	S3NA-305-WI7	Dustless Vacuum Safety Card
6.8	S3NA-305-WI8	Power Drill Safety Card
6.9	S3NA-305-WI9	Pressure Washer Safety Card
6.10	S3NA-305-WI10	Reciprocating Saw Safety Card
6.11	S3NA-305-WI11	Sander Safety Card
6.12	S3NA-305-WI12	Utility Knife Safety Card
6.13	S3NA-305-WI13	Wood Chipper Safety Card
6.14	S3NA-305-WI14	Clearing and Grubbing Equipment Safety Card
6.15	S3NA-305-WI15	Pneumatic Tools Safety Card
6.16	S3NA-305-WI16	Manual Hand Tools Safety Card
6.17	S3NA-305-WI17	Small Engines Safety Card
6.18	S3NA-305-WI18	Electric and Battery Powered Hand Tools Safety Card
6.19	S3NA-305-GL1	Hand and Power Tools Guide

Americas

Chainsaw Safety Card

S3NA-305-WI1

1.0 Objective / Overview

1.1 Available in a variety of types and capacities, chainsaws are one of the most powerful, yet dangerous cutting tools available.

1.2 Working safely with a chain saw begins with training.

1.3 Additional safety measures include proper training, good body mechanics and felling technique, well-maintained equipment, and protective clothing.

2.0 Safe Operating Guidelines

2.1 A sharp chainsaw is safer than a dull one. Keep the saw clean, lubricated, and adjusted. Before starting work inspect and test the chain brake, chain catch, throttle lock, handles and guards, all nuts and bolts, spark arrestor, and muffler and air filter. The chain tension should be properly adjusted and the carburetor tuned. Never “drop start” the saw.

2.2 A chainsaw is not only dangerous to the operator but also to surrounding persons. Keep the saw close to the body. Bend from the knees, not the waist. Improper lifting techniques and poor posture contribute to injuries.

3.0 Potential Hazards

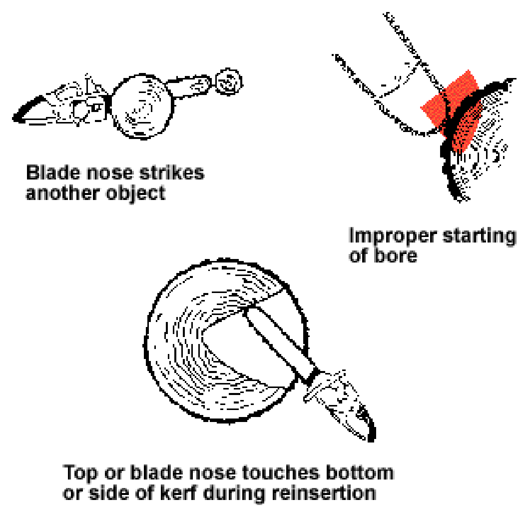
3.1 Kickback – Sudden and violent reverse movement of the saw

3.2 Hand/arm vibration

3.3 Noise

3.4 Flying/falling debris

3.5 Severe cuts



Avoid Situations That Can Cause Kickback

4.0 Training Requirements

4.1 Review of training requirements per the Training Needs Assessment (TNA).

4.2 Demonstrated knowledge on the use of a chainsaw.

4.3 Review of manufacturers operating guidelines.

5.0 Personal Protective Equipment (Level D PPE)

5.1 Debris Shield

5.2 Chainsaw Chaps

5.3 Leather Gloves

5.4 Hearing Protection

6.0 Other Safety Tips

6.1 Always avoid standing on the log and making cuts with the saw between your legs; always cut with the saw to the outside of your legs.

6.2 Determine where the tree/limb will fall prior to cutting. Always ensure that personnel and equipment are not in the path of the falling tree/log, and that you have time to move away. If necessary, flag/or fence off the area to prevent entry.

6.3 Always stand to one side of the limb you are to cut, never straddle it.

6.4 Always keep in mind where the chain will go if it breaks; never position yourself or other people in line with the chain.

6.5 Keep the chain out of the dirt, debris will fly, the teeth will be dulled and the chain life shortened.

Americas

Circular Saw Safety Card

S3NA-305-WI2

1.0 Objective / Overview

1.1 The circular saw is used in cutting wood products (i.e., plywood, construction lumber, etc.).

1.2 Safe measures for use include proper training, good body mechanics and felling technique, well-maintained equipment, and protective equipment. Potential Hazards

1.3 Kickback – Sudden and violent reverse movement of the saw

1.4 Noise

1.5 Flying debris

1.6 Sharp, moving blade (severe cuts)

2.0 Safe Operating Guidelines

2.1 Use sharp blades. Dull blades cause binding, stalling and possible kickback.

2.2 Use the correct blade for the application and check for proper operation before each cut.

2.3 Check often to ensure that guards return to their normal position quickly. Never defeat the guard to expose the blade.

2.4 Before starting a circular saw, be sure the power cord and extension cords are out of the blade path and are long enough to freely complete the cut. A sudden jerk or pulling on the cord can cause loss of control of the saw and a serious accident.

2.5 Secure the work being cut to avoid movement.

2.6 For maximum control, hold the saw firmly with both hands after securing the work piece.

2.7 Keep the upper and retracting lower blade guard and the motor free from dust.

2.8 Do not hold or force the retracting lower guard in the open position.

2.9 Do not over tighten the blade-locking nut.

2.10 Do not twist the saw to change, cut or check alignment.

2.11 Do not use a saw that vibrates or appears unsafe in any way.

2.12 Do not force the saw during cutting.

2.13 Do not cut materials without first checking for obstructions or other objects such as nails and screws.

2.14 Check frequently to be sure clamps remain secure.

2.15 Avoid cutting small pieces that can't be properly secured and material on which the saw shoe can't properly rest.

2.16 Do not overreach. Keep proper footing and balance.

2.17 When you start the saw, allow the blade to reach full speed before contacting the work piece.

3.0 Training Requirements

3.1 Review of training requirements per the Training Needs Assessment (TNA).

3.2 Demonstrated knowledge on the use of a circular saw.

3.3 Review and follow manufacturer's operating guidelines.

4.0 Personal Protective Equipment (Level D PPE)

4.1 Leather Gloves

4.2 Safety glasses

4.3 Hearing Protection

5.0 Other Safety Tips

5.1 Circular saws are designed for right-hand operation; left-handed operation will demand more care to operate safely.

5.2 Disconnect power supply before adjusting or changing the blade.

5.3 Do not place hand under or in front of the shoe or guard of the saw when operating.

5.4 Cut at the proper depth (¼ inch/ 0.64 centimeter) below work surface (see picture). Set the depth of the blade prior to use, when the saw is unplugged.

5.5 Circular saw must be double-insulated or protected by a ground fault circuit interrupter.

Americas

Cut off Saw Safety Card

S3NA-305-WI3

1.0 Objective / Overview

1.1 Cut-off saws are high-speed cutting tools and very dangerous to operate. Therefore, it is very important to review the general safety rules, training, Personal Protective Equipment and procedures for working with portable cut off saws.

1.2 Cut off saws are used in a variety of activities (i.e. concrete, piping, metal, etc.).

2.0 Potential Hazards

2.1 Noise

2.2 Flying debris

2.3 Sharp, moving blades (severe cuts)

2.4 Burns from engine

2.5 Fire hazard from sparks and gasoline

2.6 Hand/arm vibration

2.7 Kickback – Sudden and violent reverse movement of the saw

3.0 Safe Operating Guidelines

3.1 **Pre-start checks** - Inspect the abrasive wheel for cracks and chips. If cracked or chip replace wheel before use. Ensure guard is positioned properly prior to start-up (*S3NA-411-PR1 Machine Guarding*). Make sure the fuel cap is properly secured.

3.2 **Starting -** Start the saw on firm ground or other solid surface in an open area. Never attempt to drop-start the engine (see picture). Clear the working area. Avoid operating the saw if the terrain is wet and/or frozen.

3.3 **Handling -** Hold the saw firmly with two hands when the engine is running, and whenever the blade is rotating until it comes to a complete stop. Carry the saw with engine stopped, muffler away from your body, while protecting the cutting wheel from striking the ground or other objects.

3.4 **Cutting -** Begin cutting at full throttle and continue at full throttle until the cut is finished. Avoid standing in a direct line with the cutting wheel. Use only downward pressure on the saw, as lateral pressure may cause the blade to break and shatter. Do not change the direction of the cut once started, as this can also cause the blade to break and shatter. Do not use abrasive-type wheels for rough grinding. Do not cut above shoulder height.

3.5 **Maintenance -** Shut off the engine and remove the spark plug wire before adjusting or working on the saw.

4.0 Training Requirements

4.1 Review of training requirements per the Training Needs Assessment (TNA).

4.2 Demonstrated knowledge on the use of a cut off saw.

4.3 Review and follow manufacturers operating guidelines.

5.0 Personal Protective Equipment (Level D PPE)

5.1 Face shield

5.2 Chainsaw Chaps

5.3 Hearing protection: earplugs and/or earmuffs

5.4 Respirator if required (concrete operations)

6.0 Other Safety Tips

6.1 Keep flammable and combustible materials away from saw while cutting metal.

Americas

Handheld Grinder Safety Card

S3NA-305-WI4

1.0 Objective / Overview

1.1 Handheld grinders are high-speed electric- or pneumatic-powered grinding tools used to shape or cut metal, and can be dangerous to operate.

1.2 Grinders are used in a variety of activities (i.e., piping installation/repair, metal, restoring, polishing, sharpening, etc.).

2.0 Potential Hazards

2.1 Kickback – Sudden and violent reverse movement of the grinder

2.2 Flying debris

2.3 Moving parts (severe cuts)

2.4 Fire hazard from sparks igniting nearby debris or objects

2.5 Noise

2.6 Hand/arm vibration

3.0 Safe Operating Guidelines

3.1 Basic safety rules can help prevent hazards associated with the use of handheld grinders:

3.1.1 Never carry the tool by the cord (or the hose for pneumatic tools).

3.1.2 Never yank the cord or the hose to disconnect the tool from the receptacle.

3.1.3 Keep cords and hoses away from heat, oil, and sharp edges.

3.1.4 Denergize tools when not in use, before servicing, and when changing accessories such as blades/bits/cutters.

3.1.5 All observers should be kept at a safe distance from the work area.

3.1.6 Always secure work with clamps or a vise, freeing both hands to operate the tool.

3.1.7 Avoid accidental starting; do not hold a finger on the trigger/switch while carrying a powered tool.

3.1.8 Tools should be maintained with care. They should be kept clean and sharp for the best performance. Follow instructions in the user's manual for lubricating and care instructions.

3.1.9 Be sure to keep your footing and maintain proper balance.

3.1.10 The proper apparel should be worn. Loose clothing or jewelry can become caught in moving parts.

3.1.11 Inspect the tool before every use. Damaged tools must be removed from use and tagged "DO NOT USE".

4.0 Training Requirements

4.1 Review of training rquirements per the Trainign Needs Assessment (TNA).

4.2 Demonstrated knowledge on the use of a handheld grinder.

4.3 Follow manufacturers operating guidelines, especially for proper grinding wheel attachment.

5.0 Personal Protective Equipment (PPE)

5.1 Leather gloves

5.2 Safety glasses with sideshields

5.3 Hearing protection: earplugs and/or earmuffs

5.4 Other PPE as necessary for the work site/activity

6.0 Other Safety Tips

6.1 Keep flammable and combustible materials away from the grinder.

6.2 Have a fire extinguisher on hand while using grinder.

6.3 Inspect the abrasive wheel for cracks and chips. If cracked or chipped, replace wheel before use.

6.4 Ensure safety guard(s) is positioned properly prior to start-up.

6.5 Never clamp a handheld grinder in a vice.

Americas

Impact Wrench Safety Card

S3NA-305-WI5

1.0 Objective / Overview

1.1 Impact wrenches are mainly used for tire changing but that does not limit their use. They can be used in all applications when a certain amount of torque is needed to loosen or tighten nuts and bolts.

1.2 The danger comes in to play when employees try to use the wrong sockets with an air wrench. Employees using air wrenches must have a general understanding of how to use them.

2.0 Potential Hazards

2.1 Flying debris

2.2 Noise

2.3 Cuts

2.4 Hand/arm vibration

3.0 Safe Operating Guidelines

3.1 Drain water from air compressor tank and condensation from air lines.

3.2 Disconnect the tool from the air supply before lubricating or changing sockets. Impact wrench sockets and accessories must be used with this tool.

3.3 Do not use hand sockets and accessories. Select the required impact socket.

3.4 Connect tool to air hose of recommended size. The use of a quick connect set makes connecting easier.

3.5 Never use a wire, soft pin, or nail to hold the socket onto the square spindle of the impact wrench.

3.6 If the proper retaining device on the tool is broken, the tool should be repaired.

3.7 On applications where a low or critical level of torque is required, it is recommended that you impact each fastener lightly, and then perform the final tightening with a hand torque wrench.

4.0 Training Requirements

4.1 Review of training requirements per the Training Needs Assessment (TNA).

4.2 Demonstrated knowledge on the use of a electric drill.

4.3 Review and follow manufacturers operating guidelines.

5.0 Personal Protective Equipment (Level D PPE)

5.1 Leather gloves/anti-vibration gloves

5.2 Hearing protection

6.0 Other Safety Tips

6.1 Be sure no one is below when using the tool at heights.

6.2 The proper fastening torque may differ depending upon the kind or size of the bolt.

6.3 Check the torque with a torque wrench.

Americas

Nail Gun Safety Card

S3NA-305-WI6

1.0 Objective / Overview

1.1 Nail guns are useful tools, but must be handled with care.

1.2 Nail guns have been shown to be the cause of unnecessary injuries when the design of the gun places emphasis on speed, rather than safety.

2.0 Potential Hazards

2.1 Flying debris/nails

2.2 Imbedded object

2.3 Puncture wounds

2.4 Noise

3.0 Safe Operating Guidelines

3.1 Watch out for other crewmembers working near you.

3.2 Never let an inexperienced crewmember use a nail gun without supervised training.

3.3 Never use bottled gas as a power source for pneumatic tools.

3.4 Disconnect a nail gun before you service it.

3.5 Hold your hand a good 12 inches back from the ends of studs or joists when you are nailing.

3.6 Keep the gun properly aligned with your work both vertically and horizontally.

3.7 Never nail with the gun pointed toward you or anyone else on the job.

3.8 Never try to nail beyond your reach.

4.0 Training Requirements

4.1 Review of training requirements per the Trainign Needs Assessment.

4.2 Demonstrated knowledge on the use of a coring machine.

4.3 Review and follow manufacturers operating guidelines.

5.0 Personal Protective Equipment (Level D PPE)

5.1 Leather gloves

5.2 Hearing protection

6.0 Other Safety Tips

6.1 When you are moving about the work area keep your finger off the trigger until you are ready to fire. Make sure you have only placed the nose guard against the material you are going to nail together.

6.2 Never rest the gun against any part of your body, or try to climb a ladder with the gun cradled against your body.

6.3 Be aware of what is located behind the nailing surface. Never place hands or other body parts directly behind the nailing surface.

6.4 Use only for intended work.

6.5 Avoid nailing into knots as nail can splinter wood.

6.6 Never disable safety tip on gun.

Americas

Dustless Vacuum Safety Card

S3NA-305-WI7

1.0 Objective / Overview

Worker is using the roto-peen (scabbler) attachment; VAC-PAC collection system shown with 55 gal drum.

1.1 Dustless decontamination system (also refered to as Pentek bradn name) removes and packages surface contamination from concrete and steel structures.

1.2 The Pentek integrated suite of manually operated equipment (e.g., squirrel III, corner cutter, roto-peen, and crack chaser) is designed for the safe removal of radioactive materials, lead-based paints, polychlorinated biphenyls, pesticides, chemical residues, and other contaminated coatings.

1.3 The Pentek system incorporates a high-performance vacuum and waste packaging unit, the VAC-PAC, in conjunction with pneumatically operated equipment to remove contaminated material. Dust and debris are captured at the cutting tool surface. Supporting equipment required to operate the unit includes a 60 kilowatt generator and an air compressor (minimum 350 cubic feet capacity), as well as a drum grappler for drum handling activities.

2.0 Potential Hazards

2.1 Hazardous noise

2.2 Vibration

2.3 Tripping hazard from cables and hoses

2.4 Hot surfaces (vacuum unit)

2.5 Electrical (high voltage)

2.6 Pinch hazard

2.7 Back strain

2.8 High pressure air

3.0 Safe Operating Guidelines

3.1 Prior to use, a pre-operation inspection must be completed to determine if the unit is in safe working condition.

3.2 The vacuum unit should be placed a minimum of 50 feet (15.2 meters) away from the work area.

3.3 Once in position to begin work, apply the brake to stabilize the unit. When raising the VAC-PAC to insert/remove a drum, do not place your body or any extremity under the VAC-PAC while it is in the raised position.

3.4 Two workers should be used to maneuver the unit into place.

3.5 A minimum 10 feet (3 meters) clearance will be established around the unit while in operation.

3.6 Workers should be aware of their position in relation to the hoses and cable to minimize tripping hazards.

3.7 A competent person will train each worker in the operation of the unit.

3.8 Maintenance in excess of preventive maintenance activities (e.g., lubrication) will be performed by manufacturer personnel ONLY.

4.0 Personal Protective Equipment (Level D PPE ensemble)

4.1 Leather gloves (maintenance)

4.2 Tyvek suit (with hood)

4.3 Anti-vibration gloves (operation)

4.4 Hearing protection (plugs or muffs)

5.0 Other Safety Tips

5.1 Always know where the emergency stop is located.

5.2 Operators of a motorized drum grappler must be trained in agreement with the powered industrial truck standard.

5.3 Review *S3NA-302-PR1 Electrical, General* prior to refueling the electrical generator and/or compressor.

Power Drill Safety Card

S3NA-305-WI8

1.0 Objective / Overview

1.1 Available in a variety of types and capacities, portable power drills are undoubtedly the most used power tools.

1.2 Because of their handiness and application to a wide range of jobs, drills often receive heavy use. For this reason, you will need to carefully check your drill's capacity limitations and accessory recommendations.

2.0 Potential Hazards

2.1 Electrical shock

2.2 Puncture wounds

2.3 Flying debris

2.4 Severe cuts

2.5 Fire

2.6 Burns (hot bits)

2.7 Manual handling (sprains/strains - wrist)

3.0 Safe Operating Guidelines

3.1 Check carefully for loose power cord connections and frays or damage to the cord. Keep all cords clear of the cutting area during drilling.

3.2 Replace damaged tool and extension cords immediately.

3.3 Always keep drill bits sharp.

3.4 Disconnect the power supply before changing or adjusting bit or attachments,

3.5 Do not use high speed steel (HSS) bits without cooling or using lubrication.

3.6 Be sure the chuck is tightly secured to the spindle. This is especially important on reversible-type drills. Tighten the bit securely as described by the owner/operators manual.

3.7 The chuck key must be removed from the chuck before starting the drill. A flying key can be an injury-inflicting missile.

3.8 Secure workpiece being drilled to prevent movement.

3.9 Check auxiliary handles, if part of the tool. Be sure they are securely installed.

3.10 Always use the auxiliary drill handle when provided. It gives you more control of the drill, especially if stalled conditions occur.

3.11 Grasp the drill firmly by insulated surfaces.

3.12 Always hold or brace the tool securely. Brace against stationary objects for maximum control. If drilling in a clockwise -- forward -- direction, brace the drill to prevent a counter-clockwise reaction.

3.13 Do not overreach. Always keep proper footing and balance.

3.14 Don't force a drill. Apply enough pressure to keep the drill bit cutting smoothly. If the drill slows down, relieve the pressure. Forcing the drill can cause the motor to overheat, damage the bit and reduce operator control.

4.0 Training Requirements

4.1 Review of training needs per the Training Needs Assessment.

4.2 Demonstrated knowledge on the use of a power drill.

4.3 Review and follow manufacturers operating guidelines.

5.0 Personal Protective Equipment (Level D PPE)

5.1 Safety glasses

5.2 Leather Gloves

6.0 Other Safety Tips

6.1 Electric drills must be double-insulated or plugged into a ground fault circuit interrupter outlet.

6.2 Never carry tool by cord or yank it to disconnect from receptacle.

6.3 Keep cord away from sharp edges.

Pressure Washer Safety Card

S3NA-305-WI9

1.0 Objective / Overview

1.1 High pressure washers can operate up to pressures of 5,000 pounds per square inch and come in a variety of types ranging from gas operated to electrical. If not used correctly and safely, pressure washers can be dangerous piece of work equipment.

1.2 AECOM only allows trained, authorized personnel to operate the high pressure washers. Along with training, other safety measures include: reviewing the manufacturers instructional booklet, proper maintenance of equipment, and personal protective equipment.

2.0 Potential Hazards

2.1 Kickback – Sudden and violent reverse movement of the gun

2.2 Flying debris

2.3 Slips and trips on wet surfaces and hoses

2.4 Noise

2.5 Manual handling

2.6 Exhaust fumes/carbon monoxide (CO) in enclosed spaces

2.7 Severe cuts

3.0 Safe Operating Guidelines

3.1 The gun valve must always be pointed at the work area, NEVER point the gun valve at yourself or another person.

3.2 High pressure washers shall be used to clean or decontaminate equipment, surfaces or structures only.

3.3 High pressure washers WILL NOT be used to clean or decontaminate workers or personal protective equipment while it is being worn.

3.4 Maintain a distance from the spray contact point to reduce noise exposure and risk of being struck by flying debris. Ensure that you are not overreaching and remain stable.

3.5 Always set the tripper safety lock when the gun valve is not in use.

4.0 Training Requirements

4.1 Review of training requirements per the Training Needs Assessment.

4.2 Demonstrated knowledge on the use of a pressure washer.

4.3 Review of manufacturers operating guidelines.

5.0 Personal Protective Equipment (Level D PPE)

5.1 Hard hat with faceshield

5.2 Heavy gloves

5.3 Hearing protection

5.4 PVC (or equivalent) rain suit

6.0 Other Safety Tips

6.1 Never fill a pressure washer fuel tank with fuel while the engine is running or if the engine is still hot.

6.2 Non-operators must remain a minimum of 25 feet from the operator.

6.3 High-pressure washing equipment should be cleaned often to avoid dirt buildup, especially around the trigger and guard area.

6.4 Always set the trigger safety lock when the gun valve is not in use.

6.5 Relieve the pressure in the system before coupling and uncoupling hoses.

6.6 Visually inspect the full length of high pressure discharge hose and inspect other high pressure fluid-handling components for abrasions or cuts, damage caused by exposure to chemicals and for damage caused by kinks in the hose.

Americas

Reciprocating Saw Safety Card

S3NA-305-WI10

1.0 Objective / Overview

1.1 The versatility of the reciprocating saw, in cutting metal, pipe, wood and other materials have made it a widely used tool.

1.2 By design, it is a simple tool to handle. Its demands for safe use, however, are very important.

2.0 Potential Hazards

2.1 Flying debris

2.2 Noise

2.3 Sharp, moving parts (cuts)

2.4 Hand/arm vibration

3.0 Safe Operating Guidelines

3.1 Use sharp blades. Dull blades can produce excessive heat, make sawing difficult, result in forcing the tool, and possibly cause an accident.

3.2 Position yourself to maintain full control of the tool, and avoid cutting above shoulder height.

3.3 To minimize blade flexing and provide a smooth cut, use the shortest blade that will do the job.

3.4 The work piece must be clamped securely, and the shoe of the saw held firmly against the work to prevent operator injury and blade breakage.

3.5 Maintain firm contact between the saw's shoe and the material being cut.

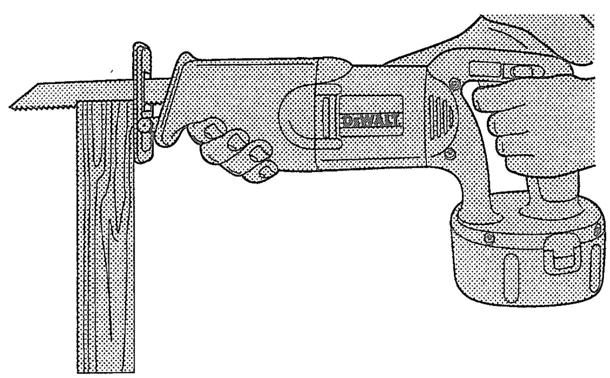
3.6 When making a "blind" cut (you can't see behind what is being cut), be sure that hidden electrical wiring, or water pipes are not in the path of the cut.

3.7 If wires are present, they must be disconnected at their power source by a qualified person or avoided, to prevent the possibility of lethal shock or fire.

3.8 Water pipes must be drained and capped.

3.9 Always hold the tool by the insulated grouping surfaces. When making anything other than a through cut, allow the tool to come to a complete stop before removing the blade from the work piece. This prevents breakage of the blade, and possible loss of tool control.

3.10 Different work surfaces demand different blades.



The correct way to hold the reciprocating saw while operating.

4.0 Training Requirements

4.1 Review of training requirement per the Training Needs Assessment (TNA).

4.2 Demonstrated knowledge on the use of a reciprocating saw.

4.3 Review and follow manufacturers operating guidelines.

5.0 Personal Protective Equipment (Level D PPE)

5.1 Safety glasses

5.2 Hearing protection

6.0 Other Safety Tips

6.1 Do not operate reciprocating saw in explosive atmospheres.

6.2 Do not overreach. Keep proper footing and balance at all times.

6.3 Do not use tool if switch is not operating correctly.

6.4 Check for misalignment or binding of moving parts, breakage or parts and any other condition that may affect the tool's operation.

6.5 Do not wear jewelry on the fingers/wrists during use.

6.6 Always use two hands to operate saw (see picture).

Americas

Sander Safety Card

S3NA-305-WI11

1.0 Objective / Overview

1.1 Sanders are commonly used at project sites for a variety of tasks.

1.2 Often times the hazards associated with sanders are overlooked; they don't appear threatening because they don't have sharp blades or bits. These misconceptions can be prevented through proper training and personal protective equipment (PPE) selection.

2.0 Potential Hazards

2.1 Kickback – Sudden and violent reverse of the sander

2.2 Noise

2.3 Hand/arm vibration

2.4 Dust exposure

2.5 Flying debris

2.6 Severe abrasive cuts

2.7 Electrocution

2.8 Explosion/fire hazard from the dust

3.0 Safe Operating Guidelines

3.1 Make sure the sander is switched "OFF" before connecting the power supply.

3.2 Disconnect power supply before changing a sanding belt, making adjustments, or emptying dust collector.

3.3 Inspect sanding belts before use. Replace those belts that are worn or frayed.

3.4 Install sanding belts that are the same widths as the pulley drum.

3.5 Adjust sanding belt tension to keep the belt running true and at the same speed as pulley drum.

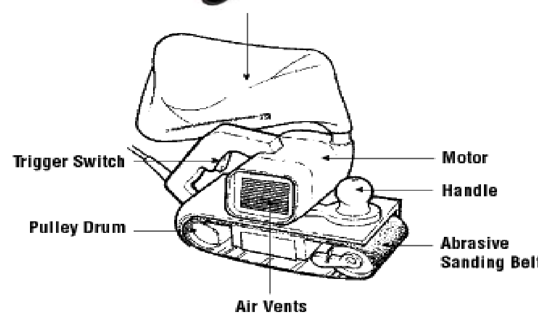
3.6 Secure the sanding belt in the direction shown on the belt and the machine. Keep hands away from the sanding belt.

3.7 Before starting a sander, be sure the power cord and extension cords are out of the belt path and are long enough to freely complete the task. The sander must be either double insulated or connected to a ground fault circuit interrupter.

3.8 Use two hands to operate sanders – one on the trigger and the other on the front handle knob.

3.9 Clean dust from the motor and vents at regular intervals.

3.10 Do not use a sander without an exhaust system or dust collector present that is in good working order. The dust created when sanding can be a fire and explosion hazard. Proper ventilation is essential.



3.11 Empty the collector when ¼ full. Minimise dust disturbance when emptying the collector.

3.12 Do not exert excessive pressure on a moving sander. The weight of the sander provides adequate pressure for the job.

3.13 Do not work on unsecured stock unless it is heavy enough to stay in place. Clamp the stop into place or use a ‘stop block’ to prevent movement.

3.14 Do not overreach. Always keep proper footing and balance.

3.15 Do not cover air vents of the sander.

3.16 Check often to ensure that guards are in their normal position.

4.0 Training Requirements

4.1 Review of training requirements per the Training Needs Assessment (TNA).

4.2 Review and follow manufacturers operating guidelines.

5.0 Personal Protective Equipment (Level D PPE)

5.1 Hearing protection

5.2 Safety Glasses

5.3 Leather gloves

Americas

Utility Knife Safety Card

S3NA-305-WI12

1.0 Objective / Overview

1.1 Utility knives serve a variety of purposes at work sites, and can be a useful tool, when used safely and correctly.

1.2 Learning proper positioning and correctly using a utility knife will drastically reduce the potential of cut-related injuries.

2.0 Safe Operating Guidelines

2.1 Always be sure that knives are sharp and not dull. A dull blade will require more force to cut, increasing the likelihood of slipping.

2.2 Be sure the blade is seated in the frame of the knife correctly, closed, and fastened together properly.

2.3 Always keep body parts away from the cut line, (e.g., fingers), and ensure that the material being cut is on firm ground and not against a body part (e.g. cutting rope against your leg).

2.4 Always pull the knife, never push the knife (the blade may break, and momentum could cause the body to come into contact with broken blade).

2.5 Always retract the blade when not in use.

3.0 Potential Hazards

3.1 Lacerations from direct contact with the blade.

3.2 Lacerations from blade breaking or shattering.

3.3 Ergonomics.

4.0 Training Requirements

4.1 Review of Applicable Standard Operating Procedures.

4.2 Review of client-specific requirements.

4.3 Demonstrated knowledge on the safe use of a utility knives.

4.4 Review and follow manufacturers operating guidelines for specialized or unusual knives.

5.0 Personal Protective Equipment (Level D PPE)

5.1 Cut resistant gloves (Kevlar, thick leather, etc.).

6.0 Other Safety Tips

6.1 Purchase safety-equipped utility knives with guarding or automatically retracting blades.

6.2 Replace dull blades – When knife begins to tear rather than cut, it is a good indicator the blade is dull.

6.3 Always wear a cut-resistant glove on your free hand.

6.4 Always use the right tool for the job – NEVER use the blade as a screwdriver or prying tool.

6.5 When using a knife to cut thicker materials, use several passes. Increased force on the blade can cause it to stray from the intended cut path, or break the blade.

6.6 When changing blades, always handle from the non-sharp side. Cover blade with duct tape and dispose.

6.7 Use an alternate tool when possible (scissors, wire cutters, etc.).

Utility Knives with Gaurding

AECOM

Americas

Wood Chipper Safety Card

S3NA-305-WI13

1.0 Objective / Overview

1.1 Wood chippers should be used with extreme caution in order to prevent personal injury, as the wood chipper is open to receive tree branches and other wooden material.

1.2 AECOM only allows trained, authorized personnel to operate a wood chipper.

1.3 Along with training, other safety measures include: reviewing the manufacturers instructional booklet, proper maintenance of equipment, and personal protective equipment.

2.0 Safe Operating Guidelines

2.1 The operator must be completely familiar with the controls and proper use of the equipment.

2.2 Workers feeding material into self-feeding wood chippers are at risk of being fed through the chipper if they reach or fall into the infeed hopper or become entangled in branches feeding into the machine.

2.3 Prior to use, make sure all safety devices and controls, such as emergency shut-off devices, are tested and verified to be functioning properly.

2.4 Make sure two workers (buddy system) are in close contact with each other when operating the chipper.

3.0 Potential Hazards

3.1 Burns from contact with the hot muffler or engine.

3.2 Flying debris.

3.3 Noise exposure.

3.4 Exhaust fumes exposure.

3.5 Entanglement in limbs and contact with chipper blades.

4.0 Training Requirements

4.1 Review of Applicable Standard Operating Procedures.

4.2 Demonstrated knowledge on the use of a wood chipper.

4.3 Review of manufacturers operating guidelines.

5.0 Personal Protective Equipment (Level D PPE)

5.1 Leather gloves

5.2 Hearing protection

5.3 Debris shield

5.4 Long sleeve shirt (e.g. working near poison ivy, poison oak, etc.)

6.0 Other Safety Tips

6.1 Stand to the side of the chipper while inserting limbs into chipper, never stand directly in front.

6.2 Insert trunk portion of tree/limb first. This will prevent the branches from getting entangled with clothing, etc. and pulling you in with the tree/limb.

6.3 Bystanders should be kept at least 25 feet away when in operation.

6.4 Keep the area around the wood chipper free of tripping hazards.

6.5 Never wear loose clothing that may get caught on feed material or moving parts.

6.6 Always set the trigger safety lock when the gun valve is not in use.

6.7 Never fill the fuel tank while the engine is running or if the engine is still hot.

Americas

Clearing and Grubbing Equipment Safety Card

S3NA-305-WI14

The following safety precautions will be followed during site clearing and tree falling

1.0 Hand Tools

1.1 All hand tools shall be in safe condition. Tools shall be inspected by the user daily.

1.2 Handles shall be sound, straight and tight-fitting.

1.3 Driven tools shall be dressed to remove any mushrooming.

1.4 Cutting tools shall be kept sharp and properly shaped.

1.5 All clearing activities shall terminate during electrical storms and periods of high winds.

1.6 Dead, broken or rotted limbs or trees (widow makers) shall be felled first.

1.7 Always wear the appropriate Personal Protective Equipment (PPE) when using hand tools, particularly eye and hand protection.

1.8 Use the right tool that is being used for the job to reduce chance of unexpected occurrences. Do not submit or use makeshift tools.

1.9 Defective tools shall not be used. They shall be taken out of service until repaired or replaced.

1.10 Check tools for damage or wear prior to each use to reduce chance of unexpected occurrences.

1.11 Replace cracked or broken handles on files, hammers, screwdrivers, or sledges.

1.12 Replace worn jaws on wrenches, pipe tools, and pliers

1.13 Redress burred or mushroomed heads on striking tools.

1.14 Sharpen cutting tools frequently to reduce chance of unexpected occurrences.

1.15 Store hand tools properly after each use.

1.16 Tools shall be clean and dry to avoid slippage when in use.

1.17 Never leave tools on ladders, scaffolds, or overhead work areas when they are not in use (a high number of injuries occur from objects/tools falling from overhead work areas in construction).

1.18 Always keep tools being used in overhead work areas in containers that will prevent them from falling.

1.19 Carry tools using a heavy belt or apron and hang tools at your sides.

1.20 Never carry tools in your pockets or hanging behind your back.

1.21 Avoid muscle strain and fatigue by doing the following:

- Avoid using hand tools with your wrist bent.
- Choose tools that allow you to keep your wrist straight when using them.
- Always PULL on wrenches and pliers. Never push unless you hold the tool with your palm open.
- Always cut away from yourself when using cutting tools.

1.22 Establish balance and stable footing when using a bar for prying. Pry bars can slip or break without warning.

1.23 Be aware of the presence of other personnel when using any tool, especially picks or axes.

2.0 Machete Use

2.1 A machete will only be used for its designated purpose; do not carelessly swing the machete when it is not needed.

2.2 To prevent lacerations, employees will wear Kevlar gloves and Kevlar chain saw chaps.

2.3 Machetes shall not be used when other employees are in the immediate work area.

3.0 Use of Weed Whips

3.1 Weed whips may be used to clear vegetation such as grass, light brush, briars and tree seedlings. The L-shaped weed whip cuts grass and weeds but is unstable for use on larger growth; the triangular-frame weed whip cuts briars and woody stems up to a half-inch in diameter. A "Suwannee" sling is a heavy duty weed whip that also has an axe blade. It does the same work as a weed whip, but can also cut through large materials. The heavier weight of this tool allows it to more easily cut off larger material than a weed whip.

3.2 When using weed whips, employees should follow these safety procedures:

3.2.1 Select the correct tool for the types and size of vegetation present across the landfill.

3.2.2 Employees will wear leather gloves when using weed whips.

3.2.3 Weed whips are meant to be swung back and forth with both hands. Avoid using a golf swing. The tool should be swung no higher than an employee's side.

3.2.4 Strong swings should be made to prevent the blade from bouncing or glancing off springy growth.

3.2.5 Screws hold the serrated double-edge blade in place. These screws can work loose so check them before each use.

3.2.6 At the end of the day, inspect the whips for damage. Clean, sharpen, and oil as necessary and store with a sheath in place.

4.0 Chain Saws

4.1 Refer to *S3NA-305-WI1 Chainsaw Safety Card.*

5.0 Felling Trees Manually

5.1 Before cutting begins, survey the work area for dead limbs, the lean of the tree to be cut, wind conditions and the location of other trees.

5.2 Remove lodged trees (tree has not fallen to the ground after being separated from its stump) as soon as possible. Never work under a lodged tree.

5.3 The distance between workers should be maintained at twice the height of the trees being felled.

6.0 Chipping Operations

6.1 Access covers and doors shall not be opened until the drum or disk is at a complete stop.

6.2 Infeed and discharge ports shall be designed to prevent employee contact with disc, knives and blower blades.

7.0 Cutting Tools

7.1 Wear safety glasses and protective gloves when using cutters.

7.2 Choose the proper cutter for the job. Cutters are designed for a specific type, hardness, and size of material.

7.3 Inspect the tool for proper working condition.

7.4 If tool is designed to have a guard, make sure guards are in place.

7.5 Cut materials straight across - keep the material being cut at right angles to the cutting edges of jaws.

7.6 Warn those in the area to take precautionary measures to avoid possible injury from flying metal pieces.

7.7 Keep cutting tools in good repair.

7.8 Adjust and lubricate cutter and moving parts daily if heavily used.

7.9 Sharpen jaws according to manufacturer's instructions.

7.10 Do not use a cutting tool until you are trained in its proper and safe use.

7.11 Do not use cushion grip handles for jobs requiring electrically-insulated handles. Cushion grips are for comfort primarily and do not protect against electric shock.

7.12 Do not use cutters which are cracked, broken or loose.

7.13 Do not exceed the recommended capacity of a tool.

7.14 Do not cut diagonally.

7.15 Do not rock cutters from side to side when cutting wire.

7.16 Do not pry or twist with tool when cutting.

7.17 Do not hammer on cutting tools or extend the handle length to achieve greater cutting power.

7.18 Do not expose cutters to excessive heat.

8.0 Selection and Use

8.1 Select tools that can be used without bending the wrist. Hand tools should allow the operator to grasp, hold, and use the tool with the wrist held straight.

8.2 Select the tool with the workplace layout and job design in mind. Sometimes a tool is correct for one operation and incorrect for another.

8.3 Use the right tool for the job. Confirm it is the right size and has sufficient power to do the job safely. When there is a choice, select a tool of a low weight.

8.4 Select low-vibrating tools, or choose tools with vibration-absorbing handles, like those covered with cork, rubber, plastic or plastic bonded to steel, to reduce hand/arm vibration.

8.5 Choose hand tools that have a center of gravity within or close to the handle.

8.6 Select tools with rounded and smooth handles that you can grip easily.

8.7 If they are available, choose hand tools with double handles to permit easier holding and better manipulation of the tool.

8.8 Select tools with a trigger strip, rather than a trigger button. This strip will allow you to exert more force over a greater area of the hand that, in turn, will reduce muscle fatigue.

8.9 Confirm that the trigger works easily to reduce the effort needed to operate it.

8.10 Confirm that your tool is well maintained and in good repair.

8.11 Frequently used tools that weigh more than 1 pound should be counter-balanced.

8.12 Hold the tool close to the body. Do not overreach.

8.13 Keep good balance and proper footing at all times. This will help operators to control the tool better, especially in response to unexpected situations.

8.14 Rest your hands by putting the tool down when you are not using it.

8.15 Reduce power to the lowest setting that can complete the job safely. This action reduces tool vibration at the source.

8.16 Confirm that cutting tools, drill bits, etc., are kept sharp, clean, and well maintained.

8.17 Do not wear gloves, loose clothing or jewelry while using revolving power tools. Tie back long hair or wear appropriate hair protection to prevent hair from getting caught in moving parts of equipment (manufacturer's operating manual for recommended PPE and/or safety issues/concerns).

8.18 Do not use a tool unless you have been trained to use it safely and know its limitations and hazards.

9.0 Storage and Handling

9.1 All tools shall be stored in a manner to prevent damage and injury. Store tools in a dry, secure location when they are not being used.

9.2 Tools shall be properly put away after each use.

9.3 Sharp or pointed tools shall be handled only if the sharp/pointed edge is covered, carried in a tool box or other device designed for that purpose, or the sharp/pointed edge is pointed downward, away from the body.

Americas

Pneumatic Tool Safety Card

S3NA-305-WI15

1.0 General Requirements

1.1 Wear safety glasses at all times and face shield if required. (Level "D" Personal Protective Equipment required).

1.2 Use hearing protection, where required.

1.3 Ensure that the compressed air supplied to the tool is clean and dry. Dust, moisture, and corrosive fumes can damage a tool. An in-line regulator filter and lubricator increases tool life.

1.4 Keep tools clean and lubricated, and maintain them according to the manufacturers' instructions.

1.5 Use only the attachments that the manufacturer recommends for the tools you are using.

1.6 Be careful to prevent hands, feet, or body from injury in case the machine slips or the tool breaks.

1.7 Reduce physical fatigue by supporting heavy tools with a counter-balance wherever possible.

1.8 Use the proper hose and fittings of the correct diameter.

1.9 Use hoses specifically designed to resist abrasion, cutting, crushing and failure from continuous flexing.

1.10 Choose air supply hoses that have a minimum working pressure rating of 150 pounds per square inch gauge or 150 percent of the maximum pressure produced in the system, whichever is higher.

1.11 Check hoses regularly for cuts, bulges and abrasions. Tag and replace, if defective.

1.12 Blow out the air line before connecting a tool. Hold hose firmly and blow away from yourself and others.

1.13 Make sure that hose connections fit properly and are equipped with a mechanical means of securing the connection (e.g., chain, wire, or positive locking device).

1.14 Install quick disconnects of a pressure-release type rather than a disengagement type. Attach the male end of the connector to the tool, NOT the hose.

1.15 Do not operate the tool at a pressure above the manufacturer's rating.

1.16 Turn off the air pressure to the hose when not in use or when changing power tools.

1.17 Do not carry a pneumatic tool by its hose.

1.18 Avoid creating trip hazards caused by hoses laid across walkways or curled underfoot.

1.19 Do not use compressed air to blow debris or to clean dirt from clothes.

2.0 Pneumatic Nailing and Stapling Tools

2.1 Permit only experienced and trained persons to operate pneumatic nailing and stapling tools.

2.2 Wear safety glasses or face a shield and, where necessary, use hearing protection.

2.3 Inspect a tool before connecting it to air supply:

- 2.3.1 Check tool safety mechanisms if applicable.
- 2.3.2 Tighten securely all screws and cylinder caps.

2.4 Check correct air supply and pressure before connecting a tool.

2.5 Check that the tool is correctly and securely connected to the air supply hose and that it is in good working order, with the safety mechanism operative, before using.

2.6 Always handle a tool as if it loaded with fasteners (nails, staples, etc.).

2.7 Equip tools with a work-contacting element that limits the contact area to one that is as small as practical.

2.8 Make sure that the mechanical linkage between the work-contacting element and trigger is enclosed.

2.9 Disconnect a tool from the air supply when the tool is unattended and during cleaning or adjustment. Before clearing a blockage, be sure that depressing the trigger exhausts all air from the tool.

2.10 Use only fasteners recommended by the manufacturer.

2.11 Permit only properly trained people to carry out tool maintenance.

2.12 Do not depress the trigger unless the nosepiece of tool is directed onto a safe work surface.

2.13 Do not carry a tool with the trigger depressed.

2.14 Do not load a tool with fasteners while the trigger is depressed.

2.15 Do not overreach. Keep proper footing and balance.

Americas

Manual Hand Tools Safety Card

S3NA-305-WI16

1.0 Hammers

1.1 Hammers are designed according to the intended purpose. Select a hammer that is comfortable for you and that is the proper size and weight for the job. Misuse can cause the striking face to chip, possibly causing a serious injury.

1.2 Choose a hammer with a striking face diameter approximately ½ inch (1.3 centimeters) larger than the face of the tool being struck (e.g., chisels, punches, wedges, etc.).

1.3 Ensure that the head of the hammer is firmly attached to the handle.

1.4 Replace loose, cracked or splintered handles.

1.5 Discard any hammer with mushroomed or chipped face or with cracks in the claw or eye sections.

1.6 Strike a hammer blow squarely with the striking face parallel to the surface being struck. Always avoid glancing blows and over and under strikes. (Hammers with beveled faces are less likely to chip or spall).

1.7 Look behind and above you before swinging the hammer.

1.8 Watch the object you are hitting.

1.9 Hold the hammer with your wrist straight and your hand firmly wrapped around the handle.

1.10 Do not use a hammer with a loose or damaged handle.

1.11 Do not use handles that are rough, cracked, broken, splintered, sharp-edged or loosely attached to the head.

1.12 Do not use any hammer head with dents, cracks, chips, mushrooming, or excessive wear.

1.13 Do not use a hammer for any purpose for which it was not designed or intended.

1.14 Do not use one hammer to strike another hammer, other hard metal objects, stones or concrete.

1.15 Do not redress, grind, weld or reheat-treat a hammer head.

1.16 Do not strike with the side or cheek of the hammer.

2.0 Wrenches

2.1 Inspect pipe wrenches periodically for worn or unsafe parts and replace them (e.g., check for worn threads on the adjustment ring and movable jaw).

2.2 Keep pipe wrench teeth clean and sharp.

2.3 Face a pipe wrench forward. Turn wrench so pressure is against heel jaw.

2.4 Pull, rather than push on the pipe wrench handle. Maintain a proper stance with feet firmly placed to hold your balance.

2.5 Do not use a pipe wrench as a hammer, or strike a pipe wrench with a hammer.

2.6 Do not use pipe wrenches on nuts and bolts.

2.7 Do not use a pipe extender for extra leverage. Get a larger pipe wrench.

2.8 Replace pipe cutter wheels which are nicked or otherwise damaged.

2.9 Use a three- or four-wheeled cutter, if there is not enough space to swing the single wheel pipe cutter completely around the pipe.

2.10 Choose a cutting wheel suitable for cutting the type of pipe material required:

2.10.1 Thin wheel for cutting ordinary steel pipe.

2.10.2 Stout wheel for cutting cast iron.

2.10.3 Other wheels for cutting stainless steel, plastic and other materials.

2.11 Select the proper hole diameter and correct tap size to tap a hole. The hole should be sized so that the thread cut by the tap will be about 75 percent as deep as the thread on the tap.

2.12 Use a proper tap wrench (with a “T” handle) for turning a tap.

2.13 Use lubricant or machine cutting fluid with metals other than cast iron.

2.14 Do not permit chips to clog flutes (groves in the tap that allow metal chips to escape from the hole). The chips may prevent the tap from turning – this may result in the tap breaking if you continue to apply pressure.

2.15 Do not use a conventional adjustable wrench for turning a tap – it will cause uneven pressure on the tap that may cause it to break.

2.16 Do not attempt to thread hardened steel. This can chip or damage the die.

2.17 Do not thread any rod or other cylindrical object that is larger in diameter than the major diameter of the die thread.

2.18 Do not use a spiral reamer on a rotating pipe. The reamer may snag and cause serious injury.

3.0 Pliers and Wire Cutters

3.1 Pliers are made in various shapes and sizes and for many uses. Use the correct pliers or wire cutters for the job.

3.2 Choose pliers or wire cutters that have a grip span of 2½ – 3½ inches (6.4 – 8.9 centimeters) to prevent your palm or fingers from being pinched when the tools are closed.

3.3 Use adjustable pliers that allow you to grip the work piece firmly while maintaining a comfortable handgrip (i.e., hand grasp is not too wide).

3.4 Use tools only if they are in good condition.

3.5 Make sure that the cutting edges are sharp. Dull and worn-down cutting edges require many times more force for cutting.

3.6 Make sure that the toothed jaws are clean and sharp. Greasy or worn-down jaws can result in compromised safety. Such tools also require increased force to hold the work piece which, in turn, increases the risk of muscular fatigue and repetitive strain injuries.

3.7 Oil pliers and wire cutters regularly. A drop of oil on the hinge will make the tools easier to use.

3.8 Pull on the pliers; do not push away from you when applying pressure. If the tool slips unexpectedly, you may lose your balance or injure your hand.

3.9 Cut at right angles. Never rock the cutting tool from side to side or bend wire back and forth against the cutting edges.

3.10 Do not cut hardened wire unless the pliers or wire cutters are specifically manufactured for this purpose.

3.11 Do not expose pliers or wire cutters to excessive heat.

3.12 Do not bend stiff wire with light pliers. Needle-nose pliers can be damaged by using the tips to bend large wire. Use a sturdier tool.

3.13 Do not use pliers as a hammer.

3.14 Do not hammer on pliers or wire cutters to cut wires or bolts.

3.15 Do not extend the length of handles to gain greater leverage. Use a larger pair of pliers for gripping or a bolt cutter for cutting.

3.16 Do not use cushion grip handles for jobs requiring tools with electrically insulated handles. Cushion grips are for comfort primarily and do not protect against electric shock.

3.17 Do not use pliers on nuts and bolts; use a wrench.

4.0 Screwdrivers

4.1 Screwdrivers are made in various shapes and sizes and for many uses. Use the correct screwdriver for the job.

4.2 Choose contoured handles that fit the shank tightly, with a flange to keep the hand from slipping off the tool.

4.3 Use a slot screwdriver with a blade tip width that is the same as the width of the slotted screw head.

4.4 For cross-head screws, use the correct size and type of screwdriver; a Phillips screwdriver may slip out of a screw head designed for use with the slightly flatter-tipped Pozi-driv screwdriver.

4.5 Use a vise or clamp to hold the stock if the piece is small or moves easily.

4.6 Keep the screwdriver handle clean. A greasy handle could cause an injury or damage from unexpected slippage.

4.7 If work must be carried out on “live” electrical equipment, use screwdrivers that have insulated handles designed for electrical work and a non-conducting shaft. Remember, most plastic handles are designed for grip and comfort.

4.8 Use non-magnetic tools when working near strong magnets (e.g., in some laboratories).

4.9 Use a screw-holding screwdriver (with screw-holding clips or magnetic blades) to get screws started in awkward, hard-to-reach areas. Square-tipped screwdrivers (e.g., Robertson) that hold screws with recessed square holes are also useful in such situations.

4.10 Use an offset screwdriver in close quarters where a conventional screwdriver cannot be used.

4.11 Use a screwdriver that incorporates the following features when continuous work is needed:

4.11.1 Use a pistol grip to provide for a straighter wrist and better leverage.

4.11.2 Use a "Yankee drill" mechanism (spiral ratchet screwdriver or push screwdriver) which rotates the blade when the tool is pushed forward.

4.11.3 Use a ratchet device to drive hard-to-move screws efficiently, or use a powered screwdriver.

4.12 File a rounded tip square making sure the edges are straight. A dull or rounded tip can slip out of the slot and cause hand injury or damage to materials.

4.13 Store screwdrivers in a rack or partitioned pouch so that the proper screwdriver can be selected quickly.

4.14 Do not lean or push on a screwdriver with any more force than necessary to keep contact with the screw. A screw properly piloted and fitted will draw itself into the right position when turned. Keep the shank directly over the screw being driven.

4.15 Do not hold the stock in one hand while using the screwdriver with the other. If the screwdriver slips out of the slot you may cut your hand.

4.16 Do not hammer screws that cannot be turned.

4.17 Do not grind the tip to fit another size screw head.

4.18 Do not try to use screwdrivers on screw heads for which they are not designed (e.g., straight blade screwdrivers on Phillips, clutch head, Torx or multi-fluted spline screw heads).

4.19 Do not use defective screwdrivers (e.g., ones with rounded or damaged edges or tips; split or broken handles; or bent shafts).

4.20 Do not use a screwdriver for prying, punching, chiseling, scoring, scraping or stirring paint.

4.21 Do not use pliers on the handle of a screwdriver for extra turning power. A wrench should be used only on the square screwdriver shank designed for that purpose.

4.22 Do not expose a screwdriver blade to excessive heat. Heat can affect the temper of the metal and weaken the tool.

4.23 Do not use a screwdriver to check if an electrical circuit is live. Use a suitable meter or other circuit testing device.

4.24 Do not carry screwdrivers in your pockets.

5.0 Snips

5.1 Wear safety glasses and protective gloves when working with snips. Small pieces of metal may go flying in the air and cut edges of metal are sharp.

5.2 Snips are made in various shapes and sizes for various tasks. The handle can be like those on scissors with finger and thumb holes or like plier handles. Models are available for cutting in straight lines and in curves to the left or right.

5.3 Universal snips can cut in both straight and wide curves.

5.4 Straight snips and duckbill snips (flat blade, "perpendicular" to the handle, with pointed tips) are generally designed to cut in straight lines; some duckbill snips are designed for cutting curved lines.

5.5 Hawk's bill snips (with crescent-shaped jaws) are used for cutting tight circles.

5.6 Aviation snips have compound leverage that reduces the effort required for cutting.

5.7 Offset snips have jaws that are set at an angle from the handle.

5.8 Select the right size and type of snips for the job; check the manufacturer's specifications about the intended use of the snips (e.g., type of cut - straight, wide curve, tight curve, right or left, and maximum thickness and kind of metal or other material that can be cut).

5.9 Use only snips that are sharp and in good condition.

5.10 Use snips for cutting soft metal only. Hard or hardened metal should be cut with tools designed for that purpose.

5.11 Use ordinary hand pressure for cutting. If extra force is needed, use a larger tool.

5.12 Cut so that the waste is on the right if you are right-handed or on the left if you are left-handed.

5.13 Avoid springing the blades. This results from trying to cut metal that is too thick or heavy for the snips you are using.

5.14 Keep the nut and the pivot bolt properly adjusted at all times.

5.15 Oil the pivot bolt on the snips occasionally.

5.16 Do not try to cut sharp curves with straight cut snips.

5.17 Do not cut sheet metal thicker than the manufacturer's recommended upper limit (e.g., cuts up to 16-gauge cold, rolled steel or 18-gauge stainless steel). Do not extend the length of handles to gain greater leverage.

5.18 Do not hammer or use your foot to exert extra pressure on the cutting edges.

5.19 Do not use cushion grip handles for tasks requiring insulated handles. They are for comfort primarily and not for protection against electric shocks.

5.20 Do not attempt to re-sharpen snips in a sharpening device designed for scissors, garden tools, or cutlery.

6.0 Wood Chisels

6.1 Wear safety glasses.

6.2 Wood chisels are made in various shapes and sizes and for many uses. Use the correct chisel for the job.

6.3 Use the right size of chisel for the job.

6.4 Choose smooth, rectangular handles that have no sharp edges and are attached firmly to the chisel.

6.5 Ensure that the cutting edge is sharp. Dull chisels can be difficult to control and require more effort to do the job.

6.6 Check stock thoroughly for knots, staples, nails, screws, or other foreign objects before chiseling.

6.7 Clamp stock so it cannot move.

6.8 Adjust your stance so that you do not lose your balance if the tool slips.

6.9 Chip or cut away from yourself.

6.10 Keep your hands and body behind the cutting edge.

6.11 Use a wooden or plastic mallet with a large striking face on all chisels. Only heavy-duty or framing chisels are made of a solid or molded handle that can be struck with a steel hammer.

6.12 Make finishing or paring cuts with hand pressure alone.

6.13 Place chisels safely within the plastic protective caps to cover cutting edges when not in use.

6.14 Replace any chisel that is bent or shows dents, cracks, chips, or excessive wear.

6.15 Store chisels in a “storage roll,” a cloth or plastic bag with slots for each chisel, and keep them in a drawer or tray.

6.16 Replace broken or splintered handles.

6.17 Sharpen cutting edges as often as necessary.

6.18 Do not use a wood chisel as a pry or a wedge.

6.19 Do not use a wood chisel on metal.

6.20 Do not use an all-steel chisel with a mushroomed face or a chipped edge. Redress with a file or whetstone.

6.21 Do not use a grinder to redress heat-treated tools. Use a whetstone.

6.22 Do not use a dull chisel.

7.0 Wrenches

7.1 Use the correct wrench for the job - pipe wrenches for pipes and plumbing fittings, and general-use wrenches for nuts and bolts.

7.2 Discard any damaged wrenches (e.g., open-ended wrenches with spread jaws or box wrenches with broken or damaged points).

7.3 Select the correct jaw size to avoid slippage.

7.4 Position your body in a way that will prevent you from losing balance and hurting yourself if the wrench slips or something (e.g., a bolt) suddenly breaks.

7.5 Use a box or socket wrench with a straight handle, rather than an off-set handle, when possible.

7.6 Ensure that the jaw of an open-ended wrench is in full contact (fully seated, “flat,” not tilted) with the nut or bolt before applying pressure.

7.7 Face an adjustable wrench “forward,” adjust tightly and turn the wrench so pressure is against the permanent or fixed jaw.

7.8 Ensure that the teeth of a pipe wrench are sharp and free of oil and debris and that the pipe or fitting is clean to prevent unexpected slippage and possible injuries.

7.9 Apply a small amount of pressure to a ratchet wrench initially to ensure that the ratchet wheel (or gear) is engaged with the pawl (a catch fitting in the gear) for the direction you are applying pressure.

7.10 Support the head of the ratchet wrench when socket extensions are used.

7.11 Pull on a wrench using a slow, steady pull; do not use fast, jerky movements.

7.12 Stand aside when work is done with wrenches overhead.

7.13 Make sure adjustable wrenches do not "slide" open during use.

7.14 Keep tools well maintained (cleaned and oiled).

7.15 Clean and place tools and wrenches in a tool box, rack or tool belt after use.

7.16 Do not push on a wrench - losing your balance is more likely if the wrench slips.

7.17 Do not use a wrench that is bent or damaged.

7.18 Do not use worn adjustable wrenches. Inspect the knurl, jaw and pin for wear.

7.19 Do not pull on an adjustable wrench that is loosely adjusted.

7.20 Do not use pipe wrenches on nuts or bolts.

7.21 Do not use pipe wrenches for lifting or bending pipes.

7.22 Do not use a wrench on moving machinery.

7.23 Do not use the wrong tools for the job. For example, never use pliers instead of a wrench or a wrench as a hammer.

7.24 Do not use a makeshift wrench.

7.25 Do not insert a shim in a wrench for better fit.

7.26 Do not strike a wrench (except a "strike face" wrench) with a hammer or similar object to gain more force.

7.27 Do not increase the leverage by adding sleeved additions (e.g., a pipe) to increase tool handle length.

7.28 Do not expose a wrench to excessive heat (like from a blow torch) that could affect the temper of the metal and ruin the tool.

8.0 Files/Rasps

8.1 Do not use a file as a pry bar, hammer, screwdriver, or chisel.

8.2 When using a file or a rasp, grasp the handle in one hand and the toe of the file in the other.

8.3 Do not hammer on a file.

9.0 Chisels

9.1 Do not use a chisel that has a dull cutting edge.

9.2 Do not use chisels that have "mushroomed" striking heads.

9.3 Hold a chisel by using a tool holder if possible.

9.4 Clamp small work pieces in the vise and chip towards the stationary jaw when working with a chisel.

10.0 Vises

10.1 When clamping a long work piece in a vise, support the far end of the work piece by using an adjustable pipe stand, saw horse or box.

10.2 Position the work piece in the vise so that the entire face of the jaw supports the work piece.

10.3 Do not use a vise that has worn or broken jaw inserts, or has cracks or fractures in the body of the vise.

10.4 Do not slip a pipe over the handle of a vise to gain extra leverage.

11.0 Clamps

11.1 Do not use the C-clamp for hoisting materials.

11.2 Do not use the C-clamp as a permanent fastening device.

12.0 Jacks

12.1 Do not exceed the jack's rated lifting capacity as noted on the label of the jack.

12.2 Clear all tools, equipment and any other obstructions from under the vehicle before lowering the jack.

Small Engine Safety Card

S3NA-305-WI17

1.0 Objective / Overview

1.1 Operate small engine machines, such as push mowers, weed trimmers, and leaf blowers, in a safe manner.

1.2 You should be trained and competent in how to operate and maintain them in a safe manner.

1.3 Read the operator's manual. It will contain detailed information on the safe operation and maintenance of the machine. If you do not have a manual, ask if one can be obtained from the manufacturer.

2.0 Potential Hazards

2.1 Flying debris

2.2 Noise

2.3 Moving and sharp parts (cuts)

2.4 Hot surfaces (burns)

3.0 Safe Operating Guidelines

3.1 Do not wear loose or baggy clothing around tools with rotating parts.

3.2 Never run the engine indoors, in poorly ventilated areas, or in a location where the exhaust could be drawn into a building through an opening.

3.3 Never store engine with fuel in fuel tank inside a building with potential sources of ignition such as hot water and space heaters, clothes dryers, electric motors, etc.

3.4 Never remove fuel cap or add fuel when engine is running.

3.5 Never start or operate the engine with the fuel fill cap removed.

3.6 Refuelling: allow engine to cool; fill in well-ventilated area; and do not smoke while re-fuelling.

3.7 Use only properly labelled, American National Standards Institute/Canadian Standards Association-approved red gasoline containers to store and dispense fuel.

3.8 Do not pour fuel from engine or siphon fuel by mouth.

3.9 Never leave the engine unattended while it is running.

3.10 Never operate the engine with an unguarded engine shaft.

3.11 Do not modify the engine or tamper with the factory setting of the engine governor.

3.12 Never operate the engine without a muffler guard in place and avoid touching hot areas of the engine.

3.13 Keep all flammable materials away from the muffler and the rest of the engine; do not idle or park the engine in dry grass or ground cover.

3.14 When working on the equipment, avoid accidental starts by removing the ignition key, turn off all engine switches, disconnect the battery and disconnect the spark plug, keeping it away from metal part.

3.15 Always wear hearing protection when operating an engine.

4.0 Training Requirements

4.1 Review of training requirements per the Training Needs Assessment (TNA).

4.2 Demonstrated knowledge on the use of small engine equipment.

4.3 Review and follow manufacturers operating guidelines.

5.0 Personal Protective Equipment (Level D PPE)

5.1 Always wear safety glasses with shields

5.2 Leather or cotton gloves

5.3 Long pants and long sleeve shirt

5.4 Safety toe work boots

5.5 Hearing protection (earmuffs or earplugs)

Americas

Electrical and Battery Hand Tools Safety Card

S3NA-305-WI18

All electrical tools and equipment must be operated in accordance with the requirements of *S3NA-302-PR1 Electrical, General.*

1.0 Safe Work Practices

1.1 Maintain all electrical tools and cords in good condition and not overloaded.

1.2 Do not wear loose or baggy clothing around tools with rotating parts.

1.3 The switch on the tool must be in the OFF position before connecting it to a power source.

1.4 Verify that the power source is the same voltage and current as indicated on the nameplate of the tool. Using a higher voltage can cause serious injury to the operator as well as burn out the tool.

1.5 The tool must have an approved three-wire cord with a three-prong plug so that it can be used only in a properly grounded three-hole receptacle, unless the tool is double insulated to protect the operator from electrical shock.

1.6 All outdoor receptacles must be protected by means of a ground fault circuit interrupter (GFCI or GFI) available in portable or fixed models. Do not use any electric power tools outdoors in a receptacle that is not properly protected.

1.7 Report all shocks and/or sparks from electrical tools, no matter how minor. The tool in question should be tagged out and not be used until it has been checked for ground fault.

1.8 Maintain electrical cords and appliances in good working order.

- 1.8.1 Cords and appliances must be American National Standards Institute/Canadian Standards Association approved.
- 1.8.2 Never carry an electric tool by the cord or disconnect the plug by pulling or jerking on the cord (can damage, loosen, or separate connections).
- 1.8.3 Check cords frequently for such damage such as kinks, cuts, and cracked or broken outer jackets (any cord that feels more than comfortably warm to the touch should be checked by an electrician for overloading).

1.9 Store electrical cords in a clean, dry area off the ground to prevent damage to cord.

1.10 Equipment must have proper guards or shields and they must remain in place. If, due to damage or deterioration, the original guard provided on a piece of equipment cannot be put in place, the tool must be removed from service.

1.11 Do not modify, remove, or disable any machine guards.

1.12 Stand to one side when engaging or disengaging an electrical circuit breaker to avoid electrical flash backs.

1.13 It's strongly advisable to use GFCI with all portable electric tools at any time.

1.14 A cord should not be pulled or dragged over nails, hooks, or other sharp objects that may cause cuts in the insulation. In addition, cords should never be placed on radiators, steam pipes, walls, and windows. Particular attention should be placed on connections behind furniture, since files and bookcases may be pushed tightly against electrical outlets, severely bending the cord at the plug.

1.15 Disconnect electrical equipment before cleaning, adjusting, or applying flammable solutions. If a guard is removed to clean or repair parts, replace it before testing the equipment and returning the machine to service.

1.16 Only authorized persons are permitted to activate, de-activate or lockout electrical equipment.

1.17 Where there is or may be a danger to a worker, from the inadvertent operation of electrical equipment, then that equipment must be locked out and tagged prior to commencing work.

1.17.1 Switch off all appropriate devices (MCC, Distribution Panel, Disconnect).

1.17.2 Lock and tag Electrical Supply devices in the "OFF" position.

1.17.3 Test to be sure the equipment cannot be operated at the STOP-START switch.

1.17.4 Test to be sure electrical equipment is de-energized.

1.17.5 After completion of task, remove padlocks and destroy tags.

2.0 Inspection

2.1 Inspect tools for any damage prior to each use.

2.2 Ensure that the power tool has the correct guard, shield or other attachment that the manufacturer recommends.

2.3 Ensure that the tools are properly grounded using a three-prong plug, are double insulated (and are labeled as such), or are powered by a low-voltage isolation transformer; this will protect users from an electrical shock.

2.4 Check electric tools to ensure that a tool with a three-prong plug has an approved three-wire cord and is grounded. The three-prong plug should be plugged in a properly grounded three-pole outlet. If an adapter must be used to accommodate a two-hole receptacle, the adapter wire must be attached to a known, functioning ground. Never remove the third, grounding prong from a plug.

2.5 Check the handle and body casing of the tool for cracks or other damage.

2.6 If the tool has auxiliary or double handles, check to see that they installed securely.

2.7 Inspect cords for defects: check the power cord for cracking, fraying, and other signs of wear or faults in the cord insulation.

2.8 Any tool with a spring-operated trigger switch shall be fully functional.

2.9 Check for damaged switches and ones with faulty trigger locks.

2.10 Inspect the plug for cracks and for missing, loose or faulty prongs.

2.11 If a tool is defective, remove it from service, and tag it clearly "Out of service for repair." Replace damaged equipment immediately – do not use defective tools "temporarily." DO NOT ATTEMPT FIELD REPAIRS.

3.0 Battery Powered Tools

3.1 Use only the kind of battery that the tool manufacturer specifies for the battery-powered tool that you are using.

3.2 Recharge a battery-powered tool only with a charger that is specifically intended for the battery in that tool.

3.3 Remove the battery from the tool or ensure that the tool is switched off or locked off before changing accessories, making adjustments, or storing the tool.

3.4 Store a battery pack safely so that no metal parts, nails, screws, wrenches and so on can come in contact with the battery terminals; this could result in shorting out the battery and possibly cause sparks, fires or burns.

4.0 Using Electric Tools

4.1 Switch off the tools before connecting them to a power supply.

4.2 If a power cord feels more than comfortably warm or if a tool is sparking excessively, have it checked by an electrician or other qualified person.

4.3 Disconnect the power supply before making adjustments or changing accessories.

4.4 Remove any wrenches and adjusting tools before turning on a tool.

4.5 Inspect the cord for fraying or damage before each use. Tag defective tools clearly with an “Out of Service” tag and replace immediately with a tool in good running order.

4.6 During use, keep power cords clear of tools and the path that the tool will take.

4.7 Use clamps, a vice or other devices to hold and support the piece being worked on, when practical to do so. This will allow you to use both hands for better control of the tool and will help prevent injuries if a tool jams or binds in a work piece.

4.8 Use only approved extension cords that have the proper wire size for the length of cord and power requirements of the electric tool that you are using. This will prevent the cord from overheating.

4.9 For outdoor work, use outdoor extension cords marked “W-A” or “W.”

4.10 Suspend power cords over aisles or work areas to eliminate stumbling or tripping hazards.

4.11 Eliminate octopus connections: if more than one receptacle plug is needed, use a power bar or power distribution strip that has an integral power cord and a built-in overcurrent protection.

4.12 Pull the plug not the cord when unplugging a tool. Pulling the cord causes wear and may adversely affect the wiring to the plug - an electrical shock to the operator may result.

4.13 Keep power cords away from heat, water, oil, sharp edges and moving parts. They can damage the insulation and cause a shock.

4.14 Avoid accidental starting by ensuring the tool is turned off before you plug it in. Also do not walk around with a plugged-in tool with your finger touching the switch.

4.15 Do not bypass the ON/OFF switch and operate the tools by connecting and disconnecting the power cord.

4.16 Do not disconnect the power supply of the tool by pulling or jerking the cord from the outlet.

4.17 Do not leave a running tool unattended. Do not leave it until it has been turned off, has stopped running completely, and has been unplugged.

4.18 Do not use electric tools in wet conditions or damp locations unless tool is connected to a GFCI.

4.19 Do not expose electric power tools to rain or wet conditions; wet tools increase the likelihood for getting an electric shock.

4.20 Avoid body contact with grounded surfaces like refrigerators, pipes and radiators when using electric powered tools; this will reduce the likelihood of shock if the operator's body is grounded.

4.21 Do not plug several power cords into one outlet by using single-to-multiple outlet adapters or converters (“cube taps”).

4.22 Do not use light duty power cords.

4.23 Do not connect or splice extension cords together to make a longer connection; the resulting extension cord may not be able to provide sufficient current or power safely.

4.24 Do not carry electrical tools by the power cord.

4.25 Do not tie power cords in knots; knots can cause short circuits and shocks. Loop the cords or use a twist lock plug.

4.26 Never break off the third prong on a plug: replace broken three-prong plugs and make sure the third prong is properly grounded.

4.27 Never use extension cords as permanent wiring; use extension cords only as a temporary power supply to an area that does not have a power outlet.

4.28 Do not walk on or allow vehicles or other moving equipment to pass over unprotected power cords. Cords should be put in conduits or protected by placing planks on each side of them.

4.29 Do not brush away sawdust, shavings or turnings while the tool is running. Never use compressed air for cleaning surfaces or removing sawdust, metal turnings, etc.

4.30 Do not operate tools in an area containing explosive vapors or gases.

4.31 Do not clean tools with flammable or toxic solvents.

4.32 Do not surprise or touch anyone who is operating a tool. Startling a tool operator could end up causing an accident or injury.

5.0 Belt Sanders

5.1 Refer to *S3NA-305-WI11 Sander Safety Card*.

6.0 Drills

6.1 Refer to *S3NA-305-WI8 Power Drill Safety Card.*

7.0 Planers

7.1 Wear safety glasses.

7.2 Disconnect the planer from the power supply before making any adjustments to the cutter head or blades.

7.3 Use blades of the same weight and set at the same height.

7.4 Ensure that the blade-locking screws are tight.

7.5 Remove adjusting keys and wrenches before turning on power.

7.6 Support the material (stock) in a comfortable position that will allow the job to be done safely and accurately.

7.7 Check stock thoroughly for staples, nails, screws, or other foreign objects before using a planer.

7.8 Start a cut with the infeed table (front shoe) resting firmly on the stock and with the cutter head slightly behind the edge of the stock.

7.9 Use two hands to operate a planer - one hand on the trigger switch and the other on a front handle.

7.10 Do not put your finger or any object in a deflector to clean out chips while a planer is running.

7.11 Disconnect the power supply when stopping to dump out chips.

7.12 Do not set a planer down until blades have stopped turning.

7.13 Keep all cords clear of cutting area.

8.0 Routers

8.1 Wear safety glasses.

8.2 Disconnect the power supply before making any adjustments or changing bits.

8.3 Ensure that the bit is securely mounted in the chuck and the base is tight.

8.4 Put the base of the router on the work, template or guide. Make sure that the bit can rotate freely before switching on the motor.

8.5 Secure stock. Never rely on yourself or a second person to support or hold the material. Sudden torque or kickback from the router can cause damage and injury.

8.6 Before using a router, check stock thoroughly for staples, nails, screws or other foreign objects.

8.7 Keep all cords clear of cutting area.

8.8 Always hold both hands on router handles, until a motor has stopped. Do not set the router down until the exposed router bit has stopped turning.

8.9 Do not overreach. Keep proper footing and balance.

8.10 When inside routing, start the motor with the bit above the stock. When the router reaches full power, lower the bit to two times the required depth.

8.11 When routing outside edges, guide the router counter clockwise around the work.

8.12 When routing bevels, moldings and other edge work, make sure the router bit is in contact with the stock to the left of a starting point and is pointed in the correct cutting direction.

8.13 Feed the router bit into the material at a firm, controlled speed.

8.14 With softwood, you can sometimes move the router as fast as it can go. With hardwood, knotty and twisted wood, or with larger bits, cutting may be very slow.

8.15 The sound of the motor can indicate safe cutting speeds. When the router is fed into the material too slowly, the motor makes a high-pitched whine. When the router is pushed too hard, the motor makes a low growling noise.

8.16 When the type of wood or size of the bit requires going slow, make two or more passes to prevent the router from burning out or kicking back.

8.17 To decide the depth of cut and how many passes to make, test the router on scrap lumber similar to the work.

9.0 Circular Saws

9.1 Refer to *S3NA-305-WI2 Circular Saw Safety Card.*

10.0 Other Saws

10.1 Wear safety glasses.

10.2 Disconnect power supply before changing or adjusting blades.

10.3 Use lubricants when cutting metals.

10.4 Keep all cords clear of cutting area.

10.5 Position the saw beside the material before cutting and avoid entering the cut with a moving blade.

10.6 Make sure guards, if present, are installed and are working properly.

10.7 Remember sabre saws cut on the upstroke.

10.8 Secure and support stock as close as possible to the cutting line to avoid vibration.

10.9 Keeps the base or shoe of the saw in firm contact with the stock being cut.

10.10 Select the correct blade for the material being cut and allow it to cut steadily. Do not force it. Clean and sharp blades operate best.

10.11 Set the blade to go no further than 1/8 to 1/4 inch deeper than the material being cut.

10.12 Do not start cutting until the saw reaches its full power.

10.13 Do not force a saw along or around a curve. Allow the machine to turn with ease.

10.14 Do not insert a blade into or withdraw a blade from a cut or lead hole while the blade is moving.

10.15 Do not put down a saw until the motor has stopped.

10.16 Do not reach under or around the stock being cut.

10.17 Maintain control of the saw always. Avoid cutting above shoulder height.

10.18 External Cuts

- 10.18.1 Make sure that the blade is not in contact with the material or the saw will stall when the motor starts.
- 10.18.2 Hold the saw firmly down against the material and switch the saw on.
- 10.18.3 Feed the blade slowly into the stock, maintaining an even forward pressure.

10.19 Internal Cuts

- 10.19.1 Drill a lead hole slightly larger than the saw blade. With the saw switched off, insert the blade in the hole until the shoe rests firmly on the stock.
- 10.19.2 Do not let the blade touch the stock until the saw has been switched on.

Americas

Hand and Power Tools Guide

S3NA-305-GL1

1.0 Exposure

1.1 **Employees** who use hand and power tools and are exposed to the hazards of falling, flying, abrasive, and splashing objects, or to harmful dusts, fumes, mists, vapors, or gases must be provided with the appropriate personal protective equipment (PPE) and training.

2.0 Basic Safety Rules

2.1 Keep all tools in good condition with regular maintenance.

2.2 Use the right tool for the job.

2.3 Examine each tool for damage before use and do not use damaged tools.

2.4 Operate tools according to the manufacturers' instructions.

2.5 Provide and use properly the right PPE.

2.6 All electrical connections for these tools must be suitable for the type of tool and the working conditions (wet, dusty, flammable vapors).

2.7 When a temporary power source is used for construction, a ground-fault circuit interrupter should be used.

2.8 Eye protection is required, and head and face protection is recommended for employees working with pneumatic tools.

2.9 Screens must also be set up to protect nearby workers from being struck by flying fragments around chippers, riveting guns, staplers, or air drills.

2.10 Compressed air guns should never be pointed toward anyone.

2.11 Workers should never "dead-end" them against themselves or anyone else.

2.12 A chip guard must be used when compressed air is used for cleaning.

2.13 Use of heavy jackhammers can cause fatigue and strains. Heavy rubber grips reduce these effects by providing a secure handhold.

2.14 Workers operating a jackhammer must wear safety glasses and safety shoes that protect them against injury if the jackhammer slips or falls. A face shield also should be used.

2.15 Hand-arm vibration exposure is associated with the use of hand tools. Consider the need for controls such as limiting your tool use time, adjusting your grip to be loose but stable, and using anti-vibration gloves.

2.16 Noise hazard is associated with pneumatic and many other tools. Working with noisy tools such as jackhammers requires proper, effective use of appropriate hearing protection.

3.0 Hazard Prevention Sharp Objects

3.1 **Employees**, when using saw blades, knives, or other tools, should direct the tools away from aisle areas and away from other employees working in close proximity.

3.2 Knives and scissors must be sharp; dull tools can cause more hazards than sharp ones.

3.3 Cracked saw blades and grinder disc must be removed from service.

3.4 Wrenches must not be used when jaws are sprung to the point that slippage occurs.

3.5 Impact tools such as drift pins, wedges, and chisels must be kept free of mushroomed heads.

3.6 The wooden handles of tools must not be splintered.

3.7 Iron or steel hand tools may produce sparks that can be an ignition source around flammable substances. Where this hazard exists, spark-resistant tools made of non-ferrous materials should be used where flammable gases, highly volatile liquids, and other explosive substances are stored or used.

4.0 Hazard Prevention of Power tools

4.1 Precautions

4.1.1 Never carry a tool by the cord or hose.

4.1.2 Never yank the cord or the hose to disconnect it from the receptacle.

4.1.3 Keep cords and hoses away from heat, oil, and sharp edges.

4.1.4 Disconnect tools when not using them, before servicing and cleaning them, and when changing accessories such as blades, bits, and cutters.

4.1.5 Keep all people not involved with the work at a safe distance from the work area.

4.1.6 Secure work with clamps or a vise, freeing both hands to operate the tool.

4.1.7 Avoid accidental starting. Do not hold fingers on the switch button while carrying a plugged-in tool.

4.1.8 Maintain tools with care; keep them sharp and clean for best performance.

4.1.9 Follow instructions in the user’s manual for lubricating and changing accessories.

4.1.10 Be sure to keep good footing and maintain good balance when operating power tools.

4.1.11 Wear proper apparel for the task. Loose clothing, ties, or jewelry can become caught in moving parts.

4.1.12 Remove all damaged portable electric tools from use and tag them: “Do Not Use.”

4.2 Guards

4.2.1 The exposed moving parts of power tools need to be safeguarded. Belts, gears, shafts, pulleys, sprockets, spindles, drums, flywheels, chains, or other reciprocating, rotating, or moving parts of equipment must be guarded.

4.2.2 Machine guards, as appropriate, must be provided to protect the operator and others from the following:

- Point of operation.
- In-running nip points.
- Rotating parts.
- Flying chips and sparks.
- Safety guards must never be removed when a tool is being used. Portable circular saws having a blade greater than 2 inches (5.08 centimeters) in diameter must be equipped at all times with guards.
- An upper guard must cover the entire blade of the saw. A retractable lower guard must cover the teeth of the saw, except where it makes contact with the work material. The lower guard must automatically return to the covering position when the tool is withdrawn from the work position.

5.0 Operating Controls and Switches

5.1 The following hand-held power tools must be equipped with a constant-pressure switch or control that shuts off the power when pressure is released: drills; tappers; fastener drivers; horizontal, vertical, and angle grinders with wheels more than 2 inches (5.08 centimeters) in diameter; disc sanders with discs greater than

2 inches (5.08 centimeters); belt sanders; reciprocating saws; saber saws, scroll saws, and jigsaws with blade shanks greater than 1/4-inch (0.63 centimeters) wide; and other similar tools.

5.2 These tools also may be equipped with a “lock-on” control, if it allows the worker to also shut off the control in a single motion using the same finger or fingers.

5.3 The following hand-held power tools must be equipped with either a positive “on-off” control switch, a constant pressure switch, or a “lock-on” control:

5.3.1 Disc sanders with discs 2 inches (5.08 centimeters) or less in diameter.

5.3.2 Grinders with wheels 2 inches (5.08 centimeters) or less in diameter.

5.3.3 Platen sanders, routers, planers, laminate trimmers, nibblers, shears, and scroll saws; and jigsaws, saber and scroll saws with blade shanks a nominal 1/4-inch (6.35 millimeters) or less in diameter.

5.3.4 It is recommended that the constant-pressure control switch be regarded as the preferred device.

5.3.5 Other hand-held power tools such as circular saws having a blade diameter greater than 2 inches (5.08 centimeters), chain saws, and percussion tools with no means of holding accessories securely must be equipped with a constant-pressure switch.

6.0 Electrical Shock Caution

6.1 Electrical shocks, which can lead to injuries such as heart failure and burns, are among the major hazards associated with electric powered tools. Under certain conditions, even a small amount of electric current can result in fibrillation of the heart and death.

6.2 An electric shock also can cause the worker to fall off a ladder or other elevated work surface and be injured due to the fall.

6.3 To protect the worker from shock and burns, electric tools must have a three-wire cord with a ground and be plugged into a grounded receptacle, be double insulated, or be powered by a low-voltage isolation transformer.

6.4 Three-wire cords contain two current-carrying conductors and a grounding conductor. Any time an adapter is used to accommodate a two-hole receptacle, the adapter wire must be attached to a known ground.

6.5 The third prong must never be removed from the plug.

6.6 Double-insulated tools are available that provide protection against electrical shock without third-wire grounding. On double-insulated tools, an internal layer of protective insulation completely isolates the external housing of the tool.

7.0 Electric Tools General Practice

7.1 Operate electric tools within their design limitations.

7.2 Use gloves and appropriate safety footwear when using electric tools.

7.3 Store electric tools in a dry place when not in use.

7.4 Do not use electric tools in damp or wet locations unless they are approved for that purpose.

7.5 Keep work areas well lighted when operating electric tools. Ensure that cords from electric tools do not present a tripping hazard.

7.6 In the construction industry, employees who use electric tools must be protected by ground-fault circuit interrupters or an assured equipment-grounding conductor program.

8.0 Pneumatic Tools (powered by compressed air)

8.1 There are several dangers associated with the use of pneumatic tools. First and foremost is the danger of getting hit by one of the tool's attachments or by some kind of fastener the worker is using with the tool.

8.2 Pneumatic tools must be checked to see that the tools are fastened securely to the air hose to prevent them from becoming disconnected.

8.3 A short wire or positive locking device attaching the air hose to the tool must also be used and will serve as an added safeguard.

8.4 If an air hose is more than 1/2-inch (12.7 millimeters) in diameter, a safety excess flow valve must be installed at the source of the air supply to reduce pressure in case of hose failure.

8.5 In general, the same precautions should be taken with an air hose that are recommended for electric cords, because the hose is subject to the same kind of damage or accidental striking, and because it also presents tripping hazards.

8.6 When using pneumatic tools, a safety clip or retainer must be installed to prevent attachments such as chisels on a chipping hammer from being ejected during tool operation.

8.7 Pneumatic tools that shoot nails, rivets, staples, or similar fasteners and operate at pressures more than 100 pounds per square inch (6,890 kPa), must be equipped with a special device to keep fasteners from being ejected, unless the muzzle is pressed against the work surface.

8.8 Airless spray guns that atomize paints and fluids at pressures of 1,000 pounds or more per square inch (6,890 kPa) must be equipped with automatic or visible manual safety devices that will prevent pulling the trigger until the safety device is manually released.

9.0 Liquid Fuel Tools (operated with gasoline)

9.1 The worker must be careful to handle, transport, and store gas or fuel only in approved flammable liquid containers, according to proper procedures for flammable liquids.

9.2 Before refilling a fuel-powered tool tank, the worker must shut down the engine and allow it to cool to prevent accidental ignition of hazardous vapors.

9.3 When a fuel-powered tool is used inside a closed area, effective ventilation and/or proper respirators such as atmosphere-supplying respirators must be utilized to avoid breathing carbon monoxide.

9.4 Noise hazards associated with gasoline engines must be mitigated by proper hearing protection utilization. Ear plugs, ear muffs or a combination of the two must be used to protect workers from excessive noise levels.

9.5 Fire extinguishers must also be available in the area.

10.0 Hydraulic Power Tools (fluid run)

10.1 The fluid used in hydraulic power tools must be an approved fire-resistant fluid and must retain its operating characteristics at the most extreme temperatures to which it will be exposed. The exception to fire-resistant fluid involves all hydraulic fluids used for the insulated sections of derrick trucks, aerial lifts, and hydraulic tools that are used on or around energized lines. This hydraulic fluid shall be of the insulating type.

10.2 The manufacturer's recommended safe operating pressure for hoses, valves, pipes, filters, and other fittings must not be exceeded.

10.3 All jacks—including lever and ratchet jacks, screw jacks, and hydraulic jacks—must have a stop indicator, and the stop limit must not be exceeded. Also, the manufacturer's load limit must be permanently marked in a prominent place on the jack, and the load limit must not be exceeded.

10.4 A jack should never be used to support a lifted load. Once the load has been lifted, it must immediately be blocked up. Put a block under the base of the jack when the foundation is not firm, and place a block between the jack cap and load if the cap might slip.

10.5 To set up a jack, make certain of the following:

10.5.1 The base of the jack rests on a firm, level surface;

10.5.2 The jack is correctly centered;

10.5.3 The jack head bears against a level surface; and

10.5.4 The lift force is applied evenly.

10.6 Proper maintenance of jacks is essential for safety. All jacks must be lubricated regularly. In addition, each jack must be inspected according to the following schedule:

10.6.1 For jacks used continuously or intermittently at one site—inspected at least once every 6 months;

10.6.2 For jacks sent out of the shop for special work—inspected when sent out and inspected when returned; and

10.6.3 For jacks subjected to abnormal loads or shock—inspected before use and immediately thereafter.

Americas

Manual Lifting, Field

S3NA-308-PR1

1.0 Purpose and Scope

1.1 This procedure provides the requirements for use when performing manual materials handling activities (e.g., lifting/handling of items or materials).

1.2 This procedure applies to all field staff for AECOM Americas-based operations.

2.0 Terms and Definitions

2.1 **Manual Materials Handling** – Moving or handling things by lifting, lowering, pushing, pulling, carrying, holding, or restraining.

2.2 **Team Handling** – Team handling occurs when more than one person is involved during the lift.

3.0 References

3.1 OSHA Technical Manual

3.2 National Safety Council

3.3 Canadian Centre for Occupational Health and Safety

4.0 Procedure

4.1 Roles and Responsibilities

4.1.1 **Project Manager**

Responsible for administering the procedure and providing resources and direction on proper lifting/handling techniques.

4.1.2 **District SH&E Manager**

Assist in identifying activities with a high potential for lifting/handling strains/injuries as well as the associated mitigation strategies and training on proper lifting/manual materials handling techniques.

4.1.3 **Employees**

Responsible for reviewing and following *S3NA-308-WI1 Manual Lifting Safe Work Practices*.

4.2 Mechanical Controls

4.2.1 Mechanical equipment or assistance such as dollies, carts, come-alongs, or rollers are preferable to be used whenever possible rather than the employee physically moving materials.

4.2.2 Mechanical assistance will be of proper size, have wheels sized for the terrain, and be designed to prevent pinching or undue stress on wrists.

4.2.3 Objects to be moved will be secured to prevent falling and properly balanced to prevent tipping.

4.3 Administrative Controls

4.4 When significant, sustained lifting work is required, it is desirable to rotate **employees** to spread the work load among several people and thereby avoid fatigue.

4.5 Rotation is not simply performing a different job but instead is performing a job that utilizes a completely different muscle group from the ones that have been overexerted.

4.6 All **employees** exposed to manual handling hazards shall be trained on safe lifting and handling of loads.

5.0 Records

5.1 None

6.0 Attachments

6.1 S3NA-308-WI1 Manual Lifting Safe Work Practices

Americas

Manual Lifting Safe Work Practices

S3NA-308-WI1

1.0 General

1.1 Before Performing a Lift:

1.1.1 Check to see if mechanical aids such as hoists, lift trucks/dollies, or wheelbarrows are available.

1.1.2 Do not lift if you are not sure that you can handle the load safely.

1.1.3 Confirm that, based on your own physical capabilities and medical limitations, you can lift the load without overexertion. Get help with heavy or awkward loads.

1.1.4 Confirm that the load is "free" to move.

1.1.5 Check that the planned destination of the load is free of obstacles and debris.

1.1.6 Confirm that the path to the planned destination of the load is clear. Grease, oil, water, litter, and debris can cause slips and falls.

1.1.7 Particular handling and lifting techniques are needed for different kinds of loads or materials being handled (for example, compact loads, small bags, large sacks, drums, barrels, cylinders, and sheet materials like metal or glass). See Section 2.0 for additional guidance.

1.2 General Tips for Lifting

1.2.1 Prepare for the lift by warming up your muscles.

1.2.2 Make certain that your balance is good. Feet should be shoulder width apart, with one foot beside and the other foot behind the object that is to be lifted.

1.2.3 Bend the knees; do not stoop. Keep the back straight, but not vertical. There is a difference. Tucking in the chin straightens the back.

1.2.4 Grip the load with the palms of your hands and your fingers. The palm grip is much more secure. Tuck in the chin again to make certain your back is straight before starting to lift.

1.2.5 Use your body weight to start the load moving, then lift by pushing up with the legs. This makes full use of the strongest set of muscles.

1.2.6 Keep the arms and elbows close to the body while lifting.

1.2.7 Carry the load close to the body. Do not twist your body while carrying the load. To change direction, shift your foot position and turn your whole body.

1.2.8 Watch where you are going!

1.2.9 To lower the object, bend the knees. Do not stoop. To deposit the load on a bench or shelf, place it on the edge and push it into position. Confirm that your hands and feet are clear when placing the load.

1.3 Engineering Controls

1.3.1 Material handling tasks should be designed to minimize the weight, range of motion, and frequency of the activity.

1.3.2 Alter the task to eliminate the hazardous motion and/or change the position of the object in relation to the employee's body—such as adjusting the height of a pallet or shelf.

1.3.3 Work methods and stations should be designed to minimize the distance between the person and the object being handled.

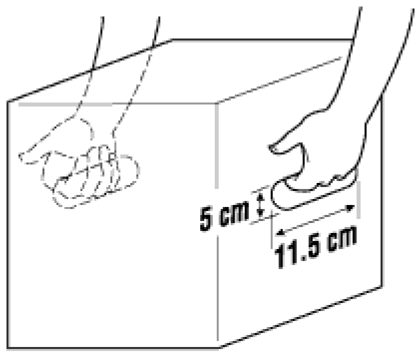
1.3.4 High-strength push-pull requirements are undesirable, but pushing is better than pulling. Material handling equipment should be easy to move, with handles that can be easily grasped in an upright posture.

1.3.5 Workbench or workstation configurations can force people to bend over. Corrections should emphasize adjustments necessary for the employee to remain in a relaxed upright stance or fully supported seated posture. Bending the upper body and spine to reach into a bin or container is highly undesirable. The bins should be elevated, tilted, or equipped with collapsible sides to improve access.

1.3.6 Repetitive or sustained twisting, stretching, or leaning to one side are undesirable. Corrections could include repositioning bins and moving employees closer to parts and conveyors.

1.3.7 Store heavy objects at waist level.

1.4 Whenever possible, utilize hand holds or other lifting attachments on objects being handled.



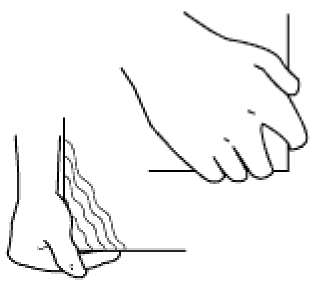
1.4.1 Use the “hook grip” on loads with cut-out handholds.

1.4.2 Curl your fingers around the edge.

1.4.3 Do not hold the load with your fingertips.

1.4.4 Use containers with handles located more than halfway up the side of the container.

1.4.5 Use the “ledge grip” to handle regularly shaped objects without handles.



1.4.6 Use vacuum lifters to handle sheet materials or plates.

1.4.7 Hold the object with hands placed diagonally.

1.4.8 Wear gloves where practical.

2.0 Specific Handling Techniques

The following guidance will be used when performing manual materials handling of various types.

2.1 Square or Rectangular Objects

2.1.1 Place one foot slightly in front of the other.

2.1.2 Squat as close to the object as possible.

2.1.3 Grasp one of the top corners away from the body and the opposite bottom corner closest to the body.

2.1.4 Tilt the object slightly away from the body, tilt forward at the hips, keep the back straight, and tuck in the chin.

2.1.5 Test to confirm that the object is loose from floor and will lift without snagging.

2.1.6 Straighten the legs, keeping the backbone straight, pull the object into the body, and stand up slowly and evenly without jerking or twisting.

2.1.7 If turning or change of direction is required, turn with feet without twisting the torso and step in the direction of travel.

2.1.8 To set an object down, reverse the sequence, being sure not to trap the bottom hand between the object and the surface on which the object is set.

2.2 Cylindrical Objects

2.2.1 When lifting/moving round or cylindrical objects, the objects should be rolled wherever possible. Rolling must be controlled by chute, tagline, or other means of limiting acceleration. Workers must not be positioned downhill from rolled objects. Use of the legs for pushing and tagline control of rolled objects must be stressed.

2.2.2 Cylindrical objects, such as drums that must remain upright, are to be handled manually by slightly tilting the object, using the legs for control, and balancing the object on the bottom edge. The handler then walks besides the object, with the object tilted toward the body, positioning the hands on the top edge away from the body and moving so they do not cross, thus maintaining balance and a steady, controlled, forward motion. Motion must be controlled so that ceasing to walk and moving the hands will stop forward motion.

2.2.3 **Use carts or tracks to transport cylinders. Make sure that two people transport a cylinder if carts cannot be used, use lifting straps to improve grip.** Technique for one person lifting a cylinder onto a platform:

- Roll the cylinder to within 3 feet (1 meter) of the platform.
- Position the forward foot around the cylinder, the back foot about 1 foot (30 centimeters) behind the cylinder.
- Bend knees slightly.
- Place one hand on the valve protective cap, the other hand underneath the cylinder about 1 foot (30 centimeter) from the ground.
- Tilt the cylinder onto the thigh of the back leg.
- Balance the cylinder on the thigh by pressing down with the back hand while lifting the cylinder with the forward hand.
- Extend both knees to initiate forward movement of the cylinder and continue by pushing up and forward with the arms until the cylinder is located on the platform.
- Climb on the platform.
- Straddle the cylinder at the valve end.
- Grasp the valve protective cap of the cylinder with both hands between the thighs.
- Lean forward and straighten the knees to set the cylinder upright.

2.3 Bags and Sacks

2.3.1 The best way to handle a bag depends on its size, weight, and how far it is to be carried. When lifting, remember to:

- Straddle the end of the bag.
- Bend the hips and knees.
- Keep the back straight.
- Grasp the bag with both hands under the closer end. Keep elbows inside the thighs.
- Lean forward, straightening the knees to set the bag upright.
- Readjust the straddle position moving feet closer to the bag.
- Readjust the grasp, with one hand clasping the bag against the body and the other under it.
- Stand up by thrusting off with the back leg and continuing in an upward and forward direction.
- Thrust the bag up with the knee while straightening the body.
- Put the bag on the shoulder opposite the knee used to thrust the bag up.
- Stabilize the bag on the shoulder.
- Move off without bending sideways.

2.3.2 Avoid unloading a bag from the shoulder directly to floor level. Use an intermediate platform or get help from a co-worker, remember to:

- Stand close to the platform.
- Place one foot in front of the platform.
- Bend hips and knees.
- Keep the back straight.
- Ease the bag off the shoulder and put it upright on the platform.
- Pull the bag slightly over the edge of the platform.
- Stand close to the platform with the bag touching the chest.
- Clasp the bag against the body with one hand, the other hand holding bottom of the bag.
- Step back.
- Bend hips and knees, keeping back straight.
- Ease the bag onto the floor.

2.3.3 Bulkier sacks are easier to carry on your back. Lift the sack onto your back from a platform:

- Move the sack to the edge of the platform.
- Put your back against the sack.
- Grasp with both hands on the upper corners of the sack.
- Ease the sack onto the back, bending hips and knees before taking the weight.
- Keep the back straight.
- Stand up and straighten the hips and knees.
- Stabilize the sack.
- Move away without bending sideways.

2.3.4 Two-person handling of a sack:

- Position one person on either side of the sack.
- Squat with one foot balancing behind the sack.

- Keep back straight.
- Grasp with the outer hand on the upper corner, the other hand holding the bottom of the sack.
- On one person's command:
  - Stand up and straighten the hips and knees.
  - Move toward the stack.
  - Put the sack on the stack.

2.4 Sheet Materials

2.4.1 When lifting sheet materials:

- Stand close to the pile of sheets in a walking stance.
- Grasp sheet firmly at the midpoint of its long side with the closer hand.
- Pull sheet up and toward the body.
- Change grip using your other hand and put your fingers on top of the sheet.
- Pull sheet up to the vertical position and to the side until one half is off the pile.
- Grasp the lower edge of the sheet with the free hand and support the hand by placing it on your knee.
- Stand up without bending or twisting body.
- Whenever moving sheet materials, be cognizant of wind conditions.

2.4.2 To carry sheets:

- Use drywall carts to carry sheet materials.
- Get help from another person where carts are not available.
- Apply carrying handles for manual carrying.
- Always use gloves and carrying handle for glass and other materials with sharp edges.

2.4.3 Use team lifting and carrying where other solutions are inappropriate.

- Remember that the combined strength of the team is less than the sum of individual strength.
- Select team members of similar height and strength.
- Assign a leader to the team.
- Determine a set of commands to be used such as "lift," "walk," "stop," and "down." Make sure that everyone knows what to do when they hear the command.
- Follow the commands given by the team leader.
- Practice team lifting and carrying together before attempting the task.

2.5 Material Storage

2.5.1 When storing materials on site:

- Store materials at a convenient height.
- Leave the lowest shelf unused if necessary.
- Use vertically mobile shelves to avoid bending and overhead reaching.
- Use bin racks for storing small items.
- Store heavy and frequently used materials at waist height.
- Do not store materials at floor level.

- Use hand trucks with elevating devices in storage and loading areas.
- Use trucks with a tilting device to avoid bending.
- Use elevating platforms to avoid overhead reaching.

Americas

Wildlife, Plants and Insects

S3NA-313-PR1

1.0 Purpose and Scope

1.1 Communicates the requirements and precautions to be taken by AECOM employees to protect against the biological hazards associated with insects, arachnids, snakes, poisonous plants, and other animals referred to herein collectively as "biological hazards".

1.2 This procedure applies to all AECOM Americas-based employees and operations.

2.0 Terms and Definitions

2.1 **Field Work –** Any activity conducted at a site that contains brush, overgrown grass, leaf litter, poisonous plants, or is located near mosquito breeding areas and includes work in structures where animals might exist that harbor fleas or ticks or where spiders and mites could be present. Field work includes, but is not limited to, Phase I, Phase II, Operations Monitoring & Maintenance, biological surveys, and other work that meets the definition of field work.

2.2 **Poisonous** – Capable of harming or killing by or as if by poison; toxic or venomous.

2.3 **Phase I Environmental Site Assessment –** Investigation of real property to determine the possibility of contamination, based on visual observation and property history, but no physical testing. Under new Environmental Protection Agency regulations that went into effect on November 1, 2006, a Phase I, as it is called for short, will be mandatory for all investors who wish to take advantage of Comprehensive Environmental Response, Compensation, and Liability Act defenses that will shield them from liability for future cleanup, should that prove necessary. The new Phase I rules, called "All Appropriate Inquiry" or AAI, also require more investigation than previously mandated. Investors can expect to see dramatic price increases over prior experiences.

2.4 **Phase II Environmental Site Assessment** – Investigation of real property through physical samplings and analyses to determine the nature and extent of contamination and, if indicated, a description of the recommended remediation method.

3.0 References

3.1 WP-001-PR Firearms Standard

3.2 S2-032-PR1 Weapons Safety

3.3 S3NA-004-PR1 Incident Report

3.4 S3NA-208-PR1 Personal Protective Equipment Program

3.5 S3NA-209-PR1 Project Hazard Assessment and Planning

3.6 S3NA-511-PR1 Heat Stress

3.7 Public Health Agency of Canada on Ticks and Lyme Disease in Canada

3.8 Public Health Agency of Canada on West Nile Virus

3.9 United States Center for Disease Control (CDC) on Lyme Disease

3.10 New York State Department of Health, 2007. Health Advisory, Tick and Insect Repellents.

3.11 Spectrum Brands, 2007. Personal Insect Repellent Products.

3.12 U.S. Centers for Disease Control and Prevention, 2004. Tick Management Handbook

3.13 U.S. Environmental Protection Agency, 2006. Permethrin Facts: Preregistration Eligibility Decision Fact Sheet

3.14 U.S. National Pesticide Information Center, 1997, National Pesticide Telecommunications Network Fact Sheet for Permethrin

3.15 U.S. Environmental Protection Agency, 2005. New Pesticide Fact Sheet, Picaridin

4.0 Procedure

4.1 Roles and Responsibilities

4.1.1 Project Managers / Supervisors

- Responsible for managing field work.
- Work with employees to see that a Task Hazard Analysis (THA) for the work to be conducted has been performed prior to the beginning of the field work and that it includes an assessment of potential biological hazards.
- If biological hazards are identified as an exposure risk in the workplace, control measures that may be applied at the project site will be implemented to reduce the potential for employees to be exposed to injuries and illnesses while working.
- If the exposures cannot be eliminated or managed with engineering controls, the **Project Manager** or **Supervisor** will approve the use of Personal Protective Equipment (PPE) and protective repellents and lotions and ensure that exposed employees have and use these products.
- Approve the costs associated with the PPE and materials necessary to protect employees from the biological hazards covered by this procedure.

4.1.2 Region Safety, Health and Environment (SH&E) Manager

- Participate in incident reporting and investigations when appropriate.
- Work with Office Manager (Operations), SH&E Department and project Safety Professionals provide training and guidance to employees consistent with this procedure.
- During the performance of project site visits, assess the precautions being taken against the requirements of this procedure.
- Assist project teams in identifying hazards and selecting appropriate control measures.

4.1.3 Office Managers (Operations)

- Assure implementation of this procedure in their regions and offices.
- Participate in incident reporting and investigations when appropriate.

4.1.4 Field Staff / Employees

- Participate in required training on this procedure.
- Participate in the development of THAs for the project, identify control measures to limit exposure and request PPE, repellents, and protective lotions required by this Procedure.
- Obtain approval from Project Managers and/or Supervisors to purchase selected PPE prior to purchasing.
- Implement the precautions appropriate to prevent exposure to the hazardous wildlife, insects and plants.
- Observe requirements for reporting as detailed within the Procedure.
- Participate in incident reporting and investigations when appropriate.

4.2 Overview

4.2.1 The procedures discussed below are detailed because these hazards have historically posed the most significant risk to AECOM employees. Note that this discussion is not a fully encompassing list of hazards and as part of the THA, in accordance with the *S3NA-209-PR1 Project Hazard Assessment and Planning,* conducted by the project team, additional consideration must be given to other biological hazards.

4.2.2 Departments of Public Health local to the worksite, as well as the Centers for Disease Control (CDC) can serve as a resource for identifying biological hazards not discussed in this procedure.

4.2.3 If additional biological hazards are identified, the project team should contact the Region SH&E Manager to discuss the hazards and identify effective control measures that can be implemented at the project site.

4.3 Employee Sensitivity

4.3.1 Sensitivity to toxins generated by plants, insects and animals varies according to dosage and the ability of the victim to process the toxin; therefore, it is difficult to predict whether a reaction will occur, or how severe the reaction will be. Staff should be aware that there are a large number of organisms capable of causing serious irritations and allergic reactions. Some reactions will only erupt if a secondary exposure to sunlight occurs. Depending on the severity of the reaction, the result can be severe scarring, blindness or even death.

4.3.2 Employees / Field Staff also need to consider whether they are sensitive to the use of insect repellents.

4.4 Planning and Hazard Assessment

4.4.1 The AECOM project team shall ensure that the potential for exposure to specific biological hazards are assessed prior to the commencement of work and that the procedures specified by this procedure are integrated into the task hazard analysis (THA) planning process and conveyed to AECOM employees conducting the field work (also referred to as field staff). This information shall be communicated in the site-specific Safe Work Plan (SWP), Health and Safety Plan (HASP), the THA, pre-project kickoff meetings, and tailgate meetings at the project site.

4.4.2 It is important to note that the precautions to be taken by AECOM employees to decrease the risk of exposure to biological hazards can directly increase the risk of heat-related illness due to thermal stresses. Therefore, heat stress monitoring and precautions shall be included as a critical component of the project-specific hazard assessments in accordance with *S3NA-511-PR1 Heat Stress***.**

4.4.3 During the preparation of the project-specific SWP, HASP and project specific THA, Project Managers, Supervisors, and the project staff will determine what biological hazards might be encountered during the project and will prescribe the precautions to be taken to reduce the potential for exposure and the severity of resulting illnesses. Consideration will be given to conditions such as weather, proximity to breeding areas, host animals, and published information discussing the presence of the hazards.

4.4.4 It should be assumed that at least one of the biological hazards exists whenever working on undeveloped property. This can include insect activity any time that local temperatures exceed 40 degrees Fahrenheit (4.5 degrees Celsius) for a period of more than 24 hours. The stubble and roots of poisonous plants can be a hazard any time of year, including when some plants are dormant or mown.

4.4.5 The hazard assessments must also consider the additional hazards posed by vegetative clearing such as the increased risk of coming in contact with poison ivy, oak or sumac and hazards associated with the use of tools and equipment to remove vegetation.

4.4.6 Employees in the field where biological hazards exist will not enter the hazard areas unless they are wearing the appropriate protective clothing, repellents, and barrier creams specified below. If the hazard is recognized in the field but was not adequately assessed during the THA, the field staff shall stop work and not proceed until the THA has been amended and protective measures implemented.

4.4.7 A decision flow chart and table for determining the potential for biological hazards in the U.S. has been provided in *S3NA-313-WI1 Biological Hazard Assessment Decision Flow Chart Hazard Assessment (U.S.).*

4.4.8 Restrictions:

- In accordance with the Global Safety Department standards, no firearms or weapons are allowed to be used without express permission by the Region Executive and chief Security Officer, refer to the *WP-001-PR Global Firearms Standard*.
- No weapons related work shall occur without an assessment that includes appropriate hazard control measures and training, refer to the *S2-032-PR1 Weapons Safety*.
- Staff with life-threatening reactions shall not undertake work in areas infested with the allergen (e.g., wasps, poison ivy), unless precautions are met which satisfy a medical practitioner's requirements.

4.5 Habitat Avoidance, Elimination, and/or Control

4.5.1 Ticks, Spiders and other Insects

- The most effective method to manage worker safety and health is to eliminate, avoid and/or control hazards. Clearing the project site of brush, high grass and foliage reduces the potential for exposure to biological hazards. Clearing will not eliminate the exposure to flying insects and there might be an increased exposure to ticks, spiders, and poisonous plants during the clearing process.
- Projects such as subsurface environmental assessment or remediation are often candidates for brush and overgrown grass to be cleared. In these instances, the **Project Manager** shall either request that the client eliminate vegetation, or request approval from the client to have vegetation clearing added to the scope of work.
- When projects must be conducted in areas that cannot or may not be cleared of foliage, personal precautions and protective measures shall be prescribed.
- Mosquitoes breed in stagnant water and typically only travel a quarter mile (less than half a kilometer) from their breeding site. Whenever possible, stagnant water should be drained to eliminate breeding areas. **Project Managers** and client site managers should be contacted to determine whether water can be drained and the most appropriate method for draining containers, containment areas, and other objects of standing water.
- If water cannot be drained, products similar to Mosquito Dunks® can be placed in the water to control mosquitoes. Once wet, the Mosquito Dunks® kill the immature, aquatic stage of the mosquito. The active ingredient is a beneficial organism that is lethal to mosquito larvae, but harmless to fish, humans, and other animals. Mosquito Dunks® provide long-term protection for 30 days or more.

4.5.2 Poisonous Plants

- If poisonous plants are identified in the work area, **field staff** will mark the plants using either flags or marking paint, and discuss what the specific indicator will be to signal to other **field staff** to avoid the designated area. If **field staff** decide to use ground-marking paint to identify poisonous plants, they should discuss this tactic with the **Project Manager** (and Client as appropriate) to gain approval.
- If removal of the plants is considered, it should be subcontracted to a professional landscaping service that is capable and experienced in removing the plant. If herbicides are considered for use, a discussion will need to occur with the **Project Manager** (and Client as appropriate) to determine whether it is acceptable to apply herbicides at the work site. Application of herbicides may require a license.

- **Field staff** shall not attempt to physically remove poisonous plants from the work area unless a clearing procedure including PPE is prepared in advance and approved by the **Region SH&E Manager**. If a SWP or HASP is prepared for the project, the clearing procedure should be included and the required PPE specified.

4.5.3 Wildlife Hazards (Wild Animals, Reptiles and Birds)

Staff must not work alone in areas where the risk of an encounter with dangerous wildlife is high. Wildlife handling must only be completed under direct supervision of an experienced individual. Refer to the following work instructions for more specifics on prevention:

- *S3NA-313-WI11 Large Carnivores*
- *S3NA-313-WI12 Bear Safety*
- *S3NA-313-WI13 Small Mammals*
- *S3NA-313-WI14 Snakes*
- *S3NA-313-WI15 Alligators*

4.5.4 Bird Droppings

Work in any area where pigeons or other flying animals may nest, a written statement from the client shall be obtained in regards to the potential for, and extent of, accumulation of excrement on/in the structure from pigeons and other winged animals.

4.6 Insects

4.6.1 Insects for which precautionary measures should be taken include but are not limited to: mosquitoes (potential carriers of disease aside from dermatitis), black flies, wasps, bees, ticks, fire ants and European fire ants.

4.6.2 Employees with known allergies to insect stings should consult their personal physician for advice on any immediate medications that they should carry with them. AECOM highly recommends that employees with known allergies inform their co-workers of the allergy and the location of the medications they might carry for the allergy.

4.6.3 Ticks

- Ticks can be encountered when walking in tall grass or shrubs. They crawl up clothing searching for exposed skin where they will insert mouthparts to drink blood. The most serious concern is a possibility of contracting a disease.
- Data from the CDC indicates that tick-borne diseases have become increasingly prevalent. At the same time, tick repellents have become both safe and effective so it is possible to prevent the vast majority of bites and, therefore, most related illnesses. The use of permethrin is strongly advised.
- The most common and severe tick-borne illnesses in the U.S. are Lyme disease, Ehrlichiosis, and Rocky Mountain spotted fever. A summary table listing CDC informational resources for these diseases is provided in *S3NA-313-WI2 Ticks* along with a listing of CDC information resources and maps showing the distribution of common tick-borne diseases in the U.S.
- When working in areas where ticks may occur, it is recommended that clothes are turned inside out and shaken at the end of day; do not wear the same clothes two days in a row.
- To remove ticks that are embedded in skin, utilize a tick key. Alternatively use tweezers or fingers to carefully grasp the tick as close to the skin as possible and pull slowly upward, avoiding twisting or crushing the tick. Do not try to burn or smother the tick. Cleanse the bite area with soap and water, alcohol, or household antiseptic. Note the date and location of the bite and save the tick in a secure container such as an empty pill vial or film canister. A bit of moistened paper towel placed inside the container will keep ticks from drying out.

- Familiarize yourself with the characteristic bulls-eye pattern of Lyme disease infection surrounding the bite. If you notice this type of pattern or rash resulting from a tick bite, contact AECOM reporting line 1 (800) 348-5046 and asked to be connected to WorkCare for medical support. If this service is unavailable, contact your personal physician or a local medical clinic.
  - Canada – National Microbiology Laboratory (NML) (Phone: (204) 789-2000; email: ticks@phac-aspc.gc.ca). The NML will conduct diagnostic testing for the Lyme disease agent as well as several other disease-causing agents. The NML results will not only benefit anyone bit by the tick, but will also assist the NML in their goal to accurately map the distribution of the tick species and associated diseases in Canada.
  - U.S. – IGeneX, Inc. (Phone: (800) 832-3200; www.igenex.com). IGeneX will test the tick for the presence of the Lyme bacteria. They also test ticks for *Babesia microti* and/or *Babesia duncani* (formerly WA-1), Ehrlichia, Bartonella henselae and Rickettsia (Rocky Mountain Spotted Fever). All tick testing should be coordinated through WorkCare, AECOM's Corporate medical provider using the *S3NA-313-FM1 Tick Test Request Form*.
- If you experience symptoms such as fever, headache, fatigue, and a skin rash, you should immediately visit a medical practitioner as Lyme disease is treated easily with antibiotics in the early stages, but can spread to the heart, joints, and nervous system if left untreated.

4.6.4 Chiggers

- Chiggers are mite larvae, approximately ½ millimeter in size, and typically invisible to the naked eye. While chiggers are not known to carry infectious diseases, their bites and resulting rashes and itching can lead to dermatitis and a secondary infection.
- Chiggers are typically active from the last hard freeze in the winter or spring to the first hard freeze. They are active all year in the Gulf Coast and tropical areas.

4.6.5 Spiders

- Spiders can be found in derelict buildings, sheltered areas, basements, storage areas, well heads and even on open ground. Spiders can be found year round in sheltered areas and are often present in well heads and valve boxes.
- Most spider bites produce wounds with localized inflammation and swelling. The Black Widow and Brown Recluse spiders in the U.S. and others outside the U.S. inject a toxin that causes extensive tissue damage and intense pain.
- Additional information on spider identification can be found in attachment *S3NA-313-WI3 Poisonous Spider Identification*.

4.6.6 Mosquitoes

4.6.6.1 When a mosquito bites, it injects an enzyme that breaks down blood capillaries and acts as an anticoagulant. The enzymes induce an immune response in the host that results in itching and local inflammation. The tendency to scratch the bite sites can lead to secondary infections.

4.6.6.2 CDC data indicates that mosquito-borne illnesses, including the strains of encephalitis, are a health risk to field staff. At least one of the Encephalitis strains listed below is known to exist in every area of the U.S. and in many other countries as well:

- Eastern Equine encephalitis
- Western Equine encephalitis
- West Nile Virus
- St. Louis encephalitis
- La Crosse encephalitis

4.6.6.3 Mosquitoes can transmit the West Nile Virus and other forms of encephalitis after becoming infected by feeding on the blood of birds which carry the virus. Positive cases of West Nile Virus have been confirmed throughout North America since 2007.

4.6.6.4 Most people infected with the virus experience no symptoms or they have flu-like symptoms. Sometimes though, the virus can cause severe illness, resulting in hospitalization and even death, so proper precautions should be taken. Consult a medical practitioner if you suspect you have West Nile Virus. Other diseases including Dengue Fever and Malaria are spread by mosquitoes in the sub-tropic and tropical parts of the world. See *S3NA-313-WI4 Mosquito Borne Diseases* for information on the locations where mosquito borne diseases are known to be present.

4.6.7 Bees and Hornets

- Wasps and bees will cause a painful sting to anyone if they are harassed. They are of most concern for individuals with allergic reactions who can go into anaphylactic shock. Also, instances where an individual is exposed to multiple stings can cause a serious health concern for anyone. These insects are most likely to sting when their hive or nest is threatened.
- Bees, hornets, and wasps may be found in derelict buildings, sheltered areas, behind covers or lids and even on open ground. Other protective measures are not normally effective against aggressive, flying insects. Be aware of the potential areas for these types of insects, approach these locations cautiously and if you locate insect back away without disturbing. Avoid reaching into areas where visibility is limited".
- If stung by a wasp, bees, or hornet, notify a co-worker or someone who can help should you have an allergic reaction. Stay calm and treat the area with ice or cold water. Seek medical attention if you have any reactions to the sting such as developing a rash, excessive swelling or pain at the site of the bite or sting, or any swelling or numbness beyond the site of the bite or sting.

4.6.8 Fire Ants

- The fire ant (southern and western U.S.) and the European fire ant (northeastern U.S. and eastern Canada) is often very abundant where it is established. It is very aggressive and commonly climbs up clothing and stings unprovoked when it comes into contact with skin. Painful irritations will persist for an hour or more.

4.6.9 Poisonous Plants

4.6.10 Plants that field staff should recognize and take precautions to avoid include: poison sumac, poison ivy (terrestrial and climbing), poison oak, giant hogweed[1] (or giant cow parsnip), wild parsnip, devil's club and stinging nettle. Many others are extremely poisonous to eat (e.g., poison hemlock; water parsnip) – do not eat anything that has not been identified. Refer to *S3NA-313-WI5 Plants of Concern* for information on locations where some of these poisonous plants are found in the U.S.

- Poisonous plants including poison ivy, oak and sumac, which contain the oil urushiol that produces a rash, can lead to dermatitis and infections. Exposure to urushiol produces a rash that can be irritating and cause the exposed employee to scratch the affected area, increasing susceptibility for an infection. It should be noted that each time an employee is exposed to urushiol the severity of the reaction increases. In cases that involve severe rashes, medical treatment may be necessary to control the rash.
- Wild parsnip is found throughout the U.S. and contains a poison that produces a rash similar to poison oak and ivy. Unlike poison oak and ivy, the active oil will not be present on unbroken leaves. See *S3NA-313-WI6 Wild Parsnip Identification* for additional information and photos of wild parsnip.

[1] Phytodermatisi producer: keep skin covered and wash well after exposure

- Of the toxic plants in the cashew family, poison ivy (*Rhus radicans*) is most widespread. It grows as ina a variety of forms from a low sprawling shrub, dense ground cover, and or a thick woody vine that grows high into the tree canopy. Poison oak (*Rhus diversiloba*) is typically a low shrub in drier soils. Both of these plants have leaves of three and white berries. Poison sumac (*Rhus vernix*) is a tall shrub that is less prolific in distribution. It grows in wet areas, has a compound leaf with a red leaf stem (rachis), and white berries. All of these plants possess urushiol oils in nearly all parts of the plant. Touching the plant causes an itchy skin rash that shows up several days following contact. People have a wide range of reactions which in severe cases can lead to oozing blisters on large parts of the body. Some people apparently never react and others who have never had a reaction may develop an allergy after years of frequent contact.
- Several plants in the carrot family contain toxic sap that causes severe dermatitis if it comes into contact with skin that is then exposed to sunlight. The most serious reaction is caused by the giant hogweed (*Heracleum mantegazzianum*), a plant that is spreading in southern Ontario and is also present in southwestern British Columbia. The plant is enormous, attaining up to 16 feet (5 meters) in height, which it does in one growing season. Contact causes painful blistering that can cause permanent disfigurement. It is to be avoided. Similar but less serious reactions can be caused by meadow parsnip (*Pastinaca sativa*) and cow parsnip (*Heracleum lanatum*). Meadow parsnip can be very abundant on disturbed sites.
- Nettles, particularly stinging nettle (*Urtica dioica*) and wood nettle (*Laportea canadensis*) contain urticating hairs on the leaves and stems that cause sharp pain or itchiness on contact with skin. The irritation is immediate and normally lasts no more than an hour and there are no lasting consequences.
- Some plants contain abundant stiff spines that can present a safety hazard, particularly if one is to fall into them. These include the cactus (*Opuntia spp.*), devils club (*Oplopanax horridum*), and prickly-ash (*Zanthoxylon americanum*).

4.6.11 A large number of plants are not harmful to touch but may contain poisonous berries or foliage that could cause serious complications or death if they are ingested. It goes without saying to not eat any berries or plants if you are unsure of their identity.

4.6.12 Giant hogweed presents the most serious health risk. Field staff should learn to recognize and avoid it if encountered.

4.6.13 Employees / Field Staff who develop a rash as a result of exposure to poisonous plants shall report the exposure immediately to their Supervisor or Project Manager who will then forward the report to the Region SH&E Manager.

4.7 Additional Wildlife Hazards (Wild Animals, Reptiles and Birds)

4.7.1 Refer to following for protection and prevention:

- *S3NA-313-WI11 Large Carnivores*
- *S3NA-313-WI12 Bear Safety*
- *S3NA-313-WI13 Small Mammals*
- *S3NA-313-WI14 Snakes*
- *S3NA-313-WI15 Alligators*

4.7.2 Bird Droppings

Bird excrement may be encountered due to the nesting of pigeons and other birds and winged animals (e.g., bats) on or in structures. Substantial accumulations of droppings can pose physical and health risks as slippery surfaces (if wet) and if the material is disturbed and becomes airborne, it can be inhaled or ingested if personal hygiene practices are not implemented. Inhalation of airborne droppings can cause diseases such as histoplasmosis. Exposure to surfaces with bird droppings shall be safeguarded by implementing proper work practices, training employees for awareness and using PPE. See *S3NA-313-WI10 Bird Droppings Safe Work Practices*.

4.8 Personal Protective Equipment (PPE)

4.8.1 The selection of PPE is dependent on the hazard present and a Task Hazard Analysis (THA) should be conducted to determine situation-specific PPE required refer to *S3NA-208-PR1 Personal Protective Equipment Program*.

4.8.2 At a minimum, in addition to any project-specific PPE, long sleeves and pants should be worn on field projects where the risk of biological encounter exists.

4.8.3 PPE for insects should include insect repellent, bug nets, bug jackets, or similar deterrents. Socks should be pulled over pant legs where the threat of exposure is anticipated.

4.8.4 Epi-pens[2] or other personal medication should be carried by those staff that is aware that anaphylactic shock is a possibility for them.

4.9 Personal Precautions and Personal Protective Measures

4.9.1 Precautions

- Be aware of the potential irritants in your area and know how to recognize them.
- Modify activities to avoid encounters (diurnal rhythms, seasonal rhythms).
- Wear protective clothing.
- When working in areas where there may be small insects that “hitchhike” (e.g., ticks, spiders, scorpions), it is recommended that clothes are turned inside out and shaken at the end of day; do not wear same clothes two days in a row.
- Staff should always be aware of where they are placing their hands, or where they are sitting in order to avoid contact with potential toxins.

4.9.2 Insects, Spiders, and Ticks

- Chemically-treated field clothing, full-length clothing, or Tyvek® coveralls.
- Use of Permethrin to treat field clothing.
- Application of insect repellent to clothing and/or exposed skin.
- Routine personal checks.
- Exercise care when collecting samples and avoid reaching into areas where visibility is limited. If stung by an insect or bitten by a spider or tick, attempt to identify the attacker and notify a co-worker or someone who can help should the bite site become painful, discolored, or swollen. Stay calm and treat the area with ice or cold water. Seek medical attention if you have any reactions to the sting such as developing a rash, excessive swelling or pain at the site of the bite, or any swelling or numbness beyond the site of the bite.
- Oil of lemon eucalyptus, DEET, and Permethrin have been recommended by the CDC for effective protection against mosquitoes that may carry the West Nile virus and related diseases.
- Note that DEET will reduce the effectiveness of Fire Resistance Clothing (FRC) and should not be applied to this clothing. If working in FRC, **field staff** can apply DEET to their skin and let dry prior to putting FRC on, or use Permethrin as it has been shown not to reduce the effectiveness of FRC. Permethrin will need to be applied to FRC well in advance of the planned work.

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[1] *Epi-pens must be prescribed by a personal physician. Renew epi-pens on a regular schedule to ensure effectiveness and make sure your field companions know where it is and how to use it if you cannot self administer the dose.*

4.9.3 Poisonous Plants

- **Field staff** conducting clearing, grubbing, or similarly disturbing work activities in areas where poisonous plants exist shall wear either long-sleeve clothing or Tyvek® coveralls, and disposable cotton, leather or synthetic gloves. **Field Staff** must not touch exposed skin (neck and face) with potentially contaminated gloves. Tyvek® and gloves worn to protect from exposure to poisonous plants will be treated as contaminated, removed from the body in a manner that the contamination is not spread, and placed in plastic bags for disposal.
- Personal clothing that has been exposed to poisonous plants shall be decontaminated with a poisonous plant cleanser such as Tecnu® or removed in a careful manner, bagged and washed separately from other clothing to remove urushiol.
- For dermatitis caused by poison ivy, poison oak, or poison sumac, calamine lotion is effective.
- Work boots will be decontaminated with either soap and water or a cleansing agent such as Tecnu® cleanser.
- Remember that in the fall and winter the hazard still exists in the form of stubble and roots.
- **Employees / Field Staff** who develop a rash as a result of exposure to poisonous plants shall report the exposure immediately to their **Supervisor** or **Project Manager** who will forward the report to the **Region SH&E Manager**.

4.9.4 PPE Recommendations

The following recommendations may be considered by the project team to determine if the use of PPE is necessary for the type of work planned:

- Disposable gloves may be cotton, leather, or synthetic materials and must not be reused after removing.
- Clearing activities present the greatest risk to **field staff** exposure but reduce the risks once completed. Recommendation – Use full protection from ticks and insects during the clearing activities including insect repellents, Tyvek® coveralls, and gloves.
- If the foliage being cleared includes poisonous plants, exposed skin will be treated with a dermal barrier cream such as Tecnu®'s Oak 'n Ivy Armor or Enviroderm's Ivy Block and either a full-face respirator or a half-face respirator (with goggles) fitted with a P-100 (HEPA) dust filter.
- Work in habitats with direct exposure to ticks, mosquitoes, and poisonous plants is likely and the scope of work does not allow for worksite control measures like vegetative clearing: Recommendation – Full protection from biological hazards including insect repellents, Tyvek® coveralls or full-length clothing, poisonous plant barrier creams and wipes, and gloves.
- Work in habitats with direct exposure to ticks and mosquitoes and no exposure to poisonous plants is likely and the scope of work typically does allow for worksite control measures like vegetative clearing: Recommendation – Protection including insect repellents and Tyvek® coveralls or full-length clothing.
- Work in habitats with direct exposure to poisonous plants and no exposure to ticks or insects is likely and the scope of work does not allow for worksite control measures like vegetative clearing: Recommendation – Full protection from poisonous plants including insect repellents, Tyvek® coveralls or full-length clothing, poisonous plant barrier creams and wipes, and gloves.
- Industrial/Commercial/Office Facilities – Direct contact with biological hazards is considered unlikely or low risk: Recommendation – PPE for biological hazards are not required; however, Tyvek coveralls and insect repellentrepellent should be available if exposure to spiders, flying insects, or other biological hazards is encountered.
- Work in areas where no biological hazards are expected because of the local environment, winter weather, or property development: Recommendation – PPE for biological hazards is not

required; however, Tyvek® coveralls and insect repellentrepellent should be available if exposures to spiders, flying insects, or other biological hazards are encountered.

4.9.5 Selection and Configuration of Field Clothing

4.9.5.1 See *S3NA-313-WI7 Configuration Clothing for Protection* against ticks and insects for illustrations and instructions for configuring, taping, and tucking clothing.

4.9.5.2 At a minimum, field staff will wear long-legged pants and long-sleeve shirts or Tyvek® coveralls to reduce the amount of exposed skin when biological hazards are identified at the work site. Gloves will also be worn consistent with the recommendations of the site-specific SWP, HASP and/or THA to minimize hand exposure.

4.9.5.3 Where ticks, chiggers, and spiders are presumed to exist, the Tyvek® or chemically treated clothing will be taped to the work boots.

4.9.5.4 Chemical Treatment of Field Clothing

Oil of lemon eucalyptus, DEET, and Permethrin have been recommended by the CDC for effective protection against mosquitoes that may carry the West Nile virus and related diseases.

4.9.5.4.1 Lemon Eucalyptus

Lemon Eucalyptus is a plant-based insect repellent on the market as Repel Lemon Eucalyptus. The products have been proven to be effective against mosquitoes, deer ticks, and no-see-ums for up to six hours. Derived from Oil of Lemon Eucalyptus, this non-greasy lotion or spray has a pleasant scent and is not known to be toxic to humans. The spray or lotions will be effective for approximately two to six hours and should be reapplied every two hours to sustain protection. Lemon Eucalyptus products cannot be applied to fire retardant clothing.

4.9.5.4.2 DEET

Note that DEET will reduce the effectiveness of FRC and should not be applied to this clothing. If working in FRC, field staff can apply DEET to their skin prior to putting FRC on, or use Permethrin as it has been shown not to reduce the effectiveness of FRC. Permethrin will need to be applied to FRC well in advance of the planned work.

4.9.5.4.3 Permethrin

- When selected as part of a project's PPE requirements, the **AECOM Project Manager** shall ensure that field teams wear clothing treated with the chemical Permethrin, which is an insecticide with repellent properties registered with the Environmental Protection Agency and recommended by the CDC. Information regarding the toxicity and product safety of Permethrin is provided in *S3NA-313-WI8 Insect Repellent Active Ingredient Product Information*. Permethrin is highly effective in preventing tick bites when applied to clothing, but is not effective when applied directly to the skin. Two options are available for Permethrin treatment of clothing worn during field work: 1) pre-treatment of fabric by the clothing manufacturer; or 2) persons treatment of their personal clothing using 0.5 percent Permethrin spray. AECOM strongly recommends the first option (**field staff** obtaining pre-treated clothing) to avoid the time required, potential risk, and housekeeping issues involved with manually treating the clothing with spray. Purchase pre-treated clothing in accordance with *S3NA-208-PR1 Personal Protective Equipment Program* and with the approval of your **Supervisor** or **Project Manager**. For more information visit the AECOM Americas SH&E website.

- The Permethrin pre-treatment is odorless and retains its effectiveness for approximately 25 washings. After 25 washings, the pre-treated clothing will be considered no longer effective and removed from service. Clothing that has been manually treated **field staff** will be considered effective for five wash cycles.
- Also, use of clothing that has been pre-treated with Permethrin offers a reduction in the use and application of other insect repellents that must be applied directly to the skin. Costs for clothing shall be charged to projects as a consumable item. If charging to the project is not possible, the charges should be managed as an operational expense. **Supervisor** or **Project Manager** approval is required prior to purchase.
- If the **employee / field staff** opts not to utilize chemically pre-treated clothing while potentially exposed to insects, spiders and/or ticks, they must either: 1) wear Tyvek® coveralls taped to the boots, or 2) wear full-length clothing consisting of long-legged pants and long-sleeved shirts treated with an insect repellent containing Permethrin, DEET, or an organic alternative to their work clothing.

4.9.5.5 Manual Treatment of Field Clothing

- If clothing pre-treated with Permethrin is not available or not purchased prior to field work, field staff may manually treat their clothing with Permethrin spray. The outer surfaces of all external clothing to be worn during field work should be treated with 0.5 percent Permethrin spray a minimum of 2 to 4 hours prior to field work (boots, trousers, shirt, jackets, rain gear) in accordance with recommendations provided by the New York State Department of Health presented in *S3NA-313-WI9 New York Department of Health Recommendations for Permethrin Application*. This will likely require treatment at home or the office prior to field mobilization. Caution should be used when applying Permethrin as it is highly toxic to fish and house cats. Clothing treatment will last for approximately five wash cycles (check the specific instructions for the product used.) Purchase of PPE and Repellents and Lotions
- Costs for clothing, repellents, lotions, and other PPE shall be charged to projects as a consumable item. If charging to the project is not possible, the charges should be managed as an operational expense. **Supervisor** or **Project Manager** approval is required prior to purchase.
- Material Safety Data Sheets (MSDS) for the repellents, lotions, and cleansers discussed in this Procedure are not required because the repellents, lotion, and clothing are consumer products used in the manner intended for the general public. Although not required, a MSDS should be obtained for the products used and placed into the office MSDS library and site-specific health and safety plans. Selected MSDSs are available on the AECOM Americas SH&E website.

4.10 Personal Hygiene and Body Checks

4.10.1 Tick-borne diseases typically require that the tick be imbedded for four hours to begin disease transfer. The oils from poisonous plants can take up to 4 hours after exposure to penetrate the skin and react with the live proteins under the skin.

4.10.2 It is recommended that exposed skin be checked frequently for the presence of ticks, insects, rashes, or discolorations. External clothing should also be checked for the presence of ticks and insects; these should be retained for identification and to determine if medical treatment is needed.

4.10.3 Field Staff will shower as soon as practical after working in the field and examine their bodies for the presence of ticks, insect bites, rashes, or swollen areas. If imbedded ticks are found, they should be removed using the technique described in *S3NA-313-WI2 Ticks*, the tick should be preserved with the date and location of the bite noted, and retained for identification if medical treatment is needed as described in Section 4.10 of this Procedure.

4.10.4 The presence of an imbedded tick, rash, or abnormal reactions will be reported as an SH&E Incident to the Project Manager or Supervisor who will forward the report to the Region SH&E Manager for follow up.

4.11 Training

4.11.1 Field staff must learn to recognize organisms that represent a threat in the regions in which they work – experienced field staff must provide on the job training to assist staff with hazard recognition.

4.11.2 Field staff who have severe allergic reactions are strongly recommended to notify their Project Manager, field Supervisor and Employees of the potential for a reaction and demonstrate what medication they might need and how it is administered.

4.12 Remedies / Exposure

4.12.1 If you suspect exposure to an irritant, identify the cause including obtaining a specimen if possible. Document the occurrence as a safety precaution if the exposure should lead to complications. There is a host of over the counter treatment options available for exposures to various biological hazards.

4.12.2 Report the incident, call WorkCare for advice, or consult a private doctor if necessary, refer to the *S3NA-004-PR1 Incident Report* procedure for more specifics.

5.0 Records

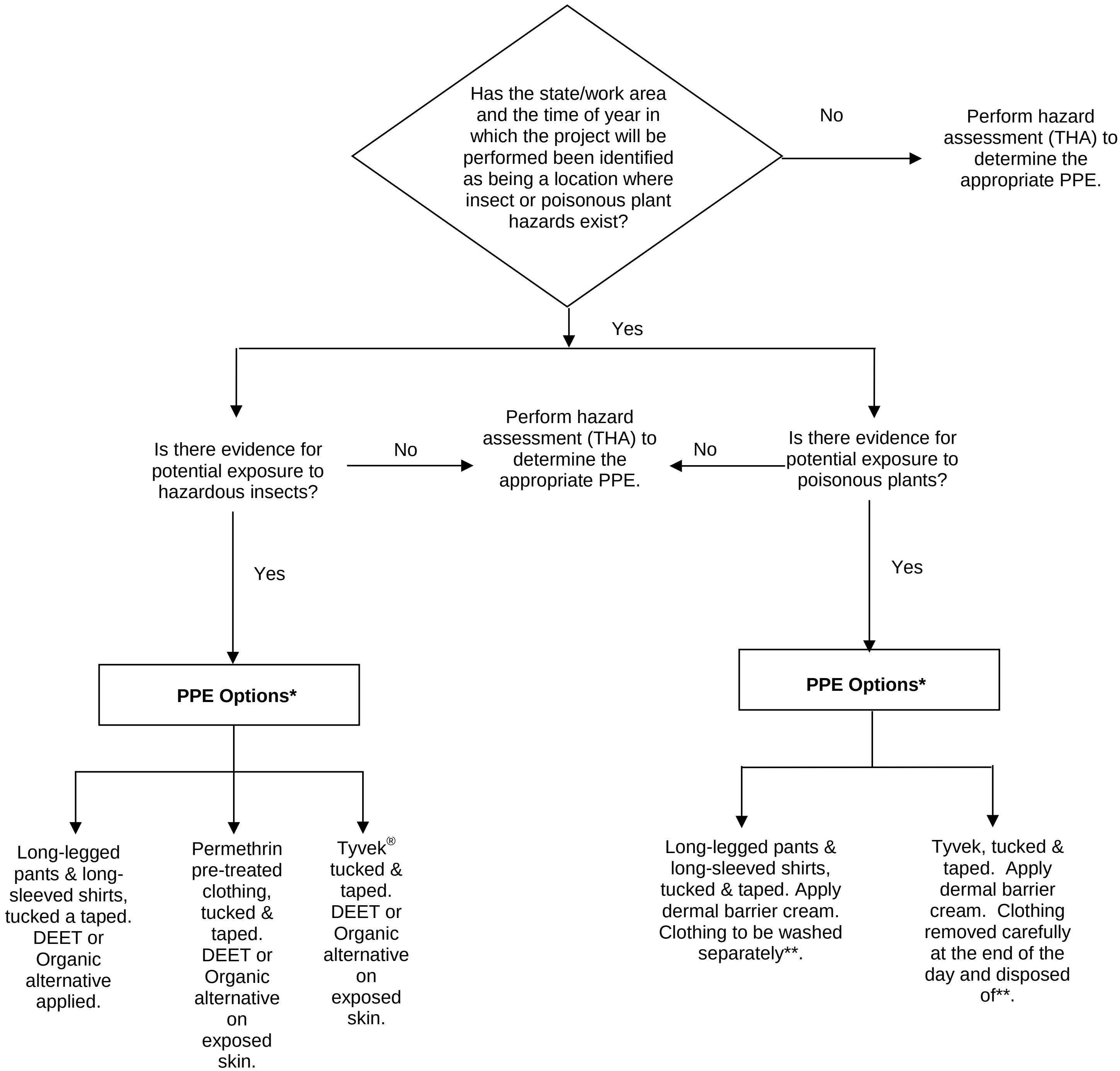
None

6.0 Attachments

6.1	S3NA-313-WI1	Biological Hazard Assessment Decision Flow Chart
6.2	S3NA-313-WI2	Ticks
6.3	S3NA-313-WI3	Poisonous Spider Identification
6.4	S3NA-313-WI4	Mosquito Borne Diseases
6.5	S3NA-313-WI5	Plants of Concern
6.6	S3NA-313-WI6	Wild Parsnip Identification
6.7	S3NA-313-WI7	Configuration Clothing for Protection against ticks and insects
6.8	S3NA-313-WI8	Insect Repellent Active Ingredient Product Information
6.9	S3NA-313-WI9	New York Department of Health Recommendations for Permethrin Application
6.10	S3NA-313-WI10	Bird Droppings Safe Work Practices
6.11	S3NA-313-WI11	Large Carnivores
6.12	S3NA-313-WI12	Bear Safety
6.13	S3NA-313-WI13	Small Mammals
6.14	S3NA-313-WI14	Snakes
6.15	S3NA-313-WI15	Alligators
6.16	S3NA-313-FM1	Tick Test Request Form

Americas

Biological Hazard Assessment Decision Flow Chart (U.S.) S3NA-313-WI1



* indicates that when both insect and poisonous plant hazards are recognized hazards at a project site, the most conservative combination of the available PPE choices will be selected.

** indicates that clothing that has been known or suspected to have come in contact with poisonous plants must be washed before it can be worn again. Similarly, Tyvek® that has been known or suspected to have come in contact with poisonous plants will be disposed of rather than reused during a subsequent day or project.

State by State Guideline for Exposure

States	Tick-Borne Diseases	Mosquito-Borne Diseases	Poisonous Plants
Alabama	Year Round Low Risk	Year Round	Year Round
Alaska	No Risk	No Risk	No Risk
Arizona	No Risk	March - July	March - November
Arkansas	March - November	March - November	March - November
California	Low Risk	March - November	Year Round
Colorado	Low Risk	March - November	No Risk
Connecticut	March - November	Low Risk March - November	March - November
Delaware	March - November	Low Risk March - November	March - November
Florida	Year Round Low Risk	Year Round	Year Round
Georgia	Year Round Low Risk	Year Round	Year Round
Hawaii	No Risk	No Risk	No Risk
Idaho	No Risk	Low Risk March - November	No Risk
Illinois	March - November	March - November	March - November
Indiana	March - November	March - November	March - November
Iowa	March - November	March - November	March - November
Kansas	Low Risk	March - November	March - November
Kentucky	March - November	March - November	March - November
Louisiana	Year Round Low Risk	Year Round	Year Round
Maine	March - November	March - November	March - November
Maryland	March - November	Low Risk	March - November
Massachusetts	March - November	March - November	March - November
Michigan	March - November	March - November	March - November
Minnesota	March - November	March - November	March - November
Mississippi	Year Round	Year Round	Year Round
Missouri	March - November	March - November	March - November
Montana	Low Risk March - July	Low Risk March - July	No Risk
Nebraska	Low Risk	Low Risk	Low Risk
Nevada	Low Risk March - July	Low Risk March - July	Low Risk March - November
New Hampshire	March - November	March - November	March - November
New Jersey	March - November	March - November	March - November
New Mexico	No Risk	Low Risk March - July	No Risk
New York	March - November	March - November	March - November
North Carolina	March - November	March - November	March - November
North Dakota	No Risk	March - November	No Risk
Ohio	Low Risk March - November	March - November	March - November
Oklahoma	March - November	Low Risk March - November	March - November
Oregon	Low Risk March - November	Low Risk March - November	March - November
Pennsylvania	March - November	March - November	March - November

States	Tick-Borne Diseases	Mosquito-Borne Diseases	Poisonous Plants
Puerto Rico	???	Low Risk March - November	Year Round
Rhode Island	March - November	Low Risk March - November	March - November
South Carolina	March - November	Low Risk March - November	March - November
South Dakota	Low Risk March - November	March - November	March - November
Tennessee	March - November	March - November	March - November
Texas	Year Round Low Risk	Year Round	Year Round
Utah	Low Risk March - July	Low Risk March - July	No Risk
Vermont	March - November	Low Risk March - November	March - November
Virginia	Low Risk March - November	March - November	March - November
Washington	Low Risk March - November	Low Risk March - November	March - November
West Virginia	Low Risk March - November	March - November	March - November
Wisconsin	March - November	March - November	March – November
Wyoming	No Risk March - July	Low Risk March - July	No Risk

Americas

Ticks

S3NA-313-WI2

1.0 Background

1.1 The Public Health Agency of Canada works with the Provinces, health authorities and other experts on research to define and monitor the occurrence of the ticks that carry *Borrelia burgdorferi*, the bacterium that causes Lyme disease. In Canada, the black-legged tick (*Ixodes scapularis*; often referred to as a deer tick) and the western black-legged tick (*Ixodes pacificus*) are the species known to transmit this disease-causing agent, as well as other less common agents.

1.2 In Quebec, black-legged tick populations are becoming established in parts of the Monteregie and Estrie regions in the southeast of the province. In Ontario, populations can be found in Long Point; Point Pelee National Park; Rondeau Provincial Park; Turkey Point; Prince Edward Point National Wildlife Area and St. Lawrence Islands National Park in the Thousand Islands region of eastern Ontario. In Nova Scotia, black-legged tick populations are found in the Lunenburg, Bedford and Shelburne areas. An established population has also been found in the southeastern corner of Manitoba. Western black-legged ticks, on the other hand, are found in British Columbia; they are fairly widely distributed but populations are largest in the lower mainland, on Vancouver Island, and in the Fraser Valley.

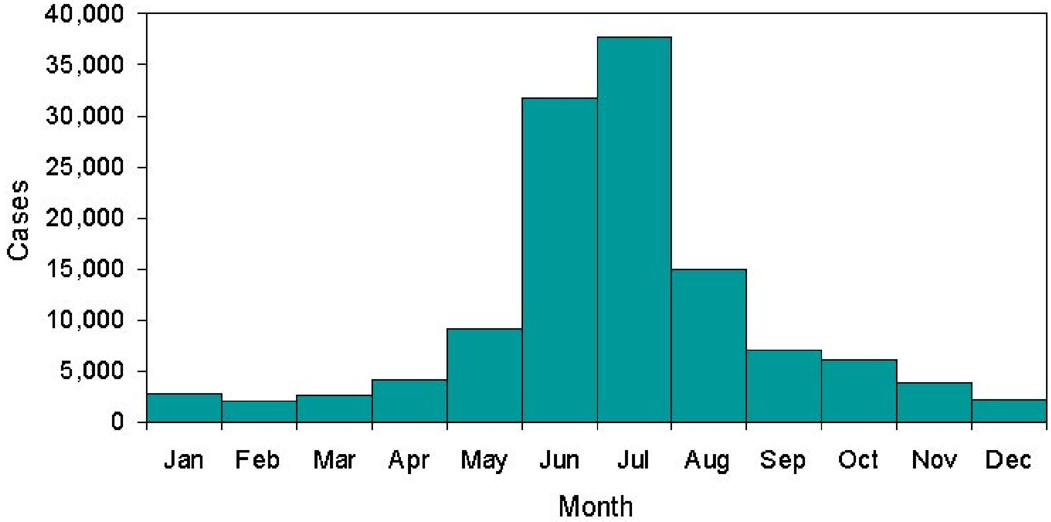
1.3 Although the distribution of black-legged ticks in Canada appears to be limited, surveillance indicates that some of the established populations are spreading within certain areas of southern Canada. The potential expansion of localized tick populations makes it difficult to precisely define the geographic limits of any given population; however, people living in or visiting areas adjacent to established tick populations may have a greater chance of contact with blacklegged ticks. Although current evidence does not suggest a widespread distribution of blacklegged tick populations in Canada, the establishment of new populations appears to be an ongoing process. Hence, it is desirable to continue surveillance and to take precautions to reduce tick contact.

1.4 The rate of infection of ticks with the bacterium that causes Lyme disease varies. Infection rates are typically higher in adult ticks compared to the other stages (nymphs and larvae). Despite the lower rates of infection, people are most likely to acquire Lyme disease from a nymph because this stage is so small and thus more likely to go unnoticed and feed for a sufficient amount of time for the Lyme disease bacterium to be transmitted (24-36 hours). Infection rates are often greater in tick populations that have been established for long periods of time (such as Long Point) compared to newly established ones. As many as 60 percent of the adult ticks at Long Point are infected; however, infection rates in adults are more often between 10 and 25 percent at the other localities where ticks are established. Partly because of differences in the types of hosts that they feed upon, infection rates of the Lyme disease agent in *Ixodes pacificus* are much lower (1-3 percent) than *Ixodes scapularis*.

1.5 While there is a higher risk of coming in contact with infected black-legged ticks in areas where populations are established, there is also a low risk of Lyme disease being contracted almost anywhere in Canada because migratory birds transport infected ticks over large geographic distances. Surveillance data indicates that about 12 percent of the ticks detected outside of areas where tick populations are established, and likely transported there on migratory birds, are infected with the agent of Lyme disease.

1.6 Source: http://www.phac-aspc.gc.ca/id-mi/tickinfo-eng.php

Figure 1 Reported Cases of Lyme Disease by Month of Illness Onset United States, 1992-2004



Lyme disease patients are most likely to have illness onset in April through November with onset peaking in June, July, or August and less likely to have illness onset from December through March.

http://www.cdc.gov/ncidod/dvbid/lyme/ld_rptmthofill.htm

2.0 Tick Removal Tips from CDC

http://www.cdc.gov/ncidod/dvrd/ehrlichia/Q&A/Q&A.htm

3.0 To Remove Attached Ticks

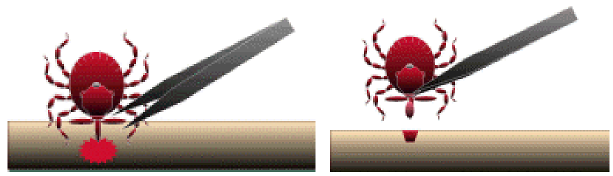
3.1 Use fine-tipped tweezers or notched tick extractor, and protect your fingers with a tissue, paper towel, or latex gloves (see figure). Persons should avoid removing ticks with bare hands.

3.2 Grasp the tick as close to the skin surface as possible and pull upward with steady, even pressure. Do not twist or jerk the tick; this may cause the mouthparts to break off and remain in the skin. (If this happens, remove mouthparts with tweezers. Consult your health care provider if illness occurs.)

3.3 After removing the tick, thoroughly disinfect the bite site and wash your hands with soap and water.

3.4 Do not squeeze, crush, or puncture the body of the tick because its fluids may contain infectious organisms. Skin accidentally exposed to tick fluids can be disinfected with iodine scrub, rubbing alcohol, or water containing detergents.

3.5 Save the tick for identification in case you become ill. This may help your doctor make an accurate diagnosis of potential diseases by determining what type of tick it is. Place the tick in a sealable plastic bag and put it in your freezer. Write the date of the bite on a piece of paper with a pencil and place it in the bag.



4.0 Devices Designed for Removing Ticks

4.1 http://www.tickkey.com/

4.2 The Tick Tool - http://www.ticktool.com/index.html

5.0 Folklore Remedies Don't Work

5.1 Folklore remedies, such as the use of petroleum jelly or hot matches, do little to encourage a tick to detach from skin. In fact, they may make matters worse by irritating the tick and stimulating it to release additional saliva or regurgitate gut contents, increasing the chances of transmitting the pathogen. These methods of tick removal should be avoided.

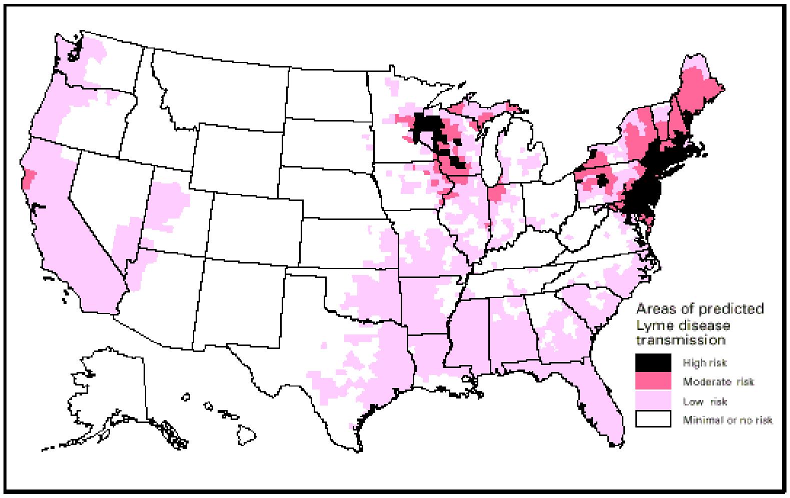
6.0 Information Regarding Common Tick-Borne Diseases

Table 1 Common Tick-Borne Diseases in the U.S. and Information Resources

Disease	Tick Species	CDC Informational Web Pages
Lyme disease	• Black-legged or deer tick • Western black legged tick	http://www.cdc.gov/ncidod/dvbid/lyme/
Ehrlichiosis	• Lone star tick • Black-legged or deer tick • Western black legged tick	http://www.cdc.gov/Ncidod/dvrd/ehrlichia/Index.htm
Rocky Mountain spotted fever	• American dog tick • Rocky Mountain wood tick • Brown dog tick	http://www.cdc.gov/ncidod/dvrd/rmsf/index.htm

7.0 Distribution

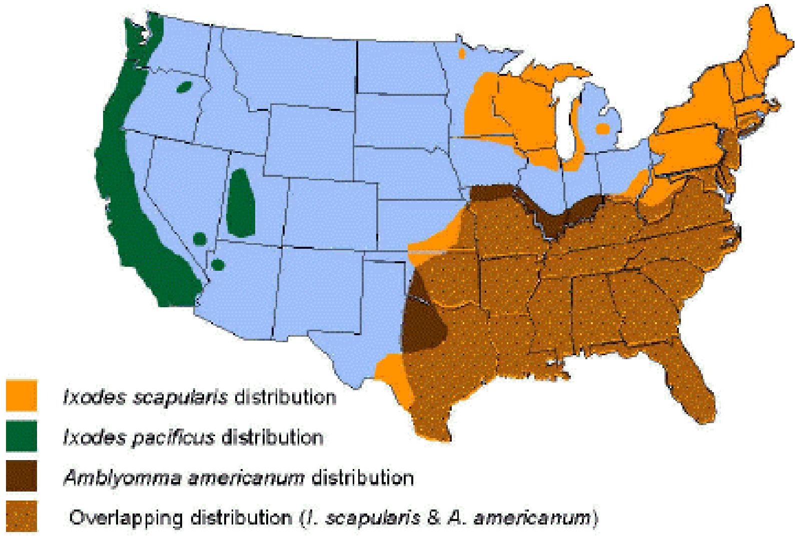
Figure 2 Distribution Map for Lyme Disease Risk, U.S.



Note: This map demonstrates an approximate distribution of predicted Lyme disease risk in the United States. The true relative risk in any given county compared with other counties might differ from that shown here and might change from year to year. Risk categories are defined in the accompanying text. Information on risk distribution within states and counties is best obtained from state and local public health authorities.

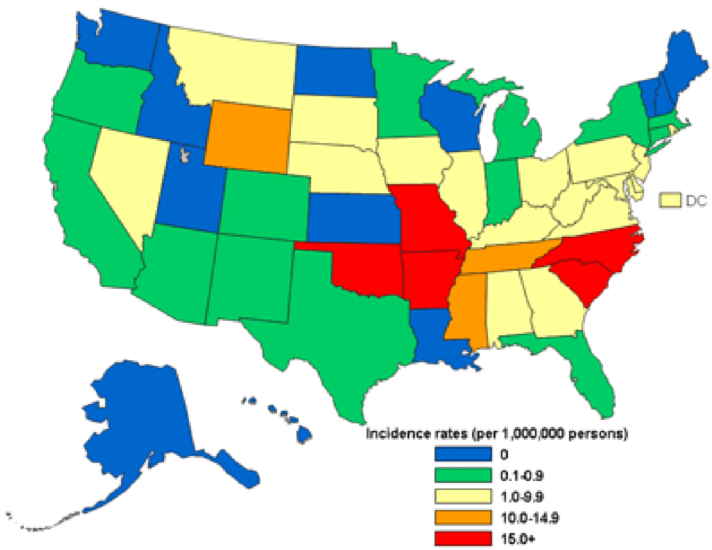
Source: CDC, http://www.cdc.gov/ncidod/dvbid/lyme/riskmap.htm

Figure 3 Distribution Map of Vector Tick Species for Human Ehrlichiosis, U.S.



Source: CDC, http://www.cdc.gov/ncidod/dvrd/ehrlichia/Q&A/Q&A.htm

Figure 4 Distribution Map of Annual Incidence of Rocky Mountain Spotted Fever, U.S



Data for calendar year 2002

Source: CDC, http://www.cdc.gov/ncidod/dvrd/rmsf/Epidemiology.htm

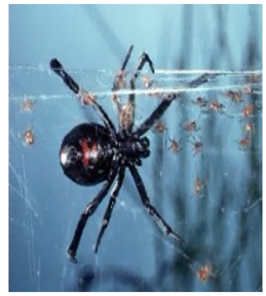
Americas

Poisonous Spider Identification

S3NA-313-WI3

Black Widow Spider

- Abdomen usually shows hourglass marking.
- The female is 1 to 1.5 inches (3-4 centimeters) in diameter.
- Have been found in well casings and flush-mount covers.
- Not aggressive, but more likely to bite if guarding eggs.
- Light, local swelling and reddening of the bite are early signs of a bite, followed by intense muscular pain, rigidity of the abdomen and legs, difficulty breathing, and nausea.
- If bitten, see physician as soon as possible.



Brown Spiders (Recluse)

- Central and South U.S., although in some other areas, as well.
- 0.25-to 0.5-inch (0.6 to 1.3 centimeters)-long body and the size of silver dollar.
- Hides in decaying wood, baseboards, ceilings, cracks, and undisturbed piles of material.
- Bite either may go unnoticed or may be followed by a severe localized reaction, including scabbing, necrosis of affected tissue, and very slow healing.
- If bitten, see physician as soon as possible.

Exercise care when collecting samples and avoid reaching into areas where visibility is limited. If bitten by a spider, attempt to identify the spider, notify a co-worker or someone who can help should the bite site become painful, discolored, or swollen. Stay calm and treat the area with ice or cold water. Seek medical attention if you have any reactions to the sting such as developing a rash, excessive swelling or pain at the site of the bite or any swelling or numbness beyond the site of the bite.

Additional U.S. Spider Identification charts are available at http://www.termite.com/spider-identification.html

Americas

Mosquito-Borne Diseases

S3NA-313-WI4

1.0 Background

1.1 CDC data indicates that mosquito-borne illnesses, including encephalitis, are a health risk to employees working in outdoor environments.

1.2 Mosquitoes pose a risk of causing infection with various forms of encephalitis and other diseases in AECOM employees. This section will focus on the transmission of encephalitis. West Nile encephalitis is an infection of the brain that is caused by a virus known as the West Nile virus.

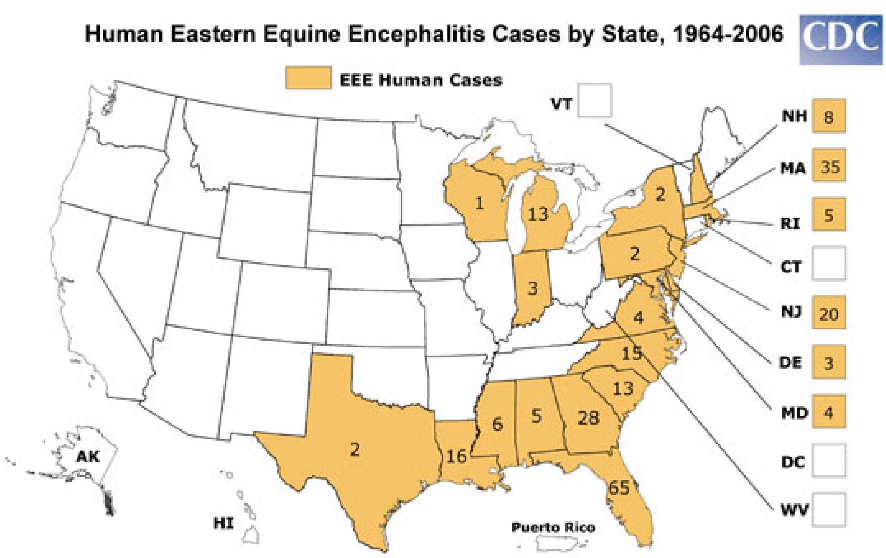
1.3 If other mosquito-borne diseases are identified in the project area, the local Public Health Department and Center for Disease Control and Prevention (CDC) should be consulted to determine what diseases are present and exposure prevention recommendation.

1.4 According to the CDC, arboviral encephalitis is a virus that is “maintained in nature through biological transmission between susceptible vertebrate hosts by blood feeding arthropods”, e.g., mosquitoes. It exists in various forms in global distribution, and in four primary forms in the U.S.: 1) eastern equine encephalitis (EEE), 2) western equine encephalitis (WEE), 3) St. Louis encephalitis (SLE), and 4) La Crosse (LAC) encephalitis; all of which are transmitted by mosquitoes.

1.5 Mosquitoes are known to breed in standing water; therefore, when standing water is found at a job site, actions should be taken to drain the water. Typically, mosquitoes will fly only a quarter of a mile (400 meters) from their breeding location.

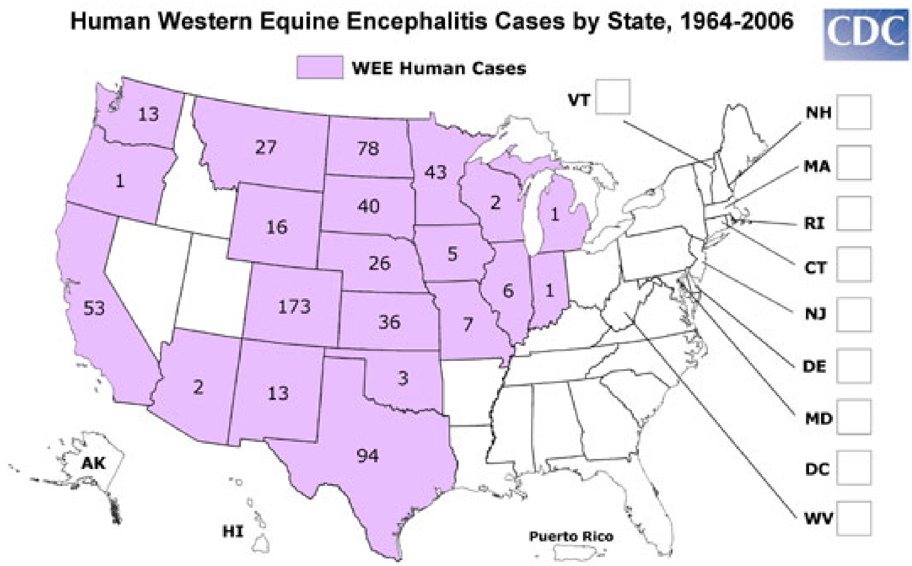
2.0 Distribution

Figure 1 Distribution Map for EEE Cases



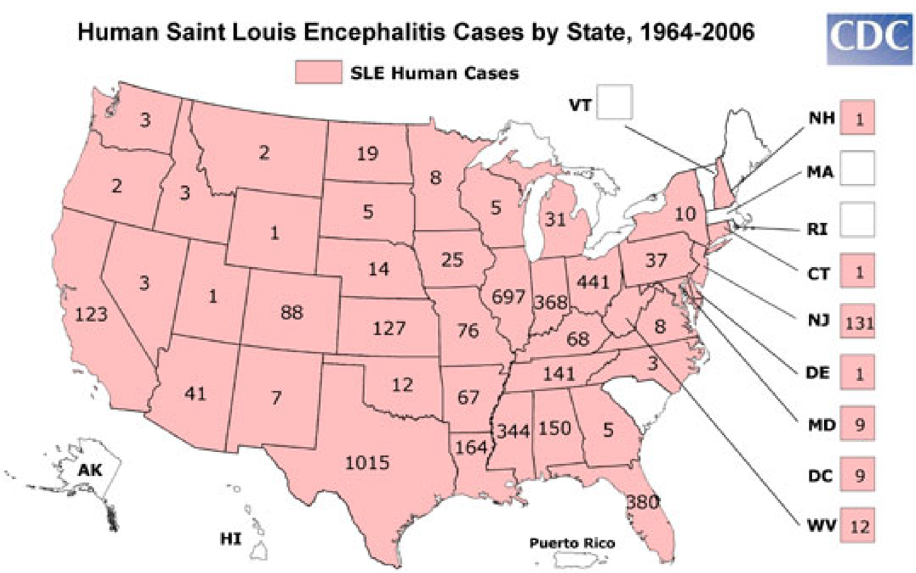
Source: http://www.cdc.gov/ncidod/dvbid/arbor/images/EEE_Map.jpg

Figure 2 Distribution Map for WEE Cases



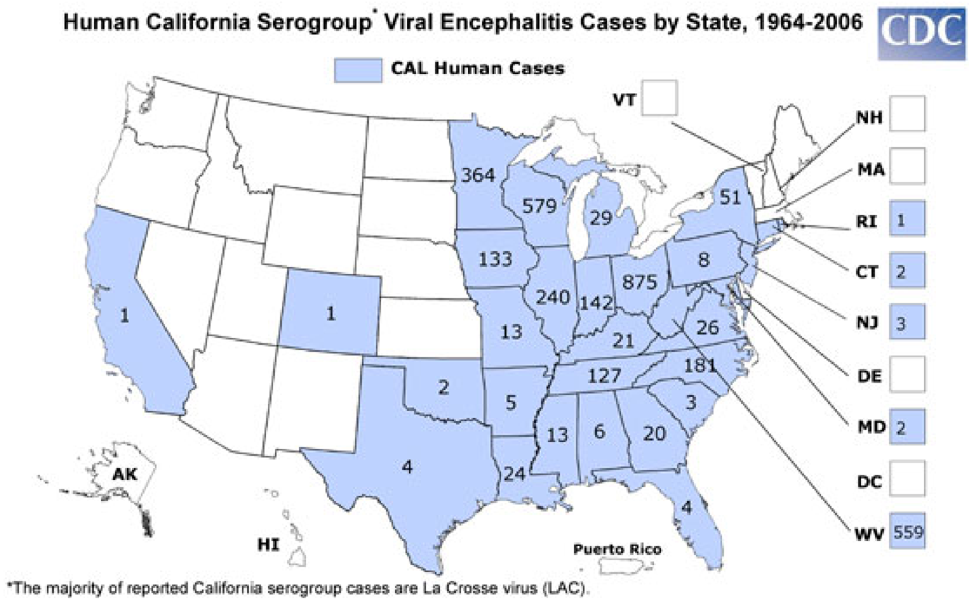
Source: http://www.cdc.gov/ncidod/dvbid/arbor/images/WEE_Map.jpg

Figure 3 Distribution Map for SLE Cases



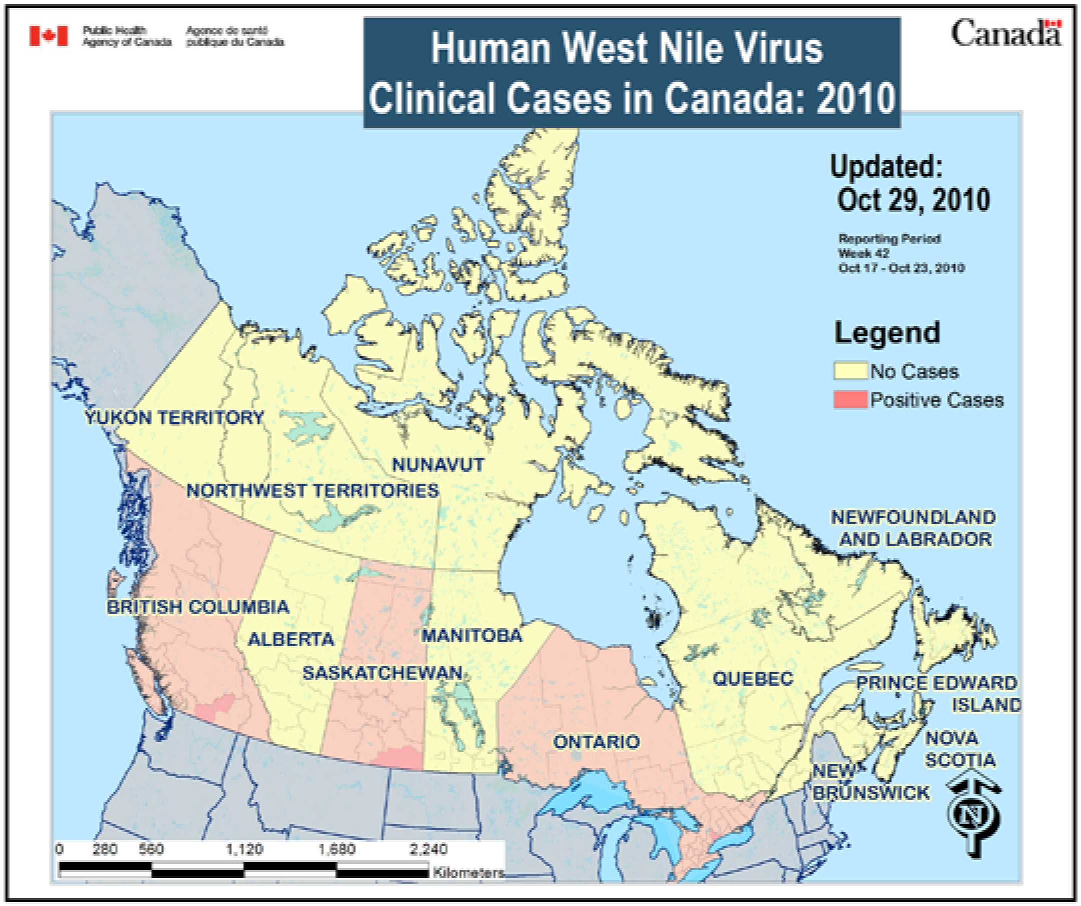
Source: http://www.cdc.gov/ncidod/dvbid/arbor/images/SLE_Map.jpg

Figure 4 Distribution Map for LAC Encephalitis Cases



Source: http://www.cdc.gov/ncidod/dvbid/arbor/images/LAC_Map.jpg

Canadian Mosquito Borne Diseases



Source: http://www.eidgis.com/wnvmonitorca/

Disease	Distribution
California encephalitis	Canada-wide
Western equine encephalitis	Western Canada
Eastern equine encephalitis	Quebec, Ontario
St Louis encephalitis	Ontario, Quebec, Manitoba, Saskatchewan
Cache Valley	Ontario, Manitoba, Saskatchewan, Alberta

Source: Paediatr Child Health. 2000 May–Jun; 5(4): 206–212.

Americas

Plants of Concern

S3NA-313-WI5

1.0 Background

1.1 Poison ivy, oak and sumac (poisonous plants) pose a significant threat to AECOM employees due to the dermatitis that results from exposure to the oil on these plants, called urushiol.

1.2 Exposure to urushiol produces a rash that can be irritating and cause the exposed employee to scratch the infected area, increasing susceptibility for an infection to result from the rash.

1.3 It should be noted that each time an employee is exposed to urushiol, it increases the severity of the reaction they will have in subsequent exposures.

2.0 Treatment

2.1 In cases that involve severe rashes, medical treatment may be necessary to control the rash.

2.2 Employees that develop a rash as a result of exposure to poison ivy, oak or sumac should report the exposure immediately to their Supervisor, Project Manager and Region Safety, Health and Environment Manager.

Figure 1 Distribution Map for Poison Ivy

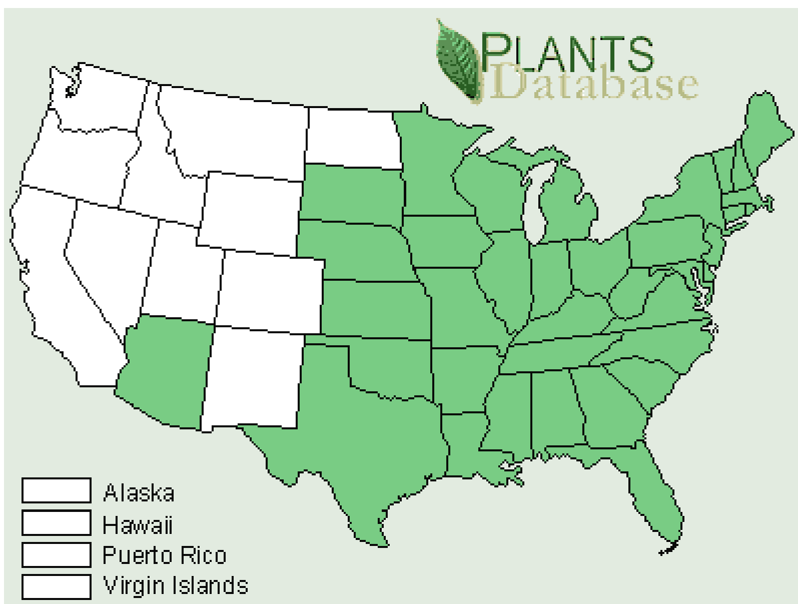


Figure 2 Distribution Map for Poison Oak

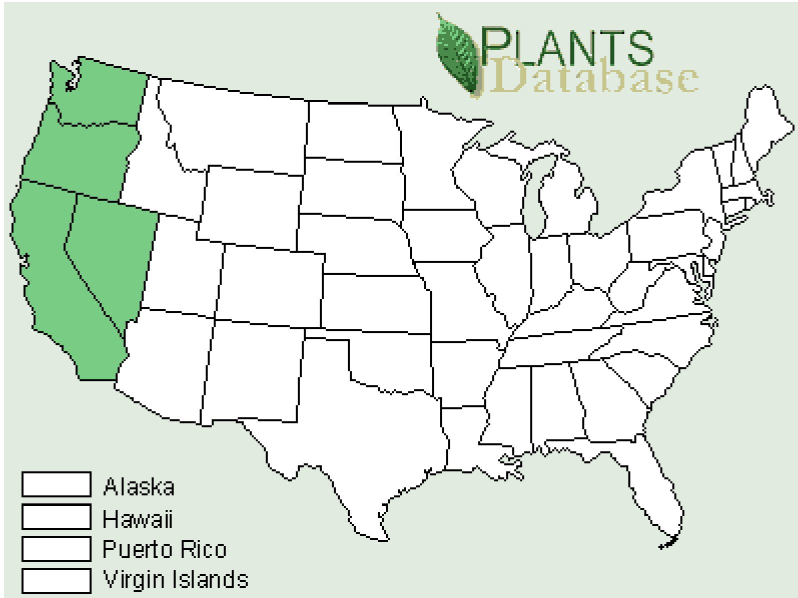
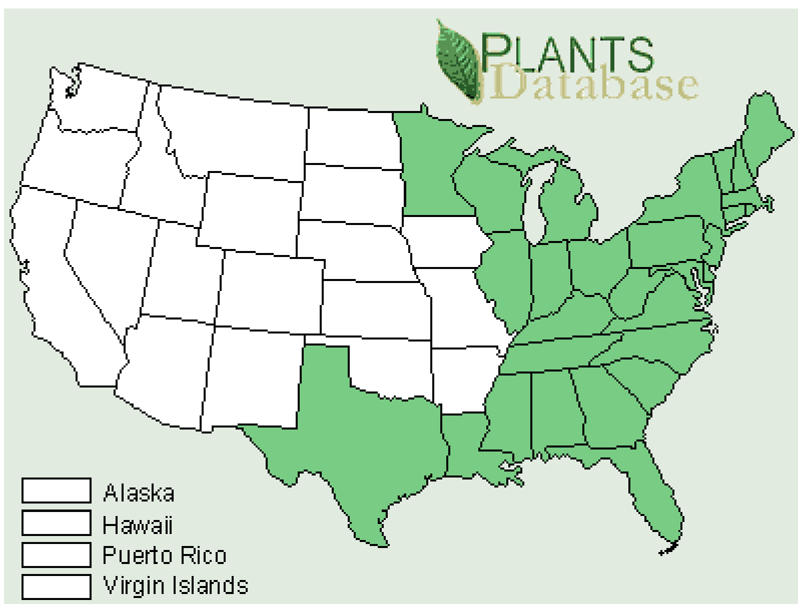


Figure 3 Distribution Map for Poison Sumac



Source for Figures 1, 2, and 3: http://www.tecnuextreme.com/plant-map.htm

Americas

Wild Parsnip Identification

S3NA-313-WI6

1.0 Background

1.1 Wild parsnip (also known as poison parsnip) looks similar to a large carrot plant and is found in open places along roadsides and in waste places throughout the United States and Canada.

1.2 This plant produces a compound that causes severe blistering and discoloration after being exposed to sunlight—a condition known as photodermatitis. That is, when the skin comes in contact with this plant's juice and then is exposed to UV light, a severe burn develops.

2.0 Hazard

2.1 Everyone can get burned by wild parsnip. Unlike poison ivy, you don't need to be sensitized by a prior exposure. However, wild parsnip is only dangerous when the juice from broken leaves or stems gets on your skin—therefore, you can touch and brush against the undamaged plant without any danger.

2.2 If one gets some of the sap of hogweed (or meadow parsnip or cow parsnip) in contact with skin, it is critical that they stay out of the sun for 8 hours. If one needs to remove the plant they should be completely covered with overalls, gloves, hat and safety glasses.

More information can be found at www.co.becker.mn.us/dept/soil_water/wild_parsnip.aspx

Configuration Clothing for Protection Against Ticks and Insects

S3NA-313-WI7

1.0 Configuration of Clothing

1.1 Loose-cuff trousers must be tucked into socks, wrapped with duct tape (or equivalent) completely around the cuff of the sock up on to the surface of the pant leg to prevent entry of insects between the sock and pants, and preferably reverse-wrapped with "sticky" side out (see figure below).

Americas

Insect Repellent Active Ingredient Product Information S3NA-313-WI8

1.0 Application of Insect Repellent

1.1 Immediately prior to the commencement of work in the field, an AECOM-approved insect repellent shall be applied to exposed skin, and to the outer surface of pant leg cuffs tucked into socks, shirt tails tucked into pants at the waist, and shirt cuffs.

1.2 Table 1 provides a list of AECOM-approved insect repellent active ingredients; employees may utilize any brand containing the minimum concentration of active ingredients as listed.

1.3 All products are registered with the U.S. Environmental Protection Agency and recommended by the Centers for Disease Control and Prevention.

1.4 Employees should select the AECOM-approved repellent which is best for them based on skin sensitivity/allergies, and personal preference, but be aware that reapplication frequency will be greater for Picaridin and lemon eucalyptus products.

1.5 Employees shall carefully read and comply with manufacturer recommendations and instructions on product labels prior to application. Repellent shall not be applied beneath clothing to minimize the potential for irritation and/or allergic reaction.

1.6 The chemical N,N-diethyl-*m*-toluamide (DEET) shall not be applied to Nomex™ fire retardant clothing as it reduces the effectiveness of the fabric.

Table 1 Approved Insect Repellents

Active ingredient and minimum concentration	Products Available	Approximate Duration of Effectiveness	Notes and Web Link to Product Safety Information
Permethrin (0.5%)	-Repel® Permanone -Coulston's Duranon™	2 weeks[1]	-Application to clothing and equipment only
DEET (23.8%)	-Deep Woods Off! ® -Repel® Sportsmen Formula®	5 hours[2]	-Cannot be applied to Nomex™ fabric
Picaridin (7%)	-Cutter Advanced™	4 hours[3]	-Protection equivalent to approximately 10% DEET
Oil of Lemon Eucalyptus (30%)	-Repel® Lemon Eucalyptus	2 hours[2]	-Protection equivalent to approximately 7% DEET -Natural, plant based product

[1] – New York State Department of Health, 2007
[2] – Fradin and Day, 2002
[3] – Spectrum Brands, 2007

1.7 Repellent shall be reapplied multiple times daily over the course of the day at a frequency identified during the hazard assessment based on manufacturers' recommendations, the approximate effective period provided in Table 1, and other factors such as perspiration, precipitation, etc.

1.8 All approved repellents are available at most department or sporting goods stores.

Product Safety Information

Facts about the repellants recommended by AECOM are available by clicking on the embedded link.

National Pesticide Telecommunications Network Fact Sheet: Permethrin and Picaridin

Picaridin

Picaridin Fact Sheet.pdf

Permethrin

Permethrin Fact Sheet.pdf

DEET

DEET Fact Sheet.pdf

Lemon Eucalyptus

Lemon Eucalyptus fact sheet.pdf

Permethrin Application

S3NA-313-WI9

1.0 Application Recommendations

1.1 Source: New York State Department of Health, 2007. Health Advisory, Tick and Insect Repellents. **http://www.health.state.ny.us/nysdoh/westnile/pdf/2737.pdf**

1.2 Products containing permethrin are for use on clothing only—not on skin. Permethrin kills ticks and insects that come in contact with treated clothes. It is effective for two weeks or more if the clothing is not laundered.

2.0 Treat Clothing Only– DO NOT APPLY TO SKIN.

2.1 Read carefully and follow manufacturer's recommendations for application.

2.2 If you accidentally get the product on your skin, immediately wash with soap and water.

2.3 Apply to clothing in a well-ventilated outdoor area, protected from wind.

2.4 Only spray Permethrin products on the outer surface of clothing and shoes before you put them on - do not apply to clothing while it is being worn. Only spray enough product to lightly moisten the outer surface of the fabric causing a slight color change or darkening; do not saturate clothing. Do not exceed recommended spraying times. Pay special attention while treating socks, trouser cuffs and shirt cuffs to ensure proper coverage. Hang the treated clothing outdoors and allow clothing to dry for at least two hours (four hours under humid conditions) before wearing.

2.5 Do not treat clothing more than once every two weeks. Launder treated clothing separately from other clothing at least once before retreating.

2.6 Keep treated clothes in a separate bag. Those who frequent tick or mosquito habitats should consider having a set of clothes, preferably long-sleeved shirt, pants and socks that are used only in such settings. These clothes can be treated with a Permethrin-containing product according to the label directions, worn only when needed, and then placed in a separate bag when not in use. In hot weather, when long-sleeved shirt and pants may be uncomfortable, pants and jackets made of insect netting (either untreated or treated with repellent) can be worn. Such clothes are available in some sporting good stores and through outdoor equipment catalogs.

1. U. S. Environmental Protection Agency. 1999. Office of Pesticide Programs List of Chemicals Evaluated for Carcinogenic Potential-August 25, 1999. Office of Pesticide Programs. Washington, DC.

Americas

Bird Droppings Safe Work Practices

S3NA-313-WI10

1.0 Background

1.1 According to the National Institute for Occupational Safety and Health (NIOSH), histoplasmosis is an infectious disease caused by inhaling spores of a fungus called *Histoplasma capsulatum (*abbreviated *H. capsulatum)* that may inhabit accumulated masses of pigeon droppings and excrement of other birds and flying animals. Its symptoms vary greatly, but the disease primarily affects the lungs. Occasionally, other organs are affected. This form of the disease is called disseminated histoplasmosis, and it can be fatal if untreated. The acute respiratory disease form of histoplasmosisis is characterized by respiratory symptoms, a general ill feeling, fever, chest pains, and a dry or non-productive cough. Distinct patterns may be seen on a chest x-ray. Chronic lung disease resembles tuberculosis and can worsen over months or years. If symptoms occur, they may start within 3 to 17 days of exposure, with an average of 10 days. On a positive note, histoplasmosis is not contagious.

1.2 Psittacosis, although primarily a respiratory disease, can cause a wide variety of clinical manifestations. Generally, about 10 days after infection occurs, the clinical illness begins abruptly with fever, chills, weakness, fatigue, muscle pain, anorexia, nausea, vomiting, excessive sweating and difficulty with breathing, headache, backache, and sensitivity to light.

1.3 Hypersensitivity pneumonitis is also known as pigeon breeder's disease.

2.0 Symptoms

2.1 The acute form of hypersensitivity pneumonitis is clinically characterized by chills, fever, cough, breathlessness without wheezing, and malaise 4-10 hours after exposure. In general, an acute attack subsides after 18 to 24 hours.

3.0 Treatment

3.1 If a person should develop any of the symptoms as noted above, or others, it is important to see a physician and inform him of an exposure to pigeon/bird or bat excrement. A failure to diagnose the preceding conditions could occur if a treating physician is unaware of a patient's exposure to pigeon/bird or bat excrement.

4.0 Prevention

4.1 Prior to work in any area where pigeons or other flying animals may nest, a written statement from the client shall be obtained in regards to the potential for, and extent of, accumulation of excrement on/in the structure from pigeons and other winged animals.

4.2 The client shall be asked to provide appropriate details as to the basis for their statement (e.g., date of last visual survey for pigeon/bird or bat excrement accumulation, date of last excrement removal effort, etc.).

4.3 In no case will an AECOM employee or contract employee be permitted to commence structure inspection procedures without the Project Manager having received and evaluated the aforementioned written statement from the client.

4.4 According to NIOSH, the best way to prevent exposure to *H. capsulatum* spores during survey and inspection work is to avoid situations where excrement and other potentially contaminated material can become airborne and inhaled. Therefore, it is preferable that the efforts to determine if, and to what extent, there is an accumulation of pigeon/bird or bat excrement on/in structures, or the efforts to clean-up/remove/dispose of such contaminated material, be left to the client or subcontracted out.

5.0 Safe Work Practices

5.1 In those cases where AECOM employees or contract employees are contracted by the client to determine the extent of accumulation of animal excrement in/on structures, the following minimum safety and health precautions shall be taken. (NOTE: precautionary measures are based on recommendations and best practices prescribed in the NIOSH 2004 public document titled *Histoplasmosis – Protecting Workers at Risk*).

5.2 All workers shall wear disposable protective clothing (Tyvek® coveralls). Disposable overalls with hoods shall be donned when working in areas where *H. capsulatum* spore-contaminated material is likely to fall from overhead.

5.3 All workers shall wear disposable shoe coverings fitted with ridged soles made of slip-resistant material to reduce the likelihood of slipping on wet or dusty surfaces. Gloves shall be worn.

5.4 All workers shall wear a full facepiece air purifying respirator fitted with P100 (HEPA) cartridges. If entering an enclosed area in which the extent of excrement contamination is unknown, additional protective measures shall be taken such that workers shall wear a <u>powered</u> air-purifying respirator (APR) with full facepiece fitted with P100 (HEPA) cartridges. Any variance from these requirements must be approved by the Region Safety, Health an Environment Manager. Workers donning APRs shall be medically screened, cleared, and trained in their proper use in accordance with AECOM safety program standards.

5.5 If contaminated material must be disturbed for purposes of removal/disposal or during the structure inspect process, it shall be wetted down prior to all work and will be rewetted as necessary to minimize airborne dusting.

5.6 After working in *H. capsulatum* spore-contaminated areas and before removing any respiratory protective equipment, workers shall remove all protective clothing and shoe coverings and seal them in a heavy-duty plastic bag for disposal.

5.7 Workers shall observe a high degree of personal hygiene, even if the exposure is casual. Special care shall be taken to wash hands, face, and other areas of exposed skin thoroughly before eating, drinking or smoking.

Large Carnivores

S3NA-313-WI11

1.0 Hazard

1.1 Most wild carnivores in the feline family (cougars, lynx, and bobcat) or the canine family (wolves and coyotes) are more predictable than bears and are not predatory towards humans; however, all wild animals can be dangerous if they feel threatened or if they are sick or starving.

1.2 Most ungulates (deer, moose, elk, and caribou) will avoid humans and will flee as soon as a human is sighted; however, females with young (during May and June) and males during the mating season (September to November) can be very aggressive, especially if provoked.

2.0 Personal Protective Equipment

2.1 Noise makers such as bear bangers, whistles and bells can be used as deterrents for an approaching animal.

2.2 Pepper (bear) spray can be used to ward off an imminent attack.

3.0 Safe Work Practice

3.1 Most negative encounters with ungulates or carnivores can be avoided with a few key preventative measures:

3.1.1 When working in wilderness isolation, always travel in pairs and make lots of noise.

3.1.2 Always store food in air-tight containers away from sleeping areas (if camping) and never carry strong smelling foods which could attract animals.

3.1.3 Keep your eyes open for fresh animal signs which may indicate a dangerous situation:

- Extensive fresh rubbing on branches in the fall might indicate the presence of a rutting male ungulate that may become aggressive to defend a potential mate.
- A fresh kill or carcass which might indicate the presence of a carnivore that may become aggressive to defend its food.

3.2 Maintaining a distance of at least 100 feet (30 meters) allows large animals an escape route. If you notice any signs of aggression or behavioral changes, you should move away to a safe location. Wildlife should not be enticed by reaching out or simulating calls.

3.3 Pets should be kept secure and away from wildlife as their actions can provoke an attack. Moose, deer and other wildlife may appear quite docile; however, if a dog makes them feel threatened, their behavior can become unpredictable.

3.4 **If you are approached by a carnivore (wolf, coyote, or cougar):**

3.4.1 Pick up small children immediately.

3.4.2 Try to appear bigger, hold your arms or an object over your head.

3.4.3 Face the animal and retreat slowly. Do not run or play dead.

3.4.4 Maintain steady eye contact with the animal.

3.4.5 If the animal continues to approach, deter an attack by yelling, waving a stick or throwing rocks.

3.4.6 If you are attacked, fight back. Hit the animal with a heavy stick or rock.

3.5 **If you are approached by an ungulate (moose, elk, deer, bison or caribou):**

3.5.1 An angry moose, elk or deer will face you with its head and ears lowered.

3.5.2 Back away slowly.

3.5.3 Look for something to get behind like a tree or a car. You can go faster around an obstacle than the ungulate can.

3.5.4 An ungulate is more likely to bluff charge but if it continues the charge and you are attacked in the open, curl up in a ball on the ground. Always protect your head with your arms and lie still.

3.5.5 Stay still after the attack until the ungulate moves away.

Americas

Bear Safety

S3NA-313-WI12

1.0 Hazard

1.1 An encounter with a bear of any species can have a wide variety of outcomes, ranging from a simple sighting, to a false charge, to a serious mauling or even death. Consequently, the risk of a bear encounter must be taken very seriously.

1.2 The hazard or risk associated with a bear encounter varies significantly depending on the location. It is important to research the project area before field work commences to determine the expected probability of encountering a bear. Remoteness from urbanized areas should not be a criterion, as bears have been encountered within city limits, especially near landfills.

1.3 The risk associated with a bear encounter also varies with the species of bear, the season, and the circumstances under which the bear is encountered.

1.4 Preparing staff for any type of encounter is key to managing the risk.

2.0 Personal Protective Equipment

2.1 The best deterrent of a “bad bear encounter” is knowledge: a good understanding of the ecology and the behavior of the bears that will likely be encountered.

2.2 Bear Spray and Bear Bangers

2.2.1 Staff must have hands-on training for the safe use of bear spray (a pre-season practice run is a good use of expired bear spray).

2.2.2 Prior to work commencing, staff must ensure that the bear spray they are carrying is still valid and not past its expiration date.

2.2.3 During travel, bear spray must be sealed in an airtight container or bag and must not travel in the cab of a vehicle, aircraft, or helicopter.

2.3 Firearms

2.3.1 Environments and conditions which pose a high risk of bear encounters, may warrant the use of an armed wildlife monitor. Project managers, in consultation with appropriate project staff and Safety, Health and Environment Management, are responsible for determining the level of risk for their projects and whether or not such measures are required.

2.3.2 A person hired as an armed bear monitor must be properly trained in wildlife monitoring as well as certified in the expert usage of firearms.

2.3.3 The usage of an armed bear monitor is intended only as an additional precautionary measure to be used in specific environments to ensure the protection of field staff; staff should still be equipped and trained appropriately for the risk.

3.0 Restrictions

3.1 Staff must not work alone in areas where there is a medium or high risk of a bear encounter.

3.2 AECOM personnel shall not carry firearms or attempt to function as a wildlife monitor and/or perform their professional duties. For possible exceptions contact the Regional SH&E Manager who will evaluate the potential hazards with Regional Manager and Legal and provide written response. This can only be over-ridden with expressed permission of Region Executive and AECOM Chief Security Officer, refer to *WP-001-PR Firearms Standard*.

4.0 Training

4.1 In-house Bear Awareness training must be taken by all field staff who work in bear country every three years at a minimum, or more often as required.

4.2 The Bear Awareness training involves testing and improving the employee's knowledge about bear encounters, watching videos regarding bear awareness and behavior, and participating in group discussions about how to avoid and how to respond to bear encounters.

4.3 Specific considerations are given to black bear, grizzly bear, and polar bear encounters.

5.0 Safe Work Practice

5.1 Staff must be aware of wildlife signs and avoid wildlife encounters.

5.2 Bear Signs

5.2.1 Fresh tracks – It is often better to see the bear's tracks than to see the actual bear. If you can tell the direction that the bear is travelling in, it is prudent to change your course of direction. Bears will travel down the same pathways people or other large animals use. If you have a clear track you can determine which type of bear has passed through the area. If you see more than one track, you can tell that it is possibly a female with cubs. Avoid females with cubs!

5.2.2 Scat – Bear scat will look different depending upon the bear's diet. Close examination of bear scat can sometimes give you an indication of what the bears have been eating at that time of year. If the scat contains remnants of human garbage, there is a human food conditioned bear in the area. These bears associate people with food and can be the most dangerous type of bear to encounter.

5.2.3 Animal carcasses – IF YOU COME ACROSS A CARCASS, LEAVE THE AREA IMMEDIATELY. Grizzly bears will often cover their kills for a few days and let it rot, then come back and eat it. THE BEAR WILL STAY CLOSE BY. Grizzly bears will defend their kill and this is a situation that could prompt a defensive attack by a bear.

5.2.4 Torn-up logs and stumps – Bears will forage for insects in dead logs and rotting trees. You will often see torn up logs and stumps, evidence of their foraging.

5.2.5 Evidence of digging – Holes dug into the ground are often made by grizzly bears digging for roots or ground squirrels. In particular, grizzlies will dig for food in the early spring soon after they leave their dens.

5.2.6 Claw marks on trees – Claw marks can be left on trees by black bears when they have climbed up a tree. Grizzly bears will also leave claw marks on trees and on the ground. Bears will often chew a small tree or a sign-post, so watch for signs of chew marks along the trail.

5.2.7 Hair on trees – Bears will rub against trees, usually trees with rough bark, to scratch themselves. You can find evidence of bears by the hair left in the tree's bark. The higher the hair left on the tree, the bigger the bear. Remember that the bear will often stand on its back legs to scratch its back on the tree.

5.2.8 Daybeds – Bears will be most active in the early morning and in the evening. It would be prudent for field staff to restrict their field activities during the bear's most active foraging times as much as possible. During the heat of the day, bears will rest in daybeds. These can be shallow depressions of piled up leaves in the forest, trampled vegetation, a shallow scrape or a hole. Daybeds are usually located in cool places. Bears will make daybeds along streams and rivers. Daybeds are often associated with feeding places and therefore should be avoided.

5.3 Prevention

5.3.1 Your best defense against bears is to actively practice bear avoidance techniques when working in the field. You can prevent chance encounters by taking the following precautions:

- Know the areas and habitats bears use at different times of the year, and attempt to avoid such areas or be extremely cautious if you have to travel through them.
- Contact the local Fish & Wildlife Office to get current information on the bears in the area. Ask what other camps are in the area and if they are following good bear avoidance practices. (i.e., do they keep a clean camp?) If there are nearby human food sources available, e.g., an open dumpsite, the local bears may not be afraid to approach your camp.
- Always be aware of your surroundings. Stay alert. Watch for signs of bears along your route.
- Use binoculars to look around for bears when you are in open terrain.
- Never approach a bear if you see one feeding in the distance.
- Note the behavior of other wildlife in the area. Flocks of ravens can alert you to a possible animal carcass, and perhaps a bear. The area should be avoided. Bird or squirrel alarm calls might be telling you that a bear is near.
- Whenever possible, travel in daylight and try to avoid areas with restricted visibility, e.g., dense brush.
- Make lots of noise, especially when travelling in dense vegetation. Sing, shout, or talk loudly. You can carry portable air horns or cans of rocks. (Please note that bear bells are not effective – they do not make enough noise to warn a bear that you are approaching. You need to be loud so the bear can hear you coming.) Remember that the noise you make can be masked by loud natural sounds such as the wind or water. Therefore it is possible that the noise you make can go unnoticed by a bear whose attention is focused on feeding. You must make every attempt not to surprise a bear. In areas of loud natural noise, be louder!
- Stay together and travel in groups. Bears are less likely to attack groups of people. When travelling in groups, stay close together. Being in a group doesn't help if the individuals have spread apart along the trail.
- Pets should not accompany you when you are travelling in bear country. If you must take your pet, keep the animal on a short leash at all times. Unleashed dogs will harass bears and once scared, run back to their owner with an angry bear in pursuit.
- Do not wear perfumes or cosmetic products when you are travelling in bear country. Do not mask your human scent.
- Women should use internal sanitary protection, (i.e. tampons) when menstruating and burn all used sanitary products after usage. Keep all used sanitary supplies in sealed bags until you have a chance to burn them.
- Children should be kept very close by in bear country.
- Carry bear deterrents and know their limitations. Be familiar with how to use the deterrents, how to transport the deterrent safely and under what conditions it is most effective. Carry the deterrent in a belt, out in front and ready to grab at a moment's notice, never in your backpack.

5.4 Field Worker Precautions in Bear Country

5.4.1 Field workers should take extra precautions when working in bear country:

- Make every effort to go out into the field with another person; you should not be working alone in the field. One person can act as a lookout for the other. Keep watch for bear signs.
- Never approach a bear.

- Report where you are going and when you will return every time you leave camp. Have a plan of action if someone does not report back to camp at a specified time.
- Bears do get used to a camp's schedule and you will have fewer surprise encounters if everyone in the camp comes and goes at the same time every day.
- Take a two-way radio with you when you go out into the field.
- Always carry bear deterrents with you in the field and understand each deterrent's limitations. Carry your deterrents on a belt, out in front and ready to use instantly. Do not carry your deterrents in your backpack.
- Keep any food that you take with you sealed in odor-proof/bear-proof containers. Make every attempt to take odorless food with you, not something with a heavy scent.
- Pack out any garbage in odor-proof containers and burn once you return to camp.
- The noise of an ATV or skidoo can scare off a bear. Starting the machine and revving it up can scare off a curious bear. DO NOT CHASE A BEAR WITH AN ATV OR SKIDOO. You may need to drive the ATV around in circles to scare off the bear, but do not chase the bear.
- Take extra precautions when travelling along lakes or stream beds; bears use streams and river beds as travel routes. Be sure to carry noise makers.
- Limit your workday so you are not out in the early morning or evening when bears are most likely to be foraging.
- All **Field Workers** should be proficient in First Aid. Do not go out into the field without first aid training.
- All field camps should have a First Aid Kit.
- All field camps should have means of communication with local ambulance or air ambulance personnel.
- A person's best defense against bears is to avoid them. If this is not possible, then being heard, smelled, or seen may lessen your chances of surprising a bear and/or provoking an attack.
- All wildlife should be respected, avoided, and not harassed at any time.
- Cooking in remote areas should be avoided. Any food should be stored in airtight containers and all garbage should be managed appropriately: "pack it in, pack it out".
- A bear in camp or within human structures is not a chance encounter. If this bear challenges you, you must fight, scream, and do whatever is necessary to live, no matter what species the bear is!
- In general, there are two types of bear encounters: Defensive and Non-defensive for grizzly bears and black bears. Your response will vary based on your assessment of the situation (your training will help you in identifying these situations and the appropriate response).

6.0 Encounters

6.1 General Recommendations When Encountering a Bear

- Consider your surroundings and assess the situation before you act.
- Remain calm. Do not turn your back to a bear.
- DO NOT RUN – You will trigger the bear's natural response to chase you. Bears are extremely fast and you cannot outrun a bear. (They are as fast as an Olympic sprinter, so if you are not faster than an Olympic sprinter, don't run! They can run 25 miles per hour [40 kilometers per hour] and you can't!) You cannot outswim a bear either.

6.2 Bear Encounters in the Field

6.2.1 Your response will depend upon the type of encounter.

6.2.2 Bears are more predictable than once believed and you can determine your best course of action in a confrontation by understanding the bear's characteristics and motivation. There are two pieces of information you should be aware of in any bear encounter:

- The type of bear you are dealing with, and
- The reason for the encounter.

6.2.3 Some people believe that when you stand your ground against a predatory black bear attack, the bear will feel threatened and leave. This has been effective in some cases. HOWEVER, it is not effective against a grizzly bear predatory attack and it is very difficult to know when it will be effective against black bears. Polar bears do not follow the same behavioral patterns as grizzly and black bears; polar bears are almost always aggressive and will not back down. Special considerations must be given to projects where polar bear encounters are anticipated.

6.3 If you can leave undetected:

6.3.1 Leave the area quietly in the same direction that you came from.

6.3.2 Move while the bear's head is down. Stop moving when the bear lifts its head to check its surroundings.

6.3.3 Stay downwind so the bear will not pick up your scent.

6.3.4 When you have moved a safe distance away, you can either watch and wait until the bear leaves or make a wide detour around the bear.

6.3.5 If the bear is unaware of you and approaching, allow the bear the right of way.

6.4 If you cannot leave undetected:

6.4.1 Let the bear know that you are present by smell first; therefore move upwind so they can pick up your scent.

6.4.2 If it is possible, try to keep the bear in your sight. Watch to see if the bear leaves when it smells that a person is nearby.

6.4.3 Attempt to move out of the way without being noticed by the bear. If you cannot do this, talk loudly to let the bear know where you are.

6.5 If the bear is aware of you but in the distance:

- Remain calm.
- Continue walking slowly in the same general direction, but head away from the bear.
- DO NOT RUN. The bear can quickly outrun you if it is so inclined.
- If the bear begins to follow you, drop your pack or some article, (not food) to distract the bear. This may distract the bear long enough for you to escape. If you drop food for the bear – you will help the bear associate food with humans and teach it that aggressive behaviour will be rewarded with food.
- If it is a grizzly following you, climb a tree if there is a large tree around. Although grizzlies can climb trees, they are often not motivated enough to try. Very large grizzlies are not able to climb trees well. If grizzlies climb, they can go 9 to 13 feet (3 to 4 meters). Grizzlies will try and push trees over so do not climb a small tree.

6.6 If the bear is aware of you and close:

- A bear will feel threatened in a close confrontation. The bear's natural tendency will be to reduce or to remove the threat. Assist the bear by acting as non-threatening as possible.
- Do not make direct eye contact with the bear.

- Do not make any sudden moves.
- Do not run!
- The bear needs to identify you as a person, so talk in low tones and slowly wave your arms over your head.
- Attempt to give the bear an opportunity to leave. Be sure the bear has an open escape route. Do not corner a wild animal.
- Try to back away slowly and/or climb a tree if appropriate.
- Attempt to deter the bear if you are in a safe position.

6.7 If the bear is close and threatening:

- If you have a deterrent such as a bear banger or bear spray, be prepared to use it depending on how close the bear is. Try to scare the bear off.
- If you do not have a deterrent, or if using the deterrent is not successful, act as non-threatening as possible.
- Talk to the bear in a calm authoritative tone of voice.
- Do not startle or provoke the bear by making sudden moves.
- Never imitate the bear's aggressive sounds, signals or posture. The bear is attempting to establish dominance and imitating its moves is a challenge to its dominance.
- Back slowly away from the bear and drop a pack or some other article in order to distract the bear momentarily.
- Remember that the bear may be defending cubs that you have not yet seen or they have a food cache nearby. Attempt to look as non-threatening as possible.

6.8 If the bear is very close and approaching:

- A distance of less than 164 feet (50 meters) in an open area and closer in a forested area.
- If the bear continues to approach, use your deterrent.
- If the bear does not respond to the deterrent you must now STAND YOUR GROUND!
- If the bear continues to approach and is acting aggressive, YOU MAY HAVE TO SHOOT if you are carrying a firearm.

6.9 If the Bear Charges:

- A bear will charge you at high speed down on all four legs and often crouched low to the ground.
- Bears do not charge when standing up on the hind legs.
- Many charges are bluffs and the bear will often stop or veer off just at the last minute. It is difficult to know if the bear is bluff charging or not until it gets very close.
- When faced with a charging bear you have two options:
  - Use your bear deterrent; or
  - Roll into a ball and cover your neck and head with your arms if you are unarmed and have no other choice.

6.10 Playing Dead

6.10.1 Note: Playing dead is a very controversial topic among seasoned field personnel. Some will tell you to never play dead in any situation, others will swear that it is the only thing you should do. Playing dead is a personal choice that you will have to make.

6.10.2 If you play dead it is possible that you can prevent serious injuries if a chance encounter with a bear results in an attack. Playing dead may reduce the threat that you represent to the bear.

6.10.3 If you decide to play dead, it is important to protect your vital areas. The older information that is still found online states that the person should roll into a ball to protect their vital organs. This has been replaced and you are now advised to lie in the prone position. Lie flat on your stomach and lace your fingers behind your neck (to protect it), Spread your legs apart to provide stability if the bear tries to turn you over. Stay in this position. If the bear manages to roll you over, immediately roll back onto your stomach to protect your face, neck and vital areas. Do not try to resist or struggle as this will intensify or prolong the attack. Once the attack is over, DO NOT MOVE until the bear has left the area. Look around and be very sure that the bear is gone before moving. (If the bear is a female with cubs, she will leave and move her cubs to safety.) If the bear covers you with leaves and vegetation, it probably thinks you are dead. Grizzlies will often cover their prey with vegetation and leave the carcass to ripen for a few days.

6.10.4 It is important to note that if the bear attack is prolonged or if the bear begins to eat you, the attack has changed from what you may have first believed to be a defensive attack to a predatory attack. Fight back in a predatory attack. Concentrate your efforts on the face, eyes and nose of the bear.

Americas

Small Mammals

S3NA-313-WI13

1.0 Hazard

1.1 Working in the field either directly or indirectly with small mammals has inherent risks of injury or exposure to zoonotic diseases (infectious diseases that can be transmitted from animals to humans) that all field staff need to protect themselves against.

1.2 The risks are usually higher when there is direct contact with a wild animal, either through a break in the skin (blood), saliva, or excrement; however, there are also risks through air-borne diseases (e.g., Hantavirus).

1.3 Obviously, wildlife biologists directly handling wildlife, dead or alive, or working with wildlife feces or in enclosed habitats (such as caves), have an increased risk of exposure to a wider range of zoonotic diseases and should take extra precautions.

2.0 Personal Protective Equipment

2.1 Full-length clothing (long sleeves and pants)

2.2 Insect repellent

2.3 Respiratory equipment (when directly handling wildlife)

2.4 Gloves (when directly handling wildlife)

3.0 References

3.1 Trapping and Tagging Small Mammals. A RIC Standard for British Columbia. 1993. Dr. Todd Zimmerling.

4.0 Restrictions

4.1 Wildlife handling must only be completed under direct supervision of an experienced individual.

5.0 Training

5.1 Any staff that will be handling wildlife must be adequately trained and/or supervised by a wildlife biologist experienced in the job task.

6.0 Safe Work Practice

6.1 Wild animals can carry a variety of diseases that humans can contract: viral, parasitic, bacterial, and protozoal. Basic Personal Protective Equipment such as full-length clothing, gloves and a respiratory mask will greatly reduce the risk of exposure.

6.2 Whenever a wild animal must be handled, the procedure must be accomplished as safely and quickly as possible.

6.3 Proper techniques must be employed to avoid or minimize the risk of personal injury while, at the same time, avoiding or minimizing injury to the animal.

6.4 Gloves, catch sticks, caging, and other appropriate equipment may be necessary when handling a wild animal. Most of these animals will be extremely stressed, resisting every restraint attempt.

6.5 In the unfortunate circumstance that a person is bitten or scratched, he or she should c<u>leanse the wound thoroughly with soap and flush with water immediately</u>, providing for a mechanical removal of potentially infective organisms. This should be followed by cleansing under medical supervision and consultation with a physician to consider the potential exposure to the rabies virus.

7.0 Rabies

7.1 You will not be able to accurately determine if an animal has rabies simply by observation as traditional symptoms of rabies (foaming at the mouth, biting, etc.) do not occur in all animals nor at all stages. There are some mammals that are at a higher risk than others for the rabies virus, such as raccoons, skunks, stray cats and dogs, foxes, coyotes, rodents. and bats; however, any mammal can contract the virus.

7.2 Rabies is contracted by contact of an infected animal's saliva with an open wound – a bite or a scratch.

7.3 Symptoms of rabies in humans usually do not present themselves for a minimum of 10 days to a year or longer (the average is 30 to 50 days). Symptoms are typical of a flu, including malaise, loss of appetite, fatigue, headache, and fever. Over half of all patients have pain (sometimes itching) or numbness at the site of exposure. They may complain of insomnia or depression. Two to ten days later, signs of nervous system damage appear; these include hyperactivity and hypersensitivity, disorientation, hallucinations, seizures, and paralysis.

7.4 Because rabies is so difficult to detect and positively identify, it is very important to consult a physician immediately. If rabies is a possibility, begin treatment with the rabies vaccine as soon as possible (unlike other vaccines, rabies vaccination begins after exposure because the virus takes a comparatively long time to induce disease).

8.0 Hantavirus

8.1 Rodents can carry a variety of diseases; of notable concern is the North American hantavirus which can cause Hantavirus Pulmonary Syndrome (HPS).

8.2 A common host of the hantavirus is deer mouse and related species (*Peromyscus* spp.), which are common throughout much of North America.

8.3 Although infection is rare, it can be fatal and, therefore, it is necessary that risk of exposure be minimized. Infection can be spread to humans when they:

- 8.3.1 Breathe air contaminated by deer mouse saliva, urine or feces containing infectious hantaviruses; or
- 8.3.2 Accidentally rub eyes, mouth or broken skin with hantavirus-infected deer mouse saliva, urine or feces.

8.4 The following precautions will be taken for all field operations:

- 8.4.1 Limit exposure to soils handling and use gloves where appropriate.
- 8.4.2 Wash or sanitize hands often throughout the day and before meals.
- 8.4.3 Equipment bags, storage areas, and vehicles will be inspected daily for signs of deer mouse infestation.
- 8.4.4 Rodent-proof storage containers will be used when practical.
- 8.4.5 Do not enter buildings infested with deer mice without adequate respiratory protection.
- 8.4.6 Droppings should never be removed by vacuuming or sweeping. Wetting down an area with a mixture of 1:9 household bleach and water solution will reduce risk of airborne exposure.

8.5 If flu-like symptoms develop three days to six weeks after exposure to rodents, a doctor should be contacted immediately (mechanical ventilation is the primary method of treatment).

Snakes

S3NA-313-WI14

1.0 Hazard

1.1 Snakes have the ability to inject venom. A bite from a venomous snake, which may inject varying degrees of toxic venom, is rarely fatal but should always be considered a medical emergency.

2.0 Personal Protective Equipment

2.1 Long pants and shirts

2.2 Heavy gloves if staff will be handling debris or be close to the ground

2.3 Rubber boots, or boots that fully cover the foot (not sandals!) and preferably are at least 10 inches (25 centimeters) high

2.4 Snake Chaps that cover at least the shin

2.5 Personal first aid kit

3.0 References

3.1 The Eastern Massasauga Rattlesnake Stewardship Guide. A resource and field guide for living with rattlesnakes in Ontario. Sponsored by the Government of Canada, and distributed on behalf of the Toronto Zoo and the Eastern Massasauga Rattlesnake Recover Team.

3.2 http://www.rattlesnakes.us/

3.3 http://drdavidson.ucsd.edu/Portals/0/snake/Crotalus.htm

4.0 Restrictions

4.1 Staff must not work alone in areas where the risk of a snake encounter is high.

5.0 Training

5.1 Staff must be notified of the hazard before work commences.

6.0 Safe Work Practice

6.1 Staff working in areas known to be inhabited by venomous snakes should take extra precautions, be able to identify the local snake species, and understand the best practices for administering first aid.

6.2 Most snakes in Canada are non-venomous; and most snake bites are not fatal, only painful. Learning to identify snake species will assist you in responding appropriately to an encounter, and will assist medical professionals in determining if antivenin needs to be administered if anyone is bit.

6.3 Most snakes are non-aggressive and will only attack if immediately threatened.

6.4 Prevention

6.4.1 Before venturing out into the wilderness, familiarize yourself with the snakes in your area, both venomous and non-venomous species.

6.4.2 Learn which habitats the venomous species in your region are likely to be encountered in, and use caution when in those habitats.

6.4.3 Try as much as possible not to take a snake by surprise.

6.4.4 Stay on trails where possible, and watch where you place your hands and feet, especially when climbing or stepping over fences, large rocks, and logs, or when collecting firewood. Take care when overturning any objects on the ground when in snake country.

6.4.5 If you see a snake, give it as much room as possible. Most snakes have a strike distance that is only half the length of their body.

6.4.6 If you get very close to a rattlesnake, hold very still until it calms down and starts to move away. Then slowly move backwards until you are at least one snake-body length away.

6.5 Treatment

6.5.1 Venomous snakebites are rare, and they are rarely fatal to humans. Of the 8,000 snakebite victims in the United States each year, only about 10 to 15 die. In Canada, the number of snake bites each year is very small. However, for any snakebite the best course of action is to get medical care as soon as possible.

6.5.2 Try to keep the snakebite victim still, as movement helps the venom spread through the body.

6.5.3 Keep the injured body part motionless and just below heart level.

6.5.4 Keep the victim warm, calm, and at rest, and transport him or her immediately to medical care.

6.5.5 Do not allow him to eat or drink anything.

6.5.6 If medical care is more than half an hour away, wrap a bandage a few inches above the bite, keeping it loose enough to enable blood flow (you should be able to fit a finger beneath it). Do not cut off blood flow with a tight tourniquet. Leave the bandage in place until reaching medical care.

6.5.7 If you have a snakebite kit, wash the bite, and place the kit's suction device over the bite. (Do not suck the poison out with your mouth.) Do not remove the suction device until you reach a medical facility.

6.5.8 Identify the snake that caused the bite to determine if it is venomous, and if antivenin needs to be administered. Do not waste time or endanger yourself trying to capture or kill it. Note the shape and color of the snake’s head.

6.5.9 If you are alone and on foot, start walking slowly toward help, exerting the injured area as little as possible.

- Note that there are several species of snakes that superficially resemble rattlesnakes. Several species, including Bull, Milk, Fox, and Rat Snakes will even rattle their tails when startled.
- Massasauga Rattlesnake is recognized as a Threatened Species in Ontario and it is an offence to harass, , or destroy the habitat of this species.
- One scorpion species, the Northern Scorpion (*Paruroctonus boreus*) occurs in semi-arid areas of southern British Columbia, Alberta, and Saskatchewan. It carries a stinger on the end of its tail. The sting is painful but not life threatening unless there is an allergic reaction.

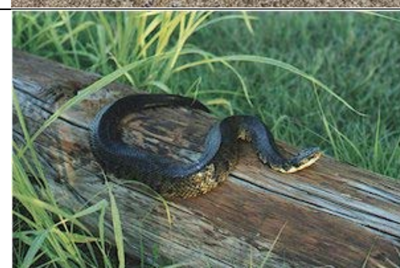
7.0 Species

7.1 Venomous Snakes in Canada

Eastern Massasauga Rattlesnake (*Sistrurus catenatus*) found around Wainfleet, Windsor, Bruce Penninsula and eastern Georgian Bay in Ontario.	 Eastern Massasauga Rattlesnake picture by Michael Redmer/Courtesy Lincoln Park Zoo
Northern Pacific Rattlesnake (*Crotalus viridis*) found primarily in Okanagan and Thompson River valleys of southern British Columbia.	
Prairie Rattlesnake (*Crotalus viridis*) found in south eastern Alberta, and south western Saskatchewan.	

7.2 Venomous snakes in the United States

Rattlesnake(*Crotalus cerastes)* found mostly concentrated in the southwestern United States, they extend north, east and south in diminishing numbers and varieties. Every contiguous state has one or more varieties of rattlesnake.	 Western Rattlesnake

The rattlesnake is found in many different biomes ranging from along the coast at sea level, the inland prairies and desert areas to the mountains at elevations of more than 10,000 feet. Species include: Sidewinder, Santa Catalina, Western, Mojave, Red Diamond, Western Diamond, Ridge Nosed, Eastern Diamondback, and Pigmy.	 Eastern Diamondback
Copperhead (*Agkistrodon contortrix*) is the most common venomous snake found in the eastern United States. It can be found in the states of Texas, Oklahoma, Kansas, Missouri, Arkansas, Louisiana, Mississippi, Alabama, Georgia, Florida, South Carolina, North Carolina, Tennessee, Kentucky, Virginia, Illinois, Indiana, Ohio, Iowa, Pennsylvania, Maryland, New Jersey, Delaware, New York, Connecticut, and Massachusetts.	
Cottonmouths (water moccasins) (*Agkistrodon piscivorus)* found in the eastern United States from Virginia, south through the Florida peninsula and west to Arkansas, eastern and southern Oklahoma, and east and central Texas.	
Coral Snake (*Micrurus sp.)* found in the southern range of many temperate United States including North Carolina, Georgia, Alabama, Mississippi, Louisiana, Texas, Arkansas, Kentucky, Arizona, and New Mexico.	 Eastern Coral Snake, *Micrurus fulvius*

Americas

Alligators

S3NA-313-WI15

1.0 Hazard

1.1 Your chance of encountering an alligator is greatest during the animal's courtship and mating season, which takes place from March through September. This is when male alligators become most dominant and aggressive as they try to intimidate rival males and attract females by their show of power. Some males end up having to travel to find a mate. July through September is when mother alligators are guarding nests.

1.2 Mating season takes up much of the warmer months - a very popular time in the southeastern USA for outdoor activities - and alligators are solar-powered, so-to-speak. The warmth from the sun fires up their metabolism, giving them renewed energy; and renewed energy means great potential for conflict.

2.0 Encounter

2.1 The alligator is naturally wary of humans, and will flee quickly if you get too close to it, or it may utter a very audible and compelling warning hiss. In some cases, however, alligators may charge or attack. Here are some examples of such cases:

2.1.1 An alligator that is accustomed to being fed by humans may not be so shy.

2.1.2 An alligator that is surprised and alarmed by your approach may attack, thinking that it is being attacked itself.

2.1.3 A mother alligator caring for her nest or for live babies. If you see alligator babies, or if you encounter a nest (usually a mound of vegetation mixed with mud), remove yourself to a safe distance, the mother alligator is sure to be close by. If you get close, the mother may sound a very audible and intimidating warning hiss. Such a nest may be difficult to identify for a non-expert, but it is likely the mother will issue you a warning.

2.1.4 Alligator mothers are well-known to be practically fearless when defending their offspring, whether the little ones have hatched or not. A mother alligator was observed leaping, jaws agape, to attack a helicopter as it approached the nest area to land. The helicopter carried biologists studying alligator nests.

2.2 Also be careful near heavy vegetation in or near the water's edge. This is where an alligator likes to enjoy privacy and peace during the daylight hours. If you trudge through there and surprise it, the outcome may not be positive.

2.3 Generally, a good minimum distance to keep between you and an alligator or nest is 15 feet (4.6 meters).

2.4 When trying to get past an alligator, make sure not to walk between the alligator and the water, because if it's spooked, it's going to run to the water.

2.5 If an alligator does approach in a threatening manner, make as much noise and movement as possible. This should show the alligator that he has taken on more than he can handle and he'll back away.

3.0 Alligator Charge

3.1 The alligator is not a natural runner. Those short legs obviously don't serve it like a horse's legs do, and the alligator can actually tire out in a relatively short time. When it charges after a human or animal, it is either trying to scare it away or seize it. It has a fast and furious burst of energy which serves it well for stealth hunting -- grabbing prey when it doesn't expect it. Furthermore, the reptile is opportunistic, which means, quite simply, it doesn't like to work very hard to get its food if it doesn't have to.

3.2 In the very rare event you are charged or chased by an alligator, move in as straight a line as possible away from it as fast as you reasonably can. In many cases, the vegetation features of the wild will serve to protect you by slowing the alligator down, like trees, bumps, bushes, etc. -- your comparatively long legs usually make it easier for you to maneuver through the trees and brush than an alligator's short legs do.

3.3 Most adult humans can outrun even a fast crocodilian, which has been clocked at a maximum of about 10 miles per hour (mph) (17 kilometers per hour [kph]), compared to a human speed of 15-17 mph (24-27 kph). But this doesn't matter much; an alligator will often give up the chase because it sees that the runner is moving away too quickly, and realizes that too much effort will be required to continue pursuit.

3.4 You may have heard somewhere that the zigzag run (running in a "z" pattern, side-to-side) is a good idea, but this is not only an unnecessary maneuver but probably a very unwise one. Here's why:

3.4.1 Unless you're an Olympic athlete, running zigzag over natural topography increases your risk of tripping and falling over rocks, plants, roots, and the like. And it goes without saying that falling while being pursued by an alligator is not good.

3.4.2 Furthermore, an alligator doesn't have the degree of stereoscopic vision we have. It actually has a small 'blind spot' directly in front of it. Hence, the alligator's vision is most effective in the 'sides' of its field of view. So, running zigzag not only slows your rate of distance from your pursuer, it may clearly indicate to the animal exactly where you are; even this point hardly matters since in many cases the alligator may keep its eyes shut while pursuing so as not to get them hit by twigs, grass stalks and branches in its path.

3.4.3 Finally, an alligator bites very effectively in a side-swiping motion, so if you are trying to run zigzag and are slowed down by plants, rocks, or other obstacles, the backwards flying leg of a running human is an optimal target for side-swiping, chomping jaws (the operative word here is "side").

3.5 Simply put, when faced with an attack, move directly away from the alligator as quickly as possible, navigating the terrain as carefully as possible. The zigzag idea will likely not serve you well.

4.0 Alligator Attack

4.1 If it seizes prey, and the prey fights back hard, the alligator may release it, depending on factors such as its own size relative to that of the victim, its own level of aggression, and its measure of hunger. Merely struggling to break free may not be enough counter-aggression to stop an alligator, and may actually prompt a devastating "death roll" response, in which the reptile furiously spins on its central axis to tear muscle and bone free of the victim's body.

4.2 These armored saurian are among the toughest beasts in the animal kingdom, so an attack victim should channel his or her nervous energy and will to survive and take the offensive by fighting hard. Not struggling...fighting very, very, very hard. Others on hand during such an event may be able to help by fighting the reptile, too. This should include punching the snout, poking the eyes, and even jabbing the ears, which are seen as small slits behind the eyes.

5.0 Additional Resources

5.1 http://www.tpwd.state.tx.us/huntwild/wild/species/alligator/index.phtml

5.2 http://corkscrew.audubon.org/Wildlife/Alligators.html

Americas

Water, Working Around

S3NA-315-PR1

1.0 Purpose and Scope

1.1 Establishes the minimum requirements and guidance for AECOM personnel assigned to projects that place them at risk of falling into water, including working ashore near to or over water.

1.2 This procedure applies to all AECOM Americas-based employees and operations.

2.0 Terms and Definitions

2.1 **PFD** – Personal Flotation Device

2.2 **Life Jacket** – A personal flotation device that will turn over an unconscious worker in the water so their face and nose are not submerged.

2.3 **USCG** – United States Coast Guard

2.4 **TC** – Transport Canada

2.5 **Lifebuoy** – A throwable buoyant rescue ring with 90 feet (28 meters) buoyant line attached.

3.0 References

3.1 Cold Water Boot Camp – http://www.coldwaterbootcamp.com

3.2 S3NA-003-PR1 SH&E Training

3.3 S3NA-208-PR1 Personal Protective Equipment Program

3.4 S3NA-209-PR1 Project Hazard Assessment and Planning

3.5 S3NA-419-PR1 Water, Marine Operations-Boating

3.6 S3NA-420-PR1 Water, Underwater Diving

4.0 Procedure

4.1 Roles and Responsibilities

4.1.1 **Project Manager**

Responsible for the overall success of a project and the performance of employees engaged in project activities (with the support of **Supervisors**), and as follows:

- Confirm that all appropriate Safety, Health and Environment (SH&E) procedures are identified and implemented and their applicability during the planning stage of field investigation projects.
- Allocate appropriate resources to implement the required measures.
- Designate a field staff person to implement and maintain these measures, maintain related documentation, and to communicate with appropriate parties as necessary.
- Consult with the purchasing department on the appropriate vendors for rentals/leases.
- Confirm that boat/watercraft rental/leasing vendors have appropriate paperwork (licenses, insurance, maintenance records, orientations, etc.).
- Confirm that the project is properly staffed with trained employees.
- Develop and submit a Health and Safety Plan, Task Hazard Analysis, Safe Work Plan or other SH&E planning documents for review and approval by the **Region SH&E Manager**.

4.1.2 **Region SH&E Manager**

Responsible for providing support to the **Project Manager** and his/her designee in the evaluation of safety and health risks and the identification of applicable policies, procedures, and appropriate precautions, and as follows:

- Review all project related Health and Safety Plans, Task Hazard Analysis as required.
- Provide access to safety records, including training records, for field staff.
- Provide support to **Project Manager**.

4.1.3 **Supervisors**

Responsible for verifying current status of field staff's training and equipping them for the work at hand, and as follows:

- Conduct daily safety meetings.
- Perform field safety inspections.
- Confirm that all safety issues and equipment deficiencies are properly corrected, and that the proper equipment is available to the field staff to safely meet the goals and quality objectives of the project.

4.1.4 **Field Staff / Employees on Site**

Responsible for complying with the safe work practices specified in this policy and all other applicable SH&E policies or procedures and reporting all unsafe working conditions, and as follows:

- Review, contribute to, and sign the Task Hazard Analysis prior to beginning the project and whenever new tasks or environmental changes occur.
- Confirming that their SH&E training is up to date.
- Confirming that equipment is properly maintained and functioning.
- Confirm they wear all required Personal Protective Equipment (PPE).

4.2 General Safety Considerations

4.2.1 During project preparation, consideration shall be given to the nature of the site, the type of water hazard, the equipment being used, and the location to determine the Personal Protection Equipment (PPE) and level of emergency preparedness that is required. All projects working near water hazards shall have an appropriate SH&E Plan or task hazard analysis (THA) prepared, refer to the *S3NA-209-PR1 Project Hazard Assessment and Planning*.

4.2.2 PPE specified in the THA is to be worn as required, to meet the specific regulations of the work area, including local and Federal legislation.

4.2.3 Whenever there exists the possibility of falling into water, personnel shall be attired in a USCG approved Type III or Type V PFD or Life jacket, refer to *S3NA315-WI1 PFD Descriptions and Use*. The vest shall be properly sized for the individual and shall be secured at all times. For cold water conditions (water temperature less than 55 degrees Fahrenheit [13 degrees Celsius]), a USCG-approved Shallang suit shall be worn to protect personnel from risks of cold water immersion.

4.2.4 Swimming is prohibited, unless it is being conducted by certified divers in the completion of their assigned task, or to prevent a serious injury or loss of life in a person in a water/person overboard emergency.

4.2.5 The buddy system shall be utilized whenever there is the possibility of falling into water, in which two persons operate as a single unit in order to monitor and assist each other in performing tasks.

4.2.6 Conducting shoreline work alone should be avoided, unless constant communications is maintained between **Field Staff** and **Supervisors,** and prior approval by the **Project Manager** is granted.

4.2.7 A throwable lifebuoy with required rescue line attached (Type IV flotation aid) shall be available.

4.2.8 Additional equipment (i.e., sounding alarms, lifting gear, or rescue boat) as required by legislation shall be immediately available to recover an individual from the water. If the shortest dimension of the water body is greater than the length of line attached to the throw buoy, a skiff or boat shall be available to facilitate a rescue.

4.3 Personal Protective Equipment (PPE)

4.3.1 PPE shall be selected based on the THA and in accordance with the *S3NA-208-PR1 Personal Protective Equipment Program*.

4.3.2 The minimum PPE required for wading in water above the knees includes:

- Personal Flotation Devices or lifejackets shall be worn by all workers who are exposed to the danger of drowning in water deep enough for the lifejacket to be effective.
- All inflatable PFD or life jackets shall be approved and have documented regular inspections.
- Shallang suits – In water temperatures below 55 degrees Fahrenheit (13 degrees Celsius) (regardless of air temperature) personnel are required to wear a USCG-approved Shallang jacket or full-flotation suit, depending on field conditions. This requirement will replace the need for a wearable PFD as these suits (if properly maintained) will provide adequate flotation.
- Waders shall have a slip resistant sole suitable for the substrate.
- Eye protection shall be worn to reduce glare.
- Wading pole shall be used for supporting and testing the substrate before wading.

4.3.3 Rescue equipment shall be on site that is appropriate to the situation (e.g., life buoys with 90 feet [28 meters]) of retrieval line, rescue boat, sounding device).

4.3.4 Blankets and an appropriate first aid kit shall be on site.

4.3.5 Immersion suits, or survival suits as they are often called, can significantly improve survival time in cold water. Recognizing that hypothermia is a major factor in lives lost at sea, the USCG requires that vessels operating in offshore waters north of 32 degrees North latitude carry an immersion suit for each person aboard. These suits are to be used in place of a Type I PFD in an abandon ship situation. It is recommended that personnel familiarize themselves with their use and practice donning the suit before leaving the dock. It is recommended that personnel be able to get into an immersion suit in under a minute. If necessary to abandon ship, personnel, attired in an immersion suit with head covered in a hat, should enter the water slowly, if possible, keep the head out of the water.

4.3.6 Suits should be stored in a clean and dry location. Avoid stacking or compressing the suits in storage as it may result in a loss of buoyancy. Federal regulations require that immersion suits be stowed so that they are readily accessible to the individual for whom they are intended, from both the individual's normal work area and berthing area. If there is no location readily accessible to both areas, then a suit shall be stowed at each location.

4.4 Land-based water work (shoreline/bridge/pier – includes wading)

4.4.1 Use a short line and harness to prevent entry into the water, or approved PFD, when working near fluid-filled tanks, ponds, lagoons, or natural waterways and stay close enough to shore to be pulled back to shore by an attendant. Refer to the *S3NA315-WI2 Safe Work Practices for Shoreline Work.*

4.4.2 Wading in a stream or water body:

- Always proceed upstream so that the wading team is walking into clear water (no turbidity caused by walking), there is good visibility for any debris floating downstream, and there is a reduced risk that the wading team will be pushed against debris or pushed into a deep hole by the current.
- Wading in water deep enough to become submerged in will be done as a two-person crew. If conditions or legislation warrant a "rescue team," then an appropriately sized crew should be

used, with the rescue team stationed on the shore with the appropriate rescue equipment, as per the site-specific rescue plan.

4.4.3 Wading will not occur in the following circumstances:

- If the water is too turbid or too deep to see tripping hazards or deep holes.
- If it appears the bottom is composed of soft sediments where stepping in may result in sinking, or if the bottom consists of clay where slipping is likely.
- If large woody debris is abundant and will be difficult to step over or move around.
- If the water is over the waist of the shortest person on the wading teaming. This does not preclude wading in water bodies that have shallow shorelines that grade into deeper waters. By not wading over waist level there will be approximately 12 Inches (30 centimeters) of “safety distance” on the chest waders, should a member of the wading team step or slip into a deeper area.
- If there is a risk of the current pushing a member of the team downstream.

4.5 Cold Water Operations

4.5.1 Cold water operations are defined as any situation that exposes an individual to falling into water that has a temperature of 55 degrees Fahrenheit (13 degrees Celsius) or less.

4.5.2 Sudden immersion in cold water can induce a gasping reaction and uncontrolled breathing which may cause the victim to ingest water and begin choking, experience cardiac arrest, and other physical body conditions all of which can result in a quick drowning.

4.5.3 Cold water incapacitation precedes hypothermia, making swimming and grasping for safety extremely difficult. So while death by hypothermia may occur in roughly one hour in a water temperature of 55 degrees Fahrenheit (13 degrees Celsius), incapacitation due to failing muscle function will occur in as little as 10 minutes, so regardless of your age, physical conditioning, or ability to swim – your odds of survival are greatly enhanced if you wear a life jacket.

4.5.4 AECOM requires personnel to wear a USCG-approved Shallang suit at all times whenever there is the risk of falling into water. Employees working in these conditions view a training video on the physiological effects of cold water immersion found at: http://www.coldwaterbootcamp.com.

4.5.5 Consideration should be given to the use of immersion of survival suits when project work involves cold water operations.

4.6 Working on Ice

4.6.1 Situations which expose personnel to the risk of falling onto ice covered waters. Working on water with the presence of ice either in the waterway or encroaching in from the shoreline.

4.6.2 Working in situations where ice exists shall be strictly limited due to the extreme hazards associated with falling through the ice cap, cold water immersion, and the logistical difficulties associated with executing a rescue. Specific information and safety considerations regarding working on ice can be found in *S3NA-315-WI3 Ice Safe Work Practices* and by viewing the training video on the physiological effects of cold water immersion found at: http://www.coldwaterbootcamp.com,

4.6.3 Personnel working on ice shall be attired in a USCG-approved Shallang survival suit and be supported by shore side personnel to assist in recovery in the event of a break through. Depending on the nature of the project, on-ice personnel should either wear a harness tethered back to shore, or push a flat bottom boat along on the ice and have the boat tethered back to shore.

4.6.4 Personnel working on ice covered waters should dramatically reduce vessel speed to avoid damaging propellers, shafts, and rudders. Personnel should be cognizant of shoreline ice which can prevent access to alternative ramps and docks that were considered as egress points in emergency planning.

4.6.5 Personnel should be wary that boat ramps on tidally influenced waters can flash freeze at low tide, precluding or compromising safe access and egress.

4.6.6 Extra safety equipment:

- Extra blankets should be kept on site (in a vehicle) when working on or near frozen water bodies.
- An ice pick, ice chisel, and/or ice auger should be used by a member of the crew with experience or training in identifying thin or weak ice.
- A braided rope, preferably 98 feet (30 meters) in length.

4.7 Training

- All **Field Staff** and **Project Managers** working on projects with exposure to open water shall receive training in the hazards, precautions, and rescue procedures associated with working in or over water, refer to the *S3NA-003-PR1 SH&E Training* program.
- All staff working on or near frozen water bodies shall complete Ice Safety Awareness e-learning.
- Staff who will be working on frozen water bodies regularly or for extended periods of time should take an Ice Rescue Training course, or obtain management approval based on their level of experience/competence working on ice.
- Staff working near cold water shall complete awareness level training on Cold Water Immersion.

5.0 Records

5.1 None

6.0 Attachments

6.1 S3NA-315-WI1 PFD Descriptions and Use

6.2 S3NA-315-WI2 Safe Work Practices for Shoreline Work

6.3 S3NA-315-WI3 Ice Safe Work Practices

Americas

PFD Descriptions and Use

S3NA-315-WI1

1.0 Personal Flotation Devices

1.1 AECOM requires all personnel to wear a U.S. Coast Guard- or Transport Canada-approved personal flotation device (PFD) or life jacket at all times whenever there exists the possibility of falling into water. The various types of PFDs to be considered are described below.

1.1.1 **Type I –** Designed for extended survival in rough, open water. This PFD has over 22 pounds of buoyancy and will usually turn an unconscious person face up in the water. It is, however, very bulky and restrictive and not well suited to working on deck; a Type III or Type V PFD is generally preferred. Regardless of this fact, all vessels working in unprotected waters are required to carry a Type I PFD for each person aboard. In the event of an abandon ship situation, all passengers are required to don their Type I PFD as this flotation device will keep you afloat in offshore waters where rescue may be slow in coming.

1.1.2 **Type II –** Designed for calm inland waters where there is a chance of a fast rescue. It is less bulky and less expensive than a Type I, and may turn an unconscious person face-up in the water.

1.1.3 **Type III** – Designed for use in calm water where there is a good chance of a fast rescue. Slightly lighter than a Type II, this PFD will generally not turn an unconscious person face-up in the water. Mustang flotation jackets are considered in the Type III category.

1.1.4 **Type IV –** These are first response rescue devices designed to be thrown to a person overboard or person in the water. These devices include boat cushions, ring buoys, and horseshoe buoys. They are NOT designed to be worn and must be supplemented by wearable PFD. These devices need to be stowed in a location and in a manner that makes them immediately available for emergencies. Type IV devices should not be used for small children, non-swimmers, or unconscious people.

1.1.5 **Type V –** This is a special-use PFD and includes three-piece work vests, flotation deck suits for hypothermia protection (such as Mustang suits), and hybrids for restricted use. Hybrid vests contain some internal buoyancy and are inflatable to provide additional flotation. Immersion suits for cold water survival are also classified as Type V flotation devices.

2.0 Standards

The following standards apply to lifejackets and personal flotation devices:

Association	Standard
British Safety (BS) Standard	BS EN 396-1994, Lifejackets and Personal Buoyancy Aids – Lifejacket 150 N, automatically inflatable units with a minimum buoyancy of 150 N (34 lbs)
Canadian General Standards Board (CGSB)	CGSB Standard CAN/CGSB-65.7-M88, Lifejackets, Inherently Buoyant Type with a minimum buoyancy of 93 N (21 lbs) CGSB Standard CAN/CGSB-65.11-M88, Personal Flotation Devices with a minimum buoyancy of 69 N (15.5 lbs) CGSB Standard 65-GP-14M, Lifejackets, Inherently Buoyant, Standard Type with a minimum buoyancy of 125 N (28 lbs)

Americas

Safe Work Practices for Shoreline Work

S3NA-315-WI2

1.0 Planning

1.1 Projects being conducted along the shoreline, on piers or bulkheads, or near or over any water of any kind where there exists the risk of falling into water should incorporate the following safety guidelines when developing field logistical plans.

2.0 Safe Work Practice

2.1 All work shall be performed in accordance with a “Buddy System”.

2.2 If sampling near or in flowing water environments, be aware of slippery or steep banks and fast currents. If the current is fast or the water looks deeper than knee height, do not enter the water. If you must enter the water, a restraining system must be worn and secured to the bank for your retrieval in the event of an emergency.

2.3 Whenever possible, positive controls in the form of fencing or barricades should be considered for long-term waterfront projects to form a security perimeter 10 feet in from the water’s edge to prevent field staff from being exposed to water hazards.

2.4 Field staff involved in sampling contaminated sediments or surface waters or conducting shoreline surveys may require a Hepatitis A and/or tetanus vaccination depending on site conditions and are advised to consult with their Safety, Health and Environment Manager. An Occupational Safety and Health Administration 40-hour HAZWOPER may be required for field staff working on site if warranted by the Project.

2.5 Take special care on slippery rocks along shorelines, lakeshores, riverbanks, and creeks. Always look ahead at the ground when walking around the water’s edge and avoid stepping on stones that have algal growth, especially those in intertidal areas, as these are extremely slippery. It is suggested that workers not be permitted to access areas where these slip/fall hazards exist, especially in locations containing tidal water flow.

3.0 Personal Protective Equipment

3.1 AECOM requires that whenever there exists the possibility of falling into water, field staff shall be attired in a United States Coast Guard-approved Type III or Type V work vest. The vest must be properly sized for the individual and must be secured at all times. Prior to and after each use, the PFD/suit shall be inspected for defects, which may alter their strength or buoyancy. Defective units shall be discarded and replaced.

3.2 Field staff protective gear must include long pants, steel-toed rubber boots; with adequate puncture resistance, and Kevlar gloves (whenever sampling or picking up or manipulating ground cover). It is recommended that field staff use a rake to move ground cover and debris and not touch these items directly by hand whenever possible.

3.3 Waders may not be worn when working along, over, or in moving waters; or in waters influenced by tides or acted upon by waves when water depths exceed knee height unless specifically approved by the Project Manager. Waders may be worn in still waters in water depths up to the waist if bottom conditions are firm and well understood. Waders shall never be worn aboard a watercraft of any kind.

4.0 Emergency Response

4.1 Emergency preparedness applies to any work where there exists the risk of falling into water, especially moving waters, along piers, bulkheads, and river banks with a sharp drop off in bathymetry.

4.2 Field staff working alongside waters, especially moving waters, where there exists the possibility of falling in must have an Emergency Response Plan to recover someone in the event they have fallen in.

4.3 A throwable rescue device must be immediately available in the event of an emergency situation. In these situations the position and accessibility of throw rings and other rescue devices (ex: ladders) and the mechanism to recover a person from the water must be considered.

4.4 The number and placement of ladders and throw rings shall be sufficient so that the maximum swimming distance to them is no more than 25 feet.

4.5 Whenever possible, or as required by regulation, at least one lifesaving skiff/boat should be immediately available at locations where employees are working over or adjacent to moving waters, especially strong currents which can quickly move a person out of range of a throwable life ring. For these conditions, it is recommended that a qualified operator be on stand-by for immediate response to aid in recovering a person from the water. Other means such as lifebuoy with throw line and boat hooks shall also be available to assist in the rescue of an incapacitated person in the water.

4.6 If workers have the potential to get stuck in mud or fluidized sediment, air injection equipment designed to free worker's feet/legs may need to be available on site. At a minimum, a safety line should be available to be deployed from safe ground. If a worker does get stuck, they should not struggle as this causes further sinking. Use a pole to conduct sediment probing to assess water depths, the stability of shoreline terrain, and the bearing capacity of bottom sediments ahead of the chosen path.

Americas

Ice Safe Work Practices

S3NA-315-WI3

1.0 Background

1.1 There is no such thing as 100-percent safe ice; there are a number of factors detailed herein which affect the bearing capacity of ice.

1.2 New ice is usually stronger than old ice. Four inches of clear, newly-formed ice may support one person on foot, while a foot or more of old, partially-thawed ice may not. Additional bearing capacity guidelines based on ice thickness can be found at: http://www.dnr.state.mn.us/safety/ice/thickness.html

1.3 Ice seldom freezes uniformly. It may be a foot thick in one location and only an inch or two just a few feet away.

1.4 Ice formed over flowing water and currents is often dangerous. This is especially true near streams, bridges and culverts. Also, the ice on the outside of river bends is usually weaker due to the undermining effects of the faster current.

1.5 The insulating effect of snow slows down the freezing process. The extra weight also reduces how much weight the ice sheet can support. Also, ice near shore can be weaker than ice that is further out.

1.6 Booming and cracking ice isn't necessarily dangerous. It only means that the ice is expanding and contracting as the temperature changes.

1.7 Schools of fish or flocks of waterfowl can also adversely affect the relative safety of ice. The movement of fish can bring warm water up from the bottom of the lake opening holes in the ice which can cause snowmobiles and cars to break through.

1.8 Heavy snowfall early in the season may result in reduced ice thickness due to the insulating effect of the snow.

1.9 A fresh fall of snow will often cover areas that would otherwise be recognized as hazardous.

1.10 Water overflow and ponding caused by increased water levels can cover hazardous areas. Be aware of overhanging riverbanks when ascending and descending.

2.0 Safe Work Practices

2.1 If considering work on frozen waters or in the presence of shoreline ice, the following requirements shall be followed:

2.1.1 Working in situations where ice exists shall be strictly limited. The risks of cold water immersion; slippery shorelines, docks and boat ramps; and navigation hazards around ice and frozen shorelines should be avoided. Field work should be rescheduled to periods of warmer temperatures, when ice and cold water hazards are not an issue.

2.1.2 Avoid working on water immediately prior to freeze-up because of floating ice sheet hazards. Avoid working on ice prior to break-up because of ice cover instability.

2.1.3 Care should be exercised when near the following areas: tributary/stream inflows, lake narrows, beaver dams, riffle areas, industry discharges, sewage lagoons, and open water, as the ice is usually thinner in these areas. Pressure ridges should also be avoided, as there may be open leads, weak ice and/or slush ice in these areas.

2.1.4 Work shall be performed in accordance with the "Buddy System" with rescue communications available.

2.1.5 Do not walk or work on ice unless there is no other way of performing work. Whenever possible, use alternate methods. One suggestion is to have field staff push a flat-bottomed boat onto the ice.

The boat shall have a safety tether tied to it that can be handled by workers standing off the ice cover along the shore line.

2.1.6 Only walk on ice that is fully frozen, not cracked or brittle, with a thickness that will support the necessary weight of workers and associated equipment.

2.1.7 When working on or near an ice surface, field staff should always check the ice thickness and condition thoroughly using an ice pick, ice chisel, and/or ice auger. It is virtually impossible to describe all conditions that may be encountered while working on ice cover; however, the following can be used as guidelines:

- The color of ice, which may range from blue to white to grey, provides an indication of its quality and strength.
- Clear blue ice is generally the strongest.
- White, opaque ice (snow ice) has a relatively high air content and its strength depends on the density; the lower the density, the weaker the ice. High-density white ice has a strength approaching that of clear blue ice.
- Grey ice generally indicates the presence of water as a result of thawing, and shall be considered highly suspect as a load-bearing surface.

2.1.8 When possible, conduct a reconnaissance prior to freeze-up and prior to actually working on the ice cover to become familiar with any potential hazards.

2.2 Personal Protective Equipment (PPE)

2.2.1 PPE shall be selected in accordance with the *S3NA-208-PR1 Personal Protective Equipment Program*.

2.2.2 Workers are required to wear an approved Shallang flotation suit in accordance with the manufacturer's requirements.

2.2.3 Workers shall wear a restraining system (a lifeline attached to the front of a full-body harness) and stay close enough to the edge to make it possible for a shoreline attendant to pull the individual back off the ice.

2.2.4 Workers shall have available (on their person) tools that can be used to partially penetrate the ice and gain leverage to help in pulling themselves out of the water and back up onto the ice. Equipment is available with capped ends that can be worn safely until needed.

2.3 Unknown Conditions

2.3.1 The following guidelines shall be used when there is insufficient evidence to prove the ice is safe for travel and when the job task cannot be postponed:

- Select an area where the ice is of good quality and hazards are minimized.
- Establish a two-person team where one person acts as an "anchorperson" on shore and the second person, connected to the anchorperson by a braided rope, acts as the "checker", slowly moving out over the ice to sampling locations. (When working on a river, testing with an ice auger or ice bar shall be more frequent than on a lake due to the uncertain nature of river ice.)
- The anchorperson continually looks for hazards and signs of ice failure. (When testing the safety of an ice cover, the best method is to use an ice pick/axe.) The ice in front and to the sides should be struck a solid blow every few paces. The checker should proceed carefully outward checking the ice every few paces. Both staff should work to keep the rope from becoming snagged on ice blocks. The anchorperson should maintain their position as long as the site is deemed hazardous. If the anchorperson has to move, the checker should remain stationary until the anchor has re-established a secure position. When returning from the sample site, the checker should use the above procedure, if required.

- Crews should not be operating on ice greater than 98 feet (30 meters) (or the length of a rope) from shore without appropriate equipment and Rope/Harness Restraint and Rescue System training, unless there is sufficient evidence to prove the ice is safe for travel.

3.0 Vehicle Traffic

3.1 Vehicles operated on ice shall travel with their windows down and with their seatbelt off, and their speed should not normally exceed 9 miles per hour (mph) (15 kilometers per hour [km/hr]) (in order to avoid the effects of the hydrodynamic wave). Nor should speed be less than 1 mph (1.5 km/hr), in order to avoid the effects of a stationary load. Ice thickness should be checked frequently when travelling over long stretches of ice.

3.2 Particular care should be exercised when approaching or travelling close to shore, or over shallow water, because of severe stressing of the ice due to reflection of the generated wave.

3.3 Stationary loads should be relocated to shore as soon as feasible and not left overnight.

The following tables contain guidelines for weight loads on ice.

Table 1. Ice Strength for Continuous Travel

Permissible Load (kg)	Effective Ice Thickness (cm) (clear, blue ice)	
	Lake	River
One person on foot	5.0	6.0
Group, in single file	8.0	9.0
Passenger car 2,000	18	21
Light truck 2,500	20	23
Medium truck 3,500	26	30
Heavy truck 7,000	35	41
10,000	38	44
25,000	63	73
45,000	80	92
70,000	100	115
110,000	123	144

Table 2. Ice Strength for Stationary Loads (more than 2 hours) and Working on Ice

Permissible Load (kg)	Effective Ice Thickness (cm) (clear, blue ice)	
	Lake	River
1,000	20	23
2,000	30	35
4,000	45	52
8,000	60	69
25,000	110	127
45,000	150	173
70,000	180	207
110,000	230	265

4.0 Rescue

4.1 If someone falls through ice:

- Don't approach the hole.
- Call the emergency number prior to attempting a rescue.
- Throw a rope or line to the victim to pull them out.
- Get medical assistance for the victim.

4.2 If you fall through the ice:

- Remain calm and look towards the shore.
- Place your hands and arms on the unbroken surface of the ice using the ice picks if available.
- Work forward by kicking your feet.
- If the ice breaks maintain your position and slide forward again.
- Once on the surface of the ice, don't stand. Instead, roll away from the hole.
- Crawl back to shore along your original path.

Americas

Boat and Vessel Operations

S3NA-419-PR1

1.0 Purpose and Scope

1.1 Establishes the procedure for AECOM employees who perform work on boats and vessels.

1.2 This procedure applies to all AECOM Americas-based employees and operations.

2.0 Terms and Definitions

Refer to *S3NA-419-WI1 Nautical Terminology* for more definitions.

2.1 **Small Boat** – A boat less than 18 feet in length including canoes, kayaks, rafts, and dinghys with an outboard motor.

2.2 **Mid-size Boat** – A boat greater than 18 feet but less than 26 feet in length, including single and pontoon-style hulls, barges, or other platforms.

2.3 **Large Vessel** – A boat or vessel larger than 26 feet in length.

2.4 **Boat or Vessel Operator** – Person responsible for the overall safe operation of the boat/vessel.

3.0 References

3.1 S3NA-003-PR1 SH&E Training

3.2 S3NA-208-PR1 Personal Protective Equipment

3.3 S3NA-209-PR1 Hazard Assessment and Planning

3.4 S3NA-301-PR1 Confined Spaces

4.0 Procedure

4.1 Roles and Responsibilities

4.1.1 **Region Safety, Health and Environment (SH&E) Manager / SH&E Department**

Provide training and technical guidance to operation, including the following:

- Approve safety plans.
- Approve personnel assigned safety duties.

4.1.2 **Project Manager**

Responsible for the overall success of a project and the performance of employees engaged in project activities. The Project Manager identifies and implements all appropriate SH&E procedures. Additional responsibilities include the following:

- Confirm that subcontractors selected to support project operations have been approved by the AECOM Region SH&E Manager.
- Select an appropriate boat/vessel for the planned work activities.
- Obtain approval from the AECOM Region SH&E Manager for the operation of any vessel in offshore, ports or harbors, navigation channels, or waterways handling commercial ship traffic.
- Develop and submit a Safe Work Plan, Task Hazard Analysis, Float Plan and other SH&E Planning Documents for review and approval by the Region SH&E Manager.
- Allocate appropriate resources, including emergency and safety equipment, to complete the project as planned.
- Designate a Marine Safety Officer to implement and maintain safe work practices and

procedures. Marine Safety Officers are responsible for the following:

- o Implement and monitoring safe work practices specified by this procedure and supporting SH&E documentation.
- o Conduct marine safety briefings and inspections as needed.
- o Conduct field verification of the competency of boat/vessel operators and field staff.

4.1.3 **Boat/Vessel Operator**

- Maintain current boating/vessel licenses as required by local, State, Provincial, and Federal regulations and standards.
- Operate boats/vessels in accordance with this SOP and as required by local, State, Provincial, and Federal regulations and standards.

4.1.4 **Marine Safety Officer**

- Shall be designated by the Project Manager and approved by the Region SHE Manager.
- Have experience in boat and vessel operations similar to those planned for the operation.

4.1.5 **Field Staff**

- Comply with the safe work practices specified in this procedure and all other applicable AECOM SH&E policies.
- Verify that they meet training and qualification requirements, and reporting deficiencies to their Supervisor and Project Manager.
- Use equipment that has been inspected, and use equipment only as intended.
- Follow all safe work practices in this procedure, in the project SH&E documents, as required by local, State, Provincial, and Federal regulations or standards, and as instructed by the Marine Safety Officer or Vessel Operator.
- Immediately report incidents, near misses, unsafe acts and conditions when they occur to the Marine Safety Officer and/or the responsible supervisor.

4.2 Training and Qualifications

4.2.1 All personnel working aboard boats/vessels shall have completed training in accordance with *S3NA-003-PR1 SH&E Training* and maintain a current:

- Safe Boating Course (approved by **Region SH&E Manager**);
- CPR/First Aid certification;
- Hazardous Waste Operations and Emergency Reponses training (if marine operations involve hazardous waste or the response to a hazardous waste emergency response);
- Hepatitis A vaccination (if marine operations involve sampling sediments or surface waters with contamination from sewage);
- Fire extinguisher training (if a fire extinguisher is required on board); and
- Additionally, all personnel shall be competent swimmers.

4.2.2 **Vessel Operators** shall have completed and maintain current:

- All training and qualification requirements noted above for all personnel working aboard boats/vessels.
- Field competency verification training or documented experience with operating the boat/vessel and that they understand all applicable marine safety regulations.
- Maintain current boat/captain licenses per local, state, provincial, and federal regulations and standards.

4.3 General Requirements

4.3.1 All boats and vessels shall be operated by a qualified **Vessel Operator** in accordance with local, State, Provincial, and Federal Marine Safety Laws.

4.3.2 All tasks performed aboard a boat/vessel shall be assessed for hazards, and hazards shall be controlled, refer to *S3NA-419-WI2 Boating Safe Work Practices*. Assessment and controls shall be documented in the Task Hazard Analysis or Safety Plan, refer to *S3NA-209-PR1 Hazard Assessment and Planning, S3NA-419-WI4 Float Plan* and S3NA-*419-WI6 Emergency Response Procedures*.

4.3.3 Personal Protective Equipment shall be selected based on the task-specific hazard analysis, refer to *S3NA-208-PR1 Personal Protective Equipment and S3NA-419-WI5 Marine Safety Equipment*.

4.3.4 All boats and vessel will be outfitted with safety equipment as required by local, State, Provincial, and Federal regulations or standards, and as identified in the task-specific hazard analysis, refer to

4.3.5 Vessels working offshore shall be sized to withstand and remain stable through all forms of expected weather conditions, refer to *S3NA-419-WI3 Small Boat Operation and S3NA-419-WI7 Hazardous Weather Operations*. Local weather, tide, current conditions, and navigational needs shall be evaluated as a part of project planning.

4.3.6 All boats/vessels equipped with propulsion machinery shall be licensed and registered in accordance with local, State, Provincial, and Federal regulations or standards.

4.3.7 Should the vessel have locations designated as confined spaces, they shall be managed in accordance with *S3NA-301-PR1 Confined Spaces*.

4.3.8 Chartered or subcontracted boats/vessel or operators shall be evaluated by the **Project Manager** for overall suitability for the intended task. Charters/subcontractors are responsible for providing qualified operators and licensed and inspected boats/vessels and for stocking and maintaining emergency supplies and equipment, refer to *S3NA-419-WI8 Charters and Subcontractors*.

4.3.9 Impacts to marine traffic shall be evaluated as a part of project planning. Notification of the Coast Guard or other jurisdictional agency shall be made, as required by local, State, Provincial, and Federal regulations and standards. Additional notifications to other vessels via day shapes may be necessary.

4.3.10 Work in security zones and security sensitive areas (near bridges, reservoirs, etc.) shall be performed only with the authorization of governing security agency(s).

4.3.11 A daily safety inspection will be conducted by the **Marine Safety Officer** prior to beginning marine operations. The inspection criteria shall be developed as a part of project SH&E documentation.

4.3.12 A daily safety briefing of all field staff and operators shall be conducted by the **Marine Safety Officer** prior to beginning marine operations. The daily safety briefing shall include, at a minimum:

- Review of planned activities, including the associated Task Hazard Analysis;
- Review of emergency procedures, including the location and operation of emergency supplies;
- Discussion of personal protective equipment required for planned actives; and
- Opportunity for field staff to ask questions.

5.0 Records

5.1 Float plans and other documents with planning and response will be retained in the project files.

6.0 Attachments

6.1 S3NA-419-WI1 Nautical Terminology

6.2 S3NA-419-WI2 Boating Safe Work Practices

6.3 S3NA-419-WI3 Small Boat Operation

6.4 S3NA-419-WI4 Float Plan

6.5 S3NA-419-WI5 Marine Safety Equipment

6.6 S3NA-419-WI6 Emergency Response Procedures

6.7 S3NA-419-WI7 Hazardous Weather Operations

6.8 S3NA-419-WI8 Charters and Subcontractors

Nautical Terminology S3NA-419-WI1

1.0 Nautical Terminology

- **Abeam** – At right angles to the keel of the boat, but not on the boat.
- **Aboard –** On or within the boat.
- **Above Deck –** On the deck (not over it – see Aloft).
- **Aft** – Toward the stern of the boat.
- **Aground** – Touching or fast to the bottom.
- **Ahead** – In a forward direction.
- **Aloft –** Above the upper deck of the boat.
- **Amidships –** In or toward the center of the boat.
- **Anchor** – A heavy metal device, fastened to a chain or line, to hold a vessel in position, partly because of its weight but chiefly because the designed shape digs into the bottom.
- **Astern –** In back of the boat, opposite of ahead.
- **Bearing –** The direction of an object expressed either as a true bearing as shown on the chart, or as a bearing relative to the heading of the boat.
- **Bight –** Any curved section, slack part, or loop formed in a rope or line.
- **Boat** – A vessel for transport by water. Constructed to provide buoyancy by excluding water and shaped to give stability and permit propulsion.
- **Bow** – The forward end of the boat.
- **Bulkhead –** Wall-like constructions inside a vessel, as for forming watertight compartments, subdividing space, or strengthening the structure.
- **Buoy** – An anchored float used for marking a position on the water, a hazard, or a shoal. A surface marker floats for a mooring.
- **Captain –** A person who is at the head of or in authority of all others aboard a vessel.
- **Certified Vessel (or Inspected Vessel) –** A category of vessel that is subject to a mandatory U.S. Coast Guard safety inspection.
- **Cleat –** A fitting to which lines are made fast. The classic cleat to which lines are belayed is approximately anvil-shaped.
- **Cockpit –** A sunken, open area, generally in the after part of a small vessel, provides space for part or all of the crew.
- **Dive –** A descent into the water, an underwater diving activity utilizing compressed gas, an ascent, and return to the surface.
- **Dock** – A protected water area in which vessels are secured to a pier or a wharf.
- **Drain Plug –** A removable plug in the transom used for draining water out of a boat.
- **Emergency Position Indicating Radio Beacon (EPIRB)** – Transmits a signal that allows rescue personnel to determine a vessels position at sea once it is activated in the event of an emergency.
- **Fathom –** A depth increment of 6 feet (1.82 meters).

- **Fender** – A cushion, placed between boats, or between a boat and a pier, to prevent damage.
- **Float Plan –** A document prepared by the boat crew and left with a competent person shore side that defines the itinerary and particulars of the vessel and crew, serving as an informational resource for emergency responders in the event the boat does not return at the appointed time.
- **Freeboard** – The portion of the side of a hull that is above the water.
- **Gunwales** – The widened edge at the top of the side rail of the boat, where the edge is reinforced.
- **Knot** – A measure of speed equal to one nautical mile (6,076 feet) per hour or 1.16 miles per hour.
- **Knot –** A fastening made by interweaving rope to form a stopper, to enclose or bind an object, to form a loop or a noose, to tie a small rope to an object, or to tie the ends of two small ropes together.
- **Leeward** – The direction away from the wind.
- **Life-line** – A line secured along the deck to lay hold of in heavy weather.
- **Listing –** Leaning to one side due to the unequal distribution of weight.
- **Mooring –** An arrangement for securing a boat to a mooring buoy or a pier.
- **Overboard –** Over the side or out of the boat.
- **Personal Flotation Device (PFD) –** PFD is official terminology for life jacket. When properly used, the PFD will support a person in the water and keep their face and nose (airway) out of the water in either a conscious or unconscious condition.
- **Port –** The left side of the boat when looking forward (toward the bow).
- **Running Lights –** Navigation lights required to be shown on boats underway between sundown and sunup.
- **SCUBA Diving** – A diving mode independent of surface supply in which the diver uses an open circuit, self-contained underwater breathing apparatus.
- **Starboard** – The right side of the boat when looking forward (toward the bow).
- **Station bill** – The posted bill showing assigned stations for each crew member during maneuvers and emergency drills.
- **Stem** – The forward most part of the bow.
- **Stern –** The after part (back) of the boat.
- **Transom** – The aft face or back board of the boat.
- **Wake –** Moving waves, track, or path that a boat leaves behind when moving across the water.
- **Wide berth –** At a considerable distance.
- **Windward –** Toward the direction from which the wind is coming (a.k.a. weather side); the opposite of leeward.

Americas

Boating Safe Work Practices

S3NA-419-WI2

1.0 General

1.1 Verify experience or conduct field competency verification of all **Boat/Vessel Operators** for the boat/vessel to which they are assigned prior to starting operations.

1.2 Boats/vessels operated offshore, in ports or harbors, in navigation channels, or in waterways handling commercial traffic require approval by the **Project Manager** and **Region Safety, Health and Environment (SH&E) Manager**.

1.3 **Project Managers** shall select a vessel of appropriate size and configuration for expected work and operating conditions.

1.4 Vessels larger than 18 feet in length and/or greater than 25 horsepower must be approved for use by the **Project Manager** and the **Region SH&E Manager**.

1.5 **Project Managers** shall select a Boat/Vessel-qualified Operator, **Marine Safety Officer,** and **field staff** for the operating conditions.

1.6 Vessel operations are limited to 12 hours (dock to dock) to minimize fatigue.

1.7 Single-handed boat/vessel operations are not permitted unless approved by the **Project Manager** and the **Region SH&E Manager**. Controls, such as a communication and/or rescue plan, shall be in place for all single-handed boat/vessel operations.

1.8 Field staff is not permitted to work on deck alone unless approved by the **Project Manager** and the **Region SH&E Manager**. Controls, such as a communication and/or rescue plan, shall be in place for all field staff working alone.

1.9 The buddy system is required for all tasks, unless approved by the **Project Manager** and the **Region SH&E Manager**. Controls, such as a communication and/or rescue plan, shall be in place for all field staff working alone.

1.10 Vessel operators shall observe speed limits, right-of-way, and other applicable boating restrictions and guidelines.

1.11 Only qualified and authorized field staff are permitted to operate hydraulic machinery (winches, A-frames, etc.) for the deployment and recovery of scientific gear or surveying equipment.

1.12 All personnel shall be advised of the inherent risks associated with marine operations, including exposure to weather, marine operations, and chemical, biological, and physical hazards.

1.13 Swimming is prohibited, unless it is being conducted by certified divers in the completion of their assigned task or to prevent a serious injury or loss of life in a person in water/person overboard emergency.

1.14 A float plan shall be filed prior to departure.

1.15 All gear, personnel effects, and deck equipment shall be properly stowed to prevent shifting and blocking of walking/working paths.

1.16 All field staff in small boats shall remain properly seated at all times while the boat is underway. Sitting on the gunwales is not permitted. Standing at the edge of open transoms whenever the boat is underway or preparing to maneuver is not permitted.

1.17 All field staff shall keep their hands, arms, legs, and body away from docks, pilings, and other stationary objects when the vessel approaches to prevent a crushing injury.

1.18 Running is prohibited on the deck of any vessel.

1.19 All lines shall be stored to prevent tripping or entanglement. All field staff shall stay clear of lines, cables, or chains under tension.

1.20 Moving and carrying gear aboard a boat shall be conducted with one free hand to hold onto railings whenever using stairwells. Heavy and bulky items shall be broken down into smaller lifts or lifted with assistance from another field staff member.

1.21 When loading boats/vessels with gear or people, distribute weight evenly to prevent listing.

Small Boat Operations

S3NA-419-WI3

1.0 Starting the Engine

1.1 The transport lock for the engine should be lifted or adjusted and the engine should be lowered into the water. If starting in a shallow area, make sure that the engine is at least lowered to the point where the cooling water intake is below the waterline

1.2 Attach engine electronics to battery leads.

1.3 Check to make sure the fuel line is properly attached. Prime the fuel line by squeezing the fuel “bulb” until it becomes firm. Open the air vent on the top of the gas can cap.

1.4 Make sure throttle position is in neutral and if necessary turn choke on.

1.5 Turn the key or pull the start recoil-to-start engine. Inspect engine to make sure that cooling water system is working (i.e. a stream of water is flowing from the engine). If the cooling water system is not working, stop the engine immediately and check to make sure water intake and exit ports are clear.

1.6 Allow engine to warm up at idle speed before leaving dock or shore.

2.0 Leaving Dock or Shore

2.1 Make sure all personnel on board are wearing life jackets.

2.2 Loosen bow and stern lines, having one line tender hold a single wrap around a cleat to hold fast until the operator has given the command to release lines.

2.3 Prior to leaving shore or dock, the boat operator will make one final observation to determine if there are any oncoming boats or other hazards.

2.4 If the waterway is clear to proceed, the boat operator will instruct the line tender to release the lines and push away from the dock.

2.5 With all personnel seated and in position, and all docking lines and boat fenders recovered, the boat operator may put the engine in gear and make headway.

3.0 Returning to Dock or Shore

3.1 Before approaching dock or shore, determine which personnel will be in charge of bow and stern lines. Notify line tenders not to “pull” the boat in by the line while docking; this may cause the operator to lose control of the boat.

3.2 Approach the dock or shore at low speed heading into any prevailing currents. Place the throttle in neutral position when arriving at dock. If the boat is still moving forward when at the dock, apply a quick burst of reverse throttle to stop the forward motion of the boat, recognizing that it may take several feet of travel to cease forward motion.

3.3 If necessary, secure fenders to the side of the boat next to the dock prior to landing

3.4 When the boat has stopped its forward motion and is sitting alongside the dock, have the bow and stern personnel step off the boat to secure the lines. Jumping any open water gap between the boat and dock is strongly discouraged; falling into the water between the boat and dock can cause serious injury. Once the lines have been secured, the engine can be secured.

4.0 Anchoring

4.1 If short-term vessel anchoring is a required part of project operations, select an area offering maximum shelter from wind, current, and boat traffic.

4.2 Determine depth of water and type of bottom (preferably sand or mud). Calculate the amount of anchor line you will need. General rule: the required length of anchor line is 5 to 7 times the depth of water plus the distance from the water to where the anchor will attach to the bow. For example, if the water depth is 8 feet (2.43 meters) and it is 2 feet (0.6 meters) from the top of water to your bow cleat, you would multiply 10 feet (3 meters) by a factor of 5 to 7 to get the amount of anchor line to put out. In tidal areas, be aware that the scope may need to be adjusted with tidal changes and boat swing.

4.3 Bring the bow of the vessel into the wind or current. When you get to the spot where you want to anchor, place the engine in neutral. When the boat comes to a stop, slowly lower the anchor. Do not throw the anchor over, as it will tend to entangle the anchor in the anchor line.

4.4 When adequate anchor line has been let out, back down on the anchor with the engine in idle reverse to help set the anchor. Secure the anchor line to the bow cleat at the point where you want it to stop; make certain you take a couple wraps around the cleat prior to "cleating off."

4.5 When the anchor is firmly set, use reference points (landmarks) in relation to the boat to make sure the boat is not drifting. Check these points frequently, especially in areas subject to tidal changes. If the holding ground is questionable, let out additional anchor line, "cleat off,' and then back down on the anchor to get a good "bite" into the bottom.

5.0 Proper Fuel Management

5.1 To ensure that you will have enough fuel to safely return to the dock, always apply the one-third rule for fuel management, which proportions your available fuel supply as follows:

5.1.1 One-third of fuel going out;

5.1.2 One third of fuel to get back; and

5.1.3 One third of fuel for reserve.

6.0 Small Boat Trailering

6.1 All boats/watercraft will be transported in accordance with Federal, State, Provincial, and local regulations. Appropriate equipment (racks or trailers) will be used to transport boats/watercraft to the project site. Always launch from trailers at a designated boat ramp.

6.2 Prior to moving vehicle to boat ramp:

- Attach bow and stern lines to boat. Make sure length of lines are such that the lines reach the dock or shore where the boat will be placed.
- Remove the belly strap holding the boat to the trailer.
- Determine one individual who will assist the driver in backing the boat down the ramp. Work out audible and visual signals to assist driver in the off-loading process.
- Check to make sure drain plug is inserted in the boat.
- Disconnect trailer signal light cable.

7.0 At the Boat Ramp

7.1 Before backing vehicle and trailer down the boat ramp, make sure the trailer and vehicle are in a straight line

7.2 Check to make sure that boat ramp is clear of personnel, vehicles, or boats before proceeding. The individual assisting the driver in backing up should stand to the driver's side of vehicle and well clear of trailer and either be positioned where the driver can make direct visual contact or see them in a mirror.

7.3 Back the trailer down the boat ramp to the edge of the water, and stop. The driver's assistant should disconnect the safety chain and cable from the boat and roll up any excess cable onto the trailer winch. (Disconnect the safety chain and cable ONLY if located on a LEVEL surface; otherwise, leave the cable and safely chain attached until the boat is floated off the trailer). The driver's assistant should take bow and stern lines in hand and then move clear of the trailer and vehicle.

7.4 Once all personnel are clear of vehicle, back the trailer into the water until the wheels are covered or the boat begins to float on its own. The backing momentum will push the boat away from the trailer. Once the boat is clear of the trailer, the trailer can be pulled out of the water. The boat should be pulled to the dock or shore and secured using bow and stern lines.

8.0 Loading the Trailer

8.1 Determine job assignments for personnel, one person will have to pilot the boat onto the trailer, one shore person will have to attach the safety cable and reel the winch, and one person will have to drive the vehicle.

8.2 Back the vehicle and trailer down the boat ramp, stopping when the tires of the trailer are submerged, or when all but the two rollers nearest the vehicle are submerged. (Apply the emergency or parking brake on the vehicle).

8.3 Maneuver the boat away from the dock and approach the trailer at a very slow speed. The boat operator should aim the bow of the boat for the bow roller. Place the control of the boat in neutral just before arriving at the trailer. The shore person should stand clear as the vessel approaches and rides up the trailer.

8.4 When the boat comes to a complete stop, the shore person steps in, attaches the safety cable to the boat, and begins to reel in the cable. As the boat is being reeled in, care should be taken to keep the boat in line with the trailer.

8.5 Once the bow of the boat is snug with the bow roller, the boat operator should raise the engine and lock it for transport. The boat operator can then climb out of the boat. Care should be taken when climbing out of the boat. Using a step ladder to facilitate exiting the boat is recommended.

8.6 Once all personnel are clear of the boat and trailer, the vehicle driver should place the vehicle in drive and slowly begin to apply the accelerator. As this is being done, the driver should release the emergency brake and pull the trailer from the water. Make sure the boat is resting on all of the trailer rollers in an even manner. If this is not the case, then back the trailer into the water, loosen the safety cable and reposition the boat.

8.7 Once the trailer is completely out of the water, stop the vehicle on a level surface. A staging area is typically provided to complete final preparations for securing the boat and equipment prior to getting on the road.

9.0 Prior to Hauling the Boat

9.1 Remove all loose equipment from boat such as personal flotation devices, personal effects, sensitive survey instrumentation, or other marine electronics. Remove all trash or flyaway items.

9.2 Secure compartment hatches, and stow and lash down anchors and other loose gear.

9.3 Remove the drain plug.

9.4 Attach the belly strap to firmly secure the boat to the trailer.

9.5 Connect the trailer electrical connection to vehicle electrical plug. Check the turn signals, brake lights, and running lights on the trailer to make sure they are all working properly.

9.6 Return the boat/watercraft to the appropriate facility.

10.0 Special Considerations for Transporting a Boat

10.1 For car top transportation of canoes and kayaks, be sure the rack system is appropriately sized and configured to secure the boat and that the vehicle is properly rated to handle the increased weight. Ratcheting or grip lock fasteners should be used to properly secure the boat and prevent shifting. A minimum of two belly straps plus additional lines both fore and aft are recommended.

10.2 For transporting small Jon-boats in the bed of a pick-up truck, ratcheting straps or grip lock fasteners are to be used to pull and hold the boat in the truck bed. One belly strap at the front end of the truck bed is also recommended to hold the boat down.

10.3 In either scenario, loads that project more than 3 feet beyond the rear bumper of the vehicle are required to fly a red warning flag from the back of the boat to warn motorists of the overhanging load.

Float Plan

S3NA-419-WI4

1.0 Float Plan

1.1 Float plans shall be prepared for all vessel operations to document vessel information (make/model, hull color, and other distinguishing features), personnel on board, description of activities being performed, expected time of departure, planned time and location for arrival, course being traveled, and pertinent contact calling information for reaching the vessel. This information shall be submitted to a competent individual on shore who assumes the responsibility of initiating emergency response procedures if the vessel does not check in at the designated time.

1.2 In the event that a vessel's return is delayed, and it is not an emergency, the boat crew must inform those holding the float plan and subsequently notify them upon returning to the dock so that the float plan can be closed out, avoiding an unnecessary and costly search.

1.3 If the vessel was trailered to a public ramp, then vehicle information (make/model and license), ramp location, and contact information for the local police department should be included in the float plan.

2.0 Sample Float Plan

FLOAT PLAN

www.cgaux.org

INSTRUCTIONS: Complete this plan before you go boating and leave it with a reliable person who can be depended upon to notify the Coast Guard, or other rescue organization, should you not return or check-in as scheduled. If you have a ***change of plans*** after leaving, be sure to notify the person holding your Float Plan.

Do NOT file this plan with the Coast Guard.

www.uscgboating.org

VESSEL

IDENTIFICATION:

Name & Home Port ______________________

Doc. / Registration No. ______________________

Year & Make ______________________

Length ______ Type PWR Draft ____ (Inch/CM) Hull Mat. Fiber

Hull Color(s) ______________________

Prominent Feature(s) ______________________

____

PROPULSION:

Primary - Type Gas IO No. Eng __ Fuel Capacity ______

Auxiliary - Type none No. Eng __ Fuel Capacity ______

TELECOMMUNICATIONS:

Radio Call Sign ______________________

DSC MMSI Number ______________________

Radio-1: Type VHF-FM Ch / Freq. Monitored ____________

Radio-2: Type ____________ Ch / Freq. Monitored ____________

Cell Phone ____________

Pager ____________

NAVIGATION: (Check all on board)

☐ Maps ☐ Charts ☐ Compass ☐ GPS / DGPS

☐ Radar ☐ Loran C ☐ Sounder ☐ ________

SAFETY & SURVIVAL

VISUAL DISTRESS SIGNALS:

☐ Day Only type

☐ Night Only type

☐ Day & Night type

PFDs: (Do not count Type IV devices)

___ Quantity on board

AUDIBLE DISTRESS SIGNALS:

☐ Horn / Whistle

☐ Bell

☐ ____________

GROUND TACKLE:

☐ Anchor - line length _____ ft.

OTHER GEAR / SUPPLIES:

☐ Lifeboat / Life Raft ☐ Flashlight / Searchlight

☐ Dinghy / Skiff ☐ Signal Mirror

☐ Food / Water ☐ Drogue / Sea Anchor

☐ EPIRB none ☐ ____________

☐ Foul Weather Gear ☐ ____________

PERSONS ON BOARD

OPERATOR:

Name ______________________ Age ___ M/F M Notes (Special medical condition, Can't swim, etc.)

Address ______________________ Experience: w/Boat ☐ w/Area ☐

City ____________ State ____ Zip code ______ Home Phone ____________

Vehicle (Year, Make & Model) ______________________ Vehicle License No. ____________

Where will trailer be parked? ______________________ Trailer License No. ____________

PASSENGERS:

	Name & Home Phone	Age	M/F	Notes (Special medical condition, Can't swim, etc.)
1.				
2.				
3.				
4.				
5.				

Attach Supplemental Passenger List if additional passengers on board

ITINERARY

	DATE	TIME	LOCATION	MODE OF TRAVEL	REASON FOR STOP	CHECK-IN TIME
Depart						
Arrive						
Depart						
Arrive						
Depart						
Arrive						
Depart						
Arrive						
Depart						
Arrive						
Depart						
Arrive						

Attach Supplemental Itinerary if additional space required

Contact 1 ______________________ Phone Number ____________

Contact 2 ______________________ Phone Number ____________

If you have a genuine concern for the safety or welfare of any persons on board this vessel, who have not returned or checked-in within a reasonable amount of time, then follow the step-by-step instructions on the **Boating Emergency Guide** included with this plan, or on the World Wide Web at:

http://www.uscgaux.org/~floatplan/BoatingEmergencyGuide.htm

Marine Safety Equipment

1.0 Requirements

1.1 All boats and vessel will be outfitted with marine safety equipment as required by local, State, Provincial, and Federal regulations and standards, and as identified in the task-specific hazard analysis.

1.2 This includes, but is not limited to:

- U.S. Coast Guard-approved personal floatation device for each person aboard the boat/vessel;
- Sufficient lines for securing boat/vessel dockside;
- A sound-signalling device or appliance;
- Emergency engine shut-off lanyard, securely attached to boat/vessel operator;
- Lifeboats/rafts (offshore vessels);
- Fire/smoke detection equipment;
- Marine fire extinguishers;
- VHF Marine Radio;
- Emergency Position Radio Beacon;
- Life Ring/Retrieval Line;
- Survival Suits - For cold water conditions (water temperature less than 55 degrees Fahrenheit [12.8 edgrees Celsius]), a Coast Guard-approved Mustang suit shall be worn to protect personnel from risks of cold water immersion;
- Functioning, battery-operated spot or flashlights;
- Paddles or manual propelling devices;
- A bailing container;
- Buoyant heaving line no less than 49 feet 3 inch (15 meters) in length;
- Maps or appropriate navigation equipment; and
- First aid kit.

1.3 Safety equipment selected shall be in accordance with local, State, Provincial, and Federal regulations and standards.

1.4 Safety equipment shall be appropriate for the configuration and crew size as well as the size of the vessel.

Americas

Emergency Response Procedures

S3NA-419-WI6

1.0 Requirements

1.1 Specific emergency response procedures shall be developed in the project-specific health and safety plan.

1.2 Review emergency procedures prior to departure to ensure that all hands understand their individual roles and responsibilities in the event of an emergency, and the location and proper use of emergency equipment aboard.

1.3 The following summary information is provided for consideration in the development of project-specific emergency response plans.

1.4 Emergency response plans may vary depending on the size and configurations of boats/vessels and the size and abilities of the crew.

2.0 Person Overboard

2.1 A person in the water shall be considered a person in distress, and immediate emergency response actions shall be taken.

2.2 Prior to the start of operations, the **Marine Safety Officer** shall confirm that suitable rescue equipment is available to facilitate the emergency rescue of an individual who has fallen into the water.

2.3 The **Marine Safety Officer** shall conduct a safety briefing to discuss emergency response procedures, the type and location of safety gear that is available, and the roles and responsibilities of each crew members during an emergency.

2.4 All crew members should be instructed to

- NEVER LOSE SIGHT OF THE INDIVIDUAL IN THE WATER,
- Inform the Captain, or vessel operator, as quickly as possible.
- Throw a ring lifebuoy to the general vicinity of the victim. Do not throw a ring lifebuoy directly at the victim. Hitting the victim with the ring buoy may cause additional injuries.

2.5 All person-overboard situations shall be reported as an incident in accordance with *S3NA-004-PR1 Incident Reporting.*

3.0 On-Board Fire

3.1 The **Marine Safety Officer** will conduct a safety orientation to inform crew members of the location of fire extinguishers, specific emergency procedures, and the individual responsibilities expected of all hands in the event of an on-board fire.

3.2 If a fire is encountered, DO NOT attempt to fight the fire without sounding an alarm first; what could appear to be a small fire can quickly get out of control.

3.3 The extinguishers generally found on project vessels are portable hand-held units designed for multiple use applications, i.e., extinguishers labeled “BC” are approved for both B and C type fires. These types of extinguishers can be carried to the fire to quickly knock down the fire before it has the chance to get out of control. Crew members must be aware that, because these extinguishers are portable, they carry only a limited supply of extinguishing agent. In general, continuous application can be sustained for only a minute or less. Extinguishers are activated by pulling the safety pin and squeezing the release handle. Aim the extinguisher at the base of the flame. Apply the extinguishing agent in short bursts and in a sweeping motion across the base of the fire until the fire is extinguished. If you must enter a space, never let the fire get between you and the door. If your initial attack with a portable extinguisher fails get out immediately and close the door.

4.0 Abandon Ship

4.1 The **Marine Safety Officer** will conduct a safety orientation prior to departure to point out the location of life rafts, procedures for manually deploying the raft, and specific individual responsibilities expected of all hands in the event the vessel needs to be abandoned.

4.2 The decision to abandon ship is a matter of last resort; it is always better to remain with the boat, which is much more visible, until rescue assistance arrives on the scene. If the severities of the situation, through causes that include collision, sinking, fires, or grounding dictate that it is safer to abandon ship, then a distress call must be made to inform authorities of your situation so that rescue assistance can be provided and that your time in the water is kept to a minimum.

4.3 For coastal and offshore waters, a distress call is made on the marine VHF radio using Channel 16. This frequency is monitored by the U.S. Coast Guard and it is the official hailing frequency reserved for ship-to-ship calling and broadcasting safety information and distress calls. Appropriate actions for transmitting a distress signal will be taken by the ship's crew, but if matters need to be taken into your own hands, the protocols of a distress call are:

4.4 A distress call protocol begins with "MAYDAY" "MAYDAY" "MAYDAY," after which the following information is provided:

- Vessel name and description,
- A brief description of your emergency
- Your position and the last landmark seen,
- The number of people that are on board and/or in the water,
- What form of assistance is needed/advise of any imminent dangers,
- Your cell phone number if calling by cell, and
- If hailing on the marine VHF wait 10 seconds for a response. Repeat this information if there is no response.

4.5 For inland waters, or work within protected coastal waters where local authorities (marine patrol, harbormaster, police, and fire rescue) may provide a more effective response, dial 911 emergency services and provide the same information listed above. It is also important to remember that most powered vessels built after 1978 are designed to float even when full of water or in the capsized position. If either of these situations occurs, it is important that you stay with the boat if possible, and remain calm. To reduce the effects of hypothermia, climb into or onto the boat to get as much of your body as possible out of the water.

4.6 Vessels working offshore must carry sufficient numbers of U.S. Coast Guard-approved life rafts to accommodate 100 percent of the persons aboard. These units are designed to float free from the sinking vessel and to inflate automatically in the unlikely event that the vessel should sink. A hydrostatic release mechanism and weak link are provided on the life raft container to satisfy this requirement. The life raft container can also be removed from the storage cradle and deployed manually, if the situation provides sufficient time to safely achieve this task. An instruction card is generally displayed in a prominent location aboard the vessel and can also be found directly on the raft container. If the vessel is operating in ocean service or coastwise transit the life raft must be rated for Ocean Service.

4.7 The decision to abandon ship lies solely with the Captain of the vessel. If the order is ever given, you will be expected to follow the directions of the ships' crew, in a calm and orderly fashion. DO NOT PANIC! You will be required to assemble at a predetermined station, fully clothed, with your lifejacket on. For offshore cold-water operations, bring your immersion suit. If time permits, don your immersion suit; the suit will protect you from the elements and provide plenty of flotation, but keep your lifejacket with you. Stand by calmly at your station and await further orders. Bring a portable radio unit and ensure that the ships' Emergency Position Indicating Radio Beacon has been energized. If the order to abandon ship is given, enter the life rafts in an orderly fashion and remain in the general vicinity of the vessel until rescue assistance arrives.

5.0 Emergency Position Indicating Radio Beacon (EPIRB)

5.1 The EPIRB is a battery-operated, self-activating emergency transmitter. All vessels operating more than 20 miles (32 kilometers) from land are required to carry at least one approved Class-A EPIRB.

5.2 An EPIRB unit is not generally required on vessels that are operating less than 20 miles (32 kilometers) from land and that are equipped with a marine VHF-FM radio. The EPIRB will enable rescuers to quickly locate a disabled vessel by providing a tracking signal to all search and rescue units within range of the unit.

5.3 Prior to departure, check with the Captain of the vessel to ensure that the unit is functioning properly and that the unit has been suitably tested within the last 30 days.

5.4 The operation of most units is usually tested simply by activating the TEST switch and checking for a positive indication from the unit. If no indication is observed, check or replace the battery, and retest. A defective unit should be returned to an authorized service center for repairs.

5.5 A functioning unit should be stowed in a suitable rack, in the inverted position, with the power switch in the automatic position. The unit will float free from the storage rack in the unlikely event the vessel sinks and begin transmitting automatically when it rights itself on the surface.

5.6 If the situation permits, the EPIRB should be brought into the life raft in the event that the vessel must be abandoned; the unit can be activated manually simply by inverting the unit to the upright position.

5.7 Do not test the EPIRB by inverting the unit, as this will send out a false alarm and initiate an unnecessary search and rescue for which you may be held accountable.

Americas

Hazardous Weather Operations

S3NA-419-WI7

The following guidelines are provided as safety considerations to avert the risks of encountering hazardous weather and seas during on-water project operations.

1.0 Planning

1.1 Use online resources such as National Oceanic and Atmospheric Administration (NOAA) marine weather forecasts to evaluate current and predicted weather and predicted sea-state information, and available National Data Buoy Center buoy information to cross-check marine forecasts with real-time and hind cast records of offshore sea-state conditions.

1.2 Additional protective measures could include assigning a coworker at the office to watch developing weather reports and radar loops to track incoming weather if there is some uncertainty in the weather at the time of departure.

1.3 On-water operations should be postponed whenever small craft warnings are in effect.

1.4 Despite the best of planning measures, severe weather such as thunderstorms, squall lines, gusty winds, and shifting wind directions with approaching storms or weather fronts can develop quickly and present a safety risk to marine personnel. Therefore, it is important that proper consideration be given to the vessel being selected to support your project and the operational limitations associated with that vessel. The vessel must be sized and configured to weather the worst case sea-state that might be expected in a given day. Factors such as length, freeboard, horsepower, sea-keeping abilities, watertight integrity of enclosed spaces, and inherent flotation should be considered in selecting a vessel for working in exposed waters, either offshore or a windward side of large bodies of water whether in coastal or inland locations.

1.5 While offshore, monitor NOAA weather radio for the latest watches, warnings, or advisories. If weather conditions are predicted to deteriorate, be sure to leave for the return trip back to dock with ample time to avoid hazardous weather conditions.

1.6 If possible, consider revising your project itinerary to reposition the vessel to work within a survey area or group of sampling stations that are closer to shore if weather conditions appear threatening or if wind directions have winds coming off the land and thus near-shore sea-states would be reduced due to the reduced fetch, saving the furthest offshore or most exposed survey areas for better weather.

2.0 Sudden Weather Changes

2.1 Dark, threatening clouds usually foretell the approach of severe weather. Other things to watch for are a sudden drop in air temperature, a shift in wind direction, an increase in winds speeds, or an increase in winds that are running counter to the prevailing current direction—a situation that can quickly increase sea states.

2.2 If thunder can be heard, you are at risk of being struck by lightning. Open-vessel platforms (those without adequate enclosed spaces for shelter) shall return to the dock immediately so that personnel can seek refuge. If there is insufficient time to get back to the dock, seek out the nearest shelter (shore side support truck, alternate dockage, or any nearby building along shoreline). As a last resort, personnel should set out an anchor and get as low as possible in the boat. Use boat cushions or other non-conducting materials to insulate the body from metal hulls. For vessels with enclosed spaces, keep below decks (if possible) keeping away from metal objects that are not grounded, and do not touch more than one grounded object at the same time.

2.3 If you find yourself in a rapidly deteriorating sea while in route back to the dock:

2.3.1 Reduce vessel speed enough to maintain control, while still maintaining headway.

2.3.2 Turn on running lights.

2.3.3 Sound fog horn or audible device if there is fog.

2.3.4 Head the bow of the boat at about a 45-degree heading to the wave direction.

2.3.5 Keep bilges free of accumulating water.

2.3.6 Check that gear is secured.

2.3.7 Remain calm and think clearly.

Charters and Subcontractors

1.0 Responsibilities

1.1 When chartering or subcontracting uninspected vessels, the **Project Manager** shall determine the overall suitability of the vessel for the expected task.

1.2 Subcontractors are responsible for:

1.2.1 Providing qualified or U.S. Coast Guard-licensed marine staff, the appropriately sized vessel, and all required gear to safely support field activities.

1.2.2 Stowing and maintaining all safety and emergency equipment.

1.2.3 Being service-ready at the start of all operations. All unsafe gear will be removed from service until unsafe conditions have been corrected.

1.2.4 Maintaining current U.S. Coast Guard inspections of the following items:

- Hull inspection to ensure seaworthiness of vessel;
- Main/auxiliary power inspection to ensure safe and operable machinery for vessel propulsion and emergency power;
- Pressure vessel inspection to ensure that they are structurally sound with operable safety devices;
- Electrical systems inspection to ensure satisfactory installation of wiring and equipment;
- Lifesaving systems inspection to ensure satisfactory and adequate means to abandon ship;
- Fire-fighting systems inspection to ensure fixed and portable devices are suitable for the intended space and type of fire;
- Navigation inspection to ensure adequacy and proper operation of navigation equipment;
- Pollution prevention inspection to ensure compliance with international regulations and domestic laws; and
- The vessel should hold some form of “letter of designation” that it can legally operate, at a minimum, as a six-passenger charter, and within this designation the vessel must be operated by a properly licensed Captain and competent crew.

Americas

Hazardous Materials Communication/WHMIS

S3NA-507-PR1

1.0 Purpose and Scope

1.1 Provides a Hazard Communication Program so that AECOM employees are informed of the hazards of the chemicals to which they may be exposed in the course of their work by way of container labeling and other forms of warning, safety data sheets (SDS), and employee training.

1.2 This procedure applies to all AECOM Americas-based employees and operations.

1.3 The program applies to the use of any hazardous substances which are known to be present in the workplace in such a manner that employees may be exposed under normal conditions of use or in a foreseeable emergency.

2.0 Terms and Definitions

2.1 **Acute Effect** – An adverse effect on the human body with immediate onset of symptoms.

2.2 **Article** – A manufactured item: (1) which is formed to a specific shape or design during manufacture; (2) which has end use function(s) dependent in whole or in part upon its shape or design during end use; and, (3) which does not release or otherwise result in exposure to, a hazardous chemical, under normal conditions of use.

2.3 **Carcinogen –** Those chemicals appearing in any of the following reference sources are established as carcinogens for hazard communication purposes:

- National Toxicology Program (NTP) Annual Report on Carcinogens.
- International Agency for Research on Cancer (IARC) Monographs, Volumes 1-34. Note: The Registry of Toxic Effects of Chemical Substances published by NIOSH indicates whether a substance has been found by NTP or IARC to be a potential carcinogen.

2.4 **Chemical Name –** The scientific designation of a substance in accordance with the nomenclature system developed by the International Union of Pure and Applied Chemistry or the system developed by the Chemical Abstracts Service.

2.5 **Chronic Effect –** An adverse effect on the human body with symptoms which develop slowly over a long period of time or which frequently recur.

2.6 **Combustible Liquid –** Any liquid having a flash point at or above 100°F (37.8°C) but below 200°F (93.3°C), except any mixture having components with flash points of 200°F (93.3°C), or higher, the total volume of which makes up 99% or more of the total volume of the mixture.

2.7 **Common Name –** Any designation or identification such as code name, code number, trade name or brand name used to identify a substance other than by its chemical name.

2.8 **Container –** Any bag, barrel, bottle, box, can, cylinder, drum, reaction vessel, storage tank or the like that contains a hazardous chemical. For purposes of this Safety Operating Procedure (SOP) and Occupational Safety and Health Administration (OSHA) standard, pipes or piping systems, and engines, fuel tanks, or other operating systems in a vehicle are not considered to be containers.

2.9 **Establishment –** Any separate and distinct AECOM office, laboratory or other company facility.

2.10 **Exposure –** Any situation arising from work operations where an employee may ingest, inhale, absorb through the skin or eyes or otherwise come into contact with a hazardous substance.

2.11 **Flammable –** A substance that falls into one of the following categories:

2.11.1 **Flammable Aerosol** – An aerosol that when tested by the method described in 16 CFR 1500.45, yields a flame projection exceeding 18 inches at full valve opening or flashback (a flame extending back to the valve) at any degree of valve opening;

2.11.2 **Flammable Gas** – A gas that at ambient temperature and pressure:

- Forms a flammable mixture with air at a concentration of 13% of volume or less; or
- Forms a range of flammable mixtures with air wider than 12% by volume, regardless of the lower limit.

2.11.3 **Flammable Liquid** – Any liquid having a flash point below 100°F (37.8°C), except any mixture having components with flash points of 100°F (37.8°C) or higher, the total of which make up 99% or more of the total volume of the mixture**.**

2.11.4 **Flammable Solid** – A solid, other than a blasting agent or explosive as defined in 8 CCR 5237(a), that is liable to cause fire through friction, absorption of moisture, spontaneous chemical change or retained heat from manufacturing or processing or which can be ignited readily and when ignited burns so vigorously and persistently as to create a serious hazard**.**

A chemical shall be considered to be a flammable solid if, when tested by the method described in 16 CFR 1500.44, it ignites and burns with a self-sustained flame at a rate greater than one-tenth of an inch per second along its major axis.

2.12 **Flash Point –** Minimum temperature of a liquid at which it gives off sufficient vapors to form an ignitable mixture with the air near the surface of the liquid or within the container used.

2.13 **Hazardous Chemical –** Those chemicals appearing in any of the following reference sources are established as hazardous chemicals for hazard communication purposes.

- 29 CFR Part 1910, Subpart Z, Toxic and Hazardous Substances, OSHA.
- Hazardous Products Act, R.C.S. 1985, c. H-3, section 2, Canada.
- For operations within the state of California, the list of hazardous substances prepared by the California Director of Industrial Relations pursuant to Labor Code Section 6382. The concentrations and footnotes, which are applicable to the list, shall be understood to modify the same substance on all other source lists or hazard determinations set forth in § 8 CCR 5194(d)(3)(B) and (d)(5)(D).

2.14 **Hazardous Substance –** A hazardous chemical or carcinogen, or a product or mixture containing a hazardous chemical or carcinogen provided that:

2.14.1 The hazardous chemical is 1% or more of the mixture or product or 2% if the hazardous chemical exists as an impurity in the mixture; or

2.14.2 The carcinogen is 0.1%or more of the mixture or product;

2.14.3 Manufacturers, importers and distributors will be relied upon to perform the appropriate hazard determination for the substances they produce or sell.

2.14.4 The following materials are not covered by the Hazard Communication Standard:

- Any hazardous waste as defined by the Solid Waste Disposal Act, as amended by the Resource Conservation and Recovery Act of 1976, as amended (42 USC 6901 et seq.) when subject to regulations issued under that act by the Environmental Protection Agency.
- Tobacco or tobacco products;
- Wood or wood products. Note: Wood dust is not exempt since the hazards of wood dust are not “self-evident” as are the hazards of wood or wood products;
- Consumer products (including pens, pencils, adhesive tape) used in the work place under typical consumer usage;
- Articles (i.e. plastic chairs);
- Foods, drugs, or cosmetics intended for personal consumption by employees while in the work place;

- Foods, drugs, cosmetics in retail store packaged for retail sale; and
- Any drug in solid form used for direct administration to the patient (i.e., tablets or pills).

2.15 **Hazardous Substance Inventory (HSI) / WHMIS Log –** A listing of all chemicals stored or used at an office or project site. Note that the list may be imbedded in a project Health and Safety Plan.

2.16 **Immediate Use –** Means that the hazardous chemical will be under the control of and used only by the person who transfers it from a labeled container and only within the work shift in which it is transferred.

2.17 **SDS –** A Safety Data Sheet prepared pursuant to state and federal regulations, OSHA Form 174 and Canada regulations (Controlled Products regulations, schedule 1).

2.18 **SDS Administrator –** The individual or group designated by the Office Manager (Operations) or Project Manager to maintain the establishment-specific inventory list or log and the SDS binder required if that establishment uses or stores hazardous substances.

2.19 **NFPA –** A system of categories, colors and numbers was created to provide basic hazard information. It enables firefighters and other emergency personnel to easily decide whether or not to evacuate an area or proceed with emergency control operations. The three principal categories of identification are Health, Flammability and Instability. A numerical range of “0 to 4” indicates the severity of the hazard. A “4” indicates the most severe and a “0” indicates a minimal hazard.

2.20 **Mixture –** Any solution or intimate admixture of two or more substances which do not react chemically with each other.

2.21 **Reactivity** – A measure of the tendency of a substance to undergo chemical reaction with the release of energy.

2.22 **Solubility –** The ability of substance to blend and mix uniformly with another.

2.23 **Specific Gravity (density) –** Ratio of the weight of a substance to the weight of the same volume of another substance. As used in this directive, specific gravity or density refers to the weight of substance as compared to the weight of an equal volume of water.

2.24 **Vapor Density –** The weight of a vapor-air mixture resulting from the vaporization of a volatile liquid at equilibrium temperature and pressure conditions, as compared with the weight of an equal volume of air under the same conditions.

2.25 **WHMIS –** The Workplace Hazardous Materials Information System (WHMIS) is Canada's national hazard communication standard. The key elements of the system are cautionary labeling of containers of WHMIS "controlled products", the provision of material safety data sheets (SDSs) and worker education and training programs.

3.0 References

3.1 Additional definitions can be found in the Hazardous Material Regulations (HMR), the Transportation of Dangerous Goods (TDG) Regulations, and the International Air Transport Association (IATA) Dangerous Goods Regulation (DGR)

3.2 S3NA-003-PR1 SH&E Training

3.3 S3NA-208-PR1 Personal Protective Equipment Program

3.4 S3NA-209-PR1 Project Hazard Assessment and Planning

3.5 S3NA-509-PR1 Hazardous Waste Operations and Emergency Response

4.0 Procedure

4.1 Roles and Responsibilities

4.1.1 **Region SH&E Manager / SH&E Department**

- Audit their regional offices to assure that they maintain an establishment-specific Hazardous Substance Inventory (HSI).
- Audit their regional offices to assure that if an establishment-specific HSI is required, that SDSs are available for each substance listed on the HSI.
- Provide interpretation of SDSs and hazard information for WHMIS labels/NFPA labels and other information to assist in training employees.
- Provide hazard communication training to AECOM employees and file documents of this training.
- Review SDS for adequacy of completion to meet the OSHA and Canadian standard and returning them to supplier, if necessary.

4.1.2 **Project Manager / Site Safety Officer (SSO)**

- Access or obtain, and maintain copies of SDS from:
  - All AECOM subcontractors bringing chemicals onto the project site; and
  - The client, for all of the client's chemicals to which AECOM or AECOM subcontract employees are potentially exposed.

4.1.3 **Office Manager (Operations)**

- Have an operations-specific, written hazard communication program which at least describes how the requirements of this Procedure and the US OSHA and Canadian Hazard Communication requirements for labels and other forms of warning, material safety data sheets, and employee information and training will be met.
- Appoint an SDS administrator for their establishment if they store or use hazardous substances.
- Confirm, if required, that the SDS Administrator maintains an HSI for their establishment.
- Confirm that SDS are available for all substances listed on their establishment's HSI.
- Confirm that a copy of this Procedure and the site-specific SDS are available to all employees. Employees shall be instructed in the location of this Procedure and the SDS.
- Confirm that all employees in their office affected by the HAZCOM standard are provided with the appropriate training, including new employees.

4.1.4 **Supervisor**

- Confirm that all employees under their supervision have received the initial and periodic training required by this SOP prior to assigning employees to tasks involve the use of, or potential exposure to, hazardous substances.
- Notify employees of hazardous substances covered by this SOP that are used in their work area.
- Determine the potential fire, toxic, or reactivity hazards which are likely to be encountered in the handling or utilization of a hazardous substance and will communicate this information to their affected employees, before any are permitted to work with it.
- Confirm that an SDS is available for each hazardous substance used, or potentially encountered, in the work areas or on the projects that are under their supervision.
- Notify subcontractors (working for AECOM) of any hazardous substances that are used or stored by AECOM to which the subcontractor's employees may be exposed.

- Notify clients or property owner/operators of chemicals brought onto their property by AECOM or AECOM's subcontractors.
- Request SDSs from all subcontractor organization for the relevant chemicals they bring onto an AECOM controlled site.

4.1.5 **Employee**

- Confirm that they have received appropriate hazard communication training prior to working with materials that fall under the standard.
- Only work with materials for which they have been instructed on how to find an SDS and how to work with that material safely.
- Provide a copy of all SDSs received to the SDS Administrator at their facility.
- Verify that an SDS is available in their work area for each hazardous substance that they use.

4.2 General Procedure

4.2.1 Confirm that containers of hazardous substances that they use are properly labelled. All employees have a right to, and should, know the properties and potential hazards of substances to which they may be exposed.

4.2.2 Should AECOM assign employees that do not read and speak English to tasks with chemical exposures, communications will be provided in the language understood by that employee.

4.3 Employee Information and Training

4.3.1 Each AECOM employee who handles or is exposed to hazardous substances must be provided information and training, refer to *S3NA-003-PR1 SH&E Training*, on hazardous substances in their work area:

- At the time of their initial assignment; and
- Whenever a new hazard is introduced into their work area.

4.3.2 As a minimum, the training requirements apply to employees in the following job categories:

- All employees who perform field work that involves the use of, or potential exposure to, hazardous substances; and
- Laboratory Employees.

4.3.3 The Initial Training will provide instruction in the following:

- Methods and observations that may be used to detect the presence or release of a hazardous substance in the work area (such as personal monitoring, visual appearance or odor of hazardous substances being released, etc.);
- The physical and health hazards of substances in the work area and measures and procedures AECOM has implemented to protect employees; and
- The details of this hazard communication program (SOP), including an explanation of the labelling system and the SDS, and how he/she can obtain and use appropriate hazard information.
- Any operations in their work area in which hazardous substances are present;
- Location and availability of this written hazard communications program (SOP);
- Their right to personally receive information regarding hazardous substances to which they may be exposed;
- Their right to have their physician receive information regarding hazardous substances to which they may be exposed; and

- Their right against discharge or other discrimination (in California) due to the employee's exercise of rights afforded pursuant to provisions of the California Hazardous Substances Information and Training Act.

4.3.4 Periodic Training and Training for Non-Routine Tasks

Additional training will be provided to employees who have received initial training whenever:

- A new hazardous substance is introduced into their work area;
- A new or revised SDS is received, which indicates significantly increased risks to employee health as compared to those stated on the previous SDS; and
- Non-routine tasks are performed, which will potentially result in exposure to hazardous substances, or exposure under circumstances, which were not addressed during initial training.

Supervisors, in coordination with their **Region SH&E Manager**, shall provide such training through an explanation of the information on the contents of the SDS for that substance.

When training their employees, supervisors shall explain:

- Any health hazards associated with use of the substance or mixture;
- Proper precautions for handling;
- Necessary personal protective equipment or other safety precautions to prevent or minimize exposure; and
- Emergency procedures for spills, fire, disposal, and first aid.

For most projects involving field work, this periodic training requirement will be facilitated through the implementation of the site specific HASP that has been developed for the project.

4.3.5 Documentation of Initial and Periodic Training

- All training required shall be documented at the time it is performed by having the employee sign a copy of a training attendance sheet.

4.4 Hazardous Waste Exemption

4.4.1 In the U.S., hazardous wastes are excluded from the state and federal Hazard Communication standards. AECOM employees who handle or are otherwise exposed to hazardous wastes are covered by the requirements of the Resource Conservation and Recovery Act (RCRA) and other local waste related laws and regulations and the OSHA Hazardous Waste Operations and Emergency Response (HAZWOPER) standard at 29 CFR 1910.120 and *S3NA-509-PR1 Hazardous Waste Operations and Emergency Response.*

4.5 Hazardous Substance Inventory and Chemical Usage

Establishment of a Specific Hazardous Substance Inventory (HSI) or WHMIS Log, as referenced or contained within the safe to work plan, refer *S3NA-209-PR1 Project Hazard Assessment and Planning*, shall include:

- If an AECOM establishment uses or stores additional hazardous substances, an establishment-specific HSI must be maintained at that establishment.
- If it is determined that an office-specific HSI is needed, the **Office Manager (Operations)** shall assure that one is developed and maintained by someone appointed as the establishment's SDS Administrator.
- The content of the office-specific written inventory shall be updated as new hazardous substances are procured for, or removed from, the establishment and shall be verified by the **Region SH&E Manager** through regular inspections of the establishment.

- In order to meet the 30-years-after-employment-termination record retention requirement, the office or project specific HSIs shall be managed as a permanent record.

Prior to using any chemical, a Task Hazard Analysis (THA) shall be completed by the employees assigned to use the chemical. The analysis will identify the hazards associated with the tasks to be performed and prescribe the Personal Protective Equipment (PPE) to be used, refer to *S3NA-208-PR1 Personal Protective Equipment Program.*

4.6 Safety Data Sheets (SDS)

4.6.1 Establishment-Specific SDS Inventory

- If it is determined that an AECOM establishment is required to maintain an establishment-specific inventory SDSs for the specific hazardous substances must be maintained on file at that establishment.
- The **Region SH&E Manager** shall audit the local office or project for SDS request and maintenance and report deficiencies to the appropriate management level, as necessary, to assure compliance with this SOP.

4.6.2 Field Project Sites and Client Facilities

- The **Project Manager** and/or the **Site Safety Officer** shall access or obtain, and maintain copies of SDS from:
    - All AECOM subcontractors bringing chemicals onto the project site; and
    - The client, for all of the client's chemicals to which AECOM or AECOM subcontract employees are potentially exposed.

4.6.3 Employee Access to SDSs

SDSs should be maintained at the local establishment that uses that hazardous substance. Copies of the SDS should be made available to the employee upon request to the office's SDS Administrator.

4.6.4 Field Access to SDSs

When hazardous substances are brought into the field, the user must assure that a copy of the SDS for that substance accompanies it and is available at the field location where it is to be used.

4.6.5 SDSs for AECOM Products

It is unlikely that AECOM activities would create a chemical for which a new SDS were needed. If such a chemical were created, the **SH&E Department** shall work with the appropriate operations groups to draft, review, and publish the new SDS.

4.6.6 Content of the Safety Data Sheet:

- Safety Data Sheets, previously referred to as Material Safety Data Sheets, will now require a 16-section format that is essentially the same as the ANSI standard for *Hazardous Workplace Chemicals-Hazard Evaluation and Safety Data Sheets and Precautionary Labeling Preparation* (ANSI Z400.1 & Z129.1 – 2010).
- Section 1, Identification includes product identifier; manufacturer or distributor name, address, phone number; emergency phone number; recommended use; restrictions on use.
- Section 2, Hazard(s) identification includes all hazards regarding the chemical; required label elements.
- Section 3, Composition/information on ingredients includes information on chemical ingredients; trade secret claims.
- Section 4, First-aid measures includes important symptoms/ effects, acute, delayed; required treatment.

- Section 5, Fire-fighting measures lists suitable extinguishing techniques, equipment; chemical hazards from fire.
- Section 6, Accidental release measures lists emergency procedures; protective equipment; proper methods of containment and cleanup.
- Section 7, Handling and storage lists precautions for safe handling and storage, including incompatibilities.
- Section 8, Exposure controls/personal protection lists OSHA's Permissible Exposure Limits (PELs); Threshold Limit Values (TLVs); appropriate engineering controls; personal protective equipment (PPE).
- Section 9, lists the chemical's characteristics.
- Section 10, Stability and reactivity lists chemical stability and possibility of hazardous reactions.
- Section 11, Toxicological information includes routes of exposure; related symptoms, acute and Section 9, Physical and chemical properties chronic effects; numerical measures of toxicity.
- Section 12, Ecological information
- Section 13, Disposal considerations
- Section 14, Transport information
- Section 15, Regulatory information
- Section 16, Other information, includes the date of preparation or last revision.

SDSs that do not contain this information shall be returned to the distributor or manufacturer to be updated.

4.6.7 Trade Secrets

Some hazardous substance suppliers may claim the information requested on SDSs is proprietary and not provide the information to AECOM.

When SDSs supplied to the **Region SH&E Manager** indicate that proprietary information has been withheld, the **Region SH&E Manager** will either obtain the necessary information to make a hazard assessment or reject the material for use within AECOM.

4.6.8 For Canadian operations, all relevant SDS must be current (no more than 3 years old) and readily available (in French and English) for all hazardous materials.

4.7 Labeling

4.7.1 Containers of hazardous substances used or stored in each AECOM establishment must be labeled, tagged or marked with the following information:

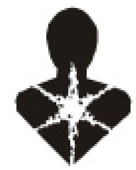
- Product name or Identifier;
- Hazard Pictogram;
- Signal Word;
- Physical, Health, Environmental Statements;
- Supplemental Information;
- Precautionary Measures and Pictograms;
- First Aid Statements;
- Name and Address of Company; and
- Telephone Number.

4.7.2 Labels on containers shall not be removed or defaced. Labels or other forms of warning shall be legible, in English and French (Canada), and prominently displayed on the container.

4.7.3 Any failure to have the appropriate labeling information on a container at any time will be cause to suspend use of the product until the container is properly labeled.

4.7.4 Carcinogen Labeling

Chemicals which have been indicated as positive or suspect carcinogens by either OSHA, ACGIH, the International Agency for Research on Cancer (IARC) (World Health Organization), or the National Toxicology Program (NTP) will be considered to be carcinogenic for purpose of the HCS. The following pictogram will be used to identify carcinogens:



4.7.5 Stationary Process Containers

If there is stationary process equipment within a work area, signs, placards, process sheets, batch tickets, operating procedures, or other such written materials may be used in lieu of fixed labels on the containers, as long as the alternative method conveys the appropriate hazard information. The written materials shall be readily accessible to the employees in the work area.

4.7.6 Portable Containers

Portable containers of hazardous substances need not be labelled when the substance is transferred from labelled containers and is intended for immediate use of the employee who performs the transfer.

Containers of hazardous substances transferred from labelled containers and not intended for the immediate use of the employee performing the transfer shall be labelled with the chemical name and a hazard warning label in accordance with the National Fire Protection Association's (NFPA) 704M Hazard Identification System shall be attached.

4.8 Chemical Storage

4.8.1 Hazardous chemicals are to be stored in labeled containers with the lids securely closed and taped if possible.

4.8.2 Flammable and combustible materials must be stored in fire impervious cabinets in designated stockroom areas. Chemicals must be stored in compliance with instructions provided on their labels, SDS, or the manufacturer's specifications.

4.8.3 All hazardous chemicals must be stored in a manner that prevents spillage and leakage from exposing people or the environment to the chemical.

4.8.4 Hazardous chemicals shall not be stored with foods or beverages. Food and beverages shall not be consumed in areas where hazardous chemicals are used or stored.

4.9 Chemical Use in Offices

4.9.1 In general, hazardous substances should not be taken into office areas, conference rooms, or break areas, contact the **SH&E Department** for guidance If this general requirement is infeasible.

4.9.2 General exceptions to this rule are the following:

- Liquid paper;
- Toner;
- Cleaners;
- Isobutylene calibration gas; and
- pH calibration solutions for instruments.

4.9.3 Each office or location using or storing hazardous materials will develop a written office/ location-specific Hazard Communication/WHMIS Program.

4.9.4 If the local office decides to implement the requirements of the standard in any way that differs from this procedure, they shall verify the changes with the **SH&E Department**, document the changes, and communicate the differences to all affected employees.

4.10 Canada-specific

4.10.1 Consumer products are exempt from supplier labels and SDS requirements. Some cleaning solvents may be packaged as consumer products and these must be labeled in accordance with the Consumer Product Act requirements.

4.10.2 In addition to the labelling of storage containers in the workplace, the contents of process piping (including valves), process vessels and reaction vessels are required to be identified through the use of colour coding, labels, placards or other modes of identifications that must be communicated to workers through training programs. It is very important for employees to be aware of and understand Client labelling requirements for these types of process systems.

5.0 Records

5.1 None

6.0 Attachments

6.1 None

Americas

Hazardous Waste Operations and Emergency Response Activities

S3NA-509-PR1

1.0 Purpose and Scope

1.1 Provides requirements for AECOM operations pertaining to hazardous waste and emergency response (HAZWOPER) services.

1.2 This procedure applies to all AECOM Americas-based employees and operations.

1.3 In Canada there is no direct federal or provincial counterpart to HAZWOPER; however, as due diligence and in compliance with applicable provincial duty of care/general duty clauses, staff working in Canada will comply with this procedure.

2.0 Terms and Definitions

2.1 **Emergency Response** – A response effort by employees from outside the immediate release area or by other designated responders (i.e., mutual-aid groups, local fire departments, etc.) to an occurrence that results, or is likely to result, in an uncontrollable release of a hazardous substance. Responses to incidental release of hazardous substances where the substance can be absorbed, neutralized, or otherwise controlled at the time of release by employees in the immediate release area or by maintenance personnel are not considered to be emergency responses within the scope of the HAZWOPER standard. Responses to releases of hazardous substances where there is no potential safety or health hazard are not considered to be emergency responses.

2.2 **Health and Safety Plan (HASP)** – A document prepared for each project that contains site-specific information including the Emergency Response Plan for the project.

2.3 **Incident Command System (ICS)** – ICS is a standardized on-scene incident management concept designed specifically to allow responders to adopt an integrated organizational structure equal to the complexity and demands of any single incident or multiple incidents without being hindered by jurisdictional boundaries. In the ICS the first person responding to an incident becomes the Incident Commander and turns that title and duties over to more qualified responders as they arrive on scene.

2.4 **First Responder** – First responders are individuals who are likely to witness or discover a hazardous substance release, injury, fire, or other incident and who have been trained to initiate an emergency response sequence by notifying the proper authorities of the release. They would take no further action beyond first aid, initial control of the incident, and notifying the authorities and others of the incident.

2.5 **Hazardous Materials Specialist** – Hazardous materials specialists are individuals who respond with and provide support to hazardous materials technicians. Their duties parallel those of the hazardous materials technician; however, those duties require a more directed or specific knowledge of the various substances they may be called upon to contain. The hazardous materials specialist would also act as the site liaison with federal, state, local, and other government authorities in regards to site activities.

2.6 **Hazardous Materials Technician** – Hazardous materials technicians are individuals who respond to releases or potential releases for the purpose of stopping the release. They assume a more aggressive role than a first responder in that they will approach the point of release in order to plug, patch, or otherwise stop the release of a hazardous substance.

2.7 **Incident Commander** – The Incident Commander (IC) is responsible for all aspects of the response, including developing incident objectives and managing all incident operations. The title and responsibilities are typically assumed by a qualified IC from the client or public sector.

2.8 **Hazardous Waste** – Hazardous waste is waste that is dangerous or potentially harmful to our health or the environment. Hazardous wastes can be liquids, solids, gases, or sludges. They can be discarded commercial products, like cleaning fluids or pesticides, or the byproducts of manufacturing processes. Hazardous waste are divided into

- Listed wastes (http://www.epa.gov/osw/hazard/wastetypes/listed.htm),
- Characteristic wastes (http://www.epa.gov/osw/hazard/wastetypes/characteristic.htm),
- Universal wastes (http://www.epa.gov/osw/hazard/wastetypes/universal/index.htmwastes), and
- Mixed wastes
- Specific procedures determine how waste is identified (http://www.epa.gov/osw/hazard/wastetypes/wasteid/index.htm), classified, listed, and delisted.

2.9 **Hazardous Materials** – A hazardous material is any item or agent (biological, chemical, physical) that has the potential to cause harm to humans, animals, or the environment, either by itself or through interaction with other factors. Additionally a hazardous material may be defined as any substance or chemical which is a "health hazard" or "physical hazard," including chemicals that are carcinogens, toxic agents, irritants, corrosives, sensitizers; agents that act on the hematopoietic system; agents that damage the lungs, skin, eyes, or mucous membranes; chemicals that are combustible, explosive, flammable, oxidizers, pyrophorics, unstable-reactive, or water-reactive; and chemicals that in the course of normal handling, use, or storage may produce or release dusts, gases, fumes, vapors, mists, or smoke that may have any of the previously mentioned characteristics. This may be caused when released by spilling, leaking, pumping, pouring, emitting, emptying, discharging, injecting, escaping, leaching, dumping, disposing into the environment, by being transported or moved, and items or chemicals that are "special nuclear source" or byproduct materials or radioactive substances.

3.0 References

3.1 Federal Emergency Management Agency—FEMA: Incident Command System www.fema.gov

3.2 29 CFCR 1910.120, Hazardous Waste Operations and Emergency Response

3.3 29 CFR 1910.38, Emergency Action Plans

3.4	I2-141-PR1	Subs Management Procedure
3.5	I2-221-PR1	Project Plan Procedure
3.6	Q3NA-141-PR1	Subs Management – Procurement, Oversight and Ratings
3.7	S3NA-003-PR1	SH&E Training
3.8	S3NA-004-PR1	Incident Reporting
3.9	S3NA-203-PR1	Emergency Response Planning, Field
3.10	S3NA-208-PR1	Personal Protective Equipment Program
3.11	S3NA-209-PR1	Project Hazard Assessment and Planning
3.12	S3NA-520-PR1	Spill Response, Incidental
3.13	S3NA-602-PR1	Exposure Monitoring
3.14	S3NA-604-PR1	Medical Records
3.15	S3NA-605-PR1	Medical Surveillance Program

4.0 Procedure

4.1 Roles and Responsibilities

4.1.1 **Office Manager (Operations)**

- Provide support to the implementation of Health and Safety Plans and Emergency Action Plans.

4.1.2 **Project Manager**

- Prepare or request a HASP for every AECOM project with Hazardous Waste Operations and Emergency Response Activities, refer to *S3NA-209-PR1 Project Hazard Assessment and Planning.*
- Verify that all personnel working on the project are qualified.
- Request client's emergency response procedures.
- Appoint a Site Safety Officer (SSO) for each project.
- Communicate the site-specific emergency response details to all employees assigned to a field project.
- Confirm that the necessary communications equipment for the project is available.
- Confirm that an accident/incident investigation is performed and a report is filed; refer to *S3NA-004-PR1 Incident Reporting*.

4.1.3 **Region SH&E Manager / SH&E Department**

- Provide technical guidance for the development and implementation of Health and Safety Plans and Emergency Action Plans.
- Prepare emergency action plans as part of project HASPs and emergency reference sheets.
- Interface with the local emergency responders when necessary.
- Interface with clients regarding facility emergency response procedures.

4.1.4 **Site Safety Officer (SSO)**

- Verify that a HASP is available for the project.
- Communicate the site-specific emergency response details to all employees assigned to a field project.
- Stop work and initiate emergency response procedures as required.
- Account for all AECOM and subcontractor employees after site evacuation.
- Conduct pre-entry briefing and daily tailgate meetings and review facility and site-specific emergency procedures.
- Brief on-site and off-site responders in the event of an emergency.

4.1.5 **Employees**

- Maintain HAZWOPER training.
- Follow the HASP and emergency procedures prepared for the project.
- Initiate emergency response via verbal communications or the alarm system if first to encounter the emergency.

4.1.6 All personnel (e.g., AECOM **employees**, general laborers, equipment operators, chemists, supervisors, etc.) performing activities at hazardous waste sites that expose or potentially expose them to hazardous wastes and health hazards are considered HAZWOPER site workers and must meet the training and medical surveillance requirements specified in 29 CFR 1910.120(e) and (f), respectively. Additional training may be required based on site activities including related exposures and risks (e.g., confined space entry, excavations, fall protection, other materials [lead], etc.). These additional training requirements are to be outlined in the project- or site-specific health and safety plan (HASP).

4.2 Personnel Qualifications—Medical Surveillance and Training

4.2.1 HAZWOPER-qualified employees will participate in the following medical surveillance and training requirements. Medical surveillance and SH&E training requirements are further described in *S3NA-605-PR1 Medical Surveillance* and *S3NA-003-PR1 SH&E Training* respectively.

4.2.2 Medical Surveillance

Specific HAZWOPER medical examination protocols have been developed by **AECOM's Corporate Medical Provider (CMP)** to meet the requirements of 29 CFR 1910.120(f). To be medically qualified to perform HAZWOPER work, **employees** receive the following medical examinations:

- Initial (Baseline) Examination—The initial examination is part of pre-employment requirements and must be completed (with results received) prior to the employee's start of work date.
- Annual Examination—HAZWOPER-qualified employees will complete a medical examination once each year. Medical qualification expires on the anniversary date of the last examination completed. There will be no "grace period" exemptions beyond this date without the express approval of the **Region SH&E Manager**. At the recommendation of the **SH&E Department**, the CMP may approve an alternate examination frequency at periods of up to two years (biennial) in cases in which the worker's exposures to environmental contaminants are infrequent and typically well below any occupational exposure limits (e.g., senior management personnel).
- Termination Examination—When reassigned to non-HAZWOPER duties, or at the conclusion of employment at AECOM, HAZWOPER-qualified personnel will be provided with the opportunity to receive a termination medical examination.
- Special Examinations—The **SH&E Department** and the CMP will jointly determine the need for special examinations because of:
  - Unusual exposure conditions; and
  - In response to possible overexposures.

  The **CMP** will determine the medical protocol elements for each of these examinations based on exposure information provided by the **SH&E Department**. The **CMP** will evaluate the results of each employee's examination and will provide a written statement of medical clearance clearly stating medical compliance with the HAZWOPER regulatory standard (29 CFR 1910.120(f)) and approval of the employee to perform unrestricted HAZWOPER activities. for initial and annual examinations, the **CMP** will also evaluate the **employee** for the use of air purifying and supplied air respiratory protection. The written evaluation from these examinations will indicate the **CMP's** approval/limitations on the employee's use of respiratory protection.

4.2.3 Training

All personnel assigned to work at a hazardous waste site must participate in training meeting the requirements of 29 CFR 1910.120(e).

Initial 40-Hour Training—Before being assigned to a HAZWOPER site, AECOM employees must complete 40 hours of off-site training meeting the requirements of 29 CFR 1910.120(e)(3)(i). At the conclusion of training, personnel will receive a written certification of course completion, signed by the instructor, that indicates the course of instruction (40-hour HAZWOPER) and training dates. A copy of this certification must be provided to the employee's **Region SH&E Manager**. **Employees** are responsible for maintaining their own copy of this certificate and for presenting it to the **site safety officer** when working on any HAZWOPER site.

In addition to the initial 40-hour training, the **employee** must receive three days of actual supervision by a trained experienced supervisor.

Available Training Sources:

- On-site training provided by the **SH&E Department**.
- Outsourced training providers approved by the **SH&E Department**.

Refresher 8-Hour Training—To remain qualified to perform on-site HAZWOPER work activities, each AECOM **employee** will complete 8 hours of HAZWOPER refresher training meeting the requirements of 29 CFR 1910.120(e)(8) at yearly intervals following completion of Initial 40-hour training. At the conclusion of training, personnel will receive a written certification of course completion, signed by the instructor, that indicates the course of instruction (8-hour HAZWOPER Refresher) and the training date. A copy of this certification must be provided to the employee's SH&E Coordinator. **Employees** are responsible for maintaining their own copy of this certificate and for presenting it to the site supervisor when working on any HAZWOPER site.

Available Training Sources:

- Internet-based training approved by **SH&E Department**;
- On-site training provided by the **SH&E Department**; and
- Outsourced training providers approved by the **SH&E Department**.

Supervisor 8-Hour Training—Any AECOM employee acting in a management capacity for HAZWOPER activities (e.g., **project manager**, **site safety officers**, etc.) must complete an additional 8 hours of HAZWOPER Supervisor training meeting the requirements of 29 CFR 1910.120(e)(4). Although this training is required only once, supervisors must maintain their overall HAZWOPER qualification through annual completion of refresher training. At the conclusion of Supervisor 8-Hour Training personnel will receive a written certification of course completion, signed by the instructor that indicates the course of instruction and the training date. A copy of this certification must be provided to the **Region SH&E Manager**. **Employees** are responsible for maintaining their own copy of this certificate and for presenting it to the senior site supervisor when working on any HAZWOPER site.

Available Training Sources:

- On-site training provided by the **SH&E Department**, and
- Outsourced training providers approved by the **SH&E Department**.

24-Hour HAZWOPER Training—Site support contractors and site visitors may qualify to substitute 24-hour HAZWOPER training in place of 40-hour training, as specified in 29 CFR 1910.120(e)(3)(ii). Personnel potentially qualifying for this alternative training include:

- Site support personnel who will not work in any Exclusion Zone areas.

Subcontractors and site visitors whose duties will not entail significant exposure to site contaminants defined as not working in any areas where airborne contaminant concentrations exceed one-half of any applicable occupational exposure limit, and no contact or exposure to materials with site contaminant concentrations exceeding natural background levels. The **Region SH&E Manager** or **SH&E department** designee must approve the substitution of 24-hour training for initial 40-hour training. Persons qualifying for 24-hour training must provide written certification of course completion prior to beginning work on site. Persons completing 24-hour training must complete 8 hours of annual refresher training at the required interval to maintain eligibility for on-site work and must provide proof of this training (as necessary to demonstrate retraining) prior to beginning work on site.

4.2.4 Subcontractor Personnel

Any subcontractor organization whose employees will support AECOM operations at a HAZWOPER site will:

- Provide the **Project Manager** with a copy of their written HAZWOPER medical surveillance and training program requirements. The elements of the program(s) must be similar to those for AECOM's own program, as detailed above, refer to *I2-141-PR1 Subs Management Procedure* and *Q3NA-141-PR1 Subs Management – Procurement, Oversight and Ratings*.
- Provide the **Project Manager** with written certification of a physician's approved medical clearance for each employee who will work on the site. Certification can be demonstrated by:
    - A copy of the physician's signed medical clearance for each **employee** (preferred), or
    - A letter identifying the medical status and clearance expiration date of every **employee**, signed by the company's safety director or an officer of the company.
    - A copy of the each employee's training certifications, which will include:
        - The initial 40-hour training certificate (24-hour training may be substituted with **Region SH&E Manager** approval).
        - The most current Refresher training certificate (must be current within the previous one-year period).
        - A copy of the Supervisor training certificate for each person serving in a site supervisory capacity (e.g., **project manager, site safety officers,** etc.).

4.3 Project SH&E Documentation—Health and Safety Plans (HASP)

4.3.1 The project SH&E documentation prepared for HAZWOPER activities is referred to as a site-specific Health and Safety Plan (HASP), and must meet the requirements presented in 29 CFR 1910.120(b)(4).

4.3.2 A safety and health risk or hazard analysis for each on-site task that will be performed.

4.3.3 The required HASP plan elements include:

- A description of the work location, the site history, and a summary of any information available concerning site hazards (including both physical hazards and contamination conditions);
- A summary of the work activities to be performed under AECOM's scope of activities;
- Identified risks must include both chemical and physical hazards to which personnel may be exposed during the conduct of the work task;
- Protective measures for each work task to prevent or mitigate the potential hazards identified in the hazard analyses;
- Personal protective equipment (PPE) requirements for each work task**,** refer to *S3NA-208-PR1 Personal Protective Equipment Program;*
- Frequency and types of air monitoring, personal monitoring, and environmental sampling techniques and instrumentation to be used;
- Site control measures;
- Decontamination procedures; and
- An emergency response plan, *S3NA-509-FM4 Emergency Information and Hazard Assessment*, addressing actions to be taken in the event of each type of credible incident that might result during the performance of planned work activities, including minor and major injuries, and chemical release and fire. Response plans must address the means for coordinating the evacuation of all on-site personnel in the event of a catastrophic incident.

4.3.4 Responsibility for development of each AECOM HASP will be coordinated between the **Project Manager** and the **Region SH&E Manager** or **SH&E Department** designee as part of project initiation. Regardless of where the HASP is developed, it will be reviewed and approved by the **SH&E Department** prior to submission to any agency outside of AECOM.

4.3.5 Contractors and Subcontractors

4.3.5.1 The health and safety of any contractor's or subcontractor's employees is solely the responsibility of that contractor or subcontractor, who shall evaluate the hazards and potential hazards to their own employees and shall adhere to their own Health and Safety Plan.

4.3.5.2 In addition, all AECOM subcontractors' Health and Safety Plans will, at a minimum conform to the requirements of the AECOM Health and Safety Plan. The AECOM Health and Safety Plan does not, nor is it intended to, address procedures of contractors or subcontractors during their site activities.

4.4 Personal Protective Equipment (PPE) Ensembles

4.4.1 Defined HAZWOPER PPE ensembles are specified for general use on all AECOM HAZWOPER operations. The project HASP may specify modifications to these requirements to meet site-specific conditions.

4.4.2 Level D Ensemble

The Level D ensemble provides a minimal level of skin protection (primarily against physical rather than chemical hazards) and no respiratory protection. Level D PPE is the minimum work uniform which will be used on HAZWOPER sites. Its use is appropriate when there is no significant potential for encountering hazardous substances or health hazards while working in controlled work areas.

Level D Equipment List:

- Hard hat,
- Eye protection,
- Safety-toe work boots,
- Shirts with sleeves and long pants (shorts are unacceptable for use), and
- Hearing protection (as required).

4.4.3 Modified Level D Ensemble

The Modified Level D ensemble provides moderate skin protection against contact with hazardous substances, but no respiratory protection. Its use is appropriate where there is a moderate-to-low potential for skin contact with known hazardous substances and health hazards, but no significant inhalation hazard is anticipated. The Modified Level D ensemble will consist of the Level D ensemble, supplemented by the addition of one or more of the following items:

Modified Level D Equipment List:

- Chemical-resistant disposable outer coveralls,
- Chemical-resistant outer gloves taped to outer coveralls,[1]
- Chemical-resistant inner gloves, and[1]
- Chemical-resistant safety-toe boots (taped to outer coveralls).

1 Selection of specific glove types/materials will be provided in the project HASP based on consideration of the contaminants and the physical conditions of the work.

4.4.4 Level C Ensemble

The Level C ensemble provides moderate skin protection against contact with hazardous substances and moderate respiratory protection. Its use is appropriate where there is the potential for skin contact with known hazardous substances and health hazards, together with a limited and well-defined potential for exposure via inhalation.

Level C Equipment List:

- Full-face air-purifying respirator (APR) equipped with cartridge types as designated in the project HASP,[2]
- Chemical-resistant disposable outer coveralls,
- Chemical-resistant outer gloves taped to outer coveralls,[3]
- Chemical-resistant inner gloves,[3]
- Hard hat,
- Safety-toe boots taped to coveralls; the use of boot covers (e.g., booties) or chemical-resistant boots may be specified, and
- Hearing protection (as required).

4.4.5 Level B Ensemble

The Level B ensemble provides both the highest level of inhalation exposure protection and considerable skin contact protection. Its use is appropriate where there are significant known or suspected hazardous substances and health hazards, involving both skin and inhalation exposure (up to and including Immediately Dangerous to Life or Health [IDLH] conditions) or where adverse atmospheric conditions cannot be mitigated by use of air purifying respirators (e.g., oxygen deficient atmospheres or chemicals with poor warning properties). The use of Level B PPE requires prior approval by the **Region SH&E Manager**.

Level B Equipment List:

- Supplied air respirator (SCBA or air line system with Grade D or better breathing air),
- Chemical-resistant disposable outer coveralls,
- Chemical-resistant outer glove taped to outer coveralls,[3]
- Chemical-resistant inner gloves,[3]
- Hard hat,
- Chemical resistant safety-toe boots taped to coveralls, and
- Hearing protection (as required).

4.4.6 Level A Ensemble

The Level A ensemble provides the highest level of both respiratory and skin protection, up to and including protection against skin contact with vapor-phase contaminants. The use of Level A PPE requires prior approval by the Americas SH&E Director.

Specific Level A ensemble components will be determined on a case-by-case basis by the **SH&E Department**.

2 Selection of specific cartridges will be made by the SH&E Department (or Competent Person – Respiratory Protection as designated by the DSM) based on contaminants present. A cartridge change-out frequency will also be specified in the HASP based on the manufacturer's cartridge performance data.

3 Selection of specific glove types/materials will be provided in the project HASP based on consideration of the contaminants and the physical conditions of the work.

4.5 Field Emergency Response Plans

4.5.1 AECOM employees are not expected to take action or to participate in rescues or responses to chemical releases beyond the initial discovery of the release and immediate mitigation actions such as closing a valve, placing absorbents, and notifying the client and or public emergency response system (911.) If AECOM employees are to participate in the response to a chemical release beyond the initial reaction, there must be a contractual provision for this response and the employees must be specifically trained for this response. This document is designed to provide guidelines on how to prepare a written plan that will ensure prompt and proper response to an emergency situation that arises during field investigations and to outline the duties of AECOM employees during a field emergency and the associated training requirements.

4.5.2 Site specific health and safety plans that are prepared to comply with the HAZWOPER standard (29 CFR 1910.120) must address emergency response. This standard specifically outlines the elements that must be contained in an emergency response plan. However, the definition of emergency response, as written in 29 CFR 1910.120, focuses on emergencies involving the uncontrolled release of hazardous substances. Under 29 CFR 1910.120, an employer can opt to evacuate employees from the danger area when such an emergency occurs. AECOM does not expect its employees to actively assist in the handling of uncontrollable chemical releases that may occur during the implementation of field programs. As such, and as provided by the HAZWOPER standard, AECOM is exempt from the emergency response plan requirements of the standard as long as it provides an emergency action plan within the HASP that complies with 29 CFR 1910.38 (a). Therefore, all emergency response plans required under 29 CFR 1910.120 will be written to comply with 29 CFR 1910.38 (a).

4.5.3 The HAZWOPER standard does not prohibit AECOM employees from performing limited response activities. AECOM employees can provide response assistance by placing absorbent pillows or vermiculite around a small, contained spill that occurs during sampling efforts. Refer to the *S3NA-520-PR1 Spill Response, Incidental* procedure which describes the specific procedures that AECOM will follow when responding to an incidental chemical spill.

4.5.4 Field Project Preparation

Every HASP that is prepared by AECOM will contain an emergency response section in which the required elements of an emergency action plan will be contained, refer to *S3NA-203-PR1 Emergency Response Planning, Field* for more specifics. For all projects that do not require a HASP, an emergency reference sheet will be prepared; minimally, the sheet will list the telephone numbers of the local emergency responders and the local hospital and provides directions to the local hospital. When AECOM is working at an operating facility, the emergency response procedures of the facility will be appended to the HASP or the emergency reference sheet.

There are two types of emergency situations that AECOM personnel must be prepared for and that must be addressed in the emergency action plan. These include:

- Emergencies related to the operations of our clients at the facility where AECOM is working.
- Emergencies related to our own on-site activities/investigations.

AECOM employees are typically not expected to take action or participate in responses to chemical releases beyond the initial discovery of the release and immediate mitigation actions such as closing a valve, placing absorbents, and notifying the client and or public emergency response system (911.)

Employees are not to accept the role of Incident Commander without specific authority from the **Region SH&E Manager** and the **Office Manager (Operations)** responsible for the project. Assuming the role of the Incident Commander requires training beyond the scope of this Procedure.

4.5.5 Client Facility Emergency Response Procedures

AECOM implements field programs on active properties, including manufacturing facilities. These facilities have typically developed an emergency response plan that is specific to facility-related emergencies. If AECOM is working at an operating facility, emergency procedures established by the facility must be followed in the event of a facility catastrophe. AECOM personnel must be aware of and familiar with the alarm signals used at the facility to alert personnel to an emergency. AECOM personnel must also know where to assemble in the event of a facility evacuation as the facility must be able to account for all personnel, including subcontractors such as AECOM in the event of an evacuation.

The first priority in AECOM's preparation of a project emergency action plan is to ensure that the responsibilities under the client's emergency response plan are fully understood. Because of the nature of their business, many of our clients have in-house fire brigades, medical staff, and hazardous materials teams that can assist AECOM in the event of an emergency related to our field activities. In many instances, our clients prefer or require that subcontractors seek emergency assistance through their facility first before calling outside responders to the site.

A copy of the facility's procedures must be made available to AECOM so that the information can be incorporated into the HASP or attached to the emergency reference sheet. If this information is not available to AECOM prior to arriving on site, the **SSO** must meet with client representatives upon arrival to the facility to review procedures in the event of an emergency related to plant operations.

4.5.6 Emergency Action Plan

As a minimum, each emergency action plan must contain the following topics as required by 29 CFR 1910.38 (a):

- Procedures and contact information for reporting emergencies to public service responders and on-site (client or host employer) emergency control centers.
- Emergency escape procedures and emergency escape route assignments.
- Procedures to be followed by employees who remain to operate critical site operations before they evacuate.
- Procedures to account for all employees after emergency evacuation is complete.
- Rescue and medical duties for those employees who are to perform them.
- Preferred means of reporting fires and other emergencies.
- PPE to protect employees from expected exposures and potential exposures during an emergency.
- Names of persons or departments who can be contacted for further information (i.e. emergency reference sheet).
- Availability of medical surveillance for workers who might have been exposed to chemicals, bloodborne pathogens, or other biological agents as a result of project work or emergency response.

In addition, each plan must establish the specific alarm system that will be used on site to warn employees of an AECOM emergency. The chosen alarm signals should not conflict with alarm signals already in place at the facility.

4.5.7 Escape Routes and Procedures

Prior to the commencement of on-site activities, the **SSO** must determine how AECOM employees will evacuate each AECOM work area of the site. Two or more routes that are separate or remote from each other for each work area must be identified. Multiple routes are necessary in case one is blocked by fire or chemical spill. These routes must not overlap because, if a common point were obstructed, all intersecting routes would be blocked.

Prominent wind direction should also be considered when designating escape routes and assembly areas. Escape routes and assembly areas should be upwind of the site whenever possible.

Upon arrival to the site, the **SSO** must verify that the selected routes are appropriate for evacuation. During an emergency, the quickest and most direct route should be selected. However, when working at an operating facility, the established escape routes of the facility should be used whenever possible. In the event of a facility-related emergency, all AECOM employees must meet at the facility's assembly area so that the client can verify that AECOM has evacuated the property.

4.5.8 Accounting Method for All Employees after Evacuation

The **SSO** is responsible for determining that all AECOM employees have been successfully evacuated from the work area(s). It is the responsibility of each AECOM subcontractor to verify that all of its employees evacuated the site and to report this information to the **SSO**. All employees must meet at the designated assembly area. A headcount is an acceptable way to determine complete evacuation when the field team is of a small size. The site log-in book should be referenced when attempting to account for more than 10 people. In the event of a facility-related emergency, the **SSO** must notify facility representatives that all AECOM employees and AECOM subcontract employees have successfully evacuated the work area(s). The **SSO** must notify emergency responders if any employee is unaccounted for and where on the site they were last seen.

In the event of a project-related emergency, the **SSO** will provide off-site emergency responders or on-site HAZMAT teams or fire brigades (Incident Commander) with all available knowledge about the emergency situation upon their arrival to the scene.

4.5.9 Employees Who Remain to Operate Critical Site Operations Before They Evacuate

All equipment and operations are required to cease in accordance with the established alarm signal procedures. The only exception will be related to health and safety. The **SSO** must determine at the time of the emergency if health and safety will be jeopardized by immediate stoppage of any particular piece of equipment. If such a determination is made, personnel involved in critical operations must be minimized. Once it is determined that the operation is no longer needed or the threat to the operators is imminent, operations will cease and the operators will immediately evacuate.

4.5.10 Rescue and Medical Duties

Only currently trained individuals will administer first aid or CPR. If the injury is life threatening, the Emergency Medical System (EMS) should be called (911). Depending on the procedures established for the project, the **SSO** would contact an emergency responder directly or notify the facility representatives for medical assistance. If the employee needs medical attention that cannot be provided on-site, the **SSO** shall escort the individual to the local hospital identified on the emergency reference sheet and shall remain with the person until release or admittance is determined. The escort will relay all appropriate medical information to the Project Manager and **Region SH&E Manager**.

4.5.11 Preferred Means of Reporting

Unless facility representatives specifically indicate that they prefer AECOM personnel to notify them first of an emergency, the **SSO** will directly contact the appropriate emergency responders listed on the emergency reference sheet.

4.5.12 Alarm Signals

An emergency communication system must be in effect at all sites. The most simple and effective emergency communication system in many situations will be direct verbal communications. However, verbal communications must be supplemented any time voices cannot be clearly perceived above ambient noise levels and any time a clear line of sight can not be easily maintained among all AECOM personnel because of distance, terrain, or other obstructions.

Portable two-way radio communications may be used when employees must work out of the line of sight of other workers.

When verbal communications must be supplemented, the following emergency signals shall be implemented using handheld portable air horns, whistles, or similar devices. Signals must be capable of being perceived above ambient noise by all employees in the affected portions of the workplace.

- One Blast: General Warning—A relatively minor and localized, yet important, on-site event. An example of this type of an event would be a minor chemical spill where there is no immediate danger to life or health yet personnel working on the site should be aware of the situation so that unnecessary problems can be avoided. If one horn blast is sounded, personnel must stop all activity and equipment on-site and await further instructions from the **SSO**.
- Three Blasts: Medical Emergency—A medical emergency for which immediate first aid or emergency medical care is required. If three horn blasts are sounded, all first aid and/or CPR trained personnel should respond as appropriate. All other activity and equipment should stop and personnel should await further instructions from the **SSO**.
- Three Blasts Followed by One Continuous Blast: Immediate Threat to Life and Health—A situation that could present an immediate danger to life and health of personnel onsite. Examples include fires, explosions, large hazardous chemical release, severe weather-related emergencies, or security threats. If three horn blasts followed by a continuous blast are sounded, all activity and equipment must stop. All personnel must evacuate the site and meet in the designated assembly area where the **SSO** will account for all employees. The **SSO** will arrange for other emergency response actions if necessary. Information concerning the need to follow decontamination procedures during an emergency evacuation will be addressed in the emergency action plan.
- The **SSO** or his designate will acknowledge the distress signal with two short blasts on the air-horn or whistle.
- One Continuous Blast Following Any of the Above: All Clear/Return to Work—Personnel who sound the initial alarm are required to send an all clear signal when the emergency is over.

4.5.13 Emergency Reference Sheet

An emergency reference sheet (see *S3NA-509-FM4 Emergency Information and Hazard Assessment*) must be prepared for projects not requiring a HASP. Each emergency reference sheet must list the following:

- Emergency phone numbers for local police, fire, and ambulance service.
- In-house facility extensions for reporting an emergency (applies to operating facilities only).
- Phone number and address of closest hospital with an emergency room to the site.
- Directions to the hospital from the site.
- Map highlighting the site-to-hospital route.
- Phone number for the Poison Control Center.
- Names and phone numbers of AECOM representatives and facility representatives.

4.5.14 On-site and Off-site Communications

Regardless of the size or location of AECOM's field projects, it is extremely important that both on-site and off-site communications be maintained so that in the event of an emergency employees can contact each other or place a phone call immediately with the appropriate responder(s).

Walkie-talkies are required when members of the field team are working in separate areas of the site and verbal communications are no longer effective because of distance. A walkie-talkie must be available for each team that is working in a separate area of the site.

When AECOM is working at an occupied facility, access to a telephone may not be a problem. When AECOM is working on abandoned properties or when there is no access to a phone, a cellular telephone must be brought to the work location.

4.5.15 Evacuation

Although emergency evacuation procedures are included in AECOM's initial 40-hour HAZWOPER training, emergency procedures at each site will be different. Therefore, employees must be instructed about the specifics of the emergency procedures developed for the site during the site-specific pre-entry briefing that must be held daily prior to the commencement of field activities. Update training is required anytime escape routes or procedures change. An evacuation drill will be conducted for projects that are scheduled for one month or longer. Visitors and untrained employees shall not be allowed into the project area until they receive a safety briefing including evacuation alarms and procedures.

4.5.16 First Responder

First responders shall have sufficient training or have had sufficient experience to objectively demonstrate competency in the following areas:

- An understanding of what hazardous substances are, and the risks associated with them in an incident.
- An understanding of the potential outcomes associated with an emergency.
- The ability to recognize the presence of hazardous substances and physical hazards in an emergency.
- An understanding of the role of the first responder.
- The ability to realize the need for additional resources and to make appropriate notifications to the communication center.

4.5.17 First Responder HAZWOPER Operations Level

First responders at the operations level are individuals who respond to releases or potential releases of hazardous substances as part of the initial response to the site for the purpose of protecting nearby persons, property, or the environment from the effects of the release. They are trained to respond in a defensive fashion without actually trying to stop the release. Their function is to contain the release from a safe distance, keep it from spreading, and prevent exposures. First responders at the operational level shall have received at least eight hours of training or have had sufficient experience to objectively demonstrate competency in the following areas in addition to those listed for the awareness level and the employer shall so certify:

- Knowledge of the basic hazard and risk assessment techniques.
- Know how to select and use proper personal protective equipment provided to the first responder operational level.
- An understanding of basic hazardous materials terms.
- Know how to perform basic control, containment, and/or confinement operations within the capabilities of the resources and personal protective equipment available with their unit.
- Know how to implement basic decontamination procedures.
- An understanding of the relevant standard operating procedures and termination procedures.

4.5.18 Hazardous Materials Technician

Hazardous materials technicians shall have received at least 24 hours of training equal to the first responder operations level and in addition have competency in the following areas and the employer shall so certify:

- Know how to implement the employer's emergency response plan.

- Know the classification, identification, and verification of known and unknown materials by using field survey instruments and equipment.
- Be able to function within an assigned role in the Incident Command System, refer to *Federal Emergency Management Agency—FEMA: Incident Command System*.
- Know how to select and use proper specialized chemical PPE provided to the hazardous materials technician.
- Understand hazard and risk assessment techniques.
- Be able to perform advance control, containment, and/or confinement operations within the capabilities of the resources and personal protective equipment available with the unit.
- Understand and implement decontamination procedures.
- Understand termination procedures.
- Understand basic chemical and toxicological terminology and behavior.

4.5.19 Hazardous Materials Specialist

Hazardous materials specialists shall have received at least 24 hours of training equal to the technician level and in addition have competency in the following areas and the employer shall so certify:

- Know how to implement the local emergency response plan.
- Understand classification, identification, and verification of known and unknown materials by using advanced survey instruments and equipment.
- Know the state emergency response plan.
- Be able to select and use proper specialized chemical PPE provided to the hazardous materials specialist.
- Understand in-depth hazard and risk techniques.
- Be able to perform specialized control, containment, and/or confinement operations within the capabilities of the resources and personal protective equipment available.
- Be able to determine and implement decontamination procedures.
- Have the ability to develop a site safety and control plan.
- Understand chemical, radiological, and toxicological terminology and behavior.

4.6 Employee Exposure Monitoring

4.6.1 Exposure monitoring at HAZWOPER sites will be conducted to determine explosive and oxygen levels, monitor and control employee exposures to airborne contaminants, and to determine and regulate controlled work area boundaries (e.g., support zone, contamination reduction zone, and exclusion zone) for the protection of non-HAZWOPER workers and the general public.

4.6.2 Direct Reading Exposure Monitoring Requirements

Explosive levels, oxygen levels, and airborne contaminants present potential hazards to HAZWOPER personnel working within controlled work areas and to non-HAZWOPER workers and the general public present outside the controlled work areas. On-site exposure monitoring will be utilized to assess the magnitude of these hazards and to provide indications of any necessary control procedures to mitigate unacceptable hazards. *S3NA-509-FM1 Direct Reading Instrument Monitoring Log* will be used to record all monitoring efforts using direct reading instruments and will remain part of the project file.

Specific exposure monitoring requirements will be established in individual HASPs, refer to *S3NA-602-PR1 Exposure Monitoring*, and will be implemented by the project team(s) subject to the following requirements:

- Direct reading instrumentation will be used in accordance with the following table:

Direct Reading Instrument	Example Trade Names	Use
Flame Ionization Detector (FID)	OVA	Detection of select organic vapors
Photo ionization detector (PID)	miniRAE, Micro-TIP	Detection of select organic vapors
Portable gas chromatograph	OVA	Detection of select organic vapors
Explosive meter	MSA ALTAIR, QRAE II, BW GasAlert	Determine explosiveness (as a percent of the Lower Explosive Limit [LEL])
Oxygen monitor	MSA ALTAIR, QRAE II, BW GasAlert	Determine oxygen concentration (in percent)
Single gas meters (mono-tox) • Hydrogen sulfide • Carbon monoxide • Oxides of nitrogen • Cyanide		Determine airborne concentrations of selected contaminants (in parts per million)
Colorimetric Detector Tubes	Drager	Determine airborne concentrations of selected contaminants (in parts per million)
Aerosol monitor	Mini-RAM	Determine airborne particulate concentration (in milligrams per cubic meter)

- Selected instruments will be capable of discriminating contaminant concentrations to concentrations of at least one-half of the HASP-specified exposure limit. All direct-reading instrumentation will be calibrated daily as directed by the manufacturer. *S3NA-509-FM2 Instrument Calibration Log* will be used to record instrument calibrations.

4.6.3 Work Area Exposure Monitoring

- Work area exposure monitoring will include breathing zone readings for the maximum exposed worker(s).
- Results will be used to determine adequacy of PPE (especially respiratory protection). Specific criteria for upgrade/downgrade will be established in the HASP.

4.6.4 Perimeter Exposure Monitoring

- Perimeter air samples will be collected when the potential exists for airborne contaminants to migrate off-site.
- Perimeter exposure monitoring will be conducted at locations downwind from the project activities at a minimum (also upwind if the potential exists for offsite contamination to migrate onto the site).
- Sample results will be recorded in a log book or on the sample log form provided in *S3NA-509-FM3 Personal Sampling Data Sheet*
- Records will indicate individual name, SSN (last 4 digits is acceptable), and job/operation at the time of sample collection.
- Samples sent out for independent laboratory analysis will follow chain of custody requirements.
- Exposure results will be posted on site and explained in a safety briefing.

- **Employees** will receive a written statement of results within 15 days of receipt from the laboratory.
- Results of all personal exposure monitoring will be provided to the **SH&E department** for inclusion in the employee medical records**,** refer to *S3NA-604-PR1 Medical Records*.

5.0 Records

5.1 All forms and documents generated during a HAZWOPER project will be maintained in the project file.

6.0 Attachments

6.1 S3NA-509-FM1 Direct Reading Instrument Monitoring Log

6.2 S3NA-509-FM2 Instrument Calibration Log

6.3 S3NA-509-FM3 Personal Sampling Data Sheet

6.4 S3NA-509-FM4 Emergency Information and Hazard Assessment

Americas

Direct Reading Instrument Monitoring Log

S3NA-509-FM1

Project: ______________________ Job No.: ______________________

Date: ______________________ Operator: ______________________

Instrument: ______________________ Calibration: ______________________
(Amt, Component, Date)

Sampling Technique: ______________________

Sample Interval: ______________________

Background Reading: ______________________

Action Level/Response: ______________________

Time	Location	Reading (units)	Detection Limits (Scale)

Americas

Instrument Calibration Log

S3NA-509-FM2

Instrument Information	
Instrument Name:	Manufacturer:
Serial Number:	Last Service Date:
Parameter(s):	Calibration Gas:
Calibration Procedure:	

Daily Calibration Results	
Date:	Calibration Result:
Name:	Signature:
Notes:	
Date:	Calibration Result:
Name:	Signature:
Notes:	
Date:	Calibration Result:
Name:	Signature:
Notes:	
Date:	Calibration Result:
Name:	Signature:
Notes:	

Project: Job No.:

Date: Operator:

Instrument: Calibration:

Americas

Personal Sampling Data Sheet

SNA-509-FM3

Client: Method:

Site Location: Job No.: Sampling Media:

		Air Flow Calibration (L/min)									Results		
Sample ID.	**Pump No.**	**Pre**	**Post**	**Average**	**Start Time**	**Stop Time**	**Total Time Minutes**	**Volume (Liters)**	**Sampler's Initials**	**Date**	**Amount (mg)**	**Conc. ppm , mg/m^3**	**Remarks (Location of sampling, Employee name, SSN)**

Americas

Emergency Information and Hazard Assessment

S3NA-509-FM4

Emergency References:

Ambulance: 911

Fire: 911

Police: 911

Medical Services/Regional Hospital (including a map is advisable):

Poison Control Center: http://www.aapcc.org/poison4.htm

Emergency Muster Point:

In case of a site/facility emergency, please meet at:

The escape route from the site and an emergency muster point will be determined and provided to all workers during the project mobilization.

Client Contacts:

Office: Cell:

AECOM Project Representatives:

Office: Mobile:

AECOM Medical Records and Medical Consultant
WorkCare
Anaheim, CA 94502
Telephone: 800-455-6155

Americas

Heat Illness Prevention

S3NA-511-PR1

1.0 Purpose and Scope

1.1 Establishes a Heat Illness Prevention Program to help ensure that employees know and recognize the symptoms of heat stress-related illnesses and are prepared to take appropriate corrective action.

1.2 This procedure applies to all AECOM Americas-based employees and operations.

2.0 Terms and Definitions

2.1 **Acclimated** – Employees who have developed physiological adaptation to hot environments characterized by increased sweating efficiency, circulation stability, and tolerance of high temperatures without stress. Acclimatization occurs after 7 to 10 consecutive days of exposure to heat and much of its benefit may be lost if exposure to hot environments is discontinued for a week.

2.2 **Chemical Protective Clothing (CPC) –** Apparel that is constructed of relatively impermeable materials intended to act as a barrier to physical contact of the Employee with potentially hazardous materials in the workplace. Such materials include Tyvek® coveralls (all types) and polyvinyl chloride coveralls and rain suits.

2.3 **Heat Cramps** – A form of heat stress brought on by profuse sweating and the resultant loss of salt from the body.

2.4 **Heat Exhaustion** – A form of heat stress brought about by the pooling of blood in the vessels of the skin and in the extremities.

2.5 **Heat Rash** – A heat-induced condition characterized by a red, bumpy rash with severe itching.

2.6 **Heat Stress** – The combination of environmental and physical work factors that constitute the total heat load imposed on the body.

2.7 **Heat Stroke** – The most serious form of heat stress, which involves a profound disturbance of the body's heat-regulating mechanism.

2.8 **Sunburn** – Caused by unprotected exposure to ultraviolet light that is damaging to the skin. The injury is characterized by red painful skin, blisters, and/or peeling.

2.9 **Unacclimated** – Employees who have not been exposed to hot work conditions for one week or more or who have become heat-intolerant due to illness or other reasons.

3.0 References

3.1 S3NA-003-PR1 SH&E Training

3.2 S3NA-004-PR1 Incident Reporting (Americas)

3.3 S3NA-203-PR1 Emergency Response Planning, Field

3.4 S3NA-208-PR1 Personal Protective Equipment

3.5 S3NA-209-PR1 Project Hazard Assessment and Planning

3.6 American Conference of Governmental Industrial Hygienists (ACGIH)

4.0 Procedures

4.1 Roles and Responsibilities

4.1.1 **Project Managers**

- Evaluate the need for heat illness prevention measures and incorporate as appropriate into the Safe Work Plan or Task Hazard Analysis.
- Allocate sufficient resources for the management of heat illness in the field including the provision of water, a shaded break area, and sufficient schedule to allow for breaks.

4.1.2 **Region Safety, Health and Environment (SH&E) Manager**

- Provide heat illness awareness training.
- Assist project teams in developing appropriate work-rest schedules.
- Conduct/support incident investigations related to potential heat stress-related illnesses.

4.1.3 **Supervisor**

- Identify those tasks that may be most impacted by heat stress and communicate the hazard to the assigned Employees.
- Ensure that Employees have been trained on the recognition of heat illness.
- Ensure that adequate supplies of appropriate fluids are readily available to Employees.
- Ensure that a proper rest area is available.
- Conduct heat illness monitoring, as applicable.
- Implement the work-rest schedule.
- Ensure that first aid measures are implemented once heat stress symptoms are identified.
- Ensure personnel are physically capable of performing the assigned tasks and are not in a physically compromised condition.
- Report all suspected heat illnesses.

4.1.4 **Employee**

- Observe each other for the early symptoms of heat illnesses.
- Maintain an adequate intake of available fluids.
- Be familiar with heat stress hazards, predisposing factors, and preventative measures.
- Report to work in a properly vested and hydrated condition.
- Report all suspected heat stress-related illnesses.

4.2 Restrictions

4.2.1 The Buddy System is required when working in high heat conditions; Employees shall not work alone. Employees shall not be exposed to levels that exceed those listed in the screening criteria for heat stress exposure in the heat stress and strain section of the ACGIH Standard. Also refer to the *S3NA-511-ST Heat Exposure* standards.

4.2.2 Clothing corrections shall be applied in accordance with the heat stress and strain section of the ACGIH Standard.

4.3 Exposure Controls

4.3.1 If **Employees** are or may be exposed, the **Supervisor** shall:

- Conduct a heat stress assessment to determine the potential for hazardous exposure of Employees, and
- Develop and implement a heat stress exposure control plan within the Safe Work Plan or Task Hazard Analysis, refer to *S3NA-209-PR1 Project Hazard Assessment and Planning*.

4.3.2 If **Employees** are or may be exposed, the **Supervisor** shall implement engineering controls (e.g., shelters, cooling devises, etc.) to reduce the exposure of **Employees** to levels below those listed in the screening criteria for heat stress exposure in the heat stress and strain section of the ACGIH Standard.

4.3.3 If engineering controls are not practicable, the **Supervisor** shall reduce the exposure of **Employees** to levels below those listed in the screening criteria for heat stress exposure in the heat stress and strain section of the ACGIH Standard by providing administrative controls, including a work-rest cycle or personal protective equipment, if the equipment provides protection equally effective as administrative controls.

4.3.4 If **Employees** are or may be exposed, the **Supervisor** shall provide and maintain an adequate supply of cool, potable water close to the work area for the use of a heat exposed **Employee**.

4.3.5 If an **Employee** shows signs or reports symptoms of heat stress or strain, they shall be removed from the hot environment and treated by an appropriate first aid attendant on site, if available, or by a physician, refer to *S3NA-511-WI2 Symptoms and Treatment* for more specifics.

4.4 Heat Stress Planning

4.4.1 Heat stress can be a significant field site hazard, especially for Employees wearing CPC. To prepare the field for emergency response planning, refer to *S3NA-203-PR1 Emergency Response Planning, Field* procedure. The project and site specific risks need to be planned using a Safe Work Plan or Task Hazard Analysis, refer to the *S3NA-209-PR1 Project Hazard Assessment and Planning* procedure.

4.4.2 The workforce will gradually work up to a full workload under potentially stressful conditions to allow for proper acclimation.

4.4.3 **Employees** shall be instructed in the recognition of heat stress symptoms, the first aid treatment procedures for severe heat stress, and the prevention of heat stress injuries. **Employees** must be encouraged to immediately report any heat stress that they may experience or observe in fellow **Employees**. **Supervisors** must use such information to adjust the work-rest schedule to accommodate such problems.

4.4.4 Wherever possible, a designated break area should be established in an air conditioned space, or in shaded areas where air conditioning is impractical. The break area should be equipped to allow **Employees** to loosen or remove protective clothing, and sufficient seating should be available for all **Employees**. During breaks, **Employees** must be encouraged to drink plenty of water or other liquids, even if not thirsty, to replace lost fluids and to help cool off. Cool water should be available at all times in the break area, and in the work area itself unless hygiene/chemical exposure issues prevent it.

4.5 Symptoms and Treatment

4.5.1 **Employees** who exhibit ANY signs of significant heat stress (e.g., profuse sweating, confusion and irritability, pale, clammy skin) shall be relieved of all duties at once, made to rest in a cool location, and provided with large amounts of cool water.

4.5.2 Anyone exhibiting symptoms of heat stroke (red dry skin, or unconsciousness) must be taken immediately to the nearest medical facility. Steps must be taken to cool the person during transportation (clothing removal, wet the skin, air conditioning, etc.).

4.5.3 Severe heat stress (heat stroke) is a life-threatening condition that must be treated by a competent medical authority.

4.6 Prevention

4.6.1 All **Employees** working in extreme heat or sun should understand the following guidelines for preventing and detecting heat exhaustion and heat stroke.

- Take frequent short breaks in areas sheltered from direct sunlight; eat and drink small amounts frequently.
- Try to schedule work for the coolest part of the day, early morning and evening.

- Avoid strenuous physical activity outdoors during the hottest part of the day.
- Wear a hat and light-colored, loose-fitting clothing to reflect the sun.
- Avoid sudden changes of temperature, refer to *S3NA-511-WI1 Temperature Thresholds*.
- Air out a hot vehicle before getting into it.
- If you take diuretics, ask your doctor about taking a lower dose during hot weather.
- When working in heat, drink 1 quart of water per hour of work.
- Avoid caffeine and alcohol as they increase dehydration.
- Monitor urine frequency and color to detect dehydration, refer to the *S3NA-511-GL1 Dehydration Chart*.

4.6.2 Personal Protective Equipment

- Review the *S3NA-208-PR1 Personal Protective Equipment* procedure.
- Wear a hat and light-colored, loose-fitting clothing to reflect the sun.
- Apply sunscreen to exposed skin (SPF 30 or greater, follow directions on label).
- Wear sunglasses with UV protection.
- Pack extra water to avoid dehydration (try freezing water in bottles overnight to help keep the water cooler for longer during the day).

4.7 Work-Rest Schedule Practices

- Intake of fluid will be increased beyond that which satisfies thirst, and it is important to avoid "fluid debt," which will not be made up as long as the individual is sweating.
- Two 8-ounce glasses of water should be taken prior to beginning work, then up to 32 ounces (1 quart) per hour during the work shift; fluid replacement at frequent intervals is most effective.
- The best fluid to drink is water; liquids like coffee or soda do not provide efficient hydration and may increase loss of water.
- If commercial electrolyte drinks (e.g., Gatorade) are used, the drink should be diluted with water, or 8 ounces of water should be taken with each 8 ounces of electrolyte beverage.
- Additional salt is usually not needed and salt tablets should not be taken.
- Replacement fluids should be cool, but not cold.
- Breaks will be taken in a cool, shaded location, and any impermeable clothing should be opened or removed.
- Dry clothing or towels will be available to minimize chills when taking breaks.
- Manual labor will not be performed during breaks, other than paperwork or similar light tasks.
- Other controls that may be used include:
  - Scheduling work at night or during the cooler parts of the day (6 a.m.–10 a.m., 3 p.m.–7 p.m.).
  - Erecting a cover or partition to shade the work area.
  - Wearing cooling devices such as vortex tubes or cooling vests beneath protective garments. If cooling devices are worn, only physiological monitoring will be used to determine work activity.

4.8 Evaluating the Work-Rest Schedule's Effectiveness

4.8.1 Once a work-rest schedule is established, the **Supervisor** must continually evaluate its effectiveness through observation of **Employees** for signs/symptoms of heart stress. Measurement of each employee's vitals (e.g., pulse, blood pressure, and temperature) can provide additional information in determining if the schedule is adequate, and is accomplished as follows:

- At the start of the workday each employee's baseline pulse rate (in beats per minute [bpm]) is determined by taking a pulse count for 15 seconds and multiplying the result by four or by using an automated pulse count device. Pulse rates can then be measured at the beginning and end of each break period to determine if the rest period allows adequate cooling by applying the following criteria:
  - Each employee's maximum heart rate at the start of any break should be a bpm of less than 180 minus employee's age. If this value is exceeded for any **Employee**, the duration of the following work period will be decreased by at least 10 minutes.
  - At the end of each work period, all employees' heart rates must have returned to within +10% of the baseline pulse rate. If any employee's pulse rate exceeds this value the break period will be extended for at least 5 minutes, at the end of which pulse rates will be remeasured and the end-of-break criteria again applied.
- Use a clinical thermometer or similar device to measure the oral/ear temperature at the beginning (before drinking liquids) and end of each break period and apply the following criteria:
  - If the oral temperature exceeds 99.6 degrees Fahrenheit (°F) (36.6 degrees Celsius [°C]), shorten the next work cycle by one-third without changing the rest period.
  - If the oral temperature still exceeds 99.6°F (36.6°C) at the beginning of the next rest period, shorten the following work cycle by one-third.
- Use of an automated or similar blood pressure device will be used to assess each employee's blood pressure at the beginning and end of each break period to determine if the rest period allows adequate cooling by applying the following criteria:
  - If the blood pressure of an Employee is outside of 90/60 to 150/90, then the **Employee** will not be allowed to begin or resume work; extend the break period by at least five minutes, at the end of which blood pressure rates will be remeasured and the end-of-break criteria again applied.

4.8.2 All physiological monitoring of heat stress will be documented using *S3NA-511-FM1 Heat Stress Monitoring Log*.

4.9 Provision of Water

4.9.1 Water shall be provided (paid) by the project or program; if **Employees** purchase their own drinking water because water is not otherwise available on site, they shall be reimbursed.

4.10 Training

4.10.1 **Employees** and their **Supervisors** that may be exposed to the hazard will be oriented to the hazard and the controls prior to work commencing.

4.10.2 Those **Employees** potentially exposed to heat stress will receive training, refer to the *S3NA-003-PR1 SH&E Training* procedure. Training will include, but is not limited to:

- Sources of heat stress (environmental and personal), influence of protective clothing, and importance of acclimatization;
- How the body handles heat and acclimatization;
- Recognition of heat-related illness symptoms;
- Preventative/corrective measures;
  - Employees will be informed of the harmful effects of excessive alcohol consumption in the prevention of heat stress.
  - All employees will be informed of the importance of adequate rest and proper diet in the prevention of heat stress.

- First aid procedures for heat stress-related illnesses; and
- Immediate reporting of any heat-related incident (injury, illness, near-miss), refer to the *S3NA-004-PR1 Incident Reporting (Americas)* procedure.

5.0 Records

5.1 None

6.0 Attachments

6.1 S3NA-511-WI1 Temperature Thresholds

6.2 S3NA-511-WI2 Symptoms and Treatment

6.3 S3NA-511-FM1 Heat Stress Monitoring Log

6.4 S3NA-511-GL1 Dehydration Chart

6.5 S3NA-511-ST Heat Exposure

Americas

Temperature Thresholds

S3NA-511-WI1

1.0 Work-Rest Schedule

The prevention of heat stress is best performed through Supervisor observation of Employees and routine heat stress awareness training activities. However, it is also necessary to implement a work routine that incorporates adequate rest periods to allow Employees to remove protective clothing, drink fluids (vital when extreme sweating is occurring), rest and recover. The frequency and length of work breaks must be determined by the Supervisor based upon the ambient temperature, amount of sunshine, humidity, the amount of physical labor being performed, the physical condition of the Employees (e.g., acclimated/not), and protective clothing being used.

1.1 Establishing a Work-Rest Schedule:

1.1.1 AECOM permits the use of either of two techniques to initially determine an appropriate daily work-rest schedule. These methods are:

- Wet Bulb Globe Thermometer (WBGT) Method: This method is preferred if a WBGT meter is available.
- Adjusted Temperature Method: This method should be used only if WBGT data is not available.

1.1.2 Either procedure will provide the Supervisor with a recommended routine; however, adjustments to this routine may be required to accommodate the specific daily conditions at the work site.

1.2 WBGT Work-Rest Schedule Guidelines:

1.2.1 Table 1, the Non-CPC Activities WBGT Chart, is intended for use where personnel are not utilizing Chemical Protective Clothing (CPC). Where workers are required to utilize CPC, Table 2, the CPC Activities WBGT Chart, will be used.

1.2.2 WBGT readings are compared directly with the values of the applicable WBGT Chart for the applicable work rate (where light work corresponds to minimal physical activity besides standing/watching; very heavy work corresponds to significant, continuous physical labor) to determine the work-rest frequency.

Table 1. Non-CPC Activities WBGT Chart

Work-Rest Regimen	WBGT			
	Light Work	**Moderate Work**	**Heavy Work**	**Very Heavy Work**
Continuous Work	85°F (29.4°C)	81°F (27.2°C)	78°F (25.6°C)	
75% Work – 25% Rest	86°F (30°C)	83°F (28.3°C)	81°F (27.2°C)	
50% Work – 50% Rest	88°F (31.1°C)	85°F (29.4°C)	83°F (28.3°C)	81°F (27.2°C)
25% Work – 75% Rest	90°F (32.2°C)	87°F (30.6°C)	86°F (30°C)	85°F (29.4°C)

Modified from ACGIH's 20`4 *Threshold Limit Values for Chemical Substances and Physical Agents*, for acclimatized workers

Table 2. CPC Activities WBGT chart

Work-Rest Regimen	WBGT			
	Light Work	**Moderate Work**	**Heavy Work**	**Very Heavy Work**
Continuous Work	74°F (23.3°C)	70°F (21.1°C)	67°F (19.4°C)	
75% Work – 25% Rest	75°F (23.9°C)	72°F (22.2°C)	70°F (21.1°C)	
50% Work – 50% Rest	77°F (25°C)	74°F (23.3°C)	72°F (22.2°C)	70°F (21.1°C)
25% Work – 75% Rest	79°F (26.1°C)	76°F (24.4°C)	75°F (23.9°C)	74°F (23.3°C)

Modified from ACGIH's 2014 *Threshold Limit Values for Chemical Substances and Physical Agents*, for acclimatized workers

1.3 Adjusted Temperature Work-Rest Schedule Guidelines:

This method can be utilized where WBGT data is not available, and requires only that the ambient temperature be known. Adjustment factors are applied to the ambient temperature to account for departures from ideal conditions (sunny conditions, light winds, moderate humidity and a fully acclimated work force). The adjustments will be made by addition or subtraction to the ambient temperature reading, or changes in table position, as indicated in Table 3. Adjustments are independent and cumulative, all applicable adjustments should be applied. The result is the Adjusted Temperature, which can be compared with the values in Table 4 for the applicable work rate (where light work corresponds to minimal physical activity besides standing/watching; very heavy work corresponds to significant, continuous physical labor) to determine the work-rest schedule.

Table 3. Temperature Adjustment Factors

Time of Day	
Before daily temperature peak[1]	+2°F (+1.11°C)
10 am – 2 pm (peak sunshine)	+2°F (+1.11°C)
Sunshine	
No clouds	+1°F (+0.56°C)
Partly Cloudy (3/8 – 5/8 cloud cover)	-3°F (-1.67°C)
Mostly Cloudy (5/8 – 7/8 cloud cover)	-5°F (-2.78°C)
Cloudy (>7/8 cloud cover)	-7°F (-3.89°C)
Indoor or nighttime work	-7°F (-3.89°C)
Wind (*ignore if indoors or wearing CPC*)	
Gusts greater than 5 miles per hour at least once per minute	-1°F (-0.56°C)
Gusts greater than 10 miles per hour at least once per minute	+2°F (+1.11°C)
Sustained greater than 5 miles per hour	-3°F (-1.67°C)
Sustained greater than 10 miles per hour	-5°F (-2.78°C)
Humidity (*ignore if wearing CPC*)	
Relative Humidity greater than 90%	+5°F (+2.78°C)
Relative Humidity greater than 80%	+2°F (+1.11°C)
Relative Humidity less than 50%	-4°F (-2.23°C)
Chemical Protective Clothing (CPC)	
Modified Level D (coveralls, no respirator)	+5°F (+2.78°C)
Level C (coveralls w/o hood, full-face respirator)	+8°F (+4.45°C)
Level C (coveralls with hood, full-face respirator)	+10°F (+5°C)

[1] This adjustment accounts for temperature rise during the day. If the temperature has already reached its daytime peak it can be ignored.

Level B with airline system	+9°F (+5.56°C)
Level B with SCBA	+9°F (+5.56°C) and right one column[2]
Level A	+14°F (+7.78°C) and right one column[2]
Other	Specified in the HASP
Miscellaneous	
Unacclimated work force	+5°F (+2.78°C)
Partially acclimated work force	+2°F (+1.11°C)
Working in shade	-3°F (-1.67°C)
Breaks taken in air conditioned space	-3°F (-1.67°C)

Table 4. Work-Rest Schedule Based on Adjusted Temperature

Work-Rest Regimen	**Adjusted Temperature**			
	Light Work	**Moderate Work**	**Heavy Work**	**Very Heavy Work**
No specified requirements	< 80°F (22.67°C)	< 75 (23.88°C)	< 70 (21.11°C)	< 65 (18.33°C)
15 minute break every 90 minutes of work	80°F – 90°F (22.67°C) - (32.22°C)	75 – 85 (23.88°C) - (29.44°C)	70 – 80 (21.11°C) - (22.67°C)	65 – 75 (37.77°C) - (23.88°C)
15 minute break every 60 minutes of work	>90 – 100 (32.22°C) - (37.77°C)	> 85 – 95 (23.88°C) - (35°C)	>80 – 85 (22.67°C) - (23.88°C)	>75 – 80 (23.88°C) - (22.67°C)
15 minute break every 45 minutes of work	>100 – 110 (37.77°C) - (43.33°C)	>95 – 100 (35°C) - (37.77°C)	>85 – 90 (23.88°C) - (32.22°C)	>80 – 85 (22.67°C) - (23.88°C)
15 minute break every 30 minutes of work	>110 – 115 (43.33°C) - (46.11°C)	>100 – 105 (37.77°C) – (40.55°C)	>90 – 95 (32.22°C) - (35°C)	>85 – 90 (23.88°C) - (32.22°C)
15 minute break every 15 minutes of work	>115 – 120 (46.11°C) - (48.88°C)	>105 – 110 (40.55°C) - (43.33°C)	>95 -100 (35°C) - (37.77°C)	>90 – 95 (32.22°C) - (35°C)
Stop Work	**>120** (48.88°C)	**>110** (43.33°C)	**>100** (37.77°C)	**>95** (35°C)

Note: Time spent performing decontamination or donning/doffing CPC should not be included in calculating work or break time lengths.

[2] Locate the proper column based on work rate, then move one column to the right (next higher work rate) before locating the corresponding adjusted temperature.

Americas

Symptoms and Treatment

S3NA-511-WI2

1.0 Heat Illness Symptoms

1.1 The following are three stages of heat-related illness:

1.1.1 Heat Cramps

Heat cramps are painful muscle cramps caused by over-exertion in extreme heat. Symtpoms include:

- Muscle spasms; and
- Pain in the hands, feet, and abdomen.

1.1.2 Heat Exhaustion

Heat exhaustion is the next stage. Symptoms include:

- Cool, moist, pale, flushed or red skin;
- Heavy sweating;
- Headache;
- Nausea or vomiting;
- Dizziness ;
- Exhaustion;
- Mood changes (irritable, or confused/can't think straight); and
- Fainting

1.1.3 Heat Stroke

Heat exhaustion can sometimes lead to heat stroke, which can be fatal and requires emergency treatment. Heat stroke happens when you stop sweating and your body temperature continues to rise, often to 105 degrees Fahrenheit (°F) (40.5 degrees Celsius [° C]) or higher. Symptoms of heat stroke:

- Vomiting;
- Decreased alertness level or complete loss of consciousness;
- High body temperature (sometimes as high as 105°F [40.5°C])
- Red, hot, usually dry skin
- Lack of or reduced perspiration
- Skin may still be moist or the victim may stop sweating and the skin may be red, hot, and dry;
- Rapid, weak pulse or rapid, strong pulse;
- Rapid, shallow breathing;
- Nausea;
- Dizziness and confusion; and
- Coma.

2.0 Recommended Treatment for Heat Stress-related Illnesses

2.1 Heat Cramps

2.1.1 Treatment for heat cramps includes:

- Gently stretch the cramped muscle and hold the stretch for about 20 seconds, then gently massage the muscle. Repeat these steps if necessary.

- Take more frequent breaks and drink more water.
- Move victim to a cool place.
- Administer drinks of cool water.
- Apply manual pressure to cramped muscles.
- Seek medical attention if symptoms are not alleviated or if more serious problems are indicated.

2.1.2 Heat Exhaustion

Treatment of heat exhaustion includes:

- Get out of the sun to a cool location and drink lots of water, a little at a time.
- Remove or loosen tight clothing.
- If you are nauseated or dizzy, lie down.
- Move the victim to a cool place.
- Remove as much clothing as possible and elevate the feet.
- Administer drinks of cool water and fan to cool.
- Seek medical attention immediately.

2.1.3 Heat Stroke

Treatment of heat stroke, or if a person's temperature exceeds 102°F (38.9 °C) includes:

- Call for immediate medical help and then try to lower the temperature as quickly as possible:
  - Apply cool (not cold) water the person's whole body, then fan the person.
  - Wrap in wet sheet.
  - If available, use cold packs under arms, neck, and ankles
  - Stop cooling once the person's temperature appears to be down; be careful not to overcool.
- Do not give aspirin or acetaminophen to reduce the temperature.
- Treat as a true medical emergency. Seek medical help immediately
- Protect from injury during convulsion.
- Ensure that the person's airway is open.
- Transfer to a medical facility immediately.

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Heat Stress Monitoring Log

S3NA-511-FM1

The purpose of this form is to monitor employees for heat illness. It is the responsibility of the Foreman or Supervisor-in-Charge to ensure that each person completes the required information.

Project Name:					**Foreman/Supervisor:**							**Work/Rest Schedule1:** IN *(min)* OUT *(min)*				
Date:	**Water Provided**[1]		**Acclimated**[2]		**Initial Vitals**[3]	**Vital Signs and Time In/Out**[3] **Celcius/ Farenheit (circle one)**										
Employee Name	Yes	No	Yes	No	**Vitals**	In	Out	**Vitals**	In	Out	**Vitals**	In	Out	**Vitals**	In	Out
					P			**P**			**P**			**P**		
					BP			**BP**			**BP**			**BP**		
					Temp			**Temp**			**Temp**			**Temp**		
					P			**P**			**P**			**P**		
					BP			**BP**			**BP**			**BP**		
					Temp			**Temp**			**Temp**			**Temp**		
					P			**P**			**P**			**P**		
					BP			**BP**			**BP**			**BP**		
					Temp			**Temp**			**Temp**			**Temp**		
					P			**P**			**P**			**P**		
					BP			**BP**			**BP**			**BP**		
					Temp			**Temp**			**Temp**			**Temp**		
					P			**P**			**P**			**P**		
					BP			**BP**			**BP**			**BP**		
					Temp			**Temp**			**Temp**			**Temp**		
					P			**P**			**P**			**P**		
					BP			**BP**			**BP**			**BP**		
					Temp			**Temp**			**Temp**			**Temp**		

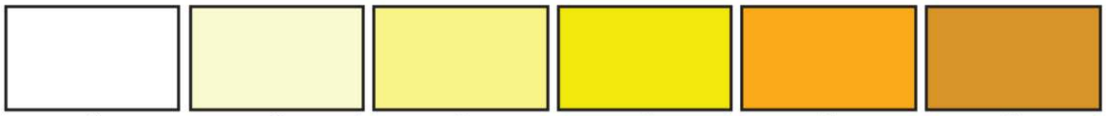
1. Each employee should be provided a sufficient amount of water or sports drink before entering the hot zone. Drinks such as coffee and cola should be discouraged.
2. Am Employee is “acclimated” if he/she has worked in a hot environment for at least 7 to 10 consecutive days. If an Employee is acclimated, check “Yes.” If an Employee is not acclimated, check “No” and reduce the “Min In” by 50 percent for that Employee until the 7- to 10-day period is reached.
3. “Vitals” refers to Employee vital signs (e.g., pulse [P], blood pressure [BP], body temperature [Temp], etc.). Initial vitals must be taken and recorded before the start of work and at each break period, or as specified in the Heat Stress Exposure Control Plan.

Dehydration Chart

S3NA-511-GL1

GUIDANCE TOOL FOR MONITORING DEHYDRATION

URINE COLORATION CHART



1 2	3 4	5 6
Target	Dehydration	Severe Dehydration
CONTINUE DRINKING WATER TO MAINTAIN CURRENT HYDRATION LEVELS.	INCREASE WATER CONSUMPTION TO IMPROVE HYDRATION LEVELS, INCREASE BREAKS FREQUENCY, TAKE BREAKS IN A COOL SHADED AREA.	STOP WORK! FIND A SHADED AREA AND BEGIN TO DRINK COOL TO ROOM TEMPERATURE WATER SLOWLY AND STEADILY.

PREVENTING DEHYDRATION

- Start hydrating at least 3 days prior to working in high heat conditions
- Always bring enough water to maintain hydration. CalOSHA requires consuming 1 quart per hour of your work shift - more may be needed

Note: This information is guidance only and should not supersede the recommendation or instruction of a personal physician or medical professional. Contact your physician or medical professional if you have a personal medical condition or take medication for a personal condition which may be adversely affected by dehydration. Urine color can be affected by medications, vitamins and or other personal health conditions.

Heat Illness Prevention

The following Occupational Health and Safety regulations apply directly to heat stress hazards:

Jurisdiction	Regulation
United States	
OSHA	1910.132
California	8 California Code of Regulations 3395
Canada	
Alberta	n/a
British Columbia	OHS Regulation (1997) Sect 7.28 – 7.32, 8.21, 12.72, 12.73
Manitoba	Workplace Health and Safety Regulation (217/2006) Sect 4.12, 4.13
New Brunswick	OHS Regulation (91-191) Sect 44
Newfoundland/Labrador	OHS Regulation (C.N.L.R. 1165/96) Sect 10
Nova Scotia	n/a
NWT/NU Territories	n/a
Ontario	O. Reg. 213/91 Sect 112 O. Reg. 851 Sect 129 Heat Stress (Health and Safety Guidelines) (April 2003)
Prince Edward Island	OHS Regulations (EC180/87) Sect 42.1
Quebec	OHS Regulation (R.R.Q., c. S-2.1, r.19.01 O.C. 885-2001) Sect 121 – 124, Schedule 4, Schedule 5
Saskatchewan	OHS Regulation (R.R.S., c. O-1, r. 1) Sect 70
Yukon Territory	Occupational Health Regulations (O.I.C. 1986/164) Sect 9, 12

Americas

Respiratory Protection Program

S3NA-519-PR1

1.0 Purpose and Scope

1.1 This procedure establishes a written respiratory protection program with the required elements and work site-specific procedures for respirator selection, use, and maintenance for any workplace where respirators are necessary to protect the health of an **E**mployee.

1.2 Prior to implementation of this program, the primary objective shall be to prevent atmospheric contamination as far as feasible by accepted engineering control measures (e.g. enclosure or confinement of the operation, general and local ventilation, and substitution of less toxic materials).

1.3 This procedure applies to all AECOM Americas-based employees and operations, except where local or governmental regulations are more stringent.

2.0 Terms and Definitions

2.1 **Air-purifying respirator** – A respirator with an air-purifying filter, cartridge, or canister that removes specific air contaminants by passing ambient air through the air-purifying element.

2.2 **Approved** – Equipment tested and listed by the Bureau of Mines, jointly by the Mining Enforcement and Safety Administration (MESA), and the National Institute for Occupational Safety and Health (NIOSH), or jointly by the Mine Safety and Health Administration (MSHA) and NIOSH.

2.3 **Assigned protection factor (APF)** – The ratio of the ambient concentration of an airborne substance (outside the respirator) to the concentration of the substance inside the respirator.

2.4 **Atmosphere-supplying respirator** – A respirator that supplies the user with breathing air from a source independent of the ambient atmosphere, including supplied-air respirators (SARs) and self-contained breathing apparatus (SCBA) units.

2.5 **Breakthrough** – The first perception of an odor, taste or irritation experienced while wearing an air-purifying respirator. Breakthrough is generally an indication that the cartridges are saturated and are no longer filtering out the contaminant. Breakthrough can also be an indication of an improperly functioning respirator.

2.6 **CNP** – Controlled Negative Pressure testing protocol

2.7 **Filtering facepiece (dust mask) –** A negative pressure particulate respirator with a filter as an integral part of the facepiece or with the entire facepiece composed of the filtering medium.

2.8 **Fit factor** – A quantitative estimate of the fit of a particular respirator to a specific individual, typically estimating the ratio of the concentration of a substance in ambient air to its concentration inside the respirator when worn.

2.9 **Fit test –** The use of a protocol to qualitatively or quantitatively evaluate the fit of a respirator on an individual. (See also Qualitative fit test [QLFT] and Quantitative fit test [QNFT].)

2.10 **Hazardous atmosphere –** Any atmosphere, either immediately or not immediately dangerous to life or health, that is oxygen-deficient or that contains a toxic or disease-producing contaminant exceeding the legally established permissible exposure limit (PEL) or, where applicable, the Threshold Limit Value established by the American Conference of Governmental Industrial Hygienists.

2.11 **Immediately dangerous to life or health (IDLH)** – An atmosphere that poses an immediate threat to life, would cause irreversible adverse health effects, or would impair an individual's ability to escape from a dangerous atmosphere.

2.12 **Maximum use concentration (MUC) –** The assigned protection factor (APF) of an approved respirator assembly times the **PEL:** MUC = APF x PEL

2.13 **Negative pressure respirator (tight fitting) –** A respirator in which the air pressure inside the facepiece is negative during inhalation with respect to the ambient air pressure outside the respirator.

2.14 **Oxygen-deficient atmosphere** – An atmosphere with oxygen content below 19.5 percent by volume.

2.15 **Physician or other licensed health care professional (PLHCP) –** An individual whose legally permitted scope of practice (i.e., license, registration, or certification) allows him or her to independently provide or be delegated the responsibility to provide some or all of the health care services required by local or governmental respiratory protection standards.

2.16 **Positive pressure respirator** – A respirator in which the pressure inside the respiratory inlet covering exceeds the ambient air pressure outside the respirator.

2.17 **Powered air-purifying respirator (PAPR)** – An air-purifying respirator that uses a blower to force the ambient air through air-purifying elements to the inlet covering.

2.18 **Pressure demand respirator** – A positive pressure atmosphere-supplying respirator that admits breathing air to the facepiece when the positive pressure is reduced inside the facepiece by inhalation.

2.19 **Qualitative fit test (QLFT)** – A pass/fail fit test to assess the adequacy of respirator fit that relies on the individual's response to the test agent.

2.20 **Quantitative fit test (QNFT) –** An assessment of the adequacy of respirator fit by numerically measuring the amount of leakage into the respirator.

2.21 **Self-contained breathing apparatus (SCBA) –** An atmosphere-supplying respirator for which the breathing air source is designed to be carried by the user.

2.22 **Supplied-air respirator (SAR) or airline respirator** – An atmosphere-supplying respirator for which the source of breathing air is not designed to be carried by the user.

2.23 **Tight-fitting facepiece** – A respiratory inlet covering that forms a complete seal with the face.

2.24 **User seal check** – An action conducted by the respirator user to determine if the respirator is properly sealed to the face.

3.0 References

3.1 Canadian Standards Association (CSA), Z180.1-00, Compressed Breathing Air and Systems

3.2 CSA, Z94.4-02, Selection, Use and Care of Respirators

3.3 Occupational Safety and Health Administration (OSHA), Title 29 Code of Federal Regulation (CFR), Part 1910.134, Respiratory Protection

3.4 OSHA, 29 CFR 1926.103, Respiratory Protection

3.5 S3NA-003-PR1 SH&E Training

3.6 S3NA-506-PR1 Compressed Gases

3.7 S3NA-604-PR1 Medical Records

3.8 S3NA-605-PR1 Medical Surveillance Program

4.0 Procedure

4.1 Roles and Responsibilities

4.1.1 Respiratory Protection Program Administrator

The Americas Safety, Health and Environment (SH&E) Director is the Respiratory Protection Program Administrator.

- Verify full compliance with this standard operating procedure (SOP).

- Determine the need for medical evaluations or any other additional medical attention related to the use of a respirator.
- Perform the program evaluations described in this SOP.

4.1.2 **Office Manager (Operations) / Project Manager /Supervisor**

- Verify compliance with the respiratory protection program set forth in this procedure.
- Verify that only those employees who are medically qualified, properly trained, and fit tested are assigned to respirator work.
- Verify that respirators are provided, repaired, or replaced as may be required due to wear and deterioration.

4.1.3 **Site Safety Officer**

- Confirm that the service is available to respond prior to any employees entering the IDLH area.

4.1.4 **Region SH&E Manager**

- Monitor compliance with the various aspects of this program.
- Provide technical assistance regarding respirator selection and use, evaluate the effectiveness of this program, and support respirator training and fit testing.
- Audit company compliance with this procedure.

4.1.5 **Employee**

- Use respiratory protection in accordance with instructions and training received.
- Maintain the respirator in accordance with this SOP and the manufacturer's instructions.
- Immediately report any malfunction of the respirator to the Supervisor or Project Manager or other responsible person.

4.2 Training

4.2.1 **Employees** who wear respiratory protection must receive training before they are assigned to a task that requires the use of respiratory protection.

4.2.2 **Employees** that may be exposed to a respiratory hazard will be oriented to the hazard and the controls prior to beginning work.

4.2.3 Atmospheric testing will be carried out by someone trained in the use, calibration, and interpretation of the test equipment.

4.2.4 Retraining shall be administered annually, and when the following situations occur:

- Changes in the workplace or the type of respirator render previous training obsolete;
- Inadequacies in the Employee's knowledge or use of the respirator indicate that the Employee has not retained the requisite understanding or skill; or
- Any other situation arises in which retraining appears necessary to verify safe respirator use.

4.2.5 Basic Respirator Training Program

Respirator training classes will include, at a minimum, the following:

- Instruction in the nature of the respiratory hazards, whether acute, chronic, or both, and a description of potential health effects if the respirators are not used;
- Why the respirator is necessary and how improper fit, usage, or maintenance can compromise the protective effect of the respirator;
- The limitations and capabilities of the respirator;

- Proper fitting, including demonstrations and practice in wearing, adjusting, determining the fit of, and performing a user seal check (in accordance with *S3NA-519-WI1 Fit Testing Protocol, S3NA-519-FM1 Respiratory Equipment Fit Test* and *S3NA-519-WI2 User Seal Check Procedures)* each time respirator is donned;
- How to inspect, put on, use and remove the respirator;
- How to use the respirator effectively in emergency situations, including situations in which the respirator malfunctions;
- The procedures for maintenance and storage of the respirator;
- How to recognize medical signs and symptoms that may limit or prevent the effective use of respirators; and
- The general requirements of local or governmental Respiratory Protection Standards.

4.3 Medical Surveillance

4.3.1 No **Employee** shall be assigned to a task that requires the use of a respirator unless it has been determined that he/she is physically able to perform the work while using the required respirator.

4.3.2 Prior to wearing a respirator, **Employees** will complete an initial baseline medical surveillance examination performed by a PLHCP in accordance with the requirements of *S3NA-605-PR1 Medical Surveillance Program.*

4.3.3 Additional medical examinations will be provided to employees who wear respirators when:

- An **Employee** reports medical signs or symptoms that are related to ability to use a respirator;
- A **PLHCP**, **Supervisor**, or the **Respiratory Protection Program Administrator** determines that an Employee needs to be reevaluated;
- Information from the Respiratory Protection Program, including observations made during fit testing and program evaluation, indicates a need for Employee reevaluation; or
- A change occurs in workplace conditions (e.g., physical work effort, protective clothing, temperature, etc.) that may result in a substantial increase in the physiological burden placed on an **Employee**.

4.3.4 All medical surveillance examinations shall occur during normal working hours; shall be convenient, understandable, and confidential; and the **Employee** will be given chance to discuss results with examining physician.

4.4 Respirator Selection

4.4.1 **Project Managers** shall select and provide an appropriate respirator based on the respiratory hazard(s) to which the **Employee** is exposed and workplace or user factors that may affect respirator performance and reliability.

4.4.2 **Project Managers** shall identify and evaluate the respiratory hazard(s) in the workplace. Evaluations shall include a reasonable estimate of employee exposures to respiratory hazard(s) and an identification of the contaminant's chemical state and physical form.

4.4.3 Where the employee exposure cannot be identified or reasonably estimated, the atmosphere shall be considered IDLH.

4.4.4 Only approved respirators shall be selected and they shall be used in compliance with the conditions of their certification.

4.4.5 Respirators shall be selected from a sufficient number of respirator models and sizes so that the respirator is acceptable to, and correctly fits, the user.

4.5 Fit Testing Procedures

4.5.1 **Employees** using a tight-fitting respirator shall pass an appropriate QLFT or QNFT prior to initial use of the respirator, whenever a different respirator facepiece (size, style, model or make) is used, and at least annually thereafter.

4.5.2 Additional fit tests will be performed:

- Whenever there is an indication that changes in the **Employee's** physical condition might have an effect on respirator fit (such conditions include, but are not limited to, facial scarring, dental changes, cosmetic surgery, or an obvious change in body weight);
- If the **Employee** notifies his/her **Supervisor** or **Region SH&E Manager** that the fit of his/her respirator is unacceptable.

4.5.3 The fit test shall be administered using a QLFT or QNFT protocol accepted by local or governmental regulations.

4.5.4 QLFT may only be used to fit test negative pressure air-purifying respirators that must achieve a fit factor of 100 or less.

4.6 Interference with Gas-Tight Seal

4.6.1 The employer shall not permit respirators with tight-fitting facepieces to be worn by **Employees** who have:

- Facial hair that comes between the sealing surface of the facepiece and the face or that interferes with valve function; or
- Any condition that interferes with the face-to-facepiece seal or valve function.

4.6.2 If an **employee** wears corrective glasses or goggles or other personal protective equipment, the **Supervisor** or **Project Manager** shall ensure that such equipment is worn in a manner that does not interfere with the seal of the facepiece to the face of the user.

4.6.3 **Employees** shall perform a user seal check each time they don the respirator.

4.7 Specification of Proper Level of Respiratory Protection

4.7.1 The **Region SH&E Manager** or his/her designated and qualified representative shall provide guidance on the proper selection and use of all respiratory protective devices, including half-face and full-face air purifying respirators, airline respirators, and self-contained breathing apparatus. This information is generally specified as part of the written site-specific Health and Safety Plan (HASP).

4.7.2 **Employees** engaged in activities not covered by a HASP must consult with the **Region SH&E Manager** or his/her designated representative to determine the proper equipment prior to use. Whenever appropriate, exposure levels will be measured to verify that the actual use conditions are within the limitations of the approvals specified by NIOSH/MSHA for the selected respirator.

4.8 Change Out Schedule

Filter cartridges shall be changed out whenever an increase in breathing resistance is detected by the user.

4.8.1 When available, chemical cartridges that are equipped with end-of-service life indicators (ESLI) shall be utilized. In those cases, cartridges should be changed when indicated by the ESLI.

4.8.2 In the absence of cartridges equipped with an ESLI, **employees** shall change chemical cartridges on the following schedule:

- Immediately if breakthrough is perceived; and
- In accordance with the change out schedule based upon the anticipated contaminant concentration, environmental conditions, employee work rate, and the specific data provided by manufacturer.

4.8.3 When PAPRs are worn, the same rules apply with the exception that filter cartridges should be changed when airflow through the filter elements decreases to an unacceptable level, as indicated by the manufacturer's test device.

4.9 Air-Supplying Respirator Use

4.9.1 Air-supplying respirators will be specified for use when it has been determined that any of the following conditions exist:

- The oxygen concentration is less than 19.5 percent;
- The contaminant is unknown or its concentration cannot be quantified;
- The airborne contaminant concentration is above its IDLH;
- An air-purifying respirator canister or cartridge that removes the contaminant is not available;
- The contaminant concentration is above the concentration for which an air-purifying canister or cartridge is approved; or
- The contaminant concentration is above the MUC of a full-face air-purifying respirator.

4.9.2 No **Employee** may engage in an operation requiring the use of an air-supplied respirator unless the **Region SH&E Manager** has reviewed the operation and approved its use.

4.9.3 The determination of the type of air-supplying respirator (i.e., SCBA, airline, demand, pressure demand, etc.) which is appropriate for the job, outside standby persons, communication, proper training and equipment, notification procedures, and necessary action all require planning. Mandatory equipment including SCBA or SAR with auxiliary air supply and emergency appropriate retrieval equipment or equivalent rescue means will be made by the **Region SH&E Manager** or his/her designated representative at the time of review. The need for any additional precautions (i.e., equipment specific training, on-site health and safety support, etc.) will also be determined by the **Region SH&E Manager**.

4.10 Minimum Procedures for IDLH atmospheres

4.10.1 One **Employee** or, when needed, more than one **Employee** shall be located outside the IDLH atmosphere. This **employee** shall be responsible for communicating with the **Employees** in the IDLH atmosphere, alerting rescue services if needed, and restricting entrance to the IDLH area by untrained and unapproved persons.

4.10.2 Visual, voice, or signal line communication shall be maintained between the **Employee**(s) in the IDLH atmosphere and the employee(s) located outside the IDLH atmosphere.

4.10.3 The **Employee**(s) located outside the IDLH atmosphere shall be trained and equipped to provide effective emergency rescue or to initiate on-site rescue services.

4.10.4 If on-site rescue services are to be used, the **Site Safety Officer** shall confirm that the service is available to respond prior to any employees entering the IDLH area.

4.10.5 **Employee**(s) located outside the IDLH area and/or on-site rescue services shall be equipped with:

- Pressure demand or other positive pressure SCBAs, or a pressure demand or other positive pressure supplied-air respirator with auxiliary SCBA; and either
- Appropriate retrieval equipment for removing the employee(s) who enter(s) these hazardous atmospheres where retrieval equipment would contribute to the rescue of the employee(s) and would not increase the overall risk resulting from entry; or
- Equivalent means for rescue where retrieval equipment would create a hazard to the Employees in the IDLH area.

4.11 Breathing Air

4.11.1 Compressed air used for respiration shall be of high purity and shall meet, as a minimum, the requirements of the specification for Grade D breathing air as described in Compressed Gas Association Specification G-7.1 (ANSI Z86.1).

4.11.2 Oxygen shall NOT be used as a source of breathing air at any time in open-circuit SCBAs or airline respirators.

4.11.3 Compressor Supplied Breathing Air

All compressors used for filling SCBA air cylinders or for supplying airline respirators shall be equipped with the following safety and standby devices:

- The compressor intake shall be located to verify that only respirable (uncontaminated) air is admitted. This requires attention to the location of the compressor intake with respect to compressor engine exhaust, chemical storage or use areas, and suitable intake screening or filtration.
- Alarms to indicate compressor failure (such as low-pressure air horns, etc.) shall be installed in the system.
- A receiver of sufficient capacity to enable the respirator wearer to exit from a contaminated atmosphere shall be provided.

If an oil-lubricated compressor is used to supply breathing air, it shall be equipped with both of the following devices:

- A continuous reading carbon monoxide monitoring system set to alarm should the carbon monoxide concentration exceed 10 parts per million; and,
- A high temperature alarm which will activate when the discharge air exceeds 110 percent of the normal operating temperature in degrees Fahrenheit.

An in-line purifying filter assembly to remove oil, condensed water, particulates, odors, and organic vapors shall be used in conjunction with the air compressor.

4.11.4 Routine inspection and maintenance of air compressor shall be performed and documented with the *S3NA-519-FM3 Respiratory Equipment Inspection*. Compressed Air Cylinder Systems for Airline Respirators

- Compressed Air Cylinders shall meet the requirements of S3NA-506-PR1 Compressed Gases
- Compressed air cylinder systems used to supply airline respirators shall be equipped with low pressure warning bells (e.g., Scott Pak-Alarm) or similar warning devices to indicate air pressure in the manifold below 500 pounds per square inch (psi). When such systems are used, one **employee** shall be assigned as safety standby within audible range of the low pressure alarm.
- Airline hose couplings shall be incompatible with outlets for other gas systems to prevent inadvertently supplying airline respirators with nonrespirable gases or oxygen.
- The air pressure at the hose connection to airline respiratory equipment shall be within the range specified in the approval of the equipment by the manufacturer.

4.11.5 Compressed Air Cylinder Systems for Recharging SCBAs

- When a cascade system is used to recharge SCBA air cylinders, it shall be equipped with a high-pressure supply hose and coupling rated at a capacity of at least 3,000 psi.

4.11.6 Escape/Egress Units

- Escape/egress unit respirators are intended for use in areas where escape with a short-term (5 minutes) air supply is necessary.

- They may be used as adjuncts to airline pressure demand respirators as a backup air supply or as independent emergency devices in areas where respiratory protection is not normally required.
- Appropriate training shall be conducted and documented prior to assigning **Employees** to tasks or locations subject to the use of these respirators.
- Escape/egress units (5 minutes) shall never be used to enter a hazardous atmosphere or as primary standby respirators for confined space entry.

4.12 Respirator Inspection, Cleaning, Maintenance, and Storage

When respirator use is required, only properly cleaned and maintained NIOSH/MSHA approved respirators shall be used.

4.12.1 Inspection

- Respirators should be inspected before and after use. Those for emergency use should be inspected once per month.
- All connections, including gaskets, o-rings should be checked for damage and tightness.
- The facepiece should be inspected for cracks and rubber or elastomer parts should be checked for deterioration and pliability.
- All respirators shall be inspected routinely by the user before, during, and after each use. Defects shall be reported to their **Supervisor** or **Project Manager**. No defective respirator shall be issued or worn.
- Routinely used respiratory equipment shall be inspected by an individual qualified by experience or training to do the work.

4.12.2 Cleaning and Maintenance

- Respirator facepiece assemblies shall be cleaned and sanitized minimally after each day of use in accordance with the requirements specified in *S3NA-519-WI3 Respirator Cleaning Procedures*.
- Respiratory equipment shall not be passed from one person to another until it has been cleaned and sanitized.
- Respiratory equipment shall be maintained according to manufacturer's instructions.
- Where respirators are assigned to individual employees, management shall verify compliance with cleaning and maintenance requirements by periodic inspection and field audits of respiratory equipment and document is with the *S3NA-519-FM2 Respiratory Equipment Maintenance Log*.
- The respirator should then be inspected for any damaged parts (repair should only be done by trained personnel with the proper tools) and cleaned with a hot water/mild detergent solution.
- In field situations, a premoistened towelette (e.g., baby wipes) can be used. The mask should then be rinsed with clean warm water and dried.
- Alcohol should never be used to clean masks as it can damage the facepieces and rubber parts.

4.12.3 Storage

- Store clean respirators so that they are protected from dust, excessive moisture, damaging chemicals, temperature extremes and direct sunlight. They should be placed in a sealed plastic bag and stored in the original box.

4.13 Hygiene

Employees must leave the work area to wash, change cartridges, or if they detect breakthrough or resistance.

4.14 Costs

The costs for training, medical examinations, fit testing, respirators, and cleaning materials should be considered as operational costs.

4.15 Program Evaluation

4.15.1 The **Region SH&E Manager** will conduct evaluations of the workplace as necessary to verify that the provisions of the current written program are being effectively implemented and that it continues to be effective.

4.15.2 The **Region SH&E Manager** will regularly (i.e., during annual training) consult **Employees** required to use respirators to assess their views on program effectiveness and to identify any problems. Any problems that are identified during this assessment shall be corrected. Factors to be assessed include but are not limited to:

- Respirator fit (including the ability to use the respirator without interfering with effective workplace performance);
- Appropriate respirator selection for the hazards to which the **Employee** is exposed;
- Proper respirator use under the workplace conditions the **Employee** encounters; and
- Proper respirator maintenance.

5.0 Records

5.1 Medical Records under this section will be maintained at a minimum in accordance with *S3NA-604-PR1 Medical Record*s.

5.2 Fit Test Records must be maintained in the Employee's health and safety records. *S3NA-519-FM1 Respiratory Equipment Fit Test* will be used to document each fit test.

5.3 Training Records shall be maintained in accordance with *S3NA-003-PR1 SH&E Training.*

6.0 Attachments

6.1 S3NA-519-WI1 Fit Testing Protocol

6.2 S3NA-519-WI2 User Seal Check Procedures

6.3 S3NA-519-WI3 Respirator Cleaning Procedures

6.4 S3NA-519-FM1 Respiratory Equipment Fit Test

6.5 S3NA-519-FM2 Respiratory Equipment Maintenance Log

6.6 S3NA-519-FM3 Respiratory Equipment Inspection

Americas

Fit Testing Protocol

S3NA-519-WI1

1.0 Selection

1.1 The Employee shall be allowed to pick the most acceptable respirator from a sufficient number of respirator models and sizes so that the respirator is acceptable to, and correctly fits, the Employee.

1.2 Prior to the selection process, the Employee shall be shown how to put on a respirator, how it should be positioned on the face, how to set strap tension, and how to determine an acceptable fit. A mirror shall be available to assist the Employee in evaluating the fit and positioning of the respirator. This instruction may not constitute the Employee's formal training on respirator use, because it is only a review.

1.3 The Employee shall be informed that he/she is being asked to select the respirator that provides the most acceptable fit. Each respirator represents a different size and shape and if fitted and used properly will provide adequate protection.

2.0 Comfort

2.1 The Employee shall be instructed to hold each chosen face piece up to the face and to eliminate those that obviously do not give an acceptable fit.

2.2 The more acceptable face pieces are noted in case the one selected proves unacceptable; the most comfortable mask is donned and worn at least 5 minutes to assess comfort.

2.3 If the Employee is not familiar with using a particular respirator, he/she shall be directed to don the mask several times and to adjust the straps each time to become adept at setting proper tension on the straps.

2.4 Assessment of comfort shall include a review of the following points with the Employee and allowing he/she adequate time to determine the comfort of the respirator:

- Position of the mask on the nose;
- Room for eye protection;
- Room to talk; and
- Position of mask on face and cheeks.

3.0 Fit Test Criteria

3.1 The following criteria shall be used to help determine the adequacy of the respirator fit:

- Chin properly placed;
- Adequate strap tension, not overly tightened;
- Fit across nose bridge;
- Respirator of proper size to span distance from nose to chin;
- Tendency of respirator to slip; and
- Self-observation in mirror to evaluate fit and respirator position.

3.2 The Employee shall conduct a user seal check, either the negative and positive pressure seal checks described in *S3NA-519-WI2 User Seal Check Procedures* or those recommended by the respirator manufacturer that provide equivalent protection to the procedures in *S3NA-519-WI2 User Seal Check Procedures.*

3.3 Before conducting the negative and positive pressure checks, the Employee shall be told to seat the mask on the face by moving the head from side to side and up and down slowly while taking in a few slow deep breaths. Another face piece shall be selected and retested if the Employee fails the user seal check tests.

3.4 The test shall not be conducted if there is any hair growth between the skin and the face piece sealing surface, such as stubble beard growth, beard, moustache, or sideburns that cross the respirator sealing surface. Any type of apparel that interferes with a satisfactory fit shall be altered or removed.

3.5 If an Employee exhibits difficulty in breathing during the tests, she or he shall be referred to a physician or other licensed health care professional, as appropriate, to determine whether the Employee can wear a respirator while performing her or his duties.

3.6 If the Employee finds the fit of the respirator unacceptable, the Employee shall be given the opportunity to select a different respirator and to be retested.

4.0 Exercise Regimen

4.1 Prior to the commencement of the fit test, the Employee shall be given a description of the fit test and their responsibilities during the test procedure. The description of the process shall include a description of the test exercises that will be performed. The respirator to be tested shall be worn for at least 5 minutes before the start of the fit test.

4.2 The fit test shall be performed while the Employee is wearing any applicable safety equipment that may be worn during actual respirator use and that could interfere with respirator fit.

5.0 General Test Exercises

5.1 The following test exercises are to be performed for all fit testing methods prescribed in this procedure, except for the Controlled Negative Pressure (CNP REDON) method. A separate fit testing exercise regimen is contained in the CNP protocol. The Employee shall perform exercises, in the test environment, in the following manner:

5.1.1 **Normal breathing**. In a normal standing position, without talking, the Employee shall breathe normally.

5.1.2 **Deep breathing.** In a normal standing position, the Employee shall breathe slowly and deeply, taking caution so as not to hyperventilate.

5.1.3 **Turning head side to side.** Standing in place, the Employee shall slowly turn his/her head from side to side between the extreme positions on each side. The head shall be held at each extreme momentarily so the Employee can inhale at each side.

5.1.4 **Moving head up and down.** Standing in place, the Employee shall slowly move his/her head up and down. The Employee shall be instructed to inhale in the up position (i.e., when looking toward the ceiling).

5.1.5 **Talking.** The Employee shall talk out loud slowly and loud enough so as to be heard clearly by the test conductor. The Employee can read from a prepared text such as the Rainbow Passage, count backward from 100, or recite a memorized poem or song.

- Rainbow Passage. "When the sunlight strikes raindrops in the air, they act like a prism and form a rainbow. The rainbow is a division of white light into many beautiful colors. These take the shape of a long round arch with its path high above and its two ends apparently beyond the horizon. There is, according to legend, a boiling pot of gold at one end. People look, but no one ever finds it. When a man looks for something beyond reach, his friends say he is looking for the pot of gold at the end of the rainbow."

5.1.6 **Grimace.** The Employee shall grimace by smiling or frowning. (This applies only to QNFT testing; it is not performed for QLFT.)

5.1.7 **Bending over.** The Employee shall bend at the waist as if he/she were to touch his/her toes. Jogging in place shall be substituted for this exercise in those test environments such as shroud-type QNFT or QLFT units that do not permit bending over at the waist.

5.1.8 **Normal breathing**. In a normal standing position, without talking, the Employee shall breathe normally (this is the same as the first test).

5.2 Each test exercise shall be performed for one minute except for the grimace exercise, which shall be performed for 15 seconds.

5.3 The Employee shall be questioned by the test conductor regarding the comfort of the respirator upon completion of the protocol. If it has become unacceptable, another model of respirator shall be tried.

5.4 The respirator shall not be adjusted once the fit test exercises begin. Any adjustment voids the test and the fit test must be repeated.

6.0 Qualitative Fit Test (QLFT) Protocols

6.1 **General**

- AECOM will ensure that persons administering QLFT are able to calibrate equipment and perform tests properly, recognize invalid tests, and ensure that test equipment is in proper working order.
- AECOM will ensure that that QLFT equipment is kept clean and well maintained so as to operate within the parameters for which it was designed.

6.2 **Irritant Smoke (Stannic Chloride) Protocol**

6.2.1 This QLFT uses a person's response to the irritating chemicals released in the "smoke" produced by a stannic chloride ventilation smoke tube to detect leakage into the respirator.

6.2.2 **General Requirements and Precautions**

- The respirator to be tested shall be equipped with high-efficiency particulate air (HEPA) or P100 series filter(s).
- Only stannic chloride smoke tubes shall be used for this protocol.
- No form of test enclosure or hood for the Employee shall be used.
- The smoke can be irritating to the eyes, lungs, and nasal passages. The test conductor shall take precautions to minimize the Employee's exposure to irritant smoke. Sensitivity varies, and certain individuals may respond to a greater degree to irritant smoke. Care shall be taken when performing the sensitivity screening checks that determine whether the Employee can detect irritant smoke to use only the minimum amount of smoke necessary to elicit a response from the Employee.
- The fit test shall be performed in an area with adequate ventilation to prevent exposure of the person conducting the fit test or the build-up of irritant smoke in the general atmosphere.

6.2.3 **Sensitivity Screening Check**

The Employee to be tested must demonstrate his or her ability to detect a weak concentration of the irritant smoke.

- The test operator shall break both ends of a ventilation smoke tube containing stannic chloride and attach one end of the smoke tube to a low flow air pump set to deliver 200 milliliters per minute or to an aspirator squeeze bulb. The test operator shall cover the other end of the smoke tube with a short piece of tubing to prevent potential injury from the jagged end of the smoke tube.
- The test operator shall advise the Employee that the smoke can be irritating to the eyes, lungs, and nasal passages and instruct the Employee to keep his/her eyes closed while the test is performed.

- The Employee shall be allowed to smell a weak concentration of the irritant smoke before the respirator is donned to become familiar with its irritating properties and to determine if he/she can detect the irritating properties of the smoke. The test operator shall carefully direct a small amount of the irritant smoke in the Employee's direction to determine that he/she can detect it.

6.2.4 **Irritant Smoke Fit Test Procedure**

- The Employee being fit tested shall don the respirator without assistance, and perform the required user seal check(s).
- The Employee shall be instructed to keep his/her eyes closed.
- The test operator shall direct the stream of irritant smoke from the smoke tube toward the face seal area of the Employee, using the low-flow pump or the squeeze bulb. The test operator shall begin at least 12 inches from the facepiece and move the smoke stream around the whole perimeter of the mask. The operator shall gradually make two more passes around the perimeter of the mask, moving to within 6 inches of the respirator.
- If the Employee being tested has not had an involuntary response and/or has not detected the irritant smoke, proceed with the test exercises.
- The General Test Exercises shall be performed by the Employee while the respirator seal is being continually challenged by the smoke, directed around the perimeter of the respirator at a distance of 6 inches.
- If the Employee being fit tested reports detecting the irritant smoke at any time, the test is failed. The Employee being retested must repeat the entire sensitivity check and fit test procedure.
- Each Employee passing the irritant smoke test without evidence of a response (involuntary cough, irritation) shall be given a second sensitivity screening check, with the smoke from the same smoke tube used during the fit test, once the respirator has been removed, to determine whether he/she still reacts to the smoke. Failure to evoke a response shall void the fit test.
- If a response is produced during this second sensitivity check, then the fit test is passed.

7.0 Quantitative Fit Test (QNFT) Protocols

7.1 General

- AECOM will confirm that persons administering QNFT are able to calibrate equipment and perform tests properly, recognize invalid tests, calculate fit factors properly, and ensure that test equipment is in proper working order.
- AECOM will ensure that QNFT equipment is kept clean and is maintained and calibrated according to the manufacturer's instructions so as to operate at the parameters for which it was designed.

7.2 Ambient Aerosol Condensation Nuclei Counter (CNC) Quantitative Fit Testing Protocol

7.2.1 The ambient aerosol CNC quantitative fit testing (Portacount™) protocol quantitatively fit tests respirators with the use of a probe. The probed respirator is only used for QNFTs. A probed respirator has a special sampling device installed on the respirator to allow the probe to sample the air from inside the mask. A probed respirator is required for each make, style, model, and size that the employer uses and can be obtained from the respirator manufacturer or distributor. The CNC instrument manufacturer, TSI Inc., also provides probe attachments (TSI sampling adapters) that permit fit testing in an Employee's own respirator. A minimum fit factor pass level of at least 100 is necessary for a half-mask respirator, and a minimum fit factor pass level of at least 500 is required for a full facepiece negative pressure respirator. The entire screening and testing procedure shall be explained to the Employee prior to the conduct of the screening test.

7.2.2 Portacount Fit Test Requirements

- Check the respirator to make sure the sampling probe and line are properly attached to the face piece and that the respirator is fitted with a particulate filter capable of preventing significant penetration by the ambient particles used for the fit test (e.g., National Institute for Occupational Safety and Health, Title 42 Code of Federal Regulations 84 series 100, series 99, or series 95 particulate filter) according to the manufacturer's instructions.
- Instruct the Employee to be tested to don the respirator for 5 minutes before the fit test starts. This purges the ambient particles trapped inside the respirator and permits the wearer to make certain the respirator is comfortable. This Employee shall already have been trained on how to wear the respirator properly.
- Check the following conditions for the adequacy of the respirator fit: chin properly placed; adequate strap tension, not overly tightened; fit across nose bridge; respirator of proper size to span distance from nose to chin; tendency of the respirator to slip; self-observation in a mirror to evaluate fit and respirator position.
- Have the person wearing the respirator do a user seal check. If leakage is detected, determine the cause. If leakage is from a poorly fitting face piece, try another size of the same model respirator, or another model of respirator.
- Follow the manufacturer's instructions for operating the Portacount and proceed with the test.
- The Employee shall be instructed to perform the exercises in General Test Exercises.
- After the test exercises, the Employee shall be questioned by the test conductor regarding the comfort of the respirator upon completion of the protocol. If it has become unacceptable, another model of respirator shall be tried.

7.2.3 Portacount Test Instrument

- The Portacount will automatically stop and calculate the overall fit factor for the entire set of exercises. The overall fit factor is what counts. The Pass or Fail message will indicate whether or not the test was successful. If the test was a Pass, the fit test is over.
- Since the pass or fail criterion of the Portacount is Employee programmable, the test operator shall confirm that the pass or fail criterion meet the requirements for minimum respirator performance.
- A record of the test needs to be kept on file, assuming the fit test was successful. The record must contain the Employee's name; overall fit factor; make, model, style, and size of respirator used; and date tested.

User Seal Check Procedures

S3NA-519-WI2

1.0 Requirements

1.1 The Employee who uses a tight-fitting respirator is to perform a user seal check to confirm that an adequate seal is achieved each time the respirator is put on.

1.2 Either the positive and negative pressure checks listed here or the respirator manufacturer's recommended user seal check method shall be used.

1.3 User seal checks are not substitutes for qualitative or quantitative fit tests.

2.0 Facepiece Positive and/or Negative Pressure Checks

2.1 **Positive pressure check**

- Close off the exhalation valve and exhale gently into the facepiece.
- The face fit is considered satisfactory if a slight positive pressure can be built up inside the facepiece without any evidence of outward leakage of air at the seal.
- For most respirators, this method of leak testing requires the wearer to first remove the exhalation valve cover before closing off the exhalation valve and then carefully replacing it after the test.

2.2 **Negative pressure check**

- Close off the inlet opening of the canister or cartridge(s) by covering with the palm of the hand(s) or by replacing the filter seal(s), inhale gently so that the facepiece collapses slightly, and hold your breath for 10 seconds.
- The design of the inlet opening of some cartridges cannot be effectively covered with the palm of the hand.
- The test can be performed by covering the inlet opening of the cartridge with a thin latex or nitrile glove.
- If the facepiece remains in its slightly collapsed condition and no inward leakage of air is detected, the tightness of the respirator is considered satisfactory.

3.0 Manufacturer's Recommended User Seal Check Procedures

3.1 The respirator manufacturer's recommended procedures for performing a user seal check may be used instead of the positive and/or negative pressure check procedures, provided that the employer demonstrates that the manufacturer's procedures are equally effective.

Americas

Respirator Clean Procedures

S3NA-519-WI3

1.0 Requirements

1.1 These procedures are general in nature. The cleaning recommendations provided by the manufacturer may be used for the respirators used by their employees, provided such procedures are as effective as those listed here.

1.2 Equivalent effectiveness simply means that the procedures used must accomplish the objectives set forth (i.e., confirm that the respirator is properly cleaned and disinfected in a manner that prevents damage to the respirator and does not cause harm to the user).

2.0 Procedures for Cleaning Respirators

2.1 Remove filters, cartridges, or canisters. Disassemble facepieces by removing speaking diaphragms, demand and pressure-demand valve assemblies, hoses, or any components recommended by the manufacturer. Discard or repair any defective parts.

2.2 Wash components in warm (110 degree Fahrenheit [°F]; 43 degree Celsuis [°C] maximum) water with a mild detergent or with a cleaner recommended by the manufacturer. A stiff bristle (not wire) brush may be used to facilitate the removal of dirt.

2.3 Rinse components thoroughly in clean, warm (110°F [43°C] maximum), preferably running water. Drain.

2.4 When the cleaner used does not contain a disinfecting agent, respirator components should be immersed for 2 minutes in one of the following:

- Hypochlorite solution (50 parts per million [ppm] of chlorine) made by adding approximately one milliliter of laundry bleach to one liter of water at 110°F (43°C); or,
- Aqueous solution of iodine (50 ppm iodine) made by adding approximately 0.8 milliliters of tincture of iodine (6-8 grams ammonium and/or potassium iodide/100 cc of 45 percent alcohol) to one liter of water at 110°F (43°C); or,
- Other commercially available cleansers of equivalent disinfectant quality when used as directed, if their use is recommended or approved by the respirator manufacturer.

2.5 Rinse components thoroughly in clean, warm (110°F [43°C] maximum), preferably running water. Drain. The importance of thorough rinsing cannot be overemphasized. Detergents or disinfectants that dry on facepieces may result in dermatitis. In addition, some disinfectants may cause deterioration of rubber or corrosion of metal parts if not completely removed.

2.6 Components should be hand dried with a clean, lint-free cloth or air dried.

2.7 Reassemble facepiece, replacing filters, cartridges, and canisters where necessary.

2.8 Test the respirator to ensure that all components work properly.

2.9 After the fit test, wipe down the respirator with a sanitary swab.

Americas

Respiratory Equipment Fit Test

S3NA-519-FM1

Date of Testing:		Respirator Type(s):	
Employee Name:		Location:	
Method & Testing Agent:			
Test Exercise	**Pass / Fail**	**Test Exercise**	**Pass / Fail**
Sensitivity Check		Normal Breathing	
Deep Breathing		Turning Head (side to side)	
Moving Head (up/down)		Rainbow Passage*	
Bending Over		Normal Breathing	

Successful Respirator Fit Determined: ☐ **Yes** ☐ **No**

I certify that I have been tested with the respirator(s) listed above. I have also had the opportunity to ask questions and those questions have been answered to my satisfaction. I also understand that the above fit test is voided if respirator limitations are not followed or the respirator is not worn or if conditions (e.g., facial hair) prevent a good face seal.

Employee Signature:	Date:
Signature of Tester:	Date:

***Rainbow Passage.** "When the sunlight strikes raindrops in the air, they act like a prism and form a rainbow. The rainbow is a division of white light into many beautiful colors. These take the shape of a long round arch with its path high above and its two ends apparently beyond the horizon. There is, according to legend, a boiling pot of gold at one end. People look, but no one ever finds it. When a man looks for something beyond reach, his friends say he is looking for the pot of gold at the end of the rainbow."*

Date: Tester:	MSA Comfo II HM S ☐ M ☐ L ☐	MSA Ultra Twin FM S ☐ M ☐ L ☐	North 7700 HM S ☐ M ☐ L ☐	North 7600 FM S ☐ M/L ☐	HM S ☐ M ☐ L ☐	FM S ☐ M ☐ L ☐
Qualitative Test Agent(s): IAA ☐ Smoke ☐	Pass ☐ Fail ☐	Pass ☐ Fail ☐	Pass ☐ Fail ☐	Pass ☐ Fail ☐	Pass ☐ Fail ☐	Pass ☐ Fail ☐
Quantitative Test Device	Overall Fit Factor	Overall Fit Factor	Overall Fit Factor	Overall Fit Factor	Overall Fit Factor	Overall Fit Factor
Date: Tester:	MSA Comfo II HM S ☐ M ☐ L ☐	MSA Ultra Twin FM S ☐ M ☐ L☐	North 7700 HM S ☐ M ☐ L ☐	North 7600 FM S ☐ M/L ☐	HM S ☐ M ☐ L ☐	FM S ☐ M ☐ L ☐
Qualitative Test Agent(s): IAA ☐ Smoke ☐	Pass ☐ Fail ☐	Pass ☐ Fail ☐	Pass ☐ Fail ☐	Pass ☐ Fail ☐	Pass ☐ Fail ☐	Pass ☐ Fail ☐
Quantitative Test Device	Overall Fit Factor	Overall Fit Factor	Overall Fit Factor	Overall Fit Factor	Overall Fit Factor	Overall Fit Factor
Date: Tester:	MSA Comfo II HM S ☐ M ☐ L ☐	MSA Ultra Twin FM S ☐ M ☐ L ☐	North 7700 HM S ☐ M ☐ L ☐	North 7600 FM S ☐ M/L ☐	HM S ☐ M ☐ L ☐	FM S ☐ M ☐ L ☐
Qualitative Test Agent(s): IAA ☐ Smoke ☐	Pass ☐ Fail ☐	Pass ☐ Fail ☐	Pass ☐ Fail ☐	Pass ☐ Fail ☐	Pass ☐ Fail ☐	Pass ☐ Fail ☐
Quantitative Test Device	Overall Fit Factor	Overall Fit Factor	Overall Fit Factor	Overall Fit Factor	Overall Fit Factor	Overall Fit Factor

Instructions
1. Complete the Employee Information at the top of the record (one record per Employee).
2. Enter the date of the test and the name of the person conducting the fit test.
3. Circle the brand and model of respirator tested (e.g., MSA Comfo II, North 7700, etc.) or enter another brand and model in one of the last two columns.
4. Circle the size of the respirator tested.
5. For qualitative fit tests, circle the test agent used - IAA = Isoamyl Acetate, Smoke = Irritant Smoke (Stannic Chloride) and the outcome of the test (i.e., Pass or Fail).
6. For quantitative fit tests, enter the name of the instrument used and the overall fit factor measured by the test.
7. Keep a copy in the Employee's training files and enter subsequent (e.g., annual) tests until the record is filled.

Americas

Respiratory Equipment Maintenance Log

S3NA-519-FM2

Unit No.	Respirator Type	Cleaned	Sterilized	Date	Performed by

Americas

Respiratory Equipment Inspection

S3NA-519-FM3

Date:		**Inspected by:**		
Air Purifier Unit #:				

	N/A	Pass	Fail
Examine Face Piece for:			
Excessive dirt	☐	☐	☐
Cracks, tears, holes, or distortion from improper storage	☐	☐	☐
Inflexibility (stretch and massage to restore flexibility)	☐	☐	☐
Cracked or badly scratched lenses in full facepieces	☐	☐	☐
Incorrectly mounted full facepiece lens or broken or missing mounting clips	☐	☐	☐
Lens sealed properly in receptacle, retaining clamp secured	☐	☐	☐
Cracked or broken air-purifying element holder(s), badly worn threads or missing gasket(s) (if appropriate)	☐	☐	☐
Examine the Head Straps or Head Harness for:			
Breaks	☐	☐	☐
Loss of elasticity	☐	☐	☐
Broken or malfunctioning buckles and attachments	☐	☐	☐
Excessively worn serrations on the head harness that might permit slippage (full facepieces only)	☐	☐	☐
Tears in headband at cradle attachment	☐	☐	☐
Examine the Inhalation and Exhalation Valves for:			
Foreign material, such as detergent residue, dust particles, or human hair under the valve seat	☐	☐	☐
Cracks, tears, or distortion in the valve material	☐	☐	☐
Improper insertion of the valve body in the facepiece	☐	☐	☐
Cracks, breaks, or chips in the valve body, particularly in the sealing surface	☐	☐	☐
Missing or defective valve cover	☐	☐	☐
Examine the Air Purifying Elements for:			
Incorrect cartridge, canister, or filter for the hazard	☐	☐	☐
Incorrect installation, loose connection, missing or worn gaskets, or cross-threading in the holder	☐	☐	☐
Expired shelf life date on cartridge or canister	☐	☐	☐

Defects Noted:		
Unit Deemed Suitable for Use	☐ Yes	☐ No

Americas

Recordkeeping

S3NA-601-PR1

1.0 Purpose and Scope

1.1 Provide the process for compliance with AECOM internal recordkeeping and reporting requirements of occupational injuries and illnesses, outside the scope of Workers Compensation reporting requirements.

1.2 This procedure applies to all AECOM Americas-based employees and operations.

2.0 Terms and Definitions

2.1 **Days Away from Work** – (This definition is for Recordability Purposes only and not for use with Workers Compensation claims.) The number of calendar days the employee was unable to work as a result of the injury or illness, regardless of whether or not the employee was scheduled to work on those day(s). Weekend days, holidays, vacation days or other days off are included in the total number of days.

2.2 **Establishment** – A single physical location where business is conducted or where services or industrial operations are performed. Distinctly separate activities performed at a single location are each treated as a separate establishment for recordkeeping purposes. Therefore, each AECOM permanent office, long-term project office (defined to include project offices that are active for 12 months or more on a continuous basis) and/or laboratory is considered a separate establishment.

2.3 **First Aid** – Any AECOM work-related injury or illness that results in any of the following:

- Using a non-prescription medication at non-prescription strength (for medications available in both prescription and non-prescription form, a recommendation by a physician or other licensed health care professional to use a non-prescription medication at prescription strength is considered medical treatment for recordkeeping purposes);
- Administering tetanus immunizations (other immunizations, such as Hepatitis B vaccine or rabies vaccine, are considered medical treatment);
- Cleaning, flushing or soaking wounds on the surface of the skin;
- Using wound coverings such as bandages, Band-Aids™, gauze pads, etc., or using butterfly bandages or Steri-Strips™ (other wound closing devices such as sutures, staples, etc., are considered medical treatment for recordkeeping purposes);
- Using hot or cold therapy;
- Using any non-rigid means of support, such as elastic bandages, wraps, non-rigid back belts, etc. (devices with rigid stays or other systems designed to immobilize parts of the body are considered medical treatment for recordkeeping purposes);
- Using temporary immobilization devices while transporting an accident victim (e.g., splints, slings, neck collars, back boards, etc.);
- Drilling of a fingernail or toenail to relieve pressure, or draining fluid from a blister;
- Using eye patches;
- Removing foreign bodies from the eye using only irrigation or a cotton swab;
- Removing splinters or foreign material from areas other than the eye by irrigation, tweezers, cotton swabs or other simple means;
- Using finger guards;
- Using massages (physical therapy or chiropractic treatment are considered medical treatment for recordkeeping purposes) (in Canada, massages are not considered first aid unless prescribed by a physician);

- Drinking fluids for relief of heat stress;
- Treating first degree burn(s);
- Applying non-prescription ointments to abrasion to prevent drying or cracking;
- Receiving negative X-ray diagnosis; and
- Conducting a brief observation of injury during visit to medical personnel.

2.4 **H&W** – Health and Wellness

2.5 **Medical Treatment** – Any medical treatment beyond first aid.

2.6 **Restriction of Work** – Occurs when an employee, after the initial day of injury, because of an AECOM work-related injury or illness:

- Is assigned to another job on a temporary basis;
- Works at their permanent job less than full time;
- Works at their permanent job but cannot perform all duties normally performed at least once per week; or
- Performs light duty work at the direction of a Supervisor.

2.7 **Recordable Injuries or Illnesses** – Any AECOM work-related injury or illness that results in any of the following:

- A fatality;
- Medical treatment (beyond first aid);
- Days away from work;
- Restricted work or transfer to another job;
- Loss of consciousness;
- A significant injury or illness as diagnosed by a physician or licensed health care professional (LHCP); and/or
- Recordable injuries or illnesses determined under criteria established in this procedure.

2.8 **Serious Reportable Injury/Illness (SRI)** – Any work-related injury or illness that results in:

- Fatality;
- Amputation;
- Hospitalization for treatment (admission more than 24 hours); or
- A heart attack at work that results in fatality.

2.9 **Significant Diagnosed Injury or Illness** – Significant progressive diseases, such as silicosis and some types of cancer, may not require medical treatment or work restrictions at the time of diagnosis, but are generally considered significant and must be recorded at the initial diagnosis. Likewise, injuries such as a fractured or cracked bone (including teeth), or a punctured eardrum must always be recorded when diagnosed by a medical professional.

2.10 **WCB** – Workers Compensation Board (Canada); known provincially by variations such as WCB, WSIB, CSST, WSCC, etc.

2.11 **Work Related** – Arising from an exposure or occurrence on the employer's premises or other locations where employees are engaged in AECOM work-related activities.

NOTE: Certain State/Province/Territory plans have more stringent reporting rules. Contact the **Region Safety, Health and Environment (SH&E) Manager** for details.

3.0 References

3.1 S2-001-PR1 Incident Reporting (Global Implementing Procedures)

3.2 S3NA-004-PR1 Incident Reporting (Americas)

3.3 S3NA-604-PR1 Medical Records

3.4 IndustrySafe (Incident Reporting System)

3.5 Recordkeeping Guidelines for Occupational Injuries and Illnesses; U.S. Department of Labor, Bureau of Labor Statistics, September, 1986OSHA Title 29, Code of Federal Regulations (CFR), Part 1904, "Recording and Reporting Injuries and Illnesses"

4.0 Procedure

4.1 Roles and Responsibilities

4.1.1 **Employees**

- Responsible for keeping their supervisors informed of any work restrictions until such time that they are returned to full duty.

4.1.2 **Supervisors**

- Report all potentially AECOM work-related illnesses and injuries they are made aware of to their **Region SH&E Manager** through completing an initial incident notification in IndustrySafe, as soon as practical but no later than four hours when they become aware of the incident, refer to *S3NA-004-PR1 Incident Reporting*.
- Report recordable injuries or illnesses to the appropriate **Region SH&E Manager** as soon as reasonably possible but no more than 2 hours after the incident in IndustrySafe or using the forms as referenced in the *S3NA-004-PR1 Incident Reporting* procedure. A recordable event must be reported to IndustrySafe within 24 hours of the occurrence.

4.1.5 **Office (Operations) Managers**

- Assure that the recordkeeping requirements are performed within their facility.

4.1.6 **Region SH&E Managers**

- Provide guidance and support within their regions relative to recordkeeping requirements.
- Track injuries and illnesses within their regions reported to them by Supervisors within their region.
- Reconcile the regional log on a weekly basis with the recordable incidents via IndustrySafe.
- Create appropriate reports to the **Regional Executive** on a quarterly basis, or as necessary, to keep them apprised.
- For U.S.-based offices, review accuracy of the OSHA 300 Log and post in establishments within their Regions.

4.1.7 **Americas SH&E Department**

- Report potential Workers' Compensation claims to the Corporate SH&E Workers Compensation Analyst, AECOM H&W Group or Workers Compensation Agency (i.e. WCB/ WSIB).
- Maintain the permanent records specified including the Supervisors Report of Incident.
- Receive all calls reported through the incident reporting line and report to the **Region SH&E Manager**.
- Participate in recordable team deliberations.

- Audit Database for completeness and accuracy. Make appropriate corrections as required.

4.2 Recordability Determination

4.2.1 **Supervisors** are expected to log potential work-related illnesses and injuries to the **Region SH&E Manager** and **Americas SH&E Department** via IndustrySafe within 2 hours after the incident (refer to the *S3NA- NA-004-PR1 Incident Reporting* (Americas) procedure for more specifics). A recordable event must be reported within 2 hours of the incident occurrence and must be reported to the online incident reporting system (IndustrySafe) within 24 hours of the occurrence. Recordable injuries and illnesses must be reviewed in IndustrySafe by the **Region SH&E Manager** within six calendar days after receiving information of the injury or illness. **Office (Operations) Managers** are responsible to make sure **Employees** know where and how to report incidents in IndustrySafe.

4.2.2 Where there is any doubt and/or debate as to the recordability of a particular case, the **Americas** and/or **Region SH&E Manager** shall always enter the case as a recordable injury in IndustrySafe at the end of the six-calendar-day period.

4.2.3 As additional or new information becomes available, the case will be “red-lined” in IndustrySafe, which automatically appears on the Log. For injuries that cross the recordable threshold in a subsequent year, that injury shall be entered on the log for the year the injury was first evident, up to the 5 years previous.

4.2.4 Due to the complexity of determining the “recordability” of an injury or illness, all decisions regarding potentially “recordable” incidents will be confirmed by **Region SH&E Manager** and **Regional Executive**.

4.2.5 In any situation where the team described above cannot reach a unanimous consensus, the **Americas SH&E Manager** will be notified and be involved in making the final determination.

4.2.6 In order to assist in documenting the decisions made by each team relative to recordability of a case, *S3NA-601-FM1 Recordability Review Form* will be completed and included in IndustrySafe’s permanent case file for incidents requiring review and for medical recordkeeping requirements, refer to *S3-NA-604-PR1 Medical Records* procedure.

4.3 U.S. Federal and State Reporting Requirements

4.3.1 OSHA (29 CFR 1904) requires that serious accidents, which result in a fatality or the hospitalization of an employee, be reported to the OSHA Area Director by the **Region SH&E Manager** within 8 hours of their occurrence. Certain states have more stringent reporting requirements. For example, California OSHA requires the reporting of any injury or illness to one or more employees, occurring in a place of employment or in connection with any employment that requires inpatient hospitalization for a period in excess of 24 hours for other than medical observation, or in which an employee suffers the loss of any member of the body, or suffers any serious degree of physical disfigurement.

4.3.2 All fatalities or serious incidents will be reported in accordance with *S3NA-004-PR1 Incident Reporting*.

4.4 U.S. Injury and Illness Recordkeeping

4.4.1 OSHA (29 CFR 1904) requires that each establishment prepare and maintain records of Recordable Injuries and Illnesses incurred by their employees.

4.4.2 Required Recordkeeping Forms

Specific requirements of this standard include the recording of each Recordable Injury and Illness on the following forms as references:

- OSHA 300 Log (Log of Work-Related Injuries and Illnesses) – One log must be maintained for each establishment.

- OSHA 301 Form (Injury and Illness Incident Report or an equivalent state "employer's first report of injury" form) – One form must be completed for each Recordable Injury and Illness. Incidents need to be classified and recorded upon entry into the log. Final determination needs to be made within 6 calendar days. If there is any doubt, incident will be classified as recordable until further information is received.
- OSHA Form 300A (Annual Summary of Work-Related Injuries and Illnesses) – One form must be completed for each establishment and posted in that establishment during the entire months of February, March and April of the following year for which it applies. The form shall be returned to a permanent establishment file beginning in May.

4.4.3 Copies of the applicable OSHA 300 and OSHA 300A will be maintained at each establishment for a period of 5 years. Electronic copies of these records will also be maintained by the Americas SH&E Department.

4.4.4 The data used to produce these OSHA forms will be maintained centrally by the **Region SH&E Manager**.

4.5 Canadian Reporting Requirements (External)

4.5.1 The **Region SH&E Manager** must immediately and by the fastest means of communication available notify the appropriate government agencies via TeksMed. Refer to your Provincial/Territorial reporting requirements if there is a:

- Serious or Critical Injury;
- Notice of Violation or Compliance Order;
- Explosion or fire occurs and a Employee is disabled or requires medical attention;
- Chemical releases; or
- Dangerous goods (spills).

4.5.2 **Region SH&E Manager** shall submit an Employers Report of Injury to the WCB/WSIB/WSCC/ CSST via TeksMed (Refer to your Provincial/Territorial reporting requirements) if the Employee received:

- Medical evaluation or treatment at a clinic or hospital;
- The Employee's unable to earn full wages after the incident due to the absence from work; and/or
- There is a doctor's order for modified or restricted work.

4.6 OSHA Recordkeeping for Areas outside of U.S.

Although OSHA does not apply outside of the United States, AECOM applies the OSHA recordkeeping regulations globally to maintain a level of consistency with reporting. Even outside of the U.S., OSHA 300 logs are maintained for contracts and programs that are issued under U.S.-contracting agencies. These injuries and illnesses need not be reported to OSHA under the recordkeeping standard, but they will be evaluated for coverage under the applicable workers compensation policy, such as Foreign Workers Compensation or the applicable Defense Base Act policy.

5.0 Records

5.1 Maintained by the SH&E Department and in IndustrySafe.

6.0 Attachments

6.1 S3NA-601-FM1 Recordability Review Form

Americas

Recordability Review Form

S3NA-601-FM1

This form is due within 2 hours of incident	
Name of Injured Employee:	**BL/Region:**
Date of Occurrence:	**Date Reported:**
Cause of Injury/Illness:	
Examined/Treated by Medical Professional: **Yes** ☐ **No** ☐	**Date:**
Name/Address of Treating Medical Professional or Clinic:	
Diagnosis or Nature of Injury/Illness:	
Injury/Illness <u>is Recordable</u> because: (Check and complete ALL that apply)	
☐ The condition is categorized as a work-related injury or illness and has been diagnosed as a specific recordable medical condition.	
☐ The condition is categorized as an injury or illness and required days away from work, hospitalization, or restriction of work. Describe in detail: Hospitalized: Est Total # of Days: Period of Lost Time: Est Total # of Work Days: Period of Restriction: Est Total # of Work Days:	
☐ Other Reason. Describe in detail:	
Injury/Illness <u>is Not Recordable</u> because:	
☐ The injury was minor and required first aid only. Describe in detail:	
☐ The injury/illness is not work-related. Describe in detail:	
☐ Other reason. Describe in detail:	
Completed by: ______________________________, Region SH&E Manager (Print name and sign)	**Date:**
Completed by: ______________________________, Office (Operations) Manager (Print name and sign) (if applicable)	**Date:**

Americas

Incident Investigation and Review

S3NA-603-PR1

1.0 Purpose and Scope

1.1 To provide a consistent approach for the internal investigation of SH&E incidents.

1.2 When AECOM is required by contract to investigate and report findings related to SH&E incidents, the procedure to be followed must be detailed in the project plan and approved by the Region SH&E Manager and Project Manager. Note – The basic requirements of this procedure must be satisfied, in addition to any client and/or contractual requirements, when the incident involves an AECOM employee or other personnel under the direct control of AECOM.

1.3 To ensure that a thorough Root Cause Analyses is performed on the incident and those outcomes of those analyses are acted upon in a timely fashion.

1.4 Ensure that appropriate Lessons Learned are gathered from SH&E incidents and that information is shared regarding lessons learned throughout the organization.

1.5 This procedure applies to all SH&E incidents that involve an AECOM Americas based employee and/or SH&E incidents that involve operations/entities under the direct control of AECOM.

2.0 Terms and Definitions

2.1 **Low/ High Potential** – 'First Aid', 'Medically Treated Injuries', 'Modified Work' or 'Lost Time Injury' can often have the potential to be a 'Fatality' or 'Significant Injury' with disability if the circumstances would have been slightly different. For example, a 'Lost Time' incident due to a back soft tissue injury would only be counted as a 'Lost Time' with 'Low Potential' for a 'Serious Injury', whereas a 'First Aid Incident' involving a remotely operated machine striking a worker and imparting a small cut would be counted as a 'First Aid Incident' with 'High Potential' for a 'Fatality' or 'Significant Injury'. Any injury having the potential to be a 'Fatality' or 'Significant Injury' if the circumstances had been slightly different must be counted as 'High Potential'; all others must be counted as 'Low Potential'. In terms of the Company's Risk Assessment language when the exposure, probability and consequence of the hazard(s) creating the incident calculate to a High or Extreme Risk level, the incident must be counted as a High Potential; all others must be counted as Low Potential.

2.2 **PIA –** A "PIA" is a performance improvement action entry to track follow up of incidents.

2.3 **SH&E Incidents** – A potentially work-related event which is possibly harmful or damaging, may result in personal injury, environmental impact, or loss or may impact the reputation of AECOM or its clients or may result in an investigation by a regulatory agency or insurer, refer to the *S3NA-004-PR1 Incident Reporting.*

3.0 References

3.1 S3NA-004-PR1 Incident Reporting

3.2 S3NA-601-PR1 Recordkeeping

4.0 Procedure

4.1 Roles and Responsibilities

4.1.1 **Lead Investigator**

- Responsible for the **incident investigation.**

4.1.2 **Office Manager (Operations) / Supervisor / Project Manager / Project Director**

- Coordinate Level 1 or 2 incident investigations.
- Participate in Level 3 investigations as requested.

4.1.3 Region SH&E Manager

- Provide technical assistance and support as requested by the Region Executive.
- Track formal corrective action to closure.

4.1.4 Region Executive

- Request an incident investigation.
- Coordinate Level 3 incident investigations under the advice of Americas Legal.
- Issue a final Investigation Report for Level 3 incidents under the advice of Americas Legal

4.1.5 Americas Legal

- Provide direction to the management regarding communication protocol.
- Review any and all written investigation reports (including drafts).

4.2 Determining need for investigation

When determining whether an Incident should be investigated, please refer to the table below:

Note: Set out in the table below are the minimum requirements to be carried out for particular types of incidents. Investigations can be initiated by a Region or by Americas SH&E Director to a stricter standard where required.

Severity Level		Safety & Health	Environment	Regulatory Notice	Commercial/ Brand Exposure	Near Miss	Incident Investigation Required?
Actual Outcome	Potential Outcome						
1	LOW	First Aid Injury only	No environmental damage Environmental hazard identified Minor on site release of pollutant (non-reportable to gov't agency) that immediately remediated with no impact to the environment	Observation	Reputation loss from local staff No disruption to contract	Could have resulted in any Actual or Potential Severity Level 1.	No
2	LOW	Medical Treatment and Other AECOM Recordable Injuries/Illnesses Restricted Time Injury Lost Time Injury < 30 days	Onsite release of pollutant (non-reportable to gov't agency) that is immediately contained and remediated AND does not migrate offsite to land or waterways.	Observation Warning	Reputation loss from local staff Disruption to contract	Could have resulted in any Actual or Potential Severity Level 2.	Yes
3	HIGH	AECOM Serious SH&E Incident Regulatory reportable incident	Onsite or offsite release of pollutant that causes land or water contamination requiring more than day of event remediation. Onsite or offsite release of pollutant that is reportable to a government agency	Fine Violation Corrective Action	Reputation loss to client Local or national media attention	Could have resulted in any Actual or Potential Severity Level 3.	Yes

4.2.1 Severity Level 1 – An incident investigation should be considered and should be:

- Managed at site (office or project) by work group, and
- Involve a representative from Americas SH&E department for consultation.

4.2.2 Severity Level 2 – An incident investigation is required and should be:

- Managed at site (office or project) by work group, and
- Involve appropriate regional operations and business line personnel for review and confirmation of findings and recommended corrective/preventative actions.
- Involve **Region SH&E Manager** for consultation and assistance in conducting the investigation and developing recommended corrective/preventative actions.

4.2.3 Severity Level 3 – An incident investigation is a mandatory requirement and must be:

- Managed by the region under the direction of **Americas Legal**; and
- Americas SH&E department must be involved in consultation and review.

4.2.4 High Potential incidents – Any incident deemed to be High Potential must be investigated regardless of the actual outcome. **Americas Legal** must also be informed.

4.3 Identify appropriate investigation team

An incident investigation can be triggered for any incident with the agreement from the relevant **Region Executive**, **Office Manager (Operations)** and the **Region SH&E Manager**. The following points below dictate the composition of the investigation teams' dependent on the severity of the incident.

4.3.1 Severity Level 1 and Severity Level 2 Investigations (Actual or Potential) – Investigations shall be coordinated by the **Project Manager** (field-related incidents) and/or responsible **Supervisor** or **Office Manager (Operations)** (office-related incidents). The **Region SH&E Manager** shall provide technical assistance and support as requested. Investigations shall be conducted at the discretion of the responsible **Supervisor** or **Office Manager (Operations)**. Recommended team members include:

- **Project Director;**
- **Region Executive;**
- **Region SH&E Manager; and**
- **Subject matter experts**.

Note: Incident review calls for all Severity Level 1 Incidents area at the discretion of the responsible regional management and SH&E department. Review calls for all Severity Level 2 Incidents are required.

4.3.2 Severity Level 3 (Actual or Potential) – Investigations shall be coordinated by the responsible **Region Executive** under the direction of **Americas Legal** and involve the **Project Manager** (field-related incidents) and/or responsible **Supervisor** or **Office Manager (Operations)** (office-related incidents). The **Region SH&E Manager** and appropriate subject matter experts shall provide technical assistance and support as requested by the **Region Executive**.

4.3.2.1 Investigations must be performed under the direction of **Americas Legal** and in compliance with the communication protocol.

4.3.2.2 An investigation review teleconference call shall be held for any Fatality or Serious SH&E Incidents. The purpose of the call will be to review the preliminary investigation report.

4.3.2.3 The investigation review conference call will be arranged by the **Region Executive** through the office of **Americas Chief Executive**. Timing for the call is no later than 10 calendar days following classification of the incident as a Fatality or Serious Incident by the **Region SH&E Manager** (unless otherwise directed by **Americas Chief Executive**, **Americas Legal** or **Americas SH&E Director**).

4.3.2.4 Required participants for the call will include:

- **Americas Chief Executive, responsible Regional Executive;**
- **Americas Legal;**
- **Responsible Supervisor** or **Project Manager** of the injured/involved employee**;**
- **Region SH&E Manager** and
- **Americas SH&E Director.**
- Other participants may include, at the discretion of the **Americas Chief Executive**:
  - **Americas HR Director**
  - **Relevant subject matter experts; or**
  - **Members of AECOM Enterprise Management Team.**

4.3.2.5 Following the investigation review teleconference call, the **Americas Chief Executive** and **Region Executive**, under the direction of **Americas Legal**, shall issue a final Investigation Report to the **AECOM Chief Corporate Officer** and **Americas VP, SH&E**[BL1].

4.3.2.6 Corrective actions identified by the investigation process must be formally tracked to closure by the **Region SH&E Manager**.

4.4 Investigation Team Procedures – All Investigations

- The team will follow an appropriate investigation technique (as agreed to by the **Lead Investigator, Region SH&E Manager** and **Americas Legal**) to determine the following:
  - Sequence of events leading up to the incident and steps followed immediately following the incident that may have had an impact on the final outcome.
  - Identification of the People, Environment, Equipment, Procedures, Organization and other factors involved in the incident, refer to *S3NA-603-WI Incident Investigation Process Checklist and Guideline*.
  - Determination of direct cause(s) and root causes using techniques agreed to by the **Lead Investigator** and **Region SH&E Manager,** refer to and example *S3NA-603-WI2 Root Cause Worksheet***.** (Note: Example root cause investigation tools include "5 Why's", TapRoot, Why Tree, Fishbone Diagram, etc.).
- The Investigation Team will prepare a preliminary report, signed by the **Lead Investigator**, documenting all findings and recommended corrective actions within 10 calendar days following the incident unless otherwise agreed by the **Lead Investigator** and **Region SH&E Manager**. All Severity Level 3 communications and reports shall be prepared at the direction of **Americas Legal** and shall be marked "Attorney Client Privileged Communication".
- The report format for all incidents classified as Severity Level 3 will follow the sample template provided in *S3NA-603-FM1 Incident Investigation Report, S3NA-603-WI1 Incident Investigation Process Checklist and S3 NA-603-FM2 Accident – Incident Statement Form*. All other reports will be at the discretion of the responsible **Region SH&E Manager**.
- Note: Incident Review Calls are designed to summarize the preliminary investigation findings and come to agreement on contributing factors, root causes and appropriate corrective actions. Direct participation by the employee(s) involved in the incident is not necessary and requires prior approval from the Senior Manager assigned to the incident review committee. Other members of the incident review committee will be at the discretion of the most Senior Manager involved in the committee (typically the **Region Executive,** the **Region SH&E Manager**) and **Americas Legal**.

4.4.1 Communication of Investigation Results

- Any and all written investigation reports (including drafts) must first be reviewed by **Americas Legal**. All drafts shall include "Attorney-Client Work-Product Privilege" at the top of such reports.
- Where appropriate based on the type, severity and/or scope of the incident, a formal Alert should be prepared by the **Lead Investigator** and responsible **Region SH&E Manager**. The Alert will be communicated to the most appropriate audience (i.e., regional, national, business line only, etc.).
- Action items and corrective actions identified by the investigation teams will be tracked to completion by the responsible **Region SH&E Manager**. Additionally, the results will be utilized by the SH&E department to develop appropriate regional, national and business line level reports and to improve existing procedures.
- Where required by local legislation and/or regulation or contract requirements, final incident investigation reports shall be provided to the appropriate workplace safety committees.
- When necessary, develop and complete Performance Improvement Actions based on investigation findings and develop and distribute appropriate lessons learned for release throughout the organization.

4.5 Communication protocol within AECOM about a Severity Level 3 incident

It is important that communication within AECOM be carefully managed following a Severity Level 3 incident.

- Before creating any written documentation relating to a Severity Level 3 incident, **Employees** should contact the **Project Manager** or **Supervisor** to ascertain how communication should be handled in relation to that particular incident.
- It is preferable for any initial communications (i.e., communication which occurs within the first hour of an incident occurring) from **Employees**, or contractor or subcontractor personnel to be conducted by telephone, with **Americas Legal** representatives on the line until such time as an **Employee** is appointed as central point of contact to avoid confusion and unnecessary documentation. If you witness a serious incident, you should contact your **Project Manager** or **Supervisor** by telephone immediately. The **Supervisor** is to then notify the **Region SH&E Manager** or if not available the **Americas SH&E Director**. SH&E Department will coordinate with **Americas Legal** representatives.
- In some cases, it will be appropriate for a Severity Level 3 incident response and investigation to be carried out under legal professional privilege. This will occur where AECOM contemplates actual or anticipated legal proceedings arising from an incident and is seeking legal advice on its position. Where an investigation is conducted under legal professional privilege, it is important to ensure that all communication is also copied to AECOM internal and/or external Legal representatives and is marked "Attorney-Client Work-Product Privilege".
- **Employees** should be aware that all written communication (including emails) and documents created as a result of the incident can be obtained by government agencies, such as US-OSHA, US-EPA, US-DOT, etc. as well as the client and injured third parties and used to form part of an investigation into the incident. For this reason, **Employees** should always record factual information *only* and avoid speculation as to the cause of an incident in any documentation. Verbal communication related to the incident should also be restricted to those persons who have a role related to the investigation and limited to the identification of facts, not speculation as to fault.

5.0 Records

5.1 All files from the incident investigation are to be maintained in the master file as defined in *S3NA-601-PR1 Recordkeeping* or as otherwise directed by Americas Legal.

6.0 Attachments

6.1	S3NA-603-WI1	Incident Investigation Process Checklist and Guideline
6.2	S3NA-603-WI2	Root Cause Worksheet
6.3	S3NA-603-FM1	Incident Investigation Report
6.4	S3NA-603-FM2	Accident – Incident Statement Form
6.5	S3NA-603-TP1	Sample Incident Investigation Report

Americas

Incident Investigation Process Checklist and Guideline

S3NA-603-WI1

- ☐ Determine Investigation Team (i.e., those to be involved in conducting the investigation).
- ☐ Gather documentation/information as soon as possible to avoid 'decay' of information.
- ☐ Interview appropriate personnel to confirm event FACTS and reveal causal factors.
- ☐ Prepare an Events & Conditions Timeline to ensure EXACT event details understood.
- ☐ Determine what 'defences' failed to prevent the event from occurring.
- ☐ Determine what 'human', 'conditional' and 'task' factors contributed to the incident.
- ☐ Determine what PROCESS (Systems) can be improved to prevent recurrence.
- ☐ Team to devise CORRECTIVE ACTIONS.
- ☐ Initiate CORRECTIVE and PREVENTATIVE ACTIONS into the PIA database in Enviance.

Collecting Information Guideline

Use the prompt boxes below to ensure information is collected from all available sources

People	Review personnel records (work history, training, time sheets, medical etc.) as required. Try to identify all the people who might have information about the event and get statements from them as soon as possible. Interview people individually away from distractions. If possible interview them at the scene of the Event to confirm at the scene information.
Ask Interviewees: • Fully describe work and conditions leading up to the Event. • Fully describe the Event sequence – start to finish. • Note anything unusual observed prior to Event (sights, sounds). • What was your role in the Event sequence? • What conditions influenced the Event (weather, time, equip, etc.) • How did people influence the Event (actions, emergency response, etc?) • What do you think caused the Event? • How do you think the Event could have been prevented? • List other possible witnesses. • Any additional comments/observations	**Determine:** • Were those involved in the Event experienced in the task? • Had they been adequately trained? • Are they physically capable of conducting the task? • What was the status of their health? • Was fatigue a factor? • Were they under stress or time pressures (work or personal)?

Environment	Examine the scene of the Event for information and to help understand the nature of the task being conducted and the local environmental conditions. The physical environments, especially sudden changes to that environment, are factors that need to be identified. The situation at the time of the Event is important, not the "usual" conditions.
Determine: • What were the weather conditions? • Was housekeeping a problem? • Was it too hot or too cold?	• Was noise a problem? • Was there adequate light? • Were toxic or hazardous gases, dusts, or fumes present?

Equipment	Examine equipment involved in the Event looking at the condition of equipment, anything that may have changed or be out of the ordinary (e.g., abnormal stress, modifications, substitutions, distortions, fractures, etc.). Identify any design flaws, mismatched components or confusing labelling or marking. Ensure that the equipment was appropriate for the task.
Determine: • Was there an equipment failure? • What caused it to fail? • Was the machinery poorly designed? • Were hazardous substances involved? Were they clearly identified?	• Was a less hazardous substance possible and available? • Was the raw material substandard in some way? • Should personal protective equipment (PPE) have been used? Was the PPE used?

Procedures	Review the task that was being conducted. Examine work procedures, scheduling of the work to see whether they contributed to the Event. Examine the availability, suitability, use and supervisory requirements of procedures.

Determine:

- Was a safe work procedure used?
- Were written procedures available?
- Was a JSA conducted as part of the planning prior to the task?

Had conditions changed to make the normal procedure unsafe?

- Were the appropriate tools and materials available?
- Were they used?
- Was lockout used when necessary?

Were safety devices working properly?

Organization	Management holds the legal responsibility for the safety of the workplace and the workforce. The role of supervisors and management must always be considered in an Event investigation.

Determine:

- Who had the responsibility for control over the site?
- Were safety rules communicated /understood by all employees?
- Were they being enforced?
- Was there adequate supervision?
- Were workers trained to do the work? When? Still valid?

Had hazards been previously identified?

- Had procedures been developed to overcome them?
- Were unsafe conditions corrected?
- Was regular maintenance of equipment carried out?
- Were regular safety inspections carried out?

Any changes to equipment, environment, people or procedures.

Investigation Categories Guideline

Check off conditions below that were related to this event.

Copy each condition into Part B of the Incident Investigation Report S3NA-603-FM1.

ABSENT OR FAILED DEFENSES

Identify the Defense factors that allowed the outcome. Defenses are those factors that are designed to detect and protect the overall system from the results of human or technical failures, that is, they are the "last minute" protection measures designed to avoid or mitigate and outcome.

Check question: ***Does the item describe the equipment, work process, control measure, detection system, procedure or attribute which normally prevents this Event or limits the consequences?***

Questions:		*Event Facts: (Tick One)*	*Questions:*		*Event Facts: (Tick One)*
DF01	*Protection systems?*	☐ Absent/Failed ☐ N/A	DF05	*PPE?*	☐ Absent/Failed ☐ N/A
DF02	*Warning systems?*	☐ Absent/Failed ☐ N/A	DF06	*Safety Device Ops?*	☐ Absent/Failed ☐ N/A
DF03	*Guards or barriers?*	☐ Absent/Failed ☐ N/A	DFD7	*ADF Other?*	☐ Absent/Failed ☐ N/A
DF04	*Escape systems?*	☐ Absent/Failed ☐ N/A			

INDIVIDUAL / TEAM ACTIONS

Identify the individual/team actions that contributed to or caused the Event. These are the errors or violations that led directly to the Event. They are typically associated with personnel having direct contact with the equipment, such as operators or maintenance personnel. They are always committed 'actively' (someone did or didn't do something) and have a direct relation with the Event.

Check question: ***Does the item tell you about a potential error or violation of a standard or procedure made in the presence of or contributing to a hazard?***

Questions:		*Event Facts: (Tick One)*	*Questions:*		*Event Facts: (Tick One)*
IT01	*Supervision?*	☐ Error/Violation ☐ N/A	IT07	*Horseplay?*	☐ Error/Violation ☐ N/A
IT02	*Operating Authority?*	☐ Error/Violation ☐ N/A	IT08	*Materials Handling?*	☐ Error/Violation ☐ N/A
IT03	*Operating speed?*	☐ Error/Violation ☐ N/A	ITD9	*Hazard Recog. Perception?*	☐ Error/Violation ☐ N/A
IT04	*Equipment use?*	☐ Error/Violation ☐ N/A	IT10	*Risk Mgmt.*	☐ Error/Violation ☐ N/A
IT05	*PPE Use?*	☐ Error/Violation ☐ N/A	IT11	*Other*	☐ Error/Violation ☐ N/A
IT06	*Procedural Compliance?*	☐ Error/Violation ☐ N/A			

TASK/ENVIRONMENTAL CONDITIONS

Identify the Task/Environmental conditions that contributed to the Event. These are the conditions in existence immediately prior or at the time of the Event. These are the conditions that directly influence human and equipment performance in the workplace. These are the circumstances under which the errors and violations took place and can be embedded in task demands, the work environment, individual capabilities and human factors.

Check question: ***Does this item describe something about the task demands, work environment, individual capabilities or human factors that promoted errors / violations or undermined the effectiveness of system's Defenses?***

Questions:		Event Facts: (Tick One)	Questions:		Event Facts: (Tick One)
HF01	*Complacency/Attitude Motiv'n*	☐ Contributor ☐ N/A	TW01	*Task Analysis/Take Two*	☐ Contributor ☐ N/A
HF02	*Drugs/Alcohol Influence*	☐ Contributor ☐ N/A	TW02	*Work Procedures*	☐ Contributor ☐ N/A
HF03	*Fatigue*	☐ Contributor ☐ N/A	TW03	*Permit to Work (Avail/Suit.)*	☐ Contributor ☐ N/A
HF04	*Time/Production Pressures*	☐ Contributor ☐ N/A	TW04	*Routine/Non-routine Task*	☐ Contributor ☐ N/A
HF05	*Peer Pressure*	☐ Contributor ☐ N/A	TW05	*Tools/Equipment/Materials*	☐ Contributor ☐ N/A
HF06	*Physical/Mental Capability*	☐ Contributor ☐ N/A	TW06	*Training*	☐ Contributor ☐ N/A
HF07	*Physical/Mental Stress*	☐ Contributor ☐ N/A	TW07	*Housekeeping*	☐ Contributor ☐ N/A
HF08	*Distraction/ Pre-occupation*	☐ Contributor ☐ N/A	TW08	*Weather Conditions*	☐ Contributor ☐ N/A
HFD9	*Competency/Experience./Skill*	☐ Contributor ☐ N/A	TW09	*Congestion, Access*	☐ Contributor ☐ N/A
HF10	*Inadequate communications*	☐ Contributor ☐ N/A	TW10	*Surface Gradient/Conditions*	☐ Contributor ☐ N/A
HF11	*Tolerance of Violations*	☐ Contributor ☐ N/A	TW11	*Lighting*	☐ Contributor ☐ N/A
HF12	*Change of Routine*	☐ Contributor ☐ N/A	TW12	*Temperature*	☐ Contributor ☐ N/A
HF13	*Other Human Factor*	☐ Contributor ☐ N/A	TW13	*Noise*	☐ Contributor ☐ N/A
HF14	*Task Planning/ Preparation*	☐ Contributor ☐ N/A	TW14	*Gas, Dust, Chemical or Fumes*	☐ Contributor ☐ N/A

ORGANIZATIONAL/SYSTEM FACTORS

Identify the Organizational Factors that contributed to the Event. These are the underlying organizational factors which produce the task / environmental conditions that affect performance in the workplace. These may include fallible management decisions, processes and practices.

Check question: ***Does this item identify a standard Organizational Factor present before the Event and which resulted in the task / environmental conditions or allowed those conditions to go un-addressed?***

Questions:		Event Facts: (Tick One)	Questions:		Event Facts: (Tick One)
OS01	*Hardware*	☐ Contributing ☐ N/A	OS07	*Maintenance Management*	☐ Contributing ☐ N/A
OS02	*Training*	☐ Contributing ☐ N/A	OS08	*Design*	☐ Contributing ☐ N/A
OS03	*Organizational Structure*	☐ Contributing ☐ N/A	OS09	*Risk Management*	☐ Contributing ☐ N/A
OS04	*Communication*	☐ Contributing ☐ N/A	OS10	*Management of Change*	☐ Contributing ☐ N/A
OS05	*Incompatible Goals*	☐ Contributing ☐ N/A	OS11	*Contractor Management*	☐ Contributing ☐ N/A
OS06	*Procedures*	☐ Contributing ☐ N/A	OS12	*Other Org./System Factor*	☐ Contributing ☐ N/A

Root Cause Worksheet

Initial Incident Report

- Document the type/severity of event
- Cover the who/what/when/where/how as known at the time

Investigation and Research Phase

- Gather relevant evidence
- Investigate - direct evidence (scene and witnesses)
- Research - indirect evidence (written sources)
- Consider People/Parts/Position/Paper

Analytical Phase:

Identification of Critical Factors

- Organize all evidence
- Map evidence
- Identify critical factors
- Use list of causes to identify all immediate and system causes

Immediate Causes

1	**Following Procedures**
1-1	Violation by individual
1-2	Violation by group
1-3	Violation by supervisor
1-4	Operation of equipment without authority
1-5	Improper position or posture for the task
1-6	Overexertion of physical capability
1-7	Work or motion at improper speed
1-8	Improper lifting
1-9	Improper loading
1-10	Shortcuts
1-11	Other
2	**Use of Tools or Equipment**
2-1	Improper use of equipment
2-2	Improper use of tools
2-3	Use of defective equipment (aware)
2-4	Use of defective tools (aware)
2-5	Improper placement of tools, equipment or materials
2-6	Operation of equipment at improper speed
2-7	Servicing of equipment in operation
2-8	Other
3	**Use of Protective Methods**
3-1	Lack of knowledge of hazards present
3-2	Personal protective equipment not used
3-3	Improper use of proper personal protective equipment
3-4	Servicing of energized equipment
3-5	Equipment or materials not secured
3-6	Disabled guards, warning systems or safety devices
3-7	Removal of guards, warning systems or safety devices
3-8	Personal protective equipment not available
3-9	Other
4	**Inattention/Lack of Awareness**
4-1	Improper decision making or lack of judgment
4-2	Distracted by other concerns
4-3	Inattention to footing and surroundings
4-4	Horseplay
4-5	Acts of violence
4-6	Failure to warn
4-7	Use of drugs or alcohol
4-8	Routine activity without thought
4-9	Other
5	**Protective Systems**
5-1	Inadequate guards or protective devices
5-2	Defective guards or protective devices
5-3	Inadequate personal protective equipment
5-4	Defective personal protective equipment
5-5	Inadequate warning systems
5-6	Defective warning systems
5-7	Inadequate isolation of process or equipment
5-8	Inadequate safety devices
5-9	Defective safety devices
5-10	Other
6	**Tools, Equipment & Vehicles**
6-1	Defective equipment
6-2	Inadequate equipment
6-3	Improperly prepared equipment
6-4	Defective tools
6-5	Inadequate tools
6-6	Improperly prepared tools
6-7	Defective vehicle
6-8	Inadequate vehicle for the purpose
6-9	Improperly prepared vehicle
6-10	Other
7	**Work Exposures to**
7-1	Fire or explosive
7-2	Noise
7-3	Energized electrical systems
7-4	Energized systems, other than electrical
7-5	Radiation
7-6	Temperature extremes
7-7	Hazardous chemicals
7-8	Mechanical hazards
7-9	Clutter or debris
7-10	Storms or acts of nature
7-11	Slippery floors or walkways
7-12	Other
8	**Work Place Environmental/Layout**
8-1	Congestion or restricted motion
8-2	Inadequate or excessive illumination
8-3	Inadequate ventilation
8-4	Unprotected height
8-5	Inadequate work place layout - controls less than adequate - displays less than adequate - labels less than adequate - locations out of reach or sight - conflicting information is presented
8-6	Other

System Causes
Personal Factors

1 Physical Capability

1-1 Vision deficiency

1-2 Hearing deficiency

1-3 Other sensory deficiency

1-4 Reduced respiratory capacity

1-5 Other permanent physical disability

1-6 Temporary disabilities

1-7 Inability to sustain body positions

1-8 Restricted range of body movement

1-9 Substance sensitivities or allergies

1-10 Inadequate size or strength

1-11 Diminished capacity due to medication

1-12 Other
~ not applicable

2 Physical Condition

2-1 Previous injury or illness

2-2 Fatigue
• due to workload
• due to lack of rest
• due to sensory overload

2-3 Diminished performance
• due to temperature extremes
• due to oxygen deficiency
• due to atmospheric pressure variation

2-4 Blood sugar insufficiency

2-5 Impairment due to drug or alcohol

2-6 Other
~ not applicable

3 Mental State

3-1 Poor judgment

3-2 Memory failure

3-3 Poor coordination or reaction time

3-4 Emotional disturbance

3-5 Fears or phobias

3-6 Low mechanical aptitude

3-7 Low learning aptitude

3-8 Influenced by medication

3-9 Other
~ Not applicable

4 Mental Stress

4-1 Preoccupation with problems

4-2 Frustration

4-3 Confusing directions/ demands

4-4 Conflicting directions/ demands

4-5 Meaningless or degrading activities

4-6 Emotional overload

4-7 Extreme judgment/ decision demands

4-8 Extreme concentration/ perception demands

4-9 Extreme boredom

4-10 Other
~ not applicable

5 Behavior

5-1 Improper performance is rewarded
• saves time or effort
• avoids discomfort
• gains attention

5-2 Improper supervisory example

5-3 Inadequate identification of critical safe behaviors

5-4 Inadequate reinforcement of critical safe behaviors
• proper performance is criticized
• inappropriate peer pressure
• inadequate performance feedback
• inadequate disciplinary process

5-5 Inappropriate aggression

5-6 Improper use of production incentives

5-7 Supervisor implied haste

5-8 Employee perceived haste

5-9 Other
~ not applicable

6 Skill Level

6-1 Inadequate assessment of required skills

6-2 Inadequate practice of skill

6-3 Infrequent performance of skill

6-4 Lack of coaching on skill

6-5 Insufficient review of instruction to establish skill

6-6 Other
~ not applicable

System Causes
Job Factors

7 Training/ Knowledge Transfer

7-1 Inadequate knowledge transfer:
• inability to comprehend
• inadequate instruction qualifications
• inadequate training equipment
• misunderstood instructions

7-2 Inadequate recall of training material
• training not reinforced on the job
• inadequate refresher training frequency

7-3 Inadequate training effort
• inadequate training program design
• inadequate training goals/objectives
• inadequate new employee orientation
• inadequate initial training
•inadequate means to determine if qualified for job

7-4 No training provided
• need for training not identified
• training records incorrect or out of date
• new work methods introduced without training
• decision made not to train

Other
~ not applicable

8 Management/ Supervision / Employee Leadership

8-1 Conflicting roles/ responsibilities
• unclear reporting relationships
• conflicting reporting relationship
• unclear assignment of responsibility
• improper or insufficient delegation of authority

8-2 Inadequate leadership
• standards of performance missing or not enforced
• inadequate accountability
• inadequate or incorrect performance feedback
• inadequate work site walk-through
• inadequate safety promotion

8-3 Inadequate correction of prior hazard/incident

8-4 Inadequate identification of worksite/job hazards

8-5 Inadequate management of change system

8-6 Inadequate incident reporting/investigation system

8-7 Inadequate or lack of safety meetings

8-8 Inadequate performance measurement & assessment

8-9 Other
~ not applicable

9 Contractor Selection & Design

9-1 Lack of contractor pre-qualifications

9-2 Inadequate contractor pre-qualifications

9-3 Inadequate contractor selection

9-4 Use of non-approved contractor

9-5 Lack of job oversight

9-6 Inadequate oversight

9-7 Other
~ not applicable

10 Engineering/ Design

10-1 Inadequate technical design
• design input obsolete
• design input not correct
• design input not available
• design output inadequate
• design input unfeasible
• design output unclear
• design output not correct
• design output inconsistent
• no independent design review

10-2 Inadequate standards, specifications, and/or design criteria

10-3 Inadequate assessment of potential failure

10-4 Inadequate ergonomic design

10-5 Inadequate monitoring of construction

10-6 Inadequate assessment of operational readiness

10-7 Inadequate monitoring of initial operation

10-8 Inadequate evaluation and/or documentation of change

10-9 Other
~ not applicable

11 Work Planning

11-1 Inadequate work planning

11-2 Inadequate preventive maintenance
• assessment of needs
• lubrication/ servicing
• adjustment/ assembly
• cleaning/ resurfacing

11-3 Inadequate repair
• communication of needed repair
• scheduling of work
• examination of parts
• parts substitution

11-4 Excessive wear and tear
• inadequate planning for use
• extension of service life
• improper loading
• use by untrained people
• use for wrong purpose

11-5 Inadequate reference materials or publications

11-6 Inadequate audit/ inspection/ monitoring
• no documentation
• no correction responsibility assigned
• no accountability for corrective action

11-7 Inadequate job placement
• appropriate personnel not identified
• appropriate personnel not available
• appropriate personnel not provided

11-8 Other
~ not applicable

System Causes
Job Factors

12 Purchasing, Material Handling & Material Control

12-1 Incorrect item received
- inadequate specifications to vendor
- inadequate specifications on requisition
- inadequate control on changes to orders
- unauthorized substitution
- inadequate product acceptance requirements
- no acceptance verification performed

12-2 Inadequate research on materials/ equipment

12-3 Inadequate mode or route of shipment

12-4 Improper handling of materials

12-5 Improper storage of materials or spare parts

12-6 Inadequate material packaging

12-7 Material shelf life exceeded

12-8 Improper identification of hazardous materials

12-9 Improper salvage and/or waste disposal

12-10 Inadequate use of safety and health data

12-11 Other
~ not applicable

13 Tools & Equipment

13-1 Inadequate assessment of needs and risks

13-2 Inadequate human factors/ ergonomics considerations

13-3 Inadequate standards or specifications

13-4 Inadequate availability

13-5 Inadequate adjustment/ repair/ maintenance

13-6 Inadequate salvage and reclamation

13-7 Inadequate removal/ replacement of unsuitable items

13-8 No equipment record history

13-9 Inadequate equipment record history

13-10 Other
~ not applicable

14 Work Rules/ Policies/ Standards / Procedures (PSP)

14-1 Lack of PSP for the task
- lack of defined responsibility for PSP
- lack of job safety analysis
- inadequate job safety analysis

14-2 Inadequate development of PSP
- inadequate coordination with process/ equipment design
- inadequate employee involvement in the development
- inadequate definition of corrective actions
- inadequate format for easy use

14-3 Inadequate implementation of PSP, due to deficiencies
- contradictory requirements
- confusing format
- more than one action per step
- no check-off spaces provided
- inaccurate sequence of steps
- confusing instructions
- technical error/ missing steps
- excessive references
- potential situations not covered

14-4 Inadequate enforcement of PSP
- inadequate monitoring of work
- inadequate supervisory knowledge
- inadequate reinforcement
- non-compliance not corrected

14-5 Inadequate communication of PSP
- incomplete distribution to work groups
- inadequate translation to appropriate languages
- incomplete integration with training
- out of date revisions still in use

14-6 Other
~ not applicable

15 Communication

15-1 Inadequate horizontal communication between peers

15-2 Inadequate vertical communication between supervisor and person

15-3 Inadequate communication between different organizations

15-4 Inadequate communication between work groups

15-5 Inadequate communication between shifts

15-6 Inadequate communication methods

15-7 No communication method available

15-8 Incorrect instructions

15-9 Inadequate communication due to job turnover

15-10 Inadequate communication of safety and health data, regulations or guidelines

15-11 Standard terminology not used

15-12 Verification/ repeat back techniques not used

15-13 Messages too long

15-14 Speech interference

15-15 Other
~ not applicable

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Incident Investigation Report

S3NA-603-FM1

- **Refer to Incident Investigation Procedure (S3NA-603-PR1) and S3NA-603-WI1 Incident Investigation Process Checklist and Guideline for a guide to complete this form.**
- **Attach the original SRI as an attachment to this completed form**

(Insert Title of Incident - Region / Incident Type / Description)

Incident Number (Office use only)	

PART A: Incident Investigation (Severity Level 1,2 and 3 incidents to complete)						
Incident Severity Rating (Level 1-3)			**Actual**		**Potential**	
Incident Date		Time of Incident		Region		
Business Line			Project (if applicable)			
Who was involved (employee, contractor, and 3rd party?)						
Client notified? **Yes** ☐ **No** ☐ **(attach documentation of contract requirement)**	Name					
	Contact No.					

Description of Incident ***(Who, what, where, how)***	**Timeline attached?**	***(Attachment 1)*** ☐
	Original Incident form attached?	***(Attachment 2)*** ☐

Details of Injuries/Damage/Impact (Nature and extent of injuries/damage)

Immediate Action Taken

Corrective Actions Recommended (If actions are accepted transfer into Part C)

Was there a risk assessment tool in use at the time of the event?				
THA ☐	Safety Work Plan ☐	HASP ☐		No ☐
Has the risk assessment tool been updated to reflect this incident?			Yes ☐	No ☐
Is there an existing procedure to control this event? Yes ☐ No ☐			**List:**	
Was this procedure in use at the time of the incident? Yes ☐ No ☐				

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Photographs (Insert photographs or diagrams below or at end of report)

Part B: Incident Investigation (<u>Must be completed for all Severity Level 3 Incidents</u>) – use Incident Investigation Procedure (S3NA-603-WI1) – Investigation Categories Guideline for guidance in classifying the categories below.			
Absent/Failed Defenses	**Individual or Team Factors**	**Task/Environmental Conditions**	**Organizational Factors**

Part C: Corrective Actions Implemented (Must be completed for all Corrective Actions)			
All Recommendations must include a timeframe for implementation and a person responsible.			
Enviance PIA No.	**Recommendations**	**Person Responsible**	**Completion Date**

add rows as required.

Part D: Key Learning's (What should the business learn and pass on from this event)

Person Completing this Form (*Contact for further information)*		
Name	**Position**	
Date	**Contact No.**	
Email	**Status of investigation**	Initial / Final
List Investigation Team Members		

Reviewed by (*Compulsory only for Level 3 Incidents)*			
Name	**GCE** **(AECOM Serious Incidents only)**	**Signature**	**Date**
Name (Americas Legal)	**Position**	**Signature**	**Date**
Name	**Position**	**Signature**	**Date**

ATTACHMENT 1 - Events and Conditions Timeline

ATTACHMENT 2 - Copy of SRI

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Accident/Incident Statement

S3NA-602-FM2

NAME of person making this statement:	
PHONE #:	**DATE:**
COMPANY:	**LOCATION:**
POSITION:	**TASK at time of incident:**
SUPERVISOR:	**TIME:**

Your statement is important to the successful resolution of the accident/incident under investigation. It should be limited to the facts of the issue and should not set forth your opinions. Your opinions may be provided verbally to the AECOM investigating official. Your statement will be used within AECOM to support corrective actions, further safety and security investigations/reviews, sharing of lessons learned, and other administrative reasons.

SIGNATURE of person making this statement:

STATEMENT by witness OR person involved in the accident/incident (gather several statements at accident/incident scene) – what happened; where exactly did it happen – N, S, E, W of (draw a diagram on a sheet of paper depicting what happened if it helps describe the incident); what did you see and hear; what did you do immediately after the accident; what did people say and who said it.
If this statement is taken by another person, print name, title & phone # here:

Sample Incident Investigation Report

S3NA-603-TP1

Executive Summary

Brief Summary:

Provide a summary of the incident that includes all critical elements of the investigation

What issues led to the incident?

Provide a bulleted list of the most critical elements in the incident sequence that "failed" or were overlooked

What steps were taken to address safety issues?

Provide a list of the most important elements of the incident sequence, including post-incident elements that went well

Critical Factors and Root Causes:

CRITICAL FACTORS

Based on the interviews, site investigations and other evidence gathered, identify the events, conditions, and/or actions (Critical Factors) that were directly responsible for the incident

CAUSAL FACTORS

Using an appropriate tool, identify the causes of the incident

Action Items:

Identify the action items from the investigation.

Lessons Learned:

Provide any information that the investigation team believes will assist other operations, projects, offices, and/or employees avoid this type of incident.

REPORT

I. General Background

Provide basic contract information as well as pertinent site information

II. Incident Description

Complete and detailed description of all aspects leading up to the incident, the incident itself, and any applicable post-incident measures that either lessened, controlled, and/or exacerbated the final outcome of the incident

III. Incident Timeline

Provide a chronological description of the events leading up to the incident and any actions following the incident that may have had an impact on the outcome

IV. Investigation Results

A. People Factors

Describe and evaluate all personnel involved including their roles, responsibilities, experience, and training

B. Parts/Equipment Factors

Describe and evaluate (using pictures or drawings where necessary) all equipment and/or parts involved. Include information relative gauge levels, meter readings, physical condition, etc.

C. Position Factors

Describe and evaluate the layout of the incident area noting the location of all people, equipment, structures, etc.

D. Paper/Documentation Factors

Describe and evaluate compliance with the procedures, programs, plans, specifications, etc. applicable to the task being performed and the people performing the task. For example, Task Hazard Analysis, project safety plan, corporate and/or project procedures, training requirements, etc.

V. Incident Analysis

For each Critical Factor identified during the investigation, identify each applicable root cause in the table below. Use a separate table for each Critical Factor.

CRITICAL FACTOR 1

Identified Root Cause	Cause Type	Cause No.	Cause Description

CRITICAL FACTOR 2

Identified Root Cause	Cause Type	Cause No.	Cause Description

VI. Action Plan

Based on the investigation and root cause analysis, the following actions have been planned:

Actions to be Taken	Responsible Party	Required Completion Date

Americas

Munitions and Explosives of Concern/Unexploded Ordnance (MEC/UXO) (US)

S4NA-514-PR1

1.0 Purpose and Scope

1.1 This SOP presents procedures for obtaining Munitions and Explosives of Concern (MEC) support during the planning or execution of environmental practice-based projects such as Hazardous, Toxic, and Radioactive Waste (HTRW) investigations and remedial construction activities. MEC support activities include anomaly avoidance and surface and subsurface removal activities.

1.2 This SOP was developed to provide AECOM employees with guidance on the procedures and requirements involved in recognizing and mitigating the potential hazards associated with MEC and Material Potentially Presenting an Explosive Hazard (MPPEH) that may be encountered during field operations.

1.3 This procedure applies to all AECOM U.S.based employees and operations, except where local or governmental regulations are more stringent.

2.0 Terms and Definitions

2.1 **Anomaly** – Any item that is seen as a subsurface irregularity after geophysical investigation. This irregularity would deviate from the expected subsurface ferrous and non-ferrous material at a site (e.g., pipes, power lines, etc.).

2.2 **Anomaly Avoidance** – Techniques employed on property known or suspected to contain UXO (unexploded ordinance), other munitions that may have experienced abnormal environments (e.g.Discarded Military Munitions), and munitions constituents in high enough concentrations to pose an explosive hazard (regardless of configuration), in an effort to avoid contact with potential surface or subsurface explosive hazards, thus allowing entry to the area for the performance of required operations.

2.3 **Discarded Military Munitions (DMM)** – Military munitions that have been abandoned without proper disposal or removed from storage in a military magazine or other storage area for the purpose of disposal. The term does not include unexploded ordnance, military munitions that are being held for future use or planned disposal, or military munitions that have been properly disposed of consistent with applicable environmental laws and regulations (10 U.S.C. 2710(e)(2)).

2.4 **Exclusion Zone** – Safety zone established around the MEC work area. Only essential project employees and authorized escorted visitors are allowed within the exclusion zone. Those authorized to be in the exclusion zone are primarily the employee performing the MEC removal tasks and those overseeing such employee. Examples of exclusion zones are safety zones around MEC intrusive activities and safety zones where MEC is intentionally detonated.

2.5 **Explosive Hazard** – A condition where danger exists because explosives are present that may react (e.g., detonate, deflagrate) in a mishap with potential unacceptable effects (e.g., death, injury, damage) to people, property, operational capability, or the environment.

2.6 **Hazardous, Toxic, and Radioactive Waste (HTRW) Activities** – HTRW activities include those activities undertaken for the Environmental Protection Agency's Superfund program, the Defense Environmental Restoration Program (DERP), including Formerly Used Defense Sites (FUDS), and Installation Restoration Program (IRP) sites at active DoD facilities, HTRW actions associated with Civil Works projects, and any other mission or non-mission work performed for others at HTRW sites.

2.7 **Material Documented as Safe (MDAS)** – MPPEH that has been assessed and documented as not presenting an explosive hazard and for which the chain of custody has been established and maintained. This material is no longer considered to be MPPEH.

2.8 **Material Documented as an Explosive Hazard (MDEH)** – MPPEH that cannot be documented as MDAS, for which the maximum explosive hazards the material is known or suspected to present has been assessed and documented, and for which the chain of custody has been established and maintained. This material is no longer considered to be MPPEH. (The MDEH characterization only addresses the explosives safety status of the material.)

2.9 **Material Potentially Presenting an Explosive Hazard (MPPEH)** – MPPEH is material potentially containing explosives or munitions (e.g., munitions containers and packaging material; munitions debris remaining after munitions use, demilitarization, or disposal; and range-related debris), or material potentially containing a high enough concentration of explosives such that the material presents an explosive hazard (e.g., equipment, drainage systems, holding tanks, piping, or ventilation ducts that were associated with munitions production, demilitarization or disposal operations).

2.10 **Military Munitions** – Ammunition products and components produced for or used by the armed forces for national defense and security. The term includes confined gaseous, liquid, and solid propellants, explosives, pyrotechnics, riot control agents, smokes, incendiaries, including bulk explosives, and chemical warfare agents, chemical munitions, rockets, guided and ballistic missiles, bombs, warheads, mortar rounds, artillery ammunition, small arms ammunition, grenades, mines, torpedoes, depth charges, cluster munitions and dispensers, demolition charges, and devices and components thereof.

2.11 **Munitions and Explosives of Concern (MEC)** – This term, which distinguishes specific categories of military munitions that may pose unique explosives safety risks, means: (a) Unexploded ordnance (UXO), as defined in 10 U.S.C. 101(e)(5); (b) discarded military munitions (DMM), as defined in 10 U.S.C. 2710(e)(2); or (c) munitions constituents (e.g., TNT, RDX), as defined in 10 U.S.C. 2710(e)(3), present in high enough concentrations to pose an explosive hazard.

2.12 **Munitions Response** – Response actions, including investigation, surface and subsurface removal actions and remedial actions to address the explosives safety, human health, or environmental risks presented by unexploded ordnance (UXO), discarded military munitions (DMM), or munitions constituents (MC), or to support a determination that no removal or remedial action is required.

2.13 **Munitions Response Area (MRA)** – An area, located on a defense site, that is known or suspected to contain UXO, DMM, or MC. Examples include former ranges and munitions burial areas. A munitions response area may be comprised of one or more munitions response sites.

2.14 **Munitions Response Site (MRS)** – A discrete location within an MRA that is known to require a munitions response.

2.15 **Unexploded Ordnance (UXO)** – Military munitions that (a) have been primed, fuzed, armed, or otherwise prepared for action; (b) have been fired, dropped, launched, projected, or placed in such a manner as to constitute a hazard to operations, installations, personnel, or material; and (c) remain unexploded either by malfunction, design, or any other cause (10 U.S.C. 101(e)(5)(A) through (C)).

2.16 **UXO Qualified Personnel** – Employees who have performed successfully in military EOD positions or are qualified to perform in the following Department of Labor, Service Contract Act, or Directory of Occupations contractor positions: UXO Technician II, UXO Technician III, UXO Safety Officer, UXO Quality Control Specialist or Senior UXO Supervisor (DDESB TP-18).

3.0 References

3.1 Applicable sections and paragraphs in the documents listed below are primarily used as references for the planning and execution of UXO operations:

3.1.1 AECOM Corporate Safety, Health & Environment Program;

3.1.2 OSHA General Industry Standards, 29 CFR 1910;

3.1.3 OSHA Construction Standards, 29 CFR 1926;

3.1.4 USACE EM 385-1-1, Safety and Health Requirements Manual;

3.1.5 DoD 4160.21-M, Defense Reutilization and Marketing Manual;

3.1.6 Applicable sections of 49 CFR Parts 100 to 199.

3.1.7 DoD 6055.9-STD, DOD Ammunition and Explosives Safety Standards;

3.1.8 DA PAM 385-64, Ammunition and Explosives Safety Standards;

3.1.9 TM 9-1300-200, Ammunition General;

3.1.10 TM 9-1300-214, Military Explosives;

3.1.11 USACE EP 385-1a, Basic Safety Concepts and Considerations for Ordnance and Explosives Operations;

3.1.12 USACE EP 75-1-2, MEC Support During HTRW and Construction Activities;

3.1.13 USACE EM 385-1-97, Explosives Safety and Health Manual;

3.1.14 USACE EM 1110-1-4009, Military Response Actions; and

3.1.15 DDESB TP 18, Minimum Qualifications for UXO Technicians and Personnel

4.0 Procedure

4.1 Roles and Responsibilities

4.1.1 **Military Munitions Response Group** and **SH&E Department** provide support to **Project Managers** in the management of the safety responsibilities associated with work locations where MEC items are known or suspected to be present. The Military Munitions Response Group and SH&E Department will:

- Review and approve site-specific MEC hazard assessment for each work site where the presence of MEC is known or suspected.
- Review and approve the Accident Prevention Plan (APP) and Site Health and Safety Plan (SSHP) to be implemented to control the potential hazards associated with the performance of planned work activities in areas of known or suspected MEC.
- Investigate any reported unsafe acts or conditions.
- Ensure that the AECOM MEC Group is involved in all projects with a known or suspected presence of MEC.

4.2 Training

4.2.1 UXO Personnel Training Requirements

- **Employees** working through the **Military Munitions Response Group** who inspect, process, or document material as safe or hazardous will be trained in the recognition and safe handling of used and unused military munitions and specific types of MPPEH and procedures that apply to MPPEH, MDEH, and MDAS that are to be released. **Employees** will meet the qualification requirements of Department of Defense Explosive Safety Board (DDESB) Technical Paper (TP) 18 and will demonstrate training and experience in the recognition and safe handling of military munitions and other MPPEH and processing of material.
- These individuals shall be certified, in writing, as being technically qualified according to the standards provided in DoDI 4140.62, November 25, 2008, and USACE guidance on the management of MPPEH and be certified in conformance with contract requirements.
- The UXO technicians will receive operational briefings and training on their duties and responsibilities for each task to be performed.

4.2.2 Non-UXO Employees Training Requirements

- Site-specific UXO awareness training will be provided for all **employees** assigned to each work site. The purpose of this training is to ensure that all **employees** fully understand the procedures and methods that will be used to perform operations at the project site, their individual duties and responsibilities, and any and all safety and environmental practices/procedures associated with operations. All **employees** will be trained before they are allowed to work on site and will receive ordnance recognition and UXO safety precautions provided by the SUXOS or UXOSO. Training topics/issues and responsibilities are detailed in the site specific work/safety plans.

- All **Employees** will receive additional training on the specific equipment they will operate while on site. A tailgate safety briefing is required at the start of each work shift to review current work operations, current site conditions, operational safety procedures, and other pertinent safety issues.

4.3 MEC Hazards

4.3.1 MEC hazards are generally encountered on land surfaces, subsurface, and within bodies of water formerly occupied and/or used by the Department of Defense (DoD). Despite efforts to remove and cleanup potential MEC hazards prior to releasing the land from DoD control, some MEC items may remain.

4.3.2 Even though evidence of MEC is not observable on the ground surface at a site, MEC hazards may be present on former DoD property.

4.3.3 MEC hazards may be present underground from remaining impacted items or may have been pushed into depressions and covered with dirt, water, or intentionally buried in pits.

4.4 General Requirements

4.4.1 Prior to beginning any activities on a site suspected of former DoD munitions use, every effort shall be made to determine whether munitions-related activities ever occurred on the specific work area or within waters on which AECOM operations/activities will take place. Normally the client, based on available historical documents or prior environmental response actions, will make an assessment determination for encountering MEC. This determination should be documented and provided to the AECOM **Project Managers** and used to plan the appropriate level of MEC/UXO support required (e.g., no support, standby or on-call support, or a removal action within the work site footprint).

4.4.2 All Munitions and Explosives of Concern (MEC) or Material Presenting a Potential Explosive Hazard (MPPEH) encountered on AECOM jobsites shall be treated as extremely dangerous and shall be reported immediately. MEC or MPPEH, regardless of age or condition, shall be handled by UXO-qualified personnel only as defined by DDESB TP 18 (Department of Defense Explosives Safety Board Technical Paper 18).

4.4.3 AECOM has established an **Military Munitions Response Group**. This group is staffed with UXO-qualified personnel and serves as the company's technical center of expertise for work activities involving the detection, evaluation, handling, and remediation of MEC. For AECOM activities where the known or suspected presence of MEC may impact work activities (non-MEC procedures), the MEC Group will provide technical support, including worker familiarization training and on-site support as needed.

4.4.4 On sites that have not been identified as having MEC or explosives contamination where **employees** have been contracted to perform environmental practice-based tasks, the following actions should be taken if suspect items are encountered.

4.5 Response Actions

4.5.1 If MEC or MPPEH is encountered or suspected to have been encountered, *DO NOT TOUCH IT*. Follow the 3Rs: RECOGNIZE, RETREAT, AND REPORT.

4.5.2 Identify the location, notify other team members, keep all unnecessary **employees** out of the area and report the finding to your supervisor. The site is now considered a potential munitions response site (MRS). *Note: The general location of the MEC hazard should be marked with tape, colored cloth, or colored ribbon. If available, attach the marker to a branch, structure, or other existing object so that it is about 3 ft (.9 m) off the ground and visible from all approaches. Place the marker* *no closer than the point where you first recognized the MEC hazard, and do not drive stakes into the ground or otherwise disturb the surface. If possible, use GPS to record the waypoint of the suspect item.*

4.5.3 Any time suspected MEC is encountered while working on a non-DoD installation, immediately call the local emergency response authority (e.g., local police, sheriff, or 911) to report the finding.

4.5.4 If encountered on an active DoD installation, immediately notify your supervisor, Government Designated Authority (GDA), and installation Point of Contact (POC), who will contact and facilitate military EOD response.

4.5.5 Ensure that the AECOM SH&E Department is notified of the presence of known or suspected MEC or MPPEH items on any work site prior to initiating field activities. This type of finding represents a potential change in scope, and the appropriate hazard analysis shall be completed prior to beginning any operations involving the MEC or MPPEH. An outline of Response Procedures for non-MEC operations is included as an attachment to this document.

4.6 Probability Assessment

4.6.1 If the site has a minimal probability of encountering MEC (e.g., current or previous land use leads to an initial determination that MEC or MPPEH is not present), no UXO support is required.

4.6.2 If the site has a low probability of encountering MEC (e.g., current or previous land use leads to an initial determination that MEC or MPPEH *may* potentially be present), only MEC standby support will be required.

4.6.3 If the probability of encountering MEC is moderate to high (e.g., current or previous land use leads to a determination that MEC was employed or disposed of within the work site or area of concern), UXO-qualified personnel shall conduct a surface clearance/removal for all areas within the proposed limits of disturbance for the planned site activities and subsurface clearance/removal any areas where intrusive type activities are to occur (i.e., sampling locations, well installation, construction footprint and access routes).

4.6.4 If MEC or MPPEH is discovered at any point in time by site **employees**, the response actions in Section 4.2 should be followed (RECOGNIZE, RETREAT, REPORT) and the probability assessment will be re-evaluated.

4.7 AECOM MEC/UXO Avoidance Support

4.7.1 During the investigative/design phase of any project on a site known or suspected to contain MEC, a probability assessment will be conducted and provisions for MEC support (if necessary) will be included in the project planning phase. For sites requiring investigation activities other than the identification and removal of MEC/UXO, MEC support refers to MEC/UXO or anomaly avoidance techniques implemented to avoid any potential encounter with surface and/or subsurface MEC items or anomalies. Intrusive activities for anomaly investigations are not authorized during anomaly avoidance activities. The appropriate level of support for these sites will be determined on a case-by-case basis by the project delivery team (PDT).

4.7.2 During MEC/UXO or anomaly avoidance activities, AECOM will provide a UXO team consisting of a minimum of two, one of whom shall be a UXO Technician III. This individual will be the UXO team leader. The UXO team shall be on site during all sampling activities. The UXO team may include additional UXO-qualified personnel, geophysicists, or any other team member, depending on site- and task-specific conditions/requirements.

4.8 Standby Support

4.8.1 If the probability of encountering MEC is low (e.g., current or previous land use leads to an initial determination that MEC may be present), only MEC standby support will be required.

4.8.2 The UXO team will meet with on-site management and construction **employees** and conduct a general work and safety briefing, including:

- Probable site hazards and site-specific safety considerations.

- MEC standby support procedures.
- Responsibilities and lines of authority for any MEC response.
- Emergency response procedures.

4.8.3 The UXO team will physically preview the actual construction footprint with the onsite management of the construction team and discuss visual observations and potential areas of concern. In the event that surface MEC is discovered, the UXO team will place flagging adjacent to the discovery for subsequent visual reference, select a course around the item, and lead any on-site **employees** out of the area. The UXO team will assess the condition of the MEC to determine if a disposal action is required.

4.8.4 When MEC is found on the surface, the PDT will perform a detailed assessment of the site to determine if the potential for encountering MEC is still low. If the potential for encountering MEC is raised to moderate to high, a subsurface removal for the construction footprint will be required.

4.9 Anomaly Avoidance

4.9.1 This paragraph discusses anomaly avoidance procedures during the investigative/design phase of any project on a site with known or suspected MEC on HTRW sites. Procedures are implemented to include, but are not limited to, surveying and mapping, environmental and natural resource assessments, surface and subsurface sampling, boring and drilling, and groundwater monitoring.

4.9.2 The purpose of anomaly avoidance is to avoid any potential surface MEC and MPPEH and subsurface anomalies during sampling activities. *Intrusive anomaly investigation is not authorized during anomaly avoidance operations.*

4.9.3 The **Military Munitions Response Group** will prepare a Work Plan detailing MEC procedures to supplement the HTRW Work Plan/Site Plan and provide additional safety precautions specific to the tasks to be performed to be included in the safety documents.

4.9.4 The UXO team members have the following responsibilities for anomaly avoidance procedures during an HTRW investigation project on a site with known or suspected MEC:

- Provide the MEC recognition, location, and safety functions for the HTRW personnel during HTRW field activities;
- Conduct MEC safety briefings for all site **employees** and visitors.

4.9.5 The senior UXO qualified person has final on-site authority on MEC procedures and explosive safety issues.

4.10 Access Surveys

4.10.1 HTRW sampling personnel shall be escorted by UXO-qualified personnel at all times in areas potentially containing MEC until the UXO team has completed the access surveys and the cleared areas have been marked. Escorted HTRW personnel will follow behind the UXO escort. If anomalies or MEC are detected, the UXO escort will halt escorted persons in place, select a course around the item, and instruct persons to follow.

4.10.2 The UXO team shall conduct a surface access survey and a subsurface survey for anomalies before any type of activities commence, including foot and vehicular traffic. Typically, the access route will be at least twice as wide as the widest vehicle that will use the route.

4.10.3 The UXO team shall also complete an access survey of an area around the proposed investigation site that is large enough to support all planned operations. The size of the surveyed area will be site-specific and will take into account, for example, maneuverability of required equipment (e.g., drill rigs, excavation equipment), parking of support vehicles, and establishment of decontamination stations. As a minimum, the surveyed area will have a dimension in all directions equal to twice the length of the longest vehicle or piece of equipment to be brought on site.

4.10.4 Geophysical instrumentation capable of detecting the smallest known or anticipated military munition will be used to locate anomalies just below the surface that may be encountered through erosion from rain or continual vehicular traffic.

4.10.5 If anomalies or surface MEC are encountered, they will be marked with flagging and the investigation area will be relocated to avoid contact. The UXO team will clearly mark the boundaries of the surveyed area using survey flagging and pin flags. The UXO team will establish a system of flagging colors that will distinguish anomalies, surface MEC, and route boundaries from each other as well as from any utility markings that have been used at the site.

4.10.6 If surface MEC is encountered, the UXO team will assess the condition of the MEC to determine if a disposal action is required. No **employees** will be allowed outside the surveyed areas.

4.11 Subsurface Geophysical Survey

4.11.1 The UXO team shall complete a subsurface geophysical survey of the subsurface sampling locations or well installation. If an anomaly is detected, HTRW sampling personnel shall select a new sampling location. Any anomalies detected will be prominently marked with survey flagging or pin flags for avoidance.

4.11.2 If the subsurface sampling or well installation depth is greater than the geophysical instrument's detection capabilities, the UXO team shall incrementally complete the geophysical survey as outlined below.

4.11.3 Once an access survey has been completed, the UXO team will install a pilot hole at each proposed drill hole location, using a hand auger. While the UXO team is completing the geophysical survey, the remaining project **employees** shall withdraw out of the immediate area to a distance determined by the senior UXO personnel. If an anomaly is detected, the pilot hole will be backfilled in accordance with site-specific procedures and HTRW sampling personnel shall select a new drill hole location. As long as no anomalies are detected, the pilot hole will be advanced to the maximum reach of the auger or to the maximum depth of the proposed drill hole, whichever is less.

4.11.4 During the excavation of the pilot hole, the auger will be withdrawn and the hole checked for anomalies every 12 inches. The pilot hole will also be inspected upon reaching the final depth, providing a total clearance depth equal to the pilot hole depth plus 12 inches.

4.11.5 In cases where the pilot hole does not reach the full depth of the proposed boring (e.g., the proposed depth of the drill hole is more than the maximum depth of the auger, or the UXO team cannot penetrate the soils using the auger), the drill rig may be brought on-site and advanced in 12-inch increments beyond the clearance depth of the pilot hole. At the end of each 12-inch increment, the drill rig's auger shall be withdrawn from the hole so that the UXO team may screen for anomalies as described above. As necessary with loose soils, a polyvinyl chloride (PVC) pipe (minimum 3 inches inner diameter) will be inserted to keep the hole open and to allow for incremental geophysical screening.

4.11.6 When working in ordnance impact areas, the UXO team may discontinue incremental screening once the drilling has extended to depths of 30 feet below ground surface, the depth of penetration of the MEC has been exceeded, or the planned depth of drilling has been reached.

4.11.7 For all other areas, incremental screening will be determined based on an assessment of the site's characteristics and history.

4.12 Recovered Chemical Warfare Materials (RCWM)

4.12.1 Any time that RCWM or munitions with unknown fillers are encountered during MEC support, all work will immediately cease. Project **employees** will withdraw along cleared paths upwind from the discovery. A team consisting of a minimum of two will secure the area to prevent unauthorized access. **Employees** will position themselves as far upwind as possible while still maintaining the security of the area.

4.13 Notification

4.13.1 When RCWM or munitions with unknown fillers are identified on formerly used defense site (FUDS) project sites, the UXO team will notify the local POC designated in the Work Plan. The local POC will facilitate the military EOD unit's response, and two **employees** will secure the site until the EOD unit's arrival. If the local POC designated in the Work Plan is not the local law enforcement agency, the local POC will inform the local law enforcement agency of the discovery.

4.13.2 The EOD unit will notify the U.S. Army Technical Escort Unit (TEU) and secure the area until arrival of TEU.

4.13.3 On active installations, the UXO team will normally notify the Range Control Officer, the Facility Engineer, Post Headquarters, or the POC designated in the Work Plan.

5.0 Records

5.1 None.

6.0 Attachments

6.1 S4NA-514-WI1 MEC/UXO Response Procedures for Non-MEC Operations (US)

Americas

MEC/UXO Response Procedures for Non-MEC Operations (US)

S4NA-514-WI1

1.0 Introduction

1.1 The potential presence of MEC/UXO at a site presents hazards to personnel performing site assessment operations both on the ground surface while conducting surface operations and in the subsurface while conducting intrusive operations, such as excavating, trenching, soil boring or drilling. For all sites where it has been determined that there is alow probability of encountering MEC/UXO, the following Response Procedures should be followed.

1.2 The basic policy to be observed regarding MEC/UXO is:

1.2.1 *DO NOT TOUCH IT*. Follow the 3Rs: RECOGNIZE, RETREAT AND REPORT. In addition, use the following information to minimize the hazards to personnel from MEC/UXO.

1.2.2 All personnel must be briefed concerning the potential MEC/UXO hazards in surface areas when a low probability of encountering MEC/UXO exists at a site.

2.0 MEC/UXO in Surface Areas

2.1 During field activities, MEC/UXO items may be present on the ground surface and present a potential hazard to employees. When moving about the site personnel should remain alert for any MEC/UXO items which might be present. Each work site should be thoroughly checked for the presence of MEC/UXO before any other activities commence.

2.2 In the event that any MEC/UXO item is observed or expected, the following will requirements will be observed:

2.2.1 Personnel should mark the location of the MEC/UXO item with highly visible marking tape and alert all other personnel in the area to its presence. If possible, use GPS to record the waypoint of the suspect item.

2.2.2 Any non-MEC AECOM work operations occurring in the area will cease and all AECOM and subcontractor employees will evacuate the area.

2.2.3 Under no circumstances will any AECOM or subcontractor employee attempt to move or otherwise handle any MEC/UXO orsuspected MEC/UXO item. COLLECTION OF “SOUVENIRS” IS PROHIBITED.

2.2.4 The client representative will be immediately informed about the MEC/UXO discovery and provided the location of the suspected item.

3.0 Excavating and Trenching Activities

Excavation activities may expose subsurface MEC/UXO items. Throughout the excavation work a member of the site team will be posted as an observer, with the responsibility to monitor the trench conditions and observe if any suspected MEC/UXO items may be present. In the event that any MEC/UXO item is encountered during excavation, the following procedures will be observed.

3.1 MEC/UXO Item Observed in the Trench

3.1.1 The work operation will cease immediately. Personnel will evacuate to a safe area/distance.

3.1.2 The area will be delineated using yellow CAUTION tape or bright paint. No stakes or rods will be driven into the ground to support the tape.

3.1.3 Responsibility for the work location will be transferred to the installation or client.

3.2 MEC/UXO Item Observed in the Spoils

3.2.1 The work operation will cease immediately and all personnel will evacuate to a safe area/distance. The equipment will be left in place.

3.2.2 Delineate MEC/UXO with yellow caution tape or bright paint.

3.2.3 All AECOM and subcontractor employees will evacuate this area.

3.2.4 Under no circumstances will any AECOM or subcontractor employee attempt to move or otherwise handle any MEC/UXO/suspected MEC/UXO item. COLLECTION OF “SOUVENIRS” IS PROHIBITED.

3.2.5 The operations manager or safety officer will be alerted as to the location of the suspected item, and responsibility for the work location will be transferred to the installation or client.

3.3 MEC/UXO Item Encountered and Detonation Occurs

3.3.1 The work operation will cease immediately. Personnel will evacuate to a safe area/distance, upwind, minimum 1,250 feet.

3.3.2 If injuries have occurred, the Emergency Action Plan will be activated.

3.3.3 Equipment will be left in place.

3.3.4 Responsibility for the work location will be transferred to the installation or client.

3.3.5 Once equipment is recovered it will be thoroughly inspected for damage before being put back into service.

4.0 Drilling Activities

In the event that any MEC/UXO item is encountered during drilling, the following procedures apply.

4.1 MEC/UXO Item Believed to be Encountered Downhole but No Detonation Occurs

4.1.1 The work operation will cease immediately.

4.1.2 If drilling, the drilling auger will be blocked in place and disconnected from the drill rig. The equipment (drill rig, backhoe, etc.) will be withdrawn from the site and the area will be delineated using yellow CAUTION tape.

4.1.3 Responsibility for the work location will be transferred to the installation or client.

4.2 MEC/UXO Item Observed in the Spoils

4.2.1 The work operation will cease immediately and all personnel will evacuate the area. The equipment will be left in place.

4.2.2 Delineate MEC/UXO with yellow caution tape or bright paint.

4.2.3 All AECOM and subcontractor employees will evacuate this area.

4.2.4 Under no circumstances will an AECOM or subcontractor employee attempt to move or otherwise handle any MEC/UXO or suspected item. COLLECTION OF “SOUVENIRS” IS PROHIBITED.

4.2.5 The operations manager or safety officer will be alerted as to the location of the suspected item, and responsibility for the work location will be transferred to the installation or client.

4.3 MEC/UXO Item Encountered Downhole and Detonation Occurs

4.3.1 The work operation will cease immediately.

4.3.2 If injuries have occurred the Emergency Action Plan will be activated. Once any necessary immediate response actions have been completed, the drilling auger will be blocked in place and disconnected from the drill rig. The drill rig will then be withdrawn from the site and the area will be delineated using yellow CAUTION tape.

4.3.3 Responsibility for the work location will be transferred to the installation or client.

4.3.4 The drill rig will be thoroughly inspected for damage before being put back into service.

Attachment D:
AECOM Corporate SH&E Field Forms

000 SERIES - SH&E ESSENTIALS

S3NA_004_FM1_SH&E Report of Incident

S3NA_004_FM2_SH&E Observation Report

200 SERIES - PROJECT MANAGEMENT

S3NA_210_FM_Tailgate Safety Meeting Log

OTHER FORMS

Contractor Significant Incident Report

Navy OHS

Machinery and Mechanized Equipment Certification Form

S3NA-004-FM1
SH&E Report of Incident

AECOM

1. EMPLOYEE MUST REPORT ALL INCIDENTS TO THEIR SUPERVISOR IMMEDIATELY.
2. REPORT THE INCIDENT TO THE APPROPRIATE INCIDENT REPORTING LINE. **(800) 348-5046**
3. COMPLETE FORM AND SEND TO SRI@AECOM.COM WITHIN ONE (1) BUSINESS DAY FOLLOWING THE OCCURRENCE OF THE INCIDENT.

I. ORGANIZATION INFORMATION

REGION: ☐ CAN-EAST ☐ CAN-WEST ☐ South America ☐ US -CENTRAL ☐ US-NORTHEAST ☐ US-SOUTHEAST ☐ US-WEST	**DISTRICT:** **PROJECT NUMBER:**
BUSINESS LINE: ☐ AECOM CORP ☐ BLDG &PLACES ☐ BUSINESS SERVICES ☐ CONSTRUCTION SERVICES ☐ ENERGY&POWER ☐ ENVIRONMENT ☐ GOVERNMENT TECHNICAL SERVICES (GTS) ☐ MINERALS & METALS ☐ TRANSPORTATION ☐ WATER	
CLIENT NAME:	**PROJECT NAME:**

II. DESCRIPTION OF EVENT (GO TO APPLICABLE SECTION)

TYPE OF OCCURRENCE: ☐ INJURY/ILLNESS (SEC III) ☐ NEAR MISS (SEC IV) ☐ MOTOR VEHICLE INCIDENT (COMPLETE PG 3) ☐ PROPERTY DAMAGE (SEC V) ☐ ENV DAMAGE/SPILL (SEC V) ☐ REGULATORY INSPECTION/NOV/CITATION (SEC VI) ☐ SUGGESTION (SEC VII) ☐ OTHER BE SPECIFIC

DESCRIPTION OF EVENT:

WHAT, WHEN, WHERE, WHY, HOW? ATTACHED NOTES/DIAGRAMS AS REQUIRED AND LIST ANY MACHINERY OR EQUIPMENT INVOLVED

DATE OF INCIDENT:	**TIME OF INCIDENT:**
AECOM CONTACT:	**REPORT COMPLETED BY:**
INCIDENT ADDRESS/LOCATION:	**CITY:**
STATE/PROVINCE/TERRITORY:	**ZIP/POSTAL CODE:**

WERE THERE ANY SUBCONTRACTORS, WITNESSES OR OTHER PERSONS INVOLVED: ☐ YES ☐ NO

IF YES, PLEASE PROVIDE DETAILS TO INCLUDE NAMES AND CONTACT INFORMATION

III. PERSONAL INJURY (COMPLETE FOR INJURY/ILLNESS ONLY)

EMPLOYEE NAME:	**EMPLOYEE NUMBER:**
WORK PHONE:	**CELL PHONE:**
EMPLOYEE STATUS ☐ FULL TIME ☐ PART TIME ☐ TEMP AGENCY ☐ SUB –AECOM CONTROLLED ☐ THIRD PARTY	**HOME OFFICE ADDRESS:**
JOB TITLE/HIRE DATE:	Date Reported to Supervisor:

TYPE OF INJURY: ☐ FIRST AID (TREATED ON-SITE) ☐ MEDICAL AID (TREATED BY PROFESSIONAL) ☐ FATALITY

DESCRIBE THE INJURY AND BODY PART AFFECTED: ***BE SPECIFIC (I.E. RIGHT HAND PINKIE & RING FINGER CRUSHED WITH HAMMER)***

WAS A DOCTOR OR HOSPITAL VISITED? ☐ YES ☐ NO	**IF YES, WHEN:**
FIRST AID/MEDICAL TREATMENT RECEIVED:	**FIRST AIDER/DOCTOR/HOSPITAL NAME:**
PROVIDER ADDRESS:	**PHONE NUMBER:**

IV. NEAR MISS ON-SITE/CORRECTIVE ACTIONS

S3NA-004-FM1
SH&E Report of Incident

Near Miss Potential Outcome: ☐ Injury/Illness ☐ Fatality ☐ Env Damage/Spill ☐ Property Damage ☐ NOV/Citation	
Incident Immediately Reported On-Site To:	
What corrective actions were immediately implemented on-site?	
What long-term or permanent corrective actions are recommended?	
V. Property/Env Damage/Spill/Damage (complete for property damage only)	
Type of Damage: ☐ AECOM Property ☐ Motor Vehicle (Skip this section and complete MVI Report Page 3) ☐ Spill or Release of a Hazardous Substance ☐ Major Structural Failure ☐ Client, Subcontractor, other:	
Describe the specific damage, structural failure or hazardous release: **Rank the severity of the damage:** ☐ Minor ☐ Serious ☐ Major	
Where can the property be seen?	**If yes, What:**
Property owner name: **Contact Information:**	
Is there any potential for civil, criminal or regulatory liability against AECOM or an employee? ☐ **Yes** ☐ **No** If Yes, discuss with AECOM Regional Counsel before proceeding with any further reporting.	
Indicate who has been notified of the event (e.g., Owner/Operator, State (US) or governing body of labour, ETC?	
VI. Regulatory Inspection/NOV/Citation	
Type of Event: ☐ Inspection ☐ NOV ☐ Citation	
Describe Event: ***be specific***	
Findings Noted at Site ☐ **Yes** ☐ **No**	**If yes, What:**
Name of Regulatory Agency	**Follow up Scheduled:**
Contact Person:	**Phone Number:**
VII. Review and Acceptance	
Employee Review of Incident:	
Employee Printed Name and Phone	**Signature and Date**
Supervisor Review of Incident:	
Supervisor Printed Name and Phone	**Signature and Date**
Manager Comments:	
Manager Printed Name and Phone	**Signature and Date**
For Regional SH&E Manager Use Only:	
Name and Signature:	**Date:**
Recordability Determination ☐ First Aid ☐ Recordable ☐ Recordability Undetermined ☐ Non Work ☐ Property Damage ☐ General Liability ☐ Vandalism COMMENTS:	

MOTOR VEHICLE INCIDENT (MVI) REPORT

ONLY COMPLETE THIS PAGE FOR VEHICLE INCIDENTS

AECOM

ADMINISTRATIVE		
AECOM VEHICLE: ☐ **FLEET** ☐ **RENTAL** ☐ **PERSONAL**	**JOB ACTIVITY AT TIME OF MVI:**	
DATE OF MVI: **TIME OF MVI:**	**LOCATION OF MVI:**	
MANAGER:	**NUMBER OF VEHICLES INVOLVED:**	

REMEMBER: **STAY CALM. TAKE PICTURES OF INCIDENT SCENE (LICENSE PLATE, DAMAGES, ETC)**

Do not admit liability, agree to pay for any damage or sign any document except as required by law.

AECOM DRIVER INFORMATION		
DRIVER:	**AECOM PASSENGERS:**	**OTHER PASSENGERS:**
DRIVER'S LICENSE:	**PROVINCE/STATE ISSUED:**	**EXPIRATION DATE:**
INJURIES TO DRIVER:		
INJURIES TO PASSENGERS:		

AECOM VEHICLE INFORMATION		
YEAR:	**MAKE:**	**MODEL:**
SERIAL/VIN #:	**LICENSE PLATE #:**	**REGISTRATION #:**
OWNER:	**INSURANCE COMPANY:**	**POLICY #:**
COMMERCIAL MOTOR VEHICLE :	**I F RENTED OR PERSONAL, CONTACT INFORMATION OF OWNER:**	
RANK THE SEVERITY OF THE DAMAGE TO THE VEHICLE: ☐ 0 - $500 ☐ $500 - $1000 ☐ $1000 - $4000 ☐ >$4000		
DESCRIPTION OF DAMAGE TO THE BODY OF THE VEHICLE:		

OTHER DRIVER/VEHICLE INFORMATION		
YEAR:	**MAKE:**	**MODEL:**
SERIAL/VIN #	**LICENSE PLATE #:**	**REGISTRATION #:**
DRIVER'S NAME:	**CONTACT INFO:**	**LICENSE #:**
OWNER:	**INSURANCE COMPANY:**	**POLICY #:**
IF RENTED OR PERSONAL, CONTACT INFORMATION OF OWNER:		
DESCRIPTION OF DAMAGE TO THE BODY OF THE OTHER VEHICLE:		

INCIDENT DESCRIPTION	
EXACT LOCATION OF MVI (HIGHWAY KM, INTERSECTION, EXACT ADDRESS, ETC.)**?**	
OTHER PROPERTY DAMAGED:	
DESCRIBE THE EVENTS LEADING UP TO AND THE INCIDENT (REPORT FACTS ONLY: SPEED OF VEHICLES, DIRECTION TRAVELLING, WEATHER CONDITIONS, ETC. DO NOT GIVE OPINIONS REGARDING CAUSE OF INCIDENT OR LOSS.)**:**	
DID THE POLICE ATTEND THE SCENE: ☐ **YES** ☐ **NO** **CITATION ISSUED:** ☐ **YES** ☐ **NO** **TO WHO:**	
POLICE :	**CONTACT INFO:**
WITNESS:	**CONTACT INFO:**
WITNESS:	**CONTACT INFO:**

SUBMIT THIS MVI REPORT WITH A COMPLETED SUPERVISORS REPORT OF INCIDENT TO THE APPROPRIATE MANAGER

COMPLETED BY:	**SIGNATURE:**	

Americas

Near Miss Report

S3NA-004-FM2

If unable to access IndustrySafe. Please use this form to report any near-misses, you encounter as a part of your work. This may include office or field locations.

ADMINISTRATIVE	
PROJECT NAME & NUMBER: ☐ **N/A**	**LOCATION:**
EMPLOYEE NAME:	**EMPLOYEE NUMBER:**
EMPLOYEE TYPE: ☐ AECOM EMPLOYEE ☐ CONTRACTOR ☐ SUBCONTRACTOR ☐ JV PARTNER ☐ 3RD PARTY/PUBLIC	**SUPERVISOR:**
HOME OFFICE:	**DEPARTMENT NUMBER:**
JOB NUMBER/PROJECT LOCATION/PROJECT DESCRIPTION:	
DATE AND TIME OF NEAR MISS:	**DATE AND TIME REPORTED:**

Work Activity	☐ Office	☐Driving	☐Field	☐Lab	☐Other: __________________

REMEMBER: IDENTIFYING A NEAR MISS DOES NOT IMPLY GUILT BUT ASSISTS IN PREVENTING INCIDENTS OR INJURIES.

OBSERVATION, RISK OR NEAR MISS DETAILS
NEAR MISS POTENTIAL OUTCOME: ☐ INJURY/ILLNESS ☐ PROPERTY DAMAGE ☐ ENVIRONMENTAL DAMAGE
POTENTIAL SEVERITY: ☐ NEGLIGABLE ☐ MARGINAL ☐ CRITICAL ☐ CATASTROPHIC
PROBABILITY: ☐ FREQUENT ☐ IMPROBABLE ☐ OCCASIONAL ☐ PROBABLE ☐ REMOTE
DESCRIPTION OF NEAR MISS:

If unable to access IndustrySafe. Please use this form to report any near-misses, you encounter as a part of your work. This may include office or field locations.

POTENTIAL IMMEDIATE CAUSES

- ☐ Procedures not followed
- ☐ Use of tools or equipment
- ☐ Use of protective measures
- ☐ Inattention/Lack of awareness
- ☐ Protective systems
- ☐ Tools, equipment, & vehicles
- ☐ Work exposures to…
- ☐ Work place environmental/layout

POTENTIAL SYSTEM CAUSES

- ☐ Physical capacity
- ☒ Physical condition
- ☐ Mental state
- ☐ Behavior
- ☐ Skill level
- ☐ Training/Knowledge transfer
- ☐ Mngmt/Supervision/Employee leadership
- ☐ Contractor selection & design
- ☐ Engineering/Design
- ☐ Work planning
- ☐ Purchasing, material handling/controls
- ☐ Tools & equipment
- ☐ Work rules/policies/stds/procedures
- ☐ Communication
- ☐ Other:___________________________

CORRECTIVE ACTIONS

Corrective Action Category Identified to Prevent Future Reoccurrence

(*Identify relevant issues in checkboxes and provide detail below, as applicable*)

- ☐ Different/New PPE needed
- ☐ New tool(s)/equipment needed
- ☐ Additional/proper personnel needed
- ☐ Change in working procedure
- ☐ New STOP WORK trigger identified
- ☐ Additional training/skills needed
- ☐ Improved housekeeping efforts
- ☐ Modified working behaviors
- ☐ Improved work planning
- ☐ Other:___________________________

WERE IMMEDIATE CORRECTIVE ACTIONS IMPLEMENTED? ☐ **YES** ☐ **NO** IF YES, PLEASE DESCRIBE:

WHAT LONG-TERM CORRECTIVE ACTIONS ARE RECOMMENDED?

FOR SH&E DEPARTMENT USE ONLY:	
CORRECTIVE ACTIONS REQUIRING IMPLEMENTATION:	RATIONALE:
COMMUNICATED BACK TO EMPLOYEE: ☐	COMMUNICATED BACK TO MANAGER: ☐
COMPLETED BY:	DATE:

Americas

Tailgate Safety Meeting Log

S3NA-210-FM1

This sign-in log documents the topics of the tailgate safety briefing and individual attendance at the briefing. Personnel who perform work operations on site are required to attend each safety briefing and acknowledge their ability to ask questions and receipt of such briefings daily. Please provide a brief narrative of the following topics as applicable to the Project.

Name of Meeting Leader	**Signature**

PROJECT NAME & LOCATION

PROJECT NUMBER	**DATE/TIME**	**WEATHER CONDITIONS**

TOPIC
Discussion – check all that apply

Topic			Topic		
Today's Scope of Work (All tasks)	☐ yes	☐ n/a	Access / Egress / Slips, Trips, & Falls	☐ yes	☐ n/a
Schedule / New Work / Scope Changes	☐ yes	☐ n/a	Smoking, Eating, & Drinking	☐ yes	☐ n/a
Reviewed Procedures, Task Hazard Analysis, etc.	☐ yes	☐ n/a	Washroom / Facilities Location	☐ yes	☐ n/a
Emergency Action Plan & Procedures	☐ yes	☐ n/a	Heat/Cold Stress	☐ yes	☐ n/a
Communications Protocol	☐ yes	☐ n/a	Exclusion Areas Barricades / Cones	☐ yes	☐ n/a
Required Personal Protection Equipment	☐ yes	☐ n/a	Required Permits, Passes, Keys, etc.	☐ yes	☐ n/a
Required Monitoring / Instruments	☐ yes	☐ n/a	Decontamination Procedures / Investigation-Derived Waste Management	☐ yes	☐ n/a
Fitness for work / Fatigue	☐ yes	☐ n/a	Equipment Inspections/Safety Checklists	☐ yes	☐ n/a
Site Control / Work Zones / Security	☐ yes	☐ n/a			

COMMENTS / OTHER

Tailgate Meeting Attendees

Print Name	**Signature**

SIX QUESTIONS FOR SUCCESS – As your final preparedness, take two minutes to think through and answer these questions**:**

1. What are we about to do?
2. What equipment are we going to use?
3. Have I/we been trained to use this equipment?
4. Have I/we been trained to do this job?
5. How can I/we be hurt?
6. How can I/we prevent this incident?

If you and your team aren't prepared to do the assigned work, STOP WORK, and take time to properly prepare.

END OF DAY SIGN-OFF:

____

Site Safety Officer Signature

☐ No Incidents Occurred

☐ Number of Near Misses/Observations Reported

☐ All Incidents Reported the Incident Reporting Line

LESSONS LEARNED / COMMENTS / OTHER

Contractor Significant Incident Report

Report Date:	**Contracting Activity/ROICC Office:**

1. Accident Classification:

☐ Injury ☐ Illness ☐ Fatality ☐ Property Damage ☐ Procedural Issues ☐ Environmental

Involving:

☐ Hazardous Materials	☐ Electrical	☐ Equipment/Motor Vehicle/ Material Handling	☐ Diving
☐ Fall	☐ Confined Space	☐ Crane/Rigging	☐ Trenching/Entrapment
☐ Fire	☐ Other	☐ Waterfront Operations	☐ Demolition/Renovation

2. Personal Data:

A. Name (Last, First, M.)	B. Age	C. Sex M / F (circle one)	D. Social Security Number

E. Job Description/Title	F. Employed By	G. Supervisor's Name

3. Witness Personal Data (Attach Signed Witness Statements to Report):

A. Name (Last, First. M.)	B. Age	C. Sex M / F (circle one)

D. Job Description/Title	E. Employed By:

4. General Information:

A. Date of Accident (Month/Day/Year)	B. Time of Accident	C. Exact Location of Accident	D. Type of Construction Equipment (Make, Model, Serial Number. Vin Number)

E. Contract Number/Title	F. Construction Activity SIC	G. Hazardous Material Spill/Release

H. Type of Contract	Contractor's Name/Address/Phone Number
☐ Construction ☐ A/E ☐ Service ☐ RAC ☐ CLEAN ☐ JOC ☐ Other ______	(1) Prime: (2) Sub:

J. Safety Manager's Name Phone #	K. Insurance Carrier
(1) Prime: (2) Sub:	(1) Prime: (2) Sub:

L. Work Activity Involved at Time of Accident	
	(1) ☐ Available & used (2) ☐ Not required (3) ☐ Available & not used (4) ☐ Not related to mishap (5) ☐ Wrong PPE for job (6) List types(s) used:

5. Injury/Illness/Fatality Information:

A. Severity of Illness/Injury Choose from the following:	B. Estimated Days Lost	C. Estimated Days Hospitalized	D. Estimated Days Restricted Duty

E. List Body Part(s) Affected	F. Nature of Illness/Injury	(1) Type	(2) Source:

6. A. Accident Description (Describe in your own words) (Use additional paper, if necessary):

B. Who provided first aid and/or cleanup of mishap site?

C. Any blood borne pathogen exposure by other than EMTs? If so who?

D. Was site secured and witness statements taken immediately?

E. List OSHA and EM 385 1-1 standards that were violated?

7. Causal Factors (Explain yes answers on supplementary sheet)	Yes	No
Design – Was the design of facility, workplace, or equipment a factor?	☐	☐
Inspection/Maintenance – Were inspection & maintenance procedures a factor?	☐	☐
Persons Physical Condition – In your opinion, was the physical condition of the person a factor?	☐	☐
Operating Procedures – Were operating procedures a factor?	☐	☐
Job Practices – Were any job safety/health practices not followed when the accident occurred?	☐	☐
Human Factors – Did any human factors, such as size or strength of person, etc., contribute to accident?	☐	☐
Environmental Factors – Did heat, cold, dust, sun, glare, etc., contribute to the accident?	☐	☐
Chemical & Physical Agent Factors – Did exposure to chemical agents (such as dust, fumes, mists, vapors, or physical agents [such as noise, radiation, etc.]) contribute to the accident?	☐	☐
Office Factors – Did office setting (such as lifting office furniture, carrying, stopping, etc.) contribute to the accident?	☐	☐
Support Factors – Were inappropriate tools or resources provided to properly perform the activity task?	☐	☐
Personal Protective Equipment – Did the improper selection, use, or maintenance of personal protective equipment contribute to the accident?	☐	☐
Drugs/Alcohol – In your opinion, was the use of drugs or alcohol a factor?	☐	☐
Job Hazard Analysis – Was lack of an adequate (IAW EM 385-1-1 01.A) activity hazard analysis a contributing factor?	☐	☐
Was it site-specific and did it address the type of work/operations performed when the mishap occurred?	☐	☐
Management – Did a lack of adequate supervision contribute to the accident?	☐	☐
Was inadequate information provided at pre-con meeting?	☐	☐

8. Training:

A. Was person trained to perform activity/task?	☐	☐

B. Type of training?

C. Date of most recent formal training? / / D. List topics discussed

9. Fully Explain What Allowed Or Caused The Accident, Include Direct and Indirect Causes:

A. Direct Cause

B. Indirect Cause

C. Action(s) taken to prevent occurrences or provide on-going corrective actions.

D. Corrective Action Dates (1) Beginning (Mo/Da/Yr)	(2) Anticipated Completion (Mo/Da/Yr)

10. OSHA

A. Date OSHA Was Notified:	C. Date of OSHA Citation: (Include cy of citation)

B. Date OSHA Investigated:	D. $ Amount of Penalties: $______

11. Report Preparer		
Print Name & Title of Supervisor Completing Report Signature: ______________________ Date (Mo/Da/Yr) __________		
12. Management Review (Contracting Officer)		
A. Accepted	B. Amendments Required	C. Comments (include program improvements required for your command, NAVFACHQ construction safety program, and EM 385-1-1)
Print Name & Title of Official Completing Report Signature: ______________________ Date (Mo/Da/Yr) __________		
13. Safety And Occupational Health Office Review		
A. Concur	B. Non Concur	C. Additional Actions/Comments
Print Name & Title of Safety Personnel Reviewing Signature: ______________________ Date (Mo/Da/Yr) __________		

CONTRACTOR SIGNIFICANT INCIDENT REPORT INSTRUCTIONS

Complete Sections Appropriate to Incident.

GENERAL. Complete a separate report for each person who was *injured, caused, or contributed to* the accident (excluding uninjured personnel and witnesses). Please type or print legibly. Appropriate items shall be marked with an "X" in box(es), non-applicable sections shall be marked "N/A". If additional space is needed, provide the information on a separate sheet and attach to the completed form. Ensure that these instructions are forwarded with the completed report to the designated management reviewers indicated.

REPORT DATE - Enter the date on which report was initiated.

CONTRACTING ACTIVITY/ROICC OFFICE - Enter the name and address of the Contracting Office administering the contract under which the mishap took place.

SECTION 1 - ACCIDENT CLASSIFICATION. (Mark All Boxes That Are Applicable)

INJURY/ILLNESS/FATALITY/PROPERTY DAMAGE/PROCEDURAL ISSUES/ENVIRONMENTAL - Mark the appropriate block if the incident resulted in any contractor lost-time injury, illness, fatality or near miss. If the mishap involved any of the conditions listed under "Involving" mark the appropriate box(es). Specific questions associated with each condition are available from the Contracting Officer.

SECTION 2 - PERSONAL DATA

A. **NAME** - Enter last name, first name, middle initial of person involved.
B. **AGE** - Enter age.
C. **SEX** - Enter M for Male and F for Female
D. **SOCIAL SECURITY NUMBER** - Enter the social security number if available.
E. **JOB DESCRIPTION/TITLE** - Enter the job description/title assigned to the injured person, e.g. carpenter, laborer, surveyor, etc.
F. **EMPLOYED BY** - Enter employment company name of person involved.
G. **SUPERVISOR'S NAME** - Enter name of the immediate supervisor.

SECTION 3 - WITNESS PERSONAL DATA

A. **NAME** - Enter last name, first name, middle initial of person involved.
B. **AGE** - Enter age.
C. **SEX** - Enter M for Male and F for Female
D. **JOB DESCRIPTION/TITLE** - Enter the job description/title assigned to the injured person, e.g. carpenter, laborer, surveyor, etc.
E. **EMPLOYED BY** - Enter employment company name of person involved.

SECTION 4 - GENERAL INFORMATION

A. **DATE OF ACCIDENT** - Enter the month, day, and year of accident.
B. **TIME OF ACCIDENT** - Enter the local time of accident in military time. Example: 1430 hrs (not 2:30 p.m.).
C. **EXACT LOCATION OF ACCIDENT** - Enter facts needed to locate the accident scene (installation/project name, building number, street, direction and distance from closest landmark, etc.).
D. **TYPE OF CONTRACTOR EQUIPMENT** - Enter the Serial Number, Model Number and specific type of equipment involved in the mishap, e.g. dump truck (off highway), crane (rubber tire, pump truck (concrete), etc.?
E. **CONTRACT NUMBER/TITLE** - Enter complete contract number and title of prime contract. e.g., N62477-85-C-0100
F. **CONSTRUCTION ACTIVITY** (SIC) - Enter your companies SIC.
G. **HAZARDOUS MATERIAL SPILL/RELEASE** - List name(s) of any reportable quantities of hazardous materials spilled/released during the mishap.
H. **TYPE OF CONTRACT** - Mark appropriate box. A/E means architect/engineer. If "OTHER" is marked, specify type of contract on line provided.
I. **CONTRACTOR'S NAME/ADDRESS/PHONE NUMBER**
(1) PRIME - Enter the exact name (title of firm), address and phone number of the prime contractor.
(2) SUBCONTRACTOR - Enter the exact name, address and phone number of any subcontractor involved in the accident.
J. **SAFETY MANAGER'S NAME/PHONE NUMBER**
(1) PRIME - Enter the name and phone number of the prime contractor safety manager.
(2) SUBCONTRACTOR - Enter the name and phone number of the subcontractors safety manager.
K. **INSURANCE CARRIER**
(1) PRIME - Enter the exact name/title of firm) of prime's insurance company.

(2) SUBCONTRACTOR - Enter the exact name of subcontractor's insurance company.

L. **WORK ACTIVITY INVOLVED IN AT TIME OF ACCIDENT** - Enter the most appropriate work activity the employee was involved in at the time of the accident (e.g., site preparation, painting, paving , masonry, welding, etc.)

M. **PERSONAL PROTECTIVE EQUIPMENT (PPE)** - Mark appropriate box(es) and list PPE which was being used by the injured person at the time of the accident (e.g. protective clothing, shoes, glasses, goggles, respirator, safety belt, harness, etc.)

SECTION 5 - INJURY/ILLNESS INFORMATION

A. **SEVERITY OF INJURY/ILLNESS** - Enter description from list below.

NO INJURY
FATALITY
PERMANENT TOTAL DISABILITY
PERMANENT PARTIAL DISABILITY
TEMPORARY DISABILITY
NO DISABILITY LIKELY
LOST WORKDAY CASE INVOLVING DAYS AWAY FROM WORK
RECORDABLE CASE WITHOUT LOST WORKDAYS
RECORDABLE FIRST AID CASE
NON-RECORDABLE INJURY

B. **ESTIMATED DAYS LOST** - Enter the estimated number of workdays the person will lose from work.

C. **ESTIMATED DAYS HOSPITALIZED** - Enter the estimated number of workdays the person will be hospitalized.

D. **ESTIMATED DAYS RESTRICTED DUTY** - Enter the estimated number of workdays the person, as a result of the accident, will not be able to perform all of their regular duties.

E. **BODY PART(S) AFFECTED** - Enter the most appropriate primary and, when applicable, secondary, etc. body part(s) affected, e.g., arm, wrist, abdomen, signal eye, jaw, both elbows, second finger, great toe, collar bone, kidney, etc.

F. **NATURE OF INJURY/ILLNESS** - Enter the most appropriate nature of injury/illness, e.g. amputation, back strain, dislocation, laceration, strain, asbestosis, food poisoning, heart condition, etc.

G. **TYPE AND SOURCE OF INJURY/ILLNESS** - Type and Source Codes are used to describe what caused the incident.

(1) TYPE Code stands for an "Action" (Example: Worker, installing conduit, lost his balance and fell five feet from a ladder. Type Code: Fell different level".) Select the most appropriate Type of injury from the list below:

TYPE OF INJURY/ILLNESS

STRUCK BY/AGAINST	CONTACTED CONTACTED WITH (INJURED PERSON MOVING) CONTACTED BY (OBJECT WAS MOVING)
FELL, SLIPPED, TRIPPED SAME LEVEL/DIFFERENT LEVEL/NO FALL	EXERTED LIFTED, STRAINED BY (SINGLE ACTION) STRESSED BY (REPEATED ACTION)
CAUGHT ON/IN/BETWEEN	EXPOSED INHALED/INGESTED/ABSORBED/EXPOSED TO
PUNCTURED, LACERATED PUNCTURED BY/CUT BY/STUNG BY/BITTEN BY	TRAVELING IN

(2) SOURCE Code stands for an "object or substance." (Example: Worker, installing conduit, lost his balance and fell five feet from a ladder. Source Code: Ladder".) Select the most appropriate Source of injury from the list below:

SOURCE OF INJURY/ILLNESS

BUILDING OR WORKING AREA WALKING/WORKING AREA STAIRS/STEPS LADDER FURNITURE BOILER/PRESSURE VESSEL EQUIPMENT LAYOUT WINDOWS/DOORS ELECTRICITY	DUST, VAPOR, ETC. DUST (SILICA, COAL, ETC.) FIBERS ASBESTOS GASES CARBON MONOXIDE MIST, STEAM, VAPOR, FUME WELDING FUMES PARTICLES (UNIDENTIFIED)

SOURCE OF INJURY/ILLNESS

ENVIRONMENTAL CONDITION TEMPERATURE EXTREME (INDOOR) WEATHER (ICE, RAIN, HEAT, ETC.) FIRE, FLAME, SMOKE (NOT TOBACCO) NOISE RADIATION LIGHT VENTILATION TOBACCO SMOKE STRESS (EMOTIONAL) CONFINED SPACE	CHEMICAL, PLASTIC, ETC. DRY CHEMICAL-CORROSIVE DRY CHEMICAL-TOXIC DRY CHEMICAL-EXPLOSIVE DRY CHEMICAL-FLAMMABLE LIQUID CHEMICAL-CORROSIVE LIQUID CHEMICAL-TOXIC LIQUID CHEMICAL-EXPLOSIVE LIQUID CHEMICAL-FLAMMABLE PLASTIC WATER MEDICINE
MACHINE OR TOOL HAND TOOL (POWERED: SAW, GRINDER, ETC.) HAND TOOL (NON POWERED) MECHANICAL POWER TRANSMISSION APPARATUS GUARD. SHIELD (FIXED, MOVEABLE, INTERLOCK) VIDEO DISPLAY TERMINAL PUMP, COMPRESSOR, AIR PRESSURE TOOL HEATING EQUIPMENT WELDING EQUIPMENT	INANIMATE OBJECT BOX, BARREL, ETC. PAPER METAL ITEM, MINERAL NEEDLE GLASS SCRAP, TRASH, WOOD FOOD CLOTHING, APPAREL, SHOES
VEHICLE AS DRIVER OF PRIVATELY OWNED, RENTAL VEHICLE AS PASSENGER OF PRIVATELY OWNED, RENTAL VEHICLE DRIVER OF GOVERNMENT VEHICLE PASSENGER OF GOVERNMENT VEHICLE COMMON CARRIER (AIRLINE, BUS, ETC.) AIRCRAFT (NOT COMMERCIAL) BOAT, SHIP, BARGE	ANIMATE OBJECT DOG OTHER ANIMAL PLANT INSECT HUMAN (VIOLENCE) HUMAN (COMMUNICABLE DISEASE) BACTERIA, VIRUS (NOT HUMAN CONTACT)
MATERIAL HANDLING EQUIPMENT EARTHMOVER (TRACTOR, BACKHOE, ETC.) CONVEYOR (FOR MATERIAL AND EQUIPMENT) ELEVATOR, ESCALATOR, PERSONNEL HOIST HOIST, SLING CHAIN, JACK CRANE FORKLIFT HANDTRUCK, DOLLY	PERSONAL PROTECTIVE EQUIPMENT PROTECTIVE CLOTHING, SHOES, GLASSES, GOGGLES RESPIRATOR, MASK DIVING EQUIPMENT SAFETY BELT, HARNESS PARACHUTE

SECTION 6 - ACCIDENT DESCRIPTION

A. Fully describe the accident in the space provided. If additional space is needed continue on a separate sheet and attach to this report. Give the sequence of events that describe what happened leading up to and including the accident. Fully identify personnel and equipment involved and their role(s) in the accident. Ensure that relationships between personnel and equipment are clearly specified. Ensure questions B - E are answered.

SECTION 7 - CAUSAL FACTORS

Review thoroughly. Answer each question by marking the appropriate block. If any answer is yes, explain in item 9 below.

(1) **DESIGN** - Did inadequacies associated with the building or work site play a role? Would an improved design or layout of the equipment or facilities reduce the likelihood of similar accidents? Were the tools or other equipment designed and intended for the task at hand?

(2) **INSPECTION/MAINTENANCE** - Did inadequately or improperly maintained equipment, tools, workplace, etc., create or worsen any hazards that contributed to the accident? Would better equipment, facility, work site or work activity inspections have helped avoid the accident?

(3) **PERSONS PHYSICAL CONDITION** - Do you feel that the accident would probably not have occurred if the employee was in "good" physical condition? If the person involved in the accident had been in better physical condition, would the accident have been less severe or avoided altogether? Was overexertion a factor?

(4) **OPERATING PROCEDURES** - Did lack of or inadequacy within established operating procedures contribute to the accident? Did any aspect of the procedures introduce any hazard to, or increase the risk associated with the work process? Would establishment or improvement of operating procedures reduce the likelihood of similar accidents?

(5) **JOB PRACTICES** - Were any of the provision of the Safety and Health Requirements Manual (EM 385-1-1) violated? Was the task being accomplished in a manner which was not in compliance with an established job hazard analysis or activity hazard analysis? Did any established job practice (including EM 385-1-1) fail to adequately address the task or work process? Would better job practices improve the safety of the task?

(6) **HUMAN FACTORS** - Was the person under undue stress (either internal or external to the job)? Did the task tend toward overloading the capabilities of the person: i.e., did the job require tracking and reacting to many external inputs such as displays, alarms or signals? Did the arrangement of the workplace tend to interfere with efficient task performance? Did the task require reach strength, endurance, agility, etc., at or beyond the capabilities of the employee? Was the work environment ill-adapted to the person? Did the person need more training, experience, or practice in doing the task? Was the person inadequately rested to perform safely?

(7) **ENVIRONMENTAL FACTORS** - Did any factors such as moisture, humidity, rain, snow, sleet, hail, ice, fog, cold, heat, sun temperature changes, wind, tides, floods, currents, dust, mud, glare, pressure changes, lighting, etc., play a part in the accident?

(8) **CHEMICAL AND PHYSICAL AGENT FACTORS** - Did exposure (either single shift exposure or long-term exposure) to chemical agents such as dusts, fibers (asbestos, etc.), silica, gases (carbon, monoxide, chlorine, etc.), mists, steam, vapors, fumes, smoke, other particulates, liquid or dry chemicals that are corrosive, toxic, explosive or flammable, by-products of combustion or physical agents such as noise, ionizing radiation, non-ionizing radiation (UV radiation created during welding, etc.) contribute to the accident/incident?

(9) **OFFICE FACTORS** - Did the fact that the accident occurred in an office setting or to an office worker have a bearing on its cause? For example, office workers tend to have less experience and training in performing tasks such as lifting office furniture. Did physical hazards within the office environment contribute to the hazard?

(10) **SUPPORT FACTORS** - Was the person using an improper tool for the job? Was inadequate time available or utilized to safely accomplish the task? Were less than adequate personnel resources (in terms of employee skills, number of workers, and adequate supervision) available to get the job done properly? Was funding available, utilized, and adequate to provide proper tools, equipment, personnel, site preparation, etc.

(11) **PERSONAL PROTECTIVE EQUIPMENT** - Did the person fail to use appropriate personal protective equipment (gloves, eye protection, hard-toed shoes, respirator, etc.) for the task or environment? Did protective equipment provided or worn fail to provide adequate protection from the hazard(s)? Did lack of or inadequate maintenance of protective gear contribute to the accident?

(12) **DRUGS/ALCOHOL** - Is there any reason to believe the person's mental or physical capabilities, judgment, etc., were impaired or altered by the use of drugs or alcohol? Consider the effects of prescription medicine and over the counter medications as well as illicit drug use. Consider the effect of drug or alcohol induced "hangovers".

(13) **JOB/ACTIVITY HAZARD ANALYSIS** - Was a written Job/Activity Hazard Analysis completed for the task being performed at the time of the accident? Mark the appropriate box. If *one was performed, attach a copy of the analysis to the report.*

(14) **MANAGEMENT** - Did the lack of supervisor or management support play a part in the mishap?

SECTION 8 - TRAINING

A. **WAS PERSON TRAINED TO PERFORM ACTIVITY/TASK?** - For the purpose of this section, "trained" means the person has been provided the necessary information (either formal and or on-the-job (OJT) training) to competently perform the activity/task in a safe and healthful manner.

B. **TYPE OF TRAINING** - Indicate the specific type of training (classroom or on-the-job) that the injured person received before the accident happened.

C. **DATE OF MOST RECENT TRAINING** - Enter the month, day, and year of the last *formal* training completed that covered the activity-task being performed at the time of the accident.

D. **LIST TOPICS DISCUSSED** - List topics that were discussed at the training identified in item c. above.

SECTION 9 - CAUSES

A. **DIRECT CAUSES** - The direct cause is the single factor which most directly lead to the accident. See examples below.

B. **INDIRECT CAUSES** - Indirect causes are those factors which contributed to, but did not directly initiate the occurrence of the accident.

C. Fully describe all the actions taken, anticipated, and recommended to eliminate the cause(s) and prevent reoccurrence of similar accidents/illnesses. Continue on blank sheets of paper if necessary to fully explain and attach to the completed report form.

D. **CORRECTIVE ACTION DATES** -

(1) Beginning - Enter the date when the corrective action(s) identified in c. above will begin.

(2) Anticipated Completion - Enter the date when the corrective action(s) identified in c. above will be completed.

Examples for section 9:

A. Employee was dismantling scaffold and fell 12 feet from unguarded opening.

Direct cause: Failure to provide fall protection at elevation.

Indirect causes: Failure to enforce USACE safety requirements: improper training/motivation of employee (possibility that employee was not knowledgeable of USACE fall protection requirements or was lax in his attitude toward safety); failure to ensure provision of positive fall protection whenever elevated; failure to address fall protection during scaffold dismantling in phase hazard analysis.

B. Private citizen had stopped his vehicle at intersection for red light when vehicle was struck in rear by contractor vehicle. (Note contractor vehicle was in proper safe working condition).

Direct cause: Failure of contractor driver to maintain control of and stop contractor vehicle within safe distance.

Indirect cause: Failure of employee to pay attention to driving (defensive driving).

SECTION 10 - OSHA - Complete this section if applicable

SECTION 11 - REPORT PREPARER

Enter the name, title and signature of persons completing the accident report and provide to the Contracting Officer/ROICC representative responsible for oversight of that contractor activity. Enter the month, day and year that the report was signed by the responsible supervisor.

SECTION 12 - MANAGEMENT REVIEW (CONTRACTING OFFICER)

The responsible report preparer, as identified in section 11, shall forward the completed report to the Contracting Officer/ROICC for review. Upon receipt, the Contracting Officer/ROICC shall review the completed report, validate the information, coordinate with supervisor (identified in section 11) for any necessary corrections, mark the appropriate boxes, provide substantive comments, sign, date, and forward to the responsible EFD/EFA/Activity Safety and Health Office.

SECTION 13 - SAFETY AND OCCUPATIONAL HEALTH REVIEW

The Safety and Occupational Health Office shall review the completed report, mark the appropriate box, ensure that any inadequacies, discrepancies, etc. are rectified by the responsible supervisor and management reviewer, provide substantive comments, sign, date, and forward the completed report to NAVFACHQ 40K.

OIL AND HAZARDOUS SUBSTANCE (OHS) SPILL RESPONSE & NOTIFICATION PROCEDURES – CONTRACTORS

SPILLER ACTIONS: Any person causing or discovering a OHS release or spill shall:

1. Immediately alert nearby personnel who may be exposed to the effects of the release or spill.

2. Activate the nearest fire alarm if imminent danger to life, the environment or property, or if fire threatens or starts.

3. Report spill immediately to:

FEDERAL FIRE DEPARTMENT (FFD) DISPATCHER
911 (24-hour, government telephones only)
471-7117 (from housing and non-governmental phones)
474-2222 (non-emergencies)

For waterborne spills: Port Operations Control Tower 474-6262

4. **ONLY IF SAFE TO DO SO**, gather as much of the following spill information as possible and provide information to the FFD Dispatcher.

• Spill Location:	• Caller/Phone Number:
• POC at the Spill Site:	• Spill is: On -Land ☐ In- Water ☐ Entered Storm Drain ☐
• Substance spilled:	• Source/Cause of Spill:
• Estimated Amount Spilled:	• Spill Area:
• Is the Spill Contained: Yes ☐ No ☐	• If yes, Actions Taken to Contain Spill:

5. Report the spill to the Contracting Officer at ___________________ immediately after the initial call to the FFD has been made.

6. For spills which meet or exceed the "reportable quantity (RQ)" or results in or threatens to result in exposure outside Navy Property, complete the following verbal notifications immediately (initial notification must not be delayed pending collection of all information):
   - Navy On-Scene Coordinator (NOSC): **(see item no. 10 below for telephone numbers)**
   - National Response Center: **1-800-424-8802**
   - State Emergency Response Commission: **(808) 586-4249 (days) / (808) 247-2191 (24 hrs.)**
   - Local Emergency Planning Committee: **(808) 523-4121 (non-emergencies) / 911 (emergencies only)**

7. **ONLY if properly trained and authorized, safe to do so, and is within the capability of the on-site personnel** initiate available on-site countermeasure to minimize the spread of contaminants and stop the source of the spill or leak.

8. If necessary, evacuate upwind/upgrade to a safe distance and standby until emergency response personnel arrive on scene. Provide known details of the spill when assistance arrives.

9. The Contractor shall complete the follow up written reports to SERC and LEPC. The Contracting Officer will submit the Navy Spill Message, and if necessary the OPREP-3 Navy Blue Message.

10. The following are the point of contacts for OHS spill related issues:
    - **NOSC: Duty Hours: 473-4689 Non-Duty Hours: 864-2463 (cell)**

MACHINERY AND MECHANIZED EQUIPMENT CERTIFICATION FORM

TO: Contracting Officer DATE:

FROM: AECOM Technical Services, Inc (AECOM)

CONTRACT NO.:

CTO No.: CTO Title:

1. This form provides certification of machinery and mechanized equipment to be used on the referenced contract task order (CTO) for the following work:

Description of equipment work:	
Project Site:	
Subcontractor providing equipment: Address:	
Dates (duration) of equipment work:	

2. Inspection and certification of machinery and mechanized equipment, as required *by U.S. Army Corps of Engineers, EM 385-1-1, "Safety and Health Requirements Manual," Section 16 - Machinery and Mechanized Equipment*, has been made prior to, but within seven calendar days advance of, use on the project site. Re-certification will be required for equipment that is used on the project site for more than one year.

Identification of equipment (make, model, serial no.)		Date of Certification
1		
2		
3		

3. The above listed equipment has been inspected and tested as indicated above, and is CERTIFIED TO BE IN SAFE OPERATING CONDITION BY THE FOLLOWING COMPETENT INDIVIDUAL:

Name		Title	
Company			
Signature		Date	

4. If there are any questions regarding this certification, please contact the following AECOM Representative:

5. Copy to: PACNAVFACENGCOM Code 00K

COTR (LRPM)
NTR (RPM)
CTO Files

Attachment E:
Activity Hazard Analyses

ACTIVITY HAZARD ANALYSIS (AHA)

Activity/Work Task: Biota Tissue Sampling	Overall Risk Assessment Code (RAC): 3
Project Location: Groundwater Monitoring and BERA Sampling, Marine Corps Base, Hawaii, Oahu	
Contract Number: N62742-03-D-1837 Task Order: CTO HC31	
Date Prepared: 6/11/20105	
Prepared by (Name/Title): Danielle Coulombe/Environmental Scientist	
Reviewed by (Name/Title): Shelley Brown, CSP / CLEAN Safety and Health Manager	
Notes: (Field Notes, Review Comments, etc.) Minimum Personal Protection Equipment: Safety Glasses, work boots, work uniform, Hard Hat, and Personal Flotation Device (Type III, U.S. Coast Guard-approved) (See HSP, Table 7-3 for details).	

Risk Assessment Code (RAC) Matrix		Mishap Probability Subcategory			
		A. Likely to occur immediately or within a short period of time.	B. Probably will occur in time.	C. May occur in time.	D. Unlikely to occur.
Hazard Severity Category	I. May cause death, permanent total disability, or loss of a facility/asset.	1	1	2	3
	II. May cause permanent partial disability, temporary total disability in excess of 90 days, or major property damage.	1	2	3	4
	III. May cause minor injury, occupational illness, or property damage.	2	3	4	5
	IV. Presents minimal threat to personnel safety or health, or property, but is still in violation of a standard.	3	4	5	5

Step 1: Review each “Hazard” with identified safety “Controls” and determine RAC (See above).

Step 2: Identify the RAC (Probability/Severity) as 1, 2, 3, 4, or 5 for each “Hazard” on AHA. Annotate the overall RAC at the top of AHA.

RAC Definitions
1- Critical
2-Serious
3-Moderate
4-Minor
5-Negligible

Job Steps	Hazards	Controls	RAC
1. Mobilize equipment and personnel to site.	• Driving hazards	• Inspect vehicles for defects and record completion of inspection in logbook. • Implement safe driving practices to prevent transportation incidents.	2

Job Steps	Hazards	Controls	RAC
2. Hold Tailgate Safety Briefing, review applicable AHAs and SOPs; Inspect and don PPE; Inspect tools and equipment.	• Incorrect PPE usage • Equipment malfunction • Lack of knowledge of tasks being performed • Potential incidents and emergencies	• Site Safety and Health Officer (SSHO) should check that required PPE (see HSP) is being used, including sunscreen with minimum SPF of 30. • User (AECOM and/or Subcontract Personnel) should inspect equipment before use. • Discuss tasks to be performed by personnel, potential hazards and control measures. • Following daily safety briefing, have personnel sign attendance form, which will be maintained on site. • Inform workers of emergency contact information and hospital route.	5
3. Evaluate area for hazards (this should be performed regularly throughout the duration of the task).	• Slips, trips and falls • Heat stress • Biological Hazards	• Personnel should identify and take measurable cautionary steps to observe areas for hazards: Ensure that pathways are clear and free of obstruction prior to initiating work; Adhere to proper housekeeping practices. • Begin heat stress monitoring and continue while work is performed. • Implement appropriate heat stress prevention procedures, e.g. drink plenty of fluids and use appropriate work/rest schedule. • Avoid contact with poisonous insects, and wildlife. • Use appropriate PPE.	3
4. Working near water.	• Slips, trips and falls • Heat stress • Biological Hazards	• Work must be performed in accordance with the "Buddy System". • Coast Guard Approved Personal Floatation Device (PFD), sized and adjusted to the wearer shall be appropriately work by all • Ensure that a lifesaving drill is performed before the start of work and periodically thereafter. • Ring buoys with at least 90 feet of line shall be provided and readily available emergency rescue operations.	2
5. Collecting sample.	• Contaminant Exposure	• Use appropriate PPE.	3
6. Decontaminate equipment.	• Muscle strain • Contaminant Exposure	• Proper lifting techniques will be used; proper tools will be used for decontamination. • Wear appropriate PPE. • Place spent decontamination water in appropriate containers or drums.	3

Equipment to be Used	Training Requirements/Qualified Personnel name(s)	Inspection Requirements
Gill nets, hand nets and crab traps.	None.	Inspect nets and traps for deterioration.

Pertinent SOPs:			
S3NA-001-PR	*Safe Work Standards and Rules*	S3NA-313-PR	*Wildlife, Plants and Insects*
S3NA-005-PR	*Driver and Vehicle Safety Program*	S3NA-315-PR	*Water, Working Around*
S3NA-203-PR	*Emergency Response Planning, Field*	S3NA-417-PR	*Utilities Underground*
S3NA-208-PR	*Personal Protective Equipment Program*	S3NA-419-PR	*Boat and Vessel Operations*
S3NA-210-PR	*Project Safety Meetings*	S3NA-420-PR	*Water, Underwater Diving*
S3NA-305-PR	*Hand and Power Tools*	S3NA-509-PR	*Hazardous Waste Operations and Emergency Response*
S3NA-307-PR	*Housekeeping, Worksite*	S3NA-511-PR	*Heat Stress Prevention*
S3NA-308-PR	*Manual Lifting, Field*		
S3NA-309-PR	*Mobile or Heavy Equipment*		

Prepared by:	Danielle Coulombe/ Environmental Scientist	(Sign and Date):	6/11/15
Approved by:	Shelley Brown, CSP/ CLEAN Safety and Health Manager	(Sign and Date):	Shelley Brown 6/11/15

ACTIVITY HAZARD ANALYSIS (AHA)

<table>
<tr><td>Activity/Work Task: Groundwater Sampling</td><td colspan="5">Overall Risk Assessment Code (RAC)</td><td>3</td></tr>
<tr><td>Project Location: Groundwater Monitoring and BERA Sampling, Marine Corps Base, Hawaii, Oahu</td><td colspan="2" rowspan="3">Risk Assessment Code (RAC) Matrix</td><td colspan="4">Mishap Probability Subcategory</td></tr>
<tr><td>Contract Number: N62742-03-D-1837
Task Order: CTO HC31</td><td>A.
Likely to occur immediately or within a short period of time.</td><td>B.
Probably will occur in time.</td><td>C.
May occur in time.</td><td>D.
Unlikely to occur.</td></tr>
<tr><td>Date Prepared: 6/11/20105</td><td></td><td></td><td></td><td></td></tr>
<tr><td>Prepared by (Name/Title): Danielle Coulombe/Environmental Scientist</td><td rowspan="4">Hazard Severity Category</td><td>I.
May cause death, permanent total disability, or loss of a facility/asset.</td><td>1</td><td>1</td><td>2</td><td>3</td></tr>
<tr><td>Reviewed by (Name/Title): Shelley Brown, CSP / CLEAN Safety and Health Manager</td><td>II.
May cause permanent partial disability, temporary total disability in excess of 90 days, or major property damage.</td><td>1</td><td>2</td><td>3</td><td>4</td></tr>
<tr><td rowspan="3">Notes: (Field Notes, Review Comments, etc.)
Minimum Personal Protection Equipment: Safety Glasses, work boots, work uniform, and Hard Hat (See HSP, Table 7-3 for details).</td><td>III.
May cause minor injury, occupational illness, or property damage.</td><td>2</td><td>3</td><td>4</td><td>5</td></tr>
<tr><td>IV.
Presents minimal threat to personnel safety or health, or property, but is still in violation of a standard.</td><td>3</td><td>4</td><td>5</td><td>5</td></tr>
<tr><td colspan="5">Step 1: Review each “Hazard” with identified safety “Controls” and determine RAC (See above).
Step 2: Identify the RAC (Probability/Severity) as 1, 2, 3, 4, or 5 for each “Hazard” on AHA.</td><td>RAC Definitions
1- Critical
2-Serious
3-Moderate
4-Minor
5-Negligible</td></tr>
</table>

Job Steps	Hazards	Controls	RAC
1. Mobilize equipment and personnel to site.	• Driving hazards	• Inspect vehicles for defects and complete inspection form. • Implement safe driving practices to prevent transportation incidents.	2
2. Hold Tailgate Safety Briefing, review applicable AHAs and SOPs; Inspect and don PPE; Inspect tools and equipment.	• Incorrect PPE usage • Equipment malfunction • Lack of knowledge of tasks being performed • Potential incidents and emergencies	• Site Safety and Health Officer (SSHO) should check that required PPE (see HSP) is being used, including sunscreen with minimum SPF of 30. • User (AECOM and/or Subcontract Personnel) should inspect equipment before use. • Discuss tasks to be performed by personnel, potential hazards and control measures. • Following daily safety briefing, have personnel sign attendance form which will be maintained onsite. • Inform workers of emergency contact information and hospital route.	3

Job Steps	Hazards	Controls	RAC
3. Evaluate area for hazards (this should be performed regularly throughout the duration of the task).	• Slips, trips and falls • Heat stress • Biological Hazards	• Personnel should take identify and take measurable cautionary steps to observe areas for hazards; Ensure that pathways are clear and free of obstruction prior to initiating work; Adhere to proper housekeeping practices. • Begin heat stress monitoring and continue while work is performed. • Implement heat stress prevention procedures, i.e. drink plenty of water and initiate work-rest schedule. • Avoid contact with poisonous plants, insects, and wildlife.	2
4. Collecting sample.	• Contaminant Exposure • Hand and Power tools	• Wear appropriate personal protective equipment (PPE). • Implement monitoring for VOCs as directed by the HSP using calibrated equipment. A certificate of calibration should be maintained on file.	3
5. Decontaminate equipment.	• Muscle strain • Contaminant Exposure	• Proper lifting techniques will be used; proper tools will be used for decontamination. • Wear appropriate PPE. • Place spent decontamination water in appropriate containers or drums.	3

Equipment to be Used	Training Requirements/Qualified Personnel name(s)	Inspection Requirements
PID, Gas meter Hand and Power tools	SSHO/Danielle Coulombe Review SOPs/Teresa Quiniola	Calibrate and maintain monitoring instruments daily Inspect all tools prior to use

Pertinent SOPs:

S3NA-001-PR	*Safe Work Standards and Rules*	S3NA-307-PR	*Housekeeping, Worksite*
S3NA-005-PR	*Vehicle and Driver Safety Program*	S3NA-308-PR	*Manual Lifting, Field*
S3NA-203-PR	*Emergency Response Planning, Field*	S3NA-313-PR	*Wildlife, Plants and Insects*
S3NA-208-PR	*Personal Protective Equipment Program*	S3NA-509-PR	*Hazardous Waste Operations and Emergency Response*
S3NA-210-PR	*Project Safety Meetings*	S3NA-511-PR	*Heat Stress*
S3NA-305-PR	*Hand and Power Tools*		

Prepared by: Danielle Coulombe/ Environmental Scientist (Sign and Date): 6/11/15

Approved by: Shelley Brown, CSP/ CLEAN Safety and Health Manager (Sign and Date): Shelley Brown 6/11/15

ACTIVITY HAZARD ANALYSIS (AHA)

Activity/Work Task: IDW Management	Overall Risk Assessment Code (RAC): 2
Project Location: Groundwater Monitoring and BERA Sampling, Marine Corps Base, Hawaii, Oahu	
Contract Number: N62742-03-D-1837 Task Order: CTO HC31	
Date Prepared: 6/11/20105	
Prepared by (Name/Title): Danielle Coulombe/Environmental Scientist	
Reviewed by (Name/Title): Shelley Brown, CSP / CLEAN Safety and Health Manager	
Notes: (Field Notes, Review Comments, etc.) Minimum Personal Protection Equipment: Safety Glasses, work boots, work uniform, and Hard Hat (See HSP, Table 7-3 for details).	

Risk Assessment Code (RAC) Matrix		Mishap Probability Subcategory			
		A. Likely to occur immediately or within a short period of time.	B. Probably will occur in time.	C. May occur in time.	D. Unlikely to occur.
Hazard Severity Category	I. May cause death, permanent total disability, or loss of a facility/asset.	1	1	2	3
	II. May cause permanent partial disability, temporary total disability in excess of 90 days, or major property damage.	1	2	3	4
	III. May cause minor injury, occupational illness, or property damage.	2	3	4	5
	IV. Presents minimal threat to personnel safety or health, or property, but is still in violation of a standard.	3	4	5	5

Step 1: Review each “Hazard” with identified safety “Controls” and determine RAC (See above).

Step 2: Identify the RAC (Probability/Severity) as 1, 2, 3, 4, or 5 for each “Hazard” on AHA.

RAC Definitions
1- Critical
2-Serious
3-Moderate
4-Minor
5-Negligible

Job Steps	Hazards	Controls	RAC
1. Mobilize equipment and personnel to site.	• Driving hazards	• Inspect vehicles for defects and complete inspection form. • Implement safe driving practices to prevent transportation incidents.	2
2. Hold Tailgate Safety Briefing, review applicable AHAs and SOPs; Inspect and don PPE; Inspect tools and equipment.	• Incorrect PPE usage • Equipment malfunction • Lack of knowledge of tasks being performed • Potential incidents and emergencies	• Site Safety and Health Officer (SSHO) should check that required PPE (see HSP) is being used, including sunscreen with minimum SPF of 30. • User (AECOM and/or Subcontract Personnel) should inspect equipment before use. • Discuss tasks to be performed by personnel, potential hazards and control measures. • Following daily safety briefing, have personnel sign attendance form which will be maintained onsite. • Inform workers of emergency contact information and hospital route.	3

Job Steps	Hazards	Controls	RAC
3. Open drum.	• Pinch points • Flammable hazards • Manual Tools	• Use proper tools (spark resistant) to open drum.	3
4. Collecting sample.	• Contaminant Exposure • Manual Tools	• Wear appropriate PPE.	3
5. Decontaminate equipment.	• Contaminant Exposure	• Proper tools will be used for decontamination. • Wear appropriate PPE. • Containerize spent water appropriately.	3
6. Moving drums.	• Muscle strain • Struck by, caught beneath	• Use mechanical aids as much as possible. • If mechanical aids are not available, roll the drum using proper drum handling techniques.	3

Equipment to be Used	**Training Requirements/Qualified Personnel name(s)**	**Inspection Requirements**
Manual Tools	Review SOPs	Inspect all tools prior to use

Pertinent SOPs:

S3NA-001-PR	*Safe Work Standards and Rules*	S3NA-307-PR	*Housekeeping, Worksite*
S3NA-005-PR	*Vehicle and Driver Safety Program*	S3NA-308-PR	*Manual Lifting, Field*
S3NA-203-PR	*Emergency Response Planning, Field*	S3NA-313-PR	*Wildlife, Plants and Insects*
S3NA-208-PR	*Personal Protective Equipment Program*	S3NA-509-PR	*Hazardous Waste Operations and Emergency Response*
S3NA-210-PR	*Project Safety Meetings*	S3NA-511-PR	*Heat Stress*
S3NA-305-PR	*Hand and Power Tools*		

Prepared by: Danielle Coulombe/ Environmental Scientist (Sign and Date): 6/11/15

Approved by: Shelley Brown, CSP/ CLEAN Safety and Health Manager (Sign and Date): Shelley Brown 6/11/15

ACTIVITY HAZARD ANALYSIS (AHA)

Activity/Work Task: Sediment and Porewater Sampling	Overall Risk Assessment Code (RAC)	2
Project Location: Groundwater Monitoring and BERA Sampling, Marine Corps Base, Hawaii, Oahu		
Contract Number: N62742-03-D-1837 Task Order: CTO HC31		
Date Prepared: 6/11/20105		
Prepared by (Name/Title): Danielle Coulombe/Environmental Scientist		
Reviewed by (Name/Title): Shelley Brown, CSP / CLEAN Safety and Health Manager		
Notes: (Field Notes, Review Comments, etc.) Minimum Personal Protection Equipment: Safety Glasses, work boots, work uniform, Hard Hat, and Personal Flotation Device (Type III, U.S. Coast Guard-approved) (See HSP, Table 7-3 for details).		

Risk Assessment Code (RAC) Matrix		Mishap Probability Subcategory			
		A. Likely to occur immediately or within a short period of time.	B. Probably will occur in time.	C. May occur in time.	D. Unlikely to occur.
Hazard Severity Category	I. May cause death, permanent total disability, or loss of a facility/asset.	1	1	2	3
	II. May cause permanent partial disability, temporary total disability in excess of 90 days, or major property damage.	1	2	3	4
	III. May cause minor injury, occupational illness, or property damage.	2	3	4	5
	IV. Presents minimal threat to personnel safety or health, or property, but is still in violation of a standard.	3	4	5	5

Step 1: Review each "Hazard" with identified safety "Controls" and determine RAC (See above).

Step 2: Identify the RAC (Probability/Severity) as 1, 2, 3, 4, or 5 for each "Hazard" on AHA. Annotate the overall RAC at the top of AHA.

RAC Definitions
1- Critical
2-Serious
3-Moderate
4-Minor
5-Negligible

Job Steps	Hazards	Controls	RAC
1. Mobilize equipment and personnel to site.	• Driving hazards	• Inspect vehicles for defects and record completion of inspection in logbook. • Implement safe driving practices to prevent transportation incidents.	2
2. Hold Tailgate Safety Briefing, review applicable AHAs and SOPs; Inspect and don PPE; Inspect tools and equipment.	• Incorrect PPE usage • Equipment malfunction • Lack of knowledge of tasks being performed • Potential incidents and emergencies	• Site Safety and Health Officer (SSHO) should check that required PPE (see HSP) is being used, including sunscreen with minimum SPF of 30. • User (AECOM and/or Subcontract Personnel) should inspect equipment before use. • Discuss tasks to be performed by personnel, potential hazards, and control measures. • Following daily safety briefing, have personnel sign attendance form that will be maintained on site. • Inform workers of emergency contact information and hospital route.	5

Job Steps	Hazards	Controls	RAC
3. Evaluate area for hazards (this should be performed regularly throughout the duration of the task). Awareness of Potential Presence of UXO	• Slips, trips and falls • Heat stress • Biological Hazards • Explosive Hazards	• Personnel should identify and take measurable cautionary steps to observe areas for hazards: Ensure that pathways are clear and free of obstruction prior to initiating work; Adhere to proper housekeeping practices. • Ensure that all lines are secured prior to initiating work. • Begin heat stress monitoring and continue while work is performed. • Implement appropriate heat stress prevention procedures, e.g., drink plenty of fluids and use appropriate work/rest schedule. • Avoid contact with poisonous insects, and wildlife. • Use appropriate PPE. • If a suspect UXO item is identified: ▪ Do not attempt to move or otherwise handle. ▪ Personnel should note the location and alert all other personnel in the area of its presence. ▪ Any AECOM work occurring within 20 feet of the item will cease. ▪ All AECOM and subcontractor employees will evacuate this area. ▪ Contact the Navy EOD/UXO Technical Support (808-474-3614-15)/mobile (808-306-6676), Navy On-Scene Coordinator (808-473-4689)/mobile (808-864-2463), Project Manager (808-356-5344) and the AECOM Incident Reporting Line (800-348-5046).	3
4. Working near water	• Slips, trips and falls • Heat stress • Biological hazards • Water hazards	• Work must be performed in accordance with the “Buddy System.” • Coast Guard Approved Personal Flotation Device (PFD), sized and adjusted to the wearer shall be appropriately worn by all • Ensure that a lifesaving drill is performed before the start of work and periodically thereafter. • Ring buoys with at least 90 feet of line shall be provided and readily available emergency rescue operations.	2
5. Collecting sample.	• Contaminant Exposure • Manual Tools • Water Exposure	• Use appropriate PPE, including PFD. • Use proper lifting techniques.	3
6. Decontaminate equipment.	• Muscle strain • Contaminant Exposure	• Proper lifting techniques will be used; proper tools will be used for decontamination. • Wear appropriate PPE. • Place spent decontamination water in appropriate containers or drums.	3

Equipment to be Used	Training Requirements/Qualified Personnel name(s)	Inspection Requirements
Explosimeter to monitor for methane and H_2S	SSHO/Danielle Coulombe	Calibrate and maintain monitoring instruments daily

Pertinent SOPs:			
S3NA-001-PR	*Safe Work Standards and Rules*	S3NA-315-PR	*Water, Working Around*
S3NA-005-PR	*Driver and Vehicle Safety Program*	S3NA-406-PR	*Electrical Lines, Overhead*
S3NA-203-PR	*Emergency Response Planning, Field*	S3NA-509-PR	*Hazardous Waste Operations and Emergency Response*
S3NA-208-PR	*Personal Protective Equipment Program*	S3NA-511-PR	*Heat Stress Prevention*
S3NA-210-PR	*Project Safety Meetings*	S3NA-514-PR	*Munitions and Explosives of Concern/Unexploded Ordnance*
S3NA-305-PR	*Hand and Power Tools*	S3NA-519-PR	*Respiratory Protection Program*
S3NA-307-PR	*Housekeeping, Worksite*		
S3NA-308-PR	*Manual Lifting, Field*		
S3NA-313-PR	*Wildlife, Plants and Insects*		

Prepared by:	Danielle Coulombe/ Environmental Scientist	(Sign and Date):	6/11/15
Approved by:	Shelley Brown, CSP/ CLEAN Safety and Health Manager	(Sign and Date):	Shelley Brown 6/11/15

ACTIVITY HAZARD ANALYSIS (AHA)

Activity/Work Task: Surface Water Sampling	Overall Risk Assessment Code (RAC): 3
Project Location: Groundwater Monitoring and BERA Sampling, Marine Corps Base, Hawaii, Oahu	
Contract Number: N62742-03-D-1837 Task Order: CTO HC31	
Date Prepared: 6/11/20105	
Prepared by (Name/Title): Danielle Coulombe/Environmental Scientist	
Reviewed by (Name/Title): Shelley Brown, CSP / CLEAN Safety and Health Manager	
Notes: (Field Notes, Review Comments, etc.) Minimum Personal Protection Equipment: Safety Glasses, work boots, work uniform, Hard Hat, and Personal Flotation Device (Type III, U.S. Coast Guard-approved) (See HSP, Table 7-3 for details).	

Risk Assessment Code (RAC) Matrix		Mishap Probability Subcategory			
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	III. May cause minor injury, occupational illness, or property damage.	2	3	4	5
	IV. Presents minimal threat to personnel safety or health, or property, but is still in violation of a standard.	3	4	5	5

Step 1: Review each “Hazard” with identified safety “Controls” and determine RAC (See above).
Step 2: Identify the RAC (Probability/Severity) as 1, 2, 3, 4, or 5 for each “Hazard” on AHA.

RAC Definitions
1- Critical
2-Serious
3-Moderate
4-Minor
5-Negligible

Job Steps	Hazards	Controls	RAC
1. Mobilize equipment and personnel to site.	• Driving hazards	• Inspect vehicles for defects and document inspection in log book. • Implement safe driving practices to prevent transportation incidents.	2
2. Hold Tailgate Safety Briefing, review applicable AHAs and SOPs; Inspect and don PPE; Inspect tools and equipment.	• Incorrect PPE usage • Equipment malfunction • Lack of knowledge of tasks being performed • Potential incidents and emergencies	• Site Safety and Health Officer (SSHO) should check that required PPE (see HSP) is being used, including sunscreen with minimum SPF of 30. • User (AECOM and/or Subcontract Personnel) should inspect equipment before use. • Discuss tasks to be performed by personnel, potential hazards and control measures. • Following daily safety briefing, have personnel sign attendance form which will be maintained onsite. • Inform workers of emergency contact information and hospital route.	5

Job Steps	Hazards	Controls	RAC
3. Evaluate area for hazards (this should be performed regularly throughout the duration of the task).	• Slips, trips and falls • Heat stress • Biological Hazards	• Personnel should take identify and take measurable cautionary steps to observe areas for hazards; Ensure that pathways are clear and free of obstruction prior to initiating work; Adhere to proper housekeeping practices. • Begin heat stress monitoring and continue while work is performed. • Implement heat stress prevention procedures, i.e. drink plenty of water and initiate work-rest schedule. • Avoid contact with poisonous plants, insects, and wildlife.	4
4. Collecting sample.	• Contaminant Exposure • Drowning • Manual Tools	• Wear appropriate personal protective equipment (PPE), including US Coast Guard-approved personal flotation device. • Ring buoys with at least 90 feet of line shall be provided and readily available emergency rescue operations.	3
5. Decontaminate equipment.	• Muscle strain • Contaminant Exposure	• Proper lifting techniques will be used; proper tools will be used for decontamination. • Wear appropriate PPE. • Place spent decontamination water in appropriate containers or drums.	3

Equipment to be Used	Training Requirements/Qualified Personnel name(s)	Inspection Requirements
Manual Tools	Review SOPs/Teresa Quiniola	Inspect all tools prior to use

Pertinent SOPs:

S3NA-001-PR	*Safe Work Standards and Rules*	S3NA-307-PR	*Housekeeping, Worksite*
S3NA-005-PR	*Vehicle and Driver Safety Program*	S3NA-308-PR	*Manual Lifting, Field*
S3NA-203-PR	*Emergency Response Planning, Field*	S3NA-313-PR	*Wildlife, Plants and Insects*
S3NA-208-PR	*Personal Protective Equipment Program*	S3NA-315-PR	*Water, Working around*
S3NA-210-PR	*Project Safety Meetings*	S3NA-509-PR	*Hazardous Waste Operations and Emergency Response*
S3NA-305-PR	*Hand and Power Tools*	S3NA-511-PR	*Heat Stress*

Prepared by: Danielle Coulombe/ Environmental Scientist (Sign and Date): 6/11/15

Approved by: Shelley Brown, CSP/ CLEAN Safety and Health Manager (Sign and Date): Shelley Brown 6/11/15

Appendix D: References

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