APPENDIX D

UXO MANAGEMENT PLANS

FINAL WORK PLAN FOR MUNITIONS RESPONSE MODIFIED REMOVAL ACTION AND CONSTRUCTION SUPPORT CONGAREE RIVER PROJECT

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Table of Contents

Figures

Tables

Appendices

ACRONYMS

°	Degrees
°C	Degrees Centigrade
°F	Degrees Fahrenheit
ACGIH	American Conference of Governmental Industrial Hygienists
ANSI	American National Standards Institute
APEX	Apex Companies, LLC
APP	Accident Prevention Plan
AR	Army Regulation
ATF	Alcohol Tobacco and Firearms
BATF	Bureau of Alcohol Tobacco and Firearms
BIP	blown in place
bpm	beats per minute
CAR	Corrective Action Request
CFR	Code of Federal Regulations
CHEMTREC	Chemical Transportation Emergency Center
COR	Contracting Officer’s Representative
CPR	Cardio-Pulmonary Resuscitation
CPFF	Cost Plus Fixed Fee
CQDM	Quality Control Data Management
CRP	Congaree River Project
CRZ	Contamination Reduction Zone
CSHP	Corporate Safety and Health Plan
CWM	Chemical Warfare Material
DESC	Dominion Energy South Carolina
DGM	Digital Geophysical Mapping
DID	Data Item Description
DDESB	Department of Defense Explosive Safety Board
DMM	Discarded Military Munition
DoD	Department of Defense
DOP	Dive Operations Plan
DOT	Department of Transportation
DQO	Data Quality Objective
DS	Dive Supervisor
EE/CA	Engineering Evaluation/Cost Assessment
EED	Electro-Explosive Device
EM	Engineer Manual
EMR	Electro-Magnetic Radiation
EMT	Emergency Medical Technician
EOD	Explosive Ordnance Disposal
EP	Engineer Pamphlet
EPA	Environmental Protection Agency
ERCP	Emergency Response Contingency Plan
ESP	Explosives Safety Plan

EZ	Exclusion Zone
FAR	Federal Acquisition Regulation
FCA	Function Check Area
FFP	Firm Fixed Price
FUP	Fixed Unit Price
GCS	geographic coordinate system
GFE	Government Furnished Equipment
GIS	Geospatial Information System
GPS	Global Positioning System
HAZMAT	Hazardous Material
HAZWOPER	Hazardous Waste Operations and Emergency Response
HE	High Explosive
HEPA	High Efficiency Particulate Air
HF	High Frequency
HPS	Hantavirus Pulmonary Syndrome
HTRW	Hazardous, Toxic, or Radiological Waste
IAW	In Accordance With
ID	Identification
ISOs	Industry Standard Objects
lbs	Pounds
MD	Munitions Debris
MDAS	Material Documented As Safe
MEC	Munitions and Explosives of Concern
MF	Modulated Frequency
MGFD	Munition with the Greatest Fragmentation Distance
MGP	Manufactured Gas Plant
MHZ	Megahertz
MM	Millimeter
MPPEH	Material Potentially Presenting Explosive Hazard
MR	Munitions Response
MRA	Modified Removal Action
MRS	Munitions Response Site
MSD	Minimum Separation distance
N/A	not applicable
NAD 83	North American Datum of 1983
NEW	Net Explosive Weight
OE	Ordnance and Explosives
OESS	Ordnance and Explosives Safety Specialist (USACE)
OJT	On the Job Training
OSHA	Occupational Safety and Health Administration
PDS	Personnel Decontamination Station
PEL	Permissible Exposure Limit
PM	Project Manager
POL	petroleum, oil, and lubricants
PPE	Personal Protective Equipment
PR	Pulse Rate
PWS	Performance Work Statement

QA	Quality Assurance
QC	Quality Control
QCI	Quality Control Inspection
QCIR	Quality Control Inspection Record
QCS	Quality Control Specialist
Q-D	Quantity-Distance
RCWM	Recovered Chemical Warfare Material
RDX	Cyclotrimethylenetrinitramine
RF	Radio Frequency
RFD	Remote Firing Device
RI	Remedial Investigation
RMSF	Rocky Mountain Spotted Fever
RRD	Range Related Debris
SCDHEC	South Carolina Department of Health and Environmental Control
SCE&G	South Carolina Electric & Gas Company
SDS	Material Safety Data Sheets
SE QCI	Search Effectiveness Quality Control Inspection
SF	Square Feet
SLED	State Law Enforcement Division
SOP	Standard Operating Procedure
SOW	Scope of Work
SSFR	Site Specific Final Report
STD	Standard
SUXOS	Senior Unexploded Ordnance Supervisor
SZ	Support Zone
TECH	Technician
TEU	Technical Escort Unit
TBD	To Be Determined
TITAN	Titan Associates Group, Inc
TLM	Tar Like Material
TM	Technical Manual
T&M	Time and Materials
TNT	Tri-Nitro Toluene
TP	Technical Publication
TLV	Threshold Limit Value
Tetra Tech	Tetra Tech Inc.
U.S.	United States
UHF	Ultra High Frequency
USACE	United States Army Corps of Engineers
USAESCH	U. S. Army Engineering and Support Center- Huntsville
UTM	Universal Transverse Mercator
UXO	Unexploded Ordnance
UXOQCS	Unexploded Ordnance Quality Control Specialist
UXOSO	Unexploded Ordnance Safety Officer
UXOSO/QCS	Unexploded Ordnance Safety Officer and Quality Control Specialist (Dual Hat Position)
VCC	Voluntary Clean Up Contract

VHF	Very High Frequency
WBGT	Wet Bulb Globe Temperature
WP	Work Plan

1. CHAPTER 1 – INTRODUCTION

1.1. General Background Information

Apex Companies, LLC (APEX) contracted Titan Associates Group, Inc (TITAN) to perform Work Plan updates for clearance of Munitions and Explosives of Concern (MEC) to include Unexploded Ordnance (UXO) personnel in support of contaminated soil and sediment removal on the Congaree River Project (CRP), located in Columbia, South Carolina (SC) for Dominion Energy South Carolina (DESC), formerly South Carolina Electric and Gas Company (SCE&G). Since the project plans were finalized, TITAN is no longer providing MEC support services, and Tetra Tech Inc. (Tetra Tech) has been contracted to take over the UXO support for the project. Revision 2 contains the revisions required to address SCDHEC comments and for Tetra Tech to perform the UXO field support. These changes include adding Tetra Tech's SOPs, processes, and staffing changes as well as changes to the designated project team and stakeholders since Revision 1 was finalized. For the CRP and these support plans, the acronyms; MEC, UXO, Discarded Military Munition (DMM), and Material Potentially Presenting an Explosive Hazard (MPPEH) will be frequently utilized. UXO and DMM are subcategories of MEC. UXO are munitions that have been fired and failed to function. They are considered to be in the most hazardous condition and must be considered armed and live until fully inspected and assessed. DMM are munitions that have been abandoned or lost and are no longer in the inventory or control of the Department of Defense (DoD). Although DMM can be full up service rounds capable of functioning, they are not armed or fired and are therefore normally in a less hazardous condition than UXO. MPPEH are any munitions-related material (ordnance shipping containers, weapons components) that may contain explosives or explosive residue that may present an explosive hazard. The use of MEC/MPPEH is the accepted acronym to describe all potential explosive hazards that may be encountered.

During the stakeholders meeting held at South Carolina Department of Health and Environmental Control (SCDHEC)'s office on November 15th, 2018, a consensus agreement was reached between stakeholders on a Modified Removal Action (MRA) that altered the original scope of the full-scale effort. The Stakeholder-developed MRA has been developed to reduce the footprints of the required removal areas and cofferdam structures and thereby reducing the adverse effects on the river from the structures and subsequently the amount of sediment to be removed. This updated work plan provides the technical approach, rationale, and field procedures to be followed in order to achieve the objectives of removal of MEC/MPPEH from the cofferdam footprints and sediments within the modified project site. This work plan was prepared in accordance with (IAW) the APEX / TITAN Master Subcontracting Services Agreement 87520200902, dated September 11, 2020.

The purpose of the Stakeholder-developed MRA (and Construction Support of the CRP) is to remove MEC/MPPEH in order to reduce explosive hazards from any Civil War era military munitions reportedly, co-located within the coal tar contaminated soil and sediment removal areas being excavated by DESC's contractors. This work plan covers the cofferdam footprints and sediment Removal Action and Construction Support. The removal activities will be completed IAW the approved Explosives Safety Plan (ESP).

1.2. Site Location

The CRP area is located on the Congaree River in Columbia, SC. The site, also referred to as the "project area", begins directly south of the Gervais Street Bridge, extends approximately 200 feet into the river from the eastern shoreline and approximately 1,500 feet downriver, towards the Blossom Street Bridge. The MEC/MPPEH intrusive activities will occur on the eastern side of Congaree River between Gervais and Blossom Street Bridges, within the two cofferdam footprints and removal areas shown on the figures in Appendix B.

1.3. Site History

In 1865, during the Civil War, DMM [i.e. cannonballs] and other articles of war produced by the Confederacy were dumped into the Congaree River near the Gervais Street Bridge by Union forces under the direction of General Sherman. This activity took place during Sherman’s occupation of Columbia. The Union Army kept some of these items for its own use, and the remainder was destroyed. One of the methods was dumping the items into the river.

Archeological investigations, conducted as late as 1980, recovered some DMM from the area as well as some other potentially historically significant artifacts. Specifically, this work was focused in and adjacent to the unnamed tributary that enters the river just south of the Gervais Street Bridge. Several cannonballs were identified during this operation and properly disposed of by trained explosive ordnance disposal (EOD) personnel located at nearby Fort Jackson.

Due to the potential presence of MEC/MPPEH within the project area, an additional reconnaissance and screening of the area in question were conducted as part of the investigative activities. An acoustic (side-scan sonar) and magnetic (magnetometer) remote sensing survey was performed to identify ordnance and other submerged cultural resources in the remediation area by Tidewater Atlantic Research, Inc., and a report was submitted on 8 February 2012. Analysis of the survey data identified concentrations of anomalies in the immediate vicinity of the Senate Street landing and scatters extending into the river. A terrestrial magnetometer investigation of the unnamed tributary below the Gervais Street Bridge was also carried out, and that investigation identified eight additional anomalies with a potential association with ordnance.

In June 2010, the occurrence of a tar-like material (TLM) within the Congaree River was reported to the SCDHEC. Preliminary testing indicated that the material may be attributable to the Huger Street former Manufactured Gas Plant (MGP) that was operated by predecessor companies of DESC beginning in the early 1900s and ending in the 1950s.

Preliminary sample results conducted on the material by SCDHEC indicated that the TLM had similar chemical and physical characteristics as coal tar. The coal tar material was a waste product from coal-gas production. DESC had previously entered into a Voluntary Cleanup Contract (VCC) with SCDHEC in August 2002 to conduct environmental assessment and cleanup activities at the former Huger Street MGP site. The VCC was later extended to include the TLM impacts within the Congaree River.

In the fall of 2015, a Field Demonstration Project was conducted in which multiple attempts were made to complete a UXO investigation on the alluvial fan, normally dry land adjacent to the river. Repeated rain events that resulted in historic flooding of the Congaree River necessitated curtailment of the MEC/MPPEH investigation efforts. Although approximately 180 anomalies were investigated, including previously identified anomalies and mag-and-dig efforts, no MEC were found.

1.4. Topography

The predominant topographic feature within the project area is the Congaree River itself, which is a broad shallow river with numerous bedrock assemblages that are visible above the water level at normal river flows. The river slope in the vicinity of the project area is approximately 2.10 feet/mile (United States Army Corps of Engineers [USACE], 1977). The river depth varies significantly in the project area due to the variability of the bedrock river bottom elevations. These bottom elevations fluctuate from an approximate high of 116 feet to approximately 105 feet. All elevations are referenced to the North American Vertical Datum of 1988. The average river flow elevation is approximately 116 feet with an extreme variance of approximately 110 to 152 feet in elevation

The project area abuts the eastern shoreline, which rises sharply from the water's edge in most places due to a steep bank that varies in height from approximately 5 to 20 feet depending on location. The ground slopes more gently to the east once the top of the riverbank is reached, with an approximate 28 feet increase in land surface elevation over approximately 500 feet. Gist Street is the first paved land surface encountered to the east of the project area. The riverbank is forested in this area with vegetative cover consisting of various trees and tall native grasses and shrubs. The undergrowth is periodically maintained and trimmed in the vicinity of the wooden scenic overlook and river walkway and is much thicker and overgrown further south.

Access to the river is provided by a partially paved private access road, which extends from the intersection of Senate and Gist Streets to the river. The Senate Street alluvial fan, a key land feature in this area, is located at the end of the access road. The alluvial fan is a relatively flat portion of the project area that extends out into the river and appears to have developed over time.

1.5. Climate

The climate in the vicinity of the project site is characterized on the following charts presented below the Figure 1-Average Monthly Temperatures, Figure 2-Average Monthly Precipitation, Figure 3-Monthly Inclement Weather Percentage, and Figure 4-Average Wind Speed.

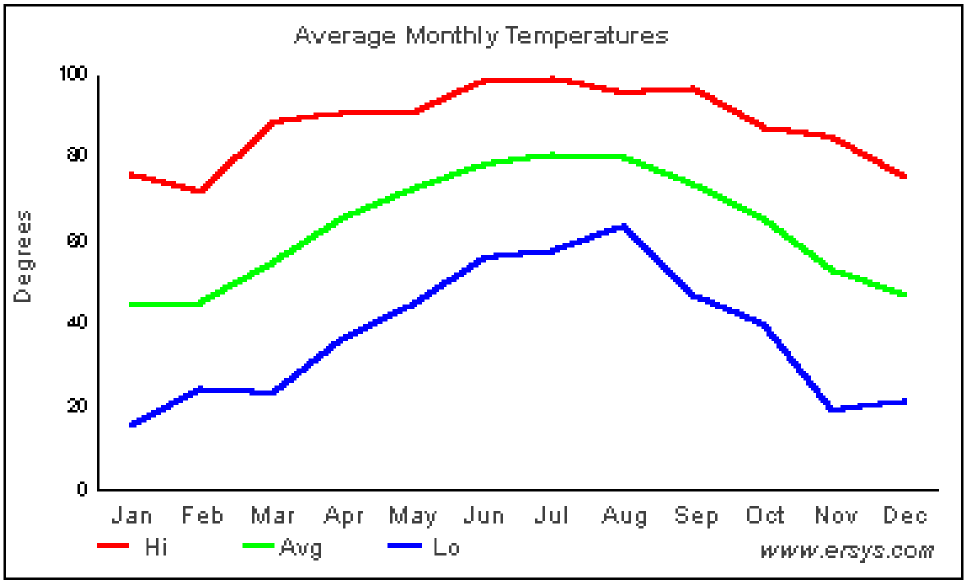

Figure 1 Average Monthly Temperatures

The two charts below show information relevant to precipitation. The first chart shows the typical precipitation for the month indicated. The second chart shows the percentage of the month that inclement weather (rain, snow, etc.) occurs. The two charts give the reader a better understanding of precipitation in the area.

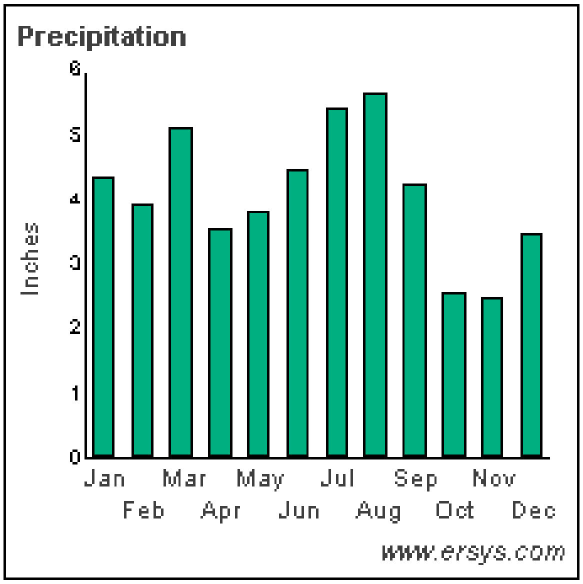

Figure 2 Average Monthly Precipitation

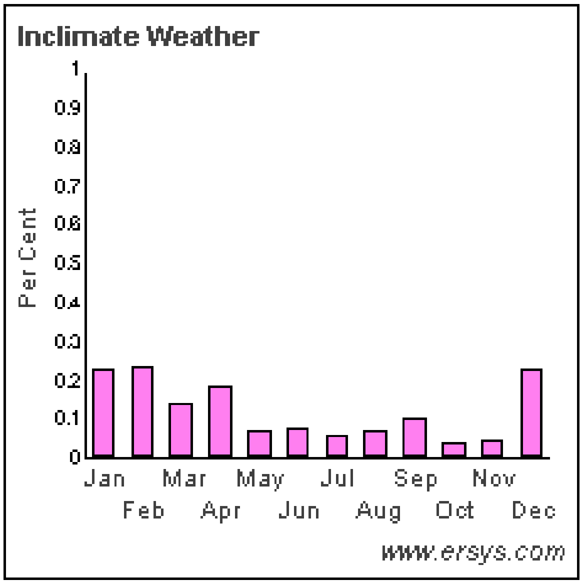

Figure 3 Monthly Inclement Weather Percentage

The chart below illustrates typical wind speeds for the Columbia, SC area.

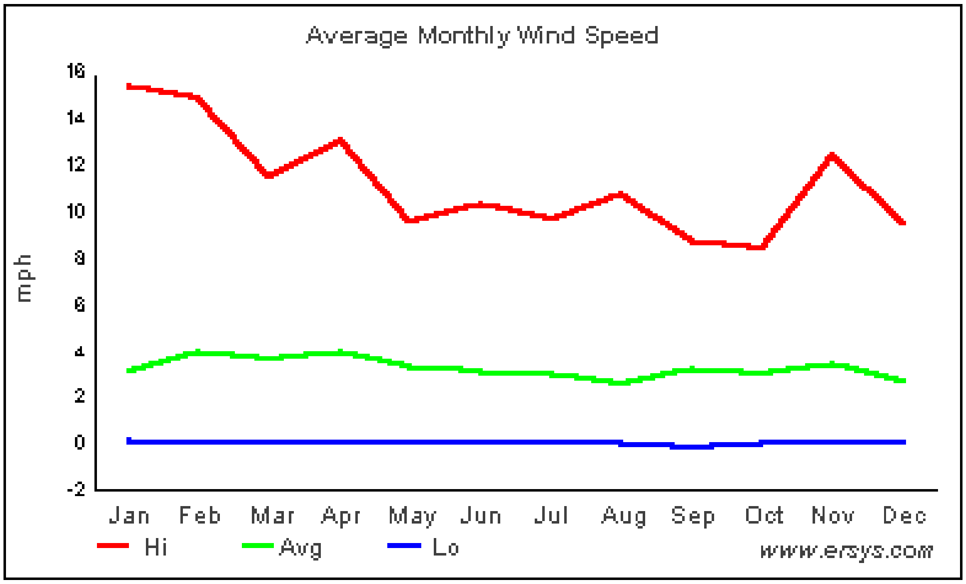

Figure 4 Average Monthly Wind Speed

1.6. Discovery of Recovered Chemical Warfare Material (RCWM)

The Congaree River Project site is not suspected of containing Recovered Chemical Warfare Material (RCWM). If, however, during planned MEC/MPPEH removal operations, if the UXO contractor identifies or suspects RCWM, all personnel will immediately withdraw upwind from the work area and contact the on-site DESC representative, who in turn will report the RCWM to the Chemical Warfare Design Center who will coordinate the emergency response with local agencies and the DoD. The UXO contractor will secure the area and provide two personnel located upwind of the suspect RCWM to secure the site until relieved by the DoD emergency response personnel.

If suspect RCWM is encountered, the following procedures will be followed:

- All work will immediately cease;
- Project personnel will withdraw along cleared paths upwind from the discovery;
- A team consisting of a minimum of two UXO contractor personnel will secure the area to prevent unauthorized access;
- The supervisors will position personnel as far upwind as possible while still maintaining the security of the area; and
- The DESC representative will immediately be notified, who will coordinate the emergency response with local agencies and the DoD.

1.7. Procedures for Change in Site Conditions

Unforeseen circumstances, such as severe weather events, may create a change in site conditions that could affect the performance of this project. Regardless of the reason for the change in site conditions, the UXO contractor will immediately notify the DESC on-site representative of the condition change and the action taken.

2. CHAPTER 2 – TECHNICAL MANAGEMENT PLAN

2.1. Objectives

The UXO contractor's objective in this task order is to prepare plans to provide all munitions response services necessary to support operations conducted by DESC to excavate sediment material within the stakeholder-developed removal areas that may be collocated with munitions that may have been discarded and dumped in the river during the American Civil War. The UXO contractor will perform operations as necessary to detect and remove suspected DMM or MEC/MPPEH from two separate areas where sediment and TLM will be excavated and removed.

The UXO contractor will also provide standby construction support during cofferdam construction, dewatering operations, sediment removal activities IAW EP 75-1-2. The UXO contractor will be prepared to mobilize additional personnel if required to dispose of MEC/MPPEH during the construction support phase of the project.

2.2. Organization

Tetra Tech's project organization is designed to effectively control the munitions investigation, removal, and MEC/MPPEH disposition portion of the MRA. Tetra Tech's Project Manager (PM), Mr. Scot Wilson PMP will be the primary point of contact with the DESC representative, and will have overall responsibility for ensuring that work is completed IAW the Work Plan. He will prepare submittals and reports IAW the Performance Work Statement (PWS). The project organization is presented on Figure 5-Organization Diagram.

The Senior UXO Supervisor/Dive Supervisor (SUXOS/DS) Mr. Don Schwalback will be the primary point of contact in the field. He will plan and supervise work completed on the site and ensure compliance with the Work Plan and other applicable requirements. He will directly coordinate with local officials, and stakeholders as necessary to minimize conflicts with scheduled activities. He will prepare and submit daily reports through the Tetra Tech PM.

The UXO Safety Officer (UXOSO) and the UXO Quality Control Specialist (UXOQCS) will be on-site when work is performed. For this project, the UXOSO and UXOQCS functions will be combined and performed by one dual-hatted person (UXOSO/QCS). That person will be responsible to ensure that work is completed safely and to standard IAW but not limited to USACE and DoD guidance (EM 385-1-97, DoD 6055.9 and Std TM 60A 1-1-31) as well as other guidance as directed throughout this Work Plan. UXOSO/QCS will evaluate work daily and report any safety or quality concern to the SUXOS, PM and / or Corporate Safety Manager. The UXOSO/QCS will work closely with the DESC on-site Safety Representative to immediately address any issues or concerns and will always have a direct line of communication with the Tetra Tech Corporate Safety Manager.

All UXO Technicians and team members will meet or exceed the requirements in Department of Defense Explosive Safety Board (DDESB) Technical Publication (TP) 18 for the positions they hold. The organizational chart below shows the key project positions and personnel and the relationships between them and other team members. The SUXOS/DS, in coordination with the PM, may adjust the project organization and reallocate resource as required to most effectively complete the entire scope of the project. Tetra Tech acknowledges that key members of the overall project team have not yet been determined (e.g. the remediation/excavation contractor). In addition to the DESC PM, and subject to coordination with any other DESC contractor, Tetra Tech proposes the following:

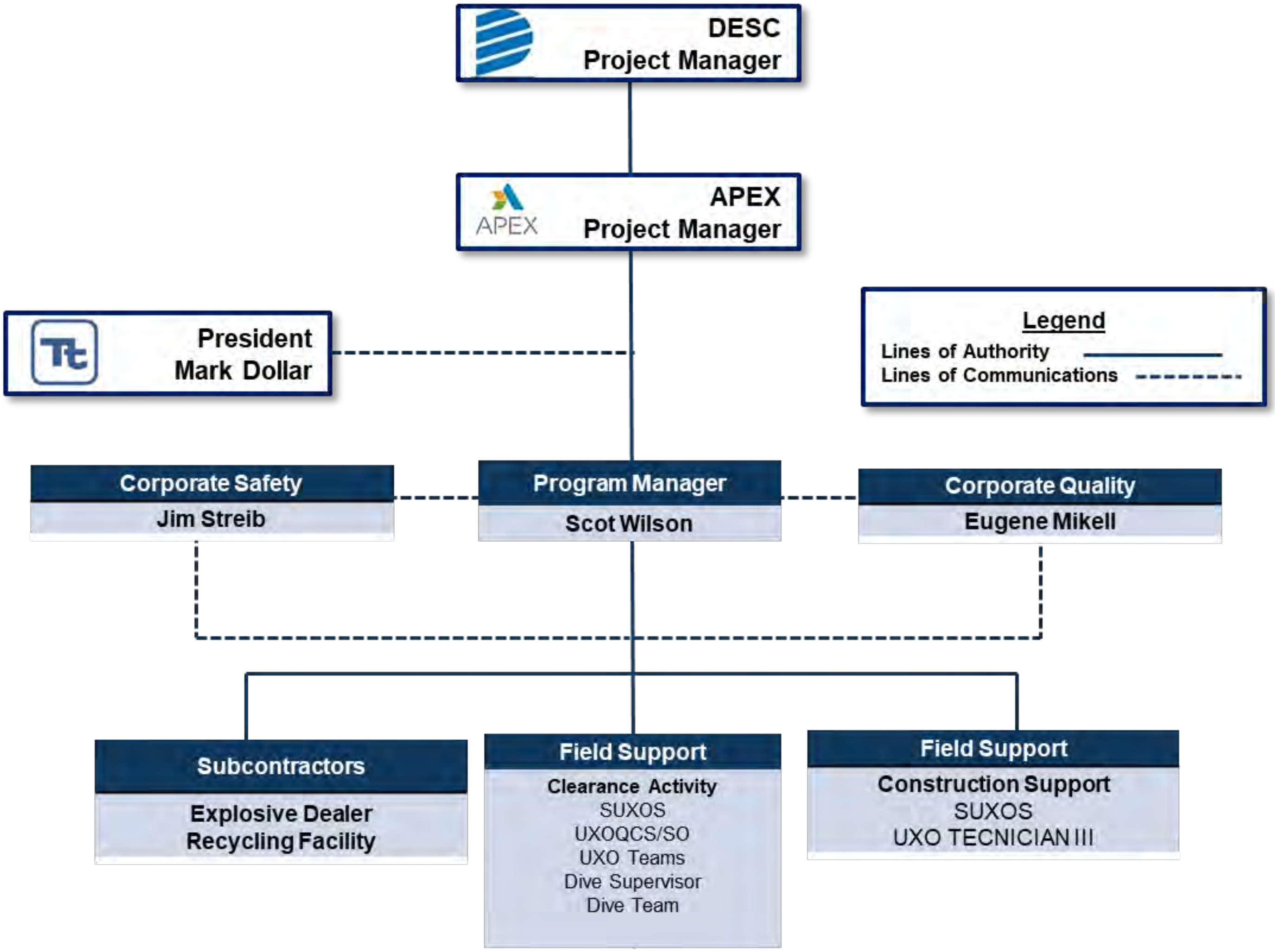

Figure 5 Organization Diagram

Tetra Tech intends to perform this MRA with up to two UXO teams and one dive team. A Team Leader will be responsible for a team of two or more personnel depending on assigned tasks and project needs. During removal operations the standard teams will consist of a UXO Tech III and up to 6 UXO Tech II/I. Team size may be reduced, at the discretion of the SUXOS. The SUXOS will make team assignments daily according to the specific needs of the project. Resumes of key personnel are included in Appendix H of this Work Plan.

2.3. Personnel

Personnel and Qualifications - Personnel required for this project will include UXO supervisors and technicians, all of whom possess the relevant personal training and experience requirements set forth in DDESB TP 18. Personnel for this project have been selected from a pool of available UXO technicians The following paragraphs describe the specific responsibilities of UXO personnel assigned to the project team.

2.3.1 Project Manager

The PM is responsible for communicating with the DESC representative. He will execute all directions received from the DESC representative, managing all aspects of the project, overseeing the overall performance of all individuals on the project team, coordinating all contract and subcontract work, and resolving project problems. The PM is also responsible for controlling cost and schedule milestones. The PM will also coordinate the preparation of the Work Plan and the implementation of on-site field activities.

The PM will interface directly with subcontractors to keep them advised of the PWS, schedule, and budgets. The PM is also responsible for ensuring that the subcontractor costs are maintained within budget and that schedule commitments are achieved.

The PM performs overall project management and is responsible for the following:

- Preparing and submitting purchase orders;
- Approving and forwarding accounts payable;
- Approving Daily Activity Report;
- Procuring necessary equipment and supplies;
- Reviewing and approving Time Sheets, Expense Reports, and Travel Order Request;
- Submitting Equipment Expense Report; and
- Supervising the Project SUXOS/DS and, UXOSO/QCS.
- Prepare and conduct coordination meetings

2.3.2 Senior UXO Supervisor/Dive Supervisor (SUXOS/DS)

The SUXOS has a minimum of more than 10 years of military/civilian EOD/UXO experience. The SUXOS/DS will manage all on-site field activities. The SUXOS/DS will keep the PM informed of activities requiring his notification. The SUXOS/DS is responsible for all daily work activities. He will brief the PM daily on all project activities to include production, quality of work, safety, equipment status and personnel status. The SUXOS/DS will directly coordinate any evacuation requirements with the DESC representative. The responsibilities of the SUXOS/DS include:

- Identification of personnel and equipment requirements;
- Supervision of all daily field team activities;
- Early detection and identification of potential problem areas and institution of corrective measures;
- Assisting with the preparation of all project reports;
- Preparation of a daily report, which will include man-hours expended, areas cleared, explosives expended, and any other information required by the PM;
- Providing on-the-job training for selected UXO Supervisor(s) who may be called upon to temporarily perform SUXOS/DS duties during his absence from the site;
- Supervision of UXO Technicians; and
- Scheduling and executing a daily safety meeting, scheduling and coordinating subcontractor field team activities, and oversight of all field activities.
- Making acceptable to move determinations for recovered MEC along with the UXOSO/QCS
- Performing MPPEH inspections and Material Documented As Safe (MDAS) certifications along with the UXOSO/QCS.
- The safe conduct of all diving and small boat operations.

- Inventory and security of all explosives and recovered MEC/MPPEH on site.

2.3.3 UXO Safety Officer (UXOSO)

The UXOSO has a minimum of more than eight years of military/civilian EOD/UXO experience. He is responsible for implementing all site Accident Prevention Plan (APP) (Appendix D) requirements, on-site training requirements, and recommending changes to the level of personal protection equipment (PPE) to the SUXOS as site conditions warrant. He has Stop Work Authority for safety conditions. He will report all safety work stoppages immediately to the Tetra Tech PM and DESC Safety Specialist. The UXOSO evaluates and analyzes any potential safety problems, implements safety related corrective actions, and maintains a Daily Safety Log. The UXOSO reports to the Tetra Tech Safety Director. The UXOSO will:

- Perform on-the-job training for selected UXO Technicians who may be called upon to temporarily perform the duties of UXOSO during his absence from the site, upon approval of the DESC Safety Specialist; and
- Maintain daily liaison with the DESC Safety Specialist.

2.3.4 UXO Quality Control Specialist (UXOQCS)

The UXOQCS has a minimum of more than eight years of military/civilian EOD/UXO experience. The UXOQCS reports to the Tetra Tech Quality Manager. The UXOQCS will perform quality inspections/review all project operations, including explosives inventories, daily reports, timesheets, and other documentation, and will inspect and approve each completed area prior to turnover to the DESC representative.

For this project, the UXOSO and UXOQCS functions will be combined and performed by one dual-hatted person (UXOSO/QCS).

2.3.5 UXO Technician III

This individual, who supervises a project team, will have experience in MEC removal operations and supervising personnel, and shall have at least a minimum of eight years combined active duty military EOD and contractor UXO experience. This individual must be able to fully perform all functions enumerated for UXO Tech I and II. Specific duties of the UXO Tech IIIs include:

- Reconnaissance and classification of MEC;
- Identifying fuzes and determining fuze conditions of all munitions, including United States (U.S.) and foreign
    - Guided missiles,
    - Bombs and bomb fuzes,
    - Projectiles and projectile fuzes,
    - Grenades and grenade fuzes,
    - Rockets and rocket fuzes,
    - Land mines and associated components,
    - Pyrotechnic items,
    - Military explosives and demolition materials,
    - Submunitions;
- Supervising the conduct of all on-site activities directly related to MEC operations;

- Supervising the location of subsurface MEC using military and/or civilian magnetometers and related equipment;
- Supervises
    - Excavation and recovery of subsurface MEC by manual means or mechanical
    - Construction of MEC-related protective works,
    - Location of surface MEC by visual means,
    - Transporting and storing MEC assuring compliance with Federal, state, and local laws,
    - Disposal of MEC by detonation,
    - Preparation of a MEC disposal site,
    - Preparation of an on-site safe holding area for MEC,
    - Donning and doffing of personal protective equipment,
    - Operation of a personnel decontamination station,
    - Maintenance and operator checks on all team equipment,
    - Segregation of Munitions Debris (MD) and Range Related Debris (RRD) from clutter,
    - Safe handling procedures,
    - Team preventive medicine and field sanitation procedures;

- Determine MEC-related storage compatibility;
- Preparing explosives storage plans IAW all applicable guidance;
- Supervise;
- Preparing required administrative reports;
- Preparing SOPs for on-site MEC operations;
- Conducting daily site safety briefings; and
- Perform Risk hazard analysis.

2.3.6 UXO Technician II

This individual will be able to fully perform all functions enumerated for UXO Tech I. In addition, the ability to perform the following functions is a requirement of the UXO Tech II:

- Identifying fuzes and determining fuze condition of all U.S. and foreign munitions, including:
    - Guided missiles,
    - Bombs and bomb fuzes,
    - Projectiles and projectile fuzes,
    - Grenades and grenades fuzes,
    - Rockets and rocket fuzes,
    - Land mines and associated components,
    - Pyrotechnics,
    - Military explosives and demolition materials, and
    - Submunitions;
- Locate subsurface MEC using military and/or civilian magnetometers and related equipment;
- Perform excavation procedures on buried MEC by
    - Manual means, and
    - Mechanical means;
- Perform operator maintenance of military and/or civilian magnetometers;
- Locate surface MEC using visual means;

- Operate motor vehicle transporting MEC material, when appropriate;
- Preparing an on-site holding area for MEC material;
- Perform storage of MEC material and demolition materials IAW applicable guidance;
- Prepare an MEC disposal site;
- Prepare
  - Non-electric firing system for an MEC disposal operation,
  - Electric firing system for an MEC disposal operation,
  - Detonating cord firing system;
  - Dispose of MEC/MPPEH by Detonation;
- Operate a personnel decontamination station;
- Don and doff appropriate personal protective equipment in contaminated areas;
- Construct MEC-related protective works;
- Determining a magnetic azimuth using current navigational/locating equipment; and
- Performing field expedient identification procedures to identify explosives contaminated soil.

2.3.7 UXO Technician I

The UXO Tech I’s specific duties (under the supervision of a UXO Tech III or a UXO-qualified individual of higher rank than the UXO Tech III) for this project will include:

- Conducting classification of MEC materials;
- Identifying all munitions including
  - Bombs and bomb fuzes,
  - Guided missiles,
  - Projectiles and projectiles fuzes,
  - Rockets and rocket fuzes,
  - Land mines and associated components,
  - Pyrotechnics items,
  - Military explosives and demolition materials,
  - Grenades and grenade fuzes,
  - Submunitions;
- Locating subsurface MEC using military and/or civilian magnetometers and related equipment;
- Performing excavation procedures on subsurface MEC by;
  - Manual means,
  - Mechanical means;
- Locate surface MEC using visual means;
- Transporting and storing MEC and demolition materials;
- Preparing firing systems, both electric and non-electric, for destruction operations disposing of ammunition/ explosives by detonation;
- Operating Personnel Decontamination Stations;
- Donning and doffing personnel protective equipment in contaminated areas;
- Erection of MEC related protective works;
- Assist in performing operator maintenance of military and/or civilian magnetometers and related equipment;
- Operate motor vehicle transporting MEC material, when appropriate; and
- Prepare an MEC disposal site.

2.4. Communication and Reporting

The Tetra Tech PM and SUXOS/DS are primarily responsible for the management of work, data, and cost. The PM will develop the initial schedule. The SUXOS/DS will maintain the schedule and adjust as required throughout the project. The SUXOS/DS will coordinate closely with the DESC representative and local officials to minimize conflicts with other planned activities. He may adjust work hours / days or the order that work is completed in order to minimize conflicts and maximize productivity. The PM will provide updated schedules throughout the project, as required.

The SUXOS/DS will submit data to the PM daily, as required. Data will include a daily report that will describe the activities completed and issues that arose during the workday. The PM will post the daily reports on the project collaboration website, along with photographs and other data relating to the project. The website will incorporate Geospatial Information System (GIS) to better display the data and project status.

The PM will control cost by completing the project on or ahead of schedule and negotiating with vendors to ensure the best prices for equipment and material.

Work will be completed IAW the requirements of the contract. Quality Management and Quality Control requirements described in Chapter 4 will be applied to all phases of the project.

2.5. Deliverables

In addition to the Periodic Reporting requirements discussed in Section 2.7, Tetra Tech will prepare a Site Specific Final Report (SSFR).

2.6. Schedule

Tetra Tech has prepared a Project Schedule that will be updated as necessary throughout the project. The initial schedule is based on the currently defined tasks, and other tasks will be scheduled as they are defined. Tetra Tech will follow the same scheduled work hours as the remediation contractor but anticipates working five, 10- hour days per week. The schedule is generally Monday through Friday. The schedule working days may be adjusted to better suit project needs, depending on weather and river conditions encountered. The SUXOS/DS will coordinate with the PM prior to adjusting workdays and working hours. A record of expenditures will be maintained by the project cost engineer

No single workday during MEC screening and removal operations will exceed ten (10) hours. During construction support, Tetra Tech UXO technicians will be available on site when intrusive operations are conducted.

2.7. Periodic Reporting

The SUXOS/DS will prepare and submit daily reports to the Tetra Tech PM. The PM will provide weekly updates to DESC project management unless events require more frequent reporting.

2.8. Costing and Billing

The PM and SUXOS/DS will control and manage costs by adhering to the project schedule and scope, documenting and tracking expenditures, and effective change management. A record of expenditures will be maintained by the project cost engineer and monitored by the PM.

2.9. Public Relations Support

The UXO contractor personnel will refer all requests for information concerning site conditions to the DESC representative.

2.10. Subcontractor Management Procedures

2.10.1 Identification of Subcontractors and Suppliers

Tetra Tech anticipates utilizing a subcontracted South Carolina-licensed professional land surveyor or surveyor subcontracted to others to provide survey and mapping support for the project. Also, suppliers or vendors may deliver equipment and materials to the project site. All subcontractor personnel will be trained to the approved Work Plan and the included APP. All visitors, including suppliers supporting the project, will receive a safety brief from the UXOSO/QCS prior to entering any area where work is ongoing. They will sign in and will be escorted as required to perform their functions on the site. Only essential personnel will be allowed in the Exclusion Zone (EZ) while intrusive operations are ongoing.

2.10.2 Means for Controlling and Coordinating Subcontractors / Suppliers

All subcontracted personnel working on the site will receive the same thorough site-specific training provided to all UXO contractor site personnel. This training will include detailed training on procedures in the Work Plan and APP. All suppliers making deliveries to the project site will receive a safety briefing, which will include recognition and awareness of potential site hazards. Suppliers will not be permitted to enter the EZ of the project site unless escorted by a Tetra Tech UXO- qualified employee. Non-essential persons, including suppliers, will not be allowed in any active EZ.

2.10.3 Safety Responsibilities of Subcontractors / Suppliers

All subcontractor personnel and suppliers making deliveries to the project site will receive a safety briefing. They are responsible for following all site safety and health procedures. They will not enter any EZ area without a UXO-qualified escort. Non-essential persons, including suppliers, will not be allowed in any active EZ. They will wear all required PPE while on the site in areas where it is required. They will report any accidents of their personnel to the SUXOS or UXOSO for investigation.

2.11. Field Operation Management Procedures

Tetra Tech's PM has overall responsibility for the management of the project. He will coordinate directly with the DESC representative and subcontractors on project-related issues, such as schedule, submittals/reports, etc. The PM reports directly to the Tetra Tech Operating Unit President. The PM frequently communicates with the SUXOS/DS and UXOSO/QCS. The SUXOS will coordinate all field activities. He will coordinate with the on-site DESC representatives and local officials. He will prepare and submit daily project status reports to the PM. Project-related reports, documents, and information will be placed on a secure project collaboration website to allow team members easy access to up-to-date project status information.

2.12. Technical Procedures to Execute Project Tasks

Detailed procedures for the execution of project tasks are contained in Chapter 3.

2.13. Data Management

A detailed accounting of all MEC/MPPEH items encountered during the investigation/removal activities will be maintained. As MEC/MPPEH is located, it will be documented on the MEC Accountability Log (Appendix F). A detailed accounting of all suspected MPPEH / MEC items encountered during the removal action will be maintained. This accounting will include:

- Identification Number (a unique ID #);
- Location;
- Nomenclature;
- Fuse Description;
- Fuse Condition; and
- Additional comments, if required.

Each suspect MEC encountered will be identified using a unique numerical identifier, such as A-3-0001 (for the first suspect item [0001] encountered in the Removal Grid A-3).

The Team Leader will provide validated data to the SUXOS at the close of each working day.

The SUXOS will:

- Collect and review the raw field data for accuracy.
- Provide the verified data to the project server for posting to Tetra Tech's project SharePoint website for use in the final report.
- For documentation purposes, photographs will be taken of encountered MEC. If MEC is determined to be acceptable to move, multiple items may be included in the same photograph. The photograph will be taken to show detail and will be annotated with the location or area discovered.
- Photographic records will be used to supplement information recorded as needed.

2.14. Data Quality Objectives (DQOs)

Data Quality Objectives (DQOs) are qualitative and quantitative statements developed, usually in the Technical Planning Process, to clarify study objectives, define the type of data needed, and specify the tolerable levels of potential decision errors. A DQO is used as the basis for establishing the type, quality, and quantity of data needed to support the decisions that will be made. For this project, quality objectives are discussed in Chapter 4. Specific quality objectives for GIS are discussed in Section 3.6 of this WP. In order to safely conduct sediment and TLM removal, a MEC clearance of the potentially co-located MEC/MPPEH is to be performed prior to cofferdam installations and excavations. A list of the type of MEC/MPPEH believed to be present is presented in Section 3.2 but consists of civil war era cannonballs (6 pounds [lbs] and 10-inch cannonballs). While a cannonball of unknown size and depth was reported in the past, the depth of MEC is unknown. Anomalies will be manually investigated and resolved to the depth of detection or to bedrock, whichever is encountered first since the sediment thickness varies from no sediment (exposed bedrock) to approximately 4 to 6 feet. The tolerable limits for this are presented in Chapter 4. While presented in Chapter 3 below, the methodology to be used is a "mag and dig" where magnetometers are used to identify anomalies and dug by hand shovel.

3. CHAPTER 3 MEC CLEARANCE PLAN

3.1. Overall Approach to Munitions Response Activities

This section describes the UXO contractor approach to completing the CRP Scope of Work requirements. Specific quality management standards and procedures used to control the work completed under the CRP contract are described in detail in Chapter 4 of this Work Plan.

This plan covers the munitions response actions in support of cofferdam installations and the removal of impacted sediment within the Congaree River. The area to be swept and intrusively investigated for MEC/MPPEH consists of approximately 5.8 acres within the Congaree River. A shallow dive operation (covered in a separately submitted Dive Operation Plan) will be performed to remove any potential MEC/MPPEH within the cofferdam footprints prior to cofferdam construction needed to dewater the sediment areas containing TLM.

All MEC/MPPEH disposal operations will be conducted IAW the procedures described in this plan and the approved ESP. DDESB 6055.09-M and EM 200-1-15 will also be followed during munitions response activities. If an unidentifiable MEC is found, the default separation distance specified in DDESB TP16 will be used to establish the appropriate EZs. Unidentified MEC will not be disposed of until the munitions filler can be determined. EM 385-1-97, dated May 2013, and EP 75-1-3 provide guidance in helping to determine unknown explosive fillers. Final disposition/disposal procedures will be determined in coordination with DESC’s designee.

Demolition operations will be conducted to destroy or vent MEC / MPPEH, as required for safe disposal. Additional discussion of MEC/MPPEH reporting requirements and disposition methods and techniques are provided in the ESP, submitted separately from the Work Plan.

3.2. Identification of Areas of Concern

The clearance area for this project is the cofferdam footprints and sediment removal areas shown in the figures in Appendix B.

3.3. Geophysical Prove-out Plan and Report

Digital Geophysical Mapping (DGM) is not planned for this project. Construction and use of Instrument Verification Strip (IVS) to document effectiveness and proficiency with analog instruments is discussed in Chapter 4.

3.4. Geophysical Investigation

DGM is not planned for this project. The use of analog instruments (Schonstedt GA 52-Cx or all-metals detector) to accomplish project objectives is discussed in Section 3.7.

3.5. Location Surveys and Mapping Plan

Surveyors (either subcontracted or provided by DESC or its contractors), will be utilized as needed, to conduct boundary surveys of the designated clearance areas.

Where feasible, stakes will be installed that clearly show the boundaries of the cleared area, and each stake will be labeled with the proper Universal Transverse Mercator (UTM) coordinate system. Flagging will be placed at the top of each stake. No stakes will be installed without approval from the UXO Tech II escort, who will check for anomalies in the location that each stake will be emplaced. The UXO Tech II will scan all stake emplacement locations with a handheld magnetometer (such as a Schonstedt GA-52Cx), or an all-metal detector (such as a White's Metal Detector), or equivalent. The UXO contractor's SUXOS will maintain a field logbook detailing all field activities, including daily entries of the personnel on-site, time of day all work started and ended, weather conditions, delays, all relevant survey data, equipment used, and field sketches.

Survey data will be submitted by hard copy and digital media. The site grid data will include a map of the entire site with grids shown and other pertinent features. Maps will be produced that accurately convey the clearance areas and data.

MEC/MPPEH location data will also be submitted in Microsoft Excel. Data will include grid number where found, item number assigned, type of item, depth, and location in the appropriate UTM coordinates.

3.6. Geographic Information System (GIS) Plan

3.6.1. GENERAL

The foundation of the GIS will be derived from existing CRP data developed during previous site efforts. Tetra Tech has acquired the existing GIS provided by APEX and will expand it to meet the needs of the project. The GIS will be maintained through the project's life cycle and accumulate all associated geospatial data along with base map layer and analysis data.

3.6.2. ACCURACY

The accuracy of the GIS will reflect the accuracy of the original data. Boundary points installed by a Surveyor are anticipated to have a minimum accuracy of +/- 3 centimeters. The location of all MEC/MPPEH items discovered during the removal will be collected using the Geo XH Global Positioning System (GPS) unit or equivalent to provide sub-meter accuracy.

3.6.3. GEOGRAPHIC INFORMATION SYSTEMS (GIS) INCORPORATION

The foundation of the GIS will be derived from base layers collected from APEX, state GIS clearinghouses, and previous munitions-related investigation/reconnaissance conducted on the site. All data will be converted or digitized into ArcGIS shapefiles and or Geodatabase formats to streamline data and avoid multiple data formats.

All data collected during field activities will be submitted to the GIS or Data Manager. The GIS or Data Manager will perform QC measures on all OE field data to elevate formatting or incorporation issues. Collected data will be incorporated into the GIS and conform to the UTM projection, a datum of the geographic coordinate system (GCS) North American Datum of 1983 (NAD 83), and with the linear unit of measure in Meters. All Geospatial data delivered to DESC will conform to UTM projection and a datum of GCS NAD 83 with linear units of measure stated.

3.6.4. PLOTTING

Tetra Tech anticipates hard copy printouts may be utilized on the project. Hard copy map graphic scales will be based on standard mapping scales. Maps will be available in digital PDF format to DESC and others as may be appropriate.

3.6.5. MAPPING

All survey boundary points related to designated work areas will be incorporated into the project-specific GIS. Maps will include true north and magnetic north arrows with the difference between them in degree and minutes shown. Tic marks at the standard interval with UTM coordinate designators for the specified area that the map covers will be shown on the edge of the map. A map legend with standard mapping symbols and map index showing the area covered on the map in relation to project boundary will be displayed on the map.

3.6.6. COMPUTER FILES & DIGITAL DATA SETS

Tetra Tech utilizes ESRI's ArcGIS to develop comprehensive and accurate geospatial data. Tetra Tech will submit the most current GIS as part of any report submitted to DESC. This will include ArcGIS project files and metadata for the geospatial data that is referenced in the project files. The GIS will be updated throughout the project's life.

All GIS data and ArcGIS projects will be developed and incorporated into the ESRI's Geodatabase format. All GIS project and layout files will be in the (ArcGIS.mxd) file format and submitted with the SSFR. All spatial imagery during the life of the project will be transferred into Geo TIFF/Geo JEPG format to help in reducing image file size unless stated otherwise by the Government.

The Federal Geographic Data Committee metadata will be developed for core Spatial Data Standard for Facilities, Infrastructure, and Environment data layers that are developed by Tetra Tech. It is assumed that spatial data retrieved from other sources such as GIS clearinghouses, previous site investigations, etc., will contain previously developed metadata created by the originator.

3.7. Intrusive Investigation

3.7.1. Intrusive Investigation Methodology

3.7.1.1 Mobilization

Immediately after receiving a notice to proceed for each phase, the UXO contractor will begin the mobilization process. It is anticipated that one phase of mobilization will occur to accomplish the clearance task. The PM will identify the personnel and equipment required, schedule a sequenced mobilization, and make the necessary travel and shipping arrangements. Personnel qualifications and certification are in Appendix H of this Work Plan.

3.7.1.2 Personnel

Personnel will be mobilized from regional locations as required to complete the work associated with the project IAW the project schedule. The PM, SUXOS, UXOQCS, and/or UXOSO will mobilize ahead of the main team body, if necessary, to help set up the project site. They will also arrange to receive equipment, coordinate with survey personnel, and ensure that all signed copies of required permits are in place. After this initial mobilization of the management staff, including coordination with local personnel and setting up the site, the mobilization body of the remaining field team required to complete all planned activities will occur.

3.7.1.3 Equipment

The UXO contractor will deliver equipment to the site as required by the project schedule. Mechanical excavation and/or brush cutting equipment are not anticipated but (if required) will be rented and delivered to the site by a local vendor. Other equipment will be delivered to the site by the UXO contractor personnel or shipped to the site by a commercial carrier.

3.7.1.4 Site Setup

Immediately upon arrival on the first field day at the site, the UXO contractor will begin site setup activities.

3.7.1.5 Office / Facilities

Tetra Tech anticipates that DESC will establish a formal project office at the project location and intends to utilize portable toilets that will be delivered during site set-up.

3.7.1.6 Work Site

Immediately upon arrival for the first field workday, Tetra Tech will set up the worksite. Where feasible, Tetra Tech will establish and survey the boundary of the designated clearance area using a subcontracted South Carolina-licensed surveyor or DESC’s designated surveyor. For underwater work within the river, Tetra Tech will utilize GPS units, diver underwater navigation tablets, and buoys or other similar means to establish the work areas. One week prior to the start of intrusive operations, Tetra Tech’s SUXOS will notify “call before you dig” number 811 or DESC 1-800-251-7234 of the intent to start subsurface clearance, if not completed by others. DESC will perform marking of any utilities within the clearance footprint, and any required digging in those areas will be carefully conducted by hand to avoid damaging any utilities.

3.7.1.7 Survey / Site Layout

The SUXOS will coordinate with the surveyor responsible for marking the work areas to ensure that the site layout is complete and document the clearance area. To date, the boundary information presented in Appendix B has been provided for this effort.

3.7.1.8 Equipment Testing

Handheld magnetometers/metal detectors will be checked on a Function Check Area (FCA). Daily checks will be conducted by each instrument operator using his assigned instrument on the FCA. The instruments will be tested against a known source to verify that it responds appropriately. Once the instrument is determined to be functioning properly, the operator will conduct a sweep of the test strip, using the methods and techniques applied in the field. The UXO Team leader and UXOQCS will observe each team member to ensure that they use proper techniques and can properly locate seed items in the FCA. If the operator displays improper techniques or is unable to accurately and consistently locate seed item, the team leader will conduct refresher training and the instrument operator will then demonstrate his proficiency on the test strip before moving to the designated clearance area. If it is determined that the operator’s technique is proper but that the instrument is the cause of his failure to locate seed items, he will be given a different instrument and will repeat the test. Equipment determined to be defective will be tagged and removed from operation. The FCA simulates site conditions. It will be placed in a location free of geophysical anomalies that may interfere with the tests or affect the results. The UXOQCS is responsible for ensuring that personnel accomplishes all QC checks and that the appropriate logbook entries are made.

As the boundaries of the areas are being marked, Tetra Tech will establish internal grids or clearance areas. The SUXOS/DS will determine the most effective way to divide the removal area into internal grids or clearance areas. The internal areas will be established based on the size and shape of the area, terrain, etc. but will generally not exceed one acre in size and likely will be much smaller areas.

3.7.1.9 Vegetation Removal

The project area will be within the boundaries of the typical river level. Only minimal vegetation clearance, if any, will be required to effectively clear MEC, as described in Section 3.7.8.2. Only vegetation required to effectively complete the removal action will be cut. Vegetation may be cut using any combination of hand or mechanized clearance methods.

3.7.1.10 Surface Removal

Removal of surface MEC will be completed IAW procedures described in Section 3.7.8.1. The removal will include all MEC/ MPPEH and magnetic anomalies on the surface that could mask items in the subsurface and MD equivalent to, or greater than 3.55 inch diameter or thickness of 3.55 inch or greater from the surface. The method used for surface clearance will be performed visually using analog detectors to assist in the location of items on the surface. Sections below describe the establishment of search lanes to ensure effective removal of the entire clearance area. Although MD and RRD are not expected on this site as it is not a range, any MD removed during the surface, and subsurface removal will be collected and processed as described in section 3.7.28. The surface removal will be completed in conjunction with the subsurface removal. A grid or designated clearance area will not be considered complete and will not be turned over for QC/QA checks until both surface, and subsurface removal is complete.

3.7.1.11 Subsurface MEC / MPPEH Removal

The cofferdam footprints and sediment removal areas are identified in the figures in Appendix B. The parameters for subsurface clearance are to remove MEC/MPPEH and any ferrous metal items equivalent to 3.55 inch diameter or thickness (length) of 3.55 inch to depths up to 11 times the width or diameter. The area may be subdivided by placing grid stakes throughout the clearance area in order to better control the removal action and facilitate reporting and quality control. The internal grids corners will be located with a sub-foot GPS unit or with measuring tapes, and corners will be marked with stakes.

3.7.1.12 Search Lanes

Those areas requiring systematic subsurface removal will be divided into lanes to ensure effective removal of the entire area. Tape measures, cones, or small lines will mark search lanes. Unless otherwise directed, the search lane width will be no wider than five feet. The maps in Appendix B show the areas that require surface and sub-surface removal. The precise location of these areas will be marked on the ground by the surveyor where feasible. Tetra Tech will utilize GPS units, diver underwater navigation tablets, and buoys, or other similar means to establish the work areas within the river. Tetra Tech will then layout grids/divisions and search lanes in each area that allow for the most efficient removal based on the size and shape of the area.

3.7.1.13 Anomaly Identification and Investigation

After establishing lanes (as described above), the areas will be cleared by teams consisting of a UXO Tech III (Team Leader) and up to six UXO Tech II/I (team members).

Each UXO Technician will use a handheld analog detector to identify potential subsurface MEC. If a geophysical anomaly is detected, it will be investigated by the dig team using mechanical and/or manual digging methods (see ESP for explosives safety information).

3.7.2. MEC Accountability and Records

As MEC/MPPEH is located it will be documented on the MEC Accountability Log (Appendix F). A detailed accounting of all suspected MEC/MPPEH items encountered during the removal action will be maintained. This accounting will include:

- Identification Number (a unique ID #);
- Location;
- Nomenclature;
- Fuze Description;
- Fuze Condition; and
- Additional comments, if required.

Each suspect MEC item encountered will be identified using a unique numerical identifier, such as A-3-0001 (for the first suspect item (0001) encountered in the Removal Area/Grid A-3).

Photographs of or suspect MEC/MPPEH items will be taken for documentation purposes. A ruler or some similar item, to show scale, will be placed adjacent to the item. The photographer needs to remember these photographs will be utilized in the final report; thus, a focused, well-thought-out photograph is necessary.

3.7.3. UXO Personnel Qualifications

UXO personnel required for this project will include UXO supervisors and technicians, all of whom possess the relevant personal training and experience requirements set forth in DDESB TP 18. Personnel for this project has been selected from a pool of available UXO technicians. Detailed personnel qualification requirements are in Section 2.3. Resumes of key personnel are included in Appendix H if not listed in the UXO database maintained by CEHNC.

3.7.4. MC Sampling Locations

MC Sampling is not a part of this project.

3.7.5. MC Sampling Procedures

MC Sampling is not a part of this project.

3.7.6. Munition with the Greatest Fragmentation Distance (MGFD)

The Munition with the Greatest Fragmentation Distance (MGFD) and minimum separation distances are presented in the ESP.

3.7.7. MEC Identification

The SUXOS and UXOSO must be in agreement on the condition of a MEC item before any removal action is attempted. All available data sources will be consulted, as required to make this determination.

3.7.8. MEC Removal

3.7.8.1 Surface and Subsurface Removal

A surface removal will be conducted in conjunction with the subsurface removal in the designated clearance areas, as shown in Appendix B. UXO Technicians will visually search and use analog detectors to locate MEC/MPPEH, MD, and metallic anomalies. The SUXOS will assign grids/clearance areas to the team, and the Team Leader (UXO Tech III) will organize his team to effectively conduct a systematic surface and subsurface clearance. If any area has heavy surface contamination, the SUXOS may opt to conduct the surface clearance prior to completing the subsurface clearance.

3.7.8.2 Brush Clearance

It is anticipated that no brush cutting will be required. If necessary, Tetra Tech will ensure effective removal in portions of the designated areas. Brush clearance will be conducted by UXO-qualified personnel.

Tetra Tech will conduct brush-cutting operations only as necessary to allow for MEC/MPPEH detection and removal efforts to take place unrestricted from vegetation undergrowth. Tetra Tech will perform only the minimum brush removal required to clear the surface and subsurface of MEC/MPPEH/MD or any ferrous metal items. Underbrush, tall grass, shrubs, small trees, and limbs may be cut in order to allow efficient anomaly detection and/or removal. Cut brush will be removed from the area identified for clearance, if necessary, to prevent interference with site operations. Tetra Tech's brush cutting team will use a variety of clearing techniques depending on the ground conditions and type of vegetation. Various hand and mechanical methods may be applied to complete this task. Tetra Tech does not anticipate heavy vegetation in the project area. However, the use of mechanical brush cutting equipment, such as chainsaws and heavy-duty steel-bladed weed eaters, may be required in the open, lightly vegetated areas. If self-propelled brush cutting equipment is used, the cutting height will be adjusted to ensure that the blades do not strike potential MEC. UXO personnel will perform a visual sweep ahead of the mechanical equipment to identify any potential hazards on the surface of the ground. In areas with soft ground, the brush cutting team will use a combination of mechanical and hand-clearing techniques, possibly including the use of equipment such as a Bobcat Brush Cat or similar equipment and weed eaters. Chain saws and chippers may also be used to cut and reduce brush and low hanging limbs that would interfere with detection and removal operations. The brush cutting team will include at least two UXO Technicians, a minimum of one of whom will meet at least the DDESB TP 18 requirements to be a UXO Tech II.

The brush clearance team(s) will be structured to safely and efficiently clear each of the designated areas. The SUXOS will designate team personnel and equipment, based on the size of the area, type of brush and terrain.

3.7.8.3 Removal of Surface and Subsurface MEC/MPPEH

The map in Figure B-1 shows the area that requires sub-surface removal. The precise location of the area will be marked by the surveyor where feasible. The field team will layout grids and search lanes in each area that allow for the most efficient removal based on the size and shape of the area.

The UXO removal team will consist of a UXO Tech III (Team Leader) and up to six UXO Tech II/I (team members). The SUXOS will organize and make team assignments to ensure that the project is completed in an efficient and safe manner. Any team assigned to complete removal or other MEC operation will have a minimum of two UXO qualified personnel, including at least one that meets the qualification of a UXO Tech III.

The UXOSO/QCS will observe removal operations to ensure that safe, quality work is conducted in compliance with the requirements of the Work Plan. The UXOQCS will conduct at least a 10% Search Effectiveness Quality Control Inspection (SE QCI) check of the area that was cleared using the same type of equipment and techniques used during the removal process. If an area fails the inspection, the team will re-sweep the area, and it will then be re-inspected. The UXOQCS will conduct blind seeding within the clearance area to ensure effective removal IAW QC procedures are contained in Chapter 4.

All analog detectors will be calibrated and working properly. All equipment will be tested prior to each use. At a minimum, equipment will be tested in the morning prior to beginning work and after lunch prior to resuming work. Analog detectors will be tested on an FCA IAW Section 4.7.3.

3.7.8.4 Search Lanes

Those areas requiring systematic subsurface removal will be divided into lanes to ensure effective removal of the entire area. Tape measures, cones, or small lines will mark search lanes. Unless otherwise directed, the search lane width will be no wider than five feet.

3.7.8.5 Anomaly Identification and Investigation

After establishing lanes (as described above), the areas will be cleared by teams consisting of a UXO Tech III (Team Leader) and up to six UXO Tech II/I (team members).

Each lane will be cleared by qualified UXO Technicians under the supervision of the Team Leader. Each UXO Technician will use a handheld analog detector to identify potential subsurface MEC. If a geophysical anomaly is detected that could be caused by MEC it will be investigated by the dig team using mechanical and/or manual digging methods. If mechanical methods are used, the team will excavate to within one foot of the anomaly, and then hand methods will be used to carefully expose the source of the anomaly. All material suspected as MEC/MPPEH will be inspected by the SUXOS and UXOSO to determine if it is acceptable to move. If, after inspection, it remains MEC and can be safely moved, it will be consolidated and destroyed by detonation as described in Section 3.7.14. If it is not acceptable to move, it will be blown in place (BIP) as described in Section 3.7.14. All MPPEH, MD, and RRD will be handled and processed IAW Section 3.7.28.

3.7.9. MEC Holding Areas

Tetra Tech will establish collection points and a holding area for MEC/MPPEH. An Alcohol Tobacco and Firearms (ATF) Type 2 magazine with proper grounding and fencing adjacent to the clearance site will be utilized for temporary MEC/MPPEH storage until demilitarization of the munitions can occur.

3.7.10. Alternative MEC/MPPEH Disposal

In the event that MEC/MPPEH are found that cannot be identified to be inert, Tetra Tech will report this to the DESC on-site representative and implement explosive safety measures to secure and render safe MEC/MPPEH. If the MEC/MPPEH is something that the SUXOS and UXOSO believe to be outside of their capability to safely perform disposal operations, Tetra Tech in conjunction with DESC will contact the Richland County bomb squad at (803) 576-3000 for assistance. If Richland County Shariff's Department cannot respond Tetra Tech in combination with DESC will request Richland County Shariff's Department contact the South Carolina State Law Enforcement Division (SLED) for assistance with the item. If SLED cannot support Tetra Tech. DESC will request SLED to contact U.S. Military EOD to assist with the demilitarization of the item.

3.7.11. Safety Precautions

A minimum of two personnel (buddy system) will be present during all MEC operations so that one UXO person will always act as a safety observer. Only UXO- qualified personnel will perform MEC procedures. As an exception, a UXO Technician I, may assist in the performance of MEC procedures when under the supervision of a UXO Technician III or higher.

During all MEC operations, only the minimum number of personnel required to safely perform the task will be allowed on-site. All non-essential personnel will remain out of the EZ.

If an unidentifiable MEC/UXO is found, or toxic chemical ordnance is found, Tetra Tech will coordinate for EOD support through the DESC on-site representative as detailed in Section 3.7.10.

UXO personnel required for this project will include qualified UXO supervisors and technicians that possess the relevant qualifications and experience. Personnel assigned to this project have been selected from a pool of available qualified UXO Technicians. All UXO personnel will meet the applicable personnel training and experience requirements.

Tetra Tech UXO personnel will not attempt to remove any fuze(s) from the MEC. Personnel will not dismantle or strip components from any MEC. Personnel are not authorized to inert any MEC items found on-site. MEC/MPPEH, MD, or MDAS items will not be taken from the site as souvenirs.

3.7.12. Off-Site Transportation

Tetra Tech does not anticipate transporting any MEC/MPPEH items off-site for disposal. If items are required to be demilitarized offsite, Tetra Tech will report this to the DESC on-site representative and implement alternative disposal methods IAW section 3.7.10.

3.7.13. Collection Points

Use of daily collection points will be performed IAW the approved ESP. At the end of each workday, recovered MEC will be transferred to the Type 2 ATF magazine for temporary storage.

3.7.14. Demolition and Post Demolition Operations

- Demolition and Post Demolition Operations will be performed IAW the approved ESP. The preferred explosive demolition method is to use the buried explosion module (BEM) to determine the required burial depth so that no blast or fragmentation reaches the surface. This will result in no blast or fragmentation at the surface and a required EZ of only 200 feet. If a MEC is deemed unacceptable-to-move, it will be BIP.
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SUXOS – The SUXOS has overall responsibility for reporting and disposition of MEC/MPPEH. He will:

- Schedule and coordinate all demolition operations;
- Ensure a MEC log is maintained;
- Assure that MD generated from demolition operations is inspected prior to placement in the holding bins; and
- Inspect all recovered MEC/MPPEH and MD.

UXOSO and the UXOQCS – The UXOSO and the UXOQCS are responsible for ensuring all MEC operations meet safety and quality requirements. They will:

- Observe and inspect all demolition operations; and
- Ensure all requirements of this section are complied with.

UXO Tech III – The UXO Tech III is responsible for the supervision of the MEC disposal operation. He will:

- Post individuals at entry points (if required);
- Construct appropriate engineering controls IAW "Use of Sandbags for Mitigation of Fragmentation and Blast Effects Due to Intentional Detonation of Munitions," HNC-ED-CS-S- 98-7, August 1998 if required;
- Assign team members to specific demolition duties;
- Assure the area is clear prior to capping in for demolition operations; and
- Check the area following each shot or series of shots.

3.7.15. General Demolition Practices

Detailed instructions for conducting demolition procedures are provided in standard operation procedures (SOPs) contained in Appendix J. Personnel will adhere to these when conducting demolition operations.

3.7.16. Material Potentially Presenting an Explosive Hazard (MPPEH)

A UXO Tech I can tentatively identify a located item as MPPEH, followed by a required confirmation by a UXO Tech II or Tech III.

A UXO Tech II will conduct a 100% inspection of each item as it is recovered and determine the following:

- Is the item a MEC/MPPEH, MD, or range-related debris?
- Does the item contain explosive hazards or other dangerous fillers?
- Does the item require detonation?
- Does the item require demilitarization (demil) or venting to expose dangerous fillers?
- Does the item require draining of engine fluids, illuminating dials, and other visible liquid hazardous, toxic, or radiological waste (HTRW) materials?

All MPPEH and MD will be re-inspected by the UXO removal Team Leader (UXO Tech III) prior to transportation to the secured containers (portable storage magazine) or collection point.

MEC/MPPEH items requiring demilitarization and/or venting will be segregated and processed in a timely manner and placed in securable containers.

The UXOSO/QCS will conduct daily audits of procedures for processing MPPEH and will conduct and document random checks of specific pieces.

SUXOS and UXOSO/QCS will ensure that Work Plan procedures, based on and in compliance with Chapter 14 of EM 200-1-15, are being followed and performed safely.

All final processed MDAS material will be placed in lockable containers, for security, before turning in for recycling. IAW Chapter 14 of EM 1110 dated 15 June 2007, and Errata Sheet No. 2, Tetra Tech will dispose of all material determined by inspection not to contain an explosive hazard. All historically significant items will be presented to the on-site archaeologist after certification as MDAS.

MEC/MPPEH items that require demilitarization Tetra Tech will report this to the DESC on-site representative and implement Tetra Tech's explosive safety measures to secure and render safe. If the item is something that the SUXOS and UXOSO believes to be outside of their capability to safely dispose of explosively, Tetra Tech in conjunction with DESC will contact Richland County bomb squad at (803) 576-3000 for assistance. If Richland County Shariff's Department cannot respond, Tetra Tech in combination with DESC will request Richland County Shariff's Department to contact the South Carolina SLED for assistance with the item. If SLED cannot support, Tetra Tech and DESC will request SLED to contact U.S. Military EOD to assist with the demilitarization of the item.

Items that require demilitarization will be demilitarized IAW DoD 4160.21-M-1, Defense

Demilitarization Manual. All MEC/MPPEH items will be investigated to ensure that there are no explosives remaining in the items. Redundancy is built into the investigation process to assure no MEC/MPPEH items are removed from the site.

3.7.17. Material Documented as Safe (MDAS)

SUXOS will:

- Ensure a Requisition and Turn-in Document, DD Form 1348-1A is completed for all munitions debris and to be transferred for final disposition.

- Perform random checks to satisfy that the munitions debris and are free from explosive hazards necessary to complete the Form, DD 1348-1A.

- Certify all munitions debris and range-related debris as free of explosive hazards, engine fluids, illuminating dials, and other visible liquid HTRW materials. No range-related debris is expected on the CRP project.

- Be responsible for ensuring that inspected MDAS is secured in a closed, labeled, and sealed in a container and documented as follows;

- The container will be closed and clearly labeled on the outside with the following information: The first container will be labeled with a unique identification number that will start with DESC/Installation Name/Contractor's Name/0001/Seal's unique identification and continue sequentially.
- The container will be closed in such a manner that a seal must be broken in order to open the container. A seal will bear the same unique identification number as the container, or the container will be clearly marked with the seal's identification information if it differs from the number on the container.
- A documented description of the container will be provided by Tetra Tech with the following information for each container: contents, weight of container, location where munitions or range-related debris was obtained, name of contractor, names of certifying and verifying individuals, unique container identification, and seal identification. Tetra Tech will also provide these documents within the Final Report.

3.8. Geospatial Information and Electronic Submittal

The GIS Plan is described in Section 3.6 of this WP.

3.9. Investigative Derived Waste Plan

If generated, Investigative Derived Waste will be contained and disposed of IAW section 6.2.1 of this WP.

3.10. Risk Characterization and Analysis

Risk Characterization and Analysis are not a part of this project per the PWS.

3.11. Analysis of Land Use Controls

Land Use Controls are not associated with this project.

3.12. Preparation of the Five-Year Review Plan

A Five-Year Review is not a part of this project.

3.13. Construction/Remediation Support

It is currently anticipated that Tetra Tech will provide a Construction Support team consisting of a SUXOS and a UXO Tech III to provide Standby Support to the construction/remediation contractor when construction activities are conducted. Additional teams may be added if required to provide adequate support to the construction contractor.

Tetra Tech will coordinate schedules with the construction contractor to ensure that the support is available when and where needed. Activities performed during standby support include, but are not necessarily limited to: safety and awareness training; MPPEH inspection/identification; anomaly detection/avoidance; area inspections; etc.

4. CHAPTER 4 – QUALITY CONTROL PLAN

4.1. QUALITY CONTROL OBJECTIVES

This section presents the project QC Plan as required by the PWS. The QC procedures described in this section will be used for all work performed during the cofferdam footprint MEC clearance and sediment MEC removal project. This site-specific QC plan is designed to manage, control, and document the performance of work efforts and to ensure quality throughout the execution of all tasks. This QC Plan will achieve the following objectives:

- Identify QC procedures and responsibilities.
- Document the quality of work efforts via audits and independent staff reviews of deliverables.
- Ensure data integrity through the implementation of data management QC procedures.
- Ensure the development of appropriate accountability and appropriate data collection.

4.2. QUALITY POLICIES

All services provided will be consistent with and will meet the requirements of all applicable laws and regulations.

Quality Management will be applied throughout all phases of the project – from the time of the task order award, until the SSFR is accepted.

Emphasis will be placed on preventive actions that minimize quality failures or defects.

All field personnel and team members are empowered to identify and evaluate potential quality problem areas and are encouraged to recommend solutions or corrective actions.

Tetra Tech will staff all project sites with the best qualified, trained, available personnel, based upon their knowledge and prior experience with the type of operations and hazards expected to be encountered. The minimum qualifications will meet or exceed the customer's requirements.

All field personnel will be provided with all of the information necessary to accomplish their assigned tasks in a safe, responsible, cost-efficient manner, and they will be held accountable for the quality of their work.

The project team will be provided with a copy of the final approved Work Plan/APP prior to the performance of any MEC-related activities on a project site.

Tetra Tech will take corrective action on any complaint or quality defect resulting from an audit of operations.

4.3. DEFINITIONS

Removal Standard - a specified size of MEC to a specified depth. The removal standard for this project is: No findings on the surface of the munitions response site of MEC or MPPEH regardless of size excluding small arms ammunition, and no munitions debris equivalent to, or greater than 3.55 inch (6 lbs shell) in diameter or width with a thickness (length) of 3.55 inch or greater; and finding within the subsurface of the munitions response site no ferrous metal items (including, but not limited to MEC and MPPEH) equivalent to, or greater than 3.55 inch in diameter or width with a thickness (length) of 3.55 inch (6 lbs shell) or greater to a depth the lesser of 11 times the item diameter (or width).

- Customer/Client - refer to the term “Purchaser” for the contract.
- Nonconformance:
    - A minor nonconformance is not likely to materially reduce the usability of the services. It is generally a departure from the approved procedures that have little bearing on the end product.
    - A major nonconformance is likely to result in failure of the services or to materially reduce the usability of the end product.
    - A critical nonconformance is likely to result in hazardous or unsafe conditions for individuals using or depending upon the services.
- Purchaser: The term purchaser shall refer to the non-government body administering the particular contract involved, or the authorized representative of that body.
- Quality Conformance Inspection (QCI): Normal inspections/audits conducted by authorized the UXO contractor personnel during the accomplishment of the organization’s mission to determine conformance to contract requirements.
- QC: The process by which the UXO contractor manages, controls, and documents its activities in the accomplishment of the mission.
- Quality Defect: A nonconformance issue with published policy and/or a contractual requirement that requires corrective action(s).
- Quality Management: All those control and assurance activities instituted to safely and effectively accomplish the assigned mission.
- Root Cause: The basic reason for an undesirable condition or problem if eliminated or corrected, would have prevented it from existing or occurring.
- Stop-Work-Authority: The right and obligation to stop all work when serious quality or safety concerns arise.
- Surface Removal: Locating and removing MEC/MPPEH, MD, and metallic objects that are visible on the surface, or partially visible. This includes items that are partially exposed, which will require only minimal hand excavation to determine identification.
- Characterize: Locating, identifying, and characterizing metallic objects that caused a geophysical response.

4.4. QC RESPONSIBILITY

Tetra Tech is solely responsible for the control of product quality. Only those products/services that conform to contractual requirements will be offered to DESC or its contractor for acceptance.

4.5. CONTRACT SUBMITTALS

All contract submittals will be prepared by qualified personnel IAW the PWS and contract requirements. All documents undergo a peer review in which they will be reviewed by an equally qualified person familiar with the project and submittal requirements.

4.6. QUALITY MANAGEMENT

The PM has the responsibility of ensuring that QC procedures are implemented IAW the work plan and applicable documents identified within it.

The Program UXO QC Manager will provide the Quality Management oversight for the project. The Project UXOQCS is a part of the project team, but is authorized to elevate any quality problems that cannot be resolved by the project team. The Project UXOQCS interacts with the PM, SUXOS, subcontractor QC staff, as appropriate, to prevent and/or correct problem situations, as necessary. Vendors and subcontractors will be monitored to ensure that they supply items and services, which meet quality requirements. Periodic audits will be performed by the UXOQCS to verify that the quality system and the UXO field staff are performing as required. He also ensures that:

- Required site training is conducted prior to the start of field activities.
- The UXO field staff are qualified and trained.
- QC is built into the Project Work Plan to support the MEC removal action.
- The requirements of the QC Plan are adhered to.

Effective day-to-day field QC management is delegated to the on-site UXOQCS. This person will interact daily with the project team to ensure that all QC procedures presented in the Project Work Plan are followed in the accomplishment of all project tasks. The UXOQCS reports directly to the Tetra Tech QC Program Manager. Scheduled activities are coordinated with the PM, SUXOS, UXOSO, and all other project team members as needed. He has the authority to:

- Initiate action to prevent the occurrence of nonconformances relating to the provided services.
- Identify and record any problems relating to the services.
- Initiate, recommend or provide solutions through the on-site management channel.
- Verify the implementation of solutions.
- Control further actions of any nonconforming services until the unsatisfactory conditions have been corrected.
- Elevate Quality concerns, which cannot be resolved on-site to the Quality Manager.

All project team members are responsible for and will be held accountable for the quality of their work. Every team member has Stop-Work-Authority when an immediate safety situation is observed, which could cause personal injury or damage to property and equipment. All project team members are encouraged to identify potential quality problems and are encouraged to suggest solutions or corrective actions to ensure all work conforms to the approved Work Plan and QC requirements. During site-specific training, personnel will be briefed by the UXOQCS on the importance of quality work and the above-stated requirements. This briefing is aimed at ensuring that all site personnel understands Tetra Tech’s dedication to quality.

4.7. QC PLAN PROCESSES

This section documents the processes affecting quality. These are essential steps to ensure a quality product is delivered to the client.

4.7.1. Specific Procedures

Described below are the specific procedure that will be used to assure quality in this PWS regarding; Audits, Corrective/Preventive Action, Data Management, Field Operations, Equipment Calibration and Maintenance, and Personnel Protective Equipment. The project will follow the 3 phases of the control inspection process, which includes preparatory, initial, and follow on inspections of each definable feature of work.

4.7.2. Scheduled Audits

Periodic audits will be performed by the designated QA Manager to ensure that the requirements of this Quality Plan are being followed. This may include on-site visits as well as frequent document review activities. Training records, periodic reports, and adherence to all aspects of this QC Plan will be monitored to assure compliance.

4.7.3. Daily QC Audits

All instruments, vehicles/machinery, and equipment will be checked prior to the start of each workday and periodically throughout the day, batteries will be replaced as needed, and instruments requiring calibration will be checked against a known source. Handheld magnetometers/metal detectors will be checked on a test plot. Daily checks will be conducted by each instrument operator using his assigned instrument on the test plot. The instruments will be tested against a known source to verify that it responds appropriately. Once the instrument is determined to function properly, the operator will conduct a sweep of the FCA, using the methods and techniques applied in the field. The UXO Team leader and UXOQCS will observe each team member to ensure that he uses proper techniques and can properly locate seed items in the FCA. If the operator displays improper techniques or is unable to accurately and consistently locate seed items, the team leader will conduct refresher training, and the instrument operator will then demonstrate his proficiency on the test plot before moving to the designated clearance area. If it is determined that the operator's technique is proper but that the instrument is the cause of his failure to locate seed items, he will be given a different instrument and will repeat the test. Equipment determined to be defective will be tagged and removed from operation. The FCA simulates site conditions. It will be placed in a location free of geophysical anomalies that may interfere with the tests or affect the results. Figure 4-1 shows the conceptual layout of the FAC, and Table 4-1 includes seed item placement details. The UXOQCS is responsible for ensuring that personnel accomplishes all QC checks and that the appropriate logbook entries are made. The UXOQCS performs random, unscheduled QCI to ensure that personnel accomplishes all work specified in the Project Work Plan. The QCI Schedule will adhere to the following Table 4-2. The UXOQCS has the latitude to modify this schedule based on the quality of work being performed and the frequency of noted activities.

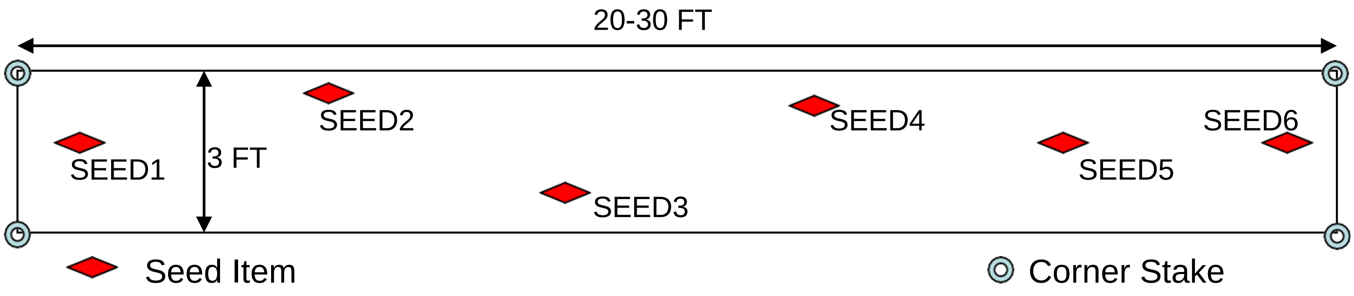

Figure 4-1 FCA Conceptual Layout

Table 4-1 IVS Seed Item Description

FAC Seed Item Description			
Seed Item ID	Description	Depth [in]	Notes
SEED1	Large ISO	34	Oriented approximately 45º from horizontal and parallel to the major axis of the test strip
SEED2	Medium ISO	28	Oriented approximately 90º from horizontal and parallel to the major axis of the test strip
SEED3	Large ISO	46	Oriented approximately horizontal and approximately perpendicular to the major axis of the test strip
SEED4	Large ISO	39	Oriented approximately 45º from horizontal and parallel to the major axis of the test strip
SEED5	Medium ISO	31	Oriented approximately 45º from horizontal and perpendicular to the major axis of the test strip
SEED6	Large ISO	43	Oriented approximately 45º from horizontal and perpendicular to the major axis of the test strip

Note: Seed items will be Industry Standard Objects (ISOs). At least two items will be blind seed items that are periodically moved by the UXOQCS.

Table 4-2 Frequency of QC Inspections and Checks

TASK	100%	DAILY	WEEKLY	BI-WEEKLY	AS NEEDED
Personnel Qualifications	✓				
Test Plot Proficiency		✓			✓
Accident/Incident Reporting	✓				
Search Effectiveness					✓
Turn-in of Recovered Munitions Debris	✓				
Preventive Maintenance		✓			
Communications Equipment Inspection		✓			
Safety Inspections		✓	✓		
Medical Support		✓			
Communications Effectiveness		✓			
Explosives Accountability					✓
Excavation Activities	✓				
MEC Final Disposal			✓		
MEC Accountability			✓		
Fire Protection – Prevention			✓		
Project Administration			✓		
Safety and Health Programs				✓	
Visitor Briefing					✓
Site-Specific Training					✓
Hazard Assessment – Risk Analysis					✓

4.8. QUALITY ASSURANCE / QUALITY CONTROL STANDARDS

4.8.1. Surface Removal

Every area designated for surface removal will undergo a Search Effectiveness Quality Control Inspection (SE QCI) involving approximately 10% of the square footage. The exact location of this square footage is at the discretion of the UXOQCS. The UXOQCS will also verify that the anomalies removed from the surface are accounted for separately, properly, and weighed accurately. The UXOQCS will place seed items, as described in this Section, to verify the effectiveness of the removal.

4.8.2. Subsurface Removal

The UXOQCS will perform a UXO QCI on at least 10% of each area excavated by the removal team. Additionally, seed items will be used, as described in Section 4.8.3, to ensure removal effectiveness. The UXO QCI will be performed using one of the following two methods, or a combination of the two methods.

- As available, a UXOQCS will monitor UXO Removal Teams while they acquire and excavate anomalies. He will observe the team's procedures to ensure quality standards are met.
- Following excavation, the UXOQCS will check the location using the same detection technology to ensure the team has removed all anomalies.

4.8.3. QC Performance Requirements

The Quality Control requirements of this project are provided in Table 4-3. The surface of all indicated removal areas will be cleared, IAW Section 3.7.8 of this work plan.

Table 4-3 Performance Requirements Matrix

Performance Requirements Matrix				
Requirement	**Applicability**	**Performance Standard**	**Frequency**	**Consequence of Failure**
Repeatability	All operators with assigned equipment	All items in the test strip detected (trains ear to items of interest).	At least daily	Replace defective equipment / remedial training. Operators that fail the retest will be assigned to other tasks for the day and will be re-tested again in the next working day.
Coverage	Site	100% of the area swept and anomalies removed / No MEC of any size and no RD/MD items ≥ 3.55 inch (6 lbs shell) diameter or width. All seed items are recovered.	At least 1-2 blind seed items per operator per lot	Redo lot
Detection and Recovery	Each Sector	All MEC/MPPEH and MD/RD greater than 3.55 inch (6 lbs) in or width removed from the surface/subsurface. All seed items are located and recovered.	At least 1-2 blind seed items per operator per lot. 10% of the area checked by UXOQCS	Redo lot
Geodetic Equipment Functionality	All	Geodetic Repeatability- Check against a known position set by a surveyor/position located within 1 foot	At least Daily	Replace defective equipment / remedial training. Operators that fail the retest will be assigned to other tasks and will not operate geodetic equipment, until proficiency is demonstrated.
Recheck of Excavations	All	After excavation, the UXOQCS will recheck the voids to determine that no magnetic signature exists.	All excavated voids will be rechecked by UXOQCS	Failure to verify that the void is free of magnetic signatures will result in further excavation and repeat of this operation after the source of the magnetic signature is identified.

The UXOQCS will use blind seed items in the test plots and in the removal areas to ensure the effectiveness and completeness of the removal action. The UXOQCS will place two or three (2-3) ISOs in areas to verify detection proficiency. The UXOQCS will record the location and depth of the seed items using GPS (location) and tape measure (depth) and will document the failure of any operator to locate them accurately. The location, depth, and the number of items will be varied each week, when conducting intrusive operations.

Additionally, the UXOQCS will place seed items on the surface and in the subsurface of the removal area. The detection seeds will also serve as coverage seeds for QC purposes. A lot is defined as the portion of the area assigned to the team to clear. The lots may be irregular shaped and may vary in size, depending on the shape of the removal area, but will generally be approximately one acre. The

UXOQCS will record the location (grid/clearance area) of each seed item and will verify that all are located prior to the final clearance of the area. Failure to recover the seed items will result in a QC failure condition that will require re-clearing of the lot. All QC logs, reports, and other QC-related documentation will be maintained in MS word and MS Excel formats and available to the client PM, Tetra Tech PM, and SUXOS.

4.9. QC FILES

The following two files will be established and maintained by the UXOQCS.

- QCI Record File
- Corrective Action Request (CAR) File

The QCI Record File will be a two-part file, containing Active and Inactive Sub-files.

The Inactive Sub-file will contain the Quality Conformance Inspection Record (QCIR) for tasks that were found to be in compliance with the Work Plan and those that were not in compliance, but have been re-inspected and are subsequently corrected.

The Active Sub-file will contain those QCIR for tasks that were found to be not in compliance with the Work Plan and have not yet been corrected.

The CAR File will be a two-part file containing an Active Sub-file and an Inactive Sub-file. A CAR will be maintained in the Active File until follow-up has been conducted and deemed satisfactory. Once the follow-up is completed, the CAR will be placed in the Inactive File.

4.10. CORRECTIVE/PREVENTATIVE ACTION

Nonconformance will be documented on a QCIR. The QCIR will document the reason for the nonconformance and describe the corrective actions taken to resolve the problem and the actions taken to prevent reoccurrence. QCI are generally intended to be preventative, rather than corrective in nature. Through preventative QCI, continuous improvement of site operations will occur.

The QCIR may be handwritten in ink when computer access is limited, but when practical, they will be prepared electronically in Microsoft Word format.

A QCIR may be completed for tasks when they are in conformance with the Work Plan. QCIRs for conforming tasks will not generally be distributed off the project site.

A QCIR will be completed for tasks when they do not conform to the Work Plan. Nonconformance QCIRs will be forwarded by email to the PM and the QA/QC Managers.

A QCIR will be completed for re-inspection of nonconformance. If the re-inspection indicates that the nonconformance has been corrected, both QCIRs will be filed in the Inactive Sub-file and a copy of the re-inspection QCIR will be forwarded to the PM and the QA/QC Manager. If the re-inspection indicates the nonconformance has NOT been corrected, both QCIRs will be filed in the Active Sub-file. A copy of the re-inspection QCIR will be forwarded to the PM and the QA/QC Manager.

Nonconformance will be evaluated and corrective action implemented by on-site management whenever possible. The PM and QA/QC Managers will track all non-conformances to assure that they have been resolved, actions to prevent re-occurrence have been implemented and that lessons learned are communicated effectively.

4.11. CUSTOMER COMPLAINTS

Customer complaints will be addressed immediately. The complaint may come in the form of a verbal comment or written correspondence. Whatever the vehicle, the PM will conduct an investigation to analyze the complaint and assure corrective action has been initiated. The corrective action will address not only the root cause but also the application of controls to assure its effectiveness.

The PM will document the complaint or nonconformance and the investigation. He will look for the root cause.

Lessons Learned will be documented on the CAR and communicated to Project personnel and the QA/QC Managers.

The action on the CAR is not complete until the UXOQCS and/or SUXOS have completed follow-up. The corrective/preventative actions have to be adequate to prevent reoccurrence, and the customer must be satisfied with these actions.

The issue addressed in the CAR will be an item for a future QCI to ensure that the corrective/preventive actions have in fact addressed the issue and the solution was effective.

4.12. DOCUMENT CONTROL AND DATA MANAGEMENT

Rigid control must be maintained over the production of QC documents. The following guidelines will apply to all documentation generated by QC staff.

4.12.1. Document Completion

All sections of forms will be completed. Any unused spaces will be marked not applicable (N/A). In long columns of empty lines, N/A may be written in the first and last lines of that column with a single line connecting the entries. Large areas of unused spaces may be designated N/A by drawing a single line through the unused areas with the letters N and A on either side of that line.

Time and date formats: To eliminate misunderstanding, the following formats will be used on all official reports and correspondence:

- Time: 24-hour (Examples: 0730H, 1930H)
- Date: MM/DD/YY (Examples: 10/05/12, 11/15/12)

All signatures will be accompanied by the date the signature was made, either in a date block or with the date written following the signature.

White opaque correction fluids/tape may not be applied to records to correct mistakes.

Incorrect entries shall be drawn through with a single line with the initials of the author and the date of the correction immediately adjacent. Corrected entries will be placed above or immediately following the line through or otherwise entered on the document in a legible, understandable means.

Any entries or corrections to a document, other than in document control blocks, made after its date of inception, shall be considered a “late entry”. Late entries will be clearly designated with the capital letters “LE”, the initials of the person making the late entry, and the date the late entry is made.

Official original documents will be distinctly marked, as such.

4.13. DATA MANAGEMENT

Electronic data and records will be managed to prevent accidental loss of information. All data will be backed up periodically, and data will not be stored only on one single media. Zip disks, compact disks, or other means of storage will be used in addition to standard computer hard drives to ensure data is not lost by the failure of any one device. Since conventional Document Control Practices do not always lend themselves to electronic records, the following additional guidelines will be followed for all electronic QC records.

Once an electronic record is completed and saved to disk, the file name will be used as the registration number for that document and shall appear on each page of the electronic record such that it also appears on printed copies. This filename will be entered in the Field Document Control Log as that documents registration number.

Changes, additions, late entries, and corrections to completed electronic records will be accomplished by creating a revision to the previously completed record. Included in the file name of the completed record will be the sequential revision number of that record. The first such revision of any record will be designated as R1 at the end of the file name. Subsequent revisions will be designated R2, R3, etc.

The original record will not be deleted electronically, and each revised record will include a description of the changes made on that particular revision as well as retaining the description of any previous revisions.

Any document that is revised after any required distribution, either off-site or to any electronic or hard copy file, will be likewise distributed to all recipients as the original document. The revision will be filed along with the original and any previous revisions.

Electronic forms, which require signatures, will be printed, and the printed original signed and dated in black ink as required. The words “signature on file” shall be entered on the electronic copy, in the signature space, of all documents requiring signatures. The signed original will be filed in the proper location. Subsequent revisions to forms requiring signatures will also be printed, signed, and filed.

Logs maintained electronically may be updated as required for daily activities without going through the above revision process. Each day’s log, however, will be saved electronically with the date included in the file name. Previous day’s logs will not be deleted from the database and will serve as additional backup should the current days log be damaged or lost.

4.14. PHOTOGRAPHIC RECORDS

Photographs will be generated to document significant site activities, MEC/MPPEH recoveries. Photographic records will be used to supplement information recorded in the daily logs, including photographs of equipment prior to use, and the condition of the site prior to any activity. Photographs will clearly show the task being accomplished and provide for a visual record of the operations. Operations will not be staged. Selected representative photographs will be included in the SSFR, and all photos will be provided on digital media accompanying the SSFR.

4.15. LOGS AND REPORTS

Field activity logbooks will be maintained in ink. All personnel will use bound and numbered field logbooks with consecutively numbered pages. These logbooks are QA records and will be completed IAW this section of this QC Plan. These activity logbooks will become part of the SSFR; thus, it is imperative that they be completed clearly and legibly. Appropriate documentation will be maintained regarding the location and disposition of all MEC/MPPEH and MD. Locations will be documented on a site map and entered in the Ordnance Accountability Log. Daily and Weekly Summary Reports will be prepared by the UXOQCS and forwarded via email to the PM on a timely basis.

4.16. DAILY ACTIVITY LOG

Daily Activity Logs will be maintained and will include the following:

- Date and recorder of field information.
- Start and end time of work activities, including lunch and downtime.
- Visitors.
- Weather conditions.
- Important telephone calls.
- Any deviations from planned activities.
- Equipment checks and calibrations.
- Equipment monitoring results, if applicable.
- QCI Performed.
- Nonconforming conditions.
- Lessons Learned.
- Signatures of the SUXOS and UXOQCS indicate concurrence.

4.17. SAFETY LOG

Safety Logs will include the following:

- Date and recorder of log.
- Significant site events relating to safety.
- Accidents.
- Stop Work due to safety concerns.
- Lessons Learned.
- Safety Audits.
- Signatures of the SUXOS and UXOQCS indicate concurrence.

4.18. TRAINING LOG

Training will be documented in the Training Log as follows:

- Date and recorder of log.
- Nature of training.
- Tailgate safety briefings (including time conducted, the person conducting the briefing, and attendees).
- Visitor Training (including names of visitors, description of the training, and the person performing training).
- Signatures of the SUXOS and UXOQCS indicate concurrence.

4.19. MEC IDENTIFICATION AND REPORTING

The SUXOS and UXOSO must be in agreement on the condition of a suspected MEC item before any removal action is attempted. All available data sources will be consulted prior to this determination.

As MEC/MPPEH is located, it will be documented on the MEC Accountability Log (Appendix F). A detailed accounting of all MEC items encountered during the removal action will be maintained. This accounting will include:

- Identification Number (a unique ID #).
- Location.
- Nomenclature.
- Fuse Description.
- Fuse Condition.
- Additional comments, if required.

Each suspect MEC/MPPEH encountered will be identified using a unique numerical identifier, such as A5–0001 (for the first suspect item [0001] encountered in grid/area A5).

Photographs of suspect MEC/MPPEH will be taken for documentation purposes. A ruler or some similar item, to show scale, will be placed adjacent to the item. The photographer needs to remember these photographs will be utilized in the SSFR; thus, a focused, well-thought-out photograph is necessary.

MEC identification data will be entered into an electronic MEC Accountability Log daily. Terminology and definitions used when completing the MEC Accountability Log will be consistent with those given in the 21 April 2005 Memorandum from the Office of the Assistant Secretary, Installation and Environment; Subject: Munitions Response Terminology. The UXOQCS will review this data to ensure accuracy and consistency in reporting. This review will include a comparison of photographs with recorded data. Any conflict or discrepancy will be discussed and resolved with the Team Leader. Signatures of the SUXOS and UXOQCS on the MEC Accountability Log indicate concurrence of the reported data.

4.20. LESSONS LEARNED

Lessons learned from day-to-day activities are an important part of the continuous improvement process. They can prove vital to preventing similar problems from occurring at other sites. Lessons learned from daily activities and from the occurrence of nonconforming conditions will be documented by the UXOQCS and UXOSO, as appropriate. Lessons learned as a result of nonconforming conditions are captured and documented on the QCIR as a result of its investigation and disposition. Other Lessons learned, from both positive and negative events will be documented in the Daily Activity Log and/or Safety Log. These items will be included in the SSFR. The QA/QC Manager will maintain a database of lessons learned for communication to other sites and for incorporation into training requirements.

4.21. TRAINING

The PM will verify that all project personnel has completed the following training prior to their assignment:

- U.S. Naval Explosive Ordnance Disposal (EOD), Indian Head, Maryland / Eglin AFB, FL or EOD Assistance Course, Redstone Arsenal, AL / Eglin AFB, FL or other formal courses of instruction meeting the requirements in DDESB TP 18 appropriate to the level of employment.
- Occupational Safety and Health Administration (OSHA) 40 Hour Hazardous Waste Operations and Emergency Response (HAZWOPER) IAW 29 Code of Federal Regulations (CFR) 1910.120 and 8-hour refreshers as needed.
- UXOSO will have OSHA 30-hour Safety Course.
- Site-Specific Training on this Work Plan and additional training, as needed, will be performed and documented on a QCIR, which will be forwarded to the PM for review.
- Safety Meetings will also be documented.
- The UXOQCS will ensure that all personnel using geophysical detection equipment are properly trained to use that piece of equipment. This may include verification of past experience as well as on-site training on using specific equipment in site-specific conditions, which will be documented on a QCIR and forwarded to the PM.
- If sweep personnel are employed, they will receive site-specific training related to the task that they will perform.

The UXOQCS will conduct, as necessary, site-specific training and/or review of known MEC to ensure that all site personnel are thoroughly familiar with the hazards and the general safety precautions and procedures required. All personnel and site visitors will also receive site-specific training and safety briefings, as required, to ensure safety on the project. Visitors must be briefed on all of the known or anticipated hazards of the site, required PPE to be worn while on the site, and site emergency procedures. Visitors will be escorted by a UXO qualified person whenever they enter the EZ, and all UXO operations will cease whenever a visitor is within the EZ.

4.22. CHEMICAL QUALITY DATA MANAGEMENT (CQDM)

No Hazardous, Toxic, and HTRW or Chemical Warfare Material (CWM) is expected at this site per the PWS, therefore a CQDM sub-plan is not applicable.

4.23. QC DOCUMENTATION SUBMITTAL

All QC documentation required by this Work Plan will be submitted as part of or as supporting documentation for the SSFR.

4.24. QC RECORD RETENTION

All original QC Records and documentation will be maintained on-site and made available for Client inspection upon request

5. CHAPTER 5 EXPLOSIVE MANAGEMENT PLAN

5.1. General

This plan details the management of explosives that may be required for the destruction or venting of MEC, suspected MEC, or MPPEH items at CRP. This plan was developed utilizing the guidelines specified in Federal Acquisition Regulation (FAR) 45.5, local and state laws and regulations, Alcohol Tobacco and Firearms Publication (ATFP) 5400.7, DA Pamphlet 385-64, and Department of Transportation (DOT) regulations. Explosives used in the performance of this Task Order will be obtained from commercial sources. These materials will be obtained and used for the specific purpose of disposal of MEC and explosive venting of inert MEC/MPPEH items, if required, recovered during the activities at the CRP site. A Remote Firing Device (RFD) will be used with an electrical detonator system. A shock tube (pyrotechnic lead) initiator may be substituted for the electrical detonator depending upon availability from the supplier.

Explosives will be delivered to the site in the quantities required on the day of planned demolition operations. All explosives delivered to the site will be consumed in the demolition operations on the same day they are delivered.

5.2. Licenses/permits

Tetra Tech will maintain on site and, upon request, make available to any local, state, or federal authority a copy of all licenses/permits required authorizing Tetra Tech to purchase, store, transport, or use explosives. If no other licenses or permits are required by the state, Tetra Tech will maintain a copy of the Federal ATF license on-site.

5.3. Description and Quantities

Explosive materials used during the performance of the work on this project will be obtained from commercial sources. These explosive materials will be for the specific purpose of disposal of suspect MEC/MPPEH and explosive venting of inert items, if required, located during the removal action.

An RFD with an electrical or nonelectrical (shock tube) firing system will be utilized. If an RFD is not available, a hard-wired electrical firing system may be used. Donor explosive materials will be delivered to the site and will be consumed in the demolition operations on the same day they are delivered.

Materials to be delivered to the site may include (approximate quantities):

- 10 each Electric Blasting Caps (1.4B) or
- 10 each Nonelectric initiators (1.4B)
- 100 each Shaped Charge perforators, 32 gram (1.1.D)
- 1000 feet Detonation Cord, (1.1D) 50 each Cast Booster ½ lb. (1.1D)

Depending upon availability from the suppliers, other sizes of boosters and/or perforators may be used. In any case, material to be used for donor explosives will be suitable for the items to be destroyed. Quantities may also vary due to minimum order quantities requirements (generally case lots).

Typically 2 ea. electric blasting caps (1.4B); and 2 ea. 32-gram perforators (1.1D) and/or 2 ea ½ lb cast booster

(1.1D) will be used during disposal or venting operations for a single item, and a detonation cord (1.1D) will be used to link perforators and/or cast boosters if multiple items are disposed of in a single demolition shot. Depending upon availability, shock tube (Non El) detonators may be used in place of electric detonators.

5.4. Acquisition Source

Donor explosives will be obtained from a regional explosives vendor or other licensed supplier, who agrees to supply and deliver the necessary quantities of demolition explosives.

List of Explosive Materials

As stated above, explosives that are expected to be used are:

- Electric Blasting Caps (1.4B) or
- Nonelectric initiators (1.4B)
- Shaped Charge perforators, 32 gram (1.1.D)
- Detonation Cord, (1.1D)
- Cast Booster ¾ lb. (1.1D)

Depending upon availability from the suppliers, other sizes of boosters and/or perforators may be used. In any case, material to be used for donor explosives will be suitable for the items to be destroyed.

5.5. Initial Receipt Procedures

Upon receipt of donor materials from licensed explosive suppliers, an inventory will be conducted to ascertain:

- correct type
- serviceable condition
- correct quantity

A copy of the invoice(s) for the incoming donor materials will be kept in the on-site donor materials accountability file.

Upon receipt, an Initial Receipt and Closeout Inventory form will be prepared, with the following information, and retained on-site:

- Date of acquisition
- Name or brand name of the manufacturer
- Manufacturer’s marks of identification
- Quantity
- Description
- Name, address, and license number of the persons from whom the explosive materials are received

5.6. Procedures for Variances between quantities shipped and quantities received.

If any discrepancies of any kind should be found during the initial receipt inventory and inspection, the following procedures will be followed:

- If, during the initial receipt inventory, a discrepancy is found between the quantity listed on the invoice and the quantity being delivered, the quantity received will be annotated on the invoice and on the memorandum.

- The SUXOS will notify the supplier of the discrepancy before the explosives are accepted from the supplier's representative.
- The PM will be notified telephonically, with a copy of the Initial Receipt and Closeout Inventory form and a copy of the invoice being emailed as soon as possible.

5.7. Establishment of the explosive storage facility

A storage facility for donor explosives will not be established at CRP. Donor explosive materials required for destruction or venting of MEC/MPPEH will be ordered from commercial suppliers and delivered to the site when needed for demolition operations. All donor explosive materials received will be used the same day or returned to the supplier.

Recovered MEC/MPPEH will be stored in an ATF Type 2 Magazine. When discovered, it will be inspected to determine if it is acceptable to move. If acceptable to move, it will be stored in the sited magazine until demilitarization activities can be conducted. If it is determined to be unacceptable to move, it will be blown in place. MEC/MPPEH will be guarded, as necessary to ensure the protection of the public (e.g. accessible to the public), until demolition operations are completed.

5.8. Physical security of explosive storage facility

An explosives storage facility will not be established for this project. Explosives for disposal of MEC will be provided and delivered by a local vendor and delivered on an as-needed basis. While donor explosives are on site, Tetra Tech will comply with all applicable regulations and requirements of ATF regulations, and DESC requirements for the security of explosives. Recovered MEC/MPPEH will be stored in an ATF Type 2 Magazine. The Magazine will be secured by the erection of a temporary fence that will be 8 to 10 ft in height and has one locked entry point.

5.9. Receipt Procedures

5.9.1. Accountability

Upon receipt from the vendor, accountability will be established for each type of explosive material IAW Paragraph 5.5 and 5.6 above. Copies of vendor invoices will be kept with the Initial Receipt and Closeout Inventory form in the donor materials accountability file in the on-site project office.

Any transactions, which include receipt, issue, and/or turn-in of donor materials, will be conducted by two persons, at least one of whom will be a UXO Tech III or higher. Discrepancies will be resolved immediately. If it is determined that a theft or loss has occurred, the procedures in Section 5.13 will be followed.

All documents associated with receipt, transfer, issue, or turn–in of donor explosives will be maintained in the Donor Materials Accountability file in the on-site project office.

5.9.2. Designated Individuals

The following individuals are authorized to order and receive explosives from the supplier:

- Senior UXO Supervisor
- UXO Safety Officer

The following individuals are authorized to transport and use donor explosives:

- Senior UXO Supervisor
- Site Safety and Health Officer
- UXO Tech III
- UXO Tech II

5.9.3. Explosive Use Certification

At the conclusion of the daily demolition operations, the SUXOS will finalize the Initial Receipt and Closeout Inventory form stating all donor explosives expended during MEC removal operations were used for their intended purpose.

5.10. Inventory

Explosives will be delivered to the site in the quantities required on the day of planned demolition operations. All explosives delivered to the site will be consumed in the demolition operations on the same day they are delivered. Therefore, no inventory will be maintained on site.

5.11. Procedures upon Discovery of Lost, Stolen, or Unauthorized Use of Explosives

Lost, stolen, or unauthorized use of explosive materials will be reported as follows:

- The SUXOS will give an immediate telephonic notification to the PM, who will notify the DESC, followed up by a written report within 24 hours.
- Notify ATF at 800-800-3855, within 24 hours of discovery (complete ATF Form 5400.5, Report of Theft or Loss - Explosive Materials and mail to nearest ATF office. Instructions for completion of the form are on the reverse side.);
- Notify the local law enforcement agency.

5.12. Returning Explosives to the Explosive Storage Area

Explosives will be delivered in the quantity required for the planned demolition operation and all delivered commercial explosives will be consumed in the demolition operation.

5.13. Disposal of Unused Explosive Materials

Explosives will be delivered in the quantity required for the planned demolition operation and all delivered commercial explosives will be consumed in the demolition operation.

5.13.1. Perform an economic analysis for different alternatives

This requirement does not apply to this Task Order.

6. CHAPTER 6 ENVIRONMENTAL PROTECTION PLAN

This chapter of the Work Plan describes environmental concerns and describes methods used during site activities designed to minimize pollution, protect and preserve natural resources, restore damage, and control noise and dust within reasonable limits.

6.1. Identification of Environmental Concerns

Environmental concerns associated with the CRP are addressed in the Joint Application submittal to USACE, including the Project Description in Appendix I.

6.2. Mitigation Procedures

6.2.1. Manifesting, transportation, and Disposal of Waste

No explosive hazardous waste that will require off-site transportation, treatment, storage, or disposal is anticipated to be generated. MEC/MPPEH will be destroyed on-site, and resulting scrap will be certified as MDAS and turned over to a recycler for smelting before it is released to the public.

Non-hazardous and municipal waste generated during this project will be transported to an approved landfill for disposal. If generated, waste material containing TLM from equipment decontamination or other sources will be contained in appropriate containers and/or staged for disposal with impacted sediment material.

6.2.2. Burning Activities

Burning activities will not be conducted during the performance of work required in the PWS.

6.2.3. Dust and Emission Control

None of the planned activities are expected to generate significant dust. Excavation operations using mechanical equipment may generate small quantities of nuisance dust. The SUXOS, UXOSO/QCS, and Team Leader will closely monitor dust emissions resulting from soil excavation operation. Dust masks will be available to workers in areas of high dust concentrations.

Other emissions will primarily result from the operation of diesel engines associated with excavation equipment. These emissions will be limited by limiting the time that equipment idles when not in use. Team leaders will ensure that equipment is turned off when not in use. If excessive emissions are generated due to engine maintenance, equipment will be shut down until inspected by a mechanic.

6.2.4. Spill Control and Prevention

Field personnel will inspect vehicles and heavy equipment before, during, and after operation to identify any leaks of petroleum, oil, and lubricants (POL). If leaks are detected, the equipment will not be used until the leak is controlled. Drip pans will be used to catch dripping POL.

POL will be stored on-site in approved containers, in approved areas with required containment. If a spill occurs, it will be reported immediately. Immediate steps will be taken to contain the spill and limit contamination. Contaminated soil will be excavated and packaged for treatment or disposal.

6.2.5. Storage Areas and Temporary Facilities

Chemical toilets may be placed on the site. These toilets will be delivered, set up, and serviced by a subcontractor.

6.2.6. Access Routes

Field personnel will primarily use existing roads and trails or new temporary access roads installed by DESC for the project to access the work areas. These routes will allow access by foot or light vehicle to areas requiring MEC clearance.

6.2.7. Trees and Shrubs Protection and Restoration

The project area requiring MEC clearance is within the Congaree River. Tetra Tech will coordinate with DESC to obtain approval if necessary, in the unlikely event that removal of trees or shrubs is required to safely and efficiently conduct MEC clearance activities.

6.2.8. Control of Water Run-on and Run-off

Extensive excavations for MEC clearance that would require run-on or run-off controls is not anticipated.

6.2.9. Decontamination of Equipment

Soil will be thoroughly cleaned from equipment and tools at the end of the project. Tools and equipment will be cleaned by brushing, sweeping and/or wiping dirt from them. Equipment may be further cleaned at established wash facilities.

Due to the presence of TLM, additional cleaning and decontamination may be necessary, including the use of soaps, detergents, or solvents if necessary. Waste material from equipment decontamination will be contained in appropriate containers and/or staged for later disposal with the impacted sediment material.

6.2.10. Minimizing Areas of Disturbance

Field personnel will minimize the areas of disturbance by working only in the areas designated in the PWS and designated for MEC clearance activities. Field personnel will limit vegetation removal and excavation to what is necessary to complete the work.

6.3. Post-activity Clean-up

After completing the project, field personnel will clean up the site and remove all equipment, tools, and material. Field personnel will police the site to remove all trash, debris, and other waste from the worksite. The SUXOS will inspect the area to ensure that area is clean prior to demobilization.

6.4. Air-monitoring Plan

There is no RCWM expected at this site. If dust levels become a nuisance or hazard to workers, water may be used as an engineering control to lower the dust levels. Dust masks will be worn, as required to further reduce exposure to dust.

Due to the presence of TLM in the removal areas, air monitoring for dust and other potential contaminants will be performed by DESC as outlined in an air monitoring plan that will be submitted to SCDHEC for approval prior to project implementation.

7. CHAPTER 7 PROPERTY MANAGEMENT PLAN

This Chapter does not apply to this Task Order.

No Government Furnished Equipment is to be used on this project.

8. CHAPTER 8 INTERIM HOLDING FACILITY SITING PLAN FOR RCWM PROJECTS

This Chapter does not apply to this Task Order.

RCWM is not expected to be encountered at the site where activities described in this Work Plan will take place. No Interim Holding Facility for RCWM is required in the PWS.

9. CHAPTER 9 PHYSICAL SECURITY PLAN FOR RCWM PROJECT SITES

This Chapter does not apply to this Task Order.

RCWM is not expected to be encountered at the site where activities described in this Work Plan will take place. No Physical Security Plan for RCWM is required in the PWS.

10.CHAPTER 10 -- REFERENCES

Alcohol Tobacco Firearms (ATF), Publication 5400.7, Federal Explosives Laws

Department of Defense Explosives Safety Board (DDESB), TP-16, Methods for Calculating Primary Fragment Characteristic

Department of Defense Explosives Safety Board (DDESB) TP-18, Minimum Qualifications for Unexploded Ordnance (UXO) Technicians and Personnel

Department of Defense (DoD), 4160.21-M-1, Defense Demilitarization Manual

Tetra Tech Corporate Quality Plan

Tetra Tech Corporate Safety Plan

ERsys.com, http://www.ersys.com/usa/45/4516000/wtr_norm.htm ; Climate Weather Norm Charts for Columbia, SC

National Fire Protection Association, NFPA 780, Standard for the Installation of Lightning Protection Systems

U.S. Army Corps of Engineers (USACE), Congaree River Basin Navigability Study, 1977.

U.S. Army Engineering Support Center Huntsville OE-CX Interim Guidance 02-03

U.S. Army, AR 385-64 Explosives Safety Program

U.S. Army, TM 60-Series Training Manuals

USACE, EM 200-1-15, Ordnance and Explosives Response

USACE, EM 385-1-1, USACE Safety and Health Requirements Manual

USACE, EM 385-1-97, Explosive Safety and Health Requirements Manual Change 1

USACE, EP 1110-1-18, Ordnance and Explosives Response

USACE, EP 75-1-2, MEC Support During Hazardous, Toxic, and Radioactive Waste (HTRW) and Construction Activities

USACE, ER 1110-1-12, Quality Management

USACE, OE-CX Interim Guidance 08-01

APPENDIX A

TASK ORDER SCOPE OF WORK

(TITAN/Tetra Tech has only been contracted to prepare plans, and no formal SOW was prepared. TITANs proposal for currently scoped work is presented below)

MUNITIONS RESPONSE WORK PLAN CONGAREE RIVER PROJECT

REMOVAL ACTION AND CONSTRUCTION SUPPORT
COLUMBIA, SC

TITAN
Associates Group Incorporated

Titan Associates Group Inc.
P.O. Box 102 • Athens, Tennessee 37371
Tel: (423) 368-9197 Online: www.titan-associates.net

Date: 10/23/2020

Mr. William Zeli, P.E
Environmental Program Manager
Apex Companies, LLC
1600 Commerce Circle
Trafford, PA 15085

Subject: DESC Congaree River Project

Dear Mr. Zeli,

Please find below TITAN's updated cost to review and revise the existing Congaree River plans in the event the MRA is approved.

Task 1- MEC Work Plan (WP). The WP will be modified/updated in accordance with Data Item Description (DID) WERS-001.01, EM 385-1-97, and EP 75-1-2, MRA and will address UXO support at the remediation site. The WP will describe specific work proposed in order to meet the project objectives and requirements. The WP will contain, at a minimum, a Technical Management Plan, an Explosive Management Plan, an Accident Prevention Plan, which includes a Site Safety and Health Plan, and a Quality Control Plan (QCP). The QCP shall be a detailed and comprehensive plan covering all aspects of the UXO support.

Task 2- Explosives Safety Submission (ESS). TITAN will modify or develop an amendment to the ESS in accordance with requirements of the Department of Defense (DoD) Manual 6055.09-M (DoD, 2008a).

Task 3- Dive Safe Practices Manual. TITAN will update the Dive Safe Practices Manual prepared in accordance with the requirements in EM 385-1-1 Section 30.

Task 4- Diving Operations Plan. TITAN will update/modify the project specific Diving Operations Plan.

Task 5- Virtual Meetings. Virtual meetings will consist of two TITAN employees, The Project Manager and the SUXOS. This task is an hourly rate.

Task 6- In-person Meetings In-person meetings are based on a per event cost. This task consists of personnel time (Project Manager and SUXOS) of 18 hours each. This included 3 hours to attend the meeting and 10 hours travel round trip. This also include lodging for one night at $112.00 GSA rate and per diem of $61 a day and 75% on travel day.

If you have any questions or concerns, please feel free to contact me at 423-368-9197 or
email tleonard@titan-associates.net.

Thank you,
Tanya Leonard
President / CEO
Titan Associates Group Inc.
Phone: 423-368-9197
www.titan-associates.net
Mailing Address:
P.O. Box 102
Athens, TN 37371

APPENDIX B MAPS

MUNITIONS RESPONSE WORK PLAN
CONGAREE RIVER PROJECT
REMOVAL ACTION AND CONSTRUCTION SUPPORT COLUMBIA, SC

FIGURE B-1
SITE LOCAITON
CONGAREE RIVER PROJECT
COLUMBIA, SOUTH CAROLINA

Prepared For:
Apex Companies, LLC

Prepared By:
TITAN Associates Group inc.

DRAWN	VERIFIED	APPROVED
M. Norris	T. Leonard	
DATE 01/8/2021	FILE B-1 Site Location.mxd	
PAGE # B-1	SCALE 1 inch = 250 feet	

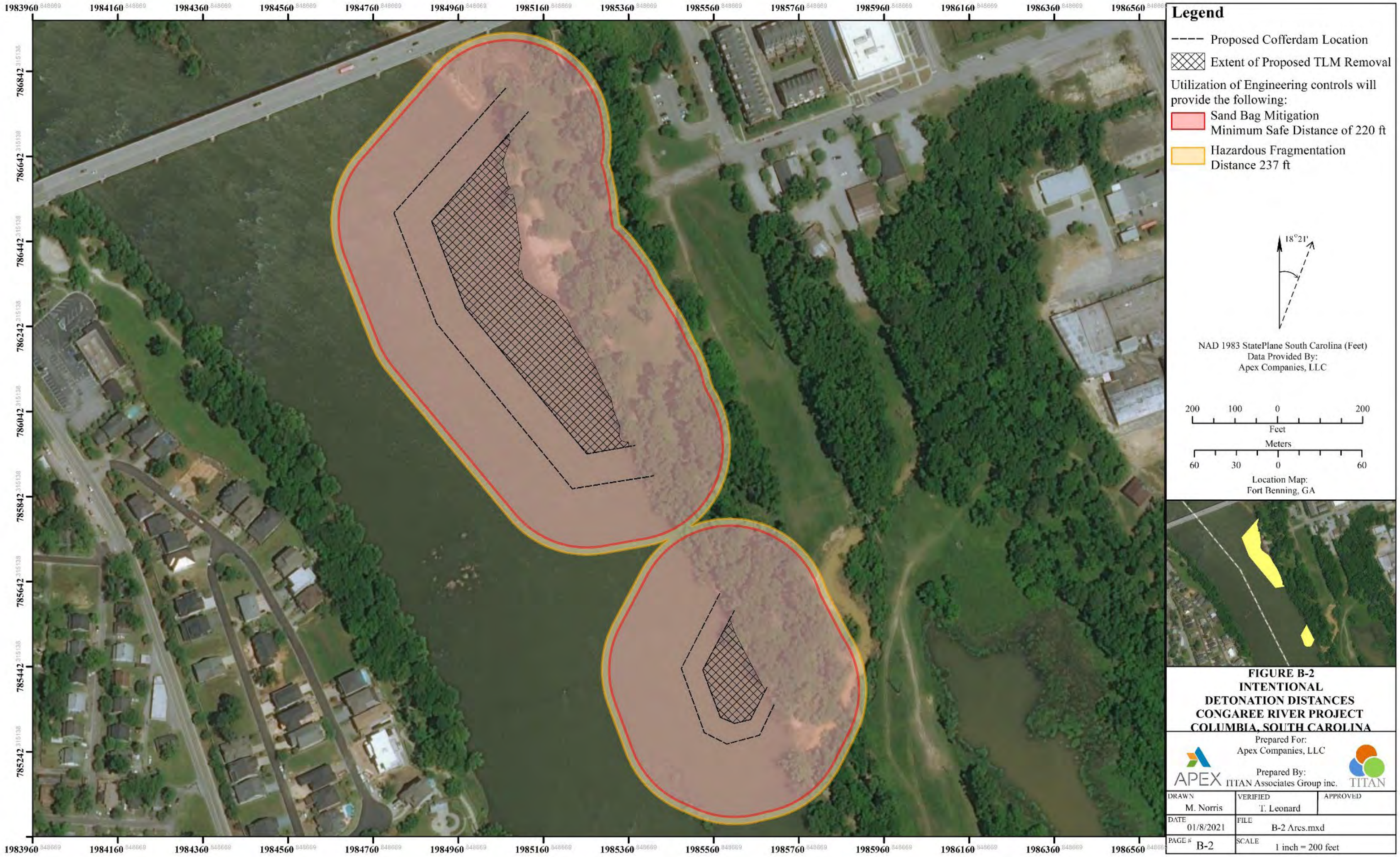

FIGURE B-2
INTENTIONAL
DETONATION DISTANCES
CONGAREE RIVER PROJECT
COLUMBIA, SOUTH CAROLINA

Prepared For:
Apex Companies, LLC

Prepared By:
TITAN Associates Group inc.

DRAWN	VERIFIED	APPROVED
M. Norris	T. Leonard	
DATE 01/8/2021	FILE B-2 Arcs.mxd	
PAGE # B-2	SCALE 1 inch = 200 feet	

FIGURE B-3
MEC STORAGE MAGAZINE
PROPOSED LOCATION
CONGAREE RIVER PROJECT
COLUMBIA, SOUTH CAROLINA

Prepared For:
Apex Companies, LLC

Prepared By:
TITAN Associates Group inc.

DRAWN M. Norris	VERIFIED T. Leonard	APPROVED
DATE 01/08/2021	FILE B-3 Magazine.mxd	
PAGE # B-3	SCALE 1 inch = 200 feet	

APPENDIX C POINTS OF CONTACT

MUNITIONS RESPONSE WORK PLAN
CONGAREE RIVER PROJECT
REMOVAL ACTION AND CONSTRUCTION SUPPORT COLUMBIA, SC

Emergency Response / Services			
Ambulance Service			911
Emergency Medical Response			911
Police*			911
Police Department – Non emergency			803-545-3500
Hospital-Palmetto Health Richland 5 Richland Medical Park Dr Columbia, SC 29203			803-434-7000 * For Emergency Dial 911
Fire Department*			911
Fire Department – Non Emergency			803-545-3700
National Poison Control Center			800-222-1222
CHEMTREC (hazardous materials response)			800-424-9300
National Response Team (hazardous materials response)			800-424-8802
Centers for Disease Control (CDC) **http://www.cdc.gov/health/diseases**			800-311-3435
Project Management / Coordination			
Tetra Tech			
	Operating Unit President	Mark Dollar	970-206-4263
	Project Manager	Scot Wilson, PMP	360-626-3193
	Safety Manager	Jim Streib	240-727-9240
DESC			
	Project Manager	Rusty Contrael	412-721-6494
APEX			
	Environmental Program Manager	William Zeli, P.E.	412-829-9650 x5004
Explosives Supplier			
	TBD	TBD	TBD

APPENDIX D ACCIDENT PREVENTION PLAN

MUNITIONS RESPONSE WORK PLAN
CONGAREE RIVER PROJECT

REMOVAL ACTION AND CONSTRUCTION SUPPORT COLUMBIA, SC

TABLE OF CONTENTS

APP APPROVAL

Project: Surface/Subsurface Clearance   Site: Congaree River Project

Contract Number: 87500614   Site Location: Columbia, SC

We have reviewed the attached Accident Prevention Plan (APP) for the referenced site. We recognize that when this form is completed, the attached APP is approved for field activities on the referenced site. Changes to this APP will be documented in writing.

January 13, 2022

Prepared by: Date
Jeffrey (Jim) Streib, CIH, CSP, CHMM

Scot M Wilson

January 13, 2022

Reviewed by: Date
Scot Wilson
Program Manager

1.0 BACKGROUND INFORMATION

Contractor:. Titan Associates Group, Inc.

Contract Number: 87500614

Project Name: MEC/UXO Clearance and Support
Congaree River Project
Columbia, South Carolina

2.0 PROJECT DESCRIPTION AND HISTORY

Apex Companies, LLC (APEX) contracted Titan Associates Group, Inc (TITAN) to perform Work Plan updates and Munitions Response (MR) service consisting of Unexploded Ordnance (UXO) support for clearance of Munitions and Explosives of Concern (MEC) and Material Potentially Presenting an Explosive Hazard (MPPEH). The MR is necessary to support the contaminated soil and sediment removal on the Congaree River Project (CRP), located in Columbia, South Carolina (SC), for Dominion Energy South Carolina (DESC). Since the project plans were finalized, TITAN has gone out of business, and Tetra Tech has been contracted to take over the UXO MR support for the project. Revision 2 contains the revisions required for Tetra Tech to perform the UXO field support. These changes include adding Tetra Tech’s SOPs, processes, and staffing changes as well as changes to the designated project team and stakeholders since Revision 1 was finalized.

Site Location: The CRP area is located on the Congaree River in Columbia, SC. The site, also referred to as the “project area”, begins directly south of the Gervais Street Bridge, extends approximately 200 feet into the river from the eastern shoreline, and approximately 1,500 feet downriver, towards the Blossom Street Bridge. The MEC intrusive activities will occur on the eastern side of the Congaree River between Gervais and Blossom Street Bridges, within the cofferdam footprint and removal areas shown on the figures in Appendix B.

Site history: In 1865, during the Civil War, Discarded Military Munitions (DMM) and other articles of war produced by the Confederacy were dumped into the Congaree River near the Gervais Street Bridge by Union forces under the direction of General Sherman. This activity took place during Sherman’s occupation of Columbia. The Union Army kept some of these items for its own use and the remainder was destroyed. One of the methods for destruction was dumping the items into the river.

Archeological investigations, conducted as late as 1980, recovered some MEC from the area as well as some other potentially historically significant artifacts. Specifically, this work was focused in and adjacent to the unnamed tributary that enters the river just south of the Gervais Street Bridge. Several cannonballs were identified during this operation and properly disposed of by trained explosive ordinance disposal (EOD) personnel located at nearby Fort Jackson.

Due to the potential presence of MEC/MPPEH within the project area, an additional reconnaissance and screening of the area in question was conducted as part of the investigative activities. An acoustic (side-scan sonar) and magnetic (magnetometer) remote sensing survey was performed to identify ordnance and other submerged cultural resources in the remediation area by Tidewater Atlantic Research, Inc., and a report was submitted on 8 February 2012. Analysis of the survey data identified concentrations of anomalies in the immediate vicinity of the Senate Street landing and scatters extending into the river. A terrestrial magnetometer investigation of the unnamed tributary below the Gervais Street Bridge was also carried out and that investigation identified eight additional anomalies with a potential association with ordnance.

In June 2010, the occurrence of TLM within the Congaree River was reported to the SCDHEC. Preliminary testing indicated that the material might be attributable to the Huger Street former MGP that was operated by predecessor companies of DESC beginning in the early 1900s and ending in the 1950s.

Preliminary sample results conducted on the material by SCDHEC and DESC indicated that the TLM had similar chemical and physical characteristics as coal tar. The coal tar material was a waste product from coal-gas production. DESC had previously entered into a VCC with SCDHEC in August 2002 to conduct environmental assessment and cleanup activities at the former Huger Street MGP site. The VCC was later extended to include the TLM impacts within the Congaree River.

Planned Removal Action: To address the presence of TLM within the river, a Stakeholder-Developed Modified Removal Action was developed and submitted to SCDHEC in December 2018. Two areas within the river, along the eastern shoreline, were proposed for removal of impacted sediment. The TLM-impacted sediment varies in thickness from a few inches to approximately 6 feet thick in some areas. The current total estimate of sediment requiring removal is approximately 11,675 cubic yards. The total project area within the river, including cofferdam footprints and removal areas, is estimated to be 5.8 acres. Sediment removal from within the river will occur after coffer dams are installed and water has been removed. Intrusive diver removal operations of metallic anomalies with be conducted prior to the installation of the cofferdams.

In December 2018, a Stakeholder-Developed Plan for the MRA was developed to reduce the footprint of the project area. The footprint was reduced to the current 2.6-acre area 1 and area 2 approximately 0.5 acres.

The removal of MEC from the cofferdam footprints and impacted sediments and assisting in the segregation and disposal of impacted sediments covered under the Work Plan is to protect worker safety and the environment. The MEC clearance area for the cofferdam footprints and removal areas is shown on the figures in Appendix B.

2.1 Chemical Warfare Material

The site is not suspected of containing CWM. However, if a suspected RCWM is encountered during removal and/or support activities, the procedures listed below will be followed:

Upon an unexpected discovery of RCWM, all work will immediately cease. Project personnel will withdraw along a cleared path upwind from the discovery. A team, consisting of a minimum of two personnel, will secure the area to prevent unauthorized access. Personnel must position themselves as far upwind as possible while still maintaining visual security of the area. Upon evacuation, the Senior Unexploded Ordnance Supervisor/Unexploded Ordnance Safety Officer (SUXOS)/(UXOSO) will account for all worksite personnel and immediately notify the DESC on-site representative who will coordinate the emergency response with local and federal agencies.

Once the RCWM item has been removed and site plans updated according to the additional site hazards encountered, work may continue.

2.2 Hazardous Chemical Contamination

By definition, hazardous substances are those materials that can threaten human health and/or environmental wellbeing if released into the environment. This describes those hazardous substances or chemical contaminants present in soil or air that pose a threat to the environment, and as such may pose a threat to site personnel and the public during removal actions. From what is currently known about the project area, TLM is expected to be present. It is prudent to be particularly aware of unusual smells, soils stains, or other indications of impacts and to follow the health and safety procedures established for this work. If drums/containers are encountered or there is reason to believe that an unplanned chemical hazard exists, the SUXOS/UXOSO will stop work and report to the Corporate Health and Safety Manager as much information as is known (i.e., names of chemicals if containers have labels, condition of containers, extent of problem, etc.) and plans will be updated to accommodate these additional site hazards prior to resuming work on the site.

2.3 Improved Conventional Munitions.

The site is not suspected to contain Improved Conventional Munitions (ICM). If suspect ICM munitions that are not determined to be practice munitions are encountered during any phase of site activities, contractor personnel will immediately withdraw from the work area, secure the site, and contact the DESC representative for assistance and guidance.

3.0 ACCIDENT EXPERIENCE

Tetra Tech has an excellent safety record. Since its creation in 2019, Tetra Tech munitions group has never had a lost time accident / injury. Tetra Tech's current Experience Modification Rate is 0.74. Tetra Tech's lost time injury rate is 0.

4.0 PHASES OF WORK REQUIRING HAZARD ANALYSIS

The following phases of work on this project require an Activity Hazard Analysis:

- Site-Setup/Layout
- Surface Preparation / Vegetation Removal
- Subsurface Clearance using "Mag & Dig" Methods
- Transportation of Explosives
- Disposal of MEC/MPPEH
- Mechanical Excavation (if used)

Activity Hazard Analyses can be found in this Accident Prevention Plan (APP) at Section 14.0 of this Appendix.

5.0 STATEMENT OF SAFETY AND HEALTH POLICY

TETRA TECH

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HEALTH AND SAFETY POLICY

Tetra Tech, Inc. is committed to providing and maintaining a healthy and safe work environment for our associates. Tetra Tech's program is designed to address the hazards associated with our business and prevent injury and illness in the workplace. Tetra Tech intends to meet its responsibilities for health and safety by committing to the following:

- Complying with applicable standards, laws and regulations,
- Designating personnel accountable for implementing health and safety programs,
- Communicating health and safety programs and practices throughout the organization,
- Mitigating potential risks through hazard identification and assessment, employee training and safe work practices,
- Allocating sufficient resources to the program,
- Implementing enforcement and accountability measures, and
- Establishing health and safety performance standards.

Management is responsible for ensuring that Tetra Tech workplaces are safe and that risks, hazards, and safety violations brought to their attention are investigated and promptly corrected.

Tetra Tech associates are responsible for complying with Tetra Tech's health and safety policy, programs and standards, and conducting their work safely and without detriment to themselves, other employees or property.

Compliance with health and safety program requirements are mandatory. Willful violation of this policy will be considered cause for disciplinary action up to and including termination.

Dan Batrack
CHIEF EXECUTIVE OFFICER

JANUARY 2020

6.0 RESPONSIBILITIES AND LINES OF AUTHORITY

6.1 Identification and Accountability

The following personnel and their safety related responsibilities for this project work are listed.

Operating Unit President (Mark Dollar) is responsible for enforcement of the Corporate Health and Safety Program at all worksites within his area of responsibility. He must ensure that personnel receives the required training, medical surveillance, and personal protective equipment necessary in order to perform their jobs in a safe and effective manner. The enforcement of the Corporate Health and Safety Program on the worksites will be a critical rating element for site personnel and managers.

Corporate Health and Safety Manager (Jeffrey (Jim) Streib)) is a CIH, CSP, and a CHMM. He assists in the development, implementation, and maintenance of the Safety Program and individual APP and Site Safety and Health Plan (SSHP). He visits projects as requested to ensure the effectiveness of the Health and Safety Program. He remains available for project emergencies. He develops or reviews modifications to APP/SSHP as needed. He evaluates occupational exposure monitoring/air sampling data and adjusts APP/SSHP requirements as necessary. He serves as a QC staff member and approves the APP/SSHP by signature. He coordinates directly with the PM and the SUXOS/UXOSO routinely to answer technical questions and to provide assistance to the worksites. He also provides safety training, as needed, and performs safety and health program inspections with the Safety and Health Manager to assure compliance with Tetra Tech's safety and health policy.

Project Manager (Scot Wilson) directly impacts the safety of the site by setting the tone for the job and encouraging safe performance among all team members. Any areas of concern or questions regarding health and safety issues are coordinated with the Corporate Health and Safety Manager, and the UXOSO. In instances of non-compliance with safety requirements, the PM issues warnings and/or provides disciplinary action up to and including removal of the employee from site operations, should this action be warranted. The PM assures that every accident on the worksite is investigated in order to determine the root cause(s), the accident report is filled out, and takes steps necessary to prevent recurrences.

Senior UXO Supervisor (SUXOS) is responsible for the successful accomplishment of the work on the project site. He directly supervises all site work and personnel and assures they are operating in a safe manner. He assures that all personnel, including visitors, are properly trained, qualified, equipped, and protected from the hazards associated with the worksite and site operations. The SUXOS reports directly to the Project Staff on all project issues. The SUXOS has stop-work authority. The SUXOS has numerous onsite responsibilities including, but not limited to:

- Coordinating with all applicable emergency response agencies to ensure appropriate response should an emergency develop on site;
- Establish medical evacuation routes and emergency telephone number listing;
- Inventory first aid equipment, PPE, fire extinguishers, and purchase replacements, as required, with concurrence from the PM;
- Survey the site for hazards;
- Provide daily safety briefings;
- Provide required safety training;
- Designate site control zones;

- Provide visitor briefing and training; and

UXO Safety Officer (UXOSO)

They are granted the authority to administer the safety and health program on the worksite. The UXOSO reports directly to the Corporate Health and Safety Manager on all project safety and health issues, technical assistance on health and safety issues at the worksite, for assistance in ordering safety equipment, medical surveillance program issues, etc. The UXOSO has stop-work authority whenever an imminent danger situation is observed. The UXOSO has numerous onsite responsibilities to support the SUXOS in maintaining a safe work environment. These responsibilities may include, but are not limited to:

- Inventory first aid equipment, PPE, fire extinguishers, and purchase replacements, as required, with concurrence from the SUXOS and PM;
- Survey the site for hazards;
- Provide daily safety briefings;
- Provide required safety training;
- Provide visitor briefing and training;
- Perform onsite monitoring, if required;
- Perform daily safety inspections of site activities to verify compliance with all safety and health requirements in this project APP, as well as the Corporate Health and Safety Program and recording any deficiencies in the Safety Log; and
- Coordination of corrective actions for any deficiencies noted during safety inspections.
- Perform onsite monitoring, if required;

Team Members are responsible for performing their assigned tasks in a safe and effective manner. Questions must be immediately brought to the attention of their supervisor. Team members must not attempt to perform an assigned task for which they have not been properly trained. All personnel must attend required safety training and be aware of the operations going on around them at the worksite. Any situations or conditions, which may affect the safety and health of any team member, must be immediately reported to their supervisor. Before, during, and after use, personnel must inspect each piece of personal protective equipment, as well as other tools and equipment, to assure it is in a safe operating condition. Any equipment that is deemed unsafe for use must be immediately turned in for repair or replacement. Personnel must know how to properly use all equipment assigned to them and must use required personal protective equipment at all times.

Competent Persons and Qualified Persons

CPs for anticipated health and safety related issues are designated by the PM and identified, by name, in the AHA where a CP is specifically required (e.g., for excavation) for a task. Subcontractor personnel will provide CPs as required where their tasks require a CP. The subcontractor CPs will also be designated by name in the AHA when needed. For tasks that require a QP, the AHA will also define the QP by name. The names of QPs or CPs designated by Tetra Tech management (e.g., the CSHM, or PM) in the AHAs will be provided to the DESC for review and acceptance before any work starting. No work will occur on-site unless a designated CP/UXOSO is present on the job site.

6.2 Lines of Authority

An organization chart depicting the lines of authority is included. Tetra Tech will require that the personnel and subcontractors follow the APP requirements and verify that they are met.

6.3 SUBCONTRACTORS AND SUPPLIERS

Identification of Subcontractors and Suppliers

A local surveying company subcontracted through APEX or the remediation contractor will provide survey support for the project. Additional subcontractors are not anticipated. However, suppliers may deliver equipment and materials to the project site. All subcontractor personnel will be trained to the approved work plan and the included APP. All visitors, including suppliers supporting the project, will receive a safety brief from the SUXOS or the UXOSO prior to entering any area where work is ongoing. They will sign in and will be escorted as required to perform their functions on the site. Only essential personnel will be allowed in the EZ while intrusive operations are ongoing.

Means for Controlling and Coordinating Subcontractors / Suppliers

All subcontracted personnel working on the site will receive the same thorough site-specific training provided to all site personnel. This training will include detailed training on procedures in the Work Plan and APP. All suppliers making deliveries on site will receive a safety briefing, which will include recognition and awareness of potential site hazards. Suppliers will not be permitted to enter the EZ of the project site unless escorted by a UXO-qualified employee.

Safety Responsibilities of Subcontractors / Suppliers

All subcontractor personnel and suppliers making deliveries on site are responsible for receiving a safety briefing. They are responsible for following all site safety and health procedures. They will not enter any EZ area without a UXO-qualified escort. They will wear all required personal protective equipment while on the site in areas where it is required. They will report any accidents of their personnel to the SUXOS and UXOSO for investigation.

7.0 TRAINING

Prior to the commencement of site activities, the UXOSO will ensure that all employees engaged in MEC operations (a type of hazardous waste operation) are informed of the nature and degree of exposure to chemical and physical hazards that are likely to result from participation in site operations. Tetra Tech will accomplish this by ensuring that all personnel entering the site have received the appropriate regulatory and site-specific training, prior to participation in site activities. The other employees working on the site in other capacities not involving MEC or hazardous waste operations will receive training on the hazards of the MEC operations on site and on MEC recognition and avoidance procedures, as well as emergency procedures. This training will be held at the time of site mobilization and will be reinforced during the daily safety briefings, to which all site workers (including subcontractor personnel) will be required to attend.

Safety Indoctrination Subjects

Safety indoctrination training will be presented by the UXOSO to all Tetra Tech employees, as well as to subcontractor personnel who will be working on this project site. This is part of on the job training (OJT), which includes classroom type instruction on the topics specified for site-specific training and on site participation in the following:

- Details of the APP;
- Employee rights and responsibilities;
- Safe work practices;
- Nature and extent of anticipated chemical, biological and physical hazards;
- Measures and procedures implemented for controlling site hazards;
- Emergency Response and Contingency Plan;
- Rules and regulations for vehicle use;
- Safe use of field equipment;
- Safe operation of heavy excavation equipment;
- Handling, storage, and transportation of hazardous materials;
- Use, care, and limitations of PPE;
- Hazard communication per OSHA 29 CFR 1910.1200.

If personnel who are not UXO-qualified come on the site, a UXO/MEC recognition and awareness training will also be presented. While there is a MEC/MPPEH hazard on the site, personnel will have a UXO-qualified employee escorting them. Once an area is cleared of surface MEC/MPPEH, these employees will be permitted to enter the area without escort as long as no intrusive operations are performed. The UXO/MEC recognition and awareness training provides an additional level of protection to these workers so that if they see something that could be ordnance related, they will know enough not to touch it and to immediately get a UXO-qualified employee to examine the item.

7.1 Initial Training

All Tetra Tech and subcontractor employees who are involved in MEC and/or hazardous waste site activities receive 40 hours of OSHA Hazardous Waste Operations and Emergency Response (HAZWOPER) training IAW 29 CFR 1910.120 (General Industry) and 29 CFR 1926.65 (Construction). If it has been more than a year since any worker has received the 40 Hour OSHA HAZWOPER training, he or she must also have a current HAZWOPER 8-Hour Refresher Training IAW 29 CFR 1910.120 and 29 CFR 1926.65 prior to working on the site. All production workers will also receive site-specific OJT under the direct supervision of a trained/experienced supervisor when they mobilize at the site.

7.2 Mandatory Training and Certifications Applicable to This Project

The following training and certifications are required for work on this project:

- EOD School Certificates (UXO-qualified personnel only)
- OSHA HAZWOPER 40 Hour Training
- OSHA HAZWOPER 8 Hour Refresher Training (as applicable)
- OSHA HAZWOPER Supervisor Training (Supervisors only)
- OSHA 30 Hour Safety Course (UXOSO)

- Valid vehicle operator license (All vehicle operators)
- Heavy Equipment Operator Training (Heavy Equipment Operators only)

7.3 Supervisory Training

On-site managers and supervisors, who are responsible for directing others, will receive the same training as the general site workers for whom they are responsible. They will also receive an additional 8 hours of OSHA required supervisory training IAW 29 CFR 1910.120 and 29 CFR 1926.65 to enhance their ability to provide guidance and make informed decisions. This additional training includes the following:

- Review of the Tetra Tech Corporate Health and Safety Program;
- Regulatory requirements;
- Management of hazardous waste site cleanup operations;
- Management of site work zones;
- How to communicate with the media and the public;
- PPE selection and limitations;
- Spill containment; and
- Monitoring site hazards.

The UXOSO, with specific responsibilities for safety and health guidance on site, will receive the training provided to general site workers and their supervisors. He also will receive advanced training in safety and health issues, policies, and techniques. The UXOSO will have completed an OSHA-approved 30-hour Construction Safety Class.

7.4 Project-Specific Training

The SUXOS and UXOSO will conduct OJT. This training will include classroom type instruction covering the topics specified for site-specific training, and on site participation in the following:

- Details of the Site-Specific Health and Safety Plan;
- Employee rights and responsibilities;
- Safe work practices;
- Nature and extent of anticipated chemical and physical hazards;
- Measures and procedures for controlling site hazards;
- Emergency Response and Contingency Plan;
- Rules and regulations for vehicle use;
- Safe use of field equipment;
- Handling, storage, and transportation of hazardous materials;
- Use, care, and limitations of PPE;
- Hazard communication per OSHA 29 CFR 1910.1200.

7.5 UXO/MEC Training

All employees performing work involving the handling and destruction of MEC must be graduates of the Naval Explosive Ordnance Disposal School or other appropriate recognized training per DDESB TP 18. A copy of their certificate of graduation will be kept on file at corporate headquarters. UXO qualified personnel must have knowledge and experience in military ordnance, ordnance components, and explosives location, identification, render safe, recovery/removal, transportation, and disposal safety precautions. UXO personnel must have the knowledge and experience to effect safe handling and transportation of found ordnance items.

7.6 Hazard Communication Training

All employees who will be performing work involving the handling of hazardous materials will receive Hazard Communication training detailing the hazards of the product, appropriate protective measures to prevent exposure to the product and work environment hazards, as well as safe procedures for storage and handling of the product, and response to emergencies. Personnel may request a Safety Data Sheet (SDS) for any hazardous material on the site at any time. The location of the SDSs for this site will be in an SDS binder in the site office, and all personnel will be made aware of that fact. This training will occur as part of the initial mobilization training at the site.

7.7 Use of Portable Fire Extinguisher

Project personnel will receive OSHA-compliant fire extinguisher education (29 CFR 1910.157[g]) to use portable fire extinguishers to respond to incipient-stage fires. Typically provided during site orientation.

7.8 First Aid and Cardiopulmonary Resucitation (CPR)

The UXOSO will identify individuals with current first aid and cardiopulmonary resuscitation (CPR) training. At a minimum, two people on-site will have current CPR/first aid certification. The UXOSO have current first aid/CPR training. The names of all CPR/first aid-qualified workers will be posted. An automatic external defibrillator (AED) will be available on-site.

7.9 Periodic Site Training

On the first workday of each workweek/period or more frequently if needed, a pertinent topic will be selected and elaborated upon by the UXOSO during the Tailgate Safety Briefing. These safety meetings will help ensure the safety and health of site personnel in the performance of regular work activities and in emergency situations. Safety meetings will be documented in the appropriate log, and the Documentation of Training Form will be completed.

7.10 Visitors

All visitors to the site, even if escorted, must receive as a minimum, a briefing on site conditions, hazards and emergency response procedures. The UXOSO will generally be the one providing the visitor briefing. All visitors to the EZ will be escorted at all times. When visitors who are not UXO qualified enter the EZ, all MEC operations will cease, and will resume again after the visitor has left the area. Visitors will not be permitted in the restricted work areas unless they have the appropriate level of OSHA training and are medically approved. Visitors not complying with the above requirements will not enter the restricted work areas; however, they may observe site conditions from a safe distance. All visitors will make appropriate entries in the Visitor's Log.

7.11 Training Documentation

A training record will be kept in each employee's individual file to confirm that adequate training for assigned tasks is provided and that training is current. In addition, Documentation of Training Forms will be completed and kept on file and made available for inspection upon request.

8.0 SAFETY AND HEALTH INSPECTIONS

Internal Safety and Health Inspections

The UXOSO will perform daily inspections on a scheduled and non-scheduled basis, of all site operations. The UXOSO will conduct non-scheduled safety and health inspections as deemed appropriate based upon the ongoing site activities. Documented vehicle inspections will be performed daily by the operator. The UXOSO will complete weekly site inspections along with any other required inspection identified within the AHAs. All inspections will be documented. When discrepancies are observed, follow-up will be documented in the UXOSO log until the corrective actions required have been completed.

External Inspections

Due to the location and type of work being performed on this site, it is anticipated that the only external inspections required would be an inspection by the DESC to confirm compliance with Work Plan and ESP requirements. Tetra Tech will also be prepared in the event that Local and State safety and health officials or other enforcement agencies may conduct inspections to ensure compliance with Local and State or Federal requirements.

9.0 SAFETY AND HEALTH EXPECTATIONS, INCENTIVES & COMPLIANCE

The goal for Tetra Tech on this project is zero accidents. All managers and supervisors are responsible for implementing the provisions of this APP and for answering team member questions about accident prevention. Management is responsible for ensuring that all safety and health policies and procedures are clearly communicated and understood by all team members. Managers and supervisors are expected to enforce the rules fairly and uniformly. This will be accomplished by:

- Informing team members of the provisions of the Safety and Health Program;
- Evaluating the safety performance of all team members;
- Recognizing team members who perform safe and healthful work practices;
- Providing training to team members whose safety performance is deficient; and
- Disciplining team members for failure to comply with safe and healthful work practices.

All team members are responsible for using safe work practices, for following all directives, policies, and procedures, and for assisting in maintaining a safe work environment. Tetra Tech recognizes that open, two- way communication between management and all team members on health and safety issues is essential to an injury-free, productive workplace. To facilitate a continuous flow of safety and health information between all team members that is readily understandable, the following will be accomplished:

- Training all new team members, during the site-specific training, on the site safety and health policies and procedures, which will include this APP;
- Training all new team members on the hazards associated with the job site;
- Conducting daily tailgate safety meeting for all team members;
- Conducting quarterly refresher type training;
- Posting and, if applicable, distributing safety information; and
- Encouraging open communications.

9.1 Incentive Program

Safety Performance is a critical element in all performance evaluations. Managers are evaluated on the safety of all operations on their project sites. Other workers are evaluated on their own participation in the safety program and compliance with safety procedures. Tetra Tech takes a team approach to safety and expects all personnel to participate actively in continuously looking for ways to improve safety performance. This will be documented and entered into Tetra Tech's TOTAL system.

9.2 Policy and Procedures Regarding Noncompliance with Safety Requirements

Disregard for safety and health requirements will not be tolerated. If the SUXOS, UXOSO and PM determine that a team member is not sufficiently committed to conforming to established safety standards, the team member's employment agreement will be terminated.

Safety rules and practices are established for the safety of all employees and to promote the welfare of the company. If the occasion arises whereby safety rules and practices established by the APP are violated, appropriate penalties will be imposed.

Infractions are divided into two categories: "Major" and "Minor". An example of a minor violation is reporting for work without the prescribed Level D PPE. Any violation of the APP that could have or did result in an accident involving personal injury or property damage is considered a major violation. The following guidelines are imposed for penalties:

Minor Violations

First Offense: Verbal warning to individual; offense to be noted in individual and supervisor's project file; discussion with individual's supervisor.

Second Offense: Written reprimand by the SUXOS will be entered in individual's file; discussion with individual and individual's supervisor.

Third Offense: Termination of employment recommended by the SUXOS to the PM, who makes the final decision after discussion with the Corporate Health and Safety Manager and SUXOS.

Major Violations

Any Offense: Minimum penalty will consist of a written reprimand to be entered in individual's file, and a discussion with the individual and the SUXOS will be conducted. Depending upon the severity of the violation, the SUXOS may temporarily dismiss the individual from the job site. If this occurs, the UXOSO or SUXOS will immediately report the incident to the Corporate Health and Safety Manager. Upon completion of a full investigation, the individual's employment may be terminated, if deemed appropriate, through a joint decision of the Program Manager, PM, Corporate Health and Safety Manager, and SUXOS.

When a violation occurs:

- An investigation of the incident will be carried out by the UXOSO to determine if a violation has in fact occurred.
- If the UXOSO determines that a violation has occurred, the following actions will be

accomplished:

- Report of the violation will be submitted to the SUXOS and Corporate Health and Safety Manager by the UXOSO.
- The UXOSO, in conjunction with the Corporate Health and Safety Manager and SUXOS, will determine if the violation is "major" or "minor".
- The SUXOS, in conjunction with the Corporate Health and Safety Manager and the PM, will determine the appropriate disciplinary action.

9.3 Procedures for Holding Managers Accountable for Safety

In all cases, supervisors are evaluated on the safety of project sites under their control. If investigation into project site accidents/incidents indicates negligence on the part of a supervisor, the investigation results will be discussed between the UXO Program Manager, the PM and the Corporate Health and Safety Manager. If there is concurrence, and depending on the severity of the situation, the supervisor could be given a written reprimand or could be removed from duty in the case of serious negligence.

10.0 ACCIDENT REPORTING

10.1 Exposure Data

Exposure data on man-hours worked on a project, will be collected by the PM. The Corporate Health and Safety Manager will be provided this information from the PM in order to prepare accident statistics for the company and exposure reports for individual projects as required.

10.2 Accident Investigations, Reports, Logs

Investigation and documentation of emergency responses shall be initiated by the SUXOS/UXOSO. This is important in all cases, but especially so when the incident has resulted in personal injury, property damage, or environmental impact. The documentation will be a written report and will be inclusive of the following:

- Accurate, concise, and objectively recorded information;
- Authentic Information: Each person making an entry must sign and date that entry. Nothing is to be removed or erased. If details are changed or revised, the person making the change should strike out the old material with a single line and initial and date the change;
- Titles and names of personnel involved;
- Actions taken, decisions made, orders given, to whom, by whom, when, what, where, and how, as appropriate;
- Summary of data available;
- Possible exposure of personnel; and
- Copies of the Employer’s Report of Occupational Injury or Illness (OSHA Form 300) or the Tetra Tech Accident Report, as appropriate, will be completed and forwarded to the Corporate Health and Safety Manager.

Reportable injury and occupational illnesses fall into one of the following categories:

- Fatality, including missing and presumed dead;
- Permanent total disability;
- Lost workday case involving days away from work;

- Recordable case without lost workdays;

The following unplanned events will also be investigated and reported:

- Damage to military property;
- Damage to contractor property; and
- Unplanned functioning of MEC.

All accidents will be investigated, and immediate steps will be taken to prevent recurrence. DESC will be notified of any accidents occurring on this project site.

Should an accident occur on the site, all reports and records will be documented. Copies will be maintained on site for the duration of site activities. A permanent copy will be maintained in Tetra Tech's Operating Unit Office.

10.3 Immediate Notification of Major Accidents [29 CFR 1904.8]

Within 8 hours after the death of any employee from a work-related incident or the in-patient hospitalization of three or more employees as a result of a work-related incident, the employer shall orally report the fatality/multiple hospitalizations by telephone or in-person to the nearest Area Office of OSHA. This will be accomplished by the Health and Safety Staff. In the event of an emergency, site personnel will be notified by either visual/verbal communication. Personnel will be notified to:

- Stop work activities;
- Evacuate to the designated assembly point;
- Begin emergency procedures; and
- Notify off site emergency response organizations.

In the event of an emergency, the SUXOS will be designated as the On-Scene Incident Commander and will have the overall responsibility for the implementation of the response and coordination with responding off-site emergency services.

Once an emergency has occurred, the SUXOS will report the incident to the client representative, the PM, and the Health and Safety Staff as soon as the situation is under control.

If the emergency involves employee injury, the UXOSO will complete the Tetra Tech Accident Report form. The Health and Safety Staff will be responsible for notifying applicable Federal, state, and local authorities/agencies where required. Once the emergency has been resolved, the UXOSO, PM, and Health and Safety Staff will conduct a follow-up investigation and a Root Cause Analysis. Actions will be taken to prevent recurrence.

11.0 MEDICAL SUPPORT

A first aid kit will be located in all the site vehicles and the project office. A CPR mask and a bloodborne pathogen kit will also be kept with each first aid kit. The SUXOS, in conjunction with the UXOSO, will have final authority on the decision to require additional professional medical services (i.e., paramedics, hospital visit, etc.) for any illness or injury. Two site employees will be certified in First Aid and CPR. They will be the first responders to any site emergency and will render first aid/CPR as needed until medical assistance arrives on the scene. A Trauma First Aid Kit will be kept in the UXOSO vehicle.

All supervisory personnel shall maintain a phone listing of the nearest available medical assistance in the event of an accident. This telephone listing will be kept beside each telephone. The UXOSO will ensure that an Emergency Medical Assistance list is updated and provided to all supervisors. Directions to the nearest medical facility will be kept in each vehicle.

The nearest medical facility address is:
Palmetto Health Richland Hyperbaric Medicine
Address: 5 Richland Medical Park Drive
Columbia, SC 29203
Phone: (803) 434-7000

From the Project Area, 9 min (3.2 miles)

Take US-176 W/US-21 N/US-321 N and US-76 E to Bull St

Head east on Gervais St/Gervais St Bridge toward Gist St 0.3 mi

Turn left onto US-176 W/US-21 N/US-321 N/Huger St 0.8 mi

Keep right at the fork, follow signs for US-21/US-176/US-321/Elmwood Ave

Continue onto US-176 W/US-21 N/US-321 N/US-76 E 0.9 mi

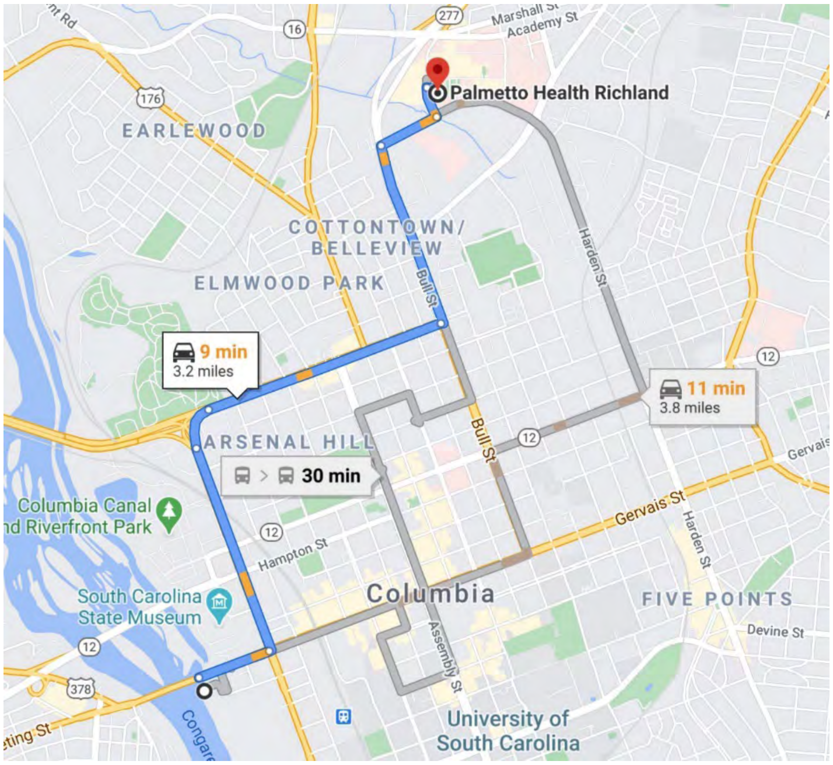
Continue on Bull St to your destination

Use the left 2 lanes to turn left onto Bull St 0.7 mi

Turn right onto Harden Street Extension (signs for Harden St) 0.2 mi

Turn left onto Medical Park Rd 0.1 mi

Arrived.



12.0 PLANS, PROGRAMS, AND PROCEDURES

12.1 PERSONAL PROTECTIVE EQUIPMENT PLAN

Whenever feasible, engineering controls as a priority and work practices, or a combination thereof, will be utilized to protect site workers from safety and health hazards and maintain personal exposures to hazardous substances below established exposure limits. The exposure limits used by Tetra Tech will be the lower of the OSHA Permissible Exposure Limits (PELs) found in 29 CFR 1910 Subpart G and 29 CFR 1910.1000, or the American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Values (TLVs). Other recognized published exposure levels, such as those found on SDSs, will be used if the substance is not listed by OSHA or the ACGIH. Tetra Tech will not utilize a system of employee rotation as a means of complying with the PEL, TLV, or other published limits.

Due to the expected hazards at this site during most operations, modified Level D PPE will be the PPE requirement. Level D PPE is a work uniform affording minimal protection, used for nuisance contamination only. The following modified Level D equipment will be required on this site:

- Leather gloves.
- Face shields – when working around chain saws, weed whackers, and vegetation removal equipment.
- Tinted or clear safety glasses with side shields or goggles.
- Hearing protection, where required by high noise levels above 85db, in the vicinity of heavy equipment operations, and vegetation clearance operations involving gas-powered equipment.
- Leather work boots with ankle support and non-slip soles (no steel toes that interfere with magnetometers).
- Cotton work clothes.
- Leg chaps – when working around vegetation removal equipment or snakes.
- Hard hat – when working around heavy equipment, and in the vicinity of chain saws, weed whackers and powered vegetation removal equipment.
- Safety Vests/Hi-Vis outer torso garments when working around Heavy Equipment.

12.2 Selection of PPE

Each task outlined in the Statement of Work will be assessed prior to its initiation to determine the potential of personnel exposure to safety and health hazards, which may be encountered during its conduct. The hazard assessment will be based on available information pertaining to the historical use of the site, site contaminant characterization data, and the anticipated operational hazards. This information will be provided to or collected by site personnel. The PPE assigned as a result of the hazard assessment represents the minimum PPE to be used during initial site activities. Since hazard/risk assessment is a continuing process, changes in the initial types and levels of PPE will be made IAW information obtained from the actual implementation of site operations and data derived from the site monitoring. As a general rule, the levels of PPE will need to be reassessed if any of the following occur:

- Commencement of a new work phase, or work that begins on a different portion of the site.
- Change in job tasks during a work phase.
- Change of season/weather.
- When temperature extremes or individual medical considerations limit the effectiveness of

PPE.
- Contaminants other than those previously identified are encountered.
- Change in ambient levels of contaminants.
- Change in work scope, which affects the degree of contact with contaminants.

During the selection of PPE the Health and Safety Staff and UXOSO will also take into consideration the following factors:
- Limitations of the equipment.
- Work mission duration.
- Temperature extremes.
- Material flexibility.
- Durability/Integrity of the equipment.

12.2.1 Eye and Face Protection

All personnel will use appropriate eye or face protection when exposed to eye or face hazards from flying particles, liquid chemicals, or other eye hazards. All personnel will use eye protection that provides side protection when there is a hazard from flying objects. Detachable side protectors (e.g. clip-on or slide-on side shields) or goggles meeting the pertinent requirements of this section are acceptable. If there is a likelihood for glare, tinted safety glasses are recommended.

All personnel who wear prescription lenses while engaged in operations that involve eye hazards shall wear eye protection that incorporates the prescription in its design, or wear eye protection that can be worn over the prescription lenses without disturbing the proper position of the prescription lenses or the protective lenses.

Eye and face PPE shall be distinctly marked to facilitate the identification of the manufacturer. Protective eye and face devices will comply with ANSI Z87.1-1989, “American National Standard Practice for Occupational and Educational Eye and Face Protection,” which is incorporated by reference as specified in Sec. 1910.6.

12.2.2 Head Protection

When working in the vicinity of heavy equipment, as well as vegetation clearance equipment, hard hats will be worn. While there is not expected to be a danger of impact to the head due to falling or flying objects during other operations, it is recommended that personnel wear caps or some type of head covering for protection from the sun. Safety Vests/Hi-Vis outer torso garments shall also be required when working around Heavy Equipment.

12.2.3 Foot Protection

Due to the uneven working surfaces and potential for tripping hazards common to a worksite, all personnel shall wear sturdy leather, work boots with ankle support that rise about the ankle, and non-slip soles. Personnel using magnetometers for the detection of buried MEC will not wear steel-toe safety shoes, as they will affect the readings of the equipment. While working around heavy equipment, UXO personnel will wear steel or composite toe boots or slip-on toe caps.

12.2.4 Hand Protection

Employees will be required to use appropriate hand protection when employees' hands are exposed to hazards such as those from skin absorption of harmful substances; severe cuts or lacerations; severe abrasions; punctures; thermal burns; and harmful temperature extremes. For most operations on this site, leather gloves will provide adequate protection against minor cuts, which are a hazard in most site operations.

12.2.5 Hearing Protection

Hearing protectors will be available to all employees exposed to an 8-hour time-weighted average of 85 decibels (OSHA Action Level) or greater at no cost to the employees. Hearing protectors will be replaced as necessary. Hearing protection will be required for all personnel working in and around any operations likely to produce high noise levels, such as during the use of chain saws and weed whackers during thinning and pruning operations and when working in the vicinity of heavy equipment.

12.2.6 Emergency Equipment

Emergency equipment will be maintained on site for the duration of site operations. An approved, emergency first aid kit, and bloodborne pathogen kit, will be kept in each site vehicle. Portable eyewashes will be located in the work area and in the site vehicles. A 5-lb. ABC fire extinguishers will be kept in each site vehicle for emergency use on site. A Trauma First Aid Kit will be maintained in the UXOSO vehicle.

12.2.7 Upgrading/Downgrading PPE

If work tasks are added or amended after completion and approval of the APP, the SUXOS/UXOSO will conduct the task hazard assessment and consult with the Corporate Health and Safety Manager. The level and type of PPE to be used will be identified. The Corporate Health and Safety Manager will allow any changes in PPE, which involve downgrading of the level of PPE, only after review of documentation demonstrating that the conditions and/or potential for hazardous exposure are reduced enough to justify the downgrade.

12.2.8 General Requirements

All personal protective equipment will be provided, used, and maintained in a sanitary and reliable condition wherever it is necessary. PPE is required due to hazards of processes or environment, chemical hazards, or mechanical irritants encountered in a manner capable of causing injury or impairment in the function of any part of the body through absorption, inhalation, or physical contact. All PPE will be used in the manner for which it was designed. The assignment of PPE will be based upon hazard analysis, and the equipment will be selected based on its protection factor against site hazards.

12.2.9 Inspection

Each piece of PPE will be inspected daily prior to use. Defective or damaged personal protective equipment will not be used. It will be removed from service and turned in for repair or removed from the site for disposal and replaced with new PPE.

12.2.10 Training

Tetra Tech will provide training to each employee who is required by this section to use PPE. Each affected employee will demonstrate an understanding of the training, and the ability to use PPE properly, before being allowed to perform work requiring the use of PPE. Each such employee will be trained to know at least the following:

- The decisions and justifications used to select each piece of PPE.
- The nature of the hazards and the consequences of not using PPE.
- What PPE will be required to conduct each task.
- When PPE will be required during the performance of each task.
- How to properly don, doff, adjust and wear each piece of PPE.
- The proper inspection, cleaning, decontaminating, maintenance, and storage of each PPE item used.
- The limitations of the PPE.

All personnel receiving PPE training will be required to demonstrate an understanding of the training topics and the ability to correctly use the PPE. This will be accomplished through the UXOSO supervising and visually inspecting everyone’s ability to properly don and use the PPE during initial use of the PPE.

When the SUXOS or UXOSO has reason to believe any affected employee who has already been trained does not have the understanding and skill required he should retrain each such employee. Circumstances where retraining is required include, but are not limited to, situations where:

- Changes in the workplace render previous training obsolete; or
- Changes in the types of PPE to be used render previous training obsolete; or
- Inadequacies in an affected employee’s knowledge or use of assigned PPE indicate that the employee has not retained the requisite understanding or skill.

Upon completion of the training and after each employee has successfully demonstrated the requisite understanding, the SUXOS or UXOSO will complete the Documentation of Training form. This identifies: the employees who attended the training course and successfully demonstrated the required knowledge; the date(s) of the training and demonstration session(s); and the PPE covered by the training session.

12.2.11 Cleaning and Decontamination

The UXOSO will be responsible for ensuring that PPE is in good, clean, working order prior to issuing the PPE the first time. Once issued, site personnel will ensure that re-usable articles of PPE are maintained in a clean and sanitary fashion. For items used inside an EZ, site personnel will ensure that the PPE is properly decontaminated as appropriate before removing the item from the EZ or Contamination Reduction Zone (CRZ).

12.2.12 Maintenance

Maintenance of PPE can vary greatly, based upon the complexity of the PPE and the intricacy of the repair involved. The UXOSO will become familiar with the manufacturer's recommended maintenance and when possible repair defective PPE. If unable or unauthorized to conduct the repair, the UXOSO will return the item to the manufacturer for repair or procure a replacement.

12.2.13 Storage

PPE will be stored in a location, which is protected from the harmful effects of sunlight, damaging chemicals, moisture, extreme temperatures, impact or crushing. If needed, the SUXOS will designate a specified area for the storage of PPE.

12.3 LAYOUT PLANS

Layout plans for site support operations are being developed by DESC and APEX. Implementation of the plans is expected to be completed by DESC in conjunction with the remediation and project oversight contractors.

12.4 EMERGENCY RESPONSE PLANS

12.4.1 Procedures and Tests

The SUXOS and UXOSO will coordinate to perform the following pre-emergency tasks before starting field activities and during the mobilization and site-specific training phase of the project, and will coordinate emergency response with emergency medical technician (EMT)/police/fire/adjacent industry personnel or other emergency response personnel when appropriate:

- Locate telephone stations;
- Post emergency telephone numbers at accessible telephone locations;
- Inspect all emergency equipment and supplies to ensure they are in proper working order;
- Provide a site map marked with planned evacuation routes, assembly points, and emergency equipment and supplies;
- Provide a map with the route to the hospital marked and highlighted, with copies of this map posted in the office/break area, in the emergency evacuation vehicle, and all other site vehicles;
- Conduct an emergency response drill to test the effectiveness of the Emergency Response Contingency Plans (ERCP); and
- Review and revise the ERCP in the event of a failure of the plan in an actual or staged emergency, or when changes in site conditions or scope of work affect the ERCP.

Before normal activities are resumed, onsite personnel must be prepared and equipped to handle another emergency. These follow-up activities should be completed:

- The Corporate Health and Safety Manager will notify appropriate government agencies as required (Reminder: OSHA must be notified if there have been any fatalities or three or more hospitalizations).
- All equipment and supplies restocked, serviced, and inspected; and
- Review and revise all aspects of the Health and Safety Plan as necessary to address and prevent future emergencies of this type.

12.4.2 Spill Plans

In the event of a spill or leak of any potentially harmful material (regardless of quantity) on site personnel will:

- Notify the SUXOS immediately;
- The SUXOS shall notify the PM of the spill/leak with relative information (location, time, chemical identity, quantity, hazards listed on the SDS), and any corrective actions/measures taken;
- Locate the source and stop the leak/spill if it can be done safely (as dictated by the UXOSO);
- Begin containment and recovery of spilled material (as directed by the UXOSO), using appropriate PPE and spill clean-up equipment and materials; and
- Once notified, the PM will in turn, notify the DESC representative.

12.4.3 Firefighting Plans

The decision on whether or not to try to extinguish a fire using available site personnel and equipment will be made by the SUXOS and UXOSO and based on whether the fire is small, large or involves explosives.

12.4.4 Small Fires

A small fire is defined as a fire that can most likely be extinguished by site personnel using portable extinguishers. A small fire must also be free and clear of explosive materials, especially MEC. If a small fire occurs, the SUXOS or UXOSO will direct site personnel to perform the following, if safe to do so:

- Evacuate unnecessary personnel to an upwind position;
- Attempt to extinguish the fire using portable fire extinguishers or by smothering;
- Remove any essential or flammable items from the path of the fire; and
- Notify emergency response services (fire, police, ambulance, hospital, etc.) as needed.

If a fire extinguisher is used, this must be immediately reported to the SUXOS. The fire extinguisher must be immediately removed from service until it can be recharged. Another fire extinguisher must be made available to the operating area. The area around where the fire occurred must be watched for a minimum of 30 minutes after the fire has been extinguished to assure re-ignition does not occur. If personnel are not working in the area, the SUXOS should check the area of the fire periodically to assure re-ignition does not occur.

12.4.5 Large Fires

A large fire is defined as a fire, which due to its size, cannot be extinguished using portable fire extinguishers. In the event that a large fire occurs and the fire does not involve explosive materials, the SUXOS/UXOSO will direct personnel to conduct the following, if safe to do so:

- Evacuate all non-essential personnel from the site to an upwind location;
- Notify the Fire Department and other emergency response services (police, ambulance, hospital, etc.) as needed;
- Notify adjacent industries and neighbors;
- Call 911
- Alert any other subs/workers and adjacent bldg. occupants and remove what equipment/combustible material you can as everyone retreats and evacuates the area
- Remove any essential or flammable items from the path of the fire.

12.4.6 Fires Involving Explosive Materials

If a fire occurs which involves explosive materials such as chemicals, fuels, or MEC, the SUXOS will order the immediate evacuation of all site personnel to an upwind assembly point at least maximum fragmentation distance from the fire site. The SUXOS will then notify the Fire Department, adjacent industries, and any other emergency services (police, ambulance, hospital, etc.) as needed. At no time will field personnel fight a fire involving explosive materials, nor will they allow outside emergency personnel to do so. The Fire Department personnel may not enter any closer than maximum fragmentation distance from the fire and they may spray water to surrounding buildings, structures, etc. in order to prevent the spread of fire.

After the fire has burned itself out, the site must be barricaded, and entry prohibited until adequate cooling time has passed (at least 24 hours for a large fire). Explosive materials that may not have discharged during the fire may still be liable to function in the presence of extreme heat. After the site has cooled down, the SUXOS and UXOSO will inspect the site and conditions of any MEC involved in the fire and make a determination as to whether or not the site is safe for others to enter.

If non-UXO qualified personnel must enter the site for purposes of fire investigation, etc. they must receive a briefing on the potential hazards of MEC on the site. They must be accompanied at all times by a UXO-qualified employee. NO OUTSIDE PERSONNEL WILL BE PERMITTED ONTO THE SITE WHILE THERE IS A KNOWN MEC HAZARD PRESENT. If, during the course of the investigation, MEC is observed, the site will be evacuated of all non-UXO qualified personnel until the site can be rendered safe for re-entry.

12.4.7 Explosions

In the event of an accidental explosion, the SUXOS will order the evacuation of all site personnel to a safe, upwind assembly point at least fragmentation distance away. The SUXOS will then notify all necessary emergency response services. After an explosion has occurred, the site will remain barricaded a minimum of 30 minutes before entry is permitted if no smoke/burning is observed. If smoke or burning is observed, wait 60 minutes after smoke/burning has stopped. The SUXOS/UXOSO will enter the site with a team member and inspect for presence and condition of MEC. Non-UXO qualified personnel may not enter the area until all known MEC has been removed or destroyed. If non-UXO qualified personnel need to enter the site, they must first be briefed on the potential hazards of the site. They must be accompanied at all times by a UXO-qualified employee. If MEC is discovered during the course of their visit, they must immediately leave the site until it can be rendered safe for re-entry.

12.4.8 Posting of Emergency Telephone Numbers

<table>
<tr><th colspan="4">Emergency Response / Services</th></tr>
<tr><td colspan="3">Ambulance Service</td><td>911</td></tr>
<tr><td colspan="3">Emergency Medical Response</td><td>911</td></tr>
<tr><td colspan="3">Police*</td><td>911</td></tr>
<tr><td colspan="3">Police Department – Non emergency</td><td>803-545-3500</td></tr>
<tr><td colspan="3">CORE Injury Case Management</td><td>1 855-683-9006</td></tr>
<tr><td colspan="3">Hospital-Palmetto Health Richland
5 Richland Medical Park Dr
Columbia, SC 29203</td><td>803-434-7000 *
For Emergency Dial 911</td></tr>
<tr><td colspan="3">Fire Department*</td><td>911</td></tr>
<tr><td colspan="3">Fire Department – Non Emergency</td><td>803-545-3700</td></tr>
<tr><td colspan="3">National Poison Control Center</td><td>800-222-1222</td></tr>
<tr><td colspan="3">CHEMTREC (hazardous materials response)</td><td>800-424-9300</td></tr>
<tr><td colspan="3">National Response Team (hazardous materials response)</td><td>800-424-8802</td></tr>
<tr><td colspan="3">Centers for Disease Control (CDC)
http://www.cdc.gov/health/diseases</td><td>800-311-3435</td></tr>
<tr><th colspan="4">Project Management / Coordination</th></tr>
<tr><td colspan="4">Tetra Tech</td></tr>
<tr><td></td><td>Operating Unit President</td><td>Mark Dollar</td><td>970-206-4263</td></tr>
<tr><td></td><td>Project Manager</td><td>Scot Wilson</td><td>360-626-3193</td></tr>
<tr><td></td><td>Safety Manager</td><td>Jim Strieb</td><td>240-727-9240</td></tr>
<tr><td colspan="4">DESC</td></tr>
<tr><td></td><td>Project Manager</td><td>Rusty Contrael</td><td>412-721-6494</td></tr>
<tr><td colspan="4">APEX</td></tr>
<tr><td></td><td>Environmental Program Manager</td><td>William Zeli, P.E.</td><td>412-829-9650 x5004</td></tr>
<tr><td colspan="4"></td></tr>
<tr><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="4">Explosives Supplier</td></tr>
<tr><td></td><td>TBD</td><td>TBD</td><td>TBD</td></tr>
</table>

12.4.9 Wild Land Fire Prevention Plan

A Wild Land Fire Prevention Plan is not expected to be needed on this site. It is anticipated that heavy vegetation will be cut prior to beginning work that could result in an accidental fire, and therefore, excess vegetation that could contribute to a fire is not expected. However, fire extinguishers will be present at the job site and would be used to immediately put out any small fire that would start in the area, thereby preventing large fires from developing.

12.5 Man Overboard/Abandon Ship

Man Overboard/Abandon Ship plan can be found in the Diving Operations Plan for the CRP.

12.6 Hazard Communication Program

As part of the Hazard Communication Program, an SDS binder will be maintained onsite, which includes copies of SDSs for all hazardous materials brought onto the site. It will be kept in the site office during operations, and all site personnel will be made aware of the location. This SDS binder will be available on request to all site personnel during all working hours. If site workers have further questions about any of the hazardous materials they encounter, the Tetra Tech Corporate Health and Safety Manager will locate the required information and pass it on to the employee.

All employees who will be performing work involving the handling of hazardous materials will receive Hazard Communication training detailing the hazards of the product, appropriate protective measures to prevent exposure to the product, proper labeling of secondary containers, as well as safe procedures for storage and handling of the product, and response to emergencies. Personnel may request an SDS for any hazardous material on the site at any time. This training will occur as part of the initial mobilization training at the site and will be documented on the Documentation of Training Form.

12.7 Respiratory Protection Plan

Due to the type of work taking place, respirators are not expected to be required on this site. Should unforeseen hazards develop, which would require a respirator, the Tetra Tech Respiratory Protection Program would be followed.

12.8 Health Hazard Control Program

Due to the type of work that will be taking place on this project site, toxic, high hazard environments are not anticipated.

12.9 Lead Abatement Plan

As lead is not expected to be a contaminant on this site, a Lead Abatement Plan will not be required.

12.10 Asbestos Abatement Plan

As asbestos is not expected to be encountered on this site and therefore, an Asbestos Abatement Plan is not required.

12.11 Abrasive Blasting Plan

Abrasive blasting is not required on this project.

12.12 Excavation Plan

Work in an excavation area is not expected to exceed 48 inches in depth. To control and mitigate the hazards associated with working in and around excavation operations, the requirements outlined in USACE EM 385-1-1, Section 25 should be followed. If deeper excavations are required, sides of the excavations will be sloped at a ratio of at least 2 horizontal feet for every 1 vertical foot of excavation to protect workers from cave-ins and allow easy ingress and egress out of the excavated areas.
A Competent Person (CP) needs to be onsite and inspecting the excavations daily and anytime there is a change of condition with the excavation.

If confined space work becomes necessary, it will be accomplished in accordance with the Tetra Tech Confined Space Program.

12.13 Power Tool and Equipment Hazardous Energy Control Plan

The work on this project may require the use of power tools and excavation equipment that would require a Tool and Equipment Hazardous Energy Control Plan.

By their very nature, power tools and heavy equipment have the capability of inflicting serious injury upon site personnel if they are not used and maintained properly. To control the hazards associated with power tool and equipment operation, the requirements outlined in USACE EM 385-1-1, Section 12 and the safe work practices listed below shall be observed when using power tools and equipment:

- Operation will be conducted by authorized personnel familiar with the tool or equipment, its operation, and safety precautions.
- Power tools and equipment will be inspected prior to use, and defective equipment will be removed from service until repaired or replaced.
- Power tools and equipment designed to accommodate guards will have such guards properly in place prior to use.
- Loose fitting clothing or unrestrained long hair will not be permitted around moving parts of power tools or equipment.
- Hands, feet, etc. will be kept away from all moving parts.
- Maintenance and/or adjustments to equipment will not be conducted while it is in operation; the power will be locked out according to the Lock-Out/Tag-Out protocol in OSHA 29 CFR 1910.147 prior to maintenance activities.
- All maintenance activities will be performed by personnel experienced and authorized to make the repairs, or it will be sent to the manufacturer for repair.
- An adequate operating area will be provided, allowing sufficient clearance and access for operation.
- Good housekeeping practices will be followed at all times.
- Safety glasses with side shields, goggles, and face shields shall be worn at all times while operating power tools and equipment or when working in the vicinity of operating power tools and equipment.

12.14 Critical Lift Procedures

Crane operations are not anticipated on this project, so critical lift procedures will not be required. Non critical lifts will not be preformed by Tetra Tech or Tetra Tech's subcontractors.

12.15 Contingency Plan for Severe Weather

Rain, dust storms, floods, electrical storms, and tornadoes in this geographic area can constitute a safety hazard to field operations at the project site. The SUXOS and UXOSO will monitor the weather closely. If the area becomes so windy, wet, muddy, or slippery that an unacceptable level of risk exists for personnel who are working in proximity to MEC items, then MEC operations will cease until the SUXOS and UXOSO determine it to be safe to continue.

No MEC operations will take place if an electrical storm is within ten miles of the site. An electrical storm/Lightning monitor will be used to determine if an electrical storm is approaching. MEC operations will cease when an electrical storm is within ten miles of the site and will not resume again until the SUXOS determines that the electrical storm is at least ten miles past the site or 30 minutes since the last lightning strike or sound of thunder.

12.16 Access and Haul Road Plan

There are no plans to create access and haul roads for this project, so the Access and Haul Road Plan is not required.

12.17 Demolition Plan (Engineering and Asbestos Surveys)

As work on this plan does not involve the demolition of buildings containing asbestos-containing material, the Demolition Plan is not required.

12.18 Emergency Rescue (Tunneling)

As work on this project does not involve tunneling operations, this Emergency Rescue plan is not required.

12.19 Underground Construction Fire Prevention and Protection Plan

As underground construction is not required on this project, the Underground Construction Fire Prevention and Protection Plan is not required.

12.20 Compressed Air Plan

As there are no plans to use compressed air on this project, a Compressed Air Plan is not required.

12.21 Formwork and Shoring Erection and Removal Plans

As this project will not involve formwork and shoring erection and removal, this plan is not required.

12.22 Jacking Plan (Lift) Slab Plans

As there will be no Lift Slab work on this project, this plan is not required.

12.23 Blasting Plan

Recovered MEC/MPPEH will be destroyed by consolidated shot or BIP operation. A detailed description of the demolition operation (blasting plan) and procedures is given in Section 3.7 of the Work Plan and will be conducted IAW the ESP.

12.24 Diving Plan

Diving portions under this project are covered under a Dive Operations Plan.

12.25 Plan for Prevention of Alcohol and Drug Abuse

The use, sale, dispensing, possession, or manufacture of illegal drugs, alcohol, and narcotics on Tetra Tech premises or work sites is prohibited. Employees will be subject to disciplinary action, up to and including termination, for bringing illegal, non-prescribed drugs and narcotics or alcoholic beverages to the workplace; being under the influence of such substances while working; using such substances while at work; or dispensing, distributing, or illegally manufacturing or selling these substances on Tetra Tech premises and work sites.

If, in the judgment of Tetra Tech management, an employee's abuse of drugs, narcotics, or alcohol adversely affects his/her ability to perform the duties intended, that employee may be terminated for cause.

Any employee who notices another employee demonstrating unusual behavioral patterns that appear to be drug, narcotic, or alcohol-related must report the observed behavior to management.
Employees may be required to submit to a test, whenever reasonable cause exists, to determine the presence of drugs, narcotics, or alcohol unless the law prohibits such tests. Refusal to submit to testing constitutes grounds for termination of employment for cause. An employee judged to be under the influence of drugs, narcotics, or alcohol will be required to leave the premises. The Employee’s Supervisor will arrange to have the employee escorted home.

Drug screening will occur as part of the on boarding process and as deemed necessary. If the drug screen is positive for illegal drugs, the employee will not be permitted to work on the Tetra Tech project site.

An employee who is diagnosed as an alcohol or drug abuser may be terminated or required to take a leave of absence without pay to undergo rehabilitation. The employee will not be permitted to return to work until medical certification is presented as evidence that the employee is drug-free and capable of performing his/her duties. Failure to cooperate with an agreed-upon treatment plan may result in disciplinary action, up to and including termination.

The status of an employee on drug/alcohol rehabilitation leave-of-absence will be reviewed by management on a case-by-case basis. Absences extending beyond six months will require medical recertification. Employees on leave for more than one year will be considered for termination without prejudice.

If an employee is taking prescription drugs for a medical condition while under a doctor's care, the SUXOS should be made aware of the situation. The side effects of some medications can reduce alertness and judgment and may cause a potential safety hazard to the employee and/or others working in the vicinity, such as a heavy equipment operator becoming drowsy while operating equipment. In cases such as this, the SUXOS has the discretion to re-assign the individual to a less hazardous position on the site until the condition is cleared and medication is no longer required. If there are no other positions available on the site, which would be safe for the individual to perform, he may be placed on sick leave or leave without pay until the condition clears up and he is medically approved to resume work.

12.26 Fall Protection Plan

As work will be occurring at ground level and below, a Fall Protection Plan is not required. Excavations will be well marked with tape and/or barricades and personnel will be advised to stay away from the perimeter, as will the operators of the heavy equipment. Work will not occur during hours of darkness, when personnel might be less likely to see the excavation.

12.27 Steel Erection Plan

As no steel erection will be taking place by Tetra Tech on this project, this plan is not required.

12.28 Night Operations Lighting Plan

As there are no plans to operate during hours of darkness, there is no requirement for a Night Operations Lighting Plan.

12.29 Site Sanitation Plan

Adequate sanitation facilities will be provided at the work site to ensure proper personal hygiene. Site sanitation will be established and maintained IAW OSHA 29 CFR 1910.120(n).

Outlets and storage containers for non-potable water, such as water for firefighting or decontamination, will be clearly labeled to indicate that the water is not suitable for drinking, washing or cooking. There will at no time be a cross-connection or open potential between a system furnishing potable water and a system furnishing non-potable water. An adequate supply of potable (drinkable) water shall be provided on site at all times.

Permanent restroom facilities are located on the project site. If they are disabled for the season or otherwise not available, Tetra Tech will locate chemical toilets in the support zone (SZ), as required to support field personnel. Toilets will be appropriately maintained, vented, and will be capable of being locked from the inside. There will be at least one toilet for every 15 site personnel.

Hand and face washing facilities will be set up in the SZ of the work area; additionally, Hand Sanitizer and Sanitizer spray bottles will be provided. These will be utilized by all personnel exiting the EZ prior to eating, drinking, using tobacco or other hand to face activities.
Portable eyewash will be available in site vehicles and the office trailer.

12.30 Fire Prevention Plan

Fire Protection: Portable fire extinguishers are rated and classified with NUMERAL and LETTER designations, based on fire tests conducted by the Underwriters Laboratories, Inc. (UL) or other nationally recognized testing laboratories. The numeral rating indicates the relative extinguishing effectiveness of extinguishers classified for Class A and B fires only. The Letter classified coincides with the class of fire. Extinguishers found to be effective on more than one class of fire have multiple letter classifications. Example: B:C

The rating of hand-portable fire extinguishers is based on the following:

- Class A fire extinguisher is used for ordinary combustible materials.
- Class B fire extinguisher is for flammable liquids.
- Class C fire extinguisher is for electrical fires.
- Class D fire extinguisher is for combustible metal fires.

Many fires are small at origin and may be extinguished by the use of proper hand-portable fire extinguishers. The fire department will be notified as soon as fire is discovered. This alarm should not be delayed awaiting result of application of portable fire extinguishers.

Fire extinguishers can represent an important segment of any overall fire protection program. However, their successful functioning depends upon the following conditions having been met:

- The extinguisher is properly located and in working order.
- The extinguisher is of proper type for a fire, which may occur.
- The fire is discovered while still small enough for the extinguisher to be effective.
- The fire is discovered by a person ready, willing, and able to use the extinguisher.
- Class A fires can be readily extinguished by quenching-cooling with water or a water-mixture agent. Class B fires are more effectively extinguished by an agent that blankets-smothers the fire through exclusion of oxygen surrounding the fire area. Those extinguishers containing bromochlorodifluoromethane, monobromotrifluoromethane, carbon dioxide, or dry chemicals are generally best suited for extinguishing Class B fires. For Class C fires, the primary consideration in extinguishing this type of fire is the selection of a nonconductive extinguishing agent to prevent dangerous electrical shock and possible death to user.
- Water or water-mixture type extinguishing agent must not be used under any circumstances on energized electrical equipment (Class C) fires. Whenever possible, electrical equipment and circuits should be de-energized before attacking a Class C fire. Due to its corrosive nature, dry chemical is not recommended for use on computerized, electronic or other equipment with extensive circuitry.

Fire Prevention: In order to prevent fire from occurring in the first place, every step will be taken to keep the site neat and clean. All equipment and materials not in use will be put away in designated locations. There will be trash cans with lids at the site, which will be emptied on a daily basis to keep trash from accumulating. All flammable liquids will be stored in approved flammable UL or FM Approved Safety Cans in order to prevent spillage and ignition of the material. Bonding and grounding procedures will be in place whenever transferring flammable liquids from their designated containers and into equipment. Equipment will never be fueled in the back of a pick-up truck with a bed liner in it. Personnel handling explosive and/or flammable materials will wear cotton under and outer garments to prevent build-up and transfer of static electricity.

13.0 CONTRACTOR INFORMATION

Tetra Tech is the subcontractor on this project. This APP has been prepared by TITAN and revised by Tetra Tech based on Tetra Tech’s procedures. In addition, subcontract site personnel will be familiar with and will comply with project procedures and safety requirements.

14.0 HAZARD ANALYSIS

An activity hazard analysis (AHA) has been conducted and documented as outlined below for each activity warranted by the hazards associated with the activity. For this project, the following AHA have been prepared for all anticipated field operations:

- Site-Setup/Layout
- Surface Preparation/ Vegetation Removal
- Subsurface Clearance using “Mag & Dig” Methods
- Transportation of Explosives
- Disposal of MPPEH
- Mechanical Excavation (if required)

Should conditions, equipment, or types of operations change during the course of the project work, the Corporate Health and Safety Manager will review an updated existing AHA for continuing work or prepare a new one for new types of operations.

Risk management is and will continue to be integrated into the planning, preparation, and execution of work at the site. Risk management is a dynamic process, and is continuously improved upon, as personnel become more familiar with the site operations, equipment, environment, etc. Personnel are urged to continuously identify hazards and assess accident risks. Once identified, these hazards will be brought to the attention of the SUXOS/UXOSO. Control measures will be developed and coordinated. All personnel are responsible for continuously assessing variable hazards and implementing risk controls.

Activity Hazard Analysis

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Activity Hazard Analysis (AHA) #1

Any modifications to the approved AHA that results in a higher RAC than the approved AHA will also be reviewed by the SHM. The AHA will be maintained by the staff performing the work, under UXOSO oversight to keep it current to the work being performed and the hazards presented by the work as a living document.

<table>
<tr><td>Activity/Work Task: Mob/Demob and Site Setup/Layout</td><td colspan="5">Overall Risk Assessment Code (RAC) (Use highest code)</td><td>L</td></tr>
<tr><td>Project Location: Remedial Action at Congaree River Project</td><td colspan="6">Risk Assessment Code (RAC) Matrix</td></tr>
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In addition to the information listed in this AHA, all field personnel must review and be familiar with all provisions of the approved APP/SSHP. EM 385-1-1 will also be available on site for personnel to review specific materials and mitigation measures associated with this project. PPE for this AHA will consist of a hard hat (when overhead safety hazards exist), leather safety-toed boots, safety glasses with side shields, a standard work uniform (long pants, tee shirt), hearing protection (as required), work gloves worn when indicated, a Class 2 high-visibility safety vest, and other PPE described in this AHA.
First Aid-/CPR-Qualified Persons: TBD</td><td colspan="6">Step 1: Review each “Hazard” with identified safety “Controls” and determine RAC (see above).</td></tr>
<tr><td colspan="4">“Probability” is the likelihood to cause an incident, near miss, or accident and is identified as Frequent, Likely, Occasional, Seldom, or Unlikely.</td><td colspan="2">RAC Chart</td></tr>
<tr><td colspan="4" rowspan="2">“Severity” is the outcome/degree if an incident, near miss, or accident did occur and is identified as Catastrophic, Critical, Marginal, or Negligible.</td><td colspan="2">E = Extremely High Risk</td></tr>
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<tr><td colspan="4" rowspan="2">Step 2: Identify the RAC (Probability/Severity) as E, H, M, or L for each “Hazard” on the AHA. Annotate the overall highest RAC at the top of the AHA.</td><td colspan="2">M = Moderate Risk</td></tr>
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AHA #1 – Mob/Demob and Site Setup/Layout

Job Steps	Hazards	Controls	RAC
Mob/Demob and unloading and initial staging of materials and equipment in laydown areas.	Vehicle operations or unloading tasks could cause injury to personnel or others on site.	• Workers operating rental vehicles will have a valid state issued driver’s license and will be authorized by Tt to operate rental vehicles per corporate procedures. • Any Commercial Driver’s License truck and trailers will be operated by CDL qualified drivers who are vetted and authorized vendors. • Tt drivers will have completed a defensive driving course • Operate at safe speeds and obey traffic speeds and rules as instructed. • Wear seat belt at all times when vehicle is in operation. • Use parking brake when parked. Use chocks when parked on inclines. Use dedicated spotter and standard hand signals for backing operations.	L
	Ergonomic hazards such as sprains, strains, or back injury could occur from lifting or repetitive actions.	• Use mechanical lifting equipment or team lift when possible rather than by hand and tool methods. • Do not bend at the waist, bend at the knees. • Do not twist at the waist and turn while lifting. Keep the load centered and close to body. • Do not lift more than 40 pounds (May be lesser for some workers) alone. • Rotate tasks and take breaks when performing repetitive tasks and try to find the best position possible to perform the task.	L
	Slips, trips, and falls could lead to injuries.	• Keep work areas free of debris and equipment in work paths. • Follow good housekeeping in work areas. • Correct hazards when seen, such as holes or other trip hazards. • If they cannot be removed, they must be covered or marked.	L
	Handling sharp objects or using hand tools or knives could cause cuts, punctures, or scrapes.	• Wear leather work gloves when handling materials that may be sharp or have sharp edges. • Be familiar with the proper use and limitations of hand tools. • Report even minor injuries to your supervisor for evaluation. • Have a first aid kit available and have a minimum of 2 persons with first aid and CPR training onsite. • Never carry a knife in one’s pocket. • Ensure knives have retractable blades. • Cut away from the body.	L
	Workers could be exposed to heat or to a lesser degree, cold stress.	• UXOSO will monitor for heat or cold stress in accordance with SWP 5-15, Heat Illness prevention and SWP 5-16 General Safe work practices for cold stress.	L

AHA #1 – Mob/Demob and Site Setup/Layout

Job Steps	Hazards	Controls	RAC
		• All workers will be trained in heat (and cold) stress signs and symptoms and proper prevention measures and will employ the buddy system to watch for signs and symptoms in co-workers. • Provide fluids, rest breaks (in shade and/or airconditioned environment; (e.g., work trucks) will be taken during warm weather. • Dress appropriately for the outdoor conditions and be prepared for changes that can occur throughout the day. • Provide a steady controlled work pace. • New workers not used to working in high heat environment may require more acclimatization to site conditions and may be more susceptible to heat stress.	
	Contracting or spreading coronavirus.	• Stay within your social/work group. • Monitor yourself for coronavirus symptoms, if displaying symptoms do not leave your room and self-isolate. • Seek medical advice. • Maintain social distance. • Wear a face covering. • Wash hands regularly. • Site will display posters and information for COVID-19 mitigation measures.	L
	Eye injuries could occur from dust or debris.	• Wear safety glasses with side shields at all times when working onsite. • If something enters the eye, do not rub. Set up portable eye wash for flushing of eye to try to remove object. • Use the eye wash for the full 15-minutes, regardless if you feel that the object has been removed. • Notify supervisor so eye can be monitored. If object still irritates or stays in the eye, seek medical attention as soon as possible. • Follow up with eye exam is recommended any time an object gets into an eye since it is necessary to ensure object does not remain, even if it cannot be felt. • To keep dust down, travel at slower speeds on unpaved roads and laydown areas. • If required, water mist will be used to control dust.	L
	Noise from operations	• Hearing protection is required when sound levels exceed 84 dBA continuously. • This rule applies to personnel working near or any other sources of loud noise. • The UXOSO will monitor and post hearing protection required areas and activities.	L

AHA #1 – Mob/Demob and Site Setup/Layout

Job Steps	Hazards	Controls	RAC
	Fall hazards (falls from heights of 6 feet or greater)	• No person will climb upon any equipment, where there is exposure to a fall of 6 feet or greater unless proper guarding and rails is in place.	L
	Potential trips or falls	• Survey the site for any slip, trip, or fall hazards. • Either eliminate the hazard or mark the hazard so it can be avoided. • Use caution when walking around the site and wear sturdy leather work boots. • Maintain a clean and orderly work site and keep travel pathways free of obstacles.	L
	Contact with biting or stinging insects could occur; including bees, wasps, hornets, ticks, and spiders.	• Workers will apply DEET to work clothing following manufacturer’s instructions as a preventative measure for biting insects as required. • Workers with allergies will let the UXOSO know using the medical data sheet and will carry their own prescription medication as applicable. • First aid and medical attention as required. • Report all bites, stings, and rashes to UXOSO. • Avoid reaching blindly into areas, depressions, debris, etc.	L
	Electrical hazards could be present during tool use or during setup of and breakdown of equipment.	• Ensure that power cords are inspected and in good condition for use, that GFCIs are used properly, and portable generators are not overloaded. • Ensure any power tools used are in good working condition and have third prong on cord or are double insulated.	L

AHA #1 – Mob/Demob and Site Setup/Layout

Equipment to be Used	Training Requirements/Competent or Qualified Personnel Name(s)	Inspection Requirements
Site vehicles and delivery vehicles	Drivers must have driver’s license. Drivers of Tetra Tech’s rental vehicles must be authorized to drive the rental vehicle in accordance with Tetra Tech’s procedures.	Receipt inspection by Equipment Supervisor (UXOSO). Vehicle inspection by drivers. Operator’s manual for each vehicle must be located with the vehicle.
Hand and power tools	Training in use of hand and power tools by the UXOSO or designee and review of operating manual. Use proper hand tools.	Daily inspection by users/operators. Inspect tools and power cords to ensure they are listed by a NRTL. Inspect for damage to tool and to cords.
First aid kit, fire extinguisher, eye wash station	Use of emergency equipment including first aid kits, fire extinguishers and eye wash must be done by personnel familiar with this plan; use and inspection criteria of the equipment, and what the equipment is used for, are by or under direction of the UXOSO/SSHO.	Fire Extinguisher • Initially and at least monthly thereafter by UXOSO First Aid Kit • Weekly and after use for restocking by UXOSO Eye Wash Station • Weekly by UXOSO • Potable water changed weekly unless a preservative solution is used
PPE	Users must be trained in the proper use of, limitations of, inspection of, donning and doffing of, and replacement of PPE.	Daily by user

Abbreviations and Acronyms:

APP – Accident Prevention Plan
DEET – 33% diethyl-meta- toluamide
EHS – Environmental, Health, and Safety
GFCI – ground-fault circuit interrupter
MEC – Munitions and Explosives of Concern
NRTL – nationally recognized testing laboratory
OSHA – Occupational Safety and Health Administration
UXOSO – UXO Safety Officer
PPE – personal protective equipment
SSHP – Site Safety and Health Plan
UL – Underwriters Laboratory
UXO – unexploded ordnance

AHA Signature Sheet

I have reviewed the above AHA and acknowledge the hazards involved with this work task and the controls that will help to minimize illness or injury during the tasks.

NAME	SIGNATURE	TITLE	DATE
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Activity Hazard Analysis (AHA) #2

Any modifications to the approved AHA that results in a higher RAC than the approved AHA will also be reviewed by the SHM. The AHA will be maintained by the staff performing the work, under UXOSO oversight to keep it current to the work being performed and the hazards presented by the work as a living document.

<table>
<tr><td>Job/Task: Surface Preparation/Vegetation Removal</td><td colspan="5">Overall Risk Assessment Code (RAC) (Use highest code)</td><td>M</td></tr>
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In addition to the information listed in this AHA, all field personnel must review and be familiar with all provisions of the approved APP/SSHP. EM 385-1-1 will also be available on site for personnel to review specific materials and mitigation measures associated with this project. PPE for this AHA will consist of a hard hat (when overhead safety hazards exist), leather safety-toed boots, safety glasses with side shields, a standard work uniform (long pants, tee shirt), hearing protection (as required), work gloves worn when indicated, a Class 2 high-visibility safety vest, and other PPE described in this AHA.

First Aid-/CPR-Qualified Persons: TBD</td><td colspan="6">Step 1: Review each “Hazard” with identified safety “Controls” and determine RAC (See above)</td></tr>
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AHA #2 – Job/Task: Surface Preparation/Vegetation Removal

Job Steps	Hazards	Controls	RAC
Surface Preparation and vegetation removal with weed whackers and chainsaws.	Slip, trip and fall hazards when walking around the site and across uneven ground surface	• Determine the best access route before transporting equipment. • Wear slip resistant footwear with ankle support. Pay attention to footing and best path of travel to avoid tripping hazards. • Prohibit jumping from truck beds or raised platforms. • Be aware of rocks, brush, animal boroughs and other hazards. Choose firm ground for walking, if possible.	M
	Dehydration, heat stress, sunburn	• Drink a minimum of two liters of water per day. • Remain in shade whenever possible. • Wear sunscreen with sun protection factor of at least 45. • UXOSO will monitor for heat or cold stress in accordance with SWP 5-15, Heat Illness prevention and SWP 5-16 General Safe work practices for cold stress.	M
	Heavy lifting: Injury from physical exertion, sprains, strains, awkward bending/lifts, fatigue, and ergonomic hazards	• Use proper lifting techniques. • Assure solid footing. • Maintain good personal level of fitness. • Rotate people between operating the equipment • Be alert to signs and symptoms of overexertion. • Do not lift greater than 50 lbs.. • Use team lift whenever possible for awkward or heavy objects. • Limit repetitive awkward motions. • Take adequate work/rest periods based on personal limitations	M
	Contracting or spreading coronavirus.	• Stay within your social/work group. • Monitor yourself for coronavirus symptoms, if displaying symptoms do not leave your room and self-isolate. • Seek medical advice. • Maintain social distance. • Wear a face covering. • Wash hands regularly. • Site will display posters and information for COVID-19 mitigation measures.	L
	Exposure to poison ivy or oak if present in the area.	• As area is inspected, identify any “suspicious” vegetation that may be poisonous.	L

AHA #2 – Job/Task: Surface Preparation/Vegetation Removal			
Job Steps	**Hazards**	**Controls**	**RAC**
		• Mark these areas with warning tape or spray paint in preparation for vegetation clearance. • Avoid contact with these plants. • Wear long sleeve shirts and pants. • Wear disposable gloves • Wear an "ivy blocker" and have Technu® or Zanfel post-exposure washing agent available. • If removal of these plants is necessary, these plants need to be removed carefully to avoid spreading vegetation throughout the site or spraying plant debris on personnel or equipment. Also cutting tools that cut this vegetation need to be cleaned and handled carefully as the oils can remain on cutting surfaces. • Do not stockpile this vegetation with other vegetation that may be used as mulch in the future – it should be disposed of separately. Never burn this vegetation.	
	Adverse weather and lightning	• Monitor warnings or indications of severe weather conditions. • Follow site protocols established in SSHP as well as onsite direction and instruction from UXOSO • Take appropriate precautions to protect personnel and property. • Be aware of lightning, use the lightning 30/30 Rule: If it takes less than 30 seconds to hear thunder after seeing the flash, lightning is near enough to pose a threat; after the storm ends, wait 30 minutes before resuming work activities. • A 30-minute wait time will be observed from last strike before field activities resume. • All personnel will evacuate as directed by the UXOSO and as established in the APP/SSHP.	L
	Cold or heat stress and weather hazards	• Properly dress for the weather. • UXOSO to monitor weather and implement heat stress and cold stress controls in accordance with APP/SSHP. • Provide breaks for personnel to get either into cool or warm environment. Encourage a steady work pace. • Ensure adequate drinking water is available. • Know the signs and symptoms of exposure and keep an eye on your partner.	M
	Contact with biting or stinging insects and spiders could occur; contact with	• Workers will apply DEET to work clothing following manufacturer's instructions as a preventative measure for biting insects as required.	L

AHA #2 – Job/Task: Surface Preparation/Vegetation Removal

Job Steps	Hazards	Controls	RAC
	venomous snakes could occur	• Workers with allergies will let the UXOSO know using the medical data sheet and will carry their own prescription medication as applicable. • First aid and medical attention as required • Immediately report all bites, stings, and rashes to UXOSO Avoid reaching blindly into areas, depressions, debris, etc.	
	Potential to encounter debris on surface that could be MEC/MPPEH	• Survey team will consist of qualified UXO technicians. • Do not handle or remove debris. • Flag debris and avoid it.	L
	Chainsaws can cut or strike workers causing severe injuries if used improperly	• Qualified workers will be trained and experienced in the proper use of chainsaws and will operate the chainsaws as per manufacturer's recommendation. • All saws shall be equipped with a clutch, chain brake (gas only), throttle trigger latch, stop switch, rear hand guard, chain catcher, vibration damper, spark arrestor, and muffler. • Anti-kick teeth will be in place and chain guard mechanism in place. • Chainsaws will be industrial or professional grade and maintained per manufacturer's requirements. • Chain will be kept sharp and lubricated. • Inspect chainsaw before use. • Wear steel toe leather work boots, leather work gloves and leather chaps when working with chainsaws. • Do not operate chainsaw at or above shoulder height. For large limbs, begin limb reduction from the tip of the limb and move towards the tree trunk. • Prohibit standing on, straddling logs while ground cutting. • Stand uphill while ground cutting • The operator will hold the saw with both hands during all cutting operations. • Workers should not hold logs while being cut. • Stop saw motor to remove saw if pinched. Don't pull on saw. Bend open cut (i.e. wedge) until saw comes free. • Wedges and chisels shall be properly pointed and tempered. • Only wood, plastic, or soft metal wedges shall be used with power saws. • Gas-powered chainsaws shall be equipped with a control that will return the saw to idling speed when released.	L
	Refueling of saws could cause fires or spills.	• Ensure saws are turned off and allowed to cool before being refueled. • Do not overfill saws by ensuring a small size fuel can is used which the	L

AHA #2 – Job/Task: Surface Preparation/Vegetation Removal

Job Steps	Hazards	Controls	RAC
		worker can maintain good control over during refueling. • Place equipment on a spill pad for refueling. Visually inspect refueling point to ensure overfill is not done. • Do not fill to capacity; leave space for expansion in the tank. • Do not smoke in or near refueling areas. • Do not refuel in back of a pickup truck. • Have a 60:BC fire extinguisher present at the refueling site and ensure workers are trained in their use.	
	Eye injuries could occur from wood chips or debris.	• Workers will wear safety glasses and a face shield (mesh) when using chainsaws in addition to other PPE specified above. Wear safety glasses with side shields when working onsite. • If something enters the eye, do not rub. • Use client-supplied, onsite eye wash for the full 15-minutes, regardless if you feel that the object has been removed. • Notify supervisor so eye can be monitored. • If object still irritates or stays in the eye, seek medical attention as soon as possible. • Follow up with eye exam is recommended any time an object gets into an eye since it is necessary to ensure object does not remain, even if it cannot be felt. • To keep dust down, travel at slower speeds on unpaved roads	L
	Handling sharp objects, vegetation, or using hand tools or knives could cause cuts, punctures, or scrapes.	• Wear leather work gloves when handling materials that may be sharp or have sharp edges. • When removing limbs using saw, watch where you are going and do not walk backwards • Be familiar with the proper use and limitations of hand tools. • Report even minor injuries to your supervisor for evaluation. • Have a first aid kit available and have a minimum of 2 persons with first aid and CPR training onsite. • Never carry a knife in one’s pocket. • Ensure knives have retractable blades. • Cut away from the body.	L

AHA #2 – Job/Task: Surface Preparation/Vegetation Removal

Equipment to be Used	Training Requirements/Competent or Qualified Personnel Name(s)	Inspection Requirements
Site vehicles and delivery vehicles	Drivers must have current driver's license. Drivers of rental vehicles must be authorized to drive the rental vehicle in accordance with Tetra Tech procedures.	Receipt inspection by UXOSO or designee (as applicable). Vehicle inspection by drivers. Operator's manual for each vehicle must be located with the vehicle.
Hand and power tools	Training in use of hand and power tools by the, UXOSO or designee and review of operating manual. Use proper hand tools.	Daily inspection by users/operators. Inspect tools for damage to tool.
First aid kit, fire extinguisher, eye wash station	Use of emergency equipment including first aid kits, fire extinguishers and eye wash must be done by personnel familiar with this plan; use and inspection criteria of the equipment, and what the equipment is used for, are by or under direction of the UXOSO.	**Fire Extinguisher** • Initially and at least monthly thereafter by UXOSO **First Aid Kit** • Weekly and after use for restocking by UXOSO **Eye Wash Station** • Weekly by Tetra Tech UXOSO • Potable water changed weekly unless a preservative solution is used
PPE	Users must be trained in the proper use of, limitations of, inspection of, donning and doffing of, and replacement of PPE.	Daily by user

Abbreviations and Acronyms:

APP – Accident Prevention Plan
CPR – Cardio Pulmonary Resuscitation
DEET – 33% diethyl-meta-toluamide
GPS – Global Positioning System
MRS – Munitions Response Site
PPE – Personal Protective Equipment
RTK – Real-time Kinematic
SSHP – Site Safety and Health Plan
UXOSO – Unexploded Ordnance Safety Officer

AHA Signature Sheet

I have reviewed the above AHA and acknowledge the hazards involved with this work task and the controls that will help to minimize illness or injury during the tasks.

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Activity Hazard Analysis (AHA) #3

Any modifications to the approved AHA that results in a higher RAC than the approved AHA will also be reviewed by the SHM. The AHA will be maintained by the staff performing the work, under UXOSO oversight to keep it current to the work being performed and the hazards presented by the work as a living document.

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AHA #3 – Job/Task: Subsurface Clearance using "Mag & Dig" Methods			
Job Steps	**Hazards**	**Controls**	**RAC**
Establish exclusion zone (EZ) and support zone equipment as required by the site ESS. Remove nonessential personnel from within the EZ boundaries. Preform subsurface clearance	Encountering MEC/MPPEH – UXO may be present and can explode if handled improperly or is misidentified.	• All workers performing UXO-related activities will be qualified UXO technicians under supervision of the SUXOS. • All activities will be performed following standard operating procedures and requirements covered in the Work Plan and ESS. • UXO technicians will have refresher training on the key identification and safety precautions for anticipated conventional munitions which could be found on site.	M
	Non-essential workers or others could come into contact with or be affected by MEC/MPPEH.	• An exclusion zone (EZ) will be established in accordance with the requirements in the Work Plan and ESS. Only qualified UXO technicians will enter the EZ. • Monitor the EZ while work is underway so work can be stopped if any unauthorized personnel enter • Follow all applicable standard operating procedures in the Work Plan and ESS regarding surface clearance and MEC avoidance. • Only UXO technicians under the direct supervision of the SUXOS will handle MEC/MPPEH.	L
	Communication between teams and communication with team outside of range area in emergency – lack of proper or working communication.	• SUXOS and UXOSO will ensure that the UXO teams can communicate with each other and that a means of communication outside the range area are possible. • In addition, emergency services, in the event of an emergency must be possible so that someone can either call for or radio someone to call for emergency services. • UXOSO will verify that all coordination with emergency services has been performed prior to start of clearance activities and communications checks will be performed at start of work day and periodically during the work day.	L
	Hand excavation could cause injury to workers.	• Use probes prior to use of hand tools. • Intrusive work to be performed by UXO-qualified personnel only. • Wear leather work gloves when using tools and digging. • Use the pivot technique when digging soil. Do not twist at the waist. • Rotate digging staff as to allow others a break as required.	L
	Failure to locate and mark utilities (if present) could cause electrocution or damage to utilities.	• If the clearance area has potential utilities, all dig locations will undergo utility surveys, private locates, and geophysical verification and marking prior to intrusive investigation and clearance. • A dig permit may be required.	L

AHA #3 – Job/Task: Subsurface Clearance using "Mag & Dig" Methods

Job Steps	Hazards	Controls	RAC
		• If utilities are present, hand digging in the location of utilities will be required and utilities will be supported in an excavation as required.	
	Removal of debris can cause back strains if objects are heavy and/or awkward and repetitive.	• If object is slightly too heavy for one person, use team lift. • Rotate repetitive tasks amongst the team so as one person is not performing awkward tasks or lifting.	L
	Contracting or spreading coronavirus.	• Stay within your social/work group. • Monitor yourself for coronavirus symptoms, if displaying symptoms do not leave your room and self-isolate. • Seek medical advice. • Maintain social distance. • Wear a face covering. • Wash hands regularly. • Site will display posters and information for COVID-19 mitigation measures.	L
	Workers could be struck by lightning if storms are in the area.	• Follow the 30-second rule (time between lightning strike and thunder) for shutdown of operations, or as determined by the UXOSO. • Immediately suspend operations when lightning is in the immediate vicinity and seek shelter in a building (preferred) or vehicle. • Monitor the local weather report daily and as necessary for any severe weather warnings. • Wait 30 minutes after the last lightning strike before resuming work. • Don't use or be in contact with metal fixtures or telephone lines when inside structures.	L
	Noise from adjacent activities (e.g., airfield operations) could cause hearing loss and make it hard to communicate.	• Hearing protection is required when sound levels exceed 84 dBA continuously. • This rule applies to personnel working near or on heavy equipment and any other sources of loud noise. • The UXOSO will monitor and post hearing protection required areas and activities.	L
	Workers could experience extreme sunburn or eye strain.	• Workers will apply a broad-spectrum sunscreen to exposed skin and reapply as necessary throughout the day. • Workers are encouraged to wear a hat with a wide brim (when hardhat is not worn) to keep sun of head and long sleeve breathable UV-blocking shirts when necessary.	L

AHA #3 – Job/Task: Subsurface Clearance using "Mag & Dig" Methods			
Job Steps	**Hazards**	**Controls**	**RAC**
		• Safety glasses should have appropriate tint for working in an outdoor environment with strong UV exposure.	
	Workers could be exposed to heat or to a lesser degree, cold stress.	• UXOSO will monitor for heat or cold stress in accordance with SWP 5-15, Heat Illness prevention and SWP 5-16 General Safe work practices for cold stress. • All workers will be trained in heat (and cold) stress signs and symptoms and proper prevention measures and will employ the buddy system to watch for signs and symptoms in co-workers. • Provide fluids and rest breaks (in shade and/or air-conditioned environment (e.g., work trucks) will be taken during warm weather. • Dress appropriately for the outdoor conditions and be prepared for changes that can occur throughout the day. • Provide a steady controlled work pace.	L
	Contact with biting or stinging insects, scorpions, and spiders can cause rash, anaphylactic shock, or illness.	• Workers will apply DEET to work clothing following manufacturer's instructions as a preventative measure for biting insects as required. • Tuck in pant legs to socks and tuck in shirt to pants. • Wear long sleeves when necessary. • Examine one's body thoroughly for evidence of tick being attached. Follow steps in the APP for removal of tick. Report bite or rashes to UXOSO for appropriate medical follow up to ensure entire tick has been removed (including mouth parts). • Workers with allergies to bees, hornets, wasps, etc. are strongly encouraged to let the UXOSO know using the medical data sheet and will be advised to carry their own prescription medication as applicable. • First aid and medical attention as required. • Stings to allergic persons or signs and symptoms of anaphylaxis should be considered an emergency situation.	L
	Potential contact with venomous snakes.	• Review biological hazards section of the APP. Wear snake gaiters or chaps when working and walking in vegetated areas, if required. • Report any bites to the UXOSO immediately. • If venomous bite is suspected, emergency services will be contacted. If it is possible to identify the suspected species of snake, provide that information to the emergency medical staff. • Provide first aid as required (refer to APP).	L

AHA #3 – Job/Task: Subsurface Clearance using “Mag & Dig” Methods			
Job Steps	**Hazards**	**Controls**	**RAC**
		• Wear leather work gloves and use caution when pickup up, turning over, or handling debris. Do not blindly place hands into depressions, holes, under rocks or debris.	
	MEC/MPPEH is known and/or anticipated to be present and consists of UXO (including potential sub munitions) which presents an explosive hazard if improperly handled and/or misidentified.	• Only UXO technicians under the direct supervision of the SUXOS will handle MEC/MPPEH. Inspection of MPPEH will include positive identification of the item and if MEC/MPPEH, a determination on whether the MEC/MPPEH is acceptable to move or not. • All MEC/MPPEH (and debris that cannot be certified explosives free) will be accounted for at all times. • Do not handle ammunition and explosives roughly or carelessly. • Extra care should be taken because in most cases the hazards of the ammunition and/or explosives increase with age, deterioration, or damage. • Keep all spark- and flame-producing materials away from energetic materials.	M
	Excavating equipment could strike MEC/MPPEH and cause detonation.	• Proceed carefully with aid of geophysical equipment and hand digging to identify item and to avoid striking object. • Proceed carefully and in a controlled manner. • When equipment is moving an item, ensure non-essential personnel are removed per requirements and SOPs in the Work Plan and ESS.	L
	If MEC is found broken open, filler could be exposed and present an explosive hazard or chemical hazard to workers who touch filler or contaminated soil around the item.	• Notify the UXOSO/SSHO and SUXOS if a MEC items is broken open and filler is exposed. • Do not handle without leather work gloves and nitrile gloves underneath. • UXOSO/SSHO will ensure decontamination procedures are put into place appropriately, and ensure a hand washing station is available and used in the Contamination Reduction Zone. • Work upwind from any contamination when possible. • Control the generation of dusts during earth disturbing activities.	L

AHA #3 – Subsurface Clearance using "Mag & Dig" Methods

Equipment to be Used	Training Requirements/Competent or Qualified Personnel Name(s)	Inspection Requirements
Hand tools, shovels	Specific training for hand tools will be provided.	Inspect before each use. Discard defective tools.
Metals detector	Only qualified UXO Technicians and/or geophysical technicians trained on care, use, and limitations of instruments.	Receipt inspection by SUXOS. Daily inspection by UXO Technician (user). Geophysical verification at Instrumentation Verification Strip. Daily function checks.
First aid kit, fire extinguisher, eye wash station	Use of emergency equipment including first aid kits, fire extinguishers and eye wash must be done by personnel familiar with this plan; use and inspection criteria of the equipment, and what the equipment is used for, are by or under direction of the UXOSO/SSHO.	Fire Extinguisher • Initially and at least monthly thereafter by UXOSO First Aid Kit • Weekly and after use for restocking by UXOSO Eye Wash Station • Weekly by UXOSO • Potable water changed weekly unless a preservative solution is used
PPE	Users must be trained in the proper use of, limitations of, inspection of, donning and doffing of, and replacement of PPE.	Daily by user

Abbreviations and Acronyms:

APP – Accident Prevention Plan
DEET – 33% diethyl-meta-toluamide
EHS – Environmental, Health, and Safety
GFCI – ground-fault circuit interrupter
MEC – Munitions and Explosives of Concern
NRTL – nationally recognized testing laboratory
OSHA – Occupational Safety and Health Administration
UXOSO – UXO Safety Officer
PPE – personal protective equipment
SSHP – Site Safety and Health Plan
SS – Site Superintendent
UL – Underwriters Laboratory
UXO – unexploded ordnance

AHA Signature Sheet

I have reviewed the above AHA and acknowledge the hazards involved with this work task and the controls that will help to minimize illness or injury during the tasks.

NAME	SIGNATURE	TITLE	DATE
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Activity Hazard Analysis (AHA) #4

Any modifications to the approved AHA that results in a higher RAC than the approved AHA will also be reviewed by the SHM. The AHA will be maintained by the staff performing the work, under UXOSO oversight to keep it current to the work being performed and the hazards presented by the work as a living document.

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<tr><td>Job/Task: Disposal of MPPEH</td><td colspan="5">Overall Risk Assessment Code (RAC) (Use highest code)</td><td>M</td></tr>
<tr><td>Project Location: Remedial Action at the Congaree River Project</td><td colspan="6">Risk Assessment Code (RAC) Matrix</td></tr>
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<tr><td rowspan="6">Notes: (Field Notes, Review Comments, etc.)
In addition to the information listed in this AHA, all field personnel must review and be familiar with all provisions of the approved APP/SSHP. EM 385-1-1 will also be available on site for personnel to review specific materials and mitigation measures associated with this project. PPE for this AHA will consist of leather safety-toed boots, safety glasses with side shields, a standard work uniform (long pants, tee shirt), hearing protection (as required), work gloves worn when indicated, and other PPE described in this AHA.
First Aid-/CPR-Qualified Persons: TBD</td><td colspan="6">Step 1: Review each “Hazard” with identified safety “Controls” and determine RAC (See above)</td></tr>
<tr><td colspan="4">“Probability” is the likelihood to cause an incident, near miss, or accident and identified as: Frequent, Likely, Occasional, Seldom or Unlikely.</td><td colspan="2">RAC Chart</td></tr>
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AHA #4– Job/Task: Disposal of MPPEH

Job Steps	Hazards	Controls	RAC
• Establish EZ based on MEC item around disposal area. • Make required notifications of demolition/venting operations. • Retrieve donor explosives. • Set up demolition charges IAW procedures • Use engineering controls, if required, to reduce the fragment travel range. • Post sentries outside Fragmentation Zone on all access roads • Ensure sentries have a full view of demolition and access areas. • Contact sentries to ensure that no pedestrian traffic is in the vicinity • Evacuate demolition crew to a safe location • Demolition occurs. • Inspect demolition site to ensure that demolition/venting has been completed properly.	Slips, trips, and falls	• Visually inspect work areas eliminate slip, trip, and fall hazards if feasible. Keep work areas neat and orderly. • Always place supplies in areas away from normal foot traffic, and equipment and tools in a safe location that does not present a trip hazard. • Workers should not stand or walk on either equipment or supplies. • Load/unload on even terrain.	M
	MEC/MPPEH hazards	• On-site MEC/MPPEH training. • Establish and enforce Exclusion Zone (EZ) around operation. • Perform MEC/MPPEH and Anomaly avoidance procedures when selecting the location for the disposal site • All UXO Technicians are certified in accordance with DDESB TP-18. • Observe all MEC/MPPEH/UXO safety precautions, such as movement, heat, shock, and friction. • Do not handle MEC/MPPEH items unnecessarily. • There will be a primary and alternate means of communication. • Leave area immediately if hazardous conditions are observed. • Be alert. Cease operations if unsafe conditions arise. • Establish EZ and secure according to type of shot. • Maintain positive site control; cease operations if unauthorized entry is made. • Observe all MEC/MPPEH safety precautions, such as movement, heat, shock, and friction. • Do not handle MEC/MPPEH items unnecessarily. • Only UXO qualified personnel will perform demolitions operations. • Use engineering controls to reduce or eliminate fragmentation/ overpressure hazards.	M
	Fire hazards	• Observe safe work practices, operating precautions, and instructions for the equipment in use. • Do not allow smoking or flame-producing devices near explosives. • Wear static resistant clothing and long pants. • First Aid kits and fire extinguishers will be readily available.	M

AHA #4– Job/Task: Disposal of MPPEH

Job Steps	Hazards	Controls	RAC
	Strains and musculoskeletal injuries	• Direct personnel to use proper lifting techniques, such as keeping the back straight, lifting with the legs without twisting, and getting help when moving debris and equipment. • Do not self-lift more than 50 pounds.	M
	EMR/static electricity hazards	• Clothing, radios and cell phones will not be used in the area once the pit is primed or during the priming process, unless radios are at the firing point and the firing line is shunted.	L
	Workers could be struck by lightning if storms are in the area.	• Follow the 30-second rule (time between lightning strike and thunder) for shutdown of operations, or as determined by the UXOSO. • Immediately suspend operations when lightning is in the immediate vicinity and seek shelter in a building (preferred) or vehicle. • Monitor the local weather report daily and as necessary for any severe weather warnings. • Wait 30 minutes after the last lightning strike before resuming work. • Do not use or be in contact with metal fixtures or telephone lines when inside structures.	L
	Workers could be exposed to heat or to a lesser degree, cold stress.	• UXOSO will monitor for heat or cold stress in accordance with SWP 5-15, Heat Illness prevention and SWP 5-16 General Safe work practices for cold stress. • All workers will be trained in heat (and cold) stress signs and symptoms and proper prevention measures and will employ the buddy system to watch for signs and symptoms in co-workers. • Provide fluids and rest breaks (in shade and/or air-conditioned environment (e.g., work trucks) will be taken during warm weather. • Dress appropriately for the outdoor conditions and be prepared for changes that can occur throughout the day. • Provide a steady controlled work pace.	L
	Contracting or spreading coronavirus.	• Stay within your social/work group. • Monitor yourself for coronavirus symptoms, if displaying symptoms do not leave your room and self-isolate. • Seek medical advice. • Maintain social distance. • Wear a face covering. • Wash hands regularly. • Site will display posters and information for COVID-19 mitigation measures.	L

AHA #4– Job/Task: Disposal of MPPEH

Job Steps	Hazards	Controls	RAC
	Contact with biting or stinging insects, and spiders can cause rash, anaphylactic shock, or illness.	• Workers will apply DEET to work clothing following manufacturer’s instructions as a preventative measure for biting insects as required. • Tuck in pant legs to socks and tuck in shirt to pants. • Wear long sleeves when necessary. • Examine one’s body thoroughly for evidence of tick being attached. Follow steps in the APP for removal of tick. Report bite or rashes to UXOSO for appropriate medical follow up to ensure entire tick has been removed (including mouth parts). • Workers with allergies to bees, hornets, wasps, etc. are strongly encouraged to let the UXOSO know using the medical data sheet and will be advised to carry their own prescription medication as applicable. • First aid and medical attention as required. • Stings to allergic persons or signs and symptoms of anaphylaxis should be considered an emergency situation.	L

AHA #4 – Job/Task: Disposal of MPPEH

Equipment to be Used	Training Requirements/Competent or Qualified Personnel Name(s)	Inspection Requirements
Demolitions Equipment Explosives	• UXO personnel will meet training and experience requirements outlined in DDESB TP 18. • Site-specific MEC/MPPEH training will be conducted for all site personnel. • Member with CO state blaster's license on site. • Training in disposal operations for items expected to be encountered. • All site personnel will have current HAZWOPER training. All site personnel will review site-specific slip/fall hazards.	• UXOSO will ensure that all controls are being followed, all equipment is being correctly utilized, and all personnel have received appropriate training. • Equipment inspected daily prior to use by user and UXOSO.
Hand and power tools	• Training in use of hand and power tools by the SSHO or designee and review of operating manual. All site personnel will have training and use proper hand tool for the task.	• Daily inspection by users/operators. • Inspect tools and power cords to ensure they are listed by a NRTL. Inspect for damage to tool and to cords.
First aid kit, AED, fire extinguisher, eye wash station	Use of emergency equipment including first aid kits, fire extinguishers and eye wash must be done by personnel familiar with this plan; use and inspection criteria of the equipment, and what the equipment is used for, are by or under direction of the UXOSO. Those who supply first aid or use AED as first responders must have current first aid/CPR and AED training. AED users must be trained to use the specific AED that will be supplied onsite with hands-on training element.	Fire Extinguisher • Initially and at least monthly thereafter by UXOSO First Aid Kit and AED • Weekly and after use for restocking by UXOSO Eye Wash Station • Weekly by UXOSO • Potable water changed weekly unless a preservative solution is used

Abbreviations and Acronyms:

APP – Accident Prevention Plan
DEET – 33% diethyl-meta-toluamide
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Activity Hazard Analysis (AHA) #5

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AHA #5 – Job/Task: Mechanical Excavations (if needed)

Job Steps	Hazards	Controls	RAC
Operating heavy equipment to the location needing to be excavated, excavating soil, backfilling excavated soil, removal of equipment from location	Struck By/ Against Heavy Equipment	• Wear reflective warning vests when exposed to vehicular traffic • Isolate equipment swing areas • Make eye contact with operators before approaching equipment • Understand and review hand signals • Step away from equipment when bucket adjustments are made. • Do not attempt verbal communication in high noise backgrounds • Park equipment in areas where operator can see clearly to dismount equipment • Report minor incidents to site supervisor	M
	Construction equipment could cause injury to personnel	• Workers operating construction equipment will be qualified and designated operators. • Operate at safe speeds and obey local traffic speeds (max 20 mph) and facility rules. • Wear seat belt while seated. • Use dedicated spotter and standard hand signals for backing operations. • Construction equipment will have backup alarms installed. • Wear high visibility vests on ground • Stay out of swing radius of heavy equipment and make positive communication with the operator before entry into work zone.	M
	Slips, Trips, Falls	• Clear, walkways of equipment, vegetation, excavated material, tools and debris • Mark, identify, or barricade other obstructions • Exit equipment slowly and maintain three point contact • Clean boot soles before climbing on equipment	L
	Contracting or spreading coronavirus.	• Stay within your social/work group. • Monitor yourself for coronavirus symptoms, if displaying symptoms do not leave your room and self-isolate. • Seek medical advice. • Maintain social distance. • Wear a face covering. • Wash hands regularly. • Site will display posters and information for COVID-19 mitigation measures.	L
	Workers could be exposed to heat or to a lesser degree, cold stress.	• UXOSO will monitor for heat or cold stress in accordance with SWP 5-15 and SWP 5-16. • All workers will be trained in heat (and cold) stress signs and symptoms and proper prevention measures and will employ the buddy system to watch for signs and symptoms in co-workers.	L

AHA #5 – Job/Task: Mechanical Excavations (if needed)			
Job Steps	**Hazards**	**Controls**	**RAC**
		• Provide fluids and rest breaks (in shade and/or air conditioned environment (e.g., work trucks) will be taken during warm weather. • Dress appropriately for the outdoor conditions and be prepared for changes that can occur throughout the day. • Provide a steady controlled work pace.	
	Noise from operating heavy equipment and trommel	• Hearing protection is required when sound levels exceed 84 dBA continuously.	L
	Excavating equipment could strike MEC/MPPEH and cause detonation.	• Proceed carefully with aid of geophysical equipment and hand digging to identify item and to avoid striking object. • Proceed carefully and in a controlled manner. • When equipment is moving an item, ensure non-essential personnel are removed per requirements and SOPs in the Work Plan and ESS.	L
	Dust generation and excavation hazards (excavation depth is anticipated presently to be less than 5 feet and most excavations will be a maximum of 1 meter in depth).	• All excavation will be overseen by the designated excavation competent person (TBD). • The excavation competent person must inspect excavations on a daily basis or more frequently as required. • Excavations will be backfilled as soon as quality control and quality assurance is attained to verify removal of detected anomalies to depth of detection. • Spoil banks and equipment must be at least 2 feet away from the excavation. • Personnel must wear class 2 high-visibility clothing around operating heavy equipment. • Handle soil carefully to avoid dust generation. Use a fine spray of water to control dust as needed if visible dusts are being generated. • Competent person will conduct inspection of the excavation to identify the proper precautions are in place to protect workers based on soil types and other site-specific factors associated with the location.	L

AHA #5 – Job/Task: Mechanical Excavations (if needed)

Equipment to be Used	Training Requirements/Competent or Qualified Personnel Name(s)	Inspection Requirements
• Excavator • Trucks	• Daily equipment inspections as per manufacturers requirements Inspection of all emergency equipment (i.e.: first aid kits, fire extinguishers)	• Review AHA with all task personnel • Review Site Specific Health and Safety Plan. • Review operations/safety manuals for all equipment utilized Review site specific chemical hazards
Hand tools	Specific training for hand tools will be provided.	Daily and before use. Use the equipment safety checklist.
First aid kit, fire extinguisher, eye wash station	Use of emergency equipment including first aid kits, fire extinguishers and eye wash must be done by personnel familiar with this plan; use and inspection criteria of the equipment, and what the equipment is used for, are by or under direction of the UXOSO.	Fire Extinguisher • Initially and at least monthly thereafter by UXOSO First Aid Kit • Weekly and after use for restocking by UXOSO Eye Wash Station • Weekly by UXOSO • Potable water changed weekly unless a preservative solution is used

Abbreviations and Acronyms:

AHA – Activity Hazard Analysis
APP – Accident Prevention Plan
CIH – Certified Industrial Hygienist
DEET – 33% diethyl-meta-toluamide
EM – Engineer Manual
EZ – exclusion zone
MEC – munitions and explosives of concern
mph – miles per hour
MPPEH – material potentially presenting an explosives hazard
OSHA – Occupational Safety and Health Administration
PPE – personal protective equipment
RAC – Risk Assessment Code
UXO – unexploded ordnance
UXOSO – UXO Safety Officer

AHA Signature Sheet

I have reviewed the above AHA and acknowledge the hazards involved with this work task and the controls that will help to minimize illness or injury during the tasks.

NAME	SIGNATURE	TITLE	DATE
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15.0 SITE SAFETY AND HEALTH PLAN

The following procedures are attached and intended to address Site-Specific hazards and controls for the CRP project. The Site Description and History for this site are in Section 2.0 of the APP. AHA's are located in Section 14.

15.1 GENERAL SAFETY

Due to the nature of planned site operations, the potential risk for exposure to safety hazards is high. Anticipated safety hazards, which may be encountered during site activities, and precautions to be followed are listed below and in individual Activity Hazard Analyses, above.

15.2 Slips, Trips, and Fall Hazards

The project site is located between a river and a park area. Site conditions consist of light to moderate terrain and light brush, which make for the possibility of slips, trips, and fall hazards. Site personnel shall be instructed to make themselves aware of the placement of their feet at all times to avoid site conditions that attribute to slips, trips, and falls. As there will be some shallow excavation work taking place, site personnel will be instructed to stay at least two feet away from the edge of excavations. The use of sturdy leather work boots with ankle support and non-slip soles will reduce the risk of slips, trips and falls.

15.3 Cuts/Laceration Hazards

Power tools, MD surfaces, and other buried debris can be expected to have sharp and rusted surfaces. Project personnel should expect a high likelihood of cuts/lacerations if proper care is not taken. During all activities involving the handling of MEC, scrap, and site materials, personnel will wear leather work gloves to prevent injury to hands.

15.4 Pinched/Crushed Fingers and Toes

The weight of MEC items expected to be recovered and handled during the surface sweep and MEC inspection activities is expected to pose only a light to moderate hazard to fingers and toes. The mishandling of even light materials can cause injuries to site personnel. All site personnel are required to wear leather work boots and gloves while activities are being conducted. Personnel will utilize proper lifting techniques and, when appropriate, will use additional personnel or material handling equipment for heavy objects.

15.5 Hand Tool Operation

Use of improper or defective tools can contribute significantly to the occurrence of accidents on site. Therefore, the safe work practices listed below shall be observed when using hand tools:

- Hand tools will be inspected for defects prior to each use.
- Defective hand tools will be removed from service and repaired or discarded.
- Tools will be selected and used in the manner in which they were designed.
- Be sure of footing and grip before using any tool.
- Do not use tools that have split handles, mushroom heads, worn jaws, or other defects.

- Gloves will be worn whenever they increase gripping ability or if cut, laceration or puncture hazards may exist during the use of hand tools.
- Safety glasses with side shields, goggles, or a face shield will be used if tool use presents an eye/face hazard.
- Do not use makeshift tools or other improper tools.
- Use non-sparking tools where there are explosive vapors, gases, or residue.

15.6 Material Lifting

Many types of objects are handled in normal day-to-day operations. Care shall be taken in lifting and handling heavy or bulky items because they are the cause of many upper extremity and back injuries. The following fundamentals address the proper lifting of materials to avoid upper extremity and back injuries:

- The size, shape, and weight of the object to be lifted must be considered. Site personnel will not lift more than 50 lbs, or any uncomfortable weight, individually. The lift will otherwise be performed mechanically or with additional personnel.
- A firm grip on the object is essential; therefore, the hands and object shall be free of oil, grease, and water, which might prevent a firm grip.
- The hands and especially the fingers shall be kept away from any points that cause them to be pinched or crushed, especially when setting the object down.
- The item will be inspected for metal slivers, jagged edges, burrs, rough or slippery surfaces, and pinch points, and gloves will be used to protect the hands.
- The feet will be placed far enough apart for good balance and stability.
- Personnel will ensure that solid footing is available prior to lift the object.
- When lifting, get as close to the load as possible, bend the legs at the knees, making sure that the back is kept as straight as possible.
- To lift the object, the legs are straightened from their bending position.
- Never carry a load that cannot be seen over or around.
- When placing an object down, the stance and position are identical to that for lifting, with the back kept straight, the legs bent at the knees and the object lowered.
- If the item to be lifted is too large, bulky, or heavy for one person to safely lift, ask a co-worker for assistance. If a piece of material handling equipment is available that can do the job, use the equipment instead of trying to lift it yourself.
- When two or more people are required to handle an object, coordination is essential to ensure that the load is lifted uniformly and that the weight is equally divided between the individuals carrying the load. When carrying the object, each person, if possible, will face the direction in which the object is being carried.

15.7 Munitions and Explosives of Concern (MEC)

MEC may be present and located during CRP site activities. UXO qualified personnel will follow the requirements of the Tetra Tech Safety Program, EP 3851-97, and EM 385-1-1, which outline the safety and health precautions to be taken if MEC are encountered and/or destroyed. All non-UXO qualified personnel will follow the safe work practices listed below:

- Non-UXO qualified personnel will receive site-specific MEC recognition training prior to participation in site activities.

- No soil penetrating activities will be allowed without the area first being cleared by UXO-qualified personnel.
- Non-UXO qualified personnel will be escorted on site by UXO qualified personnel, until such time as the area is cleared.
- Once an area has been cleared and flagged, non-UXO qualified personnel may perform non-intrusive duties in the area unescorted but shall not leave the cleared area unescorted.
- Non-UXO qualified personnel will not touch or disturb any object, which could potentially be MEC, related, and will immediately notify the nearest UXO qualified person of the presence of the object.

Tetra Tech will establish an EZ based on the Hazardous Frag Distance of the Munition with the Greatest Fragmentation Distance (MGFD) for all CRP UXO operations other than MEC Disposal. For MEC Disposal Operations, the EZ will be based on the Maximum Frag Distance of the MGFD. If an unexpected hazardous MEC is located, a review of the MGFD may result in an adjustment to the size of the EZ. Tetra Tech will have control of the entrance to the project area until the area has been cleared. Should personnel not associated with the project operations need to enter the EZ in order to gain access to the area, all MEC operations will halt for the duration of time the person is within the EZ. Once they have departed the area, MEC operations may resume.

15.8 Chemical Hazards

Anticipated chemical hazards expected during CRP site activities include the TLM in the impacted sediments that will be removed from within the cofferdam areas. Use of proper PPE and other health and safety procedures established for this work will be followed to assure worker protection.

The anticipated chemical hazards expected during CRP site activities also include those fuels and oils brought on-site, for equipment maintenance. All site personnel will follow the procedures and precautions outlined in the appropriate SDS. The SDS binder will be kept in the site office and will be available to all employees on request. CWM procedures are outlined in Section 2.1 of this appendix but are not anticipated as necessary during this site operation.

15.9 Physical Hazards

For the planned site activities to be conducted, the potential for exposure to physical hazards is high. The physical hazards that may be encountered during site operations and precautions to be taken are addressed in the Activity Hazard Analysis in Section 14 of this appendix.

15.10 Flammable/Explosive Hazards from Fueling Equipment and Site Vehicles

The chance of fire and/or explosion during vehicle and equipment refueling and maintenance is high when improper procedures are used. All site vehicles will be equipped with a portable fire extinguisher readily available to fight a fire. Equipment will never be refueled on the back of a pick-up truck with a bed liner. Cellular phones will not be used around Flammable Liquids. Grounding and bonding procedures will be used during all fueling operations.

15.11 Noise Hazards

Protection against the effects of noise exposure shall be provided when the sound pressure levels exceed those shown below when measured on the A-scale of a standard sound level meter at slow response.

When employees are subjected to sound exceeding those listed in the following table, feasible administrative or engineering controls shall be utilized. If such controls fail to reduce sound levels to within these levels, personal protective equipment shall be provided and used to reduce sound levels within the levels of the table. If the variations in noise level involve maximal intervals of 1 second or less, it is to be considered continuous.

PERMISSIBLE NOISE EXPOSURES (1)	
Duration per Day, (Hours)	**Sound level dBA (Slow Response)**
8.00	90
6.00	92
4.00	95
3.00	97
2.00	100
1.50	102
1.00	105
0.50	110
0.25	115
Footnote (1). When the daily noise exposure is composed of two or more periods of noise exposure of different levels, their combined effect should be considered, rather than the individual effect of each. If the sum of the following fractions: C1./T1. + C2./T2. C(n)/T(n) exceeds unity, then, the mixed exposure should be considered to exceed the limit value. C(n) indicates the total time of exposure at a specified noise level, and T(n) indicates the total time of exposure permitted at that level. Exposure to impulsive or impact noise should not exceed 140 dB peak sound pressure level.	

Tetra Tech will make hearing protectors available to all employees exposed to an 8-hour time-weighted average of 85 decibels or greater at no cost to the employees. Hearing protectors will be replaced as necessary. Hearing protection will be required for all personnel working in and around any operations likely to produce high noise levels, such as during the use of chain saws and weed whackers during thinning and pruning operations and when working in the vicinity of heavy equipment.

15.12 Cold and Heat Stress

Due to the duration, location, and time of year of this project, there is a moderate probability of encountering extreme heat. Precautions for the prevention of cold stress are also provided for the possibility of unseasonable cold temperatures. For unseasonable cool temperatures, workers will dress in warm layered clothing to protect against low temperatures. Fluids will be available on site, and workers will be encouraged to drink frequently. If required for cold temperatures, workers will be given opportunities to warm up in heated facilities based on the ACGIH recommended Work-Warming Regimen.

15.13 Heat Stress

Heat stress is one of the most common (and potentially serious) illnesses that affect hazardous waste site workers. When site personnel are engaged in operations involving hot environments and/or the use of semi- or impermeable clothing, a number of physiological responses can occur which may seriously affect the health and safety of the workers. These affects can be eliminated or controlled through the use of a comprehensive heat stress prevention and monitoring program.

Level D PPE is being used at this site, so the heat stress program will be implemented if the ambient temperature exceeds 75°F according to the ACGIH Heat Stress Recommendations for unacclimatized workers.

Heat Stress Monitoring: Heat stress monitoring will be conducted using WBGT readings, in order to assure adequate work/rest cycles are implemented at the site if ambient dry-bulb temperatures exceed 75^{o}F. Pulse monitoring may also be used in addition to the WBGT readings, particularly during acclimatization, to assure workers are adapting to the conditions safely. Monitoring will be performed by the UXOSO, and results will be documented. Heat stress monitoring will be used to determine work-rest cycles to be implemented on site as referenced by the ACGIH TLV guidelines for Heat Stress.

Causes of Heat Stress

The most common cause of heat stress during site activities is the effect that PPE has on the body's natural cooling mechanism. Impermeable or semi-impermeable PPE interferes with the evaporation of perspiration and causes the body to retain metabolic and environmentally induced heat. Individuals will vary in their susceptibility and degree of response to the stress induced by increased body heat. Heat stress can result in health effects ranging from transient heat fatigue to serious illness or death. Heat stress is caused by a number of interacting factors including environmental condition, clothing, workload, and the individual characteristics of the worker. Because heat stress is probably one of the most common (and potentially serious) illnesses at hazardous waste sites, regular monitoring and other preventive precautions are vital.

Factors, which may predispose a worker to heat stress, include:

- Lack of physical fitness.
- Lack of acclimatization to hot environments.
- Degree of hydration.
- Level of obesity.
- Current health status (i.e., having an infection, chronic disease, diarrhea, etc.).
- Alcohol or drug use.
- The worker's age and sex.
- Sunburn.

Prior to initiating site activities each day, and periodically throughout the day, the UXOSO will inspect the site personnel for evidence of the previously mentioned factors to determine those personnel who are at increased risk for heat stress-related disorders. Evidence of extreme dehydration, illness, or drug or alcohol use may require the SUXOS or UXOSO to restrict the worker's activities until such time as the worker is fit for duty. Personnel identified as being at high risk for heat stress, who are allowed to participate in site operations, will be monitored frequently by the UXOSO throughout the day.

Heat Stress Disorders

This section outlines the major heat-related illnesses that may result from exposure to high heat environments and/or the use of semi- or impermeable clothing. For the purpose of this Program, reference to "liquids" will indicate the use of water or an electrolyte replacement solution, and not tea or coffee (unless it is decaffeinated) or carbonated soft drinks.

Heat Rash

Heat rash is caused by continuous exposure to heat and humid air and is aggravated by wet chafing clothes. This condition can decrease a worker's ability to tolerate hot environments.

Symptoms: Mild red rash, especially in areas of the body, which sweat heavily.

Treatment: Decrease the amount of time in protective gear and provide powder such as cornstarch or baby powder to help absorb moisture and decrease chafing. Maintain good personal hygiene standards and change into dry clothes if needed.

Heat Cramps

Heat cramps are caused by a profuse rate of perspiration that is not balanced by adequate fluid and electrolyte intake. The occurrence of heat-related cramps are often an indication that excessive water and electrolyte loss has occurred, which can further develop into heat exhaustion or heat stroke.

Symptoms: Acute, painful spasms of voluntary muscles such as the back, abdomen, and extremities.

Treatment: Remove victim to a cool area and loosen restrictive clothing. Stretch and massage affected muscles to increase blood flow to the area. Have the patient drink one to two cups of liquids immediately and every twenty minutes thereafter. Consult with a physician if the condition does not improve. If available, an electrolyte replacement solution should be taken along with liquids. For maximum benefit, this should be taken in at least a 2:1 ratio with at least two glasses of water to one glass of electrolyte replacement liquid.

Heat Exhaustion

Heat exhaustion is a state of very definite weakness or exhaustion caused by increased stress on various organs to meet increased demands to cool the body due to excessive loss of fluids from the body. This condition leads to inadequate blood supply and cardiac insufficiency. Heat exhaustion is less dangerous than heat stroke, but nonetheless must be treated. If allowed to go untreated, heat exhaustion can quickly develop into heatstroke.

Symptoms: Symptoms of heat exhaustion include pale or flushed, clammy, moist skin, profuse perspiration, and extreme weakness. The body’s temperature is basically normal or slightly elevated, the pulse is weak and rapid, and breathing is shallow. The individual may have a headache, be dizzy or nauseated.

Treatment: Remove the individual to a cool, air-conditioned place, loosen clothing, elevate feet and allow the individual to rest. Consult a physician, especially in severe cases. Have the patient drink one to two cups of liquids immediately, and every twenty minutes thereafter. Total liquid consumption should be about one to two gallons per day. If the signs and symptoms of heat exhaustion do not subside, or become more severe, immediate medical attention will be required.

Heat Stroke

Heatstroke is an acute and dangerous reaction to heat stress caused by a failure of the heat-regulating mechanisms of the body. The failure of the individual’s temperature control system causes the perspiration system to stop working correctly. When this occurs, the body core temperature rises very rapidly to a point (105+°F) where brain damage and death will result if the person is not cooled quickly.

Symptoms: The victim’s skin is hot, and may or may not be red and dry, (due to the fact that the individual may still be wet from having sweat while wearing protective clothing earlier), nausea, dizziness, confusion, extremely high body temperatures, rapid respiratory and pulse rate (PR), delirium, convulsions, unconsciousness or coma.

Treatment: Cool the victim immediately. If the body temperature is not brought down quickly, permanent brain damage or death may result. The victim should be moved to a shady area; lie down, and keep the head elevated. Gradually cool the victim by either sponging or immersing the victim in cool water to reduce the core temperature to a safe level (<102°F). If they are conscious, give the victim cool liquids to drink. Observe the victim and obtain immediate medical help. Do not give the victim caffeinated or alcoholic beverages. Heatstroke is considered a medical emergency. Medical emergency assistance must be summoned.

Heat Stress Preventive Measures

Proper training and preventive measures will help avert serious illness and loss of work productivity. Preventing heat stress is particularly important because once someone suffers from heat exhaustion, that person may become predisposed to additional heat injuries. In order to avoid heat-related illnesses, proper preventive measures will be implemented whenever environmental conditions dictate the need. These preventive measures represent the minimal steps to be taken and will include the following procedures:

- SUXOS or UXOSO will examine each site worker prior to the start of daily operations to determine the individuals susceptible to heat-induced stress. Workers exhibiting factors which make them susceptible to heat stress will be closely monitored by the UXOSO.
- Site workers will be trained to recognize and treat heat-related illnesses. This training will include the signs, symptoms, and treatment of heat stress disorders as outlined in this program.
- In order to maintain workers' body fluids at normal levels, workers will be encouraged to drink, as a minimum, approximately sixteen ounces of liquids prior to start of work in the morning, after lunch, and prior to leaving the site at the conclusion of the day's activities.
- Disposable four (4) to twelve (12) ounce cups and liquids will be provided on site.
- Acceptable liquids will include water and an electrolyte replacement solution, with the recommended intake being two cups of water for each cup of electrolyte replacement solution.
- Liquids containing caffeine are to be avoided.

When ambient conditions and site workload requirements dictate, as determined by the SUXOS, workers will be required to drink a minimum of sixteen (16) to thirty-two (32) ounces of liquids during each rest cycle. The normal thirst mechanism is not sensitive enough to ensure that enough water will be taken to replace lost sweat. When heavy sweating occurs, workers should be encouraged to drink even though they may not be thirsty. The following strategies may be useful in encouraging fluid intake:

- Maintain water temperature at 50°F to 60°F (10°C to 15.6°C).
- Provide small disposable cups that hold about 4 ounces (0.1 liter).
- Have workers drink 16 ounces (0.5 liters) of fluids (preferably water or dilute drinks) before beginning work.
- Urge workers to drink a cup or two every 15 to 20 minutes, or at each monitoring break. A total of 1 to 1.6 gallons (4 to 6 liters) of fluid per day are recommended, but more may be necessary to maintain body weight.

Monitoring of ambient or physiological heat stress indices will be conducted to allow prevention and/or early detection of heat-induced stress. Monitoring will be conducted IAW applicable paragraphs of this

Program. Site workers will be given time to acclimatize to site work conditions, temperature, and workload. Acclimatization usually takes about a week of continued work in hot environments, and allows the worker's body to become adjusted to this level and type of work. This process involves a gradual increase in the workload over the required period, the length of which depends upon the nature of the work performed, the ambient temperatures and the individual's susceptibility to heat stress. Work schedules will be adjusted as follows:

- Modify work/rest schedules according to monitoring requirements.
- Mandate work slowdowns as needed.
- Rotate personnel: alternate job functions to minimize overstress or overexertion at one task.
- Add additional personnel to work teams.
- Perform work during cooler hours of the day if possible or at night if adequate lighting can be provided.

Supplemental Preventive Measures

Workers will be encouraged to achieve and maintain an optimum level of physical fitness. Increased physical fitness will allow workers to better tolerate and respond to hot environments and heavy workloads. In comparison to an unfit person, a fit person will have a less physiological strain, a lower heart rate and body temperature, and a more efficient sweating mechanism.

Administrative Controls and Work Practices

Training is the key to good work practices. Unless all employees understand the reasons for new or changing old work practices, the chances of such a program succeeding are greatly reduced. The following will be discussed during the site-specific training and repeatedly as determined by the SUXOS or UXOSO:

- Knowledge of the hazards of heat stress;
- Recognition of predisposing factors, danger signs, and symptoms;
- Awareness of first-aid procedures for, and the potential health effects of, heatstroke;
- Employee responsibilities in avoiding heat stress;
- Dangers of using drugs, including therapeutic ones, and alcohol in hot work environments;
- Use of protective clothing and equipment;
- Purpose and coverage of environmental and medical surveillance programs and the advantages of worker participation in such programs; and
- Dietary effects on heat stress.

Because the incidence of heat stress depends on a variety of factors all workers, even those not wearing protective equipment, should be monitored. Initially, the frequency of physiological monitoring depends on the air temperature adjusted for solar radiation and the level of physical work (see Table 15.1). The length of the work cycle will be governed by the frequency of the required physiological monitoring.

For workers wearing permeable clothing (e.g., standard cotton or synthetic work clothes), recommendations for monitoring requirements and suggested work/rest schedules in the current ACGIH TLVs for Heat Stress shall be followed. If the actual clothing worn differs from the ACGIH standard ensemble in insulation value and/or wind and vapor permeability, change the monitoring requirements and work/rest schedules accordingly.

The goal of all heat stress monitoring is to ensure that the worker’s body temperature does not exceed 100.4°F. The physiological monitoring methods listed below are to be implemented based upon the severity of the heat and workload. As a minimum the UXOSO will perform WBGT monitoring. He may also choose to monitor the worker’s heart rate as an indication of potential heat stress. The frequency of physiological monitoring will be determined using the information presented in Table 15.1.

Heart Rate Monitoring

The worker’s baseline heart rate should be recorded prior to initiation of site activities by measuring the radial PR for thirty seconds. After each work cycle the heart rate should be measured by taking the PR for 30 seconds as early as possible into the resting period. Taking the radial (wrist) PR is the preferred method; however the carotid (neck) PR may be taken if a worker has difficulty finding the radial pulse. The PR at the beginning of the rest period should not exceed one hundred and ten (110) beats per minute (bpm). If the PR is higher than 110 bpm, the next work period should be shortened by thirty-three percent, while the length of the rest period stays the same. If the PR exceeds 110 bpm at the beginning of the next rest period, the work cycle should be further shortened by thirty-three percent. This procedure will be continued until the worker’s PR at the beginning of the rest cycle is maintained below 110 bpm.

Wet Bulb, Dry Globe Temperature (WBGT) Monitoring

For CRP site conditions where personnel are working in Level D PPE, and the ambient temperature is greater than 75°F, the UXOSO will conduct WBGT monitoring to assist in controlling the potential for site workers experiencing heat-related adverse health effects. The SUXOS will use WBGT monitor readings obtained from the monitoring equipment, and after estimating the workload, use the values expressed in Table 15.2, to determine the work/rest schedule to be implemented. The values outlined in this table are designed such that nearly all acclimatized, fully clothed workers with adequate salt and water intake will be able to function without the body temperature exceeding 100.4°F.

Acclimatization is the adaptive process that results in a decrease of the physiological response produced by the application of a constant environmental stress. On initial exposure to a hot environment, there is an impaired ability to work and evidence of physiological strain. If the exposure is repeated on several successive days, there is a gradual return of the ability to work and a decrease in physiological strain. Within 4 to 7 days following initiation of the acclimatization process, a dramatic improvement in the ability to perform work is noticed, subjective discomfort practically disappears, body temperature and heart rate are lower, there is a more stable blood pressure, and the sweat is more profuse and dilute.

Alcohol should not be consumed in a hot environment because the loss of body fluids increases the risk of heat stress.

Heat Stress Documentation

Should it be required due to site conditions, the UXOSO will be responsible for recording all heat stress-related information. This will include training sessions and monitoring data. Training sessions will be documented using the Documentation of Training Form. PR monitoring data will be recorded on the Heat Stress Monitoring Log, with the WBGT being recorded in the Site Safety Log and/or Site Monitoring Log.

Table 15.1
SUGGESTED FREQUENCY OF PHYSIOLOGICAL MONITORING FOR FIT AND ACCLIMATIZED WORKERS[a]

ADJUSTED TEMPERATURE	**NORMAL WORK ENSEMBLE**	**IMPERMEABLE ENSEMBLE**
90°F (32.2°C) or above	After each 45 minutes of work	After each 15 minutes of work
87.5°-90°F (30.8°-32.2°C)	After each 60 minutes of work	After each 30 minutes of work
82.5°-87.5°F (28.1°-28.1°C)	After each 90 minutes of work	After each 60 minutes of work
77.5°-82.5°F (25.3°-28.1°C)	After each 120 minutes of work	After each 90 minutes of work
75°-77.5°F (22.5°-25.3°C)	After each 150 minutes of work	After each 120 minutes of work

[a] For work levels of 250 kilocalories/hour.

[b] Calculate the adjusted air temperature (at adj) by using this equation: at adj °F = ta °F + (13 x % sunshine). Measure air temperature (at) with a standard mercury-in-glass thermometer, with the bulb shielded from radiant heat. Estimate percent sunshine by judging what percent time the sun is not covered by clouds that are thick enough to produce a shadow. (100 percent sunshine = no cloud cover and a sharp, distinct shadow; 0 percent sunshine = no shadows.)

[c] A normal work ensemble consists of cotton coveralls or other cotton clothing with long sleeves and pants.

Table 15.2
SCREENING CRITERIA WBGT HEAT EXPOSURE THRESHOLD LIMIT VALUES

Work - Rest Regimen	**WORKLOAD**		
	Light*	**Moderate**	**Heavy**
Continuous work	(29.5)	(27.5)	(26.0)
75% Work - 25% Rest, each hour	(30.5)	(28.5)	(27.5)
50% Work - 50% Rest, each hour	(31.5)	(29.5)	(28.5)
25% Work - 75% Rest, each hour	(32.5)	(31.0)	(30.0)

Consult the ACGIH TLV booklet for definitions of Light, Moderate, and Heavy workloads. Values are given in (^{0}C) WBGT and are intended for workers wearing single-layer summer type clothing. Use of semi or totally impermeable clothing requires monitoring IAW the Tetra Tech Heat Stress Prevention Program. As workload increases, the heat stress impact on a non-acclimated worker is exacerbated. For non-acclimatized workers performing a moderate level of work, the permissible heat exposure TLV should be reduced by approximately 2.5^{0}C.

15.14 Ionizing Radiation Hazards

Ionizing radiation is not expected to be an issue on this project site.

15.15 Biological Hazards

Biological hazards, which are usually found on site, include insects, such as ticks, spiders, poisonous snakes and hazardous plants. Employee awareness and the safe work practices outlined in the following sections should be followed to reduce the risk associated with these hazards.

15.16 Hazardous Plants

During the conduct of CRP site activities, the number and variety of plants that may be encountered is large and extensive. However, the plants presenting the greatest degree of risk to site personnel (i.e. potential for contact vs. effect produced) are those, which produce skin reactions and skin and tissue injury.

15.17 Plants Causing Skin and Tissue Injury

Contact with splinters, thorns, and sharp leaf edges is of special concern to site personnel, as is the contact with the pointed surfaces found on branches, limbs, and small trunks. This concern stems from the fact that punctures, cuts, and even minor scrapes caused by accidental contact may result in non-infectious skin lesions, and the introduction of fungi or bacteria through the skin or eye. Personnel receiving any of the injuries listed above, even minor scrapes, will report immediately to the UXOSO for initial and continued observation and care of the injury.

15.18 Plants Causing Skin Reactions

The poisonous plants of greatest concern are poison ivy, poison sumac, and poison oak. Both poison ivy and poison oak thrive in all types of light and usually grow in the form of a trailing vine; however, it can also grow as a bush and can attain heights of 10 feet or more. Poison ivy has shiny pointed leaves that grow in clusters of three. Poison oak can have shiny or dull, pointed leaves that grow in clusters of three. Poison oak leaves are more rounded rather than jagged, and the underside of poison oak leaves are covered with hair. Poison sumac has smooth leaves, grows only in wetlands, and has 7-9 leaves per stem.

The skin reaction associated with contacting these plants is caused by the body’s allergic reaction to toxins contained in oils produced by the plant. Becoming contaminated with the oils does not require contact with just the leaves. Contamination can be achieved through contact with other parts of the plant such as the branches, stems, or berries, or contact with contaminated items such as tools and clothing. The allergic reaction associated with exposure to these plants will generally cause the following signs and symptoms:

- Blistering at the site of contact, usually occurring within 12 to 48 hours after contact.
- Reddening, swelling, itching and burning at the site of contact.
- Pain, if the reaction is severe.
- Conjunctivitis, asthma, and other allergic reactions if the person is extremely sensitive to the poisonous plant toxin.

If the rash is scratched, secondary infections can occur. The rash usually disappears in 1 to 2 weeks in cases of mild exposure and up to 3 weeks when exposure is severe. Preventive measures, which can prove effective for most site personnel are:

- Avoid contact with any poisonous plants on site and keep a steady watch to identify report, and mark poisonous plants found on site.
- Wash hands, face, or other exposed areas at the beginning of each break period and at the end of each workday.
- Avoid contact with, and wash on a daily basis, contaminated tools, equipment, and clothing.
- Barrier creams, detoxification/wash solutions and orally administered desensitization may prove effective and should be tried to find the best preventive solution.
- Keeping the skin covered as much as possible (i.e., long pants and long sleeved shirts) in areas where these plants are known to exist will limit much of the potential exposure.
- If burning of these plants occurs, make sure personnel are located upwind of the smoke, as inhalation of the smoke or contact with airborne particles from these plants can still cause a reaction to occur.

15.19 Snakes

When site activities are conducted in warm weather on sites that are located in wooded, grassy or rocky environments, the potential for contact with venomous snakes becomes a very real danger. There are 38 snake species in South Carolina, only six of which are venomous. These are Copperhead, Coral Snake, Cottonmouth, Pigmy Rattlesnake, Eastern Diamondback Rattlesnake, and Timber Rattlesnake. Normally, if a person is approaching a snake, the noise created by the person is usually sufficient to frighten the snake off. However, during the warm months, extreme caution must be exercised when conducting site operations around areas where snakes might be found (i.e. rocks, bushes, logs, or in holes, crevices, and abandoned pipes). If venomous snakes are identified on the CRP site, Tetra Tech will issue protective clothing, such as snake leggings, to site personnel. The rules to follow if a snake bites someone are:

- DO NOT cut “Xs” over the bite area, as this will intensify the effect of the venom.
- DO NOT apply suction to the wound since this has minimal effectiveness in removing venom.
- DO NOT apply a tourniquet since this will concentrate the venom and increase the amount of tissue damage in the immediate area.
- If possible, try to get a good look at the snake so it can be identified for proper selection of anti-venom.
- DO NOT allow the victim to run for help since running increases the heart rate and will increase the spread of the venom throughout the body.
- Keep the victim calm and immobile.
- Have the victim hold the affected extremity lower than the heart while waiting for medical assistance. Do not delay evacuation.

- Transport the victim to medical attention immediately.

15.20 Tick Bites

The Centers for Disease Control (CDC) has noted the increase of Lyme Disease and Rocky Mountain Spotted Fever (RMSF) which are caused by bites from infected ticks in and near wooded areas, tall grass, and brush. Ticks are small, ranging from the size of a comma up to about one-quarter inch. They are sometimes difficult to see. The tick season extends from spring through summer. When embedded in the skin, they may look like a freckle.

Lyme disease has occurred in 43 states, with the heaviest concentrations in the Northeast, the upper Midwest, and along the northern California coast. It is caused by deer ticks and the lone star ticks, which have become infected with spirochetes. Female deer ticks are about one-quarter inch in size and are black and brick red in color. Male deer ticks are smaller, and completely black. Lone star ticks are larger and chestnut brown in color.

Rocky Mountain Spotted Fever has occurred in 36 states, with the heaviest concentrations in Oklahoma, North Carolina, South Carolina, Texas, and Virginia. It is caused by Rocky Mountain wood ticks, and dog ticks which have become infected with rickettsia. Both are black in color.

Symptoms: The first symptoms of either disease are flu-like chills, fever, headache, dizziness, fatigue, stiff neck, and bone pain. If immediately treated by a physician, most individuals recover fully in a short period of time. If not treated, more serious symptoms can occur.

If you believe a tick has bitten you, or if any of the signs and symptoms noted above appear, contact the UXOSO, who will authorize you to visit a physician for an examination and possible treatment.

Protective Measures: Standard field gear (work boots, socks, and light-colored coveralls) provides good protection against tick bites, particularly if the joints are taped. Light-colored coveralls allow easier identification of ticks on clothing. However, even when wearing field gear, the following precautions shall be taken when working in areas that might be infested with ticks:

- When in the field, check yourself often for ticks, particularly on your lower legs and areas covered with hair.
- Spray outer clothing, particularly your pant legs and socks, BUT NOT YOUR SKIN, with an insect repellent that contains permethrin or permanone. Apply Deet (vapor-active repellent) to any exposed skin surface (except eyes and lips), and apply permethrin repellent spray to field clothing. Allow the permethrin to dry before using treated clothing. The repellent system, Deet and permethrin, offer maximum protection.
- When walking in wooded areas, wear a hat, and avoid contact with bushes, tall grass, or brush as much as possible.
- If you find a tick, remove it by pulling on it gently with tweezers.
- If the tick resists, cover the tick with salad oil for about 15 minutes to asphyxiate it, then remove it with tweezers.
- DO NOT use matches, a lit cigarette, nail polish, or any other type of chemical to “coax” the tick out.

- Be sure to remove all parts of the tick's body and disinfect the area with alcohol or a similar antiseptic after removal.
- For several days to several weeks after removal of the tick, look for the signs of the onset of Lyme disease, such as a rash that looks like a bulls-eye or an expanding red circle surrounding a light area, frequently seen with a small welt in the center.
- Also look for the signs of the onset of RMSF, such as an inflammation which is visible in the form of a rash comprising many red spots under the skin, which appears 3 to 10 days after the tick bite.

15.20 Bees, Hornets and Wasps

Contact with stinging insects like bees, hornets, and wasps may result in site personnel experiencing adverse health effects that range from being mildly uncomfortable to being life-threatening. Therefore, stinging insects present a serious hazard to site personnel, and extreme caution must be exercised whenever site and weather conditions increase the risk of encountering stinging insects. Some of the factors related to stinging insects that increase the degree of risk associated with accidental contact are as follows:

- The nests for these insects are frequently found in remote wooded or grassy areas.
- The nests can be situated in trees, rocks, and bushes or in the ground, and are usually difficult to see.
- Accidental contact with these insects is highly probable, especially during warm weather conditions when the insects are most active.
- If a site worker accidentally disturbs a nest, the worker may be inflicted with multiple stings, causing extreme pain and swelling, which can leave the worker incapacitated and in need of medical attention.
- Some people are hypersensitive to the toxins injected by a sting, and when stung, experience a violent and immediate allergic reaction resulting in a life-threatening condition known as anaphylactic shock.
- Anaphylactic shock manifests itself very rapidly and is characterized by extreme swelling of the body, eyes, face, mouth, and respiratory passages.
- The hypersensitivity needed to cause anaphylactic shock, can in some people, accumulate over time and exposure, therefore even if someone has been stung previously, and not experienced an allergic reaction, there is no guarantee that they will not have an allergic reaction if they are stung again.

With these things in mind, and with the high probability of contact with stinging insects, all site personnel will comply with the following safe work practices:

- If a worker knows that he is hypersensitive to bee, wasp, or hornet stings, he must inform the UXOSO of this condition prior to participation in site activities.
- All site personnel will be watchful for the presence of stinging insects and their nests and will advise the UXOSO if a stinging insect nest is located or suspected in the area.
- Any nests located on site will be flagged off, and site personnel will be notified of its presence.
- If stung, site personnel will immediately report to the UXOSO to obtain first aid treatment

and to allow the UXOSO to observe them for signs of allergic reaction. If a breathing emergency (anaphylactic shock) occurs as a result of the sting, immediately call 911.
- Site personnel with a known hypersensitivity to stinging insects will keep required emergency medication on or near their person at all times, and will let the SUXOS, UXOSO, and co-workers know where it is kept.

15.21 Spiders

A large variety of spiders may be encountered during CRP site activities. While most spider bites merely cause localized pain, swelling, reddening, and in some cases, tissue damage, there are a few spiders that, due to the severity of the physiological effects caused by their venom, are dangerous. These species include the black widow and the brown or violin spiders.

The black widow is a coal-black bulbous spider about ¾-inch in length, with a bright red hourglass on the underside of the abdomen. The black widow is usually found in dark moist locations, especially under rocks, rotting logs, and may even be found in outdoor toilets where they inhabit the underside of the seat. Victims of a black widow bite may exhibit the following signs or symptoms:

- Sensation of pinprick or minor burning at the time of the bite.
- Appearance of small punctures (but sometimes none are visible).
- After 15 to 60 minutes, intense pain is felt at the site of the bite which spreads quickly, and is followed by profuse sweating, rigid abdominal muscles, muscle spasms, breathing difficulty, slurred speech, poor coordination, dilated pupils and generalized swelling of face and extremities.

The brown recluse or violin spider is brownish to tan in color, rather flat, about 5/8-inch long with a dark brown "violin" shape on the top. Of the brown spider, there are three varieties found in the United States, which present a problem to site personnel. These are the brown recluse, the desert violin, and the Arizona violin. These spiders may be found in a variety of locations, including trees, rocks, or in dark locations. Victims of a brown or violin spider bite may exhibit the following signs or symptoms:

- Blistering at the site of the bite, followed by a local burning at the site 30 to 60 minutes after the bite.
- Formation of a large, red, swollen, postulating lesion with a bull's-eye appearance.
- Systemic affects may include a generalized rash, joint pain, chills, fever, nausea, and vomiting.
- Pain may become severe after 8 hours, with the onset of tissue necrosis.

There is no effective first aid treatment for either of these bites. Except for very young, very old or weak victims, these spider bites are not considered to be life-threatening; however, medical treatment must be sought to reduce the extent of damage caused by the injected toxins.

Scorpions are stinging arachnids found over much of the United States. The two prodoment are the Southern Unstriped Scorpion and the Striped Southern Scorpion. All known scorpion species possess venom and use it primarily to kill or paralyze their prey so that it can be eaten; in general, it is fast-acting, allowing for effective prey capture. It is also used as a defense against predators. The venom is a mixture of compounds (neurotoxins, enzyme inhibitors, etc.) each not only causing a different effect, but possibly also targeting a specific animal. Each compound is made and stored in a pair of glandular sacs and is released in a quantity regulated by the scorpion itself. Of the 1000+ known species of scorpion, only 25 have venom that is dangerous to humans.

The SUXOS/UXOSO will brief site personnel as to the identification and avoidance of the spiders and scorpions. As with stinging insects, site personnel shall report to the SUXOS/UXOSO if they locate either of these spiders or scorpions on site or notice any type of bite or sting while involved in site activities.

15.22 Hazard Mitigation

The hazards listed above will be addressed through a combination of training, engineering controls, and personal protective equipment, with engineering controls as the method of preference, when feasible.

Implementation of Engineering Controls and Work Practices

Training for site procedures and the use of site equipment is instrumental in preventing accidents from occurring. Training in MEC recognition will be given to all site workers, and all will be watchful for MEC or pieces of MEC, which could be hazardous. When MEC or pieces of MEC are encountered, it is everyone’s duty to contact a UXO-qualified person to handle the situation. Other controls include the EZ, which will be used to keep unauthorized personnel out of the project site, and shielding material to protect the operators of heavy equipment.

Upgrades/Downgrades in Levels of Personal Protective Equipment

Due to the types of hazards at the CRP site, Level D PPE will be required. This type of PPE is used for levels of contamination that may present a nuisance, but not an identifiable hazard. This consists of a hard hat, safety glasses, hearing protection, leather work gloves, rubber over-boots, and non-steel-toed work boots to prevent interference with metal detectors. The hard hat will only be worn in head hazard areas, such as in the vicinity of the heavy equipment operations and during vegetation clearance operations. Rubber over-boots will only be worn over leather boots in watered areas. If hazards are encountered that are greater than estimated, the PPE level will be increased. This will be accomplished by the Corporate Health and Safety Manager, and the decision will be based on documented evidence of the hazards. If excessive dust levels near heavy equipment warrant via exposure monitoring, appropriate respiratory protection will be implemented IAW Tetra Tech’s corporate respiratory protection program. If the site is not as hazardous as originally anticipated, the level of PPE can be downgraded by the Corporate Health and Safety Staff. This decision would also be based on definitive data that demonstrates the conclusion that the PPE can be lessened. Normally to downgrade PPE would require at least one week’s worth of data, during consistent site operation, demonstrating that the site is not as hazardous as originally suspected. PPE levels will conform to Section 5 of EM 385-1-1.

Work Stoppage and/or Emergency Evacuation of On-Site Personnel

All personnel are trained to be constantly aware of their work environment. Anyone has the ability to stop operations for safety reasons. No worker is expected to perform any operation for which he has not been trained, or to perform any operation that is considered to be unsafe. After operations are stopped for safety reasons, the SUXOS and UXOSO will be notified, and they will evaluate the situation. The SUXOS will, in consultation with the Corporate Health and Safety Manager, determine what steps need to be taken to make the situation safe for operations to continue.

Emergency Evacuation

In the event of an emergency that requires evacuation of the site, verbal instruction will be given by the SUXOS to evacuate the area. Personnel will exit the area to the pre-designated assembly point, which will be the office trailer.

After evacuation, the SUXOS will account for all personnel, ascertain information about the emergency and advise responding onsite personnel. The SUXOS will contact, advise and coordinate with responding off-site emergency personnel if deemed necessary by the situation.

In all situations that require evacuation, personnel shall not re-enter the work area until:

- The conditions causing the emergency have been corrected;
- The hazard has been reassessed;
- The Site-Specific Safety and Health Plan has been revised and reviewed with onsite personnel, if needed; and
- Instructions have been given for authorized re-entry by the SUXOS.

Prevention and/or Minimization of Public Exposure to Hazards Created by Site Activities

Establishment and maintenance of an EZ create separation between the CRP site footprint and the general public acts as a safety cushion to protect the public against site hazards. Controlling access to the site, closing roads, signs, and barricades are all means of keeping the general public from accidentally wandering into the site during site operations. Training all site workers in the hazards of MEC will have more eyes looking for MEC. Any worker observing MEC or pieces of MEC will not touch or handle it in any way. He will inform a UXO-qualified Tetra Tech worker, who will then handle the situation. If unauthorized personnel are observed in the EZ, all MEC operations will cease until the area is cleared of unauthorized personnel.

16.0 STAFF ORGANIZATION, QUALIFICATIONS, AND RESPONSIBILITIES

Descriptions of qualifications and responsibilities of Safety Staff members are contained in Section 6.0 of the APP.

17.0 PERSONAL PROTECTION EQUIPMENT

PPE requirements are contained in Section 12.1 of the APP. PPE requirements will be reevaluated as appropriate per Section 12.1 and section 15.2 and will comply with Section 5 of EM 385-1-1.

18.0 MEDICAL SURVEILLANCE

Medical surveillance of Tetra Tech employees will be conducted IAW the requirements of OSHA 29 CFR 1910.120(f)(HAZWOPER), 29 CFR 1910.134(b)(10) (Respiratory Protection), and other established guidelines. Personnel to be included in the Medical Surveillance Program will be those who perform hazardous waste operations that may potentially expose the worker to hazardous substances or other significant safety and health threats. All Tetra Tech personnel on the project site will be part of the Tetra Tech Medical Surveillance Program. Visitors desiring entry into the EZ must be on their employer's Medical Surveillance Program and must have a current physician's statement prior to entry.

18.1 Baseline Health Assessment Physical or Bi/Annual Physical

A baseline health assessment physical or bi/annual physical will be conducted prior to participating in site operations, to determine the worker's ability to perform hazardous waste operations in a safe and healthful manner. The PM, in conjunction with the SUXOS and UXOSO, will ensure that all health assessments address the site-specific health hazards to which workers may be exposed.

Physicals will be scheduled through the services of a board-certified occupational medicine physician in the vicinity of the employee's home or job site. The designated physician will perform the medical assessments and review medical examination results to determine each worker's ability to perform his assigned hazardous waste duties. The physician will also be responsible for determining if supplemental or follow-up examinations are required and for maintaining medical and exposure records IAW OSHA 29 CFR 1910.120(d).

The purposes of the Medical Surveillance Program are to:

- Assess the individual's health status prior to participation in hazardous waste operations; determine the individual's ability to perform work assignments requiring the use of PPE and clothing;
- Establish baseline data for comparison to future medical data in order to provide a means of monitoring a worker's health status;
- Establish facilities and procedures for emergency and non-emergency medical treatment;
- Establish procedures for maintenance and storage of medical and exposure records.

18.2 Physician's Statement

The results of this examination will be made available to the employee, and a written physician's statement will be sent to Tetra Tech. A copy of the physician's statement will be kept in each employee's file at the project site for the duration of site operations. The physician's statement will include the following:

- The physician's opinion regarding any conditions which would place the employee at an increased risk from working in hazardous waste operations;
- The physician's recommended limitations upon the employee's assigned work, if any; and
- A statement that the employee has been informed by the physician of the results of the examination, and any conditions which may require further examination or treatment.

18.3 Supplemental Examination

Any site worker will undergo a supplemental examination if they have been:

- injured;
- received health impairment;
- developed signs or symptoms from possible over-exposure; or
- received a documented over-exposure without the use of respiratory protection.

The contents of this examination will be based upon the type of injury, illness, signs, or symptoms of exposure involved and will be determined by the physician. Prior to reassignment to site activities, the physician will certify that the employee is fit to return to work. If necessary, the physician will specify in writing any activity restrictions or additional tests, which may be required.

18.4 Follow-up Health Assessments

If, during any pre-assignment, annual or supplemental examination, a condition is detected which requires follow-up tests, the physician will notify Tetra Tech and the employee as to the nature of the follow-up health assessment. The physician will determine the schedule and content of the follow-up health assessment. A statement outlining the employee’s fitness for work will be provided to Tetra Tech and the employee upon the conclusion of the follow-up health assessment.

18.5 Emergency and Non-emergency Medical Treatment

The medical treatment facility for use at this project site will be:

Hospital-Palmetto Health Richland
5 Richland Medical Park Dr
Columbia, SC 29203(803) 434-7000 ** For Emergency Dial 911*

Directions to the hospital can be found at Section 11.0 of this Appendix.

18.6 Record Keeping

Tetra Tech will retain and maintain copies of all physician statements, exposure records, and associated information for all employees involved in hazardous waste operations. These records will be kept at the project files for the duration of site operations. When the site work is complete, the records will be retained by Tetra Techoccupational health provider. Examining physicians will be responsible for maintaining records related to laboratory and other tests for each employee examined. All records, whether maintained by Tetra Tech or by the examining physician, will be kept on file for a period of thirty (30) years beyond an employee’s termination OSHA 29 CFR 1910.1020(d).

18.7 Exposure Monitoring/Air Sampling Program

Once sampling is completed on the coal tar like substance this section will reviewed, but it is not expected to be any significant exposure to hazardous chemicals or excessive levels of dust at this site, exposure monitoring will not be required. As the workers on this site will normally be in Level D PPE, heat stress monitoring will be required if the temperature goes above 75°F. Should it be required, site monitoring data will be recorded using the Site Monitoring Log and will be maintained as part of the project record.

18.8 Dust Monitoring

Dust or particulates created during excavation operations may be a nuisance to operators and those working around the equipment but are not expected to exceed a permissible exposure level according to OSHA guidelines for total or respirable particulates. The team leaders will monitor the dust levels in the areas that their teams are working if airborne levels seem excessive.

18.9 Heat Stress Monitoring: Heat stress monitoring will be conducted using WBGT readings, in order to assure adequate work/rest cycles are implemented at the site if ambient dry-bulb temperatures exceed 75°F. Pulse monitoring may also be used in addition to the WBGT readings, particularly during acclimatization, to assure workers are adapting to the conditions safely. Monitoring will be performed by the UXOSO, and results will be documented. Heat stress monitoring will be used to determine work-rest cycles to be implemented on site as referenced by the ACGIH TLV guidelines detailed in Section 15 above.

18.10 Meteorological Monitoring

Rain and/or other weather conditions can constitute a safety hazard to field operations at this site. The SUXOS and UXOSO will monitor the weather closely. If the area becomes so wet, muddy, or slippery that an unacceptable level of risk exists for personnel who are working in proximity to MEC items, then MEC operations will cease until the SUXOS determines it to be safe to continue.

No MEC operations will take place if an electrical storm is within ten miles of the site. An electrical storm monitor will be used to determine if an electrical storm is approaching. MEC operations will cease when an electrical storm is within ten miles of the site, and will not resume again until the SUXOS determines that the electrical storm is at least ten miles past the site.

19.0 STANDARD OPERATING SAFETY PROCEDURES, ENGINEERING CONTROLS AND WORK PRACTICES

Using common sense and following safe practices can reduce hazards due to normal site activities. Personnel must keep the prudent guidelines listed below in mind when conducting field activities.

- Hazard assessment is a continuous process. Personnel must be aware of their surroundings and constantly be aware of the MEC, chemical, and physical hazards that are or may be present.
- The number of personnel in the EZ will be the minimum number necessary to perform work tasks in a safe and efficient manner.
- Team members will be familiar with the physical characteristics of each site, including wind direction, site access, and the location of communication devices and safety/emergency equipment.
- The location of overhead power lines and underground utilities must be established.
- Contact with potentially contaminated surfaces, walking through puddles or pools of liquid, kneeling on the ground, or leaning, sitting, or placing equipment on the contaminated soil should be avoided.
- Detection or appearance of unusual liquids, odors or discolored soil could indicate the presence of contaminants and should be reported to the SUXOS/UXOSO immediately.
- Site personnel are to report any other unusual or potentially hazardous condition to the SUXOS/UXOSO for investigation and/or corrective action.

All personnel on site will be required to follow the safe work practices contained in this Program, as they relate to the hazards encountered during site activities. All site personnel will be required to read, understand and comply with the provisions of this APP. If new tasks or hazards are identified during site operations, which pose additional hazards, the APP will be amended by the Corporate Health and Safety Manager to include additional safe work practices and other control methods as needed.

19.1 Site Rules/Prohibitions

Safe practices can reduce hazards due to normal site activities. Personnel must keep the prudent guidelines listed below in mind when conducting field activities. General personnel requirements include:

- Horseplay or fighting is prohibited.
- Eating, drinking, smoking, chewing gum, tobacco, or any other hands-to-face activities are prohibited on-site, except in designated areas after both face and hands have been washed.
- Wearing contact lenses is prohibited in the EZ.
- When required to sit or kneel on the ground, avoid contaminated surfaces.
- Placing equipment on contaminated surfaces should be avoided.
- Climbing on or over obstacles is prohibited. Stacks of materials can be unstable and could cause injury.
- Open flames of any type are prohibited on-site.
- Bringing defective or unsafe equipment on-site is prohibited.
- Only authorized employees may enter the worksite. Only essential personnel will be admitted within the EZ during MEC operations. Visitors must check in with the SUXOS, receive an appropriate safety briefing, and be escorted by UXO-qualified personnel at all times while on-site.

19.2 Buddy System

The buddy system is a safety practice in which each individual is concerned with the health and well-being of co-workers. The buddy system will be implemented during all on-site activities and will be incorporated whenever workers may be isolated or as determined by the SUXOS/UXOSO. The objective of the Buddy System is to ensure that no individual is ever alone on-site.

- A minimum of two UXO-qualified personnel will be present during all MEC operations. A UXO Technician I may assist in MEC operations with the supervision of a UXO Technician III or higher. Non-UXO-qualified personnel who have been determined essential for the operations being performed may be utilized to perform MEC-related procedures when supervised by a UXO Technician III or higher.
- At no time will an individual desert his assigned team unless while working in pairs, his partner goes down, and it is considered too hazardous to render assistance. Technicians will enter and exit EZ together and frequently monitor one another for signs of fatigue, heat stress, and any other problems. In such cases, the worker in danger may not even be aware he/she is having a problem. The technicians must always be alert to changes in the behavior of his teammate so that he can remove him from the situation immediately.
- Technicians should inspect each other’s equipment, including PPE, to ensure that it is adequate and in proper working order.

19.3 Work Permit Requirements

At this time, Tetra Tech does not anticipate work permits for its work on this project. Under the contract, there are no requirements for hot work. All site personnel, to eliminate the hazards from ignition sources, will utilize the general, fire safety precautions and procedures. Excavation work is generally expected to be less than four feet in depth, and there are expected to be no confined spaces or radioactive work on this project. Should this situation change, this APP will be updated to include these additional hazards and shall handle them IAW the Tetra Tech Corporate Health and Safety Program, which addresses all these issues.

19.4 Material Handling Procedures

Many types of objects are handled in normal day-to-day operations. Care will be taken in lifting and handling heavy or bulky items because they are the cause of many joint and back injuries. The following fundamentals address the proper lifting of materials to avoid joint and back injuries:

- The size, shape, and weight of the object to be lifted must be considered. Site personnel will not lift more than they can handle comfortably. They will use mechanical lifting equipment for lifts greater than 50 lbs that are unassisted.
- A firm grip on the object is essential; therefore, the hands and object will be free of oil, grease, and water, which might prevent a firm grip.
- The hands, and especially the fingers, will be kept away from any points that cause them to be pinched or crushed, especially when setting the object down.
- The item will be inspected for metal slivers, jagged edges, burrs, rough or slippery surfaces, and pinch points, and gloves will be used, if necessary, to protect the hands.
- The feet will be placed far enough apart for good balance and stability.
- Personnel will ensure that solid footing is available prior to lift the object.
- When lifting, get as close to the load as possible, bend the legs at the knees, making sure that the back is kept as straight as possible.
- To lift the object, the legs are straightened from their bending position.
- Never carry a load that cannot be seen over or around.
- When placing an object down, the stance and position are identical to that for lifting, with the back kept straight, the legs bent at the knees, and the object lowered.
- If the item to be lifted is too large, bulky, or heavy (over 50 lb.) for one person to safely lift, ask a co-worker for assistance. If a piece of material handling equipment is available that can do the job, the employee should use the equipment instead of trying to lift the object himself/herself.
- When two or more people are required to handle an object, coordination is essential to ensure that the load is lifted uniformly and that the weight is equally divided between the individuals carrying the load. When carrying the object, each person, if possible, will face the direction in which the object is being carried.

19.5 Spill Containment

Major spills are not expected on this site. Hazardous materials, where necessary, are being brought to the site in small quantity containers. This will minimize the amount of material involved, should a spill occur, as well as reduce the amount of hazardous material on hand to the minimum amount consistent with efficient operations. If a small amount of liquid hazardous material is spilled, it will be cleaned up with absorbent material by site personnel wearing appropriate chemical-resistant gloves. It will then be containerized, labeled, and sent for disposal at an approved facility.

19.6 Drum/Container/Tank Handling

The use of containers/tanks is not anticipated. The use of 55-gallon drums may be used to contain recovered MDAS items as well as water and/or sediment from decontamination operations. Drums will be handled using drum dollies and mechanical lift gates for transferring onto transport trucks and staging areas.

19.7 Comprehensive Activity Hazard Analysis of Treatment Technologies

Treatment technologies are not expected to be used on this project.

20.0 SITE CONTROL MEASURES

20.1 Site Map

A site map will be utilized during the Tailgate safety briefing to inform the workers of the location of hazardous areas on the site, the assembly areas to be used in the event of a site evacuation, and any other information relevant to the day's activities. The site map will include:

- Site topography
- Site work zones
- Location of unusual/hazardous areas
- Prevailing winds
- Ingress and egress corridors
- Evacuation routes and assembly points
- Location of emergency supplies

20.2 Work Zone Delineation and Access Points

Site work zones will be established by the SUXOS and UXOSO prior to initiating operations to control site access. Establishment of site work zones is based upon site conditions, activities, and exposure potentials. A site EZ will be set up, which includes the footprint of the area where work will take place and a distance based on the MGFD around that to protect areas outside the site from potential fragmentation, depending on the site activities. Site work zones will be marked using barricades and signage, closing roads into the area to unauthorized vehicular traffic. Barricades and signs will remain in place for the duration of site work.

20.3 Site Access Control

The SUXOS will control access to each work zone and will ensure that all site workers and visitors have received the proper training and medical surveillance required to enter a specific zone. Access will be denied to any potential entrant not meeting these requirements.

20.4 Exclusion Zone

The EZ includes all areas where significant hazards do or could occur and includes all areas where PPE is required to control worker exposure to chemical or physical hazards. All personnel entering the EZ will be logged in/out by the SUXOS. All visitors to the EZ must be escorted by a UXO-qualified Tetra Tech employee. The EZ of this site will be designated as the footprint area of actual project operations and the required separation distance surrounding the area. This distance is based on the MGFD during specifically defined site operations. When non-essential personnel are required to enter within the EZ, all UXO operations will cease until nonessential personnel are beyond the hazardous fragmentation area of the EZ.

20.5 Support Zone

The SZ is the area outside the EZ where site support activities are conducted. This zone includes break areas and sanitation facilities. Visitors desiring entry into the EZ must first meet with the SUXOS or UXOSO and receive the appropriate safety and emergency procedures briefing in the SZ before gaining admittance to the EZ, and they will be escorted at all times by a UXO-qualified employee while in the EZ.

Site access control will be implemented by the SUXOS or UXOSO and will be accomplished through a program that limits the movement and activities of people and equipment at the project site. This control will be based on site-specific characteristics to include:

- Potential chemical, biological, physical, or explosive hazards
- Terrain
- Expected weather conditions
- Planned site activities
- Site proximity to populated areas

The degree of site access control will include the following:

- Controlled site ingress/egress points – Work area will be clearly visible to anyone approaching the site and vice versa. Only authorized personnel will be permitted within the EZ during MEC operations. All others will remain in the SZ.
- Worker/visitor registration – All personnel working on the site sign in daily at the time of their daily safety briefing in the morning. All visitors to the site must sign the visitor log when they report to the site for their visitor briefing.
- Escort of visitors – All visitors to the site will be escorted by a UXO-qualified employee. Visitors will be briefed on site hazards, PPE requirements, and emergency procedures. Visitors who are not deemed essential will not be permitted within the EZ during MEC operations. If visitors need to access the EZ, all MEC operations will cease while they are in the area, and the visitors will be escorted at all times.
- PPE requirements – PPE requirements have been established based on the site hazards. Personnel working in areas requiring PPE will wear the required PPE for the duration of the operation. Visitors to the area will be required to have the required PPE for the area they will be visiting.

20.6 On and Off-Site Communication System

On and off-site communication will be established using cellular telephones and radios. All personnel will have emergency phone numbers and understand how and under what conditions they are to be used. Cell phones will not be used around MEC where EMR may present a hazard but will remain in the site vehicles with the emergency telephone number list for access during operating hours. Radios can be used to communicate to personnel on the site and in the site office.

21.0 PERSONAL HYGIENE AND DECONTAMINATION

Sanitation facilities will be provided in the SZ area so that employees can wash prior to eating, drinking, smoking, or engaging in any other hand-to-face activities. Chemical toilets may be available in the SZ of the work area, and there are plumbed toilets. As chemical contamination is not expected to be an issue at this site, basic washing of equipment and standard hygiene practices are all that will be required. Site sanitation will be established and maintained IAW OSHA 29 *CFR* 1910.120(n) and USACE EM 385-1-1, Section 2. In particular:

Permanent restroom facilities are located on the project site. If they are disabled for the season or otherwise not available, Tetra Tech will locate chemical toilets in the SZ, as required to support field personnel. Chemical toilets used in these locations and will be serviced every week. Each temporary toilet will be naturally lighted, have a toilet seat with a seat cover, have a urinal, have ventilation with vents screened, and be lockable from the inside. There will be at least one toilet for every 15 workers at the work site if required.

Hand and face washing facilities will be set up at the Tetra Tech worksite and will be utilized by all personnel exiting the EZ prior to eating, drinking, tobacco use, or other hand-to-face activities. Paper towels will be provided for drying. A trash receptacle will be provided for discarded paper towels. IAW ANSI Z358.1-1998, eye-wash facilities will be available on the worksite where operations in any of the work zones involve handling substances, which could be hazardous to the eyes. An eyewash kit will also be located in each site vehicle.

General work practices include the following:

- Safe work practices will be implemented whenever possible to eliminate or reduce the potential for employee exposure.
- Employees will wash their hands immediately or as soon as feasible after the removal of gloves or other PPE.
- Employees will wash hands and any other skin with soap and water, or flush mucous membranes with water immediately following contact with blood or potentially infectious materials.
- If potentially contaminated sharps are encountered, the item will immediately be disposed of in an appropriate container or decontaminated.
- Eating, drinking, smoking, applying cosmetics or lip balm, handling of contact lenses, or storage/handling of food are prohibited in all areas where potentially infectious materials are present.
- Equipment that has become contaminated will be decontaminated prior to servicing or storage, unless decontamination is not feasible, in which case the equipment will be disposed of properly.

22.0 EQUIPMENT DECONTAMINATION

At a minimum, basic washing of equipment will be required. Due to the presence of TLM, additional cleaning and decontamination may be necessary, including the use of soaps, detergents, or solvents if necessary. Portable decontamination stations will be established to contain wash water and sediment. Waste material from equipment decontamination will be contained for later disposal with the impacted sediment material.

23.0 EMERGENCY EQUIPMENT AND FIRST AID

Emergency equipment will be maintained on site for the duration of site operations. An approved, emergency first aid kit, bloodborne pathogen kit, and spill control kit will be kept in the UXOSO vehicle. Portable eyewashes will be located in the work area in the site vehicles. A 5-lb. ABC fire extinguishers will be kept in each site vehicle for emergency use on site. This equipment will be inspected on a weekly basis to ensure they are maintained and ready to use. Any used items will be replaced immediately.

First aid kits are assigned by the Safety Office and approved by the Occupational Health Physician. The size and number of first aid kits shall be sufficient to accommodate the maximum number of people on site at any given time. First aid kits will be located in all operational vehicles, each team, and the site office. A large medical kit, with trauma supplies, will be located with the UXOSO.

Biohazard kits will be available in each operational vehicle and with each team working inside the EZ. The kit will be used any time an injury occurs or where there is the release of body fluids.

Portable kits of eyewash will be available during operations at the site where the potential for hazardous materials may contact the eyes. Portable eyewash bottles will be used while the injured person is being transported to the site eyewash station or medical attention.

Fire extinguishers will be stored where they are well marked and readily accessible. Fire extinguishers shall be protected from the damaging effects of environmental elements. The UXOSO is responsible to ensure that all fire extinguishers are visually inspected monthly and that these inspections are documented. All site personnel will be familiar with the locations of fire extinguishers and will be trained in their use.

24.0 EMERGENCY RESPONSE AND CONTINGENCY PLAN (ERCP)

The ERCP address the emergencies, which could occur during site operations, and outlines the appropriate response actions. field personnel will investigate magnetic anomalies to locate, identify, and dispose of MEC/MPPEH. MEC/MPPEH will be destroyed by site personnel using donor explosive charges obtained from commercial sources.

24.1 Pre-Emergency Planning

The SUXOS and UXOSO will perform pre-emergency planning before starting field activities and will coordinate emergency response with EMT/police/fire personnel and the servicing medical facility when appropriate. Pre-emergency planning meetings shall be used to inform local authorities of the nature of site activities that will be performed under the PWS and the potential hazards that activities may pose to site workers, the environment, and the public. An agreement will be established between Tetra Tech and emergency response personnel and the hospital regarding responsibilities of each party in responding to a project site emergency. The UXOSO will verify all on-site emergency services information, to include telephone numbers and procedures for requesting services. It will be the UXOSO’s responsibility to post these procedures and telephone contact numbers IAW the requirements of this APP. Pre-emergency planning tasks include:

- Locate telephone stations;
- Post emergency telephone numbers at accessible telephone locations;
- Inspect all emergency equipment and supplies to ensure they are in proper working order;
- Provide a site map marked with planned evacuation routes, assembly points, and emergency equipment and supplies;
- Provide a map with the route to the hospital marked and highlighted, with copies of this map posted in the office/break area, in the emergency evacuation vehicle and all other site vehicles;
- Conduct an emergency response drill to test the effectiveness of the ERCP; and
- Review and revise the ERCP in the event of a failure of the plan in an actual or staged emergency, or when changes in site conditions or scope of work affect the ERCP.
-

24.2 Personnel and Lines of Authority

In the event of an emergency, the SUXOS will be designated as the On-Scene Incident Commander and will have the overall responsibility for implementation of the ERCP and coordination with responding off site emergency services.

Once an emergency has occurred, the SUXOS will report the incident to the client representative, the PM, and the Corporate Health and Safety Manager as soon as the situation is under control.

If the emergency involves employee injury, SUXOS and UXOSO will complete the Tetra Tech Accident Report form. The Corporate Health and Safety Manger will be responsible for notifying applicable Federal, state, and local authorities/agencies. Once the emergency has been resolved, the SUXOS, UXOSO, PM, and Corporate Health and Safety Manger will conduct a follow-up investigation and critique. Actions will be taken to prevent recurrence.

24.3 Criteria and Procedures for Emergency Recognition and Evacuation

Prevention of emergencies will be aided by the effective implementation of this APP, personnel awareness, contingency planning, and onsite safety meetings. Anticipated emergencies may include physical injury, fire, explosion, chemical spill or release, inclement weather, and natural disasters. The SUXOS and UXOSO will use the site-specific briefing and/or the Tailgate Safety Briefings to inform site workers of the recognition, prevention, and response procedures for each anticipated emergency.

In the event of an emergency, site personnel will be notified by either visual/verbal communication. Personnel will be notified to:

- Stop work activities;
- Evacuate to the designated assembly point;
- Begin emergency procedures; and
- Notify off site emergency response organizations and adjacent industries.

In the event of an emergency that requires evacuation of the site, verbal instruction will be given by the SUXOS to evacuate the area. Personnel will exit the area to the pre-designated assembly point.

After evacuation, the SUXOS will account for all personnel, ascertain information about the emergency and advise responding onsite personnel. The SUXOS will contact, counsel with, and coordinate with responding off-site emergency personnel if deemed necessary by the situation.

In all situations that require evacuation, personnel shall not re-enter the work area until:

- The conditions causing the emergency have been corrected;
- The hazard has been reassessed;
- The Site-Specific Safety and Health Plan has been revised and reviewed with onsite personnel, if needed; and
- Instructions have been given for authorized re-entry by the SUXOS/UXOSO.

24.4 Decontamination and Medical Treatment of Injured Personnel

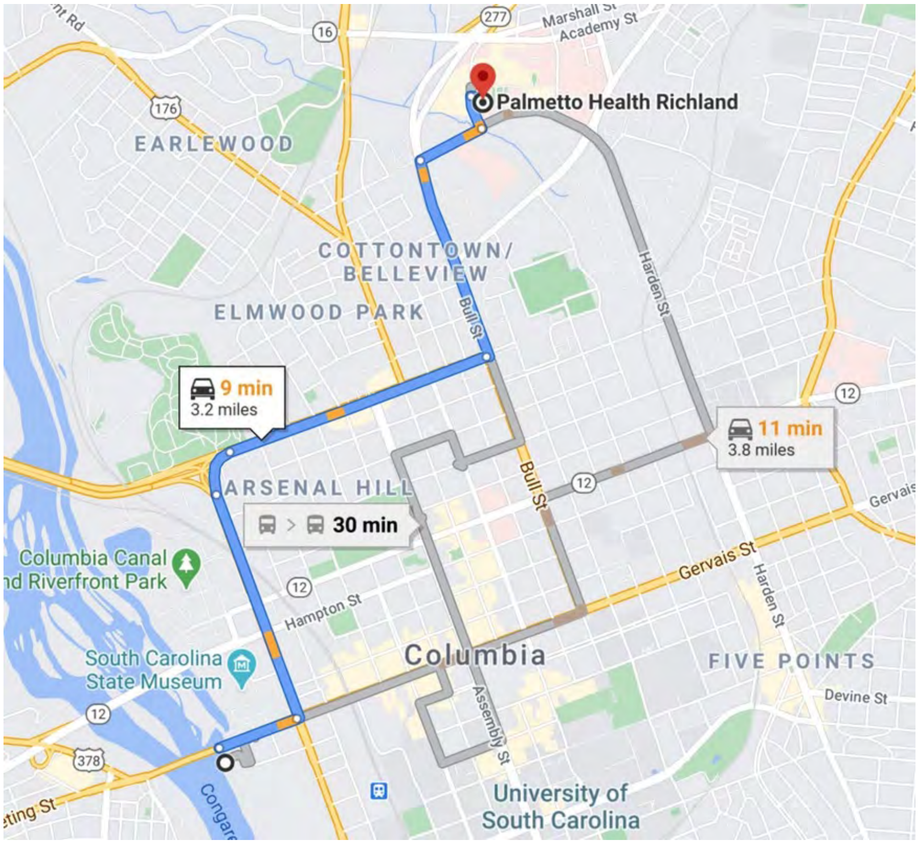
It is not anticipated that hazardous waste decontamination shall be required during any activities under the PWS. This determination has been made based upon archival documentation and past activities conducted at the site.

24.5 Emergency Medical Facilities

The nearest medical facility address is:

Palmetto Health Richland Hyperbaric Medicine
Address: 5 Richland Medical Park Drive
Columbia, SC 29203
Phone: (803) 434-7000

From the Project Area, 9 min (3.2 miles)
Take US-176 W/US-21 N/US-321 N and US-76 E to Bull St
Head east on Gervais St/Gervais St Bridge toward Gist St 0.3 mi
Turn left onto US-176 W/US-21 N/US-321 N/Huger St 0.8 mi
Keep right at the fork, follow signs for US-21/US-176/US-321/Elmwood Ave
Continue onto US-176 W/US-21 N/US-321 N/US-76 E 0.9 mi
Continue on Bull St to your destination
Use the left 2 lanes to turn left onto Bull St 0.7 mi
Turn right onto Harden Street Extension (signs for Harden St) 0.2 mi
Turn left onto Medical Park Rd 0.1 mi



The emergency telephone list can be found at Section 12.3.8 of this Appendix.

24.6 Criteria for Alerting the Local Community Responders

In the event of an on-site emergency the individual team leader or first person aware of the emergency will contact the SUXOS by field radio, cellular phone, or in person, as circumstances allow. The SUXOS will normally be responsible for requesting emergency services. If the order is given to evacuate the site of all personnel, each on-site team leader will assemble, account for, and evacuate all team personnel to the pre-designated staging area. The SUXOS/UXOSO will initially instruct the on-site CPR/First Aid trained personnel to respond to the emergency. These individuals shall render emergency first aid treatment and stay with the injured until relieved by off-site emergency services personnel, who would be called in at the discretion of the SUXOS.

24.7 Safety Data Sheets (SDS)

As part of the Tetra Tech Hazard Communication Program, an SDS binder will be maintained onsite, which includes copies of SDSs for all hazardous materials brought onto the site. It will be kept in the site office during operations. This SDS binder will be available on request to all site personnel during all working hours of the site. If site workers have further questions about any of the hazardous materials they come into contact with, the Tetra Tech Corporate Health and Safety Manager will locate the required information and pass it on to the employee.

24.8 Safe Distances and Places of Refuge

Normally, during an evacuation, personnel would evacuate to the office trailer and staging area in the SZ, where the SUXOS would take roll and account for all site personnel. An exception to this rule would be in the case of encountering a CWM item, in which case personnel would evacuate at least 450 feet upwind of the item. This location would change with the shifting winds, so it cannot be specifically identified.

24.9 Site Security and Control

During emergency procedures, the UXOSO will direct emergency vehicles into the site. The site personnel will also be notified that emergency vehicles are coming and be ready to assist where necessary. The UXOSO will ensure that Fire Department personnel approach at no closer than fragmentation distance from any fire that might start in the area. EMT/ambulance personnel will be instructed by the UXOSO as to where to safely proceed to get to the injured worker. Site personnel will assist if required, at the direction of the SUXOS.

24.10 Evacuation Routes and Procedures

In the event of an emergency that requires evacuation of the site, an alarm will be sounded or verbal instruction given by the SUXOS/UXOSO to evacuate the area to the worksite “Staging Areas.” This point will be established outside the EZ and in the SZ. Personnel will be shown the location of the staging areas daily, during the Site Safety Briefing. The location of the assembly point may change as work activity progresses within the project area. However, it will normally be at the office trailer.

After evacuation, the SUXOS will account for all personnel, ascertain information about the emergency, and advise responding on-site personnel. The SUXOS will contact, advise, and coordinate with responding off-site emergency personnel and points of contact for adjacent industries, if deemed necessary by the situation or the client Safety and Health Representative. In all situations that require evacuation, personnel will not re-enter the work area until the conditions causing the emergency have been corrected; the hazard reassessed; the APP has been revised and reviewed with on-site personnel, if needed; and instructions have been given for authorized re-entry by the SUXOS.

The route directions to the medical facility will be posted in the Tetra Tech office, at the worksite, and in site vehicles. This map also will indicate the evacuation route.

24.11 Decontamination

Due to the type of work on this project, it is not expected that a major chemical spill would occur that would require personnel decontamination prior to leaving the site. If a worker is accidentally injured using chemicals brought onto the site, the first aid procedures described in the SDS would be followed by co-workers to clean as much of the chemical off as possible before the ambulance arrives. In a case like this, the SDS will be sent to the hospital with the worker to inform the medical staff of the exposure and how best to treat it.

24.12 Emergency Medical Treatment and First Aid

A minimum of two persons on the project site will be certified in First Aid/CPR. These persons will act as First Responders to any site emergency. First Aid kits will be available for their use in that capacity. The First Responders will perform first aid and/or CPR until medical personnel arrives on site. The SUXOS will contact the EMT/ambulance based on the type of injury received and send the injured worker to the designated emergency treatment facility. If the injury is not so serious, the SUXOS may ask a co-worker to take the injured worker to the hospital for treatment. Maps and directions to the hospital will be kept in all site vehicles. Directions to the hospital can be found in Section 11 of this Appendix.

24.13 Spill Alerting and Response Procedure

Major hazardous substance spills are not expected due to the type of work taking place on this project. In the event of a minor hazardous substance spill causing an injury, the first responders would provide first aid based on the instruction in the SDS for the substances. The SDS would be taken with the injured worker to the hospital to provide information on the treatment of that chemical.

The emergency alerting procedure on the site will normally be a verbal warning to evacuate the site, and the evacuation procedures outlined above would be implemented. Due to the fact that there should be no large quantities of chemicals found on this site, the only type of chemical spill would be a small one. If a small spill occurs, the individual who caused the spill will inform the SUXOS. He will then get the spill control kit, and use the absorbent material, clean up most of the spill. If some of the soil is contaminated, that soil will be dug up and placed with the rest of the spill clean-up materials. It will all be disposed of at an approved disposal facility. Personnel involved in this clean-up will wear chemical-resistant gloves. Larger spills might require the use of Tyvek suit and respirator as well, but spills of that size are not anticipated on this site.

24.14 Critique of Response and Follow-Up

After any type of site emergency, the SUXOS/UXOSO, the PM, MEC Safety and Health Coordinator, and the Corporate Health and Safety Manager will review the situation and determine if changes need to be made to the emergency procedures to make them more effective. Applicable changes will be made to the APP, and these changes will be reviewed with all employees, so they are aware of the new procedures.

24.15 Emergency Response Team

There will be a minimum of two persons on the project site who are certified in first aid and CPR. These persons will serve as the first responders. They will respond to any site emergency and assist the victim until medical assistance arrives. The SUXOS will call for outside emergency assistance if it is needed. As soon as the professional emergency response services arrive on site, the first responders will turn over the medical care of the injured worker to them. They will be on standby to assist the ambulance crew if requested to do so.

24.16 Personnel Training Requirements

Personnel acting as first responders will be certified in First Aid and CPR from the American Red Cross or a similar other training entity. They will be qualified to provide basic first aid and CPR and will relinquish authority to the EMT/ambulance crew when they arrive on site.

24.17 Emergency Response Team Responsibilities

The responsibility of the emergency response team is to respond to on-site emergencies. They will provide only first aid and CPR, and they will attempt to calm and stabilize the patient until professional help arrives.

25.0 LOGS, REPORTS AND RECORD KEEPING

Each person on the site will have an individual file folder, which contains a copy of the following:

- 40 hr HAZWOPER Certificate.
- Current 8 hr HAZWOPER Annual Refresher Certificate.
- 8 hr HAZWOPER Supervisor Certificate, if applicable.
- EOD/UXO Training Certificate
- Any other applicable training certificates.

Personnel folders will be maintained by the SUXOS on-site. Training/Tailgate Safety Record will be completed for all on-site daily training. The SUXOS or UXOSO will maintain the file, which will be made available for the client as requested. This form may be completed in ink, but it is preferred that it be completed with a computer in Word.

25.1 Daily Safety Inspection Logs

The UXOSO will perform daily inspections on a scheduled and non-scheduled basis, of all site operations. The UXOSO will conduct non-scheduled safety and health inspections as deemed appropriate based upon the ongoing site activities. Scheduled safety and health inspections will be conducted as outlined in Section 8.0. All inspections will be documented. When discrepancies are observed, follow-up will be documented in the UXOSO log until the corrective actions required have been completed.

25.2 Visitor Log

The Visitor’s Log will be maintained by the SUXOS. The log will document the visitor’s name, company name, date, time, and reason for visit. There will also be documentation that the visitor was given a visitor safety briefing prior to being permitted to enter the EZ of the site. Visitors will be escorted at all times within the EZ, and MEC operations will cease during the time they are within the EZ.

25.3 Medical Surveillance Records and Certifications

A copy of the Physician Statement from a licensed physician who is certified in Occupational Medicine by the American Board of Preventive Medicine, regarding the current annual HAZWOPER physical examination will be maintained in the personnel folder with the other HAZWOPER certificates. The Physician Statements will remain in the individual's file on the project site for the duration of site operations. The files will then be transferred to the Knoxville Office.

25.4 Air Monitoring Results

Due to the operations being performed on this project, air monitoring is not required.

25.5 Personal Exposure Records

As there is no chemical work taking place on this project, personal exposure records are not expected to be required.

25.6 Records Maintenance

All personal exposure and medical monitoring records, if generated, will be maintained IAW applicable OSHA standards, 29 CFR 1904, 1910, and 1926.

25.7 Final Report

Tetra Tech will develop, retain and submit as part of the final report, all visitor registration logs, training logs, and daily safety inspection logs as part of the daily QC Reports.

25.8 Site Monitoring Results

All site-monitoring results will be documented. This will be kept in a file at the project site for reference and will become a part of the permanent site record at the conclusion of site activities. At this site, heat exposure monitoring is the only monitoring anticipated to occur and that is dependent upon the site temperature.

25.9 Accident Reporting Records

Accidents/incidents shall be reported IAW EM 385-1-1 using the Tetra Tech Accident Report form. Should an accident occur on the site, all reports and records will be documented. Copies will be maintained on site for the duration of site activities. A permanent copy will be maintained in the Athens Tetra Tech Office.

25.10 Safety Exposure Report

A Safety Exposure Report, a tabulation of field labor hours, lost workday accidents, and number of lost workdays shall be submitted.

26.0 UNFORESEEN HAZARDS

Should any unforeseen hazard become evident during the performance of work, the SUXOS and

UXOSO shall bring such hazard information to the attention of the Corporate Health and Safety Manager and the on-site government representative (both verbally and in writing) for resolution as soon as possible. In the interim, necessary action shall be taken to reestablish and maintain safe working conditions until the procedures to address the new hazards can be put into place and the APP updated accordingly.

APPENDIX E

MUNITIONS CONSTITUENTS SAMPLING AND ANALYSIS PLAN

MUNITIONS RESPONSE WORK PLAN
CONGAREE RIVER PROJECT
REMOVAL ACTION AND CONSTRUCTION SUPPORT
COLUMBIA, SC

NOT APPLICABLE

APPENDIX F

CONTRACTOR FORMS

MUNITIONS RESPONSE WORK PLAN
CONGAREE RIVER PROJECT
REMOVAL ACTION AND CONSTRUCTION SUPPORT
COLUMBIA, SC

TABLE OF CONTENTS

NOTE:

A CD containing all Contractor-specific forms will be maintained on site. The forms in this appendix are examples of the forms that the Contractors will be using during this project. Forms may be modified to meet specific project reporting needs.

TETRA TECH

HSE TRAINING COURSE SIGN-IN SHEET

Reset Button

Name of Course:

Location:

Date:

Topics Covered (list or attach agenda):

1.

2.

3.

4.

5.

Instructors:
Instructor signature authorizes electronic-signature on certificate.

1. (Print Name) (Sign Name)
2. (Print Name) (Sign Name)
3. (Print Name) (Sign Name)

ATTENDEES

	Date	**Print Name**	**Sign Name**	**Job Title**	**Company / OU**
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3.					
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TETRA TECH

HSE TRAINING COURSE SIGN-IN SHEET

Name of Course:		**Location:**		**Date:**	
ATTENDEES					
	Date	**Print Name**	**Sign Name**	**Job Title**	**Company / OU**
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APP ACKNOWLEDGMENT

Project: ____________________ Site: ____________________
Contract Number: ____________________ Site Location: ____________________

Project Manager: ____________________
SUXOS: ____________________
UXOSO:

I acknowledge that I understand the requirements of this APP/SSHP and AHAs. I agree to abide by the procedures and limitations specified. I also acknowledge that I have been given an opportunity to have my questions concerning the APP and its requirements answered prior to performing field activities. Health and Safety Training and Medical Surveillance requirements applicable to my field activities at this site are current and will not expire during onsite activities.

Tetra Tech PERSONNEL:

SIGNATURE	EMPLOYEE NO.	DATE

OTHER PERSONNEL:

SIGNATURE	**ORGANIZATION**	**DATE**

TETRA TECH

WEEKLY CHECKLIST AND ACTION ITEM REPORT

Resset Form

Project/Location:	**Inspector/s:**	**Time/Date:** /
TOPIC	**OBSERVATIONS**	**FINDING** **(Yes/No or N/A)**

This inspection checklist is meant to capture the health, safety, and environment (HSE) inspection items that are appropriate for the particular project being inspected based on the scope of work and relevant project plans (e.g., safety plan, Environmental Protection Plan, Waste Management Plan, at a minimum). Additional relevant plans may include a Stormwater Pollution Prevention Plan (SWPPP) or Spill Prevention, Controls, and Countermeasures Plan (SPCC). This checklist should be completed by a qualified inspector who is familiar with the project plans and scope of work. Not all elements will be applicable to every project. If not applicable, indicate "N/A."

Weather Conditions at time of Inspection ____.

WORK CONDITIONS		YES	NO	NA
1. Housekeeping		☐	☐	☐
2. Walking/Working Surfaces		☐	☐	☐
3. Aisles and Passageways		☐	☐	☐
4. Platforms		☐	☐	☐
5. Ladders		☐	☐	☐
6. Stairs, Guardrails, Toe Boards		☐	☐	☐
7. Exits/Egress		☐	☐	☐
8. Roadways		☐	☐	☐
9. Lighting		☐	☐	☐
10. Noise Exposure		☐	☐	☐
11. Ergonomics		☐	☐	☐
12. Site Perimeter and Control Zones Identified		☐	☐	☐
EQUIPMENT		**YES**	**NO**	**NA**
13. Hand/Portable Tool Condition, Storage, and Use		☐	☐	☐
14. Machine, Conditions/Guarding		☐	☐	☐
15. Mobile/Heavy Equipment a. Physical inspection of equipment b. Review of daily inspection reports c. Review of equipment deficiency corrections logs/records		☐	☐	☐

TETRA TECH

WEEKLY CHECKLIST AND ACTION ITEM REPORT

Project/Location:	**Inspector/s:**	**Time/Date:** /

TOPIC	**OBSERVATIONS**	**FINDING (Yes/No or N/A)**

This inspection checklist is meant to capture the health, safety, and environment (HSE) inspection items that are appropriate for the particular project being inspected based on the scope of work and relevant project plans (e.g., safety plan, Environmental Protection Plan, Waste Management Plan, at a minimum). Additional relevant plans may include a Stormwater Pollution Prevention Plan (SWPPP) or Spill Prevention, Controls, and Countermeasures Plan (SPCC). This checklist should be completed by a qualified inspector who is familiar with the project plans and scope of work. Not all elements will be applicable to every project. If not applicable, indicate "N/A."

MATERIAL-HANDLING EQUIPMENT		**YES**	**NO**	**NA**
16. Hoisting and Rigging		☐	☐	☐
17. Lifting Aids Used When Possible		☐	☐	☐
18. Proper Lifting Techniques Used		☐	☐	☐
ELECTRICAL SAFETY		**YES**	**NO**	**NA**
19. Power Cords		☐	☐	☐
20. GFCI		☐	☐	☐
21. Generators		☐	☐	☐
22. Breaker Box Access/Clearance		☐	☐	☐
HAZARDOUS MATERIALS		**YES**	**NO**	**NA**
23. Hazardous Materials Inventory Current		☐	☐	☐
24. Safety Data Sheets (SDS)		☐	☐	☐
25. Labeling		☐	☐	☐
26. Signs/Postings/Color Coding		☐	☐	☐
27. Proper Storage and Segregation of Hazardous Materials		☐	☐	☐
28. Compressed Gas Storage and Use		☐	☐	☐
EMERGENCY SYSTEMS		**YES**	**NO**	**NA**
29. Emergency Phone Numbers Posted		☐	☐	☐
30. Evacuation Routes, Rally Points Shown on Site Map		☐	☐	☐
31. Fire Extinguishers Inspected Monthly		☐	☐	☐
32. Eyewashes and Showers Periodically Inspected, Units Flushed, and Fluids Periodically Changed		☐	☐	☐

TETRA TECH

WEEKLY CHECKLIST AND ACTION ITEM REPORT

Project/Location:

Inspector/s:

Time/Date: /

TOPIC	OBSERVATIONS	FINDING (Yes/No or N/A)		
This inspection checklist is meant to capture the health, safety, and environment (HSE) inspection items that are appropriate for the particular project being inspected based on the scope of work and relevant project plans (e.g., safety plan, Environmental Protection Plan, Waste Management Plan, at a minimum). Additional relevant plans may include a Stormwater Pollution Prevention Plan (SWPPP) or Spill Prevention, Controls, and Countermeasures Plan (SPCC). This checklist should be completed by a qualified inspector who is familiar with the project plans and scope of work. Not all elements will be applicable to every project. If not applicable, indicate "N/A."				
33. First Aid Kits/Stations		☐	☐	☐
34. Bloodborne Pathogen Kits		☐	☐	☐
35. Emergency Rescue Equipment		☐	☐	☐
PROTECTIVE EQUIPMENT		**YES**	**NO**	**NA**
36. PPE Used, Stored, and Maintained in Accordance with Project EHS Plan		☐	☐	☐
37. Respirator Use, Storage, and Maintenance		☐	☐	☐
SPILL PREVENTION AND PREPAREDNESS		**YES**	**NO**	**NA**
38. Are Petroleum Products Stored in Containers or Tanks as Specified in Project-Specific Plans?		☐	☐	☐
39. Outside of Containers or Tanks (as Applicable) Show No Signs of Deterioration, Leaks, or Discharges at Seams, Gaskets, Piping, Pumps, Valves, Rivets, or Bolts.		☐	☐	☐
40. Appropriate Containment Materials are Available and Accessible, Including: Drip Pans, Dikes, Berms, Retaining Walls, Curbing, Other Barriers, Spill Diversion Ponds, Retention Ponds, or Integrated Secondary Containment Structures.		☐	☐	☐
41. Spill Control and Response Materials are Available, Including: Designated Spill Response Kits, Drip Pans, Sorbent Materials, Oil Retention Booms (Floating or Sorbent), Sand Bags/Temporary Curbing Devices, Fuel Recovery Pumps/Collection Hoses, Fuel Recovery Tank Trucks, and Tools.		☐	☐	☐
42. Is There Any Evidence of a Sheen or Discoloration on the Ground? Are Hazardous Materials Stored Properly in a Manner that Minimizes Potential For Spills?		☐	☐	☐
43. Emergency Contact Lists are Current and Posted.		☐	☐	☐

WEEKLY CHECKLIST AND ACTION ITEM REPORT

Project/Location:	**Inspector/s:**	**Time/Date:** /		
TOPIC	**OBSERVATIONS**	**FINDING (Yes/No or N/A)**		
This inspection checklist is meant to capture the health, safety, and environment (HSE) inspection items that are appropriate for the particular project being inspected based on the scope of work and relevant project plans (e.g., safety plan, Environmental Protection Plan, Waste Management Plan, at a minimum). Additional relevant plans may include a Stormwater Pollution Prevention Plan (SWPPP) or Spill Prevention, Controls, and Countermeasures Plan (SPCC). This checklist should be completed by a qualified inspector who is familiar with the project plans and scope of work. Not all elements will be applicable to every project. If not applicable, indicate "N/A."				
44. Workers Have Received Spill Prevention Response Training.		☐	☐	☐
45. Does the Project Have a Spill Response, Controls, and Countermeasures (SPCC) Plan? If Yes, are Inspections being Performed and Documented as Required in the Plan? Has the Plan Been Updated as Required?		☐	☐	☐
STORMWATER POLLUTION PREVENTION AND EROSION CONTROLS		**YES**	**NO**	**NA**
46. Are Site Activities that Cause Land Disturbance being Performed (Grading, Excavating, Clearing and Grubbing, Demolition and Foundation Removal, Etc?		☐	☐	☐
47. Are Surface Waters Present on or Adjacent to the Site that Could Be Impacted By Runoff from the Site? Is There Any Evidence of Runoff from The Project Site to These Areas?		☐	☐	☐
48. Are There Storm Drains, Catch Basins or Other Conveyances that Collect Stormwater? Are There Activities Occurring that Could Cause Oil, Contaminants, or Sediments to Enter These Conveyances? If Yes, Are There Measures In Place Or Needed to Protect Stormwater Quality?		☐	☐	☐
49. Does The Project Have a Total Land Disturbance = or > 1 Acre or is the Project Part of a Larger or Common Plan of Development That Could Exceed 1 Acre of Disturbance? If Yes, Confirm the Stormwater Pollution Prevention Plan is in Place. If No, Check the Environmental Protection Plan for Requirements or Indicate N/A (E.G., if the Project Does Not Involve Land-Disturbing Activities)		☐	☐	☐
50. Are There Signs of Erosion on Recently Disturbed Soils (Channelization, Rivulets, Siltation Runoff, Etc.)? Can the Erosion Lead to Sediment or Runoff to Surface Water or Conveyances? If Yes, are		☐	☐	☐

WEEKLY CHECKLIST AND ACTION ITEM REPORT

Project/Location:	**Inspector/s:**	**Time/Date:** /

TOPIC	**OBSERVATIONS**	**FINDING (Yes/No or N/A)**		

This inspection checklist is meant to capture the health, safety, and environment (HSE) inspection items that are appropriate for the particular project being inspected based on the scope of work and relevant project plans (e.g., safety plan, Environmental Protection Plan, Waste Management Plan, at a minimum). Additional relevant plans may include a Stormwater Pollution Prevention Plan (SWPPP) or Spill Prevention, Controls, and Countermeasures Plan (SPCC). This checklist should be completed by a qualified inspector who is familiar with the project plans and scope of work. Not all elements will be applicable to every project. If not applicable, indicate "N/A."

Erosion Control BMPs Necessary or Recommended?				
51. Are BMPs Being Implemented per the Environmental Project Plans or (if Prepared) SWPPP)? For Instance, Preventative Maintenance, Good Housekeeping Practices, Proper Waste Storage and Storage of Hazardous Materials, Structural BMPs, Etc.?		☐	☐	☐
52. If the Project Has a Stormwater Pollution Prevention Plan (SWPPP), are Inspections being Performed and Documented as Required in the Plan?		☐	☐	☐
53. Fugitive Dust – Appropriate BMPs are Instituted for Fugitive Dust Emissions.		☐	☐	☐
OTHER CONDITIONS OR WORK PRACTICES		**YES**	**NO**	**NA**
54. Are all required postings placed within the site? (deficiency log, OSHA 300A, etc.)		☐	☐	☐
55.		☐	☐	☐
56.		☐	☐	☐
57.		☐	☐	☐

Reviewed by: ______________________________ ____________________

Signature Date

File the Weekly Inspection Checklist with the Site Safety and Health Officer (SSHO)
Additionally, send a copy to the Project Manager and Safety and Health Director
IF A STOP WORK IS REQUIRED, NOTIFY THE DIRECTOR OF SAFETY

TETRA TECH

WEEKLY CHECKLIST AND ACTION ITEM REPORT

Project/Location:	**Inspector/s:**	**Time/Date:** /

ACTION ITEM	RESPONSIBLE PARTY	SCHEDULE (DAY(S)/WEEK(S) TO COMPLETE)	DATE COMPLETED
1.			/
2.			/
3.			/
4.			/
5.			/
6.			/
7.			/
8.			/
9.			/
10.			/
11.			/

DAILY BRIEFING/STAFF & VISITOR SIGN-IN SHEET
SAFETY INSPECTION REPORT

PART I: Daily Safety Briefing/Staff & Visitor Sign-In Sheet

Report #

Date:

Office/Project Name/Location:

Shift/Department:

Contract/Task Order:

Weather:

1. Awareness: (e.g., special EHS concerns, chemical or physical hazards, recent incidents, etc.)

2. Other Issues: (ESQ Plan changes, action items, attendee comments, etc._

3. Medical Support Available:

Hospital:

Urgent/Routine Care:

Ordnance Training
Presented by:

Attendees

By signing in below, I certify that I understand the hazards and risk controls associated with each task I am to perform. I understand the permit requirements applicable to the work being performed and am aware that all tasks must be assessed. I am also aware of my obligation to "stop work." Furthermore, I am physically and mentally fit for duty and am not under the influence of any type of medication, drugs, or alcohol that could affect my ability to work safety. I am aware of my responsibility to bring any injury, illness, or other safety issue to the attention of the UXOSO.

By signing out below, I certify that I am uninjured unless I have already informed the TL, PM, or UXOSO.

Print Name	Signature	Company	Time In	Time Out

DAILY BRIEFING/STAFF & VISITOR SIGN-IN SHEET
SAFETY INSPECTION REPORT

PART I: Daily Safety Briefing/Staff & Visitor Sign-In Sheet (continued)

PRINT NAME	SIGNATURE	COMPANY	TIME IN	TIME OUT

VI. SIGNATURES:	I certify all personnel were present, accounted for, and participated in the Daily Safety Briefing.
UXOSO Name (Print)	Signature

DAILY BRIEFING/STAFF & VISITOR SIGN-IN SHEET
SAFETY INSPECTION REPORT

PART II: Safety Inspection Report

DATE:	**TIME:**	**REPORT NO.:**

CONTRACT NO.:	**TASK ORDER NO.:**

SITE NAME AND LOCATION:

WEATHER CONDITONS:

Temperature:	Humidity:

Conditions (circle one): Sunny Partly Sunny Cloudy Partly Cloudy Rain Snow

I. WORK CONDUCTED:

II. INSPECTION POINTS

Item Description	Pass	Item Description	Pass
1. Personal Protection (PPE)	Y / N	9. Site Communications	Y / N
2. Work Processes	Y / N	10. House Keeping	Y / N
3. Site Control	Y / N	11. Heavy Equipment	Y / N
4. First Aid Kit(s)/Eyewash	Y / N	12. Refueling Operations	Y / N
5. Fire Extinguisher(s)	Y / N	13. Other: (list)	Y / N
6. Site Vehicles	Y / N	14. Other: (list)	Y / N
7. Safety and Health Monitoring Equipment	Y / N	15. Other: (list)	Y / N
8. Power Tools	Y / N	16. Other: (list)	Y / N

III. SIGNIFICANT EVENTS:

IV. DEFICIENCIES and CORRECTIVE ACTIONS: (If required)

V. REINSPECTION RESULTS: (If Required)

VI. SIGNATURES:

Contractor's Verification: On behalf of the Contractor, I certify this report is complete and correct, and all materials used, and work performed during this reporting period are in compliance with the contract plans and specifications to the best of my knowledge, except as may be noted above.

UXOSO Name (Print)	Signature

QUALITY CONFORMANCE INSPECTION (QCI) RECORD

See Reverse for Completion Instructions

DATE: ___________________ **PROJECT SITE:** ____

QC SPECIALIST: ____

TASK INSPECTED: ____

SCHEDULED INSPECTION ( ) **REINSPECTION ( )**
DAILY ( ) **WEEKLY ( )** **OTHER ( )** ________________________

RESULTS:
( ) TASK **IS** BEING ACCOMPLISHED IN CONFORMANCE TO WP/SSHP.
( ) TASK **IS NOT** BEING ACCOMPLISHED IN CONFORMANCE TO WP/SSHP.

THE NOTED NONCONFORMANCE IS AS FOLLOWS: _____________________

____

____

____

____

____

____

____

REINSPECTION:

TASK AND DATE OF NONCONFORMANCE BEING REINSPECTED:

____

____

RESULTS:
( ) TASK **IS** BEING ACCOMPLISHED IN CONFORMANCE TO THE WP/SSHP.
( ) TASK **IS NOT** BEING ACCOMPLISHED IN CONFORMANCE TO WP/SSHP.

THE RE-OCCURRING NONCONFORMANCE IS AS FOLLOWS:

____

____

INSTRUCTIONS FOR COMPLETION

A QCI record will be completed on each task inspected.

Date: Enter the date the inspection took place.

Project Site: Enter the project site's name.

QC Specialist: Name of the QC Specialist conducting the QCI.

Task Inspected: Enter the name of the task being inspected as per the QCI Schedule.

Scheduled Inspection: Place a "X" in the appropriate ( ). If Other is applicable, note the reason for the QCI.

Results:
Enter a ""X" in the appropriate ( ).
If the task is in conformance, no other information is required on this form.
If the task is not in conformance, continue with the explanation in space provided.

Reinspection:
Date and Task being reinspected: Enter the date and pertinent task.
Results: Enter a "X" in the appropriate ( ).
If the task is still not in conformance, continue with the explanation in space provided.

Distribution of completed forms:

Conformances: 1- Project Manager
1 - On-site QC File (Inactive)

Nonconformances: 1 - Project Manager
1- Quality Manager
1 - On-site QC File (Active)

Re-inspections: 1 - Project Manager
1 - Quality Manager
1 - On-Site QC File (Inactive) (if compliant)
(Active) (if noncompliant)

Quality Control
Corrective Action Log

Project: ________________________
Location: ______________________
SUXOS: ________________________
UXOQCS: _______________________

Non Conformance			Correction		
Date	Activity	Nature	Action Taken	Completed By	Date

MEC Accountability Log

Identification					Description			Disposition			
ID #	Anomaly #	Date	Grid/Area	Location	Nomenclature	Fuze Description	Fuze Condition	Method	Date	By Whom	Photo #

DD FORM 1348-1A, JUL 91 (EG) ISSUE RELEASE/RECEIPT DOCUMENT

1 2 3	DOC IDENT
4 5 6	RI FROM
7	M & S
23	UNIT
24	ISS
25 26 27 28 29	QUANTITY
45	SER
46 47 48 49 50	SUPPLE-MENTARY ADDRESS
51	SIG
52 53	FUND
54 55 56	DIS-TRI-BU-TION
57 58 59	PRO-JECT
60 61	PRI
62 63 64	REQD DEL DATE
65 66	ADV
67 68 69	RI
70	O/P
71	COND
72	MGT
73	
74 75 76 77 78 79 80	UNIT PRICE DOLLARS CTS

1. TOTAL PRICE

DOLLARS CTS

2. SHIP FROM

3. SHIP TO

4. MARK FOR

5. DOC DATE

6. NMFC

7. FRT RATE

8. TYPE CARGO

9. PS

10. QTY. REC'D

11.UP

12. UNIT WEIGHT

13. UNIT CUBE

14. UFC

15. SL

16. FREIGHT CLASSIFICATION NOMENCLATURE

17. ITEM NOMENCLATURE

18. TY CONT

19. NO CONT

20. TOTAL WEIGHT

21. TOTAL CUBE

22. RECEIVED BY

23. DATE RECEIVED

24. DOCUMENT NUMBER & SUFFIX (30-44)

25. NATIONAL STOCK NO. & ADD (8-22)

26. RIC (4-6)
UI (23-24)
QTY (25-29)
CON CODE (71)
DIST (55-56)
UP (74-80)

27. ADDITIONAL DATA

PREVIOUS EDITION MAY BE USED

Adobe Designer 8.0

Form Approved
OMB No. 0704-0246
Expires 20210930

The public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing the burden, to the Department of Defense, Washington Headquarters Services, at whs.mc-alex.esd.mbx.dd-dod-informationcollections@mail.mil. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to any penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number.

TETRA TECH

VEHICLE INSPECTION CHECKLIST

Reset Form

Project:	
Manufacturer:	Model:
License Number:	Team Number:
Date Period: /	Mileage start/end: /

Equipment Checklist (Check all that apply and provide description of corrections needed)

Item	Status	Corrective Action
Steering	Pass ☐ Fail ☐ NA ☐	
Service Brakes	Pass ☐ Fail ☐ NA ☐	
Emergency Brake	Pass ☐ Fail ☐ NA ☐	
Transmission	Pass ☐ Fail ☐ NA ☐	
Warning Gauges	Pass ☐ Fail ☐ NA ☐	
Leaks	Pass ☐ Fail ☐ NA ☐	
Lights	Pass ☐ Fail ☐ NA ☐	
Mirrors	Pass ☐ Fail ☐ NA ☐	
Fluids	Pass ☐ Fail ☐ NA ☐	
Seat and Seat Belts	Pass ☐ Fail ☐ NA ☐	
Tires/Tread	Pass ☐ Fail ☐ NA ☐	
Regular Horn	Pass ☐ Fail ☐ NA ☐	
Back Up Alarm	Pass ☐ Fail ☐ NA ☐	
Hand Hold/Running Boards	Pass ☐ Fail ☐ NA ☐	
Fire Extinguisher	Pass ☐ Fail ☐ NA ☐	
Emergency Kit	Pass ☐ Fail ☐ NA ☐	
Other:	Pass ☐ Fail ☐ NA ☐	
Other:	Pass ☐ Fail ☐ NA ☐	

Remarks:

NOTE: If the vehicle requires attention or there is something missing, you are required to contact your Responsible Manager before operating vehicle. *Please initial appropriate box.*

Sun	Mon	Tue	Wed	Thu	Fri	Sat

Approvals

Operator's Signature:		Date:
Supervisor's Signature: *(Repairs or adjustments Completed)*		Date:
Safety Review by Signature:		Date:

Reset Form

TETRA TECH

DAILY HEAVY EQUIPMENT INSPECTION CHECKLIST

Project:

Date:

Manufacturer:

Model:

Unit Number:

Hours Start/End: /

Equipment Checklist (Check all that apply and provide description of corrections needed)

Item	Status	Corrective Action
Steering Mechanism[1]	Pass ☐ Fail ☐ NA ☐	
Service Brakes[2]	Pass ☐ Fail ☐ NA ☐	
Emergency Brake[1]	Pass ☐ Fail ☐ NA ☐	
Transmission & Controls	Pass ☐ Fail ☐ NA ☐	
Warning Gauges	Pass ☐ Fail ☐ NA ☐	
Leaks	Pass ☐ Fail ☐ NA ☐	
Lights	Pass ☐ Fail ☐ NA ☐	
Mirrors	Pass ☐ Fail ☐ NA ☐	
Fluids	Pass ☐ Fail ☐ NA ☐	
Seat and Seat Belts (w/Roll Over Protection System)	Pass ☐ Fail ☐ NA ☐	
Tires / Tread	Pass ☐ Fail ☐ NA ☐	
Regular Horn	Pass ☐ Fail ☐ NA ☐	
Audible Back Up Alarm	Pass ☐ Fail ☐ NA ☐	
Steps / Handholds	Pass ☐ Fail ☐ NA ☐	
Fire Extinguisher	Pass ☐ Fail ☐ NA ☐	
Spill Kit	Pass ☐ Fail ☐ NA ☐	
Fenders / Mud Flaps	Pass ☐ Fail ☐ NA ☐	
Heater / Defroster	Pass ☐ Fail ☐ NA ☐	
All items within Cab/bed Secured	Pass ☐ Fail ☐ NA ☐	
Machine Cleaned Out Daily	Pass ☐ Fail ☐ NA ☐	
Other:	Pass ☐ Fail ☐ NA ☐	
Other:	Pass ☐ Fail ☐ NA ☐	

Approvals

Operator's Signature:		Date:
Supervisor's Signature: *(repairs or adjustments completed)*		Date:
Safety Review by Signature:		Date:

---

[1] Items required to be operational by OSHA 1926.602 before use.

[2] Service brake must be capable of stopping and holding equipment fully loaded.

Same-Day Transaction Report

DATE	MANUFACTURER VENDOR	MANUFACTURER'S MARKS & DESCRIPTION	QTY RCVD	QTY USED	QTY RTNED	BALANCE	NAME/SIGNATURE OF VENDOR REPRESENTATIVE

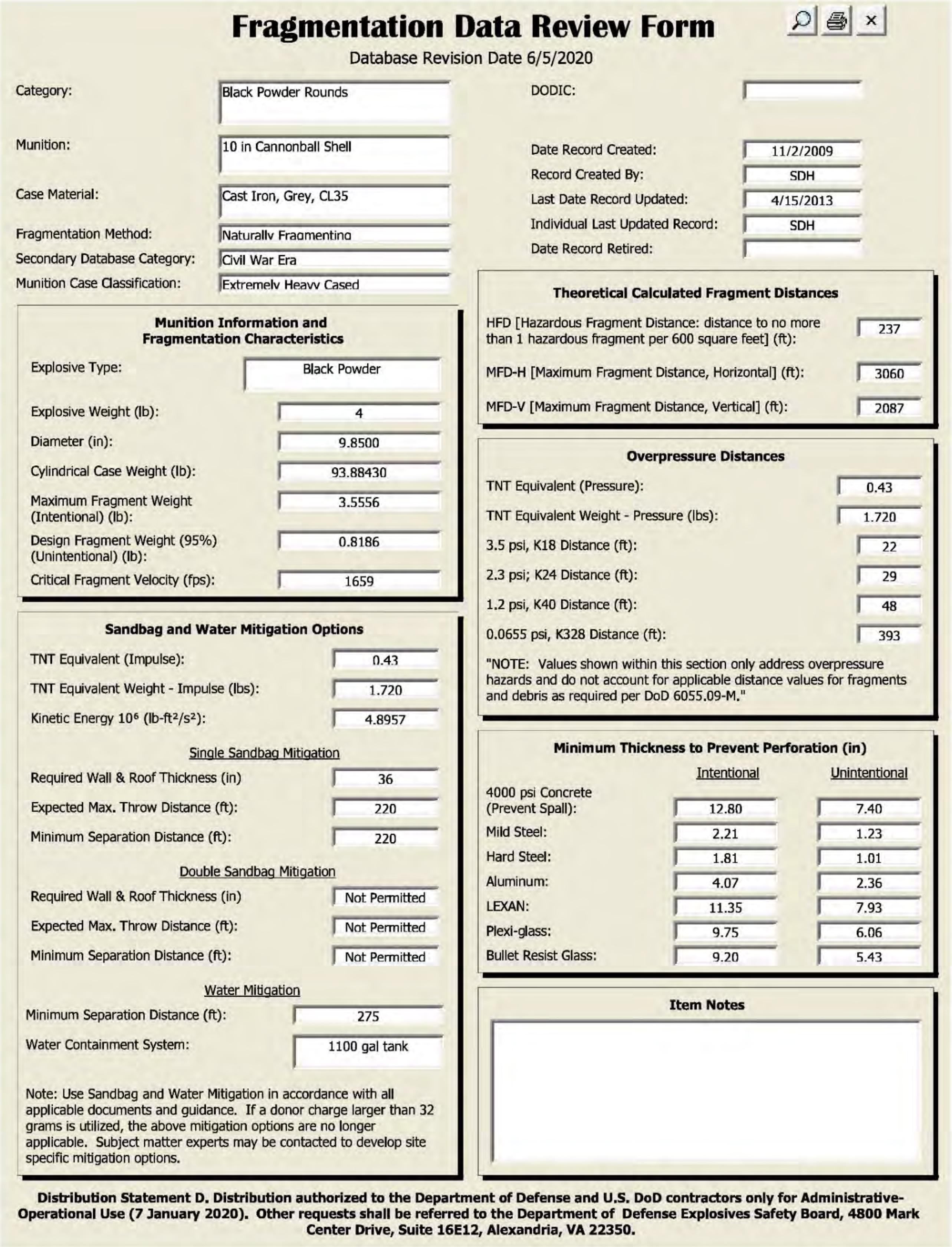
Note: The Same-Day Transaction Report is to be used when procuring explosives from a vendor for same-day events where all materials will be used or returned to the vendor, leaving a balance of “0” on hand. Complete this report and attach the PO and vendor invoice as part of your explosives files.

APPENDIX G

MUNITIONS FRAGMENTATION SHEETS

MUNITIONS RESPONSE WORK PLAN CONGAREE RIVER PROJECT

REMOVAL ACTION AND CONSTRUCTION SUPPORT
COLUMBIA, SC



Fragmentation Data Review Form

Database Revision Date 6/5/2020

Category: Black Powder Rounds
Munition: 10 in Cannonball Shell
Case Material: Cast Iron, Grey, CL35
Fragmentation Method: Naturally Fragmenting
Secondary Database Category: Civil War Era
Munition Case Classification: Extremely Heavy Cased

DODIC:
Date Record Created: 11/2/2009
Record Created By: SDH
Last Date Record Updated: 4/15/2013
Individual Last Updated Record: SDH
Date Record Retired:

Munition Information and Fragmentation Characteristics

Explosive Type:	Black Powder
Explosive Weight (lb):	4
Diameter (in):	9.8500
Cylindrical Case Weight (lb):	93.88430
Maximum Fragment Weight (Intentional) (lb):	3.5556
Design Fragment Weight (95%) (Unintentional) (lb):	0.8186
Critical Fragment Velocity (fps):	1659

Theoretical Calculated Fragment Distances

HFD [Hazardous Fragment Distance: distance to no more than 1 hazardous fragment per 600 square feet] (ft):	237
MFD-H [Maximum Fragment Distance, Horizontal] (ft):	3060
MFD-V [Maximum Fragment Distance, Vertical] (ft):	2087

Overpressure Distances

TNT Equivalent (Pressure):	0.43
TNT Equivalent Weight - Pressure (lbs):	1.720
3.5 psi, K18 Distance (ft):	22
2.3 psi; K24 Distance (ft):	29
1.2 psi, K40 Distance (ft):	48
0.0655 psi, K328 Distance (ft):	393

"NOTE: Values shown within this section only address overpressure hazards and do not account for applicable distance values for fragments and debris as required per DoD 6055.09-M."

Sandbag and Water Mitigation Options

TNT Equivalent (Impulse):	0.43
TNT Equivalent Weight - Impulse (lbs):	1.720
Kinetic Energy 10^6 (lb-ft²/s²):	4.8957

Single Sandbag Mitigation

Required Wall & Roof Thickness (in)	36
Expected Max. Throw Distance (ft):	220
Minimum Separation Distance (ft):	220

Double Sandbag Mitigation

Required Wall & Roof Thickness (in)	Not Permitted
Expected Max. Throw Distance (ft):	Not Permitted
Minimum Separation Distance (ft):	Not Permitted

Water Mitigation

Minimum Separation Distance (ft):	275
Water Containment System:	1100 gal tank

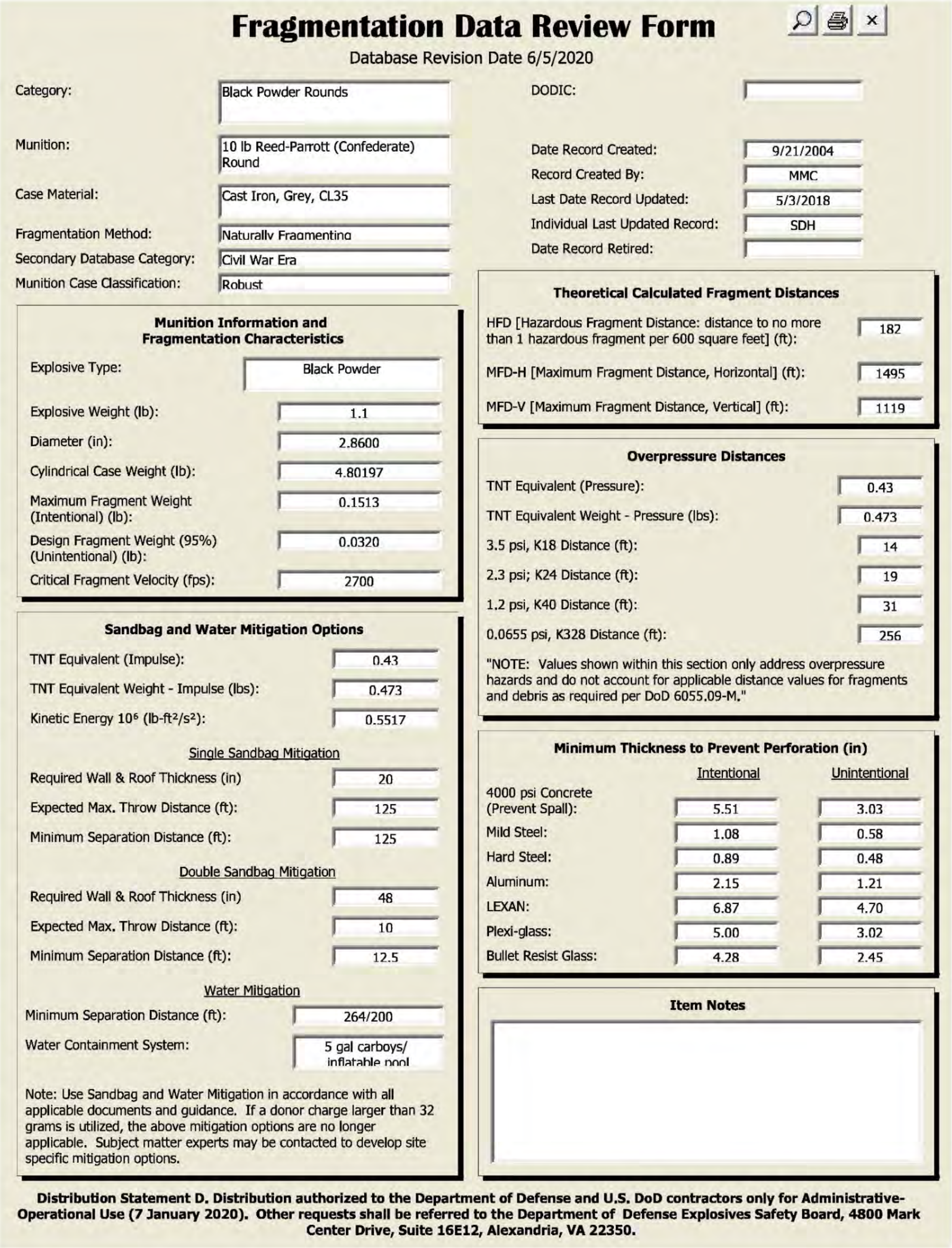
Note: Use Sandbag and Water Mitigation in accordance with all applicable documents and guidance. If a donor charge larger than 32 grams is utilized, the above mitigation options are no longer applicable. Subject matter experts may be contacted to develop site specific mitigation options.

Minimum Thickness to Prevent Perforation (in)

	Intentional	Unintentional
4000 psi Concrete (Prevent Spall):	12.80	7.40
Mild Steel:	2.21	1.23
Hard Steel:	1.81	1.01
Aluminum:	4.07	2.36
LEXAN:	11.35	7.93
Plexi-glass:	9.75	6.06
Bullet Resist Glass:	9.20	5.43

Item Notes

Distribution Statement D. Distribution authorized to the Department of Defense and U.S. DoD contractors only for Administrative-Operational Use (7 January 2020). Other requests shall be referred to the Department of Defense Explosives Safety Board, 4800 Mark Center Drive, Suite 16E12, Alexandria, VA 22350.



Fragmentation Data Review Form

Database Revision Date 6/5/2020

Category: Black Powder Rounds

Munition: 10 lb Reed-Parrott (Confederate) Round

Case Material: Cast Iron, Grey, CL35

Fragmentation Method: Naturally Fragmenting

Secondary Database Category: Civil War Era

Munition Case Classification: Robust

DODIC:

Date Record Created: 9/21/2004

Record Created By: MMC

Last Date Record Updated: 5/3/2018

Individual Last Updated Record: SDH

Date Record Retired:

Munition Information and Fragmentation Characteristics

Explosive Type: Black Powder

Explosive Weight (lb): 1.1

Diameter (in): 2.8600

Cylindrical Case Weight (lb): 4.80197

Maximum Fragment Weight (Intentional) (lb): 0.1513

Design Fragment Weight (95%) (Unintentional) (lb): 0.0320

Critical Fragment Velocity (fps): 2700

Sandbag and Water Mitigation Options

TNT Equivalent (Impulse): 0.43

TNT Equivalent Weight - Impulse (lbs): 0.473

Kinetic Energy 10^6 (lb-ft^2/s^2): 0.5517

Single Sandbag Mitigation

Required Wall & Roof Thickness (in): 20

Expected Max. Throw Distance (ft): 125

Minimum Separation Distance (ft): 125

Double Sandbag Mitigation

Required Wall & Roof Thickness (in): 48

Expected Max. Throw Distance (ft): 10

Minimum Separation Distance (ft): 12.5

Water Mitigation

Minimum Separation Distance (ft): 264/200

Water Containment System: 5 gal carboys/ inflatable pool

Note: Use Sandbag and Water Mitigation in accordance with all applicable documents and guidance. If a donor charge larger than 32 grams is utilized, the above mitigation options are no longer applicable. Subject matter experts may be contacted to develop site specific mitigation options.

Theoretical Calculated Fragment Distances

HFD [Hazardous Fragment Distance: distance to no more than 1 hazardous fragment per 600 square feet] (ft): 182

MFD-H [Maximum Fragment Distance, Horizontal] (ft): 1495

MFD-V [Maximum Fragment Distance, Vertical] (ft): 1119

Overpressure Distances

TNT Equivalent (Pressure): 0.43

TNT Equivalent Weight - Pressure (lbs): 0.473

3.5 psi, K18 Distance (ft): 14

2.3 psi; K24 Distance (ft): 19

1.2 psi, K40 Distance (ft): 31

0.0655 psi, K328 Distance (ft): 256

"NOTE: Values shown within this section only address overpressure hazards and do not account for applicable distance values for fragments and debris as required per DoD 6055.09-M."

Minimum Thickness to Prevent Perforation (in)

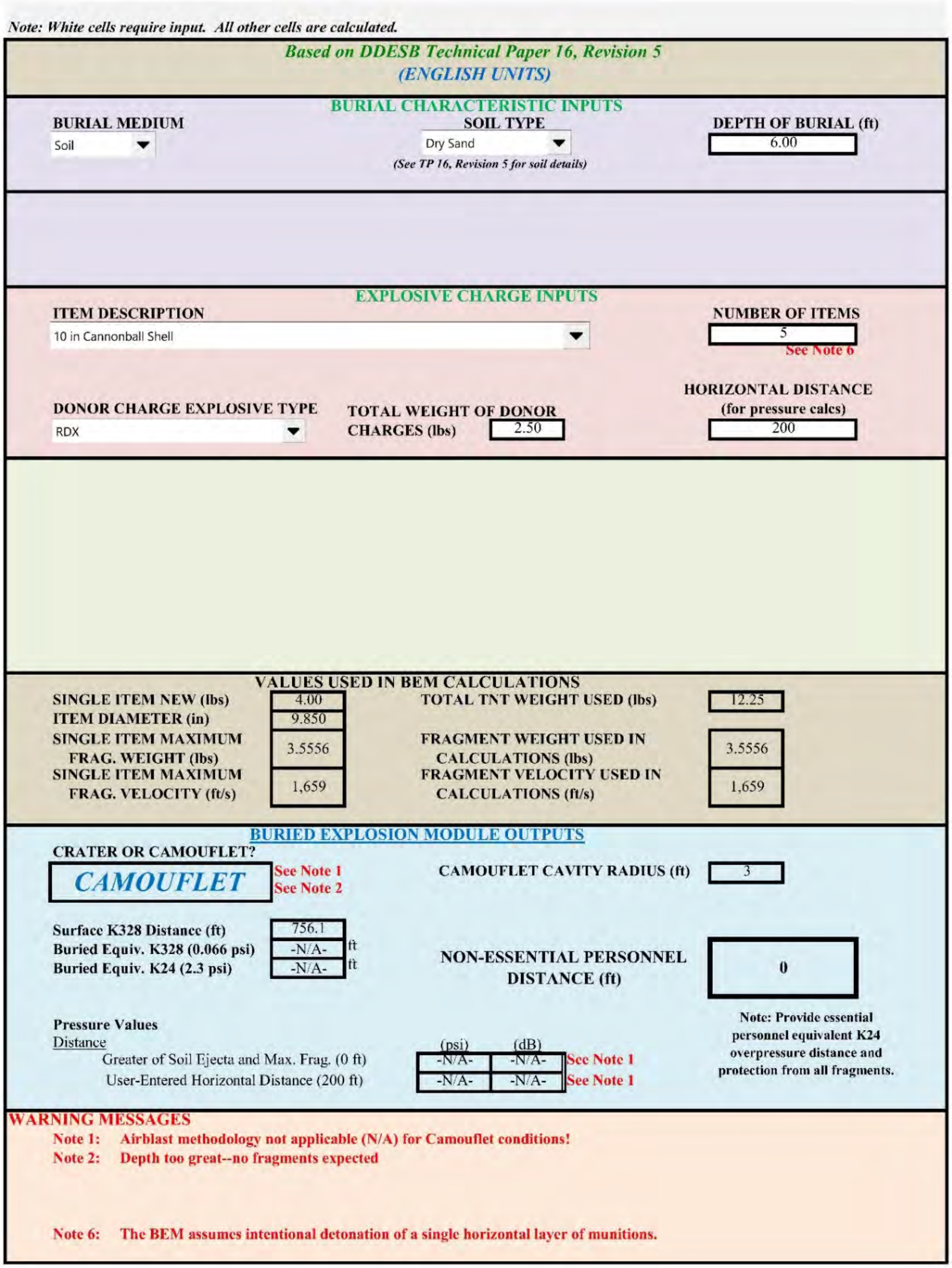
	Intentional	Unintentional
4000 psi Concrete (Prevent Spall):	5.51	3.03
Mild Steel:	1.08	0.58
Hard Steel:	0.89	0.48
Aluminum:	2.15	1.21
LEXAN:	6.87	4.70
Plexi-glass:	5.00	3.02
Bullet Resist Glass:	4.28	2.45

Item Notes

Distribution Statement D. Distribution authorized to the Department of Defense and U.S. DoD contractors only for Administrative-Operational Use (7 January 2020). Other requests shall be referred to the Department of Defense Explosives Safety Board, 4800 Mark Center Drive, Suite 16E12, Alexandria, VA 22350.

BURIED EXPLOSION MODULE

(Version 7.2)



Note: White cells require input. All other cells are calculated.

Based on DDESB Technical Paper 16, Revision 5
(ENGLISH UNITS)

BURIAL CHARACTERISTIC INPUTS

BURIAL MEDIUM: Soil
SOIL TYPE: Dry Sand
(See TP 16, Revision 5 for soil details)
DEPTH OF BURIAL (ft): 6.00

EXPLOSIVE CHARGE INPUTS

ITEM DESCRIPTION: 10 in Cannonball Shell
NUMBER OF ITEMS: 5 See Note 6
DONOR CHARGE EXPLOSIVE TYPE: RDX
TOTAL WEIGHT OF DONOR CHARGES (lbs): 2.50
HORIZONTAL DISTANCE (for pressure calcs): 200

VALUES USED IN BEM CALCULATIONS

SINGLE ITEM NEW (lbs): 4.00
ITEM DIAMETER (in): 9.850
SINGLE ITEM MAXIMUM FRAG. WEIGHT (lbs): 3.5556
SINGLE ITEM MAXIMUM FRAG. VELOCITY (ft/s): 1,659
TOTAL TNT WEIGHT USED (lbs): 12.25
FRAGMENT WEIGHT USED IN CALCULATIONS (lbs): 3.5556
FRAGMENT VELOCITY USED IN CALCULATIONS (ft/s): 1,659

BURIED EXPLOSION MODULE OUTPUTS

CRATER OR CAMOUFLET?
CAMOUFLET See Note 1 See Note 2
CAMOUFLET CAVITY RADIUS (ft): 3

Surface K328 Distance (ft): 756.1
Buried Equiv. K328 (0.066 psi): -N/A- ft
Buried Equiv. K24 (2.3 psi): -N/A- ft

NON-ESSENTIAL PERSONNEL DISTANCE (ft): 0

Note: Provide essential personnel equivalent K24 overpressure distance and protection from all fragments.

Pressure Values

Distance	(psi)	(dB)	
Greater of Soil Ejecta and Max. Frag. (0 ft)	-N/A-	-N/A-	See Note 1
User-Entered Horizontal Distance (200 ft)	-N/A-	-N/A-	See Note 1

WARNING MESSAGES

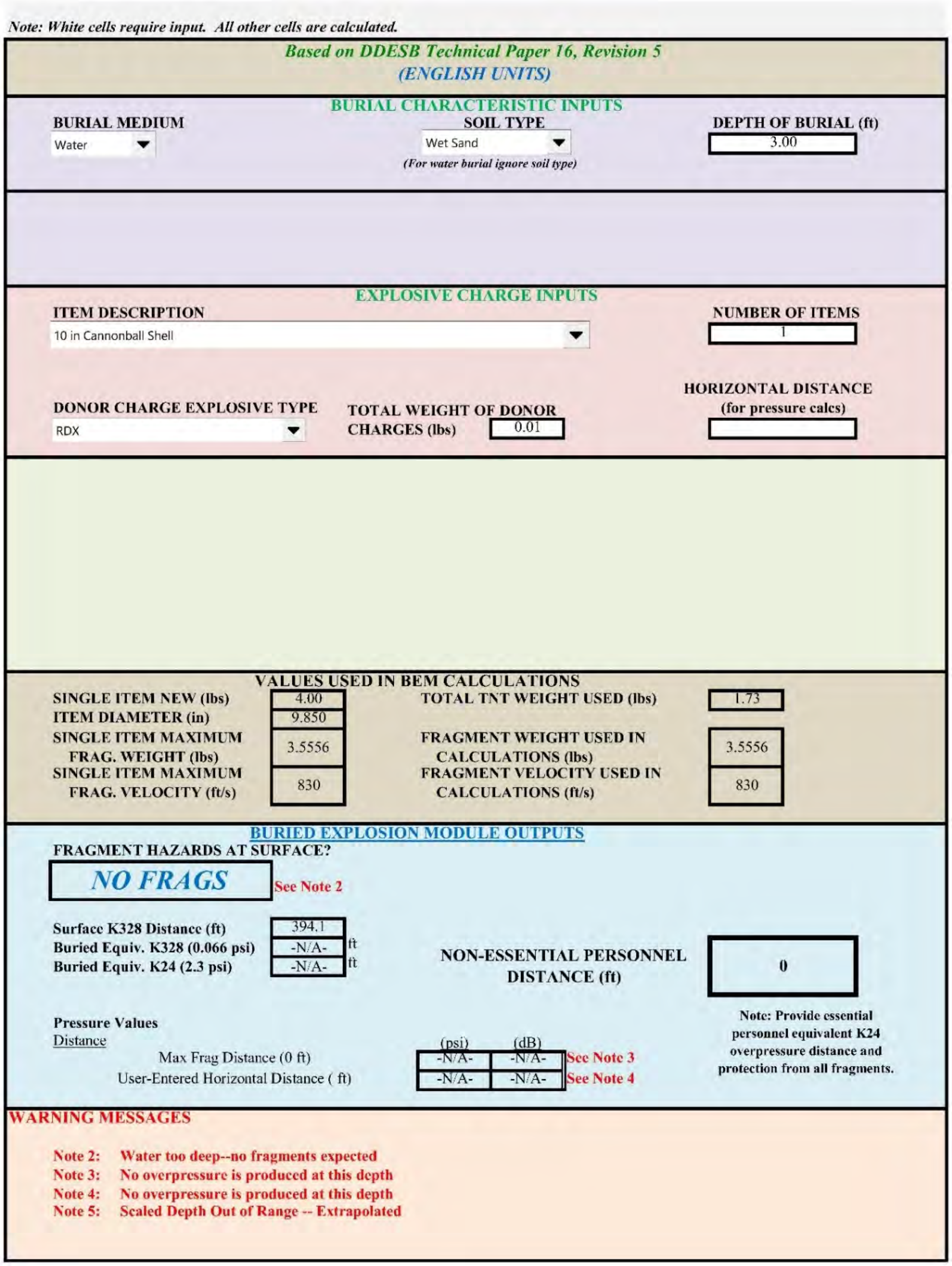
Note 1: **Airblast methodology not applicable (N/A) for Camouflet conditions!**
Note 2: **Depth too great--no fragments expected**

Note 6: **The BEM assumes intentional detonation of a single horizontal layer of munitions.**

8/23/2021
1

BURIED EXPLOSION MODULE

(Version 7.2)



Note: White cells require input. All other cells are calculated.

Based on DDESB Technical Paper 16, Revision 5
(ENGLISH UNITS)

BURIAL CHARACTERISTIC INPUTS

BURIAL MEDIUM: Water
SOIL TYPE: Wet Sand
(For water burial ignore soil type)
DEPTH OF BURIAL (ft): 3.00

EXPLOSIVE CHARGE INPUTS

ITEM DESCRIPTION: 10 in Cannonball Shell
NUMBER OF ITEMS: 1
DONOR CHARGE EXPLOSIVE TYPE: RDX
TOTAL WEIGHT OF DONOR CHARGES (lbs): 0.01
HORIZONTAL DISTANCE (for pressure calcs):

VALUES USED IN BEM CALCULATIONS

SINGLE ITEM NEW (lbs)	4.00	**TOTAL TNT WEIGHT USED (lbs)**	1.73
ITEM DIAMETER (in)	9.850		
SINGLE ITEM MAXIMUM FRAG. WEIGHT (lbs)	3.5556	**FRAGMENT WEIGHT USED IN CALCULATIONS (lbs)**	3.5556
SINGLE ITEM MAXIMUM FRAG. VELOCITY (ft/s)	830	**FRAGMENT VELOCITY USED IN CALCULATIONS (ft/s)**	830

BURIED EXPLOSION MODULE OUTPUTS

FRAGMENT HAZARDS AT SURFACE?

NO FRAGS See Note 2

Surface K328 Distance (ft)	394.1	
Buried Equiv. K328 (0.066 psi)	-N/A-	ft
Buried Equiv. K24 (2.3 psi)	-N/A-	ft

NON-ESSENTIAL PERSONNEL DISTANCE (ft): 0

Note: Provide essential personnel equivalent K24 overpressure distance and protection from all fragments.

Pressure Values

Distance	(psi)	(dB)	
Max Frag Distance (0 ft)	-N/A-	-N/A-	See Note 3
User-Entered Horizontal Distance (ft)	-N/A-	-N/A-	See Note 4

WARNING MESSAGES

Note 2: Water too deep--no fragments expected
Note 3: No overpressure is produced at this depth
Note 4: No overpressure is produced at this depth
Note 5: Scaled Depth Out of Range -- Extrapolated

10/14/2021
1

APPENDIX H

CONTRACTOR PERSONNEL QUALIFICATIONS CERTIFICATION LETTER

MUNITIONS RESPONSE WORK PLAN CONGAREE RIVER PROJECT

REMOVAL ACTION AND CONSTRUCTION SUPPORT
COLUMBIA, SC

RESUMES OF KEY PERSONNEL

The following personnel are proposed as key personnel for the activities on this project:

Scot Wilson	Project Manager	Resume included
Don Schwalback	SUXOS	CEHNC # 0196
TBD	UXOSO/QCS	
TBD	UXO Technician III	
TBD	UXO Technician II	
TBD	UXO Technician II	
TBD	UXO technician I	
TBD	UXO technician I	

Personnel Qualifications Certification Letter

I, Mark Dollar, Operating Unit President, certify that the personnel listed above meet or exceed contract requirements for the function they will perform.

If changes in the identified personnel are required, due to the availability of the proposed personnel or schedule conflicts, Tetra Tech will propose fully qualified personnel to fill the position. Resumes of proposed key personnel that are not in the CEHNC database will be submitted for review and approval.

11. Scot Wilson, PMP, Program Manager

Education	MS, Information Systems and Operations, Naval Post Graduate School BS, Oceanography, University of Washington Internship, Applied Physics Laboratory, University of Washington Graduate, Naval EOD School, Navy Dive Officer School
Active Professional Registrations/Special Qualifications	Project Management Professional (PMP), #1436776 USACE Registered UXO Technician #3260 OSHA 40-Hour HAZWOPER OSHA 8-Hour Refresher, current

Mr. Wilson is a graduate of the Navy's Explosive Ordnance Disposal School, a Master Explosive Ordnance Disposal Technician, and a Navy Diving Officer, with over 30 years of experience in diving and UXO field operations and 20 years experience in project and program management leading complex technical projects. He has served as the Project Manager for multiple project sites involving underwater munitions, including the Navy's underwater and terrestrial munitions cleanup projects at Jackson Park, WA; the US Army Corps of Engineers' UXO Remedial Investigation in Culebra, Puerto Rico; and the National Fireworks site in Hanover, MA.. He has led over 4,000 hours of high risk UXO diving and over 1,500 hours of UXO disposal operations while maintaining a perfect safety record.

Program Manager, Tetra Tech Underwater Technology and UXO Diving Program.
Provides strategic guidance and technical oversite of Tetra Tech's underwater programs for diving and underwater technology. Develops test plans and pilot studies to evaluate advanced underwater systems and sensors for UXO detection, identification, and recovery. This includes underwater geophysical sensors, sonars, mixed sensor platforms, ROVs, and underwater navigation, vision, and communication systems. Serves as chairman of the Tetra Tech Diving Review Board.

Project Manager, MassDEP, Immediate Response Action, National Fireworks Site, Hanover MP. Managed the UXO remediation and diving scope of this complex $25M T&M multi-contaminate cleanup project performed by a field staff of 25 UXO technicians, geophysicists, and equipment operators. The site contains high amounts of 20mm and 40mm projectiles mixed with asbestos, chemically impacted soil and pond sediment, and laboratory waste. During the initial 4 years of this ongoing project, he prepared all planning documents and SOPs for the field work and diving operations, achieved consensus with multiple stakeholders for change approval to adapt plans and procedure to evolving site conditions, and directed the recovery and disposal of over 17,000 munitions, 500 separate munition disposal events, and the recovery and recycling of over 15 tons of munitions scrap without a recordable injury or incident in the history of the project which totals over 75,000 man hours to date. This project was named the TT Corporate Safety Award winner for 2020.

Project Manager, USAESCH, Phase III RI/FS; Culebra Water Ranges, PR. Managed this $2.2M FFP/CPFF underwater UXO RI/FS to characterize MEC and MC at two munitions response/FUDS sites off Culebra Island, PR. This three-phase RI/FS includes an environmental baseline survey to delineate the marine habitat; identification of metallic anomalies; and anomaly investigation by UXO-qualified divers to identify MEC through electromagnetic induction (EM) surveys and MC sediment sampling. Conducted side scan, multi-beam, and video data collection over a 1,100-acre open-ocean area. Developed project plans and designed/implemented an innovative environmental baseline survey plan to delineate/identify listed and protected coral species, which expedited regulatory approval by eight stakeholder agencies. Served as the single POC who communicated and coordinated with USAESCH and stakeholders. Responsible for submitting detailed and accurate monthly progress and cost reporting. Met all performance-based milestones, completing Phase I ahead of schedule, with zero safety incidents.

Project Manager, NAVFAC SW, Formal Dispute Resolution Support and RI/FS Project Plans for Munitions Investigation for OU 3M Jackson Park Housing Complex, Bremerton, WA. Project manager of three CPFF CTOs, totaling $4.5M, responsible for all munitions and MC actions. Consistently received CPARs ratings of Exceptional on all task orders. For the OU3-M RI/FS, developed project plans, WP, Naval Ordnance Safety and Security Activity (NOSSA) ESS and After-Action Report, RI/FS Report, and resolution documents from regulatory negotiations, gaining acceptance for remedial alternatives. Managed 16-person team during a 35-acre surface sweep on 122 private properties. Managed diving operations to investigate/recover Discarded Military Munitions (DMM) at over 800 magnetic anomaly sites in Ostrich Bay. Completed all field tasks ahead of schedule and under budget, maintaining a perfect safety record. Received outstanding ratings in all categories of CPAR evaluation. Met all performance-based objectives, including completing an explosive safety submission (ESS), diving safety submission, and remedial design for the OU3-M pilot study in half the time scheduled. Implemented innovative techniques to minimize processed sediment during munitions dredging that saved the client thousands of dollars in off-site disposal costs. Managed approximately $500K in government-owned property.

Project Manager, NAVFAC SW, Phase 2 RI/FS for OU 3-M, Jackson Park Housing Complex, WA. Managed and directed a $4.1 million task order with a project staff of 16 people during the 2009 field season at the Jackson Park OU3-M site. This work included conducting a 35-acre surface sweep for discarded military munitions (DMMs) and diving operations to investigate and recover DMM at over 800 magnetic anomaly sites at the bottom of Ostrich Bay. All field tasks were completed ahead of schedule and under budget while maintaining a perfect safety record. Following the field work, authored the NOSSA After Action Report, the Remedial Investigation/Feasibility Study Report, and dispute resolution documents supporting the Navy during negotiations with the regulators for acceptance of the remedial alternatives. The project earned the highest award fee evaluation possible, ensuring the company received the maximum available fee.

Project Manager, NAVFAC NW, UXO Underwater EM Survey of Jackson Park Pier Area, Jackson Park OU3-M Site, Bremerton, WA. Managing this $500K CPAF CTO to conduct an underwater EM induction survey for magnetic anomalies over a 10-acre parcel surrounding Pier Two in Ostrich Bay. Developed remote sensing survey plan using proprietary underwater EM array sensor suite to conduct surveys near large structures otherwise inaccessible with a magnetometer. Prepared QAPP, managed survey, and prepared/submitted the survey report. Met all performance-based milestones to date, including completing the identification of >3,000 new anomalies on time, within budget, and with zero safety incidents. Received CPARS ratings of outstanding in all categories.

Munitions Technical Lead, NAVFAC SW, Naval Weapons Station Concord, CA. Led field staff in performance of small arms range clearance and HTRW contaminated soil cleanup. Prepared work plans, ESS, and after-action reports. Led field staff in NOSSA audit and pre-audit preparation with zero safety findings.

Munitions Technical Lead, NAVFAC SW, Naval Weapons Station (NWS) Seal Beach Detachment Fallbrook, CA. Led field staff performing a TCRA on this $1.6M, 13-acre UXO site involving biological avoidance and surface range clearance of all accessible metals and exposed Material Potentially Presenting an Explosive Hazard (MPPEH). Recovered >3,000 lbs. of scrap metal and 15 drums of Material Documented as Safe (MDAS)-classified inert munitions debris (MD). To mitigate potential site hazards, an exposed burial pit containing MPPEH was also excavated during the TCRA. Led field team through more than 2,000 labor hours with no safety incidents.

Project Manager, NAVFAC SW, Explosives Safety Submission and Conceptual Remedial Design, Bremerton Naval Complex, WA. Authored the Explosive Safety Submission for the OU3-M Pilot Study in half the time listed in the project schedule. Wrote amendment to 2006 Explosive Safety Submission for OU3-M RI/FS to include an innovative underwater collection point, allowing the Navy to open a previously closed public recreation area. Developed new techniques for munitions dredging during the Conceptual Remedial Design to minimize the amount of sediment that must be processed, saving thousands of dollars in off-site disposal. The project earned the highest award fee evaluation possible.

APPENDIX I

JOINT APPLICATION SUPPLEMENT
PROJECT DESCRIPTION

MUNITIONS RESPONSE WORK PLAN CONGAREE RIVER PROJECT

REMOVAL ACTION AND CONSTRUCTION SUPPORT
COLUMBIA, SC

JOINT APPLICATION SUPPLEMENT
PROJECT DESCRIPTION

CONGAREE RIVER STAKEHOLDER-DEVELOPED MODIFIED REMOVAL ACTION
COLUMBIA, SOUTH CAROLINA

September 2020

Prepared for:

Dominion Energy South Carolina, Inc.
400 Otarre Parkway
Cayce, South Carolina 29033

Prepared by:

Apex Companies, LLC
1600 Commerce Circle
Trafford, Pennsylvania 15085

TABLE OF CONTENTS

TABLES

FIGURES

APPENDICES

1.0 INTRODUCTION

This Project Description has been prepared on behalf of Dominion Energy South Carolina, Inc. (DESC) to provide supplemental information for the Joint Federal and State Application Form (Joint Application) for the planned Modified Removal Action (MRA) for tar-like material (TLM) and impacted sediments within a portion of the Congaree River in Columbia, South Carolina.

The general site location and planned removal areas are shown on Figure 1. The project area includes the proposed removal areas and landside area necessary for access and operations to support the removal activities. As summarized in the Joint Application Form (item 33), the purpose of the MRA is to remove TLM and impacted sediments from the project area and eliminate its potential for human contact. The MRA will also mitigate the potential for resuspension and downstream movement of impacted sediments.

The MRA is being planned at the direction of the South Carolina Department of Health and Environmental Control (SCDHEC). A plan for the removal of tar-like material within the Congaree River was requested by SCDHEC in a letter dated July 31, 2018 (see Appendix A). The documentation in Appendix A is being provided as required by Nationwide Permit (NWP) Regional General Condition 47a.

In response to the July 2018 SCDHEC letter, a Preliminary Removal Action Work Plan (PRAWP) was prepared and submitted to SCDHEC on September 12, 2018. In a letter dated October 22, 2018 (see Appendix A), SCDHEC acknowledged receipt of the PRAWP and proposal to remove tar-like material from the Congaree River, and directed DESC to proceed with the process of obtaining permit approval from the US Army Corps of Engineers (USACE).

To facilitate the planning process and assure concurrence with the scope of the planned removal efforts, DESC participated in a meeting with Stakeholders on November 15, 2018. As follow-up to that meeting, DESC prepared the Conceptual Plan for a Modified Removal Action – December 2018 (Stakeholder-Developed MRA Plan) described in Section 2.0. The Stakeholder-Developed MRA Plan was submitted to SCDHEC on December 12, 2018 for confirmation of Stakeholders agreement. In a letter dated February 7, 2019 (see Appendix A), SCDHEC provided their agreement with the plan along with Declarations of Support from two primary stakeholders, Congaree Riverkeeper and Guignard Associates LLC.

There has been a considerable amount of work undertaken in support of this project, which is available in the Administrative Record and can be found on SCDHEC's website at the following location: http://www.scdhec.gov/HomeAndEnvironment/Pollution/CleanUpPrograms/OngoingProjectsUpdates/CongareeRiverSediment/AdministrativeRecord/. The Administrative Record is also available for review at the main branch of the Richland County Public Library located at 1431 Assembly Street, Columbia, SC 29201.

2.0 DESCRIPTION OF OVERALL PROJECT

The Stakeholder-Developed MRA Plan delineates a revised approach toward completing a "Modified" Removal Action to address impacted sediment that exists within a portion of the Congaree River in

Columbia, SC. The project objective is to pursue a MRA that consists of the removal of TLM and impacted sediment from two separate areas as depicted on Figure 2 as a revised approach that may be able to receive a favorable USACE permit decision for the necessary cofferdam as well as all other required regulatory approvals. The project description in this section is being provided for general information purposes and as a supplement to item 32 in the Joint Application Form.

The MRA will involve removal of impacted sediments from areas that are:

- Close to the shoreline and therefore more susceptible to human dermal contact or exposure (e.g., river users such as kayakers, waders/swimmers, fishermen etc.); and
- More concentrated with tar-like-material (TLM), or where thicker deposits of TLM are shown to exist.

Figure 2 shows the outline of the previously proposed full-scale removal area versus the currently proposed two areas comprising the MRA. The volumes shown on Figure 1 for each approach were calculated using a combination of new survey information collected in the spring of 2018 and the sediment coring logs collected from the remedial investigations conducted in 2010 to 2012. Figure 3 shows the proposed MRA areas with a GIS visualization of each sediment boring as a TLM “hot-spot” which depicts the greater thickness of the TLM by a brighter color. Figure 4 provides an updated depiction of the average TLM thickness with estimated volume, using a similar GIS tool in which the data representation extends into the adjacent data point. Sediments in the “other areas” that will not be removed consist of either:

- Relatively minor thicknesses of TLM, and/or
- Are now covered by additional sediment resulting from the “superstorm” of 2015; and/or
- Occur far enough away from the shoreline and in deeper water, whereby risk of human dermal contact or exposure is minimal.

The currently proposed MRA consists of two areas as shown on Figures 2 through 4. Area 1 is approximately 2.6 acres and as proposed, has a similar footprint to the original full-scale Phase 1 Area. Area 2 is approximately 0.5 acres in size. Table 1 provides a comparison of volume estimates from previously submitted documents. Assuming successful completion of the MRA, an estimated 73 percent of the total TLM will have been removed from the Congaree River.

3.0 IMPLEMENTATION CONSIDERATIONS

The primary implementation considerations involve the following items discussed in this section:

- Access to the project area;
- Cofferdam placement within the river for isolation of the removal areas;
- Site operations plan for the landside support zone;
- Dewatering and water management for the removal areas inside the cofferdams;

- TLM and sediment excavation, management, transport and disposal; and
- Support plans for screening and management of unexploded ordnance (UXO) and historical artifacts.

3.1 Project Area Access

DESC evaluated several options for access to the project area, including access from the north along the river using City of Columbia-owned property (northern access), from Senate and Gist Streets (central access), and from Blossom Street (southern access).

Landside access to the project area within the river is currently anticipated from Senate and Gist Streets using the central access option. A lease agreement with the property owner is anticipated to allow for both access to the river and the landside operations that will be necessary to support MRA activities within the river. Site access and the anticipated lease area are identified on the conceptual site operations plan provided as Figure 5.

3.2 Cofferdams

To isolate the removal areas and allow for dewatering and screening the areas for the potential presence of UXO and historical artifacts, reinforced rockfill berm cofferdams will be installed. The cofferdam locations around Areas 1 and 2 are identified on Figure 3. The design of the cofferdams is presented with the set of drawings provided as Attachment B to the Joint Application.

<u>Design and Construction Considerations</u>

Features of the design include:

- A spillway height of 123.5 feet (NGVD 29), designed to minimize overtopping events during the primary construction season;
- Full reinforcement of the outboard side of the cofferdam to minimize damage and risk of material loss;
- Full reinforcement of the overtopping structure to minimize damage to the cofferdam during overtopping events;
- A level surface at the top of the cofferdam, of sufficient width and finish to provide a driving surface for project support vehicles;
- Placement of a HDPE liner within the fill to reduce leakage and associated water handling requirements; and
- A HDPE pipe (or equivalent) through the downriver end of the cofferdam with a check valve, to allow for dewatering of the interior area following an overtopping event.

Prior to initiating cofferdam construction, the footprint of each cofferdam will be addressed following the Mussel Relocation Plan described in Section 5.0 and UXO Management Plans described in Section 3.6. Detailed plans for cofferdam construction will be developed by the construction/remediation contractor. Each area will be addressed separately using the following general construction considerations:

- Total suspended solids (TSS) monitoring will be conducted in accordance with the TSS Monitoring Plan provided in Appendix E during cofferdam construction to monitor and control potential sediment release from the work area;
- The river bank surface that interfaces with the cofferdam will be stripped and prepared properly during installation;
- Material will generally be placed in lifts as the cofferdam is constructed;
- The outlet structure will be installed as material lifts are being placed;
- HDPE liner and reinforcement material (articulated concrete block (ACB) mats) will be placed over the outboard slope and crest of the cofferdam, with additional reinforcement on the inboard slope at the spillways and other critical sections (based on anticipated sediment removal depth);
- Diversion berms, sumps and pumps will be utilized for dewatering the inboard area;
- To the extent practicable during initial dewatering, fish present within the cofferdam area will be captured and relocated within the river, and the presence of vulnerable or imperiled plant species (Rocky Shoal’s Spider Lily) will be assessed and these plants will be relocated to a suitable habitat.
- Removal of TLM and sediment within the isolated area, to the extent feasible;
- Pressure wash the exposed bedrock bottom of the river where necessary;
- Deconstruction (i.e., removal of the reinforcement and other cofferdam materials from within the river following completion of sediment removal within each area); and
- The cofferdam in each area will be constructed following the same general sequence.

Real-Time Water Quality Monitoring

Downstream and upstream (background) real-time TSS monitoring will be conducted during cofferdam construction activities to ensure the project does not contribute to elevated TSS levels within the river. Conducting real-time TSS monitoring downstream of the construction area and comparing the results to the background levels from upstream, if needed, will provide timely notification of elevated project related TSS conditions, should they occur. Mitigation measures, such as deployment of a silt curtain, will be employed if an increase above the established conservative TSS action level is indicated. Specific details with respect to the TSS monitoring, action level and the mitigation procedures are provided in the TSS Monitoring Plan located in Appendix E.

Inspection and Maintenance

The Cofferdam Inspection and Maintenance Plan (Appendix B) provides a detailed daily cofferdam structure inspection plan that will be implemented by project oversight personnel. Areas of inspection include the cofferdam structural integrity, exterior conditions (such as debris buildup), riverbank tie-in locations, overall performance and leakage volumes, navigational signage and notification components, expected future river levels, etc. An inspection form will be completed during each work day and any potential areas in need of repairs will be documented and addressed as soon as practical. Implementation of this plan will ensure that cofferdam structural issues are identified and rectified in a timely manner and that project personnel are aware of changing river conditions and can plan accordingly.

3.3 Site Operations Plan

The Site Operations Plan (Appendix C) is intended to provide general procedures to safely and effectively implement the proposed MRA activities. Several site preparation activities will take place prior to initiating the removal work to assure the safe and effective implementation of the MRA. The conceptual approach to the site operations plan is summarized on Figure 5. Some variations to the plan may occur, depending on site conditions encountered at the time of remediation. The actual layout for site operations will be finalized at the discretion of remediation personnel provided DESC, SCDHEC and the landside property owner concur with any significant modifications.

Site preparation and operations will involve the following activities addressed in the plan:

- Landside support zone construction;
- Utility clearance and management;
- Archaeologist demarcation of historic and archaeological sites;
- Evaluation of the power line corridor and demarcation of plant species of concern locations, if present;
- Site office location;
- Site security and fencing;
- Stormwater management and sedimentation controls;
- Work zones;
- Traffic control; and
- Staging areas.

3.4 Water Management

Management of water will be a major component of the overall remediation project. The Water Management Plan (Appendix D) provides details on the anticipated procedures to be implemented during remediation activities. For implementation purposes, water to be managed has been divided into two categories: non-contact water and contact water.

Non-contact water is visually unimpacted water that has not been in contact with TLM or impacted sediments. It includes water from initial dewatering or overtopping events, cofferdam leakage, landside stormwater run-on, and non-contact removal area water including precipitation falling within the cofferdams. Contact water is water that has been in contact with TLM or impacted sediments or appears to be visually impacted (e.g., contains large amounts of suspended solids, exhibits a sheen, or has TLM particles suspended within the water column). The area of origin of the water will be a primary consideration in determining which mode of water management will be used, along with a visual evaluation by site personnel.

The on-site water management system will be used to contain, filter and discharge contact water. The planned discharge location is a sanitary sewer manhole located near the eastern perimeter of the landside support zone shown on Figure 5. Stormwater from the landside operations area will be controlled via the requirements and best management practices (BMPs) established in the Comprehensive Stormwater Pollution Prevention Plan (C-SWPPP) submitted with the Notice of Intent (NOI) for coverage under the South Carolina National Pollutant Discharge Elimination System (NPDES) General Permit for Stormwater Discharges from Construction Activities. Non-contact water within the removal areas, including leakage through the cofferdam, will be contained and returned to the river as described further in the Water Management Plan.

3.5 Excavation and Material Management

The major objective of this project is the removal of the TLM and impacted sediment from within the removal areas to the extent practicable. However, visually un-impacted sediment will also be removed and conservatively managed similar to “impacted sediment”. After the cofferdam in each area is constructed, initial dewatering operations will begin and the water from within the cofferdam will be systematically lowered. At this point coordination of several activities will be required including:

- Conduct mussel relocation activities, if not conducted in conjunction with the cofferdam footprint;
- Safely screen the removal area for potential UXO as described in the UXO Management Plans;
- Complete final dewatering of the removal area; and
- Construct an internal, bermed area along the toe of the cofferdam for the leakage/seepage water collection system.

There will be two types of advance screening of the work areas, including mussel relocation activities and UXO clearance and management. No intrusive removal operations will be conducted unless the planned removal area has been screened and designated as safe by the UXO management personnel. UXO screening and management will be conducted in accordance with the UXO Management Plans further discussed in Section 3.6. The UXO personnel will clear portions or the entire isolated and dewatered area prior to permitting the initiation of removal operations. The mussel relocation activities are further discussed in Section 5.0.

After final dewatering and construction of the leakage/seepage water collection system, the removal area will be relatively water-free and suitable for safe removal of the sediment. A combination of removal methodologies and equipment will most likely be required to successfully complete the project due to the varying thickness of sediment and changing bathymetric conditions within the project area. Standard excavation methods coupled with vacuum removal or other techniques will likely be employed.

It is currently estimated that approximately 11,700 cubic yards (CY) of sediment material (or 23,350 tons using a 2.0 conversion factor) are present within the proposed removal areas. Table 1 provides a summary of the material estimates. These volume estimates are approximations due to the inherent difficulties with measuring sediment thicknesses and the variations of the river bottom within the project area. Additionally, the majority of material to be removed from the river will likely require addition of a drying agent or other bulking agent to render the material suitable for transportation to the on-site screening facility or the off-site disposal facility. Therefore, the actual final tonnage will depend on a number of variables.

Sediment material removed from the river will be screened for historical artifacts on-site by trained professionals operating under direct supervision of the project archaeologist. Methods and procedures to be used have been developed and reviewed by SCIAA. A Memorandum of Agreement (MOA) between DESC, USACE and SCIAA was signed in May 2017 and will be updated as necessary. If required, more highly impacted material may be transported directly to a prepared site at the disposal landfill for artifact screening. Recovered artifacts will be preserved in accordance with SCIAA-approved procedures.

As envisioned, sediment removal will start from the northern portion of each cofferdam and progress southward. However, the removal area sequence is subject to change based on conditions including the river bottom characteristics, sediment volume and thickness, and presence of TLM, as well as the judgement of the remediation contractor. Sediment removal within the cofferdam will be further controlled via the establishment of grids, or controlled sequences, to minimize the area of open excavation, to document progress and conditions, and for artifact recovery purposes. To the extent practicable, sediment removal operations will extend inward toward the riverbank until visual impacts are no longer present.

To the extent practicable, the excavated sediment will be piled or stacked in designated draining areas where entrained water will be allowed to flow away from excessively wet material. This water will be contained and ultimately transferred to the water management system. This technique will reduce the amount of material conditioning required to transport the impacted sediment to the next location or step in the process. Any contact water collected on the landside will also be transferred to the water management system.

After allowed to drain, the sediment will be mixed with a conditioning or drying agent (e.g., saw dust) or commercially available polymer, as necessary, to render it suitable for transport to the landside support zone for further conditioning and artifact screening. After the artifact screening process, DESC will utilize appropriately licensed transportation companies to conduct the material transportation activities to the landfill. Similar to material disposal during remediation of the Huger Street former MGP site, use of the Waste Management Richland County Landfill is currently anticipated for disposal of the excavated material. All shipments will be manifested in accordance with federal and state requirements.

3.6 UXO and Historical Artifacts Support Plans

Due to the potential presence of UXO and historical artifacts in the removal areas, support plans have been developed to address these items. The plans have been provided as attachments to the Joint Application in response to application or permit condition requirements and are summarized below.

UXO Screening and Management

UXO screening and management will be conducted in accordance with the UXO Management Plans (Attachment N to the Joint Application), which provide specific details pertaining to the UXO management operations. No intrusive construction or removal operations will be conducted unless the work area has been screened and designated as safe by the UXO management personnel. As currently planned, the UXO management personnel will conduct diving operations to clear the path of the cofferdam footprint prior to the initiation of cofferdam construction. The area within the cofferdam will be cleared in sections or its entirety after the area has been adequately dewatered.

DESC previously retained Explosive Ordnance Technologies, Inc. (EOTI) to address the planning phase for screening, removal and management of the UXOs. EOTI developed the following four UXO Management Plan documents, consistent with typical USACE guidance and protocols:

- Draft Work Plan for Munitions Response MEC Clearance and Support;
- Explosive Safety Submission Munitions and Explosives of Concern Clearance and Support;
- Dive Safe Practices Manual; and
- Diving Operations Plan.

These four plans, provided in Attachment N to the Joint Application, will be updated, as necessary. During implementation of the MRA, each identified metal anomaly will be evaluated and confirmed as either UXO, historical artifact or other metallic debris and managed in accordance with the approved plans.

Historical Artifacts Screening and Recovery

This project involves the potential presence of historical artifacts located within the river. Therefore, DESC has worked closely with the South Carolina Institute of Archaeology and Anthropology (SCIAA) and the State Historical Preservation Office (SHPO) to develop an appropriate approach to recover and preserve any potential historical properties.

The Cultural Resource Identification Survey and Archaeological Data Recovery Plan developed by TRC Environmental Corporation are provided in Appendix M. The recovery plan contains the specific methodology and techniques that are currently planned for processing the removed material and segregating the potential artifacts. Recovered artifacts will be preserved in accordance with SCIAA-approved procedures. A draft Memorandum of Agreement (MOA) between USACE, DESC and SHPO/SCIAA is also provided in Appendix M.

4.0 SITE RESTORATION

Minimizing disturbance and properly restoring disturbed areas will be a critical component of the overall project. Figure 5 provides the currently anticipated site operations plan scenario and indicates the potential approximate areas of activity for landside operations, removal operations within the river, and locations along the eastern shoreline of the riverbank that will likely be disturbed as a result of MRA activities. Efforts will be undertaken to safeguard the remainder of the areas from impacts. Areas where disturbance may not be necessary will be demarcated with flagging or fencing to ensure they are not impacted by removal operations or heavy equipment movement unless required. This preservation technique will be a key to minimizing the disturbed areas.

In areas where landside operations occur and shoreline impacts are unavoidable, DESC will conduct restoration activities. DESC plans to strategically locate landside site operations components in areas that will limit the need for clearing and grading activities, as much as practical. This scenario will reduce disturbance of currently forested land and further preserve the riparian corridor. It will also minimize the amount of landside restoration activities that will be required prior to final demobilization. Restoration plans are described in two documents provided as attachments to the Joint Application in response to application or permit condition requirements (Attachment K – Draft Stormwater Management and Sediment Control Plan and Attachment P – Restoration Operation, Maintenance and Monitoring Plan). Restoration of the landside operations area, removal areas within the river, and the disturbed riverbank and shoreline locations are described briefly below.

Landside Restoration

Prior to mobilization, a Notice of Intent will be submitted to the City of Columbia for coverage under South Carolina NPDES General Permit For Stormwater Discharges From Construction Activities SC100000. This submittal will include a Comprehensive Stormwater Pollution Prevention Plan which includes a Stormwater Management and Sediment Control Plan (SMSCP). The SMSCP provides details on erosion and sediment control methods to be established, maintained and inspected at the site during active operations, as well as plans for final restoration following completion of landside activities. The general approach to final restoration of the landside operations areas is to restore the locations to pre-MRA conditions to the extent practical.

River Restoration

DESC plans on removing all sediment and gravel, small rocks, etc. (both visually impacted with TLM and visually unimpacted material) from the removal areas to the extent practical. Large rocks that are visually unimpacted may be temporarily relocated within the work area to facilitate sediment removal and then returned to their approximate original locations. As an additional measure, DESC plans to pressure wash the exposed bedrock bottom of the river where necessary. Water generated during the pressure washing stage will be collected and removed from the excavation for treatment and discharge to the City of Columbia Public Owned Treatment Works (POTW). The intent is to remove any residual staining or impacts due to the presence of TLM.

Current plans do not include replacing any removed material with backfill. The TLM, impacted sediment, and visually un-impacted sediment will be removed down to the top of the underlying bedrock. In many areas, this will only require removal of several inches of sediment. Following completion of the removal activities, the cofferdam will be removed and over time, the natural depositional processes of the river will restore the river bottom to natural conditions. This process will allow for natural re-deposition of sediment within the removal area based on current river hydraulics. Not replacing the impacted sediment with fill material will also eliminate the potential for backfill materials to be washed downstream and deposited in other areas or degrade other habitats through siltation, etc.

Riverbank and Shoreline Restoration

Detailed plans for the riverbank and shoreline restoration are provided in Attachment P to the Joint Application (Restoration Operation, Maintenance and Monitoring Plan). It is estimated that approximately 975 linear feet of the project area shoreline may be impacted by MRA activities. Shoreline disturbances will be limited to the extent practical. These locations include access roads and cofferdam/riverbank tie-in locations. Available delineation data suggest that TLM is not located within the riverbank soil and as a result, much of the riverbank and riparian corridor may be left undisturbed.

Restoration will include recreating the approximate shoreline slope, stabilization of the bank via riprap and/or bioengineered solutions, and restoration of vegetative cover where practical. DESC's goals are to minimize riverbank disturbance where possible, to restore disturbed areas to natural pre-MRA conditions, and to utilize bioengineering techniques and structures to the extent practical when repairing impacted shoreline. As stated above, portions of the riparian corridor where disturbance may not be necessary will be demarcated to ensure that they are not impacted unless required. This preservation technique will be a key component of the overall project.

Following completion of the MRA sediment removal and restoration activities, the riverbank and shoreline area will be monitored to assure restoration was successful. Periodic inspections will occur on a monthly basis or following significant weather-related events for a period of one year, unless property owner redevelopment plans result in an earlier change to restored conditions. Should issues be identified during inspections that warrant mitigation, DESC will implement repairs to the affected area(s), as necessary, to assure sufficient stabilization.

As project plans are further developed, certain details or specifications regarding restoration may be modified in order to reflect minor changes or input from applicable experts and/or the property owner. The USACE, SCDHEC and other agencies, as may be appropriate, will be made aware of any major modifications to planned activities prior to implementation.

5.0 MITIGATION MEASURES

Measures to mitigate potential impacts during implementation of the MRA are described in this section. The measures are based on anticipated requirements of the permit authorization as determined from review of the Joint Application, NWP General Conditions (GC) and Regional General Conditions (RGC). This information supplements Items 39 and 40 of the Joint Application and addresses factors identified in GC 23. The mitigation measures described below include plans to address:

- Navigation within the river during MRA implementation (based on GC 1);
- Aquatic life, spawning areas and endangered species within the project area (based on GCs 2,3 and 18); and
- Historic properties within the project areas (based on GC 20).

Additional measures to avoid impacts associated with MRA implementation are described in plans developed to address other requirements of the Joint Application. These measures address landside, riverbank and shoreline, and within the river project areas, and include:

- Draft Stormwater Management and Sediment Control Plan for the landside area (Attachment K to the Joint Application);
- Restoration Operation, Maintenance and Monitoring Plan which addresses the riverbank and shoreline, including the area below the ordinary high-water mark (Attachment P to the Joint Application); and
- Total Suspended Solids Monitoring Plan which describes monitoring and contingency measures for TSS within the river (Section 3.2 and Appendix E in this Project Description).

Compensatory mitigation is not required because no wetlands are adversely impacted and the MRA project has an overall positive environmental impact. The proposed removal action within the river portion of the project area is short-term and the improvement resulting from removal of the TLM-impacted sediment will be permanent. Removing the impacted sediment will provide benefit in the form of reduced potential for contact with the TLM by humans and other organisms. Removal of the TLM also reduces the potential for resuspension and downstream movement and reduction in the potential for flux of dissolved phase constituents with the water column. Aquatic resource function and quality will be improved due to the removal of the impacted sediment. The cofferdams and other support operations will be removed and disturbed portions of the riparian corridor will be restored following completion of the MRA. No permanent loss of wetlands, open waters, riparian areas or aquatic habitat will occur.

5.1 Navigation (GC 1)

The Draft Navigation Plan (Attachment G to the Joint Application) was developed in accordance with the instructions provided with the United States Coast Guard (USCG) Private Aids to Navigation Application. The Application and Draft Navigation Plan will be finalized and submi8tted to the USCG for approval following receipt of permit authorization for the USACE.

The Plan provides specific methods for notifying boaters and other users of the river in advance of the project location (upriver and downriver) and the need to take appropriate measures to avoid the cofferdam structure. It provides the specific methods for demarcating the area to be avoided and the buoy/signage/lighting scenario for the project. Implementation of the MRA will have no adverse impact on navigation in the Congaree River.

5.2 Aquatic Life Movements, Spawning Areas and Endangered Species (GCs 2, 3 and 18)

Aquatic Life Movements

Because the project area will only occupy a portion of the river at any given time and downstream and upstream movement and access of aquatic organisms will not be impeded, no impact on aquatic life movements is anticipated.

Spawning Areas

Downstream movement of suspended particles and sediment liberated from the work area can potentially impact spawning areas and other aquatic resources. BMPs such as roadway construction and maintenance, shoreline stabilization and deployment of sediment (i.e., silt) curtains, etc. will be utilized as needed. Erosion and sediment control measures associated with the landside support zone are presented in the Draft Stormwater Management and Sediment Control Plan (Attachment K to the Joint Application).

As described in Section 3.2, downstream and upstream (background) real-time TSS monitoring will be conducted during cofferdam construction activities to ensure the project does not contribute to elevated TSS levels within the river. Specific details with respect to the TSS monitoring, action level and the mitigation procedures are provided in the TSS Monitoring Plan located in Appendix E. Conducting real-time TSS monitoring downstream of the construction area and comparing the results to the background levels from upstream, if needed, will provide timely notification of elevated project related TSS conditions, should they occur. Mitigation measures, such as deployment of a silt curtain, will be employed if an increase above the established conservative TSS action level is indicated.

Endangered Species

The project area was evaluated for the potential presence of threatened and endangered species and spawning habitat. Due to the nature of the project and the associated mitigation measures built into the project plans, specifically the project construction schedule (Section 6.0) and the freshwater mussel relocation activities described in this section, project related activities are not anticipated to negatively impact sensitive species or spawning areas/migrations. A number of sources were used to assess the potential presence of endangered or threatened species in the project area and include:

- U.S. Fish and Wildlife Service (FWS);
- U.S. National Marine Fisheries Service (NMFS);
- South Carolina Department of Natural Resources (SCDNR); and
- The Rare, Threatened and Endangered Species Assessment developed by Kleinschmidt (March, 2008) prepared for the Saluda Hydroelectric Relicensing Project (FERC project no. 516).

Table 2 provides a summary of Federal and State Rare, Threatened and Endangered Species for the project area general vicinity. The Kleinschmidt report was primarily focused on Lake Murray and the Lower Saluda River and the downriver extent was generally terminated at the confluence with the Broad River or the headwaters of the Congaree River (Figure 1). However, the shortnose sturgeon study and the freshwater mussels study conducted as part of the assessment activities extended into the upper Congaree River including the planned project area. Review of these assessments and the available information from the FWS and SCDNR identified a number of federal and state threatened and endangered species, federal candidate species and other species of concern.

Of specific interest to this general project area are the Rafinesque’s big-eared bat, shortnose sturgeon, robust redhorse sucker, species of freshwater mussels, and three plant species (Georgia aster, smooth coneflower and Rocky Shoal’s Spider Lily). The Rafinesque’s big-eared bat and shortnose sturgeon are listed as state endangered species and state and federal endangered species, respectively. The robust redhorse sucker is identified as critically imperiled on the federal list. Eight species of freshwater mussels listed in Table 2 are potentially present in the project area and range from “vulnerable” to “imperiled” at either the national or state level in the NatureServe database. The smooth coneflower is a federal endangered species, the Georgia aster is a federal candidate species, and the Rocky Shoal’s Spider Lily is a federal vulnerable and NatureServe imperiled species.

The Rafinesque’s big-eared bat’s range includes the sandhills region and it is known to roost under I-beam and T-beam bridges. The Gervais Street Bridge may provide a roosting site for this bat. However, project activities will occur downstream of the bridge and should not impact potential roosting sites within the structure.

The shortnose sturgeon have been anecdotally reported to be present in the vicinity of the project area during spawning runs. Based on available information and prior communications with USACE trustees (NMFS and USFWS), if the project is completed between the months of May through October it will not impact potential sturgeon migration. The robust redhorse sucker has been stocked in large numbers in the Broad River and may be periodically present in the vicinity of the project area. The relatively limited extent of project operations within the river will not be detrimental to this species, if present. Also, during initial dewatering of the areas within the cofferdams, any fish present within the cofferdam areas will be captured and relocated within the river to the extent practicable.

DESC has agreed to conduct freshwater mussel screening and relocation operations in an attempt to preserve indigenous freshwater mussels that may be present within the project footprint. As seen in Table 2, a number of sensitive mussel species were identified in the planned project vicinity. The anticipated mussel relocation activities are explained in detail in the Mussel Relocation Plan (Attachment H). Mussels located within the removal areas, including the planned footprint of the cofferdam structures, will be collected and relocated. As currently envisioned, one of two potential scenarios will be implemented based on project logistical considerations. The first scenario includes conducting the mussel collection and relocation in one mobilization per construction phase following determination of a suitable relocation site. Relocation area(s) will be chosen by the subject matter experts and will be located close to the planned project area. A combination of wading and diving will be necessary in order to adequately survey the majority of the project area. The second scenario includes mobilizing the collection and relocation team and removing the mussels from the approximate footprint of the planned cofferdam and the outboard buffer zone. The relocation team would then demobilize until the cofferdam is constructed and the isolated area is partially dewatered. The team would remobilize and complete the collection and relocation of the mussels within the isolated area. With this scenario, the partial dewatering will facilitate access to the mussels and potentially increase the effectiveness and overall efficiency of the process.

The potential habitat for the smooth coneflower and Georgia Aster would be along the power line corridor located directly east of the river-based project area. Current plans include the use of portions of the power line corridor for landside support activities. During site operations setup activities, the corridor will be evaluated for the presence of smooth coneflower and Georgia Aster. If identified, their location will be demarcated and avoided to the extent practicable during implementation of the project. Should disturbance of these locations become necessary, these plants will be protected or relocated to the extent practical.

The Rocky Shoal's Spider Lily is a perennial plant that inhabits rocky shoals or bedrock outcrops in large streams or rivers at or above the fall line (Kleinschmidt, 2008). It is found in relatively large numbers directly upstream of the project area at the confluence of the Saluda and Broad Rivers, and some portions of the project area may exhibit favorable conditions for its occurrence. Because of the potential for Rocky Shoal's Spider Lily to exist within the removal areas within the river, DESC plans to assess their presence during cofferdam installation and initial dewatering activities. If present, these plants will be relocated to a suitable habitat to the extent practicable.

5.3 Historical Properties (GC 20)

Historic and archaeological properties in the general project vicinity have been identified and specific activities will be undertaken as needed to safeguard these properties during project implementation. A Cultural Resources Identification Survey (CRIS) was conducted by TRC (Attachment M to the Joint Application) that covered the overall project area and general vicinity. In addition, potential historical sites were researched using ArchSite, which is a geographic information system (GIS) maintained by SHPO and SCIAA. A historic and archaeological properties identification, including tabular listing and figure showing locations, is provided as Attachment L to the Joint Application.

Two separate sites are located in the general vicinity of the project area that are designated as historically significant. The sites consist of the Gervais Street Bridge and the Columbia Canal. Both properties are listed in the National Register of Historic Places. The Gervais Street Bridge is located directly upstream of the project area. Implementation of the project is not expected to adversely impact the Gervais Street Bridge. Although MRA activities are located within the Columbia Canal area as defined by the National Register, project related activities are not expected to adversely impact this historic property.

Nine archaeological sites have been identified in the vicinity of the project area. The locations of these sites are shown on the figure in Attachment L to the Joint Application and include:

- Late 19th to Early 20th Century Artifact Scatter/Dump Site (ID# 38RD233)
- Underwater Civil War Era Ordnance Dumpsite (ID# 38RD286)
- Possible Ruins of Briggs' Saw Mill (ID# 38RD224)
- Late 19th to Early 20th Century Structure Foundation – House (ID# 38RD234)
- Underwater Deposit of Historic Ceramics and Metal Artifacts (ID# 38RD278)
- 19th to 20th Century Bottle Dump/Landfill (ID# 38RD223)
- Expanded Boundary of Underwater Civil War Era Ordnance Dumpsite (ID# 38RD286)
- Unknown Prehistoric Lithic Flake and Brick Fragment Scatter, 20th Century (ID# 38RD275)
- V-Shaped Wooden Object Eroding Out of Riverbank (ID# 38RD235)

One of these sites (ID# 38RD233) is located north of the Gervais Street Bridge and is not expected to be within the disturbed project area. Two of these sites (ID# 38RD275 and ID# 38RD235) are located south of Area 2 and the tributary near the downstream end of Area 2 and are also not expected to be within the disturbed project area.

The originally identified underwater Civil War era ordnance dumpsite area (ID# 38RD286) is just north of the northern end of Area 1 and is not expected to be disturbed. [It should be noted however, that the limits of the Civil War ordnance dumpsite were expanded based on the findings of initial magnetometer studies conducted as part of this project. Area 1 and Area 2 are situated within the ordnance dumpsite (ID# 38RD286).] A 19th to 20th century bottle dump/landfill (ID# 38RD223) is located on the eastern bank of the river between Area 1 and Area 2 and may be partially disturbed although intrusive activities are not expected. Possible ruins from a saw mill (ID# 38RD224) and a former structure foundation (ID# 38RD234) are located directly adjacent to Area 1. The archaeologist will locate these sites in the field, and they will be sufficiently demarcated and avoided to the extent practicable during implementation of the project. Should disturbance of these areas become necessary, proper precautions will be undertaken similar to the plans developed for the protection of other locations of historical significance.

An underwater deposit of historic items (ID# 38RD278) is located adjacent to and within Area 1, and the expanded boundary of the underwater Civil War era dumpsite (ID# 38RD286) is located within the river, including the cofferdam and removal areas. These areas will be impacted by cofferdam construction and sediment removal activities and are of primary concern. The presence of the Civil War dumpsite presents two primary issues or concerns, including the potential for the artifacts to be UXO and the need to properly recover and preserve any historical artifacts encountered. DESC, SCDHEC and the USACE have invested considerable time and effort into addressing these issues. Multiple UXO management plans have been developed to specify the potential management of such items. The current plans are provided as Attachment N to the Joint Application and will be updated as necessary prior to implementation.

The Field Demonstration Project (FDP) was conducted in the fall of 2015 to evaluate metallic anomalies, and potentially identify historical items or UXO in the alluvial fan area and none were found. Fifty-one previously identified metallic anomaly locations were investigated and only cultural debris and trash was uncovered. As a result, it is expected that a minimal amount of historically significant items and/or UXO is still present within the project area. However, as a precaution, an archaeologist will be on-site to properly document and secure any potential historical items. The Archaeological Data Recovery Plan develop by TRC Environmental Corporation is provided as Attachment M to the Joint Application. It contains the specific methodology and techniques that are currently planned for processing the removed material and segregating the potential artifacts. Recovered artifacts will be preserved in accordance with SCIAA-approved procedures.

An archaeologist will be on-site during intrusive activities to screen material and disturbed areas for historical artifacts after the areas have been prescreened for UXOs as described in the UXO Management Plans. If required, more highly impacted material may be transported directly to a prepared site at the disposal landfill for artifact screening. If historical items are identified, the archaeologist will document the finding and secure the item for transmittal to SCIAA/SHPO in accordance with the Archaeological Data Recovery Plan. The required licenses (Intensive Survey License and Data Recovery License) were previously obtained and will be updated as necessary prior to implementation.

6.0 CONSTRUCTION SCHEDULE

A detailed schedule of activities will be developed following receipt of the required permit approval from USACE and approval of the Final MRA Work Plan by SCDHEC. Key components of the schedule include:

- Obtaining other required permits and approvals, including access;
- Contractor selection; and
- Implementation of the removal action.

Due to seasonal fluctuations in typical river levels, the active in-the-river construction season for building or relocating the cofferdams will be from May through October of each year (pending approval). This construction season also avoids impacts on aquatic life migration and spawning seasons within the river.

The cofferdam construction and sediment removal work will require several seasons to complete. DESC has also requested permission to work behind the cofferdam year-round, with minimal site activity projected during the months of December through April. Conceptually, the UXO screening may be able to be completed during the off-season, assuming favorable weather/river conditions. The total duration of the project will be contingent upon factors including:

- Detailed plans of the selected contractor, developed in conjunction with DESC;
- Weather and river level conditions;
- The extent of UXO, historical artifact, and cultural debris presence within the project area; and
- Volume of water to be managed.

General considerations regarding the overall schedule for implementation of the MRA include:

- SCDHEC approval – Prepare a Final MRA Work Plan, submit to SCDHEC for review including public and stakeholder comments, and receive authorization.
- Access agreement(s) – Obtain agreement(s) with property owner(s) for landside operations and access to the proposed removal areas.
- City of Columbia approvals – Develop and submit applications to the City of Columbia and receive the required authorizations.
- Remediation Contractor procurement and site operations setup – Prepare project specifications, obtain and review contractor bids, select contractor, and complete site operations setup including access roads.
- Sediment removal with restoration and documentation – Removal of the impacted sediment within Areas 1 and 2, including construction and removal of the cofferdams, is expected to occur over three seasons.

7.0 COMPLIANCE CERTIFICATION STATEMENT

Pursuant to requirements of NWP General Condition 30, following completion of MRA activities, DESC will provide a signed certification documenting completion of the authorized activities and implementation of any required compensatory mitigation.

The certification document is expected to be provided by USACE with the NWP verification letter and to include the following items:

- A statement that the authorized activities were done in accordance with the NWP authorization, including any general, regional or activity-specific conditions;
- If applicable, a statement that the implementation of any required compensatory mitigation was completed in accordance with the permit conditions; and
- The signature of the permittee certifying completion of the activities, and mitigation if applicable.

TABLES

Table 1 Estimated Removal Volumes

Estimated by	MTR	Glenn & Associates	Apex	
	EE/CA Sediment Volume Estimate January 2013 Original, Full-Area Removal	Preliminary Removal Action Work Plan (PRAWP) September 2018 Full-Area Removal	Proposed Conceptual Plan - MRA Sediment Volume Estimate December 2018 MRA Areas 1 & 2	Percent Removal MRA vs PRAWP
Total Volume of Sediment to be Removed	26,700 CY	25,550 CY	11,675 CY	46%
Total Volume of TLM to be Removed	Not Estimated	5,745 CY	4,204 CY	73%

TABLE 2

SUMMARY OF RARE, THREATENED AND ENDANGERED SPECIES FOR THE PROJECT AREA AND VICNITY

Congaree River Sediments
Columbia, South Carolina

Common Name	Scientific Name	Federal Listed and Status(2)	State Protection and Status(3)	Potential Occurrence
Mammals				
Rafinesque's Big-Eared Bat	*Corynorhinus Rafinesquii / Plecotus Rafinesquii*	No	Yes - Endangered	Potential for occurrence in project vicinity under the Gervais and Blossom Street bridges.
American Alligator	*Alligator mississippiensis*	Yes - Threatened	Yes - Threatened	No - habitat not suitable
Birds				
Red-Cockaded Woodpecker	*Picoides Borealis*	Yes - Endangered	Yes - Endangered	No - habitat not suitable.
Wood stork	*Mycteria Americana*	Yes - Threatened	Yes - Endangered	No - habitat not suitable, extremely rare and if present likely from dispersion or migration.
Bald Eagle	*Haliaeetus Leucocephalus*	No	Yes - Threatened	Noted upstream of the project area but not in vicinity of project area. No anticipated impact.
Fish/Amphibians/Reptiles				
Pine Barrens Treefrog	*Hyla Andersonii*	No	Yes - Threatened	No - found in the sandhills region located northeast of the project area.
Shortnose Sturgeon	*Acipenser Brevirostrum*	Yes - Endangered	Yes - Endangered	Yes - though if present numbers likely limited
Robust Redhorse Sucker	*Moxostoma Robustum*	N1 - Critically Imperiled	SNR - Not Ranked	Yes - stocked by SCDNR below Parr Shoals dam.
Southern Hognose Snake	*Heterodon Simus*	No	Yes - Threatened	No - habitat not suitable
Freshwater Mussels				
Carolina Heelsplitter	*Lasmigona Decorata*	Yes - Endangered	Yes - Endangered	No - found in rivers and tributaries other than the Congaree River.
Roanoke Slabshell	*Elliptio Roanokensis*	N3 - Vulnerable	S2 - Imperiled	Yes - potential for occurrence in project vicinity
Yellow Lampmussel	*Lampsilis Cariosa*	N3N4 - Vulnerable, Apparentley Secure	S2 - Imperiled	Yes - potential for occurrence in project vicinity
Carolina Slabshell	*Elliptio Congaraea*	N3 - Vulnerable	S3 - Vulnerable	Yes - potential for occurrence in project vicinity
Carolina Lance	*Elliptio Angustata*	N4 - Apparently Secure	S3 - Vulnerable	Yes - potential for occurrence in project vicinity
Fatmucket	*Lampsilis Splendida*	N3 - Vulnerable	S2 - Imperiled	Yes - potential for occurrence in project vicinity
Eastern Floater	*Pyganodon cataracta*	N5 - Secure	SNR - Not Ranked	Yes - potential for occurrence in project vicinity
Creeper	*Strophitus undulatus*	N5 - Secure	S2 - Imperiled	Yes - potential for occurrence in project vicnity
Eastern Creekshell	*Villosa delumbis*	N4 - Apparently Secure	S4 - Apparently Secure	Yes - potential for occurrence in project vicinity
Plants				
Canby's Dropwort	*Oxypolis Canbyi*	Yes - Endangered	S2 - Imperiled	No - habitat not suitable
Georgia Aster	*Symphyotrichum Georgianum*	Yes - Candidate	SNR - Not Ranked	Yes - power line corridor provides potential habitat.
Rough-Leaved Loosestrife	*Lysimachia Asperulaefolia*	Yes - Endangered	S1 - Critically Impaired	No - habitat is not suitable.
Rocky Shoal's Spider Lily	*Hymenocallis coronaria*	G3 - Vulnerable	S2 - Imperiled	Yes - known to occur directly upriver of project area.
Michaux's Sumac	*Rhus michauxxi*	Yes - Endangered	SX - Presumed Extinct	No - habitat is not suitable.
Smooth Coneflower	*Echnincea Laevigata*	Yes - Endangered	S3 - Vulnerable	Yes - power line corridor provides potential habitat.

Notes:

(1) Freshwater mussel occurrence taken from Kleinschmidt, March 2008.

(2) If species was not listed in the USFWS Endangered Species Database the NaturServe Global or National Status is shown.

(3) If species was not listed in the SCDNR SC Rare, Threatened & Endangered Species Inventory the NatureServe State or Subnational Status is shown.

(4) Federal and state listed threatened and endangered mammals, birds, fish, amphibians, reptiles and plants are provided in table. Mussels with a NatureServe rank are also listed due to their potential presence in the project area.

FIGURES

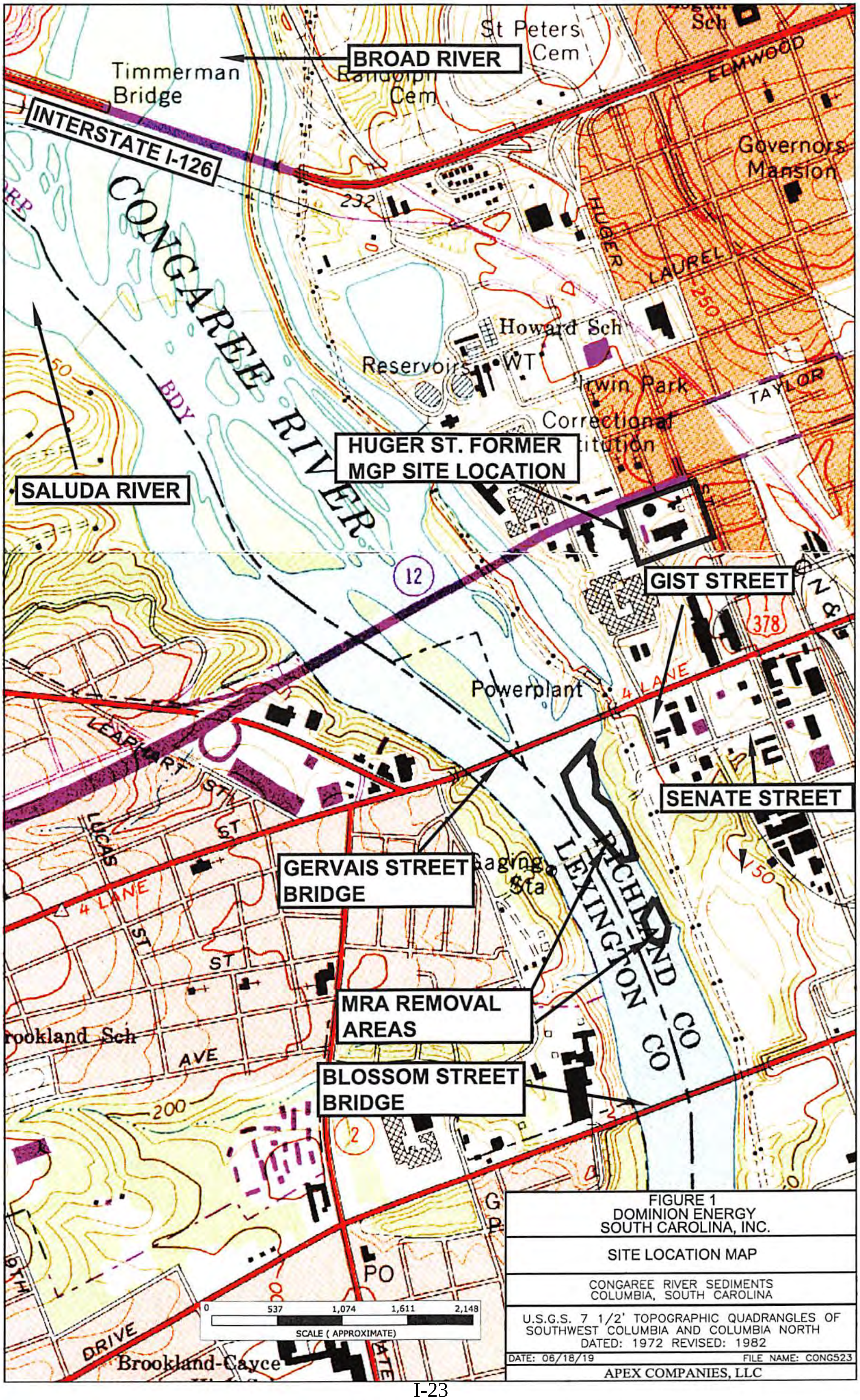


FIGURE 1
DOMINION ENERGY
SOUTH CAROLINA, INC.

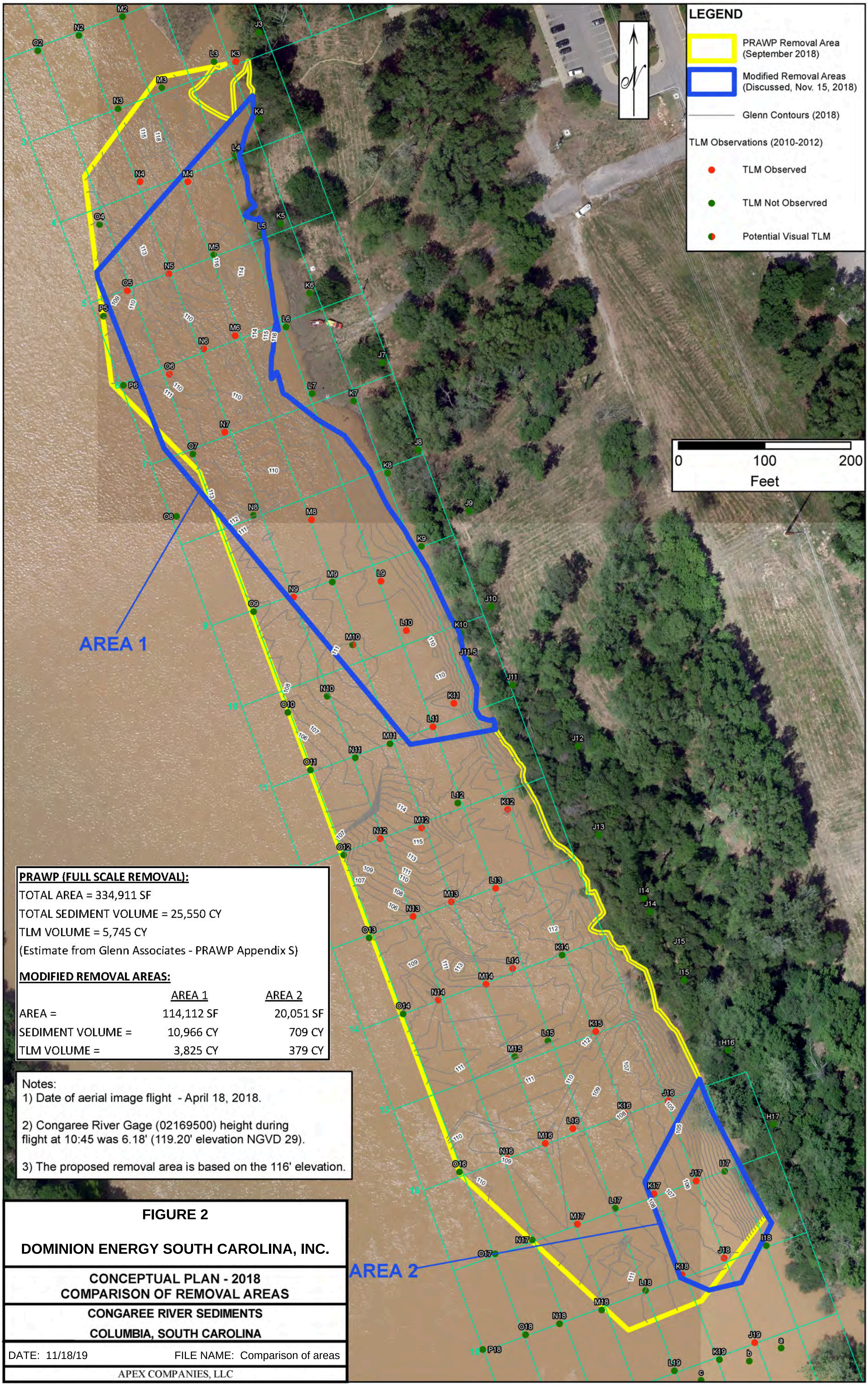
SITE LOCATION MAP

CONGAREE RIVER SEDIMENTS
COLUMBIA, SOUTH CAROLINA

U.S.G.S. 7 1/2' TOPOGRAPHIC QUADRANGLES OF
SOUTHWEST COLUMBIA AND COLUMBIA NORTH
DATED: 1972 REVISED: 1982

DATE: 06/18/19 FILE NAME: CONG523

APEX COMPANIES, LLC



PRAWP (FULL SCALE REMOVAL):

TOTAL AREA = 334,911 SF

TOTAL SEDIMENT VOLUME = 25,550 CY

TLM VOLUME = 5,745 CY

(Estimate from Glenn Associates - PRAWP Appendix S)

MODIFIED REMOVAL AREAS:

	AREA 1	AREA 2
AREA =	114,112 SF	20,051 SF
SEDIMENT VOLUME =	10,966 CY	709 CY
TLM VOLUME =	3,825 CY	379 CY

Notes:
1) Date of aerial image flight - April 18, 2018.

2) Congaree River Gage (02169500) height during flight at 10:45 was 6.18' (119.20' elevation NGVD 29).

3) The proposed removal area is based on the 116' elevation.

FIGURE 2

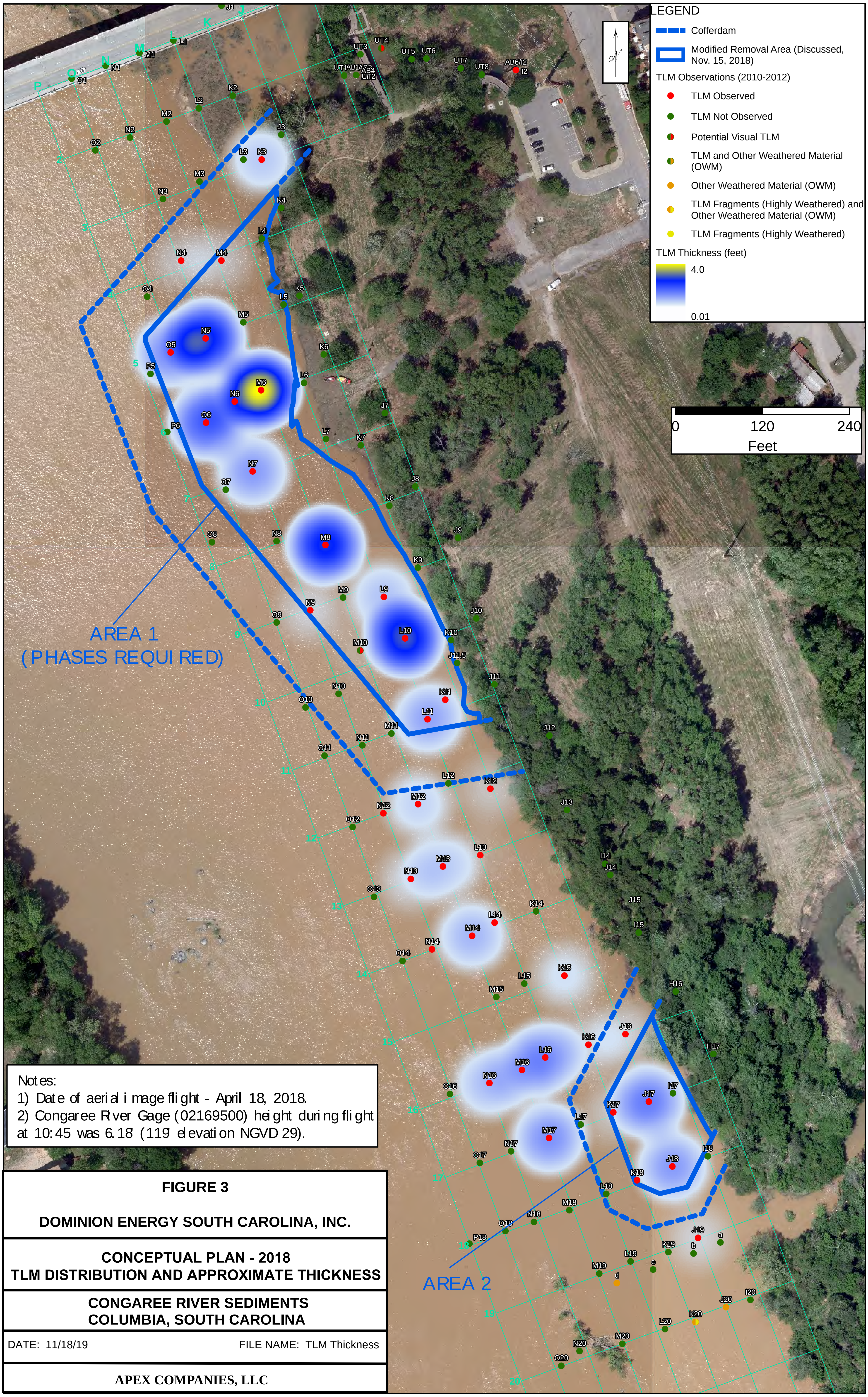
DOMINION ENERGY SOUTH CAROLINA, INC.

CONCEPTUAL PLAN - 2018
COMPARISON OF REMOVAL AREAS

CONGAREE RIVER SEDIMENTS
COLUMBIA, SOUTH CAROLINA

DATE: 11/18/19 FILE NAME: Comparison of areas

APEX COMPANIES, LLC



Notes:
1) Date of aerial image flight - April 18, 2018.
2) Congaree River Gage (02169500) height during flight at 10:45 was 6.18 (119 elevation NGVD 29).

FIGURE 3

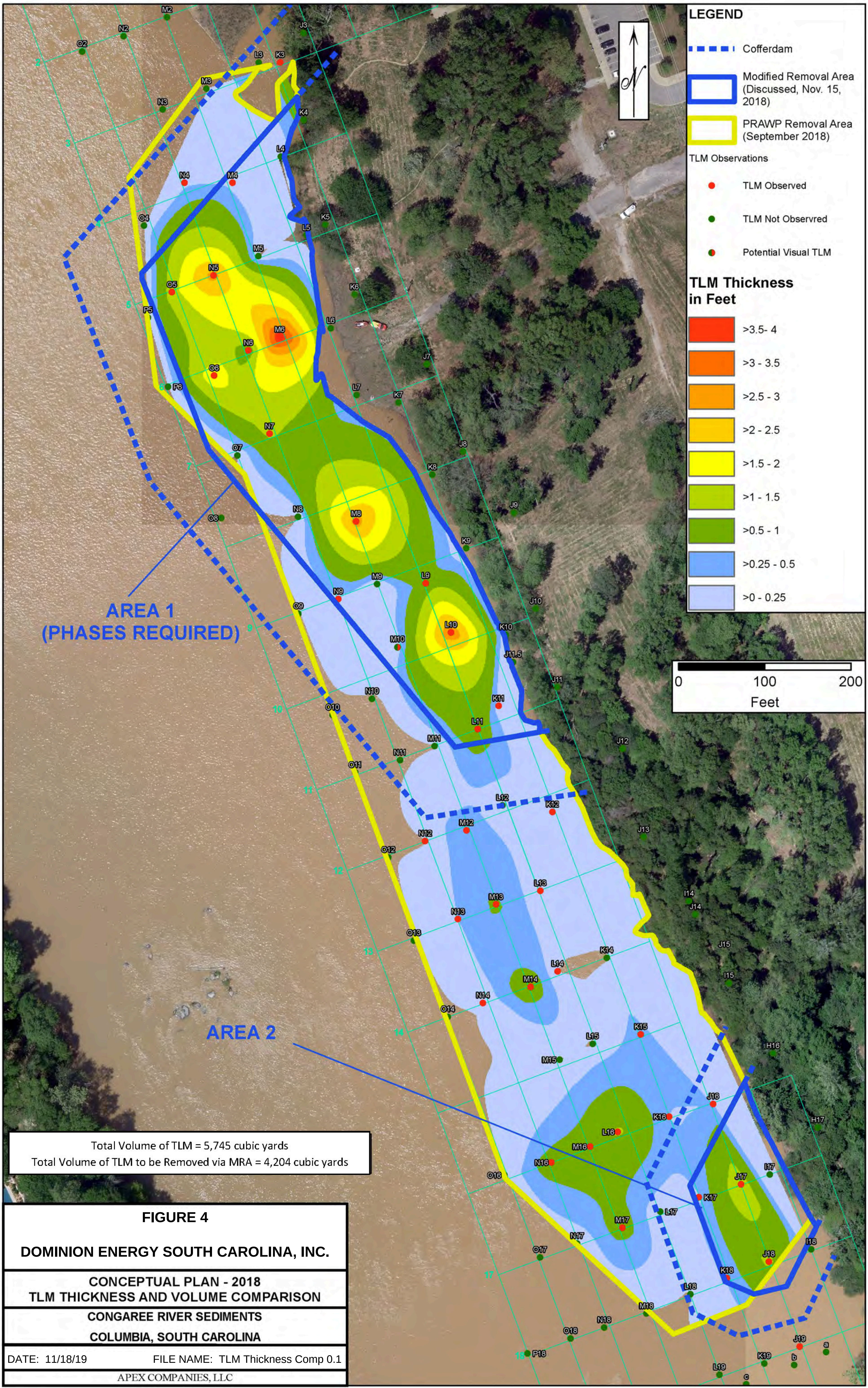
DOMINION ENERGY SOUTH CAROLINA, INC.

CONCEPTUAL PLAN - 2018
TLM DISTRIBUTION AND APPROXIMATE THICKNESS

CONGAREE RIVER SEDIMENTS
COLUMBIA, SOUTH CAROLINA

DATE: 11/18/19 FILE NAME: TLM Thickness

APEX COMPANIES, LLC



Total Volume of TLM = 5,745 cubic yards
Total Volume of TLM to be Removed via MRA = 4,204 cubic yards

FIGURE 4

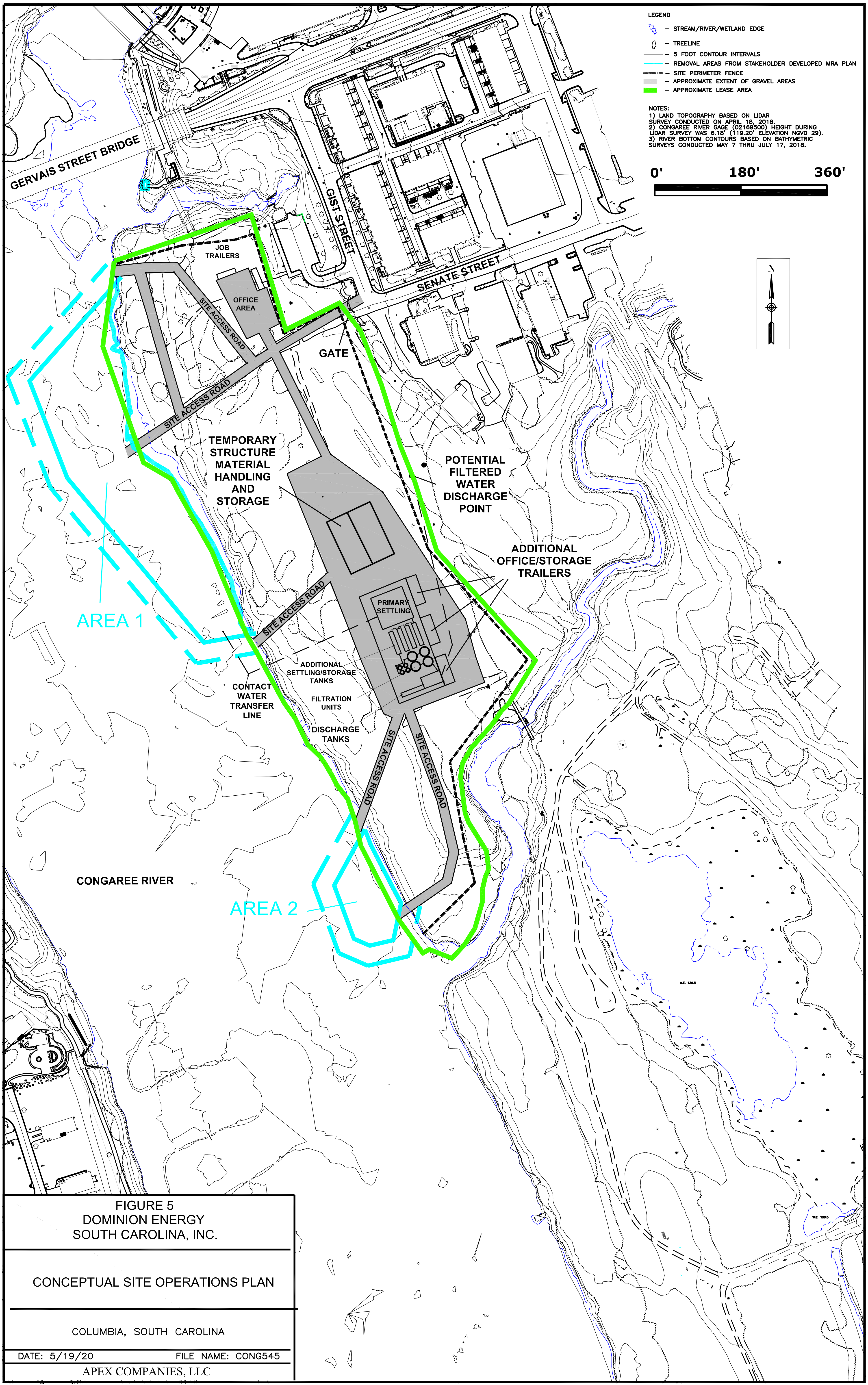
DOMINION ENERGY SOUTH CAROLINA, INC.

CONCEPTUAL PLAN - 2018
TLM THICKNESS AND VOLUME COMPARISON

CONGAREE RIVER SEDIMENTS
COLUMBIA, SOUTH CAROLINA

DATE: 11/18/19 FILE NAME: TLM Thickness Comp 0.1

APEX COMPANIES, LLC



LEGEND

⌇	– STREAM/RIVER/WETLAND EDGE
⌇	– TREELINE
───	– 5 FOOT CONTOUR INTERVALS
───	– REMOVAL AREAS FROM STAKEHOLDER DEVELOPED MRA PLAN
–x–x–	– SITE PERIMETER FENCE
▨	– APPROXIMATE EXTENT OF GRAVEL AREAS
🟩	– APPROXIMATE LEASE AREA

NOTES:
1) LAND TOPOGRAPHY BASED ON LIDAR SURVEY CONDUCTED ON APRIL 18, 2018.
2) CONGAREE RIVER GAGE (02169500) HEIGHT DURING LIDAR SURVEY WAS 6.18' (119.20' ELEVATION NGVD 29).
3) RIVER BOTTOM CONTOURS BASED ON BATHYMETRIC SURVEYS CONDUCTED MAY 7 THRU JULY 17, 2018.

FIGURE 5
DOMINION ENERGY
SOUTH CAROLINA, INC.

CONCEPTUAL SITE OPERATIONS PLAN

COLUMBIA, SOUTH CAROLINA

DATE: 5/19/20 FILE NAME: CONG545

APEX COMPANIES, LLC

APPENDIX J

STANDARD OPERATING PROCEDURES

MUNITIONS RESPONSE WORK PLAN CONGAREE RIVER PROJECT

REMOVAL ACTION AND CONSTRUCTION SUPPORT
COLUMBIA, SC

TETRA TECH

UXO SOP for MEC Management and Disposal

Procedure: UXO SOP - MEC Management and Disposal		
Procedure Owner: Director, Technical Operations and Explosives Safety	Effective Date: 7/1/2020	
Reference Corporate Procedure UXO-01, 02, & 03	Tetra Tech	Revision: 0

RECORD OF DEVELOPMENT, REVIEW, VALIDATION, AND APPROVAL

This Standard Operating Procedure (SOP) contains the procedures by which Tetra Tech, Inc will conduct MEC Management and Disposal operations for munitions response projects. Any changes or deviations will be included in the project plans and approved by the Director of Technical Operations and Explosives Safety. SOPs will be reviewed annually.

Director, Health, Safety, & Environmental Jim Streib, CSP, SMS, CQA, CHST		Date:	
Director, Technical Operations & Explosives Safety Patrick Tatman		Date:	6/23/2020

Review Date	Reviewer	Next Review

WORKER'S STATEMENT

I have read UXO SOP MEC Management and Disposal and received the training necessary to demonstrate my capability to perform the procedures addressed in this SOP. If I identify a hazard not addressed in this SOP or encounter an operation I cannot perform in accordance with this SOP, I will stop the process and notify my immediate supervisor.

Worker's Name	Date	Supervisor's Name	Date

TABLE OF CONTENTS

1.0 PURPOSE AND SCOPE

This Standard Operating Procedures (SOP) provides Munitions and Explosive Concern (MEC) management and basic explosive demolition procedures for the treatment of MEC and material potentially presenting material potentially posing an explosive hazard (MPPEH) found during the MEC activities on Munitions Response Site (MRSs). These procedures will be conducted in accordance with the Quality Assurance Project Plan (QAPP) or equivalent planning documents.

This SOP provides the detailed information needed to safely configure, conduct demolition procedures, and perform post demolition inspection and area restoration. These operations include:

- Documenting the recovery, accountability, and management of MEC/MPPEH
- Conducting disposal operations involving MEC/MPPEH
- Post disposal operations

All training on equipment or software will be either formal or on-the-job training (OJT). Training will be documented by site personnel and subject to review for accuracy and completeness. The Unexploded Ordnance (UXO) Quality Control Specialist (UXOQCS) will verify training is completed and documented.

2.0 PERSONNEL, EQUIPMENT, AND MATERIALS

This section describes the personnel, equipment, and materials required to implement this SOP.

2.1 PERSONNEL REQUIREMENTS

Explosive demolition operations require specific organizational roles and personnel assignments, specifically:

- Senior Unexploded Ordnance Supervisor (SUXOS), to oversee all demolition operations.
- Demolition Supervisor (DS), an Unexploded Ordnance (UXO) Technician Level III or above, designated by the SUXOS. The DS is responsible for planning, directing, and executing all demolition operations. The SUXOS may perform duties of the DS based on the project manning.
- Unexploded Ordnance Safety Officer (UXOSO), ensures that all demolition operations are performed safely and following the approved site-specific plans.
- Two Unexploded Ordnance Technicians Level II or I, designated to assist the DS.

2.2 EQUIPMENT

The Demolition teams conducting MEC management and disposal tasks will be equipped with the following:

- Analog Geophysical Sensor
- Disposal equipment
- Donor explosives
- Logbook and/or personal digital assistant (PDA) for recording data
- Camera

3.0 PROCEDURES AND GUIDELINES

3.1 MEC/MPPEH MANAGEMENT

When MEC and MPPEH are discovered, they are inspected and positively identified using a three-tiered inspection process while the munitions are left in place.

1. Inspected first by the UXO technician discovering the munition(s) to determine if it is MEC or MPPEH,
2. Second by a UXO Tech II to independently classify the munitions(s), and
3. Third by the UXO Tech III, Team Leader.

For MEC/MPPEH, the SUXOS and UXOSO must assess and agree that the risk associated with the movement of MEC or suspected munition is acceptable and necessary. They will document the decision in writing. If necessary, the Director of Technical Operations and Explosives Safety will be consulted and concur with the decision to move the ordnance. Based on knowledge of the site, this may be accomplished before field operations beginning.

If MEC/MPPEH are determined by the SUXOS and UXOSO to be unacceptable to move, they will be conspicuously marked, secured, and scheduled for Blow-in-Place (BIP) treatment by a demolition team.

All MEC shall be secured or guarded by a UXO technician or approved security personnel until demolition operations.

All MEC will be photographed, and as much information as possible will recorded on the dig sheet or PDA. Recorded data to include nomenclature (if known), type (projectile, mortar, rocket, mine, etc.), size, physical condition, fuzed or unfuzed, fuze type by function (e.g., point detonating, mechanical time, etc.), condition (e.g., fired or unfired, armed or unarmed), filler if known, Global Positioning System (GPS) coordinates (if different from the relocated position) and depth.

3.2 NOTIFICATIONS

The SUXOS will ensure that the agencies responsible for emergency response are notified as far in advance as possible that demolition activities will be taking place. The notifications should address scheduling, evacuations, road closures, exclusion zones (EZs), and any other required support. Table 1 provides a list of emergency telephone numbers and contacts.

Table 1: Emergency Contact Numbers

Contact	Phone Number
Fire Department	
EMS	
Police	
FAA	
Base Operations	
Anyone else not listed….	

3.3 EXCLUSION ZONES, ENGINEERING CONTROLS, AND ROAD CLOSURES

Engineering controls should be employed whenever possible to minimize the damage from demolition operations. These controls may consist of sandbags, ecology blocks, trenching, buttressing, taping of glass, mounding, flooding and/or venting to reduce the effects of detonations.

The SUXOS will ensure EZ barricades are set up with signs at all access roads and marked appropriately: Danger, UXO Remediation Project in Progress, DO NOT ENTER, and list contact information on the barricade sign.

3.4 WEATHER AND ENVIRONMENTAL CONSIDERATIONS

Before commencing demolition operations, the SUXOS or UXOSO will obtain a local weather report.

Demolition operations will not be conducted if electrical storms are within 10 miles of the demolition site or during severe weather conditions that would impact safety.

The SUXOS and UXOSO will decide on whether wind speed and visibility will hamper the safe execution of demolition operations.

3.5 FIRE SUPPORT

The telephone number of the responding fire departments will be posted in plain sight at the site office and the disposal site.

The Fire Department nearest the disposal site location will be notified of disposal operations each day.

When the fire hazard is high due to dry conditions, disposal operations will not be conducted unless mobile fire-fighting equipment is standing by and the fire department is capable of responding within five (5) minutes.

Fire extinguishers, portable water tanks, and shovels will be on-site to fight small fires. Evacuate the area if the fire approaches ordnance or explosives. Do not fight grass fires in areas where there may be ordnance or kick-outs.

Conduct a fire risk assessment before conducting disposal operations to consider the type of ordnance to be disposed of, environmental conditions on the site, and appropriate preventative measures to be employed before initiation of explosive procedures.

Consider preventative measures to include: Movement of the MEC to a prepared site, if possible, ground preparation to include scraping and vegetation removal, wetting of the site just before the commencement of operations, and tamping of the shot with sand, or water.

3.6 DEMOLITION OPERATIONS

3.6.1 Demolition Briefing

The DS will brief all personnel involved in range operations in the following areas:

- General Safety Precautions
- Type of MEC or MPPEH being destroyed
- Type, placement, and quantity of demolition material being used

- Method of initiation (electric or Nonel)
- Team assignments
- Equipment being used (e.g., Remote Firing Device [RFD], galvanometer, blasting machine, firing wire, etc.)
- Misfire procedures
- Post-shot cleanup of range procedures
- Emergency procedures

3.6.2 Preparing Donor Charges for Initiation

One Pound Pentolite Booster

1. Insert the 80-grain detonating cord into the detonator well. Insert all the way through the first hole and back through the second hole, then tie an overhand knot to secure it.
2. When using more than one booster, insert the detonating cord through each of the booster's detonator wells and secure to keep it from sliding along the detonating cord.
3. Place the booster on the MEC/material documented as an explosive hazard (MDEH) using tape or other suitable material to prevent it from moving.

Jet Perforator

1. Using tape or detonating cord clips secure the detonating cord to the jet perforator.
2. Place the jet perforator on the MEC/MPPEH using tape or other suitable material to prevent it from moving.

Binary Explosives

1. Obtain part A and part B.
2. Mix per manufacturer requirements and the site where the operation will be conducted.
3. Place on item in same manner as booster and as discussed during demolition briefing.

3.6.3 Initiation Set-ups

The UXOSO will act as a safety observer during demolition set-ups and will depart the range/demolition area before the demo team priming the donor charge. He/she will maintain communications with the team, the SUXOS, and Site Field Office at all times.

A maximum of 2 people will prime the shot. All others will be located outside the EZ.

Electric Blasting Cap

- Prior to making a connection with the electric blasting cap, the firing circuit will be continuity tested.
- All parts of the firing circuit will be kept insulated from the ground or other conductors such as bare wires, rails, pipes, or other paths of stray current.
- The shunt will not be removed from the wires until the individual performing the operation has been grounded. Electric blasting caps will be connected to the firing circuit before connection to the main initiation charge.
- Electric blasting caps of different manufacturers or types will not be used in the same system.
- The electric blasting caps will be tested for continuity with a galvanometer at least 50-ft (15.2-m) downwind from any explosives before connecting them to the firing circuit. After the testing is completed, the lead

wires will be short-circuited by twisting the bare ends of the wires together. The wires will remain shunted until ready to connect to the firing circuit.

- The electrical lead wires of electric blasting caps, detonators, or other electro-explosive devices should not be pulled; detonation may occur.
- The legs should be unrolled so that the cap is as far as possible from the operator and pointing away from him before testing.
- The blasting cap will be placed in a hole, behind a barricade, or under a sandbag before removing the shunt and testing for continuity. The cap should not point toward other personnel or explosives. Always test at the extent of lead wires with ones back towards the blasting cap.
- Only authorized and serviceable testing equipment will be used.
- The remote receiver will not be connected to the firing wires until all pre-firing tests have been completed, and all preparations have been made to fire the charge.

Nonel Blasting Cap

- No testing required
- Blasting cap should be placed in a hole, behind a barricade, or under a sandbag before priming.
- The blasting cap should not point towards other personnel or explosives.

Nonel Lead Line Splicing

- Care should be taken to keep moisture from the cut end of the shock tube.
- The DS or designated UXO Technician will perform the following procedures to cut and splice the shock tube.
- Minimize the number of splices in a shock tube line to as few as possible.
- Lead Line splicing procedure as follows:
  1. Use a sharp knife or razor blade to squarely cut (at a 90-degree angle) approximately 12 inches from a new roll or the cut-off end of a partial roll.
  2. Loosely tie the two-shock tube ends to be spliced together. Leave at least 2 inches free at the end of each shock tube beyond the knot.
  3. Pull the shock tube lightly to tighten the knot, but not so tight as to significantly deform the shock tube in the knot.
  4. Use only the splicing tubes provided to make splices. Taping the two cut ends of the shock tubes together does not make a reliable splice.
  5. Push one of the free shock tubes, to be spliced, firmly into one of the pre-cut splicing tubes at least 1/4 inch.
  6. Push the other shock tube end firmly into the other end of the splicing tube at least 1/4 inch. Attempt to push the two ends up against each other or get as close as possible.

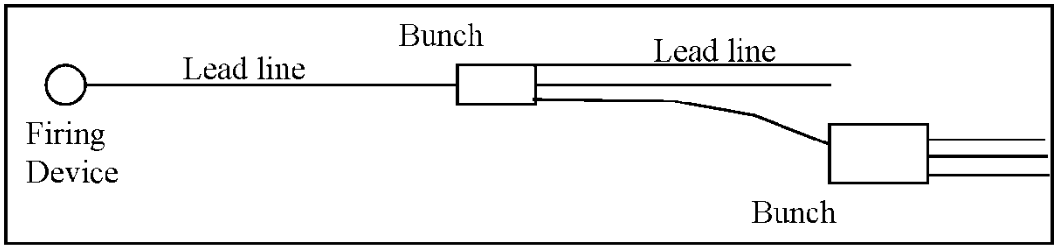
Nonel Lead Line Preparation

The DS or designated UXO Technician will perform the following procedures to set up the lead line.

1. Layout the required length of lead line from the demolition area back to the firing point.
2. Attach an EZTL 30 Bunch Block (or equivalent method) to the lead line at the demolition site using the supplied splicing tube.
3. Secure the bunch block or immobilize with sandbags.
4. Run additional lead line(s) from the bunch block to the MEC/MPPEH (see Figure 3-1).

Note: Only attach a maximum of six additional leads per bunch block. Use additional bunch blocks, if necessary.

Figure 3-1 Nonel Lead Line Setup



3.6.4 Initiation Systems

The firing system will use RFD with Nonel or electric blasting caps. As a back-up to the RFD, the Scorpion Electronic Blasting Machine with electric caps or Nonel will be used.

Remote Firing Device Preparation

1. Perform system pre-operational test and set up using the operator's manual. Remove key from controller unit until ready to fire.
2. Place the remote near the detonation site with the antenna in the vertical position. If using electric caps, the remote should be within 100 feet of the shot. Using the unit blast shield, sandbags, or natural cover to protect the remote.
3. Ensure the remote indicates a READY condition for the selected initiation method (green READY LED on steady, red ARMED LEG off).
4. If using Nonel, connect the shock tube to the igniter tip. The tube should be wrapped around through holes in the tip's molded casing to keep it from falling out. Prime the shot and return to the safe area.
5. If using electric caps, cut off a length of firing wire that will reach between the remote and the charges (100' or less).
6. Conduct a continuity check of the firing wire with a galvanometer. Shunt the free ends of the wire to prevent an electric charge from building up in the firing wire.
7. Test each electric blasting cap 50 feet downwind of other explosives with a galvanometer.
8. Place blasting caps in a hole, behind a barricade or under a sandbag before removing the shunt and testing for continuity.
9. Fully extend the leg wires and ensure the cap is pointing away from the person conducting the continuity test.
10. Secure the leg wires to prevent the cap from moving during the test.
11. Use only a special silver-chloride dry cell battery in the testing galvanometer. Other type batteries may provide sufficient voltage to fire the blasting cap.
12. Upon completion of testing, re-shunt the leg wires. The wires will remain shunted until ready to connect to the firing circuit.
13. For dual priming connect blasting caps in a parallel circuit to the extension wires.
14. Test the circuit with the Galvanometer, and then connect extension wires to the remote.
15. Retrieve caps from barricade, prime shot, and return to safe area.

Scorpion Electronic Blasting Machine Preparation

1. Perform pre-operational check as per instructions on blasting machine.
2. Layout firing wire or Nonel.
3. Conduct a continuity check of the firing wire with a galvanometer. Shunt the free ends of the wire to prevent an electric charge from building up in the firing wire.
4. Test each blasting cap with a galvanometer 50 feet downward of other explosives.
5. Place blasting caps in a hole, behind a barricade or under a sandbag before removing the shunt and testing for continuity.
6. Fully extend the leg wires and ensure the cap is pointing away from the person conducting the continuity test.
7. Secure the leg wires to prevent the cap from moving during the test.
8. Use only a special silver-chloride dry cell battery in the testing galvanometer. Other type batteries may provide sufficient voltage to fire the blasting cap.
9. Upon completion of testing, re-shunt the leg wires. The wires will remain shunted until ready to connect to the firing circuit.
10. For dual priming connect blasting caps in a parallel circuit to the firing wire.
11. Retrieve caps from barricade, prime shot, and return to safe area.

Initiation Sequence

The SUXOS or DS will ensure that the actions taken before initiating a demolition shot are completed as follows.

1. Ensure all required notifications have been made.
2. Set up EZ and post guards at the barricades.
3. Visually inspect EZ and surrounding area for unauthorized personnel.
4. **Five-minute warning**. The DS will give the five-minute warning on the radio, followed by a one-minute series of long blasts on the air-horn.
5. **One-minute warning**. The DS will give the one-minute warning on the radio, followed by a one-minute series of short blasts on the air-horn before the shot. At this time, the arming of the RFD or Blasting Machine will occur.
6. Before initiating the shot, the DS will give three loud "*Fire in the Hole!*" warnings and then give the “fire” command on the radio.

Firing the Remote Firing Device

1. Install the key and engage the "POWER" switch on the controller to the right until the BATTERY LED illuminates.
2. Momentarily depress the controller STATUS button. The yellow TRANSMIT LED will flash for approximately one second. At the end of this time, a green READY LED will come on steady, indicating that the remote is on and in the standby mode. The steady green LED also means the remote is within range of the controller.
3. Push the ARM/DISARM switch to the left and hold for one second. The red ARMED LED will flash for approximately 18 seconds then come on steady. The remote is now armed.
4. The SUXOS or DS gives three loud "Fire-in-the-Hole" warnings.
5. Then the SUXOS gives permission to fire the shot.
6. Lift the safety cover on the FIRE switch and push the FIRE switch forward.

Firing the Scorpion Electronic Blasting Machine

1. Connect the firing leads to the terminal posts of the blasting machine.
2. For Nonel plug in the shock tube adapter and attach Nonel.
3. SUXOS or DS gives three loud "Fire-in-the-Hole" warnings.
4. Then the SUXOS gives permission to fire the shot.
5. Degrees and hold CHARGE button (keep depressed throughout sequence).
6. Press DETONATE button when green ready light comes on. For non-electric shots hold DETONATE button down for one second and release.

3.6.5 Misfires

If a misfire does occur, it must be cleared with extreme caution. The responsible technician will investigate and correct the situation using the steps outlined below.

Misfire Procedures for the Remote Firing Device

1. Make three successive attempts to fire.
2. Turn off the controller and remove the key.
3. Wait 1 hour from the last initiation attempt.
4. After the wait time has elapsed, the SUXOS or DS and one other UXO technician will proceed downrange to inspect the firing system.
5. Disconnecting from RFD:
    - 5.1 If Nonel was used, do not remove the caps from the charge. Disconnect Nonel from the igniter tip on the remote firing device.
    - 5.2 If electric caps were used, remove the old blasting caps from charge and disconnect from extension wires. Shunt cap leg wires.
6. Set up new firing system.

Misfire Procedures for the Scorpion Electronic Blasting Machine

1. Make three successive attempts to fire.
2. If using firing wire and still unsuccessful disconnect wires and check continuity.
3. If continuity is good, reconnect to blasting machine and make three more attempts to fire.
4. If still unsuccessful check connections of firing wires to terminals and make three more attempts to fire.
5. Change blasting machine after third unsuccessful attempt.
6. If unsuccessful with new blasting machine disconnect and shunt firing leads.
7. If using Nonel disconnect from blasting machine.
8. Wait 1 hour from the last initiation attempt.
9. After the wait time has elapsed, the SUXOS or DS and one other UXO technician will proceed downrange to inspect the firing system.
10. Clearing the primed shot:
    - 10.1 If electric caps were used, remove the old blasting caps from charge and disconnect from firing wire. Shunt cap leg wires.
    - 10.2 If detonating cord was used cut detonating cord between cap and charge, disconnect cap from fire wire. Shunt cap leg wires.
    - 10.3 If Nonel was used, do not remove the caps from the charge. Place a new, primed explosive charge next to the misfired charge.
11. Set up new firing system.

3.6.6 Post Demolition Procedures

1. Wait the designated wait times specified by the SOP. A minimum of 5 minutes after a single shot or after a series of shots that can be counted. A minimum of 30 minutes after multiple shots that could not be counted.
2. The SUXOS or DS and one other UXO technician will return to the detonation site and check the results of the shot. If the procedure was successful, the demo supervisor will call in additional personnel to clean up the site. UXO personnel will conduct a visual sweep of the detonation site and the immediate area to gather fragments and explosive residue if present.
    2.1 Metal fragments will be examined to ensure complete consumption of explosive material.
    2.2 Explosive residue will be collected and detonated.
    2.3 Intact MEC items will be disposed of if they fail to detonate.
3. After the area is swept and cleared, the SUXOS or DS will notify the remaining personnel over the radio that the "All Clear" is given.
4. Backfill hole, as necessary.
5. Recover all equipment.

3.7 DOCUMENTATION

Forms and checklists should be generated and/or modified to meet site-specific requirements. The forms provided in this SOP may be used, or alternate forms containing the same information may be used. The SUXOS will make this determination. For disposal operations, the SUXOS or the UXO DS will, as a minimum, complete the following.

- General Safety Precautions
- Disposal Operations Checklist
- Explosive Disposal Log

4.0 QUALITY CONTROL

The MEC Management and Disposal operations will meet the quality control (QC) performance objectives identified in the QAPP or equivalent planning document and the attached quality control inspection checklist.

The QC team will verify the quality of the task through the three phases of the control process and document the results as described in the QAPP or equivalent planning document. Any tasks the QC team determines do not meet the quality control metrics, will be considered deficient or non-conforming. If a deficiency or nonconformance occurs, the UXOQCS will prepare a Deficiency Report or Nonconformance Report.

ATTACHMENTS

ATTACHMENT 1

DEMOLITION EQUIPMENT CHECKLIST

TETRA TECH

DEMOLITION EQUIPMENT CHECKLIST

Equipment List

Equipment	Quantity	Comments
Explosive Vehicle(s)		
Personnel Vehicle(s)		
Digital Camera		
Air Horn		
Hand-held Radios		
Cellular Telephone(s)		
Remote Firing Device		
White XLT all-metals detector		
Shovel, round point, long handle		
Shovel, round point, short handle		
Blasting Machine		
Tape, duct		
Tape, measuring, 50- or 100-meter		
Tape, electricians, plastic		
Toolbox, general hand tools		
Galvanometer		
IME-22 container		
Knife		
Initiating explosives		
Donor explosives		
Fire Extinguishers, 20B:C		
Wheel Chocks		

Checklist Verification

Disposal Supervisor Signature:	Date:

ATTACHMENT 2

HEALTH AND SAFETY EQUIPMENT CHECKLIST

TETRA TECH

HEALTH AND SAFETY EQUIPMENT CHECKLIST

Equipment List

Equipment	Quantity	Comments
Air Horn, emergency		
Burn Blanket		
Burn Kit		
Emergency Eye Wash		
Hand-held Radio and Satellite Phone		
Lightning Detector		
Fire Extinguisher, 20-pound ABC		
Bloodborne Pathogen Kit		
First Aid Kit		
Gloves, leather		
Goggles		
Face Shield(s)		
Fire Retardant Gloves		
Fire Retardant Apron(s)		
Rain Suit(s)		
Safety Vest(s)		
Stretcher		
Water, 5-gal bottle (emergency shower)		
Water, drinking -- 1 liter per person		

Checklist Verification

Disposal Supervisor Signature:

Date:

ATTACHMENT 3

GENERAL SAFETY PRECAUTIONS

TETRA TECH

GENERAL SAFETY PRECAUTIONS

1. Carry blasting caps in approved containers and keep them out of the direct rays of the sun. Keep the caps located at least 25 feet from other explosives until they are needed for priming.
2. Do not work with electric blasting caps or other electro-explosive devices while wearing clothing prone to producing static electricity such as nylon, silk, synthetic hair, etc.
3. Do not use explosives or accessory equipment that is obviously deteriorated or damaged. They may cause premature detonation or fail completely.
4. Always point the explosive end of blasting caps, detonators, and explosive devices away from the body during handling.
5. Use only standard blasting caps of at least the equivalent of a commercial No. 8 blasting cap.
6. Use electric blasting caps of the same manufacturer for each demolition shot involving more than one cap.
7. Do not use improvised methods for initiating blasting caps.
8. Do not bury blasting caps. Use detonating cord to transmit the explosive wave from the blasting caps, on the surface, to a buried/tamped explosive charge. Buried blasting caps are subject to unobserved pressures and movement, which could lead to premature firing or misfires.
9. Test electric-blasting caps for continuity at least 50 feet from any other explosives before connecting them to the firing circuit. Upon completion of testing, the lead wires will be shunted by twisting the bare ends of the wires together. The wires will remain shunted until ready to be connected to the firing circuit.
10. In the event of a misfire when disposing of explosives by detonation, do not approach the disposal site for at least 60 minutes after the expected detonation time, when firing electrically.
11. Items with lugs, strong backs, tail-booms, base plates, etc., should be oriented away from personnel locations.
12. Consideration should be given to tamping the UXO to control fragments if the situation warrants. Fragments will be minimized not only to protect personnel but also property, such as buildings, trees, etc.
13. Avoid inhaling the smoke, dust, or fumes of burning pyrotechnic or incendiary materials. The smoke, dust, and fumes from many of these materials are irritating and/or toxic if inhaled.
14. Do not use water on incendiary fires. Water may induce a violent reaction or be completely ineffective, depending on the mixture.
15. Anticipate a high order detonation when burning pyrotechnic or incendiary-loaded MEC. Safety measures for personnel and property must be based upon this possibility.
16. Inert ordnance will not be disposed of, or sold for scrap, until the internal fillers have been exposed and unconfined. The heat generated during a reclamation operation can cause the inert filler, moisture, or air to expand and burst the sealed casings. Venting or exposure may be accomplished in any way necessary to preclude rupture due to pressure from being confined. All requirements of the UXO Procedure for the Management and Disposition of MPPEH will be met before releasing any inert ordnance material.
17. Maintain minimum safe distances between electromagnetic-radiating sources and electro-explosive devices (IAW EODB/TM-TO 60A-1-1-12).
18. Do not conduct blasting or demolition operations during an electrical, dust, sand, or snowstorm severe enough to produce atmospheric static electrical charges, or when such a storm is nearby (within 6 miles). Under such conditions, all operations will be suspended or terminated, cap and lead wires shunted, and personnel removed from the demolition area. Demolition operations will also be terminated if visibility becomes less than 600 feet.
19. Loose initiating explosives: lead azide, mercury fulminate, lead styphnate, and tetracene, these explosives manifest extreme sensitivity to friction, heat, and impact. Extra precautions are required when handling

GENERAL SAFETY PRECAUTIONS

these types of explosives. Keep initiating explosives in a water-wet condition at all times until ready for final preparation for detonation. The sensitivity of these explosives is significantly increased when dry.

20. Exercise extreme care when handling and preparing high explosives for detonation. They are subject to detonation by heat, shock, or friction.
21. Do not pack bomb fuze wells with explosives unless it can be positively confirmed that the fuze well does not contain any fuze components.
22. Photo flash bombs must be handled with the same care as black powder-filled munitions.
23. MEC containing white phosphorous will not be detonated into the ground. White phosphorous munitions will be counter-charged on the bottom centerline (CCBC) when possible.
24. A search of the detonation site, after the demo operation, will be conducted to assure complete disposal was accomplished.
25. Do not abandon any explosives.
26. Do not leave explosives, empty cartridges, boxes, liners, or other materials used in the packing of explosives lying around where children, unauthorized persons or livestock can get at them.
27. Do not allow any wood, paper, or other materials used in packing explosives to be burned in a stove, fireplace, or other confined space, or be re-used for any other purpose. Such materials will be destroyed by burning at an isolated location out of doors, with no one allowed within 100 feet of the burning operation.
28. Do not fight fires involving explosive material. Evacuate all personnel to a safe location and secure the area.
29. Know and observe international, federal, state, and local laws/regulations that apply to the transportation, storage, and use of explosives.
30. Do not permit metal, except approved metal truck bodies, to contact explosive containers.
31. Do not transport metal, flammable, or corrosive substances with explosives.
32. Do not allow smoking, or the presence of unauthorized personnel, in vehicles transporting explosives.
33. Carefully load and unload explosives from vehicles. Never throw or drop explosives from the vehicle.
34. Assure the load is blocked and braced to prevent it from movement and displacement.
35. Do not drive vehicles containing explosives over public highways until all permits and certifications have been obtained from the state enforcement agencies.
36. All routes must be approved in writing before transporting explosive materials over public highways.
37. Licensed commercial carriers will conduct the shipment of explosive materials over public highways unless Tetra Tech UXO personnel have been specifically licensed and certified to make the shipment.
38. Never leave a vehicle that is loaded with explosives unattended.
39. Do not store blasting caps, detonators, or other items containing initiating explosives in the same box, container, or magazine with other explosives.
40. Store explosive materials in military or ATF-approved magazines only. Ensure the magazines used for the storage comply with quantity distance requirements, for the class of explosive material they contain. Reference documents include: NAVSEA OP-5, TM 9-1300-206, AMCR 385-100, ATF - Explosives Law and Regulation, ATF P 5400.7, and 49 CFR.
41. Do not store spark-producing metal/tools in an explosive magazine.
42. Do not permit smoking, matches, or any source of fire or flame within 100 feet of an explosive magazine.
43. Do not allow leaves, grass, brush, or debris to accumulate within 50 feet of an explosive magazine.
44. Do not permit the discharge of firearms within 300 feet of an explosive magazine.

TETRA TECH

GENERAL SAFETY PRECAUTIONS

45. Do not use any alkaline material such as lye, washing soda, or soap to remove TNT exudate. Alkaline materials will react with TNT to render it more sensitive.
46. Do not permit smoking, matches, or other sources of fire or flame within 100 feet of an area in which explosives are being handled.
47. Do not expose explosives or devices containing explosive to prolonged exposure to direct sunlight. Such exposure can increase sensitivity and deterioration.
48. Ensure all unused explosives are returned to their proper containers, and the container closed after use.
49. Do not carry explosives or explosive components in pockets or on the body.
50. Do not strike, tamper with, or attempt to remove or investigate the contents of an electric/non-electric blasting cap, detonator, or other explosive initiating device. A detonation may occur.
51. Do not pull on the electrical lead wires of electric blasting caps, detonators, or their electro-explosive devices. A detonation may occur.
52. Do not attempt to remove an unfired or misfired primer or blasting cap from a base coupling. There is a high risk of an explosion.
53. Do not allow unauthorized or unnecessary personnel to be present when explosives are being handled.
54. Do not use pull rings or safety pins to lift or handle explosive devices.

ATTACHMENT 4

DISPOSAL OPERATIONS CHECKLIST

TETRA TECH

DISPOSAL OPERATIONS CHECKLIST

FUNCTION	DATE/TIME	SIGNATURE
SUXOS		
Assign Disposal Team		
Brief Disposal Team Review emergency procedures Discuss MEC/MPPEH to be disposed Describe Disposal procedures and method		
Inspect Range/Exclusion Zone upon completion of operations		
Disposal Supervisor		
Assign demolition task to team members		
Verify Not Later Than (NLT) disposal time includes wait time for misfire procedures		
Verify roads are closed		
Verify Exclusion Zone boundaries in place		
Complete health and safety and equipment checklists		
Ensure Field Site Office has completed the verification checklist Responsible activity Medical Facility Fire Department Security/Police Department		
Disposal Supervisor tailgate safety brief: Designate emergency vehicles Designate emergency evacuation route Review emergency response procedures		
Verify daily equipment inspection		
Verify detonators are separated from explosives		
Verify area has been evacuated		
Verify engineering controls are correct		
Notify Field Site Office that operations are commencing		
Start disposal activities		
Inspect shot after designated wait time		
Collect all metal fragments for later disposal		
QC check performed		
QA check (if required)		
Tetra Tech to notify upon completion: Client Responsible Activity Medical Facility Fire Department Security/Police Department		
Complete MEC/MPPEH Accountability Log and record data in Explosive Disposal Log		
Demolition Supervisor signature:		Date:

ATTACHMENT 5

EXPLOSIVE DISPOSAL LOG

TETRA TECH

EXPLOSIVE DISPOSAL LOG

Project Information

Project Name: ______________________________ Start Time: ____________________

Project Location: Stop Time:

MEC Disposed of This Date (List items and quantity of each item)

QTY	NOMENCLATURE	GRID	MEC	MDAS	DATE LOCATED	DATE DISPOSAL

Donor Explosive Used (List types and quantity)

QTY	TYPE
	ELECTRIC DETONATORS
	DETONATNG CORD
	COMMERCIAL SHAPED CHARGES

Remarks

Approval

Demolition Supervisor (Signature): Print Name ______________________________	Date:

ATTACHMENT 6

QUALITY CONTROL INSPECTION CHECKLIST

MEC MANAGEMENT AND DISPOSAL

TEAM INFORMATION

Team:	**Location:**	**Date:**
Team Leader:		
Personnel Present:		
Contract #:		
Task Order #:		

QC CHECKLIST POINTS

ITEM	REF.	INSPECTION POINT	YES	NO	N/A	COMMENTS
1	**Workers' Statement**	Have all MEC Management and Disposal Team Members read this SOP?				
2	**QAPP**	Have assigned disposal team members received training on and demonstrated proficiency with the RFD?				
3	**SOP**	Did all personnel attending the morning safety/operational briefing sign-in?				
4	**SOP**	Did the Team Leader conduct and document the Tailgate Safety Briefing before beginning operations?				
5	**SOP**	Did all recovered MPPEH undergo the three-tiered inspection process?				
6	**SOP**	Did the SUXOS and UXOSO assess all MEC and agree that the risk associated with movement is acceptable or not?				
7	**SOP**	Was the decision to move MEC documented in writing before movement or transporting the items to the storage magazines for temporary storage?				
8	**SOP**	Were MPPEH items further classified as or MDAS, as appropriate?				
9	**SOP**	Were all MEC items photographed?				
10	**SOP**	Did the Demolitions Supervisor conduct and document the demolitions briefing?				
11	**SOP**	Was the EZ established and observed?				
12	**SOP**	Was the demolition sequence observed?				
13	**SOP**	Were donor charges properly prepared?				
14	**SOP**	Were post-demolition operations conducted?				

FINDINGS

Item	Comments

Conducted By: ____________________ **Reviewed By:** ____________________

UXO SOP MPPEH and MDAS Management and Disposal

Procedure: UXO SOP – MPPEH and MDAS Management and Disposal		
Procedure Owner: Director, Technical Operations & Explosives Safety	Effective Date: 7/1/2020	
Reference Corporate Procedure: N/A	Tetra Tech	Revision: 0

RECORD OF DEVELOPMENT, REVIEW, VALIDATION, AND APPROVAL

This Standard Operating Procedure (SOP) contains the procedures by which Tetra Tech, Inc will conduct MPPEH and MDAS management and disposal operations for munitions response projects. Any changes or deviations will be included in the project plans and approved by the Director of Technical Operations and Explosives Safety. SOPs will be reviewed annually.

Director, Health, Safety, & Environmental Jim Streib, CSP, SMS, CQA, CHST		Date:	
Director, Technical Operations & Explosives Safety Patrick Tatman		Date:	6/23/2020

Review Date	Reviewer	Next Review

WORKER'S STATEMENT

I have read UXO SOP – MPPEH and MDAS Management and Disposal and received the training necessary to demonstrate my capability to perform the procedures addressed in this SOP. If I identify a hazard not addressed in this SOP or encounter an operation I cannot perform in accordance with this SOP, I will stop the process and notify my immediate supervisor.

Worker's Name	Date	Supervisor's Name	Date

TABLE OF CONTENTS

1.0 PURPOSE AND SCOPE

The purpose of this standard operating procedure (SOP) is to provide procedures and technical guidance for material potentially presenting an explosive hazard (MPPEH) inspection, management, safety, security and chain of custody (CoC) certification during munitions response activities. This applies to all Tetra Tech Unexploded Ordnance (UXO) Technicians involved in the inspection and management process for certifying MPPEH as material documented as safe (MDAS) before transfer within or release from U.S. Department of Defense (DOD) control.

This SOP is not a stand-alone document and should be used together with the Quality Assurance Project Plan (QAPP) or equivalent planning documents, other Tetra Tech SOPs, applicable Federal, State, local regulations, and contract restrictions and guidance.

All training on equipment or software will be either formal or on-the-job training (OJT). Training will be documented by site personnel and subject to review for accuracy and completeness. The UXO Quality Control Specialist (UXOQCS) will verify training is completed and documented.

2.0 PERSONNEL, EQUIPMENT, AND MATERIALS

This section describes the personnel, equipment, and materials required to implement this SOP.

2.1 PERSONNEL

The following individuals may be involved in MPPEH and MDAS Management and Disposal activities:

- Senior Unexploded Ordnance Supervisor (SUXOS)
- UXOQCS
- Unexploded Ordnance Safety Officer (UXOSO)
- UXO Technicians, Levels III, II, and I
- Government or third-party Quality Assurance personnel

2.2 EQUIPMENT

- MDAS containers (e.g., 55-gallon drums, 20yd roll-off, etc.)
- Unique Numbered Seals
- Expray Kit
- Logbook and/or PDA for recording data
- Bottled water
- Camera
- Communications equipment
- First-aid kit
- Level D personal protective equipment (PPE)
- Fire extinguisher

3.0 PROCEDURES AND GUIDELINES

3.1 UXO TECHNICIAN RESPONSIBILITIES AND PROCEDURES

The objective of the following procedures is to ensure that an inspection of the exterior and interior surfaces of all recovered MPPEH is safely conducted to ensure these items do not present an explosive hazard and are not transferred from DOD or Tetra Tech custody.

3.1.1 Unexploded Ordnance Sweep Personnel (UXOSP)

Will only mark suspected MPPEH and will not be allowed to perform any assessment of a suspect MPPEH to determine its status.

3.1.2 UXO Technician I

Can tentatively identify a located material as MPPEH confirmation by a UXO Technician II or III.

3.1.3 UXO Technician II

Will perform a 100 percent inspection of each piece of MPPEH as it is recovered and determine the following:

a. Is the MPPEH MEC, munitions debris (MD), range-related debris (RRD) or is non-munition related debris (NMRD)?

b. Does the MPPEH contain explosives hazards or other dangerous fillers?

c. Does the MPPEH/MEC require detonation?

d. Does the MPPEH/MEC require demilitarization or venting to expose dangerous fillers of cavities not inspectable?

e. Does the MPPEH require removal of batteries, mercury seals, or switches; the draining of engine fluids, illuminating dials, and other visible liquid hazardous, toxic, or radiological waste (HTRW) materials?

Will segregate material MPPEH requiring demilitarization or venting procedures from those items ready for certification.

Will process any MPPEH found to contain explosives hazards or other dangerous fillers following applicable UXO SOP – MEC Management and Disposal.

3.1.4 UXO Technician III:

Will perform a 100 percent re-inspection of all reclassified MPPEH to determine if free of explosives hazards or other dangerous fillers and engine fluids, illuminating dials, and other visible liquid HTRW materials.

Will supervise detonation of MEC/MPPEH found to contain explosive hazards or other dangerous fillers and venting/demil procedures.

Will supervise the consolidation of inspected MPPEH for containerization and sealing. MD and RRD or NMRD will be segregated.

3.1.5 UXO Quality Control Specialist (UXOQCS)

Will conduct daily audits of the procedures used by UXO teams and individuals for processing MPPEH.

Will perform and document random sampling (by pieces, volume, or area) of all MPPEH collected from the various teams to ensure no MD, RRD, or NMRD contains and explosive hazard, engine fluids, illuminating dials, and other visible liquid HTRW.

The UXOQCS will sign as the verifier on the DD Form 1348-1 in the absence of a government representative.

3.1.6 UXO Site Safety Officer (UXOSO)

Will ensure the specific procedures and responsibilities for processing MPPEH for certification as MD or RRD specified in the work plan are being followed.

Will ensure all procedures for processing MPPEH are being performed safely and consistent with applicable regulations.

3.1.7 SUXOS:

Will be responsible for ensuring work and Quality Control (QC) plans specify the procedures and responsibilities for processing MPPEH for final disposition as MD or RRD.

Will ensure a Requisition and Turn-in Document DD Form 1348–1A is completed for all MD and RRD to be transferred for final disposition.

Will perform a final 100 percent re-inspection of all recovered MPPEH to certify that they are free of explosives hazards or other dangerous fillers and engine fluids, illuminating dials, and other visible liquid HTRW material necessary to complete the DD Form 1348–1A.

Will be responsible for ensuring that inspected debris is secured in a closed, labeled, and sealed container and documented as follows:

a. The container will be closed and clearly labeled on the outside with the following information: The first container will be labeled with a unique identification that will start with the applicable DOD component/Installation Name/Tetra Tech/0001/Seal's unique identification and continue sequentially.

b. The container will be closed in such a manner that a seal must be broken to open the container. A seal will bear the same unique identification number as the container, or the container will be clearly marked with the seal's identification if different from the container.

c. Tetra Tech will provide a documented description of the container with the following information for each container: contents, weight of the container, location where munitions or RRD was obtained, name of the contractor, names of certifying and verifying individuals, unique container identification, and seal identification, if required.

Will establish a secure location for the collection, processing, and storage of MD, RRD, and NMRD until transferred off-site.

All acceptable to move MEC or MPPEH will be stored in a magazine or secured until disposal.

3.2 MD CERTIFICATION AND CONTAINERIZATION

MPPEH procedures will be per DOD Instruction 4140.62, EM 385-1-97 or OP-5. All MPPEH will be assessed and its explosive safety status determined and documented before transfer within the DOD or release from DOD control. Before release to the public, MPPEH will be documented by personnel who are authorized in writing and technically qualified to certify or verify MDAS after a 100 percent inspection, and an independent 100 percent re-inspection to ensure that it is safe from an explosive perspective. The following certification and verification procedures will be followed for material suspected or determined as MPPEH:

- The SUXOS will certify that the debris is free of explosives hazards.
- The UXOQCS or similarly trained individual in the absence of a government representative will verify that the debris is free of explosive hazards.

- DD Form 1348–1A Issue Release/Receipt Document will be used as the certification/verification documentation. The DD Form 1348–1A must clearly show the names and contact numbers of the SUXOS and the UXOQCS, similarly trained UXO-qualified individual or Government representative and will be completed with the following information:

Block 2: Site Address

Block 3: Address where the MDAS will be shipped to

Block 5: Document date

Block 8: Cargo type (MDAS or NMRD – non-munitions related debris)

Block 9: Mandatory Entry - Enter "U" if Unclassified material. For more Controlled Inventory Item Codes (CIIC) see DOD 4100.39-M, Volume 10, Chapter 4**,** Table 61.

Block 10: Actual quantity received. Entered by Receiver

Block 11: Number of items for this unit. Enter "1" if only one container is listed on the form.

Block 12: Enter the weight of the container listed on the form

Block 15: Mandatory Entry – Enter "0" for No Shelf-life. For more codes see DOD 4100.39-M Volume 10, Chapter 4, Table 50

Block 16: Leave blank for the transport company

Block 17: Basic material content such as Material Documented as Safe or Non-Munitions Related Debris with the type of metal (steel or mixed)

Block 18: Type of container

Block 19: Number of containers that make up the shipment

Block 20: Total weight of all containers that make up the shipment

Block 22: Signature of receiver

Block 23: Date received

Block 24:

- Site Name
- Site Location
- Company name
- Contract Number

Block 25: Container number - DOD component/Installation Name/Tetra Tech/0001/Seal's unique identification

Block 26:

- The following certification/verification will be entered on each DD Form 1348–1A for MD or RRD transferred within or release from DOD control and will be signed by the SUXOS and the UXOQCS, a similarly trained UXO-qualified individual or Government representative. This statement will be used on any ranges where range related debris is to be processed along with MD:

  "This certifies that the material listed has been 100 percent properly inspected and, to the best of our knowledge and belief, are free of explosive hazards, engine fluids, illuminating dials, and other visible liquid HTRW materials."

- The following certification/verification will be entered on each DD Form 1348–1A for turnover of MD and will be signed by the SUXOS and the UXOQCS, similarly trained UXO-qualified individual or Government representative where only munitions debris is being processed:

  "This certifies and verifies that the material listed has been 100 percent inspected and, to the best of our knowledge and belief, are inert and/or free of explosives or related materials."

Block 27: Signature Block for both the SUXOS and UXOQCS containing:

- Certified by: SUXOS Name / Verified by: UXOQCS Name or other verifier
  Tetra Tech (OU Name Here), Munitions Response Services
  Applicable OU Address
  Home Office: XXX-XXX-XXXX
  SUXOS phone number / UXOQCS phone number or other verifier
  Signature of SUXOS / Signature of UXOQCS or other verifier

Upon receipt of the material identified on the DD Form 1348–1A, the PM is responsible for ensuring the following blocks are completed by the qualified recycler:

- Block 10: Quantity of material receive;
- Block 22: Signature; and
- Block 23: Date.

3.3 MAINTAINING CHAIN OF CUSTODY AND FINAL DISPOSITION

Tetra Tech will arrange for maintaining the chain of custody and final disposition of the certified and verified materials. The certified and verified material will be released only to an organization that will:

A. Upon receiving the unopened labeled containers, each with its uniquely identified and unbroken seal ensuring a continued chained of custody, and after reviewing and concurring with all the provided supporting documentation, the receiving vendor will sign for having received and agreeing with the provided documentation that the sealed containers contained no explosive hazards upon receipt. This will be signed on company letterhead that states the contents of these sealed containers will not be sold, traded, or otherwise given to another party until the contents have been smelted and are only identifiable by their basic content.

B. ***Send notification and supporting documentation to the sealed container-generating contractor documenting the contents of the sealed containers have been smelted and are now only identifiable by their basic content.***

C. ***If the chain of custody is broken, the affected shipment must undergo a 100 percent inspection, a second 100 percent re-inspection, and be documented to verify its explosives safety status.***

MDAS is no longer considered MPPEH as long as the chain of custody remains intact. A legible copy of the inspection, re-inspection, and documentation must accompany the material through final disposition and be maintained thereafter for three years.

4.0 QUALITY CONTROL

The MPPEH and MDAS Management and Disposal operations will meet the QC metrics outlined within the QAPP or equivalent planning document and the Compliance Checklist in this SOP.

The UXOQCS will verify the quality of the task through the three-phase of control and document the results as described in the QAPP or equivalent planning documents. Any tasks the UXOQCS determines not to meet the QC metrics will be considered deficient or non-conforming. If a deficiency or nonconformance occurs, the UXOQCS will prepare a Deficiency Report or Nonconformance Report.

4.1 QC CHECKLIST: MPPEH/MDAS MANAGEMENT AND DISPOSAL

TEAM INFORMATION

Team:	Location:	Date:

Team Leader:

Personnel Present:

Contract #:

Task Order #:

QC CHECKLIST POINTS

Item	Ref.	Inspection Points	Yes	No	N/A	Comments
1	SOP	Have all personnel read and signed the workers' statement?				
2	SOP	Do all personnel performing this DFW meet the minimum qualifications required?				
3	SOP	Have all personnel performing this DFW been trained on this SOP, and is it documented?				
4	SOP	Have the teams been provided maps of the overall project site and evacuation routes?				
5	SOP	Are all equipment and materials required to perform the DFW inspected, available on-site, and is it documented?				
6	SOP	Was each received container marked as MPPEH or MDAS, sealed and contained in a cleared area?				
7	SOP	Is the PPE serviceable and worn properly?				

FINDINGS

Item	Comments

Conducted By: ______________________ **Reviewed By:** ______________________

TETRA TECH

UXO SOP for Intrusive Investigation

Procedure: UXO SOP – Intrusive Investigation Operations Approver: MMRP Working Group		
Procedure Owner: Director of Technical Operations and Explosives Safety	Effective Date: 11/9/2020	
Reference Corporate Procedure N/A	Tetra Tech	Revision: 1

RECORD OF DEVELOPMENT, REVIEW, VALIDATION AND APPROVAL

This Standard Operating Procedure (SOP) contains the procedures by which Tetra Tech, Inc will conduct Intrusive Investigation Operations for munitions response projects. Any changes or deviations will be included in the project plans and approved by the Director of Technical Operations and Explosives Safety. SOPs will be reviewed annually.

Director Health, Safety, & Environmental Jim Streib, CSP, SMS, CQA, CHST		Date:	4/24/2020
Director, Technical Operations & Explosives Safety Patrick Tatman		Date:	6/23/2020

Review Date	Reviewer	Next Review
11/9/2020	Added new paragraph 3.2.3.1, Mag and Flag/Eugene Mikell	As required

WORKER'S STATEMENT

I have read UXO SOP – Intrusive Investigation Clearance Operations and received the training necessary to demonstrate my capability to perform the procedures addressed in this SOP. If I identify a hazard not addressed in this SOP or encounter an operation I cannot perform in accordance with this SOP, I will stop the process and notify my immediate supervisor.

Worker's Name	Date	Supervisor's Name	Date

TABLE OF CONTENTS

1.0 PURPOSE AND SCOPE

The purpose of this Standard Operating Procedure (SOP) is to provide procedures and technical guidance for the Intrusive Investigation Operations to include surface clearance at designated munitions response sites. These operations include:

- Surface Clearance
- Mag and Flag Operations
- Mag and Dig Operations
- Target Investigations as a result of geophysical data collection

All training on equipment or software will be either formal or on-the-job training (OJT). This training will be documented by site personnel and subject to review for accuracy and completeness. The Unexploded Ordnance (UXO) Quality Control Specialist (UXOQCS) will verify training is complete and documented.

2.0 PERSONNEL, EQUIPMENT, AND MATERIALS

This section describes the personnel, equipment, and materials that may be required to implement this activity.

2.1 PERSONNEL

The following individuals or vendors may be involved in Surface Sweep/Clearance activities:

- Geophysical Personnel
- UXO Personnel

2.2 EQUIPMENT

- Personal protective equipment outlined in the Activity Hazard Analysis (AHA)/Job Safety Analysis (JSA)
- Geophysical or metal-detector instruments
- Global positioning system (GPS) or real-time surveying (RTS) positioning units
- Computers/Tablets
- Cameras
- Marking flags or ribbon
- Utility or Passenger Vehicles
- First-aid kit
- Fire extinguisher

3.0 PROCEDURES AND GUIDELINES

The Senior UXO Supervisor (SUXOS), UXO Safety Officer (UXOSO), and UXO Team Leader (TL) will review the site terrain and determine the best approach for intrusive investigation operations. Any inaccessible locations will be documented in the field logbook.

3.1 EQUIPMENT SET-UP

Materials or equipment received at the site will be inspected for serviceability and against purchase order requirements or operations manuals. Photos will be taken and filed with the daily quality control reports, the quality receipt inspection report (QRIR) or equivalent record.

Analog metal detector sensors will be assembled with fully charged batteries and tested for functionality at an Instrument Test Strip (ITS) prepared under the direction of the UXOQCS. The test strips will include a collection of Industry Standard Objects (ISO) buried at depths and orientations defined in the Quality Assurance Project Plan (QAPP) or equivalent planning document. This will simulate the size and depth of the targets expected at the project site. Sensors will be tested at the ITS prior to beginning operations each day and the results recorded in the team logbook or on forms. All tests will be reported to the UXOQCS for inclusion in the daily report.

Geophysical sensors (EM61) will be assembled and operated in accordance with the appropriate SOPs. GPS or RTS positioning systems will be assembled and operated in accordance with the appropriate civil survey SOP. This includes daily equipment checks and data recordings as appropriate to their use in support of Intrusive Investigations.

Cameras will have video cards and batteries checked.

All tests will be reported to the UXOQCS for inclusion in the daily report.

3.2 OPERATIONS

3.2.1 General Safety

The most pertinent rules for handling munitions and explosives of concern (MEC) are summarized below:

- Assume munitions contain a live charge until determined otherwise.
- Avoid inhalation of and skin contact with smoke, fumes, and vapors of explosives and related hazardous materials.
- Consider munitions that have been exposed to fire or detonation as extremely hazardous. Chemical and physical changes may have occurred to the contents, which can render them much more sensitive than their original state (e.g., changes to the condition of the fuze or explosives).
- Make every effort to identify the munitions. Carefully examine the munition for markings and other identifying features such as shape, size, and external fittings. Do not move the suspected munition until it is identified and confirmed safe to move by the SUXOS and UXOSO.
- Plan for, provide, and know the measures to be taken in the event of an accident.
- Provide a designated emergency vehicle in the area in case of an accident or an emergency.

- Do not handle, use, or remain near explosives during the approach or progress (within 10-miles) of an electrical storm. All personnel will shelter as identified in the Accident Prevention Plan (APP) or as directed by the UXOSO.
- Only allow essential personnel to be present near the munitions.
- Always base operations on minimum exposure consistent with efficient operations.
- Do not rely on the color-coding of MEC for positive identification of contents. Munitions having non-existent, incomplete, or improper color codes may be present.
- Avoid the area forward of the ammunition's nose until it can be determined that the item is not a shape-charge or high-explosive anti-tank round. The explosive jet can be fatal to great distances forward of the item's longitudinal axis. Assume any shape-charge munitions contain a piezoelectric fuzing system until the fuzing is otherwise identified. Piezoelectric fuzes are extremely sensitive, can fire at the slightest physical change, and may remain hazardous for an indefinite period.
- Approach an unfired rocket motor from the side. Ignition will create a moving projectile hazard and hot exhaust. Do not allow electrically fired rocket motors within 25 feet of any exposed electronic transmitting equipment or antenna leads.

3.2.2 Daily Briefing

After arriving at the worksite, the SUXOS or designee will conduct a tailgate operations/safety meeting at the work location. The UXOSO or designee will brief the teams on potential hazards in the area and operations conducted during the shift and review the AHA/JSA for the task. The SUXOS will assign selected worksites to each of the UXO teams for intrusive investigation.

The TL will ensure hand-held instruments, GPS, communications equipment, safety gear or other equipment is function checked and serviceable before beginning field operations. The checks will be documented in team logs or on forms.

3.2.3 Intrusive Operations

3.2.3.1 Mag and Flag Operations

The general process for mag and flag operations are:

- The government will be afforded time prior to analog operations for seeding.
- The TL will take a photograph of the area to be cleared once the ropes are setup. This photograph will serve as evidence in proper setup
- The TL will assign lanes to each team member. The TL will document the person assigned to each lane, the start time, stop time, and distance of each lane or transect worked by team member. This information can be recorded on grid sheets or the team logbook.
- For mag and flag operations, lay ropes, lines, or any means to establish a search area within the grid or transect. It will be the TLs discretion to determine the width of the search lanes based on the anomaly density.
- Guide on the lines while walking forward slowly down the search lane sweeping the head of the analog sensor smoothly from side to side;
- Ensure the sensor head exceeds the width of the search lane;

- A wide head electromagnetic analog sensor requires an overlap of one-half the width of the head to perform an effective search. The sensor head must be parallel to the ground surface. Keep the head close to the ground;
- A small head magnetic sensor such as a Schonstedt, requires a sweep spacing of six inches or less depending on the smallest munitions anticipated at the site;
- The sensor head must be kept at a constant height throughout the sweep;
- Each pass across a search lane should take 2-3 seconds;
- Mark and document the location for every anomaly detected that is consistent with the smallest munition anticipated at the site;
- Do not be deceived by a dull or low volume signal from a sensor. Deep targets do not necessarily produce a loud or sharp signal;
- Continue the process until the assigned area/lane is complete.
- TLs will verify lane or grid sheets/personal digital assistant (PDA) are filled out correctly, are complete, and correct.

3.2.3.2 Mag and Dig Operations

The general intrusive investigation procedures for mag and dig operations are:

- For mag and dig operations, lay ropes, lines, or any means to establish a search area within the grid or transect. It will be the TLs discretion to determine the width of the search lanes based on the anomaly density.
- Guide on the lines while walking forward slowly down the search lane sweeping the head of the analog sensor smoothly from side to side;
- Ensure the sensor head exceeds the width of the search lane to slightly overlap the adjacent lane;
- A wide head electromagnetic analog sensor requires an overlap of one-half the width of the head to perform an effective search. The sensor head must be parallel to the ground surface. Keep the head close to the ground;
- A small head magnetic sensor such as a Schonstedt, requires a sweep spacing of six inches or less depending on the smallest munitions anticipated at the site;
- The sensor head must be kept at a constant height throughout the sweep;
- Each pass across a search lane should take 2-3 seconds;
- Investigate every anomaly detected that is consistent with the smallest munition anticipated at the site;
- Do not be deceived by a dull or low volume signal from a sensor. Deep targets do not necessarily produce a loud or sharp signal;
- Define the extent of the anomaly using the analog sensor;
- Technicians may use a non-sparking probe if soil conditions permit;
- Using a shovel, trowel or other suitable tool, remove soil in small amounts from the side of the anomaly and work inward toward the anomaly;
- Once the anomaly is uncovered characterize and recover it as described in this SOP;
- Recheck the excavation with the analog sensor and continue clearing the anomaly if necessary;

- When restarting the sweeping activity, back up a foot and begin sweeping this should ensure that no residual target is present in the excavation;
- Backfill any excavation after completing documentation unless otherwise instructed; and
- Continue the process until the assigned area/lane is complete.
- TLs will verify dig sheets/personal digital assistant (PDA) are filled out correctly, are complete, correct, standardized nomenclature is used, and no-finds are listed. MEC requires positive identification on the dig sheet. Gross weight of material documented as safe (MDAS) per grid is documented separately. Location and depth of item is recorded.
- Blind seed items (BSIs) must be recovered and correctly identified/documented.

3.2.3.3 DGM Target Investigation

The specific intrusive investigation procedures for digital geophysical mapping (DGM) target investigations are:

- The selected targets from the DGM data are marked with non-metallic flags using the appropriate positioning system;
- Each target flag will be investigated to the radius and depth defined in the work plan by passing the analog sensor over the surface of the ground and then investigating all contacts identified within the search radius. The search radius may be extended by the geophysical data processor and noted in the dig sheet.
- After prosecution of the target to the extent required, the EM61 or analog metal detector will be used to verify the remaining signature is less than the threshold criteria selected for the project. Once complete the flag should be bent to indicate a completed target.

Upon completion of the target clearance, all munitions debris (MD), radiological dispersal devices (RDD) and non-munition related debris (NMRD) will be 100% inspected by a UXO Technician II and a UXO Technician III before it is removed from the grid to ensure it is free of explosive hazards. If MEC/ material potentially presenting an explosive hazard (MPPEH) is found it will be left in-place, clearly marked, and the UXO Technician III will notify the SUXOS and UXOSO.

The TL will photograph all MEC/MPPEH and record as much information as possible in the Team Leader's logbook or in the PDA. Recorded data includes nomenclature (if known), type (projectile, mortar, rocket, etc.), size, physical condition, fuzed or unfuzed and fuze type by function (point detonating, mechanical time, etc.), condition (fired or unfired, armed or unarmed), filler if known, GPS coordinates.

All MD, RDD, and NMRD will be brought to the central consolidation point for SUXOS and UXOQCS or government representative inspection. See SOP for MPPEH and MDAS Management.

All project records will be returned to the SUXOS or project data manager at the end of the day

3.2.4 Collection Points

Collection points allow for temporary accumulation of recovered MEC/MPPEH that are acceptable to move to another area for storage or destruction. The net explosive weight, location, and separation distances between the collection point will be identified in the explosive safety documents. No MEC/MPPEH will be transported from one munitions response site to another.

3.2.5 Field Communication

When feasible, handheld radios will be used for any required communications between the UXO teams and the site office/site management personnel. The site office will relay all required communication to other on-site personnel using established radio links or by telephone/cell phone. Applicable telephone numbers can be found in the APP/SSHP. Additionally, these will be posted in the site office and placed in all site vehicles. If necessary, a radio base station or repeaters will be used to ensure reliable communications across the site.

3.3 MPPEH CHARACTERIZATION

Refer to the specific SOP for full details on MPPEH characterization.

- The first person who discovers the MPPEH will conduct the initial classification (MEC, MD, RDD, NMRD). If the person is a UXO Tech I he will have a UXO Tech II or higher verify the classification. UXO Sweep personnel will never touch or move MPPEH until directed by a UXO Tech II or higher.
- The UXO Tech III (UXO TL) will inspect all MD, RDD, and NMRD before leaving the clearance area (i.e., grid, transect
- The UXO TL will determine whether the MPPEH, once visible, is MEC and notify the SUXOS and UXOSO. MPPEH that is not inspectable will be treated as MEC, as discussed in the Work Plan.
- The SUXOS will make the final identification of any suspected MEC.
- The SUXOS and UXOSO will make a joint decision on the acceptable to move determination. The two must be in agreement of the decision and it will be documented.
- If an MEC/MPPEH is determined by the SUXOS and UXOSO to be unsafe to move, it will be blow in place (BIP) or may be moved remotely after all appropriate precautions have been taken. MEC will not be left unsecured in the field at any time. Notifications to the client, Ordnance and Explosives Safety Specialist or equivalent and PM will be made as outlined in the Work Plan.
- Protective works will be implemented as described in the explosive safety documents for BIPs
- If MEC is not intact upon discovery (i.e., exposed high explosive [HE] or filler), this will be noted on the Investigation Data Sheet & MEC Accountability Log. If the MEC/MPPEH is judged to be safe to transport, it will be placed in a container to prevent further loss of the filler and will be destroyed by detonation at a point identified in the Explosive Safety Plan (ESS) or Explosives Safety Plan (ESP). Any HE or filler found on/in the soil will be marked with a digital global positioning system (DGPS) coordinate and logged in the TL's logbook and reported to the SUXOS and Project Manager (PM).
- Any suspected hazardous material (not munitions-related related) identified will be assessed on a case-by-case basis by the SUXOS and PM in consultation with client. A hazardous material will be suspected to be hazardous if it emits a chemical odor, has caused soil staining, or is contained in a drum or other container commonly used (or marked) for storage of hazardous materials. If any doubt, materials will be reported for further investigation.

3.4 MEC/MPPEH and MDAS

Refer to the specific SOP for full details on MEC/MPPEH and MDAS disposal.

MPPEH identified as MEC [i.e., UXO, discarded military munitions (DMM), recovered bulk explosive, or Munitions Constituents (MC)] will be disposed of via detonation in-situ or relocated to a collection point. MEC/MPPEH will disposed of individually or as part of a consolidated shot, the day they are found, using a same-day donor explosives delivery service or guarded until disposal is able to be conducted. MEC Management and Disposal SOP addresses how MEC/MPPEH is transported.

MEC/MPPEH will be tracked/documented from discovery to final disposal in an accountability log.

Materials that cannot be certified and verified as inert (either following demolition disposal or otherwise) will have demolition activities performed on them again. MEC/MPPEH certified as explosive-free (materials documented as safe) will be managed and recycled as scrap metal in accordance with the MPPEH and MDAS Management SOP.

4.0 DATA MANAGEMENT

The following sections describe the data that is needed to perform this SOP and the resulting data.

4.1 INPUT DATA REQUIRED

No data other than sensor user manuals and target location Geographic Information Systems (GIS) files are required to perform intrusive operations.

4.2 OUTPUT DATA

The primary output from this SOP is the quantities and locations of MEC/MPPEH and the amounts of MD, RDD, and NMRD recovered that are recovered. Secondary outputs include equipment inspection records and daily quality reports.

5.0 QUALITY CONTROL

QC for this SOP will be achieved through three-phase of control of the Definable Feature of Work (DFW), completion of the QC Checklist for Intrusive Investigation Operation (Section 5.3), and performance metrics identified in the plans are met. The checklist will be filled out and signed by the onsite quality lead or designee upon completion of unit of production.

5.1 MEASUREMENT QUALITY OBJECTIVES

The Measurement Quality Objectives (MQOs) for Intrusive Investigation Operation are presented in the project plans. Results will be documented in the daily quality control report.

5.2 REPORTING

Input to the project MEC/MPPEH Accountability Log and disposal records are the only reporting output from this SOP.

5.3 QC CHECKLIST FOR INTRUSIVE INVESTIGATIONS

TEAM INFORMATION		
Team:	Location:	Date:
Team Leader:		
Personnel Present:		
Contract #:		
Task Order #:		

QC CHECKLIST POINTS

Item	Ref.	Inspection Points	Yes	No	N/A	Comments
1	UXO SOP	Have personnel read and signed the workers' statement?				
2	UXO SOP	Has the equipment been checked out and is it documented correctly?				
3	UXO SOP	Have all intrusive results been fully and appropriately documented?				
4	UXO SOP	Have the appropriate MQOs been achieved for Intrusive Investigation?				
5	UXO SOP	Were all seeds (if instituted) recovered?				

FINDINGS

Item	Comments

Signature:

UXOQCS or Designee: ______________________________ Date: ______________

TETRA TECH

UXO SOP for MEC AVOIDANCE

Procedure: UXO SOP - MEC Avoidance	Approver: MMRP Working Group	
Procedure Owner: Director of Technical Operations and Explosives Safety	Effective Date: 7/1/2020	
Reference Corporate Procedure N/A	Tetra Tech	Revision: 0

RECORD OF DEVELOPMENT, REVIEW, VALIDATION, AND APPROVAL

This Standard Operating Procedure (SOP) contains the procedures by which Tetra Tech, Inc will conduct Munitions and Explosives of Concern (MEC) avoidance operations for munitions response projects. Any changes or deviations will be included in the project plans and approved by the Director of Technical Operations and Explosives Safety. SOPs will be reviewed annually.

Director, Health, Safety, & Environmental Jim Streib, CSP, SMS, CQA, CHST		Date:	
Director, Technical Operations & Explosives Safety Patrick Tatman		Date:	6/23/2020

Review Date	Reviewer	Next Review

WORKER'S STATEMENT

I have read UXO SOP – MEC Avoidance and received the training necessary to demonstrate my capability to perform the procedures addressed in this SOP. If I identify a hazard not addressed in this SOP or encounter an operation I cannot perform in accordance with this SOP, I will stop the process and notify my immediate supervisor.

Worker's Name	Date	Supervisor's Name	Date

TABLE OF CONTENTS

1.0 PURPOSE AND SCOPE

The purpose of this Standard Operating Procedure (SOP) is to provide procedures and technical guidance for the MEC Avoidance at designated munitions response sites. These operations include:

- Civil survey operations to establish boundary lines, control points, grids, and transects;
- Vegetation Clearance/Removal operations
- Soil Sampling
- Escort
- Construction Support

2.0 PERSONNEL, EQUIPMENT, AND MATERIALS

This section describes the personnel, equipment, and materials that may be required to implement this activity.

2.1 PERSONNEL

The following individuals or vendors may be involved in Munitions and Explosive Concern (MEC) Avoidance activities:

- Subcontractors (Surveyors, Construction workers, Soil Sampling, etc.)
- Unexploded Ordnance (UXO) Personnel
- Visitors or other site personnel

2.2 EQUIPMENT

- Personal protective equipment outlined in the Activity Hazard Analysis (AHA) (gloves, safety glasses, etc.)
- Hand-held geophysical instruments
- Hand-held Global Positioning System (GPS) Unit
- Computers/Tablets
- Cameras
- Utility or Passenger Vehicles
- First-aid gear
- Fire extinguisher

3.0 PROCEDURES AND GUIDELINES

3.1 EQUIPMENT SET-UP

3.1.1 Receipt Onsite

Materials or equipment received at the site will be inspected for serviceability and against purchase order requirements. Photos will be taken and filed with the daily quality control reports or the Quality Receiving Inspection Report (QRIR).

Hand-held geophysical sensors will be tested and, if applicable, search programs uploaded and verified in the test strip for functionality per the operator’s manual.

Hand-held or other Global positioning systems for use during MEC Avoidance will be checked for correct project and coordinate upload.

Cameras will have video cards and batteries checked.

Utility vehicles or passenger vehicles will be inspected for damage and verified as operational. Photos of vehicles will be taken and given to the site safety officer.

3.1.2 Daily Prior to Operations

Electronic equipment will be tested prior to beginning operations each day and the results recorded in the team logbook or on forms. All tests will be reported to the lead onsite quality representative for inclusion in the daily report.

GPS devices will be checked against know points before use to ensure accuracy during use.

Hand-held geophysical sensors will be checked in an established test strip or against a metal piece on the surface before beginning daily operations.

UTVs or passenger vehicles will be inspected daily for damage and operability. Inspection forms will be submitted to the site safety officer weekly.

3.2 OPERATIONS

3.2.1 General Safety

Intrusive anomaly investigation is not authorized during MEC avoidance activities. Avoidance for intrusive construction activities such as grading and trenching will only be conducted on projects with a documented low MEC probability based on past use and historical evidence.

MEC avoidance activities will not be conducted until the required training and proper equipment checks have been completed, documented, and the appropriate exclusion zone (EZ) is established, marked, and secured.

The appropriate authorities will mark all utilities before intrusive operations.

Avoidance activities at any given location onsite may be conducted by a single individual trained as a UXO Technician I, provided a second UXO Technician and reliable communications between UXO Technician has been established in case of emergency.

The appropriate supervisor will be notified immediately of all MEC or suspected MEC finds.

Non-UXO personnel must always be escorted by UXO-trained personnel, after receiving 3R training, in areas potentially containing MEC.

If MEC is encountered that presents an immediate threat to life or property, it will be marked and secured until turned over to EOD or the appropriate local authorities.

UXO personnel must remain onsite at all times when non-UXO personnel are conducting intrusive operations.

Do not touch or disturb MEC; mark their location with a red pin flag or surveyors' tape and avoid them.

Do not expose electrically fired munitions to radio, cell phone, or satellite phone transmissions within 25-ft. (7.6-m).

Do not collect souvenirs.

Do not smoke except in designated areas.

Prohibit non-essential personnel from encroaching upon the site.

Suspend all operations immediately upon approach of an electrical storm (within 10-miles).

3.2.2 Survey of Access Lanes and Work Sites

UXO technician must conduct a surface and subsurface survey for anomalies on the access path both to and from the worksite before any type of activities commence, including foot and vehicular traffic. The surface area checked should be at least twice the width of the largest vehicle to be used. The UXO technician will also complete a surface and subsurface survey of the proposed work site, as listed in the work plan. The work site will be a minimum dimension in all directions equal to twice the length of the longest vehicle or equipment to be used unless stated in the work plan. These boundaries will be clearly marked using survey flagging or pin flags.

The UXO Technician will use the appropriate magnetometer to clear the areas listed above. Subsurface anomalies will be marked with proper pin flags and will be avoided. If MEC is located, the UXO technician will halt escorted personnel in place, mark the item, and notify the appropriate supervisor for further instruction.

3.2.3 Avoidance for Sampling Activities

A survey of all access lanes, worksites, and buffer zones in accordance with 7.5.1 must be completed before conducting sampling activities. UXO technicians equipped with appropriate magnetometer will clear all sampling sites and observe all sampling activities. If anomalies are detected, they will be marked, avoided, and a new sampling location was chosen. If MEC is located, the UXO technician will halt sampling activities, mark the item, and notify the appropriate supervisor, who will then notify the proper authorities.

3.2.4 Avoidance for Civil Survey Operations

A UXO technician must survey access lanes ahead of the surveyor when locating specific survey points. Once the surveyor has found the survey point, the area must be checked for anomalies with the magnetometer before placing a grid stake or pin. If an anomaly is located, the pin placement will be moved to another area. If MEC is found, the UXO technician will mark the item and notify the appropriate supervisor.

3.2.5 Escort Duties

A UXO trained person will escort all non-UXO trained personnel as necessary to support project operations. The UXO Escort will lead the group and visually and, if needed, utilize a hand-held instrument to detect surface contacts in vegetated areas.

3.2.6 Discovery Of Anomalies/Items Other Than MEC

Material other than munitions may be located during the MEC avoidance operations, including metal debris, underground utilities, chemicals, and other hazards.

Metal debris located during MEC avoidance will be clearly marked with surveyors' tape, paint, or another identifiable item and left in place unless stated in the contract or presents a safety hazard.

Suppose there are any indications that a near-surface utility line is present (such as a signal from the locator or discovery of marking tape). In that case, all activities will cease, and the appropriate supervisor will be notified. The work area should be relocated to another site, if possible.

Locating industrial chemicals is a possibility during MEC avoidance operations. If any evidence of chemical contamination is detected (stained soil, chemical odors, powders, or other substances resembling chemicals), all activities will cease. The appropriate supervisor will make the required notifications as per the work plan.

Suppose sealed drums or other suspect materials or conditions indicate a potential health or safety hazard are encountered during the investigation. In that case, all activities will cease, and the appropriate supervisor will make the required notification as per the work plan.

4.0 DATA MANAGEMENT

The following sections describe the data that is needed to perform this SOP and the resulting data.

4.1 INPUT DATA REQUIRED

The data input in order to perform MEC avoidance is varied depending on what task is being performed.

4.2 OUTPUT DATA

The primary output from this SOP are areas ready for civil survey, soil sampling data is collected, or areas are identified for surface operations.

5.0 QUALITY CONTROL

Quality Control (QC) for this SOP will be achieved through visual checks of the definable feature of work (DFW), completion of the QC Checklist for MEC Avoidance (Section 5.3), and performance metrics identified in the plans are met. The checklist will be filled out and signed by the onsite quality lead or designee upon completing the area or grid.

5.1 MEASUREMENT QUALITY OBJECTIVES

The Measurement Quality Objectives (MQOs) for MEC Avoidance are presented in the project plans, with results documented in the team logbook.

5.2 REPORTING

Input to the project MEC/Material Potentially Posing an Explosive Hazard (MPPEH) Accountability Log is the only reporting output from this SOP.

5.3 QC CHECKLIST FOR MEC AVOIDANCE

TEAM INFORMATION		
Team:	Location:	Date:
Team Leader:		
Personnel Present:		
Contract #:		
Task Order #:		

QC CHECKLIST POINTS

Item	Ref.	Inspection Points	Yes	No	N/A	Comments
1	UXO SOP X	Have personnel read and signed the workers' statement?				
2	UXO SOP X	Has the equipment been checked out, and is it documented correctly?				
3	UXO SOP X	Are daily position checks within specified tolerances if the GPS is used?				
4	UXO SOP X	Have the appropriate MQOs been achieved for MEC Avoidance?				
5						

FINDINGS

Item	Comments

Signature:

UXOQCS or Designee: ______________________ Date: ____________

TETRA TECH

UXO SOP for Surface Sweep/Clearance Operation

Procedure: UXO SOP – Surface Sweep/Clearance Operations	Approver: MMRP Working Group	
Procedure Owner: Director of Technical Operations and Explosives Safety	Effective Date: 7/1/2020	
Reference Corporate Procedure N/A	Tetra Tech	Revision: 0

RECORD OF DEVELOPMENT, REVIEW, VALIDATION, AND APPROVAL

This Standard Operating Procedure (SOP) contains the procedures by which Tetra Tech, Inc will conduct Surface Sweep or Clearance Operations for munitions response projects. Any changes or deviations will be included in the project plans and approved by the Director of Technical Operations and Explosives Safety. SOPs will be reviewed annually.

Director, Health, Safety, & Environmental Jim Streib, CSP, SMS, CQA, CHST		Date:	
Director, Technical Operations & Explosives Safety Patrick Tatman		Date:	6/23/2020

Review Date	Reviewer	Next Review

WORKER'S STATEMENT

I have read UXO SOP – Surface Sweep/Clearance Operations and received the training necessary to demonstrate my capability to perform the procedures addressed in this SOP. If I identify a hazard not addressed in this SOP or encounter an operation I cannot perform in accordance with this SOP, I will stop the process and notify my immediate supervisor.

Worker's Name	Date	Supervisor's Name	Date

TABLE OF CONTENTS

Procedure: UXO SOP – Surface Sweep/Clearance Operations	Approver: MMRP Working Group	
Procedure Owner: Director of Technical Operations and Explosives Safety	Effective Date: 7/1/2020	Page **1** of **7**
Reference Corporate Procedure N/A	Tetra Tech	Revision: 0

1.0 PURPOSE AND SCOPE

The purpose of this Standard Operating Procedure (SOP) is to provide procedures and technical guidance for the Surface Sweep/Clearance Operations at designated munitions response sites. This SOP does not cover escort duties for Construction Support, Soil Sampling, or Surveyor operations. These operations include:

- Surface Sweep/Clearance
- Construction Support (access)

2.0 PERSONNEL, EQUIPMENT, AND MATERIALS

This section describes the personnel, equipment, and materials that may be required to implement this activity.

2.1 PERSONNEL

The following individuals or vendors may be involved in Surface Sweep/Clearance activities:

- Unexploded Ordnance (UXO) Sweep Personnel
- Sampling Technicians
- Professional Licensed Surveyors
- Construction Workers
- UXO Personnel

2.2 EQUIPMENT

- Personal protective equipment outlined in the Activity Hazard Analysis (AHA)/Job Safety Analysis (JSA)
- Hand-held geophysical instruments
- Global Positioning System (GPS) units
- Computers/Tablets
- Cameras
- Marking flags or ribbon
- Utility or Passenger Vehicles
- First-aid Kit
- Fire extinguisher

3.0 PROCEDURES AND GUIDELINES

All training on equipment will be either formal or on-the-job training (OJT). This training will be documented by site personnel and subject to review for accuracy and completeness. The UXO Quality Control Specialist (UXOQCS) will verify and document that all personnel assigned to surface sweep/clearance teams have received training on the equipment, Accident Prevention Plan/Site-Specific Health and Safety Plan (APP/SSHP), AHA/JSA, environmental requirements, and as dictated in the Work Plan.

The Senior UXO Supervisor (SUXOS), UXO Safety Officer (UXOSO), and UXO Team Leader (TL) will review the site terrain and determine the best approach for sweep/clearance operations. Although not expected, all inaccessible locations will be documented in the field logbook.

3.1 EQUIPMENT SET-UP

3.1.1 Receipt Onsite

Materials or equipment received at the site will be inspected for serviceability and against purchase order requirements or operations manuals. Photos will be taken and filed with the daily quality control reports or the quality receipt inspection report (QRIR) or equivalent record.

Hand-held geophysical sensors will be tested and, if applicable, search programs uploaded and verified in the test strip for functionality per the operator’s manual.

Hand-held or other Global positioning systems for use during Surface Sweep/Clearance will be checked for correct project and coordinate upload.

Cameras will have video cards and batteries checked.

Utility/passenger vehicles and heavy equipment will be inspected for damage and verified as operational. Photos of vehicles will be taken and filed, as stated above.

3.1.2 Daily Prior To Use

Electronic equipment will be tested prior to beginning operations each day and the results recorded in the team logbook or on forms. All tests will be reported to the lead on-site quality representative for inclusion in the daily report.

GPS devices will be checked against know points before use to ensure accuracy during use.

Hand-held geophysical sensors will be checked in an established test strip or against a piece of metal on the surface before beginning daily operations.

Personal Protection Equipment (PPE) will be inspected before use.

First-aid kits and fire extinguishers will be inspected weekly.

Utility terrain vehicles (UTVs) or passenger vehicles will be inspected daily for damage and operability. Inspection forms will be submitted to the site safety officer weekly.

3.2 OPERATIONS

3.2.1 General Safety

The most pertinent rules for handling Munitions and Explosive Concern (MEC) are summarized below:

- Assume munitions contain a live charge until determined otherwise.
- Avoid inhalation of and skin contact with smoke, fumes, and vapors of explosives and related hazardous materials.
- Consider munitions that have been exposed to fire or detonation as extremely hazardous. Chemical and physical changes may have occurred to the contents, which can render them much more sensitive than their original state (e.g., changes to the condition of the fuze or explosives).
- Make every effort to identify the munitions. Carefully examine the munition for markings and other identifying features such as shape, size, and external fittings. Do not move the suspected munition until it is identified and confirmed to be safe to move by the SUXOS and UXOSO.
- Plan for, provide, and know the measures to be taken in the event of an accident.
- Provide a designated emergency vehicle in the area in case of an accident or an emergency.
- Do not handle, use, or remain near explosives during the approach or progress (within 10-miles) of an electrical storm. All personnel will shelter as identified in the Accident Prevention Plan (APP) or as directed by the UXOSO.
- Only allow essential personnel to be present near the munitions.
- Always base operations on minimum exposure consistent with efficient operations.
- Do not rely on the color-coding of MEC for positive identification of contents. Munitions having non-existent, incomplete, or improper color codes may be present.
- Avoid the area forward of the ammunition’s nose until it can be determined that the item is not a shape-charge or high-explosive anti-tank round. The explosive jet can be fatal to great distances forward of the item’s longitudinal axis. Assume any shape-charge munitions contain a piezoelectric fuzing system until the fuzing is otherwise identified. Piezoelectric fuzes are extremely sensitive, can fire at the slightest physical change, and may remain hazardous for an indefinite period.
- Approach an unfired rocket motor from the side. Ignition will create a moving projectile hazard and hot exhaust. Do not allow electrically fired rocket motors within 25 feet of any exposed electronic transmitting equipment or antenna leads.

3.2.2 Daily Briefing

After arriving at the worksite, the SUXOS will conduct a tailgate operations/safety meeting at the work location. The UXOSO will brief the teams on potential hazards in the area and the operations performed during the shift, and review the AHA/JSA for the task. The SUXOS will assign selected worksites to each of the UXO teams for surface sweep/clearance operations.

The TL will ensure hand-held instruments, GPS, communications equipment, safety gear, or other non-construction equipment is function checked and serviceable before beginning field operations. The checks will be documented in team logs or on forms.

3.2.3 Surface Sweep/Clearance

All analog geophysical sensor visual surface sweep/clearance operations will be performed under the direct supervision of a Qualified UXO Technician III or higher. The UXO team will consist of one UXO Technician III, two UXO Technician IIs, and four UXO TIs or UXO Sweep personnel (UXOSP). A standard team will not exceed seven personnel, but if large areas require surface sweep/clearance as many as 22 personnel can perform this activity. If the area to be swept is large, two additional UXO Technician IIs and up to twelve UXO sweep personnel may be added to the basic team (for a total of twenty-two personnel).

- The UXO team members will be spaced approximately 5–ft (1.5-m) apart. At the direction of the UXO Technician III, will move through the grid/area, making sure the hand-held instruments do not interfere with one another as the technicians traverse the area to be swept. Hand-Held instruments meeting the detection performance metrics will be used to detect any surface debris that may be obscured by brush or heavy grasses.
- If UXO Sweep personnel are utilized, the UXO Sweep person will visually look at a contact once the hand-held instrument indicates a target is present. They will notify a UXO Tech II or higher to make the identification. At no time will UXO Sweep personnel touch with their instrument or hands any contact.
- IF UXO Personnel are used to conduct sweep/clearance operations, the UXO Technician will make a tentative identification to determine if the contact is MPPEH or Non-munitions-related debris (NMRD) [note, the identification of any debris discovered by a UXO Technician I must be confirmed by a fully qualified UXO Technician (defined as a UXOTII or above)]. The UXO Technician II will inspect the contact to verify if it is MPPEH, munitions debris (MD), range-related debris (RDD), or NMRD. All MEC/MPPEH will be left in place and marked as identified in the Explosive Safety Submission (ESS) or Explosives Siting Plan (ESP).
- As the team moves forward, the team member at the edge of the grid will use the grid stakes (or other visual marking) as one clearance lane boundary. The team member on the opposite end of the line will mark the limit of the cleared lane with pin flags, ribbon, cone, or other marking mechanism. These markers become the guide for the turnaround and define the limits of the previously cleared lane.
- This procedure is continued until the grid or area is completely cleared.
- The UXO Technician II and III will follow behind the sweep line depending on team configuration (seven or 22 personnel), ensuring that proper spacing is maintained, will inspect and verify the identification of the flagged MEC/MPPEH, and record data on the type, nomenclature, and location of the items as required.

Upon completion of the grid clearance all MD, RDD, and NMRD will be 100% inspected by a UXO Technician II and a UXO Technician III before it is removed from the grid or area to ensure it is free of explosive hazards. If MEC is found, it will be left in place, clearly marked, and the UXO Technician III will notify the SUXOS for further instructions. The UXO Technician III will also notify the SUXOS when MPPEH (not able to be 100% inspected) is found and request further instructions.

The team leader will photograph all MEC or MPPEH and record as much information as possible in the Team Leader's logbook or in the personal digital assistant (PDA). Recorded data includes nomenclature (if known), type (projectile, mortar, rocket, etc.), size, physical condition, fuzed or unfuzed, and fuze type by function (point detonating, mechanical time, etc.), condition (fired or unfired, armed or unarmed), filler if known, and global positioning system (GPS) coordinates.

The SUXOS and UXOSO are the only personnel who are authorized to make them acceptable to move determination for MEC or suspected MPPEH.

3.2.4 Collection Points

Collection points allow for temporary accumulation of recovered MEC/MPPEH that are acceptable to move to another area for storage or destruction. The net explosive weight, location, and separation distances between the collection point will be identified in the explosive safety documents. No MEC/MPPEH will be transported from one munitions response site to another.

3.2.5 Field Communication

Hand-held radios will be used for any required communications between the UXO teams and the site office/site management personnel. The site office will relay all required communication to other on-site personnel using established radio links or by telephone/cell phone. Applicable telephone numbers can be found in the APP/SSHP and will be posted in the site office and placed in all vehicles. If necessary, a radio base station or repeaters will be used to ensure reliable communications across the site.

3.3 MPPEH CHARACTERIZATION

- The first person who discovers the MPPEH will conduct the initial classification (MEC, MD, RDD, NMRD). If the person is a UXO Tech I, he will have a second person UXO Tech II or higher verify the classification. UXO Sweep personnel will never touch or move MPPEH until directed by a UXO Tech II or higher.
- The UXO Tech III (UXO TL) will inspect all MD, RDD, and NMRD before leaving the clearance area (i.e., grid, transect
- The UXO TL will determine whether the MPPEH, once visible, is MEC and notify the SUXOS and UXOSO. MPPEH that is not inspectable will be treated as MEC, as discussed in the Work Plan.
- The SUXOS will make the final identification of any suspected MEC.
- The SUXOS and UXOSO will make a joint decision on the acceptable to move determination. The two must be in agreement with the decision, and it will be documented.
- If an MEC/MPPEH is determined by the SUXOS and UXOSO to be unsafe to move, it will be blow in place (BIP) or may be moved remotely after all appropriate precautions have been taken. MEC will not be left unsecured in the field at any time. Notifications to the client, Ordnance and Explosives Safety Specialist or equivalent and PM will be made as outlined in the Work Plan.
- Protective works will be implemented as described in the explosive safety documents for BIPs
- If MEC is not intact upon discovery (i.e., exposed high explosive [HE] or filler), this will be noted on the Investigation Data Sheet & MEC Accountability Log. If the MEC/MPPEH is judged to be safe to transport, it will be placed in a container to prevent further loss of the filler and will be destroyed by detonation at a point identified in the ESS or ESP. Any HE or filler found on/in the soil will be marked with a digital global positioning system (DGPS) coordinate and logged in the TL's logbook and reported to the SUXOS and PM.
- Any suspected hazardous material (not munitions-related related) identified will be assessed on a case-by-case basis by the SUXOS and PM in consultation with the client. Hazardous material will be suspected to be hazardous if it emits a chemical odor, has caused soil staining, or is contained in a drum or other container commonly used (or marked) for storage of hazardous materials. If any doubt, materials will be reported for further investigation.

3.4 MEC/MPPEH AND MDAS

MPPEH identified as MEC [i.e., UXO, discarded military munitions (DMM), recovered bulk explosive, or Munitions Constituents (MC)] will be disposed of via detonation in-situ or relocated to a collection point. MEC/MPPEH will dispose of individually or as part of a consolidated shot, the day they are found, using a same-day donor explosives delivery service or guarded until disposal can be conducted. MEC Management and Disposal SOP addresses how MEC/MPPEH is transported.

MEC/MPPEH will be tracked/documented from discovery to final disposal in an accountability log.

Materials that cannot be certified and verified as inert (either following demolition disposal or otherwise) will have demolition activities performed on them again. MEC/MPPEH certified as explosive-free (materials documented as safe [MDAS]) will be managed and recycled as scrap metal following the MPPEH and MDAS Management SOP.

4.0 DATA MANAGEMENT

The following sections describe the data that is needed to perform this SOP and the resulting data.

4.1 INPUT DATA REQUIRED

No data other than the Geographic Information System (GIS) files are required to perform surface sweep/clearance operations.

4.2 OUTPUT DATA

The primary output from this SOP is the MEC/MPPEH, MD, RDD, and NMRD quantities that are recovered during the operation and its location and identifying information.

5.0 QUALITY CONTROL

Quality Control (QC) for this SOP will be achieved through three-phase of control of the definable features of work (DFW), completion of the QC Checklist for Surface Sweep/Clearance Operation (Section 5.3), and performance metrics identified in the plans are met. The checklist will be filled out and signed by the on-site quality lead or designee upon completion of unit of production.

When surface sweep/clearance using hand-held instruments is the remedy, coverage seeds placement and measurement quality objectives (MQOs) developed by the project team will be followed. EM200-1-15 does not recognize a surface clearance or sweep as a final remedy.

5.1 MEASUREMENT QUALITY OBJECTIVES

The MQOs for Surface Sweep/Clearance Operations are presented in the project plans. Results will be documented in the daily quality control report.

5.2 REPORTING

Input to the project MEC/MPPEH Accountability Log and disposal records are the only reporting output from this SOP.

5.3 QC CHECKLIST FOR SOIL SURFACE SWEEP/CLEARANCE

TEAM INFORMATION						
Team:		Location:				Date:
Team Leader:						
Personnel Present:						
Contract #:						
Task Order #:						
QC CHECKLIST POINTS						
Item	Ref.	Inspection Points	Yes	No	N/A	Comments
1	UXO SOP	Have personnel read and signed the workers' statement?				
2	UXO SOP	Has the equipment been checked out, and is it documented correctly?				
3	UXO SOP	Have the appropriate MQOs been achieved for Surface Sweep/Clearance?				
4	UXO SOP	Were all seeds (if instituted) placed and recovered?				

FINDINGS	
Item	Comments

Signature:

UXOQCS or Designee: ______________________ Date: ____________

UXO SOP for Vegetation Clearance/Removal

Procedure: UXO SOP - Vegetation Clearance/Removal Approved By: Tetra Tech MMRP Working Group		
Procedure Owner: Director of Technical Operations and Explosives Safety	Effective Date: 7/1/2020	
Reference Corporate Procedure N/A	Tetra Tech	Revision: 0

RECORD OF DEVELOPMENT, REVIEW, VALIDATION, AND APPROVAL

This Standard Operating Procedure (SOP) contains the procedures by which Tetra Tech, Inc will conduct vegetation clearance/removal operations for munitions response projects. Any changes or deviations will be included in the project plans and approved by the Director of Technical Operations and Explosives Safety. SOPs will be reviewed annually.

Director, Health, Safety, & Environmental Jim Streib, CSP, SMS, CQA, CHST		Date:	
Director, Technical Operations & Explosives Safety Patrick Tatman		Date:	6/23/2020

Review Date	Reviewer	Next Review

WORKER'S STATEMENT

I have read this UXO SOP – Vegetation Clearance/Removal and received the training necessary to demonstrate my capability to perform the procedures addressed in this SOP. If I identify a hazard not addressed in this SOP or encounter an operation I cannot perform in accordance with this SOP, I will stop the process and notify my immediate supervisor.

Worker's Name	Date	Supervisor's Name	Date

TABLE OF CONTENTS

1.0 PURPOSE AND SCOPE

The purpose of this Standard Operating Procedure (SOP) is to provide procedures and technical guidance for the vegetation clearance/removal at designated munitions response sites. These operations include:

- Vegetation clearance of boundary lines, control points, grids and transects;
- Manual and mechanical vegetation clearance/removal operations

2.0 PERSONNEL, EQUIPMENT, AND MATERIALS

This section describes the personnel, equipment, and materials that may be required to implement this activity.

2.1 PERSONNEL

The following individuals or vendors may be involved in vegetation clearance/removal activities or be in the area during these operations:

- Vegetation Clearance/Removal Subcontractors
- Surveyors
- Site Geophysicist
- Unexploded Ordnance (UXO) Technicians
- UXO Quality Control Specialist (UXOQCS)

2.2 EQUIPMENT

- Hand brush clearing tools
- Mechanical brush clearing equipment (chainsaws, skid steers, hydro axes, etc.)
- Personal protective equipment outlined in the Activity Hazard Analysis (AHA)/Job Safety Analysis (JSA)
- Hand-held geophysical instruments
- Hand-held Global Positioning System (GPS) Unit
- Computers/Tablets
- Cameras
- Utility or Passenger Vehicles
- First-aid Kit
- Fire extinguisher
- Refueling equipment

3.0 PROCEDURES AND GUIDELINES

3.1 EQUIPMENT SET-UP

3.1.1 Receipt onsite:

Materials or equipment received at the site will be inspected for serviceability and against purchase order requirements. Photos will be taken and filed with the daily quality control report or the Quality Receiving Inspection Report (QRIR).

GPS units or GPS enabled tablets will be loaded with the coordinates specific to the project. Upon receipt at the site, receipt inspections will verify all electronic equipment is operational and that coordinate systems and layers are loaded for the project.

Hand-held geophysical sensors will be tested and, if applicable, search programs uploaded and verified in the test strip for functionality per the operator's manual.

Cameras will have video cards and batteries checked.

Utility vehicles, passenger vehicles, or mechanized brush clearing equipment will be inspected for damage and verified as operational. Photos of vehicles/equipment will be taken and given to the site safety officer.

3.1.2 Daily Prior to Operations:

Electronic equipment will be tested prior to beginning operations each day of use and the results recorded in the team logbook or on forms. All tests will be reported to the lead onsite quality representative for inclusion on the daily quality control report.

GPS devices will be checked against know points before use to ensure accuracy during use.

Hand-held geophysical sensors will be checked in an established test strip or against a piece of metal on the surface before beginning daily operations.

Mechanized or power equipment will be checked out before use, following owners' operations manuals and documented on forms or in a logbook.

Utility terrain vehicles (UTVs)/passenger vehicles will be inspected daily for damage and operability. Inspection forms will be submitted to the site safety representative weekly.

3.2 OPERATIONS

3.2.1 General Safety

Surface sweeps will be performed before vegetation clearance/removal operations if Munitions and Explosives of Concern (MEC) is known to exist on the surface. UXO Escorts may be used in place of surface sweeps if the UXO escort surveys the grid or area if MEC is not confirmed on the surface.

Vegetation will be removed as limited by the contract. All vegetation at or below the allowed removal size will be chipped, mulched, shredded, or cut down and removed from the area operations will be conducted.

The measurement to determine if a tree is allowed to be removed will be measured from a height of 4-feet above the ground surface. All trees exceeding the allowed removal size will not be removed, and all practical measures to limit damage will be taken by vegetation removal personnel.

When powered equipment is in use, a Safety observer not engaged with brush cutting activities will be designated.

Observe safety precautions/warnings found in the operator's manual/manufacturer's publications.

Maintain 6 inches of ground clearance during vegetation cutting operations.

Maintain exclusion zone site control.

Non-UXO personnel must always be escorted by UXO-trained personnel in areas potentially containing MEC.

Avoidance activities at any given location onsite may be conducted by a single individual trained as a UXO Technician I, provided a second UXO Technician or the Senior UXO Supervisor (SUXOS) is readily available and reliable communications between UXO Technician has been established in case of emergency.

Observe MEC safety precautions for items encountered or suspected.

Extreme caution must be used when any vegetation removal equipment, powered or otherwise, is in use. Personnel observing manual brush clearing operations will stand outside of the debris throwing distance for that equipment. For mechanized brush clearing equipment, the safe distance identified in the operations manual will be observed.

Onsite mobile refueling operations will only be conducted when equipment is shut down. Additionally, the task will have the appropriate spill prevention and containment controls in place, along with the required fire extinguisher for that task.

The appropriate supervisor will be notified immediately of all MEC or suspected MEC finds.

Non-UXO personnel must be escorted by UXO-trained personnel at all times in areas potentially containing MEC.

If MEC is encountered that presents an immediate threat to life or property, it will be marked and secured until turned over to Explosive Ordnance Disposal (EOD) or the appropriate local authorities.

Do not touch or disturb MEC; mark their location with a red pin flag or surveyors' tape or other means and avoid them.

Do not expose electrically fired munitions to radio, cell phone or satellite phone transmissions within 25-ft. (7.6-m).

Do not collect souvenirs.

Do not smoke except in designated areas.

Prohibit non-essential personnel from encroaching upon the site.

Suspend all operations immediately upon the approach of an electrical storm as defined within AHA/JSA

In areas where vegetation removal is needed, UXO Technicians will first conduct a hand-held instrument-assisted surface sweep of the area to mark any surface material potentially presenting an explosives hazard (MPPEH), will remove any surface debris and identify other hazards that might damage equipment or injure personnel. Hazards will be marked with the flagging, paint, pin flag to ensure the vegetation team can clearly see the hazard. Team personnel will be briefed on location and type of hazardous features before commencing the vegetation removal.

If the purpose of the project is to gather data to determine area contamination density, the number of contacts removed will be recorded in logbooks or forms and reported to the SUXOS, Site Geo, or designee.

Team personnel are to ensure that 6 inches of ground clearance is maintained during removal operations. Those areas marked as hazards are to be avoided. The manner in which operations are accomplished will follow safe work practices and procedures. If MPPEH/MEC is located, the UXO technician will halt operations, mark the item, and notify the SUXOS and UXOSO.

Upon completion of the unit of production (grid, transect, or grouping of grids), the UXO person assigned to the vegetation clearance/removal operation will notify the SUXOS or Lead Site Manager by the end of the production day. The Site Geophysicist and UXOQCS or designee will inspect the area for compliance with the contract and requirements in the plan. Inspections will be documented on the daily quality control report and the project database updated.

4.0 DATA MANAGEMENT

The following sections describe the data that is needed to perform this SOP and the resulting data.

4.1 INPUT DATA REQUIRED

The data input to perform vegetation clearance/removal is the Geographic Information System (GIS) or project layout data loaded into the GPS or tablet system being utilized.

4.2 OUTPUT DATA

The primary output from this SOP are areas ready for civil survey, surface clearance (if not previously performed), blind seeding, and preparations for further geophysical or intrusive activities.

5.0 QUALITY CONTROL

Quality Control (QC)for this SOP will be achieved through inspection of the area or grids; completion of the QC Checklist for vegetation clearance/removal (Section 5.3) and performance metrics identified in the plans are met. The checklist will be filled out and signed by the Site Geophysicist, and onsite quality lead upon completion of the area or grid.

5.1 MEASUREMENT QUALITY OBJECTIVES

The Measurement Quality Objectives (MQOs) for vegetation clearance/removal are presented in the project plans. Results will be documented in the project GIS tracking system and daily quality control reports.

5.2 REPORTING

The project GIS tracking system will contain all vegetation clearance/removal status. Control documentation checks (coordinate readings) will be recorded in team logbooks. The UXOQCS will verify the completion of the checks and proper documentation on the frequency specified in the plans. The check will be documented on the daily quality control report when performed. For any work performed by a land surveyor subcontractor, a surveyor's report will be generated by the subcontractor upon completion of the work.

5.3 QC CHECKLIST FOR VEGETATION CLEARANCE

TEAM INFORMATION		
Team:	Location:	Date:
Team Leader:		
Personnel Present:		
Contract #:		
Task Order #:		

QC CHECKLIST POINTS

Item	Ref.	Inspection Points	Yes	No	N/A	Comments
1	UXO SOP	Have personnel read and signed the workers' statement?				
2	UXO SOP	Has the equipment been checked out, and is it documented correctly?				
3	UXO SOP	Are daily position checks within specified tolerances if the GPS is used?				
4	UXO SOP	Have the appropriate MQOs been achieved for vegetation clearance?				
5	UXO SOP	Has the Site Geophysicist or UXOQCS conducted a visual walkthrough of the area to ensure the work is acceptable?				
6	UXO SOP	Has the GIS Tracking system been updated?				

FINDINGS

Item	Comments

Item	Comments

Signature:

UXOQCS or Designee: ______________________________ Date: ______________

FINAL

EXPLOSIVES SAFETY PLAN

MUNITIONS AND EXPLOSIVES OF CONCERN

REMOVAL ACTION AND CONSTRUCTION SUPPORT

CONGAREE RIVER PROJECT

COLUMBIA, SOUTH CAROLINA

December 2021

Prepared by

Titan

Revised by

Tetra Tech

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Contents

TABLES

APPENDICES

1 Acronyms

ATF&E	Bureau of Alcohol, Tobacco, Firearms and Explosives
BEM	Buried Explosion Module
BGS	below ground surface
BIP	blown in place
CD	Cultural Debris
CM	Conventional Munitions
CWM	Chemical Weapons Material
DDESB	Department of Defense Explosives Safety Board
DESC	Dominion Energy South Carolina, Inc.
DHEC	Department of Health and Environmental Control
DMM	Discarded Military Munitions
DoD	Department of Defense
EM	Engineering Manual
EMM	Earth Moving Machinery
EOD	explosive ordnance disposal
EZ	exclusion zone
FCA	functional check area
IAW	In Accordance With
IDW	investigation derived waste
ISO	industry standard objects
MCE	Maximum Credible Event
MDAS	Material Documented as Safe
MEC	Munitions and Explosives of Concern
MGFD	munitions with the greatest fragmentation distance
MGP	Manufactured Gas Plant
MPPEH	Material Potentially Presenting an Explosive Hazard
MRS	Munitions Response Site
MSD	Minimum Separation Distance
NEW	Net Explosive Weight
OE	Ordnance and Explosives
PM	Project Manager
PTR	public traffic route

PTRD	Public Transportation Route Distance
QA	Quality Assurance
QC	quality control
QCM	Quality Control Manager
Q-D	Quantity Distance
RCWM	recovered chemical warfare materiel
SC	South Carolina
SCDHEC	South Carolina Department of Health and Environmental Control
SLED	State Law Enforcement Division
SUXOS	Senior Unexploded Ordnance Supervisor
TLM	tar-like materials
TP	Technical Paper
USACE	U.S. Army Corps of Engineers
UXO	Unexploded Ordnance
UXOSO	Unexploded Ordnance Safety Officer
VCC	Voluntary Cleanup Contract

1. Background

1.1. Site location

The Congaree River Project area is located on the Congaree River in Columbia, South Carolina (SC). The site, also referred to as the “project area”, begins directly south of the Gervais Street Bridge, extends approximately 200 feet into the river from the eastern shoreline, and approximately 1,500 feet downriver, towards the Blossom Street Bridge. The munitions and explosives of concern (MEC) intrusive activities will occur on the eastern side of Congaree River between Gervais and Blossom Street Bridges, within the cofferdam and removal areas shown on the figures in Appendix A. Underwater intrusive activities will occur within the cofferdam footprints prior to their installation. See Appendix A for the footprint of the cofferdam locations.

1.2. Site Description

1.2.1. Terrain and Vegetation

The predominant topographic feature within the project area is the Congaree River itself, which is a broad shallow river with numerous bedrock assemblages that are visible above the water level at normal river flows. The river slope in the vicinity of the project area is approximately2.10 feet/mile (U.S. Army Corps of Engineers [USACE], 1977). The river depth varies significantly in the project area due to the variability of the bedrock river bottom elevations.

The project area abuts the eastern shoreline, which rises sharply from the water’s edge in most places due to a steep bank that varies in height from approximately 5 to 20 feet depending on location. The ground slopes more gently to the east once the top of the riverbank is reached with an approximate 28 feet increase in land surface elevation. The riverbank is forested in this area with a vegetative cover consisting of various trees and tall native grasses and shrubs. The undergrowth is periodically maintained and trimmed in the vicinity of the wooden scenic overlook and river walkway and is much thicker and overgrown further south. The terrain and vegetation are not anticipated to hinder the field activities at the site.

Current access to the river is provided by a partially paved access road, which extends from the intersection of Senate and Gist Streets to the river.

1.2.2. Soil Condition

The landside Congaree Riverbank soil/sediments are unconsolidated, ranged in particle size from clay to gravels, displayed layering, and were approximately 12 feet to 27 feet thick.

Generally, soil/sediment thickness increased in the downriver direction, and is attributed to down cutting of the granite by the Congaree River. The uppermost soil/sediments were generally found to range from clays to medium sands. Below this is gray silt that overlies a sand and gravel layer. The Congaree River and project area can be generalized by shoreline (gray silt) and channel (sands and gravel). It is not anticipated that soils and or tar-like materials (TLM) will impact detection equipment results.

1.3. Site History

In 1865, during the Civil War, MEC and other articles of war produced by the Confederacy were dumped into the Congaree River near the Gervais Street Bridge by Union forces under the direction of General Sherman. This activity took place during Sherman's occupation of Columbia.

Archeological investigations, conducted as late as 1980, recovered some Discarded Military Munitions (DMM) from the area as well as some other potentially historically significant artifacts. Specifically, this work was focused in and adjacent to the unnamed tributary that enters the river just south of the Gervais Street Bridge. Several cannonballs were identified during this operation and properly disposed of by Army Explosive Ordnance Disposal (EOD) personnel located at nearby Fort Jackson.

Due to the potential presence of MEC within the project area, an additional reconnaissance and screening of the area in question was conducted as part of the investigative activities. Analysis of the survey data identified concentrations of anomalies with DMM potential in the immediate vicinity of the Senate Street landing and scatters extending into the river. A terrestrial magnetometer investigation of the unnamed tributary below the Gervais Street Bridge was also carried out, and that investigation identified eight additional anomalies with a potential association with ordnance.

In June 2010, the occurrence of a TLM within the Congaree River was reported to the South Carolina Department of Health and Environmental Control (SCDHEC). Preliminary sample results conducted on the material by SCDHEC and Dominion Energy South Carolina, Inc. (DESC) indicated that the TLM had similar chemical and physical characteristics as coal tar, a by-product of Manufactured Gas Operations, which were common in cities from the late 1800s until the 1950s. Additional research found that the most likely source of the TLM was a former Manufactured Gas Plant (MGP) located northeast of the river at 1409 Huger Street that operated from about 1906 until the mid-1950s prior to the existence of environmental regulations and permitting. Later this was the location of the city bus terminal until 2008.

DESC had previously entered into a Voluntary Cleanup Contract (VCC) with South Carolina Department of Health and Environmental Control (SCDHEC) in August 2002 to conduct environmental assessment and cleanup activities at the former Huger Street MGP site. DESC has worked proactively and cooperatively with SCDHEC under its existing VCC to determine the extent of TLM in the Congaree River and to develop a plan for cleanup.

To address the presence of TLM within the river, a Stakeholder-Developed Modified Removal Action was developed and submitted to SCDHEC in December 2018. Two areas within the river, along the eastern shoreline, were proposed for the removal of TLM impacted sediment. The TLM-impacted sediment varies in thickness from a few inches to approximately 6 feet thick in some areas. The current total estimate of sediment requiring removal is approximately 11,675 cubic yards. The total project area within the river, including cofferdam footprints and removal areas, is estimated to be 5.8 acres. Sediment removal from within the water area will occur after cofferdams are installed, and water has been removed. Intrusive investigations and removal operations of metallic anomalies by unexploded ordnance (UXO) divers will be conducted prior to the installation of the cofferdams.

The removal of MEC/Material Potentially Presenting an Explosive Hazard (MPPEH) from the project area and assisting in the segregation and disposal of impacted TLM sediment removed by DESC covered under this explosive safety plan is intended to protect the public, essential personnel, and the environment.

1.4. Current and Future Land Use

Current land use for the project area is public recreation and residential (the Congaree River), with adjacent private property along the eastern shoreline. The future land use is expected to be the same (Congaree River waterway).

1.5. Project Area

The site, also referred to as the “project area”, begins directly south of the Gervais Street Bridge, extends approximately 200 feet into the river from the eastern shoreline, and approximately 1,500 feet downriver, towards Blossom Street Bridge. The MEC intrusive activities will occur on the eastern side of Congaree River between Gervais and Blossom Street Bridges, within the cofferdam and removal areas shown on the figures in Appendix A. Underwater intrusive activities will also occur within the cofferdam footprint prior to their installation. See Appendix A for the footprint of the cofferdam location.

1.6. General

This Explosives Safety Plan (ESP) covers the munitions response actions in support of cofferdam installations and removal of impacted sediment within the Congaree River. The area to be swept and intrusively investigated for MEC/MPPEH consists of approximately 5.8 acres within the Congaree River. A shallow dive operation (covered in a separately submitted Dive Operation Plan) will be performed to remove any potential MEC/MPPEH within the cofferdam footprints prior to cofferdam construction needed to dewater the sediment areas containing TLM.

MEC items determined acceptable to move and recovered by the UXO divers will be transported by workboat and moved by hand cart to a placarded vehicle for transport to a designated collection point or to the portable storage magazine for temporary storage. Any MEC deemed not acceptable to move may be rigged by UXO personnel for remote movement using rope or cable that is suitable for moving the MEC remotely. For remote movement of not acceptable to move MEC, non-essential personnel must be separated from the operation by the maximum fragmentation distance horizontal (MFD-H) of 3060 ft for the selected munition with the greatest fragmentation distance (MGFD). This can be mitigated by sandbag engineering controls to reduce the distance to the K328 blast distance of 393 feet. Essential personnel in armored equipment or protected by shielding designed to defeat hazardous fragments must remain outside the K24 blast distance of 29 ft. until the MEC has been repositioned to the location where it will be blown in place. If possible, the explosive disposal operation will be conducted using the required burial depth calculated using the buried explosion module (BEM). This will result in no blast or fragmentation at the surface and a required exclusion zone of only 200 feet to comply with the Department of Defense (DoD) explosive safety requirements for intentional detonations.

Once the cofferdams have been constructed and water removed from within, a surface sweep and intrusive mag and dig process for MEC/MPPEH will be performed prior to excavation of TLM material. The area will be cleared of all surface MEC/MPPEH regardless of size (excluding small arms ammunition .50 caliber and below not visually detectable). Sub-surface ferrous metal anomalies will be investigated to the depth of detection up to three feet below ground surface (BGS). In TLM contaminated areas requiring deeper excavations, the excavation will be performed in three-foot lifts, and the surface of each lift will be inspected by the UXO technicians prior to each successive lift. The Senior Unexploded Ordnance Supervisor (SUXOS) and Unexploded Ordnance Safety Officer (UXOSO) will ensure all essential personnel are fully trained on the associated hazards and fully aware of the safety procedures to be followed when MEC/MPPEH investigation operations commence.

1.7. History and Characterization Data Analysis

Site History and previous characterization data are presented above in Site History section 1.5.

1.8. Selected Munitions Response Actions

In order to support the removal of TLM from the project area a “mag and dig” type removal action has been selected to remove the MEC/MPPEH prior to cofferdam installation and sediment/soil excavation. There will be no underwater removal of sediments prior to dewatering. A shallow wading/dive operation to sweep the area of the cofferdam footprint will be performed prior to cofferdam installation and is covered under a separate dive operations plan. Stand-by construction support will also be performed during sediment/soil excavation.

1.9. Land Use Controls (LUC)

No permanent land use controls are being proposed. Currently, there are signs announcing that no swimming is allowed in the area of the TLM. Prior to field activities, the operations area will be fenced, and signs posted to keep the public out for safety and protection of civil war era antiquities. Temporary fencing to prevent unauthorized access to the site will be put up and maintained during the entire removal action project.

1.10. Reason for Munitions and Explosives of Concern (MEC)

In 1865, during the Civil War, MEC and other articles of war produced by the Confederacy were dumped into the Congaree River near the Gervais Street Bridge by Union forces under the direction of General Sherman.

1.11. Type of MEC

Based on historical information primarily from an Inventory of Stores Captured in Columbia, SC document dated February 17, 1865, MEC/MPPEH items of interest that could potentially be encountered are identified below. The historical list contained a more general nomenclature than that used in the DoD Fragmentation database of today. The list below is taken directly in name from the 1865 document.

- Case shot, fixed, 12 pounder gun
- Fuse-shell, fixed, 12 pounder gun
- Grape, 12 pounder gun
- Canister, fixed, 12 pounder gun
- Shot, fixed, 6 pounder gun
- Case, fixed, 6 pounder gun
- Fuse-shell, fixed, 6 pounder gun
- Canister, fixed, 6 pounder gun
- Shot, fixed, 24 pounder gun
- Shell, fixed, 24 pounder gun
- Canister, fixed, 24 pounder gun
- Shell, fixed, 8 inch
- Shot and shell, not fixed, 8 inch
- Shot and shell, not fixed, 8 inch
- Shot and shell, not fixed, 10 inch

2. Maps

Figure A-1 in appendix A shows a map of the site in relation to the surrounding area. Figure A- 3 shows the proposed magazine location in regard to MEC clearance within the river. Figure A-2 is a map that shows the area with the Quantity Distance (Q-D) arcs that will be used during the MEC removal action in the area.

3. Explosive Safety Quantity -Distance

3.1. Munitions with Greatest Fragmentation Distance (MGFD)

According to historical information for Columbia, SC inventory, a variety of other munitions were identified as having been used or stored at the site. No information found to date associates any other munitions with the project site. Therefore, the 10 in “cannonball” shell has been selected as the MGFD for the project. Table 3-1 shows the maximum fragmentation distance and safe underwater overpressure distances for the selected MGFD. Q-D arcs are shown in Appendix A on Figure A-3. See Appendix B for Fragmentation Data Sheets.

Table 3-1. MGFD Table for Congaree River TLM Remediation Project

MGFD Type	Munitions Item	HFD (feet)	MFD-H (feet)	Safe Underwater Overpressure Distances in Feet at Specific Depths[2/]				
				1≥	5 ft	10 ft	15 ft	20 ft[3/]
Primary	10 Inch Cannonball Shell	237 [1/]	3060 [1/]	312	990	1,080	1,170	1,259

Notes:
1/ From Fragmentation Data Review Form, updated June 5, 2020
2/ From Chief of Naval Operations Interim Guidance 2014. For swimmers 1 foot deep or less, the safe distance = $(13000/50)*(NEW^{1/3})$. For swimmers/divers deeper than 1 foot, the safe distance = $15*(DOB*NEW^{1/5})+900$. Where DOB = Depth of blast, NEW = net explosive weight
3/ Estimated maximum depth of Congaree River within the Cofferdam Footprint.

3.2. MEC Area(s)

The exclusion zones (EZ) required for the public/non-essential personnel will be applied during all MEC intrusive, movement, and disposal operations. The minimum separation distance (MSD) for the project is presented in Table 3-1. Preliminary site work such as surveying, laying grid lanes, and anomaly avoidance does not require the establishment of an MSD for Q-D purposes. Essential personnel are defined as those on-site contractor and personnel required to participate in the MEC removal, along with those approved and authorized visitors. All other personnel are non-essential personnel. The outer boundaries of the MSD arcs are depicted on the Q-D map in

Figure A-3. The team separation distance at this site will be the K40 overpressure distance shown in Table 6-1. Positive control of the EZ based on the MSD will be maintained at all times that MEC operations are being conducted. Prior to beginning MEC operations, the contractor will ensure that there are no non-essential personnel within the EZ, and the contractor will ensure that the EZ remains clear of non-essential personnel throughout the MEC operations.

Only UXO-qualified personnel (see Department of Defense Explosives Safety Board [DDESB] Technical Paper [TP]-18 for definitions) will perform MEC intrusive investigation, construction support, and removal activities. Activities will be accomplished in accordance with the procedures detailed in the current USACE Engineering Manual (EM) 385-1-97. “Explosives Safety and Health Requirements Manual”. The UXO personnel will clear all excavation, construction, and laydown locations to ensure no intentional physical contact with MEC during removal/excavation operations.

Any occupied buildings or public roadways in the EZ areas during MEC operations will be evacuated and/or roadways blocked to prevent non-essential personnel from entering during the conduct of MEC operations. In addition, spotters will be used to stop work when non-essential personnel enters the EZ during the conduct of MEC operations.

3.3. Demolition Explosives

3.3.1. Delivery on As-Needed Basis

Donor explosives will be provided by a local vendor on an as-needed basis. MEC that is deemed acceptable to move will be transported to a portable storage magazine for temporary storage, MEC that is deemed not acceptable to move will be marked and guarded until disposal is accomplished

3.3.2. Explosive Storage Magazines

Due to the fact that on-going explosives needs might be present on the project, an on-site magazine to store recovered MEC will be utilized on this project. MEC will be stored in the un-barricaded type II ATF&E explosives magazine as hazard class/division (C/D) 1.1. The UXO contractor will maintain/control the sited explosive storage magazine.

Positioning of the magazine will be in accordance with (IAW) DESR 6055.09, DA PAM 385-64, and Section 55.206 of ATFP 5400.7. The closest occupied structure relative to the explosives magazine is 700 ft, and the nearest public road is 850 ft. The Magazine will be secured by the erection of a temporary fence that will be 8 to 10 ft in height and has one locked entry point. The maximum Net Explosive Weight (NEW) that will be stored will be less than 31 lbs. IAW DESR 6055.09 Section V3.E3.1.2.1.1.5.1, it has been determined that the Public Transportation Route Distance (PTRD) for the proposed magazine location has no public road access. The traffic for the area of the magazine is less than 400 car/rail passengers per day, and less than 80 ship passengers per day. The PTRD is, therefore, no Minimum Fragment Distance (MFD) is required for public traffic route (PTR) distance (DA PAM 385-64 Section 5-5, and DESR 6055.09 Section V.3.E3.1.3).

Inhabited Building Distance exclusion for the magazine is 200 ft; this is based on a NEW of less than 31 lbs IAW DESR 6055.09 table V3. E3.T2.

Demolition areas planned for this project are to be located within the fenced open area to be located far enough away from the road and inhabited buildings as not to include them within required EZ (EZ distance based on NEW of the MEC and donor charge and engineering control being used) of the demolition area.

3.4. Blow-in-place

If a MEC is deemed unacceptable-to-move, it will be blown in place (BIP) on land or remotely moved for in water removal operations. Underwater BIP procedures will not be conducted. All explosive disposal activities will be performed by DDESB TP-18, “Minimum Qualifications for UXO Technicians and Personnel” revision 1, 24 June 2020 qualified UXO personnel within the munitions response site (MRS). Please see table 3-1 for minimum separation distances for BIP procedures.

If it is determined that an item is acceptable to move, then the MEC/MPPEH will be consolidated on land and a consolidated demolition shot will be performed IAW TP-18 as stated above. The SUXOS and UXOSO must agree in writing that MEC is deemed acceptable to move.

3.5. Collection Points

Collection points are those areas used to temporarily accumulate MEC pending destruction at a later time using consolidated shots. The maximum NEW at a collection point will be limited such that the K40 overpressure distance for the total NEW does not exceed the HFD for the area (see Table 3-1, footnote 1). If multiple collection points are used, they must be separated by the K11 overpressure distance for the NEW of MEC at each collection point.

3.6. In-Grid Consolidated Shots

If determined acceptable to move by the SUXOS and UXOSO, consolidating multiple MEC within the MRS is anticipated for this project. U.S. Army Engineering and Support Center, publication “Procedures for Demolition of Multiple Rounds (Consolidated Shots) on Ordnance and Explosives (OE) Sites”, dated March 2000 will be used, and a copy of this guidance will be available on site. The maximum NEW for a consolidated shot will be limited such that the K328 overpressure distance for the total NEW (including donor charges) does not exceed the MFD-H for the intentional detonation.” The preferred explosive disposal method is to use the BEM to determine the required burial depth so that no blast or fragmentation reaches the surface.

3.7. Maximum Credible Event (MCE)

This section is not applicable to this project; no explosive soil, chemical weapons material (CWM), or explosives-contaminated facilities are expected.

4. Start Date

The start date for field activities will be coordinated with SCDHEC and DESC.

5. MEC Migration

MEC migration potential within the Congaree River is not expected to be significant. To facilitate removal operations, given the seasonal time constraints for work within the river, MEC clearance of the cofferdam footprints may be completed in advance of contractor mobilization for the construction and removal activities.

6. Detection Equipment and Response Techniques

6.1. Removal Depth

The removal depths for MRS 1 and 2 land/water subsurface clearance of MEC/ MPPEH, and any ferrous metal items is two feet for underwater and three feet for land. However, anomaly signals on land will be followed until they are resolved or one foot below the maximum required excavation depth.

6.2. Detection Equipment

The handheld detectors that will be used for this project include Schondstedt or Ceia magnetometers for land and an all metals electromagnetic (EM) detector (White’s) for underwater investigations. The handheld magnetometers have similar detection characteristics and can be expected to consistently detect the MEC items shown in Table 1-1 at their expected depths. The underwater EM detectors have a shorter detection range; however, they will still reliably detect a 10-inch cannonball at depths greater than 4 feet.

6.3. Analog Mag and Flag using Hand Held Detectors

The handheld detectors that will be utilized will be the Schondstedt or Ceia, and an all metals detector (Whites Spectrum XLT or similar).

6.4. Sweep Procedures

Each UXO Technician will demonstrate proficiency with the handheld geophysical device before site activities begin by locating industry standard objects (ISOs) buried in the functional check area (FCA). The site will be divided into grids, and search lanes will be used to sweep for surface MEC and mag, and dig procedures detailed in the work plan will be conducted to investigate subsurface targets detected by the handheld detectors. See the work plan for more information on sweep and mag and dig procedures.

6.5. Exclusion Zone Control

Positive control of the EZ will be maintained at all times when MEC operations are being conducted. Prior to beginning MEC operations, the UXOSO will ensure that there are no non-essential personnel within the EZ, and the UXO contractor field staff will ensure that the EZ remains clear of non-essential personnel throughout the MEC operations. This will include barricading access roads and entry control points as necessary and displaying appropriate signage indicating explosive operations at barricade points, and posting safety observers to facilitate the halting of traffic and pedestrians. Tables 6-1a and 6-1b provide required Ezs for the MGFD on the surface and underwater.

Table 6-1a. Surface Exclusion Zones for MGFD

MGFDs		**Exclusion Zones (feet)**				
		Fragmentation Effects$^{2/}$		**Blast Overpressure Effects$^{2/}$**		
Description	**Net Explosive Weight (lb.)** $^{1/}$	**HFD**	**MFD**	**K328**	**K40**	**K24**
10-inch Cannonball Shell	1.172	237	3,060	393	48	29

Notes:
1/ Trinitrotoluene (TNT)-Equivalent Weight
2/ From Fragmentation Data Review Form, updated June 5, 2020.

Table 6-1b. Exclusion Zones for Personnel in Water for MGFD

MGFDs		**Exclusion Zones (feet)**		
			Blast Overpressure Effects in Water$^{3/}$	
			Swimmers ≤ 1 ft	**Swimmers/Divers > 1 ft**
Description	**NEW (lb.)$^{1/}$**	**No Fragmentation Depth$^{2/}$**	**$13000*W^{(1/3)}/50$ $^{4/}$**	**$15*[DOB*W^{(1/5)}]+300*3$ $^{5/}$**
10-inch Cannonball Shell	1.172	3	312	990 – 1,259$^{6/}$

Notes:
1/ TNT-Equivalent Weight
2/ From BEM 7.2
3/ Chief of Naval Operations-accepted Navy Underwater Criteria, 2014
4/ Exclusion zone for underwater unintentional detonation for swimmers in the top 1 foot of water, where W=net explosives weight (NEW).
5/ Exclusion Zone for unintentional underwater detonation for divers/dive teams, where W=NEW and DOB=Depth of Blast (underwater depth of munition item being investigated/removed).
6/ Range based on 1-foot DOB to 20-foot DOB (maximum depth of river at cofferdam footprint). A surface EZ will be established using the BEM when water depth is less than the No Fragmentation Depth.

The controlling EZs are shown in table 6-2 below.

Table 6-2. Controlling Exclusion Zones for unitions Response Site

Operation	Sited As	Exposed Sites	Basis$^{2/}$	ESQD (feet)
Manual Operations$^{1/}$ (Surficial)	Unintentional Detonation	UXO teams	K40 of the MGFD	29^{3}
	Unintentional Detonation	Public and non-essential personnel	HFD of the MGFD	237$^{3/}$
Underwater Operations$^{1/4}$	Unintentional Detonation	Swimmers depth ≤ 1 foot	$D=(13{,}000*W^{1/3})/50$	312$^{5/}$
Underwater Operations$^{1/4}$	Unintentional Detonation	Swimmers/diver ≥ 1 foot	$S=[15(DOB*W^{1/5})+300]*3$	990 – 1,259/
Portable Magazine (31) lb. NEW) Storage of recovered MEC/MPPEH	Aboveground, U.S. Bureau of Alcohol, Tobacco, Firearms (ATF) Type II magazine	Non-essential personnel in structures	Inhabited Building Distance (K40)	200
		Non-essential personnel in the open	Public Traffic Route (K24)	75
MEC Disposal Operations using BEM with 2.5 lb. donor charge	Intentional Detonation	Essential and non-essential personnel	BEM V7.2	Primary 0$^{5/}$

Notes:

1/ Manual operations involve in-water and surface excavation of anomalies with hand tools.

2/ Primary MGFD is the 10 inch Cannonball Shell 4 pounds (lbs.) NEW of black powder equal to 1.720 NEW TNT.

3/ From Fragmentation Data Review Form, updated June 5, 2020.

4/ DOB=Depth of Blast (See Table 6-1b). Range based on 1-foot DOB to 40-foot DOB (maximum depth of bay at high tide is 40 feet). A surface EZ will be established using the BEM when water depth is less than the No Fragmentation Depth, as discussed in Section 6.2.1.

5/ BEM Version 7.2 BEM Printouts are located in Appendix A.

6.6. Operational Risk Management

Munitions response actions involve inherent risks and require evaluation of those risks. Table 6-3 lists risk assessments for the planned project activities using the DoD method for risk assessment.

Table 6-3. Hazard Analysis Matrix for Congaree River Project

Process Step	Hazard	Triggering Event	Initial Risk Index	Hazard Mitigation	Final Risk Index
1	Manual removal of MEC underwater	MEC reacts to movement during removal	C/III/4	UXO technicians	D/III/5
2	Movement and inspection of MEC	MEC reacts to movement and handling during inspection	C/II/3	UXO technicians	D/II/4
3	MEC/MPPEH Transportation	MEC/MPPEH reacts to direct	C/II/2	Item determined acceptable to move. Item packed in sand in a wooden box.	D/II/4

Process Step	Hazard	Triggering Event	Initial Risk Index	Hazard Mitigation	Final Risk Index
		impact or shock		If item is electrically initiated or fuzed, it will be wrapped in aluminum foil and placed in a closed metal container.	
4	MPPEH Processing	MPPEH reacts to impact during processing	C/II/4	MPPEH will be certified and verified as MDAS by two UXO technicians prior to archeological inspection and recycling.	D/II/5
5	MEC/MPPEH Storage	MEC/MPPEH reacts to heat, shock, or friction	C/I/2	ATF Type II HD 1.1 Portable Magazines with fire break utilized for MEC/MPPEH storage.	D/III/5
6	Receipt, handling, holding of donor charges	Donor charges react to heat, shock, or friction	C/II/3	Use of binary explosives, which have no explosive storage requirements or same-day donor charge delivery; detonators stored separately from main charges in ATF-approved day box; demolition operations will not take place if electrical storm <10 miles	D/II/4
7	MEC/MPPEH Disposal using BEM	MEC/MPPEH/ Donor reacts to heat, shock, or friction	C/II/3	Use of BEM to mitigate frag, all demolition operations personnel trained, demolition operations will not take place if electrical storm <10 miles	D/II/4

6.7. Intrusive Investigation

Non-Mechanized MEC removal and identification of anomalies will be performed using the criteria and procedures outlined below. Only DDESB TP-18 qualified personnel will perform intrusive excavation and investigation of anomalies. To gain access to a subsurface anomaly, excavation will be initiated to the side of the anomaly and will not be conducted directly over the anomaly until such time as the depth of the anomaly can be ascertained. Earth Moving Machinery (EMM) excavation of the soil overburden may be performed for anomalies for the purpose of removing overburden. However, the EMM will not be used within 12 inches directly over the anomaly.

Additional excavation will be conducted with care using small hand tools only. A detailed accounting of all MEC located at each site will be made and maintained by the SUXOS. A log entry and photograph will be made for each MEC indicating the item’s identification, explosive status, location (x, y, and z measurements), and final disposition. All munitions debris excavated during this investigation will be removed from the dig site and consolidated in appropriate containers for archeological screening and recycling.

6.8. Quality Control and Quality Assurance

The details of the quality control (QC) process that includes three phases of control QC inspections, equipment checks, and blind seeding are located in the project work plan. Upon conclusion of the removal activities in each grid within each area, the UXO Quality Control Specialist (UXOQCS) will conduct a surface and subsurface quality control (QC) inspection. QC inspection results will be submitted to the DESC for submission and review by SCDHEC for Quality Assurance (QA). Any non-conformance to contractual requirements will be documented and reported in writing to the SUXOS, Quality Control Manager (QCM), and Project Manager (PM). The SUXOS will be responsible for the field remediation of the non- conformance.

6.9. Equipment Tests

See section 6.4 Sweep Procedures for information regarding equipment tests.

7. Disposition Techniques

7.1. Demolition Operations

If disposal activities are required, they will be performed by personnel qualified in accordance with DDESB TP-18 and performed within the MRS. The EZs for intentional detonations are shown in Table 3-1, and Q-D Arcs are shown in Figure A-3.

7.1.1. Methods of Disposal

A. If disposal activities are required, they will be performed by qualified UXO personnel within the MRS. The EZs for intentional detonations are shown in Table 3-1, and Q-D Arcs are shown in Figure A-2.

B. MEC will be marked and guarded, if deemed not acceptable to move until disposal is accomplished. MEC that is deemed acceptable to move will be transported to the portable storage magazine for temporary storage or to a designated collection point and guarded until MEC disposal operations are scheduled.

C. All explosive operations will follow the UXO contractor’s SOPs for explosive disposal procedures and follow the guidance outlined in TM 60A-1-1-31 and EM 385-1-97, Explosives Safety and Health Requirements Manual. Demolition operations will be performed as needed based magazine capacity, and volume of MEC recovered.

The magazine location chosen for this effort is located within a fenced open area. It has controlled access. All gates are to be locked at all times when not under supervision.

The nearest improved public road is approximately 850 feet away. The nearest inhabited building is 700 feet away.

7.2. Explosive Storage, Accountability, and Transportation

The UXO contractor does not anticipate generating any munitions-based hazardous waste that will require off-site transportation, treatment, storage, or disposal. MEC and/or MPPEH will be destroyed on-site and the resulting scrap will be certified as Material Documented as Safe (MDAS) and turned over to a recycler for smelting before it is released to the public. Non-hazardous cultural debris (CD) and municipal waste generated during this project will be transported to a municipal landfill for disposal.

7.3. Engineering Controls

The primary engineering control for on-site explosive neutralization will be the DDESB BEM calculator (V7.2). Using the BEM calculator will ensure no blast or fragmentation will reach the surface. For MEC deemed unacceptable to move, sandbags will be the primary engineering control following the guidance in (HNC-ED-CS-S-98-7, HNC Safety Advisory dated 7 November 2011, the DDESB Memorandum “Clarifications Regarding Use of Sandbags for Mitigation of Fragmentation and Blast Effects due to Intentional Detonation of Munitions”, Nov. 29 2010, and DDESB Memorandum “Revision of DDESB Approval for Use of Sandbag Mitigation of Fragmentation and Blast Effects Resulting from the Intentional Detonation of Munitions”, May 22 2014) or Water Mitigation (HNC-ED-CS-S-00-3) may be used to reduce the intentional detonation EZ.

7.4. Scrap Procedures

7.4.1. Inspection and Certification

MPPEH processing procedures will be IAW DoDI 4140.62 and EM 200-1-15. All MPPEH will be assessed and its explosives safety status determined and documented prior to transfer to a third party for disposal recycling or preservation. Prior to release to the public, MPPEH will be documented by authorized and technically qualified personnel as MDAS after a 100% inspection and an independent 100% re-inspection to determine that it is safe from an explosives safety perspective. A DD Form 1348-1A will be completed for all munitions debris and range- related debris to be transferred for final disposition and certified by the USXQCS & SUXOS.

7.4.2. DD Form 1348-1A

Upon completion of all removal activities, the UXO contractor will complete a DD Form 1348-1A IAW EM 200-1-15 that will include the following statement regarding processed MDAS & investigation derived waste (IDW) materials:

"This certifies and verifies that the materials listed have been 100 percent inspected and to the best of our knowledge and belief, are inert / or free of explosive or related material."

7.4.3. Alternative Disposal Techniques

The UXO contractor will not transport any MEC/ MPPEH off-site for disposal. If MEC/MPPEH are required to be demilitarized off-site, the UXO contractor will report this to the DESC on-site representative and implement explosive safety measures to secure the recovered munitions. The UXO contractor in conjunction with DESC will contact the Richland County bomb squad at (803) 576-3000 for assistance. If Richland County Shariff's Department cannot respond, DESC will request Richland County Shariff's Department to contact the South Carolina State Law Enforcement Division (SLED) for assistance with the munition. If SLED cannot support a response, DESC will request SLED to contact U.S. Military EOD to assist with the demilitarization of the item.

8. Environmental, Ecological or Cultural Consideration

Cofferdam construction activities will be conducted around the short-nosed sturgeon spawn season. DESC will determine when the area is safe to work in prior to giving the notice to proceed to the UXO contractor. Ordnance that can be inspected and certified as MDAS will be transferred to the artifact recovery team.

In the event that any environmental, ecological, or cultural considerations arise during project performance, project activities or affected portions of project activities will immediately cease, and the Project SUXOS, PM, DESC, and Government Representatives will be immediately notified. Project activities will not commence in project-affected areas until the contractor is notified to proceed in a manner determined appropriate.

9. Technical Support

9.1. Military Support

No CWM is suspected at this site. However, if suspected CWM is encountered at the project site, all work will immediately cease. All project personnel will withdraw along identified, cleared paths upwind from the discovery. The senior UXO person on site will designate a two-person team to secure the area and prevent unauthorized access. This team will position themselves as far upwind as possible while still maintaining visual contact and control of the area. The senior UXO person on-site following evacuation will immediately notify the PM, who will immediately coordinate with DESC and Government Project Representatives to contact and facilitate military control and EOD response. The contractor will maintain control of the site until control is relinquished to the military. Additionally, local law enforcement will be contacted of the discovery. If the item is recovered chemical warfare materiel (RCWM) or has an unknown liquid filler, the on-site DESC representative will notify the Chemical Warfare Design Center (CWM-DC) at the CEHNC by calling the 24/7 telephone number at 256-895-1180.

9.2. Contractor

All on-site UXO Personnel will meet the required training and minimum experience required by DDESB TP-18.

10. Residual Risk Management

10.1. Land Use Control

No permanent land use controls are being proposed. Temporary fencing to prevent unauthorized access to the site will be put up and maintained during the entire removal action project.

10.2. Long-Term Management

Any long-term management is the responsibility of DESC or other stakeholders related to the project.

11. UXO Safety Education Program

The UXO contractor has not been contracted to perform any UXO Safety education program outside daily safety briefings that are utilized to make other site personnel aware of hazards presented by UXO and the proper procedures in notifying the UXO contractor if evidence of UXO is discovered.

12. Stakeholder Involvement

This project was coordinated with SCDHEC, DESC, and other project stakeholders. All agencies will remain active in the final planning and response stages of the project as required, to include Work Plan review and final approval, progress review and schedule adjustments as required to accommodate construction schedules, EZ establishment, and control support as necessary, unplanned environmental emergency as necessary, and final report review, comment, and acceptance.

13. Contingencies

Contingency plans for dealing with MEC/MPPEH that requires external state or federal EOD support are detailed in section 7.4.3

Appendix A

Maps

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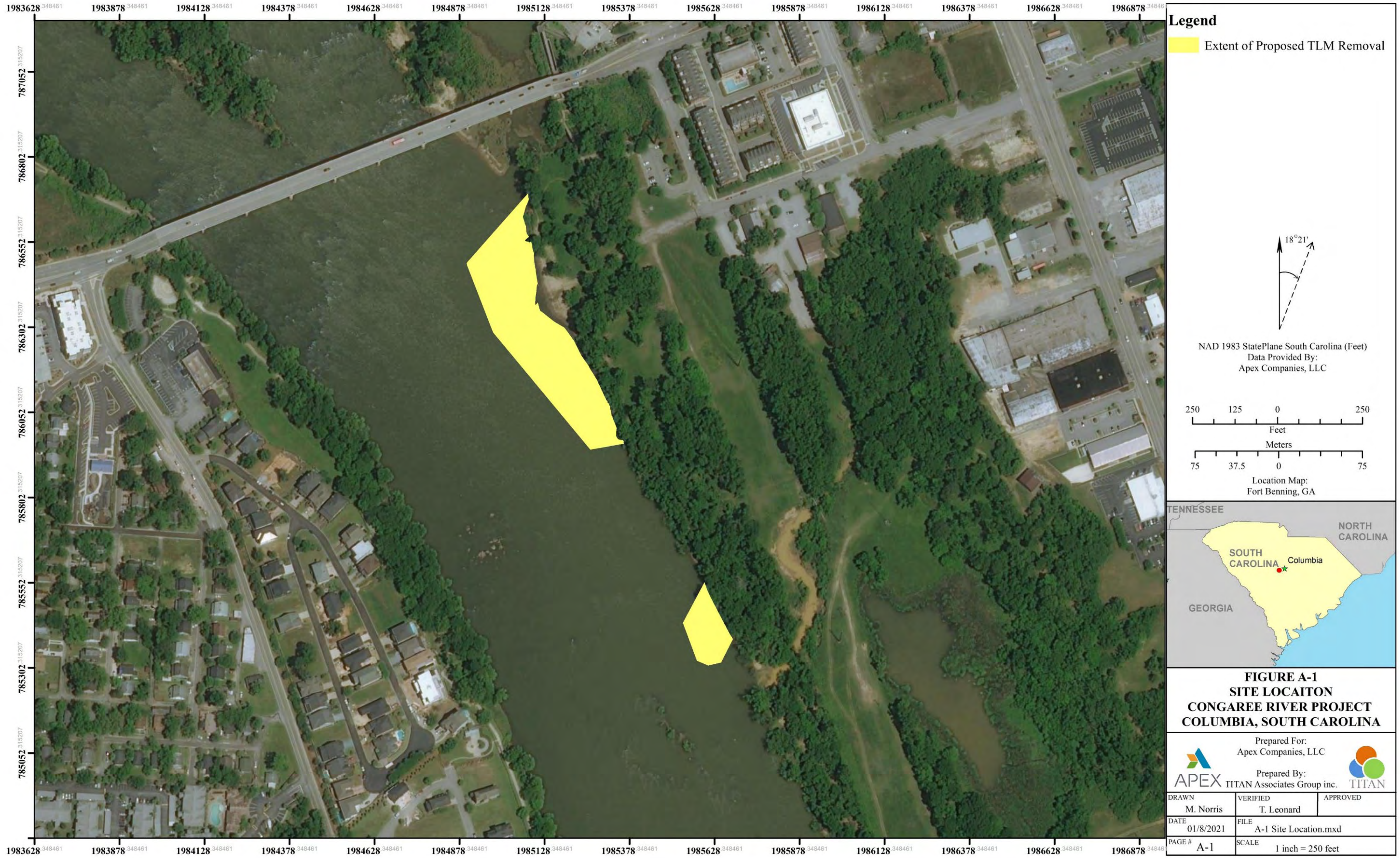

NAD 1983 StatePlane South Carolina (Feet)
Data Provided By:
Apex Companies, LLC

Location Map:
Fort Benning, GA

FIGURE A-1
SITE LOCAITON
CONGAREE RIVER PROJECT
COLUMBIA, SOUTH CAROLINA

Prepared For:
Apex Companies, LLC

Prepared By:
TITAN Associates Group inc.

DRAWN M. Norris	VERIFIED T. Leonard	APPROVED
DATE 01/8/2021	FILE A-1 Site Location.mxd	
PAGE # A-1	SCALE 1 inch = 250 feet	

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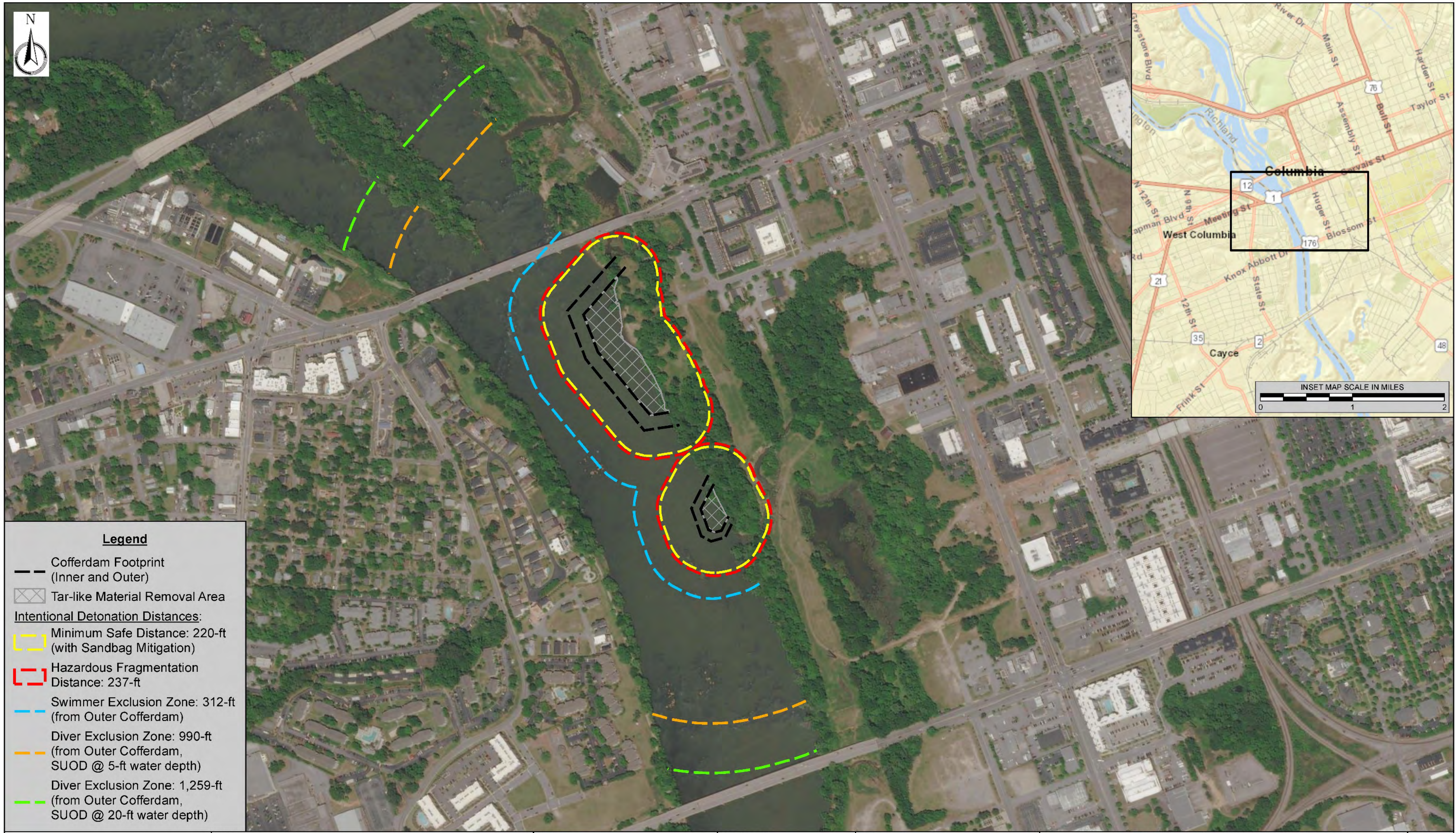

(GFS\tts232fs1\CES-EC\) P:\APEX\Congaree_River_MRA\120-GIS\MXD\ESP\FigA-2_CongareeR_ESP_IntentDetonation.mxd 2021/10/18: jeff.dahoda

1 INCH = 500 US FEET (SCALE AT 17" X 11")

SCALE IN US FEET
0 500 1,000

NAD 1983 STATE PLANE SOUTH CAROLINA
FIPS 3900 US FEET

Creator: JPD / Checked: SMW / Approved: MWD

NOTES:
1) Basemaps from ESRI imagery web mapping service, provider of basemap, aerial, and satellite imagery (Source for Main Map: Maxar, resolution 0.5-m, 04/27/2021. Source for Inset Map: World Street Map).

ACRONYMS:
MRA = Munitions Response Area
SUOD = Safe Underwater Overpressure Distance

PREPARED FOR:
APEX

PREPARED BY:
TETRA TECH

TITLE:
CONGAREE RIVER MRA: EXPLOSIVES SAFETY PLAN
INTENTIONAL DETONATION DISTANCES

A
REVISION

PROJECT:
CONGAREE RIVER MRA, SC

PROJECT NO.:
179-47200023

LOCATION:
COLUMBIA, SOUTH CAROLINA

DATE:
10/18/2021

FIGURE:
Figure A-2

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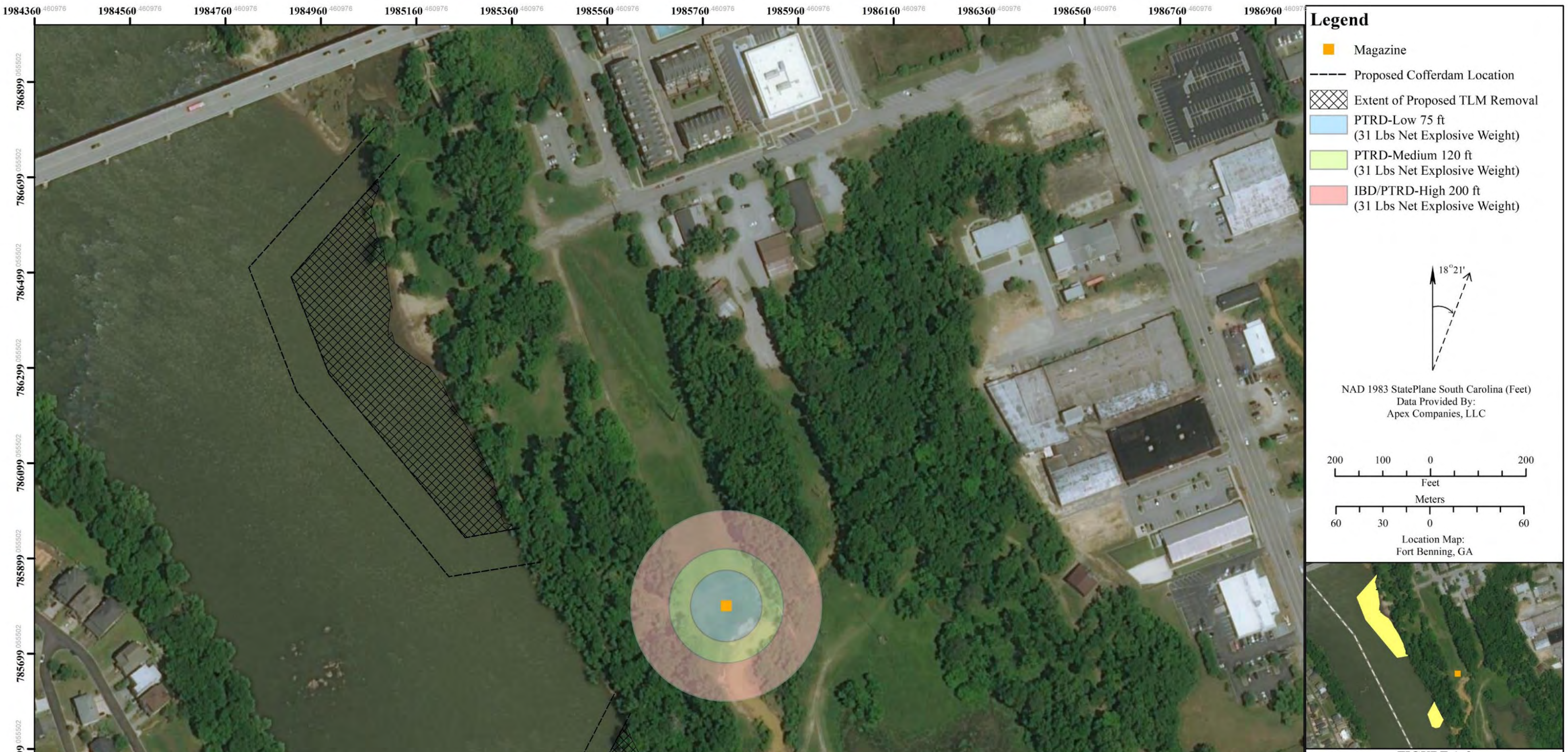

FIGURE A-3
MEC STORAGE MAGAZINE
PROPOSED LOCATION
CONGAREE RIVER PROJECT
COLUMBIA, SOUTH CAROLINA

Prepared For:
Apex Companies, LLC

Prepared By:
TITAN Associates Group inc.

DRAWN M. Norris	VERIFIED T. Leonard	APPROVED
DATE 01/08/2021	FILE A-3 Magazine.mxd	
PAGE # A-3	SCALE 1 inch = 200 feet	

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Appendix B

Supporting Explosives Safety Data

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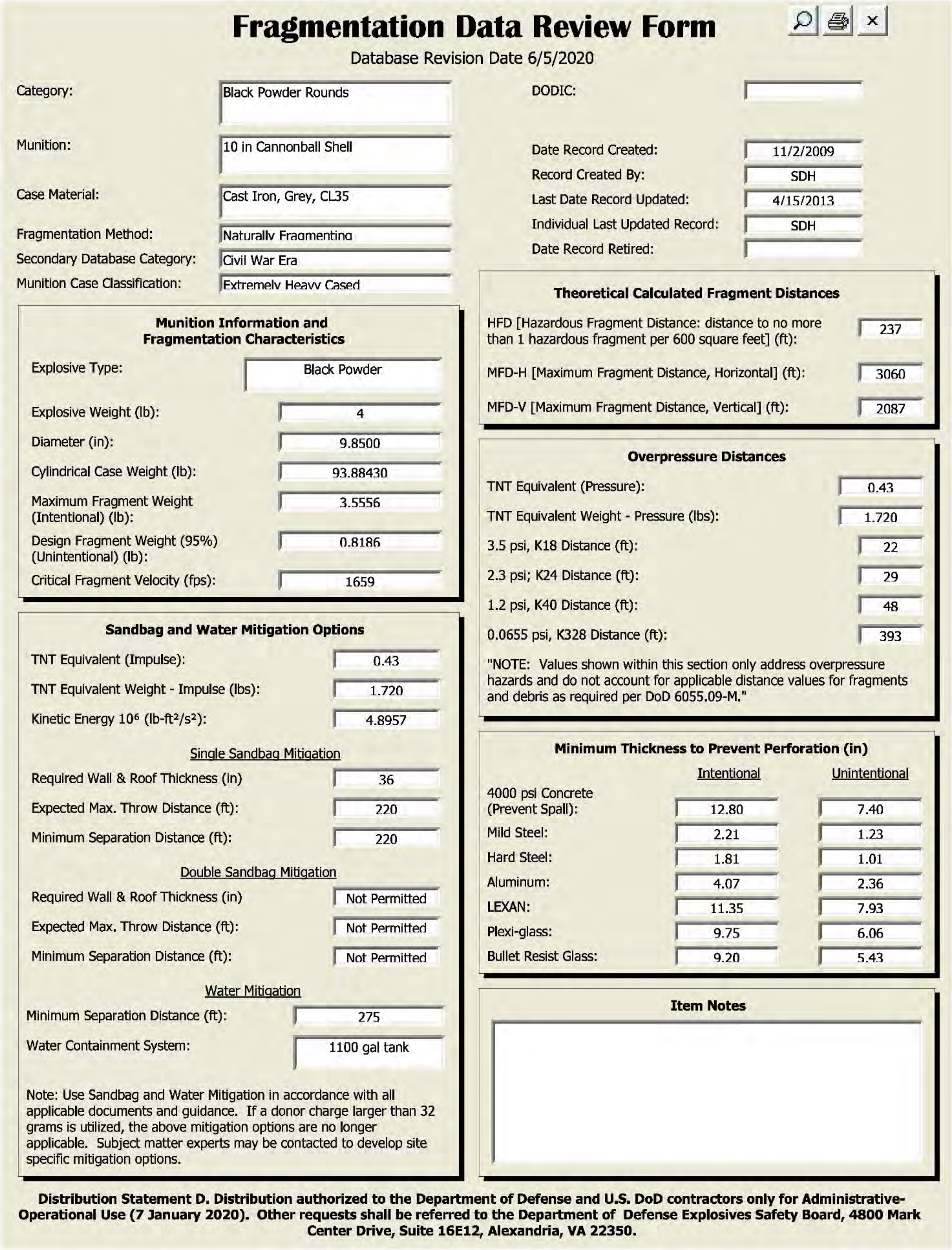


Fragmentation Data Review Form

Database Revision Date 6/5/2020

Category: Black Powder Rounds

Munition: 10 in Cannonball Shell

Case Material: Cast Iron, Grey, CL35

Fragmentation Method: Naturally Fragmenting

Secondary Database Category: Civil War Era

Munition Case Classification: Extremely Heavy Cased

DODIC:

Date Record Created: 11/2/2009

Record Created By: SDH

Last Date Record Updated: 4/15/2013

Individual Last Updated Record: SDH

Date Record Retired:

Munition Information and Fragmentation Characteristics

Explosive Type: Black Powder

Explosive Weight (lb): 4

Diameter (in): 9.8500

Cylindrical Case Weight (lb): 93.88430

Maximum Fragment Weight (Intentional) (lb): 3.5556

Design Fragment Weight (95%) (Unintentional) (lb): 0.8186

Critical Fragment Velocity (fps): 1659

Sandbag and Water Mitigation Options

TNT Equivalent (Impulse): 0.43

TNT Equivalent Weight - Impulse (lbs): 1.720

Kinetic Energy 10⁶ (lb-ft²/s²): 4.8957

Single Sandbag Mitigation

Required Wall & Roof Thickness (in): 36

Expected Max. Throw Distance (ft): 220

Minimum Separation Distance (ft): 220

Double Sandbag Mitigation

Required Wall & Roof Thickness (in): Not Permitted

Expected Max. Throw Distance (ft): Not Permitted

Minimum Separation Distance (ft): Not Permitted

Water Mitigation

Minimum Separation Distance (ft): 275

Water Containment System: 1100 gal tank

Note: Use Sandbag and Water Mitigation in accordance with all applicable documents and guidance. If a donor charge larger than 32 grams is utilized, the above mitigation options are no longer applicable. Subject matter experts may be contacted to develop site specific mitigation options.

Theoretical Calculated Fragment Distances

HFD [Hazardous Fragment Distance: distance to no more than 1 hazardous fragment per 600 square feet] (ft): 237

MFD-H [Maximum Fragment Distance, Horizontal] (ft): 3060

MFD-V [Maximum Fragment Distance, Vertical] (ft): 2087

Overpressure Distances

TNT Equivalent (Pressure): 0.43

TNT Equivalent Weight - Pressure (lbs): 1.720

3.5 psi, K18 Distance (ft): 22

2.3 psi; K24 Distance (ft): 29

1.2 psi, K40 Distance (ft): 48

0.0655 psi, K328 Distance (ft): 393

"NOTE: Values shown within this section only address overpressure hazards and do not account for applicable distance values for fragments and debris as required per DoD 6055.09-M."

Minimum Thickness to Prevent Perforation (in)

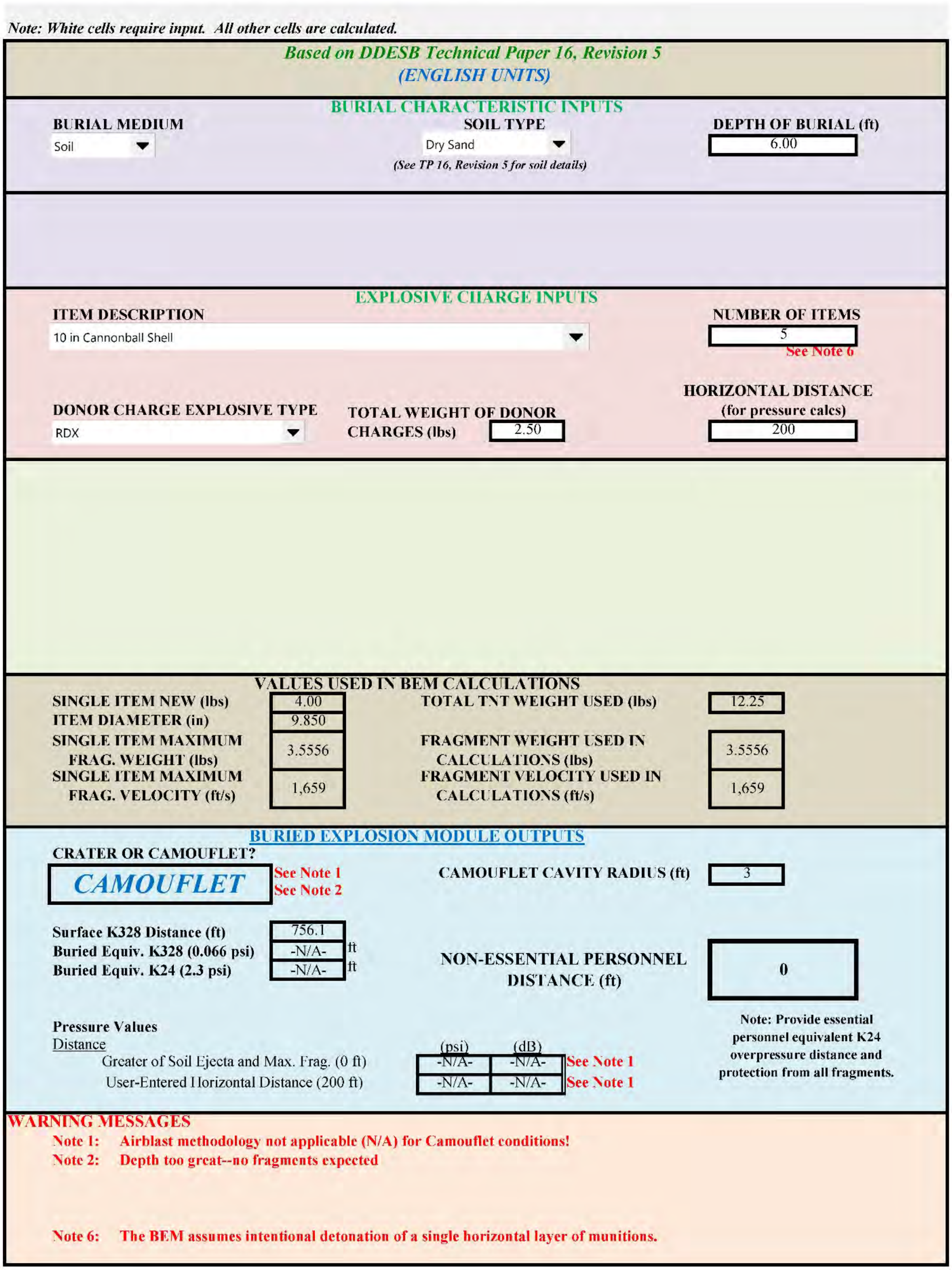
	Intentional	Unintentional
4000 psi Concrete (Prevent Spall):	12.80	7.40
Mild Steel:	2.21	1.23
Hard Steel:	1.81	1.01
Aluminum:	4.07	2.36
LEXAN:	11.35	7.93
Plexi-glass:	9.75	6.06
Bullet Resist Glass:	9.20	5.43

Item Notes

Distribution Statement D. Distribution authorized to the Department of Defense and U.S. DoD contractors only for Administrative-Operational Use (7 January 2020). Other requests shall be referred to the Department of Defense Explosives Safety Board, 4800 Mark Center Drive, Suite 16E12, Alexandria, VA 22350.

BURIED EXPLOSION MODULE

(Version 7.2)



Note: White cells require input. All other cells are calculated.

Based on DDESB Technical Paper 16, Revision 5
(ENGLISH UNITS)

BURIAL CHARACTERISTIC INPUTS

BURIAL MEDIUM: Soil

SOIL TYPE: Dry Sand

(See TP 16, Revision 5 for soil details)

DEPTH OF BURIAL (ft): 6.00

EXPLOSIVE CHARGE INPUTS

ITEM DESCRIPTION: 10 in Cannonball Shell

NUMBER OF ITEMS: 5 See Note 6

DONOR CHARGE EXPLOSIVE TYPE: RDX

TOTAL WEIGHT OF DONOR CHARGES (lbs): 2.50

HORIZONTAL DISTANCE (for pressure calcs): 200

VALUES USED IN BEM CALCULATIONS

SINGLE ITEM NEW (lbs)	4.00	**TOTAL TNT WEIGHT USED (lbs)**	12.25
ITEM DIAMETER (in)	9.850		
SINGLE ITEM MAXIMUM FRAG. WEIGHT (lbs)	3.5556	**FRAGMENT WEIGHT USED IN CALCULATIONS (lbs)**	3.5556
SINGLE ITEM MAXIMUM FRAG. VELOCITY (ft/s)	1,659	**FRAGMENT VELOCITY USED IN CALCULATIONS (ft/s)**	1,659

BURIED EXPLOSION MODULE OUTPUTS

CRATER OR CAMOUFLET?

CAMOUFLET See Note 1 See Note 2

CAMOUFLET CAVITY RADIUS (ft): 3

Surface K328 Distance (ft)	756.1	
Buried Equiv. K328 (0.066 psi)	-N/A-	ft
Buried Equiv. K24 (2.3 psi)	-N/A-	ft

NON-ESSENTIAL PERSONNEL DISTANCE (ft): 0

Note: Provide essential personnel equivalent K24 overpressure distance and protection from all fragments.

Pressure Values

Distance	(psi)	(dB)	
Greater of Soil Ejecta and Max. Frag. (0 ft)	-N/A-	-N/A-	See Note 1
User-Entered Horizontal Distance (200 ft)	-N/A-	-N/A-	See Note 1

WARNING MESSAGES

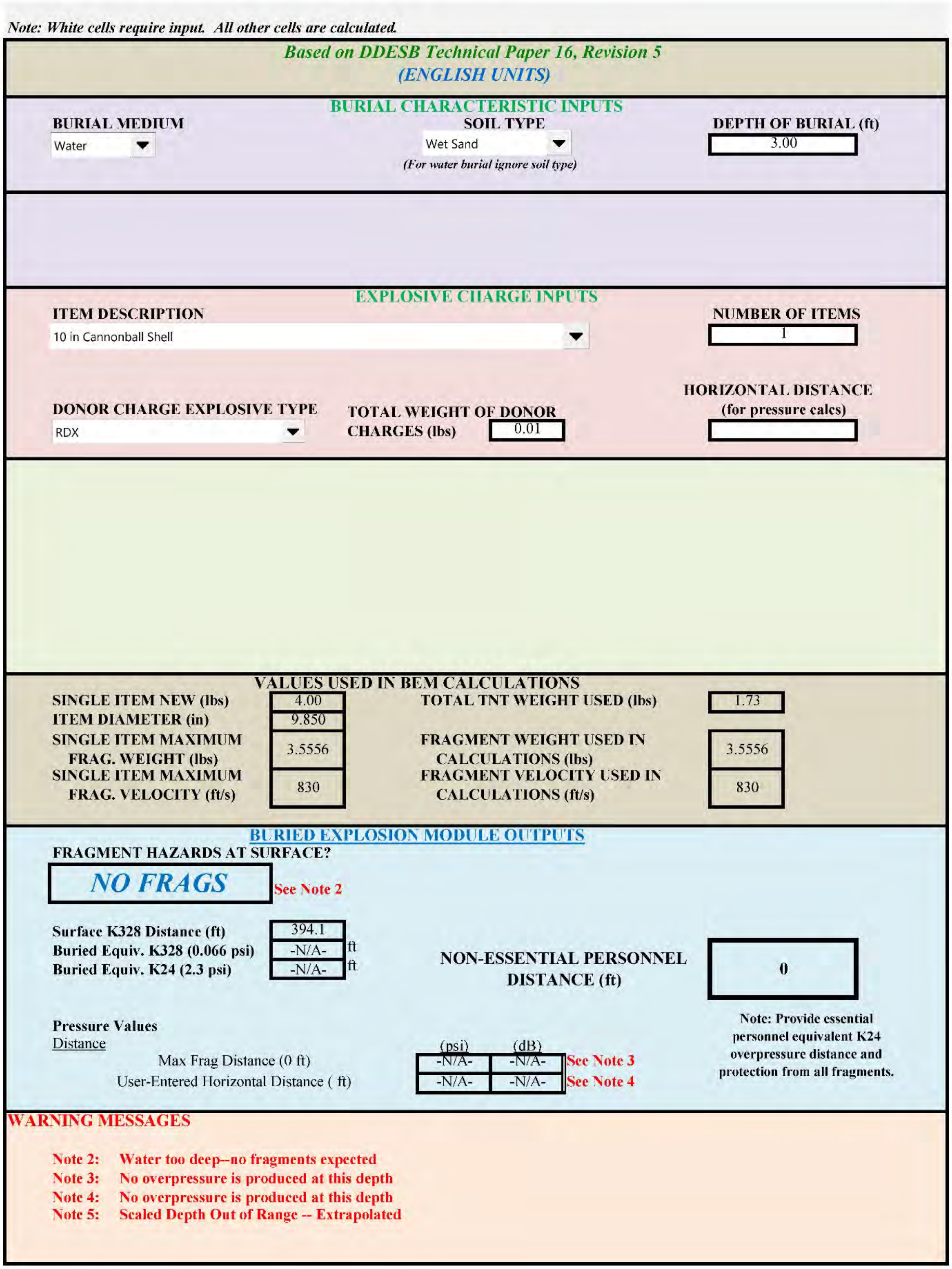
Note 1: **Airblast methodology not applicable (N/A) for Camouflet conditions!**

Note 2: **Depth too great--no fragments expected**

Note 6: **The BEM assumes intentional detonation of a single horizontal layer of munitions.**

BURIED EXPLOSION MODULE

(Version 7.2)



Note: White cells require input. All other cells are calculated.

Based on DDESB Technical Paper 16, Revision 5
(ENGLISH UNITS)

BURIAL CHARACTERISTIC INPUTS

BURIAL MEDIUM: Water
SOIL TYPE: Wet Sand
(For water burial ignore soil type)
DEPTH OF BURIAL (ft): 3.00

EXPLOSIVE CHARGE INPUTS

ITEM DESCRIPTION: 10 in Cannonball Shell
NUMBER OF ITEMS: 1
DONOR CHARGE EXPLOSIVE TYPE: RDX
TOTAL WEIGHT OF DONOR CHARGES (lbs): 0.01
HORIZONTAL DISTANCE (for pressure calcs):

VALUES USED IN BEM CALCULATIONS

SINGLE ITEM NEW (lbs)	4.00	**TOTAL TNT WEIGHT USED (lbs)**	1.73
ITEM DIAMETER (in)	9.850		
SINGLE ITEM MAXIMUM FRAG. WEIGHT (lbs)	3.5556	**FRAGMENT WEIGHT USED IN CALCULATIONS (lbs)**	3.5556
SINGLE ITEM MAXIMUM FRAG. VELOCITY (ft/s)	830	**FRAGMENT VELOCITY USED IN CALCULATIONS (ft/s)**	830

BURIED EXPLOSION MODULE OUTPUTS

FRAGMENT HAZARDS AT SURFACE?
NO FRAGS See Note 2

Surface K328 Distance (ft)	394.1	
Buried Equiv. K328 (0.066 psi)	-N/A-	ft
Buried Equiv. K24 (2.3 psi)	-N/A-	ft

NON-ESSENTIAL PERSONNEL DISTANCE (ft): 0

Note: Provide essential personnel equivalent K24 overpressure distance and protection from all fragments.

Pressure Values
Distance

	(psi)	(dB)	
Max Frag Distance (0 ft)	-N/A-	-N/A-	See Note 3
User-Entered Horizontal Distance (ft)	-N/A-	-N/A-	See Note 4

WARNING MESSAGES

Note 2: Water too deep--no fragments expected
Note 3: No overpressure is produced at this depth
Note 4: No overpressure is produced at this depth
Note 5: Scaled Depth Out of Range -- Extrapolated

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Diving Operations Plan

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Revised by:
Tetra Tech, Inc.
Munitions Response Services
19803 North Creek Parkway
Bothell, WA. 98011

Under contract to:
Apex Companies, LLC
1600 Commerce Circle
Trafford, PA 15085

Dated: December 2021
Project: Dominion Energy South Carolina, Inc.
Congaree River Project UXO Support

DIVING OPERATIONS PLAN

This Diving Operations Plan (DOP) is a general overview of the underwater diving operations to be performed while conducting intrusive underwater activities at the Congaree River Project in Columbia, South Carolina. This DOP addresses the health and safety practices and controls that will be implemented by all Tetra Tech, Inc. (Tetra Tech) employees and subcontractors participating in this contract.

This phase of the work to be performed cannot be fully accomplished by means other than diving (i.e., through the use of cameras, remotely operated vehicles, or dewatering of the work area). This work prepares the project site for dewatering prior to final clearance.

Activities to be performed under this DOP comply with applicable sections of:

- 29 Code of Federal Regulations (CFR) 1910.120,
- 29 CFR 1910 Subpart T – Commercial Diving Operations,
- United States (U.S.) Department of Defense Explosives Safety Board (DDESB) – Technical Paper 18,
- U.S. Army Corps of Engineers – Engineer Manual (EM) 385 1-1 Section 30,
- U.S. Navy Diving Manual Revision 7, and
- Tetra Tech Diving Safe Practices Manual, which is included as Attachment D to this DOP.

This DOP is not meant to be a stand-alone document. This DOP will be implemented in conjunction with the associated site-specific Final Work Plan (WP)). The WP is the overarching plan for the project. Sections of the WP are referenced (or duplicated in some cases) in this DOP. All project planning documents will be available and accessible to personnel during diving activities. Diver personnel must be familiar with the WP and this DOP before beginning fieldwork.

If, for any reason, the DOP is altered in mission, depth, personnel, or equipment, the corporate Dive Safety Officer will be contacted to review and accept the alteration prior to actual operation.

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Table of Contents

List of Tables

List of Figures

List of Attachments

Acronyms and Abbreviations

ADCI	Association of Diving Contractors International
AHA	activity hazard analysis
APEX	Apex Companies, LLC
CFR	Code of Federal Regulations
CPR	cardiopulmonary resuscitation
CRP	Congaree River Remediation Project
DDESB	Department of Defense Explosives Safety Board
DESC	Dominion Energy South Carolina, Inc.
DoD	Department of Defense
DOP	Diving Operations Plan
DPIC	Designated Person in Charge
DS	Dive Supervisor
DSO	Dive Safety Officer
DSPM	Tetra Tech Diving Safe Practices Manual
EM	Engineering Manual
EZ	exclusion zone
FFM	full-face mask
ffw	feet of fresh water
GPS	global positioning system
HAZWOPER	Hazardous Waste Operation and Emergency Response
HASP	Health and Safety Plan
HP	High Pressure
IAW	in accordance with
MC	munitions constituents
MD	munitions debris
MEC	munitions and explosives of concern
MGP	Manufactured Gas Plant
MPPEH	materials potentially presenting an explosive hazard
MRA	Modified Removal Action
NMRD	non-munitions related debris
OSHA	Occupational Safety and Health Administration

PM	Project Manager
psi	pounds per square inch
PSIG	pounds per square inch gauge
QC	quality control
QCP	Quality Control Plan
RTK	real-time kinematic positioning
SADS	surface air delivery system
SC	South Carolina
SCDHEC	South Carolina Department of Health and Environmental Control
SCUBA	self-contained underwater breathing apparatus
SHM	Safety and Health Manager
SSHP	Site Safety and Health Plan
SUXOS	Senior Unexploded Ordnance Supervisor
Tetra Tech	Tetra Tech, Inc.
TLM	Tar Like Material
U.S.	United States
USACE	United States Army Corps of Engineers
UXO	unexploded ordnance
UXOQCS	UXO Quality Control Specialist
UXOSO	UXO Safety Officer
VCC	Voluntary Cleanup Contract
WP	Work Plan

1. PROJECT INTRODUCTION

1.1 PROJECT WORK AUTHORITY

Apex Companies, LLC (APEX) has contracted Tetra Tech, Inc. (Tetra Tech) to revise plans to perform underwater clearance of Munitions and Explosives of Concern (MEC in support of contaminated sediment removal on the Congaree River Project (CRP), Columbia, South Carolina (SC).

This Diving Operations Plan (DOP) is a living document. A living document is one that can be modified, as necessary, to best achieve the goals and objectives stated within. Based on field observations, site conditions, and other unknown circumstances or conditions, this document may be modified best to achieve the objectives of the intrusive underwater activities

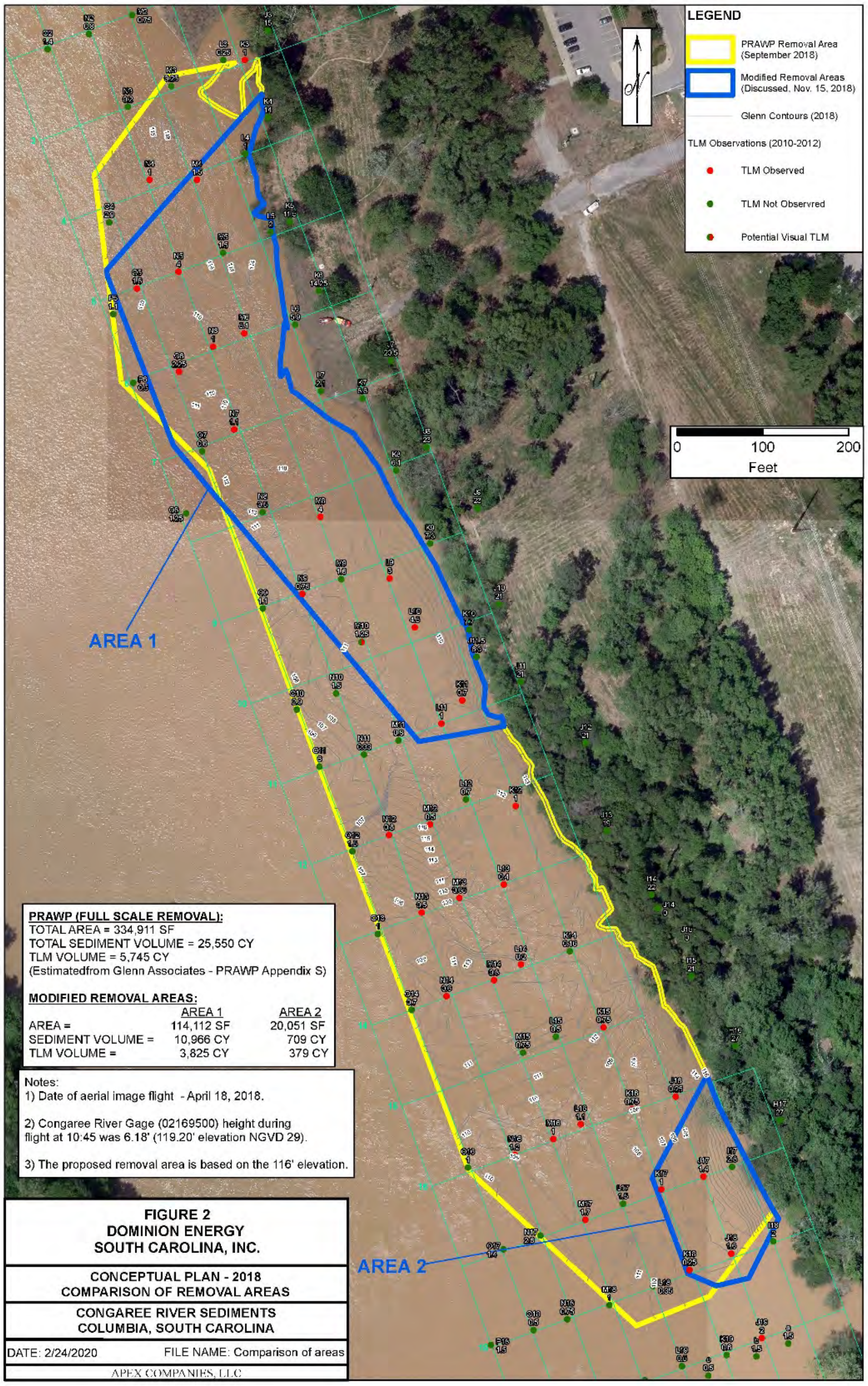
This DOP provides the technical approach, rationale, and field procedures to be followed to achieve the objectives of the underwater clearance activities during the CRP, Columbia, SC. This DOP was revised in accordance with the APEX Contract Number 87500614, dated October 29, 2021.

1.2 PROJECT PURPOSE

The purpose of the CRP diving activities in the cofferdam and remediation areas shown in Figures 1-1 through 1-3 is to remove MEC which, which will reduce hazards from Civil War-era military munitions co-located within the Tar Like Material (TLM) contaminated sediment removal areas. Tetra Tech will be performing dive operations to remove MEC materials potentially presenting an explosive hazard (MPPEH) from cofferdam footprints prior to installation. The intrusive underwater activities will be completed IAW United States Army Corps of Engineers (USACE) approved procedures and an Explosives Safety Plan IAW Department of Defense (DoD) Explosives Safety Board (DDESB) guidance.

1.3 PROJECT LOCATION

The CRP area is located on the Congaree River in Columbia, SC. The site, also referred to as the “project area”, has been divided into two separate areas and begins directly south of the Gervais Street Bridge. Area 1 consists of approximately 2.6 acres, and Area 2 is approximately 0.5 acres in total and extends downriver towards the Blossom Street Bridge. Cofferdam installations are planned around each area, so the areas may be dewatered, and MEC screening and sediment removal may occur on dry land. The intrusive underwater activities will occur within the cofferdam footprint areas prior to installation on the eastern side of Congaree River between Gervais and Blossom Street Bridges, shown in Figure 1-1.



PRAWP (FULL SCALE REMOVAL):
TOTAL AREA = 334,911 SF
TOTAL SEDIMENT VOLUME = 25,550 CY
TLM VOLUME = 5,745 CY
(Estimatedfrom Glenn Associates - PRAWP Appendix S)

MODIFIED REMOVAL AREAS:

	AREA 1	AREA 2
AREA =	114,112 SF	20,051 SF
SEDIMENT VOLUME =	10,966 CY	709 CY
TLM VOLUME =	3,825 CY	379 CY

Notes:
1) Date of aerial image flight - April 18, 2018.

2) Congaree River Gage (02169500) height during flight at 10:45 was 6.18' (119.20' elevation NGVD 29).

3) The proposed removal area is based on the 116' elevation.

FIGURE 2
DOMINION ENERGY
SOUTH CAROLINA, INC.

CONCEPTUAL PLAN - 2018
COMPARISON OF REMOVAL AREAS

CONGAREE RIVER SEDIMENTS
COLUMBIA, SOUTH CAROLINA

DATE: 2/24/2020 FILE NAME: Comparison of areas

APEX COMPANIES, LLC

Figure 1-1. Site Location

1.4 SITE BACKGROUND, AND DESCRIPTION

In 1865, during the Civil War, live munitions and other articles of war produced by the Confederacy were dumped into the Congaree River near the Gervais Street Bridge by Union forces under the direction of General Sherman. This activity took place during Sherman's occupation of Columbia. The Union Army kept some of these items for its own use, and the remainder was destroyed. One of the methods for destruction was dumping the items into the river.

Archeological investigations, conducted as late as 1980, recovered some live and unstable munitions or MEC from the area as well as some other potentially historically significant artifacts. Specifically, this work was focused on the unnamed tributary entering the river just south of the Gervais Street Bridge. Several live cannonballs were identified during this operation and properly disposed of by trained explosive ordinance disposal personnel located at nearby Fort Jackson.

Due to the potential presence of live munitions within the project area, an additional reconnaissance and screening of the area in question were conducted as part of the investigative activities. An acoustic (side-scan sonar) and magnetic (magnetometer) remote sensing survey was performed to identify ordnance and other submerged cultural resources in the remediation area by Tidewater Atlantic Research, Inc. and a report submitted on February 8, 2012. Analysis of the survey data identified concentrations of anomalies with the potential to be MEC in the immediate vicinity of the Senate Street landing and scatters extending into the river. A terrestrial magnetometer investigation of the unnamed tributary below the Gervais Street Bridge was also carried out, and that investigation identified eight additional anomalies with a potential association with ordnance.

In June 2010, the occurrence of a TLM within the Congaree River was reported to the South Carolina Department of Health and Environmental Control (SCDHEC). Preliminary testing indicated that the material might be attributable to the Huger Street former Manufactured Gas Plant (MGP) that was operated by predecessor companies of Dominion Energy South Carolina, Inc. (DESC) beginning in the early 1900s and ending in the 1950s.

Preliminary sample results conducted on the material by SCDHEC and DESC indicated that the TLM had similar chemical and physical characteristics as coal tar, a by-product of Manufactured Gas Operations that were common in cities from the late 1800s until the 1950s. Additional research found that the most likely source of the TLM was a former MGP located northeast of the river at 1409 Huger Street that operated from about 1906 until the mid-1950s. Later this was the location of the city bus terminal until 2008. Figure 1-2 shows the location of TLM detected during the investigative activities.

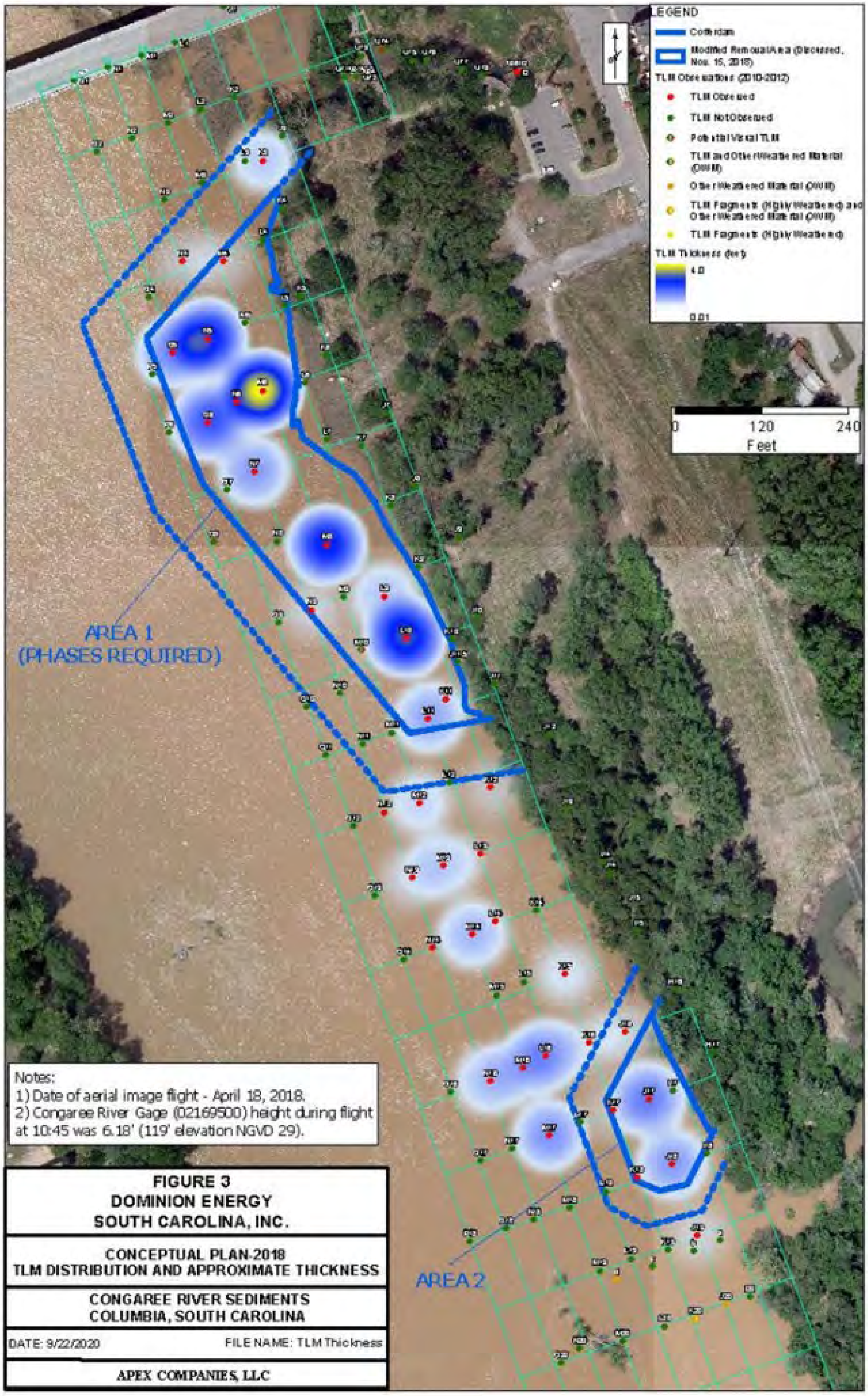
DESC had previously entered a Voluntary Cleanup Contract (VCC) with SCDHEC in August 2002 to conduct environmental assessment and cleanup activities at the former Huger Street MGP site. DESC has worked proactively and cooperatively with SCDHEC under its existing VCC to determine the extent of TLM in the Congaree River and to develop a plan for cleanup.

To address the presence of TLM within the river, a Stakeholder-Developed Modified Removal Action (MRA) was developed and submitted to SCDHEC in December 2018. Two areas within the river, along the eastern shoreline, were proposed for the removal of impacted sediment. The TLM-impacted sediment varies in thickness from a few inches to approximately 6 feet thick in some areas. The current total estimate of sediment requiring removal is approximately 11,675 cubic yards. The total project area within the river, including cofferdam footprints and removal areas, is estimated to be 5.8 acres. Sediment removal from within the river will occur after coffer dams are installed, and water has been removed. Intrusive Dive removal operations of metallic anomalies will be conducted prior to the installation of the coffer dams.

In December 2018, a Stakeholder-Developed Plan for the MRA was developed to reduce the footprint of the project area. The footprint was reduced to the current 2.6-acre area 1 and area 2 approximately 0.5 acres. See figure 1-3.

1.5 REMOVAL OBJECTIVES

The objective of this DOP is to locate and remove MEC from underwater sediment in the location of future cofferdam area footprints. The cofferdams are to be installed prior to coal tar contaminated sediment removal. Figure 1-3 shows the location of the footprint to be cleared for each project area. The overall objective of removing MEC is to reduce the risk to environmental construction workers and eliminate/reduce the potential of MEC within the removal action area boundaries.



Notes:
1) Date of aerial image flight - April 18, 2018.
2) Congaree River Gage (02169500) height during flight at 10:45 was 6.18' (119' elevation NGVD 29).

FIGURE 3
DOMINION ENERGY
SOUTH CAROLINA, INC.

CONCEPTUAL PLAN-2018
TLM DISTRIBUTION AND APPROXIMATE THICKNESS

CONGAREE RIVER SEDIMENTS
COLUMBIA, SOUTH CAROLINA

DATE: 9/22/2020
FILE NAME: TLM Thickness

APEX COMPANIES, LLC

Figure 1-2. TLM Distribution and Thickness

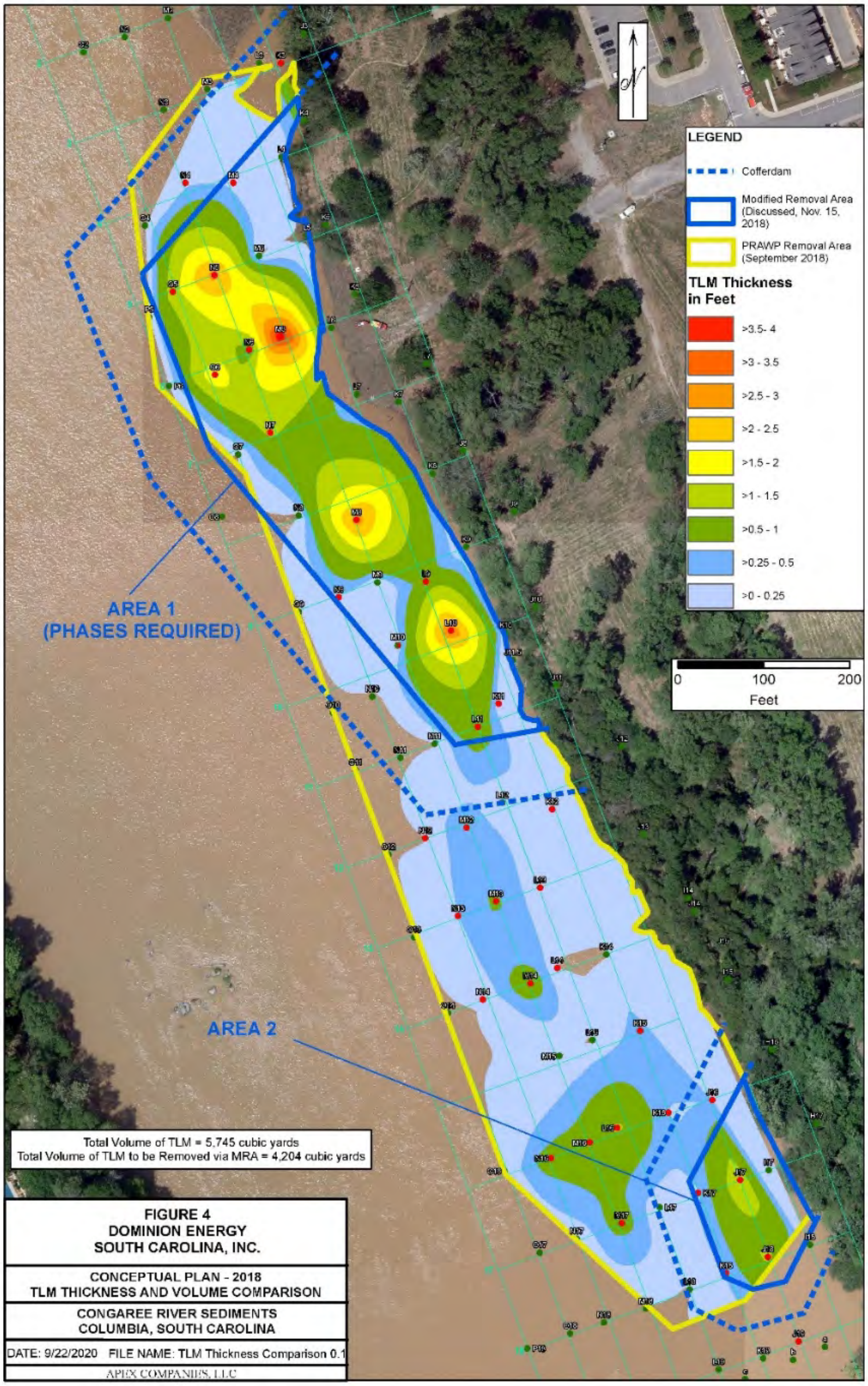


Figure 1-3. Modified Removal Area

1.6 SCHEDULE

The intrusive underwater activities for the cofferdam footprints are tentatively scheduled to begin in Spring/Summer 2022. The preliminary schedule is as follows:

- Respond to comments and finalize DOP in January 2022.
- Complete Area 1 and 2 coffer dam underwater intrusive activities in May up to August 2022.
- Project reporting activities November to December 2022.

During intrusive underwater activities, modifications to the schedule may be necessary. The schedule modifications will be submitted to DESC, and will include:

- Reasons for the modification
- Descriptions of the alternatives evaluated to increase productivity (e.g., increase manpower, lengthen workdays, more efficient equipment, etc.)
- Methods that will be used to prevent similar delays from happening again

1.7 DIVING OPERATIONS PLAN ORGANIZATION

This DOP is organized as follows:

- **Section 1 – Introduction**. Presents the authority, purpose, project description and general scope, personnel, site description and history, removal objectives, and tentative schedule for CRP underwater intrusive activities.
- **Section 2 – Dive Team**. Summarizes the names and duties of personnel involved with diving operations for CRP.
- **Section 3 – Equipment**. Provides a description of the required equipment and platform to be utilized during diving operations.
- **Section 4 – Tasks**. Summarizes the tasks for intrusive underwater activities.
- **Section 5 – Dive Operations**. Details the procedures to be followed during diving operations, intrusive underwater activities, field Quality Control (QC) procedures, and requirements to be followed.
- **Section 6 – Key Personnel**. Describes project key personnel and organization for diving activities.
- **Section 7 – Project Records and Reporting**. Lists project reporting deliverables for the CRP underwater intrusive activities.
- **Section 8 – References**. Provides references used to develop this DOP.

This section provides information on the CRP Dive Operations Team for intrusive underwater activities.

2. DIVE TEAM

2.1. PERSONNEL

Listed in Table 2-1 below are the minimum team requirements, as defined in the Tetra Tech Diving Safe Practices Manual (DSPM), that will be met for surface air delivery system (SADS), self-contained underwater breathing apparatus (SCUBA)), and Surface Supplied Air (SSA) diving operations:

Table 2-1. Dive Team Personnel Composition

SCUBA – Tethered with communications, 0 to 100 FSW	
Personnel	**Number**
Diving Supervisor **	1
Diver in water	1
Standby Diver* (tethered with communications)	11
Tender	1
TOTAL TEAM	**44**

Surface Supplied Air – 0 to 100 FSW Within No Decompression Limits		
Personnel	**Number**	**Penetration Dive**
Diving Supervisor **	1	1
Diver	1	2
Standby Diver*	1	1
Tender	1	2
TOTAL TEAM	**4**	**6**

** The stand-by diver will be rested and capable of performing emergency rescue assistance. When work is limited to no-decompression limits, the stand-by diver shall be sufficiently free of residual nitrogen to allow for 25 minutes of bottom time at the working depth without exceeding "No Decompression Limits."*

*** The supervisor will be dual-hatted as SUXOS. The supervisor may be the stand-by Tender.*

2.2. SCUBA AND SADS OPERATIONS

- SADS diving operations will not be conducted at depths deeper than 4 feet.
- SCUBA diving operations will not be conducted at depths deeper than 100 feet.
- During all SADS/ SCUBA dives, a stand-by diver will be available while a diver is in the water.
- A SCUBA diver will be line-tended from the surface or accompanied by another diver in the water in continuous visual contact during the diving operations. If any SCUBA diver is tended, they will wear a harness meeting the following standard:
    - Each tethered SCUBA diver shall wear a safety harness with a positive buckling device, attachment point for the safety line, and a lifting point to distribute the pull force of the line over the diver's body while maintaining the body in a heads-up vertical position when unconscious.
- The planned time of such a diving operation will not exceed the no-decompression limits according to the United States (U.S.) Navy Dive Manual, or the air supply duration of the cylinders in use, exclusive of the reserve supply. The cylinder pressure will be determined immediately before each dive.
- The diver will surface when the primary bottle pressure is 500 pounds per square inch gauge (PSIG.).
- The daily maximum bottom time for each diver is 300 minutes.

2.3. SURFACE SUPPLIED OPERATIONS

- SSA diving operations will not be conducted at depths deeper than 100 feet.
- During all SSA dives, a stand-by diver will be available while a diver is in the water.
- The diver will surface when the topside console pressure is 200 PSIG.
- The daily maximum bottom time for each diver is 300 minutes.
- The diver's surface-supplied air supply may originate from an air compressor, a bank of high-pressure air flasks, or a combination of both. Regardless of the source, the air must:
- Meet the purity standards;
- Be supplied in an adequate volume for breathing;
- Have a rate of flow that properly ventilates the helmet or mask; and
- Be provided at enough pressure to overcome the bottom water pressure and the pressure losses due to flow through the diving hose, fittings, and valves.
- The air supply requirements depend on specific factors for each dive, such as depth, duration, level of work, number of divers being supported, and type of diving system being used.
- The capacity of the primary air supply must meet the consumption rate for the designated number of divers for the full duration of the dive (bottom time plus decompression time). The maximum depth of the dive, the number of divers, and the equipment to be used must

be considered when sizing the supply.

- The secondary air supply must be sized to support the recovery of all divers using the equipment and dive profile of the primary supply, if the primary supply malfunctions or fails at the worst-case time (i.e., immediately prior to completion of the planned bottom time of maximum dive depth, when decompression obligation is greatest).

Breathing gas supply hoses will:

- Have a working pressure at least equal to the pressure of the total breathing gas system;
- Have a rated bursting pressure at least 4 times the operating pressure;
- Be tested annually (at a minimum) to 1.5 times their working pressure;
- Have their ends taped, capped, or plugged when not in use;
- Have connections made of corrosion-resistant material, and be resistant to accidental disengagement; and
- Have connectors with a working pressure at least equal to the hose to which they are attached.

Umbilical's will:

- Be marked (starting from the diver's end) at 10-foot increments for the first 100 feet; and 50-foot increments thereafter;
- Be made of kink-resistant material; and
- Have a working pressure greater than the pressure equivalent of the maximum depth of the dive plus 100 pounds per square inch. (psi).

The Project Dive Operations Team is identified in Table 2-2.

Table 2-2. Dive Team Personnel and Duties

NAME	DUTIES
Don Schwalback	DS, SUXOS, DPIC, UXO Diver, Standby Diver, Tender, Boat Operator
Patrick Oberley	UXOQCS Diver, Standby Diver, Dive Tender, Boat Operator
Kevin Borkowski	UXOSO, DS (alternate), DPIC (alternate), Standby Diver, Dive Tender, Boat Operator
Noah Esparza	UXO Team Leader, UXO Diver, Standby Diver, Dive Tender, UXO Technician III, Boat Operator
Jason Null	UXO Diver, Standby Diver, Dive Tender, UXO Technician III, Boat Operator
Ralph Gibeson	UXO Diver, Standby Diver, Dive Tender, UXO Technician III, Boat Operator
Derek Gaudin	Dive Tender, Standby Diver, UXO Technician I, Boat and Equipment Operator

If for some reason, a diver is unable to complete the project (e.g., health, family emergency, etc.), a qualified alternate diver will be substituted. Alternate diver qualification will be submitted to DESC prior to a new diver joining the dive operations.

The dive station will be manned by no less than a Dive Supervisor (DS), Diver, Standby Diver, and Tender. Under normal operations, one diver will be in the water at a time. The Tender will maintain constant contact with the diver, tend the tether and monitor potential hazards to the diver. A stand-by diver will be dressed and ready to assist in an emergency any time that a diver is in the water. The primary / DS / Senior Unexploded Ordnance Supervisor (SUXOS) is Don Schwalback. He is the person responsible for all dive operations.

The DS is responsible for all diving operations on this project. The DS is also the Designated Person in Charge (DPIC) for all aspects of the diving operations affecting the health and safety of dive team members. As the DPIC, the DS will be physically at the dive location where the dive operations are conducted. The Alternate DS (and alternate DPIC) is the UXO Safety Officer (UXOSO.).

The SUXOS, UXOSO, and UXO Quality Control Specialist (UXOQCS) will maintain the overall field management of the project site. The dive location is defined as the surface or vessel from which a diving operation is conducted.

The organizational structure and responsibilities of the Project Manager (PM), Scot Wilson, DS, UXOSO, UXOQCS, and SUXOS are included in the Work Plan (WP.). The Tetra Tech Diving Safety Officer (DSO), Patrick Tatman, is the person to whom the PM, DS, and UXOSO report for all diving and explosive safety-related matters, including near misses or event reporting. Should this approved DOP require modification, or should any of the diving procedures or activities change, any changes must be approved by the PM, Tetra Tech DSO, and procedurally as outlined in WP.

Support for boating operations (boats and equipment operators) will be provided by a subcontractor, Global Remediation.

Prior to mobilization, personnel records will be reviewed by the DSO, PM, DS and confirmed by the UXOSO to ensure that dive personnel has the appropriate training, licenses, certifications, and experience and that all are following the regulations. Copies of certifications/qualifications will be submitted for review two weeks prior to beginning dive operations, and copies will be maintained on-site and available for review by DESC representatives. The relevant personnel requirements for intrusive underwater activities at CRP will include the following:

- Workers who may be exposed to contaminated media will have completed 40-hour Hazardous Waste Operations and Emergency Response (HAZWOPER) certification, 8-hour HAZWOPER refresher certification as appropriate, and medical monitoring set forth in 29 Code of Federal Regulations (CFR) 1910.120. Workers who are not in direct contact with contaminated media will be exempt from this requirement. Exempt workers include Quality Assurance representatives and project management, if they are protected from exposure to contaminated media and remain outside the exclusion zone (EZ) for intrusive activities.[1]

- Divers will meet or exceed the minimum qualification IAW DDESB Technical Paper 18.
- Site supervisors must successfully complete the Occupational Safety and Health Administration (OSHA) 8-hour HAZWOPER Supervisor Course.
- Diver personnel has completed the OSHA-approved basic 40-hour health and safety training HAZWOPER course, annual refreshers of the same, military diver course for the apparatus utilized on-site, oxygen administrator, first aid, and cardiopulmonary resuscitation (CPR). Field personnel, required training, and the most current completion date of training are presented in a separate stand-alone document submitted to DESC and are not included in this DOP.
- Divers will meet or exceed the requirements of Engineering Manual (EM) 385-1-1, Section 30.A.0505 through 30.A.09.
- All workers will be required to read and understand the WP, Health and Safety Plan (HASP), DSPM, Emergency Management Plan, Activity Hazards Analysis (AHA), Standard Operating Procedures, and daily safety briefings will be completed as work.

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[1] [1] 29 CFR 1910.120(e)(3)(i) defines employees who are required to have 40-hour HAZWOPER training. It requires workers "…engaged in hazardous substance removal or other activities which expose or potentially expose workers to hazardous substances and health hazards…" to receive 40 hoursof HAZWOPER training. An OSHA Interpretation Letter dated November 19, 1991 states that "if potential for exposure is extremely unlikely the standard would not apply." Employees protected from exposure and that remain outside of the exclusion zone during intrusive operations are extremely unlikely to be present.

This section provides information on the anticipated diving and support equipment to be utilized at CRP.

3. EQUIPMENT

3.1 DIVE EQUIPMENT, ACTIVITIES AND PLATFORMS

The diving method for this project will utilize SADS, SCUBA and SSA where appropriate. The associated equipment and requirements to support SADS and SCUBA operations:

- Divers will wear appropriate thermal protection and PPE consisting of a wet suit or dry suit and sufficient undergarment layering for warmth for the anticipated diving conditions as required. Impermeable gloves, hoods, and boots will also be worn. Overalls may be used to protect diving equipment and divers from exposure to TLM.
- Intrusive investigation diver’s gloves will be impermeable, and the outer layer will have Kevlar (or suitable equivalent) palm lining for the handling of debris, with potentially sharp edges of the debris being investigated.
- Professional grade diving mask (optional)
- Swim fins (as required)
- Dive knife
- Weight belt and weights
- Buoyancy compensator having a manually activated inflation source, an oral inflation device, and an exhaust valve. (SCUBA operations)
- Primary and secondary regulator system with pressure and depth gauges
- Dive light
- Compass
- Safety harness positively attached to buoy, tending line, or SADS
- Minimum 80-cubic-foot compressed air cylinder (having passed the visual and hydrostatic test) filled with certified Grade D breathing air (diver carried or SADS).
- Minimum 30 square feet bailout bottle for emergency use pressurized to at least 90 percent of its working psi rating and equipped with a separate first and second stage regulator (diver carried or SADS).
- Communication device (if not equipped with mask) or line pull signal capability, as well as a means of timekeeping.
- Surface emergency recall system on the dive boat

For SSA operations, the UXO divers are outfitted with the following equipment:

- Dive helmet or full-face mask (FFM) with umbilical adapter for communication system,
- Buoyant diver’s umbilical with integrated primary air, pneumo, and comms
- Minimum 30CF30 cubic-foot tank secondary air source – bail/out,
- Diver visible pressure gauges for secondary air source (bail out),
- Emergency Gas Supply–switch over the manifold block (if FFM used and not integrated with dive helmet),
- Quick-release weight system,
- 5-point safety harness w/ jock strap, attachment, and positive buckling device for umbilical
- Appropriate thermal protection,
- fins (optional),
- knife,
- Submersible time keeping device,
- An auditory signaling device
- abrasion/protection for body, feet, and hands,
- an underwater metal detector,
- hand tools

Surface Supplied Air Dive Station on the support boat will include:

- Divers Air, High Pressure (HP) - K bottles (min 3 @ 1800 psi)
- Buoyant diver’s umbilical with integrated primary air, pneumo, and comms (2 min)
- Air Control System – 2 Diver min - configured for HP with independent air source capability (two HP input)
- Topside comms and video systems
- Ladder – (Min 400 pounds rated and long enough to extend 3 feet below the surface if necessary)

The minimum support equipment to be utilized will include the following:

- Dive Flag
- Medical Kit
- Underwater Camera
- Current Flow Probe
- Oxygen Kit

- Marine Radio
- Fathometer
- Litter/Backboard
- Cellular Phone

All dive equipment used on this project is subject to a Diving Equipment Preventive Maintenance Program (see Section 13 of the DSPM). This program ensures that equipment is inspected and serviced to meet the manufacturer’s maintenance interval. In addition, equipment will be maintained in compliance with the manufacturer’s recommendations. Damaged or worn equipment will be repaired or replaced as required prior to being put into service.

All dive equipment and safety gear will be inspected daily before use. Damaged equipment will be taken out of service and repaired or replaced. After use, equipment will be cleaned (with light soapy water and rinse according to manufacturer instructions) and will be stored in a dry location when not in use. Diving inspection checklists (pre- and post-dive) are included in Attachment 11 of the DSPM.

3.2 PRE-DIVING ACTIVITIES

Pre-diving activities will include the following:

- The UXOSO will verify that all team personnel, including divers and supervisors, boat operators, and geophysical personnel, have reviewed site-specific HASP and any DOP training sessions and have reviewed the AHAs in Appendix B, and that copies of all certifications and training are on-site (prior to first dive and all new divers).
- The DS will hold a briefing each day to discuss personnel assignments, techniques, and equipment to be used, and the UXOSO will review the AHAs and emergency procedures.
- Diving equipment will be inspected each day by the divers and prior to the dive by the DS.
- Appropriate thermal protection will be worn under the dry suit if used.
- The DS will review the Dive Plan Brief (Attachment 1 in the DSPM) to ensure the proper checks are made and documented each day prior to starting dive activities.
- The Pre-Dive Checklist in Attachment 2 of the DSPM will be filled out daily by the DS prior to commencing diving activities. Daily before diving, and during diving, the DS will evaluate conditions such as temperature (water and air), tide (high and low), current speed/direction, wind speed/direction, sunrise and sunset times, and wave action (height and direction), as necessary. The boat operator will monitor the weather forecast or be in communication with the SSHO/UXOSO, who will monitor the weather forecast.
- The DS will ensure divers have not flown within 12 hours prior to a dive. The DS will ensure that no team members fly within 24 hours if previously exposed to hyperbaric pressure during multiple dive days.
- A working means of communication will be verified (cell phone and/or project radio between boats and the DS and SUXOS, and designated very high frequency radio channel)

before starting the project and daily to ensure that communications work in the area and that communications are working between the boat(s) and the other team members. The emergency contact list in Attachment A of this DOP will be on board each boat and in the project office.

- All emergency signals, including any communication recall, re-call commands, air/boat horn signals, hand signals, and line pull signals (see Attachment 8 of the DSPM), will be reviewed. The DS will use the diver(s) underwater communications system as the primary diver recall method. If the communications system is inoperative and the diver is tended, line pull signals will be the secondary diver recall method. The tertiary diver recall method will be the surface diver recall system if the above methods prove unsuccessful. If there is no response to these methods, the stand-by diver will then be used to recall, recover, or assist the diver.
- The physical condition of the divers will be checked.
- The anticipated hazards of the dive will be reviewed.
- Ensure a litter or backboard with flotation is available for emergency retrieval of an injured or unconscious diver onto the boat or, if diving is done from land entry, is immediately available onshore.
- Emergency procedures, contacts, and numbers will be reviewed, and a vehicle will be available at (or within proximity to) the designated evacuation site for transportation of personnel to the hospital if required.

3.3 DIVING PROCEDURES

The specific diving procedures are summarized below.

SADS:

- When the team arrives at the dive site, the boat coxswain will position the boat at the diving work zone as briefed by the DS and secure, place the motor in neutral or hold position as required. The divers will suit up, and don required diving, safety equipment, and gear.
- Prior to entry into the water, the DS will ensure the boat operator has the boat motor in the off or neutral position and that diver(s) are entering the water only when the propeller is off or not engaged. The DS will notify the boat operator when diver(s) or any diver tending, or diver buoy lines are not in proximity to the propeller and when it is safe to engage the propeller.
- A stand-by diver will be readily available on the dive boat in case of emergency.
- Diving will be discontinued if sudden squalls, electric storms, or any other condition exists that, in the opinion of the DS, jeopardize the safety of the team. At no time will diving operations be conducted in poor weather conditions.
- The boat will always be positioned between the divers and any potential hazard.
- A red and white “diver down” and a Code “Alpha” flag (international diver signal) will always be prominently displayed at the dive site during all diving operations. A Code “Bravo” flag will also be prominently displayed during intrusive investigation and recovery operations.

- All dives will be planned “no decompression” dives during this project using the USU.S. Navy no decompression dive tables.
- If required, a ladder must extend a minimum 3 feet below the surface of the water, and handrails above the diving platform will be provided to assist the divers on entry and exit from the water (inflatable boats are exempt from this requirement).
- The propeller(s) of the dive vessel will be verified to be in the neutral position or switched off before the diver(s) approach the dive boat and exit the water.
- The diver dons the FFM, will enter the water, and with the SADS positively attached, wade over to the previously marked anomaly targets.
- If the FFM is removed, the diver may use the attached surface radio on the SADS in the voice-activated mode to communicate with the DS when on the surface during the initial reacquisition of the anomaly target.
- Once the diver has reacquired the anomaly target or entry to the assigned transect, and conditions (depth) required him to break the surface of the water to conduct the investigation and excavation, the diver will contact the DS and report “leaving surface”.
- Once the diver has left the surface, the diver will do a communications check with the DS on the underwater communication system before beginning work, and then normal dive communication protocol will be followed.
- If the diver encounters MEC during the investigation, the diver will contact the DS to receive acceptable to move approval if identification is confirmed. If identification cannot be confirmed, he would surface, return to the platform or boat to confer with the DS and UXOSO. Additional reconnaissance will be conducted until a positive identification and confirmation of status can be made by the DS and UXOSO IAW the WP.
- Once excavation, investigation, and recovery of the anomaly target is complete, diver will surface and complete reporting on the target using the surface radio on the SADS if necessary to ensure all pertinent information is obtained.
- Diver will wade over to the next target or continue the transect and repeat this process.
- If confirmed to be MEC and if it is categorized as acceptable to move, the MEC will be moved to a temporary collection point at a designated collection buoy or transported to an established collection point on shore IAW the ongoing munitions response operations. The land based UXO Team will take possession of all MEC/MPPEH, munitions debris (MD,), and non-munitions related debris (NMRD) targets brought ashore and will manage and process them. In such cases, the DS and UXOSO must concur and agree with the UXO Divers identification, risk determination and document this decision in writing prior to movement of the MEC.

SCUBA/SSA:

- When the team arrives at the dive site, the boat coxswain will position the boat at the diving work zone as briefed by the DS and secure, place the motor in neutral or hold position as required. The divers will suit up, and don required diving, safety equipment, and gear.
- Prior to entry into the water, the DS will ensure the boat operator has the boat motor in the off or neutral position and that diver(s) are entering the water only when the propeller is off or not engaged. The DS will notify the boat operator when diver(s) or any diver tending, or diver buoy lines are not in proximity to the propeller and when it is safe to engage the propeller.

- A tended stand-by diver will be readily available on the dive boat in case of emergency. Diving will be discontinued if sudden squalls, electric storms, or any other condition exists that, in the opinion of the DS, jeopardize the safety of the team. At no time will diving operations be conducted in poor weather conditions.
- The boat will always be positioned between the divers and any potential hazard. For SSA operations, the boat will be anchored and secure. Live boating will not be permitted during SSA operations. DS will ensure approval by the DSO for live boating during SADS and SCUBA operations.
- A red and white “diver down” and a Code “Alpha” flag (international diver signal) will always be prominently displayed at the dive site during all diving operations. A Code “Bravo” flag will also be prominently displayed during intrusive investigation and recovery operations.
- All dives will be planned “no decompression” dives during this project using the U.S. Navy no decompression dive tables.
- If required, a ladder must extend a minimum 3 feet below the surface of the water, and handrails above the diving platform will be provided to assist the divers on entry and exit from the water (inflatable boats are exempt from this requirement).
- The propeller(s) of the dive vessel will be verified to be in the neutral position or switched off before the diver(s) approach the dive boat and exit the water.
- Once the diver has left the surface, the diver will do a communications check with the DS before beginning work, and then normal dive communication protocol will be followed.
- Once diver has reacquired the anomaly target, they will contact the DS and begin work on the anomaly target.
- If the diver encounters MEC during the investigation, the diver will contact the DS to receive acceptable to move approval if identification is confirmed. If identification cannot be confirmed, he would surface, return to the boat to confer with the DS and UXOSO. Additional reconnaissance will be conducted until a positive identification and confirmation of status can be made by the DS and UXOSO IAW the WP.
- Once excavation, investigation, and recovery of the anomaly target is complete, diver will complete reporting on the target using the underwater communication system to ensure all pertinent information is obtained.
- Diver will surface and will swim or be transported over to the next target or continue the transect and repeat this process as anomalies are encountered.
- If confirmed to be MEC and if it is categorized as acceptable to move, the MEC will be moved to a temporary collection point at a designated collection buoy or be transported to an established collection point on shore IAW the ongoing munitions response operations. All MEC, MPPEH, MD and NMRD brought ashore will be managed and processed as outlined in the WP. In such cases, the DS and UXOSO must concur and agree with the UXO diver’s identification, risk determination and document this decision in writing prior to movement of the MEC.

3.4 POST DIVE ACTIVITIES

The DS will check the physical conditions of the divers between rotations and/or at the end of the shift. Any adverse health problems, however minor they may seem (including any rashes, itching, etc.), must be reported to the DS and UXOSO as soon as the diver has knowledge of the condition.

Additionally, all divers will report conditions that could present a potential hazard to the divers so appropriate measures can be taken to remove or minimize the potential for exposure. Additional Post-diving procedures are summarized below.

- Upon completion of each diving operation or at the end of each day, a dive team debriefing will be conducted by the DS.
- The DS must follow the Tetra Tech Post-Dive Checklist in Attachment 3 of the DSPM.
- Team members will clean and stage equipment for the next day’s diving event.
- The DS will complete the Tetra Tech Working Dive Log for each dive (see Attachment 6 of the DSPM).
- The DS will forward copies of the Working Dive Log to the UXO/ DSO.
- Information from the daily dives reviewed and progress evaluated. Plans will be made for the next day’s diving activities.
- Upon completion of the project or weekly, all Working Dive Logs will be recorded by the DS on the Dive Smooth Log (Attachment 7 of the DSPM).
- This log will be submitted to the PM for inclusion in the project files and submission to the client with a copy to the UXO/ DSO for the Tetra Tech files.

3.5 PLATFORMS

During all operation phases, the diver will be walking/wading in from the shore, working off the MK3 zodiac inflatable dive boat or Global Remediation dive support vessel. During operations, one of these vessels will be designated as the safety boat.

This section provides the required tasks for intrusive underwater activities at CRP.

4. TASKS

4.1 TASK 1 MOBILIZATION AND DEMOBILIZATION

Once pre-mobilization activities are complete, the dive crew and all associated materials and equipment necessary to perform the intrusive underwater activities will mobilize to CRP. The personnel and operations-specific equipment are summarized in Sections 2 and 3.

Demobilization of all diving-related personnel and equipment will occur after all intrusive underwater objectives have been safely completed and accepted by DESC.

4.2 TASK 2 DOCUMENTATION

Tetra Tech will prepare all required diving-related documents and plans for review by APEX and DESC. All plans will be approved by SCDHEC prior to mobilization to CRP. Required documents include the safety, pre and post-dive checklists, and dive logs from the DSPM and this DOP with its attachments, including an Emergency Management Plan and AHA. These documents will be available on-site during the field work.

4.3 TASK 3 CRP REMOVAL ACTION

The goal of the removal action is to locate and remove MEC from within the cofferdam footprint. The Dive Operations Team will perform underwater mag and dig of all anomalies encountered using manual search pattern techniques described in the DSPM. Each anomaly identified will be manually investigated. The maximum depth that the divers can safely hand excavate an anomaly will be three feet below grade level of the river bottom. If additional excavation depth is required, it will be implemented using mechanical excavation techniques, which would require approval and modification of DOP.

This section details the procedures to be followed during diving operations and the conditions anticipated while conducting intrusive underwater activities.

5. DIVE OPERATIONS

Diving operations shall be performed IAW with USACE EM 385-1-1, Section 30. If for any reason, the DOP is altered in mission, depth, personnel, or equipment, the Tetra Tech DSO will be contacted to review and accept the alteration prior to actual operation.

Direct communications between the dive site, project office, DESC representative, Tetra Tech DSO and other involved personnel will be via cell phone. Divers will have communication with the surface, and diver-to-diver. The DS will positively control diver movement within the designated work area. Divers will be monitored by thru-water communication system.

Required dives as outlined in EM 385-1-1 30.A.07 and emergency drills may be required and will be conducted prior to the commencement of field operations.

5.1 CRP REMOVAL ACTION

The goal of the removal action is to locate and remove MEC from within the cofferdam footprint in two separate areas, as shown in Figure 1-3. The Dive Operations Team will perform an underwater mag and dig of anomalies encountered. Each anomaly identified will be manually investigated not to exceed a depth of 33 feet or to bedrock, whichever is encountered first. Removal of MEC from the area within the coffer dams will be done after the water has been removed under a separate effort covered under a work plan for the dry land portion of the MEC clearance.

Divers will gather information describing the source of each anomaly, including the following: item description, item weight, MEC condition, MEC nomenclature, bottom type/condition, and any other notable features. Acceptable to move MEC and MD will be transferred to land for final disposition. Unacceptable to move MEC will be detonated in place. Non-munitions-related debris will be left in place during this task.

Each MEC or MD item found will be marked using a global positioning system (GPS) unit to an accuracy of +/- 36 inches. Once an item has been positively identified, and determined acceptable to move, it will be relocated within the land portion of the project area. The final explosives safety status of a discovered MEC item as acceptable or not acceptable to move will be made by the SUXOS-qualified DS in consultation with the diver who investigated the item. Information such as the munition type, nomenclature, condition, and surrounding environment will be considered when determining if an item is acceptable to move or not.

Divers will use an all metals locator along grid lines established as part of the stationary jackstay method described in the DSPM. Each target anomaly location will be manually investigated and resolved not to exceed three feet in depth below the river bottom. The anticipated maximum depth of dives is 30 feet of fresh water (ffw). Divers will be utilizing a “no decompression limit” of 30 ffw for a maximum bottom time of 371 minutes.. A maximum daily dive bottom time for any diver will not exceed 300 minutes.

Munitions Constituents (MC) sampling of the sediment is not required for this field effort. Should MC sampling be needed, it may be conducted by divers either during the removal process or as a separate dive. If sediment sampling is needed, the DSDS will coordinate all underwater sampling activities.

At the end of each diving day, all data, including field notes, site photographs, and positioning data will be consolidated and submitted to the Tetra Tech PM.

5.2 DIVING CONDITIONS

The Dive Operations Team will perform all assigned tasks during the daytime within allowed current restrictions. General factors that affect diving operations include:

- Surface conditions – No diving will be performed if the surface conditions do not permit the diver to maintain depth control. Dive operations will be suspended at Beaufort scale Sea State 3.

- Boat Traffic – Anticipate some boat traffic during the operation period. Whenever boat traffic is present in the vicinity of diving operations, the Tetra Tech safety boat will keep other boats away from the area of dive operations. The safety boat will be positioned with visibility of the dive operation and avenues for approaching boats. Communication will be maintained between the safety boat and dive location. If possible, the safety boat will divert boat traffic around the EZ. If a boat enters the EZ the DS will be notified and will immediately halt intrusive operation until the boat is safely outside of the EZ.

- Underwater conditions – Shallow dives are heavily influenced by the surface conditions and may impact diving operations. No dives will be performed if conditions do not permit the diver to maintain depth control. The DS will have the ultimate decision to cease diving operations if unsafe conditions occur.

- Visibility – Visual survey will be suspended when nominal visibility is less than 1 foot. A tactile survey with tethered divers may be conducted if visibility is degraded below 3 feet.

- Water Temperature – Thermal protection for the divers will be provided by a wetsuit or dry suit, as needed, to ensure diver protection and comfort. Divers will choose dive dress, and selection will be approved by the Tetra Tech DS/SUXOS.

- <u>Currents</u> – Prior to conducting dive operations and prior to deploying any divers, the DS will measure current velocity using an FP 211 Global Flow Probe or similar instrument. If currents exceed 1-knot, SADS/ SCUBA divers will not be deployed, and dive operations will be continued after the team switches the diving method to SSA.

5.3 SITE HAZARD CHARACTERIZATION

The primary hazards associated with diving include drowning, dive-related illnesses (e.g., arterial gas embolism and barotrauma), hypothermia or heat stress, hazardous areas, munitions-related explosive hazards, encountering dangerous animals (e.g., venomous snakes), severe weather, and being struck by surface vessels. These hazards, as well as boating-related hazards, heavy equipment, and other physical hazards, are described below and referenced to the appropriate section of the HASP. In addition, the hazards and mitigation strategies to follow to minimize potential injuries during diving operations are also addressed in AHAs, which are included as Appendix C to this Dive Operations Plan. As stated before, the boating AHA in the HASP will also be reviewed by all team members prior to the start of the diving activities. Before beginning work, all site personnel will be informed of these hazards and the means that will be taken to control them. In addition, the full requirements of the HASP will be reviewed with all site personnel.

5.4. DIVING HAZARDS

The DSPM states that anyone on the dive team can stop work if they feel that the work environment is or may become unsafe. Prior to diving, the DS and UXOSO is responsible for examining the dive site to identify potential hazards (see Section 15 of the DSPM).

5.4.1. Slips, Trips, and Falls

There is a potential for site personnel to fall while walking to and from the dive boat and while onboard the dive boats. Carrying loads (e.g., SCUBA air tanks) while suited up in diving equipment can be cumbersome and easily result in a loss of footing. In addition, beach staging and launching areas are often soft and uneven, which can result in poor footing. These concerns will be addressed by monitoring the loads being transported and staging equipment to the extent practical prior to donning of diving gear. The dive boat deck and other surfaces can be slippery and uneven or be limited in space for maneuvering or hindered by lines and other equipment on board. Good housekeeping will be maintained in work areas, and workers will wear sturdy deck shoes on waterfront, structures, and on boats.

5.4.2. Drowning

Falls overboard from boats or structures can result in drowning, and diving operations can result in drowning. The requirement to use personal flotation devices on piers and boats is described in the HASP and in each AHA.

Drowning hazards during diving operations could result from running out of breathing air, a medical emergency of a diver, or equipment malfunction while underwater. Procedures in this plan will be followed to minimize the potential for drowning under these scenarios. Such procedures include regular gear and equipment inspection, servicing, and maintenance of dive gear; re-call procedures to manage the dive bottom times; use of certified Grade D breathing air; diver-carried reserve air supply for emergencies; dive team configuration and buddy system observation; and evaluation of diver fitness through the Tetra Tech medical surveillance program. Divers will terminate their dives when a minimum tank pressure of 500 psi is observed.

5.4.3. Diver-Related Illnesses

The maximum planned depth of the dives during this project is 15 feet, and the average depth of dives is anticipated to range from 1 to 10 feet. All dives at this site will be planned “no decompression” dives. At these depths, arterial gas embolism, shallow water blackout, or barotrauma is a primary risk if divers’ surface improperly, run out of breathing air, or do not follow the safety precautions. These illnesses can be prevented by following the procedures in this plan and those in the DSPM (Attachment D). In addition, equipment for the dive team will include emergency oxygen, which can only be administered by qualified persons for diving emergencies. As a precaution, the location and telephone numbers of the recompression chamber in the local area will be available in the project trailer and on the dive boats.

5.4.4. Thermal Stress

The likelihood of this occurring depends on environmental conditions, the level of work activity, and the control measures that are used to manage body heat (work-rest cycles, physical conditioning, and wearing of protective clothing, such as wet suits or thermal garments under a dry suit).

Appropriate control measures will be taken to manage thermal stress concerns, as described in the Heat and Cold Stress Monitoring Plan if applicable. The DS will monitor water temperatures in the work area and will monitor the effectiveness of the personal protective gear, and modify these controls as needed to provide for diver safety and comfort. Rotation of diver personnel may also be used as necessary to allow divers to warm up between dives. In addition, ambient air temperatures will range depending on the season. Workers could be exposed to thermal stress from hot or cold temperatures at the surface, including the effects of wind. If wearing a dive ensemble on the surface, workers could also have heat stress effects on warm days or under direct sun. Ambient air temperatures and wind conditions will also be monitored by the DS, and appropriate control measures will be taken to manage these stress concerns, as described in the HASP. Shade for surface support staff on boats may be required and will be implemented as necessary (e.g., Tarp or Bimini top on boat).

5.4.5. Severe Weather

Severe weather (flash flooding, strong winds, or thunderstorms, including associated lightning) could occur. Severe weather hazards for marine work are addressed in the HASP. Weather conditions and water conditions will be monitored before and during dives, and weather that is determined hazardous to boating and/or diving operations will result in halting of those operations at DS direction.

5.4.6. Boating

Operating boats or vessels on the water carries the risk of having a crew member fall overboard and possibly drown, striking or being struck by other vessels operating in the area, losing power or steering, and drifting into hazardous areas (e.g., shore, piers), or onboard fires or other vessel emergencies. The risk of a boating accident can be reduced by ensuring the boat operators are experienced, and when applicable, licensed; operating the vessel in compliance with U.S. Coast Guard rules and regulations; maintaining the vessel in good mechanical order; avoiding bad weather and dangerous seas; and ensuring emergency equipment is available on board (life vests, life rings, lifeboats, fire extinguishers, communication equipment, first aid equipment, etc.). The DS will discuss safe boating near diving operations in the diving safety brief. All dive team members will be trained in first aid, CPR, and emergency oxygen administration through the American Red Cross, Divers Alert Network, or equivalent course. A first aid handbook will be available on-site for reference as needed.

All work conducted from small vessels will comply with Tetra Tech Procedure HSE 1-10, Working Over or Near Water, and applicable U.S. Coast Guard regulations. The boat operator will be responsible for the safety of all personnel on the boat and for the integrity of the vessel and its safety equipment. The boat operator will have successfully completed a boating safety course meeting the criteria of the U.S. Coast Guard Auxiliary and National Association of Safe Boating Law Administrators or equivalent, and will have motorboat handling training, based on the type of boat the operator will use and be designated boat operators by their employer. A Boating Pre-Operation Checklist is included in Attachment 11 of the DSPM.

5.4.7. Boat Strikes

Divers could be struck by boats, including propellers if engaged and operating. In addition, other boats could come into the work area where dive operations are being conducted. To minimize the potential for injury to divers from project boat traffic, work zone controls will be established during diving operations. A red and white “diver down” flag will be displayed at the dive site. During the intrusive investigation, a code “bravo” flag will be added. An explosive arc EZ will also be established to maintain safe team separation and to keep unauthorized personnel a safe distance away from active operations, including non-essential site personnel that could come into the area.

Live boating is not authorized without specific acceptance by the DSO. When divers enter or are retrieved from the water, all motors will be in the neutral position or in the off position so that potential strikes from propellers do not occur.

5.4.8. Explosive Hazards

Non-UXO-qualified employees or non-essential subcontractors will not be authorized in the EZ during underwater anomaly reacquisition, investigation, identification, and removal operations. Site access and enforcement of diving restrictions will be coordinated by the DS and SUXOS following the requirements and procedures in the IRA, Interim Removal Action, Quality Control Plan (QCP,), the Explosives Safety Submission, and the HASP, as well as this DOP.

A significant challenge to the diving operations in the Congaree river is the soft sediments, which can negatively impact the diver's visibility, unnecessarily release, and possibly spread contaminates when disturbed. Divers used in this operation will have extensive training and experience in standard diving techniques (e.g., buoyancy control) and in MEC removal operations.

5.4.9. Biological Hazards

Biological hazard mitigation is described in the Biological Hazards section of the HASP.

5.4.10. Underwater Obstacles

Underwater obstacles consist of concrete, metal, and other debris in the footbridge area; this debris may be present in and on top of the sediments. This debris can pose entanglement hazards to divers, or if divers are working around large debris, debris could shift and may trap a diver. Each location where divers will work will be evaluated for debris hazards and safety concerns. Penetration dives are not authorized. Divers will not position themselves underneath or within voids in debris or dig underneath large debris during this task and will observe debris for sharp edges that could cut dive suits or equipment, and entanglement hazards that equipment could become snagged on.

5.5. OTHER HAZARDOUS CONDITIONS

Other hazardous conditions, though not as likely to occur during the diving activities as the above, include:

- Electrical Shock – Electrical shock is rare under or in the water but may occur when using power equipment underwater or topside. A ground fault circuit interrupter must be used with electrical equipment employed on the boat, both on the surface and in the water.
- Bacteria – Divers could encounter potentially unpleasant forms of pollution in the Congaree River.
- Pollution – TLM and other contaminants are present in the sediments in the Congaree River. These contaminants should not pose a risk to divers performing work in protective SCUBA gear due to the protection the gear provides and because most sediment on diver's suits will wash off in the water column when resurfacing to the boat. Other potential contaminants could

include contact with munition constituents if ruptured DDEC is found and handled during intrusive investigations. Divers' gloves will help prevent skin contact with any ruptured items found during diving activities. In addition, it is possible that other unforeseen contamination could be discovered (e.g., unknown sheen or discoloration of the water, drums, or other potentially hazardous material) during the investigation. If unanticipated contamination or hazards are discovered, they will be reported by the DS to the PM, the Safety and Health Manager (SHM), UXO/DSO, and the Project Environmental and Safety Manager. If contamination gets onto the diver, the SHM will be notified, and the process for decontamination and follow-up will be established.

5.6. COVID-19 GUIDANCE FOR DIVING OPERATIONS

Diving operations will follow the applicable recommended guidelines outlined by the Association of Diving Contractors International (ADCI). The following general protocols will be implemented along with the current Federal and State guidelines:

- Ensure project team members are not infected before mobilization and during project execution.
- A means and equipment to deal with a possibly infected individual to prevent the spread to other team members.
- Evacuation plan should an individual's condition worsen, such as dock facility and medevac via boat or helicopter.
- Daily ongoing procedures to reduce the risk of exposure to the crew to include but not limited to social distancing, personal hygiene, and equipment cleanliness/sterilization.
- Verifying that items such as project tools and equipment are not contaminated.
- The single greatest point of contamination risk for this task is via the Diving helmet, FFM and second stage regulators on the SADS or SCUBA equipment. Divers will be assigned or verified to have individual FFMs and regulators. The corporate dive helmets will be sanitized before each diver's use. They will be responsible for keeping clean and returning company equipment when the project is complete. Additionally, all common area project equipment will be cleaned daily IAW project HASP guidance.

5.6.1. COVID-19 Hygiene Measures for Diving Equipment

The following recommended hygiene measures will be implemented during post-dive activities. Records of cleaning activities should be logged and retained.

The USU.S. Navy recommends the use of MadaCide FD for diver-worn equipment. MadaCide disinfectant is a more aggressive disinfectant and requires less time for cleaning. MadaCide FD is a "fast drying" agent, and no wiping or rinsing is required. Once the agent is applied and allowed to dry, the component is ready for use. This agent is recommended for use on all dive helmets, BIBS, and mattresses (Surface Diving Decompression Chamber). The ADCI publication outlining these COVID-19 measures will be available on-site. The DS, SSHO, and team members will be familiar with the protocols and response measures outlined in this guidance that are applicable to this project task.

5.7. QUALITY CONTROL/QUALITY ASSURANCE OVERSIGHT

The QC process for the target investigation will consist of a daily check of the real-time kinematic positioning (RTK) GPS system by comparing the RTK GPS location to a known location (control point) and documenting the results as outlined in the project QCP. The GPS location must read within 6 inches of the control point, or it will be deemed a QC failure. Each handheld metal detector will be checked daily by passing it over a known metal object at the designated functional check area. The handheld detector must produce an audible or visual indication when passed over the item. The UXOQCS diver will conduct QC dives on a total of 10% of each grid. The UXOQCS may designate an alternate QC diver for any days that the UXOQCS diver does not dive. If the UXOQCS diver locates any item larger than a 37mm37-millimeter projectile, it will be considered a QC failure for that grid.

Oversight of field activities may be requested by offsite DESC, SCDHEC, or other stakeholders. At least 48 hours prior notice will be given to Tetra Tech by those requesting oversight for purposes of coordination.

It is anticipated that DESC will have an on-site representative assigned in a safety and quality oversight role and may also be present during diving operations. If there is a need to answer questions, etc., the Tetra Tech DS will be the primary point of contact.

This section describes project key personnel and organization for diving activities

6. KEY PERSONNEL

6.1 DIVE TEAM

6.1.1 DIVE SUPERVISOR/SUXOS

The DS is responsible for all diving operations on this project. The DS is also the DPIC for all aspects of the diving operations affecting the health and safety of dive team members. As the DPIC, the DS will be physically at the dive location where the dive operations are conducted. The DS will also serve as the SUXOS and is responsible oversight of diving operations, field documentation, submittal of Daily Contractor Production Reports (DCPR) the Tetra Tech PM and DESC representative and assisting in the preparation of progress reports. The DS will report directly to the Tetra Tech PM and is responsible for leading and coordinating the day-to-day activities of the various resource specialists. Specific DS responsibilities are identified in the DSPM.

6.1.2 UXOSO/SSHO

The UXOSO and is responsible for ensuring safety and health procedures outlined in the HASP, AHAs, oversight of diving operations, field documentation, submittal of daily safety reports and inspections to the Tetra Tech PM, Tetra Tech health and safety, and DESC representative. The UXOSO is also designated as an Alternate DS (and alternate DPIC). The UXOSO will assist in the field management and preparation of progress reports.

6.1.3 UXOQCS Diver

The UXOQCS Diver and is responsible for ensuring QC procedures outlined in the QCP, field equipment calibration, oversight of diving operations, field documentation, submittal of Daily Quality Control Reports to the Tetra Tech PM, Tetra Tech QC Manager and DESC representative. Also, the UXOQCS will assist in the field management and preparation of progress reports.

6.1.4 UXO Diver

The diving UXO Specialist is the diver in the water. He is a U.S. Navy-trained diver that is UXO qualified with the proper diving and MEC experience to perform assigned tasks. Specific requirements and responsibilities for the position are described the DSPM.

6.1.5 Standby Diver

The stand-by diver meets all the requirements of the UXO diver and is dressed and prepared to enter the water to assist the diver anytime the diver is in the water. Specific requirements and responsibilities for the position are described in the DSPM.

6.1.6 Tender

A dedicated tender will be assigned to the diver while he is in the water. If the stand-by enters the water, the DS will serve as his Tender. The responsibilities of the Tender are described in the DSPM.

6.2. FIELD PERSONNEL REVIEW

The Field Personnel Review form serves as documentation that field personnel have read, or have been informed of, and understand the provisions of the DOP. It is maintained on-site by the SSHO/UXOSO as a project record. Each dive team member will sign this section after site-specific training is completed and before being permitted to work on site. In addition, the HASP and project AHAs will be reviewed and signed by all team members prior to beginning work.

FIELD PERSONNEL REVIEW FORM

I have read, or have been informed of, and understand the information contained in this DOP for the anomaly reacquisition, investigation, MEC, and MD recovery activities to be conducted at the CRP in Columbia, SC. I have the ability and obligation to stop work if I see any safety or procedural issue which may cause a personnel or equipment incident. I will comply with the provisions contained herein.

Name (Print and Sign)	**Date**

This section presents the Project Records and Reporting for intrusive underwater activities during the MEC clearance diving activates.

7. PROJECT RECORDS AND REPORTING

7.1. PROJECT RECORDS

7.1.1. Field Documentation

Field documentation includes daily reports for each day of fieldwork that present information pertaining to field activities. These reports will be maintained by the DS and include field notes, photographs, and positioning data. Reports are submitted to the Tetra Tech PM and the DESC representative.

7.1.2. Dive Logs

Dive logs/records will be completed for each diver on each diving day during intrusive underwater activities. The individual dive logs will document conditions and exposure to diving. Dive logs will be maintained by members of the dive team and crosschecked for completeness at the end of each day by the DS. They will be signed and dated by each individual diver making their personal entries, their dive buddy (if applicable), and the DS. Dive logs will be submitted to DESC upon completion of dive operations.

7.2. PROJECT REPORTING

Project reporting requirements include the preparation of reports that document all diving-related field activities completed at CRP. These will include draft/draft final deliverable project reports, as well as documents summarizing field activities. These reports will be based on project records that include field logbooks; discrepancy reports; and records of conversations, meetings, and correspondence.

This section provides references used to develop this DOP

8. REFERENCES

Association of Diving Contractors International (ADCI) 2020. COVID-19 Guidance for Surface Diving Operations, Revision 2. July 17.

DDESB2016 (Department of Defense Explosives Safety Board). 2016. TP 16. Revision 5 Methodologies for Calculation Primary Fragment Characteristics. December 19.

DDESB (Department of Defense Explosives Safety Board).). 2016. Technical Paper 18,, Minimum Qualifications for Personnel Conducting Munitions and Explosives of Concern-Related Activities. September 1.

Department of Defense (DoD) Ammunition and Explosives Safety Standards. 2012. DoD Ammunition and Explosives Safety Standards DOD Manual 6055.09-M. February 28. Administratively Reissued August 4, 2010

Department of Defense (DoD). 20152015. DoD Instruction (DoDI) 4140.62, Material Potentially Presenting an Explosive Hazard. 20 August 20.

Dominion Energy South Carolina, Inc. (DESC). 2018. Congaree River Project Conceptual Plan for a Modified Removal Action Revision 1 – December 20212021.

Management and Technical Resources, Inc. 2013. Final Engineering Evaluation/Cost Analysis (EE/CA), Congaree River Sediments, Columbia, South Carolina. January.

NAVY (United States Department of the Navy). 2018. Diving Manual,, Volumes 1-5, Revision 7, Change A, Commander, Navy Sea Systems Command, Supervisor of Salvage and Diving. April 30.

OSHA (United States Department of Labor). 2011. 29 CFR; Subpart T, Commercial Diving Operations. Occupational Safety and Health Administration. December 27.

South Carolina Department of Health and Environmental Control (SCDHEC) 2013. Public Notice-Congaree River Project. August 21.

Tidewater Atlantic Research, Inc. 2012. A Terrestrial Remote-Sensing Survey of the Congaree River Below the Gervais Street Bridge, Phase IV Report, Columbia, South Carolina. February 8.

Tetra Tech (Tetra Tech, Inc.). 2021. Diving Safe Practices Manual. Corporate Policy DSP-01. February 15.

United States Army Corps of Engineers (USACE) 2013. Safety and Health Requirements Manual EM 385-1-97 (with Errata) May 17.

USACE (U.S. Army Corps of Engineers). 2014. Safety and Health Requirements. Engineer Manual (EM) 385-1-1, Section 30. November 30.

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ATTACHMENT A

EMERGENCY MANAGEMENT PLAN

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***Note:** This Emergency Management Plan is to be used in conjunction with the Site Safety and Health Plan. Ensure that all personnel are familiar with the policies, procedures, and requirements outlined in both plans.*

Emergency Service (Ambulance, Fire, Police)—911

Columbia Fire Dept.
1800 Laurel St Columbia, SC
(803) 545-3700

Palmetto Health Richland
5 Richland Medical Park Drive Columbia, SC 29203
(803) 434-7000

Nearest Hyperbaric Chamber Facility

Palmetto Health Richland
5 Richland Medical Park Drive Columbia, SC 29203
(803) 434-7000

Divers Alert Network (D.A.N.)
Emergency +1-919-684-9111 Phone 1-800-446-2671

Poison Control Center
(800) 962-1253

DESC Project Manager
Rusty Contrael
Cell: (412) 721-6494
Email: rcontrael21@outlook.com

APEX Project Manager
William Zeli
Office: 412-829-9650 x5004
william.zeli@apexcos.com

Tetra Tech Project Manager
Scot Wilson
Direct : 360-626-3193
scot.wilson@tetratech.com

Nearest Hospital Information and Route

Name: **Palmetto Health Richland**
Address: 5 Richland Medical Park Drive; Columbia, SC 29203
Phone: (803) 434-7000

See the description and map of the route below.

Nearest Recompression Chamber

Name: **Palmetto Health Richland Hyperbaric Medicine**
Address: 5 Richland Medical Park Drive; Columbia, SC 29203
Phone: (803) 434-7000

From the Project Area, 9 min (3.2 miles)

Take US-176 W/US-21 N/US-321 N and US-76 E to Bull St

Head east on Gervais St/Gervais St Bridge toward Gist St 0.3 mi

Turn left onto US-176 W/US-21 N/US-321 N/Huger St 0.8 mi

Keep right at the fork, follow signs for US-21/US-176/US-321/Elmwood Ave

Continue onto US-176 W/US-21 N/US-321 N/US-76 E 0.9 mi

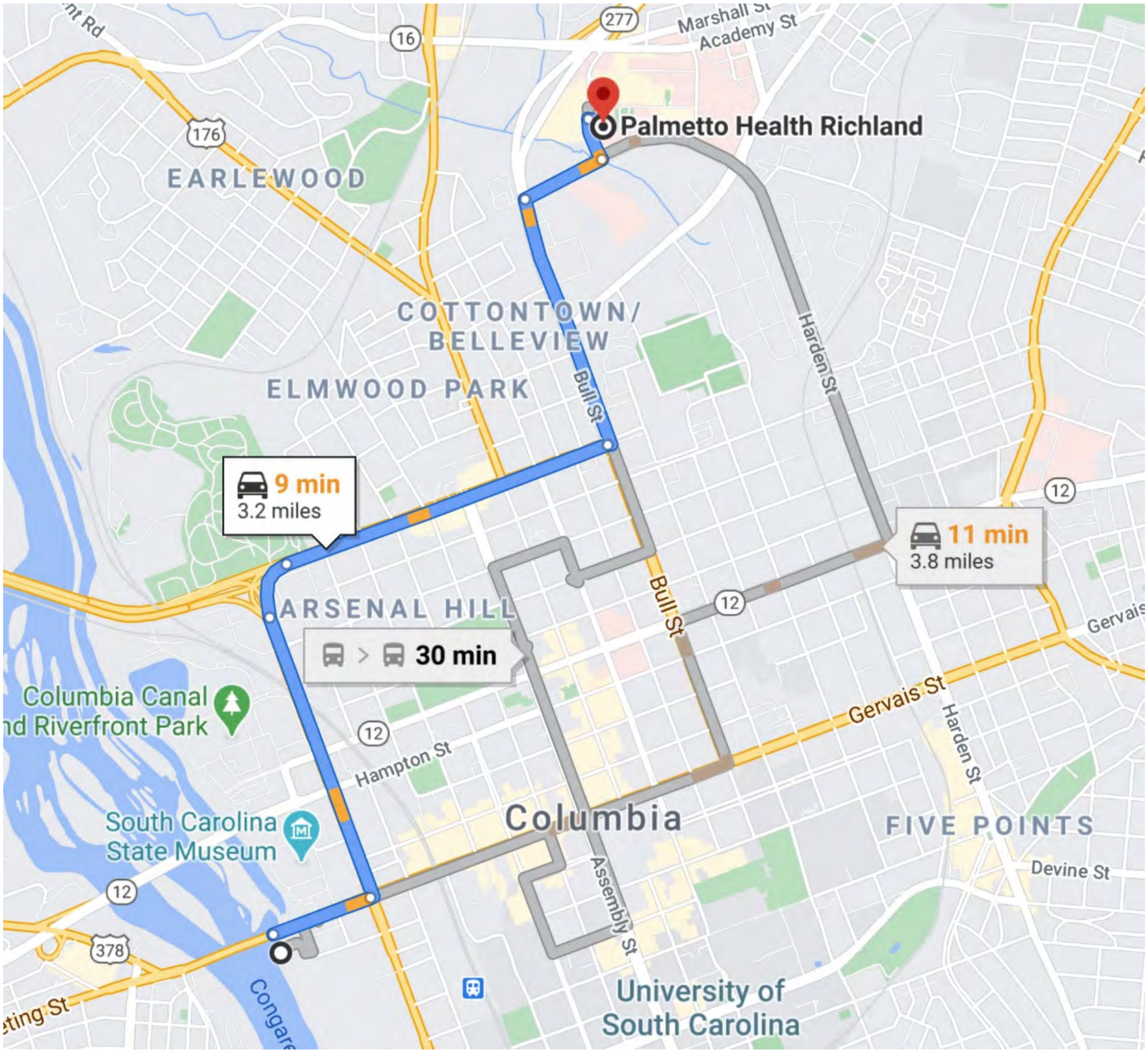
Continue on Bull St to your destination

Use the left 2 lanes to turn left onto Bull St 0.7 mi

Turn right onto Harden Street Extension (signs for Harden St) 0.2 mi

Turn left onto Medical Park Rd 0.1 mi

Arrived.



Hospital Route

Emergency Procedures

In every diving operation, the possibility of an accident occurring must be considered. The need for a prompt, decisive plan of action in an emergency is essential for the safety of all diving personnel. The Dive Supervisor (DS) will implement the following procedures for the respective situations described below.

1. **Buddy Separation**
   - The divers will look/feel 360 degrees around for his dive partner; and
   - Both divers will come to the surface with one hand above their head.
2. **Lost Diver**
   - Initiate diver re-call and wait one (1) minute for response;
   - Mark the last known position of the lost diver with a buoy to establish a reference point where searches can start;
   - Deploy the stand-by diver (DS direction) to swim after bubbles or to conduct a circle line search starting at the lost diver buoy;
   - Notify ship/boats in the area to look out for the lost diver;
   - Request emergency medical help and report the situation to DESC Project Office and Tetra Tech Corporate Offices; and
   - Ensure stricken divers recovered, get immediate, effective treatment.
3. **Loss of Air/Equipment Malfunction**
   - Signal dive partner and abort dive;
   - Buddy breath/activate reserve; and
   - Exhale to the surface.

NOTE: No diving will proceed until the equipment is replaced/repaired (with functional checks performed) and the Dive Supervisor has given the OK to proceed with the operation.

4. **Mechanical Injury**
   - Diver will inform the DS of any mechanical injuries, no matter how slight they may seem;
   - DS will rule out any doubt of decompression sickness; and
   - If immediate treatment is required, re-call all divers and transport to recompression chamber/emergency Room.
5. **Decompression Sickness ("The Bends") or Arterial Gas Embolism (air embolism)**
   - Re-call all divers from the water;

- Arrange immediate transport of stricken diver(s) to chamber;
- Notify DESC Project Office and Tetra Tech Corporate Office of circumstances;
- Perform neurological exam and record on Tetra Tech Diving Safe Practices Manual (DSPM); and
- Treat for shock.

6. **Fouled Diver**
   - Diver will notify dive partner, if appropriate, otherwise will notify DS through line pull signals;
   - If only one diver is in the water, then the stand-by diver will assist the fouled diver under the direction of the DS;
   - Diver and dive boat personnel must remain calm; and
   - Take additional cylinders of air to the fouled diver, if needed.
7. **Explosive Detonation with Diver (s) in the Water**
   - Attempt to establish communications with the diver via tending line:
   - If communications are established with the diver, immediately re-call diver to the surface;
   - If no communications are reestablished, slowly pull the tending line to the surface to recover the diver. If the tending line is fouled, deploy the stand-by diver;
   - If the tending line has parted, mark the last location of the diver and begin a surface search of the area. If no contact is made, deploy the stand-by diver in the last known diver location and begin a systematic search of the area.
8. **Diver Emergency Recall**
   - If diver is tended use standard line-pull signals to re-call diver (See Attachment 4 of the DSPM);
   - If diver is untended, use diver audible (Metal-on-metal in the water) or mechanical re-call; and
   - Upon notification of re-call by any means, the diver will surface immediately.
9. **Injured Diver:** If a diver is injured and unable to enter the boat under his/her own power, the remaining team aboard the boat/platform (**DS**, Tender/assistant, etc.) will be used to assist or place the injured diver into/on the boat/platform or may hold onto the diver and use the boat/platform to get to the shoreline. Contact first responders immediately and render emergency first aid as necessary.
10. **Fire:** Fire extinguishers will be maintained ready at the dive site location. Only attempt to put out small fires as necessary to prevent injury or loss of life. Contact first responders immediately upon discovery. Also, see HASP submitted as part of the Work Plan (WP)**.**
11. **Inclement weather:** All diving operations will be suspended if lightning is located within 10 nautical miles of the dive site. During high winds greater than 30 miles per hour, boating and

platform operations will be suspended. Also, see HASP submitted as part of the WP.

12. **Medical Injury or Illness:** See Attachment 4 to the **DSPM** as well as the HASP submitted as part of the **WP**. Contact first responders immediately. Render first aid as necessary until an emergency medical team arrives.
13. **Critical Equipment Failure:** In the event of an equipment failure of a critical component of the dive operations, all dive operations will be discontinued until the equipment is replaced or repaired and the **DS** has given authorization for dive operations to continue.
14. **Injury/illness of surface crew:** If a severe injury or illness occurs while a diver is in the water, the diver will be **re-called** immediately to the surface. Diver will either enter the boat/platform to help render assistance or head to the shore and provide assistance as necessary.
15. **Dive Blow Up / Over Rapid Ascent to the Surface:** Depths of dives for the project are unlikely to produce a requirement for decompression during ascent. If a diver is believed to have ascended too rapidly, the **DS** will evaluate the situation to confirm that no decompression stop was required. Dive tables will be consulted. The diver will be observed on the surface for one hour. If symptoms of decompression sickness are observed or suspected, the diver will be treated for decompression sickness as described above.
16. **Loss of Communications:** If communications are lost between a tender and diver and cannot be regained quickly, an audible **re-call** signal will be sounded. If the diver does not surface in a reasonable amount of time after the audible re-call signal has been initiated, the stand-by diver will be dispatched to the last known location of the diver. If communications are lost between the diver and the T**ender** and cannot be regained quickly, the diver will surface immediately. The reason for the loss of communications will be investigated and remedied prior to the continuation of the dive.
17. **Emergency Victim Transportation:** If an injury or illness requires treatment beyond first aid, the victim will be transported to the appropriate medical facility, identified above (or as determined by first responders). The first aid-trained technician treating the victim will make the initial assessment related to the need for additional treatment. First responders will be notified of the situation through a call to 911. If the situation requires transportation by ambulance, the victim will be moved (if determined safe and necessary to do so) to a pick-up location where first responders can be directed. Two personnel will remain with the victim until emergency responders arrive. One will administer first aid and monitor the victim, and the other will maintain communication with the first responders. If it is appropriate or necessary for **Tetra Tech** to transport a victim for follow-up care, three personnel will accompany the victim. One will administer first aid and monitor the victim, one will drive, and the third will maintain communication with the treatment facility, as necessary.

FIRST AID FOR DIVING RELATED INJURIES

1. FIRST AID FOR INJURIES REQUIRING IMMEDIATE TRANSPORT TO A CHAMBER FACILITY

1.1 AIR EMBOLISM

Recognition - Usually occurs during or immediately after surfacing Symptoms (one or more of the following)

Disorientation or Fatigue Skin Itch

Chest Pain

Numbness, Tingling, Paralysis or Weakness Dizziness, Vertigo, or Ringing in the Ears Blurred Vision

Personality Change

Signs (one or more of the following)

Bloody froth from nose or mouth, Paralysis or Weakness Unconsciousness, Convulsions

Shortness of Breath or Cessation of Breathing Apparent Death

Note: Symptoms and signs usually appear within 15 minutes to 12 hours after surfacing; in severe cases, symptoms may appear immediately or even before the dive is completed. Delayed occurrence of symptoms is rare but can occur, especially if air travel follows diving. The quicker treatment begins, the better the chances of a full recovery.

Early Management

Cardiopulmonary resuscitation (CPR), if required

Open airway, prevent aspiration, and incubate if trained person available Give O^2; remove only to open airway or if convulsion ensue

- If conscious, give non-alcoholic liquids, place in a horizontal, neutral position
- Restrain convulsing person loosely and resume O^2 as soon as airway is open Protect from excessive cold, heat, water, or fumes
- Arrange emergency transport, send divers profile with the diver, and send all diving equipment for examination or have it examined locally.

1.2 DECOMPRESSION SICKNESS

Recognition - Symptoms usually appear 15 minutes to 12 hours after surfacing Symptoms (one or more of the following):

- Tired Feeling

- Itching
- Pain, arms, legs, or trunk
- Dizziness
- Numbness, tingling, or paralysis

Chest compression or shortness of breath Anything unusual after the dive

Signs (one or more of the following)

- Blotchy Rash
- Paralysis or weakness anywhere in the body
- Coughing Spasms
- Staggering or instability
- Unconsciousness
- Personality change

Early Management

Stabilize patient the same way as for Air Embolism

Arrange for emergency transport, send divers profile with the diver, and send all diving equipment for examination or have it examined locally

3.1 FIRST AID FOR INJURIES REQUIRING TRANSPORT TO A HOSPITAL FACILITY

3.2 PNEUMOTHORAX

Symptoms (one or more of the following)

- Pains in the chest
- Shortness of breath

Signs (one or more of the following)

- Shallow Rapid Breathing
- Cyanosis (blue skin, lips, fingernails)
- Possible crackling under the skin of the neck
- Possible mediastinal shift (heart sounds not in the usual place)

Emergency Actions:

Call for help and immediate transport

Mediastinal Emphysema (Lung overpressure accident)

Recognition - Always associated with pneumothorax

3.3 Symptoms (one or more of the following)

Pain in the chest (beneath the breastbone) Faintness

Shortness of breath

Signs (one or more of the following)

- Obvious difficulty breathing

Brassy change in voice

Emergency Actions:

- Transport to a medical facility for evaluation

3.4 DROWNINFG-NEAR DROWNING

Recognition

- Unconsciousness
- Lack of respiration

Cyanosis (blue skin, lips, fingernails)

Management

- Try to identify the time the victim was last seen breathing
- Assess ABC’s airway, breathing, and circulation
- Removal of gear
- Transport to the boat or shore
- Immediate call for help and transport to facility Start CPR

3.5 OXYGEN TOXCITY (WITH CONVULSIONS)

Signs (one or more of the following)

- Decreased or loss of consciousness; followed by Convulsions

Symptoms (one or more of the following)

- Nausea Dizziness

- Ringing in the ears
- Abnormal Vision
- Confusion Prevention

Avoidance of gases with high O2 concentrations (as in Nitrox at inappropriate depth) Avoid CO2 retention that can precipitate O2 convulsions at any depth

If convulsions occur at depth, be prepared to treat near drowning and/or air embolism TREATMENT - Call for help and immediate transport

3.6 SEVERE TRAUMA OR LARGE PREDATOR INJURY (HEAD INJURY, LIMB INJURY DUE TO FALLS, EQUIPMENT CRUSH, PROP INJURIES)

- call for help and immediate transport
- open airway
- treat for shock on site and stabilize before evacuation
- face up neutral position
- direct pressure over bleeding wounds
- CPR if no pulse or respiration
- keep warm
- be mindful of the possibility of neck injury
- splint limb injuries call for help and immediate transport

3.7 SUSPECTED HEART ATTACK OR STROKE

- Call for help and immediate transport
- Treat for shock
- CPR if no pulse or respiration
- Keep warm
- Call for help and immediate transport

3.8 SEVERE ALLERGIC REACTION

- Remove any remnant of allergen (i.e., jellyfish tentacles, foreign material)
- Wash out wounds of injury with alcohol, vinegar, or water
- Call for help and immediate transport
- Treat for shock
- CPR if no pulse or respiration

- Keep warm
- Pain Relief, if available
- Transport to a medical facility for evaluation

3.9 STINGING FISHES (STINGRAYS, SCORPIN FISH)

- Immobilize
- Remove spine and debride (scrub the wound)
- Irrigate wound
- Soak in hot water (thermolabile toxin) 122 degrees F, for 30-90 minutes
- Call for help and immediate transport
- Treat for shock, hydrate

3.10 HYPOTHERMIA

- Keep the core temperature above 95° F
- Keep airway open
- Immobilize
- Wrap in blankets, preferably next to another person
- Basic life support, CPR, if needed
- Warm liquids, if alert, unless very cold - then avoid due to possibility of ventricular tachycardia (rapid, useless fluttering of the heart)
- Call for help and immediate transport

3.11 HYPERTHERMIA (HEAT EXHAUSTION DUE TO EXCESSIVE FLUID LOSS)

- Remove from source of heat
- Lower temperature (cool compresses at arterial points and head)
- Keep calm
- Keep airway open
- Call for help and immediate transport if unstable

3.12 HEAT STROKE

- Remove all clothing
- Cover with cool wet sheet
- Place in an air-conditioned area

- Cold packs to neck, scalp, groin, and armpits
- If convulsions occur, ensure the victim does not cause further harm to themselves
- Call for help and immediate transport

3.0 AID FOR INJURIES THAT CAN BE TREATED ON BOARD

3.1 NITROGEN NARCOSIS

Signs (one or more of the following)

- Inappropriate behavior at depth
- Ignoring hand signals and instructions
- Stupor or coma

Symptoms (one or more of the following)

- Inflexible thinking and attitude
- Decrease or loss of judgment
- False sense of security
- Lack of concern for safety
- Inability to think through problems
- Panic
- Near unconsciousness or loss of consciousness at depth

<u>Treatment</u>

- Ascend until free of symptoms
- Surface with a controlled ascent
- Transport to a medical facility for evaluation

3.1 CARBON DIOXIDE POISONING

Symptoms (one or more of the following)

- Rapid breathing
- Feeling of suffocation or shortness of breath
- Headache, nausea, dizziness
- Rapid heartbeat

Confusion and unclear thinking Signs (one or more of the following)

- Slowed responses

Muscle irritability (twitching) Loss of consciousness

- Treatment

Remove the cause (over-exertion, equipment failure, rebreathers, etc.) Stop and rest during early symptoms to avoid loss of consciousness Surface, Transport to a medical facility for evaluation

3.2 EAR DISORDERS

Middle Ear Barotrauma

- Keep quiet and calm
- Without DCS or rupture of the round or oval windows, give Benadryl 25 mg
- Transport to a medical facility for evaluation
- Discontinue diving until cleared by an emergency medical technician (EMT)
- Inner Ear Barotrauma
- Recognize round or oval window damage (loss balance, ataxia, tinnitus, deafness) Keep head up, and affected ear elevated
- Discourage straining
- Transport to a medical facility for evaluation
- EMT evaluation, no more diving until cleared by EMT

3.3 SEASICKNESS

The best medications have been found to be Meclizine, Bonine, Dramamine, and Trans-derm Scope.

- Keep your eyes on the horizon
- Stay on deck
- Keep yourself well hydrated with non-alcoholic beverages
- Try antacid tablets or lemon drops
- If diving, try to be the first diver in water.

ATTACHMENT B

ACTIVITY HAZARD ANALYSIS

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Activity Hazard Analysis (AHA) #1

Activity/ Work Task: Mobilization and Site Preparation (Dive Ops)

Project Location: Congaree River, Columbia, SC

Contract Number:

Date Prepared: November 2021

Prepared by: Don Schwalback, Diving Supervisor

Reviewed by: Scot Wilson, PM

Overall Risk Assessment Code (RAC) (Use highest code)	**M**

Risk Assessment Code (RAC) Matrix

Severity	**Probability**				
	Frequent	Likely	Occasional	Seldom	Unlikely
Catastrophic	**E**	**E**	**H**	**H**	**M**
Critical	**E**	**H**	**H**	**M**	**L**
Marginal	**H**	**M**	**M**	**L**	**L**
Negligible	**M**	**L**	**L**	**L**	**L**

Notes: (Field Notes, Review Comments, etc.)

In addition to the information listed in this AHA, all field personnel must review and be familiar with all provisions of the approved work plan. EM 385-1-1 and other regulations will also be available on-site for review of specific materials and mitigation measures.

Personal Protective Equipment for this AHA will consist of high visibility safety vest (in traffic areas) and hard hat (when working around heavy equipment and/or an overhead safety hazards exist), safety toed boots, safety glasses with side shields, standard work uniform (long pants, ¾ length sleeve shirt). Hearing protection (as required). Work gloves worn when indicated.

Step 1: Review each **“Hazard”** with identified safety **“Controls”** and determine RAC (see above).

“Probability” is the likelihood to cause an incident, near miss, or accident and is identified as Frequent, Likely, Occasional, Seldom, or Unlikely.

“Severity” is the outcome/degree if an incident, near miss, or accident did occur and is identified as Catastrophic, Critical, Marginal, or Negligible.

Step 2: Identify the RAC (Probability/Severity) as E, H, M, or L for each “Hazard” on the AHA. Annotate the overall highest RAC at the top of the AHA.

RAC Chart
E = Extremely High Risk
H = High Risk
M = Moderate Risk
L = Low Risk

AHA #1 – Activity/ Work Task: Mobilization and Site Preparation

Job Steps	Hazards	Controls	RAC
1. Arrival at Location	• Lack of Emergency preparedness and Health and Safety (General) before beginning work	✓ Get to know the location if not familiar. ✓ SSHO to locate the emergency hospital and ensure routes are correct as shown in approved WP. ✓ Conduct site orientation with the crew involved in mobilization tasking including establishment of laydown areas, unpacking and unloading and staging of materials and equipment and haul routes ✓ Review the APP and this AHA, and the Emergency Response Plan and document the training. ✓ Ensure communications are established and working properly among team members. ✓ Develop a plan for mobilization organization and tasking and emphasize communication ✓ Ensure emergency and basic safety equipment and PPE is located and available for use prior to starting site work. ✓ Use buddy system. ✓ SSHO will have site workers fill out medical data sheets that are included in an appendix to the APP ✓ Post the emergency evacuation routes and procedures as well as emergency contact list in a designated location until a permanent location is established at the field office trailer.	**L**
2. Unloading and initial staging of materials and equipment including set up of site office/shop.	• Vehicle operations from Tt or other tenant operations and delivery vendors could cause injury to personnel or others onsite	✓ Workers operating company or subcontractor vehicles will have a valid state issued driver's license and will be appropriately badged and cleared for entry per Installation requirements prior to entry. ✓ Any Commercial Driver's License (CDL) truck and trailers will be operated by CDL qualified drivers. ✓ Operate at safe speeds and obey local and facility-required traffic speeds (no more than 25 M.P.H.) and additional rules and restrictions to follow while on facility. ✓ Wear seat belt always when vehicle is in operation. ✓ Use chocks when parked on inclines. ✓ When motor vehicle except for auxiliary operation, is left unattended (operator is beyond 25 feet of view of vehicle), turn off the ignition, put the transmission in gear (park) and apply the parking brake. ✓ Yield the right-of-way to any emergency vehicles displaying a flashing light. Pull to right edge of road and stop until the approaching vehicle passes. Obey all signs. Yield to pedestrians. ✓ Use dedicated spotter and standard hand signals for backing operations. ✓ Wear class 2 high visibility vest when working around operating vehicle traffic.	**L**

AHA #1 – Activity/ Work Task: Mobilization and Site Preparation

Job Steps	Hazards	Controls	RAC
	• Ergonomic hazards such as sprains, strains, or back injury from lifting or repetitive actions	✓ Use mechanical lifting equipment or team lift when possible rather than by hand and tool methods. ✓ Do not bend at the waist, bend at the knees. ✓ Do not twist and turn while lifting. Keep the load centered and close to body. ✓ Do not lift more than 50 pounds (may be lesser for some workers) alone. ✓ Rotate tasks and take breaks when performing repetitive tasks and try to find the best position possible to perform the task.	
	• Slips, trips, and falls could lead to injuries	✓ Keep work areas free of debris and equipment in work paths. ✓ Follow good housekeeping in work areas. ✓ Correct hazards when seen, such as holes or other trip hazards. ✓ Conspicuously mark trip hazards that cannot be corrected ✓ The site trailer will be cribbed in level position. ✓ Tie down of the trailer will comply with EM 385 1-1, Section 04.A.03 requirements.	**M**
	• Handling sharp objects or using hand tools or knives could cause cuts, punctures, or scrapes	✓ Wear work gloves when handling materials that may be sharp or have sharp edges. ✓ Be familiar with the proper use and limitations of hand tools. ✓ Report even minor injuries to your supervisor for evaluation. ✓ Have a first aid kit available and have a minimum of 2 persons with first aid and CPR training onsite ✓ Ensure knives are folding type or have retractable blades.	**L**
	• Worker exposure to extreme temperatures and sunburn.	✓ Properly dress for the weather. ✓ SSHO to monitor weather and implement heat stress and cold stress controls as specified in the APP. ✓ Provide breaks for personnel to get either into cool (heat stress) or warm (cold stress) environment. ✓ Encourage a steady work pace. ✓ Ensure adequate potable drinking water is available. ✓ Know the signs and symptoms of exposure and keep an eye on your partner. ✓ SSHO to implement EHS 4-6, Temperature Extremes.	**L**
	• Severe weather can cause unsafe working conditions	✓ SSHO will monitor weather forecast at a minimum of two times per day or more. ✓ Outdoor work will cease during extreme weather conditions, such as electrical storms, high wind, heavy rain and extreme temperatures that present unsafe working conditions. ✓ Shut all equipment down when lightning is visible and wait for “all-clear” from the SSHO (30/30 rule). Take cover indoors or in vehicle or heavy equipment cab (fully enclosed cab only).	**L**

AHA #1 – Activity/ Work Task: Mobilization and Site Preparation

Job Steps	Hazards	Controls	RAC
	• Eye injuries from dust or debris or struck by	✓ Wear safety glasses with side shields always when working. ✓ If something enters the eye, do not rub. ✓ Set up portable eyewash for flushing of eye to try to remove object. Notify supervisor so eye can be monitored. ✓ If object still irritates or stays in the eye, seek medical attention as soon as possible. Follow up with eye exam is recommended any time an object gets into an eye since it is necessary to ensure object does not remain, even if it cannot be felt. ✓ To keep dust down, travel at slower speeds on unpaved roads and laydown areas. ✓ If required, water mist can be used to control dust on roads and in laydown areas.	**L**
	• Wind could make materials hard to handle	✓ Avoid handling materials that could respond like a sail (e.g., plywood) in wind. ✓ Position vehicles so that doors do not get caught by the wind when opened. ✓ Hang onto door when opening and closing in high wind. ✓ Open and close doors carefully in the wind and only open one door at a time.	**L**
	• Noise could cause hearing loss and make it hard to communicate	✓ Hearing protection is required when sound levels exceed 84 dBA continuously. ✓ This rule applies to personnel working near or on heavy equipment and any other sources of loud noise. ✓ Generators, if used will be quiet in operation or will be shielded to minimize noise generation in common work areas so that hearing protection is not required to work in the area.	M
	• Lack of proper illumination in work areas could cause hazards to not be recognized or eye strain	✓ During mobilization, if lighting is not yet set up, temporary lighting such as portable bright lumen flashlights may be necessary if ambient lighting is not sufficient, especially within the trailer. ✓ Work during daylight hours or provide adequate lighting source for work areas as specified in the APP Night Operations Lighting Plan (currently limited to daylight hours only) to minimize potential for injuries to occur from lack of visibility.	L
	• Fall hazards (falls from heights of 6 feet or greater)	✓ Utilize fall protection when working at heights 6’ or greater. ✓ Ensure ladders are stable and secured appropriately. ✓ Utilize 3 points of contact when ascending/descending ladders, stairs, equipment, etc. ✓ SSHO to identify site fall hazards and ensure appropriate controls are in place if workers could be exposed to a fall.	M
	• Head injuries from struck by or falling objects	✓ Wear hard hat when overhead hazards exist and when working in areas with operating construction equipment. ✓ Do not position under any suspended load at any time.	M

AHA #1 – Activity/ Work Task: Mobilization and Site Preparation

Job Steps	Hazards	Controls	RAC
	• Contact with biting or stinging insects.	✓ Wear long sleeve shirts and long pants in areas where contact with mosquitos may occur. ✓ Use Environmental Protection Agency (EPA)-registered insect repellents with one of the following active ingredients: – DEET, picaridin, IR3535, oil of lemon eucalyptus or para-menthane-diol, or 2-undecanone. – Always follow the product label instructions. ✓ Workers will exercise caution when working in brushy or grassy areas, wood or debris piles, and recessed areas. ✓ Site orientation will include briefing on biological hazards associated with insects as well as local hazardous flora and fauna, signs and symptoms of exposure and precautions to take. ✓ Workers with allergies will let the SSHO know using the medical data sheet and will carry their own prescription medication as applicable. ✓ First aid and medical attention as required. Report any bites, stings, or rashes to the SSHO.	L
	• Electrical hazards could be present during tool use or during hookup of trailer	✓ Ensure that a certified electrician performs all electrical work to hook up office trailer to electrical power source. ✓ Electrician to properly ground systems in accordance with electrical code. ✓ Ensure that power cords are inspected and in good condition for use, that GFCIs are used properly, and portable generators are not overloaded. ✓ Ensure any power tools used are in good working condition and have third prong on cord or are double insulated. ✓ All live work requires arc flash protection. ✓ Contact SHM if there will be any live work so that additional precautions can be identified and incorporated into this AHA.	L
	• Injury from improper use of power and hand tools	✓ Maintain steady pace when using tools and take adequate rest periods. ✓ Use appropriate tools for the task and maintain tools in good condition. ✓ Wear leather work gloves when using tools. ✓ Avoid working too close to other workers. ✓ Inspect all tools for damage before each use, including electrical cords/ pneumatic hoses. ✓ Ensure double insulation on electrical tools. ✓ Train personnel in the proper use of hand tools. ✓ GFCI required for all connections to outdoor use of power tool and other electrical equipment insulation.	M

AHA #1 – Activity/ Work Task: Mobilization and Site Preparation

Job Steps	Hazards	Controls	RAC
	• Refueling of equipment use could present fire hazards or spills	✓ Only use a UL rated, National Fire Protection Association-approved fuel tanks and fuel transfer hoses. ✓ A minimum 60:BC fire extinguisher will be set up and staged within 50 feet of the fueling area and tank ✓ No smoking at any location unless specifically approved by the SS and SSHO and Installation requirements. ✓ Signage will be posted as flammable and no open flame. ✓ There are no matches or other flame producing materials allowed in the Restricted Area unless specifically permitted. ✓ Spill kit will be available in the refueling area (sorbent pads, kitty litter, gloves, waste bag). Fueling will be done over a secondary containment device to catch incidental fuel in case of overflow or drips. ✓ Operator will be present and have positive control on dispensing of fuel during filling operations at all times and a means to stop the flow of fuel. ✓ Tanks will be able to be monitored to gauge fuel level to prevent overfilling. ✓ Generators, if used will be equipped with mufflers/spark arresters. ✓ If mobile equipment or tools are refueled, the equipment will be turned off and allowed to cool prior to refueling.	L
	• Dry vegetation may be present and presents a potential fire hazard	✓ No smoking at any location except as specifically designated as smoking areas by the SS and as per Installation requirements. ✓ Do not refuel equipment in vegetated areas. ✓ No spark producing tasks or any other open flame tasks in areas of vegetation and not without a Hot Work Permit issued by the SSHO and removal of combustible materials including dry vegetation first. ✓ No spark producing tasks or flame producing equipment allowed in the Restricted Area.	L
3. Backing of boats on boat trailers	• Failure of proper backing can cause struck by and pinch point injuries or property damage.	✓ Use spotters for all backing operations. Ensure spotter stands in line of sight of the person backing the vehicle. All personnel who back a trailer are trained and qualified to do so and are designated by the PjM for such activities. Use boat checklist in APP prior to launching boat. Verify understanding of hand signals used for backing, going forward, stopping, and turning left or right. Use parking brake and ensure operator is not moving vehicle before unhitching boat from trailer. Follow EHS 6-6, Boating Procedure. Ground personnel involved in backing operations will wear class 2 high visibility vest.	M

AHA #1 – Activity/ Work Task: Mobilization and Site Setup

Equipment to be Used	Training Requirements/Competent or Qualified Personnel Name(s)	Inspection Requirements
- Site vehicles	• Drivers must have current state-issued driver's license.	✓ Daily vehicle inspection by drivers. Receipt inspection by SSHO.
- Boats	• Qualified Operators will have USCG approved boater safety qualifications identified in the APP and experience in use of the boats on the project.	✓ Inspect daily, and before use. ✓ Use the boating checklist form. ✓ Follow procedures in EHS 6-6, Boating Procedures
- Hand and power tools	• Training in use of hand and power tools by the SSHO or designee and review of operating manual. Use proper hand tool for the task.	✓ Daily inspection by users/operators. ✓ Inspect tools and power cords ✓ Inspect for damage to tool and to cords.
- First aid kit, fire extinguisher, eyewash station	• Use of emergency equipment including first aid kits, fire extinguishers and eyewash must be done by personnel familiar with this plan; use and inspection criteria of the equipment, and what the equipment is used for, are by or under direction of the SSHO	✓ Fire Extinguisher - initially and at least monthly thereafter by SSHO ✓ First Aid Kit - Weekly and after use for restocking by SSHO ✓ Eye Wash Station - Weekly by SSHO; Potable water changed weekly unless a preservative solution is used
- RTK GPS	• Geo Technician to check each day prior to operations.	✓ Only properly trained operator will use.
- Type II or better PFD to be worn	• User will inspect each day before use.	✓ Boat captain or SSHO will instruct in proper use.
- Personal Protective Equipment	• Users must be trained in the proper use of, limitations of, inspection of, donning and doffing of, and replacement of PPE used	✓ Daily inspection by user before use.

Abbreviations and Acronyms:

AHA – Activity Hazard Analysis
APP – Accident Prevention Plan
dBA – decibels, A-scale
CFR – Code of Federal Regulations
DEET – N,N-diethyl-meta-toluamide
EHS – Environmental, Health, and Safety
EM – Engineer Manual
GPS – global positioning system
PFD – personal flotation device
PPE – personal protective equipment
RAC – Risk Assessment Code
RTK – real-time kinematic
SDS – Safety Data Sheet
SSHO – Site Safety and Health Officer
USCG – U.S. Coast Guard

AHA#1 - Mobilization and Site Preparation Signature Sheet

I have reviewed the above AHA and acknowledge the hazards involved with this work task and the controls that will help to minimize illness or injury during the tasks.

NAME	SIGNATURE	TITLE	DATE

Activity Hazard Analysis (AHA) #2

Activity/ Work Task: Boat Operations

Project Location: Congaree River, Columbia, SC

Contract Number:

Date Prepared: November 2021

Prepared by: Don Schwalback, Diving Supervisor

Reviewed by: Scot Wilson, PM

Overall Risk Assessment Code (RAC) (Use highest code)	**M**

Risk Assessment Code (RAC) Matrix

Severity	**Probability**				
	Frequent	Likely	Occasional	Seldom	Unlikely
Catastrophic	**E**	**E**	**H**	**H**	**M**
Critical	**E**	**H**	**H**	**M**	**L**
Marginal	**H**	**M**	**M**	**L**	**L**
Negligible	**M**	**L**	**L**	**L**	**L**

<u>Notes</u>: (Field Notes, Review Comments, etc.)

In addition to the information listed in this AHA, all field personnel must review and be familiar with all provisions of the approved work plan. EM 385-1-1 and other regulations will also be available on-site for review of specific materials and mitigation measures.

<u>Personal Protective Equipment for this AHA</u>: Safety glasses with side shields (including appropriate tint of lens); sturdy rubber soled deck shoes; work gloves; standard Level "D" work clothes; a Type II or auto-inflatable personal flotation device (PFD) when in transit or on decks without adequate guardrails (exemption to this is a diver who is outfitted in dive-ready diver ensemble, as provided for in the Diving Operations Plan). In addition, sun protection including a hat with a wide brim is recommended onboard vessels if workers do not have immediate access to shade.

Step 1: Review each **"Hazard"** with identified safety **"Controls"** and determine RAC (see above).

	RAC Chart
"Probability" is the likelihood to cause an incident, near miss, or accident and is identified as Frequent, Likely, Occasional, Seldom, or Unlikely.	
"Severity" is the outcome/degree if an incident, near miss, or accident did occur and is identified as Catastrophic, Critical, Marginal, or Negligible.	**E = Extremely High Risk**
	H = High Risk
	M = Moderate Risk
Step 2: Identify the RAC (Probability/Severity) as E, H, M, or L for each "Hazard" on the AHA. Annotate the overall highest RAC at the top of the AHA.	**L = Low Risk**

AHA #2 – Activity/ Work Task: Boat Operations

Job Steps	Hazards	Controls	RAC
1. Boating	• Failure to meet EM 385-1-1 Section 19F or EHS 06-6 requirements for use of boats could cause injury or death.	✓ Follow the requirements of EM 385-1-1 and EHS 6-6, Boating Procedure, using the inspection checklist provided in the APP. ✓ All boat operators are qualified and trained in boat use and procedures. ✓ Ensure boat passengers have been briefed on the location, use, and inspection of emergency equipment onboard and the procedures to follow in the event of a shipboard emergency. ✓ Practice drills will be done prior to or during first deployment for situations such as man overboard, fires and explosions, and abandon ship.	**M**
	• <u>Fueling of boat</u> – potential for fire, environmental release. Run out of fuel when operating.	✓ No smoking or other sources of ignition when fueling. ✓ Engine must be off. ✓ There must be a fire extinguisher available. ✓ Refuel in a manner to prevent any spills, especially spills into the water. (If there is any sheen in the water the spill must be reported). ✓ Check for fuel leaks in the boat, if fuel lines are in the boat.). ✓ Ensure there is enough fuel supply for the trip and the return to dock plus 1/3 in reserve.	**M**
	• Boat could malfunction and drift into open water if engine does not work.	✓ Ensure communications are working on boat. ✓ Have anchor and enough line to deploy in the event of motor/engine malfunction. Ensure that a Float Plan is filed in accordance with the APP using the example Coast Guard Float Plan in the APP. ✓ File this plan daily with the PjM or designee before leaving the dock and notify them of your return.	
	• Grounding.	✓ Use caution in the shallow areas. ✓ Use depth meter and spotting to avoid striking the bottom or grounding.	
	• Personnel can slip or trip while on the dock and when getting on or off the boat.	✓ Personnel should use appropriate footwear (sturdy leather deck shoes) to ensure that there is enough tread on the soles to minimize slipping. ✓ Look out for trip hazards. Those hazards that cannot be removed must be marked. When climbing up or down or on and off boats, always ensure three points of contact.	
	• Sunburn for personnel in boat.	✓ Use broad spectrum sunscreen SPF 30 or greater as necessary on all exposed skin areas. ✓ Wear a hat with a bill or brim.	

		✓ Suggest wearing of neck protector if neck is exposed to sun or Bimini top on boat is not installed for shade.	
	• Severe weather can cause dangerous seas and hazardous boating conditions.	✓ Monitor the local and national weather service broadcasts prior to mobilization by boat and during the day. ✓ Pay attention to weather advisories and storm warnings, namely hurricanes. ✓ Monitor actual water conditions for dangerous wave or ground swell action. ✓ Follow provisions in the APP for severe weather.	
	• Heat or cold stress may be experienced.	✓ Boat occupants will be monitored for signs and symptoms of heat stress and cold stress (in colder weather, wet weather, or if wind chill is a factor) in accordance with the APP and EHS 4-6, Temperature Extremes. ✓ Hydration and work/rest regimens will be followed. ✓ Survival kits on the boat will include blankets in the event of hypothermia for boat occupants. ✓ Boat occupants will be prepared with raingear and a change of clothing in the event they get wet and chilled. ✓ Boat survival kit, if used, will be restocked with necessary equipment. Adequate drinking water and electrolyte fluids will be available for boaters. ✓ Boat cabin shall have air conditioning or at a minimum, shade for employees to rest in.	
	• Boat could be struck by other boats in area.	✓ Boat Captain oversees situational awareness while on the water. ✓ Boat Captain will not be doing other tasks. ✓ Monitor Channel 16 and U.S. Coast Guard rules for lighting and other vessel operations. ✓ Use air horn in the event of a boat coming close.	
2. Search with divers preselected anomalies, grids and transects as described in the approved work plan. 3. Locate MDAS, MPPEH and MEC under water using divers with underwater navigation and metal detectors to characterize the site.	• Underwater MPPEH / MEC hazards • Uneven and/ or moving working surfaces of the boat – slip, trip, and fall hazards • Muscle strain carrying instruments/equipment • Pinch points/ laceration hazards from boat equipment • Heat Stress	✓ On-site MPPEH and MEC Training ✓ Perform MEC avoidance by avoiding operating the boat in shallow waters in which the boats hull, outdrives or jet-drives impact the sea floor ✓ Boat Operator will ensure that boat is well maintained and in good condition prior to taking on passengers. ✓ Boat Operator will ensure that Captain and vessel are licensed in accordance with local requirements. ✓ Boat Operator will be in communication with Captain and aware of destination, when boat leaves wharf and docks on each trip. ✓ Emergency radios will be in operating condition prior to leaving the wharf. There will be a primary and alternate means of communication, and extra batteries will be available. ✓ Directions for contacting the Coast Guard and hospital will be posted with each radio and cell phone.	**M**

	• Biological hazards – bees, wasps, mosquitoes, jellyfish, corals, sharks • Noise • Sunburn • Hazardous weather conditions	✓ Personnel will attend daily safety briefing by Captain prior to transport by boat and will obey all directions from the Captain during transport. ✓ Boat will be equipped with rescue equipment to handle a man overboard situation (such as life ring with rope, or similar equipment), and personnel trained in its use. ✓ Personnel will wear rubber-soled shoes to prevent slipping while on the boat and will avoid stepping in wet areas that could be slippery. ✓ Follow appropriate lifting/carrying procedures. Lift with legs, maintain balance, use work gloves, and never lift more than you can safely carry. ✓ Ensure hoisting mechanism is adequate for the load imposed and is securely braced and anchored. ✓ A positive latching device will be used to secure the load and rigging. ✓ Operator of any hoisting equipment will be trained in its use. ✓ Hoisting and rigging equipment will be inspected daily. ✓ Heat stress monitoring, drinking water, work-rest schedule, and cool shelter for breaks. ✓ Training in biological hazards avoidance. ✓ Use PPE in accordance with this AHA. ✓ Use insect repellents as necessary. ✓ Use sunscreen and wear protective clothing. ✓ Fire extinguishers will be readily available. ✓ First Aid Kits will be readily available. ✓ Shark Marine system and underwater cameras will be characterizing levels of underwater MEC contamination and sensitive habitats through videotaping of underwater conditions. ✓ Contact with MEC items is not intended or anticipated. ✓ Personnel will remain seated while boat is in motion, and keep all ✓ extremities inside the boat. ✓ All personnel will wear personal flotation devices while boat is in transit and during inclement weather. At all other times, a personal flotation device should be readily available and accessible. ✓ Good housekeeping standards will be enforced. Cargo will be properly staged on the boat to prevent tripping hazards. ✓ Local weather will be monitored, and boat operations will be terminated during an approaching storm or should sea conditions make it unsafe to continue.	

AHA #2 – Activity/ Work Task: Boat Operations

Equipment to be Used	Training Requirements/Competent or Qualified Personnel Name(s)	Inspection Requirements
PPE: – Footwear with rubber soles to prevent slipping. Safety toe footwear required near heavy diving equipment (SCUBA cylinders) – Type II or better PFD to be worn in transit – Back braces (optional) – Appropriate clothing and PPE (to include personal flotation device, puncture resistant or leather work gloves, safety sunglasses and cap). Hearing protection will be required if noise from boat engine reaches hazardous levels. – Chemical-resistant gloves for use when handling MPPEH/MEC and in fueling operation	• PPE requirements training	✓ PPE inspected daily prior to use by user with additional random inspections by SSHO.
Boat/s: – RTK systems – HERO Underwater camera – Fuel spill kit – Boat tool kit – Fuel container	• UXO personnel will meet training and experience requirements outlined in DDESB TP 18 • Site specific MEC training will be presented to all site personnel • Equipment familiarity training • Site-specific training, slip/fall hazards • Site-specific training/lifting and carrying techniques • Current HAZWOPER training • Site-specific training in use of equipment and tools	✓ SSHO will ensure that all controls are being followed, all equipment is being correctly utilized, and all personnel have received appropriate training. ✓ Equipment inspected daily prior to use by user and SSHO. ✓ Daily serviceability check of magnetometers by user and UXOQCS. ✓ Geo Tech or designee to check SM and RTK each day prior to operations.
Emergency gear: – Communications equipment – First Aid Kit – Fire extinguishers – Vessel rescue equipment (hook, rope, life ring) – WBGT monitor	• Emergency response procedures • Heat stress symptoms/first aid • Site-specific biological hazards to include first aid • Equipment familiarity training	✓ Communications equipment checked daily prior to use by SSHO. ✓ First Aid Kits checked daily and inspected weekly by the SSHO. ✓ Fire extinguishers checked daily and inspected weekly by the SSHO. ✓ Equipment inspected daily prior to use by user and SSHO.

Abbreviations and Acronyms:

AOC – Area of Concern
APP – Accident Prevention Plan
CHMM – Certified Hazardous Materials Manager
CIH – Certified Industrial Hygienist
CRL – Corporate Reference Library
CSP – Certified Safety Professional
dBA – decibels, A-scale
EHS – Environmental, Health, and Safety
SSHO – Site Safety and Health Officer
SHM – Safety and Health Manager
UXOQCS – UXO Quality Control Specialist

AHA#2 – Boat Operations Signature Sheet

I have reviewed the above AHA and acknowledge the hazards involved with this work task and the controls that will help to minimize illness or injury during the tasks.

NAME	SIGNATURE	TITLE	DATE

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Activity Hazard Analysis (AHA) #3

Activity/ Work Task: Vehicle Operations

Overall Risk Assessment Code (RAC) (Use highest code) **L**

Project Location: Congaree River, Columbia, SC

Contract Number:

Date Prepared: November 2021

Prepared by: Don Schwalback, Diving Supervisor

Reviewed by: Scot Wilson, PM

Risk Assessment Code (RAC) Matrix

Severity	**Probability**				
	Frequent	Likely	Occasional	Seldom	Unlikely
Catastrophic	**E**	**E**	**H**	**H**	**M**
Critical	**E**	**H**	**H**	**M**	**L**
Marginal	**H**	**M**	**M**	**L**	**L**
Negligible	**M**	**L**	**L**	**L**	**L**

Notes: (Field Notes, Review Comments, etc.)

In addition to the information listed in this AHA, all field personnel must review and be familiar with all provisions of the approved work plan. EM 385-1-1 and other regulations will also be available on-site for review of specific materials and mitigation measures.

<u>Personal Protective Equipment for this AHA: </u>High visibility safety vest and hard hat (when working with an overhead safety hazards exist), safety toed boots, safety glasses, standard work uniform (long pants, ¾ length sleeve shirt). Sun protection. Hearing protection (as required). Appropriate work gloves worn when indicated.

Step 1: Review each **"Hazard"** with identified safety **"Controls"** and determine RAC (see above).

"Probability" is the likelihood to cause an incident, near miss, or accident and is identified as Frequent, Likely, Occasional, Seldom, or Unlikely.

"Severity" is the outcome/degree if an incident, near miss, or accident did occur and is identified as Catastrophic, Critical, Marginal, or Negligible.

Step 2: Identify the RAC (Probability/Severity) as E, H, M, or L for each "Hazard" on the AHA. Annotate the overall highest RAC at the top of the AHA.

RAC Chart
E = Extremely High Risk
H = High Risk
M = Moderate Risk
L = Low Risk

AHA #3 – Activity/ Work Task: Vehicle Operations

Job Steps	Hazards	Controls	RAC
1. Identify the hazards associated with vehicle operations	• Slip, trip, and fall hazards • Back strain from carrying equipment • Heat stress • Biological hazards – bees, wasps, mosquitoes, spiders • Sunburn • Weather hazards • Potential for vehicle accidents during field operations • Cargo hazards (MEC/ Explosives) • Fire hazards	✓ Daily vehicle inspections will be performed to ensure a safe operating vehicle. ✓ Operator must have a valid driver's license (permits for transporting explosives). ✓ Use the parking brake if parked on inclines and/or as necessary. ✓ Use spotter when backing ✓ Fire extinguisher and First Aid kit must be with vehicle. If transporting ✓ explosives, two fire extinguishers are required. ✓ Ensure placards are visible on all four sides of vehicle when transporting explosive materials. ✓ Ensure explosives are properly packed and braced in the vehicle. ✓ Fill out DD Form 626 when transporting explosives. ✓ Ensure vehicle is chocked while loading/unloading cargo.	**L**
2. Inspect vehicle			
3. Load cargo onto vehicle			
4. Drive to and from destinations	• Potential for vehicle accidents during field operations • Cargo hazards (MEC/ Explosives) • Fire hazards	✓ Always wear a seat belt. ✓ Use a ground guide when reversing and/or as needed. ✓ Prior to backing or when working alone, drivers will apply the GOAL technique: "Get Out and Look." ✓ Obey the speed limit. ✓ Obey all traffic signs. ✓ Use established roads. ✓ Use the parking brake if parked on inclines and/or as necessary. ✓ Never leave the vehicle running unattended. ✓ Operator must have a valid driver's license (permit for transporting explosives).	**L**

5. Secure vehicle		✓ Fire extinguisher and First Aid kit must be with vehicle. If transporting explosives, two fire extinguishers are required. ✓ Never fuel a vehicle loaded with explosive cargo. ✓ No passengers will be transported in bed of a pick-up truck. All passengers will be in a seat with a seat belt in use during vehicle operation. ✓ There will be no use of cell phones, portable headphones, earphones, or other electronic devices while operating a vehicle. ✓ Silence or turn off all electronic devices prior to operating motor vehicle. ✓ If an electronic device must be used, park the vehicle in an appropriate location and turn engine off prior to turning on and using electronics. ✓ Always lock/ secure vehicle.	

AHA #3 – Activity/ Work Task: Vehicle Operations

Equipment to be Used	**Training Requirements/Competent or Qualified Personnel Name(s)**	**Inspection Requirements**
- Accident Prevention Plan	• Daily Safety Brief; SUXOS/ Diving Supervisor, UXOSO	✓ All members sign APP acknowledgement. ✓ Sign daily safety brief
- Site vehicles - Placards	• Drivers must have current state-issued driver's license. • UXO personnel will meet training and experience requirements outlined in DDESB TP 18 • Site specific MEC training will be presented to all site personnel • All personnel will have MPPEH training • Equipment familiarity training • Site-specific training, slip/fall hazards • Site-specific training/lifting and carrying techniques • All site personnel will have current HAZWOPER training	✓ Daily vehicle inspection by drivers. Receipt inspection by SSHO. ✓ UXOSO will ensure that all controls are being followed, all equipment is being correctly utilized, and all personnel have received appropriate training. ✓ Equipment inspected daily prior to use by user and UXOSO.
- First Aid kit - Fire extinguisher - Communication equipment	• Knowledge of the Emergency Response and Notification procedures. • Fire extinguisher training. • Equipment familiarity.	✓ Communications equipment checked daily prior to use by UXOSO. ✓ First Aid kits checked daily and inspected weekly by UXOSO. ✓ Fire extinguishers checked daily and inspected weekly by UXOSO.
- Hand and power tools	• Training in use of hand and power tools by the SSHO or designee and review of operating manual. Use proper hand tool for the task. • Site-specific training in use of tools	✓ Daily inspection by users/operators. ✓ SSHO inspect tools and power cords to ensure they are listed by a NRTL. ✓ Inspect for damage to tool and to cords.

Abbreviations and Acronyms:

AOC – Area of Concern
APP – Accident Prevention Plan
CHMM – Certified Hazardous Materials Manager
CIH – Certified Industrial Hygienist
CRL – Corporate Reference Library
CSP – Certified Safety Professional
dBA – decibels, A-scale
EHS – Environmental, Health, and Safety
ESP – Explosive Site Plan
EZ – Exclusion Zone
PPE – Personal Protective Equipment
MDAS – Material Documented As Safe
MEC - Munitions and Explosives of Concern
MPPEH – Material Potentially Possessing an Explosive Hazard
SSHO – Site Safety and Health Officer
SHM – Safety and Health Manager
SUXOS – Senior UXO Supervisor
UXO – Unexploded Ordnance
UXOSO – UXO Safety Officer
UXOQCS – UXO Quality Control Specialist

AHA #3 – Vehicle Operations Signature Sheet
I have reviewed the above AHA and acknowledge the hazards involved with this work task and the controls that will help to minimize illness or injury during the tasks.

NAME	SIGNATURE	TITLE	DATE

Activity Hazard Analysis (AHA) #4

Activity/ Work Task: Diving Operations	**Overall Risk Assessment Code (RAC) (Use highest code)**	**H**

Project Location: Congaree River, Columbia, SC

Contract Number: RTN 4-0000090

Date Prepared: November 2021

Prepared by: Don Schwalback, Diving Supervisor

Reviewed by: Scot Wilson, PM

Risk Assessment Code (RAC) Matrix

Severity	**Probability**				
	Frequent	Likely	Occasional	Seldom	Unlikely
Catastrophic	**E**	**E**	**H**	**H**	**M**
Critical	**E**	**H**	**H**	**M**	**L**
Marginal	**H**	**M**	**M**	**L**	**L**
Negligible	**M**	**L**	**L**	**L**	**L**

Notes: (Field Notes, Review Comments, etc.)

In addition to the information listed in this AHA, all field personnel must review and be familiar with all provisions of the approved work plan. EM 385-1-1 and other regulations will also be available on-site for review of specific materials and mitigation measures.

Personal Protective Equipment for this AHA: PFD (when in transit on boat), appropriate and properly configured diving equipment as outlined in EM385-1-1 Sect 30, high visibility safety vest and hard hat (when working with an overhead safety hazards exist), safety toed boots, safety glasses, standard work uniform (long pants, ¾ length sleeve shirt). Sun protection. Hearing protection (as required). Appropriate work gloves worn when indicated.

Step 1: Review each **"Hazard"** with identified safety **"Controls"** and determine RAC (see above).

"Probability" is the likelihood to cause an incident, near miss, or accident and is identified as Frequent, Likely, Occasional, Seldom, or Unlikely.

"Severity" is the outcome/degree if an incident, near miss, or accident did occur and is identified as Catastrophic, Critical, Marginal, or Negligible.

Step 2: Identify the RAC (Probability/Severity) as E, H, M, or L for each "Hazard" on the AHA. Annotate the overall highest RAC at the top of the AHA.

RAC Chart

E = Extremely High Risk

H = High Risk

M = Moderate Risk

L = Low Risk

AHA #4 – Activity/ Work Task: Diving Operations

Job Steps	Hazards	Controls	RAC
1. Pre-Dive Safety Brief	• Fire hazards on boat • Slips, trips and falls on boat deck • Heat Stress • Biological hazards – hazardous sea life, bees, wasps, centipedes, mosquitoes, spiders, and rodents • Muscle strain carrying equipment • Sunburn • Equipment shifting during boat transit in sea states • Falling overboard/ drowning hazards • Diving related injury	✓ Be observant while walking on decks and docks ✓ Personnel will wear close toed shoes/ boots appropriately soled for working on boat decks ✓ Perform proper stowage and securing of equipment on boat prior to transit ✓ Assure fire extinguishers and first aid kit are available and operational ✓ Assure communications equipment is available and operational ✓ Heat stress monitoring, drinking water, work-rest schedule and cool shelter for breaks ✓ Training in biological hazards avoidance ✓ Use insect repellants as necessary ✓ Use proper lifting/carrying techniques ✓ Use sunscreen and wear cap ✓ Wear personal flotation device always while in transit on boat ✓ Review specific hazards and controls located in the Diving Operations Plan. ✓ Review SOPs as related to current task, assignment, or pre, during, and post dive activities. ✓ Review Diving emergency procedures.	L
	• Submerged Objects • Shallow Water • Non-Secured Ladder • Falling • Pinch Points	✓ Verify water depth prior to entry ✓ Proper entrance ladder or walk-in entry only ✓ Ladder extends minimum of 3 feet below water surface ✓ Maintain three points of contact to ladder ✓ Sweep for submerged objects	L
	• Vessel Traffic	✓ Coordinate Inspection with Port Control ✓ Display Commercial Dive Alpha Flag ✓ Display Recreational Dive Flag ✓ Topside Personnel Aware of Boat Traffic	L
	• Primary Air Supply Failure	✓ Failure of the primary air supply - Diver switch over to the emergency air source. ✓ Dive operations will be terminated**.**	L
	• Loss of Communications	✓ Initiate diver locator system- lost diver buoy ✓ Attempt to establish visual contact ✓ Terminate dive operations ✓ Initiate diver recall system ✓ Dive team surface	L

AHA #4 – Activity/ Work Task: Diving Operations

Job Steps	Hazards	Controls	RAC
	• Fouled Diver • Entrapped Diver	✓ Diver must always be aware of his surroundings and avoid any hazardous situations if identified. ✓ All hazardous situations will be communicated to the dive supervisor or team leader immediately. ✓ Request Stand-by diver to assist if any problems ✓ Terminate dive operations as necessary	L
	• Carbon Monoxide Poisoning	✓ The primary air source tank to be filled at air fill stations properly tested and within purity standards as outlined in the Dive Operations Plan.	L
	• Minor Diver Injury Sick Diver	✓ Terminate dive operations ✓ Distressed diver assesses conditions ✓ Dive informs topside of condition ✓ Self-transport to medical facilities	L
	• Critical Diver Injury	✓ Terminate dive operations ✓ Distressed diver assesses conditions ✓ Diver informs topside of condition ✓ Topside initiates emergency response ✓ Standby diver deployed if necessary ✓ Stabilize Injured diver ✓ Dive team is extracted	M
	• Unconscious/ Breathing Diver • Lost Diver	✓ Initiated by loss of communications contact procedures ✓ Distressed diver remains submerged ✓ Terminate dive operations ✓ Assess distressed diver condition ✓ Initiate critical diver related injury procedures ✓ Provide Emergency Oxygen	M

AHA #4 – Activity/ Work Task: Diving Operations

Job Steps	Hazards	Controls	RAC
	• Unconscious/ Non-Breathing Diver	✓ Initiated by loss of Communications contact procedures ✓ Distressed diver remains submerged ✓ Terminate dive operations ✓ Topside initiates emergency response ✓ Locate and recover distressed diver ✓ Initiate critical diver related injury procedures ✓ Provide Emergency Oxygen	M
	• Rapid Accent • Blow Up to Surface	✓ Terminate Dive Operations ✓ Topside Initiates Emergency Response ✓ Deploy Standby Diver if necessary ✓ Recover Diver to Dive Stage ✓ Monitor Distressed Diver and Provide Emergency Oxygen	M
	• Hazardous Marine Life	✓ Wear Protective Outer-Garments (wet/ skin suits or coveralls) ✓ Wear protective gloves ✓ Avoid hazards ✓ Terminate dive operations on any imminent threats (sharks)	L
2. Deploy and recover divers to/ from the water.	• Fire hazards on boat • Falling overboard/ drowning hazards Heat Stress • Biological hazards – hazardous sea life, bees, wasps, centipedes, mosquitoes, spiders, and rodents • Sunburn • Slips, trips, and falls on boat deck. • Stability of divers on dive boat when entering and exiting the water.	✓ Be observant while walking on docks and decks ✓ Personnel will wear close toed shoes/ boots appropriately soled for working on boat decks ✓ Personnel will maintain at least three points of contact with boat during transits ✓ Divers will be paired with tenders always. Tenders will maintain positive control of divers while maneuvering around the dive boat and entering/exiting the water. ✓ All personnel trained in diving distress signals ✓ Wear personal flotation device at all time while on boat ✓ Assure fire extinguishers and first aid kit are available and operational ✓ Assure communications equipment is available and operational ✓ Heat stress monitoring, drinking water, work-rest schedule and cool shelter for breaks ✓ Training in biological hazards avoidance ✓ Use insect repellants as necessary ✓ Use sunscreen and protective clothing	L

AHA #4 – Activity/ Work Task: Diving Operations

Job Steps	Hazards	Controls	RAC
3. Deploy underwater waypoints, transects and grids	• MEC hazards • Line entanglement • Pinch Points	✓ On-site MEC Training ✓ Perform MEC operations using approved methods and techniques ✓ Ensure lines, buoys and anchors systems are deployed IAW work plan and applicable SOPs.	M
4. Diver(s) perform underwater survey	• MEC hazards • Line entanglement	✓ On-site MEC Training ✓ Perform MEC operations using approved methods and techniques ✓ Anomalies will be investigated using hand tools, without moving the MEC until it can be identified and inspected ✓ Standby diver assigned to the team will be at the ready when diver(s) are in the water ✓ MEC operations will cease if unauthorized watercraft/personnel enter the area and will be asked to leave.	M
5. Diver(s) excavate anomalies	• MEC hazards	✓ On-site MEC Training ✓ Perform MEC operations using approved methods and techniques ✓ Anomalies will be investigated using hand tools, without moving the MEC until it can be identified and inspected ✓ Standby diver assigned to the team will be at the ready when diver(s) are in the water ✓ MEC operations will cease if unauthorized watercraft/personnel enter the area. Personnel will be informed of the site hazards and of the fact that they are not authorized to be near the site operations and will be asked to leave.	H
6. Diver(s) identify and process MEC/ MPPEH	• MEC hazards	✓ On-site MEC Training ✓ Perform MEC operations using approved methods and techniques	M
7. Diver(s) and dive team extraction	• Non-secured ladder • Falling • Pinch points • No-fly safety	✓ Ladder properly secured and extending 3 feet below the water surface. ✓ Walk-in entry only ✓ Maintain three points of contact to ladder ✓ No divers between boats or objects and boats ✓ Do not place hands, feet or legs in between boats or boats and docks ✓ **12-Hour** no-flight after single dive ✓ **24-Hour** no-flight after multi-dive days	L

AHA #4 – Activity/ Work Task: Diving Operations

Job Steps	Hazards	Controls	RAC
8. Dive Team transit	• Fire • Man overboard • Dehydration • Sun Exposure • Minor Topside Injury Sickness	✓ Locate fire suppressing devices prior to dive operations ✓ Extinguish fire with fire suppressing devices ✓ All personnel don Personal Floatation Devices (PFD's) ✓ Deploy safety tender ✓ Topside exits ✓ Supply appropriate amount of water ✓ Maintain hydration ✓ Supply sunscreen w/ minimum SPF 30 ✓ Apply sunscreen ✓ Assess Injury/illness ✓ Self-transport to medical facilities if necessary	L
9. Equipment transit and maintenance	• Muscle strain • Slips, trips and falls • Heat stress • Muscle strain • Sunburn	✓ Practice safe lifting procedures ✓ Assist Team Members Lifting Heavy Objects ✓ Supply sunscreen w/ minimum SPF 30 ✓ Apply sunscreen ✓ Assess Injury/illness ✓ Self-transport to medical facilities if necessary	L

AHA #4 – Activity/ Work Task: Diving Operations

Equipment to be Used	Training Requirements/Competent or Qualified Personnel Name(s)	Inspection Requirements
- Diving Operations Plan	✓ Pre-Dive Safety Brief; SUXOS/ Diving Supervisor, UXOSO	Sign daily safety brief
- Site vehicles	✓ Drivers must have current state-issued driver's license.	Daily vehicle inspection by drivers. Receipt inspection by SSHO.
PPE: - Diving equipment as outlined in the DOP/TtEC DSPM - Footwear with rubber soles to prevent slipping - Safety toe footwear required near lifting operations - Back braces (optional) - Appropriate clothing (to include personal flotation device, canvas or leather work gloves, safety sunglasses and cap). - Hearing protection will be required if noise from boat engine or generator reaches hazardous levels. - Chemical-resistant gloves for use in fueling and MPPEH operations	✓ PPE Training ✓ UXO personnel will meet training and experience requirements outlined in DDESB TP 18. ✓ All divers are certified per EM 385-1-1 sect. 30 ✓ All personnel will demonstrate strong swimming skills. ✓ Training in hazardous tides and currents and how to handle them. ✓ Training in biological hazards. ✓ All dive team members will review and be briefed on the Dive Operations Plan, Dive SOPs, and this AHA. ✓ Site-specific training on slip, trip, and fall hazards. ✓ Site-specific training/lifting techniques. ✓ Site-specific training in use of tools and equipment. ✓ UXO Divers and tenders all emergency procedures. ✓ All site personnel will have current HAZWOPER training.	PPE inspected daily prior to use by user with additional inspections by SSO/ UXOSO. Dive Supervisor will ensure that all personnel have received appropriate training. Dive equipment inspected daily prior to use by user and Dive Supervisor. Dive Supervisor will inspect location to be used for water entry and determine depth. Dive Supervisor will inspect divers for proper tending line attachment (if required). Dive Supervisor inspects lines and floats (if required). Dive Supervisor inspects dive ladder or platform.
- Boats - White's underwater magnetometer - Shark Marine Navigation System - RTK systems - SCUBA equipment - Fuel spill kit - Fuel container	✓ UXO personnel will meet training and experience requirements outlined in DDESB TP 18 ✓ Site specific MEC training will be presented to all site personnel ✓ All personnel will have MPPEH training ✓ Equipment familiarity training ✓ Site-specific training, slip/fall hazards ✓ Site-specific training/lifting and carrying techniques ✓ All site personnel will have current HAZWOPER training ✓ Site-specific training in use of tools	UXOSO will ensure that all controls are being followed, all equipment is being correctly utilized, and all personnel have received appropriate training. Equipment inspected daily prior to use by user and UXOSO. Daily serviceability check of magnetometers by user and UXOQCS.
- Hand and power tools	✓ Training in use of hand and power tools by the SSHO or designee and review of operating manual. Use proper hand tool for the task.	Daily inspection by users/operators. Inspect tools and power cords to ensure they are listed by a NRTL. Inspect for damage to tool and to cords.
- Fire extinguishers	✓ Fire Extinguisher Training including use/limitations.	At least monthly by SSHO or designee.

AHA #4 – Activity/ Work Task: Diving Operations		
- First aid kits and emergency equipment	✓ Use of emergency equipment/first aid kits must be done by personnel familiar with this plan; use and inspection criteria of the equipment, and what the equipment is used for, are by or under direction of the SSHO.	Initially and at least weekly thereafter or after use for restocking. Eyewashes inspected weekly. Potable water changed weekly unless a preservative solution is used.

Abbreviations and Acronyms:

AOC – Area of Concern
APP – Accident Prevention Plan
CHMM – Certified Hazardous Materials Manager
CIH – Certified Industrial Hygienist
CRL – Corporate Reference Library
CSP – Certified Safety Professional
dBA – decibels, A-scale
EHS – Environmental, Health, and Safety
ESP – Explosive Site Plan
EZ – Exclusion Zone
PPE – Personal Protective Equipment
MDAS – Material Documented As Safe
MEC - Munitions and Explosives of Concern
MPPEH – Material Potentially Possessing an Explosive Hazard
SSHO – Site Safety and Health Officer
SHM – Safety and Health Manager
SUXOS – Senior UXO Supervisor
UXO – Unexploded Ordnance
UXOSO – UXO Safety Officer
UXOQCS – UXO Quality Control Specialist

AHA#4 – Diving Operations Signature Sheet

I have reviewed the above AHA and acknowledge the hazards involved with this work task and the controls that will help to minimize illness or injury during the tasks.

NAME	SIGNATURE	TITLE	DATE

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Activity Hazard Analysis (AHA) #5

Activity/ Work Task: Surface Air Delivery System (SADS) Operations	**Overall Risk Assessment Code (RAC) (Use highest code)** **M**
Project Location: Congaree River, Columbia, SC	
Contract Number:	
Date Prepared: November 2021	
Prepared by: Don Schwalback, Diving Supervisor	
Reviewed by: Scot Wilson, PM	

Risk Assessment Code (RAC) Matrix

Severity	**Probability**				
	Frequent	Likely	Occasional	Seldom	Unlikely
Catastrophic	**E**	**E**	**H**	**H**	**M**
Critical	**E**	**H**	**H**	**M**	**L**
Marginal	**H**	**M**	**M**	**L**	**L**
Negligible	**M**	**L**	**L**	**L**	**L**

Notes: (Field Notes, Review Comments, etc.)
In addition to the information listed in this AHA, all field personnel must review and be familiar with all provisions of the approved work plan. EM 385-1-1 and other regulations will also be available on-site for review of specific materials and mitigation measures.

Personal Protective Equipment for this AHA: PFD (when in transit on boat), appropriate and properly configured SADS equipment as outlined in EM385-1-1 Sect 30, high visibility safety vest and hard hat (when working with an overhead safety hazards exist), safety toed boots, safety glasses, standard work uniform (long pants, ¾ length sleeve shirt). Sun protection. Hearing protection (as required). Appropriate work gloves worn when indicated.

Step 1: Review each **"Hazard"** with identified safety **"Controls"** and determine RAC (see above).

"Probability" is the likelihood to cause an incident, near miss, or accident and is identified as Frequent, Likely, Occasional, Seldom, or Unlikely.	**RAC Chart**
"Severity" is the outcome/degree if an incident, near miss, or accident did occur and is identified as Catastrophic, Critical, Marginal, or Negligible.	**E = Extremely High Risk** **H = High Risk**
Step 2: Identify the RAC (Probability/Severity) as E, H, M, or L for each "Hazard" on the AHA. Annotate the overall highest RAC at the top of the AHA.	**M = Moderate Risk** **L = Low Risk**

AHA #5 – Activity/ Work Task: SADS Operations			
Job Steps	**Hazards**	**Controls**	**RAC**
1. Pre-operations brief, task assignments, and check equipment.	• Boating hazards • Drowning hazards • Hazardous tides or currents (rip tides, high tide, etc.) • Uneven and/or moving working surfaces of the boat – slip, trip, and fall hazards • Biological hazards – bees, wasps, mosquitoes, spiders • Weather hazards • Sunburn	✓ Boat will be equipped with rescue equipment to handle a "man overboard" situation (such as rescue hook, life ring with rope or similar equipment), and personnel trained in its use. ✓ All personnel will be familiar with emergency signal to request assistance. ✓ Personnel will wear rubber-soled shoes to prevent slipping while on boat and will avoid stepping in wet areas that could be slippery. ✓ Training in biological hazards avoidance. ✓ Use sunscreen. ✓ Weather radio and local weather will be monitored, and boat operations will be terminated should a storm be approaching or should sea conditions make it unsafe to continue. Snorkelers will return to the boat to evacuate. ✓ Emergency VHF radios will be in operating condition prior to leaving the wharf. There will be a primary and alternate means of communication, and extra batteries will be available. ✓ Be observant while in water; note, avoid, and report unsafe conditions or activities. Avoid stepping on coral or sharp underwater objects. ✓ Determine types of hazardous aquatic life found in this location from local marine, police or lifeguard headquarters. ✓ Training in biological hazards avoidance. ✓ Use insect repellents as necessary. ✓ Use PPE IAW this AHA. ✓ Local weather will be monitored, and boat operations will be terminated should a storm or sea conditions make it unsafe to continue. ✓ Determine areas where hazardous tasks, tides, or currents may be present and times of day or conditions likely to cause them from local marine or harbor police or lifeguard headquarters. Training in how to safely handle these circumstances. ✓ Wear protective clothing and use sunscreen.	**L**

AHA #5 – Activity/ Work Task: SADS Operations

Job Steps	Hazards	Controls	RAC
2. Transit boat to SADS operations area.	• Boating hazards • Drowning hazards • Hazardous tides or currents (rip tides, high tide, etc.) • Uneven and/or moving working surfaces of the boat – slip, trip, and fall hazards • Biological hazards (land) – bees, wasps, mosquitoes, spiders • Biological hazards (water) – Box Jellyfish, sharks, barracuda, corals and sting rays • Weather hazards • Sunburn	✓ Boat will be equipped with rescue equipment to handle a "man overboard" situation (such as rescue hook, life ring with rope or similar equipment), and personnel trained in its use. ✓ Emergency VHF radios will be in operating condition prior to leaving the wharf. There will be a primary and alternate means of communication, and extra batteries will be available. ✓ Determine types of hazardous aquatic life found in this location from local marine or harbor police or lifeguard headquarters. ✓ All passengers will wear a personal flotation device while on the boat with boat in transit to work station. ✓ Passengers will remain seated while boat is in motion and keep all extremities inside boat. ✓ Use PPE IAW this AHA. ✓ Determine areas where hazardous tasks, tides, or currents may be present and times of day or conditions likely to cause them from local marine or harbor police or lifeguard headquarters. Training in how to safely handle these circumstances. ✓ Weather radio and local weather will be monitored, and boat operations will be terminated should a storm or sea conditions make it unsafe to continue. Snorkelers will return to the boat to evacuate. ✓ All personnel will be familiar with emergency signal to request assistance. ✓ Personnel will wear rubber-soled shoes to prevent slipping while on boat and will avoid stepping in wet areas that could be slippery. ✓ Training in biological hazards avoidance. ✓ Use insect repellents as necessary. ✓ Wear protective clothing and use sunscreen.	**M**

3. Perform SADS operations.	• Underwater MEC hazards • Weather hazards • Sunburn • Drowning • Underwater hazards from stepping on coral or other sharp underwater objects • Biological hazards (water) – box jellyfish, sharks, barracudas, sea urchins, corals and stingrays • Hazardous tides or currents (rip tides, high tide, etc.)	✓ On-site MEC Training. ✓ Perform MEC avoidance measures using approved methods and techniques. ✓ Standby safety swimmer assigned to the team will be at the ready when snorkelers are in the water. ✓ All personnel will be familiar with emergency signal to request assistance. ✓ Boat will be equipped with rescue equipment to handle a "man overboard" situation (such as rescue hook, life preserver with rope, or similar equipment) ✓ Personal flotation devices will be worn during boat transit and during inclement weather and will be readily available and accessible at all other times while on boat. ✓ The snorkelers must be escorted by a boat. The boat, when in waters deeper than 5 feet, must remain within 50 ft of the snorkelers ✓ Two snorkelers will work as both observer/assistants to each other and will remain within 50 ft of each other ✓ Snorkelers must wear a device providing a minimum of 15.5 pounds (7 kg) of positive buoyancy (Type III personnel flotation device (PFD), fully inflated SADS vest, etc.). ✓ A throw device that can reach out to 70 feet is available on the boat for emergencies ✓ Areas of extreme water velocity and turbulence will be avoided ✓ Emergency VHF radios will be in operating condition prior to leaving the wharf. There will be a primary and alternate means of communication, and extra batteries will be available. ✓ Be observant while in water; note, avoid, and report unsafe conditions or activities. Avoid stepping on coral or sharp underwater objects. ✓ Determine types of hazardous aquatic life found in this location from local marine or harbor police or lifeguard headquarters. ✓ Training in biological hazards avoidance: If sharks are a hazard in this area, operations will not occur at dawn or at dusk, when they are most likely to be feeding. Personnel will be observant for schools of bait fish on which sharks feed and leave the area immediately if sighted No flashing jewelry will be worn. ✓ Weather radio and local weather will be monitored, and boat operations will be terminated should a storm or sea conditions make it unsafe. ✓ Determine areas where hazardous tasks, tides or currents may be present and times of day or conditions likely to cause them from local marine or police or lifeguard headquarters. ✓ Training in how to safely handle these circumstances. ✓ Be observant while walking. ✓ Use dive booties and fins to protect feet. ✓ Use PPE IAW this AHA. ✓ Use sunscreen and protective clothing.	**M**

AHA #5 – Activity/ Work Task: SADS Operations

Job Steps	Hazards	Controls	RAC
4. Recover operators and return to shop.	• MEC hazards • Boating Hazards • Biological hazards (land) – bees, wasps, mosquitoes, spiders, • Biological Hazards (water) - box jellyfish, sharks, barracudas, sea urchins and stingrays • Hazardous tides or currents (rip tides, high tide, etc.) • Uneven and/or moving working surfaces of the boat – slip, trip, and fall hazards • Sunburn • Weather hazards • Heat stress	✓ Boat will be equipped with rescue equipment to handle a "man ✓ overboard" situation (such as rescue hook, life ring with rope or similar equipment) ✓ Personal flotation devices will be worn during boat transit and during inclement weather and will be readily available and accessible at all other times while on boat. ✓ Emergency VHF radios will be in operating condition prior to leaving the wharf. There will be a primary and alternate means of communication, and extra batteries will be available. ✓ Determine types of hazardous aquatic life found in this location from local marine or harbor police or lifeguard headquarters. Training in biological hazards avoidance. ✓ Determine areas where hazardous tasks, tides. or currents may be present and times of day or conditions likely to cause them from local marine or harbor police or lifeguard headquarters. Training in how to safely handle these circumstances. ✓ Training in biological hazards avoidance: If sharks are a hazard in this area, operations will not occur at dawn or at dusk, when they are most likely to be feeding. Personnel will be observant for schools of bait fish on which sharks feed and leave the area immediately if sighted No flashing jewelry will be worn. ✓ Personnel will wear rubber-soled shoes to prevent slipping while on boat and will avoid stepping in wet areas that could be slippery. ✓ Use PPE IAW this AHA. ✓ Use sunscreen. ✓ Weather radio and local weather will be monitored, and boat operations will be terminated should a storm be approaching or should sea conditions make it unsafe to continue. ✓ Heat stress monitoring, drinking water, work-rest schedule, and cool ✓ shelter for breaks.	

AHA #5 – Activity/ Work Task: SADS Operations

Equipment to be Used	**Training Requirements/Competent or Qualified Personnel Name(s)**	**Inspection Requirements**
- Diving Operations Plan	• Pre-Dive Safety Brief; SUXOS/ Diving Supervisor, UXOSO	✓ Sign daily safety brief
- Site vehicles	• Drivers must have current state-issued driver's license.	✓ Daily vehicle inspection by drivers. Receipt inspection by SSHO.
PPE: - SADS equipment as outlined in the DOP/TtEC DSPM - Footwear with rubber soles to prevent slipping - Safety toe footwear required near lifting operations - Back braces (optional) - Appropriate clothing (to include personal flotation device, canvas or leather work gloves, safety sunglasses and cap). - Hearing protection will be required if noise from boat engine or generator reaches hazardous levels. - Chemical-resistant gloves for use in fueling and MPPEH operations	• PPE Training • UXO personnel will meet training and experience requirements outlined in DDESB TP 18. • All divers are certified per EM 385-1-1 sect. 30 • Training in hazardous tides and currents and how to handle them. • Training in biological hazards. • All dive team members will review and be briefed on the Dive Operations Plan, Dive SOPs, and this AHA. • Site-specific training on slip, trip, and fall hazards. • Site-specific training/lifting techniques. • Site-specific training in use of tools and equipment. • All dive team members have training on emergency procedures. • All site personnel will have current HAZWOPER training.	✓ PPE inspected daily prior to use by user with additional inspections by SSO/ UXOSO. ✓ Dive Supervisor will ensure that all personnel have received appropriate training. ✓ Dive equipment inspected daily prior to use by user and Dive Supervisor. ✓ Dive Supervisor will inspect location to be used for water entry and determine depth. ✓ Dive Supervisor will inspect divers for proper tending line attachment (if required). ✓ Dive Supervisor inspects lines and floats (if required). ✓ Dive Supervisor inspects dive ladder or platform.
- Boats - White's underwater magnetometer - RTK systems - SADS equipment - Fuel spill kit - Fuel container	• UXO personnel will meet training and experience requirements outlined in DDESB TP 18 • Site specific MEC training will be presented to all site personnel • All personnel will have MPPEH training • Equipment familiarity training • Site-specific training, slip/fall hazards • Site-specific training/lifting and carrying techniques • All site personnel will have current HAZWOPER training • Site-specific training in use of tools	✓ UXOSO will ensure that all controls are being followed, all equipment is being correctly utilized, and all personnel have received appropriate training. ✓ Equipment inspected daily prior to use by user and UXOSO. ✓ Daily serviceability check of magnetometers by user and UXOQCS.
- Hand and power tools	• Training in use of hand and power tools by the SSHO or designee and review of operating manual. Use proper hand tool for the task.	✓ Daily inspection by users/operators. Inspect tools and power cords to ensure they are listed by a NRTL. Inspect for damage to tool and to cords.
- Fire extinguishers	• Fire Extinguisher Training including use/limitations.	✓ At least monthly by SSHO or designee.

AHA #5 – Activity/ Work Task: SADS Operations

- First aid kits and emergency equipment	• Use of emergency equipment/first aid kits must be done by personnel familiar with this plan; use and inspection criteria of the equipment, and what the equipment is used for, are by or under direction of the SSHO.	✓ Initially and at least weekly thereafter or after use for restocking. Eyewashes inspected weekly. Potable water changed weekly unless a preservative solution is used.

Abbreviations and Acronyms:

AOC – Area of Concern
APP – Accident Prevention Plan
CHMM – Certified Hazardous Materials Manager
CIH – Certified Industrial Hygienist
CRL – Corporate Reference Library
CSP – Certified Safety Professional
dBA – decibels, A-scale
EHS – Environmental, Health, and Safety
ESP – Explosive Site Plan
EZ – Exclusion Zone
PPE – Personal Protective Equipment
MDAS – Material Documented As Safe
MEC - Munitions and Explosives of Concern
MPPEH – Material Potentially Possessing an Explosive Hazard
SSHO – Site Safety and Health Officer
SHM – Safety and Health Manager
SUXOS – Senior UXO Supervisor
UXO – Unexploded Ordnance
UXOSO – UXO Safety Officer
UXOQCS – UXO Quality Control Specialist

AHA #5 – SADS Operations Signature Sheet

I have reviewed the above AHA and acknowledge the hazards involved with this work task and the controls that will help to minimize illness or injury during the tasks.

NAME	SIGNATURE	TITLE	DATE

Activity Hazard Analysis (AHA) #6

Activity/ Work Task: Underwater Anomaly Reacquisition and Intrusive Investigation

Project Location: Congaree River, Columbia, SC

Contract Number:

Date Prepared: November 2021

Prepared by: Don Schwalback, Diving Supervisor

Reviewed by: Scot Wilson, PM

Overall Risk Assessment Code (RAC) (Use highest code)	**M**

Risk Assessment Code (RAC) Matrix

Severity	**Probability**				
	Frequent	Likely	Occasional	Seldom	Unlikely
Catastrophic	**E**	**E**	**H**	**H**	**M**
Critical	**E**	**H**	**H**	**M**	**L**
Marginal	**H**	**M**	**M**	**L**	**L**
Negligible	**M**	**L**	**L**	**L**	**L**

Notes: (Field Notes, Review Comments, etc.)

In addition to the information listed in this AHA, all field personnel must review and be familiar with all provisions of the approved work plan. EM 385-1-1 and other regulations will also be available on-site for review of specific materials and mitigation measures.

Personal Protective Equipment for this AHA: PFD (when in transit on boat), appropriate and properly configured diving equipment as outlined in EM385-1-1 Sect 30, high visibility safety vest and hard hat (when working with an overhead safety hazards exist), safety toed boots, safety glasses, standard work uniform (long pants, ¾ length sleeve shirt). Sun protection. Hearing protection (as required). Appropriate work gloves worn when indicated.

Step 1: Review each **"Hazard"** with identified safety **"Controls"** and determine RAC (see above).

	RAC Chart
"Probability" is the likelihood to cause an incident, near miss, or accident and is identified as Frequent, Likely, Occasional, Seldom, or Unlikely.	
"Severity" is the outcome/degree if an incident, near miss, or accident did occur and is identified as Catastrophic, Critical, Marginal, or Negligible.	**E = Extremely High Risk** **H = High Risk**
Step 2: Identify the RAC (Probability/Severity) as E, H, M, or L for each "Hazard" on the AHA. Annotate the overall highest RAC at the top of the AHA.	**M = Moderate Risk** **L = Low Risk**

AHA #6 – Activity/ Work Task: Underwater Anomaly Reacquisition and Intrusive Investigation

Job Steps	Hazards	Controls	RAC
1. Intrusive anomaly investigation will occur in areas with high anomaly densities. Using underwater man portable magnetometers to reacquire anomalies	• Underwater MEC hazards • Uneven and/or moving working surfaces of the boat • Slip, trip, and fall hazards • Back strain from carrying equipment • Heat stress • Biological hazards – bees, wasps, mosquitoes, spiders • Sunburn • Falling overboard/drowning • Weather hazards	✓ On-site MEC training. ✓ Personnel will wear rubber-soled shoes to prevent slipping while on boat and will avoid stepping in wet areas that could be slippery. ✓ Follow appropriate lifting/carrying procedures: Lift with legs; maintain footing; use gloves for firm grip; never lift more than you can safely handle. ✓ Heat stress monitoring, drinking water, work-rest schedule, and cool shelter for breaks. ✓ Training in biological hazards avoidance. ✓ Use insect repellents as necessary. ✓ Use PPE IAW this AHA. ✓ Use sunscreen and wear protective clothing. ✓ Boat will be equipped with rescue equipment to handle a "man overboard" situation (such as life ring with rope or similar equipment), and personnel trained in its use. ✓ Local weather will be monitored, and boat operations will be terminated should a storm or sea conditions make it unsafe to continue.	**L**
2. SCUBA or SADS will perform an instrument aided survey of the preselected targets and jack stay search patterns. 3. UXO-qualified divers investigate anomalies using hands and hand tools. 4. Non-MEC metal items will be brought to the surface for collection and sent to a qualified recycler at the end of project operations.		✓ On-site MEC Training. ✓ Perform MEC avoidance measures using approved methods and techniques. ✓ All divers are certified per EM 385-1-1. ✓ Review specific hazards and controls located in the Dive Plan. ✓ Review SOPs as related to current task, assignment, or pre-, during, and post-dive activities. ✓ Accurately determine water depth. ✓ If water less than 6 feet, ease diver over side versus roll-off entry. ✓ Check for object on surface or near entry point. ✓ Ensure dive partner is clear of entry point. ✓ Ensure vessel engine is in neutral or turned off. ✓ Standby diver assigned to the team will be at the ready when divers are in the water. Tender will be aware of diver's movement. ✓ Walk line around boat passing line under anchor line. ✓ All personnel trained in diving distress signals.	**M**

5. MPPEH will be inspected by two UXO Technicians and MDAS will be brought to the surface for collection and sent to a qualified recycler at the end of project operations. 6. MEC that is acceptable to move will placed in a designated consolidation area to be further transported to a designated disposal location on shore, where a MEC treatment will occur. 7. MEC that is not acceptable to move will be marked and determination made to which mechanized operation will be performed. (High or low input).	• MEC hazards • Drowning hazards • Boating hazards • Underwater hazards from stepping on coral or other sharp underwater objects • Biological hazards • Hazardous tides or currents (rip tides, high tide, etc.) • Diving-related illnesses • Diver impact with bottom • Impact with unseen objects • Impact with dive partner • Fouled/Entangled diver • Tending line/witness float line fouled in prop • Limited visibility • Lost diver • Loss of air • Decompression sickness and Arterial Gas Embolism	✓ Boat will be equipped with rescue equipment to handle a "man overboard" situation (such as rescue hook, life preserver with rope, or similar equipment). ✓ Dive Supervisor equipped with rescue equipment and First Aid supplies and equipment. ✓ Personal flotation devices will be worn during boat transit and during inclement weather and will be readily available and accessible at all other times while on boat. ✓ Emergency VHF radios will be in operating condition prior to leaving the wharf. There will be a primary and alternate means of communication, and extra batteries will be available. ✓ Be observant while in water; note, avoid, and report unsafe conditions or activities. Avoid stepping on coral or sharp underwater objects. Terminate the dive should conditions warrant. ✓ Determine types of hazardous aquatic life found in this location from local marine or harbor police or lifeguard headquarters. Training in biological hazards avoidance. ✓ Personnel will be observant for schools of bait fish on which sharks feed and leave the area immediately if sighted No flashing jewelry will be worn. ✓ Determine areas where hazardous tasks, tides, or currents may be present and times of day or conditions likely to cause them from local marine or harbor police or lifeguard headquarters. Training in how to safely handle these circumstances. If currents exceed 1 knot, the dive will be terminated until the speed of the current subsides. ✓ If a diver becomes fouled, diver and/or dive partner will assist to free diver. ✓ Standby diver may be deployed if situation warrants. ✓ <u>Topside actions for lost diver:</u> Initiate emergency recall. Identify GPS coordinates of the last known location of the diver. Mark last known location with anchor and buoy. ✓ Divers underwater should look in 360º to look for dive partner. Diver will surface if dive partner cannot be seen. Dive Supervisor will deploy the Standby diver to aid in search of missing diver. ✓ If breathing resistance occurs on the bottom, surface immediately, using controlled ascent. ✓ If out of air completely, go onto emergency air from bail-out bottle. ✓ Divers will surface when primary air reaches 500 PSIG. ✓ Alternative method is to "Buddy Breath" with dive partner. ✓ Adhere to No D tables to prevent decompression sickness. ✓ Divers will be required to remain in sight of each other always, during and after dive. ✓ Divers will not investigate anomalies unless there is suitable visibility.	

AHA #6 – Activity/ Work Task: Underwater Anomaly Reacquisition and Intrusive Investigation

Job Steps	Hazards	Controls	RAC
		✓ Dive team to maintain neutral buoyancy as much as possible to remain above seabed. ✓ Divers plan to approach anomaly from down-current side to prevent unintended contact. ✓ Divers photograph and video anomaly on surface of sea floor in a manner that equipment does not strike the anomaly. ✓ Diver will perform excavation by hand of anomalies in the sand bottom. Use diver discipline to maintain neutral buoyancy. ✓ Divers will wait at least 12 hours before flying after any dive. This will be extended to 24 hours following multiple days of repetitive dives.	

AHA #6 – Activity/ Work Task: Underwater MEC Investigation

Equipment to be Used	Training Requirements/Competent or Qualified Personnel Name(s)	Inspection Requirements
- Diving Operations Plan	• Pre-Dive Safety Brief; SUXOS/ Diving Supervisor, UXOSO	✓ Sign daily safety brief
- Site vehicles	• Drivers must have current state-issued driver's license.	✓ Daily vehicle inspection by drivers. Receipt inspection by SSHO.
PPE: - Diving equipment as outlined in the DOP/TMR DSPM - Footwear with rubber soles to prevent slipping - Safety toe footwear required near lifting operations - Back braces (optional) - Appropriate clothing (to include personal flotation device, canvas or leather work gloves, safety sunglasses and cap). - Hearing protection will be required if noise from boat engine or generator reaches hazardous levels. - Chemical-resistant gloves for use in fueling and MEC operations	• PPE Training • UXO personnel will meet training and experience requirements outlined in DDESB TP 18. • All divers are certified per EM 385-1-1 sect. 30 • All personnel will demonstrate strong swimming skills. • Training in hazardous tides and currents and how to handle them. • Training in biological hazards. • All dive team members will review and be briefed on the Dive Operations Plan, Dive SOPs, and this AHA. • Site-specific training on slip, trip, and fall hazards. • Site-specific training/lifting techniques. • Site-specific training in use of tools and equipment. • UXO Divers and tenders all emergency procedures. • All site personnel will have current HAZWOPER training.	✓ PPE inspected daily prior to use by user with additional inspections by SSO/ UXOSO. ✓ Dive Supervisor will ensure that all personnel have received appropriate training. ✓ Dive equipment inspected daily prior to use by user and Dive Supervisor. ✓ Dive Supervisor will inspect location to be used for water entry and determine depth. ✓ Dive Supervisor will inspect divers for proper tending line attachment (if required). ✓ Dive Supervisor inspects lines and floats (if required). ✓ Dive Supervisor inspects dive ladder or platform.
- Boats - Communications equipment - White's underwater magnetometer - Shark Marine Navigation System - RTK systems - SCUBA equipment - Fuel spill kit - Fuel container	• UXO personnel will meet training and experience requirements outlined in DDESB TP 18 • Site specific MEC training will be presented to all site personnel • All personnel will have MPPEH training • Equipment familiarity training • Site-specific training, slip/fall hazards • Site-specific training/lifting and carrying techniques • All site personnel will have current HAZWOPER training • Site-specific training in use of tools	✓ UXOSO will ensure that all controls are being followed, all equipment is being correctly utilized, and all personnel have received appropriate training. ✓ Equipment inspected daily prior to use by user and UXOSO. ✓ Daily serviceability check of magnetometers by user and UXOQCS.
- Hand and power tools	• Training in use of hand and power tools by the SSHO or designee and review of operating manual. Use proper hand tool for the task.	✓ Daily inspection by users/operators. ✓ SSHO inspect tools and power cords to ensure they are listed by a NRTL. ✓ Inspect for damage to tool and to cords.

Abbreviations and Acronyms:

AOC – Area of Concern
APP – Accident Prevention Plan
CHMM – Certified Hazardous Materials Manager
CIH – Certified Industrial Hygienist
CRL – Corporate Reference Library
CSP – Certified Safety Professional
dBA – decibels, A-scale
EHS – Environmental, Health, and Safety
ESP – Explosive Site Plan
EZ – Exclusion Zone
PPE – Personal Protective Equipment
MDAS – Material Documented As Safe
MEC - Munitions and Explosives of Concern
MPPEH – Material Potentially Possessing an Explosive Hazard
SSHO – Site Safety and Health Officer
SHM – Safety and Health Manager
SUXOS – Senior UXO Supervisor
UXO – Unexploded Ordnance
UXOSO – UXO Safety Officer
UXOQCS – UXO Quality Control Specialist

AHA #6 – Underwater MEC Investigation Signature Sheet

I have reviewed the above AHA and acknowledge the hazards involved with this work task and the controls that will help to minimize illness or injury during the tasks.

NAME	SIGNATURE	TITLE	DATE

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Activity Hazard Analysis (AHA) #7

<table>
<tr><td>Activity/ Work Task: Demobilization and Site Restoration (Diving Ops)</td><td colspan="5">Overall Risk Assessment Code (RAC) (Use highest code)</td><td>M</td></tr>
<tr><td>Project Location: Congaree River, Columbia, SC</td><td colspan="6">Risk Assessment Code (RAC) Matrix</td></tr>
<tr><td>Contract Number:</td><td rowspan="2">Severity</td><td colspan="5">Probability</td></tr>
<tr><td>Date Prepared: November 2021</td><td>Frequent</td><td>Likely</td><td>Occasional</td><td>Seldom</td><td>Unlikely</td></tr>
<tr><td rowspan="2">Prepared by: Don Schwalback, Diving Supervisor</td><td>Catastrophic</td><td>E</td><td>E</td><td>H</td><td>H</td><td>M</td></tr>
<tr><td>Critical</td><td>E</td><td>H</td><td>H</td><td>M</td><td>L</td></tr>
<tr><td rowspan="2">Reviewed by: Scot Wilson, PM</td><td>Marginal</td><td>H</td><td>M</td><td>M</td><td>L</td><td>L</td></tr>
<tr><td>Negligible</td><td>M</td><td>L</td><td>L</td><td>L</td><td>L</td></tr>
<tr><td rowspan="6">Notes: (Field Notes, Review Comments, etc.)
In addition to the information listed in this AHA, all field personnel must review and be familiar with all provisions of the approved work plan. EM 385-1-1 and other regulations will also be available on-site for review of specific materials and mitigation measures.
Personal Protective Equipment for this AHA will consist of high visibility safety vest (in traffic areas) and hard hat (when working around heavy equipment and/or an overhead safety hazards exist), safety toed boots, safety glasses with side shields, standard work uniform (long pants, ¾ length sleeve shirt). Hearing protection (as required). Work gloves worn when indicated.</td><td colspan="6">Step 1: Review each “Hazard” with identified safety “Controls” and determine RAC (see above).</td></tr>
<tr><td colspan="4">“Probability” is the likelihood to cause an incident, near miss, or accident and is identified as Frequent, Likely, Occasional, Seldom, or Unlikely.</td><td colspan="2">RAC Chart</td></tr>
<tr><td colspan="4" rowspan="2">“Severity” is the outcome/degree if an incident, near miss, or accident did occur and is identified as Catastrophic, Critical, Marginal, or Negligible.</td><td colspan="2">E = Extremely High Risk</td></tr>
<tr><td colspan="2">H = High Risk</td></tr>
<tr><td colspan="4" rowspan="2">Step 2: Identify the RAC (Probability/Severity) as E, H, M, or L for each “Hazard” on the AHA. Annotate the overall highest RAC at the top of the AHA.</td><td colspan="2">M = Moderate Risk</td></tr>
<tr><td colspan="2">L = Low Risk</td></tr>
</table>

AHA #7 – Activity/ Work Task: Demobilization and Site Restoration (Dive Ops)

Job Steps	**Hazards**	**Controls**	**RAC**
1. Arrival at Location	• Lack of emergency preparedness and health and safety (general) before beginning work	✓ SSHO to locate the emergency hospital and ensure routes are correct as shown in approved WP. ✓ Conduct site orientation with the crew involved in demobilization tasking including establishment of laydown areas, packing, loading and staging of materials and equipment and haul routes ✓ Review the APP and this AHA, and the Emergency Response Plan and document the training. ✓ Ensure communications are established and working properly among team members. ✓ Develop a plan for demobilization organization and tasking and emphasize communication ✓ Ensure emergency and basic safety equipment and PPE is located and available for use prior to starting site work. ✓ Use buddy system. ✓ SSHO will have site workers fill out medical data sheets that are included in an appendix to the APP ✓ Post the emergency evacuation routes and procedures as well as emergency contact list in a designated location until a permanent location is established at the field office trailer.	**L**
2. Loading and staging of materials and equipment for outbound shipment including site office/shop.	• Vehicle operations from TMR or other tenant operations and vendors could cause injury to personnel or others onsite	✓ Workers operating company or subcontractor vehicles will have a valid state issued driver’s license and will be appropriately badged and cleared for entry per Installation requirements prior to entry. ✓ Any Commercial Driver’s License (CDL) truck and trailers will be operated by CDL qualified drivers. ✓ Operate at safe speeds and obey local and facility-required traffic speeds (no more than 25 M.P.H.) and additional rules and restrictions to follow while on facility. ✓ Wear seat belt always when vehicle is in operation. ✓ Use chocks when parked on inclines. ✓ When motor vehicle except for auxiliary operation, is left unattended (operator is beyond 25 feet of view of vehicle), turn off the ignition, put the transmission in gear (park) and apply the parking brake. ✓ Yield the right-of-way to any emergency vehicles displaying a flashing light. Pull to right edge of road and stop until the approaching vehicle passes. Obey all signs. Yield to pedestrians. ✓ Use dedicated spotter and standard hand signals for backing operations.	**L**

AHA #7 – Activity/ Work Task: Demobilization and Site Restoration (Dive Ops)			
Job Steps	**Hazards**	**Controls**	**RAC**
		✓ Wear class 2 high visibility vest when working around operating vehicle traffic.	
	• Ergonomic hazards such as sprains, strains, or back injury from lifting or repetitive actions	✓ Use mechanical lifting equipment or team lift when possible rather than by hand and tool methods. ✓ Do not bend at the waist, bend at the knees. ✓ Do not twist and turn while lifting. Keep the load centered and close to body. ✓ Do not lift more than 50 pounds (may be lesser for some workers) alone. ✓ Rotate tasks and take breaks when performing repetitive tasks and try to find the best position possible to perform the task.	
	• Slips, trips, and falls could lead to injuries	✓ Keep work areas free of debris and equipment in work paths. ✓ Follow good housekeeping in work areas. ✓ Correct hazards when seen, such as holes or other trip hazards. ✓ Conspicuously mark trip hazards that cannot be corrected ✓ The site trailer will be cribbed in level position. ✓ Tie down of the trailer will comply with EM 385 1-1, Section 04.A.03 requirements.	**M**
	• Handling sharp objects or using hand tools or knives could cause cuts, punctures, or scrapes	✓ Wear work gloves when handling materials that may be sharp or have sharp edges. ✓ Be familiar with the proper use and limitations of hand tools. ✓ Report even minor injuries to your supervisor for evaluation. ✓ Have a first aid kit available and have a minimum of 2 persons with first aid and CPR training onsite ✓ Ensure knives are folding type or have retractable blades.	**L**
	• Worker exposure to extreme temperatures and sunburn.	✓ Properly dress for the weather. ✓ SSHO to monitor weather and implement heat stress and cold stress controls as specified in the APP. ✓ Provide breaks for personnel to get either into cool (heat stress) or warm (cold stress) environment. ✓ Encourage a steady work pace. ✓ Ensure adequate potable drinking water is available. ✓ Know the signs and symptoms of exposure and keep an eye on your partner. ✓ SSHO to implement EHS 4-6, Temperature Extremes.	**L**
	• Severe weather can cause unsafe working conditions	✓ SSHO will monitor weather forecast at a minimum of two times per day or more.	**L**

AHA #7 – Activity/ Work Task: Demobilization and Site Restoration (Dive Ops)

Job Steps	Hazards	Controls	RAC
		✓ Outdoor work will cease during extreme weather conditions, such as electrical storms, high wind, heavy rain and extreme temperatures that present unsafe working conditions. ✓ Shut all equipment down when lightning is visible and wait for "all-clear" from the SSHO (30/30 rule). Take cover indoors or in vehicle or heavy equipment cab (fully enclosed cab only).	
	• Eye injuries from dust or debris or struck by	✓ Wear safety glasses with side shields always when working. ✓ If something enters the eye, do not rub. ✓ Set up portable eyewash for flushing of eye to try to remove object. Notify supervisor so eye can be monitored. ✓ If object still irritates or stays in the eye, seek medical attention as soon as possible. Follow up with eye exam is recommended any time an object gets into an eye since it is necessary to ensure object does not remain, even if it cannot be felt. ✓ To keep dust down, travel at slower speeds on unpaved roads and laydown areas. ✓ If required, water mist can be used to control dust on roads and in laydown areas.	**L**
	• Wind could make materials hard to handle	✓ Avoid handling materials that could respond like a sail (e.g., plywood) in wind. ✓ Position vehicles so that doors do not get caught by the wind when opened. ✓ Hang onto door when opening and closing in high wind. ✓ Open and close doors carefully in the wind and only open one door at a time.	**L**
	• Noise could cause hearing loss and make it hard to communicate	✓ Hearing protection is required when sound levels exceed 84 dBA continuously. ✓ This rule applies to personnel working near or on heavy equipment and any other sources of loud noise. ✓ Generators, if used will be quiet in operation or will be shielded to minimize noise generation in common work areas so that hearing protection is not required to work in the area.	M
	• Lack of proper illumination in work areas could cause hazards to not be recognized or eye strain	✓ During demobilization, if lighting is not yet set up, temporary lighting such as portable bright lumen flashlights may be necessary if ambient lighting is not sufficient, especially within the trailer. ✓ Work during daylight hours or provide adequate lighting source for work areas as specified in the APP Night Operations Lighting Plan (currently limited to	L

AHA #7 – Activity/ Work Task: Demobilization and Site Restoration (Dive Ops)

Job Steps	Hazards	Controls	RAC
		daylight hours only) to minimize potential for injuries to occur from lack of visibility.	
	• Fall hazards (falls from heights of 6 feet or greater)	✓ Utilize fall protection when working at heights 6' or greater. ✓ Ensure ladders are stable and secured appropriately. ✓ Utilize 3 points of contact when ascending/descending ladders, stairs, equipment, etc. ✓ SSHO to identify site fall hazards and ensure appropriate controls are in place if workers could be exposed to a fall.	M
	• Head injuries from struck by or falling objects	✓ Wear hard hat when overhead hazards exist and when working in areas with operating construction equipment. ✓ Do not position under any suspended load at any time.	M
	• Contact with biting or stinging insects.	✓ Wear long sleeve shirts and long pants in areas where contact with mosquitos may occur. ✓ Use Environmental Protection Agency (EPA)-registered insect repellents with one of the following active ingredients: – DEET, picaridin, IR3535, oil of lemon eucalyptus or para-menthane-diol, or 2-undecanone. – Always follow the product label instructions. ✓ Workers will exercise caution when working in brushy or grassy areas, wood or debris piles, and recessed areas. ✓ Site orientation will include briefing on biological hazards associated with insects as well as local hazardous flora and fauna, signs and symptoms of exposure and precautions to take. ✓ Workers with allergies will let the SSHO know using the medical data sheet and will carry their own prescription medication as applicable. ✓ First aid and medical attention as required. Report any bites, stings, or rashes to the SSHO.	L
	• Electrical hazards could be present during tool use or during hookup of trailer	✓ Ensure that a certified electrician performs all electrical work to hook up office trailer to electrical power source. ✓ Electrician to properly ground systems in accordance with electrical code. ✓ Ensure that power cords are inspected and in good condition for use, that GFCIs are used properly, and portable generators are not overloaded. ✓ Ensure any power tools used are in good working condition and have third prong on cord or are double insulated.	L

AHA #7 – Activity/ Work Task: Demobilization and Site Restoration (Dive Ops)

Job Steps	Hazards	Controls	RAC
		✓ All live work requires arc flash protection. ✓ Contact SHM if there will be any live work so that additional precautions can be identified and incorporated into this AHA.	
	• Injury from improper use of power and hand tools	✓ Maintain steady pace when using tools and take adequate rest periods. ✓ Use appropriate tools for the task and maintain tools in good condition. ✓ Wear leather work gloves when using tools. ✓ Avoid working too close to other workers. ✓ Inspect all tools for damage before each use, including electrical cords/ pneumatic hoses. ✓ Ensure double insulation on electrical tools. ✓ Train personnel in the proper use of hand tools. ✓ GFCI required for all connections to outdoor use of power tool and other electrical equipment insulation.	M
	• Refueling of equipment use could present fire hazards or spills	✓ Only use a UL rated, National Fire Protection Association-approved fuel tanks and fuel transfer hoses. ✓ A minimum 60:BC fire extinguisher will be set up and staged within 50 feet of the fueling area and tank ✓ No smoking at any location unless specifically approved by the SS and SSHO and Installation requirements. ✓ Signage will be posted as flammable and no open flame. ✓ There are no matches or other flame producing materials allowed in the Restricted Area unless specifically permitted. ✓ Spill kit will be available in the refueling area (sorbent pads, kitty litter, gloves, waste bag). Fueling will be done over a secondary containment device to catch incidental fuel in case of overflow or drips. ✓ Operator will be present and have positive control on dispensing of fuel during filling operations at all times and a means to stop the flow of fuel. ✓ Tanks will be able to be monitored to gauge fuel level to prevent overfilling. ✓ Generators, if used will be equipped with mufflers/spark arresters. ✓ If mobile equipment or tools are refueled, the equipment will be turned off and allowed to cool prior to refueling.	L
	• Dry vegetation may be present and presents a potential fire hazard	✓ No smoking at any location except as specifically designated as smoking areas by the SS and as per Installation requirements. ✓ Do not refuel equipment in vegetated areas.	L

AHA #7 – Activity/ Work Task: Demobilization and Site Restoration (Dive Ops)

Job Steps	Hazards	Controls	RAC
		✓ No spark producing tasks or any other open flame tasks in areas of vegetation and not without a Hot Work Permit issued by the SSHO and removal of combustible materials including dry vegetation first. ✓ No spark producing tasks or flame producing equipment allowed in the Restricted Area.	
3. Backing of vehicles	• Failure of proper backing can cause struck by and pinch point injuries or property damage.	✓ Use spotters for all backing operations. ✓ Ensure spotter stands in line of sight of the person backing the vehicle. ✓ All personnel who back a trailer are trained and qualified to do so and are designated by the PM for such activities. ✓ Use boat checklist in APP prior to launching boat. ✓ Verify understanding of hand signals used for backing, going forward, stopping, and turning left or right. ✓ Use parking brake and ensure operator is not moving vehicle before unhitching boat from trailer. ✓ Follow EHS 6-6, Boating Procedure. ✓ Ground personnel involved in backing operations will wear class 2 high visibility vest.	M

AHA #7 – Activity/ Work Task: Demobilization and Site Restoration (Dive Ops)

Equipment to be Used	**Training Requirements/Competent or Qualified Personnel Name(s)**	**Inspection Requirements**
Site vehicles	Drivers must have current state-issued driver's license.	Daily vehicle inspection by drivers. Receipt inspection by SSHO.
Boats	Qualified Operators will have USCG approved boater safety qualifications identified in the APP and experience in use of the boats on the project.	Inspect daily, and before use. Use the boating checklist form. Follow procedures in EHS 6-6, Boating Procedure
Hand and power tools	Training in use of hand and power tools by the SSHO or designee and review of operating manual. Use proper hand tool for the task.	Daily inspection by users/operators. Inspect tools and power cords to ensure they are listed by a NRTL. Inspect for damage to tool and to cords.
First aid kit, fire extinguisher, eyewash station	Use of emergency equipment including first aid kits, fire extinguishers and eyewash must be done by personnel familiar with this plan; use and inspection criteria of the equipment, and what the equipment is used for, are by or under direction of the SSHO	Fire Extinguisher – Initially and at least monthly thereafter by SSHO First Aid Kit – Weekly and after use for restocking by SSHO Eye Wash Station – Weekly by SSHO – Potable water changed weekly unless a preservative solution is used
Personal Protective Equipment	Users must be trained in the proper use of, limitations of, inspection of, donning and doffing of, and replacement of PPE used	Daily inspection by user before use.

Abbreviations and Acronyms:

AHA – Activity Hazard Analysis
APP – Accident Prevention Plan
dBA – decibels, A-scale
CFR – Code of Federal Regulations
DEET – N,N-diethyl-meta-toluamide
EHS – Environmental, Health, and Safety
EM – Engineer Manual
GPS – global positioning system
PFD – personal flotation device
PPE – personal protective equipment
RAC – Risk Assessment Code
RTK – real-time kinematic
SDS – Safety Data Sheet
SSHO – Site Safety and Health Officer
USCG – U.S. Coast Guard

AHA#7 - Demobilization and Site Restoration (Dive Ops) Signature Sheet

I have reviewed the above AHA and acknowledge the hazards involved with this work task and the controls that will help to minimize illness or injury during the tasks.

NAME	SIGNATURE	TITLE	DATE

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ATTACHMENT C

TETRA TECH STANDARD OPERATING PROCEDURES

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TMR Procedure

HSE 1-10 Boating

Status:	Approved	**Approved By:**	Mark W. Dollar, President
Version Date:	09/08/2021	**Title:**	HSE 1-10, Boating
Revision #:	Rev. 2	**Original Issue Date:**	03/31/2020
Category:	Procedure	**Sections:**	Safety
Reference Driver:	CFR 33/EM 385-1-1	**Document Type:**	Procedure
Keyword Index:	Boating/Health, Safety and Environmental	**Document Owner:**	Scot Wilson

1.0 PURPOSE AND SCOPE

The purpose of this procedure is to establish the minimum requirements for boating safety. This procedure applies to all Tetra Tech Munitions Response (TMR) project sites and activities, including subcontractor activities.

2.0 DEFINITIONS

Definitions are provided to understand their intent as they pertain to a procedure and projects requiring quality program planning.

A Master List of Definitions is located in the Corporate Reference Library on the intranet (https://tetratechinc.sharepoint.com/sites/OU-TMR). In addition, the following definitions are specific to this procedure.

Inshore/Nearshore- For the purposes of TMR boating operations, inshore operations typically consist of the use of a boat less than 26 feet (Class A or Class I) that will not operate more than 1 mile from the nearest land.

Offshore- For the purposes of TMR boating operations, offshore operations typically consist of the use of a boat greater than 26 feet (Class II, Class III, or greater) that will operate more than 1 mile from the nearest land.

Boat – Any powered or non-powered watercraft utilized for the transport of personnel on a body of water.

Class	**Description**
Class A	Less than 16 feet (4.8 meters) length overall
Class I	16 feet (4.8 meters) to less than 26 feet (8 meters) length overall
Class II	26 feet (8 meters) to less than 40 feet (12 meters) length overall
Class III	40 to 65 feet (12 to 20 meters) length overall
Small Research Vessel (SRV)	Greater than 65 feet (20 meters) length overall but less than 300 gross tons
Diving Support Vessel (DSV)	Greater than 65 feet (20 meters) length overall but less than 300 gross tons

3.0 PROCEDURE

3.1 Responsibilities

3.1.1 Line Management

Project manager (PM) is responsible for coordinating with the dive program safety officer to implement the requirements of this procedure. The PM shall provide the necessary management support and allocate enough project resources to enable project personnel to operate boats in a safe manner.

Site managers (SMs) and supervisors are responsible for implementation of this boating safety program in the field.

3.1.2 HSE Personnel

The Health, Safety, and Environmental (HSE) director shall ensure that the requirements of this program are incorporated into site HSE plans.

3.1.3 Boat Captain

The captain of the boat is responsible for the overall health and safety of those on the boat. The boat captain shall ensure that all persons on the boat are given a safety orientation regarding emergency procedures. The boat captain shall also ensure that safety requirements in the applicable safety plan governing the work, such as the use of personal protective equipment, are implemented. The captain is also responsible for the inspection of the boat being used and for having the proper safety equipment, in good working order, on the boat. The captain of the boat will have the final say concerning safety, specifically concerning that of the personnel and craft during operations.

3.2 General Requirements

3.2.1 Boating Towing and Launching

Those TMR personnel who will tow a boat on a trailer to the launching site will be experienced in this capacity and be responsible for reviewing the Boat Pre-Operation Checklist prior to departure. This person will ensure that the boat is not loaded with project equipment, which will overload the bearings and axle weight capacity. Overweight equipment should be carried in another vehicle or the towing vehicle.

The PM must designate a person experienced in towing a boat, launching, or piloting a vessel. This person must have attended a nationally recognized boating safety class (i.e., United States Coast Guard [USCG] Auxiliary or Power Squad). Pre-launch checks will be done before the boat is backed into the water. This includes checking the engine oil and/or fuel mixtures in the tanks. Any mixing of fuel and oil will be done in a separate Underwriters Laboratory (UL) approved flammable liquid storage container prior to filling the vessel tanks. This will ensure the gas/oil mixture is correct.

Whenever possible, perform fuel mixing and transfer in an environmentally safe area where spills can be easily cleaned.

To launch the vessel, back part of the way down the boat ramp, remove the rear tie down straps to the trailer, ensure the boat plug is installed, and continue backing into the water's edge. Place the fenders/bumpers on the side that will be in contact with the pier, to prevent damage. Ensure that the bow and stern lines are being handled by personnel on the pier as the vessel is backed further into the water—until the vessel is floating freely. An alternative plan is to have the coxswain in the boat lower the engine and start it when the rear is in the water and floating free from the trailer. Carefully back the boat with the engine clear of the trailer. Pull the truck and trailer forward and park and secure. Secure the bow and stern lines to the dock and load additional equipment. Lower the engine/out drive, if applicable, and start the engine. Once warm, check all indicators and gauges to ensure that the motor is working properly.

For vessel recovery, reverse the process listed above. Back the truck and trailer down the ramp and place the truck in park with the emergency brake on. Keep the bow winch connected to the vessel until the vessel is out of the water and onto the trailer. Raise the motor/outdrive and secure in the up position. Once the vessel is trailered, remove additional equipment as necessary to reduce weight; and secure the vessel to the trailer with bow and stern straps and the safety chain near the winch. The vessel is not to be towed with a person in the vessel.

3.2.2 Boat Operators

Only designated TMR personnel who meet appropriate Federal, State or local training requirements shall operate a boat during a project. These requirements are a valid USCG license for vessels over 40 feet (12 meters) or any USCG recognized training such as the USCG Auxiliary Boating Skills and Seamanship Training for vessels less than 40 feet (12 meters).

Boat operators must possess basic knowledge to troubleshoot common mechanical problems that can occur on the boat. The boat operator shall be responsible for all personnel's safety on board the boat and for the integrity of all boat and safety equipment.

Each designated boat operator shall give a safety briefing to boat occupants prior to leaving shore. **Boats are to be occupied during use by not less than one qualified operator plus one additional person.** If the "additional person" is not a qualified operator, a basic safety and operations demonstration will be conducted before launching.

3.3 Logbook

Boat captains shall maintain a logbook for each vessel. The logbook will be used to note weather, tides, maintenance issues, equipment status, and to record completion of the safety orientation given to each day’s passengers. Captains will make notes of any additional observations regarding the boat and its safe operation. This logbook will be kept with the vessel.

3.4 Float Plan

A Float Plan shall be filled out by the boat captain, unexploded ordnance (UXO) safety officer (UXOSO) or field operations lead (FOL) for all trips made by boat using the USCG Float Plan (Attachment 2). The UXOSO or FOL shall always be aware of the location of all project boats and designated use personnel. If several boats and crews are involved in the work or are traveling to remote areas, each designated boat operator shall file a written USCG Float Plan or equivalent with the UXOSO or SM/FOL. This plan can be filed electronically, via email or text message, if necessary. The Float Plan shall include the following:

- The names of the boat operator and passengers.
- A description and registration numbers of the boat.
- Radio call sign or cellular telephone number if boat is so equipped.
- A trip itinerary with expected time and location of return.
- Steps the UXOSO or SM/FOL will take to initiate a search response if the expected time of return is exceeded.

A Float Plan shall be prepared by each designated boat operator and approved by the PM, UXOSO, and/or qualified person prior to the activity. For boats that are operated with one crew, the Float Plan shall be developed that ensures the boat returns to the dock in no more than 12 hours.

3.5 Boat Registration and Numbering

The UXOSO or SM/FOL shall ensure that all project boats meet USCG or state boat registration and numbering requirements. The USCG requires that all motorized boats be numbered in the state of principal use. Many states also require that certain non-motorized boats be numbered (sailboats, rafts, and dinghies). A valid certificate or number showing the numbers issued to the boat is required to be on board the boat whenever the boat is in use. Boat registration numbers are required to be painted or permanently attached to the outside of each side of the forward half of the boat. Boat registration must be updated annually or as required by the registering state.

3.6 USCG -Approved Equipment

All TMR project boats will meet or exceed USCG requirements for safety equipment. These requirements are summarized below for small craft (less than 40 feet or 12 meters in length). The UXOSO or SM/FOL shall consult with the HSE director if larger craft are required.

3.6.1 Flame Arresters

All gasoline engines, except outboard motors, installed in a boat must have an approved flame arrestor (backfire preventer) fitted to the carburetor/intake.

3.6.2 Sound Signaling Devices

Although not required for small craft, all TMR boats shall carry at least one air horn or similar sound-signaling device.

3.6.3 Personal Flotation Devices

All TMR personnel and passengers shall always wear an approved personal flotation device (PFD) when operating or being transported in a boat. A positively buoyant wet suit may be substituted for a PFD. PFDs shall be Type III or higher (capable of turning its wearer in a vertical or slightly backward position in the water). Automatic inflating PFDs can be used providing that they are approved in the HSE Plan, and Activity Hazards Analysis addresses its use. For persons less than 90 pounds, a child PDF must be used. PDFs shall be inspected, maintained, and stored in accordance with the manufacturer's instruction. In addition, each boat up to 26 feet (8 meters) in length shall be equipped with at least one Type IV PFD ring buoy, 24 inches (6 meters) in diameter with 90 feet (27 meters) of buoyant line attached, designed to be thrown to a person in the water, grasped and held by the user until rescued.

A buoyant boat cushion equipped with straps and a float ring are two common examples of additional types of life rings that can qualify as a Type IV PFD and help in a rescue.

For boat operations in cold water environments, immersion/exposure suits will be required for each person on board based on the location of boat operations listed below.

AREA OF OPERATION	VSL TYPE	DEVICE
Seaward of the Boundary Line, north of 32ºN, or south of 32ºS, and Lake Superior.	Documented	Immersion Suit/Exposure Suit
Coastal Waters on the West Coast of the U.S. north of Pt. Reyes, CA; Beyond coastal waters, cold waters; and Lake Superior	All	Immersion Suit/Exposure Suit

3.6.4 Fire Extinguishers

Each boat used by TMR personnel less than 26 feet (8 meters) shall carry at least one Type 1-A:10-B:C fire extinguisher (for use in gasoline, oil, and grease fires) approved by UL. Motorboats or skiffs over 26 feet (8 meters) will have a minimum of two 1-A:10BC fire extinguishers available. Larger craft will have additional requirements. Each fire extinguisher shall be inspected by the UXOSO or SM/FOL at least once every week to ensure that it is sufficiently charged and that the nozzles are free and clear. Discharged fire extinguishers shall be replaced or recharged immediately. The number and sizes of extinguishers required will depend on the vessel size and applicable regulations.

3.6.5 Navigation Lights

All TMR project boats shall be equipped with navigation lights. These lights shall always be utilized when operating between sunset and sunrise. Navigational lighting shall meet all USCG requirements. Boats shall be operated at reduced speeds at night and when visibility is reduced.

3.6.6 Visual Distress Signals

All TMR boats shall carry a selection of pyrotechnic and non-pyrotechnic visual distress signals. Pyrotechnic visual distress signals include red flares, orange smoke (day use only), and aerial red meteor or parachute flares. No pyrotechnic visual distress signals include an orange distress flag (day use only) and a flashlight or other electric distress light (night use only). No single signaling device is ideal under all conditions and for all purposes. Pyrotechnic visual distress signals shall not be used past the expiration date.

3.6.7 Pollution Control

The Refuse Act of 1899 prohibits the throwing, discharging, or depositing of any refuse matter of any kind (including trash, garbage, oil, and other liquid pollutants) into the waters of the United States (U.S.). The Federal Water Pollution Control Act prohibits the discharge of oil or hazardous substances in quantities that may be harmful into U.S. navigable waters. No person may intentionally drain oil or oily wastes from any source into the bilge of any vessel. Vessels 26 feet (8 meters) and greater in length, with machinery spaces, must display a placard fixed in a conspicuous place in the machinery spaces, or at the bilge pump control station stating the rules of the Federal Water Pollution Control Act governing the discharge of oil or oily waste to the water (see Reference No. 3). Pumping of bilge water without using an oily-water separator should be undertaken with caution. Any vessels equipped with toilet facilities must be equipped with a USCG-approved marine sanitation device and shall observe all no-discharge areas shown on National Oceanic and Atmospheric Administration (NOAA) charts.

TMR employees shall report any significant oil spills to water to the HSE director who must report the spill to the USCG or other applicable regulatory agency. The procedure for incident reporting and investigation shall be followed when reporting the spill. (See Tetra Tech Safety Manual, DCN 02-02, Incident Reporting & Investigation Program)

3.7 Weather

A daily weather check shall be conducted prior to any boating operation. If severe weather is forecast, work should be delayed or cancelled. All HSE plans covering boating operations shall address the hazards that weather poses to boating operations, and specific actions to be taken to avoid these hazards. The field supervisor in consultation with the boat captain, site safety and health officer and PM shall establish maximum sea state or go/no-go criteria, ensuring compliance with the applicable project safety plans, prior to the beginning of operations.

3.8 Load Capacity

Boats less than 20 feet shall not be loaded (passengers and gear) beyond the weight capacity printed on the USCG capacity plate attached to the stern. For boats without capacity plates, the licensed captain/trained operator shall evaluate the safe loading of crew, cargo, and equipment on a trip-by-trip basis. Several factors must be considered when loading a boat: distribute the load evenly; keep the load low; do not stand up in a small boat or canoe; and do not overload the boat.

3.9 Tool Kit

All TMR motorized boats shall carry a tool kit with enough tools for the boat operator to troubleshoot common mechanical problems such as fouled spark plugs, flooded carburetor, electrical shorts, etc. Boats operated in remote areas shall also carry appropriate spare parts (e.g., propellers, shear pins, patch kits, air pumps). The tool kit shall be maintained by the boat operator, with supplies replaced immediately upon use.

3.10 Survival Kit/Ditch Bag

All TMR boats utilized in remote areas shall carry a survival kit. The survival kit shall contain, at a minimum: a first aid kit; high-energy canned or preserved foods; drinking water; blankets; a heat source; signaling devices; waterproof matches; and other items as necessary to ensure survival for a minimum of 24 hours for the entire crew. For offshore work, a “ditch bag” consisting of an Emergency Position-Indicating Radio Beacon (EPIRB); handheld very high frequency (submersible) signaling devices – visual and audible; and/or strobe light or light stick may be required. The ditch bag should be waterproof, float and preferably be high visibility in color. Survival suits may be required by the HSE plans for operations in cold environments.

3.11 Communications

All TMR boats operated in remote areas shall carry a two-way radio or cellular telephone that enables communication back to the field camp or other pre-established location. Exceptions to this requirement must be negotiated with the HSE director. Additional communication and locating methods may be utilized such as SPOT Messenger, global positioning system, EPIRB, and satellite telephones.

3.12 Boating Accident Report

The USCG requires filing a boating accident report within 24 hours of an accident (death, disappearance overboard, medical treatment beyond first aid, property damage > $2000, or if the boat is destroyed).

TMR personnel involved in a boating accident shall follow the procedure outlined in HSE plans and Tetra Tech's Safety Manual, Incident Reporting and Investigation Program (DCN 02-02), for accident and injury reporting. This procedure will provide for proper notification of the USCG.

3.13 Good Housekeeping

TMR personnel using a boat shall properly stow and secure all gear and equipment against unexpected shifts when underway. Decks and open spaces must be kept clear and free from clutter and trash to minimize slip, trip, and fall hazards.

3.14 Fuel Management

TMR personnel shall utilize the "one-third rule" in boating fuel management. Use one-third of the fuel to get to the destination, one-third to return, and keep one-third in reserve.

3.15 Training

Boat operators shall be trained on, and pass the test of, a nationally recognized boating safety organization such as the USCG Auxiliary or Power Squadron. All operators and passengers shall be trained on the requirements of this program. Training records shall be maintained in accordance with the Tetra Tech Safety Manual, DCN 01-04, Recordkeeping and Reporting Requirements.

3.16 Operations

Operations of motorboats/skiffs can be hazardous to personnel considering other boaters, weather conditions, the task assigned, and the condition of the boat/skiff you are operating. Ensure Boat Pre-Operation Checklist is completed before departing the launch area. The boat captain or designee must utilize and fill out the checklist each day the vessel is used (use is defined as being launched from the trailer or departing the dock or moorage) and submit it to the UXOSO or FOL. This checklist can be filed electronically, via email or text message, if necessary.

When operating in restricted waters, near shipping channels, in rough fast flowing water, or near obstacles that could damage or capsize the boat, plan for emergency rescue in case the boat motor fails, or you become incapacitated from operating the boat and you are in personal danger. Consideration would be for a second motor or a safety boat operating in the area or other rescue capability available.

4.0 REFERENCES

CFR Title 33, Navigation and Navigable Waters, Chapter I - Coast Guard, Department of Homeland Security (Parts 1-199), Subchapter S, Boating Safety (Parts 173-199), Retrieved from https://www.gpo.gov/fdsys/granule/CFR-2010-title33-vol2/CFR-2010-title33-vol2-chapI-subchapS

USACE EM 385-1-1 (November 30, 2014), Safety and Health Requirements Manual. Retrieved from https://www.publications.usace.army.mil/Portals/76/Publications/EngineerManuals/EM_385-1-1.pdf

Title 33 USC. Chapter 9 Protection of Navigable Waters and of Harbor and River Improvements. Subchapter I - In General. 407 - Deposit of refuse in navigable waters generally. (pp. 46). Retrieved from https://www.gpo.gov/fdsys/pkg/USCODE-2011-title33/pdf/USCODE-2011-title33-chap9-subchapI.pdf

Tetra Tech Safety Manual, Incident Reporting and Investigation Program, DCN 02-02.[1]

Tetra Tech Safety Manual, Recordkeeping and Reporting Requirements, DCN 01-04.[2]

U.S Department of Homeland Security. United States Coast Guard Auxiliary (2015 v.10.2). USCG Float Plan. Retrieved from http://www.floatplancentral.org

DOC NOAA. Office of Marine & Aviation Operations. NOAA Small Boat Standards and Procedures Manual (April 30, 2018, 4.1 Edition), Retrieved from https://www.omao.noaa.gov/sites/default/files/documents/2018%200430%20SBS%26PM%204.1.pdf.

5.0 RECORDS

Records associated with the awareness and recognition programs will be retained in the appropriate project or office files.

6.0 GUIDELINES

HSE-25 Boat Pre-Operation Checklist

HSE-26 Float Plan Template

7.0 APPLICABLE ISO17025 CLAUSES

None.

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[1] https://tetratechinc.sharepoint.com/:b:/r/sites/Health-Safety/Health%20%20Safety%20Manual/02_General%20Health%20and%20Safety%20Programs/DCN%2002-02%20Incident%20Reporting%20and%20Investigation%20Program.pdf

[2] https://tetratechinc.sharepoint.com/:b:/r/sites/Health-Safety/Health%20%20Safety%20Manual/01_Health%20and%20Safety%20Program%20Administration/DCN%2001-04%20Recordkeeping%20and%20Reporting%20Requirements.pdf

TETRA TECH

UXO SOP for MEC Management and Disposal

RECORD OF DEVELOPMENT, REVIEW, VALIDATION, AND APPROVAL

This Standard Operating Procedure (SOP) contains the procedures by which Tetra Tech, Inc will conduct MEC Management and Disposal operations for munitions response projects. Any changes or deviations will be included in the project plans and approved by the Director of Technical Operations and Explosives Safety. SOPs will be reviewed annually.

Director, Health, Safety, & Environmental Jim Streib, CSP, SMS, CQA, CHST		Date:	
Director, Technical Operations & Explosives Safety Patrick Tatman		Date:	6/23/2020

Review Date	Reviewer	Next Review

WORKER'S STATEMENT

I have read UXO SOP MEC Management and Disposal and received the training necessary to demonstrate my capability to perform the procedures addressed in this SOP. If I identify a hazard not addressed in this SOP or encounter an operation I cannot perform in accordance with this SOP, I will stop the process and notify my immediate supervisor.

Worker's Name	Date	Supervisor's Name	Date

TABLE OF CONTENTS

1.0 PURPOSE AND SCOPE

This Standard Operating Procedures (SOP) provides Munitions and Explosive Concern (MEC) management and basic explosive demolition procedures for the treatment of MEC and material potentially presenting material potentially posing an explosive hazard (MPPEH) found during the MEC activities on Munitions Response Site (MRSs). These procedures will be conducted in accordance with the Quality Assurance Project Plan (QAPP) or equivalent planning documents.

This SOP provides the detailed information needed to safely configure, conduct demolition procedures, and perform post demolition inspection and area restoration. These operations include:

- Documenting the recovery, accountability, and management of MEC/MPPEH
- Conducting disposal operations involving MEC/MPPEH
- Post disposal operations

All training on equipment or software will be either formal or on-the-job training (OJT). Training will be documented by site personnel and subject to review for accuracy and completeness. The Unexploded Ordnance (UXO) Quality Control Specialist (UXOQCS) will verify training is completed and documented.

2.0 PERSONNEL, EQUIPMENT, AND MATERIALS

This section describes the personnel, equipment, and materials required to implement this SOP.

2.1 PERSONNEL REQUIREMENTS

Explosive demolition operations require specific organizational roles and personnel assignments, specifically:

- Senior Unexploded Ordnance Supervisor (SUXOS), to oversee all demolition operations.
- Demolition Supervisor (DS), an Unexploded Ordnance (UXO) Technician Level III or above, designated by the SUXOS. The DS is responsible for planning, directing, and executing all demolition operations. The SUXOS may perform duties of the DS based on the project manning.
- Unexploded Ordnance Safety Officer (UXOSO), ensures that all demolition operations are performed safely and following the approved site-specific plans.
- Two Unexploded Ordnance Technicians Level II or I, designated to assist the DS.

2.2 EQUIPMENT

The Demolition teams conducting MEC management and disposal tasks will be equipped with the following:

- Analog Geophysical Sensor
- Disposal equipment
- Donor explosives
- Logbook and/or personal digital assistant (PDA) for recording data
- Camera

3.0 PROCEDURES AND GUIDELINES

3.1 MEC/MPPEH MANAGEMENT

When MEC and MPPEH are discovered, they are inspected and positively identified using a three-tiered inspection process while the munitions are left in place.

1. Inspected first by the UXO technician discovering the munition(s) to determine if it is MEC or MPPEH,
2. Second by a UXO Tech II to independently classify the munitions(s), and
3. Third by the UXO Tech III, Team Leader.

For MEC/MPPEH, the SUXOS and UXOSO must assess and agree that the risk associated with the movement of MEC or suspected munition is acceptable and necessary. They will document the decision in writing. If necessary, the Director of Technical Operations and Explosives Safety will be consulted and concur with the decision to move the ordnance. Based on knowledge of the site, this may be accomplished before field operations beginning.

If MEC/MPPEH are determined by the SUXOS and UXOSO to be unacceptable to move, they will be conspicuously marked, secured, and scheduled for Blow-in-Place (BIP) treatment by a demolition team.

All MEC shall be secured or guarded by a UXO technician or approved security personnel until demolition operations.

All MEC will be photographed, and as much information as possible will recorded on the dig sheet or PDA. Recorded data to include nomenclature (if known), type (projectile, mortar, rocket, mine, etc.), size, physical condition, fuzed or unfuzed, fuze type by function (e.g., point detonating, mechanical time, etc.), condition (e.g., fired or unfired, armed or unarmed), filler if known, Global Positioning System (GPS) coordinates (if different from the relocated position) and depth.

3.2 NOTIFICATIONS

The SUXOS will ensure that the agencies responsible for emergency response are notified as far in advance as possible that demolition activities will be taking place. The notifications should address scheduling, evacuations, road closures, exclusion zones (EZs), and any other required support. Table 1 provides a list of emergency telephone numbers and contacts.

Table 1: Emergency Contact Numbers

Contact	Phone Number
Fire Department	
EMS	
Police	
FAA	
Base Operations	
Anyone else not listed….	

3.3 EXCLUSION ZONES, ENGINEERING CONTROLS, AND ROAD CLOSURES

Engineering controls should be employed whenever possible to minimize the damage from demolition operations. These controls may consist of sandbags, ecology blocks, trenching, buttressing, taping of glass, mounding, flooding and/or venting to reduce the effects of detonations.

The SUXOS will ensure EZ barricades are set up with signs at all access roads and marked appropriately: Danger, UXO Remediation Project in Progress, DO NOT ENTER, and list contact information on the barricade sign.

3.4 WEATHER AND ENVIRONMENTAL CONSIDERATIONS

Before commencing demolition operations, the SUXOS or UXOSO will obtain a local weather report.

Demolition operations will not be conducted if electrical storms are within 10 miles of the demolition site or during severe weather conditions that would impact safety.

The SUXOS and UXOSO will decide on whether wind speed and visibility will hamper the safe execution of demolition operations.

3.5 FIRE SUPPORT

The telephone number of the responding fire departments will be posted in plain sight at the site office and the disposal site.

The Fire Department nearest the disposal site location will be notified of disposal operations each day.

When the fire hazard is high due to dry conditions, disposal operations will not be conducted unless mobile fire-fighting equipment is standing by and the fire department is capable of responding within five (5) minutes.

Fire extinguishers, portable water tanks, and shovels will be on-site to fight small fires. Evacuate the area if the fire approaches ordnance or explosives. Do not fight grass fires in areas where there may be ordnance or kick-outs.

Conduct a fire risk assessment before conducting disposal operations to consider the type of ordnance to be disposed of, environmental conditions on the site, and appropriate preventative measures to be employed before initiation of explosive procedures.

Consider preventative measures to include: Movement of the MEC to a prepared site, if possible, ground preparation to include scraping and vegetation removal, wetting of the site just before the commencement of operations, and tamping of the shot with sand, or water.

3.6 DEMOLITION OPERATIONS

3.6.1 Demolition Briefing

The DS will brief all personnel involved in range operations in the following areas:

- General Safety Precautions
- Type of MEC or MPPEH being destroyed
- Type, placement, and quantity of demolition material being used

- Method of initiation (electric or Nonel)
- Team assignments
- Equipment being used (e.g., Remote Firing Device [RFD], galvanometer, blasting machine, firing wire, etc.)
- Misfire procedures
- Post-shot cleanup of range procedures
- Emergency procedures

3.6.2 Preparing Donor Charges for Initiation

One Pound Pentolite Booster

1. Insert the 80-grain detonating cord into the detonator well. Insert all the way through the first hole and back through the second hole, then tie an overhand knot to secure it.
2. When using more than one booster, insert the detonating cord through each of the booster's detonator wells and secure to keep it from sliding along the detonating cord.
3. Place the booster on the MEC/material documented as an explosive hazard (MDEH) using tape or other suitable material to prevent it from moving.

Jet Perforator

1. Using tape or detonating cord clips secure the detonating cord to the jet perforator.
2. Place the jet perforator on the MEC/MPPEH using tape or other suitable material to prevent it from moving.

Binary Explosives

1. Obtain part A and part B.
2. Mix per manufacturer requirements and the site where the operation will be conducted.
3. Place on item in same manner as booster and as discussed during demolition briefing.

3.6.3 Initiation Set-ups

The UXOSO will act as a safety observer during demolition set-ups and will depart the range/demolition area before the demo team priming the donor charge. He/she will maintain communications with the team, the SUXOS, and Site Field Office at all times.

A maximum of 2 people will prime the shot. All others will be located outside the EZ.

Electric Blasting Cap

- Prior to making a connection with the electric blasting cap, the firing circuit will be continuity tested.
- All parts of the firing circuit will be kept insulated from the ground or other conductors such as bare wires, rails, pipes, or other paths of stray current.
- The shunt will not be removed from the wires until the individual performing the operation has been grounded. Electric blasting caps will be connected to the firing circuit before connection to the main initiation charge.
- Electric blasting caps of different manufacturers or types will not be used in the same system.
- The electric blasting caps will be tested for continuity with a galvanometer at least 50-ft (15.2-m) downwind from any explosives before connecting them to the firing circuit. After the testing is completed, the lead

wires will be short-circuited by twisting the bare ends of the wires together. The wires will remain shunted until ready to connect to the firing circuit.

- The electrical lead wires of electric blasting caps, detonators, or other electro-explosive devices should not be pulled; detonation may occur.
- The legs should be unrolled so that the cap is as far as possible from the operator and pointing away from him before testing.
- The blasting cap will be placed in a hole, behind a barricade, or under a sandbag before removing the shunt and testing for continuity. The cap should not point toward other personnel or explosives. Always test at the extent of lead wires with ones back towards the blasting cap.
- Only authorized and serviceable testing equipment will be used.
- The remote receiver will not be connected to the firing wires until all pre-firing tests have been completed, and all preparations have been made to fire the charge.

Nonel Blasting Cap

- No testing required
- Blasting cap should be placed in a hole, behind a barricade, or under a sandbag before priming.
- The blasting cap should not point towards other personnel or explosives.

Nonel Lead Line Splicing

- Care should be taken to keep moisture from the cut end of the shock tube.
- The DS or designated UXO Technician will perform the following procedures to cut and splice the shock tube.
- Minimize the number of splices in a shock tube line to as few as possible.
- Lead Line splicing procedure as follows:
  1. Use a sharp knife or razor blade to squarely cut (at a 90-degree angle) approximately 12 inches from a new roll or the cut-off end of a partial roll.
  2. Loosely tie the two-shock tube ends to be spliced together. Leave at least 2 inches free at the end of each shock tube beyond the knot.
  3. Pull the shock tube lightly to tighten the knot, but not so tight as to significantly deform the shock tube in the knot.
  4. Use only the splicing tubes provided to make splices. Taping the two cut ends of the shock tubes together does not make a reliable splice.
  5. Push one of the free shock tubes, to be spliced, firmly into one of the pre-cut splicing tubes at least 1/4 inch.
  6. Push the other shock tube end firmly into the other end of the splicing tube at least 1/4 inch. Attempt to push the two ends up against each other or get as close as possible.

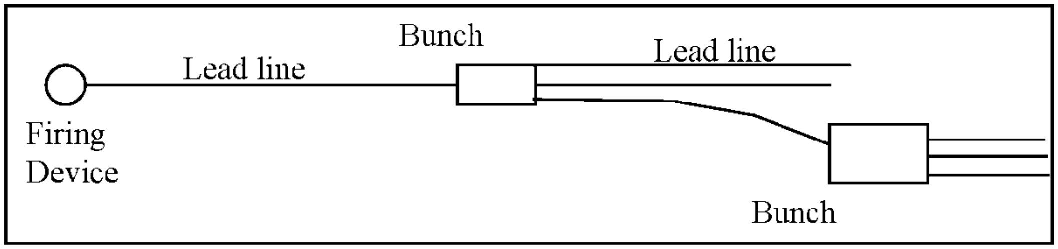
Nonel Lead Line Preparation

The DS or designated UXO Technician will perform the following procedures to set up the lead line.

1. Layout the required length of lead line from the demolition area back to the firing point.
2. Attach an EZTL 30 Bunch Block (or equivalent method) to the lead line at the demolition site using the supplied splicing tube.
3. Secure the bunch block or immobilize with sandbags.
4. Run additional lead line(s) from the bunch block to the MEC/MPPEH (see Figure 3-1).

Note: Only attach a maximum of six additional leads per bunch block. Use additional bunch blocks, if necessary.

Figure 3-1 Nonel Lead Line Setup



3.6.4 Initiation Systems

The firing system will use RFD with Nonel or electric blasting caps. As a back-up to the RFD, the Scorpion Electronic Blasting Machine with electric caps or Nonel will be used.

Remote Firing Device Preparation

1. Perform system pre-operational test and set up using the operator's manual. Remove key from controller unit until ready to fire.
2. Place the remote near the detonation site with the antenna in the vertical position. If using electric caps, the remote should be within 100 feet of the shot. Using the unit blast shield, sandbags, or natural cover to protect the remote.
3. Ensure the remote indicates a READY condition for the selected initiation method (green READY LED on steady, red ARMED LEG off).
4. If using Nonel, connect the shock tube to the igniter tip. The tube should be wrapped around through holes in the tip's molded casing to keep it from falling out. Prime the shot and return to the safe area.
5. If using electric caps, cut off a length of firing wire that will reach between the remote and the charges (100' or less).
6. Conduct a continuity check of the firing wire with a galvanometer. Shunt the free ends of the wire to prevent an electric charge from building up in the firing wire.
7. Test each electric blasting cap 50 feet downwind of other explosives with a galvanometer.
8. Place blasting caps in a hole, behind a barricade or under a sandbag before removing the shunt and testing for continuity.
9. Fully extend the leg wires and ensure the cap is pointing away from the person conducting the continuity test.
10. Secure the leg wires to prevent the cap from moving during the test.
11. Use only a special silver-chloride dry cell battery in the testing galvanometer. Other type batteries may provide sufficient voltage to fire the blasting cap.
12. Upon completion of testing, re-shunt the leg wires. The wires will remain shunted until ready to connect to the firing circuit.
13. For dual priming connect blasting caps in a parallel circuit to the extension wires.
14. Test the circuit with the Galvanometer, and then connect extension wires to the remote.
15. Retrieve caps from barricade, prime shot, and return to safe area.

Scorpion Electronic Blasting Machine Preparation

1. Perform pre-operational check as per instructions on blasting machine.
2. Layout firing wire or Nonel.
3. Conduct a continuity check of the firing wire with a galvanometer. Shunt the free ends of the wire to prevent an electric charge from building up in the firing wire.
4. Test each blasting cap with a galvanometer 50 feet downward of other explosives.
5. Place blasting caps in a hole, behind a barricade or under a sandbag before removing the shunt and testing for continuity.
6. Fully extend the leg wires and ensure the cap is pointing away from the person conducting the continuity test.
7. Secure the leg wires to prevent the cap from moving during the test.
8. Use only a special silver-chloride dry cell battery in the testing galvanometer. Other type batteries may provide sufficient voltage to fire the blasting cap.
9. Upon completion of testing, re-shunt the leg wires. The wires will remain shunted until ready to connect to the firing circuit.
10. For dual priming connect blasting caps in a parallel circuit to the firing wire.
11. Retrieve caps from barricade, prime shot, and return to safe area.

Initiation Sequence

The SUXOS or DS will ensure that the actions taken before initiating a demolition shot are completed as follows.

1. Ensure all required notifications have been made.
2. Set up EZ and post guards at the barricades.
3. Visually inspect EZ and surrounding area for unauthorized personnel.
4. **Five-minute warning**. The DS will give the five-minute warning on the radio, followed by a one-minute series of long blasts on the air-horn.
5. **One-minute warning**. The DS will give the one-minute warning on the radio, followed by a one-minute series of short blasts on the air-horn before the shot. At this time, the arming of the RFD or Blasting Machine will occur.
6. Before initiating the shot, the DS will give three loud "*Fire in the Hole!*" warnings and then give the “fire” command on the radio.

Firing the Remote Firing Device

1. Install the key and engage the "POWER" switch on the controller to the right until the BATTERY LED illuminates.
2. Momentarily depress the controller STATUS button. The yellow TRANSMIT LED will flash for approximately one second. At the end of this time, a green READY LED will come on steady, indicating that the remote is on and in the standby mode. The steady green LED also means the remote is within range of the controller.
3. Push the ARM/DISARM switch to the left and hold for one second. The red ARMED LED will flash for approximately 18 seconds then come on steady. The remote is now armed.
4. The SUXOS or DS gives three loud "Fire-in-the-Hole" warnings.
5. Then the SUXOS gives permission to fire the shot.
6. Lift the safety cover on the FIRE switch and push the FIRE switch forward.

Firing the Scorpion Electronic Blasting Machine

1. Connect the firing leads to the terminal posts of the blasting machine.
2. For Nonel plug in the shock tube adapter and attach Nonel.
3. SUXOS or DS gives three loud "Fire-in-the-Hole" warnings.
4. Then the SUXOS gives permission to fire the shot.
5. Degrees and hold CHARGE button (keep depressed throughout sequence).
6. Press DETONATE button when green ready light comes on. For non-electric shots hold DETONATE button down for one second and release.

3.6.5 Misfires

If a misfire does occur, it must be cleared with extreme caution. The responsible technician will investigate and correct the situation using the steps outlined below.

Misfire Procedures for the Remote Firing Device

1. Make three successive attempts to fire.
2. Turn off the controller and remove the key.
3. Wait 1 hour from the last initiation attempt.
4. After the wait time has elapsed, the SUXOS or DS and one other UXO technician will proceed downrange to inspect the firing system.
5. Disconnecting from RFD:
    - 5.1 If Nonel was used, do not remove the caps from the charge. Disconnect Nonel from the igniter tip on the remote firing device.
    - 5.2 If electric caps were used, remove the old blasting caps from charge and disconnect from extension wires. Shunt cap leg wires.
6. Set up new firing system.

Misfire Procedures for the Scorpion Electronic Blasting Machine

1. Make three successive attempts to fire.
2. If using firing wire and still unsuccessful disconnect wires and check continuity.
3. If continuity is good, reconnect to blasting machine and make three more attempts to fire.
4. If still unsuccessful check connections of firing wires to terminals and make three more attempts to fire.
5. Change blasting machine after third unsuccessful attempt.
6. If unsuccessful with new blasting machine disconnect and shunt firing leads.
7. If using Nonel disconnect from blasting machine.
8. Wait 1 hour from the last initiation attempt.
9. After the wait time has elapsed, the SUXOS or DS and one other UXO technician will proceed downrange to inspect the firing system.
10. Clearing the primed shot:
    - 10.1 If electric caps were used, remove the old blasting caps from charge and disconnect from firing wire. Shunt cap leg wires.
    - 10.2 If detonating cord was used cut detonating cord between cap and charge, disconnect cap from fire wire. Shunt cap leg wires.
    - 10.3 If Nonel was used, do not remove the caps from the charge. Place a new, primed explosive charge next to the misfired charge.
11. Set up new firing system.

3.6.6 Post Demolition Procedures

1. Wait the designated wait times specified by the SOP. A minimum of 5 minutes after a single shot or after a series of shots that can be counted. A minimum of 30 minutes after multiple shots that could not be counted.
2. The SUXOS or DS and one other UXO technician will return to the detonation site and check the results of the shot. If the procedure was successful, the demo supervisor will call in additional personnel to clean up the site. UXO personnel will conduct a visual sweep of the detonation site and the immediate area to gather fragments and explosive residue if present.
   - 2.1 Metal fragments will be examined to ensure complete consumption of explosive material.
   - 2.2 Explosive residue will be collected and detonated.
   - 2.3 Intact MEC items will be disposed of if they fail to detonate.
3. After the area is swept and cleared, the SUXOS or DS will notify the remaining personnel over the radio that the "All Clear" is given.
4. Backfill hole, as necessary.
5. Recover all equipment.

3.7 DOCUMENTATION

Forms and checklists should be generated and/or modified to meet site-specific requirements. The forms provided in this SOP may be used, or alternate forms containing the same information may be used. The SUXOS will make this determination. For disposal operations, the SUXOS or the UXO DS will, as a minimum, complete the following.

- General Safety Precautions
- Disposal Operations Checklist
- Explosive Disposal Log

4.0 QUALITY CONTROL

The MEC Management and Disposal operations will meet the quality control (QC) performance objectives identified in the QAPP or equivalent planning document and the attached quality control inspection checklist.

The QC team will verify the quality of the task through the three phases of the control process and document the results as described in the QAPP or equivalent planning document. Any tasks the QC team determines do not meet the quality control metrics, will be considered deficient or non-conforming. If a deficiency or nonconformance occurs, the UXOQCS will prepare a Deficiency Report or Nonconformance Report.

ATTACHMENTS

ATTACHMENT 1

DEMOLITION EQUIPMENT CHECKLIST

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DEMOLITION EQUIPMENT CHECKLIST

Equipment List

Equipment	Quantity	Comments
Explosive Vehicle(s)		
Personnel Vehicle(s)		
Digital Camera		
Air Horn		
Hand-held Radios		
Cellular Telephone(s)		
Remote Firing Device		
White XLT all-metals detector		
Shovel, round point, long handle		
Shovel, round point, short handle		
Blasting Machine		
Tape, duct		
Tape, measuring, 50- or 100-meter		
Tape, electricians, plastic		
Toolbox, general hand tools		
Galvanometer		
IME-22 container		
Knife		
Initiating explosives		
Donor explosives		
Fire Extinguishers, 20B:C		
Wheel Chocks		

Checklist Verification

Disposal Supervisor Signature:

Date:

ATTACHMENT 2

HEALTH AND SAFETY EQUIPMENT CHECKLIST

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HEALTH AND SAFETY EQUIPMENT CHECKLIST

Equipment List

Equipment	Quantity	Comments
Air Horn, emergency		
Burn Blanket		
Burn Kit		
Emergency Eye Wash		
Hand-held Radio and Satellite Phone		
Lightning Detector		
Fire Extinguisher, 20-pound ABC		
Bloodborne Pathogen Kit		
First Aid Kit		
Gloves, leather		
Goggles		
Face Shield(s)		
Fire Retardant Gloves		
Fire Retardant Apron(s)		
Rain Suit(s)		
Safety Vest(s)		
Stretcher		
Water, 5-gal bottle (emergency shower)		
Water, drinking -- 1 liter per person		

Checklist Verification

Disposal Supervisor Signature:	Date:

ATTACHMENT 3

GENERAL SAFETY PRECAUTIONS

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GENERAL SAFETY PRECAUTIONS

1. Carry blasting caps in approved containers and keep them out of the direct rays of the sun. Keep the caps located at least 25 feet from other explosives until they are needed for priming.
2. Do not work with electric blasting caps or other electro-explosive devices while wearing clothing prone to producing static electricity such as nylon, silk, synthetic hair, etc.
3. Do not use explosives or accessory equipment that is obviously deteriorated or damaged. They may cause premature detonation or fail completely.
4. Always point the explosive end of blasting caps, detonators, and explosive devices away from the body during handling.
5. Use only standard blasting caps of at least the equivalent of a commercial No. 8 blasting cap.
6. Use electric blasting caps of the same manufacturer for each demolition shot involving more than one cap.
7. Do not use improvised methods for initiating blasting caps.
8. Do not bury blasting caps. Use detonating cord to transmit the explosive wave from the blasting caps, on the surface, to a buried/tamped explosive charge. Buried blasting caps are subject to unobserved pressures and movement, which could lead to premature firing or misfires.
9. Test electric-blasting caps for continuity at least 50 feet from any other explosives before connecting them to the firing circuit. Upon completion of testing, the lead wires will be shunted by twisting the bare ends of the wires together. The wires will remain shunted until ready to be connected to the firing circuit.
10. In the event of a misfire when disposing of explosives by detonation, do not approach the disposal site for at least 60 minutes after the expected detonation time, when firing electrically.
11. Items with lugs, strong backs, tail-booms, base plates, etc., should be oriented away from personnel locations.
12. Consideration should be given to tamping the UXO to control fragments if the situation warrants. Fragments will be minimized not only to protect personnel but also property, such as buildings, trees, etc.
13. Avoid inhaling the smoke, dust, or fumes of burning pyrotechnic or incendiary materials. The smoke, dust, and fumes from many of these materials are irritating and/or toxic if inhaled.
14. Do not use water on incendiary fires. Water may induce a violent reaction or be completely ineffective, depending on the mixture.
15. Anticipate a high order detonation when burning pyrotechnic or incendiary-loaded MEC. Safety measures for personnel and property must be based upon this possibility.
16. Inert ordnance will not be disposed of, or sold for scrap, until the internal fillers have been exposed and unconfined. The heat generated during a reclamation operation can cause the inert filler, moisture, or air to expand and burst the sealed casings. Venting or exposure may be accomplished in any way necessary to preclude rupture due to pressure from being confined. All requirements of the UXO Procedure for the Management and Disposition of MPPEH will be met before releasing any inert ordnance material.
17. Maintain minimum safe distances between electromagnetic-radiating sources and electro-explosive devices (IAW EODB/TM-TO 60A-1-1-12).
18. Do not conduct blasting or demolition operations during an electrical, dust, sand, or snowstorm severe enough to produce atmospheric static electrical charges, or when such a storm is nearby (within 6 miles). Under such conditions, all operations will be suspended or terminated, cap and lead wires shunted, and personnel removed from the demolition area. Demolition operations will also be terminated if visibility becomes less than 600 feet.
19. Loose initiating explosives: lead azide, mercury fulminate, lead styphnate, and tetracene, these explosives manifest extreme sensitivity to friction, heat, and impact. Extra precautions are required when handling

these types of explosives. Keep initiating explosives in a water-wet condition at all times until ready for final preparation for detonation. The sensitivity of these explosives is significantly increased when dry.

20. Exercise extreme care when handling and preparing high explosives for detonation. They are subject to detonation by heat, shock, or friction.
21. Do not pack bomb fuze wells with explosives unless it can be positively confirmed that the fuze well does not contain any fuze components.
22. Photo flash bombs must be handled with the same care as black powder-filled munitions.
23. MEC containing white phosphorous will not be detonated into the ground. White phosphorous munitions will be counter-charged on the bottom centerline (CCBC) when possible.
24. A search of the detonation site, after the demo operation, will be conducted to assure complete disposal was accomplished.
25. Do not abandon any explosives.
26. Do not leave explosives, empty cartridges, boxes, liners, or other materials used in the packing of explosives lying around where children, unauthorized persons or livestock can get at them.
27. Do not allow any wood, paper, or other materials used in packing explosives to be burned in a stove, fireplace, or other confined space, or be re-used for any other purpose. Such materials will be destroyed by burning at an isolated location out of doors, with no one allowed within 100 feet of the burning operation.
28. Do not fight fires involving explosive material. Evacuate all personnel to a safe location and secure the area.
29. Know and observe international, federal, state, and local laws/regulations that apply to the transportation, storage, and use of explosives.
30. Do not permit metal, except approved metal truck bodies, to contact explosive containers.
31. Do not transport metal, flammable, or corrosive substances with explosives.
32. Do not allow smoking, or the presence of unauthorized personnel, in vehicles transporting explosives.
33. Carefully load and unload explosives from vehicles. Never throw or drop explosives from the vehicle.
34. Assure the load is blocked and braced to prevent it from movement and displacement.
35. Do not drive vehicles containing explosives over public highways until all permits and certifications have been obtained from the state enforcement agencies.
36. All routes must be approved in writing before transporting explosive materials over public highways.
37. Licensed commercial carriers will conduct the shipment of explosive materials over public highways unless Tetra Tech UXO personnel have been specifically licensed and certified to make the shipment.
38. Never leave a vehicle that is loaded with explosives unattended.
39. Do not store blasting caps, detonators, or other items containing initiating explosives in the same box, container, or magazine with other explosives.
40. Store explosive materials in military or ATF-approved magazines only. Ensure the magazines used for the storage comply with quantity distance requirements, for the class of explosive material they contain. Reference documents include: NAVSEA OP-5, TM 9-1300-206, AMCR 385-100, ATF - Explosives Law and Regulation, ATF P 5400.7, and 49 CFR.
41. Do not store spark-producing metal/tools in an explosive magazine.
42. Do not permit smoking, matches, or any source of fire or flame within 100 feet of an explosive magazine.
43. Do not allow leaves, grass, brush, or debris to accumulate within 50 feet of an explosive magazine.
44. Do not permit the discharge of firearms within 300 feet of an explosive magazine.

TETRA TECH

GENERAL SAFETY PRECAUTIONS

45. Do not use any alkaline material such as lye, washing soda, or soap to remove TNT exudate. Alkaline materials will react with TNT to render it more sensitive.
46. Do not permit smoking, matches, or other sources of fire or flame within 100 feet of an area in which explosives are being handled.
47. Do not expose explosives or devices containing explosive to prolonged exposure to direct sunlight. Such exposure can increase sensitivity and deterioration.
48. Ensure all unused explosives are returned to their proper containers, and the container closed after use.
49. Do not carry explosives or explosive components in pockets or on the body.
50. Do not strike, tamper with, or attempt to remove or investigate the contents of an electric/non-electric blasting cap, detonator, or other explosive initiating device. A detonation may occur.
51. Do not pull on the electrical lead wires of electric blasting caps, detonators, or their electro-explosive devices. A detonation may occur.
52. Do not attempt to remove an unfired or misfired primer or blasting cap from a base coupling. There is a high risk of an explosion.
53. Do not allow unauthorized or unnecessary personnel to be present when explosives are being handled.
54. Do not use pull rings or safety pins to lift or handle explosive devices.

ATTACHMENT 4

DISPOSAL OPERATIONS CHECKLIST

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DISPOSAL OPERATIONS CHECKLIST

FUNCTION	DATE/TIME	SIGNATURE
SUXOS		
Assign Disposal Team		
Brief Disposal Team Review emergency procedures Discuss MEC/MPPEH to be disposed Describe Disposal procedures and method		
Inspect Range/Exclusion Zone upon completion of operations		
Disposal Supervisor		
Assign demolition task to team members		
Verify Not Later Than (NLT) disposal time includes wait time for misfire procedures		
Verify roads are closed		
Verify Exclusion Zone boundaries in place		
Complete health and safety and equipment checklists		
Ensure Field Site Office has completed the verification checklist Responsible activity Medical Facility Fire Department Security/Police Department		
Disposal Supervisor tailgate safety brief: Designate emergency vehicles Designate emergency evacuation route Review emergency response procedures		
Verify daily equipment inspection		
Verify detonators are separated from explosives		
Verify area has been evacuated		
Verify engineering controls are correct		
Notify Field Site Office that operations are commencing		
Start disposal activities		
Inspect shot after designated wait time		
Collect all metal fragments for later disposal		
QC check performed		
QA check (if required)		
Tetra Tech to notify upon completion: Client Responsible Activity Medical Facility Fire Department Security/Police Department		
Complete MEC/MPPEH Accountability Log and record data in Explosive Disposal Log		
Demolition Supervisor signature:		Date:

ATTACHMENT 5

EXPLOSIVE DISPOSAL LOG

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EXPLOSIVE DISPOSAL LOG

Project Information

Project Name: ______________________

Start Time: ______________________

Project Location:

Stop Time:

MEC Disposed of This Date (List items and quantity of each item)

QTY	NOMENCLATURE	GRID	MEC	MDAS	DATE LOCATED	DATE DISPOSAL

Donor Explosive Used (List types and quantity)

QTY	TYPE
	ELECTRIC DETONATORS
	DETONATNG CORD
	COMMERCIAL SHAPED CHARGES

Remarks

Approval

Demolition Supervisor (Signature):

Print Name ______________________

Date:

ATTACHMENT 6

QUALITY CONTROL INSPECTION CHECKLIST

MEC MANAGEMENT AND DISPOSAL

TEAM INFORMATION

Team:	**Location:**	**Date:**
Team Leader:		
Personnel Present:		
Contract #:		
Task Order #:		

QC CHECKLIST POINTS

ITEM	REF.	INSPECTION POINT	YES	NO	N/A	COMMENTS
1	**Workers' Statement**	Have all MEC Management and Disposal Team Members read this SOP?				
2	**QAPP**	Have assigned disposal team members received training on and demonstrated proficiency with the RFD?				
3	**SOP**	Did all personnel attending the morning safety/operational briefing sign-in?				
4	**SOP**	Did the Team Leader conduct and document the Tailgate Safety Briefing before beginning operations?				
5	**SOP**	Did all recovered MPPEH undergo the three-tiered inspection process?				
6	**SOP**	Did the SUXOS and UXOSO assess all MEC and agree that the risk associated with movement is acceptable or not?				
7	**SOP**	Was the decision to move MEC documented in writing before movement or transporting the items to the storage magazines for temporary storage?				
8	**SOP**	Were MPPEH items further classified as or MDAS, as appropriate?				
9	**SOP**	Were all MEC items photographed?				
10	**SOP**	Did the Demolitions Supervisor conduct and document the demolitions briefing?				
11	**SOP**	Was the EZ established and observed?				
12	**SOP**	Was the demolition sequence observed?				
13	**SOP**	Were donor charges properly prepared?				
14	**SOP**	Were post-demolition operations conducted?				

FINDINGS

Item	Comments

Conducted By: ____________________ **Reviewed By:** ____________________

TETRA TECH

UXO SOP MPPEH and MDAS Management and Disposal

RECORD OF DEVELOPMENT, REVIEW, VALIDATION, AND APPROVAL

This Standard Operating Procedure (SOP) contains the procedures by which Tetra Tech, Inc will conduct MPPEH and MDAS management and disposal operations for munitions response projects. Any changes or deviations will be included in the project plans and approved by the Director of Technical Operations and Explosives Safety. SOPs will be reviewed annually.

Director, Health, Safety, & Environmental Jim Streib, CSP, SMS, CQA, CHST		Date:	
Director, Technical Operations & Explosives Safety Patrick Tatman		Date:	6/23/2020

Review Date	Reviewer	Next Review

WORKER'S STATEMENT

I have read UXO SOP – MPPEH and MDAS Management and Disposal and received the training necessary to demonstrate my capability to perform the procedures addressed in this SOP. If I identify a hazard not addressed in this SOP or encounter an operation I cannot perform in accordance with this SOP, I will stop the process and notify my immediate supervisor.

Worker's Name	Date	Supervisor's Name	Date

TABLE OF CONTENTS

1.0 PURPOSE AND SCOPE

The purpose of this standard operating procedure (SOP) is to provide procedures and technical guidance for material potentially presenting an explosive hazard (MPPEH) inspection, management, safety, security and chain of custody (CoC) certification during munitions response activities. This applies to all Tetra Tech Unexploded Ordnance (UXO) Technicians involved in the inspection and management process for certifying MPPEH as material documented as safe (MDAS) before transfer within or release from U.S. Department of Defense (DOD) control.

This SOP is not a stand-alone document and should be used together with the Quality Assurance Project Plan (QAPP) or equivalent planning documents, other Tetra Tech SOPs, applicable Federal, State, local regulations, and contract restrictions and guidance.

All training on equipment or software will be either formal or on-the-job training (OJT). Training will be documented by site personnel and subject to review for accuracy and completeness. The UXO Quality Control Specialist (UXOQCS) will verify training is completed and documented.

2.0 PERSONNEL, EQUIPMENT, AND MATERIALS

This section describes the personnel, equipment, and materials required to implement this SOP.

2.1 PERSONNEL

The following individuals may be involved in MPPEH and MDAS Management and Disposal activities:

- Senior Unexploded Ordnance Supervisor (SUXOS)
- UXOQCS
- Unexploded Ordnance Safety Officer (UXOSO)
- UXO Technicians, Levels III, II, and I
- Government or third-party Quality Assurance personnel

2.2 EQUIPMENT

- MDAS containers (e.g., 55-gallon drums, 20yd roll-off, etc.)
- Unique Numbered Seals
- Expray Kit
- Logbook and/or PDA for recording data
- Bottled water
- Camera
- Communications equipment
- First-aid kit
- Level D personal protective equipment (PPE)
- Fire extinguisher

3.0 PROCEDURES AND GUIDELINES

3.1 UXO TECHNICIAN RESPONSIBILITIES AND PROCEDURES

The objective of the following procedures is to ensure that an inspection of the exterior and interior surfaces of all recovered MPPEH is safely conducted to ensure these items do not present an explosive hazard and are not transferred from DOD or Tetra Tech custody.

3.1.1 Unexploded Ordnance Sweep Personnel (UXOSP)

Will only mark suspected MPPEH and will not be allowed to perform any assessment of a suspect MPPEH to determine its status.

3.1.2 UXO Technician I

Can tentatively identify a located material as MPPEH confirmation by a UXO Technician II or III.

3.1.3 UXO Technician II

Will perform a 100 percent inspection of each piece of MPPEH as it is recovered and determine the following:

a. Is the MPPEH MEC, munitions debris (MD), range-related debris (RRD) or is non-munition related debris (NMRD)?

b. Does the MPPEH contain explosives hazards or other dangerous fillers?

c. Does the MPPEH/MEC require detonation?

d. Does the MPPEH/MEC require demilitarization or venting to expose dangerous fillers of cavities not inspectable?

e. Does the MPPEH require removal of batteries, mercury seals, or switches; the draining of engine fluids, illuminating dials, and other visible liquid hazardous, toxic, or radiological waste (HTRW) materials?

Will segregate material MPPEH requiring demilitarization or venting procedures from those items ready for certification.

Will process any MPPEH found to contain explosives hazards or other dangerous fillers following applicable UXO SOP – MEC Management and Disposal.

3.1.4 UXO Technician III:

Will perform a 100 percent re-inspection of all reclassified MPPEH to determine if free of explosives hazards or other dangerous fillers and engine fluids, illuminating dials, and other visible liquid HTRW materials.

Will supervise detonation of MEC/MPPEH found to contain explosive hazards or other dangerous fillers and venting/demil procedures.

Will supervise the consolidation of inspected MPPEH for containerization and sealing. MD and RRD or NMRD will be segregated.

3.1.5 UXO Quality Control Specialist (UXOQCS)

Will conduct daily audits of the procedures used by UXO teams and individuals for processing MPPEH.

Will perform and document random sampling (by pieces, volume, or area) of all MPPEH collected from the various teams to ensure no MD, RRD, or NMRD contains and explosive hazard, engine fluids, illuminating dials, and other visible liquid HTRW.

The UXOQCS will sign as the verifier on the DD Form 1348-1 in the absence of a government representative.

3.1.6 UXO Site Safety Officer (UXOSO)

Will ensure the specific procedures and responsibilities for processing MPPEH for certification as MD or RRD specified in the work plan are being followed.

Will ensure all procedures for processing MPPEH are being performed safely and consistent with applicable regulations.

3.1.7 SUXOS:

Will be responsible for ensuring work and Quality Control (QC) plans specify the procedures and responsibilities for processing MPPEH for final disposition as MD or RRD.

Will ensure a Requisition and Turn-in Document DD Form 1348–1A is completed for all MD and RRD to be transferred for final disposition.

Will perform a final 100 percent re-inspection of all recovered MPPEH to certify that they are free of explosives hazards or other dangerous fillers and engine fluids, illuminating dials, and other visible liquid HTRW material necessary to complete the DD Form 1348–1A.

Will be responsible for ensuring that inspected debris is secured in a closed, labeled, and sealed container and documented as follows:

a. The container will be closed and clearly labeled on the outside with the following information: The first container will be labeled with a unique identification that will start with the applicable DOD component/Installation Name/Tetra Tech/0001/Seal's unique identification and continue sequentially.

b. The container will be closed in such a manner that a seal must be broken to open the container. A seal will bear the same unique identification number as the container, or the container will be clearly marked with the seal's identification if different from the container.

c. Tetra Tech will provide a documented description of the container with the following information for each container: contents, weight of the container, location where munitions or RRD was obtained, name of the contractor, names of certifying and verifying individuals, unique container identification, and seal identification, if required.

Will establish a secure location for the collection, processing, and storage of MD, RRD, and NMRD until transferred off-site.

All acceptable to move MEC or MPPEH will be stored in a magazine or secured until disposal.

3.2 MD CERTIFICATION AND CONTAINERIZATION

MPPEH procedures will be per DOD Instruction 4140.62, EM 385-1-97 or OP-5. All MPPEH will be assessed and its explosive safety status determined and documented before transfer within the DOD or release from DOD control. Before release to the public, MPPEH will be documented by personnel who are authorized in writing and technically qualified to certify or verify MDAS after a 100 percent inspection, and an independent 100 percent re-inspection to ensure that it is safe from an explosive perspective. The following certification and verification procedures will be followed for material suspected or determined as MPPEH:

- The SUXOS will certify that the debris is free of explosives hazards.
- The UXOQCS or similarly trained individual in the absence of a government representative will verify that the debris is free of explosive hazards.

- DD Form 1348–1A Issue Release/Receipt Document will be used as the certification/verification documentation. The DD Form 1348–1A must clearly show the names and contact numbers of the SUXOS and the UXOQCS, similarly trained UXO-qualified individual or Government representative and will be completed with the following information:

  Block 2: Site Address

  Block 3: Address where the MDAS will be shipped to

  Block 5: Document date

  Block 8: Cargo type (MDAS or NMRD – non-munitions related debris)

  Block 9: Mandatory Entry **-** Enter “U” if Unclassified material. For more Controlled Inventory Item Codes (CIIC) see DOD 4100.39-M, Volume 10, Chapter 4**,** Table 61.

  Block 10: Actual quantity received. Entered by Receiver

  Block 11: Number of items for this unit. Enter “1” if only one container is listed on the form.

  Block 12: Enter the weight of the container listed on the form

  Block 15: Mandatory Entry – Enter “0” for No Shelf-life. For more codes see DOD 4100.39-M Volume 10, Chapter 4, Table 50

  Block 16: Leave blank for the transport company

  Block 17: Basic material content such as Material Documented as Safe or Non-Munitions Related Debris with the type of metal (steel or mixed)

  Block 18: Type of container

  Block 19: Number of containers that make up the shipment

  Block 20: Total weight of all containers that make up the shipment

  Block 22: Signature of receiver

  Block 23: Date received

  Block 24:

  - Site Name
  - Site Location
  - Company name
  - Contract Number

  Block 25: Container number - DOD component/Installation Name/Tetra Tech/0001/Seal’s unique identification

Block 26:

- The following certification/verification will be entered on each DD Form 1348–1A for MD or RRD transferred within or release from DOD control and will be signed by the SUXOS and the UXOQCS, a similarly trained UXO-qualified individual or Government representative. This statement will be used on any ranges where range related debris is to be processed along with MD:

  “This certifies that the material listed has been 100 percent properly inspected and, to the best of our knowledge and belief, are free of explosive hazards, engine fluids, illuminating dials, and other visible liquid HTRW materials.”

- The following certification/verification will be entered on each DD Form 1348–1A for turnover of MD and will be signed by the SUXOS and the UXOQCS, similarly trained UXO-qualified individual or Government representative where only munitions debris is being processed:

  “This certifies and verifies that the material listed has been 100 percent inspected and, to the best of our knowledge and belief, are inert and/or free of explosives or related materials.”

Block 27: Signature Block for both the SUXOS and UXOQCS containing:

- Certified by: SUXOS Name / Verified by: UXOQCS Name or other verifier
  Tetra Tech (OU Name Here), Munitions Response Services
  Applicable OU Address
  Home Office: XXX-XXX-XXXX
  SUXOS phone number / UXOQCS phone number or other verifier
  Signature of SUXOS / Signature of UXOQCS or other verifier

Upon receipt of the material identified on the DD Form 1348–1A, the PM is responsible for ensuring the following blocks are completed by the qualified recycler:

- Block 10: Quantity of material receive;
- Block 22: Signature; and
- Block 23: Date.

3.3 MAINTAINING CHAIN OF CUSTODY AND FINAL DISPOSITION

Tetra Tech will arrange for maintaining the chain of custody and final disposition of the certified and verified materials. The certified and verified material will be released only to an organization that will:

A. Upon receiving the unopened labeled containers, each with its uniquely identified and unbroken seal ensuring a continued chained of custody, and after reviewing and concurring with all the provided supporting documentation, the receiving vendor will sign for having received and agreeing with the provided documentation that the sealed containers contained no explosive hazards upon receipt. This will be signed on company letterhead that states the contents of these sealed containers will not be sold, traded, or otherwise given to another party until the contents have been smelted and are only identifiable by their basic content.

B. Send notification and supporting documentation to the sealed container-generating contractor documenting the contents of the sealed containers have been smelted and are now only identifiable by their basic content.

C. If the chain of custody is broken, the affected shipment must undergo a 100 percent inspection, a second 100 percent re-inspection, and be documented to verify its explosives safety status.

MDAS is no longer considered MPPEH as long as the chain of custody remains intact. A legible copy of the inspection, re-inspection, and documentation must accompany the material through final disposition and be maintained thereafter for three years.

4.0 QUALITY CONTROL

The MPPEH and MDAS Management and Disposal operations will meet the QC metrics outlined within the QAPP or equivalent planning document and the Compliance Checklist in this SOP.

The UXOQCS will verify the quality of the task through the three-phase of control and document the results as described in the QAPP or equivalent planning documents. Any tasks the UXOQCS determines not to meet the QC metrics will be considered deficient or non-conforming. If a deficiency or nonconformance occurs, the UXOQCS will prepare a Deficiency Report or Nonconformance Report.

4.1 QC CHECKLIST: MPPEH/MDAS MANAGEMENT AND DISPOSAL

TEAM INFORMATION		
Team:	Location:	Date:
Team Leader:		
Personnel Present:		
Contract #:		
Task Order #:		

QC CHECKLIST POINTS

Item	Ref.	Inspection Points	Yes	No	N/A	Comments
1	SOP	Have all personnel read and signed the workers' statement?				
2	SOP	Do all personnel performing this DFW meet the minimum qualifications required?				
3	SOP	Have all personnel performing this DFW been trained on this SOP, and is it documented?				
4	SOP	Have the teams been provided maps of the overall project site and evacuation routes?				
5	SOP	Are all equipment and materials required to perform the DFW inspected, available on-site, and is it documented?				
6	SOP	Was each received container marked as MPPEH or MDAS, sealed and contained in a cleared area?				
7	SOP	Is the PPE serviceable and worn properly?				

FINDINGS

Item	Comments

Conducted By: ______________________ **Reviewed By:** ______________________

UXO SOP for Removal of MEC in a Marine Environment

RECORD OF DEVELOPMENT, REVIEW, VALIDATION, AND APPROVAL

This Standard Operating Procedure (SOP) contains the procedures by which Tetra Tech, Inc will conduct the removal of Munitions and Explosives of Concern (MEC) in a marine environment for munitions response projects. This SOP covers high and low input mechanized and underwater demolition operations. Any changes or deviations will be included in the project plans and approved by the Director of Technical Operations and Explosives Safety. SOPs will be reviewed annually.

Diving Program Manger Scot Wilson, PMP	Scot M Wilson	Date:	May 19, 2021
Diving Safety Officer Patrick Tatman		Date:	May 19, 2021

Review Date	Reviewer	Next Review

SUPERVISOR'S STATEMENT

I have read and understood this SOP. To the best of my knowledge, the procedures described in this SOP can be performed in a safe, healthful, and environmentally sound manner. I have confirmed that all persons assigned to this process are qualified, have read and understood the requirements of this SOP, and have signed the worker's statement for this purpose. I will ensure the SOP contains current procedures. If a major change to the SOP is necessary, I will ensure active processes are suspended until the SOP is revised and approved. If unexpected safety, health, or environmental hazards are identified, I will make sure the process is stopped until the hazards have been eliminated.

SUXOS/Diving Supervisor Date

WORKER'S STATEMENT

I have read UXO SOP Removal of MEC in a Marine Environment and have received the training necessary to demonstrate my capability to perform the procedures addressed in this SOP. If I identify a hazard not addressed in this SOP or encounter an operation I cannot perform in accordance with this SOP, I will stop the process and notify my immediate supervisor.

Worker's Name	Date	Supervisor's Name	Date

TABLE OF CONTENTS

Appendices

ACRONYMS AND ABBREVIATIONS

APP	accident prevention plan
BEM	buried explosion module
BIP	blow-in-place
DDESB	Department of Defense Explosives Safety Board
DOD	U.S. Department of Defense
DS	diving supervisor
DSPM	diving safe practices manual
ESA	Endangered Species Act
ESP	explosives site plan
EZ	exclusion zone
LED	light-emitting diode
MEC	munitions and explosives of concern
MFD	maximum fragment distance
MPPEH	material potentially presenting an explosive hazard
MQO	measurement quality objective
MRB	master reference buoy
MRDB	master reference disposal buoy
MSD	minimum separation distance
PM	project manager
QC	quality control
RFD	remote firing device
RTB	raise, tow, and beach
SM	shark marine dive tablet
SOP	standard operating procedure
SUXOS	senior unexploded ordnance supervisor
TL	team leader
TP	technical paper
U.S.	United States
USCG	U.S. Coast Guard
UXO	unexploded ordnance
UXOQCS	UXO quality control specialist
UXOSO	UXO safety officer

1.0 PURPOSE AND SCOPE

1.1 PURPOSE

This standard operating procedure (SOP) provides basic procedures specific to the recovery of munitions and explosives of concern (MEC) in a marine environment identified during a target intrusive investigation. Mechanized MEC processing operations outlined in explosive safety planning are often referred to as raise, tow, and beach (RTB) operations in the field. Phases of this SOP include the following:

- Target reacquisition and recovery of the MEC using unexploded ordnance (UXO) dive teams
- Mechanized operations - RTB MEC for disposition
- Disposition/ treatment of the MEC using demolition procedures

The procedures above will be conducted following a project-specific Work Plan (of which this SOP will be a part), Accident Prevention Plan (APP), and applicable United States (U.S.) Department of Defense (DOD) guidance, including EM 385-1-1, EM 200-1-15, DOD 6055.09-M, EM 385-1-97, Explosives Site Plan or Submission, and DOD Explosives Safety Board (DDESB) Technical Papers (TP)16 and TP18. In addition, underwater explosive detonation (blow-in-place [BIP], consolidated shot, or deep-water disposal) is not allowed unless coordination to address concerns of endangered marine life has been completed with the appropriate authorities. All mitigation requirements shall be coordinated and in place for this activity. This coordination will take place with the understanding that underwater detonation would take place as a last resort and only if avoidance/minimization measures can be implemented in a way that avoids jeopardy of listed species or destruction and adverse modification of designated critical habitat. This procedure's diving aspects will be per our corporate Diving Safe Practices Manual (DSPM), EM 385-1-1, and the project work plan.

1.2 SCOPE

This SOP provides the detailed information needed to safely perform the procedures above and protect the environment, particularly Endangered Species Act (ESA) resources. Specific requirements are defined in the approved work plan for notification procedures, personnel, training, equipment/ material, field procedures, and documentation. This SOP will be used in conjunction with applicable DOD guidance. This document's procedures apply to Tetra Tech UXO employees who conduct recovery and disposition of MEC.

The senior UXO supervisor (SUXOS)/UXO diving supervisor (DS), in collaboration with the project manager (PM), is responsible for the execution of this procedure. The final approval authority for changes ultimately rests with the Tetra Tech director of technical operations and explosives safety.

2.0 PERSONNEL, TRAINING, EQUIPMENT, AND MATERIALS

This section describes the personnel, equipment, and materials that may be required to implement this activity.

2.1 PERSONNEL

All field personnel will meet the requirements of DDESB TP 18, including those UXO technicians selected to perform diving operations. It is expected that all target investigations will occur in a marine environment or have a marine component; thus, field operations will be planned and conducted by the following personnel:

- SUXOS / UXO DS

- UXO Quality Control (QC) Specialist (UXOQCS)
- UXO Safety Officer (UXOSO)
- UXO Dive Team (minimum of four personnel)

Note: High input mechanized operations for MECs not acceptable to move and to require remote removal may need additional support personnel to conduct simultaneous operations and coordination as required.

A complete dive team with assigned and qualified demolition members will conduct any underwater demolition operations. An underwater explosive detonation (BIP, consolidated shot, or deep-water disposal) is not allowed unless coordination to address endangered marine life concerns has been completed with the appropriate authorities. All mitigation requirements are coordinated and in place for this activity. A BIP would be performed as in an emergency, as a last resort, and only if avoidance/minimization measures can be implemented in a way that avoids jeopardy of listed species or destruction and adverse modification of designated critical habitat.

The SUXOS/DS will be responsible for planning, directing, and executing all field operations. The SUXOS/DS may designate the UXO technician III/team leader (TL) as the Demolition Supervisor. An assigned demolition team will assist the TL as required during the demolition operations. The SUXOS/DS may designate an alternate UXO Dive Supervisor to assist with the mechanized operations in the MEC recovery phase.

The UXOSO will be stationed on-site and will maintain visual contact to the best extent possible with the dive and demolition teams downrange during field operations. The UXOSO will maintain communications with the team and the Tetra Tech site office.

The UXOQCS will ensure all operations are performed correctly in accordance with this SOP, the QC plan, and all other applicable guidelines of the approved project work plan. He will also assist the UXOSO as an on-site safety observer.

2.2 TRAINING

All Tetra Tech UXO technicians will meet the qualification and professional training requirements presented in the DDESB TP-18 and the approved project work plan. Before conducting field operations, project-specific training will be provided to all involved personnel. The topics to be covered include, but will not be limited to, the following:

- Project summary and approach – Work Plan review
- APP review
- Dive Plan and SOP review
- Demolition notifications
- Exclusion zone (EZ) management
- Type and condition of potential MEC
- MEC accountability
- Material potentially presenting an explosive hazard (MPPEH) management/handling/inspection procedures
- Review of donor charge placement
- Documentation and recordkeeping
- Logbook/personal digital assistants
- Demolition/dive team staffing (team assignments)
- Subcontractor management (same day explosives delivery procedures) if applicable
- Equipment training
- RTB Materials (Mechanized Operations Equipment Checklist, Appendix 1)

- Demolition Equipment Checklist (Appendix 3)
- All-metals Detector
- Shark Marine Dive Tablet II
- Daily health and safety briefing
- Emergency equipment review
- Talk through/walk-through of emergency procedures
- First aid/cardiopulmonary resuscitation
- Daily site-specific munitions training

Other pertinent guidance documents, including the various MEC that may be encountered, will also be reviewed, as required. A practical training exercise (rehearsal) with all team members will be conducted before any RTB operations.

2.3 EQUIPMENT

The SUXOS/DS will be responsible for ensuring all required equipment and materials are on site. At a minimum, the following will be checked daily before commencing field operations:

- Mechanized operations equipment (Appendix 1)
- Health and safety equipment per Boat Pre-Operation Checklist (project work plan)
- Support vessels, small boats/inflatables as required
- Diving equipment per the project work plan and DSPM
- Demolition operations equipment (Appendix 3)
- Health and Safety equipment (Appendix 4)

3.0 PLANNING

The task-specific procedures for conducting each of the major field operations listed for removal of ordnance in a marine environment are as follows:

3.1 GENERAL SAFETY

MEC removal activities will not be conducted until the required training and proper equipment checks have been completed, documented, and the appropriate EZ is established, marked, and secured.

If applicable, all utilities will be marked by the appropriate authorities before the intrusive operation.

As a rule, when a MEC is determined as unacceptable to move, one tended UXO technician diver will attach any lifting system or explosive charge. The SUXOS/DS will have the discretion to use additional divers (as needed) if additional divers are determined to be less hazardous to perform all required tasks.

Non-UXO personnel must always be escorted by UXO-trained personnel, after receiving site orientation and 3R training, in areas potentially containing MEC.

- Do not expose MEC to radio, cell phone, or satellite phone transmissions within 25 feet.
- Do not smoke except in designated areas.
- Prohibit non-essential personnel from encroaching upon the site.

- Suspend all operations immediately upon the approach of an electrical storm within 10-miles.

Additional and specific safety precautions will be further outlined in Appendix 5 and the project work plan.

3.2 NOTIFICATION AND COORDINATION

Coordination regarding activities at the worksite with the agencies and personnel listed below will be required for the safe conduct of all field operations, including any additional requirements that must be met as determined by the appropriate authorities after completion of the environmental/endangered species coordination process. Prior to conducting demolition operations, the disposition of individual targets will be coordinated with the resource agencies. The coordination will include determining the method and location of disposal. The SUXOS/DS will act as the coordinator for personnel and equipment to safely conduct all field operations. Specific notifications, described below, will be required to be made before commencing RTB operations. Notices are coordinated through the SUXOS/DS and the regulating authorities, which may include, but are not limited to:

- Local Police Department
- Local Fire Department
- U.S. Coast Guard (USCG) or applicable local organization
- Federal Aviation Administration or applicable local organization
- U.S. Fish and Wildlife Service or applicable local organization
- U.S. Environmental Protection Agency or applicable local organization
- National Oceanic and Atmospheric Administration or applicable local organization
- Local municipality
- Tetra Tech PM or the SUXOS/DS will notify the regulating authorities before disposal operations (per the approved work plan)

Prior to the initial on-site field operations, a coordination meeting will be conducted to establish roles and responsibilities, and meeting minutes will be prepared and submitted for approval. The meeting will address specific planning and organizational responsibilities, communication pathways, coordination and notification processes, and reporting requirements. Topics will include:

- Target reacquisition and recovery diving team makeup and assignments
- Demolition team makeup and assignments
- Explosive handling, storage, and transportation
- Required support services, fire, medical, security, etc.
- Emergency procedures
- Maintenance of EZs
- Community impact
- Identification of project reporting requirements during all phases of project planning, execution, and closeout (e.g., Work Plans, Production Reports, Project Status Reports, Daily Quality Reports)
- Endangered species/critical habitat impact and mitigation requirements
- Notification process to stakeholders and regulating authorities

3.3 COMMUNICATIONS

Two methods of communication will be used during field operations. A designated cell phone will be the primary means of notifying emergency responders (i.e., dialing 911). If available, Tetra Tech site office landlines will be the secondary means of off-site communication. As the operation will be conducted on the water, a marine Very High Frequency handheld radio will be on-site and available to communicate with the USCG (or local authorities). Communication (via radio) among the field team members. Communication checks between the security teams, TLs, UXOSO, UXOQCS, and the SUXOS/DS will be verified before commencing operations.

3.4 EXCLUSION ZONES

Mechanized MEC processing operations may be considered high or low input operations per DOD 6055.09-M, Volume 7, depending on the risk assessment. If MEC is deemed to be unacceptable to move, and it may be relocated remotely using a lifting mechanism, this will be viewed as a high input operation due to a higher level of risk. If MEC is deemed acceptable to move and on-site transport using a lifting balloon is performed, this will be considered a low input operation. The Maximum Fragment Distance (MFD) will be used while towing a munition underwater for high and low input operations. The MFD will be calculated by the Buried Explosion Module (BEM) using the depth of water the MEC is being suspended while under tow. MEC must remain submerged at a water depth allowing the MEC to clear any obstructions on the bottom, but also provide enough tamping to be protective to the UXO team conducting the lift and tow operations. A witness buoy will be attached to the MEC to provide visibility if the MEC becomes separated from the lifting mechanism during the lift and tow procedures.

For the MEC requiring mechanized MEC processing operations, net explosive weight, depth of water, and burial depth for planned detonation will be used to calculate the appropriate EZ using the U.S. Army Munitions Response Actions – Minimum Separation Distances (Relative to Impulse Water Pressure) from Underwater Detonations (Safe Separation Distance for Swimmers and Divers) SAIE-ESOH Memorandum, dated 16 Sep 2013 and the most recent BEM model. EZs will be calculated and may be adjusted for the following situations:

- Initial EZs will be calculated for the specific MEC and will be observed during the mechanized operations.
- During tow operations, EZs will be adjusted on the surface using the BEM for the appropriate depth of tow. Underwater EZ will also be adjusted and maintained along the entire tow route considering the depth of tow.
- A support boat of adequate size to support operations will remain outside the exclusion zone and be prepared to support the UXO dive team as required.
- Before the beaching operations, the SUXOS/DS shall ensure the predetermined surface EZ is established and maintained for the MEC. This exclusion zone will be enforced until the MEC is buried (if using the BEM), which can then be further adjusted for the calculated BEM used.

MEC will be towed only on the approved routes based on the factors outlined above. This information will be provided to the regulating authorities for confirmation and approval. The EZ will remain intact until the SUXOS/DS has verified the site is safe and all field operations are complete. If EZ cannot be secured, guards will be posted, and work halted if non-essential personnel enter the minimum separation distance (MSD). Mechanized MEC operations will not resume until non-essential personnel has exited the MSD.

3.5 WEATHER AND ENVIRONMENTAL CONSIDERATIONS

Prior to commencing field operations, the SUXOS/DS will obtain a local weather report. Operations will not be conducted above sea state 1 or if small craft warnings are forecasted. Demolition operations will not be conducted if electrical storms are within 10 miles of the demolition site or during any severe weather conditions, including electrical storms or small craft warnings that might impact safety.

Any biological monitoring will be conducted following the project work plan. Reconnaissance by the regulatory agencies, project biologists, Marine Mammal Observer (if assigned), and the SUXOS/DS of the primary and alternate tow routes and the approved beaching sites will be conducted to ensure that:

- Minimum habitat impact to the landing area on the beach.
- Proper depth of tow and the tow route selected provide enough area to conduct the task safely and will not adversely impact or damage any habitat before RTB operations. Use of a floating line for the primary tow and beaching lines to minimize impact to habitat.
- The routes and beach landing areas will be marked physically using visible markers, buoys, and line of sight and/or electronically using a global positioning system (GPS) when required.

3.6 MEDICAL

Specific medical support requirements are identified in the project work plan APP. A medically qualified person will be on-site for all demolition shots and will have equipment capable of treating traumatic injuries resulting from an explosion unless adequate medical support is within 5 minutes of the operation site.

3.7 FIRE

All project support vessels and vehicles will have at least one fire extinguisher onboard. Additional firefighting equipment will be provided as outlined in appendix 3, 4, and 6 and following the project work plan.

3.8 PERSONAL PROTECTIVE EQUIPMENT

Unless otherwise directed, all land-based field operations will be conducted in Level “D” personal protective attire. The SUXOS/DS may modify the PPE level as required. Divers will be dressed following the project work plan and the DSPM.

3.9 RECORDKEEPING

For field operations, the SUXOS will ensure, at a minimum, complete the following:

- Field Team Logs (maintained by UXO technician III/TL)
- MEC Accountability Log
- Appropriate MPPEH Inspection Certifications
- Dive logs as required in the project work plan and DSPM

4.0 EQUIPMENT SETUP

4.1 RECEIPT ON-SITE

Materials or equipment received at the site will be inspected for serviceability and against purchase order requirements. Photos will be taken and filed with the daily QC reports or the Quality Receiving Inspection Report.

Handheld geophysical sensors will be tested. If applicable, search programs uploaded and verified in the applicable Functional Check Area or Instrument Verification Strip for functionality, following the approved project work plan and manufacturer’s operator’s manual.

Handheld or other GPS devises for use during these operations will be checked for the correct project and coordinate upload.

All cameras will have video cards and batteries checked.

Vessels, utility, or passenger vehicles will be inspected for damage and verified as operational. Photos will be taken and given to the site safety officer.

4.2 DAILY - PRIOR TO OPERATIONS

Electronic equipment will be tested prior to beginning operations each day, and the results recorded in the team logbook or on forms. All tests will be reported to the lead on-site quality representative for inclusion in the daily report.

GPS devices will be checked against know points before use to ensure accuracy during use.

Handheld geophysical sensors will be checked in an established test strip or against a piece of metal on the surface before daily operations begin.

Vessels, utility, or passenger vehicles will be inspected daily for damage and operability. Inspection forms will be submitted to the site safety officer weekly.

5.0 OPERATIONS

5.1 PROJECT BRIEFS

The following briefs will be given and documented before conducting mechanized and/or underwater demolition operations:

- Operation overview
- Team assignments
- Type and condition of expected MEC
- Dive Plan
- Demolition Plan
- Emergency procedures

In addition, a briefing by the project biologist and/or client regulatory representative may be required based on the requirements identified after completion of the ESA coordination process.

5.2 TARGET REACQUISITION

Targets will be reacquired by navigating to the target site using the Shark Marine Navigation system or a GPS unit and deploying a master reference buoy (MRB) offset by 10 feet down current from the location of the target. The anchor will be a soft anchor, such as a sandbag or soft dive weight, and lowered by hand to the bottom. The diver will deploy on this MRB. If the target is buried or in case of low visibility, the diver should utilize search equipment. The diver will then navigate to the last known position indicated by the Shark Marine Dive Tablet (SM) (if used) to reacquire the MEC. If GPS is used, the diver will conduct a circle line search around the MRB to reacquire the MEC. Once the MEC is reacquired, the diver will affix a marker float directly to the target. The diver will then proceed with RTB procedures (described in 5.3) or underwater detonation procedures (described in 5.4).

5.3 RECOVERY USING HIGH AND LOW INPUT MECHANIZED PROCEDURES

Where an underwater detonation is not permitted, land demolition operations must be carried out. MEC determined as unacceptable to move, or any MEC that is of a size and weight that are acceptable to move but cannot be lifted and recovered by the UXO diver (or manually/ mechanically hoisted by dive boat personnel), will be remotely raised, towed to beach site, and remotely beached for follow-on disposal by detonation. Appropriate earthworks and earthen tamping will be employed to reduce the blast and fragmentation distances for the specific munition involved. It should be noted that the EZ for the munition involved must be observed during the RTB operations, as there is a possibility of the MEC detonating during such activities. Once beached, the MEC will be disposed of as outlined in the Tetra Tech UXO SOP MEC Management and Disposal, including the placement of donor explosives for the MEC encountered. Utilizing a main charge, detonating cord, and remote positive control initiation (using NONEL detonators as the primary and electric detonators as the secondary, in conjunction with the radio-controlled firing device).

The general process for mechanized operations using RTB are as follows:

- Lifts for MEC that are determined as unacceptable to move will involve the use of a remotely operated lifting device (e.g., Reverse cam or SUBSALV Orca remote lifting balloon)
- Lifts for MEC determined as acceptable to move can be manually transported to the designated disposal site using commonly used commercial salvage techniques. (e.g., commercial lifting balloons)
- Diver/s will reacquire the MEC using the SM or GPS described in paragraph 5.2.
- Diver/s will affix a lifting bridle, cargo net, or a mesh bag to the MEC if not part of the lifting system.
- Diver/s will attach the remote lifting system if not part of the bridle to the MEC.
- Diver/s will attach the tow line to the MEC.
- Diver/s surfaces and attaches the tow line to a preplaced transfer float (MRB used in reacquisition).
- After the dive team has recovered the diver, the tow vessel will transit to the transfer buoy and connect the tow line to the towboat bridal or bollard if equipped.
- After the tow vessel verifies that the EZs are clear of other vessel traffic and non-essential personnel, the tow vessel captain will request permission from the SUXOS to actuate the remote lifting device or remotely lift the MEC.

When the remote lift device reaches the surface, the tow vessel will ensure the MEC has been lifted, no unintentional detonation occurred, and MEC is stable. The towboat then slowly (headway speed) begins to tow the MEC on the approved route to the selected beaching site and transfer the tow line using another preplaced transfer buoy to the beach recovery team.

5.3.1 Upon Target Reacquisition

Upon target reacquisition, the diver/s will configure the selected attachment system (mesh bag, cargo net, or bridle) outlined in the project work plan.

5.3.2 Attach Remote Lifting Device (Reverse Cam/ MK V Orca/ Commercial Lift Bag)

If using the SUBSALV Orca Lift balloon set up using procedures outlined in the MK V Orca Operations and Maintenance Manual. For large MEC, Diver/s deploys on marker float carrying the lift balloon (with transfer line attached). A buoy will be clipped to the end of the transfer line. Diver attaches a lift balloon and opens the balloon air supply bottle. Diver/s ensures there are no obstructions to the valve release mechanism and returns to the surface following the transfer line.

When used, diver/s will rig commercial lift bags to MEC using approved methods outlined in the project work plan and the corporate DSPM.

For small MEC, diver/s will rig MEC using a reverse cam system. The reverse cam system consists of the tow rope, adequately sized tow buoy (Formula = 1 square feet for every 64 pounds), and a traxion pulley. This system will be attached to the bridle or other attachment system. The MEC will then be remotely pulled (by towboat) up to a designated depth using a stop knot, and the tow will commence using guidelines established in 5.3.3. ***Safety note: UXO Diver/s must return to the surface and be recovered before continuing operations.***

5.3.3 Actuate Remote Lifting Device/ Commence Tow

Towboat personnel will consist of: Coxswain, who drives the boat, Tender to handle lines, and Safety Observer, who continuously watches the balloon/load. The Safety Observer must be ready to jettison the tow line in the event of an emergency.

Towboat personnel (an assigned tender) will attach a tow line to the transfer line. The buoy will be disconnected from the transfer line and clipped to the end of the tow line if the line must be jettisoned. When the SUXOS gives permission, the towboat will execute the remote lifting method. Once on the surface, and if authorized by the SUXOS, a support boat may be used to verify the load is secured, undertow, and at the proper depth of tow. The MEC's depth will be selected for the tow depending upon the size and explosive weight of the MEC. This method is used to reduce the hazards of fouling, unintentional detonation, and damage to habitat. This also takes advantage of the DDESB-TP-16 BEM model using the water tamp to reduce the EZ during the tow as outlined in the Explosives Site Plan (ESP). The EZ will return to the MFD-Horizontal outlined in the ESP when the beaching phase of the MEC is outlined in 5.3.4.

Only the pre-approved and planned route to the beaching site will be used; alteration of the route is not authorized. Towboat should proceed only fast enough to maintain steerage. The towboat will initiate the tracking feature on the GPS if so equipped. The towboat will shorten the tow as required for safe navigation and maneuverability through restricted areas. Proper signals will be displayed to alert nearby mariners of restricted movement. Safety boats will provide security from any approaching vessels and observers for ESA species.

5.3.4 Beaching Operation

A basic beaching operation site setup is outlined in Appendix 2.

The towboat will connect the MEC being towed to the beaching line at the Transition Buoy. Lines will be attached using a shackle. The towboat will then move toward the second buoy and attach to the beaching line. A buoy will be clipped to the end of the beaching line if the line must be jettisoned. Resume the tow until the balloon/load is on the beach at the preselected location. The towboat will then slacken the line and disconnect from the tow. Refer to the project work plan and the UXO SOP MEC Management and Disposal for disposal procedures.

5.4 UNDERWATER MEC DISPOSAL

This section addresses identified/recovered MEC that will be disposed of using BIP or consolidated underwater shots. However, no underwater explosive detonations (BIP, consolidated shots, or deep-water disposal) are allowed unless coordination with appropriate authorities has been completed to address endangered marine life concerns. All mitigation requirements shall be coordinated and in place for this activity. This coordination will take place with the understanding that underwater detonation would take place only if avoidance/minimization measures can be implemented in a way that avoids jeopardy of listed species or destruction and adverse modification of designated critical habitat. It is expected the field team will encounter the need for one or all the options listed below.

5.4.1 Blow-in-Place

MEC/MPPEH to be disposed of via explosive demolition using the BIP technology on the bottom of the water where located. Formal approval must be obtained from the local regulatory agency for this activity. This procedure will require a diver to deliver an explosive charge consisting of donor explosives (amount and placement depending on the MEC encountered), primed with a shockwave transmission method (e.g., detonating cord). Shockwave transmitter shall be 1 ½ to 3 times the anticipated depth of water. This will provide an adequate scope to the surface and secured with a flotation device/buoy. The charge will be secured to the MEC, and a strain relief will be provided for the detonating cord. The detonating cord will not be secured to the marker anchor but will have its own anchor (dog stake, sandbag, etc.) offset from the MEC location to provide adequate strain relief. When ready for detonation, the explosive supply vessel will approach the detonating cord float and attach the NONEL detonators for initiation.

5.4.2 Consolidated Shots

For MEC located in sensitive areas where BIP is not an option, one of two options, depending on individual circumstances, will be employed for disposal.

5.4.2.1 Shallow Water Disposal Area

A bottom survey will identify an underwater disposal area free of coral formations or other sensitive flora/fauna that cannot withstand an underwater detonation. This area should have a hard sand bottom, be between 30 and 50 feet of seawater, and protected from high-sea states, if possible. Once found and identified, this area will have a master reference buoy installed to mark the area's center. An EZ will be established based on the worst-case munition and depth of water per the Buried Explosive Module DDESB TP 16, or as provided by the remedial PM. The munition will be raised, towed, and allowed to rest on the bottom within this disposal area. The disposal will then be conducted in accordance with Section 5.5.

5.4.2.2 Deep Water Disposal Area

For deep-water disposal, the MEC will be recovered remotely and towed to the designated deep-water disposal area, estimated to be in excess of 100 feet in depth. This area will include a semi-permanent master reference disposal buoy (MRDB), located in the center of the disposal area. From the MRDB, disposable buoys will be attached to the MRDB with 100 feet of line. The MEC will be suspended below these buoys at appropriate depths, depending on the MEC and water depth necessary to reduce the EZ to an acceptable level. This is assumed to be 30 to 50 feet in depth. Depending on the MEC, the donor charge can be placed on the MEC after being recovered into the explosive vessel. Then it can be lowered to the appropriate depth and suspended from the disposable buoys via a suspension line, not the detonating cord, which will be 3 times the depth of suspension, with the initiating end attached to a flotation device. If the MEC is not safe to move, it will not be recovered into the boat but towed and secured to the disposable buoy. A diver will then attach the donor charge, as described above. Depending on the MEC size, a substantial flotation device may be required to support it in the water column (e.g., large bombs may require several 55-gallon drums to provide adequate buoyancy for detonation).

5.5 UNDERWATER MEC DISPOSAL PROCEDURES

5.5.1 Disposal Shot Initiation

Initiation will be performed for in-water scenarios by placing and protecting the receiver of the radio-controlled firing device (RFD) in an improvised waterproof float assembly consisting of an inner tube or appropriate floatation device.

The NONEL or electrical leads connected to the receiver, and with adequate strain relief via small lines, so the NONEL or electric detonators are adequately protected when connected to the detonating cord. The RFD receiver must also be protected from the water environment, and a suitable separation provided from the detonating cord and RFD, when initiated, to protect the RFD receiver. The receiver is not an expendable item. All initiation components will be waterproofed using an appropriate sealant before deployment.

5.5.2 Shockwave Transmission Methods

The selected donor explosives are initiated by standard shockwave transmission methods using either a NONEL shock tube or a detonation cord. Detonation cord used for underwater demolition shall be reinforced and contain an explosive charge of at least 80 grams per foot. Shock tube and detonating cord components will be waterproofed using an appropriate sealant and reinforced with a strain relief method before deployment. Shock tube or detonating cord shall be 1 ½ to 3 times the anticipated depth of the donor explosive charge/ MEC. Longer lengths should be considered for deeper water depths if higher current or difficult sea conditions are anticipated.

5.5.3 Main Charge - Donor Explosives

The donor explosives used for MEC disposal are anticipated to include an appropriate main charge, detonating cord or shock tube, NONEL detonators as primary, electric detonators as primary, and a non-electric cap fuse as an alternative. A designated UXO technician/diver will perform all setup procedures as outlined in the project work plan, explosive safety plan or submission, and applicable Tetra Tech UXO SOPs. All donor explosive main charges will be waterproofed before deployment as required. All donor explosives will be stored following the project explosives site plan or submission.

5.5.4 Operation of the RFD

5.5.4.1 Preparation

Perform system preoperational tests and setup procedures using the operator’s manual. **Do not insert the RFD key from the controller unit until ready to fire.** The SUXOS/DS will maintain custody of the key until the demolition shot is ready for initiation.

- Place the receiver in the flotation device and ensure it is watertight. Ensure there is enough standoff to protect the receiver.
- Ensure the receiver indicates a READY condition for the selected initiation method (***GREEN READY*** light-emitting diode [LED] on steady, ***RED ARMED LED*** off).
- When using electric blasting caps, cut off a firing wire length that will reach between the receiver and the detonating cord.
- Conduct a continuity check of the firing wire with a galvanometer. Shunt the free ends of the wire to prevent an electric charge from building up in the firing wire.
- Test each electric blasting cap 50 feet downwind of other explosives with a galvanometer.
- Place blasting caps behind a barricade or under a sandbag before removing the shunt and testing for continuity.
- Fully extend the leg wires and ensure the cap is pointing away from the person conducting the continuity test.
- Secure the leg wires to prevent the cap from moving during the test.
- Use only a special silver-chloride dry cell battery in the galvanometer. (Other types of batteries may provide enough voltage to fire the blasting cap.)

- Upon completion of testing, shunt the leg wires. The wires will remain shunted until ready to connect to the firing circuit.
- Retrieve caps from the barricade, ensure there is a strain relief on the firing wire.
- Approach the detonating cord float and connect the blasting caps to the detonating cord's priming loop and the strain relief to the float, so the caps cannot be pulled out of the priming loop of the detonating cord.
- For dual priming, connect blasting caps in a parallel circuit to the firing wire.
- Test the circuit with the galvanometer, and then connect the firing wire to the receiver.
- Allow the receiver float to trail downwind/current of the detonating cord float.
- Withdraw to the safe area outside of the EZ and prepare to fire the RFD.

5.5.4.2 Firing the RFD

The SUXOS will verify the EZ is clear, then give the pre-blast warnings. After sounding the 5- and 1-minute warnings on the air horn/siren and radio, the SUXOS/DS will insert the RFD key, turn the POWER switch on the controller to the right until the BATTERY LED illuminates, and perform the following procedures:

- Momentarily depress the controller STATUS button. The ***YELLOW TRANSMIT LED*** will flash for approximately 1 second. At the end of that time, a ***GREEN READY LED*** will become steady, indicating that the remote is on and in standby mode. The steady ***GREEN LED*** also indicates the remote is within range of the controller.
- Push the ARM/DISARM switch to the left and hold for 1 second. The ***RED ARMED LED*** will flash for approximately 18 seconds and then become steady. The remote is now armed.
- The SUXOS/DS will request permission to fire from the UXO Safety.
- The SUXOS/DS will then give three loud “Fire-in-the-Hole” warnings.
- The SUXOS/DS will give the command to fire the shot.
- The SUXOS/DS will then lift the safety cover on the FIRE switch and push the FIRE switch forward.

5.5.4.3 Misfire Procedures for the RFD

The SUXOS/DS will perform the following if there is a misfire:

- Make three successive attempts to fire.
- Turn off the controller and remove the key.
- Wait 60 minutes from the last initiation attempt if using NONEL or an electric firing train.
- After the wait time has elapsed, the SUXOS/DS and a safety observer will proceed via a small boat to inspect the float's firing system.
- If NONEL was used, do not remove the detonators from the detonating cord. Disconnect NONEL from the igniter tip on the receiver. Place a new NONEL detonator with lead on the igniter tip and attach it to the detonating cord priming loop.
- If electric caps were used, do not remove the old blasting caps from the detonating cord, but disconnect the firing wire from the receiver and shunt the firing wire.
- Prepare a new firing wire with dual caps. Attach to the detonating cord, as described above.

5.5.5 Non-Electric Blasting Cap and Time/ Safety Fuse

If the RFD is inoperable or not available, the secondary means of initiating the explosives will be a non-electric cap and time fuse. The SUXOS/DS will adhere to the following setup, firing, and misfire procedures.

5.5.5.1 Preparation

- Prior to each daily use, the time/safety fuse's burn rate must be tested to ensure the accurate determination of the length of time/safety fuse needed to achieve the minimum burn time of 5 minutes required to conduct demolition operations.
- Using approved crimpers, cut 6 inches off the end of the roll of time/safety fuse.
- Cut a 6-foot length of fuse from the roll and attach an igniter.
- In a safe location, ignite the fuse and measure the ignition time to spit at the 6-foot fuse end. Note this time in seconds. Divide by 6, which will give you the burn rate per foot of fuse.
- The minimum time to be used on any demolition shot will be no shorter than 5 minutes burn time, or, in this case, the minimum time required to travel outside the EZ from the time the igniters are pulled.
- Dual priming will be used. Cut two lengths of time/safety fuse from the same roll as needed to provide the required escape time. Attach igniters to one end of each length.
- Using an approved crimper, attach one No. 8 or equivalent non-electric blasting cap to the other end of each length of time/safety fuse.
- Tape the two systems together and add flotation along the length (bubble wrap works well for this). The firing system is now ready for priming.
- Cushion and protect the blasting caps for transit in the boat to the detonating cord priming loop.

5.5.5.2 Priming and Firing the Non-Electric Blasting Cap and Time/Safety Fuse System

- The SUXOS/DS will verify the EZ is clear with the UXOSO.
- The SUXOS/DS and one UXO technician/diver will approach the detonating cord float and attach the blasting caps to the detonating cord priming loop.
- The SUXOS/DS will request permission to fire from the UXOSO on the support vessel.
- The UXOSO will sound the 5- and 1-minute warnings on the air horn/siren and radio.
- The SUXOS/DS, when permission is granted, will provide three loud “Fire in the Hole” commands verbally and one via the radio, and then pull the igniters, noting the time when pulled.

5.5.5.3 Misfire Procedures for the Non-Electric Blasting Cap and Time/Safety Fuse System

The SUXOS/DS will perform the following misfire procedures:

- Observe a wait time of 60 minutes from the expected time of detonation.
- Prepare another firing system, as described above.
- After the wait time has elapsed, the SUXOS/DS and one UXO technician/diver will proceed to the detonating cord float to inspect the firing system.
- Leave the old caps and firing system in place. Attach the new system to a clean area on the detonating cord priming loop.
- Follow the procedures above for initiation.

5.5.6 Post-Demolition Procedures

Upon completion of the demolition operation, the procedures described below will be followed by all personnel or the designated UXO technicians, as appropriate:

- Wait a minimum of 5 minutes after a single shot or after a series of shots in which all detonations are accounted for. Wait a minimum of 30 minutes after shots that could not be counted.

- A confirmation dive may be required to confirm the MEC was successfully detonated depending on the MEC's size and depth of detonation, and whether the MEC was detonated on the bottom or in the water column. For larger MEC, this may be obvious from the detonation plume, but smaller MEC may not break the water's surface, again depending on the depth of water and position in the water column.
- The inspection dive will determine the MEC condition, a high order detonation, a low order detonation, or possibly mechanical damage. The inspection dive will also ascertain any damage to the bottom or surrounding area.
- If the MEC was low ordered, all pieces will be collected at the site, and a second attempt will be performed.
- The dive team will recover munitions debris after the disposal shot and will process the recovered metal following the material documented as safe screening process.

6.0 QUALITY CONTROL (QC)

QC for this SOP will be achieved through visual checks of the definable feature of work, completing the QC Checklist for removal of MEC in a marine environment, and performance metrics identified in the plans are met. The checklist will be filled out and signed by the on-site quality lead or designee upon completing the mechanized operations.

6.1 MEASUREMENT QUALITY OBJECTIVES

The Measurement Quality Objectives (MQOs) for removing MEC in a marine environment are presented in the project plans. Results will be documented in the team logbooks and the daily field management team's reporting.

6.2 REPORTING

The SUXOS/DS will provide input and updates to the project MEC Accountability Log, the SUXOS/DS, UXOQCS, and UXOSO will provide input and updates using reporting procedures from this SOP and as outlined in the project work plan.

6.3 QC CHECKLIST FOR REMOVAL OF MEC IN A MARINE ENVIRONMENT

TEAM INFORMATION		
Team:	Location:	Date:
Team Leader:		
Personnel Present:		
Contract #:		
Task Order #:		

QC CHECKLIST POINTS

Item	Ref.	Inspection Points	Yes	No	N/A	Comments
1	UXO SOP X	Have personnel read and signed the workers' statement?				
2	UXO SOP X	Has the equipment been checked out, and is it documented correctly?				
3	UXO SOP X	Are daily position checks within specified tolerances if the GPS is used?				
4	UXO SOP X	Have the appropriate MQOs been achieved for removal of MEC in a marine environment?				
5						

FINDINGS

Item	Comments

Signature:

UXOQCS or Designee: ______________________ Date: ____________

APPENDIX 1 MECHANIZED OPERATIONS EQUIPMENT CHECKLIST

TETRA TECH

MECHANIZED OPERATIONS EQUIPMENT CHECKLIST

Equipment List

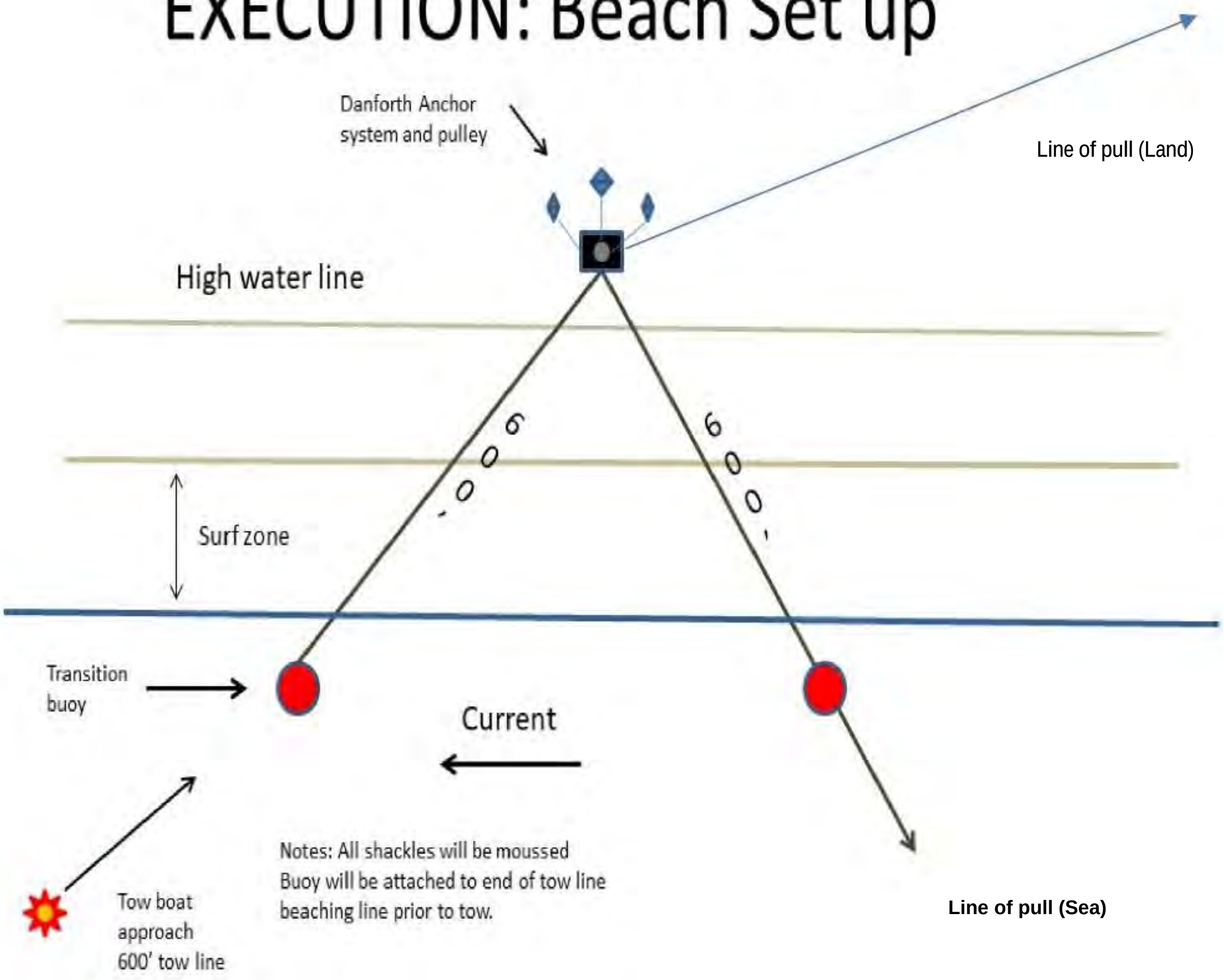
Equipment	Quantity	Comments
Dive Support Boat		
Tow – Transport Boat		
Towing Day Shape (Ball/Diamond/Ball)		
Support Vessel(s)		
Handheld Radios (Marine Band)		
Cellular Telephones		
GPS		
Lift System (MK V Orca)		
Towline - AMSTEEL FLOATING		
Beaching Line - AMSTEEL FLOATING		
Transition Buoy System		
Sandbags		
Shackles (assorted sizes)		
Fairlead/Pully		
3-Anchor System/ Deadman		
3’ Augers		
Shovel		
Buoys (small)		
Quick-release System/Pelican hook		
Load Attachment System (Bridle/Cargo		
Binoculars		
Knife		
U/W Locator		
Traxion Pulley/ (Reverse) Cam		

Checklist Verification

SUXOS Signature:	Date:

APPENDIX 2 MECHANIZED OPERATIONS BEACHING SETUP

EXECUTION: Beach Set up



Notes: All shackles will be moussed
Buoy will be attached to end of tow line beaching line prior to tow.

APPENDIX 3 DEMOLITION EQUIPMENT CHECKLIST

TETRA TECH

DEMOLITION EQUIPMENT CHECKLIST

Equipment List

Equipment	Quantity	Comments
Explosive Vessel(s)		
Support vessel(s)		
Camcorder/Digital Camera		
Siren		
Air Horn		
Handheld Radios		
Cellular Telephone(s)		
Electronic Firing Device		
Radio Controlled Firing Device		
Ruler, 24-inch		
Fisher U/W Locator		
Shovel, round point, long handle		
Shovel, round point, short handle		
Blasting Machine		
Tape, duct		
Tape, measuring, 50- or 100-meter		
Tape, plastic		
Toolbox, general hand tools		
Galvanometer		
Firing Wire		
Demolition Kit without Donor Explosives		
Knife		
Floats/buoys		
600’ ¼ inch nylon line		
Zip Ties		

Checklist Verification

Demolition Supervisor Signature:	Date:

APPENDIX 4 HEALTH AND SAFETY EQUIPMENT CHECKLIST

TETRA TECH

HEALTH AND SAFETY EQUIPMENT CHECKLIST

Equipment List

Equipment	Quantity	Comments
Air Horn, emergency		
Burn Blanket		
Burn Kit		
Emergency Eye Wash		
Fire Blanket		
Fire Extinguisher, 10-pound ABC		
Bloodborne Pathogen Kit		
First Aid Kit		
Gloves, leather		
Goggles		
Face Shield(s)		
Welders' Gloves		
Welders' Apron(s)		
Rain Suit(s)		
Safety Vest(s)		
Stretcher		
Water, 5-gal bottle (emergency shower)		
Water, drinking - 1 liter per person		
Personal Flotation Devices		
Other:		

Checklist Verification

Demolition Supervisor Signature:	Date:

APPENDIX 5 GENERAL SAFETY PRECAUTIONS

GENERAL SAFETY PRECAUTIONS

General and Pre-Detonation

1. Carry blasting caps in approved containers and keep them out of the direct rays of the sun. Keep the caps located at least 25 feet from other explosives until they are needed for priming.
2. Do not work with electric blasting caps or other electro-explosive devices while wearing clothing prone to producing static electricity (e.g., nylon, silk, synthetic hair).
3. Do not use explosives or accessory equipment that is obviously deteriorated or damaged. They may cause premature detonation or fail completely.
4. Always point the explosive end of blasting caps, detonators, and explosive devices away from the body during handling.
5. Use only standard blasting caps of at least the equivalent of a commercial No. 8 blasting cap.
6. Use electric blasting caps of the same manufacturer for each demolition shot involving more than one cap.
7. Do not bury blasting caps. Use detonating cord to transmit the explosive wave from the blasting caps, on the surface, to a buried/tamped explosive charge. Buried blasting caps are subject to unobserved pressures and movement, leading to premature firing or misfires.
8. Test electric blasting caps for continuity at least 50 feet from any other explosives before connecting them to the firing circuit. Upon completion of testing, the lead wires will be shunted by twisting the wires' bare ends together. The wires will remain shunted until ready to be connected to the firing circuit.
9. MECs with lugs, strong backs, tail-booms, base plates, etc., should be oriented away from personnel locations.
10. Consideration should be given to tamping the MEC to control fragments if the situation warrants. Fragments will be minimized to protect personnel and property, such as buildings, trees, etc.
11. Loose initiating explosives (tetracene, lead styphnate, mercury fulminate, and lead azide) manifest extreme sensitivity to friction, heat, and impact. Extra precautions are required when handling these types of explosives. Always keep initiating explosives in a water-wet condition until ready for final preparation for detonation. The sensitivity of these explosives is significantly increased when dry.
12. Exercise extreme care when handling and preparing high explosives for detonation. They are subject to detonation by heat, shock, or friction.
13. Do not pack bomb fuze wells with explosives unless it can be positively confirmed that the fuze well does not contain any fuze components.
14. Photo flash bombs must be handled with the same care as black powder-filled munitions.
15. Know and observe federal, state, and local laws/regulations, which apply to the transportation, storage, and use of explosives.
16. Do not permit metal, except approved metal truck bodies, to contact explosive containers.
17. Do not transport metal, flammable, or corrosive substances with explosives.

GENERAL SAFETY PRECAUTIONS

18. Do not allow smoking or unauthorized personnel in vehicles transporting explosives.
19. Carefully load and unload explosives from vehicles. Never throw or drop explosives from the vehicle.
20. Ensure the load is blocked and braced to prevent it from movement and displacement.
21. Do not drive vehicles containing explosives over public highways until all permits and certifications have been obtained from state enforcement agencies.
22. All routes must be approved in writing before transporting explosive materials over public highways.
23. Licensed commercial carriers will conduct the shipment of explosive materials over public highways.
24. Never leave a vehicle loaded with explosives unattended.
25. Do not store blasting caps, detonators, or other items containing initiating explosives in the same box or container with other explosives.
26. Do not use any alkaline material such as lye, washing soda, or soap to remove TNT exudate. Alkaline materials will react with TNT to render it more sensitive.
27. Do not permit smoking, matches, or other fire or flame sources within 100 feet of an area in which explosives are being handled.
28. Do not expose explosives or devices containing explosives to direct sunlight. Prolonged exposure can increase sensitivity and deterioration.
29. Do not carry explosives or explosive components in pockets or on the body.
30. Do not use pull rings or safety pins to lift or handle explosive devices.

Detonation

31. Do not use improvised methods for initiating blasting caps.
32. In the event of a misfire when disposing of explosives by detonation, do not approach the disposal site for at least 30 minutes after the expected detonation time when firing electrically. When conducting non-electric procedures, the wait time will be at least one hour from the expected time of detonation.
33. Anticipate a high-order detonation when burning pyrotechnic or incendiary-loaded MEC. Safety measures for personnel and property must be based on this possibility.
34. Maintain minimum safe distances between electromagnetic-radiating sources and electro-explosive devices in accordance with EODB/TM-TO 60A-1-1-12.
35. Do not conduct blasting or demolition operations during an electrical, dust, sand, or a snowstorm severe enough to produce atmospheric static electrical charges or when such a storm is nearby (within 10 miles). All operations will be suspended or terminated under such conditions, cap and lead wires shunted, and personnel removed from the demolition area. Demolition operations will also be terminated if visibility becomes less than 600 feet.
36. MEC containing white phosphorous will not be detonated into the ground. White phosphorous munitions will be counter-charged on the bottom centerline (CCBC) when possible.

GENERAL SAFETY PRECAUTIONS

37. Do not allow any wood, paper, or other materials used in packing explosives to be burned in a stove, fireplace, or other confined space or to be re-used for any other purpose. The donor explosives delivery subcontractor will remove such materials.

38. Do not insert anything but a time fuse or detonating cord into the open end of a blasting cap.

39. Do not strike, tamper with, or attempt to remove or investigate the contents of an electric/non-electric blasting cap, detonator, or other explosive initiating devices. A detonation may occur.

40. Do not pull on the electrical lead wires of electric blasting caps, detonators, or electro-explosive devices. A detonation may occur.

41. Do not attempt to remove an unfired or misfired primer or blasting cap from a base coupling. There is a high risk of an explosion.

42. Do not allow unauthorized or unnecessary personnel to be present when explosives are being handled.

43. Always point the explosive end of blasting caps, detonators, and other explosive devices away from the body.

Post-Detonation

44. Avoid inhaling the smoke, dust, or fumes of burning pyrotechnic or incendiary materials. The smoke, dust, and fumes from many of these materials are irritating and/or toxic if inhaled.

45. Do not use water on incendiary fires. Water may induce a violent reaction or be completely ineffective, depending on the mixture.

46. After the demolition operation, a search of the detonation site will be conducted to ensure complete disposal was accomplished.

47. Do not abandon any explosives.

48. Do not leave explosives, empty cartridges, boxes, liners, or other materials used in the packing of explosives lying where children, unauthorized persons, or livestock can approach them.

49. Do not fight fires involving explosive material. Evacuate all personnel to a safe location and secure the area.

50. Ensure all unused explosives are returned to their proper containers and ensure the container is closed after use.

APPENDIX 6 DEMOLITION OPERATIONS CHECKLIST

TETRA TECH

DEMOLITION OPERATIONS CHECKLIST

FUNCTION	DATE/TIME	SIGNATURE
Senior UXO Supervisor		
Assign Demolition Team		
Brief Demolition Team: - Review emergency procedures - Discuss MEC to be disposed - Describe disposal procedures		
Inspect range/EZ upon completion of operations		
Disposal Supervisor		
Verify roads are closed		
Verify EZ boundaries are in place		
Complete health and safety and equipment checklists		
Ensure the command center has completed the verification checklist: - Range Control - Medical Facility, - Fire Department, - Security/Police Department		
Demolition Supervisor tailgate safety brief: - Designate emergency vehicles - Designate emergency evacuation route - Review emergency-response		
Verify daily equipment inspection		
Verify detonators are separated from explosives		
Verify area has been evacuated		
Notify command center when operations are commencing		
Start demolition activities		
Inspect shot after the designated wait time		
Collect all metal fragments for later disposal		
Quality Control (QC) check performed		
Stop demolition activities		
QA check (if required)		
Tetra Tech notifications upon completion: - Notify client - Responsible activity - Medical facility - Fire department - Security/Police department		
Complete MEC Accountability Log		
Demobilize		
Record data in Explosive Demolition Log		
Approval		
Demolition supervisor signature:		Date:

APPENDIX 7 EXPLOSIVE DEMOLITION LOG

TETRA TECH

EXPLOSIVE DEMOLITION LOG

Project Information

Project Name:

Start Time:

Project Location:

Stop time:

MEC/MDEH Disposed of This Date (List items and quantity of each item.)

Donor Explosive Used (List types and quantity.)

Remarks

Approval

Demolition Supervisor:	Date:

UXO SOP for Underwater Intrusive Investigation Operations

RECORD OF DEVELOPMENT, REVIEW, VALIDATION, AND APPROVAL

This Standard Operating Procedure (SOP) contains the procedures by which Tetra Tech, Inc will conduct Intrusive Investigation Operations for munitions response projects. Any changes or deviations will be included in the project plans and approved by the Director of Technical Operations and Explosives Safety. SOPs will be reviewed annually.

Diving Program Manger Scot Wilson, PMP		Date:	May 19, 2021
Diving Safety Officer Patrick Tatman		Date:	May 19, 2021

Review Date	Reviewer	Next Review

SUPERVISOR'S STATEMENT

I have read and understood this SOP. To the best of my knowledge, the procedures described in this SOP can be performed in a safe, healthful, and environmentally sound manner. I have confirmed that all persons assigned to this process are qualified, have read and understood the requirements of this SOP, and have signed the worker's statement for this purpose. I will ensure the SOP contains current procedures. If a major change to the SOP is necessary, I will ensure active processes are suspended until the SOP is revised and approved. If unexpected safety, health, or environmental hazards are identified, I will make sure the process is stopped until the hazards have been eliminated.

SUXOS/ Diving Supervisor Date

WORKER'S STATEMENT

I have read UXO SOP – Underwater Intrusive Investigation Operations and received the training necessary to demonstrate my capability to perform the procedures addressed in this SOP. If I identify a hazard not addressed in this SOP or encounter an operation I cannot perform in accordance with this SOP, I will stop the process and notify my immediate supervisor.

Worker's Name	Date	Supervisor's Name	Date

TABLE OF CONTENTS

ACRONYMS AND ABBREVIATIONS

AHA	activity hazard analysis
AOI	areas of interest
BEM	buried explosion module
DDESB	Department of Defense Explosives Safety Board
DGM	digital geophysical mapping
DMM	discarded military munitions
DS	diving supervisor
ESP	explosives site plan
ESS	explosive safety submission
ETA	equipment test area
EZ	exclusion zone
GPS	global positioning system
JSA	job safety analysis
MC	munitions constituents
MD	munitions debris
MDAS	material documented as safe
MEC	munitions and explosives of concern
MPPEH	material potentially presenting an explosive hazard
MQO	measurement quality objective
MSD	minimum separation distance
NMRD	non-munition related debris
PDA	personal digital assistant
RRD	radiological dispersal device
SM	shark marine dive tablet
SOP	standard operating procedure
SUXOS	senior UXO supervisor
TL	team leader
TP	technical paper
U.S.	United States
UXO	unexploded ordnance
UXOQCS	UXO quality control specialist
UXOSO	UXO safety officer

1.0 PURPOSE AND SCOPE

The purpose of this Standard Operating Procedure (SOP) is to provide procedures and technical guidance for the Underwater Intrusive Investigation Operations at designated munitions response sites. These operations include:

- Mag and Dig Operations
- Target Investigation of Targets and Areas of Interest (AOI) as a result of geophysical data collection

All training on equipment or software will be either formal or on-the-job training. This training will be documented by site personnel and subject to review for accuracy and completeness. The Unexploded Ordnance (UXO) Quality Control Specialist (UXOQCS) will verify training is complete and documented.

2.0 PERSONNEL, EQUIPMENT, AND MATERIALS

This section describes the personnel, equipment, and materials that may be required to implement this activity.

2.1 PERSONNEL

The following individuals or vendors may be involved in Underwater Investigation activities:

- UXO divers qualified in accordance with the United States (U.S.) Department of Defense Explosives Safety Board (DDESB) technical paper (TP) 18, Minimum Qualifications for Personnel Conducting Munitions and Explosives of Concern-Related Activities (DDESB 2015).
    - Senior UXO supervisor/diving supervisor (SUXOS/DS). Responsible for planning, directing, and executing all field operations.
    - Field UXOQCS. Responsible for all aspects of project quality.
    - Project UXO safety officer (UXOSO)/site safety and health officer. Responsible for all aspects of health and safety on the project site.
    - UXO divers. Responsible for performing the intrusive investigation operations under the guidance and direction of the SUXOS/DS.
    - Geophysical personnel as required by the project work plan.
- Subcontractors (Marine/Boat services, biologist/marine mammal observer, geophysics technicians, Security support, etc.)
- Visitors or other site personnel

2.2 EQUIPMENT

- Personal protective equipment outlined in the Activity Hazard Analysis (AHA)/Job Safety Analysis (JSA)
- Hand-held geophysical instruments - underwater all metals detectors.
- Global Positioning System (GPS) Unit / Shark Marine Dive Tablet (SM).
- Underwater capable cameras.
- Operations support vehicles.
- Marker floats or buoys with appropriate anchoring as authorized in the project work plan.

- Support vessels, small boats as required.
- Health and safety equipment per Pre-Operation Checklists.
- Diving equipment as outlined in the project work plan and the Diving Safe Practices Manual.

3.0 PROCEDURES AND GUIDELINES

The SUXOS, UXOSO, and UXO Team Leader (TL) will review the site terrain and determine the best approach available in the project work plan for intrusive investigation operations. Any inaccessible locations will be documented in the field logbook. Any changes to the procedures will be made by a field change request as outlined in the project work plan.

3.1 EQUIPMENT SET-UP

Materials or equipment received at the site will be inspected for serviceability and against purchase order requirements or operations manuals. Photos will be taken and filed with the daily quality control reports, the quality receipt inspection report, or equivalent record.

Analog metal detector sensors will be assembled with fully charged batteries and tested for functionality at an Equipment Test Area (ETA) prepared under the direction of the UXOQCS. The test strips will include a collection of Industry Standard Objects buried at depths and orientations defined in the Quality Assurance Project Plan or equivalent planning document. This will simulate the size and depth of the targets expected at the project site. Sensors will be tested at the ETA before beginning operations each day, and the results recorded in the team logbook or on forms. All tests will be reported to the UXOQCS for inclusion in the daily report.

GPS or Robotic Total Station positioning systems will be assembled and operated following the appropriate civil survey SOP. This includes daily equipment checks and data recordings as appropriate to their use in support of Underwater Intrusive Investigations.

Cameras, when used, will have video cards and batteries checked as applicable.

All tests will be reported to the SUXOS/DS and the UXOQCS for inclusion in the daily reporting.

3.2 EXCLUSION ZONES, ENGINEERING CONTROLS, AND ROAD CLOSURES

Engineering controls should be employed whenever possible to minimize the damage from demolition operations. These controls may consist of sandbags, ecology blocks, trenching, buttressing, taping of glass, mounding, flooding and/or venting to reduce the effects of detonations.

During underwater intrusive activities (*designated as unintentional detonation operations*), the open-air exclusion zone for vessels and non-essential personnel will be the hazardous fragment distance for the munitions with the greatest fragmentation distance of the approved project Explosive Safety Submission (ESS) or Explosives Site Plan (ESP) as appropriate. Underwater minimum separation distances (MSDs) will be provided by the U.S. Army using the U.S. Army Munitions Response Actions – Minimum Separation Distances (Relative to Impulse Water Pressure) from Underwater Detonations (Safe Separation Distance for Swimmers and Divers) SAIE-ESOH Memorandum, dated 16 Sep 2013 and the most recent buried explosion module (BEM) model. All vessels and personnel at the water surface will be outside of the Blast Withdrawal Distance or the Maximum Fragment Distance, whichever is greater, as calculated using the BEM. If an underwater intentional detonation is permitted, then depth of water will be factored into the BEM and used as an engineering control.

The SUXOS will ensure exclusion zone (EZ) barricades are set up with signs at all access roads and marked appropriately: Danger, UXO Remediation Project in Progress, DO NOT ENTER, and list contact information on the barricade sign. If roads/water areas cannot be blocked, guards will be posted, and work halted if non-essential personnel enter the MSD. The explosives of concern (MEC) intrusive operations will not resume until non-essential personnel have exited the MSD.

4.0 OPERATIONS

4.1 GENERAL SAFETY

The most pertinent rules for handling munitions and MEC are summarized below:

- Underwater Investigation activities will not be conducted until the required training and proper equipment checks have been completed, documented, and the appropriate EZ is established, marked, and secured.
- A designated DS with a dive team consisting of a minimum of four personnel will perform MEC investigation, reacquisition, and recovery operations.
- The UXOSO will be stationed on-site and will maintain visual contact to the best extent possible with the dive and demolition teams downrange during field operations. The UXOSO will maintain communications with the team and the Tetra Tech site office.
- The appropriate authorities will identify all utilities prior to intrusive operation.
- Appropriate supervisors will be notified immediately of all MEC or suspected MEC finds as outlined in the project work plan.
- Non-UXO personnel must always be escorted by UXO-trained personnel after receiving a site safety briefing and 3R training in areas potentially containing MEC.
- If MEC is encountered that presents an immediate threat to life or property, it will be marked and secured until a plan for the item's safe disposition has been made and approved.
- UXO personnel must always remain on site when non-UXO personnel are conducting intrusive operations.
- Personnel will not collect souvenirs under any circumstances.
- If non-essential personnel are encroaching upon the site, all intrusive operations will be suspended immediately until resolved.
- Suspend all operations immediately upon the approach of an electrical storm (within 10-miles). All personnel will shelter as identified in the project work plan or as directed by the UXOSO.
- Assume munitions contain a live charge and are ready to fire until determined otherwise.
- Make every effort to identify the munitions. Carefully examine the munition for markings and other identifying features such as shape, size, and external fittings. Do not move the suspected munition until it is identified and confirmed acceptable to move by the SUXOS and UXOSO.
- Plan for, provide, and know the measures to be taken in the event of an accident.
- Provide a designated emergency vehicle (if applicable) in the area in case of an accident or an emergency.
- Always base operations on minimum exposure consistent with efficient operations.

- Do not rely on the color-coding of MEC for positive identification of contents. Munitions having non-existent, incomplete, or improper color codes may be present.
- Avoid the area forward of the ammunition's nose until it can be determined that the item is not a shape-charge or high-explosive anti-tank round. The explosive jet can be fatal to great distances forward of the item's longitudinal axis. Assume any shape-charge munitions contain a piezoelectric fuzing system until the fuzing is otherwise identified. Piezoelectric fuzes are extremely sensitive, can fire at the slightest physical change, and may remain hazardous for an indefinite period.

4.2 DAILY BRIEFING

After arriving at the worksite, the SUXOS/DS or designee will conduct a field operation brief at the work location. The UXOSO or designee will conduct a safety brief to all team members on potential hazards in the area and the operations conducted during the shift and review the AHA/JSA for the task. The following briefings will be given:

- Operation overview
- Team assignments
- Type and condition of expected MEC
- Dive Plan
- Emergency procedures

The TL will ensure hand-held instruments, GPS, communications equipment, safety gear, or other equipment are function checked and serviceable before beginning field operations. All daily meetings, briefs, and equipment checks will be documented in team logs and project forms outlined in the work plan.

4.3 INTRUSIVE OPERATIONS

4.3.1 Underwater Intrusive Investigation of Targets and AOI

Reacquisition of specific targets will be made using the SM or GPS to navigate the known anomaly location. The vertices of grid locations will be provided to the field teams. In general, grids will be systematically investigated, starting in the deeper, lower density areas and moving toward the shallower depths and high-density areas. The following are general descriptions of the options available to investigate underwater mini-grids and discrete anomalies using the SM or manual search methods, based on depth, bottom type, and the local environment:

4.3.2 Rectangular Mini grids

For rectangular mini-grids in water 3 to 4 feet or deeper, the investigation team will conduct a mini-grid lane search using a SCUBA diver(s) tethered to the SM. The diver(s) will utilize the SM, including self-contained navigation and underwater imaging system, providing the diver(s) with location, navigation, and situational awareness. The diver(s) will use the SM to descend to the entrance point (grid corner). Guided by the SM, the diver(s) will then swim and search each lane within the mini-grid, performing an analog instrument-assisted visual search.

As the diver(s) encounter anomalies, they will note the item's location, status, and condition and take a photograph using the SM underwater camera. At the completion of the search, the population of MEC and munitions debris (MD) within the mini-grid will be recorded. For areas with coral, rock, or another hard substrate, the diver(s) will conduct an analog instrument-assisted visual search. In areas with soft substrate or seagrass, the diver(s) will use the SM for navigation and a hand-held metal detector to help locate anomalies.

If an anomaly is buried in a soft substrate, the diver(s) will use their hands or small hand tools to excavate down to the anomaly until an identification can be made. If the diver(s) have not reached the anomaly after excavating to a predetermined depth or the depth of refusal, the anomaly will be labeled accordingly in the Access database Intrusive Results table.

If the SM cannot be used, a manual jackstay search pattern (two marker buoys with sandbag anchors placed by GPS location and a highway line between them on the bottom) may be used.

4.3.3 Circular Mini-Grids

For circular grids in water 3 to 4 feet or deeper, the investigation team will conduct diving operations using a SCUBA diver(s) tethered to the SM. The diver(s) will use the SM to descend to the center of the grid. Guided by the SM, the diver(s) will perform a search pattern expanding around the center point until the entire circular grid is investigated. As the diver(s) encounter anomalies, they will note the item's location, status, and condition and take a photograph using the SM underwater camera. At the completion of the search, the population of MEC and MD within the mini-grid will be recorded. If an anomaly is buried in a soft substrate, the diver(s) will use their hands or small hand tools to excavate down to the anomaly until an identification can be made. If the diver(s) have not reached the anomaly after excavating to a predetermined depth or the depth of refusal, the anomaly will be labeled accordingly in the Access database Intrusive Results table.

If the SM cannot be used, a manual circle line search pattern (one marker buoys with sandbag anchor placed by GPS location and a manual circle line search pattern attached) may be used.

4.3.4 Shallow Water

For anomalies that are located in water shallower than 3 to 4 feet, the investigation team will use either snorkeler(s) or technician(s) on a paddleboard(s) (lying down or seated in a position to ensure legs are not dangling in the water) who can investigate the anomaly from the surface, or technician(s) wading in shallow non-coral areas where contact with the bottom is feasible. A preliminary identification will be made, the item's location, status, and condition will be recorded, and a photograph will be taken using the SM camera. For either option, the snorkeler(s)/technician(s) will be equipped with a GPS capable of recording the target's location.

For AOIs in water shallower than 3 to 4 feet, the investigation team will conduct mini-grid searches over areas delineated with GPS boundaries. The geometric shapes of these areas will be selected to correspond to the shapes of the AOIs. To investigate these areas, UXO snorkeler(s) or technician(s) will use a paddleboard to investigate the target from the surface, or technician(s) wading in shallow non-coral areas where contact with the bottom is feasible. A preliminary identification will be made, the item's location, status, and condition will be recorded, and a photograph will be taken. For either option, the snorkeler(s)/technician(s) will be equipped with a GPS capable of recording the target's location. At the completion of the search, the population of MEC and MD within the mini-grid and its status and condition will be recorded.

If MEC is found, it will be left in place, documented as outlined in the project work plan, and clearly marked. The UXO diver will notify via a post-dive debrief the TL, SUXOS, and UXOSO or their findings.

4.3.5 Underwater Mag and Dig Operations

The general intrusive investigation procedures for mag and dig operations are:

- For mag and dig operations, establish a search area within the grid or transect as outlined above;
- If SM navigated pattern is used; diver/s will guide the SM operator while swimming forward slowly down the search lane sweeping the head of the analog sensor smoothly from side to side;

- If the manual search pattern is used; diver/s will guide on the lines while swimming forward slowly down the search lane sweeping the head of the analog sensor smoothly from side to side;
- Ensure the sensor head exceeds the width of the search lane to slightly overlap the adjacent lane;
- A wide-head electromagnetic analog sensor requires an overlap of one-half the head's width to perform an effective search. The sensor head must be parallel to the ground surface. Keep the head close to the ground;
- The sensor head must be kept at a constant height throughout the sweep;
- Each pass across a search lane should take 2-3 seconds;
- Investigate every anomaly detected that is consistent with the smallest munition anticipated at the site;
- Do not be deceived by a dull or low volume signal from a sensor. Deep targets do not necessarily produce a loud or sharp signal;
- Define the extent of the anomaly using the analog sensor;
- Technicians may use hand tools if sediment conditions permit;
- Using a shovel, trowel, or other suitable tools, remove sediment in small amounts from the side of the anomaly and work inward toward the anomaly;
- Once the anomaly is uncovered, characterize it as described in this SOP;
- Recheck the excavation with the analog sensor and continue clearing the anomaly if necessary;
- When restarting the sweeping activity, back up a foot and begin sweeping. This should ensure that no residual target is present in the excavation;
- Backfill any excavation after completing documentation unless otherwise instructed; and
- Continue the process until the assigned area/lane is complete.
- TLs will verify dig sheets/personal digital assistant (PDA) are filled out correctly, are complete, correct, standardized nomenclature is used, and no-finds are listed. MEC requires positive identification on the dig sheet. The gross weight of material documented as safe (MDAS) per grid is documented separately. Location and depth of item are recorded.
- Blind seed items must be recovered and correctly identified/documented.

4.3.6 Underwater DGM Target Investigation

The specific intrusive investigation procedures for digital geophysical mapping (DGM) target investigations are:

- The selected targets from the DGM data are marked with target buoys using the appropriate positioning system/s;
- Each target will be investigated to the radius and depth defined in the work plan bypassing the analog sensor over the ground's surface and then investigating all contacts identified within the search radius. The search radius may be extended by the geophysical data processor and noted in the dig sheet.
- After prosecution of the target to the extent required, the analog metal detector will verify any remaining signature is less than the threshold criteria selected for the project. Once complete, the target buoy may be recovered and documented to indicate a completed target.

- If the target investigation results in a "no find", the target marker will be removed and repositioned. A second UXO diver will investigate the target and record the results. The TL will follow all procedures for documentation, as outlined in the project work plan.

Upon completion of the target clearance, all MD, range related debris (RRD), and non-munition related debris (NMRD) will be 100% inspected by a UXO technician II and a UXO technician III, before it is removed from the grid to ensure it is free of explosive hazards. If MEC/ material potentially presenting an explosive hazard (MPPEH) is found, it will be left in place, clearly marked, and the UXO Technician III will notify the SUXOS and UXOSO.

The TL will photograph all MEC/MPPEH and record as much information as possible in the TL's logbook or the PDA. Recorded data includes nomenclature (if known), type (projectile, mortar, rocket, etc.), size, physical condition, fuzed or unfuzed and fuze type by function (point detonating, mechanical time, etc.), condition (fired or unfired, armed or unarmed), filler if known, GPS coordinates.

All MD, RRD, and NMRD will be brought to the central collection point for SUXOS and UXOQCS or government representative inspection as outlined in the project work plan. See SOP for MPPEH and MDAS Management.

All project records will be returned to the SUXOS or project data manager at the end of the day.

4.4 COLLECTION POINTS

Collection points allow for temporary accumulation of recovered and classified MEC and MPPEH that are acceptable to move to another area for storage or destruction. Collection points must be authorized by the project work plan and the associated ESP/ESS. A bottom survey will identify an underwater disposal area free of coral formations or other sensitive flora/fauna. This area should have a hard sand bottom, be between 30 and 50 feet of seawater, and protected from high-sea states, if possible. Once identified, this area will be marked using GPS. An EZ will be established based on the worst-case munition item and depth of water per the BEM TP 16, or as provided by the Remedial Project Manager. The munition item will be raised, towed, and allowed to rest on the bottom within this area. MEC and MPPEH will not be transported from one munition response site to another within the Munitions Response Area unless authorized in the project work plan and applicable ESS/ESP.

4.5 FIELD COMMUNICATION

Two methods of communication will be used during field operations. Marine hand-held radios will be used for communication among the team during any routine field operations. A designated cell phone will be the primary means of notifying emergency responders (e.g., dialing 911). As the operation will be conducted on the water, a marine Very High Frequency hand-held radio will be on-site and be capable of communicating with the U.S. Coast Guard via channel 16 (or designated channel for local authorities). If available, Tetra Tech site office landlines can be used for off-site communication.

Communication (via hand-held radio) among the field teams, the UXOSO, UXOQCS, and the SUXOS/DS will be verified before commencing operations. Applicable telephone numbers will be found in the project work plan. Additionally, these will be posted in the site office and placed in all site vehicles and vessels. If necessary, a radio base station or repeaters will ensure reliable communications across the site.

4.6 MPPEH CHARACTERIZATION

Refer to the specific SOP for full details on MPPEH characterization.

- As the diver(s) encounter anomalies, they will note the item's location, status, and condition and take a photograph using the SM underwater camera. The first UXO Technician who discovers the suspected MPPEH will conduct the initial classification as MEC: UXO, discarded military munitions (DMM) or Munitions

Constituents (MC); Or if the target is not MPPEH (e.g., MD, RRD, NMRD). If a UXO Tech I, the suspected target, will have to have a UXO Tech II or higher verify the classification before further action is taken.

- A UXO Tech III will inspect all MEC, MD, RRD, and NMRD before leaving the Area of Interest (i.e., target, grid, or transect).
- The UXO TL will determine whether the MPPEH, once visible, is MEC and notify the SUXOS and UXOSO. Note: Suspected MPPEH that is not inspectable will be treated as MEC.
- The SUXOS will make the final identification of any suspected MEC.
- The SUXOS and UXOSO will make a joint decision on the acceptable to move determination. The two must agree with the decision and it will be documented.
- If MEC and MPPEH are determined by the SUXOS and UXOSO to be unsafe to move, it will be blown-in-place (BIP) or may be moved remotely using mechanized operations after all appropriate precautions have been taken. MEC or MPPEH will not be left unsecured in the field at any time. Notifications to the client, Ordnance and Explosives Safety Specialist or equivalent, and PM will be made as outlined in the Work Plan.
- Protective works will be implemented as described in the explosive safety documents for BIPs
- If MEC is not intact upon discovery (e.g., has exposed high explosive or filler), this will be noted on the Investigation Data Sheet and the MEC Accountability Log. If the MEC or MPPEH is judged to be safe to transport, it will be destroyed by detonation at a location identified in the ESP or ESS.
- Any suspected hazardous material (not munitions-related related) identified will be assessed on a case-by-case basis by the SUXOS and PM in consultation with the client. Hazardous material will be suspected to be hazardous if it emits a chemical odor, has caused soil staining, or is contained in a drum or other container commonly used (or marked) to store hazardous materials. If any doubt, materials will be reported for further investigation.

4.7 MEC, MPPEH, AND MDAS

Refer to the specific SOP for full details on MEC/MPPEH and MDAS disposal.

Targets identified as MEC or MPPEH (e.g., UXO, DMM, recovered bulk explosive, or MC) will be demolished by explosive detonation in-situ or relocated to a collection point. MEC and MPPEH will be demolished individually or as part of a consolidated shot. The day they are found, using a same-day donor explosives delivery service, placed at an approved unmarked underwater collection point, or guarded until disposal can be conducted. MEC and MPPEH will be documented from discovery to final disposal in the MEC accountability log.

Materials that cannot be certified and verified during the initial inspection as explosive free will have demolition or demilitarization activities performed on them in accordance with the project work plan.

Materials that cannot be certified and verified as inert (either following demolition disposal or otherwise) will have demolition activities performed on them again. MEC and MPPEH certified as explosive-free will be further classified as MDAS (materials documented as safe) then managed and recycled as scrap metal following the MPPEH and MDAS Management SOP and project work plan.

5.0 DATA MANAGEMENT

The following sections describe the data that is needed to perform this SOP and the resulting data.

5.1 INPUT DATA REQUIRED

No data other than sensor user manuals and target location Geographic Information Systems files must perform intrusive operations.

5.2 OUTPUT DATA

The primary output from this SOP is the quantities and locations of MEC, MPPEH, and the amounts of MD, RRD, and NMRD recovered. Secondary outputs include equipment inspection records and daily quality reports, and any other documentation outlined in the project work plan.

6.0 QUALITY CONTROL

Quality control will be achieved through three-phase of control of the Definable Feature of Work, completion of the QC Checklist for Underwater Intrusive Investigation Operation (Section 6.3), and performance metrics identified in the plans are met. The checklist will be filled out and signed by the on-site quality lead or designee upon completing the production unit.

6.1 MEASUREMENT QUALITY OBJECTIVES

The Measurement Quality Objectives (MQOs) for Underwater Intrusive Investigation Operation are presented in the project plans. Results will be documented in the daily quality control report.

6.2 REPORTING

Input to the project MEC Accountability Log and disposal records are the only reporting output from this SOP.

6.3 QC CHECKLIST FOR INTRUSIVE INVESTIGATIONS

TEAM INFORMATION						
Team:		Location:				Date:
Team Leader:						
Personnel Present:						
Contract #:						
Task Order #:						
QC CHECKLIST POINTS						
Item	Ref.	Inspection Points	Yes	No	N/A	Comments
1	UXO SOP	Have personnel read and signed the workers' statement?				
2	UXO SOP	Has the equipment been checked out, and is it documented correctly?				
3	UXO SOP	Have all intrusive results been fully and appropriately documented?				
4	UXO SOP	Have the appropriate MQOs been achieved for underwater Intrusive Investigation?				
5	UXO SOP	Were all blind seeds (if instituted) recovered?				

FINDINGS	
Item	Comments

Signature:

UXOQCS or Designee: ______________________________ Date: ______________

ATTACHMENT D

TETRA TECH DIVING SAFE PRACTICES MANUAL

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TETRA TECH

Diving Safe Practices Manual

February 2021

Safety Excellence

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TMR Manual

DSP-01 Diving Safe Practices Manual

Status:	Approved	**Approved By:**	M.W.D. Mark W. Dollar, President
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TABLE OF CONTENTS

ABBREVIATIONS AND ACRONYMS

ACFM	actual cubic feet per minute
ADCI	The Association of Diving Contractors International
AED	automated external defibrillator
AGE	arterial gas embolism
AHA	Activity Hazard Analysis
Army	U.S. Army
ATA	Atmosphere Absolute
CFR	*Code of Federal Regulations*
CRL	Corporate Reference Library
CNS	central nervous system
CPR	cardiopulmonary resuscitation
DCS	decompression sickness
DDC	District Diving Coordinator
DDESB	Department of Defense Explosives Safety Board
DOT	U.S. Department of Transportation
DRB	Diving Review Board
DSO	Diving Safety Officer
DSR	Diving Safety Representative
DSPM	Diving Safe Practices Manual
EM	Engineers Manual
ESSQ	Environment, Safety, Security and Quality
FSW	feet of seawater
HAZWOPER	Hazardous Waste Operations and Emergency Response
HASDP	Health and Safety Dive Plan
MEC	munitions and explosives of concern
NIOSH	National Institute for Occupational Safety and Health
NOAA	National Oceanographic and Atmospheric Administration
NOSSA	Naval Ordnance Safety and Security Activity
OSHA	Occupational Safety and Health Administration

ABBREVIATIONS AND ACRONYMS (Continued)

PFD	personal flotation device
PPM	parts per million
PSI	pounds per square inch (gauge)
SCUBA	self-contained underwater breathing apparatus
SDS	Senior Diving Supervisor
SHM	Safety and Health Manager
SOP	Standard Operating Procedures
SSHO	Site Safety and Health Officer
SUXOS	Senior UXO Supervisor
TP	Technical Paper
Tt	Tetra Tech
TMR	Tetra Tech Munitions Response
USACE	U.S. Army Corps of Engineers
USCG	U.S. Coast Guard
USN	U.S. Navy
U.S.	United States
UXO	unexploded ordnance

1.0 PURPOSE

This Tetra Tech Munitions Response (TMR) Diving Safe Practices Manual (DSPM) provides TMR employees and subcontractors with the requirements and guidance for conducting safe diving operations. Contractors working directly for the client will be required to have safe practices that meet or exceed the requirements of this manual while operating from TMR-owned or leased equipment or property.

This manual ensures TMR diving operations meet and/or exceed the requirements of federal and state agencies. The project management team, designated dive supervisor/lead divers, project quality managers (PQMs), and site safety and health officers (SSHOs) will ensure compliance with Occupational Safety and Health Administration (OSHA) regulations and standards by implementing these procedures during dive operations.

This manual was prepared in accordance with the OSHA regulations. Federal, state, and local regulations were also considered during the preparation of this manual. If a conflict arises between the current edition of this manual and applicable or updated federal or other legal directives or statutes, the latter shall always take precedence.

2.0 FEDERAL AND STATE STANDARDS REQUIREMENTS

This manual was developed using guidelines, procedures, rules, and regulations from the following government and civilian agencies:

- OSHA
- U.S. Army Corps of Engineers (USACE)
- The Association of Diving Contractors International (ADCI)
- U.S. Navy (USN)
- U.S. Coast Guard (USCG)
- U.S. Army (Army)
- National Oceanographic and Atmospheric Administration (NOAA)

This manual provides the **minimum regulatory standards** for team composition, diving procedures, equipment maintenance, and operations.

3.0 SCOPE

This document contains procedures applicable to all TMR projects involving underwater operations that use divers or snorkelers to perform work or scientific research. The procedures in this document shall meet the requirements in 29 *Code of Federal Regulations* (CFR) 1910.401, Subpart T. Requirements that are not specifically included in this DSPM will be included in the project specific Health and Safety Dive Plan (HASDP). When contracted to dive for clients who mandate following USACE standards, additional equipment, procedures, and review requirements will be addressed in the project specific HASDP. The specific requirements are identified in Section 30 of USACE Engineers

Manual (EM) 385-1-1, Safety and Health Requirements Manual. If there are any conflicts between this manual, OSHA, and/or federal and state/ local regulations, the most stringent regulations will take precedence, provided site safety is not compromised. All conflicts will be detailed, with procedures provided in the project specific HASDP.

4.0 REVISIONS

Revisions to this manual will be periodically completed based on new advances in diving practices, technological advances, and changes in regulations.

5.0 DIVING REVIEW BOARD

The diving program manager is designated the Chairman of the Diving Review Board (DRB) and is responsible for updating this manual. The designated diving safety officer (DSO) will maintain the qualification records of personnel approved for diving and will approve all other divers (including subcontracted divers) involved on TMR projects.

6.0 GENERAL RESPONSIBILITIES

This manual will be reviewed by the diving program manager, DSO, and the TMR senior diving supervisor (SDS) for technical content involving TMR diving. They will ensure diving operations are conducted in a safe and efficient manner throughout the company. Their responsibilities include:

- Review existing policies and procedures to ensure safe, effective diving operations.
- Develop recommendations to improve diving operations.
- Review and discuss diving accident report releases by various sources and ensure the distribution of copies to Dive Team members.
- Review any TMR near-miss or actual diving mishaps and develop procedures and policies to prevent future occurrences.
- Ensure that the TMR dive program conforms to all the guidelines in this DSPM, as well as all applicable federal, state, and local laws and regulations.
- Coordinate proper recordkeeping for diving personnel, diving operations, and dive equipment maintenance.
- Coordinate periodic diver training and safety programs as needed.
- Review, prior to approval, prospective TMR dive operations that use non-standard diving modes and procedures or carry above average risk.
- Review the qualifications and performance of all divers and potential Diving Supervisors/ Lead Divers.
- Stay updated on new safety procedures, as well as OSHA, USN, USCG, USACE, and ADCI requirements.
- The Quality Department will review this manual for compliance with appropriate laws and regulations.

- Approval authority rests with the TMR President, with review by the dive program manager.
- The Chairman of the DRB will be responsible for all required corporate recordkeeping in accordance with this manual, and maintenance of all identified references.
- For unexploded ordnance (UXO) diving operations, the dive program manager will review and approve all TMR employees and subcontractor personnel involved in UXO diving.

The DSPM will never substitute for prior planning, sound judgment, and a continuing concern for maximum safety. Safety is not a rulebook; it is a state of mind and must be continually maintained in our workplace culture. However, not all circumstances or situations can be explained and detailed in this DSPM. For this reason, TMR only recommends deviating from these guidelines when, in the opinion of the diving supervisor/lead diver, an emergency exists where the health and safety of personnel is a concern. The diving supervisor/lead diver will have final authority regarding safe conditions at the dive site. A written event report will be submitted to the Chairman of the DRB within 48 hours of the deviation from the DSPM to document possible changes to this manual and conformation to OSHA and other regulatory requirements.

6.1 Waiver of Requirements

The DRB may grant a waiver for specific requirements of training, examinations, and minimum activity to maintain certification.

6.2 Diving Program Manager/Chairman, DRB

The diving program manager is the Chairman of the TMR DRB. The DRB is composed of the diving program manager, the DSO, and the SDS from the TMR Operating Unit as assigned by the appropriate manager. The Chairman of the DRB is responsible for managing the TMR Diving Program in conjunction with the assigned board members; they will maintain the diving logs and references as required by OSHA in 29 CFR 1910.401, Subpart T. The DSO will maintain qualifications and physical records for all TMR divers. The Chairman will review and approve divers, including subcontractors who are assigned to individual projects.

6.3 DSO/DRB Member

The diving safety officer (DSO), as a permanent DRB member, is responsible for the safe conduct of UXO and construction diving operations. The DSO is responsible for the appropriate diver training and qualifications for UXO operations. The DSO will submit to the DRB the names of qualified UXO divers to be certified by TMR to work on company projects. The DSO will maintain a recent copy of the USN Diving Manual. OSHA, USACE, USCG, American National Standards Institute, applicable local regulations and the Association of Diving Contractors International Consensus and Technical Standards. The DSO will make these manuals available to the diving supervisors as required.

The DSO identifies diving supervisors/lead divers. Upon concurrence of the DRB, the DSO officially assigns them to the position in writing.

6.4 SDS/DRB Member

The senior diving supervisor (SDS) will be a senior TMR diver designated by the DSO and will be a member of the DRB. The SDS is responsible for the operational readiness of the TMR dive equipment and supporting assets. The SDS also provides supervision of the TMR divers, makes recommendations for dive staff assignments. The SDS is the SME for development of new diving procedures, technology, and capabilities.

6.5 Senior UXO Supervisor

A senior UXO supervisor (SUXOS) will be designated, in writing by the DSO, to projects that have both a UXO removal/investigation requirement and a diving requirement. The SUXOS will coordinate all ordnance response requirements and establish safe procedures for the investigation and removal of all UXO hazards.

On larger operations involving both diving and UXO operations, the Diving Supervisor/Lead Diver will normally supervise diving, and the SUXOS will oversee the UXO response. The same person can serve as SUXOS and diving supervisor/lead diver, if that person has both qualifications on smaller projects. The SUXOS shall be a qualified TMR environmental safety supervisor person in accordance with the guidelines outlined in Department of Defense Explosives Safety Board [DDESB] Technical Paper [TP] 18, Reference (e).

6.6 Diving Supervisor/ Lead Diver

The diving supervisor/lead diver will be designated in writing as the Designated Person in Charge for each diving operation. This designation is based on knowledge, experience, and level of training. The diving supervisor/lead diver is in charge of the overall diving operation and is responsible for the planning and execution of the dive, as well as the safety and health of the dive team. The diving supervisor/lead diver will be a qualified TMR qualified SUXOS. In carrying out these duties, their responsibilities will include, but will not be limited to:

- Ensuring that all dive team members who are exposed to, or control the exposure of others to, hyperbaric conditions will be trained in diving-related physics and physiology.
- Ensuring that each dive team member will be assigned tasks in accordance with the employee's experience or training. Limited additional tasks may be assigned to an employee undergoing training, provided that these tasks are performed under the direct supervision of an experienced dive team member.
- Ensuring that a dive team member will not be required to be exposed to hyperbaric conditions against the employee's will, except when necessary to complete decompression or treatment procedures.
- Ensuring that a dive team member will not be permitted to dive or otherwise be exposed to hyperbaric conditions for the duration of any physical impairment or condition which is known and is likely to adversely affect the safety or health of a dive team member.

- Investigating and evaluating each incident of decompression sickness based on the recorded information, consideration of the past performance of decompression table used, and individual susceptibility.
- Taking appropriate corrective action to reduce the probability of or recurrence of decompression sickness.
- Preparing a written evaluation of the decompression procedure assessment, including any corrective action taken, within 10 days of the incident of decompression sickness.
- Being fully aware of all relevant governmental regulatory agency regulations that apply to the diving operation and the diving mode employed.
- Being in immediate control and available to implement emergency procedures during diving operations. The dive supervisor/lead diver is not permitted to dive unless another qualified person is present and has been formally appointed and designated to assume this responsibility.
- Ensuring, prior to diving, that all additional parties are informed that diving operations are about to be undertaken. These parties include, but are not limited to, craft masters, boat pilots, harbormasters, managers of pipelines, and managers for civil engineering sites and inland waterways.
- Ensuring that diving operations are conducted from a suitable and safe location on the surface.
- Establishing a project specific HASDP, and ensuring that sufficient air supply, supplies, and proper equipment are available for the safe and timely completion of the job task. This must be approved by the TMR DRB prior to conducting any diving evolution.
- Briefing the dive team as to the plan of attack, and soliciting suggestions outlined in Attachment 1, diving supervisor/lead diver Dive Plan Brief, native file format located in the Guidelines Templates and Tools folder in the Corporate Reference Library (CRL). During the briefing, they will make team assignments, designate required equipment, review diving signals, establish a positive diver recall method, and cover emergency procedures.
- Using the TMR Diving Supervisor Pre-Dive and Post-Dive Checklists (see Attachments 2, Diving Supervisor/Lead Diver Pre-Dive Checklist, and 3, Diving Supervisor/Lead Diver Post-Dive Checklist, which are also available in the native file format located in the Guidelines Templates and Tools folder in the CRL
- Ensuring all members of the diving team are familiar with the emergency procedures contained in the Emergency Procedures (see Attachment 4, which is available in the native file format located in the Guidelines Templates and Tools folder in the CRL).
- Being aware of the procedures to follow and the routes to take to obtain medical support in the event of an accident, either diving- or non-diving-related.
- Ensuring that a two-way communication system is available and tested.
- Ensuring that the Emergency Phone Numbers Checklist (see Attachment 5, which is available in the native file format located in the Guidelines Templates and Tools folder in the CRL) is completed and posted at the dive site.

- Determining the qualifications and proficiency of all personnel and ensuring that no dives are made by unqualified persons.
- Verifying that all equipment required is on scene and in working order.
- Ensuring that all relevant operating instructions, manuals, decompression schedules, treatment tables, and regulatory publications are available on the dive site.
- Maintaining a dive profile log for each diver, which includes depth, bottom time, and residual nitrogen time (see Attachments 6 and 7, which are also available in the CRL).
- Terminating diving operations at any time when, in their opinion, safe diving procedures are not being followed or conditions prevent safeguarding the divers. The diving supervisor/lead diver will not resume diving operations until the unsafe conditions have been removed or corrected.
- Ensuring that, after every dive, the Post-Dive Checklists in Attachment 3, which is available in the native file format located in the Guidelines Templates and Tools folder in the CRL, are used.
- Ensuring that, after any treatment or unplanned dive conducted outside the no-decompression limits, the diver is instructed to stay awake and remain in the vicinity of the chamber for at least 1 hour.
- Reporting all accidents or incidents involving personnel as required by TMR procedures and relevant governmental regulations.
- Ensuring all reports and paperwork are completed and submitted at the end of the diving day.
- Maintaining certification in cardiopulmonary resuscitation (CPR), first aid (American Red Cross or equivalent), automated external defibrillator (AED), and emergency oxygen administration.

6.7 Divers and Snorkelers

Divers must be at least 18 years of age, be medically certified as "fit to dive," and have a knowledge of diving theory, diving-related physics, and physiology. They will provide copies of their certifications to the DRB Chairman before being allowed to dive. On diving projects involving UXO operations, the minimum age of the diver must be 21 years, per the Bureau of Alcohol, Tobacco and Firearms regulations concerning the handling of explosives.

Divers must have a full understanding of the diving equipment in use, and of the tasks assigned. A diver is assigned by the diving supervisor/lead diver to perform specific tasks underwater and topside. The diver must be qualified for the diving technique, equipment selected, and the task assigned. Each diver will meet the following requirements:

- Know how to use the tools, equipment, and systems relevant to assigned tasks.
- Know the techniques of the assigned diving mode.
- Accomplish all tasks assigned by the diving supervisor/lead diver. In the event that the diver is assigned a task for which he/she does not consider himself/herself

to be qualified either by training or experience, the diver will immediately inform the diving supervisor/lead diver.

- Read, understand, and comply with all TMR policies and with applicable government regulations as they relate to their qualifications or performance while engaged in diving.
- Maintain a high level of physical fitness.
- Immediately obey all commands or instructions from the diving supervisor/lead diver to return to the surface, or first decompression stop, as appropriate.
- Keep topside personnel advised of conditions on the bottom.
- Be responsible for the diving gear worn and ensure that it is complete, in good repair, and ready for use at any time in accordance with regulations or instructions concerning its use, maintenance, repair, and testing.
- Report to the diving supervisor/lead diver any defect or malfunction of the diving equipment provided for the diving operation.
- Ensure the deepest depth of the dive has been established before ascent.
- Report to the diving supervisor/lead diver any recent medical treatment or illness so that the proper determination can be made concerning the diver’s fitness to dive.
- Immediately report all symptoms or suspected symptoms of decompression sickness as early and accurately as possible.
- Always follow safe diving practices during the diving operation, whether topside or in the water. The diver will bring any questionable items to the attention of the diving supervisor/lead diver and will be alert for the safety of all.
- Remain awake and in the vicinity of the decompression chamber for at least one hour following recompression treatment or a hyperbaric exposure beyond no-decompression limits.
- Know and observe the rules for ascending to altitude, including flying after diving.
- Ensure that their diving equipment has been properly maintained, prepared, and tested before each dive. This requirement should never be delegated to others.
- Maintain a divers' logbook, which details all dives, medical examinations, courses taken, and personal equipment maintenance.
- Ensure their medical certificates are up to date and recorded in the diving logbooks. Divers will present their logbooks to the diving supervisor/lead diver at every job when requested.
- Ensure that he/she is not exposed to hyperbaric conditions against their will, except when necessary to complete decompression or treatment procedures.
- Maintain certification in CPR, First Aid, AED, and emergency oxygen administration.

A diver may refuse to dive, without fear of penalty, whenever they feel it is unsafe for them to make the dive. It is the diver's responsibility and duty to refuse to dive if, in their judgment, conditions are unsafe or unfavorable, or if they would be violating the precepts of their training, abilities or the regulations and guidelines in this manual or the project DSPM.

6.8 Standby Diver

The standby diver is a fully qualified diver, assigned for backup to provide emergency assistance, and is ready to enter the water when conducting diving operations with a single-tended diver. When assigned during buddy diving, where two divers are conducting the dive together, he/she will be ready to enter the water prior to commencing the dive, and then may remove tank, mask, and fins at the diving supervisor/lead diver's discretion. Under no circumstances will he/she leave the dive site. The standby diver receives the same briefings and instructions as the working divers, wears the same diving equipment, monitors the progress of the dive, and is fully prepared to respond if called upon for assistance. While acting as a standby diver, **in addition to** the requirements listed above, the standby diver will:

- Be rested and fully capable of performing emergency rescue assistance.
- Be sufficiently free of residual nitrogen to allow for enough bottom time for the prescribed task at the working depth without exceeding the no-decompression limits for that depth.
- Be dressed appropriately to allow prompt entry into the water as directed by the diving supervisor/lead diver.
- Remain at their station throughout the entire dive.
- Refuse any tasks that might interfere with their duties as a standby diver whenever there is a diver in the water.

6.9 Dive Tender

The tender is a member of the dive team who works most closely with the diver on the bottom. Though it is preferred that the tender be a qualified diver, it is not mandatory. If the tender is not a qualified diver, they must be familiar with line pull signals and all emergency procedures. The tender is assigned by the diving supervisor/lead diver to continuously tend (monitor) the diver. They will devote their full attention to tending the diver they are assigned to, from preparation of the dive through its completion. They will not be assigned any other task while the diver is in the water. The tender shall further:

- Assist the diver in dressing and undressing and confirm that the diver's equipment is functioning properly.
- Always tend the diver’s safety line and be aware of the diver’s depth and location.
- Set up and operate all equipment as directed by the diving supervisor/lead diver.
- Immediately inform the diving supervisor/lead diver if they are assigned a task for which they do not consider themselves qualified either by training or experience.
- Be alert and immediately report any conditions that are hazardous or unsafe.
- Assist in topside work as required or directed.
- Maintain certification in CPR, first aid, AED, and emergency oxygen administration.

7.0 DIVING POLICY

It is the policy of TMR to consistently provide safe diving operations that meet the client's required level of work and that are following applicable laws and regulations. This work shall be consistent with the project-defined scope, schedule, budget, and level of quality. To accomplish this objective, TMR will provide the appropriate qualified personnel, resources, and guidance to the Operating Units where diving is required. Such resources may include specialized diver expertise that may be in another office, or corporate affiliate, or maybe subcontracted to the appropriate company.

This DSPM addresses procedures for the safe utilization of self-contained underwater breathing apparatus (SCUBA) and surface-supplied air diving operations. Mixed-gas diving is not authorized for employees of TMR covered under these procedures. All dives will be planned to adhere to the Standard Air, No Decompression, or Shallow Water dive tables set forth in the USN Diving Manual, refer to Attachment 10, available in the Guidelines Templates and Tools folder in the CRL.

The individual local or state requirements will be reviewed and incorporated into the project specific HASDP. This review will be performed prior to commencing any diving operations within the affected state. Prior to diving, the project specific HASDP must be approved by the Chairman of the TMR DRB for construction diving or the scientific DSO for scientific diving, with the approved copy forwarded to and retained by the TMR Chairman of the DRB.

8.0 SCIENTIFIC DIVING

All TMR Scientific diving will be conducted in accordance with Tetra Tech Corporate Safety DCN 02-15 Scientific Diving Program[1] in the Corporate Health and Safety Manual.

9.0 REQUIREMENTS FOR DIVING AND SNORKELING

9.1 General Requirements

The requirements presented in this section will be used in conjunction with procedures and requirements for individual dive techniques presented in the following sections of the DSPM. All dives will be executed under the regulations and guidelines outlined in Section 2.0.

- The qualifications of personnel and equipment requirements for snorkeling are the same as diving, except for the required air supply for diving.
- A ladder extending a minimum of 3 feet below the diving platform below the surface of the water and appropriate handrails will be provided to assist the diver on entry and exit from the water. (*Note: Inflatable boats are exempt from this requirement.*)
- A means will be provided to assist an injured diver from the water.

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[1] https://tetratechinc.sharepoint.com/:b:/r/sites/Health-Safety/Health%20%20Safety%20Manual/02_General%20Health%20and%20Safety%20Programs/DCN%2002-15%20Scientific%20Diving%20Program.pd

- When diving from vessels, the international code alpha and recreational dive flag with a minimum dimension of 23 square inches will be displayed whenever diving operations are being conducted. The flag will not be removed until diving operations have been completed and all divers are safely out of the water. TMR divers will comply with all site-specific local, state, federal, and international regulations regarding marking of diving activities.
- For enclosed areas, i.e., Intracoastal Waterway or marinas, individual buoys with recreational diver flags will mark the outline of the diving area. The divers may have a "marker" buoy with the recreational dive flag to determine their exact location. A rigid replica of the International Code Alpha flag at least 1 meter in height and visible from all directions will be displayed at the dive location.
- A diver will be stationed at the underwater point of entry when diving is conducted in enclosed or physically confining spaces.
- Positive communications to the recompression facility, the designated medical facility, and any required transportation to these facilities (medivac, ambulance, etc.) will be checked daily. This communication will include cellular telephone or radio communications with a constantly manned location with telephone access at the dive site. Diving operations will not be conducted without established communications.
- The diving supervisor/lead diver will not be permitted to dive, unless another qualified supervisor is present and has assumed the dive supervisor/lead diver roles and responsibilities.

9.2 Snorkeling Requirements

TMR employees engaged in snorkeling operations will comply with the general requirements for diving and the following additional requirements, unless otherwise specified in a project specific and approved HASDP:

- Snorkeling will be conducted only with prior approval and acceptance of the district diving coordinator (DDC).
- Snorkeling will be allowed only for shallow water site assessments and reconnaissance. It will not be used for structural inspections or other work.
- An on-site snorkeling team shall be made up of no less than two persons: snorkeler and observer/assistant. Additional site personnel may be required by the DDC or safety office DSR based on site hazards and conditions. Snorkeling team plans and procedures shall be developed and enacted by a team supervisor who is qualified and experienced in snorkeling and incorporated in the HASDP.
- Snorkeling will only be done on the surface of the water. Breath-hold or free diving of any kind is not permitted.
- Generally, untethered snorkeling will NOT be allowed in waters deeper than 5 feet of seawater (FSW), in bodies of water that a snorkeler cannot wade across, or anywhere a pressure differential may exist.
- Snorkeling in open waters greater than 5 feet deep may be allowed by the DDC, based on an acceptable Activity Hazard Analysis (AHA) and compliance with the following:
    - Any requirements incorporated in the approved HASDP.

  - A single snorkeler shall be tethered with a harness and a maximum of 40 FSW of floating line. The tether must be constantly tended from the shore or boat.
  - The snorkeler must wear a device providing a minimum of 15.5 pounds of positive buoyancy (Type III personal flotation device [PFD], fully inflated snorkeling vest, etc.).
  - There are no potential tether entanglement hazards in the snorkeling area (e.g., overhanging branches, surface stumps, rocks, etc.).
- All snorkelers and observers/assistants will be certified as skin divers (snorkelers) or open water divers by a nationally recognized organization (e.g., Professional Association of Diving Instructors, National Association of Underwater Instructors, etc.) or the U.S. Forest Service Snorkel Safety Program.
- An observer/assistant will always accompany each untethered snorkeler either along the shore or in a boat and be within 50 feet of the snorkeler.
- Two untethered snorkelers in the same body of water may act as observer/assistant for each other if they remain within 50 feet of each other.
- Non-snorkeling observer/assistants shall wear a PFD and be equipped with a throw bag and/or ring buoy with at least 70 FSW of line and must be capable of performing a rescue on the specific snorkeler(s) in an emergency.
- Areas of extreme water velocity and turbulence will be avoided, especially those immediately upstream from debris jams or bedrock outcrops.
- Snorkelers will be provided with appropriate thermal protection.
- Employees will be determined medically fit by a licensed physician (doctor of osteopathy or medical doctor) prior to snorkeling. This certification shall be signed by a physician familiar with sports medicine, and state that each snorkeler is physically and medically fit to perform snorkeling activities according to commonly accepted sports medicine guidelines.
- All snorkeling team members shall be certified in first aid and CPR. Certification shall be in accordance with most recent emergency cardiovascular care guidelines, and/or American Heart Association or American Red Cross standards.
- A first aid kit will be available at each location where snorkeling is being performed. A means of securely transporting an unconscious person, such as a litter or stretcher, shall be provided when snorkeling is conducted in areas inaccessible to vehicles or boats.
- A means of communication capable of contacting emergency services must be available at locations where snorkeling is performed.
- Each snorkeler will be equipped with a professional grade mask, fins, snorkel, and snorkeling vest.
- A snorkeling protocol will be developed and included in the project HASDP. It will contain as a minimum, the following:
  - An AHA for each specific snorkeling mission (Particular detail will be given to currents and other environmental considerations.)
- Records for snorkeling activities will be maintained and will include as a minimum:
  - Snorkeler’s annual physician certifications

  - AHAs
  - A snorkeling plan incorporated in the HASDP that is based on the requirements of USACE EM 385-1-1; Section 30.A.15.a-e
- Snorkelers will wear apparel which provides appropriate protection from environmental conditions. The apparel must include fins or other appropriate foot protection.

9.3 SCUBA Diving Requirements

TMR employees engaged in SCUBA diving operations will comply with the general requirements for diving and the following additional requirements, unless otherwise specified in a project specific and approved HASDP:

- The minimum sized SCUBA tank allowed as primary air is a standard 80 cubic-foot aluminum tank pressurized to at least 90 percent, or 2,700 pounds per square inch (PSI) at the beginning of dive operations.
- Divers shall terminate their dive so that they reach the surface with a minimum tank pressure of 500 PSI.
- Audio communications are preferred in all diving situations. However, this type of communication is not required for a diver who is accompanied by another diver (buddy), or who can communicate with the tender on the surface via a safety line using line pull signals.
- The planned time of such a diving operation will not exceed the no decompression limits according to the USN Dive Manual, or the air supply duration of the cylinders in use, exclusive of the reserve supply. The cylinder pressure will be determined immediately before each dive.
- Each diver will be equipped with a knife, a diving wristwatch, a depth gauge or dive computer, a facemask, a submersible cylinder pressure gauge, and a buoyancy compensator.
- A weight belt or integrated weight system with a quick release that is appropriate for the suit and the depth of the dive will be worn.
- A cylinder harness with a quick release will be worn to secure the SCUBA cylinders to the diver.
- The weight belt and cylinder harness will be independently attached to permit release of either one without interference by the other.
- A personal flotation or buoyancy compensation device will be worn. An exception will be considered during approval of the HASDP for diving in enclosed spaces or under the ice.
- SCUBA diving operations will not be conducted at depths deeper than 100 feet.
- USACE or DDC exemption approval is required for dives to any depths from 100 feet to 130 feet, and if approved, a recompression chamber must be available within 5 minutes of reaching the surface.
- During all SCUBA dives, a standby diver will be available while a diver is in the water.

- A SCUBA diver will be line-tended from the surface or accompanied by another diver in the water in continuous visual contact during the diving operations. If any SCUBA diver is tended, they will wear a harness meeting the following standard:
  - Each tethered SCUBA diver shall wear a safety harness with a positive buckling device, attachment point for the safety line, and a lifting point to distribute the pull force of the line over the diver's body while maintaining the body in a heads-up vertical position when unconscious.
- A diver-carried independent reserve breathing gas supply consisting of the following will be provided for each diver:
  - Each diver shall be equipped with a minimum 30 cubic-foot bailout bottle for emergency use pressurized to at least 90 percent of its working PSI rating and equipped with a separate first- and second-stage regulator. An "octopus" is not considered to be an alternate air source.

9.4 Surface-Supplied Diving Requirements

Employees engaged in surface-supplied diving will comply with the general requirements for diving, and the following additional requirements, unless otherwise specified in a project specific and approved HASDP:

- The approximate depth of each dive will be determined prior to the start of operations.
- A weight belt appropriate for the suit and depth of the dive will be worn, except when conditions dictate otherwise for the safety of the diver.
- A five-point safety harness, with a positive buckling device, will be worn under all other types of equipment (*except when diver is dressed in heavy gear*). This harness will have an attachment point for the umbilical to distribute the weight of the diver's body and prevent any strain from being placed on the diver's mask or helmet if/when the umbilical is pulled on. The safety harness will also have a lifting point to distribute the pull force of the line over the diver's body. The safety harness may be equipped with a backpack to contain a bailout bottle.
- Surface-supplied dives will not exceed 190 FSW and will not enter into exceptional exposure dives as set forth in the USN standard air decompression tables.
- A decompression chamber will be ready for use on site for any dive outside the no-decompression limits or deeper than 100 FSW.
- Each diver will be continuously tended by another dive team member while in the water.
- A diver will be stationed at the underwater entry point when diving is conducted in enclosed or physically confining spaces.
- A standby diver will be available while a diver is in the water.
- Each dive will have a primary air supply capable of supplying the diver(s) with the specified air volume, pressure, and flow rate, in accordance with the manufacturer's specifications associated with the diving apparatus worn, throughout the planned depth of the dive, including any required decompression.
- Each dive location will have a reserve breathing air supply, in line, capable of supporting the dive operation.

- A diver-carried reserve breathing gas supply will be provided for each diver on dives deeper than 60 FSW or outside no-decompression limits, or when the diver does not have direct access to the surface and on all surface-supplied dives operating under USACE EM 385-1-1. This does not apply when heavy gear is used.
- On all dives deeper than 100 FSW or outside the no-decompression limits, an extra breathing gas hose capable of supplying gas to the diver in the water will be available to the standby diver.
- On all dives deeper than 100 FSW or outside the no-decompression limits, an in-water stage will be provided.

10.0 DIVER TRAINING AND QUALIFICATIONS

The following section describes the minimum requirements for TMR divers. Additional training may be needed for site-specific conditions, or required under federal, state, or local regulations.

The level of experience or training required by the standard depends on the job the employees are required to do. All dive team members must have either experience or training in the use of tools, equipment, systems, techniques, operations, operational procedures, and emergency procedures that are pertinent to, and necessary for, the assigned tasks for the diving mode.

It is essential that those dive team members who are exposed to hyperbaric conditions, or those members who control the exposure of others, have knowledge of the physiological effects of diving and the related effects of pressure. Accordingly, this standard also requires that employees be trained in diving-related physics and physiology. Employee qualifications achieved through field experience and classroom training may be used to meet the requirements of the standard.

- Divers must have federal certificates (such as from the USACE, NOAA, and/or military diving school).
- Divers must have civilian diving school certificates of completion for the appropriate training level issued by schools associated with the ADCI.
- Each dive team member must be trained in CPR (American Red Cross or equivalent), first aid, AED, and emergency oxygen administration. Employees completing this training are issued a card certifying that they have successfully completed the course.
- Each member of the TMR diving team will be qualified to conduct the work assigned by completion of training and/or experience. This qualification will be documented by completion of a certified course of instruction, to include one or more of the following: a certified commercial course (Association of Commercial Diving Educators accredited), a civilian certification with experience for the profile of the dive, or a documented military diver training and experience.
- All divers will maintain a personal dive log that will document all hyperbaric exposures. Additionally, dates of diving physicals and a record of all relevant training will accompany the log. The following minimum information should be included in the log:

- Location of exposure
- Maximum depth
- Time left surface, total bottom time, and time reached surface
- Type of breathing apparatus and mixture used
- Task performed
- Decompression table and schedule used
- Any decompression sickness symptoms or injury
- Signature of the Diving Supervisor/Lead Diver
- Comments

10.1 Entry Level Training

All TMR non-divers who have the required skills and training to participate in diving-related activities must be certified by an internationally recognized agency.

10.2 SCUBA Training

All TMR divers will provide a copy of their diver certification to the Chairman of the DRB that represents successful completion of a swimming evaluation, practical diver training, written examination, and open water evaluation. Scientific divers will also provide a copy of their diver certification to the DSO. The certificate from the training activity will be used to document the location and date of training. The dive log will document the depth and number of diving qualification dives.

10.3 Surface-Supplied Diver Training

The training certificate to document previous training and dive log to document the number of dives and depth of diving qualifications will be provided. Training dives will be required to ensure all divers are current in the type of equipment and the depth expected of the diving project.

11.0 PERSONNEL REQUIREMENTS

In establishing the number of dive team members required for a dive, proper consideration must be given to 29 CFR 1910.421(d), Planning and Assessment, and 29 CFR 1910.421(e), Hazardous Activities. The second provision requires employers to provide a means to assist an injured diver from the water, such as a small boat or stokes basket, which may necessitate additional dive team members.

11.1 Self-Contained Underwater Breathing Apparatus (SCUBA)

For diving that requiring the use of SCUBA, the following number of divers are required for the work:

Dive Team Composition SCUBA – Untethered, 0 to 100 FSW	
Personnel	**Number**
Diving Supervisor	1
Divers (in visual contact)	2
Standby Diver*	1
TOTAL TEAM	**4**

Dive Team Composition SCUBA – Tethered with communications, 0 to 100 FSW	
Personnel	**Number**
Diving Supervisor **	1
Diver in water	1
Standby Diver* (tethered with communications)	1
Tender	1
TOTAL TEAM	**4**

** The standby diver will be rested and capable of performing emergency rescue assistance. When work is limited to no decompression limits, the standby diver shall be sufficiently free of residual nitrogen to allow for 25 minutes of bottom time at the working depth without exceeding "No Decompression Limits."*

*** The supervisor may be the standby tender for dives under 100 FSW.*

11.2 Surface-Supplied Diving (0-100 FSW with no Decompression Diving)

For surface-supplied diving, from 0 to 100 FSW, the number of divers required to perform the work is listed below:

Dive Team Composition Surface Supplied Air – 0 to 100 FSW Within No Decompression Limits		
Personnel	**Number**	**Penetration Dive**
Diving Supervisor **	1	1
Diver	1	2
Standby Diver*	1	1
Tender	1	2
TOTAL TEAM	**4**	**6**

** The standby diver will be rested and capable of performing emergency rescue assistance. When work is limited to no-decompression limits, the standby diver shall be sufficiently free of residual nitrogen to allow for 25 minutes of bottom time at the working depth without exceeding "No Decompression Limits."*

*** The supervisor may be the standby tender for dives under 100 FSW.*

11.2.1 Deploying the Standby Diver as a Worker Diver

The standby diver may be deployed as a working diver provided **all** the following conditions are met:

1) Surface-supplied no-decompression dive of 60 FSW or less;
2) Divers are in proximity, (based on site specific requirements), with unimpeded access to each other;
3) Divers always have communications with each other;
4) No entanglement hazards exist;
5) Prior to deploying the standby diver, the work area shall be determined to be free of hazards (i.e., suctions, discharges) by the first diver on the job site;
6) The dive is NOT a penetration or confined space dive; and
7) Each diver has a full-time tender (which brings the minimum number of team members to five).

11.3 Surface-Supplied Diving (Deeper than 100 FSW or decompression diving)

For surface-supplied diving deeper than 100 FSW, or decompression diving, the number of divers required to perform the work is listed below:

Dive Team Composition

Surface Supplied Air – 0 to 100 FSW Requiring Decompression

All Surface Supplied Air, 101 to 190 FSW

Personnel	**No Decompression Dives**	**Decompression Dives**	**Penetration Dives**
Diving Supervisor	1	1	1
Chamber Operator**	1**	1***	1
Diver	1	1	2
Standby Diver*	1	1	1
Tender	1	1	2
Standby Diver Tender	1	1	1
TOTAL TEAM	**5/6**	**5/6**	**8**

** The standby diver will be rested and capable of performing emergency rescue assistance. When work is limited to no-decompression limits, the standby diver shall be sufficiently free of residual nitrogen to allow for 25 minutes of bottom time at the working depth without exceeding "No Decompression Limits."*

*** The Competent Person/chamber operator may be any non-diving member of the dive team when the chamber is only for emergency use when diving within the no-decompression limits. Saturation diving requires that a life support technician will serve as the chamber operator.*

**** The Competent Person/chamber operator may be any non-diving member of the dive team if all diving ceases during chamber decompression.*

11.4 Other Diving Operations

An additional dive crew member may be required for any diving operations involving an increased likelihood of diver entrapment or the potential for rendering the diver unconscious or incapacitated from chemical, physical, electrical, or topside hazards. These operations include, but are not limited, to:

- Diving on ordnance and/or explosives projects
- Diving from a small boat
- Diving in remote areas where assistance from non-diving crew personnel is not immediately available, but within communication range
- Penetration diving, both horizontal and vertical
- Diving requiring crane operations
- Diving in any situation where the diver uses surface-tended equipment
- Diving from a platform greater than 8 feet above the water surface

12.0 MEDICAL REQUIREMENTS

Each diver will receive a diving physical examination initially when assigned diving duties and yearly thereafter. In addition, a medical examination will be conducted whenever a diver has been hospitalized for more than 24 hours due to an injury or illness. A determination as to their fitness to continue to dive will be prepared by the examining physician. The physician will prepare a written report containing the following statement: “Based on the following, I certify the diver as ‘Fit to Dive’.” In addition, the report will contain the following information:

- Medical requirements of this standard and a summary of the nature and extent of hyperbaric exposure to which the diver will be exposed, including diving modes and types of work to be assigned (TMR will provide the dive information).
- The diver’s medical history (a diver’s Medical History and Supplemental Diving Questionnaire, available in the CRL), which will be filled out completely and will be provided to the examining physician.
- The results of the medical examination. A basic diving physical examination will be conducted initially and annually for all TMR divers, which will include a chest X-ray, vision testing, audiogram, pulmonary function test, blood chemistry panel, complete blood count with differential, urinalysis with microscopic analysis (U.S.), and any additional tests required by the examining physician. An electrocardiogram will be performed. An exercise stress test may be indicated based on a risk factor assessment performed by the doctor.
- The examining physician’s opinion of the employee’s fitness to be exposed to hyperbaric conditions, including any recommendations or limitations to such

exposure. TMR will provide the employee with a copy of the physician's written report.

Determination of the employee's fitness to dive will be based on the physician's written report and review by the DRB. If the physician has recommended a restriction or limitation on the employee's exposure to hyperbaric conditions, and the employee does not agree with the physician's findings, the employee has the right to obtain his own diving-certified physician to perform a diving physical. If the second physician does not agree with the findings of the first physician, a third physician will be consulted for resolution.

13.0 EQUIPMENT CONSIDERATIONS

The diving supervisor/lead diver, in conjunction with the DRB, will establish the equipment requirements for individual projects. This list will be included in the HASDP and will include the required dive gear, boat equipment, and any required task-specific equipment. This list should be submitted to the project manager when the HASDP has been approved. Each equipment modification, repair, test, calibration, or maintenance service that is required will be recorded by means of a tagging or logging system. This system will include the date, serial number of the item, nature of the work performed, and the initials of the person who conducted the work.

13.1 Equipment Maintenance

Typically, TMR underwater operations use a variety of diving systems and component equipment. This equipment is considered life support equipment and should be treated as such.

- All equipment will be maintained in accordance with the directives set forth by OSHA and the Manufacturer's Specifications.
- Any maintenance performed on equipment will be logged on the maintenance form and forwarded to the project equipment manager for entry into the Equipment Maintenance Log.
- Dive supervisor/lead divers shall have the required expertise to maintain the systems used by TMR.
- Dive Team Members shall treat all equipment in a responsible manner and immediately inform the dive supervisor/lead diver of any potential equipment problems that they may observe.
- Bi-annual air quality tests will be performed on all breathing air compressors, and the results kept on file by the Chairman of the DRB.
- Equipment requiring periodic calibrations shall be sent to their respective manufacturers or licensed professionals for proper maintenance and calibration. The dive supervisor/lead diver shall inform the project equipment manager of any equipment taken offline.

If the equipment was provided by the TMR warehouse, the equipment manager will manage and report equipment concerns in accordance with TMR Procedure PO-18, Warehouse Management.

13.2 Air Supply Requirements

Diver air will be procured from a facility where the compressors meet the requirements established in Compressed Gas Association Pamphlet G-7.1 or more stringent standards. The tanks will be filled with compressed air from a source that complies with, at a minimum, 29 CFR 1910.430 (equipment). The breathable air supplied to the diver will be tested every 6 months and will not contain:

- A level of carbon monoxide greater than 10 parts per million (ppm)
- A level of carbon dioxide greater than 1,000 ppm
- A level of oil mist greater than 5 milligrams per cubic meter
- A level of hydrocarbons, other than methane, greater than 25 ppm
- Noxious or pronounced odor

A copy of the latest air test results will be reviewed and/or obtained and filed with the HASDP. When using local established vendors, a check of current certification is required every 6 months. If air test results are not available, TMR will draw an air sample from the compressor for appropriate analyses.

13.3 Regulators

TMR divers will be responsible for inspecting and scheduling maintenance on their regulators prior to the first use and every 12 months thereafter. Documentation of the inspections and maintenance will be maintained in the TMR diving files.

13.4 Compressed Air Cylinders

Compressed breathing air cylinders will:

- Be constructed with seamless steel or aluminum that meets U.S. Department of Transportation (DOT) 3AA and DOT 3AL specifications.
- Have identification symbols stamped into the shoulder of the cylinder.
- Be inspected internally and externally for corrosion and pitting on an annual basis. If a defect is found that may impair the safety of the pressure vessel, a hydrostatic test must be performed.
- Be hydrostatically tested every fifth year in accordance with DOT regulations. The test dates will be stamped into the shoulder of each cylinder. Documentation of each cylinder inspection will be maintained in the TMR diving files.
- Be stored in a ventilated area and protected from excessive heat.
- Be secured from falling.
- Have shutoff valves recessed into the cylinder or protected by a cap, except when in use, when installed with a manifold, or when used for SCUBA diving.

13.5 Air Compressor Systems

Air compressors used to supply air to the diver will:

- Be equipped with a volume tank that has a check valve on the inlet side, a pressure gauge, a relief valve, and a drain valve.

- Have intakes located away from areas where exhaust fumes or other air contaminants may be present.
- Be tested every 6 months by means of samples taken at the connection to the distribution system to ensure that the air supplied meets all applicable standards (see Section 3.6.1, above). Non-oil lubricated compressors do not have to be tested for oil mist.
- Be equipped with a moisture separator and filtration system.

A log shall be maintained showing all tests, repairs, maintenance, and run time on all air compressors systems.

13.6 Surface Supplied Air

The diver's surface-supplied air supply may originate from an air compressor, a bank of high-pressure air flasks, or a combination of both. Regardless of the source, the air must:

- Meet the purity standards stated above;
- Be supplied in an adequate volume for breathing;
- Have a rate of flow that properly ventilates the helmet or mask; and
- Be provided at enough pressure to overcome the bottom water pressure and the pressure losses due to flow through the diving hose, fittings, and valves.

The air supply requirements depend on specific factors for each dive, such as depth, duration, level of work, number of divers being supported, and type of diving system being used.

The capacity of the primary air supply must meet the consumption rate for the designated number of divers for the full duration of the dive (bottom time plus decompression time). The maximum depth of the dive, the number of divers, and the equipment to be used must be considered when sizing the supply.

The secondary air supply must be sized to support recovery of all divers using the equipment and dive profile of the primary supply, if the primary supply malfunctions or fails at the worst-case time (i.e., immediately prior to completion of planned bottom time of maximum dive depth, when decompression obligation is greatest).

13.6.1 Breathing Gas Supply Hoses

Breathing gas supply hoses will:

- Have a working pressure at least equal to the pressure of the total breathing gas system;
- Have a rated bursting pressure at least 4 times the working pressure;
- Be tested annually (at a minimum) to 1.5 times their working pressure;
- Have their ends taped, capped or plugged when not in use;
- Have connections made of corrosion resistant material, and be resistant to accidental disengagement; and
- Have connectors with a working pressure at least equal to the hose to which they are attached.

13.6.2 Divers' Air Supply Hoses

Umbilical's will:

- Be marked (starting from the diver's end) at 10-foot increments for the first 100 feet; and 50-foot increments thereafter;
- Be made of kink-resistant material; and
- Have a working pressure greater than the pressure equivalent of the maximum depth of the dive plus 100 pounds per square inch.

13.7 Gauges and Timekeeping Devices

The following requirements apply to each diver's gauge or timekeeping device:

- Each depth gauge will be deadweight tested or calibrated against a master reference gauge every 6 months, and when there is a discrepancy greater than 2 percent of full scale between any two equivalent gauges.
- A cylinder pressure gauge that is capable of being monitored by the diver during the dive will be worn by each SCUBA diver and surface-supplied diver when equipped with a bailout bottle.
- Each SCUBA diver will wear a diving watch capable of displaying elapsed time.
- A timekeeping device will be available at each dive location.
- Dive computers will be approved for use after the review and approval of the DRB (see paragraph 13.10 below).

13.8 Buoyancy Control

The following requirements apply to each diver's buoyancy control device:

- A dry suit or buoyancy compensator not directly connected to the helmet or mask will be equipped with an exhaust valve.
- Helmets or masks directly connected to a dry suit or other buoyancy-changing device will be equipped with an exhaust valve.
- When used for SCUBA diving, a buoyancy compensator will have an inflation source separate from the breathing gas supply and a manual inflator hose.
- An inflatable flotation device capable of maintaining the diver at the surface in a face-up position, having a manual activated inflation source independent of the breathing gas supply, an oral inflation device, and an exhaust valve is required for SCUBA diving, except when diving in enclosed spaces or under the ice.

13.9 Masks and Helmets

The following requirements apply to each diver's mask or helmet:

- Surface-supplied masks/helmets will have a non-return valve at the attachment point between helmet or mask and hose that will close readily and positively. Masks/ helmets will also have an exhaust valve.
- Surface-supplied air masks and helmets will have a minimum ventilation rate capability of 4.5 actual cubic feet per minute at any depth at which they are operated, or they will have the capability of maintaining the diver's inspired carbon

dioxide partial pressure below 0.02 atmosphere absolute (ATA) when the diver is producing carbon dioxide at the rate of 1.6 standard liters per minute.

13.10 Dive Computers

Dive computers that calculate decompression time based on time and depth are not to be used unless authorized by the dive supervisor/ lead diver and incorporated into the project specific HASDP. They must be checked for accuracy prior to use.

13.11 Backpacks

Backpacks worn during diving operations without integrated flotation devices and weight systems must be equipped with a quick-release device.

13.12 Handheld Power Tools

Handheld power tools are not normally used during SCUBA diving operations, but, if used, they will be used in accordance with the following safeguards:

- Handheld power tools and equipment will be de-energized before being placed into or out of the water.
- Handheld power tools will not be supplied with power from the dive location until requested from the diver.
- Two-way voice communications between divers and topside must be used.

13.13 Dive Tables

Dive tables shall be made available to divers at all diving locations.

13.14 Welding/Cutting/Burning

Welding, cutting, and burning procedures are not addressed in this manual. When a diving project requires welding, cutting, or burning operations, those specific procedures will be addressed in the project specific HASDP for that project.

13.15 First Aid/CPR/AED/Emergency Oxygen

A first aid kit, appropriate for diving operations and approved by a physician, will be available at the dive site. This kit will contain an American Red Cross standard first aid handbook or equivalent, a bag-type resuscitator with transparent mask and tubing, and a stokes litter or backboard with flotation capabilities.

Additionally, a portable source of oxygen will be available at the dive site for transport of a diving-related casualty to the hyperbaric treatment facility. One additional first aid kit will be the AED. It has been proved that, in the case of cardiac arrest, the AED, if used within the first 3 minutes, would save an additional 74 percent of patients.

13.16 Equipment Procedures Checklists

Pre-dive and post-dive checklists for both Surface-Supplied Air and SCUBA operations will be used during setup and breakdown of the dive station.

14.0 RECORDKEEPING REQUIREMENTS

The following records are required by 29 CFR 1910.401, Subpart T, and will be maintained as follows:

- The TMR Chairman, via the DRB, will maintain all historical records.
- Records will also be retained in the project, office, or department files, in accordance with TMR Procedure PO-08 Document Control and Records Management.
- Records and documents will be maintained in accordance with 29 CFR 1910.401, Subpart T, and will be provided upon request to employees, designated representatives, and others as determined by TMR.

14.1 Dive Profile Log (Depth-Time Profile)

The TMR Dive Smooth Log (Attachment 7, which is available in the native file format located in the Guidelines Templates and Tools folder in the CRL) will be forwarded to the Chairman of the DRB and maintained for 1 year. If there has been a diving-related illness or injury on the project, the records will be maintained for a period of 5 years. After the 5-year time limit, the records will be forwarded to the National Institute for Occupational Safety and Health (NIOSH). The TMR DSO will maintain copies for all scientific divers.

14.2 Diving-Related Injury Records

Any diving-related injury or illness, which requires any dive team member to be transported to a hospital for treatment related to any diving incident, will be reported to the safety and health manager (SHM) and documented by specifying the circumstances of the incident and extent of the injuries in the section provided in the Dive Profile Log.

The SSHO will subsequently report this accident/ incident to the TMR organization in accordance with procedure DCN 02-02, event reporting and investigation. The Dive Smooth Log and written Accident/Incident Report will then be forwarded to the designated SHM, who will forward it to the Chairman of the DRB. The Chairman will include the Dive Profile Log sheet in the TMR Dive Log, which is available in the native file format located in the Guidelines Templates and Tools folder in the CRL.

14.3 Recording of Dive

As stated above, a Dive Profile Log sheet will be completed for each dive, and, upon completion of the dive, will be forwarded to the Chairman of the DRB. The Chairman of the DRB will include the Dive Profile Log sheet in the TMR Dive Log, which will document all dives conducted by TMR personnel. The Diver’s Medical History and Supplemental Diving Questionnaire must be completed for each diver before they commence diving.

14.4 Decompression Procedure Assessment Evaluation

In the event of a diving-related incident that requires treatment by recompression, the section of the Dive Profile Log sheet for Decompression Procedure Assessment Evaluation will be completed and forwarded to the Chairman of the DRB, who will include the log in the TMR Dive Log. The Dive Log will be maintained for a period of 5 years. The Chairman of the DRB or designee will conduct the accident investigation.

14.5 Equipment Inspections and Testing Records

The current log entry or tag for required equipment must be maintained until the equipment is removed from service.

14.6 Records of Hospitalization

All medical records generated by a hospitalization visit must be forwarded to the TMR Medical Provider.

14.7 Diver Medical Records

The Tetra Tech Corporate Safety Procedure DCN 3-02F, MS-2, Release of Medical and Exposure Records[2] form is retained by TMR Human Resources Department. The Tetra Tech Corporate Safety Procedure DCN 3-02F, MS-1, Physician's Certification form[3] is retained by the Tetra Tech Medical Provider, and copies are maintained in project site files by the SSHO. All personal information protected by the Health Insurance Portability and Accountability Act is maintained by Tetra Tech's independent medical provider. Employee medical records will be handled in accordance with Tetra Tech Corporate Safety Procedure DCN 1-04, Recordkeeping and Reporting Requirements[4].

Diver qualification medical records that are signed by the TMR Medical Provider will be maintained for the duration of employment plus 30 years in accordance with 29 CFR 1910.1020(d).

14.8 Diving Safe Practices Manual

The current version of this DSPM is required to be maintained at the dive location.

14.9 Forwarding of Records

Employers are no longer required to notify and/or transfer records to NIOSH. OSHA's 29 CFR 1910.1020(h)(1) provides that whenever an employer is ceasing to do business, they must "transfer all records subject to this section to the successor employer. The successor employer shall receive and maintain these records.

14.10 Termination of Diving Operations

If TMR ceases to do business, the successor employer will receive and retain all dive and employee medical records required by 29 CFR 1910.1020(h)(2); The employer shall notify affected current employees of their rights of access to records at least three (3) months prior to the cessation of the employer's business

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[2] https://tetratechinc.sharepoint.com/:b:/r/sites/Health-Safety/Health%20%20Safety%20Manual/03_Environmental%20and%20Remediation%20Operations/DCN%2003-02F%20MS-2%20Release%20of%20Medical%20and%20Exposure%20Records.pdf

[3] https://tetratechinc.sharepoint.com/:b:/r/sites/Health-Safety/Health%20%20Safety%20Manual/03_Environmental%20and%20Remediation%20Operations/DCN%2003-02F%20MS-1%20Physicians%20Certification%20Form.pdf

[4] https://tetratechinc.sharepoint.com/:b:/r/sites/Health-Safety/Health%20%20Safety%20Manual/01_Health%20and%20Safety%20Program%20Administration/DCN%2001-04%20Recordkeeping%20and%20Reporting%20Requirements.pdf

14.11 Training Records

Copies of each diver's successful completion of the USN Dive School or civilian certification, and any other certificates of any specialized training (relevant to the job), will be forwarded to the Chairman, of the DRB and kept on the project site. Additionally, any training conducted in preparation for the job will be documented and retained on site and copies forwarded to the Chairman of the DRB.

15.0 OPERATIONS PLANNING

This section provides guidance on effective dive planning for any size operation. The success of any diving operation is a direct outcome of careful, thorough planning. The site-specific circumstances of each operation determine the scope of the planning effort, but certain considerations apply to every operation.

The HASDP provides a basic outline of minimum required information to successfully plan the diving operation. A project specific plan will be developed and implemented by the DRB, Project Manager and designated Diving Supervisor/Lead Diver for each separate diving project. The TMR SSHO for the project shall complete applicable self-assessment checklists. A project HASDP shall be developed to address the general diving and to include the following:

- Describe dive team composition, personnel qualifications, and responsibilities, along with the proper up-to-date documentation.
- Provide name and qualifications of the designated person in charge/diving supervisor responsible for diving activities (that is, years and type of experience and training background).
- Describe safe work practices for other activities to be performed during this project (for example, use of ladders, fall protection, use of electrical power tools, and use of personal protective equipment).
- Describe site-specific training, diver workups, equipment uses, and other training requirements (e.g., hazard communication, first aid, and CPR).
- Describe methods to identify and protect wetlands, endangered species, or cultural/historic resources, if applicable.
- Describe procedures for operating in inclement weather, including lightning, high winds, and severe rainstorms.
- Describe the Emergency Response Plan for equipment, incident response, treatment, evacuation, and notifications.
- Provide supplemental diving safety procedures.

The HASDP can reference overlapping plans or other pertinent project documents to minimize redundancy.

15.1 Risk Management and Assessment

Identifying the risks of the dive and developing a plan of action to minimize one's exposure to risk is crucial to safe and effective diving operations. The HASDP will be developed to address possible emergencies that may arise at each specific dive site. This plan shall incorporate steps for extraction of a stricken diver from the water, subsequent first aid and emergency response, and evacuation to a higher level of care. Job hazard analysis forms and safety checklists that are site-specific may be substituted providing they meet or exceed the requirements outlined in this manual and are approved by the diving supervisor/lead diver. Each team member shall be provided a copy of the HASDP prior to starting a job.

Once on the job, the diving supervisor/lead diver shall give a safety briefing to the dive team prior to each day of diving, and at the start of a new task. Emergency procedures will be reviewed on site to include local emergency/rescue points of contact. Wherever practicable, dives will be planned within the No Decompression Limits according to the USN dive tables and procedures.

The project manager and diving supervisor/lead diver, prior to the start of any fieldwork, must complete detailed planning and all required forms. Dive Team members must be made aware of the following:

- All known and potential hazards at the job site as reflected on the Job Hazard Analysis form.
- Required scope of work and individual responsibilities as detailed in the Pre-Dive Briefing Form.
- Equipment and tool requirements for all tasks
- Contingency and emergency plans

Diving shall be discontinued if sudden squalls, electric storms, heavy seas, unusual tide, or any other condition exists that, in the opinion of the diving supervisor/lead diver, jeopardizes the safety of the divers. It must be noted here that **ANYONE ON A TMR DIVE TEAM CAN STOP WORK** on a job if they feel that the work environment is/becomes unsafe.

Prior to diving, the diving supervisor/lead diver shall be responsible for examining the dive site to identify potential hazards. Some examples of potential surface and subsurface hazards include the following:

- Surface vessel traffic and/or vehicular traffic
- Swift currents and sea state
- Subsurface/underwater debris
- Overhead crane operations
- Mooring lines
- Pedestrian traffic/onlookers
- Petroleum products and/or other materials that are hazardous to divers and/or tenders
- Airborne contaminants
- Contaminated water
- Outfall and intake pipes

- Flotsam/jetsam (marine debris)
- Propeller/thrusters and intake/discharges of moored vessels
- Potential for structural collapse
- Hazardous marine life
- Limited access and/or confined workplace
- Fishing lines and nets
- Turbid (limited visibility) water
- Hazardous materials
- Abandoned piles and/or other structures
- Sonar equipment likely to be used or tested on nearby vessels

15.2 Termination of Dive Operations

The working interval of a dive will be terminated under any of the following conditions:

- The activities are completed as planned.
- A diver requests termination.
- A diver fails to respond correctly to communications.
- Communications are lost and cannot be quickly re-established between the diver and a dive team member at the dive location, or between the designated person-in-charge and the person controlling the vessel in live boating operations.
- A diver begins to use diver-carried reserve breathing gas or the dive location reserve breathing gas.
- The diving supervisor/lead diver determines that any unsafe condition exists.

16.0 CONSIDERATIONS FOR DIVE PLANNING

TMR diving mode options include Surface-Supplied Air Diving, Lightweight Surface-Supplied Air Diving, and SCUBA (with or without communications). Specific tasks and environmental conditions will dictate the safest and most efficient diving mode; however, there are certain requirements that must be followed regardless of the chosen dive mode selected.

16.1 Primary Breathing Air Supply

Air will be the primary breathing gas used during diving operations. A low-pressure air compressor, volume tank and filter assembly or high-pressure cylinders, with a regulated supply, provide the breathing air during Surface-Supplied Air diving. Compressed air cylinders worn by the diver supply the primary breathing air during SCUBA diving operations.

16.2 Reserve Breathing Air Supply

High-pressure air cylinders connected to the dive manifold supply the reserve air to the Surface-Supplied Air Diver. Additionally, the diver carries a reserve breathing air supply known as a bail-out system. The bail-out system provides a reserve air supply for the diver when surface-supplied air is compromised.

A redundant tank and regulator, or spare air cylinder carried by the diver provide the reserve air supply for SCUBA diving operations.

16.3 Exposure Protection

The site and environmental conditions are directly related to the type and amount of exposure protection required for a diver's comfort and safety. In cold or contaminated water, a dry suit with an adequate thermal undergarment is required. In the absence of contaminants, a neoprene wetsuit may be worn. A lightweight wetsuit, dive skin, or swimsuit with chaffing coveralls may be considered in warmer climates, providing the environment in which the dive will take place is free of contamination. Divers will wear some form of hand and foot protection while working in the water to minimize the possibility of injury. A neoprene or Lycra wetsuit hood is suggested when using SCUBA to provide protection for the diver's head and ears.

16.4 Dive Team Assignments

Each TMR Dive Team will have, as a minimum, four qualified personnel. The diving program manager will assign personnel to the dive teams. Personnel requirements are outlined in Section 11. Team assignments will be based on the scope of the project and the availability of qualified personnel. The logistics of the project and any unusual safety considerations at the job site may dictate additional personnel requirements.

- Additional personnel may be required to supplement the dive team in order to comply with standards set forth by a client or agency. In these instances, the required standards will be reviewed and strictly adhered to.
- All diving projects undertaken by the company for TMR government clients (e.g. USN or the USACE) will be carried out in strict compliance with DDESB TP-18, reference (c).

16.5 Decompression Procedures

The TMR standard of practice is to plan dives as no decompression dives according to the USN no-decompression limits. Should situations arise that necessitate the use of decompression diving to safely and efficiently complete the scope of work, USN Standard Air Dive Tables and outlined ascent procedures will be implemented and incorporated into the HASDP at that time.

16.6 Water Entry/Egress

A securely attached ladder or similar device will be provided for the diver to enter and exit the water. The ladder must extend at least 3 feet below the surface of the water and be capable of supporting the combined loads of both the diver and tender.

Divers shall enter the water in a controlled manner. In turbid or low visibility water conditions, there is always a possibility of submerged hazards or protruding objects that could pose a danger to the diver; therefore, extreme caution must be exercised during water entry.

Equipment required for the safe extraction of an unconscious diver from the water shall be provided at each dive site.

16.7 Warning Display

An International Alpha code flag and recreational “Diver Down” flag shall be prominently displayed during all diving operations. Flags will be placed in a highly visible position to provide as much warning as possible for all approaching vessels. For work in navigable waters, flag dimensions shall be at least one meter in height and width (or as specified by local jurisdictions) and illuminated at night.

16.8 Pre-Dive Brief

Prior to each dive, the diving supervisor/lead diver shall conduct a pre-dive Briefing to inform each Dive Team Member of the following:

- Diver’s health and readiness
- Standard and emergency procedures for diving mode employed and location of work
- Review of the AHAs, equipment checklists, and hazards or environmental variables that will impact diving operations
- Any deviations from standard procedures which may be necessitated by the operation
- Diver re-call procedure
- Factors which will terminate the dive

17.0 SPECIAL CONSIDERATIONS FOR DIVE PLANNING

In addition to the requirements above, there are many other items or circumstances that must be considered when planning a dive, regardless of the chosen diving mode.

17.1 Hazardous Environmental Conditions

Effective dive planning must provide for extremes in environmental conditions. Diving will be discontinued if sudden squalls, electric storms, heavy seas, unusual tide, or any other condition exists that, in the opinion of the diving supervisor/lead diver, jeopardizes the safety of the divers.

17.2 Communications

Adequate communications for the dive site will be provided as follows:

- **Diver to diver** – Wireless electronic communication is preferred for SCUBA operations, but diver-to-diver hand signals or line pull signals, in accordance with the Navy Diving Manual, are acceptable, refer to Attachment 8 USN Diving Line Pull and Hand Signals, which is also available in the native file format located in the Guidelines Templates and Tools folder in the CRL. Surface-supplied diving requires an operational two-way audio communication system between the diver and topside.

- **Surface to Diver/Diver to Surface** – Wireless electronic communication is preferred for SCUBA operations, but line pull signals in accordance with the USN Diving Manual, are acceptable. Surface-supplied diving requires an operating two-way audio communication system between the diver and topside.
- **Emergency Assistance** – Telephone communications will be maintained on site via a landline, cell phone, or two-way radio communications with a constantly manned location to activate emergency services if required.

17.3 Cold Water Diving

Cold water diving is defined as diving in water at or below a temperature of 37 degrees Fahrenheit. Cold water diving requires the use of special equipment and techniques. All dives conducted in cold water will be in accordance with Attachment 9, Cold Water Considerations and Safety Precautions, which is available in the native file format located in the Guidelines Templates and Tools folder in the CRL.

Hypothermia demands immediate treatment and prompt evacuation to a medical facility. The Diving Supervisor/Lead Diver will also take into consideration hypothermia for the surface support personnel. The responding medical facility must be notified of the possibility of hypothermia prior to the commencement of diving operations. Emergency re-warming and evacuation plans should be established with the medical facility's recommendations.

Diving under the ice requires extremely specialized training and equipment and **will not** be performed by TMR employees.

17.4 Diving at Altitude

Diving operations may be required in bodies of water at higher altitudes. Because of the reduced atmospheric pressure, dives conducted at altitude require more decompression than identical dives conducted at sea level. Standard air decompression tables, therefore, cannot be used as written.

Planning must address the effects of the atmospheric pressures that may be lower than those at sea level.

- No correction is required for dives conducted at altitudes between sea level and 300 feet; the additional risk associated with these dives is minimal.
- At altitudes between 300 and 1,000 feet, correction is required for dives deeper than 145 FSW (actual depth).
- At altitudes above 1,000 feet, correction is required for all dives.

High-altitude diving requires special equipment and techniques and will be conducted in accordance with the provisions of the USN Diving Manual.

Additionally, Standard Operating Procedures (SOPs) addressing the special requirements and support will be developed prior to commencing any high-altitude diving and included in the project specific HASDP.

17.5 Diving on UXO

Diving in the vicinity of explosive ordnance combines the inherent risk of diving and the explosive hazards of ordnance. Diving to investigate, recover, or dispose of explosive ordnance found underwater, regardless of the type or fuzing, will only be accomplished by specifically trained and qualified UXO divers (in accordance with DDESB TP-18).

Generally, it is safer for divers to work in pairs rather than alone. However, when diving on explosive ordnance, the use of two divers doubles the exposure to the ordnance and the amount of bottom time expended and increases the risk to life from an unplanned detonation. Consequently, the Diving Supervisor/SUXOS should employ a single tended or marked diver when any manipulation or removal of the ordnance is anticipated. However, the option to use two divers for ordnance search operations is authorized and preferred.

When performing activities not involving intentional contact with munitions and explosives of concern (MEC) while using anomaly avoidance techniques within a MEC environment, it is preferred to deploy two UXO divers. Deploying one UXO diver and one non-UXO diver is allowable if authorized by a NOSSA-approved or DDESB-approved ESS/Explosives Safety Submittal.

The development and use of SOPs to address the hazards associated with explosive ordnance is required when conducting UXO diving.

17.6 Diving in Contaminated Water

Divers may encounter dangerous or unpleasant forms of pollution such as effluent from a sewer or industrial outfall, oil leaking from a wellhead or damaged fuel tank, toxic materials or volatile fuels leaking from barges or tanks, and ordnance or chemical warfare material, which can cause severe problems.

The dive team should not conduct the dive until the contaminant has been identified, the safety factors evaluated, and the process for decontamination set up. When diving in a known or suspected radiological environment, proper radiological procedures must be followed.

When diving in contaminated waters, the appropriate dress should be a fully contained dry suit with gloves and hood, with a positive-pressure full face mask or the Dirty Harry surface-supplied diving system. Technical advice for contaminated water diving is available from the NOAA Hazardous Materials Department at (206) 526-6317.

18.0 DIVING HAZARDS

In addition to environmental hazards, and the hazards directly attributable to diving, a diver may occasionally be exposed to operational hazards that are not unique to the diving environment. These hazards are described below.

- **Underwater Obstacles** – Various underwater hazards, such as broken pilings, rocks, wrecks, dumping grounds, and discarded munitions, offer serious hazards to divers.

- **Electrical Shock** – Electrical shock is rare underwater but may occur when using power equipment underwater or topside. A ground fault interrupter must be used with electrical equipment employed on the dive site, both on the surface and underwater.
- **Explosions** – Explosions may occur during demolition tasks or during ordnance clearance operations, intentionally or accidentally. When using explosives, or as identified during UXO diving, separate SOPs and work plans will be developed to cover all aspects of the use or possibility of encountering explosives/ordnance underwater. All divers will be out of the water prior to any planned detonation of explosives or ordnance.
- **Explosives** – All diving-related explosives will be pre-approved by the Manager of UXO Operations. The procedures for explosives handling, use, storage, and underwater procedures will be detailed in the specific HASDP for the project.
- **Sonar** – Additional precautions are required when diving in the vicinity of vessels that employ active sonar. Ships use low-frequency sonar for object location and depth finding. It is a dense, high-energy pulse of sound that can cause damage to divers' ears. Avoid diving in the vicinity of low-frequency sonar and approach no closer than 600 yards. The optimal separation distance is 3,000 yards.

Additionally, the USN Diving Manual has a worksheet to compute actual time and distance restrictions for various types of sonar. This worksheet considers such variables as depth, time, diving apparatus, and wetsuit hoods. High-frequency (greater than 100 kilohertz), short-duration sonar, such as that used with side-scan and hand-held sonar, poses little danger to the diver. The diver will abort the dive if active low-frequency sonar is energized while they are in the water.

- **Marine Life** – Certain marine life, because of its aggressive or venomous nature, may be dangerous to man. Some species of marine life are extremely dangerous, while some are merely an uncomfortable annoyance. Most marine life poses little threat, as they tend to leave humans alone. The diver's best defense against injury is knowledge. All divers should be able to identify the dangerous species that are likely to be found in the area of operations and should be able to deal with each appropriately. The USN Diving Manual provides specific information about dangerous marine life.
- **Ascent to Altitude including Flying after Diving** – Leaving the dive site may require temporary ascent to a higher altitude. For example, divers may drive over a mountain pass at higher altitude or leave the dive site by air. Ascent to altitude after diving increases the risk of decompression sickness because of the additional reduction in atmospheric pressure. The higher the altitude, the greater the risk. The cabin pressure in commercial aircraft is maintained at a constant value regardless of the actual altitude of the flight. Though cabin pressure varies somewhat with aircraft type, the nominal value is 8,000 feet.

For all diving projects, divers will wait at least **12 hours** before flying after any dive, or **24 hours following multiple days of repetitive dives**. The ascent to altitude table located in the USN Diving Manual gives the surface interval (hours, minutes) required before making a further ascent to altitude. The surface interval depends on the planned increase in altitude and the highest repetitive group designator obtained in the previous 24-hour period. Enter the table with the highest repetitive group designator obtained in the previous

24-hour period and read the required surface interval from the column for the planned change in altitude.

18.1 Boating

All boating activities will be conducted according to applicable state, USCG, and Tt Procedure. Further, the following guidelines will be adhered to:

- Diving operations involving live boating will not be conducted unless cleared by the DDC in writing in the approved HASDP or subsequent Field Change Request.
- Live boating will not be conducted unless 1) using surface-supplied air at depths that are restricted to no deeper than 100 FSW, in rough seas that significantly impede diver mobility or work function, or 2) in non-daylight hours.
- The propeller of the vessel will be stopped before the diver enters or exits the water.
- A device will be used that minimizes the possibility of entanglement of the diver's hose in the propeller of the vessel.
- Two-way voice communication between the designated person-in-charge (Dive Supervisor/Lead Diver) and the person controlling the vessel will be available while the diver is in the water.
- Each diver engaged in live boating operations will carry a diver-carried reserve breathing gas supply.

19.0 OTHER HAZARDS

Other diving-related hazards that may be encountered by TMR divers are described below.

19.1 Noise

Some operations may require the use of generators, pumps, compressors, engines, and other equipment that can generate high levels of noise. Short-term exposure to extremely loud noise and/or long-term exposure to low level noise can cause hearing loss. Personnel assigned to a high noise area will wear proper hearing protection and be enrolled in a hearing conservation program.

19.2 Lifting Hazards

During some operations, there may be several instances when personnel will be called on to lift and/or carry a heavy load, sometime over rough or unstable terrain. When doing so, personnel should be instructed to observe the following rules:

- Test the load to ensure it can be moved safely.
- Plan the move to ensure the travel path is clear.
- Keep the back in its normal arched position while lifting, bend at the knees to lift.
- Lift with the legs and stand up in one smooth motion.
- Move the feet to change direction, do not twist at the waist.

20.0 DIVING EMERGENCY PROCEDURES

20.1 Surface Supplied Diving

20.1.1 Loss of Primary Air Supply

- Activate the secondary back up breathing air supply.
- If necessary, ensure diver goes on bail-out bottle.
- Alert the standby diver.
- Have Diver surface and proceed to ladder or stage.
- Terminate the dive (if instructed by Dive Supervisor/Lead Diver).

20.1.2 Loss of Communications

- Attempt to establish line-pull signals.
- Alert the standby diver.
- If unable to establish any form of communications with the diver within 60 seconds, immediately deploy the standby diver for assistance.
- Ensure diver proceeds to the ladder or stage.
- Terminate the dive.

20.1.3 Fouled or Entrapped Diver

- Diver informs Surface Support.
- Alert the standby diver.
- Diver determines the nature and extent of entrapment.
- Diver attempts to free them.
- If required, deploy the standby diver to assist the diver.
- When free, diver and tender confirm that direct contact with each other is re-established.

20.1.4 Injured Diver in Water

- Diver informs Surface Support (if possible).
- Alert the standby diver.
- Diver determines nature and extent of injury.
- Deploy the standby diver to assist diver (if necessary).
- Standby diver remains with diver.
- Extract the diver and provide first aid or oxygen accordingly.
- Request immediate medical assistance and emergency evacuation (if required).

20.1.5 Severance of Complete Umbilical

- Diver activates bail-out bottle.

- Establish line pull signals, if possible, try to inform surface support of the situation.
- Top side crew should secure primary the air supply and activate the air supply to the pneumo hose. If the diver can maintain a hold of the severed section of the hose, they can use it for breathing air and call follow it up to the surface.
- Diver surfaces and terminates the dive.

20.1.6 Unconscious Diver

- Attempt to establish voice and line pull communications with the diver.
- Deploy the standby diver.
- Determine the nature and extent of the diver's situation.
- Secure the diver and ensure an open airway; open the dive helmet free flow if the diver is not breathing.
- Extricate the diver, provide First Aid, CPR, AED, and/or emergency oxygen accordingly.
- Request immediate medical assistance and emergency evacuation.

20.1.7 Activate the secondary back up breathing air supply

- Inform the diver of the situation and establish line pull signals if necessary.
- Diver activates bail-out bottle (if necessary).
- Extinguish fire and secure the equipment.
- Diver surfaces and terminates the dive.
- Determine the damage and test all equipment prior to continuing the dive.

20.1.8 Equipment Failure – Diver in the Water

- Inform the diver of the situation and establish line pull signals if necessary.
- Evaluate the effect on the diver.
- Alert the standby diver.
- Diver informs topside of their readiness.
- Terminate the dive.

20.2 SCUBA Diving

20.2.1 Out of Air – Primary Source

- Diver activates secondary the air supply.
- Diver informs buddy diver or topside crew.
- Terminate the dive.

20.2.2 Out of Air – Primary and Secondary Source

- Diver surfaces with controlled ascent and informs buddy diver or topside crew.
- Buddy diver gives secondary air source to diver.

- Terminate the dive.

20.2.3 Fouled or Entrapped Diver

- Diver determines the extent of entrapment.
- Diver attempts to correct the situation.
- Diver informs topside or buddy diver; deploy the standby diver if required
- When clear, diver returns to ladder and evaluates situation with the Dive Supervisor/ Lead Diver.
- Dive Supervisor/Lead Diver decides to continue or terminate the dive.

20.2.4 Diver Injured in Water

- Diver determines nature and extent of injury.
- Diver informs topside or buddy diver.
- Alert the standby diver and deploy if necessary.
- Buddy/standby diver remains with the diver.
- Extract the diver and terminate the dive.
- Provide First Aid or oxygen accordingly.
- Request medical assistance and emergency evacuation (if necessary).

20.2.5 Equipment Failure

- Evaluate effect on the system and the diver
- Diver informs topside or buddy diver.
- Deploy the standby diver (if necessary).
- Terminate the dive.

20.2.6 Lost Diver and Communication

- Use the Buddy Recall System.
- Each diver surfaces.
- If a diver is not quickly located, the Dive Supervisor/Lead Diver immediately initiates search procedures.
- Deploy additional diver (if necessary).
- When located, divers return to ladder and evaluates the situation with the Dive Supervisor/ Lead Diver.
- Dive Supervisor/Lead Diver decides whether to continue or terminate the dive.

20.2.7 Diver Rapid Ascent or Blow up to Surface

- Buddy diver surfaces in a controlled ascent.
- Both divers terminate the dive.
- Deploy the standby diver to assist; if necessary.

- Monitor the diver and provide oxygen accordingly.
- Immediately notify emergency and medical personnel and inform them of omitted decompression.

20.2.8 Loss of Consciousness

- Buddy diver/standby diver initiates rescue diving.
- Determine the nature and extent of the diver's situation.
- Secure the diver and ensure an open airway; overpressure second stage (if possible) if diver is not breathing.
- Extricate diver, provide First Aid, CPR/AED and/or oxygen accordingly.
- Request immediate medical assistance and emergency evacuation.

21.0 DIVING SPECIFIC EMERGENCY MEDICAL TREATMENT

21.1 DCS Type 1 – (Pain only)

Diver surfaces with or develops joint pain (dull ache) that gradually worsens over time, develops skin problems such as itching or a rash, or develops swelling and pain in lymph nodes. Time to onset of symptoms is 0 to 24 hours. Actions to be taken:

- Perform necessary first aid and give 100 percent emergency oxygen upon surfacing.
- Contact local emergency resources for transport to nearest hyperbaric facility.
- Follow USN Dive Manual Treatment Table procedures.

21.2 DCS Type 2 – Central Nervous System (CNS)

Diver has DCS symptoms in water, or surfaces with any neurological symptoms (numbness, tingling, decrease touch sensation, muscle weakness, or paralysis). Time to onset of symptoms is 0 to 24 hours. Actions to be taken:

- Perform necessary first aid and give 100 percent oxygen upon surfacing.
- Contact local emergency resources for transport to nearest hyperbaric facility.
- Follow USN Dive Manual Treatment Table procedures.

21.3 Arterial Gas Embolism (AGE)

Diver surfaces or becomes unconscious within 10 minutes of surfacing, exhibits signs of a stroke or other neurological disorder, blurred vision, or convulsions. Actions to be taken:

- Perform necessary first aid or CPR.
- Administer 100 percent oxygen with the diver supine or in the recovery position.
- Contact local emergency resources for immediate transport to the nearest hyperbaric facility and initiate recompression treatment as soon as possible.

21.4 Chokes (Heart Pumps Frothy Blood)

Diver surfaces with chest pain aggravated by inspirations, an irritating cough, an increased breathing rate, increased lung congestion with subsequent heart attack. Death is imminent due to heart attack. Actions to be taken:

- Perform necessary first aid and give 100 percent oxygen upon surfacing.
- Contact local emergency resources for immediate transport to nearest hyperbaric facility.

21.5 Pneumothorax

Diver displays difficult or rapid breathing leans towards affected side and experiences pain while inhaling deeply. Hypotension, cyanosis, and shock may be present, leading to death. Actions to be taken:

- Position diver on affected side.
- Administer 100 percent oxygen and treat for shock.
- Contact local emergency resources for immediate transport to nearest medical facility (air must be vented from chest cavity).

22.0 VESSEL OPERATIONS DURING DIVING OPERATIONS

22.1 Safe Boating Guidelines

These procedures are for the safety of the employees and other vessels on the waterways during waterborne operations. If a conflict arises between the current edition of this section and the approved project specific HASDP, applicable federal, state, local laws or other legal directives, the latter shall take precedence.

22.2 Preparing for Waterborne Operations

All personnel on board a vessel employed on a TMR assignment will be fully competent in the vessel operations, maintenance, and equipment usage. The Dive Supervisor/Lead Diver shall complete any project Pre-Operation Maintenance and Safety Inspection Checklists prior to casting off.

22.3 Operations

All TMR employees regularly involved in boat operations must be knowledgeable and capable in the area of rules of the road, vessel maintenance, marine safety, and vessel registration requirements.

22.4 Rules of the Road

As with vehicular traffic on land, rules exist to promote safe vessel movement on navigable waterways. All employees engaged in waterborne operations will know the rules of the road specific to the project area. The local rules can be researched through the USCG or the applicable state government agency that governs a body of water. Several topics included in the rules of the road, relevant to TMR operations, are listed below.

22.5 Navigation, Signals, Markers and Signs

Each crewmember will know the meaning and use of each signal for meeting and passing situations while underway, for leaving a mooring, and signals used in limited visibility conditions. The required signals will be used in accordance with the rules of the road.

Each crewmember will know and understand the meaning of all navigation markers, buoys, and lights on the waterways. The vessel operator will follow the directions of each navigation marker, buoy and light unless evidence indicates the marker is damaged and providing inaccurate information.

22.6 Anchoring and Mooring

Vessel crewmembers will know how to properly anchor and moor the vessel from which they are operating. They will ensure that the anchor, chain, all lines, fenders, bumpers, and cleats are in good working order. The anchor line should be at least seven times longer than the working water depth. Crewmembers will continually monitor anchor and mooring lines while moored in areas affected by tides and strong currents.

22.7 Required Safety Equipment

All vessels operated by TMR, except for vessels less than 18 feet in length, will have the following equipment on board and in operating condition:

- A fixed fire extinguishing system installed in machinery space(s) or B-1 type extinguishers
- Type 1 PFD required for each person on board plus one throw able Type 4 life ring or cushion
- A Coast Guard approved flare kit
- A sounding device to signal maneuvering intentions and position during periods of reduced visibility
- A fully charged and tested VHF radio, prior to departure from dock
- A bilge pump appropriately sized for the vessel
- Additional engine fluids
- Vessels operated by TMR that are less than 18 feet in length shall have a Type 1 PFD for each person onboard.

22.8 Vessel Maintenance

Due to the difficulty of performing repairs afloat, regular maintenance and necessary services shall be carried out onshore before commencing operations. Use of the owner’s manuals, maintenance checklists, and repair logs are necessary to track equipment usage and inform future operators of equipment status.

Engine – The owner’s manual will be stored on board each vessel in a watertight bag and compartment. Suggested maintenance schedules will be followed. The engine fuel and oil levels will be checked before each use. Other engine components and propeller(s) will be checked for proper function.

Batteries – Each battery will be checked for proper charge level, cleanliness of contact posts, condition of wiring, and water level if required. Batteries will be secured, and all electrical systems turned off after operations are completed. Bilge pumps are directly wired and as such, will remain in constant operation.

Fuel – Check fuel level of primary tanks and emergency supply tanks prior to embarkation. Refill all fuel tanks, with the proper fuel, to the full level after returning each day. Inspect all fuel lines, bilge, and areas around the vessel for leaks.

Electronic Systems – Inspect all circuits to ensure good connections and operation of all components and equipment. Have spare batteries, fuses, and wiring available for repairs. Ensure connection of shore power after returning, when deemed necessary.

Checklists and Logs – Accurately complete checklists and logs prior to and after each day's operation of the vessel.

Safety Equipment – Inspect all fire extinguishers for annual inspection and pressure, first aid kits for required and expired items, PFD for proper fit or deterioration and for spare carbon dioxide cartridges, signaling devices for expired or deteriorated items, and radios for proper functioning.

22.9 General Marine Safety

Dive operations conducted from the relative stability of a pier or shoreline requires safety awareness and constant diligence. Conducting operations from the deck of a pitching/rolling vessel only compound these requirements. All personnel will conduct themselves in a safe and responsible manner while near or on board any vessel and in accordance with SWP 5- 06 Working over or near water. These guidelines are in place for the safety and wellbeing of TMR employees involved in marine operations.

- A USCG-approved PFD must be available for each person on board the vessel. The PFD must have a proper fit for the individual who will be using it and each person should know how to don the PFD in the vessel and in the water. PFDs must be inspected regularly for damage and excessive wear.
- Shoes should have non-skid soles. Personnel should maintain three points of contact when transferring equipment or personnel to and from the vessel. Deck area should be clear of lines, hoses and unnecessary clutter.
- Personnel should not sit on the edge of a vessel or on lifelines while underway.
- Personnel should avoid sailing at night, in fog, in poor visibility, in ice flows, during flood conditions, debris flows, small craft advisories, gales, hurricanes, or other heavy surf conditions, whenever possible.
- Personnel should be familiar with and have the means to handle emergency situations, including man overboard, abandon ship, fire, loss of power or propulsion, storm, and use of emergency signaling devices, as well as how to recover a person in the water.
- Personnel should know what emergency and standard equipment is required on each TMR owned vessel, where it is located and how to operate that equipment.

- Detailed tide, current, and marine weather forecast should be obtained before commencing waterborne operations.
- Ensure that all equipment is secure or lashed properly when underway.
- Personnel should be familiar with, and anticipate water and weather states and conditions respectively, when mooring.

22.10 Vessel Registration

Each vessel operating on navigable waterways requires a state registration identification sticker or USCG Certification. The designated Equipment Manager will ensure that each TMR vessel maintains a current state registration for the state in which the vessel is located. Trailer registrations, if applicable, will also be kept up to date.

22.11 Chain of Command

22.11.1 Projects that are Captained and Crewed by a Subcontractor

The designated Captain of the vessel will have overall authority for the vessel and personnel aboard. They will work with the Project Manager, Dive Supervisor/Lead Diver and SSHO to ensure the safety of all personnel.

22.11.2 Projects that are not Captained and Crewed by a Subcontractor

The Project Manager shall designate the vessel operator for each project. If a designee has not been assigned, the Dive Supervisor/Lead Diver will assume or designate the position of vessel operator. The vessel operator has overall authority and responsibility of the crew, passengers, and vessel operations safety while moored or underway. Before embarking, the Dive Supervisor/Lead Diver will assign crew positions and responsibilities to each team member. They will also designate a chain of command should the vessel operator become injured or is away from the vessel. The vessel operator will work with the Dive Supervisor/Lead Diver and project DSO and SSHO to ensure the safety of all personnel.

22.12 Offshore Operations

When the vessel will be operating greater than 500 yards from the shoreline, in breaking waves, or in a strong current, additional safety precautions are warranted. Under such conditions, any vessel employed on a TMR assignment must adhere to the following:

- The vessel shall be operated by an experienced and qualified boat operator as approved by the Project Manager.
- The vessel operator must perform research on local conditions and be aware of potential hazards.
- A marine weather radio shall be on-board the vessel and periodically monitored to keep abreast of changing weather conditions.
- The vessel must be equipped with a backup propulsion system, such as an extra motor, that can return the vessel to a safe harbor in the event of failure of the primary propulsion system.

- The vessel shall be thoroughly examined by the vessel operator to verify the sound mechanical condition of the vessel and bilge pump, and the presence of appropriate safety equipment as designated above.

23.0 REQUIRED FORMS AND CHARTS

23.1 Forms

The vessel operator will ensure that all required forms are accurately and filled out before embarkation. Spare forms should be kept on board each TMR-operated vessel. The HASDP and Attachment 11, Equipment Checklists, will provide the required forms listed below:

- BOAT PRE-OPERATION CHECKLIST
- DIVE EQUIPMENT CHECKLIST (GENERAL, MEDICAL, SCUBA)
- PRE-DIVE: SSA DIVE HELMET CHECKOFF SHEET
- PRE-DIVE: SURFACE SUPPLIED LIGHTWEIGHT (AGA)

23.2 Charts

The vessel operator will ensure that all required charts and maps for navigation to, from, and within the area of operations are on board before embarkation. All crewmembers will review and become familiar with these charts. These documents should be continually revised, as updates become available.

24.0 REFERENCES

ADCI (Association of Diving Contractors International). 2019. Consensus Standards for Commercial Diving Operations - Sixth Edition (Revision 6.3). Houston, TX. www.adc-int.org

CGA. 2018. G-7.1 Standards - Air quality standards; Compressed Gas Association. Chantilly, VA. www.cganet.com

DDESB (Department of Defense Explosives Safety Board). 2020. Technical Paper-18 Revision 1 - Minimum Qualifications for Personnel Conducting Munitions and Explosives of Concern-Related Activities. Washington, DC.

DOT (U.S. Department of Transportation). 2020. 49 CFR 178.37 - DOT Cylinder Maintenance, Retest and Certification Requirements. Washington DC. www.gpo.gov

OSHA (Occupational Safety and Health Administration). 2017. 29 CFR 1910.401 Subpart "T" - Commercial Diving Operations. Washington DC. www.osha.gov

OSHA (Occupational Safety and Health Administration). 2017. 29 CFR 1910.1020 Subpart Z (h)(1)(2) - Access to employee exposure and medical records. Washington DC. www.osha.gov

Tt (Tetra Tech). Health and Safety Manual:

________ DCN 1-04, Recordkeeping and Reporting Requirements.[5]

________ DCN 02-02 Event Reporting and Investigation.[6]

________ DCN 02-15 Scientific Diving Program.[7]

________ DCN 3-02, MS 1, Physician's Certification form.[8]

________ DCN 3-02, MS 2, Release of Medical and Exposure Records.[9]

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[5] https://intranet.tetratech.com/healthsafety/Manual/DCN%2001-04%20Recordkeeping%20and%20Reporting%20Requirements.pdf

[6] https://intranet.tetratech.com/healthsafety/Manual/DCN%2002-02%20Incident%20Reporting%20and%20Investigation%20Program.pdf

[7] https://intranet.tetratech.com/healthsafety/Manual/DCN%2002-15%20Scientific%20Diving%20Program.pdf

[8] https://intranet.tetratech.com/healthsafety/Manual/DCN%2003-02F%20MS-1%20Physicians%20Certification%20Form.pdf

[9] https://intranet.tetratech.com/healthsafety/Manual/DCN%2003-02F%20MS- 2%20Release%20of%20Medical%20and%20Exposure%20Records.pdf

_________ SWP 05-06 Working Over or Near Water.[10]

TMR (Tetra Tech Munitions Response):

_________PO-08 – Document Control and Records Management.

_________PO-18 – Warehouse Management.

_________TMR HSE 01-10 - Boating

USACE (U.S. Army Corps of Engineers). .

_________2014. EM 385-1-1, Section 30. Department of the Army, Washington DC. www.publications.usace.army.mil

USCG (U.S. Coast Guard). 46 CFR CH I Subpart "V" – Marine Occupational Safety and Health Standards - Shipping, Volume 7, Chapter 1 – Coast Guard, Part 197 – General Provisions, Subpart B. Commercial Diving Operations. Department of Transportation, Washington, DC. https://www.law.cornell.edu/cfr/text/46/part-197/subpart-B

USN (U.S. Navy). 2018. U.S. Navy Diving Manual, Volumes 1-5, Revision 7 Change A – Commander, Navy Sea Systems Command, Supervisor of Salvage and Diving. https://www.navsea.navy.mil/Portals/103/Documents/SUPSALV/Diving/US%20DIVING%20MANUAL_REV7_ChangeA-6.6.18.pdf

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[10] https://intranet.tetratech.com/healthsafety/Manual/SWP%2005-06%20Working%20Over%20or%20Near%20Water.pdf

25.0 ATTACHMENTS

Attachment 1 – Diving Supervisor/Lead Diver Dive Plan Brief
Attachment 2 – Diving Supervisor/Lead Diver Pre-Dive Checklist
Attachment 3 – Diving Supervisor/Lead Diver Post-Dive Checklist
Attachment 4 – Emergency Procedures
Attachment 5 – Emergency Phone Numbers Checklist
Attachment 6 – Working Dive Log
Attachment 7 – Dive Smooth Log
Attachment 8 – USN Diving Line Pull and Hand Signals
Attachment 9 – Cold Water Considerations and Safety Precautions
Attachment 10 – U.S. Navy Dive Tables
Attachment 11 – Equipment Checklists

GLOSSARY

Definitions are provided for the purpose of understanding their intent as they pertain to a procedure and projects requiring quality program planning. A Master List of Definitions is located in the CRL on the TMR intranet (https://tetratechinc.sharepoint.com/sites/OU-TMR). In addition, the definitions provided below are specific to this manual.

ASME Code or equivalent

ASME (American Society of Mechanical Engineers) Boiler and Pressure Vessel Code, Section VIII, or an equivalent code which the employer can demonstrate to be equally effective.

Arterial Gas Embolism (AGE)

An embolism caused by entry of gas bubbles into the arterial circulation system then act as blood vessel obstructions called emboli.

Atmosphere Absolute (ATA)

Total pressure exerted on an object, by a gas or mixture of gases at a specific depth or elevation, including normal atmospheric pressure.

Bell

An enclosed compartment pressurized (closed bell) or unpressurized (open bell), which allows the diver to be transported to and from the underwater work area and which may be used as a temporary refuge during diving operations.

Bottom Time

The total elapsed time from when the divers leave the surface to the time (rounded up to the next whole minute) they begin their ascent from the bottom or from the deepest depth attained. This time is measured in minutes.

Breath-Holding Diving

A diving mode in which the diver uses no self-contained or surface-supplied air or oxygen supply.

Buddy Breathing

Sharing of a single air source between divers.

Buddy Diver

Second (paired) member of the dive team set.

Buddy System

Two comparably equipped self-contained underwater breathing apparatus (SCUBA) divers in the water in constant communication.

Buoyant Ascent

An ascent made using some form of positive buoyancy.

Bursting Pressure

The pressure under which a pressure-containment device would fail structurally.

Certified Diver

A diver who holds a recognized valid certification from an organizational member, internationally recognized certifying agency, or through military training.

Chairman, Diving Review Board (DRB)

Environment, Safety, Security and Quality (ESSQ) Department member who manages and oversees the DRB.

Controlled Ascent

Any one of several kinds of ascents including normal, swimming, and air-sharing ascents where the diver(s) maintain control so a pause or stop can be made during the ascent.

Cylinder

A pressure vessel for the storage of gases.

Decompression Chamber

A pressure vessel for human occupancy. Also called a hyperbaric chamber.

Decompression Schedule

A specific decompression procedure for a given combination of depth and bottom time as listed in a decompression table. It is normally indicated as feet/minutes.

Decompression Sickness

A condition with a variety of symptoms, which may result from the presence of gas and bubbles in the tissues of divers after pressure reduction.

Decompression Table

A profile or set of profiles of depth-time relationship for ascent rates and breathing mixtures to be followed by divers after a specific depth-time exposure or exposures.

Decompression Time

Elapsed time from when the divers leave the bottom to the time when they reach the surface.

Descent Time

The total elapsed time from when the divers leave the surface to the time, they reach the bottom. Descent time is rounded up to the next whole minute.

Dive Computer

A microprocessor-based device that computes a diver's theoretical decompression status, in real time, by using pressure (depth) and time as an input to a decompression model, or set of decompression tables, programmed into the device.

Dive Location

The surface location from which diving operations are conducted, such as a vessel, barge, wharf, pier, riverbank or offshore rig.

Dive Location Reserve Breathing Gas

A supply system of air at the dive location that is independent of the primary system and enough to support divers during the planned decompression.

Dive Team

Divers and support employees involved in a diving operation, including the Diving Supervisor/Lead Diver.

Diver

An employee working in water using underwater apparatus, including snorkel, that supplies breathing gas at the ambient pressure.

Diver-Carried Reserve Breathing Gas

A diver-carried independent supply of air enough under standard operating conditions to allow the diver to reach the surface, or another source of breathing gas, or to be reached by another driver.

Diving Review Board

The TMR Review Board has oversight for all diving operations within the company. Board members will review the diving procedures and qualification of divers before authorization is given to conduct diving operations. The board is made up of qualified divers from the UXO Group, the Science Department, and the ESSQ Department.

DSO

The individual who manages the TMR science diving program and represents the science divers on the Diving Review Board.

Diving Mode

A type of diving requiring specific equipment, procedures and techniques (SCUBA, surface-supplied air, or mixed gas).

Equivalent Single Dive Time

The sum of the residual nitrogen time and the bottom time of a repetitive dive. Equivalent single dive time is used to select the decompression schedule for a repetitive dive. This time is expressed in minutes.

Heavy Gear

Deep-sea dress, including helmet, breast plate, dry suit, and weighted shoes. Advances in diving equipment and technology have led to heavy gear that does not include a breastplate. Surface-supplied diving gear, including helmet, dry suit, and weighted shoes (i.e., with the helmet directly connected to the drysuit, forming a self-contained pressure envelope for the diver) constitutes heavy gear as well.

Hyperbaric Conditions

Pressure conditions in excess of surface pressure.

In-water stage

A suspended underwater platform that supports a diver in the water.

Lead Diver

A certified diver with the experience and training to lead the diving operations.

Live Boating

The practice of supporting a surface-supplied-air diver from a vessel which is underway

Mixed-Gas Diving

A diving mode in which the diver is supplied in the water with a breathing gas other than air.

No Decompression (No "D") Limits

The depth-time limits of the ‘‘no-decompression limits and repetitive dive group designation table for no-decompression air dives,’’ USN Diving Manual or equivalent limits which the employer can demonstrate to be equally effective.

Penetration Diving

Passing through a barrier where the diver’s lifeline/umbilical requires tending by another diver or swimmer.

Pressure-Related Injury

An injury resulting from pressure disequilibrium within the body as the result of hyperbaric exposure. Examples include decompression sickness, pneumothorax, mediastinal emphysema, air embolism, subcutaneous emphysema, or ruptured eardrum.

Pulmonary Over Inflation Syndrome

Disorders that are caused by gas expanding in the lungs, and include arterial gas embolism, pneumothorax, mediastinal and subcutaneous emphysema.

Recompression/Decompression Chamber

A pressure vessel for human occupancy, such as a surface decompression chamber, closed bell, or deep diving system, used to decompress divers and to treat decompression sickness.

Repetitive Dive

Any dives conducted within 12 hours of a previous dive.

Repetitive Group Designation

A letter that is used to relate directly to the amount of residual nitrogen remaining in a diver's body.

Residual Nitrogen

Nitrogen gas that is still dissolved in a diver's tissues after surfacing.

Residual Nitrogen Time

Time, in minutes, which must be added to the bottom time of a repetitive dive to compensate for the nitrogen still in solution in a diver's tissues from a previous dive.

Safety and Health Manager (SHM)

The individual responsible for all safety aspects of the diving evolution. The on-site SSHO qualified person reports to the SHM on all safety related matters.

Scientific Diving

Diving performed solely as a necessary part of a scientific, research, or educational activity by employees whose sole purpose for diving is to perform scientific research tasks. Scientific diving does not include performing any tasks usually associated with commercial diving such as: Placing or removing heavy objects underwater; inspection of pipelines and similar objects; construction; demolition; cutting or welding; or the use of explosives.

SCUBA Diving

A diving mode independent of surface supply in which the diver uses an open-circuit self-contained underwater breathing apparatus.

Single Dive

Any dives conducted more than 12 hours after a previous dive.

Standby Diver

A designated safety diver at the dive location properly equipped and available to assist a working diver in the water.

Surface Interval

The time a diver has spent on the surface following a dive. It begins as soon as the diver surfaces and ends as soon as he starts his next descent.

Surface-Supplied Air Diving

A diving mode where the breathing gas is supplied from the surface by means of a pressurized umbilical hose. The umbilical generally consists of a gas supply hose, strength member, pneumofathometer hose, and communication line. The umbilical supplies a helmet or full-face mask. The diver may rely on the tender at the surface to keep up with the diver's depth, time, and diving profile.

Tended/Marked Diver

A diver who has a buoy line to the surface or is tended by another diver located in the diving boat or on the surface platform.

Treatment Table

A USN developed and tested depth-time and breathing gas profile designed to treat decompression sickness or pulmonary over inflation syndromes.

Total Bottom Time

The total elapsed time from when the divers leave the surface to the time (rounded up to the next whole minute) they begin their ascent from the bottom or from the deepest depth attained. This time is measured in minutes.

Total Decompression Time

The total elapsed time from when the divers leave the bottom to the time to the time all decompression obligations are met. For No Decompression dives, this is the time the diver reaches the surface. This time is measured in minutes.

Total Time of Dive

The total elapsed time from when the divers leave the surface to the time (rounded up to the next whole minute) until the diver reaches the surface. This time includes all ascent delays and decompression time. This time is measured in minutes.

Umbilical

The composite hose bundle between a dive location and the diver or bell, or between a diver and a bell, which supplies the diver or bell with breathing gas, communications, power, or heat as appropriate to the diving mode or conditions. This includes a safety line between the diver and the dive location or dive bell.

Volume Tank

A pressure vessel connected to the outlet of a compressor and used as an air reservoir.

Working Pressure

The maximum pressure to which a pressure containment device may be exposed under standard operating conditions.

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ATTACHMENT 1

DIVING SUPERVISOR/LEAD DIVER DIVE PLAN BRIEF

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ATTACHMENT 1

DIVING SUPERVISOR/ LEAD DIVER DIVE PLAN BRIEF

PROJECT NAME/NUMBER: ______________________________

1. **NOTIFICATIONS –** The following list of notifications is not to be considered all-inclusive and should be modified to fit the intended task. Check off each representative as notified, include the phone number and person talked to:

   Harbor Master: ______________________________

   Pipeline Manager: ______________________________

   Boat Pilot: ______________________________

   Port Services: ______________________________

   Cognizant Authority: ______________________________

   Ambulance/Air Evacuation: ______________________________

   Recompression Chamber: ______________________________

   Medical Facility: ______________________________

   Coast Guard: ______________________________

   U.S. Army Corps of Engineers Representative: ____________________

   U.S. Navy Representative: ______________________________

   Support Personnel: ______________________________

2. **PERSONNEL ASSIGNMENTS**

   Diving Supervisor/Lead Diver: ______________________________

   Senior UXO Supervisor: ______________________________

   Diver/s: ______________________________

   Tender: ______________________________

   Standby Diver: ______________________________

   Tender: ______________________________

   Coxswain: ______________________________

   Assistance: ______________________________

	YES	**NO**	**COMMENTS**
• Has any diver been diving in the last 12 hours?	____	____	______________
• Is any diver taking any type of medication?	____	____	______________

ATTACHMENT 1

DIVING SUPERVISOR/ LEAD DIVER DIVE PLAN BRIEF

PROJECT NAME/NUMBER: ____________________

	YES	**NO**	**COMMENTS**
• Does any diver have any aches or pains?	____	____	____________
• Can divers clear on the surface?	____	____	____________
• Is any diver wearing contact lenses?	____	____	____________
• Do divers feel well enough to make the dive?	____	____	____________
• Do divers have any problem making the dive?	____	____	____________
• Do divers know the emergency procedures for the diving mode?	____	____	____________

3. **ENVIRONMENTAL DATA**:

Temperature: Water: ____________Air: ____________

Tide: High: ___________/___________ Low: ____________/___________

Visibility expected: ____________ Bottom type: ____________

Current speed/direction: ____________

Wind Direction/Speed: ____________/_____________

Landmarks: ____________

Sunrise/Sunset: ______________/______________

Wave action: Height: _____________ Direction: ____________

Dive platform: ____________

4. **OBJECTIVES:**

Purpose of the dive (TASK): ____________

Location: ____________
General comments: ____________

Dive schedule: __________/__________ Depth: __________ Max depth: _________

Dive mode to be used: ____________

ATTACHMENT 1

DIVING SUPERVISOR/ LEAD DIVER DIVE PLAN BRIEF

PROJECT NAME/NUMBER: ______________________________

5. **ANTICIPATED HAZARDS**:

Boating: ______________________________

☐ Ensure the "Code ALPHA" flag is flying from the vessel, or a 1-meter rigid "Code ALPHA" flag is prominently displayed from the non-vessel dive platform (pier, shore, etc.).

☐ Ensure the "Divers down" flag is also displayed.

Climate: ______________________________

Sea Life: ______________________________

Expected Ordnance: ______________________________

Pollution: ______________________________

Other: ______________________________

6. **EQUIPMENT REQUIREMENTS**:

Diving Mode: ______________________________

Search Equipment: ______________________________

Recovery Equipment: ______________________________

Explosive Disposal Equipment: ______________________________

Special Task Equipment: ______________________________

7. GENERAL DIVING SAFETY PRECAUTIONS CHECKLIST

- Ensure divers are physically and mentally ready to perform the assigned dive task.
- Determine the exact depth of the dive site through use of lead line or Fathometer.
- Gauge diving and emergency air cylinders prior to diving.
- All dives will be no-decompression dives.
- Ensure the dive platform is in a position for rapid and safe recovery of the divers.
- Each diver is responsible for the condition of his/ her own diving equipment.
- Ensure the standby diver is well briefed and ready to enter the water.
- The buddy system will be used whenever possible. If the buddy system is not used or inappropriate for the dive, the diver will be tended.

ATTACHMENT 1

DIVING SUPERVISOR/ LEAD DIVER DIVE PLAN BRIEF

PROJECT NAME/NUMBER: ______________________________

- Ensure the international code “alpha” and “divers down” are prominently displayed. If diving is not conducted from a vessel, then a 1-meter square rigid replica of the “alpha” flag will be displayed.
- Ensure divers are briefed and protected against local harmful marine life.
- The Diving Supervisor/ Lead Diver must be aware of local ship and small boat traffic in the vicinity of the diving operation.
- Ensure the appropriate diving mode and dress have been selected for the task at hand.
- All dives conducted where there is not free access to the surface must be tended dives.
- Do not inflate life jacket or BCD where ascent to the surface is restricted.
- The Diving Supervisor/ Lead Diver will use the Pre-dive and Post-dive check-off sheets, Attachment 2 and 3, respectively.
- Review the methods of diver recall IAW the HASDP.
- The dive will be aborted in the event of any equipment malfunction.
- Inflate your life vest if surfacing with injuries or excessive fatigue.
- Use the proper ascent and descent rates of 75 feet per minute for descent and 30 feet per minute for ascent.
- Divers will not position themselves between any objects (camels, pier, boat, etc.).
- Brief task-specific safety precautions (UXO diving, altitude diving, ordnance/ explosive safety, etc.).
- Brief special line-pull signals Attachment 8.
- Brief appropriate ordnance safety precautions.
- If necessary, review cold water precautions (EHS 2-02 Attachment 9).

8. **COMMUNICATIONS:**

Radio frequency: ______________________________

Radio call signs:

Primary: ______________________________

Secondary: ______________________________

Telephone location: ______________________________

Site cell phone number: ______________________________

Other cell phones: ______________________________

ATTACHMENT 1

DIVING SUPERVISOR/ LEAD DIVER DIVE PLAN BRIEF

PROJECT NAME/NUMBER: ____

9. **SPECIAL CONSIDERATIONS**:

   Meals: ______________ Water: _______________ Heat source: ______________

   Clothing change: ____

10. **EMERGENCY PROCEDURES**: Review as outlined in Project HASDP and TtEC DSPM (EHS 2-02 Attachments 4 and 5).

ATTACHMENT 1

DIVING SUPERVISOR/ LEAD DIVER DIVE PLAN BRIEF

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ATTACHMENT 2

DIVING SUPERVISOR/LEAD DIVER PRE-DIVE CHECKLIST

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ATTACHMENT 2

DIVING SUPERVISOR/ LEAD DIVER PRE-DIVE CHECKLIST

PROJECT NAME/NUMBER:____

1. DIVING SUPERVISOR/ LEAD DIVER PRE-DIVE CHECKLIST FOR SCUBA DIVING

a. All divers shall have the following minimum equipment:

______ Proper dress for dive conditions, dry/wet suit, coveralls

______ Safety Harness w/tending line or witness float attached for single diver
NOTE**: Mandatory for projects which fall under EM385-1-1 (if any diver is tended).**

______ Adequate emergency breathing supply with separate independent regulator

______ SCUBA with regulator

______ Buoyancy Compensator (BC)

______ Submersible cylinder pressure gauge

______ Weight belt

______ Mask

______ Knife

______ Depth gauge

______ Diving watch or diving computer

______ Fins

______ Cylinder pressure is adequate for both the emergency air supply ***(90% capacity @ 2700 psig)*** and primary SCUBA supply ***(2500 psig minimum)***.

______ All quick-release buckles and fastenings can be reached by either hand and are properly rigged for quick release.

______ Weight belt is outside of all other belts, straps, and equipment, and is not likely to become pinched under the bottom edge of the cylinders.

______ Buoyancy Compensator is not constrained, is free to expand.

______ Check position of the knife to ensure that it will remain with the diver no matter what equipment he may jettison.

______ Conduct time check and synchronize watches.

______ Open cylinder valve and then back off 1/4 to 1/2 turn.

______ Ensure all inflation hoses are attached and function properly.

ATTACHMENT 2

DIVING SUPERVISOR/ LEAD DIVER PRE-DIVE CHECKLIST

PROJECT NAME/NUMBER:____

______ Depth gauge is zeroed.

______ AGA/ FFM Pre-Dive Checks (***Skip if not applicable***)

- ☐ Adjust pressure equalizer pad.
- ☐ Ensure all screws on mask are tight, and exhaust valve retaining ring is tight.
- ☐ Check connection from mask to supply hose.
- ☐ Check comm wire connection and through water transmitter.
- ☐ Don Mask.
- ☐ Inhale deeply to turn on positive pressure. (*If equipped*)
    - Check positive pressure flow.

______ Have diver breathe for 30 seconds. While doing this, diver should be alert for any impurities in the air or for any unusual physiological reactions.

______ Conduct final review of the dive plan.

______ Brief the divers on the following reasons for terminating the dive:

- ☐ The diver requests termination.
- ☐ The diver fails to respond correctly to communications or signals.
- ☐ Communications are lost and cannot be quickly reestablished.
- ☐ The diver begins to use his/her reserve breathing air.
- ☐ Puncture/tear of a dry suit.

______ Divers physically and mentally ready to enter the water.

______ Ladder is in place to retrieve divers from water.

______ Divers know the maximum depth and bottom time.

______ Review proper/special line pull signals.

______ Code Alpha and Divers Down flags are displayed.

______ Conduct Dive Supe checks on Standby diver.

ATTACHMENT 2

DIVING SUPERVISOR/ LEAD DIVER PRE-DIVE CHECKLIST

PROJECT NAME/NUMBER:____

______ Ensure standby diver knows searching signals.

______ Verify that personnel and equipment are ready to give proper visual, sound, or radio signals to warn off other vessels.

______ Ensure O_2 kit is on dive station with adequate supply, and the O2 bottle has been gauged and documented.

______ Diver or divers are now ready to enter the water.

b. Surface Check :

______ Conduct a breathing check of the SCUBA. Breathing should be easy, without resistance, and with no evidence of water leaks.

______ Visually check dive partner’s equipment for leaks, especially at all connection points (cylinder valves hoses at regulator and mouthpiece).

______ Check face mask seal.

______ Check partner for loose or entangled straps.

______ Check buoyancy. SCUBA divers should strive for neutral buoyancy.

______ If divers are wearing a dry suit, check valve function and for leaks.

______ Orient yourself with your surroundings. Note any obstructions that you may encounter upon surfacing.

NOTES:

1. ***Ensure divers are not sick or have not been recently treated for an injury or illness.***
2. ***Ensure all dive station personnel are monitored during surface intervals when extreme weather conditions exist.***

ATTACHMENT 2

DIVING SUPERVISOR/ LEAD DIVER PRE-DIVE CHECKLIST

PROJECT NAME/NUMBER:____

2. DIVING SUPERVISOR'S PRE-DIVE CHECKLIST FOR SURFACE-SUPPLIED DIVING

CAUTION: ***This checklist is an overview intended for use with the detailed Operating Procedures (OPs) from the appropriate equipment checklists as outlined in Attachment 11 and the specific equipment O&M technical manual*.**

a. Basic Preparation:

______ ***Dives deeper than 100 FSW or dives requiring decompression***, verify that a recompression chamber is present on the diving station and is on line.

______ Verify that proper signals indicating underwater operations being conducted are displayed correctly.

______ Ensure that all personnel concerned, or in the vicinity, are informed of diving operations.

______ Determine that all valves, switches, controls, and equipment components affecting diving operations are tagged-out to prevent accidental shut-down or activation.

b. Equipment Protection:

______ Assemble all members of the diving team and support personnel (winch operators, boat crew, etc.) for a pre-dive briefing.

______ Assemble and lay out all dive equipment, both primary equipment and standby spares for diver (or standby diver), including all accessory equipment and tools.

______ Check all equipment for superficial wear, tears, dents, distortion, or other discrepancies.

______ Check all masks, helmets, view ports, faceplates, seals, and visors for damage.

______ Check all harnesses, laces, strain relief, and lanyards for wear; replace as needed.

c. Helmets and Masks:

______ Ensure that all set up and operating procedures have been completed in accordance with the appropriate Technical Manual and Operating Procedures.

d. General Equipment:

______ Check that all accessory equipment – tools, lights, special systems, spares, etc. are on site and in working order. In testing lights, tests should be conducted with lights submerged in water and extinguished before removal, to prevent overheating and failure.

ATTACHMENT 2

DIVING SUPERVISOR/ LEAD DIVER PRE-DIVE CHECKLIST

PROJECT NAME/NUMBER:____

______ Erect diving stage or attach diving ladder. In the case of the stage, ensure that the screw pin shackle connecting the stage line is securely fastened with the shackle pin seized with wire or a safety shackle is used to help prevent opening.

______ Ensure first aid kits, portable O_2, and automatic external defibrillators are available and working.

e. Preparing the Diving System:

______ Check that a primary and suitable back-up air supply is available with a capacity in terms of purity, volume, and supply pressure to completely service all divers and standby diver, including decompression, recompressions, and accessory equipment throughout all phases of the planned operation.

______ Verify that all diving system operating procedures have been conducted to properly align the dive system.

______ Ensure that qualified personnel are available to operate and stand watch on the dive system.

f. Compressors:

______ Determine that sufficient fuel, coolant, lubricants, and antifreeze are available to service all components throughout the operation. All compressors should be fully fueled, lubricated, and serviced (with all spillage cleaned up completely).

______ Check maintenance and repair logs to ensure the suitability of the compressor (both primary and back-up) to support the operation.

______ Verify that all compressor controls are properly marked and appropriate valves are tagged with ***"Divers Air Supply - Do Not Touch"*** signs.

______ Ensure that the compressor is secure in the diving craft and will not be subject to operating angles, caused by roll or pitch that will exceed 15 degrees from the horizontal.

______ Verify that oil in the compressor is an approved type. Check that the compressor oil does not overflow the FULL mark; contamination of air supply could result from fumes or oil mist.

______ Check that compressor exhaust is vented away from work areas and, specifically, does not foul the compressor intake.

______ Check that compressor intake is obtaining a free and pure suction without contamination. Use pipe to lead intake to a clear suction location if necessary.

______ Check all filters, cleaners, and oil separators for cleanliness.

ATTACHMENT 2

DIVING SUPERVISOR/ LEAD DIVER PRE-DIVE CHECKLIST

PROJECT NAME/NUMBER:____

______ Bleed off all condensed moisture from filters and from the bottom of volume tanks. Check all manifold drain plugs, and that all petcocks are closed.

______ Check that all belt-guards are properly in place on drive units.

______ Check all pressure-release valves; check valves and automatic unloaders.

______ Verify that all supply hoses running to and from compressor have proper leads, do not pass near high-heat areas such as steam lines, are free of kinks and bends, and are not exposed in such a way that they could be rolled over, damaged, or severed by machinery or other means.

______ Verify that all pressure supply hoses have safety lines and strain reliefs properly attached.

g. Activate the Air Supply in accordance with approved Operating Procedures.

1. Compressors

______ Ensure that all warm-up procedures are completely followed.

______ Check all petcocks, filler valves, filler caps, overflow points, bleed valves, and drain plugs for leakage or malfunction of any kind.

______ Verify that there is a properly functioning pressure gauge on the air receiver and that the compressor is meeting its delivery requirements.

2. Cylinders

______ Gauge all cylinders for proper pressure.

______ Verify availability and suitability of reserve cylinders.

______ Check all manifolds and valves for operation.

______ Activate and check delivery.

For all air supply systems, double check "Do Not Touch" tags (tag out).

h. Diving Hoses:

______ Ensure all hoses have a clear lead and are protected from excessive heating and damage.

ATTACHMENT 2

DIVING SUPERVISOR/ LEAD DIVER PRE-DIVE CHECKLIST

PROJECT NAME/NUMBER:____

______ Ensure that the hose (or any length) has not been used in a burst test program. No hose length involved in such a program will be part of an operational diving hose.

______ Check that hoses are free of moisture, packing material, or chalk.

______ Soap test hose connections after connection to air supply and pressurization.

______ Ensure umbilical boots are in good condition.

i. Test Equipment with Activated Air Supply:

______ Hook up all air hoses to helmets, masks, and chamber; make connections between back-up supply and primary supply manifold.

______ Verify flow to helmets and masks from primary and secondary air supply.

______ Check all exhaust and non-return valves.

______ Hook up and test all communications.

______ Check air flow from both primary and back-up supplies to chamber.

j. Recompression Chamber Checkout (Pre-dive only):

______ Check that chamber is completely free and clear of all combustible materials.

______ Check primary and back-up air supply to chamber and all pressure gauges.

______ Check that chamber is free of all odors or other “contaminants.”

______ Hook up and test all communications.

______ Check air flow from both primary and back-up supplies to chamber.

k. Final Preparations:

______ Verify that all necessary records, logs, and timesheets are on the diving station.

______ Check that appropriate decompression tables are readily at hand.

______ Place the dressing bench in position, reasonably close to the diving ladder or stage, to minimize diver travel.

l. Dress Diver/s:

______ Dress divers in accordance with requirements of approved workplan and in considerations of the site environmental conditions.

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ATTACHMENT 3

DIVING SUPERVISOR/LEAD DIVER POST-DIVE CHECKLIST

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ATTACHMENT 3

DIVING SUPERVISOR/ LEAD DIVER POST-DIVE CHECKLIST

PROJECT NAME/ NUMBER:____

______ Check the physical condition of the diver.

______ Instruct the diver to report any physical problems or adverse physiological effects including symptoms of decompression sickness.

______ Advise the diver of the location of the closest recompression chamber that is ready for use.

______ Alert the diver to the potential hazards of ascending to altitude, including flying after diving (see DSPM Section 18)

______ Assemble diving equipment and return to site support facility.

______ Have divers shower and consume warm liquids, avoid beverages with caffeine.

______ Observe the divers on the surface for symptoms of diving disorders for a minimum of 10 minutes before allowing the divers to leave the dive site.

______ Wash all diving equipment in fresh water and hang to dry.

______ Reorder/replace equipment as necessary.

______ Complete a dive profile log for all divers and submit the log to the Chairman of the Diving Review Board for input into TtEC's master dive log.

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ATTACHMENT 4

EMERGENCY PROCEDURES

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ATTACHMENT 4

EMERGENCY PROCEDURES

GENERAL DIVING EMERGENCY PROCEDURES

1. **Decompression Sickness or Arterial Gas Embolism**:
    - Recall all divers.
    - Administer first aid, CPR and emergency O_2 as required.
    - Notify Recompression Chamber.
    - Begin transport to chamber on oxygen.
2. **Fire in Equipment**:
    - Evaluate effect of fire on diver AND topside crew.
    - Terminate dive.
    - Inform crew and diver of action planned.
    - Activate plan outlined in Project HASDP.
3. **Explosive Detonation with Divers in the Water**:
    - Try to establish communications with the divers using standard line pull signals or communications.
    - If contact is established with the divers, recall, recover, and administer first aid as required. Transport in accordance with project HASDP as required.
    - If communications cannot be established, activate the standby diver and recover the divers via the tending line, and administer first aid as required.
    - Request medical assistance and remember that unconscious divers should be treated for possible arterial gas embolism (AGE)
    - Discontinue diving operations until the cause of the explosion is determined.
4. **Boat Breakdown:**

    This situation is considered to constitute an emergency due to the loss of control of the divers.

    - Recall and recover the divers.
    - Discontinue diving operations.
    - Deploy the anchor
    - Request assistance via radio, phone, or signals.
5. **Variations in Ascent Rate**

    Always ascend at a rate of 30 feet per minute (FPM) (20 seconds per 10 feet of seawater [FSW]). Minor variations in the rate of travel between 20 and 40 FSW/minute are acceptable. Any variation in the rate of ascent must be corrected in accordance with the following procedures; however, a delay of up to 1 minute in reaching the first decompression stop can be ignored.

    - **Travel Rate Exceeded.** On a Standard Air Dive, if the rate of ascent is greater than 30 FPM, STOP THE ASCENT, allow the watches to catch up, and then continue ascent. If the decompression stop is arrived at early, start the stop time after the watches catch up.

- **Delay greater than 1 minute, deeper than 50 FSW**. Add the total delay time (rounded up to the next whole minute) to the bottom time, re-compute a new decompression schedule, and decompress accordingly.
- **Delay greater than 1 minute, shallower than 50 FSW**. If the rate of ascent is less than 30 FPM, add the delay time to the diver's first decompression stop. If the delay is between stops, disregard the delay. The delay time is rounded up to the next whole minute.

6. Unplanned Ascent (Blowup)

- **Ascent from 20 Feet or Shallower with No Decompression Stops Required.** No recompression is required if the diver surfaces from 20 feet or shallower but was within no-decompression limits and is asymptomatic. The diver should be observed on the surface for 1 hour. Consider administering O_2.
- **Ascent from 20 Feet or Shallower (Shallow Surfacing) with Decompression Stops Required.** If decompression is required and the diver surfaces from 20 FSW or shallower (missed the 20- and/or 10-foot stop) and is asymptomatic, the diver is returned to that decompression stop.
    - If the time from the surface back to the stop was less than 1 minute, add 1 minute to the stop.
    - If the time from the surface back to the stop was more than 1 minute and the diver remains asymptomatic, multiply the 20- and/or 10-foot stops by 1.5.
    - Observe diver for 1 hour. Consider administering O_2.
- **Ascent from Deeper than 20 Feet (Uncontrolled Ascent).** Any unexpected surfacing of the diver from depths in excess of 20 feet is considered an uncontrolled ascent. If the diver is within no-decompression limits and asymptomatic, he/she should be observed for at least 1 hour on the surface. Recompression is not necessary unless symptoms develop. Consider administering emergency O_2.
- **Asymptomatic Uncontrolled Ascent.** Asymptomatic divers who experience an uncontrolled ascent and who have missed decompression stops are treated by recompression based on the amount of decompression missed as follows:
    - **Oxygen Available.** Immediately compress the diver to 60 feet in the recompression chamber. If less than 30 minutes of decompression (total ascent time from the tables) was missed, decompress from 60 feet on appropriate Treatment Table. If more than 30 minutes of decompression was missed, decompress from 60 feet on appropriate Treatment Table.
    - **Oxygen Not Available**. If less than 30 minutes of decompression was missed, compress the diver to 100 feet in the recompression chamber and treat on appropriate Treatment Table. If more than 30 minutes was missed, compress to 165 feet and treat on appropriate Treatment Table.

- **Symptomatic Uncontrolled Ascent.** If a diver has had an uncontrolled ascent and has any symptoms, he/she should be recompressed immediately in a recompression chamber to 60 FWS.
  - If the diver surfaced from 60 FWS or shallower, compress to 60 FSW and begin appropriate Treatment Table.
  - If the diver surfaced from a greater depth, compress to 60 FSW or depth where the symptoms are significantly improved, not to exceed 165 FSW, and begin appropriate Treatment Table.

7. Emergency Evacuation

- Notify diver and dive team of emergency and abort dive.
- Evacuate all unnecessary personnel.
- Decompress the diver (if required) and recover. If decompression is not possible, follow omitted decompression procedures.

ATTACHMENT 4

EMERGENCY PROCEDURES

SCUBA EMERGENCY PROCEDURES

1. **Buddy Separation** – Make a 360-degree check, above and below; if your buddy is not found, surface immediately. Check the surface for bubbles and notify the Diving Supervisor/ Lead Diver immediately.

2. **Lost Diver** – The first stage of a lost diver is when communications have been lost and emergency recall has failed.
   - Initiate diver recall.
   - Wait 1 minute for response.
   - Deploy lost diver buoy.
   - Deploy standby diver (Dive Supervisor's/ Lead Diver's discretion); follow bubbles or conduct expanding circle line search from last known position.
   - Notify ships/ boats in the area to look out for lost diver and request assistance from the Coast Guard Rescue Center, if necessary.

3. **Loss of Air/Equipment Malfunction (SCUBA)**
   - Signal buddy/surface and abort dive.
   - Buddy breath/activate reserve/breath from emergency air supply.
   - Exhale to the surface.

4. **Mechanical Injury:**
   - Signal buddy/surface and abort dive.
   - Inform Diving Supervisor/Lead Diver.
   - Rule out possible decompression sickness.
   - If immediate treatment required, recall all divers and transport to hospital.

5. **Fouled/Trapped Diver**:
   - Don't panic, stop and think!
   - Notify your buddy diver or topside, if possible (2-2-2 fouled and need assistance, or 3-3-3 fouled and can clear myself).
   - Carefully and calmly try to work yourself free of the entanglement.
   - If required, ditch your equipment and make a buoyant ascent to the surface.
   - If the diver is trapped, the buddy diver should mark the position of the trapped diver with a circle line, his tending line or any available method of marking the trapped diver's position, and then surface and report to the Diving Supervisor.
   - The Diving Supervisor/ Lead Diver will formulate a rescue plan, while the diver delivers additional air to the trapped diver.
   - The Diving Supervisor/Lead Diver will then brief the rescue plan to the dive team and execute the rescue.

ATTACHMENT 4

EMERGENCY PROCEDURES

After rescue, observe the divers on the surface for signs of AGE, asphyxia, physical injury, omitted decompression, and hypothermia.

SURFACE SUPPLIED EMERGENCY PROCEDURES

1. Loss of Breathing Media

- Re-establish breathing media supply:
  - Activate topside secondary breathing media supply
  - Diver initiate emergency procedure using bailout bottle.
  - **<u>ONLY AS A LAST RESORT</u>** – Pressurize the diver's pneumofathometer hose (135 PSI) and have the diver insert the hose into his/her helmet or mask.
- Alert standby diver.
- Have stricken diver go to bell, stage or ladder.
- If required, send standby diver to assist.
- Terminate dive.

2. Loss of Communications

- Attempt to establish communications with line pull signals.
- Put constant air to the diver's pneumofathometer.
- Alert standby diver.
- If communications are established using line pull signals, abort dive and decompress if required.
- If communications are not established, send stand-by diver to diver's assistance, abort dive, and decompress if required.

3. Fouled or Trapped Diver

- Avoid panic and ensure diver does NOT ditch equipment.
- Diver informs topside — gives a detailed report.
- Alert standby diver.
- Diver determines the extent of entrapment.
- Diver attempts to free yourself.
- If required, deploy standby for assistance.
- Abort dive and decompress if required

4. Injury in the Water

- Diver informs topside of injury and extent — gives a detailed report.
- Alert standby diver.

- If required, deploy standby diver to assist stricken diver.
- Abort dive and follow decompression protocol, unless injury indicates a greater risk than omitted decompression. Check surface decompression tables for alternate protocol.
- Request required medical assistance.

5. Severance of Divers Air Supply

- Diver initiates emergency procedure using bailout bottle.
- **If pneumofathometer hose intact and then ONLY AS A LAST RESORT –** Pressurize the diver’s pneumofathometer hose (135 PSI) and have the diver insert the hose into his helmet or mask.
- Alert standby diver.
- Abort dive and decompress.
- Deploy standby diver with more air and/or assist stricken diver if required.

6. Severance of Complete Umbilical

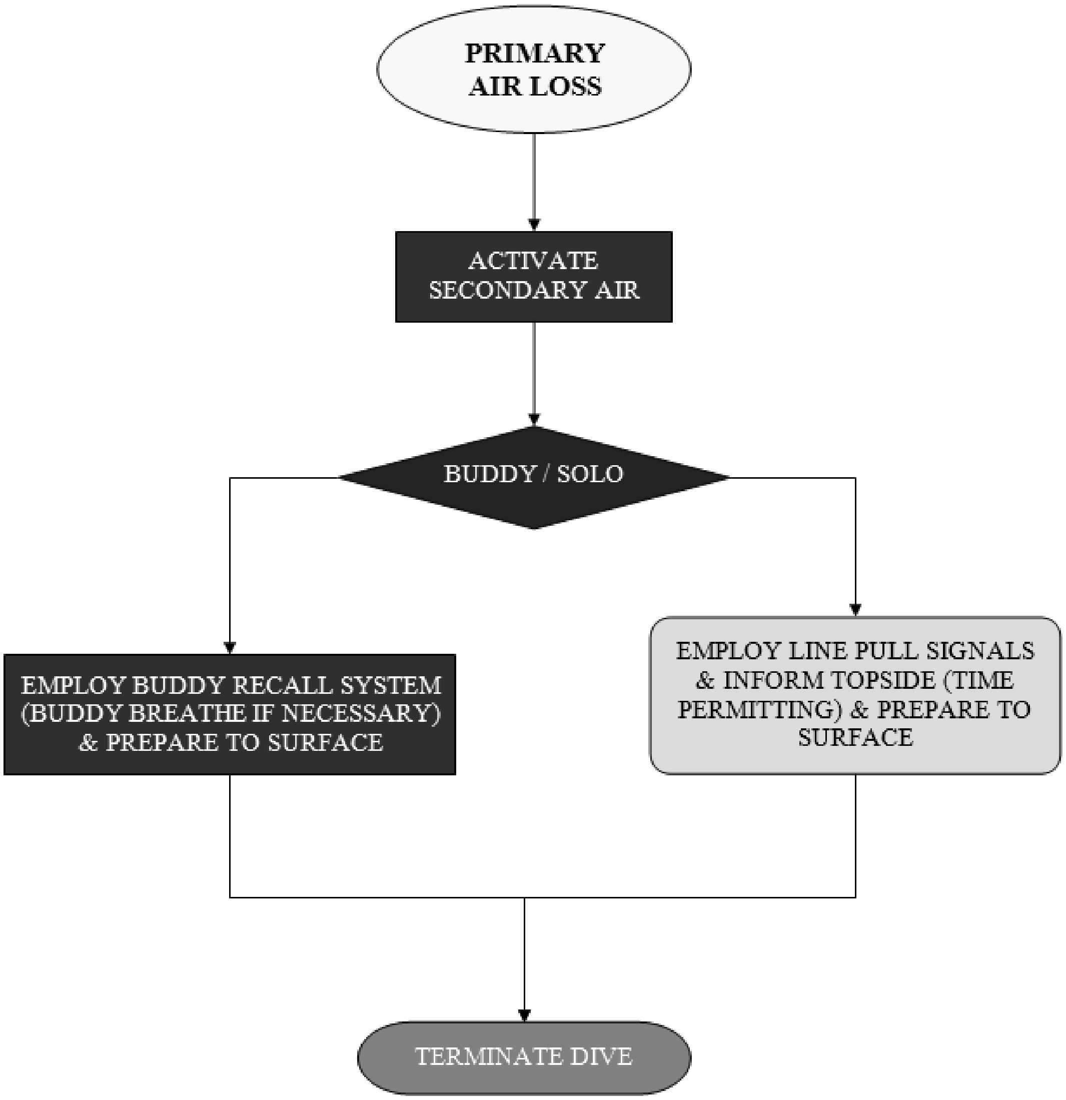
- Diver initiates emergency procedure using bailout bottle.
- Topside alerts standby diver.
- Deploy standby diver down stage line, diver’s umbilical (if visible), or descent line with additional air supply (pneumofathometer, if necessary) to assist stricken diver and inform topside of conditions.
- Abort dive and decompress. Check surface decompression tables for shorter water time.

ATTACHMENT 4

EMERGENCY PROCEDURES

DIVING EMERGENCY DECISION FLOW CHARTS

SCUBA EMERGENCY PROCEDURES



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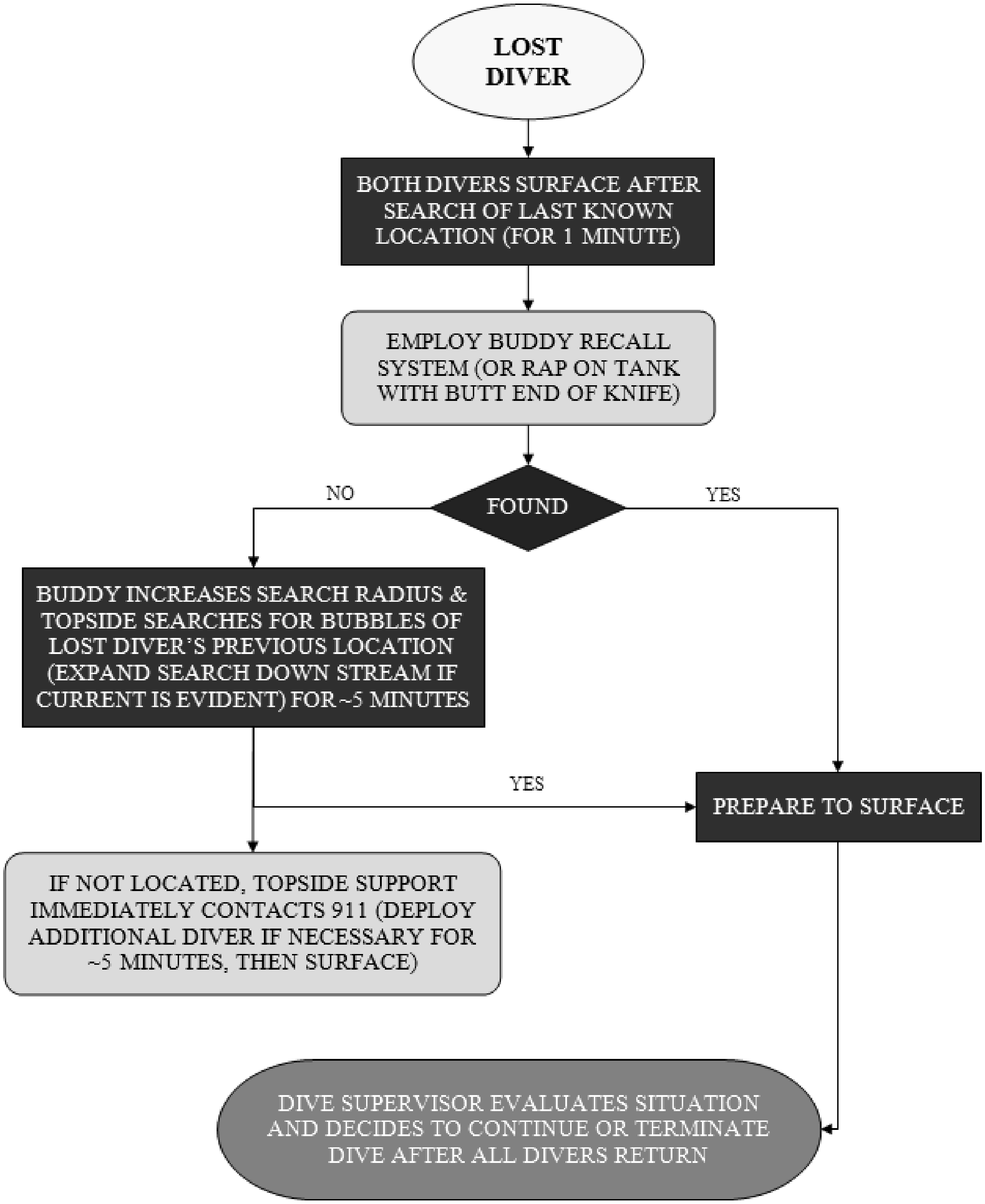
EMERGENCY PROCEDURES



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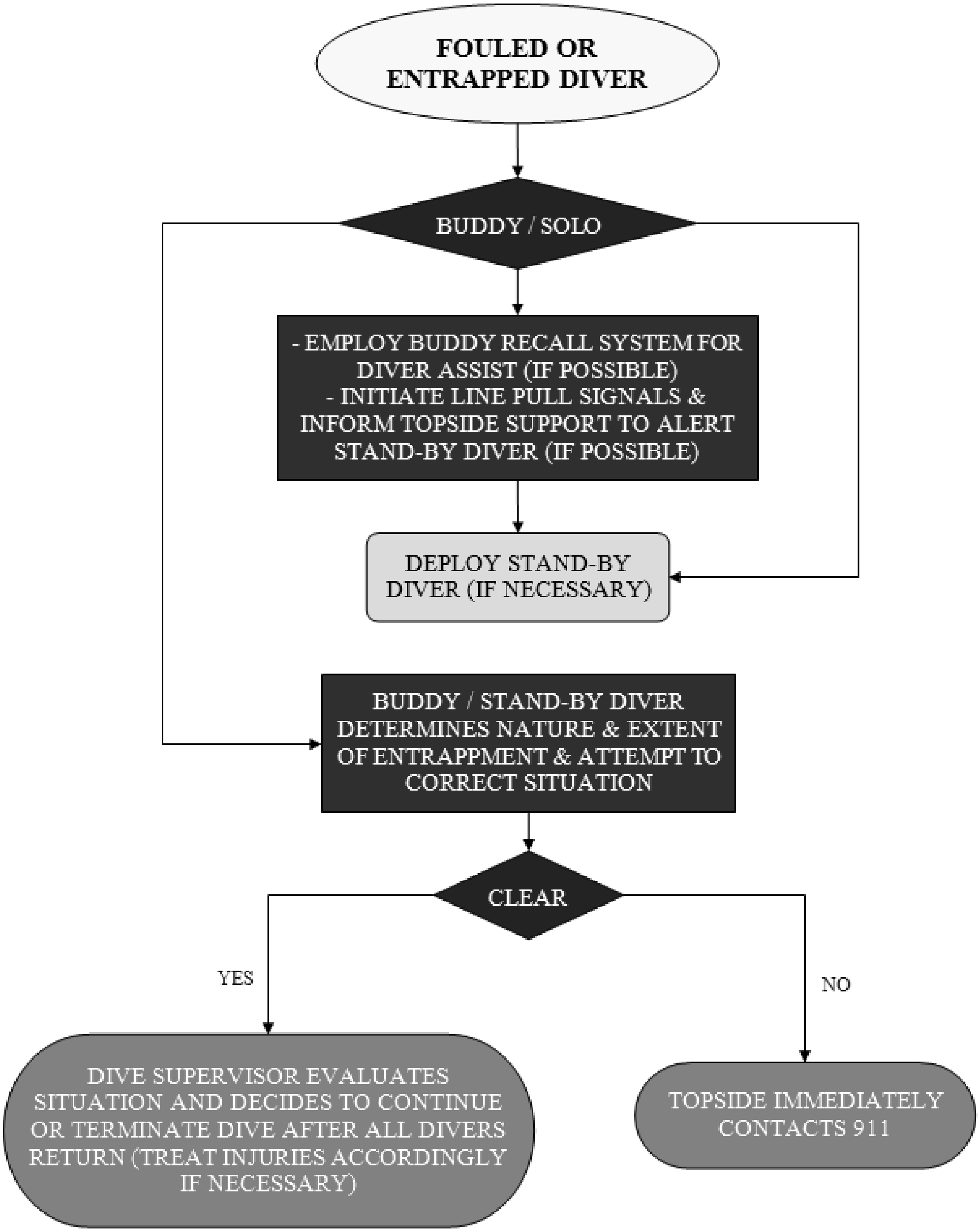
EMERGENCY PROCEDURES



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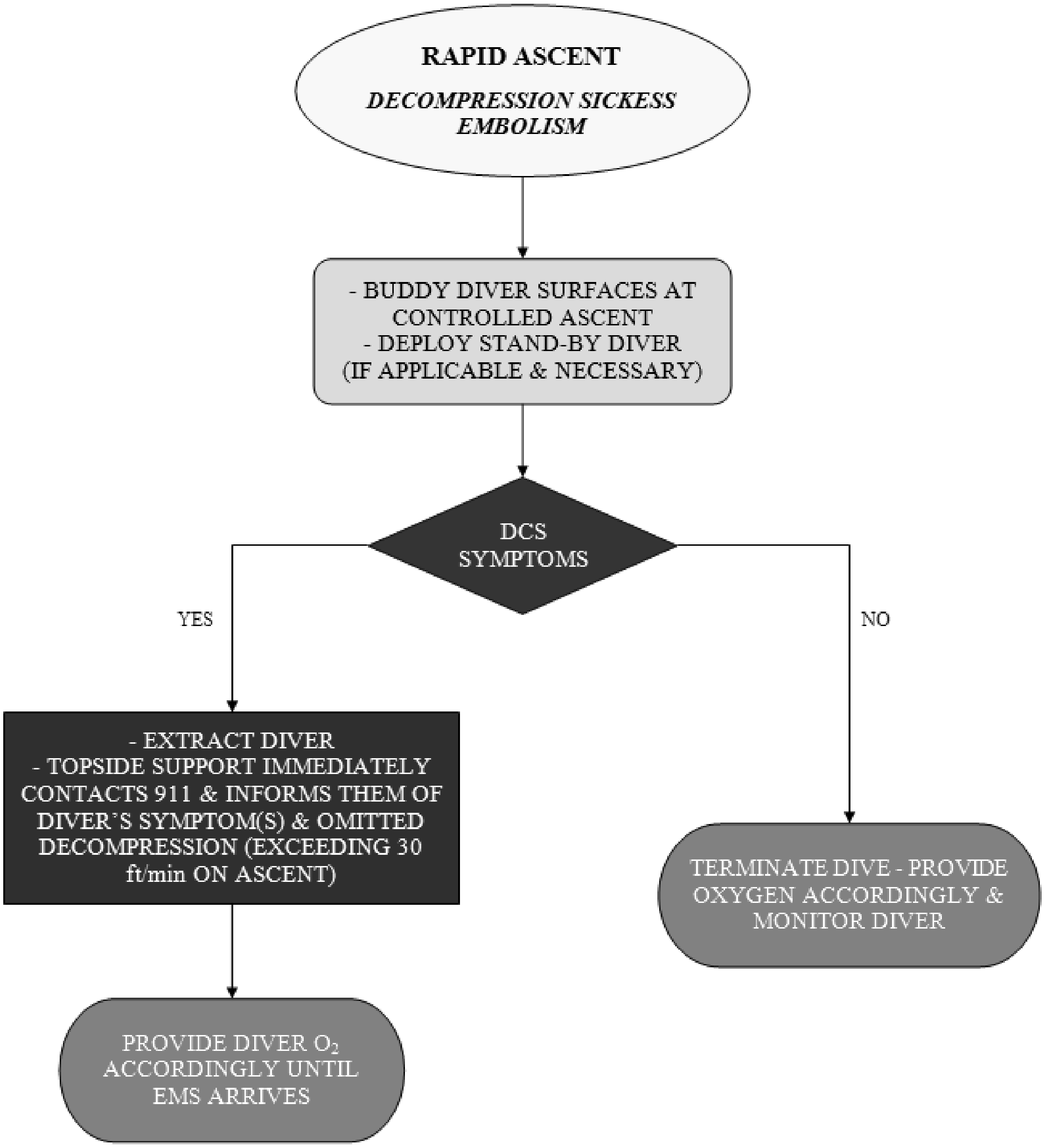

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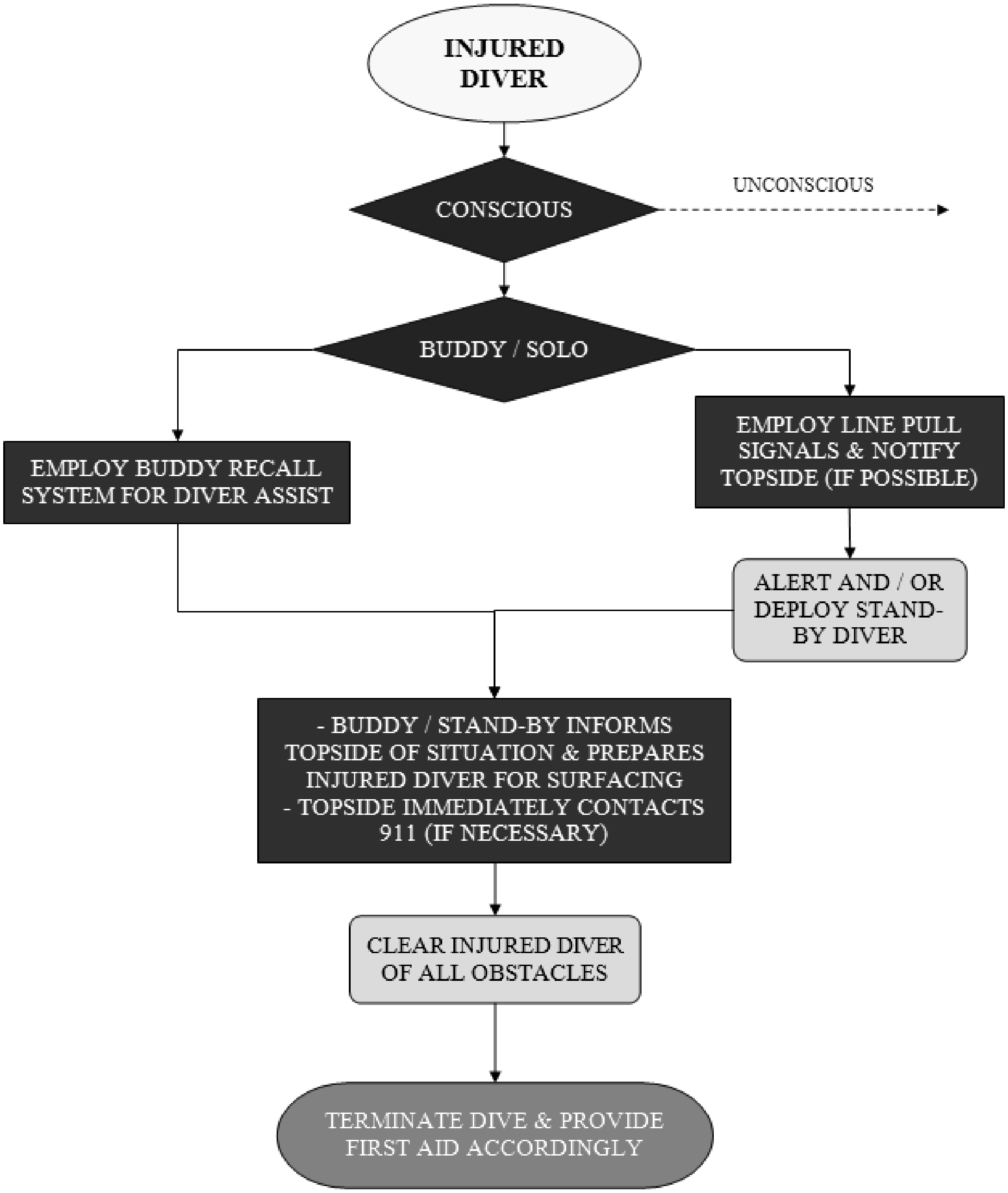
EMERGENCY PROCEDURES



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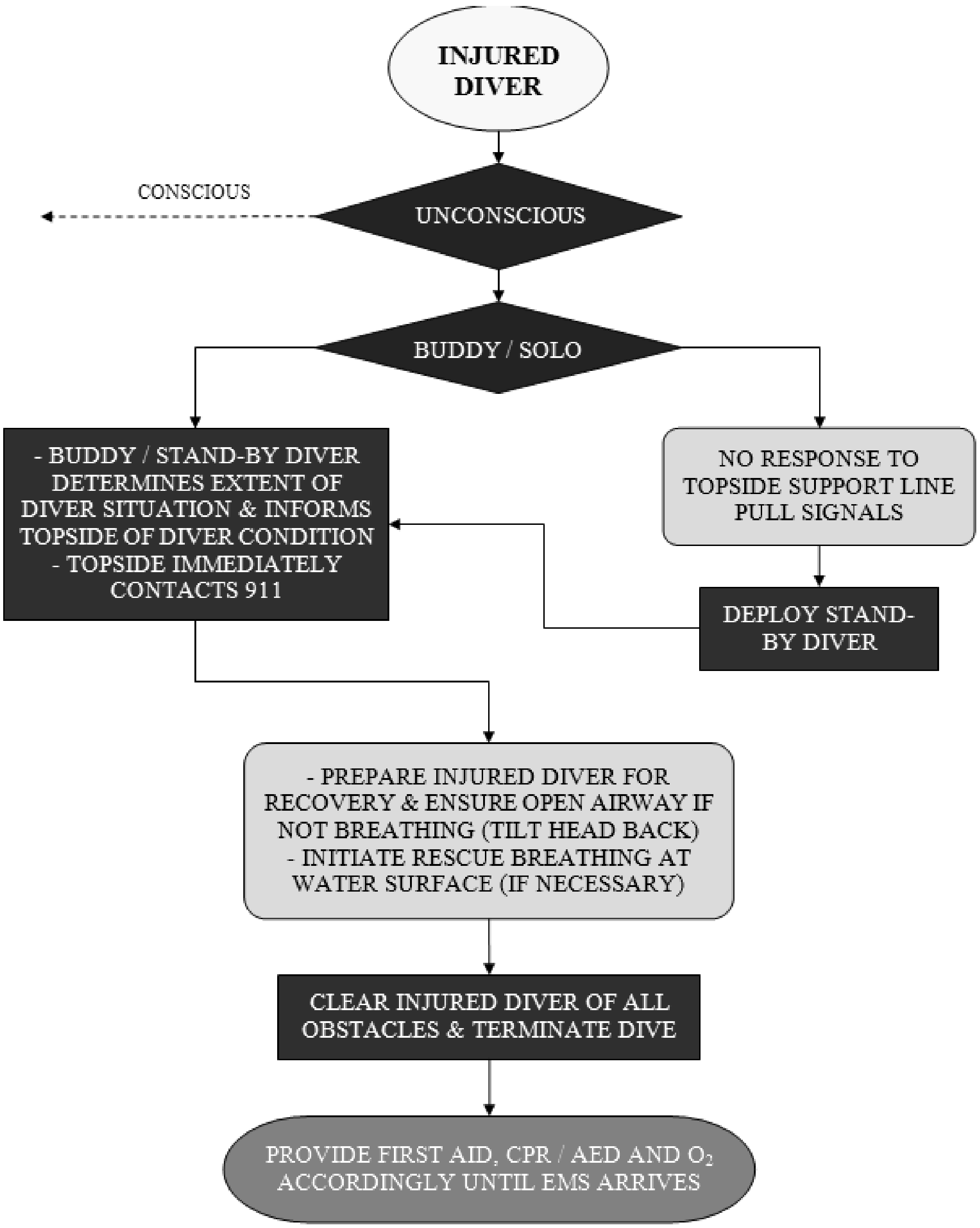
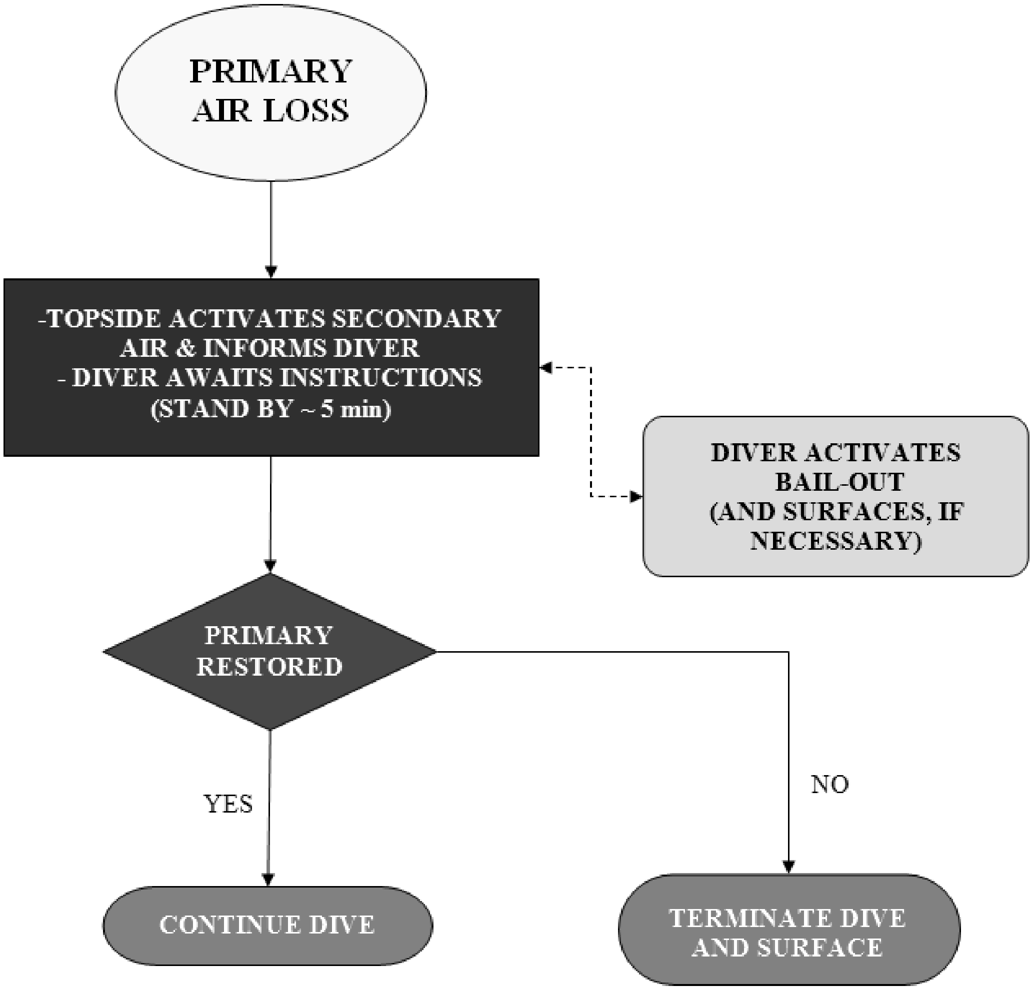
EMERGENCY PROCEDURES



ATTACHMENT 4

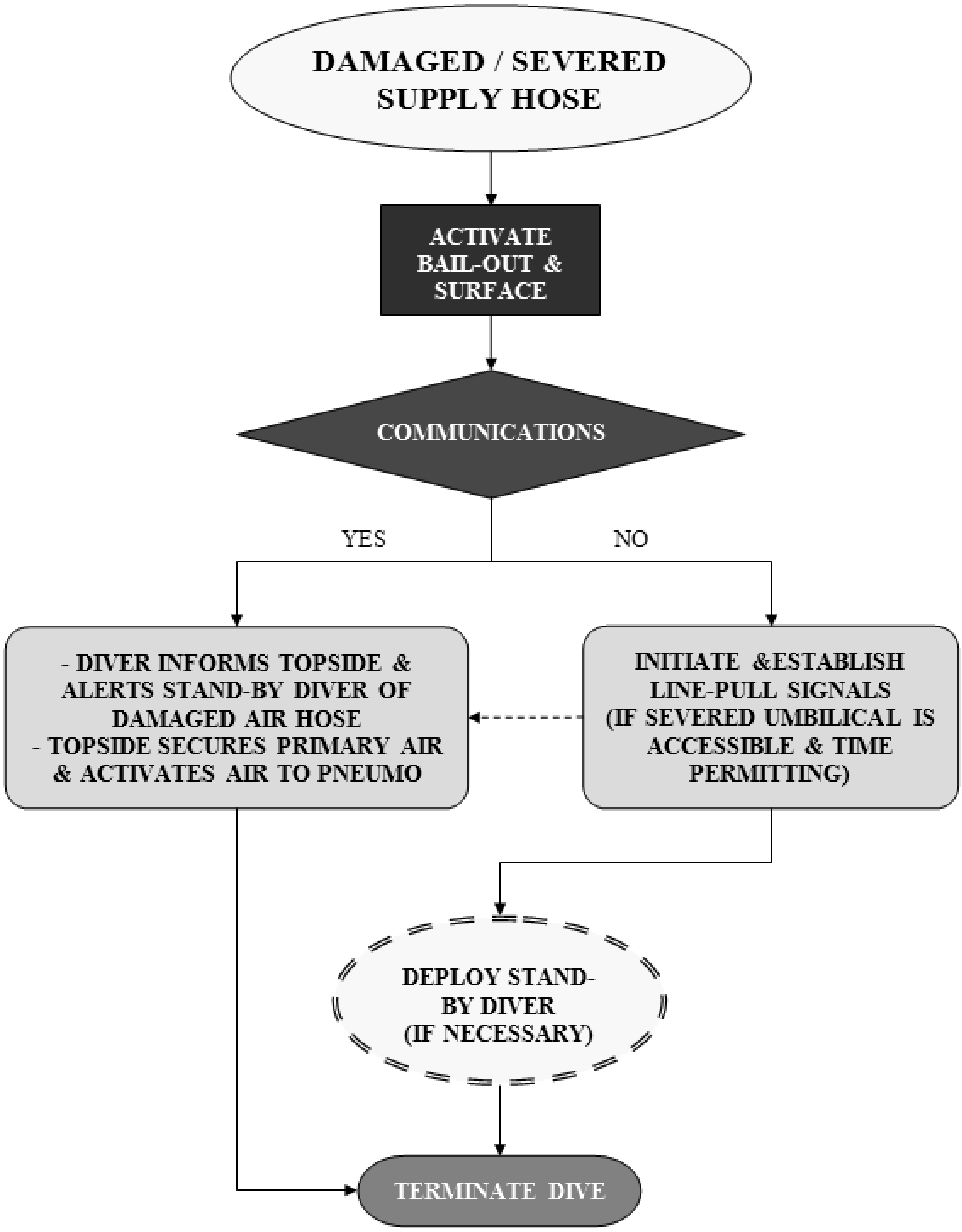
EMERGENCY PROCEDURES

SURFACE SUPPLIED EMERGENCY PROCEDURES



ATTACHMENT 4

EMERGENCY PROCEDURES



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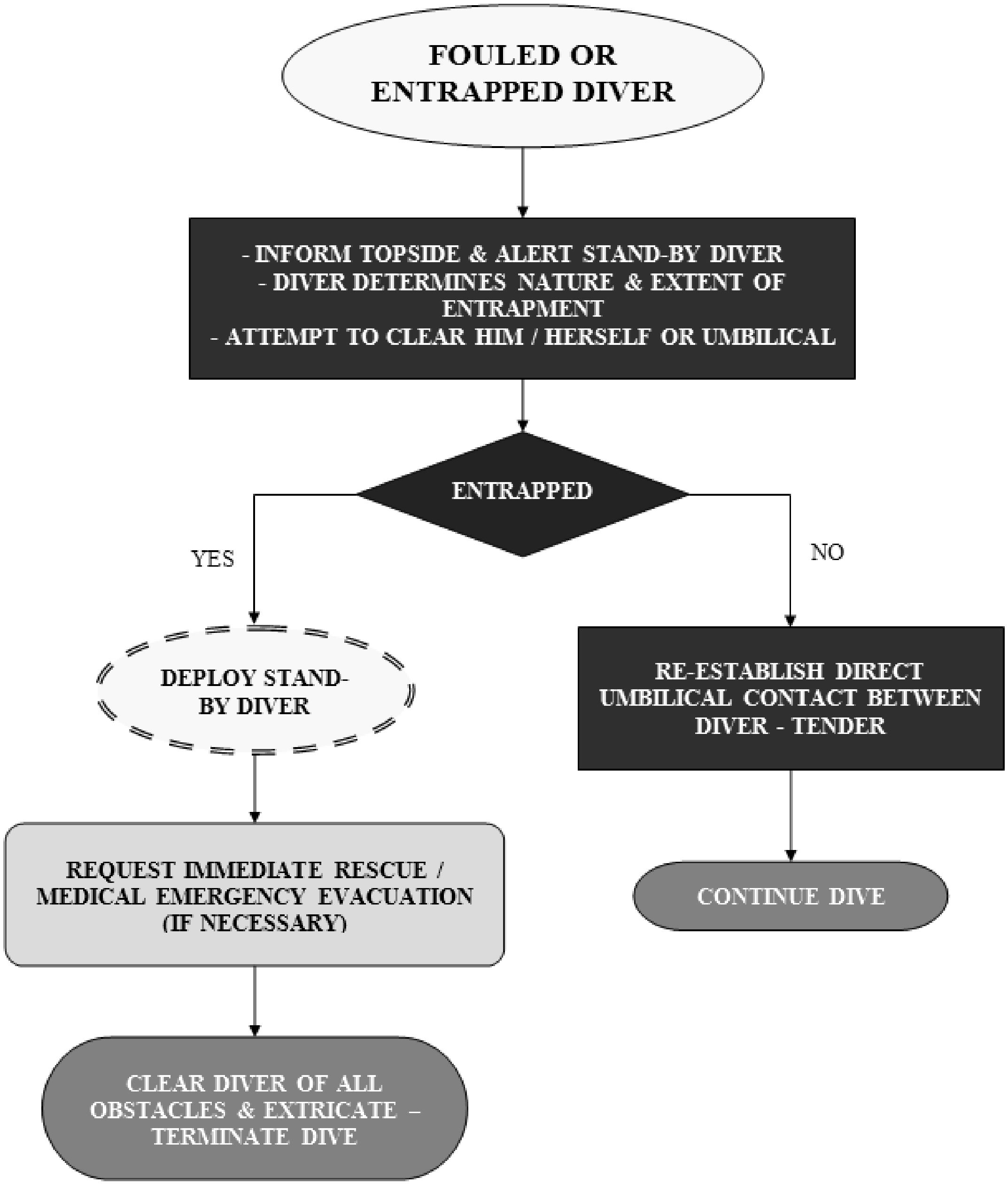
EMERGENCY PROCEDURES



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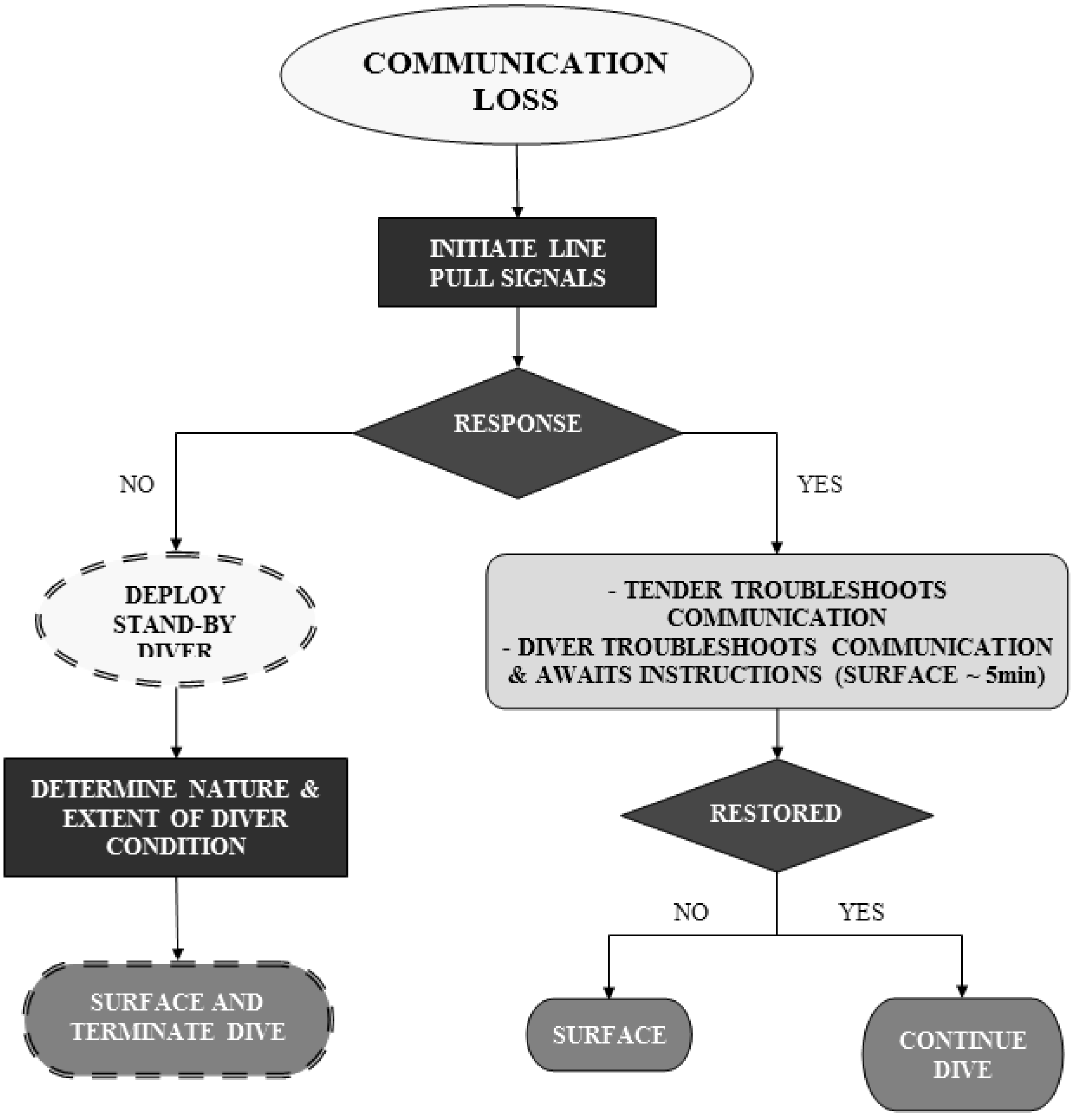
EMERGENCY PROCEDURES



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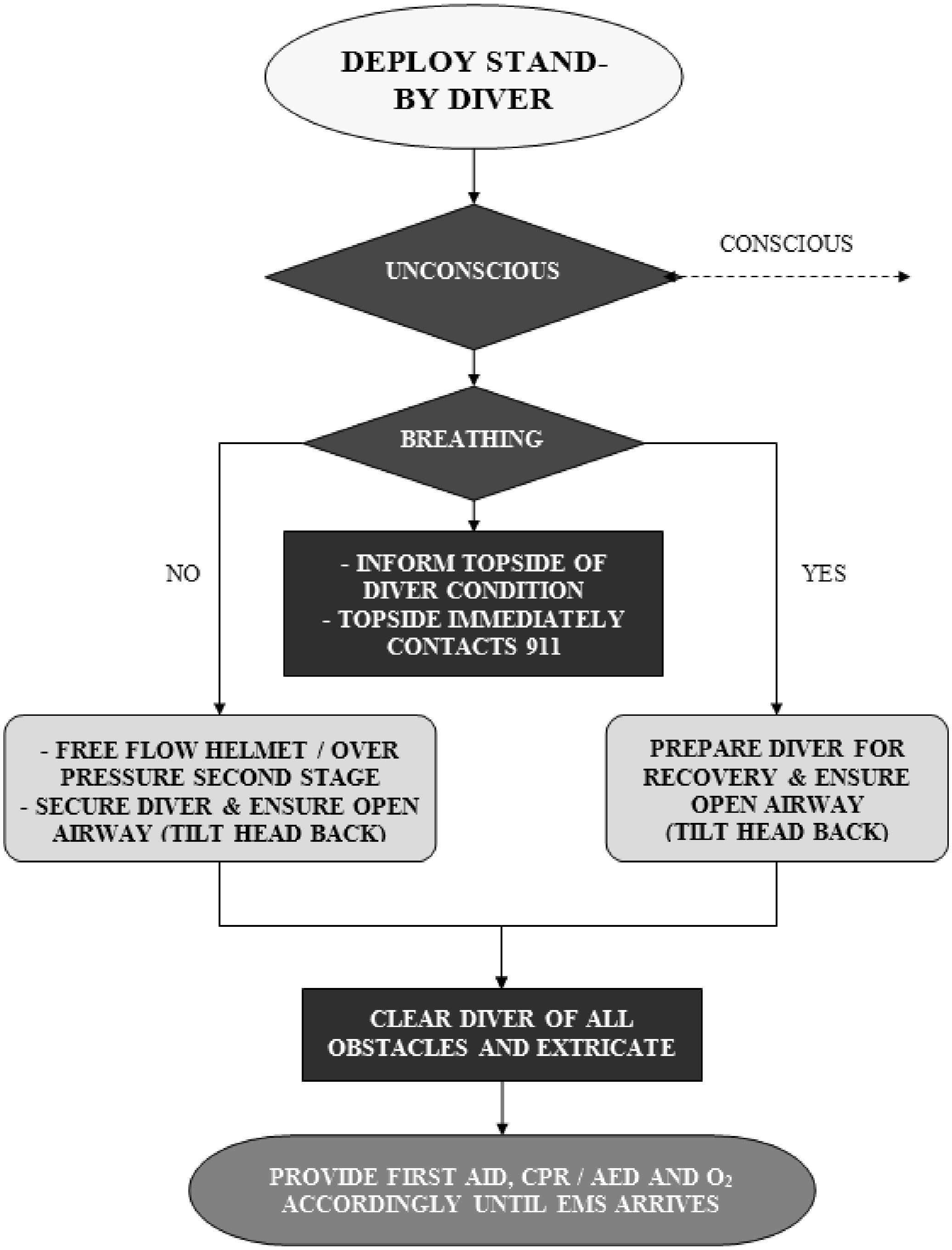

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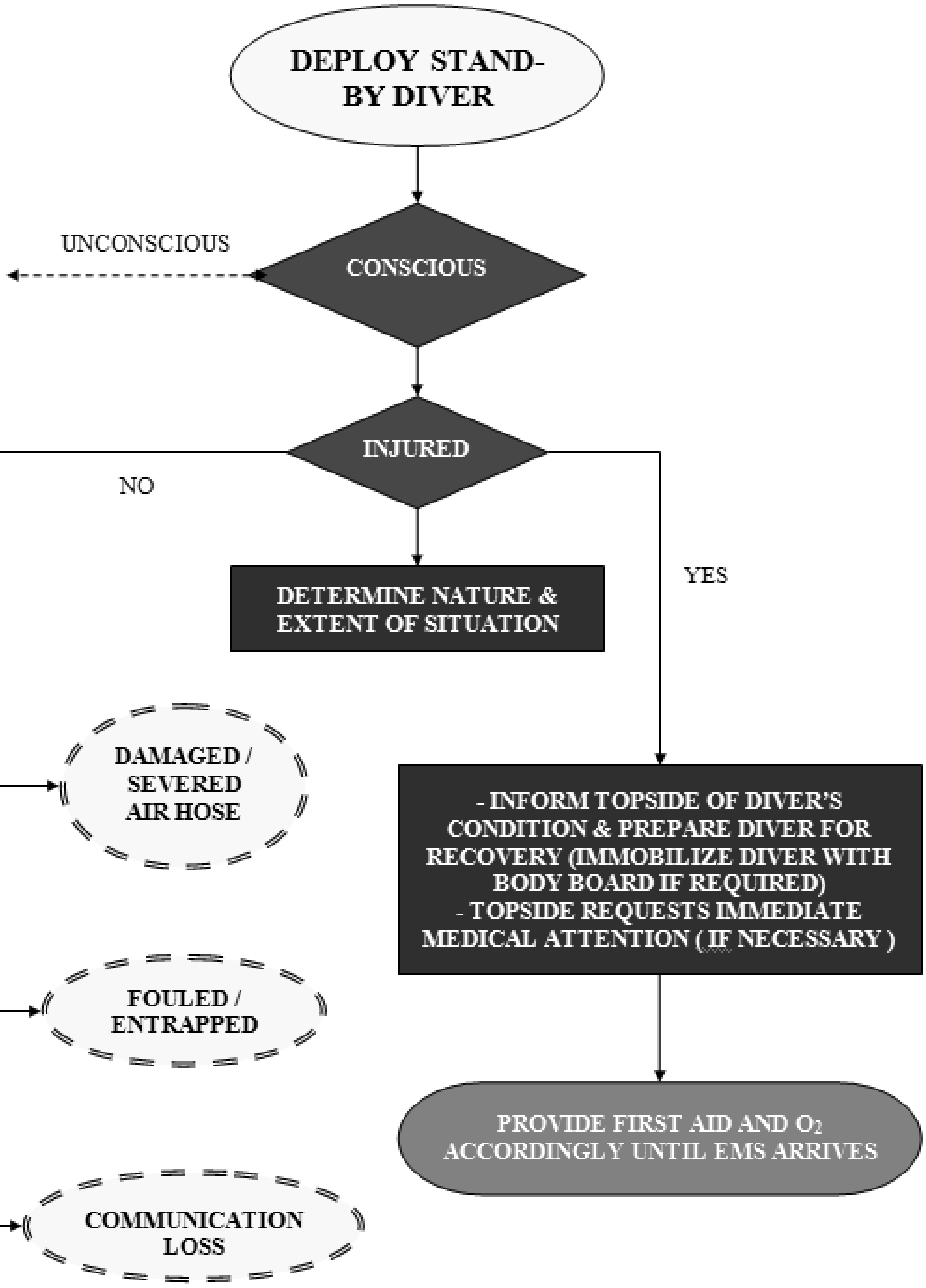
EMERGENCY PROCEDURES



ATTACHMENT 5

EMERGENCY PHONE NUMBERS CHECKLIST

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ATTACHMENT 5

EMERGENCY PHONE NUMBERS CHECKLIST

PROJECT NAME/NUMBER:____

RECOMPRESSION CHAMBER:

ADDRESS/ LAT-LONG ____

PHONE NUMBER: ____

POC: ____

RESPONSE TIME: ____

HOSPITAL:

ADDRESS/ LAT-LONG ____

PHONE NUMBER: ____

POC: ____

RESPONSE TIME: ____

AIR TRANSPORTATION:

ADDRESS/ LAT-LONG ____

PHONE NUMBER: ____

POC: ____

RESPONSE TIME: ____

SEA TRANSPORTATION:

ADDRESS/ LAT-LONG ____

PHONE NUMBER: ____

POC: ____

RESPONSE TIME: ____

ATTACHMENT 5

EMERGENCY PHONE NUMBERS CHECKLIST

PROJECT NAME/NUMBER:____

AMBULANCE:

ADDRESS/ LAT-LONG ____

PHONE NUMBER: ____

POC: ____

RESPONSE TIME: ____

PHYSICIAN:

ADDRESS/LAT-LONG ____

PHONE NUMBER: ____

POC: ____

RESPONSE TIME: ____

COMMUNICATIONS:

ADDRESS/ LAT-LONG ____

PHONE NUMBER: ____

POC: ____

RESPONSE TIME: ____

USCG RESCUE:

ADDRESS/ LAT-LONG ____

PHONE NUMBER: ____

POC: ____

RESPONSE TIME: ____

NOTE – THIS CHECKLIST WILL BE PROMINENTLY POSTED AT THE DIVE SITE AND BE PLACED IN ALL BOATS AND RESPONSE VEHICLES.

ATTACHMENT 6

WORKING DIVE LOG

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ATTACHMENT 6

TETRA TECH TMR WORKING DIVE LOG

1. All Tetra Tech TMR (Tt TMR) dives will be recorded on this attachment during field operations each dive day.

2. The information on these working Dive Logs will be then transferred/ recorded on the Tt TMR Dive Smooth Log by the Dive Supervisor/ or designee and forwarded to the Project Manager for the official project files. A copy will be further forwarded to the Chairman of the Tt TMR Diving Review Board.

   For scientific divers, a copy will also be sent to the Tt TMR Diving Safety Officer. The Chairman of the Diving Review Board will retain this log for 1 year, except where there has been an injury or incident of decompression sickness and then the record will be retained for 5 years.

3. Definitions:

   a. <u>Old Group</u> – Repetitive group designation from previous dive. Leave blank if this is the first dive.

   b. <u>Surface Interval</u> – The time, which a diver has spent on the surface following a dive. It begins as soon as the diver surfaces and ends as soon as the diver starts his/her next descent. Not required for first dive.

   c. <u>RNT – RESIDUAL NITROGEN TIME</u> – Time, in minutes, which must be added to the bottom time of a repetitive dive to compensate for the nitrogen still in solution in a diver's tissues from a previous dive.

   d. <u>Depth</u> – Depth of current dive.

   e. <u>Bottom Time</u> – The total elapsed time from when the divers leave the surface to the time (rounded up to the next whole minute) they begin their ascent from the bottom.

   f. <u>Decompression time</u> – Decompression schedule/decompression time.

   g. <u>Equivalent Single Dive Time</u> – RNT plus actual bottom time.

   h. <u>New Group</u> – REPETITIVE GROUP DESIGNATION – A letter, which is used to relate directly to the amount of residual nitrogen remaining in a diver's body.

4. <u>RNT Exception Rule</u> – If performing a repetitive dive to the same depth or deeper, and the RNT is greater than the bottom time of the previous dive, use the bottom time of the previous dive as the RNT.

5. See Attachment 10 for the required U.S. Navy Dive Tables needed to complete these logs.

ATTACHMENT 6

TETRA TECH EC WORKING DIVE LOG

PROJECT NAME/NUMBER: ____ **DATE:** _______________________

NAME	LS	RS	TBT	DEPTH	TDT	RNT	ESDT	T/S	REPET GROUP	SI
DIVE SUPERVISOR					STBY DIVER					

ATTACHMENT 7

DIVE SMOOTH LOG

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ATTACHMENT 7

TETRA TECH TMR DIVE SMOOTH LOG

PROJECT NAME/ NUMBER: ____

1. All Tetra Tech TMR dives will be recorded on this attachment and be the final legal record concerning a diver's hyperbaric exposure during operations.

2. Upon completion of the project or weekly, all working Dive Logs from Attachment 6 will be recorded on this Dive Smooth Log by the Dive Supervisor/ Lead Diver and forwarded to the Project Manager for the Project files and the Chairman Diving Review Board. For science divers, a copy will also be sent to the Tt TMR Diving Safety Officer. The Chairman of the Diving Review Board will retain this log for 1 year, except where there has been an injury or incident of decompression sickness and then the record will be retained for 5 years.

3. Data field definitions:

   a) Date – Date of the diving operation.
   b) Project Name – Name of the Project that dive operations are supporting.
   c) Project Number – Associated Project number.
   d) Location – General Project Location.
   e) Platform – Platform from which the dive operations are conducted.
   f) Gas Source – Source of diver's breathing medium.
   g) Apparatus – The diving mode and equipment used during the operation.
   h) Dress – The exposure protection used by the diver(s).
   i) Project Location – The specific location in the project location that the dive is conducted.
   j) Air Temp – The ambient air temperature at the project dive site.
   k) Current – The observed or reported current at the dive site.
   l) Visibility – The observed underwater visibility reported by the diver(s) at depth.
   m) Altitude – The observed altitude recorded at the dive site.
   n) Water Temp – The observed underwater temperature reported by the diver(s) at depth.
   o) Wave Ht. – The observed wave height recorded at the dive site.
   p) Bottom Type – The observed bottom type reported by the diver(s) at depth.
   q) Tools Used – The tools used for the specific Project task during the dive.
   r) Divers Name – Self-explanatory.
   s) Left Surface (LS) – The recorded time that the diver(s) left the surface (begin descent)
   t) Left Bottom (LB) – the recorded time that the diver(s) left the bottom. (begin ascent)
   u) Total Bottom Time (TBT) – the recorded bottom time (From when diver LS to diver LB).
   v) Total Decompression Time (TDT) – The recorded time of ascent (to include any decompression stops or delays) from when diver LB to diver RS.

   w) Reach Surface (RS) – The recorded time that the diver(s) reach the surface.

ATTACHMENT 7

TETRA TECH TMR DIVE SMOOTH LOG

PROJECT NAME/ NUMBER: ____

x) Total Time of Dive (TTD) – The recorded time from when the diver(s) LS to when the diver(s) RS.

y) Depth – The deepest depth recorded of the reported dive.

z) Surface Interval (SI) – The time, that a diver has spent on the surface following a dive. It begins as soon as the diver surfaces and ends as soon as the diver starts his/her next descent. Not required for first dive.

aa) Residual Nitrogen Time (RNT) – Time, in minutes, which must be added to the bottom time of a repetitive dive to compensate for the nitrogen still in solution in a diver's tissues from a previous dive.

bb) Equivalent Single Dive Time (ESDT) – A diver's RNT time plus total bottom time. Used to measure remaining time and new schedule for repetitive dives

cc) Table and Schedule (T/S) – The Table and Schedule used to measure a diver's hyperbaric exposure for a recorded dive.

dd) Repetitive Group (RG) – Repetitive group designation from previous dive and used for repetitive and final dive calculations. Leave blank if this is the diver's first dive.

4. RNT Exception Rule – If performing a repetitive dive to the same depth or deeper, and the RNT is greater than the bottom time of the previous dive, use the bottom time of the previous dive as the RNT.

5. Repetitive Group Designation – A final letter designation, which is used to relate directly to the amount of residual nitrogen remaining in a diver's body after that dive.

6. Use the applicable U.S. Navy Dive Tables located in Attachment 10. These tables are required to complete this log.

TETRA TECH

DIVE LOG

Project

Date:

Project Name:

Project Number:

Location:

Equipment

Platform:

Gas Source:

Apparatus:

Dress:

Environment

Project Location:

Air Temp:

Current:

Visibility:

Altitude:

Water Temp:

Wave Ht.

Bottom Type:

Tools Used:

Dive Data

Diver (Last, First MI)	LS	LB	TBT	TDT	RS	TTD	Depth	SI	RNT	ESDT	T/S	RG	NOTES

Dive Description

Purpose:

Description:

Approval

Signature:

Dive Supervisor:

Date:

ATTACHMENT 8

USN DIVING LINE PULL AND HAND SIGNALS

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ATTACHMENT 8

USN DIVING LINE PULL AND HAND SIGNALS

From Tender to Diver		From Diver to Tender	
1 Pull	Are you all right? When diver is descending, 1 pull means STOP.	1 Pull	I am all right. When diver is descending, 1 pull means I am on the bottom.
2 Pulls	Leave surface; Go down.	2 Pulls	Give me slack.
3 Pulls	Standby to come up.	3 Pulls	Take up my slack.
4 Pulls	Come up.	4 Pulls	Haul me up.
7 Pulls	On/Off search signals.	7 Pulls	On/Off search signals.
1 Pull	Stop and search where you are at.	2-1 Pull	I understand, Talk to me.
2 Pulls	Move directly away from the tender if given slack; Move towards the tender if strain is taken.	3-2 Pulls	More air.
3 Pulls	Face umbilical, take a strain, and move RIGHT.	4-3 Pulls	Less air.
4 Pulls	Face umbilical, take a strain, and move LEFT.	1-2-3 Pulls	Send me a square mark.
2-1 Pull	I understand, talk to me.	2-1-2 Pulls	Send me a slate.
3-2 Pulls	Ventilate rig.	5 Pulls	Send me a line.
4-3 Pulls	Circulate rig.	5-5 Pulls	Reacquired anomaly *(for UXO tasking only).*

EMERGENCY—From Diver to Tender	
2-2-2 Pulls	I am fouled and need assistance (“I need you”).
3-3-3 Pulls	I am fouled but can clear myself (“I need me”).
4-4-4 Pulls	Haul me up immediately.

ATTACHMENT 8

USN DIVING LINE PULL AND HAND SIGNALS

	Meaning/Signal	Comment
	STOP Clenched fist.	
	SOMETHING IS WRONG Hand flat, fingers together, palm out, thumb down then hand rocking back and forth on axis of forearm.	This is the opposite of Okay. The signal does not indicate an emergency.
	I AM OKAY or ARE YOU OKAY? Thumb and forefinger making a circle with three remaining fingers extended (if possible).	Divers wearing mittens may not be able to extend three remaining fingers distinctly. Short range use.
	OKAY ON THE SURFACE (CLOSE) Right hand raised overhead giving Okay signal with fingers.	Given when diver is close to pickup boat.
	OKAY ON THE SURFACE (DISTANT) Both hands touching overhead with both arms bent at 45° angle.	Given when diver is at a distance from the pickup boat.
	DISTRESS or HELP or PICK ME UP Hand waving overhead (diver may also thrash hand in water).	Indicates immediate aid is required.
	WHAT TIME? or WHAT DEPTH? Diver points to either watch or depth gauge.	When indicating time, this signal is commonly used for bottom time remaining.
	GO DOWN or GOING DOWN Two fingers up, two fingers and thumb against palm.	
	GO UP or GOING UP Four fingers pointing up, thumb against palm.	
	I'M OUT OF AIR Hand slashing or chopping at throat.	Indicates signaler is out of air.
	I NEED TO BUDDY BREATHE Fingers pointing to mouth or regulator.	Signaler's regulator may be in or out of mouth.

Figure 7-9. SCUBA Hand Signals (page 1 of 3).

ATTACHMENT 8

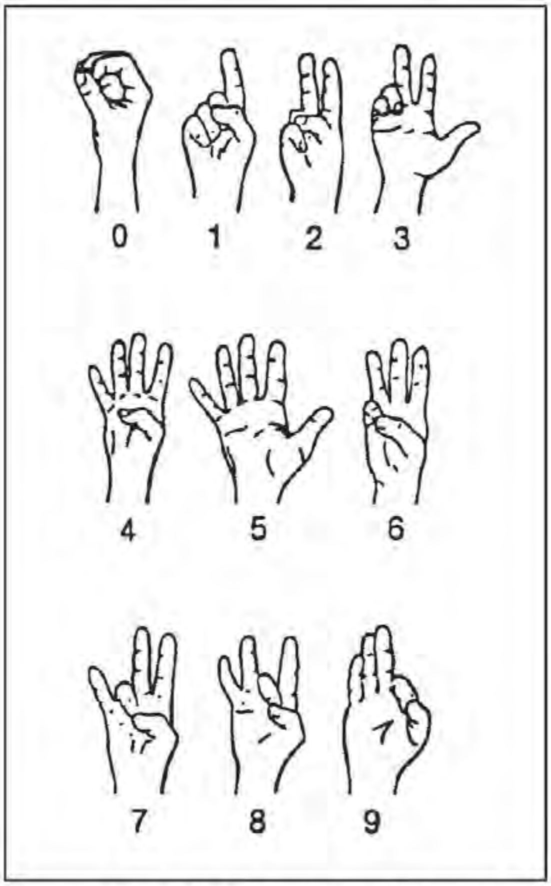
USN DIVING LINE PULL AND HAND SIGNALS

	Meaning/Signal	Comment
	**COME HERE** Hand to chest, repeated.	
	**ME or WATCH ME** Finger to chest, repeated.	
	**OVER, UNDER, or AROUND** Fingers together and arm moving in and over, under, or around movement.	Diver signals intention to move over, under, or around an object.
	**LEVEL OFF or HOW DEEP?** Fingers and thumb spread out and hand moving back and forth in a level position.	
	**GO THAT WAY** Fist clenched with thumb pointing up, down, right, or left.	Indicates which direction to swim.
	**WHICH DIRECTION?** Fingers clenched, thumb and hand rotating right and left.	
	**EAR TROUBLE** Diver pointing to either ear.	Divers should ascend a few feet. If problem continues, both divers must surface.
	**I'M COLD** Both arms crossed over chest.	
	**TAKE IT EASY OR SLOW DOWN** Hand extended, palm down, in short up-and-down motion.	
	**YOU LEAD, I'LL FOLLOW** Index fingers extended, one hand forward of the other.	

Figure 7-9. SCUBA Hand Signals (page 2 of 3).

ATTACHMENT 8

USN DIVING LINE PULL AND HAND SIGNALS



NIGHT DIVING SIGNALS
(Buddy at Distance)

When buddy is near, use regular hand signals in front of light.

Something is wrong.
I require assistance.
(Large, rapid up-and-down motions with arm extended.)

I am Okay.
Are you Okay?
(Large, slow circles with light.)

Figure 7-9. SCUBA Hand Signals (page 3 of 3).

ATTACHMENT 9

COLD WATER CONSIDERATIONS AND SAFETY PRECAUTIONS

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ATTACHMENT 9

COLD WATER CONSIDERATIONS AND SAFETY PRECAUTIONS

UNDER ICE DIVING

Diving under the ice requires extremely specialized training and equipment and will not be performed by Tetra Tech TMR employees unless approved by the Diving Review Board.

COLD WATER DIVING

In addition to decompression, thermal problems arising from exposure to cold water pose the major consideration when planning operational dives and selecting equipment. The working diver commonly experiences heat loss during immersion and often expects to be uncomfortably chilled at the end of a dive. Bottom time limits may be determined by the diver's cold tolerance rather than by decompression considerations.

An individual thoroughly conditioned physically can be transported from warm climates into cold climates and immediately begin diving without harmful effects. However, individuals differ in how well suited they are for cold weather operations. At least half of the diving team should have previous experience in ice or cold water diving operations and should be well qualified to train the less experienced.

Personnel scheduled to go to Polar Regions should be instructed in cold weather physiology and the prevention of cold injuries. To prevent injury, any techniques that aid heat balance, protection, and basic metabolism should be used.

Cold water immersion may also cause excessive urination, severely dehydrating the diver. This in turn reduces performance and may increase the risk of developing decompression sickness. A diver who is dehydrated may appear normal in the water. However, exiting the water combined with warming of the skin may cause pooling of the blood in the extremities leading to fainting. This means that divers who have been in cold water for any period of time and who appear cold should be assisted from the water and sit or lie down and take fluids until they are sure they can stand without problems.

Vertigo is caused by cold water stimulating the balance mechanism of the inner ear.

In repetitive diving with cold exposure, the operation should be planned so that the diver is re-warmed to the point of sweating before diving again. If cold water exposures are severe and if more than a 30-minute duration, then consideration should be given to requiring an overnight rest between exposures. The diver must also have sufficient non-caffeine beverages to replace the excessive body fluid loss from cold water induced urination.

The support equipment required for ice and cold water diving must be carefully evaluated for effectiveness and suitability.

Maintaining proper body temperature is particularly difficult for a diver working underwater. The principal temperature control problem encountered by divers involves keeping the body warm. The high thermal conductivity of water, coupled with the normally cool-to-cold waters in which divers operate, can result in rapid and excessive heat loss. At extremely low temperatures or with prolonged immersion, body heat loss will reach a point at which death will occur. Appropriate dress can greatly reduce the effects of heat loss, and a diver with proper dress can work in very cold water for reasonable periods of time.

ATTACHMENT 9

COLD WATER CONSIDERATIONS AND SAFETY PRECAUTIONS

In very cold water, the wet suit is only a marginally effective thermal protective measure and its use exposes the diver to hypothermia and restricts available bottom time. The use of alternative thermal protective equipment should be considered in these circumstances.

The variable volume dry suit and hot water suit are effective means of thermal protection for cold water diving. Wet suits made of incompressible material are now available. Such suits offer more protection at depth than standard wet suits of the same thickness. Prior to the use of variable volume dry suits and hot water suits in cold and ice-covered waters, divers must be trained in their use and be thoroughly familiar with the operation of these suits.

More weight must be used with a variable volume dry suit than with a wet suit due to the great positive buoyancy of a dry suit. Manufacturer's recommendations should be followed to select starting weight. The additional weight makes use of a weight vest or harness desirable. A shoulder harness is one method of preventing the heavy, awkward belts from slipping down during a dive. A few heavy hip hugger weights are better than several smaller weights.

Both single- and double-hose regulators are used for ice and cold water diving. The single-hose regulator is preferred for buddy breathing, is less bulky, and is easier to maintain than the double-hose; however, it is more subject to freeze-up than the double-hose regulator. Due to the serious nature of the freeze-up problems in single-hose regulators, they should not be allowed to free-flow or be purged for over five seconds at a time. Only regulators having a cold water conversion will be used for ice/cold water diving.

The single-hose regulator should be kept in a warm place before diving. It is important that the divers test the regulator in a warm place, then refrain from breathing it until submerging. When returning to the surface, the regulator should remain submerged and the diver should refrain from breathing from the regulator until re-submerging. The diver's time on the surface should be kept to a minimum. Once under the water, chances of a freeze-up are reduced. However, if a regulator is allowed to free-flow at depth for as little as 5 seconds, freeze-up may occur. The diver should therefore avoid purging the second stage of the regulator when diving in cold water. If water needs to be purged from the mouthpiece, the diver should do so by exhaling into it.

Where water temperature is at or below 37ºF, a redundant SCUBA system (twin SCUBA bottles, each having a "K" valve and an approved cold water regulator) or twin SCUBA bottles with one common manifold and an approved cold water regulator (with octopus) may be used. When selecting the redundant SCUBA system, maximum depth and bottom time are greatly reduced because the extra SCUBA will be used for emergencies only.

Using surface supplied diving in cold water requires detailed operations planning and extensive logistical support. This includes thermal protection for an elaborate dive station and recompression chamber and hot water heating equipment. In addition, dive equipment may require cold climate modification. Because of logistical considerations, scuba is used in most ice diving situations. However, surface supplied diving may be required because of prolonged bottom times, depth requirements, and complex communications between topside and diver. When diving in cold water that is not ice covered, logistic and equipment support requirements are reduced; however, very cold water poses many of the same dangers to the surface-supplied diver as ice diving.

The diver's mask may show an increased tendency to fog in cold water. An anti-fog solution should be used to prevent this from occurring. Saliva will not prevent this fogging.

HYPOTHERMIA

When diving in cold water, hypothermia may predispose the diver to decompression sickness. Hypothermia is easily diagnosed. The hypothermic diver loses muscle strength, the ability to concentrate, and may become irrational or confused. The victim may shiver violently, or, with severe hypothermia, shivering may be replaced by muscle rigidity. Profound hypothermia may so depress the heartbeat and respiration that the victim appears dead. However, a diver should not be considered dead until the diver has been re-warmed and all resuscitation attempts have been proven to be unsuccessful.

Hypothermia demands immediate treatment and prompt evacuation to a medical facility. A hypothermic diver must not be allowed to walk; i.e., the diver should be transported in a horizontal position. Improper handling of the diver can cause dangerous rhythms of the heart and a drop in the body core temperature, known as after drop. The local/responding medical facility must be notified of the possibility of hypothermia PRIOR to the commencement of diving operations. Emergency re-warming and evacuation plans should be established with their recommendations.

Some of the signs and symptoms of hypothermia are shivering, mental confusion, and loss of memory, speech /sensory impairment, and hallucinations. At approximately 88ºF, all shivering stops, the victim will not recognize familiar people, followed by the victim experiencing muscle rigidity and loss of consciousness.

ATTACHMENT 9

COLD WATER CONSIDERATIONS AND SAFETY PRECAUTIONS

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ATTACHMENT 10

U.S. NAVY DIVE TABLES

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ATTACHMENT 10

U.S. NAVY DIVE TABLES

1. All Tetra Tech TMR dive logs will use the tables in the attachment to complete the dive logs in Attachment 6 and 7 and when developing any Tt TMR project Health and Safety Dive Plans.

2. **U.S. Navy No-Decompression Table (Table 9-7)** – This table gives the maximum time that can be spent at a given depth without the need for decompression stops during the subsequent ascent to the surface. This table is sometimes called the “no-stop” table. At depths of 20 feet of seawater (FSW) and shallower, there is no limit on the amount of time that can be spent at depth. Deeper than 20 FSW, the time that can be spent is limited. For example, at 60 FSW, any dive longer than 63 minutes will require decompression stops.

   The No-Decompression Table also provides the repetitive group designators for dives that fall within the no-decompression limits. Even though no decompression stops are required during ascent, the diver still surfaces with some residual nitrogen in his tissues. This residual nitrogen needs to be accounted for if a repetitive dive is planned. If a diver exceeds the limits given in the No-Decompression Table, then the decompression stop requirement must be calculated using U.S Navy Standard Air Table (Table 9-9).

   For each depth listed in the No-Decompression Table, the corresponding no decompression limit is indicated in the second column. This limit is the maximum bottom time that a diver may spend at that depth and still return to the surface without taking decompression stops. To find the no-decompression limit, enter the table at the depth equal to or next greater than the maximum depth of the dive.

   Follow that row to the second column to obtain the no-decompression limit. The columns to the right of the no-decompression limit column contain the repetitive group designators for dives with bottom times equal to or shorter than the no-decompression limit. A repetitive group designator must be assigned to a diver after every dive, even a no-decompression dive.

3. **Optional Shallow Water No-Decompression Table (Table 2A-1)** – This table contains an expanded version of Table 9-7 and Table 9-8 covering the depth range of 30–50 FSW in one-foot increments. In this depth range, a small change in the diver’s maximum depth can make a substantial difference in the allowable no-decompression time. For example, at 35 FSW the no-decompression limit is 232 minutes; at 40 FSW it is only 163 minutes, more than an hour less. When the diver’s maximum depth is accurately known at the beginning of the dive, for example in ballast tank dives, or when continuous depth recording is available, for example with a decompression computer, the expanded table can be used to maximize no-decompression time.

   These optional tables are most suited to ship husbandry diving, but can be used in other shallow air diving applications as well.

4. **Residual Nitrogen Time Table for Repetitive Air Dives (Figure 9-8)** - The procedures for conducting a repetitive dive are summarized in this table. Upon completing the first dive, the diver is assigned a repetitive group designator from either the Air Decompression Table or the No-Decompression Table. This designator tells the diver how much residual nitrogen he has

upon surfacing from the first dive. A diver in Group A has the lowest amount of residual nitrogen; a diver in Group Z has the highest.

As nitrogen passes out of the diver's body during the surface interval, the repetitive group designation changes to a lower letter group to reflect the lower quantity of residual nitrogen.

The top half of the table allows the repetitive group designator to be determined at any time during the surface interval. The lower half of the table gives the Residual Nitrogen Time (RNT) corresponding to the repetitive group designator at the end of the surface interval and the depth of the repetitive dive. The residual nitrogen time is the time a diver would have had to spend at the depth of the repetitive dive to absorb the amount of nitrogen he has left over from the previous dive. The residual nitrogen time is added to the bottom time of the repetitive dive to obtain the Equivalent Single Dive Time (ESDT).

The decompression schedule for the repetitive dive is obtained by entering either the Air Decompression Table or the No-Decompression Table at the depth of the repetitive dive and the equivalent single dive time.

NOTE: When using the Optional Shallow Water No Decompression Tables above ensure the corresponding *Residual Nitrogen Timetable for Repetitive Shallow Water Air Dives (Table 2A-2)* is used for your repetitive dive calculations.

5. **U.S Navy Standard Air Table (Table 9-9)** – This table combines three modes of decompression into one table. These modes are: (1) in-water decompression on air, (2) in-water decompression on air and oxygen, and (3) surface decompression on oxygen.

   Refer to reference (b), Chapter 9, when using the Standard Air Tables in any of the above modes when developing HASDPs where decompression diving profiles are anticipated.

   These tables are to be available to the Dive Supervisor/ Lead Diver on Tt TMR dive sites for emergency procedure in water decompression on planned no decompression dive plans.

Table 9-7. *No-Decompression Limits and Repetitive Group Designators for No-Decompression Air Dives.*

Depth (fsw)	No-Stop Limit	Repetitive Group Designation															
		A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	Z
10	Unlimited	57	101	158	245	426	*										
15	Unlimited	36	60	88	121	163	217	297	449	*							
20	Unlimited	26	43	61	82	106	133	165	205	256	330	461	*				
25	1102	20	33	47	62	78	97	117	140	166	198	236	285	354	469	992	1102
30	371	17	27	38	50	62	76	91	107	125	145	167	193	223	260	307	371
35	232	14	23	32	42	52	63	74	87	100	115	131	148	168	190	215	232
40	163	12	20	27	36	44	53	63	73	84	95	108	121	135	151	163	
45	125	11	17	24	31	39	46	55	63	72	82	92	102	114	125		
50	92	9	15	21	28	34	41	48	56	63	71	80	89	92			
55	74	8	14	19	25	31	37	43	50	56	63	71	74				
60	63	7	12	17	22	28	33	39	45	51	57	63					
70	48	6	10	14	19	23	28	32	37	42	47	48					
80	39	5	9	12	16	20	24	28	32	36	39						
90	33	4	7	11	14	17	21	24	28	31	33						
100	25	4	6	9	12	15	18	21	25								
110	20	3	6	8	11	14	16	19	20								
120	15	3	5	7	10	12	15										
130	12	2	4	6	9	11	12										
140	10	2	4	6	8	10											
150	8		3	5	7	8											
160	7		3	5	6	7											
170	6			4	6												
180	6			4	5	6											
190	5			3	5												

* Highest repetitive group that can be achieved at this depth regardless of bottom time.

Table 9-8. *Residual Nitrogen Time Table for Repetitive Air Dives.*

Locate the diver's repetitive group designation from his previous dive along the diagonal line above the table. Read horizontally to the interval in which the diver's surface interval lies.

Next, read vertically downward to the new repetitive group designation. Continue downward in this same column to the row that represents the depth of the repetitive dive. The time given at the intersection is residual nitrogen time, in minutes, to be applied to the repetitive dive.

* Dives following surface intervals longer than this are not repetitive dives. Use actual bottom times in the Air Decompression Tables to compute decompression for such dives.

Repetitive Group at Beginning of Surface Interval

A																:10 2:20 *
B															:10 1:16	1:17 3:36 *
C														:10 :55	:56 2:11	2:12 4:31 *
D													:10 :52	:53 1:47	1:48 3:03	3:04 5:23 *
E												:10 :52	:53 1:44	1:45 2:39	2:40 3:55	3:56 6:15 *
F											:10 :52	:53 1:44	1:45 2:37	2:38 3:31	3:32 4:48	4:49 7:08 *
G										:10 :52	:53 1:44	1:45 2:37	2:38 3:29	3:30 4:23	4:24 5:40	5:41 8:00 *
H									:10 :52	:53 1:44	1:45 2:37	2:38 3:29	3:30 4:21	4:22 5:16	5:17 6:32	6:33 8:52 *
I								:10 :52	:53 1:44	1:45 2:37	2:38 3:29	3:30 4:21	4:22 5:13	5:14 6:08	6:09 7:24	7:25 9:44 *
J							:10 :52	:53 1:44	1:45 2:37	2:38 3:29	3:30 4:21	4:22 5:13	5:14 6:06	6:07 7:00	7:01 8:16	8:17 10:36 *
K						:10 :52	:53 1:44	1:45 2:37	2:38 3:29	3:30 4:21	4:22 5:13	5:14 6:06	6:07 6:58	6:59 7:52	7:53 9:09	9:10 11:29 *
L					:10 :52	:53 1:44	1:45 2:37	2:38 3:29	3:30 4:21	4:22 5:13	5:14 6:06	6:07 6:58	6:59 7:50	7:51 8:44	8:45 10:01	10:02 12:21 *
M				:10 :52	:53 1:44	1:45 2:37	2:38 3:29	3:30 4:21	4:22 5:13	5:14 6:06	6:07 6:58	6:59 7:50	7:51 8:42	8:43 9:37	9:38 10:53	10:54 13:13 *
N			:10 :52	:53 1:44	1:45 2:37	2:38 3:29	3:30 4:21	4:22 5:13	5:14 6:06	6:07 6:58	6:59 7:50	7:51 8:42	8:43 9:34	9:35 10:29	10:30 11:45	11:46 14:05 *
O		:10 :52	:53 1:44	1:45 2:37	2:38 3:29	3:30 4:21	4:22 5:13	5:14 6:06	6:07 6:58	6:59 7:50	7:51 8:42	8:43 9:34	9:35 10:27	10:28 11:21	11:22 12:37	12:38 14:58 *
Z	:10 :52	:53 1:44	1:45 2:37	2:38 3:29	3:30 4:21	4:22 5:13	5:14 6:06	6:07 6:58	6:59 7:50	7:51 8:42	8:43 9:34	9:35 10:27	10:28 11:19	11:20 12:13	12:14 13:30	13:31 15:50 *

Repetitive Group at the End of the Surface Interval

Dive Depth	Z	O	N	M	L	K	J	I	H	G	F	E	D	C	B	A
10	**	**	**	**	**	**	**	**	**	**	**	427	246	159	101	58
15	**	**	**	**	**	**	**	**	450	298	218	164	122	89	61	37
20	**	**	**	**	**	462	331	257	206	166	134	106	83	62	44	27
25	†	†	470	354	286	237	198	167	141	118	98	79	63	48	34	21
30	372	308	261	224	194	168	146	126	108	92	77	63	51	39	28	18
35	245	216	191	169	149	132	116	101	88	75	64	53	43	33	24	15
40	188	169	152	136	122	109	97	85	74	64	55	45	37	29	21	13
45	154	140	127	115	104	93	83	73	64	56	48	40	32	25	18	12
50	131	120	109	99	90	81	73	65	57	49	42	35	29	23	17	11
55	114	105	96	88	80	72	65	58	51	44	38	32	26	20	15	10
60	101	93	86	79	72	65	58	52	46	40	35	29	24	19	14	9
70	83	77	71	65	59	54	49	44	39	34	29	25	20	16	12	8
80	70	65	60	55	51	46	42	38	33	29	25	22	18	14	10	7
90	61	57	52	48	44	41	37	33	29	26	22	19	16	12	9	6
100	54	50	47	43	40	36	33	30	26	23	20	17	14	11	8	5
110	48	45	42	39	36	33	30	27	24	21	18	16	13	10	8	5
120	44	41	38	35	32	30	27	24	22	19	17	14	12	9	7	5
130	40	37	35	32	30	27	25	22	20	18	15	13	11	9	6	4
140	37	34	32	30	27	25	23	21	19	16	14	12	10	8	6	4
150	34	32	30	28	26	23	21	19	17	15	13	11	9	8	6	4
160	32	30	28	26	24	22	20	18	16	14	13	11	9	7	5	4
170	30	28	26	24	22	21	19	17	15	14	12	10	8	7	5	3
180	28	26	25	23	21	19	18	16	14	13	11	10	8	6	5	3
190	26	25	23	22	20	18	17	15	14	12	11	9	8	6	5	3

Residual Nitrogen Times (Minutes)

** Residual Nitrogen Time cannot be determined using this table (see paragraph 9-9.1 subparagraph 8 for instructions).

† Read vertically downward to the 30 fsw repetitive dive depth. Use the corresponding residual nitrogen times to compute the equivalent single dive time. Decompress using the 30 fsw air decompression table.

Table 2A-1. *No-Decompression Limits and Repetitive Group Designators for Shallow Water Air No-Decompression Dives.*

Depth (fsw)	No-Stop Limit (min)	Repetitive Group Designation															
		A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	Z
30	371	17	27	38	50	62	76	91	107	125	145	167	193	223	260	307	371
31	334	16	26	37	48	60	73	87	102	119	138	158	182	209	242	282	334
32	304	15	25	35	46	58	70	83	98	114	131	150	172	197	226	261	304
33	281	15	24	34	45	56	67	80	94	109	125	143	163	186	212	243	281
34	256	14	23	33	43	54	65	77	90	104	120	137	155	176	200	228	256
35	232	14	23	32	42	52	63	74	87	100	115	131	148	168	190	215	232
36	212	14	22	31	40	50	61	72	84	97	110	125	142	160	180	204	212
37	197	13	21	30	39	49	59	69	81	93	106	120	136	153	172	193	197
38	184	13	21	29	38	47	57	67	78	90	102	116	131	147	164	184	
39	173	12	20	28	37	46	55	65	76	87	99	112	126	141	157	173	
40	163	12	20	27	36	44	53	63	73	84	95	108	121	135	151	163	
41	155	12	19	27	35	43	52	61	71	81	92	104	117	130	145	155	
42	147	11	19	26	34	42	50	59	69	79	89	101	113	126	140	147	
43	140	11	18	25	33	41	49	58	67	76	87	98	109	122	135	140	
44	134	11	18	25	32	40	48	56	65	74	84	95	106	118	130	134	
45	125	11	17	24	31	39	46	55	63	72	82	92	102	114	125		
46	116	10	17	23	30	38	45	53	61	70	79	89	99	110	116		
47	109	10	16	23	30	37	44	52	60	68	77	87	97	107	109		
48	102	10	16	22	29	36	43	51	58	67	75	84	94	102			
49	97	10	16	22	28	35	42	49	57	65	73	82	91	97			
50	92	9	15	21	28	34	41	48	56	63	71	80	89	92			

Table 2A-2. *Residual Nitrogen Time Table for Repetitive Shallow Water Air Dives.*

Locate the diver's repetitive group designation from his previous dive along the diagonal line above the table. Read horizontally to the interval in which the diver's surface interval lies.

Next, read vertically downward to the new repetitive group designation. Continue downward in this same column to the row that represents the depth of the repetitive dive. The time given at the intersection is residual nitrogen time, in minutes, to be applied to the repetitive dive.

* Dives following surface intervals longer than this are not repetitive dives. Use actual bottom times in the Air Decompression Tables to compute decompression for such dives.

Repetitive Group at Beginning of Surface Interval

	Z	O	N	M	L	K	J	I	H	G	F	E	D	C	B	A
A																:10 2:20 *
B															:10 1:16	1:17 3:36 *
C														:10 :55	:56 2:11	2:12 4:31 *
D													:10 :52	:53 1:47	1:48 3:03	3:04 5:23 *
E												:10 :52	:53 1:44	1:45 2:39	2:40 3:55	3:56 6:15 *
F											:10 :52	:53 1:44	1:45 2:37	2:38 3:31	3:32 4:48	4:49 7:08 *
G										:10 :52	:53 1:44	1:45 2:37	2:38 3:29	3:30 4:23	4:24 5:40	5:41 8:00 *
H									:10 :52	:53 1:44	1:45 2:37	2:38 3:29	3:30 4:21	4:22 5:16	5:17 6:32	6:33 8:52 *
I								:10 :52	:53 1:44	1:45 2:37	2:38 3:29	3:30 4:21	4:22 5:13	5:14 6:08	6:09 7:24	7:25 9:44 *
J							:10 :52	:53 1:44	1:45 2:37	2:38 3:29	3:30 4:21	4:22 5:13	5:14 6:06	6:07 7:00	7:01 8:16	8:17 10:36 *
K						:10 :52	:53 1:44	1:45 2:37	2:38 3:29	3:30 4:21	4:22 5:13	5:14 6:06	6:07 6:58	6:59 7:52	7:53 9:09	9:10 11:29 *
L					:10 :52	:53 1:44	1:45 2:37	2:38 3:29	3:30 4:21	4:22 5:13	5:14 6:06	6:07 6:58	6:59 7:50	7:51 8:44	8:45 10:01	10:02 12:21 *
M				:10 :52	:53 1:44	1:45 2:37	2:38 3:29	3:30 4:21	4:22 5:13	5:14 6:06	6:07 6:58	6:59 7:50	7:51 8:42	8:43 9:37	9:38 10:53	10:54 13:13 *
N			:10 :52	:53 1:44	1:45 2:37	2:38 3:29	3:30 4:21	4:22 5:13	5:14 6:06	6:07 6:58	6:59 7:50	7:51 8:42	8:43 9:34	9:35 10:29	10:30 11:45	11:46 14:05 *
O		:10 :52	:53 1:44	1:45 2:37	2:38 3:29	3:30 4:21	4:22 5:13	5:14 6:06	6:07 6:58	6:59 7:50	7:51 8:42	8:43 9:34	9:35 10:27	10:28 11:21	11:22 12:37	12:38 14:58 *
Z	:10 :52	:53 1:44	1:45 2:37	2:38 3:29	3:30 4:21	4:22 5:13	5:14 6:06	6:07 6:58	6:59 7:50	7:51 8:42	8:43 9:34	9:35 10:27	10:28 11:19	11:20 12:13	12:14 13:30	13:31 15:50 *

Repetitive Group at the End of the Surface Interval

Dive Depth	Z	O	N	M	L	K	J	I	H	G	F	E	D	C	B	A
30	372	308	261	224	194	168	146	126	108	92	77	63	51	39	28	18
31	334	282	243	210	183	159	139	120	103	88	74	61	49	38	27	17
32	305	262	227	198	173	151	132	115	99	85	71	59	47	36	26	17
33	282	244	213	187	164	144	126	110	95	81	69	57	46	35	25	16
34	262	229	201	177	156	138	121	105	91	78	66	55	44	34	25	16
35	245	216	191	169	149	132	116	101	88	75	64	53	43	33	24	15
36	231	204	181	161	143	126	111	98	85	73	62	51	41	32	23	15
37	218	194	173	154	137	122	107	94	82	70	60	50	40	31	23	14
38	207	185	165	148	132	117	103	91	79	68	58	48	39	30	22	14
39	197	177	158	142	127	113	100	88	77	66	56	47	38	29	21	14
40	188	169	152	136	122	109	97	85	74	64	55	45	37	29	21	13
41	180	163	146	132	118	105	93	82	72	62	53	44	36	28	20	13
42	173	156	141	127	114	102	91	80	70	61	52	43	35	27	20	13
43	166	150	136	123	110	99	88	78	68	59	50	42	34	26	19	12
44	160	145	131	119	107	96	85	75	66	57	49	41	33	26	19	12
45	154	140	127	115	104	93	83	73	64	56	48	40	32	25	18	12
46	149	136	123	111	101	90	81	71	63	54	46	39	32	25	18	12
47	144	131	119	108	98	88	78	70	61	53	45	38	31	24	18	11
48	139	127	116	105	95	85	76	68	60	52	44	37	30	24	17	11
49	135	123	112	102	92	83	74	66	58	51	43	36	30	23	17	11
50	131	120	109	99	90	81	73	65	57	49	42	35	29	23	17	11

Residual Nitrogen Times (Minutes)

Table 9-9. *Air Decompression Table.*

(DESCENT RATE 75 FPM—ASCENT RATE 30 FPM)

30 FSW

Bottom Time (min)	Time to First Stop (M:S)	Gas Mix	DECOMPRESSION STOPS (FSW) Stop times (min) include travel time, except first air and first O_2 stop									Total Ascent Time (M:S)	Chamber O_2 Periods	Repet Group
			100	90	80	70	60	50	40	30	20			
371	1:00	AIR									0	1:00	0	Z
		AIR/O_2									**0**	1:00		
380	0:20	AIR									5	6:00	0.5	Z
		AIR/O_2									**1**	2:00		
In-Water Air/O_2 Decompression or SurDO_2 Recommended --														
420	0:20	AIR									22	23:00	0.5	Z
		AIR/O_2									**5**	6:00		
480	0:20	AIR									42	43:00	0.5	
		AIR/O_2									**9**	10:00		
540	0:20	AIR									71	72:00	1	
		AIR/O_2									**14**	15:00		
Exceptional Exposure: In-Water Air Decompression ------------ In-Water Air/O_2 Decompression or SurDO_2 Required -----------														
600	0:20	AIR									92	93:00	1	
		AIR/O_2									**19**	20:00		
660	0:20	AIR									120	121:00	1	
		AIR/O_2									**22**	23:00		
720	0:20	AIR									158	159:00	1	
		AIR/O_2									**27**	28:00		

35 FSW

Bottom Time (min)	Time to First Stop (M:S)	Gas Mix	100	90	80	70	60	50	40	30	20	Total Ascent Time (M:S)	Chamber O_2 Periods	Repet Group
232	1:10	AIR									0	1:10	0	Z
		AIR/O_2									**0**	1:10		
240	0:30	AIR									4	5:10	0.5	Z
		AIR/O_2									**2**	3:10		
In-Water Air/O_2 Decompression or SurDO_2 Recommended --														
270	0:30	AIR									28	29:10	0.5	Z
		AIR/O_2									**7**	8:10		
300	0:30	AIR									53	54:10	0.5	Z
		AIR/O_2									**13**	14:10		
330	0:30	AIR									71	72:10	1	Z
		AIR/O_2									**18**	19:10		
360	0:30	AIR									88	89:10	1	
		AIR/O_2									**22**	23:10		
Exceptional Exposure: In-Water Air Decompression ------------ In-Water Air/O_2 Decompression or SurDO_2 Required -----------														
420	0:30	AIR									134	135:10	1.5	
		AIR/O_2									**29**	30:10		
480	0:30	AIR									173	174:10	1.5	
		AIR/O_2									**38**	44:10		
540	0:30	AIR									228	229:10	2	
		AIR/O_2									**45**	51:10		
600	0:30	AIR									277	278:10	2	
		AIR/O_2									**53**	59:10		
660	0:30	AIR									314	315:10	2.5	
		AIR/O_2									**63**	69:10		
720	0:30	AIR									342	343:10	3	
		AIR/O_2									**71**	82:10		

Table 9-9. *Air Decompression Table (Continued).*

(DESCENT RATE 75 FPM—ASCENT RATE 30 FPM)

Bottom Time (min)	Time to First Stop (M:S)	Gas Mix	DECOMPRESSION STOPS (FSW) Stop times (min) include travel time, except first air and first O_2 stop									Total Ascent Time (M:S)	Chamber O_2 Periods	Repet Group
			100	90	80	70	60	50	40	30	20			
40 FSW														
163	1:20	AIR									0	1:20	0	O
		AIR/O_2									**0**	1:20		
170	0:40	AIR									6	7:20	0.5	O
		AIR/O_2									**2**	3:20		
180	0:40	AIR									14	15:20	0.5	Z
		AIR/O_2									**5**	6:20		
In-Water Air/O_2 Decompression or SurDO_2 Recommended --														
190	0:40	AIR									21	22:20	0.5	Z
		AIR/O_2									**7**	8:20		
200	0:40	AIR									27	28:20	0.5	Z
		AIR/O_2									**9**	10:20		
210	0:40	AIR									39	40:20	0.5	Z
		AIR/O_2									**11**	12:20		
220	0:40	AIR									52	53:20	0.5	Z
		AIR/O_2									**12**	13:20		
230	0:40	AIR									64	65:20	1	Z
		AIR/O_2									**16**	17:20		
240	0:40	AIR									75	76:20	1	Z
		AIR/O_2									**19**	20:20		
Exceptional Exposure: In-Water Air Decompression ------------- In-Water Air/O_2 Decompression or SurDO_2 Required -----------														
270	0:40	AIR									101	102:20	1	Z
		AIR/O_2									**26**	27:20		
300	0:40	AIR									128	129:20	1.5	
		AIR/O_2									**33**	34:20		
330	0:40	AIR									160	161:20	1.5	
		AIR/O_2									**38**	44:20		
360	0:40	AIR									184	185:20	2	
		AIR/O_2									**44**	50:20		
420	0:40	AIR									248	249:20	2.5	
		AIR/O_2									**56**	62:20		
480	0:40	AIR									321	322:20	2.5	
		AIR/O_2									**68**	79:20		
Exceptional Exposure: In-Water Air/0_2 Decompression ------------- SurDO_2 Required---														
540	0:40	AIR									372	373:20	3	
		AIR/O_2									**80**	91:20		
600	0:40	AIR									410	411:20	3.5	
		AIR/O_2									**93**	104:20		
660	0:40	AIR									439	440:20	4	
		AIR/O_2									**103**	119:20		
Exceptional Exposure: SurDO_2 ---														
720	0:40	AIR									461	462:20	4.5	
		AIR/O_2									**112**	128:20		

Table 9-9. *Air Decompression Table (Continued).*

(DESCENT RATE 75 FPM—ASCENT RATE 30 FPM)

Bottom Time (min)	Time to First Stop (M:S)	Gas Mix	DECOMPRESSION STOPS (FSW) Stop times (min) include travel time, except first air and first O_2 stop									Total Ascent Time (M:S)	Chamber O_2 Periods	Repet Group
			100	90	80	70	60	50	40	30	20			
45 FSW														
125	1:30	AIR									0	1:30	0	N
		AIR/O_2									**0**	1:30		
130	0:50	AIR									2	3:30	0.5	O
		AIR/O_2									**1**	2:30		
140	0:50	AIR									14	15:30	0.5	O
		AIR/O_2									**5**	6:30		
In-Water Air/O_2 Decompression or SurDO_2 Recommended --														
150	0:50	AIR									25	26:30	0.5	Z
		AIR/O_2									**8**	9:30		
160	0:50	AIR									34	35:30	0.5	Z
		AIR/O_2									**11**	12:30		
170	0:50	AIR									41	42:30	1	Z
		AIR/O_2									**14**	15:30		
180	0:50	AIR									59	60:30	1	Z
		AIR/O_2									**17**	18:30		
190	0:50	AIR									75	76:30	1	Z
		AIR/O_2									**19**	20:30		
Exceptional Exposure: In-Water Air Decompression ------------- In-Water Air/O_2 Decompression or SurDO_2 Required -----------														
200	0:50	AIR									89	90:30	1	Z
		AIR/O_2									**23**	24:30		
210	0:50	AIR									101	102:30	1	Z
		AIR/O_2									**27**	28:30		
220	0:50	AIR									112	113:30	1.5	Z
		AIR/O_2									**30**	31:30		
230	0:50	AIR									121	122:30	1.5	Z
		AIR/O_2									**33**	34:30		
240	0:50	AIR									130	131:30	1.5	Z
		AIR/O_2									**37**	43:30		
270	0:50	AIR									173	174:30	2	
		AIR/O_2									**45**	51:30		
300	0:50	AIR									206	207:30	2	
		AIR/O_2									**51**	57:30		
330	0:50	AIR									243	244:30	2.5	
		AIR/O_2									**61**	67:30		
360	0:50	AIR									288	289:30	3	
		AIR/O_2									**69**	80:30		
Exceptional Exposure: In-Water Air/0_2 Decompression ------------- SurDO_2 Required---														
420	0:50	AIR									373	374:30	3.5	
		AIR/O_2									**84**	95:30		
480	0:50	AIR									431	432:30	4	
		AIR/O_2									**101**	117:30		
Exceptional Exposure: SurDO_2 --														
540	0:50	AIR									473	474:30	4.5	
		AIR/O_2									**117**	133:30		

Table 9-9. *Air Decompression Table (Continued).*

(DESCENT RATE 75 FPM—ASCENT RATE 30 FPM)

Bottom Time (min)	Time to First Stop (M:S)	Gas Mix	**DECOMPRESSION STOPS (FSW)** Stop times (min) include travel time, except first air and first O_2 stop									Total Ascent Time (M:S)	Chamber O_2 Periods	Repet Group
			100	90	80	70	60	50	40	30	20			
50 FSW														
92	1:40	AIR									0	1:40	0	M
		AIR/O_2									**0**	1:40		
95	1:00	AIR									2	3:40	0.5	M
		AIR/O_2									**1**	2:40		
100	1:00	AIR									4	5:40	0.5	N
		AIR/O_2									**2**	3:40		
110	1:00	AIR									8	9:40	0.5	O
		AIR/O_2									**4**	5:40		
In-Water Air/O_2 Decompression or SurDO_2 Recommended ---														
120	1:00	AIR									21	22:40	0.5	O
		AIR/O_2									**7**	8:40		
130	1:00	AIR									34	35:40	0.5	Z
		AIR/O_2									**12**	13:40		
140	1:00	AIR									45	46:40	1	Z
		AIR/O_2									**16**	17:40		
150	1:00	AIR									56	57:40	1	Z
		AIR/O_2									**19**	20:40		
160	1:00	AIR									78	79:40	1	Z
		AIR/O_2									**23**	24:40		
Exceptional Exposure: In-Water Air Decompression ------------- In-Water Air/O_2 Decompression or SurDO_2 Required -----------														
170	1:00	AIR									96	97:40	1	Z
		AIR/O_2									**26**	27:40		
180	1:00	AIR									111	112:40	1.5	Z
		AIR/O_2									**30**	31:40		
190	1:00	AIR									125	126:40	1.5	Z
		AIR/O_2									**35**	36:40		
200	1:00	AIR									136	137:40	1.5	Z
		AIR/O_2									**39**	45:40		
210	1:00	AIR									147	148:40	2	
		AIR/O_2									**43**	49:40		
220	1:00	AIR									166	167:40	2	
		AIR/O_2									**47**	53:40		
230	1:00	AIR									183	184:40	2	
		AIR/O_2									**50**	56:40		
240	1:00	AIR									198	199:40	2	
		AIR/O_2									**53**	59:40		
270	1:00	AIR									236	237:40	2.5	
		AIR/O_2									**62**	68:40		
300	1:00	AIR									285	286:40	3	
		AIR/O_2									**74**	85:40		
Exceptional Exposure: In-Water Air/O_2 Decompression ------------- SurDO_2 Required---														
330	1:00	AIR									345	346:40	3.5	
		AIR/O_2									**83**	94:40		
360	1:00	AIR									393	394:40	3.5	
		AIR/O_2									**92**	103:40		
Exceptional Exposure: SurDO_2 ---														
420	1:00	AIR									464	465:40	4.5	
		AIR/O_2									**113**	129:40		

Table 9-9. *Air Decompression Table (Continued).*

(DESCENT RATE 75 FPM—ASCENT RATE 30 FPM)

Bottom Time (min)	**Time to First Stop (M:S)**	**Gas Mix**	**DECOMPRESSION STOPS (FSW)** Stop times (min) include travel time, except first air and first O_2 stop									**Total Ascent Time (M:S)**	**Chamber O_2 Periods**	**Repet Group**
			100	**90**	**80**	**70**	**60**	**50**	**40**	**30**	**20**			
55 FSW														
74	1:50	AIR									0	1:50	0	L
		AIR/O_2									**0**	1:50		
75	1:10	AIR									1	2:50	0.5	L
		AIR/O_2									**1**	2:50		
80	1:10	AIR									4	5:50	0.5	M
		AIR/O_2									**2**	3:50		
90	1:10	AIR									10	11:50	0.5	N
		AIR/O_2									**5**	6:50		
In-Water Air/O_2 Decompression or SurDO_2 Recommended --														
100	1:10	AIR									17	18:50	0.5	O
		AIR/O_2									**8**	9:50		
110	1:10	AIR									34	35:50	0.5	O
		AIR/O_2									**12**	13:50		
120	1:10	AIR									48	49:50	1	Z
		AIR/O_2									**17**	18:50		
130	1:10	AIR									59	60:50	1	Z
		AIR/O_2									**22**	23:50		
140	1:10	AIR									84	85:50	1	Z
		AIR/O_2									**26**	27:50		
Exceptional Exposure: In-Water Air Decompression ------------- In-Water Air/O_2 Decompression or SurDO_2 Required -----------														
150	1:10	AIR									105	106:50	1.5	Z
		AIR/O_2									**30**	31:50		
160	1:10	AIR									123	124:50	1.5	Z
		AIR/O_2									**34**	35:50		
170	1:10	AIR									138	139:50	1.5	Z
		AIR/O_2									**40**	46:50		
180	1:10	AIR									151	152:50	2	Z
		AIR/O_2									**45**	51:50		
190	1:10	AIR									169	170:50	2	
		AIR/O_2									**50**	56:50		
200	1:10	AIR									190	191:50	2	
		AIR/O_2									**54**	60:50		
210	1:10	AIR									208	209:50	2.5	
		AIR/O_2									**58**	64:50		
220	1:10	AIR									224	225:50	2.5	
		AIR/O_2									**62**	68:50		
230	1:10	AIR									239	240:50	2.5	
		AIR/O_2									**66**	77:50		
240	1:10	AIR									254	255:50	3	
		AIR/O_2									**69**	80:50		
Exceptional Exposure: In-Water Air/0_2 Decompression ------------- SurDO_2 Required--														
270	1:10	AIR									313	314:50	3.5	
		AIR/O_2									**83**	94:50		
300	1:10	AIR									380	381:50	3.5	
		AIR/O_2									**94**	105:50		
330	1:10	AIR									432	433:50	4	
		AIR/O_2									**106**	122:50		
Exceptional Exposure: SurDO_2 --														
360	1:10	AIR									474	475:50	4.5	
		AIR/O_2									**118**	134:50		

Table 9-9. Air Decompression Table (Continued).

(DESCENT RATE 75 FPM—ASCENT RATE 30 FPM)

Bottom Time (min)	Time to First Stop (M:S)	Gas Mix	DECOMPRESSION STOPS (FSW) Stop times (min) include travel time, except first air and first O_2 stop									Total Ascent Time (M:S)	Chamber O_2 Periods	Repet Group
			100	90	80	70	60	50	40	30	20			
60 FSW														
63	2:00	AIR									0	2:00	0	K
		AIR/O_2									**0**	2:00		
65	1:20	AIR									2	4:00	0.5	L
		AIR/O_2									**1**	3:00		
70	1:20	AIR									7	9:00	0.5	L
		AIR/O_2									**4**	6:00		
80	1:20	AIR									14	16:00	0.5	N
		AIR/O_2									**7**	9:00		
In-Water Air/O_2 Decompression or SurDO_2 Recommended --														
90	1:20	AIR									23	25:00	0.5	O
		AIR/O_2									**10**	12:00		
100	1:20	AIR									42	44:00	1	Z
		AIR/O_2									**15**	17:00		
110	1:20	AIR									57	59:00	1	Z
		AIR/O_2									**21**	23:00		
120	1:20	AIR									75	77:00	1	Z
		AIR/O_2									**26**	28:00		
Exceptional Exposure: In-Water Air Decompression ------------- In-Water Air/O_2 Decompression or SurDO_2 Required -----------														
130	1:20	AIR									102	104:00	1.5	Z
		AIR/O_2									**31**	33:00		
140	1:20	AIR									124	126:00	1.5	Z
		AIR/O_2									**35**	37:00		
150	1:20	AIR									143	145:00	2	Z
		AIR/O_2									**41**	48:00		
160	1:20	AIR									158	160:00	2	Z
		AIR/O_2									**48**	55:00		
170	1:20	AIR									178	180:00	2	
		AIR/O_2									**53**	60:00		
180	1:20	AIR									201	203:00	2.5	
		AIR/O_2									**59**	66:00		
190	1:20	AIR									222	224:00	2.5	
		AIR/O_2									**64**	71:00		
200	1:20	AIR									240	242:00	2.5	
		AIR/O_2									**68**	80:00		
210	1:20	AIR									256	258:00	3	
		AIR/O_2									**73**	85:00		
220	1:20	AIR									278	280:00	3	
		AIR/O_2									**77**	89:00		
Exceptional Exposure: In-Water Air/0_2 Decompression ------------- SurDO_2 Required---														
230	1:20	AIR									300	302:00	3.5	
		AIR/O_2									**82**	94:00		
240	1:20	AIR									321	323:00	3.5	
		AIR/O_2									**88**	100:00		
270	1:20	AIR									398	400:00	4	
		AIR/O_2									**102**	119:00		
Exceptional Exposure: SurDO_2 --														
300	1:20	AIR									456	458:00	4.5	
		AIR/O_2									**115**	132:00		

Table 9-9. Air Decompression Table (Continued).

(DESCENT RATE 75 FPM—ASCENT RATE 30 FPM)

Bottom Time (min)	Time to First Stop (M:S)	Gas Mix	**DECOMPRESSION STOPS (FSW)** Stop times (min) include travel time, except first air and first O_2 stop									Total Ascent Time (M:S)	Chamber O_2 Periods	Repet Group
			100	90	80	70	60	50	40	30	20			
70 FSW														
48	2:20	AIR									0	2:20	0	K
		AIR/O_2									**0**	2:20		
50	1:40	AIR									2	4:20	0.5	K
		AIR/O_2									**1**	3:20		
55	1:40	AIR									9	11:20	0.5	L
		AIR/O_2									**5**	7:20		
60	1:40	AIR									14	16:20	0.5	M
		AIR/O_2									**8**	10:20		
In-Water Air/O_2 Decompression or SurDO_2 Recommended ---														
70	1:40	AIR									24	26:20	0.5	N
		AIR/O_2									**13**	15:20		
80	1:40	AIR									44	46:20	1	O
		AIR/O_2									**17**	19:20		
90	1:40	AIR									64	66:20	1	Z
		AIR/O_2									**24**	26:20		
Exceptional Exposure: In-Water Air Decompression ------------- In-Water Air/O_2 Decompression or SurDO_2 Required -----------														
100	1:40	AIR									88	90:20	1.5	Z
		AIR/O_2									**31**	33:20		
110	1:40	AIR									120	122:20	1.5	Z
		AIR/O_2									**38**	45:20		
120	1:40	AIR									145	147:20	2	Z
		AIR/O_2									**44**	51:20		
130	1:40	AIR									167	169:20	2	Z
		AIR/O_2									**51**	58:20		
140	1:40	AIR									189	191:20	2.5	
		AIR/O_2									**59**	66:20		
150	1:40	AIR									219	221:20	2.5	
		AIR/O_2									**66**	78:20		
160	1:20	AIR								1	244	247:00	3	
		AIR/O_2								**1**	**72**	85:00		
Exceptional Exposure: In-Water Air/0$_2$ Decompression ------------- SurDO_2 Required--														
170	1:20	AIR								2	265	269:00	3	
		AIR/O_2								**1**	**78**	91:00		
180	1:20	AIR								4	289	295:00	3.5	
		AIR/O_2								**2**	**83**	97:00		
190	1:20	AIR								5	316	323:00	3.5	
		AIR/O_2								**3**	**88**	103:00		
200	1:20	AIR								9	345	356:00	4	
		AIR/O_2								**5**	**93**	115:00		
210	1:20	AIR								13	378	393:00	4	
		AIR/O_2								**7**	**98**	122:00		
Exceptional Exposure: SurDO_2 --														
240	1:20	AIR								25	454	481:00	5	
		AIR/O_2								**13**	**110**	140:00		

Table 9-9. *Air Decompression Table (Continued).*

(DESCENT RATE 75 FPM—ASCENT RATE 30 FPM)

Bottom Time (min)	Time to First Stop (M:S)	Gas Mix	DECOMPRESSION STOPS (FSW) Stop times (min) include travel time, except first air and first O_2 stop									Total Ascent Time (M:S)	Chamber O_2 Periods	Repet Group
			100	90	80	70	60	50	40	30	20			
80 FSW														
39	2:40	AIR									0	2:40	0	J
		AIR/O_2									**0**	2:40		
40	2:00	AIR									1	3:40	0.5	J
		AIR/O_2									**1**	3:40		
45	2:00	AIR									10	12:40	0.5	K
		AIR/O_2									**5**	7:40		
In-Water Air/O_2 Decompression or SurDO_2 Recommended ---														
50	2:00	AIR									17	19:40	0.5	M
		AIR/O_2									**9**	11:40		
55	2:00	AIR									24	26:40	0.5	M
		AIR/O_2									**13**	15:40		
60	2:00	AIR									30	32:40	1	N
		AIR/O_2									**16**	18:40		
70	2:00	AIR									54	56:40	1	O
		AIR/O_2									**22**	24:40		
80	2:00	AIR									77	79:40	1.5	Z
		AIR/O_2									**30**	32:40		
Exceptional Exposure: In-Water Air Decompression ------------- In-Water Air/O_2 Decompression or SurDO_2 Required -----------														
90	2:00	AIR									114	116:40	1.5	Z
		AIR/O_2									**39**	46:40		
100	1:40	AIR								1	147	150:20	2	Z
		AIR/O_2								**1**	**46**	54:20		
110	1:40	AIR								6	171	179:20	2	Z
		AIR/O_2								**3**	**51**	61:20		
120	1:40	AIR								10	200	212:20	2.5	
		AIR/O_2								**5**	**59**	71:20		
130	1:40	AIR								14	232	248:20	3	
		AIR/O_2								**7**	**67**	86:20		
Exceptional Exposure: In-Water Air/0_2 Decompression ------------- SurDO_2 Required--														
140	1:40	AIR								17	258	277:20	3.5	
		AIR/O_2								**9**	**73**	94:20		
150	1:40	AIR								19	285	306:20	3.5	
		AIR/O_2								**10**	**80**	102:20		
160	1:40	AIR								21	318	341:20	4	
		AIR/O_2								**11**	**86**	114:20		
170	1:40	AIR								27	354	383:20	4	
		AIR/O_2								**14**	**90**	121:20		
Exceptional Exposure: SurDO_2 ---														
180	1:40	AIR								33	391	426:20	4.5	
		AIR/O_2								**17**	**96**	130:20		
210	1:40	AIR								51	473	526:20	5	
		AIR/O_2								**26**	**110**	158:20		

Table 9-9. *Air Decompression Table (Continued).*

(DESCENT RATE 75 FPM—ASCENT RATE 30 FPM)

Bottom Time (min)	Time to First Stop (M:S)	Gas Mix	DECOMPRESSION STOPS (FSW) Stop times (min) include travel time, except first air and first O_2 stop									Total Ascent Time (M:S)	Chamber O_2 Periods	Repet Group
			100	90	80	70	60	50	40	30	20			
90 FSW														
33	3:00	AIR									0	3:00	0	J
		AIR/O_2									**0**	3:00		
35	2:20	AIR									4	7:00	0.5	J
		AIR/O_2									**2**	5:00		
40	2:20	AIR									14	17:00	0.5	L
		AIR/O_2									**7**	10:00		
In-Water Air/O_2 Decompression or SurDO_2 Recommended --														
45	2:20	AIR									23	26:00	0.5	M
		AIR/O_2									**12**	15:00		
50	2:20	AIR									31	34:00	1	N
		AIR/O_2									**17**	20:00		
55	2:20	AIR									39	42:00	1	O
		AIR/O_2									**21**	24:00		
60	2:20	AIR									56	59:00	1	O
		AIR/O_2									**24**	27:00		
70	2:20	AIR									83	86:00	1.5	Z
		AIR/O_2									**32**	35:00		
Exceptional Exposure: In-Water Air Decompression ------------- In-Water Air/O_2 Decompression or SurDO_2 Required -----------														
80	2:00	AIR								5	125	132:40	2	Z
		AIR/O_2								**3**	**40**	50:40		
90	2:00	AIR								13	158	173:40	2	Z
		AIR/O_2								**7**	**46**	60:40		
100	2:00	AIR								19	185	206:40	2.5	
		AIR/O_2								**10**	**53**	70:40		
110	2:00	AIR								25	224	251:40	3	
		AIR/O_2								**13**	**61**	86:40		
Exceptional Exposure: In-Water Air/0_2 Decompression ------------- SurDO_2 Required---														
120	1:40	AIR							2	28	256	288:20	3.5	
		AIR/O_2							2	**14**	**70**	98:40		
130	1:40	AIR							5	28	291	326:20	3.5	
		AIR/O_2							5	**14**	**79**	110:40		
140	1:40	AIR							8	28	330	368:20	4	
		AIR/O_2							8	**14**	**87**	126:40		
Exceptional Exposure: SurDO_2 --														
150	1:40	AIR							11	34	378	425:20	4.5	
		AIR/O_2							11	**17**	**94**	139:40		
160	1:40	AIR							13	40	418	473:20	4.5	
		AIR/O_2							13	**20**	**101**	151:40		
170	1:40	AIR							15	45	451	513:20	5	
		AIR/O_2							15	**23**	**106**	166:40		
180	1:40	AIR							16	51	479	548:20	5.5	
		AIR/O_2							16	**26**	**112**	176:40		
240	1:40	AIR							42	68	592	704:20	7.5	
		AIR/O_2							42	**34**	**159**	267:40		

Table 9-9. Air Decompression Table (Continued).

(DESCENT RATE 75 FPM—ASCENT RATE 30 FPM)

Bottom Time (min)	Time to First Stop (M:S)	Gas Mix	DECOMPRESSION STOPS (FSW) Stop times (min) include travel time, except first air and first O_2 stop									Total Ascent Time (M:S)	Chamber O_2 Periods	Repet Group
			100	90	80	70	60	50	40	30	20			
100 FSW														
25	3:20	AIR									0	3:20	0	H
		AIR/O_2									**0**	3:20		
30	2:40	AIR									3	6:20	0.5	J
		AIR/O_2									**2**	5:20		
35	2:40	AIR									15	18:20	0.5	L
		AIR/O_2									**8**	11:20		
In-Water Air/O_2 Decompression or SurDO_2 Recommended --														
40	2:40	AIR									26	29:20	1	M
		AIR/O_2									**14**	17:20		
45	2:40	AIR									36	39:20	1	N
		AIR/O_2									**19**	22:20		
50	2:40	AIR									47	50:20	1	O
		AIR/O_2									**24**	27:20		
55	2:40	AIR									65	68:20	1.5	Z
		AIR/O_2									**28**	31:20		
60	2:40	AIR									81	84:20	1.5	Z
		AIR/O_2									**33**	36:20		
Exceptional Exposure: In-Water Air Decompression ------------- In-Water Air/O_2 Decompression or SurDO_2 Required -----------														
70	2:20	AIR								11	124	138:00	2	Z
		AIR/O_2								**6**	**39**	53:00		
80	2:20	AIR								21	160	184:00	2.5	Z
		AIR/O_2								**11**	**45**	64:00		
90	2:00	AIR							2	28	196	228:40	2.5	
		AIR/O_2							2	**14**	**53**	82:00		
Exceptional Exposure: In-Water Air/0$_2$ Decompression ------------- SurDO_2 Required---														
100	2:00	AIR							9	28	241	280:40	3	
		AIR/O_2							9	**14**	**66**	102:00		
110	2:00	AIR							14	28	278	322:40	3.5	
		AIR/O_2							14	**14**	**76**	117:00		
120	2:00	AIR							19	28	324	373:40	4	
		AIR/O_2							19	**14**	**85**	136:00		
Exceptional Exposure: SurDO_2 ---														
150	1:40	AIR						3	26	46	461	538:20	5	
		AIR/O_2						3	26	**23**	**109**	183:40		

Table 9-9. *Air Decompression Table (Continued).*

(DESCENT RATE 75 FPM—ASCENT RATE 30 FPM)

Bottom Time (min)	Time to First Stop (M:S)	Gas Mix	DECOMPRESSION STOPS (FSW) Stop times (min) include travel time, except first air and first O_2 stop									Total Ascent Time (M:S)	Chamber O_2 Periods	Repet Group
			100	90	80	70	60	50	40	30	20			
110 FSW														
20	3:40	AIR									0	3:40	0	H
		AIR/O_2									**0**	3:40		
25	3:00	AIR									5	8:40	0.5	I
		AIR/O_2									**3**	6:40		
30	3:00	AIR									14	17:40	0.5	K
		AIR/O_2									**7**	10:40		
In-Water Air/O_2 Decompression or SurDO_2 Recommended --														
35	3:00	AIR									27	30:40	1	M
		AIR/O_2									**14**	17:40		
40	3:00	AIR									39	42:40	1	N
		AIR/O_2									**20**	23:40		
45	3:00	AIR									50	53:40	1	O
		AIR/O_2									**26**	29:40		
50	3:00	AIR									71	74:40	1.5	Z
		AIR/O_2									**32**	35:40		
Exceptional Exposure: In-Water Air Decompression ------------- In-Water Air/O_2 Decompression or SurDO_2 Required -----------														
55	2:40	AIR								5	85	93:20	1.5	Z
		AIR/O_2								**3**	**33**	44:20		
60	2:40	AIR								13	111	127:20	2	Z
		AIR/O_2								**7**	**36**	51:20		
70	2:40	AIR								26	155	184:20	2.5	Z
		AIR/O_2								**14**	**42**	64:20		
Exceptional Exposure: In-Water Air/0_2 Decompression ------------ SurDO_2 Required---														
80	2:20	AIR							9	28	200	240:00	2.5	
		AIR/O_2							9	**14**	**54**	90:20		
90	2:20	AIR							18	28	249	298:00	3.5	
		AIR/O_2							18	**14**	**68**	113:20		
100	2:20	AIR							25	28	295	351:00	3.5	
		AIR/O_2							25	**14**	**79**	131:20		
110	2:00	AIR						5	26	28	353	414:40	4	
		AIR/O_2						5	26	**14**	**91**	154:00		
Exceptional Exposure: SurDO_2 ---														
120	2:00	AIR						10	26	35	413	486:40	4.5	
		AIR/O_2						10	26	**18**	**101**	173:00		
180	1:40	AIR					3	23	47	68	593	736:20	7.5	
		AIR/O_2					3	23	47	**34**	**159**	298:40		

Table 9-9. *Air Decompression Table (Continued).*

(DESCENT RATE 75 FPM—ASCENT RATE 30 FPM)

Bottom Time (min)	Time to First Stop (M:S)	Gas Mix	**DECOMPRESSION STOPS (FSW)** Stop times (min) include travel time, except first air and first O_2 stop									Total Ascent Time (M:S)	Chamber O_2 Periods	Repet Group
			100	**90**	**80**	**70**	**60**	**50**	**40**	**30**	**20**			
120 FSW														
15	4:00	AIR									0	4:00	0	F
		AIR/O_2									**0**	4:00		
20	3:20	AIR									4	8:00	0.5	H
		AIR/O_2									**2**	6:00		
25	3:20	AIR									9	13:00	0.5	J
		AIR/O_2									**5**	9:00		
In-Water Air/O_2 Decompression or SurDO_2 Recommended ---														
30	3:20	AIR									24	28:00	0.5	L
		AIR/O_2									**13**	17:00		
35	3:20	AIR									38	42:00	1	N
		AIR/O_2									**20**	24:00		
40	3:00	AIR								2	49	54:40	1	O
		AIR/O_2								**1**	**26**	30:40		
45	3:00	AIR								3	71	77:40	1.5	Z
		AIR/O_2								**2**	**31**	36:40		
Exceptional Exposure: In-Water Air Decompression ------------- In-Water Air/O_2 Decompression or SurDO_2 Required -----------														
50	3:00	AIR								10	85	98:40	1.5	Z
		AIR/O_2								**5**	**33**	46:40		
55	3:00	AIR								19	116	138:40	2	Z
		AIR/O_2								**10**	**35**	53:40		
60	3:00	AIR								27	142	172:40	2	Z
		AIR/O_2								**14**	**39**	61:40		
70	2:40	AIR							13	28	190	234:20	2.5	
		AIR/O_2							13	**14**	**51**	86:40		
Exceptional Exposure: In-Water Air/0_2 Decompression ------------- SurDO_2 Required--														
80	2:40	AIR							24	28	246	301:20	3	
		AIR/O_2							24	**14**	**67**	118:40		
90	2:20	AIR						7	26	28	303	367:00	3.5	
		AIR/O_2						7	26	**14**	**80**	140:20		
100	2:20	AIR						15	25	28	372	443:00	4	
		AIR/O_2						15	25	**14**	**95**	167:20		
Exceptional Exposure: SurDO_2 ---														
110	2:20	AIR						21	25	38	433	520:00	5	
		AIR/O_2						21	25	**19**	**105**	188:20		
120	2:00	AIR					3	23	25	47	480	580:40	5.5	
		AIR/O_2					3	23	25	**24**	**113**	211:00		

Table 9-9. Air Decompression Table (Continued).

(DESCENT RATE 75 FPM—ASCENT RATE 30 FPM)

Bottom Time (min)	Time to First Stop (M:S)	Gas Mix	DECOMPRESSION STOPS (FSW) Stop times (min) include travel time, except first air and first O_2 stop									Total Ascent Time (M:S)	Chamber O_2 Periods	Repet Group
			100	90	80	70	60	50	40	30	20			
130 FSW														
12	4:20	AIR									0	4:20	0	F
		AIR/O_2									**0**	4:20		
15	3:40	AIR									3	7:20	0.5	G
		AIR/O_2									**2**	6:20		
20	3:40	AIR									8	12:20	0.5	I
		AIR/O_2									**5**	9:20		
In-Water Air/O_2 Decompression or SurDO_2 Recommended ---														
25	3:40	AIR									17	21:20	0.5	K
		AIR/O_2									**9**	13:20		
30	3:20	AIR								2	32	38:00	1	M
		AIR/O_2								1	**17**	22:00		
35	3:20	AIR								5	44	53:00	1	O
		AIR/O_2								**3**	**23**	30:00		
40	3:20	AIR								6	66	76:00	1.5	Z
		AIR/O_2								**3**	**30**	37:00		
Exceptional Exposure: In-Water Air Decompression ------------- In-Water Air/O_2 Decompression or SurDO_2 Required -----------														
45	3:00	AIR							1	11	84	99:40	1.5	Z
		AIR/O_2							1	**6**	**33**	49:00		
50	3:00	AIR							2	20	118	143:40	2	Z
		AIR/O_2							2	**10**	**36**	57:00		
55	3:00	AIR							4	28	146	181:40	2	Z
		AIR/O_2							4	**14**	**40**	67:00		
60	3:00	AIR							12	28	170	213:40	2.5	Z
		AIR/O_2							12	**14**	**46**	81:00		
Exceptional Exposure: In-Water Air/0_2 Decompression ------------- SurDO_2 Required--														
70	2:40	AIR						1	26	28	235	293:20	3	
		AIR/O_2						1	26	**14**	**63**	117:40		
80	2:40	AIR						12	26	28	297	366:20	3.5	
		AIR/O_2						12	26	**14**	**79**	144:40		
90	2:40	AIR						22	25	28	375	453:20	4	
		AIR/O_2						22	25	**14**	**95**	174:40		
Exceptional Exposure: SurDO_2 --														
100	2:20	AIR					6	23	26	38	444	540:00	5	
		AIR/O_2					6	23	26	**20**	**106**	204:20		
120	2:20	AIR					17	24	27	57	534	662:00	6	
		AIR/O_2					17	24	27	**29**	**130**	255:20		
180	2:00	AIR				13	21	45	57	94	658	890:40	9	
		AIR/O_2				13	21	45	57	**46**	**198**	418:00		

Table 9-9. *Air Decompression Table (Continued).*

(DESCENT RATE 75 FPM—ASCENT RATE 30 FPM)

Bottom Time (min)	Time to First Stop (M:S)	Gas Mix	**DECOMPRESSION STOPS (FSW)** Stop times (min) include travel time, except first air and first O_2 stop									Total Ascent Time (M:S)	Chamber O_2 Periods	Repet Group
			100	90	80	70	60	50	40	30	20			
140 FSW														
10	4:40	AIR									0	4:40	0	E
		AIR/O_2									**0**	4:40		
15	4:00	AIR									5	9:40	0.5	H
		AIR/O_2									**3**	7:40		
20	4:00	AIR									13	17:40	0.5	J
		AIR/O_2									**7**	11:40		
In-Water Air/O_2 Decompression or SurDO_2 Recommended ---														
25	3:40	AIR								3	24	31:20	1	L
		AIR/O_2								**2**	**12**	18:20		
30	3:40	AIR								7	37	48:20	1	N
		AIR/O_2								**4**	**19**	27:20		
35	3:20	AIR							2	7	58	71:00	1.5	O
		AIR/O_2							2	**4**	**26**	36:20		
Exceptional Exposure: In-Water Air Decompression ------------- In-Water Air/O_2 Decompression or SurDO_2 Required -----------														
40	3:20	AIR							4	7	82	97:00	1.5	Z
		AIR/O_2							4	**4**	**33**	50:20		
45	3:20	AIR							5	18	114	141:00	2	Z
		AIR/O_2							5	**9**	**36**	59:20		
50	3:20	AIR							8	27	145	184:00	2	Z
		AIR/O_2							8	**14**	**39**	70:20		
55	3:00	AIR						1	15	29	171	219:40	2.5	Z
		AIR/O_2						1	15	**15**	**45**	85:00		
Exceptional Exposure: In-Water Air/0_2 Decompression ------------ SurDO_2 Required--														
60	3:00	AIR						2	23	28	209	265:40	3	
		AIR/O_2						2	23	**14**	**56**	109:00		
70	3:00	AIR						14	25	29	276	347:40	3.5	
		AIR/O_2						14	25	**15**	**74**	142:00		
80	2:40	AIR					2	24	25	29	362	445:20	4	
		AIR/O_2					2	24	25	**15**	**91**	175:40		
Exceptional Exposure: SurDO_2 --														
90	2:40	AIR					12	23	26	38	443	545:20	5	
		AIR/O_2					12	23	26	**19**	**107**	210:40		

Table 9-9. *Air Decompression Table (Continued).*

(DESCENT RATE 75 FPM—ASCENT RATE 30 FPM)

Bottom Time (min)	Time to First Stop (M:S)	Gas Mix	DECOMPRESSION STOPS (FSW) Stop times (min) include travel time, except first air and first O_2 stop									Total Ascent Time (M:S)	Chamber O_2 Periods	Repet Group
			100	**90**	**80**	**70**	**60**	**50**	**40**	**30**	**20**			
150 FSW														
8	5:00	AIR									0	5:00	0	E
		AIR/O_2									**0**	5:00		
10	4:20	AIR									2	7:00	0.5	F
		AIR/O_2									**1**	6:00		
15	4:20	AIR									8	13:00	0.5	H
		AIR/O_2									**5**	10:00		
In-Water Air/O_2 Decompression or SurDO_2 Recommended ---														
20	4:00	AIR								2	15	21:40	0.5	K
		AIR/O_2								1	**8**	13:40		
25	4:00	AIR								7	29	40:40	1	M
		AIR/O_2								**4**	**14**	22:40		
30	3:40	AIR							4	7	45	60:20	1.5	O
		AIR/O_2							4	**4**	**22**	34:40		
Exceptional Exposure: In-Water Air Decompression ------------- In-Water Air/O_2 Decompression or SurDO_2 Required -----------														
35	3:40	AIR							6	7	74	91:20	1.5	Z
		AIR/O_2							6	**4**	**30**	44:40		
40	3:20	AIR						2	6	14	106	132:00	2	Z
		AIR/O_2						2	6	**7**	**35**	59:20		
45	3:20	AIR						3	8	24	142	181:00	2	Z
		AIR/O_2						3	8	**12**	**40**	72:20		
50	3:20	AIR						4	14	28	170	220:00	2.5	Z
		AIR/O_2						4	14	**14**	**46**	87:20		
Exceptional Exposure: In-Water Air/0_2 Decompression ------------ SurDO_2 Required--														
55	3:20	AIR						7	21	28	212	272:00	3	
		AIR/O_2						7	21	**14**	**57**	113:20		
60	3:20	AIR						11	26	28	248	317:00	3	
		AIR/O_2						11	26	**14**	**67**	132:20		
70	3:00	AIR					3	24	25	28	330	413:40	4	
		AIR/O_2					3	24	25	**14**	**85**	170:00		
Exceptional Exposure: SurDO_2 --														
80	3:00	AIR					15	23	26	35	430	532:40	4.5	
		AIR/O_2					15	23	26	**18**	**104**	205:00		
90	2:40	AIR				3	22	23	26	47	496	620:20	5.5	
		AIR/O_2				3	22	23	26	**24**	**118**	239:40		
120	2:20	AIR			3	20	22	23	50	75	608	804:00	8	
		AIR/O_2			3	20	22	23	50	**37**	**168**	356:20		
180	2:00	AIR		2	19	20	42	48	79	121	694	1027:40	10.5	
		AIR/O_2		2	19	20	42	48	79	**58**	**222**	538:00		

Table 9-9. Air Decompression Table (Continued).

(DESCENT RATE 75 FPM—ASCENT RATE 30 FPM)

Bottom Time (min)	Time to First Stop (M:S)	Gas Mix	DECOMPRESSION STOPS (FSW) Stop times (min) include travel time, except first air and first O_2 stop									Total Ascent Time (M:S)	Chamber O_2 Periods	Repet Group
			100	90	80	70	60	50	40	30	20			
160 FSW														
7	5:20	AIR									0	5:20	0	E
		AIR/O_2									**0**	5:20		
10	4:40	AIR									4	9:20	0.5	F
		AIR/O_2									**2**	7:20		
15	4:20	AIR								2	10	17:00	0.5	I
		AIR/O_2								**1**	**6**	12:00		
In-Water Air/O_2 Decompression or SurDO_2 Recommended --														
20	4:00	AIR							1	4	19	28:40	0.5	L
		AIR/O_2							1	**2**	**10**	18:00		
25	4:00	AIR							4	7	35	50:40	1	N
		AIR/O_2							4	**4**	**17**	30:00		
30	3:40	AIR						2	6	7	62	81:20	1.5	Z
		AIR/O_2						2	6	**4**	**26**	42:40		
Exceptional Exposure: In-Water Air Decompression ------------- In-Water Air/O_2 Decompression or SurDO_2 Required -----------														
35	3:40	AIR						4	6	8	89	111:20	1.5	Z
		AIR/O_2						4	6	**4**	**34**	57:40		
40	3:40	AIR						6	6	21	134	171:20	2	Z
		AIR/O_2						6	6	**11**	**38**	70:40		
45	3:20	AIR					2	5	11	28	166	216:00	2.5	Z
		AIR/O_2					2	5	11	**14**	**45**	86:20		
Exceptional Exposure: In-Water Air/0_2 Decompression ------------- SurDO_2 Required---														
50	3:20	AIR					2	8	19	28	207	268:00	3	
		AIR/O_2					2	8	19	**15**	**55**	113:20		
55	3:20	AIR					3	11	26	28	248	320:00	3	
		AIR/O_2					3	11	26	**14**	**67**	135:20		
60	3:20	AIR					6	17	25	29	291	372:00	3.5	
		AIR/O_2					6	17	25	**15**	**77**	154:20		
Exceptional Exposure: SurDO_2 --														
70	3:20	AIR					15	23	26	29	399	496:00	4.5	
		AIR/O_2					15	23	26	**15**	**99**	197:20		
80	3:00	AIR				6	21	24	25	44	482	605:40	5.5	
		AIR/O_2				6	21	24	25	**23**	**114**	237:00		

Table 9-9. *Air Decompression Table (Continued).*

(DESCENT RATE 75 FPM—ASCENT RATE 30 FPM)

Bottom Time (min)	**Time to First Stop (M:S)**	**Gas Mix**	**DECOMPRESSION STOPS (FSW)** Stop times (min) include travel time, except first air and first O_2 stop									**Total Ascent Time (M:S)**	**Chamber O_2 Periods**	**Repet Group**
			100	**90**	**80**	**70**	**60**	**50**	**40**	**30**	**20**			
170 FSW														
6	5:40	AIR									0	5:40	0	D
		AIR/O_2									**0**	5:40		
10	5:00	AIR									6	11:40	0.5	G
		AIR/O_2									**3**	8:40		
In-Water Air/O_2 Decompression or SurDO_2 Recommended ---														
15	4:40	AIR								3	13	21:20	0.5	J
		AIR/O_2								2	**6**	13:20		
20	4:20	AIR							3	6	24	38:00	1	M
		AIR/O_2							3	**3**	**12**	23:20		
25	4:00	AIR						1	7	7	41	60:40	1	O
		AIR/O_2						1	7	**4**	**20**	37:00		
Exceptional Exposure: In-Water Air Decompression ------------- In-Water Air/O_2 Decompression or SurDO_2 Required -----------														
30	4:00	AIR						5	7	7	77	100:40	1.5	Z
		AIR/O_2						5	7	**3**	**30**	50:00		
35	3:40	AIR					2	6	6	15	120	153:20	2	Z
		AIR/O_2					2	6	6	**8**	**37**	68:40		
40	3:40	AIR					4	6	9	25	158	206:20	2.5	Z
		AIR/O_2					4	6	9	**12**	**44**	84:40		
Exceptional Exposure: In-Water Air/0_2 Decompression ------------- SurDO_2 Required---														
45	3:40	AIR					5	7	16	28	197	257:20	2.5	Z
		AIR/O_2					5	7	16	**14**	**53**	109:40		
50	3:20	AIR				1	5	11	23	28	244	316:00	3	
		AIR/O_2				1	5	11	23	**14**	**66**	134:20		
55	3:20	AIR				2	7	16	26	28	289	372:00	3.5	
		AIR/O_2				2	7	16	26	**14**	**77**	156:20		
60	3:20	AIR				2	11	21	26	28	344	436:00	4	
		AIR/O_2				2	11	21	26	**14**	**88**	181:20		
Exceptional Exposure: SurDO_2 --														
70	3:20	AIR				7	19	24	25	39	454	572:00	5	
		AIR/O_2				7	19	24	25	**20**	**109**	228:20		
80	3:20	AIR				17	22	23	26	53	525	670:00	6	
		AIR/O_2				17	22	23	26	**27**	**128**	267:20		
90	3:00	AIR			8	19	22	23	37	66	574	752:40	7	
		AIR/O_2			8	19	22	23	37	**33**	**148**	319:00		
120	2:40	AIR		9	19	20	22	42	60	94	659	928:20	9	
		AIR/O_2		9	19	20	22	42	60	**46**	**198**	454:40		
180	2:20	AIR	10	18	19	40	43	70	97	156	703	1159:00	11.5	
		AIR/O_2	10	18	19	40	43	70	97	**74**	**229**	648:00		

Table 9-9. Air Decompression Table (Continued).

(DESCENT RATE 75 FPM—ASCENT RATE 30 FPM)

180 FSW

Bottom Time (min)	Time to First Stop (M:S)	Gas Mix	DECOMPRESSION STOPS (FSW) Stop times (min) include travel time, except first air and first O_2 stop 100	90	80	70	60	50	40	30	20	Total Ascent Time (M:S)	Chamber O_2 Periods	Repet Group
6	6:00	AIR									0	6:00	0	E
		AIR/O_2									**0**	6:00		
10	5:20	AIR									8	14:00	0.5	G
		AIR/O_2									**4**	10:00		
In-Water Air/O_2 Decompression or SurDO_2 Recommended --														
15	4:40	AIR							2	3	14	24:20	0.5	K
		AIR/O_2							2	**2**	**7**	16:40		
20	4:20	AIR						1	5	7	29	47:00	1	M
		AIR/O_2						1	5	**3**	**15**	29:20		
25	4:20	AIR						5	6	7	57	80:00	1.5	O
		AIR/O_2						5	6	**4**	**24**	44:20		
Exceptional Exposure: In-Water Air Decompression ------------- In-Water Air/O_2 Decompression or SurDO_2 Required -----------														
30	4:00	AIR					3	6	6	7	95	121:40	1.5	Z
		AIR/O_2					3	6	6	**4**	**34**	63:00		
35	3:40	AIR				1	5	6	6	22	144	188:20	2	Z
		AIR/O_2				1	5	6	6	**11**	**41**	79:40		
Exceptional Exposure: In-Water Air/0_2 Decompression ------------- SurDO_2 Required---														
40	3:40	AIR				2	6	5	13	28	178	236:20	2.5	
		AIR/O_2				2	6	5	13	**14**	**48**	97:40		
45	3:40	AIR				4	5	10	20	28	235	306:20	3	
		AIR/O_2				4	5	10	20	**14**	**63**	130:40		
50	3:40	AIR				4	8	13	25	29	277	360:20	3.5	
		AIR/O_2				4	8	13	25	**15**	**75**	154:40		
55	3:40	AIR				5	11	19	26	28	336	429:20	4	
		AIR/O_2				5	11	19	26	**14**	**87**	181:40		
Exceptional Exposure: SurDO_2 --														
60	3:20	AIR			1	8	13	23	25	31	406	511:00	4.5	
		AIR/O_2			1	8	13	23	25	**16**	**100**	205:20		
70	3:20	AIR			4	12	21	24	25	48	499	637:00	5.5	
		AIR/O_2			4	12	21	24	25	**24**	**119**	253:20		

Table 9-9. *Air Decompression Table (Continued).*

(DESCENT RATE 75 FPM—ASCENT RATE 30 FPM)

Bottom Time (min)	Time to First Stop (M:S)	Gas Mix	DECOMPRESSION STOPS (FSW) Stop times (min) include travel time, except first air and first O_2 stop									Total Ascent Time (M:S)	Chamber O_2 Periods	Repet Group
			100	90	80	70	60	50	40	30	20			
190 FSW														
5	6:20	AIR									0	6:20	0	D
		AIR/O_2									**0**	6:20		
10	5:20	AIR								2	8	16:00	0.5	H
		AIR/O_2								1	**4**	11:00		
In-Water Air/O_2 Decompression or SurDO_2 Recommended --														
15	4:40	AIR						1	3	3	16	28:20	0.5	K
		AIR/O_2						1	3	**2**	**8**	19:40		
20	4:20	AIR					1	2	6	7	34	55:00	1	N
		AIR/O_2					1	2	6	**4**	**17**	35:20		
Exceptional Exposure: In-Water Air Decompression ------------- In-Water Air/O_2 Decompression or SurDO_2 Required -----------														
25	4:20	AIR					2	6	7	7	72	99:00	1.5	Z
		AIR/O_2					2	6	7	**3**	**28**	51:20		
30	4:00	AIR				1	6	5	7	13	122	158:40	2	Z
		AIR/O_2				1	6	5	7	**7**	**38**	74:00		
Exceptional Exposure: In-Water Air/0_2 Decompression ------------- SurDO_2 Required--														
35	4:00	AIR				4	5	6	8	26	165	218:40	2.5	Z
		AIR/O_2				4	5	6	8	**13**	**45**	91:00		
40	3:40	AIR			1	5	5	8	17	28	217	285:20	3	
		AIR/O_2			1	5	5	8	17	**15**	**58**	123:40		
45	3:40	AIR			2	5	6	12	24	29	264	346:20	3.5	
		AIR/O_2			2	5	6	12	24	**15**	**71**	149:40		
50	3:40	AIR			3	5	10	17	26	28	324	417:20	4	
		AIR/O_2			3	5	10	17	26	**14**	**85**	179:40		
Exceptional Exposure: SurDO2 ---														
55	3:40	AIR			4	8	10	24	25	30	397	502:20	4.5	
		AIR/O_2			4	8	10	24	25	**15**	**99**	204:40		
60	3:40	AIR			5	10	16	24	25	40	454	578:20	5	
		AIR/O_2			5	10	16	24	25	**20**	**109**	233:40		
90	3:20	AIR		11	19	20	21	28	51	83	626	863:00	8.5	
		AIR/O_2		11	19	20	21	28	51	**41**	**178**	408:20		
120	3:00	AIR	15	17	19	20	37	46	79	113	691	1040:40	10.5	
		AIR/O_2	15	17	19	20	37	46	79	**55**	**219**	551:00		

Table 9-9. Air Decompression Table (Continued).

(DESCENT RATE 75 FPM—ASCENT RATE 30 FPM)

Bottom Time (min)	Time to First Stop (M:S)	Gas Mix	DECOMPRESSION STOPS (FSW) Stop times (min) include travel time, except first air and first O_2 stop									Total Ascent Time (M:S)	Chamber O_2 Periods	Repet Group
			100	90	80	70	60	50	40	30	20			
200 FSW														
Exceptional Exposure --														
5	6:40	AIR									0	6:40	0	E
		AIR/O_2									**0**	6:40		
10	5:40	AIR								3	8	17:20	0.5	H
		AIR/O_2								**2**	**4**	12:20		
15	5:00	AIR						2	3	5	19	34:40	0.5	L
		AIR/O_2						2	3	**3**	**9**	23:00		
20	4:40	AIR					2	4	6	7	43	67:20	1	O
		AIR/O_2					2	4	6	**4**	**20**	41:40		
25	4:20	AIR				1	5	6	6	7	85	115:00	1.5	Z
		AIR/O_2				1	5	6	6	**4**	**32**	64:20		
30	4:20	AIR				4	6	5	7	19	145	191:00	2	Z
		AIR/O_2				4	6	5	7	**10**	**42**	84:20		
35	4:00	AIR			2	5	5	6	13	28	188	251:40	2.5	
		AIR/O_2			2	5	5	6	13	**14**	**51**	106:00		
40	4:00	AIR			4	5	5	11	21	28	249	327:40	3.5	
		AIR/O_2			4	5	5	11	21	**14**	**68**	143:00		
45	3:40	AIR		1	4	5	10	14	25	28	306	397:20	3.5	
		AIR/O_2		1	4	5	10	14	25	**14**	**81**	168:40		
50	3:40	AIR		2	4	8	10	21	26	28	382	485:20	4.5	
		AIR/O_2		2	4	8	10	21	26	**14**	**97**	201:40		
210 FSW														
Exceptional Exposure --														
4	7:00	AIR									0	7:00	0	D
		AIR/O_2									**0**	7:00		
5	6:20	AIR									2	9:00	0.5	E
		AIR/O_2									**1**	8:00		
10	5:40	AIR							2	3	9	20:20	0.5	I
		AIR/O_2							2	**2**	**4**	14:40		
15	5:00	AIR					1	3	3	6	24	42:40	1	M
		AIR/O_2					1	3	3	**3**	**12**	28:00		
20	4:40	AIR				1	3	5	6	7	57	84:20	1	O
		AIR/O_2				1	3	5	6	**4**	**23**	47:40		
25	4:40	AIR				3	6	5	7	8	110	144:20	2	Z
		AIR/O_2				3	6	5	7	**4**	**38**	73:40		
30	4:20	AIR			2	5	6	6	6	26	163	219:00	2.5	Z
		AIR/O_2			2	5	6	6	6	**13**	**45**	93:20		
35	4:00	AIR		1	4	5	6	7	18	28	223	296:40	3	
		AIR/O_2		1	4	5	6	7	18	**14**	**60**	130:00		
40	4:00	AIR		2	5	5	7	11	26	28	278	366:40	3.5	
		AIR/O_2		2	5	5	7	11	26	**14**	**76**	161:00		
45	4:00	AIR		4	4	6	11	18	26	28	355	456:40	4	
		AIR/O_2		4	4	6	11	18	26	**14**	**91**	194:00		
50	3:40	AIR	1	4	5	10	12	23	26	36	432	553:20	5	
		AIR/O_2	1	4	5	10	12	23	26	**18**	**105**	223:40		

Table 9-9. *Air Decompression Table (Continued).*

(DESCENT RATE 75 FPM—ASCENT RATE 30 FPM)

Bottom Time (min)	Time to First Stop (M:S)	Gas Mix	DECOMPRESSION STOPS (FSW) Stop times (min) include travel time, except first air and first O_2 stop												Total Ascent Time (M:S)	Chamber O_2 Periods	Repet Group
			130	120	110	100	90	80	70	60	50	40	30	20			
220 FSW																	
Exceptional Exposure --																	
4	7:20	AIR												0	7:20	0	E
		AIR/O_2												**0**	7:20		
5	6:40	AIR												3	10:20	0.5	E
		AIR/O_2												**2**	9:20		
10	6:00	AIR										3	4	10	23:40	0.5	J
		AIR/O_2										3	**2**	**5**	17:00		
15	5:20	AIR								3	2	4	7	28	50:00	1	N
		AIR/O_2								3	2	4	**4**	**14**	33:20		
20	5:00	AIR							2	4	6	6	7	70	100:40	1.5	Z
		AIR/O_2							2	4	6	6	**4**	**26**	54:00		
25	4:40	AIR						1	5	6	6	6	14	133	176:20	2	Z
		AIR/O_2						1	5	6	6	6	**7**	**41**	82:40		
30	4:20	AIR					1	4	5	6	6	10	28	183	248:00	2.5	
		AIR/O_2					1	4	5	6	6	10	**14**	**50**	106:20		
35	4:20	AIR					3	5	5	5	10	22	28	251	334:00	3.5	
		AIR/O_2					3	5	5	5	10	22	**14**	**68**	147:20		
40	4:00	AIR				1	4	5	5	9	15	26	28	319	416:40	4	
		AIR/O_2				1	4	5	5	9	15	26	**14**	**84**	183:00		
250 FSW																	
Exceptional Exposure --																	
4	7:40	AIR												4	12:20	0.5	F
		AIR/O_2												**2**	10:20		
5	7:40	AIR												7	15:20	0.5	G
		AIR/O_2												**4**	12:20		
10	6:20	AIR								2	2	4	3	15	33:00	0.5	L
		AIR/O_2								2	2	4	**2**	**7**	24:20		
15	5:40	AIR						2	2	3	4	6	7	53	83:20	1	O
		AIR/O_2						2	2	3	4	6	**4**	**22**	49:40		
20	5:20	AIR					2	2	4	6	6	6	11	125	168:00	2	Z
		AIR/O_2					2	2	4	6	6	6	**6**	**39**	82:20		
25	5:00	AIR				1	4	4	5	6	6	10	28	189	258:40	2.5	
		AIR/O_2				1	4	4	5	6	6	10	**14**	**51**	112:00		
30	4:40	AIR			1	4	4	4	5	6	9	25	28	267	358:20	3.5	
		AIR/O_2			1	4	4	4	5	6	9	25	**15**	**72**	160:40		
35	4:40	AIR			3	4	4	5	5	10	19	26	28	363	472:20	4	
		AIR/O_2			3	4	4	5	5	10	19	26	**14**	**93**	203:40		

300 FSW

Bottom Time (min)	Time to First Stop (M:S)	Gas Mix	DECOMPRESSION STOPS (FSW) Stop times (min) include travel time, except first air and first O_2 stop												Total Ascent Time (M:S)	Chamber O_2 Periods	Repet Group
			130	120	110	100	90	80	70	60	50	40	30	20			
Exceptional Exposure ----------																	
4	9:00	AIR											3	7	19:40	0.5	G
		AIR/O_2											**2**	**4**	15:40		
5	8:40	AIR										3	3	8	23:20	0.5	I
		AIR/O_2										3	**2**	**4**	18:40		
10	7:20	AIR						2	3	2	3	4	7	35	64:00	1	N
		AIR/O_2						2	3	2	3	4	**4**	**18**	44:20		
15	6:20	AIR			1	2	2	3	3	5	6	7	11	125	172:00	2	Z
		AIR/O_2			1	2	2	3	3	5	6	7	**6**	**39**	86:20		
20	6:00	AIR		2	2	2	4	5	5	5	6	16	28	219	300:40	3	
		AIR/O_2		2	2	2	4	5	5	5	6	16	**14**	**59**	137:00		
25	5:40	AIR	1	3	4	4	4	5	5	5	18	26	28	324	433:20	4	
		AIR/O_2	1	3	4	4	4	5	5	5	18	26	**14**	**85**	195:40		

ATTACHMENT 11

EQUIPMENT CHECKLISTS

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ATTACHMENT 11

GENERAL DIVE EQUIPMENT LOADOUT

PROJECT NAME: ______________________________________ **DATE:** _________________

General Dive Equipment

Item	Quantity	Inspected for operation and Loaded
DIVE FLAG (CIVILIAN AND CODE ALPHA)		
LOST DIVER BUOY		
TENDING LINES AND HARNESSES		
HANDHELD GPS		
BUDDY LINES		
DIVE SYSTEM(S)		
AIR SUPPLY/ BOTTLES		
CELLULAR PHONE (ON AND CHARGED)		
VHF RADIO		
DRINKING WATER		
PERSONAL DIVE GEAR		
DIVE OPS WORK PLAN		
DIVE SAFE PRACTICES MANUAL		
U.S. NAVY DIVE MANUAL		
EMERGENCY CONTACT LIST (POSTED)		
REQUIRED LINES, BUOYS, ANCHORS		

ATTACHMENT 11

GENERAL DIVE EQUIPMENT LOADOUT

Medical Equipment

Item	Quantity	Inspected for operation and Loaded	
FIRST AID KIT/ TRAUMA KIT			
EMERGENCY OXYGEN SYSTEM		**PSIG**	**PSIG**
STRETCHER OR BACKBOARD			

Tools, UXO Related Equipment, Explosive Materials

Item	Quantity	Inspected for operation and Loaded

Loadout Checked (Name) Signature

Diving Supervisor Name Diving Supervisor Signature

ATTACHMENT 11

GENERAL DIVE EQUIPMENT LOADOUT

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ATTACHMENT 11

BOAT PRE-OPERATION CHECKLIST

Project Description:	**Date:**
Project Location:	**Job#:**

Step No.	Description	Check Completed (Initials)
1	**Inspect exterior of vessel** ☐ Inspect for visible damage ☐ POL leaks ☐ Maintenance issues ☐ Boat registration ☐ Hull plugs in place	
2	**Inspect propulsion system** ☐ a. Engine (propeller, oil, fuel level and extra fuel on board, hours since last maintenance, functional, and adequately secured to vessel) ☐ b. Steering system (functional, forward/reverse gears) ☐ c. Batteries (charged, water in cells, contacts clean)	
3	**Inspect all communication equipment** ☐ a. Perform VHF radio check with a base station ☐ b. Perform cellular phone check with a base station ☐ c. Perform dive communication check with radio and dive hats ☐ d. Have spare batteries charged and within reach of all comm. equip.	
4	**Inspect electrical systems and all other communication equipment** Ensure the following are on board and in work order ☐ a. Dive flags (Alpha and Recreational) and pole ☐ b. Sound signaling device (vessel horn, hand horn, whistle) ☐ c. Flares (rocket/parachute, hand held, smoke) ☐ d. Water dye canister, flash light, signaling mirror, EPIRB, and strobe lights for PFDs ☐ e. Deck and Navigation lighting (port, starboard, fore/aft, search, and cabin) ☐ f. Bilge pump	
5	**Inspect mooring systems** ☐ a. Anchor secured to line/chain and functional ☐ b. Line/chain in working order and ready for use ☐ c. Fenders secure and ready for use ☐ d. Extra line available for use	
6	**Ensure navigational equipment is functioning** ☐ a. GPS (locked on 4 satellites, correct datum, power source) ☐ b. Compass and binoculars ☐ c. Charts / maps	
7	**Place copies of the following in cabin near helm** ☐ a. Emergency procedures plan ☐ b. Safe diving practices and operations manual ☐ c. Air decompression tables	

ATTACHMENT 11

BOAT PRE-OPERATION CHECKLIST

Step No.	Description	Check Completed (Initials)
8	**Inspect lifesaving equipment** ☐ a. Ensure 1 PFD per person and 1 throw ring (USCG approved, in working order and properly fitted with strobe, whistle and knife attached) ☐ b. First aid kit (stocked, non-expired contents), First aid book, back board ☐ c. Fire extinguisher (charged, current inspection, accessible)	
9	**Inspect tool box** ☐ a. Spare parts for engine and other vessel systems ☐ b. Tools (clean and in working order) for repairing vessel systems and dive equipment	
10	**Alternate propulsion systems** ☐ a. Hand paddles (2) ☐ b. Spare outboard engine (complete, working, with spare fuel source)	
11	**Personal comfort equipment** ☐ a. Water ☐ b. Food ☐ c. Sunscreen/motion sickness medicine ☐ d. Clothing as required by conditions/locations (hard hat, sun glasses, ball cap, extreme weather, steel toed boots, change of clothes)	

<u>NOTES</u>:

1. File completed checklist in daily job log.
2. Record any maintenance issues in vessel log and report to Project Manager.
3. Complete dive boat safety checklist after completing this checklist.

ATTACHMENT 11

SCUBA CHECKLISTS

PROJECT NAME: ______________________________________ **DATE:** _________________

SCUBA EQUIPMENT INSPECTION

Cylinders				**FFMs/ Regulators/ Gauges**		**Buoyancy Compensators**	
Primary		**Emergency Bail-Out**					
Pre-Dive	Post Dive	Pre-Dive	Post Dive	Pre-Dive	Post Dive	Pre-Dive	Post Dive
Serial # Inspect	Clean and Charge (PSIG)	Serial # Inspect	Clean and Charge (PSIG)	Serial # Inspect /Test	Clean and Inspect	Serial # Inspect /Test	Clean/Inspect

Notes:

1. Fill-in and initial each block prior to and after each dive. Place PSI level in block as indicated.
2. Ensure cylinders are gauged at minimum 90% capacity ***(2700 PSI)*** following charge. *(**NOTE**: Gauge after bottles are cool).*

Specific Pre-Dive Procedures:

FFM

- Inspect – Nose pad/ one-way/ comms/ purge/ ABV/ seal/ straps/test breathe

Specific Post Dive Procedures:

Cylinders

- Rinse cylinders with fresh water.
- Leak check cylinders during charging.

Masks / Regulators / Gauges

- Rinse with fresh water and sterilize regulator.
- Inspect mask, regulator and hoses.
- Rinse & inspect gauges.

Buoyancy Compensators

- Rinse with fresh water and clean BC.
- Inspect BC inflation and dump valves.
- Empty any water in BC, Inflate and leave overnight for drying and leak check

______________________________________ ______________________________________

Diving Supervisor Name Diving Supervisor Signature

ATTACHMENT 11

SCUBA CHECKLISTS

PROJECT NAME: ______________________________ **DATE:** ______________

ALL ITEMS WILL BE CHECKED IN APPROPRIATE BLOCKS AS FOLLOWS:

1. **ALL PERSONNEL MUST WEAR SAFETY GLASSES WHEN WORKING WITH HP AIR**
2. **Initial for each completed and satisfactory check.**
3. **When completed, person completing the checks will sign as appropriate (blocks 1 thru 4) and then turn in to the Diving Supervisor for his checks, review and signature.**

Set Number	Diver Signature	Dive Supervisor Signature

Initial	Procedure	Remarks
Air Cylinders		
	Cylinders – inspect for current hydro and visual	
	O ring and valve – inspect condition	
	Pressure – adequate for days operations	
	Bail-Out Bottles - *Repeat above steps	
Buoyancy Compensator (BC)		
	Straps / Buckles / Harness – inspect condition and adjust for fit	
	Air bladder – leak check	
	Cylinder and bail-out – mount securely	
	Inflator fitting and hose – inspect condition	
	Dump valves – check for proper function	
Regulator(s)		
	Hoses / Connectors – inspect condition	
	1st and 2nd stages – inspect condition	
	Cylinder yoke assembly – secure	
	Bail-out regulator(s) – repeat above checks	
	Regulator assemblies – attach to cylinders	
	Inflation whip – attach to BC	
	Valves – open / leak check cylinder O ring	
	Pressure gauge – reading properly	
	Dive Computer – inspect, check batt, function	
	BC inflation – check proper function	
	Primary regulator / bail-out regulator - test	
	Fittings - Check for leaks	
	FFM – Nose pad/ one-way valves / comms/ pp/ ABV**/** seal/straps	
Notes:		

ATTACHMENT 11

SCUBA CHECKLISTS

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ATTACHMENT 11

PRE-DIVE: SSA DIVE HELMET CHECKOFF SHEET

PROJECT NAME/NUMBER: ______________________ DATE: _____________________
TENDER/DIVER: ____

NOTE: ALL ITEMS WILL BE CHECKED IN APPROPRIATE BLOCKS AS FOLLOWS:

1. **An initial for each completed and satisfactory check.**
2. **An N/A for each item not applicable to the Dive Helmet being pre-dove.**
3. **An "R" for any repairs made. A brief description in the remarks section. If more space required use the "notes" section for continuation.**
4. **When completed, person completing the checks will sign as appropriate (blocks 1 thru 4) and then turn in to the Diving Supervisor for his checks, review and signature.**

Helmet/Mask Type	Serial No.	Checked By:	Signature	Dive Supe Signature
1.				
2.				
3.				
4.				

	Procedure	1	2	Remarks
1	Test non-return valve (suck and blow)			
2	Check helmet for damage / deterioration			
3	Check neck dam seal (lube if required)			
4	Check oral nasal mask			
5	Check side block assembly – ensure secure			
6	Check 2nd stage regulator			
7	Check inhalation diaphragm			
8	Check exhaust valve			
9	Check neck dam for damage			
10	Check neck dam assembly			
11	Check locking mechanism			
12	Check 1st stage assembly			
13	Check HP and LP hoses			
14	Check face plate secure and not damaged *(DO NOT use screwdriver)*			
15	Check harness assembly			
16	Check bailout PSIG *(2700 minimum)*			PSIG 1: PSIG 2: PSIG 3:
17	Check air spread OP's completed			
18	Check to ensure flow restrictor in place			
19	Stow flow restrictor plug in safe place			
20	Connect hoses			
21	Adjust dial-a-breath			
22	Check free-flow			
23	Check purge			
24	Check EGS valve			
25	Check communications OK			

Notes:

ATTACHMENT 11

POST-DIVE: SSA DIVE HELMET CHECKOFF SHEET

PROJECT NAME/NUMBER: ______________________ DATE: _____________________
TENDER/DIVER: ____

NOTE: ALL ITEMS WILL BE CHECKED IN APPROPRIATE BLOCKS AS FOLLOWS:

1. **An initial for each completed and satisfactory check.**
2. **An N/A for each item not applicable to the Dive Helmet being pre-dove.**
3. **An "R" for any repairs made. A brief description in the remarks section. If more space required use the "notes" section for continuation.**
4. **When completed, person completing the checks will sign as appropriate (blocks 1 or 2) and then turn in to the Diving Supervisor for his checks, review and signature.**

Helmet/Mask Type	Serial No.	Checked By:	Signature	Dive Supe Signature
1.				
2.				
3.				
4.				

	Procedure	1	2	Remarks
1	Secure system and emergency air			
2	Bleed and disconnect hoses			
3	Make sure flow restrictor remains on helmet when using dry suit inflator whip			
4	Install flow restrictor plug			
5	Disconnect comms: 2-wire or MM plug			
6	Cap helmet and umbilical fittings			
7	Check helmet for damage			
8	Check neck dam O-ring for damage (lube)			
9	Check neck dam assembly for damage			
10	Check locking mechanisms for damage			
11	Remove head liner			
12	Check oral nasal mask			
13	Check side block assembly - secured			
14	Check 2nd stage regulator			
15	Check inhalation diaphragm			
16	Check LP and HP hoses (1st stage)			
17	Check face plate secure and not damaged *(DO NOT use screwdriver)*			
18	Wash with soap and water. Then dry.			
19	Disinfect with antibacterial wipes			
20	Open all valves – back of ¼ turn			
21	Remove covers from ear speakers / comms pod			

Notes:

Number of dives:

ATTACHMENT 11

PRE-DIVE: SURFACE SUPPLIED LIGHTWEIGHT (FFM)

PROJECT NAME/NUMBER: ______________________ DATE: ______________________
TENDER/DIVER: ____

ALL ITEMS WILL BE CHECKED IN APPROPRIATE BLOCKS AS FOLLOWS:

1. **ALL PERSONNEL MUST WEAR SAFETY GLASSES WHEN WORKING WITH HP AIR**
2. **Initial for each completed and satisfactory check.**
3. **When completed, person completing the checks will sign as appropriate (blocks 1 THRU 3) and then turn in to the Diving Supervisor for his checks, review and signature.**

Mask/ Type	Serial No.	Diver Signature	Dive Supervisor Signature
1.			
2.			
3.			

Initial	Procedure	Remarks		
	Ensure HP Air Bottles secured; Check cylinder pressures; Record cylinder pressures	#1:	#2:	#3:
	Ensure ACS on solid surface and secured			
	Inspect ACS condition			
	Check Umbilical condition and secured			
	Ensure all ACS valves are SECURED (closed); regulator valve low pressure (*all the way counterclockwise*)			
	Attach HP whips to bottles			
	Open bottles slowly; record HP Supply Pressure	1 HP PSIG:	2 HP PSIG:	
	Attach Divers supply/ pneumo hoses/ comm wires and mic to ACS			
	Open 1 HP supply (slowly)			
	Set required OB pressure on ACS	OB PSIG:		* *Initial set @ 135 PSIG*
	Check harness assembly			
	Check bailout bottle PSIG (90% @ min 2700)	PSIG DVR:	PSIG STBY:	
	Attach bailout first stage to pony bottle			** Attach QD (first stage to KM block)*
	Check KM Manifold Block (*Suck and blow*)			
	Blow down diver's umbilical's			
	Connect umbilical hose to KM blocks			
	Connect comms (Hi-use connector)			* *Secure dummy plugs/ tape connector*
	Inspect Full Face Mask (FFM) - Nose pad/ one-way/ comms/ pp/ ABV/ seal / straps			
	Connect FFM to Block			
	Air to Masks			
	Check air to FFM; purge mask			
	Check comms – DV to console; DV to DV			
	Check pneumo for both umbilical's			
	Check all air spread OP's completed			

Notes:

ATTACHMENT 11

POST-DIVE: SURFACE SUPPLIED LIGHTWEIGHT (AGA)

PROJECT NAME/NUMBER: ______________________ DATE: _____________________
TENDER/DIVER: ____

ALL ITEMS WILL BE CHECKED IN APPROPRIATE BLOCKS AS FOLLOWS:

1. **ALL PERSONNEL MUST WEAR SAFETY GLASSES WHEN WORKING WITH HP AIR**
2. **Initial for each completed and satisfactory check.**
3. **When completed, person completing the checks will sign as appropriate (blocks 1 or 2) and then turn in to the Diving Supervisor for his checks, review and signature.**

Mask/ Type	Serial No.	Diver Signature	Dive Supervisor Signature
1.			
2.			
3.			

Initial	Procedure	Remarks
	Secure HP air; bleed down both HP whips and umbilical’s	
	Disconnect FFM air / comms	
	Check FFM for damage/ post dive	
	Disinfect with antibacterial wipes	*Note: Contact time is 5 minutes.*
	Wash with soap and water. Then dry.	
	Bleed down EGS; Disconnect QD	
	Remove B/O first stage from pony	
	Bleed and disconnect hoses from KM block, inspect block and harness	
	Cap all fittings on block and umbilical	** Use dummy plugs/ tape connector.*
	Remove umbilicals from ACS/ stow	
	Cap all fittings on umbilical and ACS	
	Remove mic from ACS/ stow	
	Ensure all air system fittings capped and valves are secured; regulator valve backed out; ACS power OFF	
	Place ACS on charge or stow	

Notes:

TETRA TECH

Diving Safe Practices Manual

February 2021

Safety Excellence

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TMR Manual

DSP-01 Diving Safe Practices Manual

Status:	Approved	**Approved By:**	M.W.D Mark W. Dollar, President
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TABLE OF CONTENTS

ABBREVIATIONS AND ACRONYMS

ACFM	actual cubic feet per minute
ADCI	The Association of Diving Contractors International
AED	automated external defibrillator
AGE	arterial gas embolism
AHA	Activity Hazard Analysis
Army	U.S. Army
ATA	Atmosphere Absolute
CFR	*Code of Federal Regulations*
CRL	Corporate Reference Library
CNS	central nervous system
CPR	cardiopulmonary resuscitation
DCS	decompression sickness
DDC	District Diving Coordinator
DDESB	Department of Defense Explosives Safety Board
DOT	U.S. Department of Transportation
DRB	Diving Review Board
DSO	Diving Safety Officer
DSR	Diving Safety Representative
DSPM	Diving Safe Practices Manual
EM	Engineers Manual
ESSQ	Environment, Safety, Security and Quality
FSW	feet of seawater
HAZWOPER	Hazardous Waste Operations and Emergency Response
HASDP	Health and Safety Dive Plan
MEC	munitions and explosives of concern
NIOSH	National Institute for Occupational Safety and Health
NOAA	National Oceanographic and Atmospheric Administration
NOSSA	Naval Ordnance Safety and Security Activity
OSHA	Occupational Safety and Health Administration

ABBREVIATIONS AND ACRONYMS (Continued)

PFD	personal flotation device
PPM	parts per million
PSI	pounds per square inch (gauge)
SCUBA	self-contained underwater breathing apparatus
SDS	Senior Diving Supervisor
SHM	Safety and Health Manager
SOP	Standard Operating Procedures
SSHO	Site Safety and Health Officer
SUXOS	Senior UXO Supervisor
TP	Technical Paper
Tt	Tetra Tech
TMR	Tetra Tech Munitions Response
USACE	U.S. Army Corps of Engineers
USCG	U.S. Coast Guard
USN	U.S. Navy
U.S.	United States
UXO	unexploded ordnance

1.0 PURPOSE

This Tetra Tech Munitions Response (TMR) Diving Safe Practices Manual (DSPM) provides TMR employees and subcontractors with the requirements and guidance for conducting safe diving operations. Contractors working directly for the client will be required to have safe practices that meet or exceed the requirements of this manual while operating from TMR-owned or leased equipment or property.

This manual ensures TMR diving operations meet and/or exceed the requirements of federal and state agencies. The project management team, designated dive supervisor/lead divers, project quality managers (PQMs), and site safety and health officers (SSHOs) will ensure compliance with Occupational Safety and Health Administration (OSHA) regulations and standards by implementing these procedures during dive operations.

This manual was prepared in accordance with the OSHA regulations. Federal, state, and local regulations were also considered during the preparation of this manual. If a conflict arises between the current edition of this manual and applicable or updated federal or other legal directives or statutes, the latter shall always take precedence.

2.0 FEDERAL AND STATE STANDARDS REQUIREMENTS

This manual was developed using guidelines, procedures, rules, and regulations from the following government and civilian agencies:

- OSHA
- U.S. Army Corps of Engineers (USACE)
- The Association of Diving Contractors International (ADCI)
- U.S. Navy (USN)
- U.S. Coast Guard (USCG)
- U.S. Army (Army)
- National Oceanographic and Atmospheric Administration (NOAA)

This manual provides the **minimum regulatory standards** for team composition, diving procedures, equipment maintenance, and operations.

3.0 SCOPE

This document contains procedures applicable to all TMR projects involving underwater operations that use divers or snorkelers to perform work or scientific research. The procedures in this document shall meet the requirements in 29 *Code of Federal Regulations* (CFR) 1910.401, Subpart T. Requirements that are not specifically included in this DSPM will be included in the project specific Health and Safety Dive Plan (HASDP). When contracted to dive for clients who mandate following USACE standards, additional equipment, procedures, and review requirements will be addressed in the project specific HASDP. The specific requirements are identified in Section 30 of USACE Engineers

Manual (EM) 385-1-1, Safety and Health Requirements Manual. If there are any conflicts between this manual, OSHA, and/or federal and state/ local regulations, the most stringent regulations will take precedence, provided site safety is not compromised. All conflicts will be detailed, with procedures provided in the project specific HASDP.

4.0 REVISIONS

Revisions to this manual will be periodically completed based on new advances in diving practices, technological advances, and changes in regulations.

5.0 DIVING REVIEW BOARD

The diving program manager is designated the Chairman of the Diving Review Board (DRB) and is responsible for updating this manual. The designated diving safety officer (DSO) will maintain the qualification records of personnel approved for diving and will approve all other divers (including subcontracted divers) involved on TMR projects.

6.0 GENERAL RESPONSIBILITIES

This manual will be reviewed by the diving program manager, DSO, and the TMR senior diving supervisor (SDS) for technical content involving TMR diving. They will ensure diving operations are conducted in a safe and efficient manner throughout the company. Their responsibilities include:

- Review existing policies and procedures to ensure safe, effective diving operations.
- Develop recommendations to improve diving operations.
- Review and discuss diving accident report releases by various sources and ensure the distribution of copies to Dive Team members.
- Review any TMR near-miss or actual diving mishaps and develop procedures and policies to prevent future occurrences.
- Ensure that the TMR dive program conforms to all the guidelines in this DSPM, as well as all applicable federal, state, and local laws and regulations.
- Coordinate proper recordkeeping for diving personnel, diving operations, and dive equipment maintenance.
- Coordinate periodic diver training and safety programs as needed.
- Review, prior to approval, prospective TMR dive operations that use non-standard diving modes and procedures or carry above average risk.
- Review the qualifications and performance of all divers and potential Diving Supervisors/ Lead Divers.
- Stay updated on new safety procedures, as well as OSHA, USN, USCG, USACE, and ADCI requirements.
- The Quality Department will review this manual for compliance with appropriate laws and regulations.

- Approval authority rests with the TMR President, with review by the dive program manager.
- The Chairman of the DRB will be responsible for all required corporate recordkeeping in accordance with this manual, and maintenance of all identified references.
- For unexploded ordnance (UXO) diving operations, the dive program manager will review and approve all TMR employees and subcontractor personnel involved in UXO diving.

The DSPM will never substitute for prior planning, sound judgment, and a continuing concern for maximum safety. Safety is not a rulebook; it is a state of mind and must be continually maintained in our workplace culture. However, not all circumstances or situations can be explained and detailed in this DSPM. For this reason, TMR only recommends deviating from these guidelines when, in the opinion of the diving supervisor/lead diver, an emergency exists where the health and safety of personnel is a concern. The diving supervisor/lead diver will have final authority regarding safe conditions at the dive site. A written event report will be submitted to the Chairman of the DRB within 48 hours of the deviation from the DSPM to document possible changes to this manual and conformation to OSHA and other regulatory requirements.

6.1 Waiver of Requirements

The DRB may grant a waiver for specific requirements of training, examinations, and minimum activity to maintain certification.

6.2 Diving Program Manager/Chairman, DRB

The diving program manager is the Chairman of the TMR DRB. The DRB is composed of the diving program manager, the DSO, and the SDS from the TMR Operating Unit as assigned by the appropriate manager. The Chairman of the DRB is responsible for managing the TMR Diving Program in conjunction with the assigned board members; they will maintain the diving logs and references as required by OSHA in 29 CFR 1910.401, Subpart T. The DSO will maintain qualifications and physical records for all TMR divers. The Chairman will review and approve divers, including subcontractors who are assigned to individual projects.

6.3 DSO/DRB Member

The diving safety officer (DSO), as a permanent DRB member, is responsible for the safe conduct of UXO and construction diving operations. The DSO is responsible for the appropriate diver training and qualifications for UXO operations. The DSO will submit to the DRB the names of qualified UXO divers to be certified by TMR to work on company projects. The DSO will maintain a recent copy of the USN Diving Manual. OSHA, USACE, USCG, American National Standards Institute, applicable local regulations and the Association of Diving Contractors International Consensus and Technical Standards. The DSO will make these manuals available to the diving supervisors as required.

The DSO identifies diving supervisors/lead divers. Upon concurrence of the DRB, the DSO officially assigns them to the position in writing.

6.4 SDS/DRB Member

The senior diving supervisor (SDS) will be a senior TMR diver designated by the DSO and will be a member of the DRB. The SDS is responsible for the operational readiness of the TMR dive equipment and supporting assets. The SDS also provides supervision of the TMR divers, makes recommendations for dive staff assignments. The SDS is the SME for development of new diving procedures, technology, and capabilities.

6.5 Senior UXO Supervisor

A senior UXO supervisor (SUXOS) will be designated, in writing by the DSO, to projects that have both a UXO removal/investigation requirement and a diving requirement. The SUXOS will coordinate all ordnance response requirements and establish safe procedures for the investigation and removal of all UXO hazards.

On larger operations involving both diving and UXO operations, the Diving Supervisor/Lead Diver will normally supervise diving, and the SUXOS will oversee the UXO response. The same person can serve as SUXOS and diving supervisor/lead diver, if that person has both qualifications on smaller projects. The SUXOS shall be a qualified TMR environmental safety supervisor person in accordance with the guidelines outlined in Department of Defense Explosives Safety Board [DDESB] Technical Paper [TP] 18, Reference (e).

6.6 Diving Supervisor/ Lead Diver

The diving supervisor/lead diver will be designated in writing as the Designated Person in Charge for each diving operation. This designation is based on knowledge, experience, and level of training. The diving supervisor/lead diver is in charge of the overall diving operation and is responsible for the planning and execution of the dive, as well as the safety and health of the dive team. The diving supervisor/lead diver will be a qualified TMR qualified SUXOS. In carrying out these duties, their responsibilities will include, but will not be limited to:

- Ensuring that all dive team members who are exposed to, or control the exposure of others to, hyperbaric conditions will be trained in diving-related physics and physiology.
- Ensuring that each dive team member will be assigned tasks in accordance with the employee's experience or training. Limited additional tasks may be assigned to an employee undergoing training, provided that these tasks are performed under the direct supervision of an experienced dive team member.
- Ensuring that a dive team member will not be required to be exposed to hyperbaric conditions against the employee's will, except when necessary to complete decompression or treatment procedures.
- Ensuring that a dive team member will not be permitted to dive or otherwise be exposed to hyperbaric conditions for the duration of any physical impairment or condition which is known and is likely to adversely affect the safety or health of a dive team member.

- Investigating and evaluating each incident of decompression sickness based on the recorded information, consideration of the past performance of decompression table used, and individual susceptibility.
- Taking appropriate corrective action to reduce the probability of or recurrence of decompression sickness.
- Preparing a written evaluation of the decompression procedure assessment, including any corrective action taken, within 10 days of the incident of decompression sickness.
- Being fully aware of all relevant governmental regulatory agency regulations that apply to the diving operation and the diving mode employed.
- Being in immediate control and available to implement emergency procedures during diving operations. The dive supervisor/lead diver is not permitted to dive unless another qualified person is present and has been formally appointed and designated to assume this responsibility.
- Ensuring, prior to diving, that all additional parties are informed that diving operations are about to be undertaken. These parties include, but are not limited to, craft masters, boat pilots, harbormasters, managers of pipelines, and managers for civil engineering sites and inland waterways.
- Ensuring that diving operations are conducted from a suitable and safe location on the surface.
- Establishing a project specific HASDP, and ensuring that sufficient air supply, supplies, and proper equipment are available for the safe and timely completion of the job task. This must be approved by the TMR DRB prior to conducting any diving evolution.
- Briefing the dive team as to the plan of attack, and soliciting suggestions outlined in Attachment 1, diving supervisor/lead diver Dive Plan Brief, native file format located in the Guidelines Templates and Tools folder in the Corporate Reference Library (CRL). During the briefing, they will make team assignments, designate required equipment, review diving signals, establish a positive diver recall method, and cover emergency procedures.
- Using the TMR Diving Supervisor Pre-Dive and Post-Dive Checklists (see Attachments 2, Diving Supervisor/Lead Diver Pre-Dive Checklist, and 3, Diving Supervisor/Lead Diver Post-Dive Checklist, which are also available in the native file format located in the Guidelines Templates and Tools folder in the CRL
- Ensuring all members of the diving team are familiar with the emergency procedures contained in the Emergency Procedures (see Attachment 4, which is available in the native file format located in the Guidelines Templates and Tools folder in the CRL).
- Being aware of the procedures to follow and the routes to take to obtain medical support in the event of an accident, either diving- or non-diving-related.
- Ensuring that a two-way communication system is available and tested.
- Ensuring that the Emergency Phone Numbers Checklist (see Attachment 5, which is available in the native file format located in the Guidelines Templates and Tools folder in the CRL) is completed and posted at the dive site.

- Determining the qualifications and proficiency of all personnel and ensuring that no dives are made by unqualified persons.
- Verifying that all equipment required is on scene and in working order.
- Ensuring that all relevant operating instructions, manuals, decompression schedules, treatment tables, and regulatory publications are available on the dive site.
- Maintaining a dive profile log for each diver, which includes depth, bottom time, and residual nitrogen time (see Attachments 6 and 7, which are also available in the CRL).
- Terminating diving operations at any time when, in their opinion, safe diving procedures are not being followed or conditions prevent safeguarding the divers. The diving supervisor/lead diver will not resume diving operations until the unsafe conditions have been removed or corrected.
- Ensuring that, after every dive, the Post-Dive Checklists in Attachment 3, which is available in the native file format located in the Guidelines Templates and Tools folder in the CRL, are used.
- Ensuring that, after any treatment or unplanned dive conducted outside the no-decompression limits, the diver is instructed to stay awake and remain in the vicinity of the chamber for at least 1 hour.
- Reporting all accidents or incidents involving personnel as required by TMR procedures and relevant governmental regulations.
- Ensuring all reports and paperwork are completed and submitted at the end of the diving day.
- Maintaining certification in cardiopulmonary resuscitation (CPR), first aid (American Red Cross or equivalent), automated external defibrillator (AED), and emergency oxygen administration.

6.7 Divers and Snorkelers

Divers must be at least 18 years of age, be medically certified as "fit to dive," and have a knowledge of diving theory, diving-related physics, and physiology. They will provide copies of their certifications to the DRB Chairman before being allowed to dive. On diving projects involving UXO operations, the minimum age of the diver must be 21 years, per the Bureau of Alcohol, Tobacco and Firearms regulations concerning the handling of explosives.

Divers must have a full understanding of the diving equipment in use, and of the tasks assigned. A diver is assigned by the diving supervisor/lead diver to perform specific tasks underwater and topside. The diver must be qualified for the diving technique, equipment selected, and the task assigned. Each diver will meet the following requirements:

- Know how to use the tools, equipment, and systems relevant to assigned tasks.
- Know the techniques of the assigned diving mode.
- Accomplish all tasks assigned by the diving supervisor/lead diver. In the event that the diver is assigned a task for which he/she does not consider himself/herself

to be qualified either by training or experience, the diver will immediately inform the diving supervisor/lead diver.

- Read, understand, and comply with all TMR policies and with applicable government regulations as they relate to their qualifications or performance while engaged in diving.
- Maintain a high level of physical fitness.
- Immediately obey all commands or instructions from the diving supervisor/lead diver to return to the surface, or first decompression stop, as appropriate.
- Keep topside personnel advised of conditions on the bottom.
- Be responsible for the diving gear worn and ensure that it is complete, in good repair, and ready for use at any time in accordance with regulations or instructions concerning its use, maintenance, repair, and testing.
- Report to the diving supervisor/lead diver any defect or malfunction of the diving equipment provided for the diving operation.
- Ensure the deepest depth of the dive has been established before ascent.
- Report to the diving supervisor/lead diver any recent medical treatment or illness so that the proper determination can be made concerning the diver’s fitness to dive.
- Immediately report all symptoms or suspected symptoms of decompression sickness as early and accurately as possible.
- Always follow safe diving practices during the diving operation, whether topside or in the water. The diver will bring any questionable items to the attention of the diving supervisor/lead diver and will be alert for the safety of all.
- Remain awake and in the vicinity of the decompression chamber for at least one hour following recompression treatment or a hyperbaric exposure beyond no-decompression limits.
- Know and observe the rules for ascending to altitude, including flying after diving.
- Ensure that their diving equipment has been properly maintained, prepared, and tested before each dive. This requirement should never be delegated to others.
- Maintain a divers' logbook, which details all dives, medical examinations, courses taken, and personal equipment maintenance.
- Ensure their medical certificates are up to date and recorded in the diving logbooks. Divers will present their logbooks to the diving supervisor/lead diver at every job when requested.
- Ensure that he/she is not exposed to hyperbaric conditions against their will, except when necessary to complete decompression or treatment procedures.
- Maintain certification in CPR, First Aid, AED, and emergency oxygen administration.

A diver may refuse to dive, without fear of penalty, whenever they feel it is unsafe for them to make the dive. It is the diver's responsibility and duty to refuse to dive if, in their judgment, conditions are unsafe or unfavorable, or if they would be violating the precepts of their training, abilities or the regulations and guidelines in this manual or the project DSPM.

6.8 Standby Diver

The standby diver is a fully qualified diver, assigned for backup to provide emergency assistance, and is ready to enter the water when conducting diving operations with a single-tended diver. When assigned during buddy diving, where two divers are conducting the dive together, he/she will be ready to enter the water prior to commencing the dive, and then may remove tank, mask, and fins at the diving supervisor/lead diver's discretion. Under no circumstances will he/she leave the dive site. The standby diver receives the same briefings and instructions as the working divers, wears the same diving equipment, monitors the progress of the dive, and is fully prepared to respond if called upon for assistance. While acting as a standby diver, **in addition to** the requirements listed above, the standby diver will:

- Be rested and fully capable of performing emergency rescue assistance.
- Be sufficiently free of residual nitrogen to allow for enough bottom time for the prescribed task at the working depth without exceeding the no-decompression limits for that depth.
- Be dressed appropriately to allow prompt entry into the water as directed by the diving supervisor/lead diver.
- Remain at their station throughout the entire dive.
- Refuse any tasks that might interfere with their duties as a standby diver whenever there is a diver in the water.

6.9 Dive Tender

The tender is a member of the dive team who works most closely with the diver on the bottom. Though it is preferred that the tender be a qualified diver, it is not mandatory. If the tender is not a qualified diver, they must be familiar with line pull signals and all emergency procedures. The tender is assigned by the diving supervisor/lead diver to continuously tend (monitor) the diver. They will devote their full attention to tending the diver they are assigned to, from preparation of the dive through its completion. They will not be assigned any other task while the diver is in the water. The tender shall further:

- Assist the diver in dressing and undressing and confirm that the diver's equipment is functioning properly.
- Always tend the diver’s safety line and be aware of the diver’s depth and location.
- Set up and operate all equipment as directed by the diving supervisor/lead diver.
- Immediately inform the diving supervisor/lead diver if they are assigned a task for which they do not consider themselves qualified either by training or experience.
- Be alert and immediately report any conditions that are hazardous or unsafe.
- Assist in topside work as required or directed.
- Maintain certification in CPR, first aid, AED, and emergency oxygen administration.

7.0 DIVING POLICY

It is the policy of TMR to consistently provide safe diving operations that meet the client's required level of work and that are following applicable laws and regulations. This work shall be consistent with the project-defined scope, schedule, budget, and level of quality. To accomplish this objective, TMR will provide the appropriate qualified personnel, resources, and guidance to the Operating Units where diving is required. Such resources may include specialized diver expertise that may be in another office, or corporate affiliate, or maybe subcontracted to the appropriate company.

This DSPM addresses procedures for the safe utilization of self-contained underwater breathing apparatus (SCUBA) and surface-supplied air diving operations. Mixed-gas diving is not authorized for employees of TMR covered under these procedures. All dives will be planned to adhere to the Standard Air, No Decompression, or Shallow Water dive tables set forth in the USN Diving Manual, refer to Attachment 10, available in the Guidelines Templates and Tools folder in the CRL.

The individual local or state requirements will be reviewed and incorporated into the project specific HASDP. This review will be performed prior to commencing any diving operations within the affected state. Prior to diving, the project specific HASDP must be approved by the Chairman of the TMR DRB for construction diving or the scientific DSO for scientific diving, with the approved copy forwarded to and retained by the TMR Chairman of the DRB.

8.0 SCIENTIFIC DIVING

All TMR Scientific diving will be conducted in accordance with Tetra Tech Corporate Safety DCN 02-15 Scientific Diving Program[1] in the Corporate Health and Safety Manual.

9.0 REQUIREMENTS FOR DIVING AND SNORKELING

9.1 General Requirements

The requirements presented in this section will be used in conjunction with procedures and requirements for individual dive techniques presented in the following sections of the DSPM. All dives will be executed under the regulations and guidelines outlined in Section 2.0.

- The qualifications of personnel and equipment requirements for snorkeling are the same as diving, except for the required air supply for diving.
- A ladder extending a minimum of 3 feet below the diving platform below the surface of the water and appropriate handrails will be provided to assist the diver on entry and exit from the water. (*Note: Inflatable boats are exempt from this requirement.*)
- A means will be provided to assist an injured diver from the water.

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[1] https://tetratechinc.sharepoint.com/:b:/r/sites/Health-Safety/Health%20%20Safety%20Manual/02_General%20Health%20and%20Safety%20Programs/DCN%2002-15%20Scientific%20Diving%20Program.pd

- When diving from vessels, the international code alpha and recreational dive flag with a minimum dimension of 23 square inches will be displayed whenever diving operations are being conducted. The flag will not be removed until diving operations have been completed and all divers are safely out of the water. TMR divers will comply with all site-specific local, state, federal, and international regulations regarding marking of diving activities.
- For enclosed areas, i.e., Intracoastal Waterway or marinas, individual buoys with recreational diver flags will mark the outline of the diving area. The divers may have a "marker" buoy with the recreational dive flag to determine their exact location. A rigid replica of the International Code Alpha flag at least 1 meter in height and visible from all directions will be displayed at the dive location.
- A diver will be stationed at the underwater point of entry when diving is conducted in enclosed or physically confining spaces.
- Positive communications to the recompression facility, the designated medical facility, and any required transportation to these facilities (medivac, ambulance, etc.) will be checked daily. This communication will include cellular telephone or radio communications with a constantly manned location with telephone access at the dive site. Diving operations will not be conducted without established communications.
- The diving supervisor/lead diver will not be permitted to dive, unless another qualified supervisor is present and has assumed the dive supervisor/lead diver roles and responsibilities.

9.2 Snorkeling Requirements

TMR employees engaged in snorkeling operations will comply with the general requirements for diving and the following additional requirements, unless otherwise specified in a project specific and approved HASDP:

- Snorkeling will be conducted only with prior approval and acceptance of the district diving coordinator (DDC).
- Snorkeling will be allowed only for shallow water site assessments and reconnaissance. It will not be used for structural inspections or other work.
- An on-site snorkeling team shall be made up of no less than two persons: snorkeler and observer/assistant. Additional site personnel may be required by the DDC or safety office DSR based on site hazards and conditions. Snorkeling team plans and procedures shall be developed and enacted by a team supervisor who is qualified and experienced in snorkeling and incorporated in the HASDP.
- Snorkeling will only be done on the surface of the water. Breath-hold or free diving of any kind is not permitted.
- Generally, untethered snorkeling will NOT be allowed in waters deeper than 5 feet of seawater (FSW), in bodies of water that a snorkeler cannot wade across, or anywhere a pressure differential may exist.
- Snorkeling in open waters greater than 5 feet deep may be allowed by the DDC, based on an acceptable Activity Hazard Analysis (AHA) and compliance with the following:
    - Any requirements incorporated in the approved HASDP.

  - A single snorkeler shall be tethered with a harness and a maximum of 40 FSW of floating line. The tether must be constantly tended from the shore or boat.
  - The snorkeler must wear a device providing a minimum of 15.5 pounds of positive buoyancy (Type III personal flotation device [PFD], fully inflated snorkeling vest, etc.).
  - There are no potential tether entanglement hazards in the snorkeling area (e.g., overhanging branches, surface stumps, rocks, etc.).
- All snorkelers and observers/assistants will be certified as skin divers (snorkelers) or open water divers by a nationally recognized organization (e.g., Professional Association of Diving Instructors, National Association of Underwater Instructors, etc.) or the U.S. Forest Service Snorkel Safety Program.
- An observer/assistant will always accompany each untethered snorkeler either along the shore or in a boat and be within 50 feet of the snorkeler.
- Two untethered snorkelers in the same body of water may act as observer/assistant for each other if they remain within 50 feet of each other.
- Non-snorkeling observer/assistants shall wear a PFD and be equipped with a throw bag and/or ring buoy with at least 70 FSW of line and must be capable of performing a rescue on the specific snorkeler(s) in an emergency.
- Areas of extreme water velocity and turbulence will be avoided, especially those immediately upstream from debris jams or bedrock outcrops.
- Snorkelers will be provided with appropriate thermal protection.
- Employees will be determined medically fit by a licensed physician (doctor of osteopathy or medical doctor) prior to snorkeling. This certification shall be signed by a physician familiar with sports medicine, and state that each snorkeler is physically and medically fit to perform snorkeling activities according to commonly accepted sports medicine guidelines.
- All snorkeling team members shall be certified in first aid and CPR. Certification shall be in accordance with most recent emergency cardiovascular care guidelines, and/or American Heart Association or American Red Cross standards.
- A first aid kit will be available at each location where snorkeling is being performed. A means of securely transporting an unconscious person, such as a litter or stretcher, shall be provided when snorkeling is conducted in areas inaccessible to vehicles or boats.
- A means of communication capable of contacting emergency services must be available at locations where snorkeling is performed.
- Each snorkeler will be equipped with a professional grade mask, fins, snorkel, and snorkeling vest.
- A snorkeling protocol will be developed and included in the project HASDP. It will contain as a minimum, the following:
  - An AHA for each specific snorkeling mission (Particular detail will be given to currents and other environmental considerations.)
- Records for snorkeling activities will be maintained and will include as a minimum:
  - Snorkeler’s annual physician certifications

  - AHAs
  - A snorkeling plan incorporated in the HASDP that is based on the requirements of USACE EM 385-1-1; Section 30.A.15.a-e
- Snorkelers will wear apparel which provides appropriate protection from environmental conditions. The apparel must include fins or other appropriate foot protection.

9.3 SCUBA Diving Requirements

TMR employees engaged in SCUBA diving operations will comply with the general requirements for diving and the following additional requirements, unless otherwise specified in a project specific and approved HASDP:

- The minimum sized SCUBA tank allowed as primary air is a standard 80 cubic-foot aluminum tank pressurized to at least 90 percent, or 2,700 pounds per square inch (PSI) at the beginning of dive operations.
- Divers shall terminate their dive so that they reach the surface with a minimum tank pressure of 500 PSI.
- Audio communications are preferred in all diving situations. However, this type of communication is not required for a diver who is accompanied by another diver (buddy), or who can communicate with the tender on the surface via a safety line using line pull signals.
- The planned time of such a diving operation will not exceed the no decompression limits according to the USN Dive Manual, or the air supply duration of the cylinders in use, exclusive of the reserve supply. The cylinder pressure will be determined immediately before each dive.
- Each diver will be equipped with a knife, a diving wristwatch, a depth gauge or dive computer, a facemask, a submersible cylinder pressure gauge, and a buoyancy compensator.
- A weight belt or integrated weight system with a quick release that is appropriate for the suit and the depth of the dive will be worn.
- A cylinder harness with a quick release will be worn to secure the SCUBA cylinders to the diver.
- The weight belt and cylinder harness will be independently attached to permit release of either one without interference by the other.
- A personal flotation or buoyancy compensation device will be worn. An exception will be considered during approval of the HASDP for diving in enclosed spaces or under the ice.
- SCUBA diving operations will not be conducted at depths deeper than 100 feet.
- USACE or DDC exemption approval is required for dives to any depths from 100 feet to 130 feet, and if approved, a recompression chamber must be available within 5 minutes of reaching the surface.
- During all SCUBA dives, a standby diver will be available while a diver is in the water.

- A SCUBA diver will be line-tended from the surface or accompanied by another diver in the water in continuous visual contact during the diving operations. If any SCUBA diver is tended, they will wear a harness meeting the following standard:
    - Each tethered SCUBA diver shall wear a safety harness with a positive buckling device, attachment point for the safety line, and a lifting point to distribute the pull force of the line over the diver's body while maintaining the body in a heads-up vertical position when unconscious.
- A diver-carried independent reserve breathing gas supply consisting of the following will be provided for each diver:
    - Each diver shall be equipped with a minimum 30 cubic-foot bailout bottle for emergency use pressurized to at least 90 percent of its working PSI rating and equipped with a separate first- and second-stage regulator. An "octopus" is not considered to be an alternate air source.

9.4 Surface-Supplied Diving Requirements

Employees engaged in surface-supplied diving will comply with the general requirements for diving, and the following additional requirements, unless otherwise specified in a project specific and approved HASDP:

- The approximate depth of each dive will be determined prior to the start of operations.
- A weight belt appropriate for the suit and depth of the dive will be worn, except when conditions dictate otherwise for the safety of the diver.
- A five-point safety harness, with a positive buckling device, will be worn under all other types of equipment (*except when diver is dressed in heavy gear*). This harness will have an attachment point for the umbilical to distribute the weight of the diver's body and prevent any strain from being placed on the diver's mask or helmet if/when the umbilical is pulled on. The safety harness will also have a lifting point to distribute the pull force of the line over the diver's body. The safety harness may be equipped with a backpack to contain a bailout bottle.
- Surface-supplied dives will not exceed 190 FSW and will not enter into exceptional exposure dives as set forth in the USN standard air decompression tables.
- A decompression chamber will be ready for use on site for any dive outside the no-decompression limits or deeper than 100 FSW.
- Each diver will be continuously tended by another dive team member while in the water.
- A diver will be stationed at the underwater entry point when diving is conducted in enclosed or physically confining spaces.
- A standby diver will be available while a diver is in the water.
- Each dive will have a primary air supply capable of supplying the diver(s) with the specified air volume, pressure, and flow rate, in accordance with the manufacturer's specifications associated with the diving apparatus worn, throughout the planned depth of the dive, including any required decompression.
- Each dive location will have a reserve breathing air supply, in line, capable of supporting the dive operation.

- A diver-carried reserve breathing gas supply will be provided for each diver on dives deeper than 60 FSW or outside no-decompression limits, or when the diver does not have direct access to the surface and on all surface-supplied dives operating under USACE EM 385-1-1. This does not apply when heavy gear is used.
- On all dives deeper than 100 FSW or outside the no-decompression limits, an extra breathing gas hose capable of supplying gas to the diver in the water will be available to the standby diver.
- On all dives deeper than 100 FSW or outside the no-decompression limits, an in-water stage will be provided.

10.0 DIVER TRAINING AND QUALIFICATIONS

The following section describes the minimum requirements for TMR divers. Additional training may be needed for site-specific conditions, or required under federal, state, or local regulations.

The level of experience or training required by the standard depends on the job the employees are required to do. All dive team members must have either experience or training in the use of tools, equipment, systems, techniques, operations, operational procedures, and emergency procedures that are pertinent to, and necessary for, the assigned tasks for the diving mode.

It is essential that those dive team members who are exposed to hyperbaric conditions, or those members who control the exposure of others, have knowledge of the physiological effects of diving and the related effects of pressure. Accordingly, this standard also requires that employees be trained in diving-related physics and physiology. Employee qualifications achieved through field experience and classroom training may be used to meet the requirements of the standard.

- Divers must have federal certificates (such as from the USACE, NOAA, and/or military diving school).
- Divers must have civilian diving school certificates of completion for the appropriate training level issued by schools associated with the ADCI.
- Each dive team member must be trained in CPR (American Red Cross or equivalent), first aid, AED, and emergency oxygen administration. Employees completing this training are issued a card certifying that they have successfully completed the course.
- Each member of the TMR diving team will be qualified to conduct the work assigned by completion of training and/or experience. This qualification will be documented by completion of a certified course of instruction, to include one or more of the following: a certified commercial course (Association of Commercial Diving Educators accredited), a civilian certification with experience for the profile of the dive, or a documented military diver training and experience.
- All divers will maintain a personal dive log that will document all hyperbaric exposures. Additionally, dates of diving physicals and a record of all relevant training will accompany the log. The following minimum information should be included in the log:

- Location of exposure
- Maximum depth
- Time left surface, total bottom time, and time reached surface
- Type of breathing apparatus and mixture used
- Task performed
- Decompression table and schedule used
- Any decompression sickness symptoms or injury
- Signature of the Diving Supervisor/Lead Diver
- Comments

10.1 Entry Level Training

All TMR non-divers who have the required skills and training to participate in diving-related activities must be certified by an internationally recognized agency.

10.2 SCUBA Training

All TMR divers will provide a copy of their diver certification to the Chairman of the DRB that represents successful completion of a swimming evaluation, practical diver training, written examination, and open water evaluation. Scientific divers will also provide a copy of their diver certification to the DSO. The certificate from the training activity will be used to document the location and date of training. The dive log will document the depth and number of diving qualification dives.

10.3 Surface-Supplied Diver Training

The training certificate to document previous training and dive log to document the number of dives and depth of diving qualifications will be provided. Training dives will be required to ensure all divers are current in the type of equipment and the depth expected of the diving project.

11.0 PERSONNEL REQUIREMENTS

In establishing the number of dive team members required for a dive, proper consideration must be given to 29 CFR 1910.421(d), Planning and Assessment, and 29 CFR 1910.421(e), Hazardous Activities. The second provision requires employers to provide a means to assist an injured diver from the water, such as a small boat or stokes basket, which may necessitate additional dive team members.

11.1 Self-Contained Underwater Breathing Apparatus (SCUBA)

For diving that requiring the use of SCUBA, the following number of divers are required for the work:

Dive Team Composition SCUBA – Untethered, 0 to 100 FSW	
Personnel	**Number**
Diving Supervisor	1
Divers (in visual contact)	2
Standby Diver*	1
TOTAL TEAM	**4**

Dive Team Composition SCUBA – Tethered with communications, 0 to 100 FSW	
Personnel	**Number**
Diving Supervisor **	1
Diver in water	1
Standby Diver* (tethered with communications)	1
Tender	1
TOTAL TEAM	**4**

** The standby diver will be rested and capable of performing emergency rescue assistance. When work is limited to no decompression limits, the standby diver shall be sufficiently free of residual nitrogen to allow for 25 minutes of bottom time at the working depth without exceeding "No Decompression Limits."*

*** The supervisor may be the standby tender for dives under 100 FSW.*

11.2 Surface-Supplied Diving (0-100 FSW with no Decompression Diving)

For surface-supplied diving, from 0 to 100 FSW, the number of divers required to perform the work is listed below:

Dive Team Composition Surface Supplied Air – 0 to 100 FSW Within No Decompression Limits		
Personnel	**Number**	**Penetration Dive**
Diving Supervisor **	1	1
Diver	1	2
Standby Diver*	1	1
Tender	1	2
TOTAL TEAM	**4**	**6**

** The standby diver will be rested and capable of performing emergency rescue assistance. When work is limited to no-decompression limits, the standby diver shall be sufficiently free of residual nitrogen to allow for 25 minutes of bottom time at the working depth without exceeding "No Decompression Limits."*

*** The supervisor may be the standby tender for dives under 100 FSW.*

11.2.1 Deploying the Standby Diver as a Worker Diver

The standby diver may be deployed as a working diver provided **<u>all</u>** the following conditions are met:

1) Surface-supplied no-decompression dive of 60 FSW or less;
2) Divers are in proximity, (based on site specific requirements), with unimpeded access to each other;
3) Divers always have communications with each other;
4) No entanglement hazards exist;
5) Prior to deploying the standby diver, the work area shall be determined to be free of hazards (i.e., suctions, discharges) by the first diver on the job site;
6) The dive is <u>NOT</u> a penetration or confined space dive; and
7) Each diver has a full-time tender (which brings the minimum number of team members to five).

11.3 Surface-Supplied Diving (Deeper than 100 FSW or decompression diving)

For surface-supplied diving deeper than 100 FSW, or decompression diving, the number of divers required to perform the work is listed below:

Dive Team Composition

Surface Supplied Air – 0 to 100 FSW Requiring Decompression

All Surface Supplied Air, 101 to 190 FSW

Personnel	No Decompression Dives	Decompression Dives	Penetration Dives
Diving Supervisor	1	1	1
Chamber Operator**	1**	1***	1
Diver	1	1	2
Standby Diver*	1	1	1
Tender	1	1	2
Standby Diver Tender	1	1	1
TOTAL TEAM	**5/6**	**5/6**	**8**

** The standby diver will be rested and capable of performing emergency rescue assistance. When work is limited to no-decompression limits, the standby diver shall be sufficiently free of residual nitrogen to allow for 25 minutes of bottom time at the working depth without exceeding "No Decompression Limits."*

*** The Competent Person/chamber operator may be any non-diving member of the dive team when the chamber is only for emergency use when diving within the no-decompression limits. Saturation diving requires that a life support technician will serve as the chamber operator.*

**** The Competent Person/chamber operator may be any non-diving member of the dive team if all diving ceases during chamber decompression.*

11.4 Other Diving Operations

An additional dive crew member may be required for any diving operations involving an increased likelihood of diver entrapment or the potential for rendering the diver unconscious or incapacitated from chemical, physical, electrical, or topside hazards. These operations include, but are not limited, to:

- Diving on ordnance and/or explosives projects
- Diving from a small boat
- Diving in remote areas where assistance from non-diving crew personnel is not immediately available, but within communication range
- Penetration diving, both horizontal and vertical
- Diving requiring crane operations
- Diving in any situation where the diver uses surface-tended equipment
- Diving from a platform greater than 8 feet above the water surface

12.0 MEDICAL REQUIREMENTS

Each diver will receive a diving physical examination initially when assigned diving duties and yearly thereafter. In addition, a medical examination will be conducted whenever a diver has been hospitalized for more than 24 hours due to an injury or illness. A determination as to their fitness to continue to dive will be prepared by the examining physician. The physician will prepare a written report containing the following statement: “Based on the following, I certify the diver as ‘Fit to Dive’.” In addition, the report will contain the following information:

- Medical requirements of this standard and a summary of the nature and extent of hyperbaric exposure to which the diver will be exposed, including diving modes and types of work to be assigned (TMR will provide the dive information).
- The diver’s medical history (a diver’s Medical History and Supplemental Diving Questionnaire, available in the CRL), which will be filled out completely and will be provided to the examining physician.
- The results of the medical examination. A basic diving physical examination will be conducted initially and annually for all TMR divers, which will include a chest X-ray, vision testing, audiogram, pulmonary function test, blood chemistry panel, complete blood count with differential, urinalysis with microscopic analysis (U.S.), and any additional tests required by the examining physician. An electrocardiogram will be performed. An exercise stress test may be indicated based on a risk factor assessment performed by the doctor.
- The examining physician’s opinion of the employee’s fitness to be exposed to hyperbaric conditions, including any recommendations or limitations to such

exposure. TMR will provide the employee with a copy of the physician's written report.

Determination of the employee's fitness to dive will be based on the physician's written report and review by the DRB. If the physician has recommended a restriction or limitation on the employee's exposure to hyperbaric conditions, and the employee does not agree with the physician's findings, the employee has the right to obtain his own diving-certified physician to perform a diving physical. If the second physician does not agree with the findings of the first physician, a third physician will be consulted for resolution.

13.0 EQUIPMENT CONSIDERATIONS

The diving supervisor/lead diver, in conjunction with the DRB, will establish the equipment requirements for individual projects. This list will be included in the HASDP and will include the required dive gear, boat equipment, and any required task-specific equipment. This list should be submitted to the project manager when the HASDP has been approved. Each equipment modification, repair, test, calibration, or maintenance service that is required will be recorded by means of a tagging or logging system. This system will include the date, serial number of the item, nature of the work performed, and the initials of the person who conducted the work.

13.1 Equipment Maintenance

Typically, TMR underwater operations use a variety of diving systems and component equipment. This equipment is considered life support equipment and should be treated as such.

- All equipment will be maintained in accordance with the directives set forth by OSHA and the Manufacturer's Specifications.
- Any maintenance performed on equipment will be logged on the maintenance form and forwarded to the project equipment manager for entry into the Equipment Maintenance Log.
- Dive supervisor/lead divers shall have the required expertise to maintain the systems used by TMR.
- Dive Team Members shall treat all equipment in a responsible manner and immediately inform the dive supervisor/lead diver of any potential equipment problems that they may observe.
- Bi-annual air quality tests will be performed on all breathing air compressors, and the results kept on file by the Chairman of the DRB.
- Equipment requiring periodic calibrations shall be sent to their respective manufacturers or licensed professionals for proper maintenance and calibration. The dive supervisor/lead diver shall inform the project equipment manager of any equipment taken offline.

If the equipment was provided by the TMR warehouse, the equipment manager will manage and report equipment concerns in accordance with TMR Procedure PO-18, Warehouse Management.

13.2 Air Supply Requirements

Diver air will be procured from a facility where the compressors meet the requirements established in Compressed Gas Association Pamphlet G-7.1 or more stringent standards. The tanks will be filled with compressed air from a source that complies with, at a minimum, 29 CFR 1910.430 (equipment). The breathable air supplied to the diver will be tested every 6 months and will not contain:

- A level of carbon monoxide greater than 10 parts per million (ppm)
- A level of carbon dioxide greater than 1,000 ppm
- A level of oil mist greater than 5 milligrams per cubic meter
- A level of hydrocarbons, other than methane, greater than 25 ppm
- Noxious or pronounced odor

A copy of the latest air test results will be reviewed and/or obtained and filed with the HASDP. When using local established vendors, a check of current certification is required every 6 months. If air test results are not available, TMR will draw an air sample from the compressor for appropriate analyses.

13.3 Regulators

TMR divers will be responsible for inspecting and scheduling maintenance on their regulators prior to the first use and every 12 months thereafter. Documentation of the inspections and maintenance will be maintained in the TMR diving files.

13.4 Compressed Air Cylinders

Compressed breathing air cylinders will:

- Be constructed with seamless steel or aluminum that meets U.S. Department of Transportation (DOT) 3AA and DOT 3AL specifications.
- Have identification symbols stamped into the shoulder of the cylinder.
- Be inspected internally and externally for corrosion and pitting on an annual basis. If a defect is found that may impair the safety of the pressure vessel, a hydrostatic test must be performed.
- Be hydrostatically tested every fifth year in accordance with DOT regulations. The test dates will be stamped into the shoulder of each cylinder. Documentation of each cylinder inspection will be maintained in the TMR diving files.
- Be stored in a ventilated area and protected from excessive heat.
- Be secured from falling.
- Have shutoff valves recessed into the cylinder or protected by a cap, except when in use, when installed with a manifold, or when used for SCUBA diving.

13.5 Air Compressor Systems

Air compressors used to supply air to the diver will:

- Be equipped with a volume tank that has a check valve on the inlet side, a pressure gauge, a relief valve, and a drain valve.

- Have intakes located away from areas where exhaust fumes or other air contaminants may be present.
- Be tested every 6 months by means of samples taken at the connection to the distribution system to ensure that the air supplied meets all applicable standards (see Section 3.6.1, above). Non-oil lubricated compressors do not have to be tested for oil mist.
- Be equipped with a moisture separator and filtration system.

A log shall be maintained showing all tests, repairs, maintenance, and run time on all air compressors systems.

13.6 Surface Supplied Air

The diver's surface-supplied air supply may originate from an air compressor, a bank of high-pressure air flasks, or a combination of both. Regardless of the source, the air must:

- Meet the purity standards stated above;
- Be supplied in an adequate volume for breathing;
- Have a rate of flow that properly ventilates the helmet or mask; and
- Be provided at enough pressure to overcome the bottom water pressure and the pressure losses due to flow through the diving hose, fittings, and valves.

The air supply requirements depend on specific factors for each dive, such as depth, duration, level of work, number of divers being supported, and type of diving system being used.

The capacity of the primary air supply must meet the consumption rate for the designated number of divers for the full duration of the dive (bottom time plus decompression time). The maximum depth of the dive, the number of divers, and the equipment to be used must be considered when sizing the supply.

The secondary air supply must be sized to support recovery of all divers using the equipment and dive profile of the primary supply, if the primary supply malfunctions or fails at the worst-case time (i.e., immediately prior to completion of planned bottom time of maximum dive depth, when decompression obligation is greatest).

13.6.1 Breathing Gas Supply Hoses

Breathing gas supply hoses will:

- Have a working pressure at least equal to the pressure of the total breathing gas system;
- Have a rated bursting pressure at least 4 times the working pressure;
- Be tested annually (at a minimum) to 1.5 times their working pressure;
- Have their ends taped, capped or plugged when not in use;
- Have connections made of corrosion resistant material, and be resistant to accidental disengagement; and
- Have connectors with a working pressure at least equal to the hose to which they are attached.

13.6.2 Divers' Air Supply Hoses

Umbilical's will:

- Be marked (starting from the diver's end) at 10-foot increments for the first 100 feet; and 50-foot increments thereafter;
- Be made of kink-resistant material; and
- Have a working pressure greater than the pressure equivalent of the maximum depth of the dive plus 100 pounds per square inch.

13.7 Gauges and Timekeeping Devices

The following requirements apply to each diver's gauge or timekeeping device:

- Each depth gauge will be deadweight tested or calibrated against a master reference gauge every 6 months, and when there is a discrepancy greater than 2 percent of full scale between any two equivalent gauges.
- A cylinder pressure gauge that is capable of being monitored by the diver during the dive will be worn by each SCUBA diver and surface-supplied diver when equipped with a bailout bottle.
- Each SCUBA diver will wear a diving watch capable of displaying elapsed time.
- A timekeeping device will be available at each dive location.
- Dive computers will be approved for use after the review and approval of the DRB (see paragraph 13.10 below).

13.8 Buoyancy Control

The following requirements apply to each diver's buoyancy control device:

- A dry suit or buoyancy compensator not directly connected to the helmet or mask will be equipped with an exhaust valve.
- Helmets or masks directly connected to a dry suit or other buoyancy-changing device will be equipped with an exhaust valve.
- When used for SCUBA diving, a buoyancy compensator will have an inflation source separate from the breathing gas supply and a manual inflator hose.
- An inflatable flotation device capable of maintaining the diver at the surface in a face-up position, having a manual activated inflation source independent of the breathing gas supply, an oral inflation device, and an exhaust valve is required for SCUBA diving, except when diving in enclosed spaces or under the ice.

13.9 Masks and Helmets

The following requirements apply to each diver's mask or helmet:

- Surface-supplied masks/helmets will have a non-return valve at the attachment point between helmet or mask and hose that will close readily and positively. Masks/ helmets will also have an exhaust valve.
- Surface-supplied air masks and helmets will have a minimum ventilation rate capability of 4.5 actual cubic feet per minute at any depth at which they are operated, or they will have the capability of maintaining the diver's inspired carbon

dioxide partial pressure below 0.02 atmosphere absolute (ATA) when the diver is producing carbon dioxide at the rate of 1.6 standard liters per minute.

13.10 Dive Computers

Dive computers that calculate decompression time based on time and depth are not to be used unless authorized by the dive supervisor/ lead diver and incorporated into the project specific HASDP. They must be checked for accuracy prior to use.

13.11 Backpacks

Backpacks worn during diving operations without integrated flotation devices and weight systems must be equipped with a quick-release device.

13.12 Handheld Power Tools

Handheld power tools are not normally used during SCUBA diving operations, but, if used, they will be used in accordance with the following safeguards:

- Handheld power tools and equipment will be de-energized before being placed into or out of the water.
- Handheld power tools will not be supplied with power from the dive location until requested from the diver.
- Two-way voice communications between divers and topside must be used.

13.13 Dive Tables

Dive tables shall be made available to divers at all diving locations.

13.14 Welding/Cutting/Burning

Welding, cutting, and burning procedures are not addressed in this manual. When a diving project requires welding, cutting, or burning operations, those specific procedures will be addressed in the project specific HASDP for that project.

13.15 First Aid/CPR/AED/Emergency Oxygen

A first aid kit, appropriate for diving operations and approved by a physician, will be available at the dive site. This kit will contain an American Red Cross standard first aid handbook or equivalent, a bag-type resuscitator with transparent mask and tubing, and a stokes litter or backboard with flotation capabilities.

Additionally, a portable source of oxygen will be available at the dive site for transport of a diving-related casualty to the hyperbaric treatment facility. One additional first aid kit will be the AED. It has been proved that, in the case of cardiac arrest, the AED, if used within the first 3 minutes, would save an additional 74 percent of patients.

13.16 Equipment Procedures Checklists

Pre-dive and post-dive checklists for both Surface-Supplied Air and SCUBA operations will be used during setup and breakdown of the dive station.

14.0 RECORDKEEPING REQUIREMENTS

The following records are required by 29 CFR 1910.401, Subpart T, and will be maintained as follows:

- The TMR Chairman, via the DRB, will maintain all historical records.
- Records will also be retained in the project, office, or department files, in accordance with TMR Procedure PO-08 Document Control and Records Management.
- Records and documents will be maintained in accordance with 29 CFR 1910.401, Subpart T, and will be provided upon request to employees, designated representatives, and others as determined by TMR.

14.1 Dive Profile Log (Depth-Time Profile)

The TMR Dive Smooth Log (Attachment 7, which is available in the native file format located in the Guidelines Templates and Tools folder in the CRL) will be forwarded to the Chairman of the DRB and maintained for 1 year. If there has been a diving-related illness or injury on the project, the records will be maintained for a period of 5 years. After the 5-year time limit, the records will be forwarded to the National Institute for Occupational Safety and Health (NIOSH). The TMR DSO will maintain copies for all scientific divers.

14.2 Diving-Related Injury Records

Any diving-related injury or illness, which requires any dive team member to be transported to a hospital for treatment related to any diving incident, will be reported to the safety and health manager (SHM) and documented by specifying the circumstances of the incident and extent of the injuries in the section provided in the Dive Profile Log.

The SSHO will subsequently report this accident/ incident to the TMR organization in accordance with procedure DCN 02-02, event reporting and investigation. The Dive Smooth Log and written Accident/Incident Report will then be forwarded to the designated SHM, who will forward it to the Chairman of the DRB. The Chairman will include the Dive Profile Log sheet in the TMR Dive Log, which is available in the native file format located in the Guidelines Templates and Tools folder in the CRL.

14.3 Recording of Dive

As stated above, a Dive Profile Log sheet will be completed for each dive, and, upon completion of the dive, will be forwarded to the Chairman of the DRB. The Chairman of the DRB will include the Dive Profile Log sheet in the TMR Dive Log, which will document all dives conducted by TMR personnel. The Diver’s Medical History and Supplemental Diving Questionnaire must be completed for each diver before they commence diving.

14.4 Decompression Procedure Assessment Evaluation

In the event of a diving-related incident that requires treatment by recompression, the section of the Dive Profile Log sheet for Decompression Procedure Assessment Evaluation will be completed and forwarded to the Chairman of the DRB, who will include the log in the TMR Dive Log. The Dive Log will be maintained for a period of 5 years. The Chairman of the DRB or designee will conduct the accident investigation.

14.5 Equipment Inspections and Testing Records

The current log entry or tag for required equipment must be maintained until the equipment is removed from service.

14.6 Records of Hospitalization

All medical records generated by a hospitalization visit must be forwarded to the TMR Medical Provider.

14.7 Diver Medical Records

The Tetra Tech Corporate Safety Procedure DCN 3-02F, MS-2, Release of Medical and Exposure Records[2] form is retained by TMR Human Resources Department. The Tetra Tech Corporate Safety Procedure DCN 3-02F, MS-1, Physician's Certification form[3] is retained by the Tetra Tech Medical Provider, and copies are maintained in project site files by the SSHO. All personal information protected by the Health Insurance Portability and Accountability Act is maintained by Tetra Tech's independent medical provider. Employee medical records will be handled in accordance with Tetra Tech Corporate Safety Procedure DCN 1-04, Recordkeeping and Reporting Requirements[4].

Diver qualification medical records that are signed by the TMR Medical Provider will be maintained for the duration of employment plus 30 years in accordance with 29 CFR 1910.1020(d).

14.8 Diving Safe Practices Manual

The current version of this DSPM is required to be maintained at the dive location.

14.9 Forwarding of Records

Employers are no longer required to notify and/or transfer records to NIOSH. OSHA's 29 CFR 1910.1020(h)(1) provides that whenever an employer is ceasing to do business, they must "transfer all records subject to this section to the successor employer. The successor employer shall receive and maintain these records.

14.10 Termination of Diving Operations

If TMR ceases to do business, the successor employer will receive and retain all dive and employee medical records required by 29 CFR 1910.1020(h)(2); The employer shall notify affected current employees of their rights of access to records at least three (3) months prior to the cessation of the employer's business

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[2] https://tetratechinc.sharepoint.com/:b:/r/sites/Health-Safety/Health%20%20Safety%20Manual/03_Environmental%20and%20Remediation%20Operations/DCN%2003-02F%20MS-2%20Release%20of%20Medical%20and%20Exposure%20Records.pdf

[3] https://tetratechinc.sharepoint.com/:b:/r/sites/Health-Safety/Health%20%20Safety%20Manual/03_Environmental%20and%20Remediation%20Operations/DCN%2003-02F%20MS-1%20Physicians%20Certification%20Form.pdf

[4] https://tetratechinc.sharepoint.com/:b:/r/sites/Health-Safety/Health%20%20Safety%20Manual/01_Health%20and%20Safety%20Program%20Administration/DCN%2001-04%20Recordkeeping%20and%20Reporting%20Requirements.pdf

14.11 Training Records

Copies of each diver's successful completion of the USN Dive School or civilian certification, and any other certificates of any specialized training (relevant to the job), will be forwarded to the Chairman, of the DRB and kept on the project site. Additionally, any training conducted in preparation for the job will be documented and retained on site and copies forwarded to the Chairman of the DRB.

15.0 OPERATIONS PLANNING

This section provides guidance on effective dive planning for any size operation. The success of any diving operation is a direct outcome of careful, thorough planning. The site-specific circumstances of each operation determine the scope of the planning effort, but certain considerations apply to every operation.

The HASDP provides a basic outline of minimum required information to successfully plan the diving operation. A project specific plan will be developed and implemented by the DRB, Project Manager and designated Diving Supervisor/Lead Diver for each separate diving project. The TMR SSHO for the project shall complete applicable self-assessment checklists. A project HASDP shall be developed to address the general diving and to include the following:

- Describe dive team composition, personnel qualifications, and responsibilities, along with the proper up-to-date documentation.
- Provide name and qualifications of the designated person in charge/diving supervisor responsible for diving activities (that is, years and type of experience and training background).
- Describe safe work practices for other activities to be performed during this project (for example, use of ladders, fall protection, use of electrical power tools, and use of personal protective equipment).
- Describe site-specific training, diver workups, equipment uses, and other training requirements (e.g., hazard communication, first aid, and CPR).
- Describe methods to identify and protect wetlands, endangered species, or cultural/historic resources, if applicable.
- Describe procedures for operating in inclement weather, including lightning, high winds, and severe rainstorms.
- Describe the Emergency Response Plan for equipment, incident response, treatment, evacuation, and notifications.
- Provide supplemental diving safety procedures.

The HASDP can reference overlapping plans or other pertinent project documents to minimize redundancy.

15.1 Risk Management and Assessment

Identifying the risks of the dive and developing a plan of action to minimize one’s exposure to risk is crucial to safe and effective diving operations. The HASDP will be developed to address possible emergencies that may arise at each specific dive site. This plan shall incorporate steps for extraction of a stricken diver from the water, subsequent first aid and emergency response, and evacuation to a higher level of care. Job hazard analysis forms and safety checklists that are site-specific may be substituted providing they meet or exceed the requirements outlined in this manual and are approved by the diving supervisor/lead diver. Each team member shall be provided a copy of the HASDP prior to starting a job.

Once on the job, the diving supervisor/lead diver shall give a safety briefing to the dive team prior to each day of diving, and at the start of a new task. Emergency procedures will be reviewed on site to include local emergency/rescue points of contact. Wherever practicable, dives will be planned within the No Decompression Limits according to the USN dive tables and procedures.

The project manager and diving supervisor/lead diver, prior to the start of any fieldwork, must complete detailed planning and all required forms. Dive Team members must be made aware of the following:

- All known and potential hazards at the job site as reflected on the Job Hazard Analysis form.
- Required scope of work and individual responsibilities as detailed in the Pre-Dive Briefing Form.
- Equipment and tool requirements for all tasks
- Contingency and emergency plans

Diving shall be discontinued if sudden squalls, electric storms, heavy seas, unusual tide, or any other condition exists that, in the opinion of the diving supervisor/lead diver, jeopardizes the safety of the divers. It must be noted here that **ANYONE ON A TMR DIVE TEAM CAN STOP WORK** on a job if they feel that the work environment is/becomes unsafe.

Prior to diving, the diving supervisor/lead diver shall be responsible for examining the dive site to identify potential hazards. Some examples of potential surface and subsurface hazards include the following:

- Surface vessel traffic and/or vehicular traffic
- Swift currents and sea state
- Subsurface/underwater debris
- Overhead crane operations
- Mooring lines
- Pedestrian traffic/onlookers
- Petroleum products and/or other materials that are hazardous to divers and/or tenders
- Airborne contaminants
- Contaminated water
- Outfall and intake pipes

- Flotsam/jetsam (marine debris)
- Propeller/thrusters and intake/discharges of moored vessels
- Potential for structural collapse
- Hazardous marine life
- Limited access and/or confined workplace
- Fishing lines and nets
- Turbid (limited visibility) water
- Hazardous materials
- Abandoned piles and/or other structures
- Sonar equipment likely to be used or tested on nearby vessels

15.2 Termination of Dive Operations

The working interval of a dive will be terminated under any of the following conditions:

- The activities are completed as planned.
- A diver requests termination.
- A diver fails to respond correctly to communications.
- Communications are lost and cannot be quickly re-established between the diver and a dive team member at the dive location, or between the designated person-in-charge and the person controlling the vessel in live boating operations.
- A diver begins to use diver-carried reserve breathing gas or the dive location reserve breathing gas.
- The diving supervisor/lead diver determines that any unsafe condition exists.

16.0 CONSIDERATIONS FOR DIVE PLANNING

TMR diving mode options include Surface-Supplied Air Diving, Lightweight Surface-Supplied Air Diving, and SCUBA (with or without communications). Specific tasks and environmental conditions will dictate the safest and most efficient diving mode; however, there are certain requirements that must be followed regardless of the chosen dive mode selected.

16.1 Primary Breathing Air Supply

Air will be the primary breathing gas used during diving operations. A low-pressure air compressor, volume tank and filter assembly or high-pressure cylinders, with a regulated supply, provide the breathing air during Surface-Supplied Air diving. Compressed air cylinders worn by the diver supply the primary breathing air during SCUBA diving operations.

16.2 Reserve Breathing Air Supply

High-pressure air cylinders connected to the dive manifold supply the reserve air to the Surface-Supplied Air Diver. Additionally, the diver carries a reserve breathing air supply known as a bail-out system. The bail-out system provides a reserve air supply for the diver when surface-supplied air is compromised.

A redundant tank and regulator, or spare air cylinder carried by the diver provide the reserve air supply for SCUBA diving operations.

16.3 Exposure Protection

The site and environmental conditions are directly related to the type and amount of exposure protection required for a diver's comfort and safety. In cold or contaminated water, a dry suit with an adequate thermal undergarment is required. In the absence of contaminants, a neoprene wetsuit may be worn. A lightweight wetsuit, dive skin, or swimsuit with chaffing coveralls may be considered in warmer climates, providing the environment in which the dive will take place is free of contamination. Divers will wear some form of hand and foot protection while working in the water to minimize the possibility of injury. A neoprene or Lycra wetsuit hood is suggested when using SCUBA to provide protection for the diver's head and ears.

16.4 Dive Team Assignments

Each TMR Dive Team will have, as a minimum, four qualified personnel. The diving program manager will assign personnel to the dive teams. Personnel requirements are outlined in Section 11. Team assignments will be based on the scope of the project and the availability of qualified personnel. The logistics of the project and any unusual safety considerations at the job site may dictate additional personnel requirements.

- Additional personnel may be required to supplement the dive team in order to comply with standards set forth by a client or agency. In these instances, the required standards will be reviewed and strictly adhered to.
- All diving projects undertaken by the company for TMR government clients (e.g. USN or the USACE) will be carried out in strict compliance with DDESB TP-18, reference (c).

16.5 Decompression Procedures

The TMR standard of practice is to plan dives as no decompression dives according to the USN no-decompression limits. Should situations arise that necessitate the use of decompression diving to safely and efficiently complete the scope of work, USN Standard Air Dive Tables and outlined ascent procedures will be implemented and incorporated into the HASDP at that time.

16.6 Water Entry/Egress

A securely attached ladder or similar device will be provided for the diver to enter and exit the water. The ladder must extend at least 3 feet below the surface of the water and be capable of supporting the combined loads of both the diver and tender.

Divers shall enter the water in a controlled manner. In turbid or low visibility water conditions, there is always a possibility of submerged hazards or protruding objects that could pose a danger to the diver; therefore, extreme caution must be exercised during water entry.

Equipment required for the safe extraction of an unconscious diver from the water shall be provided at each dive site.

16.7 Warning Display

An International Alpha code flag and recreational “Diver Down” flag shall be prominently displayed during all diving operations. Flags will be placed in a highly visible position to provide as much warning as possible for all approaching vessels. For work in navigable waters, flag dimensions shall be at least one meter in height and width (or as specified by local jurisdictions) and illuminated at night.

16.8 Pre-Dive Brief

Prior to each dive, the diving supervisor/lead diver shall conduct a pre-dive Briefing to inform each Dive Team Member of the following:

- Diver’s health and readiness
- Standard and emergency procedures for diving mode employed and location of work
- Review of the AHAs, equipment checklists, and hazards or environmental variables that will impact diving operations
- Any deviations from standard procedures which may be necessitated by the operation
- Diver re-call procedure
- Factors which will terminate the dive

17.0 SPECIAL CONSIDERATIONS FOR DIVE PLANNING

In addition to the requirements above, there are many other items or circumstances that must be considered when planning a dive, regardless of the chosen diving mode.

17.1 Hazardous Environmental Conditions

Effective dive planning must provide for extremes in environmental conditions. Diving will be discontinued if sudden squalls, electric storms, heavy seas, unusual tide, or any other condition exists that, in the opinion of the diving supervisor/lead diver, jeopardizes the safety of the divers.

17.2 Communications

Adequate communications for the dive site will be provided as follows:

- **Diver to diver** – Wireless electronic communication is preferred for SCUBA operations, but diver-to-diver hand signals or line pull signals, in accordance with the Navy Diving Manual, are acceptable, refer to Attachment 8 USN Diving Line Pull and Hand Signals, which is also available in the native file format located in the Guidelines Templates and Tools folder in the CRL. Surface-supplied diving requires an operational two-way audio communication system between the diver and topside.

- **Surface to Diver/Diver to Surface** – Wireless electronic communication is preferred for SCUBA operations, but line pull signals in accordance with the USN Diving Manual, are acceptable. Surface-supplied diving requires an operating two-way audio communication system between the diver and topside.
- **Emergency Assistance** – Telephone communications will be maintained on site via a landline, cell phone, or two-way radio communications with a constantly manned location to activate emergency services if required.

17.3 Cold Water Diving

Cold water diving is defined as diving in water at or below a temperature of 37 degrees Fahrenheit. Cold water diving requires the use of special equipment and techniques. All dives conducted in cold water will be in accordance with Attachment 9, Cold Water Considerations and Safety Precautions, which is available in the native file format located in the Guidelines Templates and Tools folder in the CRL.

Hypothermia demands immediate treatment and prompt evacuation to a medical facility. The Diving Supervisor/Lead Diver will also take into consideration hypothermia for the surface support personnel. The responding medical facility must be notified of the possibility of hypothermia prior to the commencement of diving operations. Emergency re-warming and evacuation plans should be established with the medical facility's recommendations.

Diving under the ice requires extremely specialized training and equipment and **will not** be performed by TMR employees.

17.4 Diving at Altitude

Diving operations may be required in bodies of water at higher altitudes. Because of the reduced atmospheric pressure, dives conducted at altitude require more decompression than identical dives conducted at sea level. Standard air decompression tables, therefore, cannot be used as written.

Planning must address the effects of the atmospheric pressures that may be lower than those at sea level.

- No correction is required for dives conducted at altitudes between sea level and 300 feet; the additional risk associated with these dives is minimal.
- At altitudes between 300 and 1,000 feet, correction is required for dives deeper than 145 FSW (actual depth).
- At altitudes above 1,000 feet, correction is required for all dives.

High-altitude diving requires special equipment and techniques and will be conducted in accordance with the provisions of the USN Diving Manual.

Additionally, Standard Operating Procedures (SOPs) addressing the special requirements and support will be developed prior to commencing any high-altitude diving and included in the project specific HASDP.

17.5 Diving on UXO

Diving in the vicinity of explosive ordnance combines the inherent risk of diving and the explosive hazards of ordnance. Diving to investigate, recover, or dispose of explosive ordnance found underwater, regardless of the type or fuzing, will only be accomplished by specifically trained and qualified UXO divers (in accordance with DDESB TP-18).

Generally, it is safer for divers to work in pairs rather than alone. However, when diving on explosive ordnance, the use of two divers doubles the exposure to the ordnance and the amount of bottom time expended and increases the risk to life from an unplanned detonation. Consequently, the Diving Supervisor/SUXOS should employ a single tended or marked diver when any manipulation or removal of the ordnance is anticipated. However, the option to use two divers for ordnance search operations is authorized and preferred.

When performing activities not involving intentional contact with munitions and explosives of concern (MEC) while using anomaly avoidance techniques within a MEC environment, it is preferred to deploy two UXO divers. Deploying one UXO diver and one non-UXO diver is allowable if authorized by a NOSSA-approved or DDESB-approved ESS/Explosives Safety Submittal.

The development and use of SOPs to address the hazards associated with explosive ordnance is required when conducting UXO diving.

17.6 Diving in Contaminated Water

Divers may encounter dangerous or unpleasant forms of pollution such as effluent from a sewer or industrial outfall, oil leaking from a wellhead or damaged fuel tank, toxic materials or volatile fuels leaking from barges or tanks, and ordnance or chemical warfare material, which can cause severe problems.

The dive team should not conduct the dive until the contaminant has been identified, the safety factors evaluated, and the process for decontamination set up. When diving in a known or suspected radiological environment, proper radiological procedures must be followed.

When diving in contaminated waters, the appropriate dress should be a fully contained dry suit with gloves and hood, with a positive-pressure full face mask or the Dirty Harry surface-supplied diving system. Technical advice for contaminated water diving is available from the NOAA Hazardous Materials Department at (206) 526-6317.

18.0 DIVING HAZARDS

In addition to environmental hazards, and the hazards directly attributable to diving, a diver may occasionally be exposed to operational hazards that are not unique to the diving environment. These hazards are described below.

- **Underwater Obstacles** – Various underwater hazards, such as broken pilings, rocks, wrecks, dumping grounds, and discarded munitions, offer serious hazards to divers.

- **Electrical Shock** – Electrical shock is rare underwater but may occur when using power equipment underwater or topside. A ground fault interrupter must be used with electrical equipment employed on the dive site, both on the surface and underwater.
- **Explosions** – Explosions may occur during demolition tasks or during ordnance clearance operations, intentionally or accidentally. When using explosives, or as identified during UXO diving, separate SOPs and work plans will be developed to cover all aspects of the use or possibility of encountering explosives/ordnance underwater. All divers will be out of the water prior to any planned detonation of explosives or ordnance.
- **Explosives** – All diving-related explosives will be pre-approved by the Manager of UXO Operations. The procedures for explosives handling, use, storage, and underwater procedures will be detailed in the specific HASDP for the project.
- **Sonar** – Additional precautions are required when diving in the vicinity of vessels that employ active sonar. Ships use low-frequency sonar for object location and depth finding. It is a dense, high-energy pulse of sound that can cause damage to divers' ears. Avoid diving in the vicinity of low-frequency sonar and approach no closer than 600 yards. The optimal separation distance is 3,000 yards.

Additionally, the USN Diving Manual has a worksheet to compute actual time and distance restrictions for various types of sonar. This worksheet considers such variables as depth, time, diving apparatus, and wetsuit hoods. High-frequency (greater than 100 kilohertz), short-duration sonar, such as that used with side-scan and hand-held sonar, poses little danger to the diver. The diver will abort the dive if active low-frequency sonar is energized while they are in the water.

- **Marine Life** – Certain marine life, because of its aggressive or venomous nature, may be dangerous to man. Some species of marine life are extremely dangerous, while some are merely an uncomfortable annoyance. Most marine life poses little threat, as they tend to leave humans alone. The diver's best defense against injury is knowledge. All divers should be able to identify the dangerous species that are likely to be found in the area of operations and should be able to deal with each appropriately. The USN Diving Manual provides specific information about dangerous marine life.
- **Ascent to Altitude including Flying after Diving** – Leaving the dive site may require temporary ascent to a higher altitude. For example, divers may drive over a mountain pass at higher altitude or leave the dive site by air. Ascent to altitude after diving increases the risk of decompression sickness because of the additional reduction in atmospheric pressure. The higher the altitude, the greater the risk. The cabin pressure in commercial aircraft is maintained at a constant value regardless of the actual altitude of the flight. Though cabin pressure varies somewhat with aircraft type, the nominal value is 8,000 feet.

For all diving projects, divers will wait at least **12 hours** before flying after any dive, or **24 hours following multiple days of repetitive dives**. The ascent to altitude table located in the USN Diving Manual gives the surface interval (hours, minutes) required before making a further ascent to altitude. The surface interval depends on the planned increase in altitude and the highest repetitive group designator obtained in the previous 24-hour period. Enter the table with the highest repetitive group designator obtained in the previous

24-hour period and read the required surface interval from the column for the planned change in altitude.

18.1 Boating

All boating activities will be conducted according to applicable state, USCG, and Tt Procedure. Further, the following guidelines will be adhered to:

- Diving operations involving live boating will not be conducted unless cleared by the DDC in writing in the approved HASDP or subsequent Field Change Request.
- Live boating will not be conducted unless 1) using surface-supplied air at depths that are restricted to no deeper than 100 FSW, in rough seas that significantly impede diver mobility or work function, or 2) in non-daylight hours.
- The propeller of the vessel will be stopped before the diver enters or exits the water.
- A device will be used that minimizes the possibility of entanglement of the diver's hose in the propeller of the vessel.
- Two-way voice communication between the designated person-in-charge (Dive Supervisor/Lead Diver) and the person controlling the vessel will be available while the diver is in the water.
- Each diver engaged in live boating operations will carry a diver-carried reserve breathing gas supply.

19.0 OTHER HAZARDS

Other diving-related hazards that may be encountered by TMR divers are described below.

19.1 Noise

Some operations may require the use of generators, pumps, compressors, engines, and other equipment that can generate high levels of noise. Short-term exposure to extremely loud noise and/or long-term exposure to low level noise can cause hearing loss. Personnel assigned to a high noise area will wear proper hearing protection and be enrolled in a hearing conservation program.

19.2 Lifting Hazards

During some operations, there may be several instances when personnel will be called on to lift and/or carry a heavy load, sometime over rough or unstable terrain. When doing so, personnel should be instructed to observe the following rules:

- Test the load to ensure it can be moved safely.
- Plan the move to ensure the travel path is clear.
- Keep the back in its normal arched position while lifting, bend at the knees to lift.
- Lift with the legs and stand up in one smooth motion.
- Move the feet to change direction, do not twist at the waist.

20.0 DIVING EMERGENCY PROCEDURES

20.1 Surface Supplied Diving

20.1.1 Loss of Primary Air Supply

- Activate the secondary back up breathing air supply.
- If necessary, ensure diver goes on bail-out bottle.
- Alert the standby diver.
- Have Diver surface and proceed to ladder or stage.
- Terminate the dive (if instructed by Dive Supervisor/Lead Diver).

20.1.2 Loss of Communications

- Attempt to establish line-pull signals.
- Alert the standby diver.
- If unable to establish any form of communications with the diver within 60 seconds, immediately deploy the standby diver for assistance.
- Ensure diver proceeds to the ladder or stage.
- Terminate the dive.

20.1.3 Fouled or Entrapped Diver

- Diver informs Surface Support.
- Alert the standby diver.
- Diver determines the nature and extent of entrapment.
- Diver attempts to free them.
- If required, deploy the standby diver to assist the diver.
- When free, diver and tender confirm that direct contact with each other is re-established.

20.1.4 Injured Diver in Water

- Diver informs Surface Support (if possible).
- Alert the standby diver.
- Diver determines nature and extent of injury.
- Deploy the standby diver to assist diver (if necessary).
- Standby diver remains with diver.
- Extract the diver and provide first aid or oxygen accordingly.
- Request immediate medical assistance and emergency evacuation (if required).

20.1.5 Severance of Complete Umbilical

- Diver activates bail-out bottle.

- Establish line pull signals, if possible, try to inform surface support of the situation.
- Top side crew should secure primary the air supply and activate the air supply to the pneumo hose. If the diver can maintain a hold of the severed section of the hose, they can use it for breathing air and call follow it up to the surface.
- Diver surfaces and terminates the dive.

20.1.6 Unconscious Diver

- Attempt to establish voice and line pull communications with the diver.
- Deploy the standby diver.
- Determine the nature and extent of the diver's situation.
- Secure the diver and ensure an open airway; open the dive helmet free flow if the diver is not breathing.
- Extricate the diver, provide First Aid, CPR, AED, and/or emergency oxygen accordingly.
- Request immediate medical assistance and emergency evacuation.

20.1.7 Activate the secondary back up breathing air supply

- Inform the diver of the situation and establish line pull signals if necessary.
- Diver activates bail-out bottle (if necessary).
- Extinguish fire and secure the equipment.
- Diver surfaces and terminates the dive.
- Determine the damage and test all equipment prior to continuing the dive.

20.1.8 Equipment Failure – Diver in the Water

- Inform the diver of the situation and establish line pull signals if necessary.
- Evaluate the effect on the diver.
- Alert the standby diver.
- Diver informs topside of their readiness.
- Terminate the dive.

20.2 SCUBA Diving

20.2.1 Out of Air – Primary Source

- Diver activates secondary the air supply.
- Diver informs buddy diver or topside crew.
- Terminate the dive.

20.2.2 Out of Air – Primary and Secondary Source

- Diver surfaces with controlled ascent and informs buddy diver or topside crew.
- Buddy diver gives secondary air source to diver.

- Terminate the dive.

20.2.3 Fouled or Entrapped Diver

- Diver determines the extent of entrapment.
- Diver attempts to correct the situation.
- Diver informs topside or buddy diver; deploy the standby diver if required
- When clear, diver returns to ladder and evaluates situation with the Dive Supervisor/ Lead Diver.
- Dive Supervisor/Lead Diver decides to continue or terminate the dive.

20.2.4 Diver Injured in Water

- Diver determines nature and extent of injury.
- Diver informs topside or buddy diver.
- Alert the standby diver and deploy if necessary.
- Buddy/standby diver remains with the diver.
- Extract the diver and terminate the dive.
- Provide First Aid or oxygen accordingly.
- Request medical assistance and emergency evacuation (if necessary).

20.2.5 Equipment Failure

- Evaluate effect on the system and the diver
- Diver informs topside or buddy diver.
- Deploy the standby diver (if necessary).
- Terminate the dive.

20.2.6 Lost Diver and Communication

- Use the Buddy Recall System.
- Each diver surfaces.
- If a diver is not quickly located, the Dive Supervisor/Lead Diver immediately initiates search procedures.
- Deploy additional diver (if necessary).
- When located, divers return to ladder and evaluates the situation with the Dive Supervisor/ Lead Diver.
- Dive Supervisor/Lead Diver decides whether to continue or terminate the dive.

20.2.7 Diver Rapid Ascent or Blow up to Surface

- Buddy diver surfaces in a controlled ascent.
- Both divers terminate the dive.
- Deploy the standby diver to assist; if necessary.

- Monitor the diver and provide oxygen accordingly.
- Immediately notify emergency and medical personnel and inform them of omitted decompression.

20.2.8 Loss of Consciousness

- Buddy diver/standby diver initiates rescue diving.
- Determine the nature and extent of the diver's situation.
- Secure the diver and ensure an open airway; overpressure second stage (if possible) if diver is not breathing.
- Extricate diver, provide First Aid, CPR/AED and/or oxygen accordingly.
- Request immediate medical assistance and emergency evacuation.

21.0 DIVING SPECIFIC EMERGENCY MEDICAL TREATMENT

21.1 DCS Type 1 – (Pain only)

Diver surfaces with or develops joint pain (dull ache) that gradually worsens over time, develops skin problems such as itching or a rash, or develops swelling and pain in lymph nodes. Time to onset of symptoms is 0 to 24 hours. Actions to be taken:

- Perform necessary first aid and give 100 percent emergency oxygen upon surfacing.
- Contact local emergency resources for transport to nearest hyperbaric facility.
- Follow USN Dive Manual Treatment Table procedures.

21.2 DCS Type 2 – Central Nervous System (CNS)

Diver has DCS symptoms in water, or surfaces with any neurological symptoms (numbness, tingling, decrease touch sensation, muscle weakness, or paralysis). Time to onset of symptoms is 0 to 24 hours. Actions to be taken:

- Perform necessary first aid and give 100 percent oxygen upon surfacing.
- Contact local emergency resources for transport to nearest hyperbaric facility.
- Follow USN Dive Manual Treatment Table procedures.

21.3 Arterial Gas Embolism (AGE)

Diver surfaces or becomes unconscious within 10 minutes of surfacing, exhibits signs of a stroke or other neurological disorder, blurred vision, or convulsions. Actions to be taken:

- Perform necessary first aid or CPR.
- Administer 100 percent oxygen with the diver supine or in the recovery position.
- Contact local emergency resources for immediate transport to the nearest hyperbaric facility and initiate recompression treatment as soon as possible.

21.4 Chokes (Heart Pumps Frothy Blood)

Diver surfaces with chest pain aggravated by inspirations, an irritating cough, an increased breathing rate, increased lung congestion with subsequent heart attack. Death is imminent due to heart attack. Actions to be taken:

- Perform necessary first aid and give 100 percent oxygen upon surfacing.
- Contact local emergency resources for immediate transport to nearest hyperbaric facility.

21.5 Pneumothorax

Diver displays difficult or rapid breathing leans towards affected side and experiences pain while inhaling deeply. Hypotension, cyanosis, and shock may be present, leading to death. Actions to be taken:

- Position diver on affected side.
- Administer 100 percent oxygen and treat for shock.
- Contact local emergency resources for immediate transport to nearest medical facility (air must be vented from chest cavity).

22.0 VESSEL OPERATIONS DURING DIVING OPERATIONS

22.1 Safe Boating Guidelines

These procedures are for the safety of the employees and other vessels on the waterways during waterborne operations. If a conflict arises between the current edition of this section and the approved project specific HASDP, applicable federal, state, local laws or other legal directives, the latter shall take precedence.

22.2 Preparing for Waterborne Operations

All personnel on board a vessel employed on a TMR assignment will be fully competent in the vessel operations, maintenance, and equipment usage. The Dive Supervisor/Lead Diver shall complete any project Pre-Operation Maintenance and Safety Inspection Checklists prior to casting off.

22.3 Operations

All TMR employees regularly involved in boat operations must be knowledgeable and capable in the area of rules of the road, vessel maintenance, marine safety, and vessel registration requirements.

22.4 Rules of the Road

As with vehicular traffic on land, rules exist to promote safe vessel movement on navigable waterways. All employees engaged in waterborne operations will know the rules of the road specific to the project area. The local rules can be researched through the USCG or the applicable state government agency that governs a body of water. Several topics included in the rules of the road, relevant to TMR operations, are listed below.

22.5 Navigation, Signals, Markers and Signs

Each crewmember will know the meaning and use of each signal for meeting and passing situations while underway, for leaving a mooring, and signals used in limited visibility conditions. The required signals will be used in accordance with the rules of the road.

Each crewmember will know and understand the meaning of all navigation markers, buoys, and lights on the waterways. The vessel operator will follow the directions of each navigation marker, buoy and light unless evidence indicates the marker is damaged and providing inaccurate information.

22.6 Anchoring and Mooring

Vessel crewmembers will know how to properly anchor and moor the vessel from which they are operating. They will ensure that the anchor, chain, all lines, fenders, bumpers, and cleats are in good working order. The anchor line should be at least seven times longer than the working water depth. Crewmembers will continually monitor anchor and mooring lines while moored in areas affected by tides and strong currents.

22.7 Required Safety Equipment

All vessels operated by TMR, except for vessels less than 18 feet in length, will have the following equipment on board and in operating condition:

- A fixed fire extinguishing system installed in machinery space(s) or B-1 type extinguishers
- Type 1 PFD required for each person on board plus one throw able Type 4 life ring or cushion
- A Coast Guard approved flare kit
- A sounding device to signal maneuvering intentions and position during periods of reduced visibility
- A fully charged and tested VHF radio, prior to departure from dock
- A bilge pump appropriately sized for the vessel
- Additional engine fluids
- Vessels operated by TMR that are less than 18 feet in length shall have a Type 1 PFD for each person onboard.

22.8 Vessel Maintenance

Due to the difficulty of performing repairs afloat, regular maintenance and necessary services shall be carried out onshore before commencing operations. Use of the owner's manuals, maintenance checklists, and repair logs are necessary to track equipment usage and inform future operators of equipment status.

Engine – The owner's manual will be stored on board each vessel in a watertight bag and compartment. Suggested maintenance schedules will be followed. The engine fuel and oil levels will be checked before each use. Other engine components and propeller(s) will be checked for proper function.

Batteries – Each battery will be checked for proper charge level, cleanliness of contact posts, condition of wiring, and water level if required. Batteries will be secured, and all electrical systems turned off after operations are completed. Bilge pumps are directly wired and as such, will remain in constant operation.

Fuel – Check fuel level of primary tanks and emergency supply tanks prior to embarkation. Refill all fuel tanks, with the proper fuel, to the full level after returning each day. Inspect all fuel lines, bilge, and areas around the vessel for leaks.

Electronic Systems – Inspect all circuits to ensure good connections and operation of all components and equipment. Have spare batteries, fuses, and wiring available for repairs. Ensure connection of shore power after returning, when deemed necessary.

Checklists and Logs – Accurately complete checklists and logs prior to and after each day's operation of the vessel.

Safety Equipment – Inspect all fire extinguishers for annual inspection and pressure, first aid kits for required and expired items, PFD for proper fit or deterioration and for spare carbon dioxide cartridges, signaling devices for expired or deteriorated items, and radios for proper functioning.

22.9 General Marine Safety

Dive operations conducted from the relative stability of a pier or shoreline requires safety awareness and constant diligence. Conducting operations from the deck of a pitching/rolling vessel only compound these requirements. All personnel will conduct themselves in a safe and responsible manner while near or on board any vessel and in accordance with SWP 5- 06 Working over or near water. These guidelines are in place for the safety and wellbeing of TMR employees involved in marine operations.

- A USCG-approved PFD must be available for each person on board the vessel. The PFD must have a proper fit for the individual who will be using it and each person should know how to don the PFD in the vessel and in the water. PFDs must be inspected regularly for damage and excessive wear.
- Shoes should have non-skid soles. Personnel should maintain three points of contact when transferring equipment or personnel to and from the vessel. Deck area should be clear of lines, hoses and unnecessary clutter.
- Personnel should not sit on the edge of a vessel or on lifelines while underway.
- Personnel should avoid sailing at night, in fog, in poor visibility, in ice flows, during flood conditions, debris flows, small craft advisories, gales, hurricanes, or other heavy surf conditions, whenever possible.
- Personnel should be familiar with and have the means to handle emergency situations, including man overboard, abandon ship, fire, loss of power or propulsion, storm, and use of emergency signaling devices, as well as how to recover a person in the water.
- Personnel should know what emergency and standard equipment is required on each TMR owned vessel, where it is located and how to operate that equipment.

- Detailed tide, current, and marine weather forecast should be obtained before commencing waterborne operations.
- Ensure that all equipment is secure or lashed properly when underway.
- Personnel should be familiar with, and anticipate water and weather states and conditions respectively, when mooring.

22.10 Vessel Registration

Each vessel operating on navigable waterways requires a state registration identification sticker or USCG Certification. The designated Equipment Manager will ensure that each TMR vessel maintains a current state registration for the state in which the vessel is located. Trailer registrations, if applicable, will also be kept up to date.

22.11 Chain of Command

22.11.1 Projects that are Captained and Crewed by a Subcontractor

The designated Captain of the vessel will have overall authority for the vessel and personnel aboard. They will work with the Project Manager, Dive Supervisor/Lead Diver and SSHO to ensure the safety of all personnel.

22.11.2 Projects that are not Captained and Crewed by a Subcontractor

The Project Manager shall designate the vessel operator for each project. If a designee has not been assigned, the Dive Supervisor/Lead Diver will assume or designate the position of vessel operator. The vessel operator has overall authority and responsibility of the crew, passengers, and vessel operations safety while moored or underway. Before embarking, the Dive Supervisor/Lead Diver will assign crew positions and responsibilities to each team member. They will also designate a chain of command should the vessel operator become injured or is away from the vessel. The vessel operator will work with the Dive Supervisor/Lead Diver and project DSO and SSHO to ensure the safety of all personnel.

22.12 Offshore Operations

When the vessel will be operating greater than 500 yards from the shoreline, in breaking waves, or in a strong current, additional safety precautions are warranted. Under such conditions, any vessel employed on a TMR assignment must adhere to the following:

- The vessel shall be operated by an experienced and qualified boat operator as approved by the Project Manager.
- The vessel operator must perform research on local conditions and be aware of potential hazards.
- A marine weather radio shall be on-board the vessel and periodically monitored to keep abreast of changing weather conditions.
- The vessel must be equipped with a backup propulsion system, such as an extra motor, that can return the vessel to a safe harbor in the event of failure of the primary propulsion system.

- The vessel shall be thoroughly examined by the vessel operator to verify the sound mechanical condition of the vessel and bilge pump, and the presence of appropriate safety equipment as designated above.

23.0 REQUIRED FORMS AND CHARTS

23.1 Forms

The vessel operator will ensure that all required forms are accurately and filled out before embarkation. Spare forms should be kept on board each TMR-operated vessel. The HASDP and Attachment 11, Equipment Checklists, will provide the required forms listed below:

- BOAT PRE-OPERATION CHECKLIST
- DIVE EQUIPMENT CHECKLIST (GENERAL, MEDICAL, SCUBA)
- PRE-DIVE: SSA DIVE HELMET CHECKOFF SHEET
- PRE-DIVE: SURFACE SUPPLIED LIGHTWEIGHT (AGA)

23.2 Charts

The vessel operator will ensure that all required charts and maps for navigation to, from, and within the area of operations are on board before embarkation. All crewmembers will review and become familiar with these charts. These documents should be continually revised, as updates become available.

24.0 REFERENCES

ADCI (Association of Diving Contractors International). 2019. Consensus Standards for Commercial Diving Operations - Sixth Edition (Revision 6.3). Houston, TX. www.adc-int.org

CGA. 2018. G-7.1 Standards - Air quality standards; Compressed Gas Association. Chantilly, VA. www.cganet.com

DDESB (Department of Defense Explosives Safety Board). 2020. Technical Paper-18 Revision 1 - Minimum Qualifications for Personnel Conducting Munitions and Explosives of Concern-Related Activities. Washington, DC.

DOT (U.S. Department of Transportation). 2020. 49 CFR 178.37 - DOT Cylinder Maintenance, Retest and Certification Requirements. Washington DC. www.gpo.gov

OSHA (Occupational Safety and Health Administration). 2017. 29 CFR 1910.401 Subpart "T" - Commercial Diving Operations. Washington DC. www.osha.gov

OSHA (Occupational Safety and Health Administration). 2017. 29 CFR 1910.1020 Subpart Z (h)(1)(2) - Access to employee exposure and medical records. Washington DC. www.osha.gov

Tt (Tetra Tech). Health and Safety Manual:

________ DCN 1-04, Recordkeeping and Reporting Requirements.[5]

________ DCN 02-02 Event Reporting and Investigation.[6]

________ DCN 02-15 Scientific Diving Program.[7]

________ DCN 3-02, MS 1, Physician's Certification form.[8]

________ DCN 3-02, MS 2, Release of Medical and Exposure Records.[9]

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[5] https://intranet.tetratech.com/healthsafety/Manual/DCN%2001-04%20Recordkeeping%20and%20Reporting%20Requirements.pdf

[6] https://intranet.tetratech.com/healthsafety/Manual/DCN%2002-02%20Incident%20Reporting%20and%20Investigation%20Program.pdf

[7] https://intranet.tetratech.com/healthsafety/Manual/DCN%2002-15%20Scientific%20Diving%20Program.pdf

[8] https://intranet.tetratech.com/healthsafety/Manual/DCN%2003-02F%20MS-1%20Physicians%20Certification%20Form.pdf

[9] https://intranet.tetratech.com/healthsafety/Manual/DCN%2003-02F%20MS- 2%20Release%20of%20Medical%20and%20Exposure%20Records.pdf

________ SWP 05-06 Working Over or Near Water.[10]

TMR (Tetra Tech Munitions Response):

________PO-08 – Document Control and Records Management.

________PO-18 – Warehouse Management.

________TMR HSE 01-10 - Boating

USACE (U.S. Army Corps of Engineers). .

________2014. EM 385-1-1, Section 30. Department of the Army, Washington DC. www.publications.usace.army.mil

USCG (U.S. Coast Guard). 46 CFR CH I Subpart "V" – Marine Occupational Safety and Health Standards - Shipping, Volume 7, Chapter 1 – Coast Guard, Part 197 – General Provisions, Subpart B. Commercial Diving Operations. Department of Transportation, Washington, DC. https://www.law.cornell.edu/cfr/text/46/part-197/subpart-B

USN (U.S. Navy). 2018. U.S. Navy Diving Manual, Volumes 1-5, Revision 7 Change A – Commander, Navy Sea Systems Command, Supervisor of Salvage and Diving. https://www.navsea.navy.mil/Portals/103/Documents/SUPSALV/Diving/US%20DIVING%20MANUAL_REV7_ChangeA-6.6.18.pdf

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[10] https://intranet.tetratech.com/healthsafety/Manual/SWP%2005-06%20Working%20Over%20or%20Near%20Water.pdf

25.0 ATTACHMENTS

Attachment 1 – Diving Supervisor/Lead Diver Dive Plan Brief
Attachment 2 – Diving Supervisor/Lead Diver Pre-Dive Checklist
Attachment 3 – Diving Supervisor/Lead Diver Post-Dive Checklist
Attachment 4 – Emergency Procedures
Attachment 5 – Emergency Phone Numbers Checklist
Attachment 6 – Working Dive Log
Attachment 7 – Dive Smooth Log
Attachment 8 – USN Diving Line Pull and Hand Signals
Attachment 9 – Cold Water Considerations and Safety Precautions
Attachment 10 – U.S. Navy Dive Tables
Attachment 11 – Equipment Checklists

GLOSSARY

Definitions are provided for the purpose of understanding their intent as they pertain to a procedure and projects requiring quality program planning. A Master List of Definitions is located in the CRL on the TMR intranet (https://tetratechinc.sharepoint.com/sites/OU-TMR). In addition, the definitions provided below are specific to this manual.

ASME Code or equivalent

ASME (American Society of Mechanical Engineers) Boiler and Pressure Vessel Code, Section VIII, or an equivalent code which the employer can demonstrate to be equally effective.

Arterial Gas Embolism (AGE)

An embolism caused by entry of gas bubbles into the arterial circulation system then act as blood vessel obstructions called emboli.

Atmosphere Absolute (ATA)

Total pressure exerted on an object, by a gas or mixture of gases at a specific depth or elevation, including normal atmospheric pressure.

Bell

An enclosed compartment pressurized (closed bell) or unpressurized (open bell), which allows the diver to be transported to and from the underwater work area and which may be used as a temporary refuge during diving operations.

Bottom Time

The total elapsed time from when the divers leave the surface to the time (rounded up to the next whole minute) they begin their ascent from the bottom or from the deepest depth attained. This time is measured in minutes.

Breath-Holding Diving

A diving mode in which the diver uses no self-contained or surface-supplied air or oxygen supply.

Buddy Breathing

Sharing of a single air source between divers.

Buddy Diver

Second (paired) member of the dive team set.

Buddy System

Two comparably equipped self-contained underwater breathing apparatus (SCUBA) divers in the water in constant communication.

Buoyant Ascent

An ascent made using some form of positive buoyancy.

Bursting Pressure

The pressure under which a pressure-containment device would fail structurally.

Certified Diver

A diver who holds a recognized valid certification from an organizational member, internationally recognized certifying agency, or through military training.

Chairman, Diving Review Board (DRB)

Environment, Safety, Security and Quality (ESSQ) Department member who manages and oversees the DRB.

Controlled Ascent

Any one of several kinds of ascents including normal, swimming, and air-sharing ascents where the diver(s) maintain control so a pause or stop can be made during the ascent.

Cylinder

A pressure vessel for the storage of gases.

Decompression Chamber

A pressure vessel for human occupancy. Also called a hyperbaric chamber.

Decompression Schedule

A specific decompression procedure for a given combination of depth and bottom time as listed in a decompression table. It is normally indicated as feet/minutes.

Decompression Sickness

A condition with a variety of symptoms, which may result from the presence of gas and bubbles in the tissues of divers after pressure reduction.

Decompression Table

A profile or set of profiles of depth-time relationship for ascent rates and breathing mixtures to be followed by divers after a specific depth-time exposure or exposures.

Decompression Time

Elapsed time from when the divers leave the bottom to the time when they reach the surface.

Descent Time

The total elapsed time from when the divers leave the surface to the time, they reach the bottom. Descent time is rounded up to the next whole minute.

Dive Computer

A microprocessor-based device that computes a diver's theoretical decompression status, in real time, by using pressure (depth) and time as an input to a decompression model, or set of decompression tables, programmed into the device.

Dive Location

The surface location from which diving operations are conducted, such as a vessel, barge, wharf, pier, riverbank or offshore rig.

Dive Location Reserve Breathing Gas

A supply system of air at the dive location that is independent of the primary system and enough to support divers during the planned decompression.

Dive Team

Divers and support employees involved in a diving operation, including the Diving Supervisor/Lead Diver.

Diver

An employee working in water using underwater apparatus, including snorkel, that supplies breathing gas at the ambient pressure.

Diver-Carried Reserve Breathing Gas

A diver-carried independent supply of air enough under standard operating conditions to allow the diver to reach the surface, or another source of breathing gas, or to be reached by another driver.

Diving Review Board

The TMR Review Board has oversight for all diving operations within the company. Board members will review the diving procedures and qualification of divers before authorization is given to conduct diving operations. The board is made up of qualified divers from the UXO Group, the Science Department, and the ESSQ Department.

DSO

The individual who manages the TMR science diving program and represents the science divers on the Diving Review Board.

Diving Mode

A type of diving requiring specific equipment, procedures and techniques (SCUBA, surface-supplied air, or mixed gas).

Equivalent Single Dive Time

The sum of the residual nitrogen time and the bottom time of a repetitive dive. Equivalent single dive time is used to select the decompression schedule for a repetitive dive. This time is expressed in minutes.

Heavy Gear

Deep-sea dress, including helmet, breast plate, dry suit, and weighted shoes. Advances in diving equipment and technology have led to heavy gear that does not include a breastplate. Surface-supplied diving gear, including helmet, dry suit, and weighted shoes (i.e., with the helmet directly connected to the drysuit, forming a self-contained pressure envelope for the diver) constitutes heavy gear as well.

Hyperbaric Conditions

Pressure conditions in excess of surface pressure.

In-water stage

A suspended underwater platform that supports a diver in the water.

Lead Diver

A certified diver with the experience and training to lead the diving operations.

Live Boating

The practice of supporting a surface-supplied-air diver from a vessel which is underway

Mixed-Gas Diving

A diving mode in which the diver is supplied in the water with a breathing gas other than air.

No Decompression (No "D") Limits

The depth-time limits of the ‘‘no-decompression limits and repetitive dive group designation table for no-decompression air dives,’’ USN Diving Manual or equivalent limits which the employer can demonstrate to be equally effective.

Penetration Diving

Passing through a barrier where the diver’s lifeline/umbilical requires tending by another diver or swimmer.

Pressure-Related Injury

An injury resulting from pressure disequilibrium within the body as the result of hyperbaric exposure. Examples include decompression sickness, pneumothorax, mediastinal emphysema, air embolism, subcutaneous emphysema, or ruptured eardrum.

Pulmonary Over Inflation Syndrome

Disorders that are caused by gas expanding in the lungs, and include arterial gas embolism, pneumothorax, mediastinal and subcutaneous emphysema.

Recompression/Decompression Chamber

A pressure vessel for human occupancy, such as a surface decompression chamber, closed bell, or deep diving system, used to decompress divers and to treat decompression sickness.

Repetitive Dive

Any dives conducted within 12 hours of a previous dive.

Repetitive Group Designation

A letter that is used to relate directly to the amount of residual nitrogen remaining in a diver's body.

Residual Nitrogen

Nitrogen gas that is still dissolved in a diver's tissues after surfacing.

Residual Nitrogen Time

Time, in minutes, which must be added to the bottom time of a repetitive dive to compensate for the nitrogen still in solution in a diver's tissues from a previous dive.

Safety and Health Manager (SHM)

The individual responsible for all safety aspects of the diving evolution. The on-site SSHO qualified person reports to the SHM on all safety related matters.

Scientific Diving

Diving performed solely as a necessary part of a scientific, research, or educational activity by employees whose sole purpose for diving is to perform scientific research tasks. Scientific diving does not include performing any tasks usually associated with commercial diving such as: Placing or removing heavy objects underwater; inspection of pipelines and similar objects; construction; demolition; cutting or welding; or the use of explosives.

SCUBA Diving

A diving mode independent of surface supply in which the diver uses an open-circuit self-contained underwater breathing apparatus.

Single Dive

Any dives conducted more than 12 hours after a previous dive.

Standby Diver

A designated safety diver at the dive location properly equipped and available to assist a working diver in the water.

Surface Interval

The time a diver has spent on the surface following a dive. It begins as soon as the diver surfaces and ends as soon as he starts his next descent.

Surface-Supplied Air Diving

A diving mode where the breathing gas is supplied from the surface by means of a pressurized umbilical hose. The umbilical generally consists of a gas supply hose, strength member, pneumofathometer hose, and communication line. The umbilical supplies a helmet or full-face mask. The diver may rely on the tender at the surface to keep up with the diver's depth, time, and diving profile.

Tended/Marked Diver

A diver who has a buoy line to the surface or is tended by another diver located in the diving boat or on the surface platform.

Treatment Table

A USN developed and tested depth-time and breathing gas profile designed to treat decompression sickness or pulmonary over inflation syndromes.

Total Bottom Time

The total elapsed time from when the divers leave the surface to the time (rounded up to the next whole minute) they begin their ascent from the bottom or from the deepest depth attained. This time is measured in minutes.

Total Decompression Time

The total elapsed time from when the divers leave the bottom to the time to the time all decompression obligations are met. For No Decompression dives, this is the time the diver reaches the surface. This time is measured in minutes.

Total Time of Dive

The total elapsed time from when the divers leave the surface to the time (rounded up to the next whole minute) until the diver reaches the surface. This time includes all ascent delays and decompression time. This time is measured in minutes.

Umbilical

The composite hose bundle between a dive location and the diver or bell, or between a diver and a bell, which supplies the diver or bell with breathing gas, communications, power, or heat as appropriate to the diving mode or conditions. This includes a safety line between the diver and the dive location or dive bell.

Volume Tank

A pressure vessel connected to the outlet of a compressor and used as an air reservoir.

Working Pressure

The maximum pressure to which a pressure containment device may be exposed under standard operating conditions.

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ATTACHMENT 1

DIVING SUPERVISOR/LEAD DIVER DIVE PLAN BRIEF

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ATTACHMENT 1

DIVING SUPERVISOR/ LEAD DIVER DIVE PLAN BRIEF

PROJECT NAME/NUMBER: ______________________________

1. **NOTIFICATIONS –** The following list of notifications is not to be considered all-inclusive and should be modified to fit the intended task. Check off each representative as notified, include the phone number and person talked to:

Harbor Master: ______________________________

Pipeline Manager: ______________________________

Boat Pilot: ______________________________

Port Services: ______________________________

Cognizant Authority: ______________________________

Ambulance/Air Evacuation: ______________________________

Recompression Chamber: ______________________________

Medical Facility: ______________________________

Coast Guard: ______________________________

U.S. Army Corps of Engineers Representative: ______________________________

U.S. Navy Representative: ______________________________

Support Personnel: ______________________________

2. **PERSONNEL ASSIGNMENTS**

Diving Supervisor/Lead Diver: ______________________________

Senior UXO Supervisor: ______________________________

Diver/s: ______________________________

Tender: ______________________________

Standby Diver: ______________________________

Tender: ______________________________

Coxswain: ______________________________

Assistance: ______________________________

	YES	**NO**	**COMMENTS**
• Has any diver been diving in the last 12 hours?	____	____	______________
• Is any diver taking any type of medication?	____	____	______________

ATTACHMENT 1

DIVING SUPERVISOR/ LEAD DIVER DIVE PLAN BRIEF

PROJECT NAME/NUMBER: ______________________________

	YES	NO	COMMENTS
• Does any diver have any aches or pains?	____	____	____________
• Can divers clear on the surface?	____	____	____________
• Is any diver wearing contact lenses?	____	____	____________
• Do divers feel well enough to make the dive?	____	____	____________
• Do divers have any problem making the dive?	____	____	____________
• Do divers know the emergency procedures for the diving mode?	____	____	____________

3. **ENVIRONMENTAL DATA**:

Temperature: Water: ____________Air: ______________________

Tide: High: ___________/___________ Low: ____________/___________

Visibility expected: ____________________ Bottom type: ____________________

Current speed/direction: ______________________________

Wind Direction/Speed: ____________/_____________

Landmarks: ______________________________

Sunrise/Sunset: ______________/______________

Wave action: Height: _____________ Direction: ____________________

Dive platform: ______________________________

4. **OBJECTIVES:**

Purpose of the dive (TASK): ______________________________

Location: ______________________________
General comments: ______________________________

Dive schedule: __________/__________ Depth: __________ Max depth: _________

Dive mode to be used: ______________________________

ATTACHMENT 1

DIVING SUPERVISOR/ LEAD DIVER DIVE PLAN BRIEF

PROJECT NAME/NUMBER: ____________________

5. **ANTICIPATED HAZARDS**:

Boating: ____________________

☐ Ensure the "Code ALPHA" flag is flying from the vessel, or a 1-meter rigid "Code ALPHA" flag is prominently displayed from the non-vessel dive platform (pier, shore, etc.).

☐ Ensure the "Divers down" flag is also displayed.

Climate: ____________________

Sea Life: ____________________

Expected Ordnance: ____________________

Pollution: ____________________

Other: ____________________

6. **EQUIPMENT REQUIREMENTS**:

Diving Mode: ____________________

Search Equipment: ____________________

Recovery Equipment: ____________________

Explosive Disposal Equipment: ____________________

Special Task Equipment: ____________________

7. **GENERAL DIVING SAFETY PRECAUTIONS CHECKLIST**

- Ensure divers are physically and mentally ready to perform the assigned dive task.
- Determine the exact depth of the dive site through use of lead line or Fathometer.
- Gauge diving and emergency air cylinders prior to diving.
- All dives will be no-decompression dives.
- Ensure the dive platform is in a position for rapid and safe recovery of the divers.
- Each diver is responsible for the condition of his/ her own diving equipment.
- Ensure the standby diver is well briefed and ready to enter the water.
- The buddy system will be used whenever possible. If the buddy system is not used or inappropriate for the dive, the diver will be tended.

ATTACHMENT 1

DIVING SUPERVISOR/ LEAD DIVER DIVE PLAN BRIEF

PROJECT NAME/NUMBER: ______________________________

- Ensure the international code "alpha" and "divers down" are prominently displayed. If diving is not conducted from a vessel, then a 1-meter square rigid replica of the "alpha" flag will be displayed.
- Ensure divers are briefed and protected against local harmful marine life.
- The Diving Supervisor/ Lead Diver must be aware of local ship and small boat traffic in the vicinity of the diving operation.
- Ensure the appropriate diving mode and dress have been selected for the task at hand.
- All dives conducted where there is not free access to the surface must be tended dives.
- Do not inflate life jacket or BCD where ascent to the surface is restricted.
- The Diving Supervisor/ Lead Diver will use the Pre-dive and Post-dive check-off sheets, Attachment 2 and 3, respectively.
- Review the methods of diver recall IAW the HASDP.
- The dive will be aborted in the event of any equipment malfunction.
- Inflate your life vest if surfacing with injuries or excessive fatigue.
- Use the proper ascent and descent rates of 75 feet per minute for descent and 30 feet per minute for ascent.
- Divers will not position themselves between any objects (camels, pier, boat, etc.).
- Brief task-specific safety precautions (UXO diving, altitude diving, ordnance/ explosive safety, etc.).
- Brief special line-pull signals Attachment 8.
- Brief appropriate ordnance safety precautions.
- If necessary, review cold water precautions (EHS 2-02 Attachment 9).

8. **COMMUNICATIONS:**

Radio frequency: ______________________________

Radio call signs:

Primary: ______________________________

Secondary: ______________________________

Telephone location: ______________________________

Site cell phone number: ______________________________

Other cell phones: ______________________________

ATTACHMENT 1

DIVING SUPERVISOR/ LEAD DIVER DIVE PLAN BRIEF

PROJECT NAME/NUMBER: ____

9. **SPECIAL CONSIDERATIONS**:

   Meals: ______________ Water: _______________ Heat source: _______________

   Clothing change: ____

10. **EMERGENCY PROCEDURES**: Review as outlined in Project HASDP and TtEC DSPM (EHS 2-02 Attachments 4 and 5).

ATTACHMENT 1

DIVING SUPERVISOR/ LEAD DIVER DIVE PLAN BRIEF

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ATTACHMENT 2

DIVING SUPERVISOR/LEAD DIVER PRE-DIVE CHECKLIST

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ATTACHMENT 2

DIVING SUPERVISOR/ LEAD DIVER PRE-DIVE CHECKLIST

PROJECT NAME/NUMBER:____

1. DIVING SUPERVISOR/ LEAD DIVER PRE-DIVE CHECKLIST FOR SCUBA DIVING

a. All divers shall have the following minimum equipment:

______ Proper dress for dive conditions, dry/wet suit, coveralls

______ Safety Harness w/tending line or witness float attached for single diver
***NOTE*: Mandatory for projects which fall under EM385-1-1 (if any diver is tended).**

______ Adequate emergency breathing supply with separate independent regulator

______ SCUBA with regulator

______ Buoyancy Compensator (BC)

______ Submersible cylinder pressure gauge

______ Weight belt

______ Mask

______ Knife

______ Depth gauge

______ Diving watch or diving computer

______ Fins

______ Cylinder pressure is adequate for both the emergency air supply ***(90% capacity @ 2700 psig)*** and primary SCUBA supply ***(2500 psig minimum)***.

______ All quick-release buckles and fastenings can be reached by either hand and are properly rigged for quick release.

______ Weight belt is outside of all other belts, straps, and equipment, and is not likely to become pinched under the bottom edge of the cylinders.

______ Buoyancy Compensator is not constrained, is free to expand.

______ Check position of the knife to ensure that it will remain with the diver no matter what equipment he may jettison.

______ Conduct time check and synchronize watches.

______ Open cylinder valve and then back off 1/4 to 1/2 turn.

______ Ensure all inflation hoses are attached and function properly.

ATTACHMENT 2

DIVING SUPERVISOR/ LEAD DIVER PRE-DIVE CHECKLIST

PROJECT NAME/NUMBER:____

______ Depth gauge is zeroed.

______ AGA/ FFM Pre-Dive Checks (***Skip if not applicable***)

- ☐ Adjust pressure equalizer pad.
- ☐ Ensure all screws on mask are tight, and exhaust valve retaining ring is tight.
- ☐ Check connection from mask to supply hose.
- ☐ Check comm wire connection and through water transmitter.
- ☐ Don Mask.
- ☐ Inhale deeply to turn on positive pressure. (*If equipped*)
    - Check positive pressure flow.

______ Have diver breathe for 30 seconds. While doing this, diver should be alert for any impurities in the air or for any unusual physiological reactions.

______ Conduct final review of the dive plan.

______ Brief the divers on the following reasons for terminating the dive:

- ☐ The diver requests termination.
- ☐ The diver fails to respond correctly to communications or signals.
- ☐ Communications are lost and cannot be quickly reestablished.
- ☐ The diver begins to use his/her reserve breathing air.
- ☐ Puncture/tear of a dry suit.

______ Divers physically and mentally ready to enter the water.

______ Ladder is in place to retrieve divers from water.

______ Divers know the maximum depth and bottom time.

______ Review proper/special line pull signals.

______ Code Alpha and Divers Down flags are displayed.

______ Conduct Dive Supe checks on Standby diver.

ATTACHMENT 2

DIVING SUPERVISOR/ LEAD DIVER PRE-DIVE CHECKLIST

PROJECT NAME/NUMBER:____

______ Ensure standby diver knows searching signals.

______ Verify that personnel and equipment are ready to give proper visual, sound, or radio signals to warn off other vessels.

______ Ensure O_2 kit is on dive station with adequate supply, and the O2 bottle has been gauged and documented.

______ Diver or divers are now ready to enter the water.

b. Surface Check :

______ Conduct a breathing check of the SCUBA. Breathing should be easy, without resistance, and with no evidence of water leaks.

______ Visually check dive partner’s equipment for leaks, especially at all connection points (cylinder valves hoses at regulator and mouthpiece).

______ Check face mask seal.

______ Check partner for loose or entangled straps.

______ Check buoyancy. SCUBA divers should strive for neutral buoyancy.

______ If divers are wearing a dry suit, check valve function and for leaks.

______ Orient yourself with your surroundings. Note any obstructions that you may encounter upon surfacing.

NOTES:

1. ***Ensure divers are not sick or have not been recently treated for an injury or illness.***
2. ***Ensure all dive station personnel are monitored during surface intervals when extreme weather conditions exist.***

ATTACHMENT 2

DIVING SUPERVISOR/ LEAD DIVER PRE-DIVE CHECKLIST

PROJECT NAME/NUMBER:____

2. DIVING SUPERVISOR’S PRE-DIVE CHECKLIST FOR SURFACE-SUPPLIED DIVING

CAUTION: ***This checklist is an overview intended for use with the detailed Operating Procedures (OPs) from the appropriate equipment checklists as outlined in Attachment 11 and the specific equipment O&M technical manual*.**

a. Basic Preparation:

______ ***Dives deeper than 100 FSW or dives requiring decompression***, verify that a recompression chamber is present on the diving station and is on line.

______ Verify that proper signals indicating underwater operations being conducted are displayed correctly.

______ Ensure that all personnel concerned, or in the vicinity, are informed of diving operations.

______ Determine that all valves, switches, controls, and equipment components affecting diving operations are tagged-out to prevent accidental shut-down or activation.

b. Equipment Protection:

______ Assemble all members of the diving team and support personnel (winch operators, boat crew, etc.) for a pre-dive briefing.

______ Assemble and lay out all dive equipment, both primary equipment and standby spares for diver (or standby diver), including all accessory equipment and tools.

______ Check all equipment for superficial wear, tears, dents, distortion, or other discrepancies.

______ Check all masks, helmets, view ports, faceplates, seals, and visors for damage.

______ Check all harnesses, laces, strain relief, and lanyards for wear; replace as needed.

c. Helmets and Masks:

______ Ensure that all set up and operating procedures have been completed in accordance with the appropriate Technical Manual and Operating Procedures.

d. General Equipment:

______ Check that all accessory equipment – tools, lights, special systems, spares, etc. are on site and in working order. In testing lights, tests should be conducted with lights submerged in water and extinguished before removal, to prevent overheating and failure.

DIVING SUPERVISOR/ LEAD DIVER PRE-DIVE CHECKLIST

PROJECT NAME/NUMBER:____

______ Erect diving stage or attach diving ladder. In the case of the stage, ensure that the screw pin shackle connecting the stage line is securely fastened with the shackle pin seized with wire or a safety shackle is used to help prevent opening.

______ Ensure first aid kits, portable O_2, and automatic external defibrillators are available and working.

e. Preparing the Diving System:

______ Check that a primary and suitable back-up air supply is available with a capacity in terms of purity, volume, and supply pressure to completely service all divers and standby diver, including decompression, recompressions, and accessory equipment throughout all phases of the planned operation.

______ Verify that all diving system operating procedures have been conducted to properly align the dive system.

______ Ensure that qualified personnel are available to operate and stand watch on the dive system.

f. Compressors:

______ Determine that sufficient fuel, coolant, lubricants, and antifreeze are available to service all components throughout the operation. All compressors should be fully fueled, lubricated, and serviced (with all spillage cleaned up completely).

______ Check maintenance and repair logs to ensure the suitability of the compressor (both primary and back-up) to support the operation.

______ Verify that all compressor controls are properly marked and appropriate valves are tagged with ***"Divers Air Supply - Do Not Touch"*** signs.

______ Ensure that the compressor is secure in the diving craft and will not be subject to operating angles, caused by roll or pitch that will exceed 15 degrees from the horizontal.

______ Verify that oil in the compressor is an approved type. Check that the compressor oil does not overflow the FULL mark; contamination of air supply could result from fumes or oil mist.

______ Check that compressor exhaust is vented away from work areas and, specifically, does not foul the compressor intake.

______ Check that compressor intake is obtaining a free and pure suction without contamination. Use pipe to lead intake to a clear suction location if necessary.

______ Check all filters, cleaners, and oil separators for cleanliness.

ATTACHMENT 2

DIVING SUPERVISOR/ LEAD DIVER PRE-DIVE CHECKLIST

PROJECT NAME/NUMBER:____

______ Bleed off all condensed moisture from filters and from the bottom of volume tanks. Check all manifold drain plugs, and that all petcocks are closed.

______ Check that all belt-guards are properly in place on drive units.

______ Check all pressure-release valves; check valves and automatic unloaders.

______ Verify that all supply hoses running to and from compressor have proper leads, do not pass near high-heat areas such as steam lines, are free of kinks and bends, and are not exposed in such a way that they could be rolled over, damaged, or severed by machinery or other means.

______ Verify that all pressure supply hoses have safety lines and strain reliefs properly attached.

g. Activate the Air Supply in accordance with approved Operating Procedures.

1. Compressors

______ Ensure that all warm-up procedures are completely followed.

______ Check all petcocks, filler valves, filler caps, overflow points, bleed valves, and drain plugs for leakage or malfunction of any kind.

______ Verify that there is a properly functioning pressure gauge on the air receiver and that the compressor is meeting its delivery requirements.

2. Cylinders

______ Gauge all cylinders for proper pressure.

______ Verify availability and suitability of reserve cylinders.

______ Check all manifolds and valves for operation.

______ Activate and check delivery.

For all air supply systems, double check “Do Not Touch” tags (tag out).

h. Diving Hoses:

______ Ensure all hoses have a clear lead and are protected from excessive heating and damage.

ATTACHMENT 2

DIVING SUPERVISOR/ LEAD DIVER PRE-DIVE CHECKLIST

PROJECT NAME/NUMBER:____

______ Ensure that the hose (or any length) has not been used in a burst test program. No hose length involved in such a program will be part of an operational diving hose.

______ Check that hoses are free of moisture, packing material, or chalk.

______ Soap test hose connections after connection to air supply and pressurization.

______ Ensure umbilical boots are in good condition.

i. Test Equipment with Activated Air Supply:

______ Hook up all air hoses to helmets, masks, and chamber; make connections between back-up supply and primary supply manifold.

______ Verify flow to helmets and masks from primary and secondary air supply.

______ Check all exhaust and non-return valves.

______ Hook up and test all communications.

______ Check air flow from both primary and back-up supplies to chamber.

j. Recompression Chamber Checkout (Pre-dive only):

______ Check that chamber is completely free and clear of all combustible materials.

______ Check primary and back-up air supply to chamber and all pressure gauges.

______ Check that chamber is free of all odors or other “contaminants.”

______ Hook up and test all communications.

______ Check air flow from both primary and back-up supplies to chamber.

k. Final Preparations:

______ Verify that all necessary records, logs, and timesheets are on the diving station.

______ Check that appropriate decompression tables are readily at hand.

______ Place the dressing bench in position, reasonably close to the diving ladder or stage, to minimize diver travel.

l. Dress Diver/s:

______ Dress divers in accordance with requirements of approved workplan and in considerations of the site environmental conditions.

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ATTACHMENT 3

DIVING SUPERVISOR/LEAD DIVER POST-DIVE CHECKLIST

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ATTACHMENT 3

DIVING SUPERVISOR/ LEAD DIVER POST-DIVE CHECKLIST

PROJECT NAME/ NUMBER:____

______ Check the physical condition of the diver.

______ Instruct the diver to report any physical problems or adverse physiological effects including symptoms of decompression sickness.

______ Advise the diver of the location of the closest recompression chamber that is ready for use.

______ Alert the diver to the potential hazards of ascending to altitude, including flying after diving (see DSPM Section 18)

______ Assemble diving equipment and return to site support facility.

______ Have divers shower and consume warm liquids, avoid beverages with caffeine.

______ Observe the divers on the surface for symptoms of diving disorders for a minimum of 10 minutes before allowing the divers to leave the dive site.

______ Wash all diving equipment in fresh water and hang to dry.

______ Reorder/replace equipment as necessary.

______ Complete a dive profile log for all divers and submit the log to the Chairman of the Diving Review Board for input into TtEC's master dive log.

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ATTACHMENT 4

EMERGENCY PROCEDURES

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ATTACHMENT 4

EMERGENCY PROCEDURES

GENERAL DIVING EMERGENCY PROCEDURES

1. **Decompression Sickness or Arterial Gas Embolism**:
    - Recall all divers.
    - Administer first aid, CPR and emergency O_2 as required.
    - Notify Recompression Chamber.
    - Begin transport to chamber on oxygen.
2. **Fire in Equipment**:
    - Evaluate effect of fire on diver AND topside crew.
    - Terminate dive.
    - Inform crew and diver of action planned.
    - Activate plan outlined in Project HASDP.
3. **Explosive Detonation with Divers in the Water**:
    - Try to establish communications with the divers using standard line pull signals or communications.
    - If contact is established with the divers, recall, recover, and administer first aid as required. Transport in accordance with project HASDP as required.
    - If communications cannot be established, activate the standby diver and recover the divers via the tending line, and administer first aid as required.
    - Request medical assistance and remember that unconscious divers should be treated for possible arterial gas embolism (AGE)
    - Discontinue diving operations until the cause of the explosion is determined.
4. **Boat Breakdown:**

    This situation is considered to constitute an emergency due to the loss of control of the divers.

    - Recall and recover the divers.
    - Discontinue diving operations.
    - Deploy the anchor
    - Request assistance via radio, phone, or signals.
5. **Variations in Ascent Rate**

    Always ascend at a rate of 30 feet per minute (FPM) (20 seconds per 10 feet of seawater [FSW]). Minor variations in the rate of travel between 20 and 40 FSW/minute are acceptable. Any variation in the rate of ascent must be corrected in accordance with the following procedures; however, a delay of up to 1 minute in reaching the first decompression stop can be ignored.

    - **Travel Rate Exceeded.** On a Standard Air Dive, if the rate of ascent is greater than 30 FPM, STOP THE ASCENT, allow the watches to catch up, and then continue ascent. If the decompression stop is arrived at early, start the stop time after the watches catch up.

- **Delay greater than 1 minute, deeper than 50 FSW**. Add the total delay time (rounded up to the next whole minute) to the bottom time, re-compute a new decompression schedule, and decompress accordingly.
- **Delay greater than 1 minute, shallower than 50 FSW**. If the rate of ascent is less than 30 FPM, add the delay time to the diver's first decompression stop. If the delay is between stops, disregard the delay. The delay time is rounded up to the next whole minute.

6. Unplanned Ascent (Blowup)

- **Ascent from 20 Feet or Shallower with No Decompression Stops Required.** No recompression is required if the diver surfaces from 20 feet or shallower but was within no-decompression limits and is asymptomatic. The diver should be observed on the surface for 1 hour. Consider administering O_2.
- **Ascent from 20 Feet or Shallower (Shallow Surfacing) with Decompression Stops Required.** If decompression is required and the diver surfaces from 20 FSW or shallower (missed the 20- and/or 10-foot stop) and is asymptomatic, the diver is returned to that decompression stop.
    - If the time from the surface back to the stop was less than 1 minute, add 1 minute to the stop.
    - If the time from the surface back to the stop was more than 1 minute and the diver remains asymptomatic, multiply the 20- and/or 10-foot stops by 1.5.
    - Observe diver for 1 hour. Consider administering O_2.
- **Ascent from Deeper than 20 Feet (Uncontrolled Ascent).** Any unexpected surfacing of the diver from depths in excess of 20 feet is considered an uncontrolled ascent. If the diver is within no-decompression limits and asymptomatic, he/she should be observed for at least 1 hour on the surface. Recompression is not necessary unless symptoms develop. Consider administering emergency O_2.
- **Asymptomatic Uncontrolled Ascent.** Asymptomatic divers who experience an uncontrolled ascent and who have missed decompression stops are treated by recompression based on the amount of decompression missed as follows:
    - **Oxygen Available.** Immediately compress the diver to 60 feet in the recompression chamber. If less than 30 minutes of decompression (total ascent time from the tables) was missed, decompress from 60 feet on appropriate Treatment Table. If more than 30 minutes of decompression was missed, decompress from 60 feet on appropriate Treatment Table.
    - **Oxygen Not Available**. If less than 30 minutes of decompression was missed, compress the diver to 100 feet in the recompression chamber and treat on appropriate Treatment Table. If more than 30 minutes was missed, compress to 165 feet and treat on appropriate Treatment Table.

ATTACHMENT 4

EMERGENCY PROCEDURES

- **Symptomatic Uncontrolled Ascent.** If a diver has had an uncontrolled ascent and has any symptoms, he/she should be recompressed immediately in a recompression chamber to 60 FWS.
  - If the diver surfaced from 60 FWS or shallower, compress to 60 FSW and begin appropriate Treatment Table.
  - If the diver surfaced from a greater depth, compress to 60 FSW or depth where the symptoms are significantly improved, not to exceed 165 FSW, and begin appropriate Treatment Table.

7. Emergency Evacuation

- Notify diver and dive team of emergency and abort dive.
- Evacuate all unnecessary personnel.
- Decompress the diver (if required) and recover. If decompression is not possible, follow omitted decompression procedures.

ATTACHMENT 4

EMERGENCY PROCEDURES

SCUBA EMERGENCY PROCEDURES

1. **Buddy Separation** – Make a 360-degree check, above and below; if your buddy is not found, surface immediately. Check the surface for bubbles and notify the Diving Supervisor/ Lead Diver immediately.
2. **Lost Diver** – The first stage of a lost diver is when communications have been lost and emergency recall has failed.
   - Initiate diver recall.
   - Wait 1 minute for response.
   - Deploy lost diver buoy.
   - Deploy standby diver (Dive Supervisor's/ Lead Diver's discretion); follow bubbles or conduct expanding circle line search from last known position.
   - Notify ships/ boats in the area to look out for lost diver and request assistance from the Coast Guard Rescue Center, if necessary.
3. **Loss of Air/Equipment Malfunction (SCUBA)**
   - Signal buddy/surface and abort dive.
   - Buddy breath/activate reserve/breath from emergency air supply.
   - Exhale to the surface.
4. **Mechanical Injury:**
   - Signal buddy/surface and abort dive.
   - Inform Diving Supervisor/Lead Diver.
   - Rule out possible decompression sickness.
   - If immediate treatment required, recall all divers and transport to hospital.
5. **Fouled/Trapped Diver**:
   - Don't panic, stop and think!
   - Notify your buddy diver or topside, if possible (2-2-2 fouled and need assistance, or 3-3-3 fouled and can clear myself).
   - Carefully and calmly try to work yourself free of the entanglement.
   - If required, ditch your equipment and make a buoyant ascent to the surface.
   - If the diver is trapped, the buddy diver should mark the position of the trapped diver with a circle line, his tending line or any available method of marking the trapped diver's position, and then surface and report to the Diving Supervisor.
   - The Diving Supervisor/ Lead Diver will formulate a rescue plan, while the diver delivers additional air to the trapped diver.
   - The Diving Supervisor/Lead Diver will then brief the rescue plan to the dive team and execute the rescue.

ATTACHMENT 4

EMERGENCY PROCEDURES

After rescue, observe the divers on the surface for signs of AGE, asphyxia, physical injury, omitted decompression, and hypothermia.

SURFACE SUPPLIED EMERGENCY PROCEDURES

1. Loss of Breathing Media

- Re-establish breathing media supply:
  - Activate topside secondary breathing media supply
  - Diver initiate emergency procedure using bailout bottle.
  - **ONLY AS A LAST RESORT** – Pressurize the diver's pneumofathometer hose (135 PSI) and have the diver insert the hose into his/her helmet or mask.
- Alert standby diver.
- Have stricken diver go to bell, stage or ladder.
- If required, send standby diver to assist.
- Terminate dive.

2. Loss of Communications

- Attempt to establish communications with line pull signals.
- Put constant air to the diver's pneumofathometer.
- Alert standby diver.
- If communications are established using line pull signals, abort dive and decompress if required.
- If communications are not established, send stand-by diver to diver's assistance, abort dive, and decompress if required.

3. Fouled or Trapped Diver

- Avoid panic and ensure diver does NOT ditch equipment.
- Diver informs topside — gives a detailed report.
- Alert standby diver.
- Diver determines the extent of entrapment.
- Diver attempts to free yourself.
- If required, deploy standby for assistance.
- Abort dive and decompress if required

4. Injury in the Water

- Diver informs topside of injury and extent — gives a detailed report.
- Alert standby diver.

- If required, deploy standby diver to assist stricken diver.
- Abort dive and follow decompression protocol, unless injury indicates a greater risk than omitted decompression. Check surface decompression tables for alternate protocol.
- Request required medical assistance.

5. Severance of Divers Air Supply

- Diver initiates emergency procedure using bailout bottle.
- **<u>If pneumofathometer hose intact and then ONLY AS A LAST RESORT –</u>** Pressurize the diver’s pneumofathometer hose (135 PSI) and have the diver insert the hose into his helmet or mask.
- Alert standby diver.
- Abort dive and decompress.
- Deploy standby diver with more air and/or assist stricken diver if required.

6. Severance of Complete Umbilical

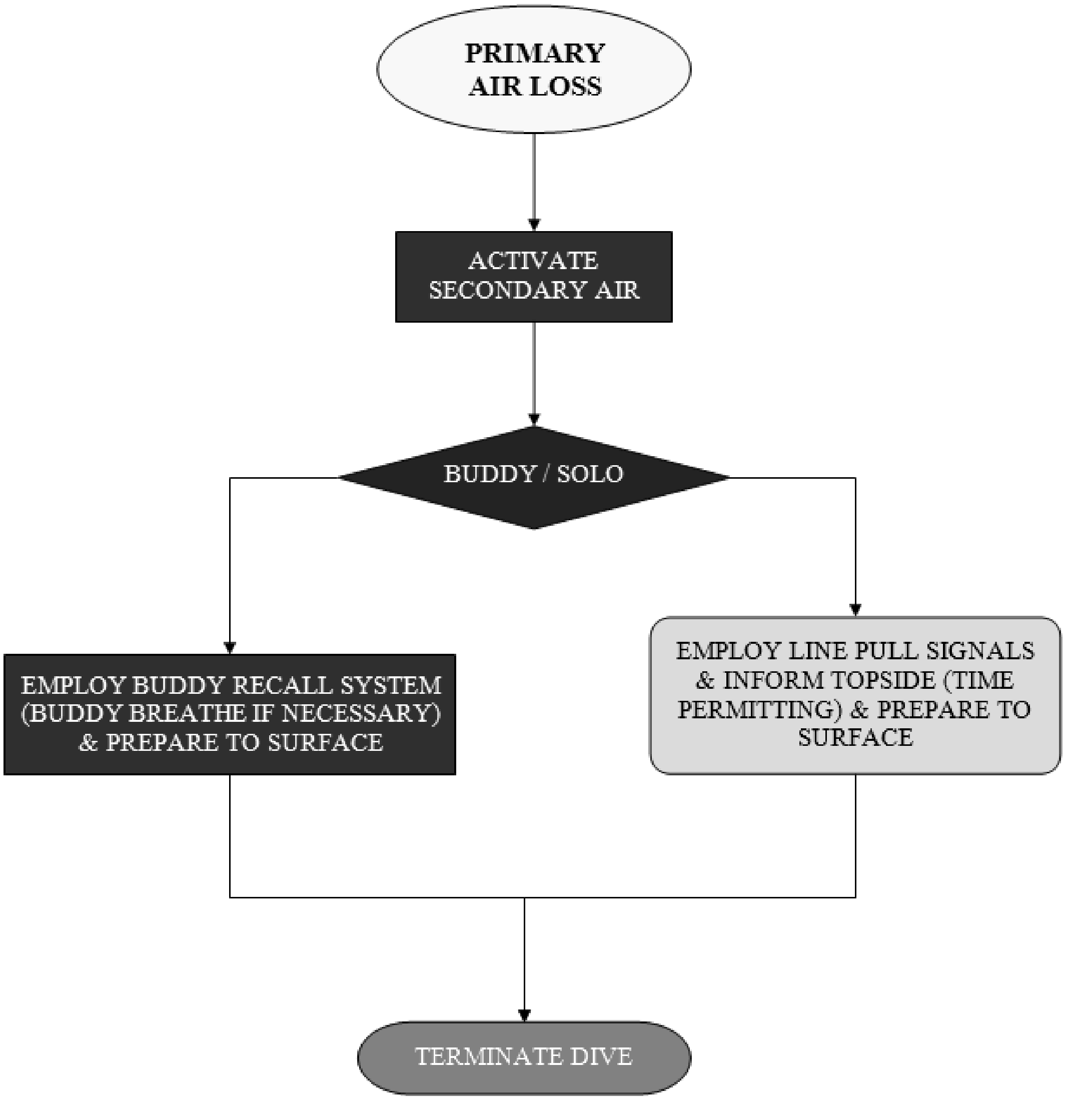
- Diver initiates emergency procedure using bailout bottle.
- Topside alerts standby diver.
- Deploy standby diver down stage line, diver’s umbilical (if visible), or descent line with additional air supply (pneumofathometer, if necessary) to assist stricken diver and inform topside of conditions.
- Abort dive and decompress. Check surface decompression tables for shorter water time.

ATTACHMENT 4

EMERGENCY PROCEDURES

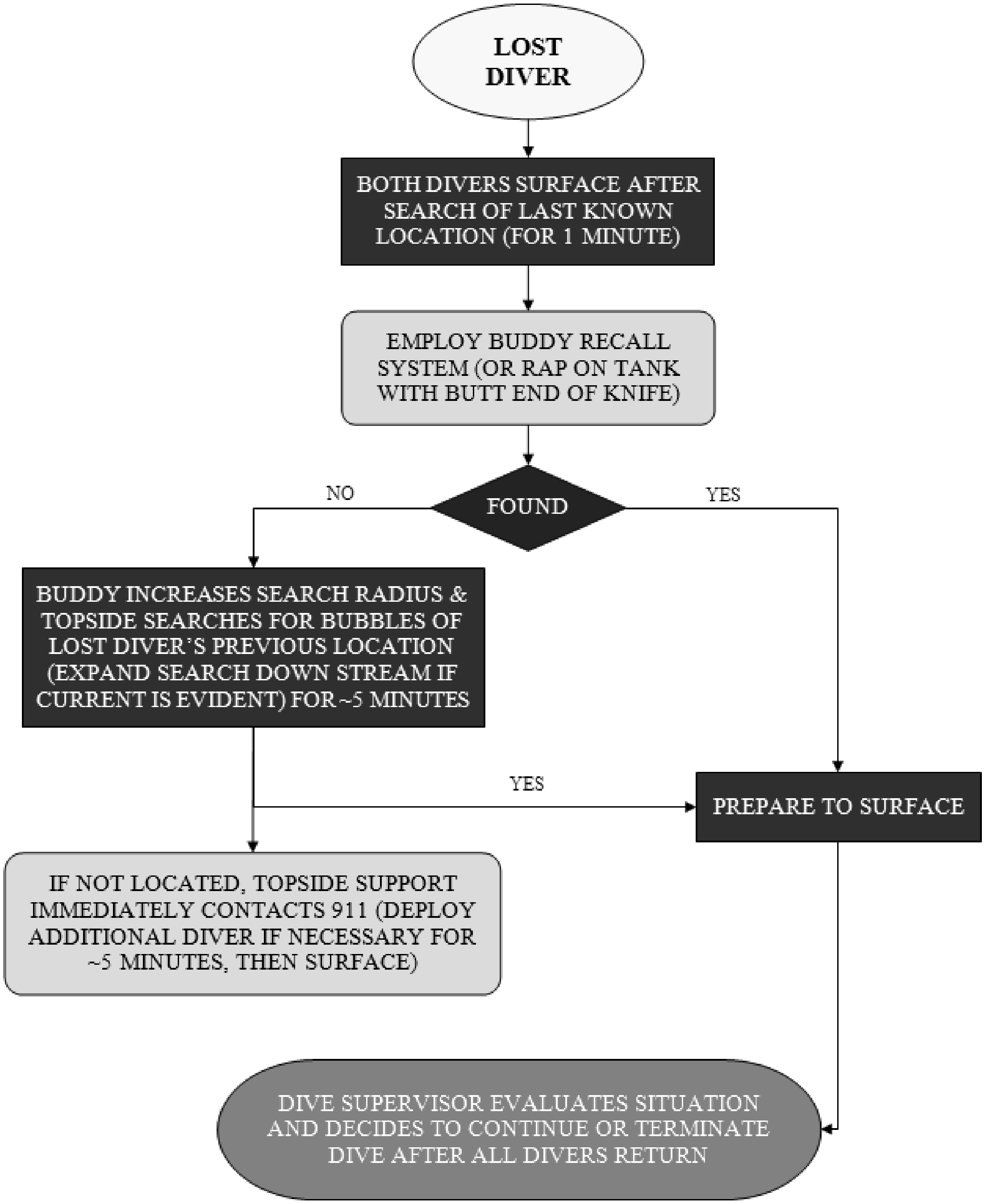
DIVING EMERGENCY DECISION FLOW CHARTS

SCUBA EMERGENCY PROCEDURES



ATTACHMENT 4

EMERGENCY PROCEDURES



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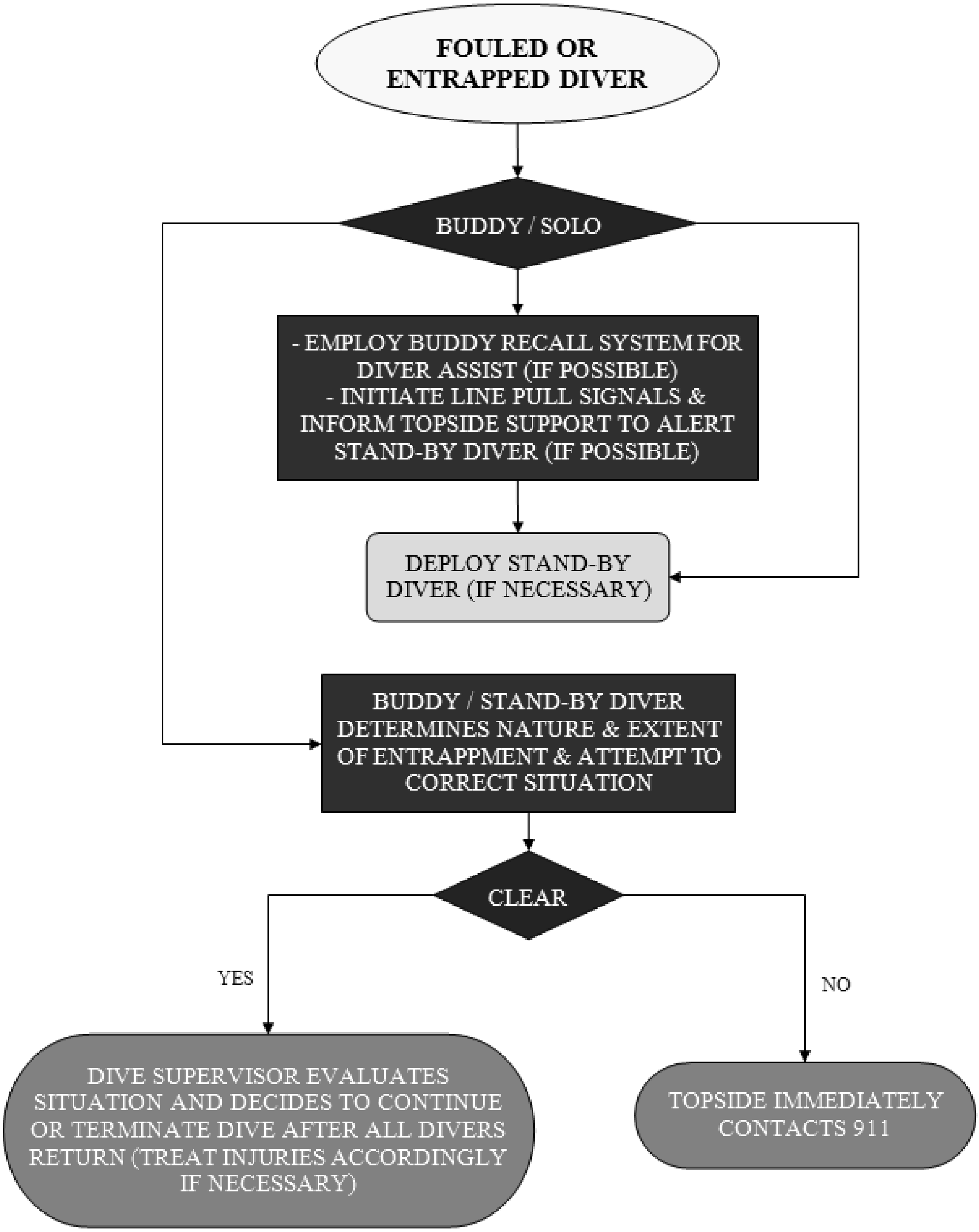

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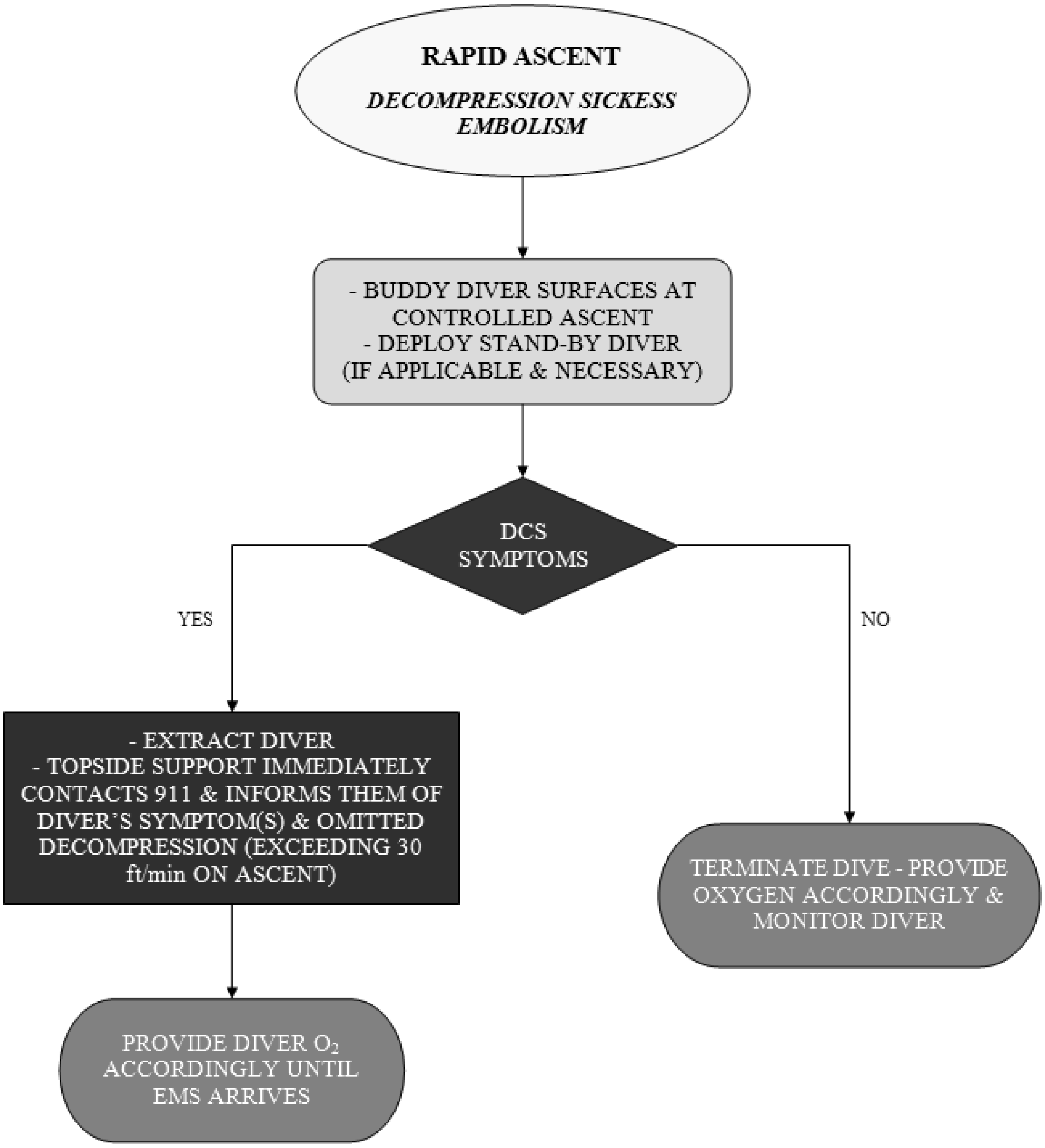
EMERGENCY PROCEDURES



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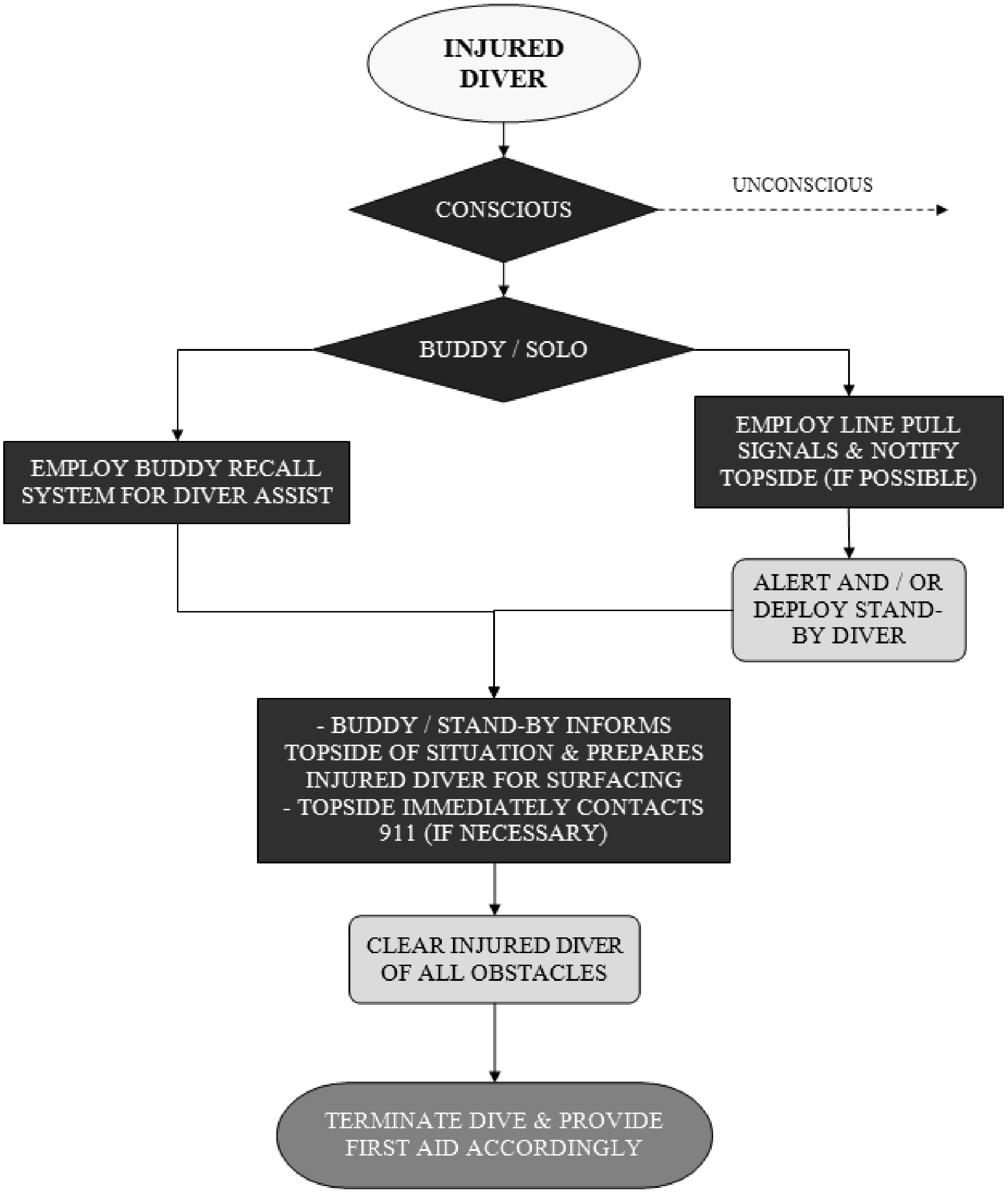
EMERGENCY PROCEDURES



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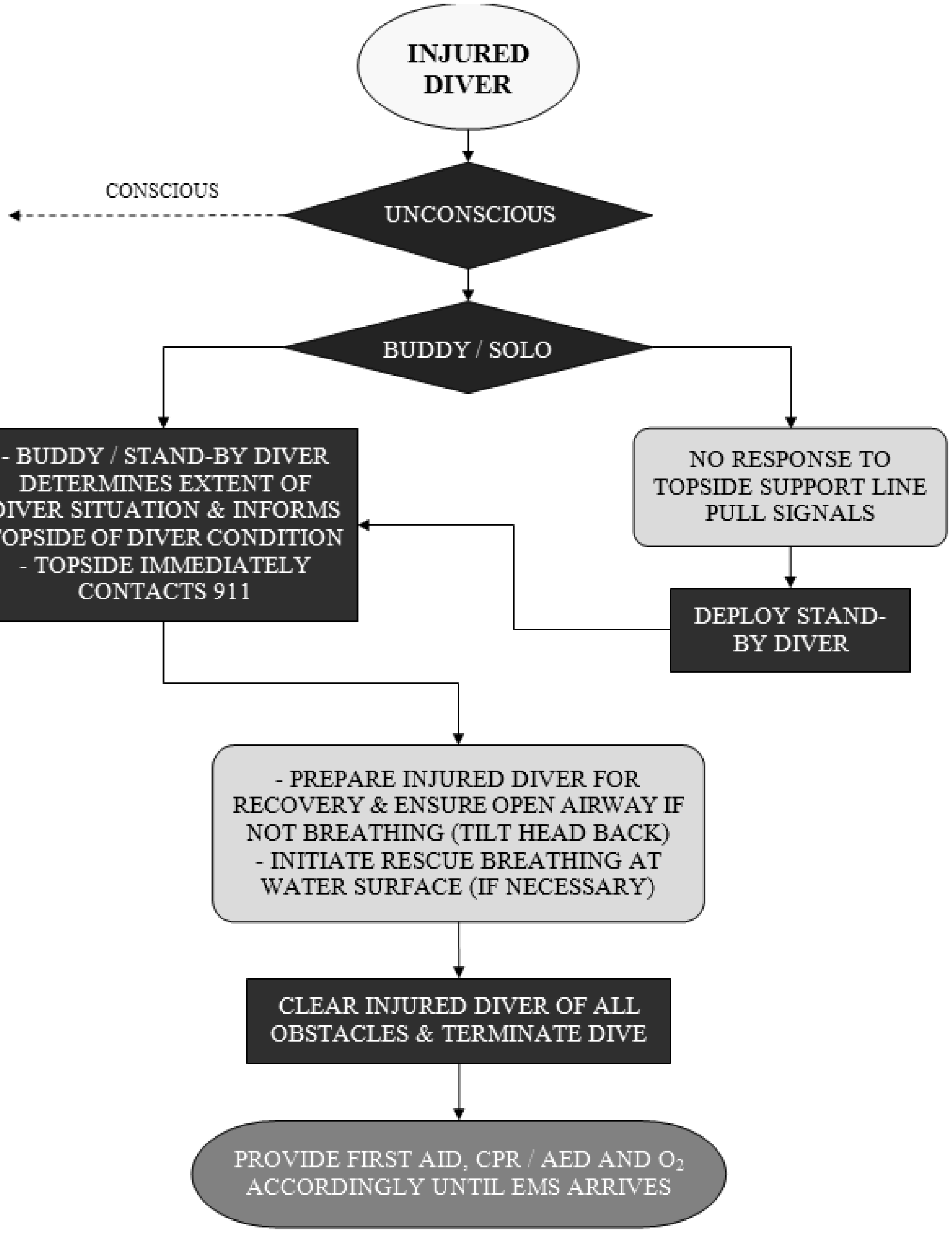
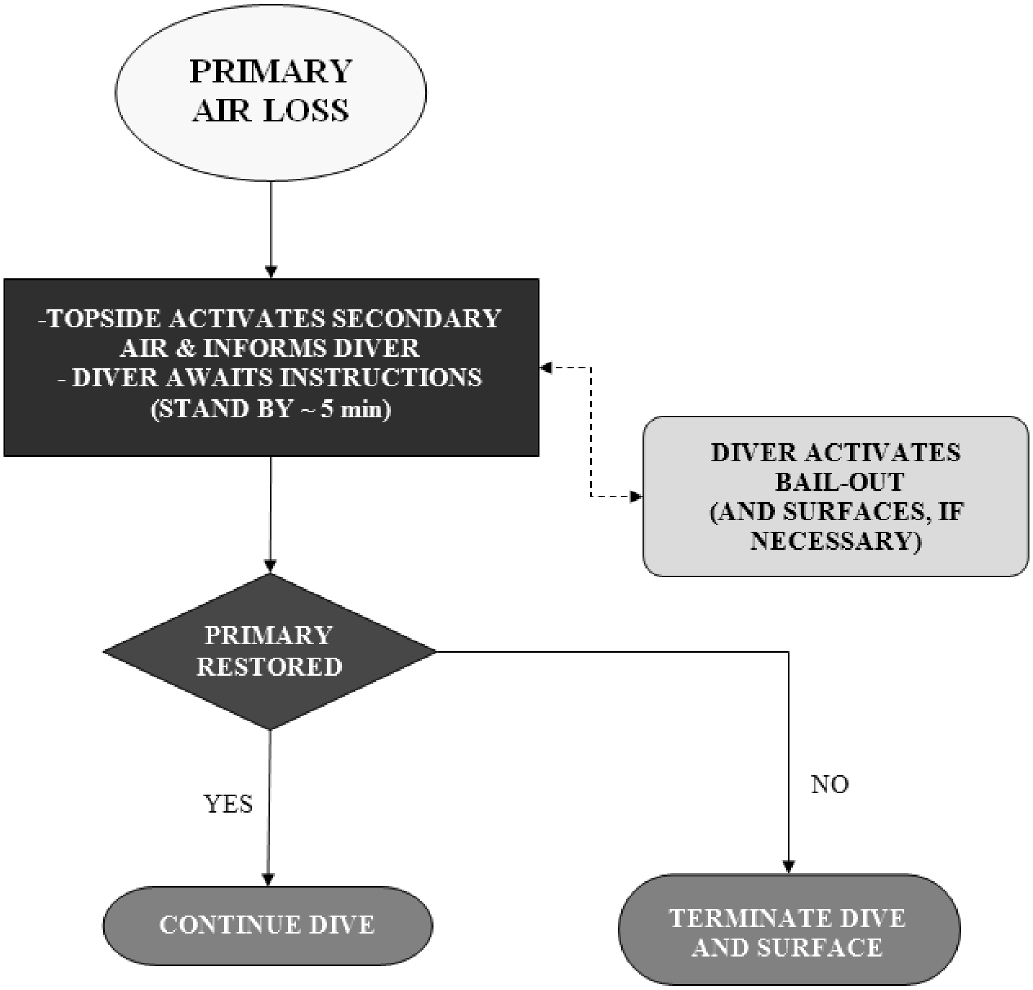
EMERGENCY PROCEDURES



SURFACE SUPPLIED EMERGENCY PROCEDURES



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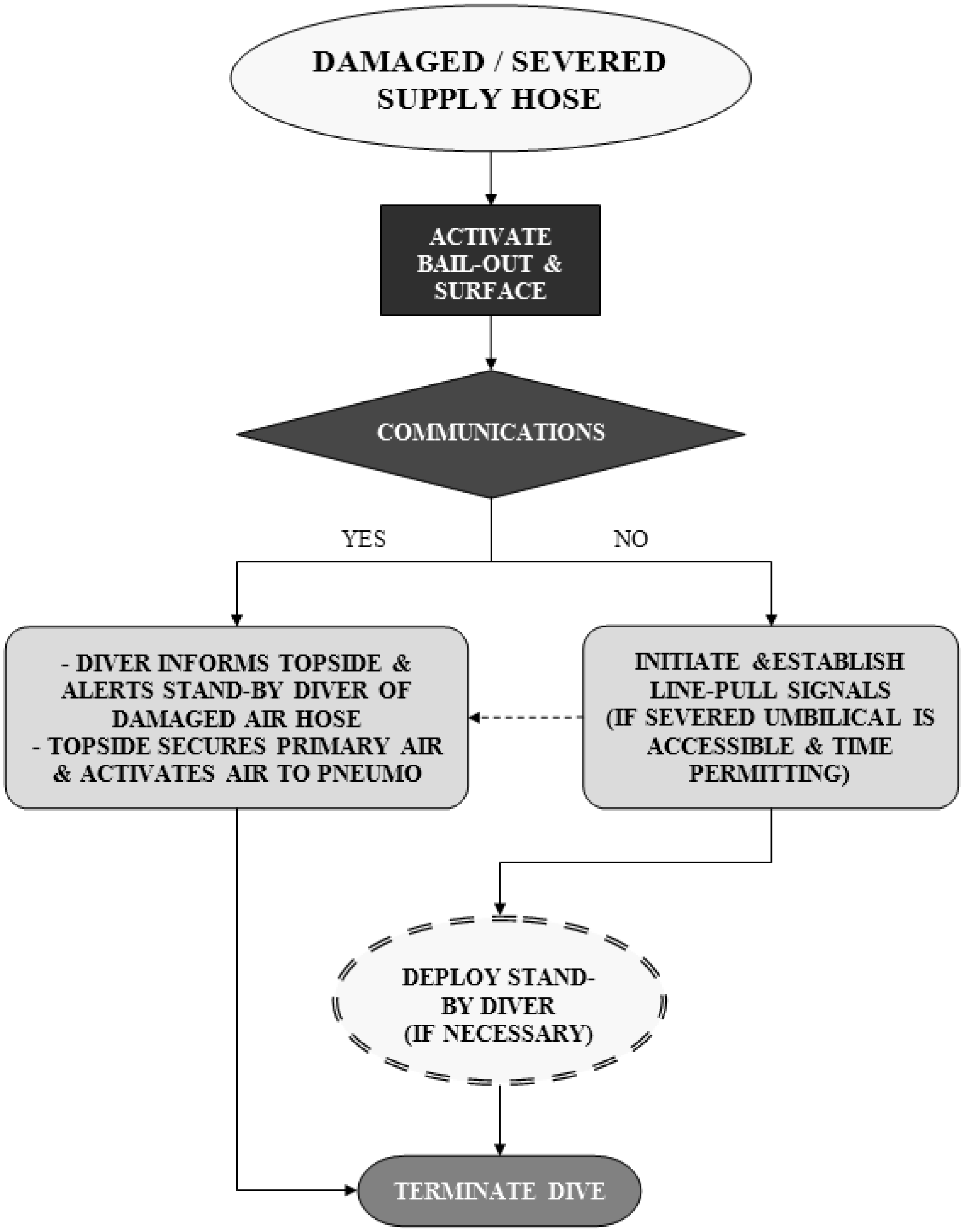
EMERGENCY PROCEDURES



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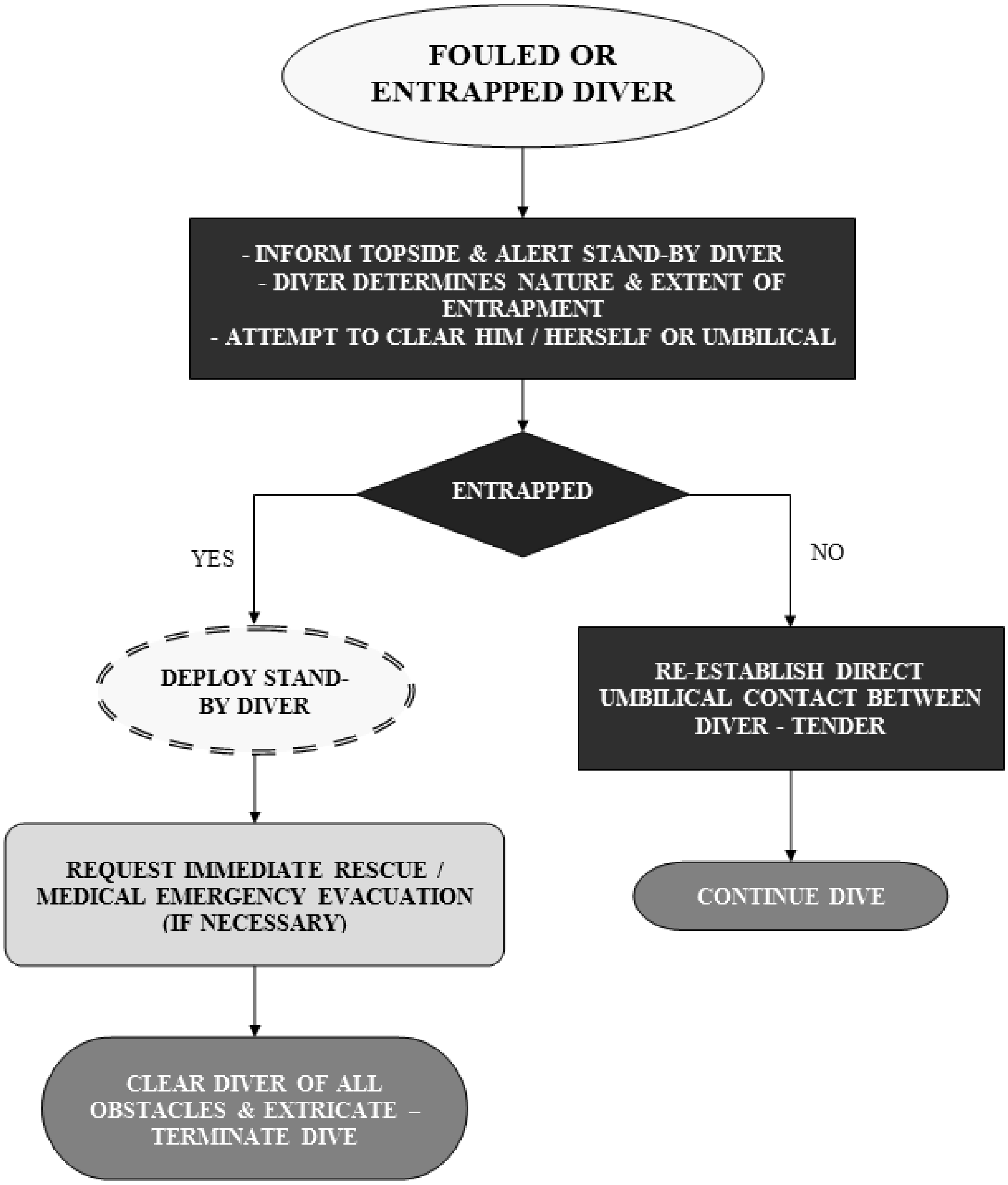

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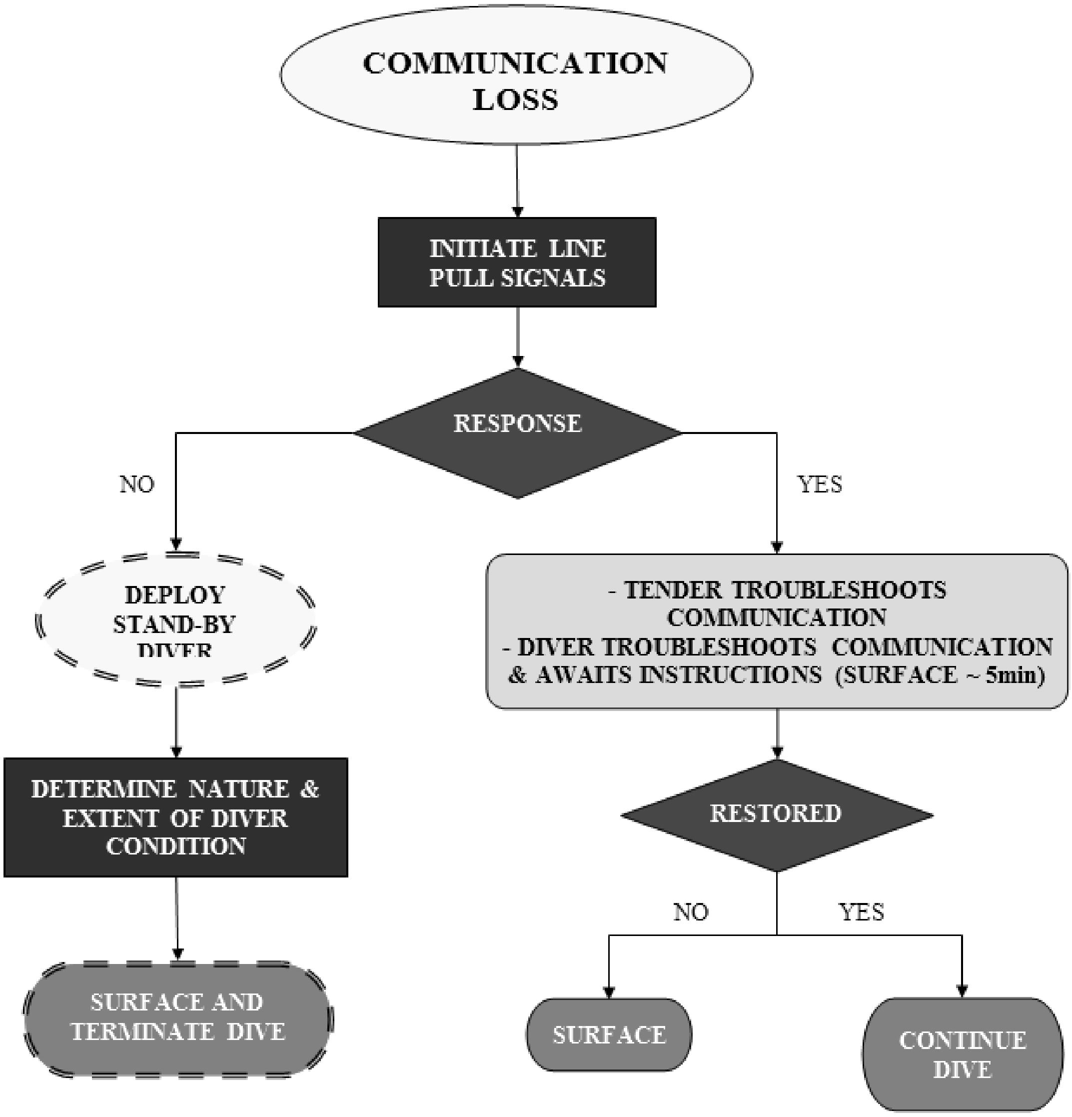

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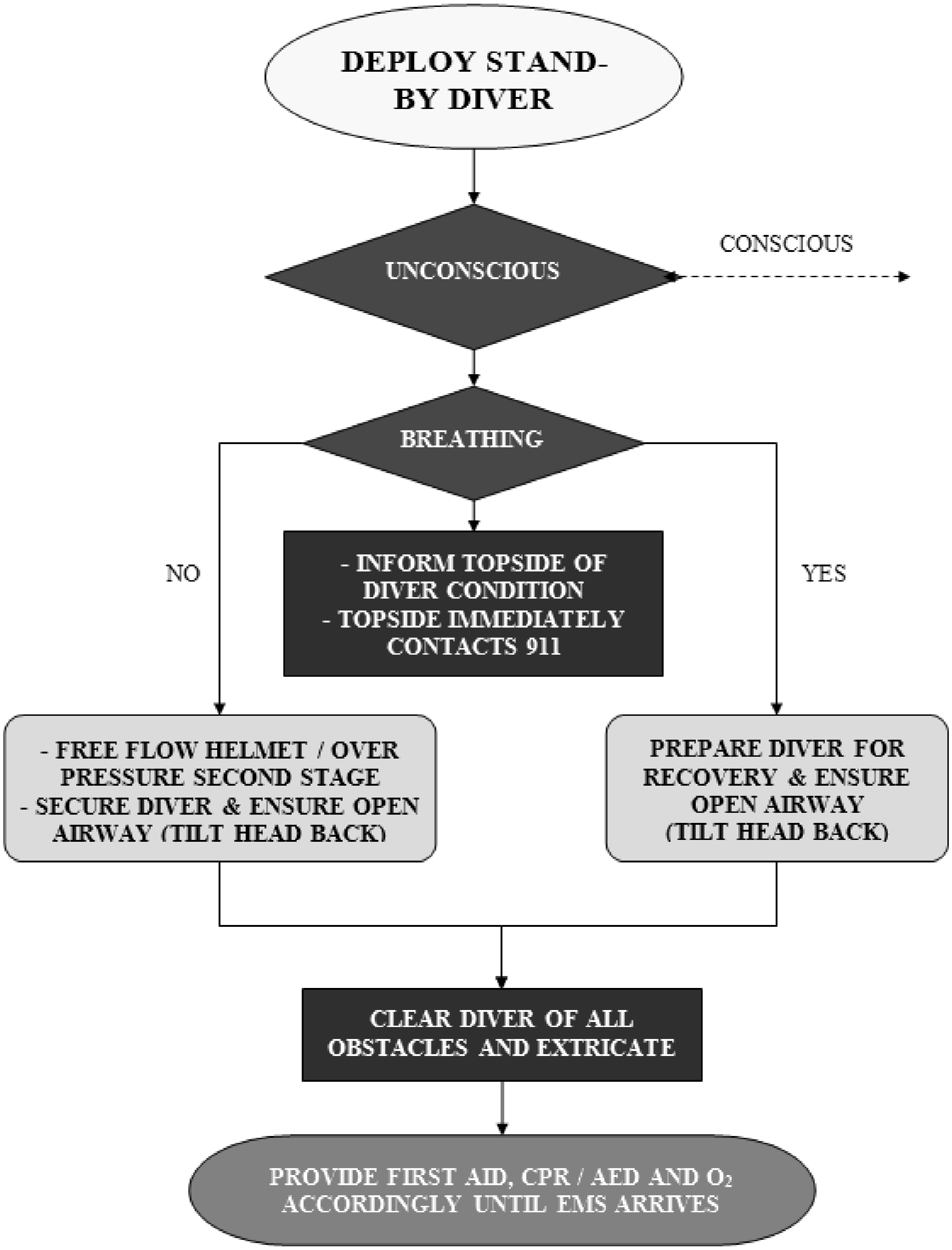
EMERGENCY PROCEDURES



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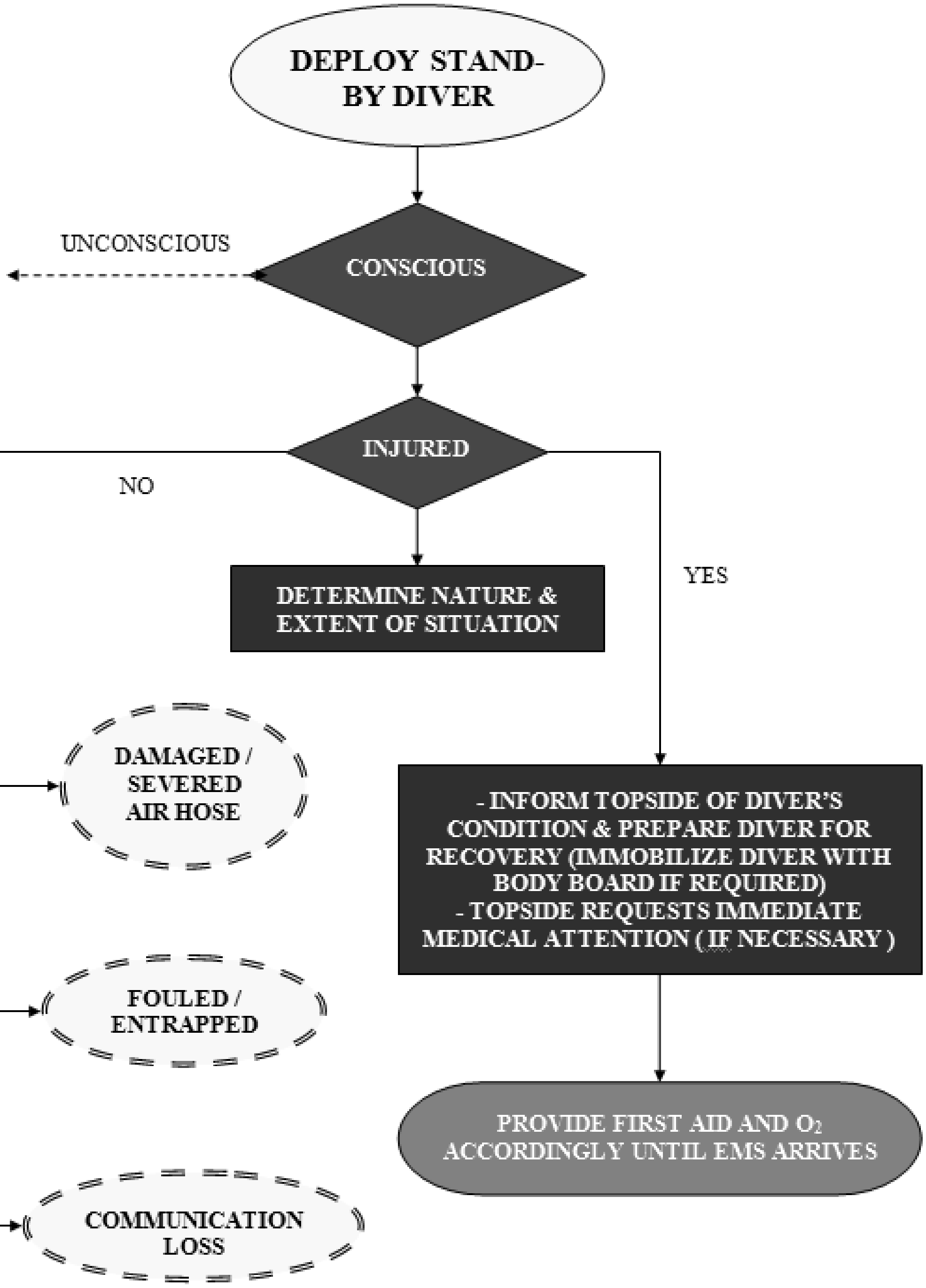

ATTACHMENT 5

EMERGENCY PHONE NUMBERS CHECKLIST

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ATTACHMENT 5

EMERGENCY PHONE NUMBERS CHECKLIST

PROJECT NAME/NUMBER:____

RECOMPRESSION CHAMBER:

ADDRESS/ LAT-LONG ____

PHONE NUMBER: ____

POC: ____

RESPONSE TIME: ____

HOSPITAL:

ADDRESS/ LAT-LONG ____

PHONE NUMBER: ____

POC: ____

RESPONSE TIME: ____

AIR TRANSPORTATION:

ADDRESS/ LAT-LONG ____

PHONE NUMBER: ____

POC: ____

RESPONSE TIME: ____

SEA TRANSPORTATION:

ADDRESS/ LAT-LONG ____

PHONE NUMBER: ____

POC: ____

RESPONSE TIME: ____

ATTACHMENT 5

EMERGENCY PHONE NUMBERS CHECKLIST

PROJECT NAME/NUMBER:____

AMBULANCE:

ADDRESS/ LAT-LONG ____

PHONE NUMBER: ____

POC: ____

RESPONSE TIME: ____

PHYSICIAN:

ADDRESS/LAT-LONG ____

PHONE NUMBER: ____

POC: ____

RESPONSE TIME: ____

COMMUNICATIONS:

ADDRESS/ LAT-LONG ____

PHONE NUMBER: ____

POC: ____

RESPONSE TIME: ____

USCG RESCUE:

ADDRESS/ LAT-LONG ____

PHONE NUMBER: ____

POC: ____

RESPONSE TIME: ____

NOTE – THIS CHECKLIST WILL BE PROMINENTLY POSTED AT THE DIVE SITE AND BE PLACED IN ALL BOATS AND RESPONSE VEHICLES.

ATTACHMENT 6

WORKING DIVE LOG

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ATTACHMENT 6

TETRA TECH TMR WORKING DIVE LOG

1. All Tetra Tech TMR (Tt TMR) dives will be recorded on this attachment during field operations each dive day.

2. The information on these working Dive Logs will be then transferred/ recorded on the Tt TMR Dive Smooth Log by the Dive Supervisor/ or designee and forwarded to the Project Manager for the official project files. A copy will be further forwarded to the Chairman of the Tt TMR Diving Review Board.

   For scientific divers, a copy will also be sent to the Tt TMR Diving Safety Officer. The Chairman of the Diving Review Board will retain this log for 1 year, except where there has been an injury or incident of decompression sickness and then the record will be retained for 5 years.

3. Definitions:

   a. Old Group – Repetitive group designation from previous dive. Leave blank if this is the first dive.

   b. Surface Interval – The time, which a diver has spent on the surface following a dive. It begins as soon as the diver surfaces and ends as soon as the diver starts his/her next descent. Not required for first dive.

   c. RNT – RESIDUAL NITROGEN TIME – Time, in minutes, which must be added to the bottom time of a repetitive dive to compensate for the nitrogen still in solution in a diver's tissues from a previous dive.

   d. Depth – Depth of current dive.

   e. Bottom Time – The total elapsed time from when the divers leave the surface to the time (rounded up to the next whole minute) they begin their ascent from the bottom.

   f. Decompression time – Decompression schedule/decompression time.

   g. Equivalent Single Dive Time – RNT plus actual bottom time.

   h. New Group – REPETITIVE GROUP DESIGNATION – A letter, which is used to relate directly to the amount of residual nitrogen remaining in a diver's body.

4. RNT Exception Rule – If performing a repetitive dive to the same depth or deeper, and the RNT is greater than the bottom time of the previous dive, use the bottom time of the previous dive as the RNT.

5. See Attachment 10 for the required U.S. Navy Dive Tables needed to complete these logs.

ATTACHMENT 6

TETRA TECH EC WORKING DIVE LOG

PROJECT NAME/NUMBER: ____ **DATE:** ________________________

NAME	LS	RS	TBT	DEPTH	TDT	RNT	ESDT	T/S	REPET GROUP	SI
DIVE SUPERVISOR					STBY DIVER					

ATTACHMENT 7

DIVE SMOOTH LOG

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ATTACHMENT 7

TETRA TECH TMR DIVE SMOOTH LOG

PROJECT NAME/ NUMBER: ____

1. All Tetra Tech TMR dives will be recorded on this attachment and be the final legal record concerning a diver's hyperbaric exposure during operations.

2. Upon completion of the project or weekly, all working Dive Logs from Attachment 6 will be recorded on this Dive Smooth Log by the Dive Supervisor/ Lead Diver and forwarded to the Project Manager for the Project files and the Chairman Diving Review Board. For science divers, a copy will also be sent to the Tt TMR Diving Safety Officer. The Chairman of the Diving Review Board will retain this log for 1 year, except where there has been an injury or incident of decompression sickness and then the record will be retained for 5 years.

3. Data field definitions:

   a) Date – Date of the diving operation.
   b) Project Name – Name of the Project that dive operations are supporting.
   c) Project Number – Associated Project number.
   d) Location – General Project Location.
   e) Platform – Platform from which the dive operations are conducted.
   f) Gas Source – Source of diver's breathing medium.
   g) Apparatus – The diving mode and equipment used during the operation.
   h) Dress – The exposure protection used by the diver(s).
   i) Project Location – The specific location in the project location that the dive is conducted.
   j) Air Temp – The ambient air temperature at the project dive site.
   k) Current – The observed or reported current at the dive site.
   l) Visibility – The observed underwater visibility reported by the diver(s) at depth.
   m) Altitude – The observed altitude recorded at the dive site.
   n) Water Temp – The observed underwater temperature reported by the diver(s) at depth.
   o) Wave Ht. – The observed wave height recorded at the dive site.
   p) Bottom Type – The observed bottom type reported by the diver(s) at depth.
   q) Tools Used – The tools used for the specific Project task during the dive.
   r) Divers Name – Self-explanatory.
   s) Left Surface (LS) – The recorded time that the diver(s) left the surface (begin descent)
   t) Left Bottom (LB) – the recorded time that the diver(s) left the bottom. (begin ascent)
   u) Total Bottom Time (TBT) – the recorded bottom time (From when diver LS to diver LB).
   v) Total Decompression Time (TDT) – The recorded time of ascent (to include any decompression stops or delays) from when diver LB to diver RS.

   w) Reach Surface (RS) – The recorded time that the diver(s) reach the surface.

x) Total Time of Dive (TTD) – The recorded time from when the diver(s) LS to when the diver(s) RS.

y) Depth – The deepest depth recorded of the reported dive.

z) Surface Interval (SI) – The time, that a diver has spent on the surface following a dive. It begins as soon as the diver surfaces and ends as soon as the diver starts his/her next descent. Not required for first dive.

aa) Residual Nitrogen Time (RNT) – Time, in minutes, which must be added to the bottom time of a repetitive dive to compensate for the nitrogen still in solution in a diver's tissues from a previous dive.

bb) Equivalent Single Dive Time (ESDT) – A diver’s RNT time plus total bottom time. Used to measure remaining time and new schedule for repetitive dives

cc) Table and Schedule (T/S) – The Table and Schedule used to measure a diver’s hyperbaric exposure for a recorded dive.

dd) Repetitive Group (RG) – Repetitive group designation from previous dive and used for repetitive and final dive calculations. Leave blank if this is the diver’s first dive.

4. RNT Exception Rule – If performing a repetitive dive to the same depth or deeper, and the RNT is greater than the bottom time of the previous dive, use the bottom time of the previous dive as the RNT.

5. Repetitive Group Designation – A final letter designation, which is used to relate directly to the amount of residual nitrogen remaining in a diver's body after that dive.

6. Use the applicable U.S. Navy Dive Tables located in Attachment 10. These tables are required to complete this log.

TETRA TECH

DIVE LOG

Project

Date:

Project Name:

Project Number:

Location:

Equipment

Platform:

Gas Source:

Apparatus:

Dress:

Environment

Project Location:

Air Temp:

Current:

Visibility:

Altitude:

Water Temp:

Wave Ht.

Bottom Type:

Tools Used:

Dive Data

Diver (Last, First MI)	LS	LB	TBT	TDT	RS	TTD	Depth	SI	RNT	ESDT	T/S	RG	NOTES

Dive Description

Purpose:

Description:

Approval

Signature:

Dive Supervisor:

Date:

ATTACHMENT 8

USN DIVING LINE PULL AND HAND SIGNALS

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ATTACHMENT 8

USN DIVING LINE PULL AND HAND SIGNALS

From Tender to Diver		From Diver to Tender	
1 Pull	**Are you all right? When diver is descending, 1 pull means STOP.**	**1 Pull**	**I am all right. When diver is descending, 1 pull means I am on the bottom.**
2 Pulls	**Leave surface; Go down.**	**2 Pulls**	**Give me slack.**
3 Pulls	**Standby to come up.**	**3 Pulls**	**Take up my slack.**
4 Pulls	**Come up.**	**4 Pulls**	**Haul me up.**
7 Pulls	**On/Off search signals.**	**7 Pulls**	**On/Off search signals.**
1 Pull	**Stop and search where you are at.**	**2-1 Pull**	**I understand, Talk to me.**
2 Pulls	**Move directly away from the tender if given slack; Move towards the tender if strain is taken.**	**3-2 Pulls**	**More air.**
3 Pulls	**Face umbilical, take a strain, and move RIGHT.**	**4-3 Pulls**	**Less air.**
4 Pulls	**Face umbilical, take a strain, and move LEFT.**	**1-2-3 Pulls**	**Send me a square mark.**
2-1 Pull	**I understand, talk to me.**	**2-1-2 Pulls**	**Send me a slate.**
3-2 Pulls	**Ventilate rig.**	**5 Pulls**	**Send me a line.**
4-3 Pulls	**Circulate rig.**	**5-5 Pulls**	**Reacquired anomaly *(for UXO tasking only).***
EMERGENCY—From Diver to Tender			
2-2-2 Pulls	**I am fouled and need assistance ("I need you").**		
3-3-3 Pulls	**I am fouled but can clear myself ("I need me").**		
4-4-4 Pulls	**Haul me up immediately.**		

ATTACHMENT 8

USN DIVING LINE PULL AND HAND SIGNALS

	Meaning/Signal	Comment
	**STOP** Clenched fist.	
	**SOMETHING IS WRONG** Hand flat, fingers together, palm out, thumb down then hand rocking back and forth on axis of forearm.	This is the opposite of Okay. The signal does not indicate an emergency.
 	**I AM OKAY or ARE YOU OKAY?** Thumb and forefinger making a circle with three remaining fingers extended (if possible).	Divers wearing mittens may not be able to extend three remaining fingers distinctly. Short range use.
 	**OKAY ON THE SURFACE (CLOSE)** Right hand raised overhead giving Okay signal with fingers. **OKAY ON THE SURFACE (DISTANT)** Both hands touching overhead with both arms bent at 45° angle.	Given when diver is close to pickup boat. Given when diver is at a distance from the pickup boat.
	**DISTRESS or HELP or PICK ME UP** Hand waving overhead (diver may also thrash hand in water).	Indicates immediate aid is required.
	**WHAT TIME? or WHAT DEPTH?** Diver points to either watch or depth gauge.	When indicating time, this signal is commonly used for bottom time remaining.
	**GO DOWN or GOING DOWN** Two fingers up, two fingers and thumb against palm.	
	**GO UP or GOING UP** Four fingers pointing up, thumb against palm.	
 	**I'M OUT OF AIR** Hand slashing or chopping at throat. **I NEED TO BUDDY BREATHE** Fingers pointing to mouth or regulator.	Indicates signaler is out of air. Signaler's regulator may be in or out of mouth.

Figure 7-9. SCUBA Hand Signals (page 1 of 3).

ATTACHMENT 8

USN DIVING LINE PULL AND HAND SIGNALS

	Meaning/Signal	Comment
	**COME HERE** Hand to chest, repeated.	
	**ME or WATCH ME** Finger to chest, repeated.	
	**OVER, UNDER, or AROUND** Fingers together and arm moving in and over, under, or around movement.	Diver signals intention to move over, under, or around an object.
	**LEVEL OFF or HOW DEEP?** Fingers and thumb spread out and hand moving back and forth in a level position.	
	**GO THAT WAY** Fist clenched with thumb pointing up, down, right, or left.	Indicates which direction to swim.
	**WHICH DIRECTION?** Fingers clenched, thumb and hand rotating right and left.	
	**EAR TROUBLE** Diver pointing to either ear.	Divers should ascend a few feet. If problem continues, both divers must surface.
	**I'M COLD** Both arms crossed over chest.	
	**TAKE IT EASY OR SLOW DOWN** Hand extended, palm down, in short up-and-down motion.	
	**YOU LEAD, I'LL FOLLOW** Index fingers extended, one hand forward of the other.	

Figure 7-9. SCUBA Hand Signals (page 2 of 3).

ATTACHMENT 8

USN DIVING LINE PULL AND HAND SIGNALS

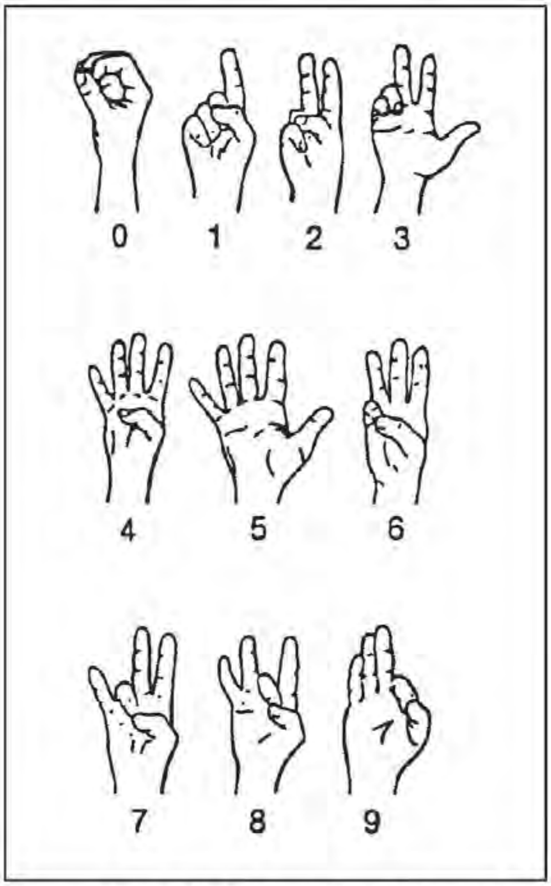

Figure 7-9. SCUBA Hand Signals (page 3 of 3).

NIGHT DIVING SIGNALS
(Buddy at Distance)

When buddy is near, use regular hand signals in front of light.

Something is wrong.
I require assistance.
(Large, rapid up-and-down motions with arm extended.)

I am Okay.
Are you Okay?
(Large, slow circles with light.)

ATTACHMENT 9

COLD WATER CONSIDERATIONS AND SAFETY PRECAUTIONS

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ATTACHMENT 9

COLD WATER CONSIDERATIONS AND SAFETY PRECAUTIONS

UNDER ICE DIVING

Diving under the ice requires extremely specialized training and equipment and will not be performed by Tetra Tech TMR employees unless approved by the Diving Review Board.

COLD WATER DIVING

In addition to decompression, thermal problems arising from exposure to cold water pose the major consideration when planning operational dives and selecting equipment. The working diver commonly experiences heat loss during immersion and often expects to be uncomfortably chilled at the end of a dive. Bottom time limits may be determined by the diver's cold tolerance rather than by decompression considerations.

An individual thoroughly conditioned physically can be transported from warm climates into cold climates and immediately begin diving without harmful effects. However, individuals differ in how well suited they are for cold weather operations. At least half of the diving team should have previous experience in ice or cold water diving operations and should be well qualified to train the less experienced.

Personnel scheduled to go to Polar Regions should be instructed in cold weather physiology and the prevention of cold injuries. To prevent injury, any techniques that aid heat balance, protection, and basic metabolism should be used.

Cold water immersion may also cause excessive urination, severely dehydrating the diver. This in turn reduces performance and may increase the risk of developing decompression sickness. A diver who is dehydrated may appear normal in the water. However, exiting the water combined with warming of the skin may cause pooling of the blood in the extremities leading to fainting. This means that divers who have been in cold water for any period of time and who appear cold should be assisted from the water and sit or lie down and take fluids until they are sure they can stand without problems.

Vertigo is caused by cold water stimulating the balance mechanism of the inner ear.

In repetitive diving with cold exposure, the operation should be planned so that the diver is re-warmed to the point of sweating before diving again. If cold water exposures are severe and if more than a 30-minute duration, then consideration should be given to requiring an overnight rest between exposures. The diver must also have sufficient non-caffeine beverages to replace the excessive body fluid loss from cold water induced urination.

The support equipment required for ice and cold water diving must be carefully evaluated for effectiveness and suitability.

Maintaining proper body temperature is particularly difficult for a diver working underwater. The principal temperature control problem encountered by divers involves keeping the body warm. The high thermal conductivity of water, coupled with the normally cool-to-cold waters in which divers operate, can result in rapid and excessive heat loss. At extremely low temperatures or with prolonged immersion, body heat loss will reach a point at which death will occur. Appropriate dress can greatly reduce the effects of heat loss, and a diver with proper dress can work in very cold water for reasonable periods of time.

ATTACHMENT 9

COLD WATER CONSIDERATIONS AND SAFETY PRECAUTIONS

In very cold water, the wet suit is only a marginally effective thermal protective measure and its use exposes the diver to hypothermia and restricts available bottom time. The use of alternative thermal protective equipment should be considered in these circumstances.

The variable volume dry suit and hot water suit are effective means of thermal protection for cold water diving. Wet suits made of incompressible material are now available. Such suits offer more protection at depth than standard wet suits of the same thickness. Prior to the use of variable volume dry suits and hot water suits in cold and ice-covered waters, divers must be trained in their use and be thoroughly familiar with the operation of these suits.

More weight must be used with a variable volume dry suit than with a wet suit due to the great positive buoyancy of a dry suit. Manufacturer's recommendations should be followed to select starting weight. The additional weight makes use of a weight vest or harness desirable. A shoulder harness is one method of preventing the heavy, awkward belts from slipping down during a dive. A few heavy hip hugger weights are better than several smaller weights.

Both single- and double-hose regulators are used for ice and cold water diving. The single-hose regulator is preferred for buddy breathing, is less bulky, and is easier to maintain than the double-hose; however, it is more subject to freeze-up than the double-hose regulator. Due to the serious nature of the freeze-up problems in single-hose regulators, they should not be allowed to free-flow or be purged for over five seconds at a time. Only regulators having a cold water conversion will be used for ice/cold water diving.

The single-hose regulator should be kept in a warm place before diving. It is important that the divers test the regulator in a warm place, then refrain from breathing it until submerging. When returning to the surface, the regulator should remain submerged and the diver should refrain from breathing from the regulator until re-submerging. The diver's time on the surface should be kept to a minimum. Once under the water, chances of a freeze-up are reduced. However, if a regulator is allowed to free-flow at depth for as little as 5 seconds, freeze-up may occur. The diver should therefore avoid purging the second stage of the regulator when diving in cold water. If water needs to be purged from the mouthpiece, the diver should do so by exhaling into it.

Where water temperature is at or below 37ºF, a redundant SCUBA system (twin SCUBA bottles, each having a "K" valve and an approved cold water regulator) or twin SCUBA bottles with one common manifold and an approved cold water regulator (with octopus) may be used. When selecting the redundant SCUBA system, maximum depth and bottom time are greatly reduced because the extra SCUBA will be used for emergencies only.

Using surface supplied diving in cold water requires detailed operations planning and extensive logistical support. This includes thermal protection for an elaborate dive station and recompression chamber and hot water heating equipment. In addition, dive equipment may require cold climate modification. Because of logistical considerations, scuba is used in most ice diving situations. However, surface supplied diving may be required because of prolonged bottom times, depth requirements, and complex communications between topside and diver. When diving in cold water that is not ice covered, logistic and equipment support requirements are reduced; however, very cold water poses many of the same dangers to the surface-supplied diver as ice diving.

The diver's mask may show an increased tendency to fog in cold water. An anti-fog solution should be used to prevent this from occurring. Saliva will not prevent this fogging.

HYPOTHERMIA

When diving in cold water, hypothermia may predispose the diver to decompression sickness. Hypothermia is easily diagnosed. The hypothermic diver loses muscle strength, the ability to concentrate, and may become irrational or confused. The victim may shiver violently, or, with severe hypothermia, shivering may be replaced by muscle rigidity. Profound hypothermia may so depress the heartbeat and respiration that the victim appears dead. However, a diver should not be considered dead until the diver has been re-warmed and all resuscitation attempts have been proven to be unsuccessful.

Hypothermia demands immediate treatment and prompt evacuation to a medical facility. A hypothermic diver must not be allowed to walk; i.e., the diver should be transported in a horizontal position. Improper handling of the diver can cause dangerous rhythms of the heart and a drop in the body core temperature, known as after drop. The local/responding medical facility must be notified of the possibility of hypothermia PRIOR to the commencement of diving operations. Emergency re-warming and evacuation plans should be established with their recommendations.

Some of the signs and symptoms of hypothermia are shivering, mental confusion, and loss of memory, speech /sensory impairment, and hallucinations. At approximately 88ºF, all shivering stops, the victim will not recognize familiar people, followed by the victim experiencing muscle rigidity and loss of consciousness.

ATTACHMENT 9

COLD WATER CONSIDERATIONS AND SAFETY PRECAUTIONS

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ATTACHMENT 10

U.S. NAVY DIVE TABLES

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ATTACHMENT 10

U.S. NAVY DIVE TABLES

1. All Tetra Tech TMR dive logs will use the tables in the attachment to complete the dive logs in Attachment 6 and 7 and when developing any Tt TMR project Health and Safety Dive Plans.

2. **U.S. Navy No-Decompression Table (Table 9-7)** – This table gives the maximum time that can be spent at a given depth without the need for decompression stops during the subsequent ascent to the surface. This table is sometimes called the “no-stop” table. At depths of 20 feet of seawater (FSW) and shallower, there is no limit on the amount of time that can be spent at depth. Deeper than 20 FSW, the time that can be spent is limited. For example, at 60 FSW, any dive longer than 63 minutes will require decompression stops.

   The No-Decompression Table also provides the repetitive group designators for dives that fall within the no-decompression limits. Even though no decompression stops are required during ascent, the diver still surfaces with some residual nitrogen in his tissues. This residual nitrogen needs to be accounted for if a repetitive dive is planned. If a diver exceeds the limits given in the No-Decompression Table, then the decompression stop requirement must be calculated using U.S Navy Standard Air Table (Table 9-9).

   For each depth listed in the No-Decompression Table, the corresponding no decompression limit is indicated in the second column. This limit is the maximum bottom time that a diver may spend at that depth and still return to the surface without taking decompression stops. To find the no-decompression limit, enter the table at the depth equal to or next greater than the maximum depth of the dive.

   Follow that row to the second column to obtain the no-decompression limit. The columns to the right of the no-decompression limit column contain the repetitive group designators for dives with bottom times equal to or shorter than the no-decompression limit. A repetitive group designator must be assigned to a diver after every dive, even a no-decompression dive.

3. **Optional Shallow Water No-Decompression Table (Table 2A-1)** – This table contains an expanded version of Table 9-7 and Table 9-8 covering the depth range of 30–50 FSW in one-foot increments. In this depth range, a small change in the diver’s maximum depth can make a substantial difference in the allowable no-decompression time. For example, at 35 FSW the no-decompression limit is 232 minutes; at 40 FSW it is only 163 minutes, more than an hour less. When the diver’s maximum depth is accurately known at the beginning of the dive, for example in ballast tank dives, or when continuous depth recording is available, for example with a decompression computer, the expanded table can be used to maximize no-decompression time.

   These optional tables are most suited to ship husbandry diving, but can be used in other shallow air diving applications as well.

4. **Residual Nitrogen Time Table for Repetitive Air Dives (Figure 9-8)** - The procedures for conducting a repetitive dive are summarized in this table. Upon completing the first dive, the diver is assigned a repetitive group designator from either the Air Decompression Table or the No-Decompression Table. This designator tells the diver how much residual nitrogen he has

upon surfacing from the first dive. A diver in Group A has the lowest amount of residual nitrogen; a diver in Group Z has the highest.

As nitrogen passes out of the diver's body during the surface interval, the repetitive group designation changes to a lower letter group to reflect the lower quantity of residual nitrogen.

The top half of the table allows the repetitive group designator to be determined at any time during the surface interval. The lower half of the table gives the Residual Nitrogen Time (RNT) corresponding to the repetitive group designator at the end of the surface interval and the depth of the repetitive dive. The residual nitrogen time is the time a diver would have had to spend at the depth of the repetitive dive to absorb the amount of nitrogen he has left over from the previous dive. The residual nitrogen time is added to the bottom time of the repetitive dive to obtain the Equivalent Single Dive Time (ESDT).

The decompression schedule for the repetitive dive is obtained by entering either the Air Decompression Table or the No-Decompression Table at the depth of the repetitive dive and the equivalent single dive time.

NOTE: When using the Optional Shallow Water No Decompression Tables above ensure the corresponding *Residual Nitrogen Timetable for Repetitive Shallow Water Air Dives (Table 2A-2)* is used for your repetitive dive calculations.

5. **U.S Navy Standard Air Table (Table 9-9)** – This table combines three modes of decompression into one table. These modes are: (1) in-water decompression on air, (2) in-water decompression on air and oxygen, and (3) surface decompression on oxygen.

   Refer to reference (b), Chapter 9, when using the Standard Air Tables in any of the above modes when developing HASDPs where decompression diving profiles are anticipated.

   These tables are to be available to the Dive Supervisor/ Lead Diver on Tt TMR dive sites for emergency procedure in water decompression on planned no decompression dive plans.

Table 9-7. *No-Decompression Limits and Repetitive Group Designators for No-Decompression Air Dives.*

Depth (fsw)	No-Stop Limit	Repetitive Group Designation															
		A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	Z
10	Unlimited	57	101	158	245	426	*										
15	Unlimited	36	60	88	121	163	217	297	449	*							
20	Unlimited	26	43	61	82	106	133	165	205	256	330	461	*				
25	1102	20	33	47	62	78	97	117	140	166	198	236	285	354	469	992	1102
30	371	17	27	38	50	62	76	91	107	125	145	167	193	223	260	307	371
35	232	14	23	32	42	52	63	74	87	100	115	131	148	168	190	215	232
40	163	12	20	27	36	44	53	63	73	84	95	108	121	135	151	163	
45	125	11	17	24	31	39	46	55	63	72	82	92	102	114	125		
50	92	9	15	21	28	34	41	48	56	63	71	80	89	92			
55	74	8	14	19	25	31	37	43	50	56	63	71	74				
60	63	7	12	17	22	28	33	39	45	51	57	63					
70	48	6	10	14	19	23	28	32	37	42	47	48					
80	39	5	9	12	16	20	24	28	32	36	39						
90	33	4	7	11	14	17	21	24	28	31	33						
100	25	4	6	9	12	15	18	21	25								
110	20	3	6	8	11	14	16	19	20								
120	15	3	5	7	10	12	15										
130	12	2	4	6	9	11	12										
140	10	2	4	6	8	10											
150	8		3	5	7	8											
160	7		3	5	6	7											
170	6			4	6												
180	6			4	5	6											
190	5			3	5												

* Highest repetitive group that can be achieved at this depth regardless of bottom time.

Table 9-8. Residual Nitrogen Time Table for Repetitive Air Dives.

Locate the diver's repetitive group designation from his previous dive along the diagonal line above the table. Read horizontally to the interval in which the diver's surface interval lies.

Next, read vertically downward to the new repetitive group designation. Continue downward in this same column to the row that represents the depth of the repetitive dive. The time given at the intersection is residual nitrogen time, in minutes, to be applied to the repetitive dive.

* Dives following surface intervals longer than this are not repetitive dives. Use actual bottom times in the Air Decompression Tables to compute decompression for such dives.

Repetitive Group at Beginning of Surface Interval	Z	O	N	M	L	K	J	I	H	G	F	E	D	C	B	A
A																:10 2:20 *
B															:10 1:16	1:17 3:36 *
C														:10 :55	:56 2:11	2:12 4:31 *
D													:10 :52	:53 1:47	1:48 3:03	3:04 5:23 *
E												:10 :52	:53 1:44	1:45 2:39	2:40 3:55	3:56 6:15 *
F											:10 :52	:53 1:44	1:45 2:37	2:38 3:31	3:32 4:48	4:49 7:08 *
G										:10 :52	:53 1:44	1:45 2:37	2:38 3:29	3:30 4:23	4:24 5:40	5:41 8:00 *
H									:10 :52	:53 1:44	1:45 2:37	2:38 3:29	3:30 4:21	4:22 5:16	5:17 6:32	6:33 8:52 *
I								:10 :52	:53 1:44	1:45 2:37	2:38 3:29	3:30 4:21	4:22 5:13	5:14 6:08	6:09 7:24	7:25 9:44 *
J							:10 :52	:53 1:44	1:45 2:37	2:38 3:29	3:30 4:21	4:22 5:13	5:14 6:06	6:07 7:00	7:01 8:16	8:17 10:36 *
K						:10 :52	:53 1:44	1:45 2:37	2:38 3:29	3:30 4:21	4:22 5:13	5:14 6:06	6:07 6:58	6:59 7:52	7:53 9:09	9:10 11:29 *
L					:10 :52	:53 1:44	1:45 2:37	2:38 3:29	3:30 4:21	4:22 5:13	5:14 6:06	6:07 6:58	6:59 7:50	7:51 8:44	8:45 10:01	10:02 12:21 *
M				:10 :52	:53 1:44	1:45 2:37	2:38 3:29	3:30 4:21	4:22 5:13	5:14 6:06	6:07 6:58	6:59 7:50	7:51 8:42	8:43 9:37	9:38 10:53	10:54 13:13 *
N			:10 :52	:53 1:44	1:45 2:37	2:38 3:29	3:30 4:21	4:22 5:13	5:14 6:06	6:07 6:58	6:59 7:50	7:51 8:42	8:43 9:34	9:35 10:29	10:30 11:45	11:46 14:05 *
O		:10 :52	:53 1:44	1:45 2:37	2:38 3:29	3:30 4:21	4:22 5:13	5:14 6:06	6:07 6:58	6:59 7:50	7:51 8:42	8:43 9:34	9:35 10:27	10:28 11:21	11:22 12:37	12:38 14:58 *
Z	:10 :52	:53 1:44	1:45 2:37	2:38 3:29	3:30 4:21	4:22 5:13	5:14 6:06	6:07 6:58	6:59 7:50	7:51 8:42	8:43 9:34	9:35 10:27	10:28 11:19	11:20 12:13	12:14 13:30	13:31 15:50 *

Dive Depth	Repetitive Group at the End of the Surface Interval															
	Z	O	N	M	L	K	J	I	H	G	F	E	D	C	B	A
10	**	**	**	**	**	**	**	**	**	**	**	427	246	159	101	58
15	**	**	**	**	**	**	**	**	450	298	218	164	122	89	61	37
20	**	**	**	**	**	462	331	257	206	166	134	106	83	62	44	27
25	†	†	470	354	286	237	198	167	141	118	98	79	63	48	34	21
30	372	308	261	224	194	168	146	126	108	92	77	63	51	39	28	18
35	245	216	191	169	149	132	116	101	88	75	64	53	43	33	24	15
40	188	169	152	136	122	109	97	85	74	64	55	45	37	29	21	13
45	154	140	127	115	104	93	83	73	64	56	48	40	32	25	18	12
50	131	120	109	99	90	81	73	65	57	49	42	35	29	23	17	11
55	114	105	96	88	80	72	65	58	51	44	38	32	26	20	15	10
60	101	93	86	79	72	65	58	52	46	40	35	29	24	19	14	9
70	83	77	71	65	59	54	49	44	39	34	29	25	20	16	12	8
80	70	65	60	55	51	46	42	38	33	29	25	22	18	14	10	7
90	61	57	52	48	44	41	37	33	29	26	22	19	16	12	9	6
100	54	50	47	43	40	36	33	30	26	23	20	17	14	11	8	5
110	48	45	42	39	36	33	30	27	24	21	18	16	13	10	8	5
120	44	41	38	35	32	30	27	24	22	19	17	14	12	9	7	5
130	40	37	35	32	30	27	25	22	20	18	15	13	11	9	6	4
140	37	34	32	30	27	25	23	21	19	16	14	12	10	8	6	4
150	34	32	30	28	26	23	21	19	17	15	13	11	9	8	6	4
160	32	30	28	26	24	22	20	18	16	14	13	11	9	7	5	4
170	30	28	26	24	22	21	19	17	15	14	12	10	8	7	5	3
180	28	26	25	23	21	19	18	16	14	13	11	10	8	6	5	3
190	26	25	23	22	20	18	17	15	14	12	11	9	8	6	5	3

Residual Nitrogen Times (Minutes)

** Residual Nitrogen Time cannot be determined using this table (see paragraph 9-9.1 subparagraph 8 for instructions).

† Read vertically downward to the 30 fsw repetitive dive depth. Use the corresponding residual nitrogen times to compute the equivalent single dive time. Decompress using the 30 fsw air decompression table.

Table 2A-1. *No-Decompression Limits and Repetitive Group Designators for Shallow Water Air No-Decompression Dives.*

Depth (fsw)	No-Stop Limit (min)	Repetitive Group Designation															
		A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	Z
30	371	17	27	38	50	62	76	91	107	125	145	167	193	223	260	307	371
31	334	16	26	37	48	60	73	87	102	119	138	158	182	209	242	282	334
32	304	15	25	35	46	58	70	83	98	114	131	150	172	197	226	261	304
33	281	15	24	34	45	56	67	80	94	109	125	143	163	186	212	243	281
34	256	14	23	33	43	54	65	77	90	104	120	137	155	176	200	228	256
35	232	14	23	32	42	52	63	74	87	100	115	131	148	168	190	215	232
36	212	14	22	31	40	50	61	72	84	97	110	125	142	160	180	204	212
37	197	13	21	30	39	49	59	69	81	93	106	120	136	153	172	193	197
38	184	13	21	29	38	47	57	67	78	90	102	116	131	147	164	184	
39	173	12	20	28	37	46	55	65	76	87	99	112	126	141	157	173	
40	163	12	20	27	36	44	53	63	73	84	95	108	121	135	151	163	
41	155	12	19	27	35	43	52	61	71	81	92	104	117	130	145	155	
42	147	11	19	26	34	42	50	59	69	79	89	101	113	126	140	147	
43	140	11	18	25	33	41	49	58	67	76	87	98	109	122	135	140	
44	134	11	18	25	32	40	48	56	65	74	84	95	106	118	130	134	
45	125	11	17	24	31	39	46	55	63	72	82	92	102	114	125		
46	116	10	17	23	30	38	45	53	61	70	79	89	99	110	116		
47	109	10	16	23	30	37	44	52	60	68	77	87	97	107	109		
48	102	10	16	22	29	36	43	51	58	67	75	84	94	102			
49	97	10	16	22	28	35	42	49	57	65	73	82	91	97			
50	92	9	15	21	28	34	41	48	56	63	71	80	89	92			

Table 2A-2. *Residual Nitrogen Time Table for Repetitive Shallow Water Air Dives.*

Locate the diver's repetitive group designation from his previous dive along the diagonal line above the table. Read horizontally to the interval in which the diver's surface interval lies.

Next, read vertically downward to the new repetitive group designation. Continue downward in this same column to the row that represents the depth of the repetitive dive. The time given at the intersection is residual nitrogen time, in minutes, to be applied to the repetitive dive.

* Dives following surface intervals longer than this are not repetitive dives. Use actual bottom times in the Air Decompression Tables to compute decompression for such dives.

Repetitive Group at Beginning of Surface Interval

	Z	O	N	M	L	K	J	I	H	G	F	E	D	C	B	A
A																:10 2:20 *
B															:10 1:16	1:17 3:36 *
C														:10 :55	:56 2:11	2:12 4:31 *
D													:10 :52	:53 1:47	1:48 3:03	3:04 5:23 *
E												:10 :52	:53 1:44	1:45 2:39	2:40 3:55	3:56 6:15 *
F											:10 :52	:53 1:44	1:45 2:37	2:38 3:31	3:32 4:48	4:49 7:08 *
G										:10 :52	:53 1:44	1:45 2:37	2:38 3:29	3:30 4:23	4:24 5:40	5:41 8:00 *
H									:10 :52	:53 1:44	1:45 2:37	2:38 3:29	3:30 4:21	4:22 5:16	5:17 6:32	6:33 8:52 *
I								:10 :52	:53 1:44	1:45 2:37	2:38 3:29	3:30 4:21	4:22 5:13	5:14 6:08	6:09 7:24	7:25 9:44 *
J							:10 :52	:53 1:44	1:45 2:37	2:38 3:29	3:30 4:21	4:22 5:13	5:14 6:06	6:07 7:00	7:01 8:16	8:17 10:36 *
K						:10 :52	:53 1:44	1:45 2:37	2:38 3:29	3:30 4:21	4:22 5:13	5:14 6:06	6:07 6:58	6:59 7:52	7:53 9:09	9:10 11:29 *
L					:10 :52	:53 1:44	1:45 2:37	2:38 3:29	3:30 4:21	4:22 5:13	5:14 6:06	6:07 6:58	6:59 7:50	7:51 8:44	8:45 10:01	10:02 12:21 *
M				:10 :52	:53 1:44	1:45 2:37	2:38 3:29	3:30 4:21	4:22 5:13	5:14 6:06	6:07 6:58	6:59 7:50	7:51 8:42	8:43 9:37	9:38 10:53	10:54 13:13 *
N			:10 :52	:53 1:44	1:45 2:37	2:38 3:29	3:30 4:21	4:22 5:13	5:14 6:06	6:07 6:58	6:59 7:50	7:51 8:42	8:43 9:34	9:35 10:29	10:30 11:45	11:46 14:05 *
O		:10 :52	:53 1:44	1:45 2:37	2:38 3:29	3:30 4:21	4:22 5:13	5:14 6:06	6:07 6:58	6:59 7:50	7:51 8:42	8:43 9:34	9:35 10:27	10:28 11:21	11:22 12:37	12:38 14:58 *
Z	:10 :52	:53 1:44	1:45 2:37	2:38 3:29	3:30 4:21	4:22 5:13	5:14 6:06	6:07 6:58	6:59 7:50	7:51 8:42	8:43 9:34	9:35 10:27	10:28 11:19	11:20 12:13	12:14 13:30	13:31 15:50 *

Repetitive Group at the End of the Surface Interval

Dive Depth	Z	O	N	M	L	K	J	I	H	G	F	E	D	C	B	A
30	372	308	261	224	194	168	146	126	108	92	77	63	51	39	28	18
31	334	282	243	210	183	159	139	120	103	88	74	61	49	38	27	17
32	305	262	227	198	173	151	132	115	99	85	71	59	47	36	26	17
33	282	244	213	187	164	144	126	110	95	81	69	57	46	35	25	16
34	262	229	201	177	156	138	121	105	91	78	66	55	44	34	25	16
35	245	216	191	169	149	132	116	101	88	75	64	53	43	33	24	15
36	231	204	181	161	143	126	111	98	85	73	62	51	41	32	23	15
37	218	194	173	154	137	122	107	94	82	70	60	50	40	31	23	14
38	207	185	165	148	132	117	103	91	79	68	58	48	39	30	22	14
39	197	177	158	142	127	113	100	88	77	66	56	47	38	29	21	14
40	188	169	152	136	122	109	97	85	74	64	55	45	37	29	21	13
41	180	163	146	132	118	105	93	82	72	62	53	44	36	28	20	13
42	173	156	141	127	114	102	91	80	70	61	52	43	35	27	20	13
43	166	150	136	123	110	99	88	78	68	59	50	42	34	26	19	12
44	160	145	131	119	107	96	85	75	66	57	49	41	33	26	19	12
45	154	140	127	115	104	93	83	73	64	56	48	40	32	25	18	12
46	149	136	123	111	101	90	81	71	63	54	46	39	32	25	18	12
47	144	131	119	108	98	88	78	70	61	53	45	38	31	24	18	11
48	139	127	116	105	95	85	76	68	60	52	44	37	30	24	17	11
49	135	123	112	102	92	83	74	66	58	51	43	36	30	23	17	11
50	131	120	109	99	90	81	73	65	57	49	42	35	29	23	17	11

Residual Nitrogen Times (Minutes)

Table 9-9. *Air Decompression Table.*

(DESCENT RATE 75 FPM—ASCENT RATE 30 FPM)

Bottom Time (min)	Time to First Stop (M:S)	Gas Mix	DECOMPRESSION STOPS (FSW) Stop times (min) include travel time, except first air and first O_2 stop									Total Ascent Time (M:S)	Chamber O_2 Periods	Repet Group
			100	90	80	70	60	50	40	30	20			
30 FSW														
371	1:00	AIR									0	1:00	0	Z
		AIR/O_2									**0**	1:00		
380	0:20	AIR									5	6:00	0.5	Z
		AIR/O_2									**1**	2:00		
In-Water Air/O_2 Decompression or SurDO_2 Recommended ---														
420	0:20	AIR									22	23:00	0.5	Z
		AIR/O_2									**5**	6:00		
480	0:20	AIR									42	43:00	0.5	
		AIR/O_2									**9**	10:00		
540	0:20	AIR									71	72:00	1	
		AIR/O_2									**14**	15:00		
Exceptional Exposure: In-Water Air Decompression ------------ In-Water Air/O_2 Decompression or SurDO_2 Required -----------														
600	0:20	AIR									92	93:00	1	
		AIR/O_2									**19**	20:00		
660	0:20	AIR									120	121:00	1	
		AIR/O_2									**22**	23:00		
720	0:20	AIR									158	159:00	1	
		AIR/O_2									**27**	28:00		
35 FSW														
232	1:10	AIR									0	1:10	0	Z
		AIR/O_2									**0**	1:10		
240	0:30	AIR									4	5:10	0.5	Z
		AIR/O_2									**2**	3:10		
In-Water Air/O_2 Decompression or SurDO_2 Recommended ---														
270	0:30	AIR									28	29:10	0.5	Z
		AIR/O_2									**7**	8:10		
300	0:30	AIR									53	54:10	0.5	Z
		AIR/O_2									**13**	14:10		
330	0:30	AIR									71	72:10	1	Z
		AIR/O_2									**18**	19:10		
360	0:30	AIR									88	89:10	1	
		AIR/O_2									**22**	23:10		
Exceptional Exposure: In-Water Air Decompression ------------ In-Water Air/O_2 Decompression or SurDO_2 Required -----------														
420	0:30	AIR									134	135:10	1.5	
		AIR/O_2									**29**	30:10		
480	0:30	AIR									173	174:10	1.5	
		AIR/O_2									**38**	44:10		
540	0:30	AIR									228	229:10	2	
		AIR/O_2									**45**	51:10		
600	0:30	AIR									277	278:10	2	
		AIR/O_2									**53**	59:10		
660	0:30	AIR									314	315:10	2.5	
		AIR/O_2									**63**	69:10		
720	0:30	AIR									342	343:10	3	
		AIR/O_2									**71**	82:10		

Table 9-9. *Air Decompression Table (Continued).*

(DESCENT RATE 75 FPM—ASCENT RATE 30 FPM)

Bottom Time (min)	Time to First Stop (M:S)	Gas Mix	DECOMPRESSION STOPS (FSW) Stop times (min) include travel time, except first air and first O_2 stop									Total Ascent Time (M:S)	Chamber O_2 Periods	Repet Group
			100	90	80	70	60	50	40	30	20			
40 FSW														
163	1:20	AIR									0	1:20	0	O
		AIR/O_2									**0**	1:20		
170	0:40	AIR									6	7:20	0.5	O
		AIR/O_2									**2**	3:20		
180	0:40	AIR									14	15:20	0.5	Z
		AIR/O_2									**5**	6:20		
In-Water Air/O_2 Decompression or SurDO_2 Recommended --														
190	0:40	AIR									21	22:20	0.5	Z
		AIR/O_2									**7**	8:20		
200	0:40	AIR									27	28:20	0.5	Z
		AIR/O_2									**9**	10:20		
210	0:40	AIR									39	40:20	0.5	Z
		AIR/O_2									**11**	12:20		
220	0:40	AIR									52	53:20	0.5	Z
		AIR/O_2									**12**	13:20		
230	0:40	AIR									64	65:20	1	Z
		AIR/O_2									**16**	17:20		
240	0:40	AIR									75	76:20	1	Z
		AIR/O_2									**19**	20:20		
Exceptional Exposure: In-Water Air Decompression ------------- In-Water Air/O_2 Decompression or SurDO_2 Required -----------														
270	0:40	AIR									101	102:20	1	Z
		AIR/O_2									**26**	27:20		
300	0:40	AIR									128	129:20	1.5	
		AIR/O_2									**33**	34:20		
330	0:40	AIR									160	161:20	1.5	
		AIR/O_2									**38**	44:20		
360	0:40	AIR									184	185:20	2	
		AIR/O_2									**44**	50:20		
420	0:40	AIR									248	249:20	2.5	
		AIR/O_2									**56**	62:20		
480	0:40	AIR									321	322:20	2.5	
		AIR/O_2									**68**	79:20		
Exceptional Exposure: In-Water Air/0_2 Decompression ------------- SurDO_2 Required--														
540	0:40	AIR									372	373:20	3	
		AIR/O_2									**80**	91:20		
600	0:40	AIR									410	411:20	3.5	
		AIR/O_2									**93**	104:20		
660	0:40	AIR									439	440:20	4	
		AIR/O_2									**103**	119:20		
Exceptional Exposure: SurDO_2 ---														
720	0:40	AIR									461	462:20	4.5	
		AIR/O_2									**112**	128:20		

Table 9-9. *Air Decompression Table (Continued).*

(DESCENT RATE 75 FPM—ASCENT RATE 30 FPM)

Bottom Time (min)	Time to First Stop (M:S)	Gas Mix	DECOMPRESSION STOPS (FSW) Stop times (min) include travel time, except first air and first O_2 stop									Total Ascent Time (M:S)	Chamber O_2 Periods	Repet Group
			100	90	80	70	60	50	40	30	20			
45 FSW														
125	1:30	AIR									0	1:30	0	N
		AIR/O_2									**0**	1:30		
130	0:50	AIR									2	3:30	0.5	O
		AIR/O_2									**1**	2:30		
140	0:50	AIR									14	15:30	0.5	O
		AIR/O_2									**5**	6:30		
In-Water Air/O_2 Decompression or SurDO_2 Recommended --														
150	0:50	AIR									25	26:30	0.5	Z
		AIR/O_2									**8**	9:30		
160	0:50	AIR									34	35:30	0.5	Z
		AIR/O_2									**11**	12:30		
170	0:50	AIR									41	42:30	1	Z
		AIR/O_2									**14**	15:30		
180	0:50	AIR									59	60:30	1	Z
		AIR/O_2									**17**	18:30		
190	0:50	AIR									75	76:30	1	Z
		AIR/O_2									**19**	20:30		
Exceptional Exposure: In-Water Air Decompression ------------- In-Water Air/O_2 Decompression or SurDO_2 Required -----------														
200	0:50	AIR									89	90:30	1	Z
		AIR/O_2									**23**	24:30		
210	0:50	AIR									101	102:30	1	Z
		AIR/O_2									**27**	28:30		
220	0:50	AIR									112	113:30	1.5	Z
		AIR/O_2									**30**	31:30		
230	0:50	AIR									121	122:30	1.5	Z
		AIR/O_2									**33**	34:30		
240	0:50	AIR									130	131:30	1.5	Z
		AIR/O_2									**37**	43:30		
270	0:50	AIR									173	174:30	2	
		AIR/O_2									**45**	51:30		
300	0:50	AIR									206	207:30	2	
		AIR/O_2									**51**	57:30		
330	0:50	AIR									243	244:30	2.5	
		AIR/O_2									**61**	67:30		
360	0:50	AIR									288	289:30	3	
		AIR/O_2									**69**	80:30		
Exceptional Exposure: In-Water Air/0_2 Decompression ------------- SurDO_2 Required--														
420	0:50	AIR									373	374:30	3.5	
		AIR/O_2									**84**	95:30		
480	0:50	AIR									431	432:30	4	
		AIR/O_2									**101**	117:30		
Exceptional Exposure: SurDO_2 --														
540	0:50	AIR									473	474:30	4.5	
		AIR/O_2									**117**	133:30		

Table 9-9. *Air Decompression Table (Continued).*

(DESCENT RATE 75 FPM—ASCENT RATE 30 FPM)

Bottom Time (min)	Time to First Stop (M:S)	Gas Mix	DECOMPRESSION STOPS (FSW) Stop times (min) include travel time, except first air and first O_2 stop									Total Ascent Time (M:S)	Chamber O_2 Periods	Repet Group
			100	90	80	70	60	50	40	30	20			
50 FSW														
92	1:40	AIR									0	1:40	0	M
		AIR/O_2									**0**	1:40		
95	1:00	AIR									2	3:40	0.5	M
		AIR/O_2									**1**	2:40		
100	1:00	AIR									4	5:40	0.5	N
		AIR/O_2									**2**	3:40		
110	1:00	AIR									8	9:40	0.5	O
		AIR/O_2									**4**	5:40		
In-Water Air/O_2 Decompression or SurDO_2 Recommended --														
120	1:00	AIR									21	22:40	0.5	O
		AIR/O_2									**7**	8:40		
130	1:00	AIR									34	35:40	0.5	Z
		AIR/O_2									**12**	13:40		
140	1:00	AIR									45	46:40	1	Z
		AIR/O_2									**16**	17:40		
150	1:00	AIR									56	57:40	1	Z
		AIR/O_2									**19**	20:40		
160	1:00	AIR									78	79:40	1	Z
		AIR/O_2									**23**	24:40		
Exceptional Exposure: In-Water Air Decompression ------------- In-Water Air/O_2 Decompression or SurDO_2 Required -----------														
170	1:00	AIR									96	97:40	1	Z
		AIR/O_2									**26**	27:40		
180	1:00	AIR									111	112:40	1.5	Z
		AIR/O_2									**30**	31:40		
190	1:00	AIR									125	126:40	1.5	Z
		AIR/O_2									**35**	36:40		
200	1:00	AIR									136	137:40	1.5	Z
		AIR/O_2									**39**	45:40		
210	1:00	AIR									147	148:40	2	
		AIR/O_2									**43**	49:40		
220	1:00	AIR									166	167:40	2	
		AIR/O_2									**47**	53:40		
230	1:00	AIR									183	184:40	2	
		AIR/O_2									**50**	56:40		
240	1:00	AIR									198	199:40	2	
		AIR/O_2									**53**	59:40		
270	1:00	AIR									236	237:40	2.5	
		AIR/O_2									**62**	68:40		
300	1:00	AIR									285	286:40	3	
		AIR/O_2									**74**	85:40		
Exceptional Exposure: In-Water Air/O_2 Decompression ------------- SurDO_2 Required---														
330	1:00	AIR									345	346:40	3.5	
		AIR/O_2									**83**	94:40		
360	1:00	AIR									393	394:40	3.5	
		AIR/O_2									**92**	103:40		
Exceptional Exposure: SurDO_2 ---														
420	1:00	AIR									464	465:40	4.5	
		AIR/O_2									**113**	129:40		

Table 9-9. Air Decompression Table (Continued).

(DESCENT RATE 75 FPM—ASCENT RATE 30 FPM)

Bottom Time (min)	Time to First Stop (M:S)	Gas Mix	DECOMPRESSION STOPS (FSW) Stop times (min) include travel time, except first air and first O_2 stop									Total Ascent Time (M:S)	Chamber O_2 Periods	Repet Group
			100	90	80	70	60	50	40	30	20			
55 FSW														
74	1:50	AIR									0	1:50	0	L
		AIR/O_2									**0**	1:50		
75	1:10	AIR									1	2:50	0.5	L
		AIR/O_2									**1**	2:50		
80	1:10	AIR									4	5:50	0.5	M
		AIR/O_2									**2**	3:50		
90	1:10	AIR									10	11:50	0.5	N
		AIR/O_2									**5**	6:50		
In-Water Air/O_2 Decompression or SurDO_2 Recommended --														
100	1:10	AIR									17	18:50	0.5	O
		AIR/O_2									**8**	9:50		
110	1:10	AIR									34	35:50	0.5	O
		AIR/O_2									**12**	13:50		
120	1:10	AIR									48	49:50	1	Z
		AIR/O_2									**17**	18:50		
130	1:10	AIR									59	60:50	1	Z
		AIR/O_2									**22**	23:50		
140	1:10	AIR									84	85:50	1	Z
		AIR/O_2									**26**	27:50		
Exceptional Exposure: In-Water Air Decompression ------------- In-Water Air/O_2 Decompression or SurDO_2 Required -----------														
150	1:10	AIR									105	106:50	1.5	Z
		AIR/O_2									**30**	31:50		
160	1:10	AIR									123	124:50	1.5	Z
		AIR/O_2									**34**	35:50		
170	1:10	AIR									138	139:50	1.5	Z
		AIR/O_2									**40**	46:50		
180	1:10	AIR									151	152:50	2	Z
		AIR/O_2									**45**	51:50		
190	1:10	AIR									169	170:50	2	
		AIR/O_2									**50**	56:50		
200	1:10	AIR									190	191:50	2	
		AIR/O_2									**54**	60:50		
210	1:10	AIR									208	209:50	2.5	
		AIR/O_2									**58**	64:50		
220	1:10	AIR									224	225:50	2.5	
		AIR/O_2									**62**	68:50		
230	1:10	AIR									239	240:50	2.5	
		AIR/O_2									**66**	77:50		
240	1:10	AIR									254	255:50	3	
		AIR/O_2									**69**	80:50		
Exceptional Exposure: In-Water Air/0_2 Decompression ------------- SurDO_2 Required--														
270	1:10	AIR									313	314:50	3.5	
		AIR/O_2									**83**	94:50		
300	1:10	AIR									380	381:50	3.5	
		AIR/O_2									**94**	105:50		
330	1:10	AIR									432	433:50	4	
		AIR/O_2									**106**	122:50		
Exceptional Exposure: SurDO_2 --														
360	1:10	AIR									474	475:50	4.5	
		AIR/O_2									**118**	134:50		

Table 9-9. *Air Decompression Table (Continued).*

(DESCENT RATE 75 FPM—ASCENT RATE 30 FPM)

Bottom Time (min)	Time to First Stop (M:S)	Gas Mix	**DECOMPRESSION STOPS (FSW)** Stop times (min) include travel time, except first air and first O_2 stop									Total Ascent Time (M:S)	Chamber O_2 Periods	Repet Group
			100	90	80	70	60	50	40	30	20			
60 FSW														
63	2:00	AIR									0	2:00	0	K
		AIR/O_2									**0**	2:00		
65	1:20	AIR									2	4:00	0.5	L
		AIR/O_2									**1**	3:00		
70	1:20	AIR									7	9:00	0.5	L
		AIR/O_2									**4**	6:00		
80	1:20	AIR									14	16:00	0.5	N
		AIR/O_2									**7**	9:00		
In-Water Air/O_2 Decompression or SurDO_2 Recommended --														
90	1:20	AIR									23	25:00	0.5	O
		AIR/O_2									**10**	12:00		
100	1:20	AIR									42	44:00	1	Z
		AIR/O_2									**15**	17:00		
110	1:20	AIR									57	59:00	1	Z
		AIR/O_2									**21**	23:00		
120	1:20	AIR									75	77:00	1	Z
		AIR/O_2									**26**	28:00		
Exceptional Exposure: In-Water Air Decompression ------------- In-Water Air/O_2 Decompression or SurDO_2 Required -----------														
130	1:20	AIR									102	104:00	1.5	Z
		AIR/O_2									**31**	33:00		
140	1:20	AIR									124	126:00	1.5	Z
		AIR/O_2									**35**	37:00		
150	1:20	AIR									143	145:00	2	Z
		AIR/O_2									**41**	48:00		
160	1:20	AIR									158	160:00	2	Z
		AIR/O_2									**48**	55:00		
170	1:20	AIR									178	180:00	2	
		AIR/O_2									**53**	60:00		
180	1:20	AIR									201	203:00	2.5	
		AIR/O_2									**59**	66:00		
190	1:20	AIR									222	224:00	2.5	
		AIR/O_2									**64**	71:00		
200	1:20	AIR									240	242:00	2.5	
		AIR/O_2									**68**	80:00		
210	1:20	AIR									256	258:00	3	
		AIR/O_2									**73**	85:00		
220	1:20	AIR									278	280:00	3	
		AIR/O_2									**77**	89:00		
Exceptional Exposure: In-Water Air/0_2 Decompression ------------- SurDO_2 Required--														
230	1:20	AIR									300	302:00	3.5	
		AIR/O_2									**82**	94:00		
240	1:20	AIR									321	323:00	3.5	
		AIR/O_2									**88**	100:00		
270	1:20	AIR									398	400:00	4	
		AIR/O_2									**102**	119:00		
Exceptional Exposure: SurDO_2 --														
300	1:20	AIR									456	458:00	4.5	
		AIR/O_2									**115**	132:00		

Table 9-9. Air Decompression Table (Continued).

(DESCENT RATE 75 FPM—ASCENT RATE 30 FPM)

Bottom Time (min)	Time to First Stop (M:S)	Gas Mix	DECOMPRESSION STOPS (FSW) Stop times (min) include travel time, except first air and first O_2 stop									Total Ascent Time (M:S)	Chamber O_2 Periods	Repet Group
			100	90	80	70	60	50	40	30	20			
70 FSW														
48	2:20	AIR									0	2:20	0	K
		AIR/O_2									**0**	2:20		
50	1:40	AIR									2	4:20	0.5	K
		AIR/O_2									**1**	3:20		
55	1:40	AIR									9	11:20	0.5	L
		AIR/O_2									**5**	7:20		
60	1:40	AIR									14	16:20	0.5	M
		AIR/O_2									**8**	10:20		
In-Water Air/O_2 Decompression or SurDO_2 Recommended --														
70	1:40	AIR									24	26:20	0.5	N
		AIR/O_2									**13**	15:20		
80	1:40	AIR									44	46:20	1	O
		AIR/O_2									**17**	19:20		
90	1:40	AIR									64	66:20	1	Z
		AIR/O_2									**24**	26:20		
Exceptional Exposure: In-Water Air Decompression ------------- In-Water Air/O_2 Decompression or SurDO_2 Required -----------														
100	1:40	AIR									88	90:20	1.5	Z
		AIR/O_2									**31**	33:20		
110	1:40	AIR									120	122:20	1.5	Z
		AIR/O_2									**38**	45:20		
120	1:40	AIR									145	147:20	2	Z
		AIR/O_2									**44**	51:20		
130	1:40	AIR									167	169:20	2	Z
		AIR/O_2									**51**	58:20		
140	1:40	AIR									189	191:20	2.5	
		AIR/O_2									**59**	66:20		
150	1:40	AIR									219	221:20	2.5	
		AIR/O_2									**66**	78:20		
160	1:20	AIR								1	244	247:00	3	
		AIR/O_2								**1**	**72**	85:00		
Exceptional Exposure: In-Water Air/0_2 Decompression ------------- SurDO_2 Required---														
170	1:20	AIR								2	265	269:00	3	
		AIR/O_2								**1**	**78**	91:00		
180	1:20	AIR								4	289	295:00	3.5	
		AIR/O_2								**2**	**83**	97:00		
190	1:20	AIR								5	316	323:00	3.5	
		AIR/O_2								**3**	**88**	103:00		
200	1:20	AIR								9	345	356:00	4	
		AIR/O_2								**5**	**93**	115:00		
210	1:20	AIR								13	378	393:00	4	
		AIR/O_2								**7**	**98**	122:00		
Exceptional Exposure: SurDO_2 ---														
240	1:20	AIR								25	454	481:00	5	
		AIR/O_2								**13**	**110**	140:00		

Table 9-9. *Air Decompression Table (Continued).*

(DESCENT RATE 75 FPM—ASCENT RATE 30 FPM)

Bottom Time (min)	Time to First Stop (M:S)	Gas Mix	DECOMPRESSION STOPS (FSW) Stop times (min) include travel time, except first air and first O_2 stop									Total Ascent Time (M:S)	Chamber O_2 Periods	Repet Group
			100	**90**	**80**	**70**	**60**	**50**	**40**	**30**	**20**			
80 FSW														
39	2:40	AIR									0	2:40	0	J
		AIR/O_2									**0**	2:40		
40	2:00	AIR									1	3:40	0.5	J
		AIR/O_2									**1**	3:40		
45	2:00	AIR									10	12:40	0.5	K
		AIR/O_2									**5**	7:40		
In-Water Air/O_2 Decompression or SurDO_2 Recommended --														
50	2:00	AIR									17	19:40	0.5	M
		AIR/O_2									**9**	11:40		
55	2:00	AIR									24	26:40	0.5	M
		AIR/O_2									**13**	15:40		
60	2:00	AIR									30	32:40	1	N
		AIR/O_2									**16**	18:40		
70	2:00	AIR									54	56:40	1	O
		AIR/O_2									**22**	24:40		
80	2:00	AIR									77	79:40	1.5	Z
		AIR/O_2									**30**	32:40		
Exceptional Exposure: In-Water Air Decompression ------------- In-Water Air/O_2 Decompression or SurDO_2 Required -----------														
90	2:00	AIR									114	116:40	1.5	Z
		AIR/O_2									**39**	46:40		
100	1:40	AIR								1	147	150:20	2	Z
		AIR/O_2								**1**	**46**	54:20		
110	1:40	AIR								6	171	179:20	2	Z
		AIR/O_2								**3**	**51**	61:20		
120	1:40	AIR								10	200	212:20	2.5	
		AIR/O_2								**5**	**59**	71:20		
130	1:40	AIR								14	232	248:20	3	
		AIR/O_2								**7**	**67**	86:20		
Exceptional Exposure: In-Water Air/0_2 Decompression ------------- SurDO_2 Required---														
140	1:40	AIR								17	258	277:20	3.5	
		AIR/O_2								**9**	**73**	94:20		
150	1:40	AIR								19	285	306:20	3.5	
		AIR/O_2								**10**	**80**	102:20		
160	1:40	AIR								21	318	341:20	4	
		AIR/O_2								**11**	**86**	114:20		
170	1:40	AIR								27	354	383:20	4	
		AIR/O_2								**14**	**90**	121:20		
Exceptional Exposure: SurDO_2 ---														
180	1:40	AIR								33	391	426:20	4.5	
		AIR/O_2								**17**	**96**	130:20		
210	1:40	AIR								51	473	526:20	5	
		AIR/O_2								**26**	**110**	158:20		

Table 9-9. *Air Decompression Table (Continued).*

(DESCENT RATE 75 FPM—ASCENT RATE 30 FPM)

Bottom Time (min)	Time to First Stop (M:S)	Gas Mix	DECOMPRESSION STOPS (FSW) Stop times (min) include travel time, except first air and first O_2 stop									Total Ascent Time (M:S)	Chamber O_2 Periods	Repet Group
			100	90	80	70	60	50	40	30	20			
90 FSW														
33	3:00	AIR									0	3:00	0	J
		AIR/O_2									**0**	3:00		
35	2:20	AIR									4	7:00	0.5	J
		AIR/O_2									**2**	5:00		
40	2:20	AIR									14	17:00	0.5	L
		AIR/O_2									**7**	10:00		
In-Water Air/O_2 Decompression or SurDO_2 Recommended --														
45	2:20	AIR									23	26:00	0.5	M
		AIR/O_2									**12**	15:00		
50	2:20	AIR									31	34:00	1	N
		AIR/O_2									**17**	20:00		
55	2:20	AIR									39	42:00	1	O
		AIR/O_2									**21**	24:00		
60	2:20	AIR									56	59:00	1	O
		AIR/O_2									**24**	27:00		
70	2:20	AIR									83	86:00	1.5	Z
		AIR/O_2									**32**	35:00		
Exceptional Exposure: In-Water Air Decompression ------------- In-Water Air/O_2 Decompression or SurDO_2 Required -----------														
80	2:00	AIR								5	125	132:40	2	Z
		AIR/O_2								**3**	**40**	50:40		
90	2:00	AIR								13	158	173:40	2	Z
		AIR/O_2								**7**	**46**	60:40		
100	2:00	AIR								19	185	206:40	2.5	
		AIR/O_2								**10**	**53**	70:40		
110	2:00	AIR								25	224	251:40	3	
		AIR/O_2								**13**	**61**	86:40		
Exceptional Exposure: In-Water Air/0_2 Decompression ------------- SurDO_2 Required---														
120	1:40	AIR							2	28	256	288:20	3.5	
		AIR/O_2							2	**14**	**70**	98:40		
130	1:40	AIR							5	28	291	326:20	3.5	
		AIR/O_2							5	**14**	**79**	110:40		
140	1:40	AIR							8	28	330	368:20	4	
		AIR/O_2							8	**14**	**87**	126:40		
Exceptional Exposure: SurDO_2 --														
150	1:40	AIR							11	34	378	425:20	4.5	
		AIR/O_2							11	**17**	**94**	139:40		
160	1:40	AIR							13	40	418	473:20	4.5	
		AIR/O_2							13	**20**	**101**	151:40		
170	1:40	AIR							15	45	451	513:20	5	
		AIR/O_2							15	**23**	**106**	166:40		
180	1:40	AIR							16	51	479	548:20	5.5	
		AIR/O_2							16	**26**	**112**	176:40		
240	1:40	AIR							42	68	592	704:20	7.5	
		AIR/O_2							42	**34**	**159**	267:40		

Table 9-9. *Air Decompression Table (Continued).*

(DESCENT RATE 75 FPM—ASCENT RATE 30 FPM)

			DECOMPRESSION STOPS (FSW) Stop times (min) include travel time, except first air and first O_2 stop											
Bottom Time (min)	**Time to First Stop (M:S)**	**Gas Mix**	**100**	**90**	**80**	**70**	**60**	**50**	**40**	**30**	**20**	**Total Ascent Time (M:S)**	**Chamber O_2 Periods**	**Repet Group**
100 FSW														
25	3:20	AIR									0	3:20	0	H
		AIR/O_2									**0**	3:20		
30	2:40	AIR									3	6:20	0.5	J
		AIR/O_2									**2**	5:20		
35	2:40	AIR									15	18:20	0.5	L
		AIR/O_2									**8**	11:20		
In-Water Air/O_2 Decompression or SurDO_2 Recommended ---														
40	2:40	AIR									26	29:20	1	M
		AIR/O_2									**14**	17:20		
45	2:40	AIR									36	39:20	1	N
		AIR/O_2									**19**	22:20		
50	2:40	AIR									47	50:20	1	O
		AIR/O_2									**24**	27:20		
55	2:40	AIR									65	68:20	1.5	Z
		AIR/O_2									**28**	31:20		
60	2:40	AIR									81	84:20	1.5	Z
		AIR/O_2									**33**	36:20		
Exceptional Exposure: In-Water Air Decompression ------------- In-Water Air/O_2 Decompression or SurDO_2 Required -----------														
70	2:20	AIR								11	124	138:00	2	Z
		AIR/O_2								**6**	**39**	53:00		
80	2:20	AIR								21	160	184:00	2.5	Z
		AIR/O_2								**11**	**45**	64:00		
90	2:00	AIR							2	28	196	228:40	2.5	
		AIR/O_2							2	**14**	**53**	82:00		
Exceptional Exposure: In-Water Air/0$_2$ Decompression ------------- SurDO_2 Required--														
100	2:00	AIR							9	28	241	280:40	3	
		AIR/O_2							9	**14**	**66**	102:00		
110	2:00	AIR							14	28	278	322:40	3.5	
		AIR/O_2							14	**14**	**76**	117:00		
120	2:00	AIR							19	28	324	373:40	4	
		AIR/O_2							19	**14**	**85**	136:00		
Exceptional Exposure: SurDO_2 ---														
150	1:40	AIR						3	26	46	461	538:20	5	
		AIR/O_2						3	26	**23**	**109**	183:40		

Table 9-9. Air Decompression Table (Continued).

(DESCENT RATE 75 FPM—ASCENT RATE 30 FPM)

Bottom Time (min)	Time to First Stop (M:S)	Gas Mix	DECOMPRESSION STOPS (FSW) Stop times (min) include travel time, except first air and first O_2 stop									Total Ascent Time (M:S)	Chamber O_2 Periods	Repet Group
			100	90	80	70	60	50	40	30	20			
110 FSW														
20	3:40	AIR									0	3:40	0	H
		AIR/O_2									**0**	3:40		
25	3:00	AIR									5	8:40	0.5	I
		AIR/O_2									**3**	6:40		
30	3:00	AIR									14	17:40	0.5	K
		AIR/O_2									**7**	10:40		
In-Water Air/O_2 Decompression or SurDO_2 Recommended --														
35	3:00	AIR									27	30:40	1	M
		AIR/O_2									**14**	17:40		
40	3:00	AIR									39	42:40	1	N
		AIR/O_2									**20**	23:40		
45	3:00	AIR									50	53:40	1	O
		AIR/O_2									**26**	29:40		
50	3:00	AIR									71	74:40	1.5	Z
		AIR/O_2									**32**	35:40		
Exceptional Exposure: In-Water Air Decompression ------------- In-Water Air/O_2 Decompression or SurDO_2 Required -----------														
55	2:40	AIR								5	85	93:20	1.5	Z
		AIR/O_2								**3**	**33**	44:20		
60	2:40	AIR								13	111	127:20	2	Z
		AIR/O_2								**7**	**36**	51:20		
70	2:40	AIR								26	155	184:20	2.5	Z
		AIR/O_2								**14**	**42**	64:20		
Exceptional Exposure: In-Water Air/0$_2$ Decompression ------------ SurDO_2 Required---														
80	2:20	AIR							9	28	200	240:00	2.5	
		AIR/O_2							9	**14**	**54**	90:20		
90	2:20	AIR							18	28	249	298:00	3.5	
		AIR/O_2							18	**14**	**68**	113:20		
100	2:20	AIR							25	28	295	351:00	3.5	
		AIR/O_2							25	**14**	**79**	131:20		
110	2:00	AIR						5	26	28	353	414:40	4	
		AIR/O_2						5	26	**14**	**91**	154:00		
Exceptional Exposure: SurDO_2 ---														
120	2:00	AIR						10	26	35	413	486:40	4.5	
		AIR/O_2						10	26	**18**	**101**	173:00		
180	1:40	AIR					3	23	47	68	593	736:20	7.5	
		AIR/O_2					3	23	47	**34**	**159**	298:40		

Table 9-9. *Air Decompression Table (Continued).*

(DESCENT RATE 75 FPM—ASCENT RATE 30 FPM)

Bottom Time (min)	Time to First Stop (M:S)	Gas Mix	DECOMPRESSION STOPS (FSW) Stop times (min) include travel time, except first air and first O_2 stop									Total Ascent Time (M:S)	Chamber O_2 Periods	Repet Group
			100	**90**	**80**	**70**	**60**	**50**	**40**	**30**	**20**			
120 FSW														
15	4:00	AIR									0	4:00	0	F
		AIR/O_2									**0**	4:00		
20	3:20	AIR									4	8:00	0.5	H
		AIR/O_2									**2**	6:00		
25	3:20	AIR									9	13:00	0.5	J
		AIR/O_2									**5**	9:00		
In-Water Air/O_2 Decompression or SurDO_2 Recommended ---														
30	3:20	AIR									24	28:00	0.5	L
		AIR/O_2									**13**	17:00		
35	3:20	AIR									38	42:00	1	N
		AIR/O_2									**20**	24:00		
40	3:00	AIR								2	49	54:40	1	O
		AIR/O_2								**1**	**26**	30:40		
45	3:00	AIR								3	71	77:40	1.5	Z
		AIR/O_2								**2**	**31**	36:40		
Exceptional Exposure: In-Water Air Decompression ------------- In-Water Air/O_2 Decompression or SurDO_2 Required -----------														
50	3:00	AIR								10	85	98:40	1.5	Z
		AIR/O_2								**5**	**33**	46:40		
55	3:00	AIR								19	116	138:40	2	Z
		AIR/O_2								**10**	**35**	53:40		
60	3:00	AIR								27	142	172:40	2	Z
		AIR/O_2								**14**	**39**	61:40		
70	2:40	AIR							13	28	190	234:20	2.5	
		AIR/O_2							13	**14**	**51**	86:40		
Exceptional Exposure: In-Water Air/0_2 Decompression ------------- SurDO_2 Required--														
80	2:40	AIR							24	28	246	301:20	3	
		AIR/O_2							24	**14**	**67**	118:40		
90	2:20	AIR						7	26	28	303	367:00	3.5	
		AIR/O_2						7	26	**14**	**80**	140:20		
100	2:20	AIR						15	25	28	372	443:00	4	
		AIR/O_2						15	25	**14**	**95**	167:20		
Exceptional Exposure: SurDO_2 --														
110	2:20	AIR						21	25	38	433	520:00	5	
		AIR/O_2						21	25	**19**	**105**	188:20		
120	2:00	AIR					3	23	25	47	480	580:40	5.5	
		AIR/O_2					3	23	25	**24**	**113**	211:00		

Table 9-9. *Air Decompression Table (Continued).*

(DESCENT RATE 75 FPM—ASCENT RATE 30 FPM)

Bottom Time (min)	Time to First Stop (M:S)	Gas Mix	**DECOMPRESSION STOPS (FSW)** Stop times (min) include travel time, except first air and first O_2 stop									Total Ascent Time (M:S)	Chamber O_2 Periods	Repet Group
			100	**90**	**80**	**70**	**60**	**50**	**40**	**30**	**20**			
130 FSW														
12	4:20	AIR									0	4:20	0	F
		AIR/O_2									**0**	4:20		
15	3:40	AIR									3	7:20	0.5	G
		AIR/O_2									**2**	6:20		
20	3:40	AIR									8	12:20	0.5	I
		AIR/O_2									**5**	9:20		
In-Water Air/O_2 Decompression or SurDO_2 Recommended ---														
25	3:40	AIR									17	21:20	0.5	K
		AIR/O_2									**9**	13:20		
30	3:20	AIR								2	32	38:00	1	M
		AIR/O_2								1	**17**	22:00		
35	3:20	AIR								5	44	53:00	1	O
		AIR/O_2								**3**	**23**	30:00		
40	3:20	AIR								6	66	76:00	1.5	Z
		AIR/O_2								**3**	**30**	37:00		
Exceptional Exposure: In-Water Air Decompression ------------- In-Water Air/O_2 Decompression or SurDO_2 Required -----------														
45	3:00	AIR							1	11	84	99:40	1.5	Z
		AIR/O_2							1	**6**	**33**	49:00		
50	3:00	AIR							2	20	118	143:40	2	Z
		AIR/O_2							2	**10**	**36**	57:00		
55	3:00	AIR							4	28	146	181:40	2	Z
		AIR/O_2							4	**14**	**40**	67:00		
60	3:00	AIR							12	28	170	213:40	2.5	Z
		AIR/O_2							12	**14**	**46**	81:00		
Exceptional Exposure: In-Water Air/0_2 Decompression ------------- SurDO_2 Required---														
70	2:40	AIR						1	26	28	235	293:20	3	
		AIR/O_2						1	26	**14**	**63**	117:40		
80	2:40	AIR						12	26	28	297	366:20	3.5	
		AIR/O_2						12	26	**14**	**79**	144:40		
90	2:40	AIR						22	25	28	375	453:20	4	
		AIR/O_2						22	25	**14**	**95**	174:40		
Exceptional Exposure: SurDO_2 --														
100	2:20	AIR					6	23	26	38	444	540:00	5	
		AIR/O_2					6	23	26	**20**	**106**	204:20		
120	2:20	AIR					17	24	27	57	534	662:00	6	
		AIR/O_2					17	24	27	**29**	**130**	255:20		
180	2:00	AIR				13	21	45	57	94	658	890:40	9	
		AIR/O_2				13	21	45	57	**46**	**198**	418:00		

Table 9-9. *Air Decompression Table (Continued).*

(DESCENT RATE 75 FPM—ASCENT RATE 30 FPM)

Bottom Time (min)	Time to First Stop (M:S)	Gas Mix	DECOMPRESSION STOPS (FSW) Stop times (min) include travel time, except first air and first O_2 stop									Total Ascent Time (M:S)	Chamber O_2 Periods	Repet Group
			100	90	80	70	60	50	40	30	20			
140 FSW														
10	4:40	AIR									0	4:40	0	E
		AIR/O_2									**0**	4:40		
15	4:00	AIR									5	9:40	0.5	H
		AIR/O_2									**3**	7:40		
20	4:00	AIR									13	17:40	0.5	J
		AIR/O_2									**7**	11:40		
In-Water Air/O_2 Decompression or SurDO_2 Recommended --														
25	3:40	AIR								3	24	31:20	1	L
		AIR/O_2								**2**	**12**	18:20		
30	3:40	AIR								7	37	48:20	1	N
		AIR/O_2								**4**	**19**	27:20		
35	3:20	AIR							2	7	58	71:00	1.5	O
		AIR/O_2							2	**4**	**26**	36:20		
Exceptional Exposure: In-Water Air Decompression ------------- In-Water Air/O_2 Decompression or SurDO_2 Required -----------														
40	3:20	AIR							4	7	82	97:00	1.5	Z
		AIR/O_2							4	**4**	**33**	50:20		
45	3:20	AIR							5	18	114	141:00	2	Z
		AIR/O_2							5	**9**	**36**	59:20		
50	3:20	AIR							8	27	145	184:00	2	Z
		AIR/O_2							8	**14**	**39**	70:20		
55	3:00	AIR						1	15	29	171	219:40	2.5	Z
		AIR/O_2						1	15	**15**	**45**	85:00		
Exceptional Exposure: In-Water Air/0_2 Decompression ------------ SurDO_2 Required--														
60	3:00	AIR						2	23	28	209	265:40	3	
		AIR/O_2						2	23	**14**	**56**	109:00		
70	3:00	AIR						14	25	29	276	347:40	3.5	
		AIR/O_2						14	25	**15**	**74**	142:00		
80	2:40	AIR					2	24	25	29	362	445:20	4	
		AIR/O_2					2	24	25	**15**	**91**	175:40		
Exceptional Exposure: SurDO_2 ---														
90	2:40	AIR					12	23	26	38	443	545:20	5	
		AIR/O_2					12	23	26	**19**	**107**	210:40		

Table 9-9. *Air Decompression Table (Continued).*

(DESCENT RATE 75 FPM—ASCENT RATE 30 FPM)

Bottom Time (min)	Time to First Stop (M:S)	Gas Mix	DECOMPRESSION STOPS (FSW) Stop times (min) include travel time, except first air and first O_2 stop									Total Ascent Time (M:S)	Chamber O_2 Periods	Repet Group
			100	**90**	**80**	**70**	**60**	**50**	**40**	**30**	**20**			
150 FSW														
8	5:00	AIR									0	5:00	0	E
		AIR/O_2									**0**	5:00		
10	4:20	AIR									2	7:00	0.5	F
		AIR/O_2									**1**	6:00		
15	4:20	AIR									8	13:00	0.5	H
		AIR/O_2									**5**	10:00		
In-Water Air/O_2 Decompression or SurDO$_2$ Recommended --														
20	4:00	AIR								2	15	21:40	0.5	K
		AIR/O_2								1	**8**	13:40		
25	4:00	AIR								7	29	40:40	1	M
		AIR/O_2								**4**	**14**	22:40		
30	3:40	AIR							4	7	45	60:20	1.5	O
		AIR/O_2							4	**4**	**22**	34:40		
Exceptional Exposure: In-Water Air Decompression ------------- In-Water Air/O_2 Decompression or SurDO$_2$ Required -----------														
35	3:40	AIR							6	7	74	91:20	1.5	Z
		AIR/O_2							6	**4**	**30**	44:40		
40	3:20	AIR						2	6	14	106	132:00	2	Z
		AIR/O_2						2	6	**7**	**35**	59:20		
45	3:20	AIR						3	8	24	142	181:00	2	Z
		AIR/O_2						3	8	**12**	**40**	72:20		
50	3:20	AIR						4	14	28	170	220:00	2.5	Z
		AIR/O_2						4	14	**14**	**46**	87:20		
Exceptional Exposure: In-Water Air/0$_2$ Decompression ------------ SurDO$_2$ Required--														
55	3:20	AIR						7	21	28	212	272:00	3	
		AIR/O_2						7	21	**14**	**57**	113:20		
60	3:20	AIR						11	26	28	248	317:00	3	
		AIR/O_2						11	26	**14**	**67**	132:20		
70	3:00	AIR					3	24	25	28	330	413:40	4	
		AIR/O_2					3	24	25	**14**	**85**	170:00		
Exceptional Exposure: SurDO$_2$ --														
80	3:00	AIR					15	23	26	35	430	532:40	4.5	
		AIR/O_2					15	23	26	**18**	**104**	205:00		
90	2:40	AIR				3	22	23	26	47	496	620:20	5.5	
		AIR/O_2				3	22	23	26	**24**	**118**	239:40		
120	2:20	AIR			3	20	22	23	50	75	608	804:00	8	
		AIR/O_2			3	20	22	23	50	**37**	**168**	356:20		
180	2:00	AIR		2	19	20	42	48	79	121	694	1027:40	10.5	
		AIR/O_2		2	19	20	42	48	79	**58**	**222**	538:00		

Table 9-9. Air Decompression Table (Continued).

(DESCENT RATE 75 FPM—ASCENT RATE 30 FPM)

Bottom Time (min)	Time to First Stop (M:S)	Gas Mix	DECOMPRESSION STOPS (FSW) Stop times (min) include travel time, except first air and first O_2 stop									Total Ascent Time (M:S)	Chamber O_2 Periods	Repet Group
			100	90	80	70	60	50	40	30	20			
160 FSW														
7	5:20	AIR									0	5:20	0	E
		AIR/O_2									**0**	5:20		
10	4:40	AIR									4	9:20	0.5	F
		AIR/O_2									**2**	7:20		
15	4:20	AIR								2	10	17:00	0.5	I
		AIR/O_2								**1**	**6**	12:00		
In-Water Air/O_2 Decompression or SurDO_2 Recommended --														
20	4:00	AIR							1	4	19	28:40	0.5	L
		AIR/O_2							1	**2**	**10**	18:00		
25	4:00	AIR							4	7	35	50:40	1	N
		AIR/O_2							4	**4**	**17**	30:00		
30	3:40	AIR						2	6	7	62	81:20	1.5	Z
		AIR/O_2						2	6	**4**	**26**	42:40		
Exceptional Exposure: In-Water Air Decompression ------------- In-Water Air/O_2 Decompression or SurDO_2 Required -----------														
35	3:40	AIR						4	6	8	89	111:20	1.5	Z
		AIR/O_2						4	6	**4**	**34**	57:40		
40	3:40	AIR						6	6	21	134	171:20	2	Z
		AIR/O_2						6	6	**11**	**38**	70:40		
45	3:20	AIR					2	5	11	28	166	216:00	2.5	Z
		AIR/O_2					2	5	11	**14**	**45**	86:20		
Exceptional Exposure: In-Water Air/0$_2$ Decompression ------------- SurDO_2 Required---														
50	3:20	AIR					2	8	19	28	207	268:00	3	
		AIR/O_2					2	8	19	**15**	**55**	113:20		
55	3:20	AIR					3	11	26	28	248	320:00	3	
		AIR/O_2					3	11	26	**14**	**67**	135:20		
60	3:20	AIR					6	17	25	29	291	372:00	3.5	
		AIR/O_2					6	17	25	**15**	**77**	154:20		
Exceptional Exposure: SurDO_2 ---														
70	3:20	AIR					15	23	26	29	399	496:00	4.5	
		AIR/O_2					15	23	26	**15**	**99**	197:20		
80	3:00	AIR				6	21	24	25	44	482	605:40	5.5	
		AIR/O_2				6	21	24	25	**23**	**114**	237:00		

Table 9-9. *Air Decompression Table (Continued).*

(DESCENT RATE 75 FPM—ASCENT RATE 30 FPM)

Bottom Time (min)	Time to First Stop (M:S)	Gas Mix	DECOMPRESSION STOPS (FSW) Stop times (min) include travel time, except first air and first O_2 stop									Total Ascent Time (M:S)	Chamber O_2 Periods	Repet Group
			100	**90**	**80**	**70**	**60**	**50**	**40**	**30**	**20**			
170 FSW														
6	5:40	AIR									0	5:40	0	D
		AIR/O_2									**0**	5:40		
10	5:00	AIR									6	11:40	0.5	G
		AIR/O_2									**3**	8:40		
In-Water Air/O_2 Decompression or SurDO_2 Recommended --														
15	4:40	AIR								3	13	21:20	0.5	J
		AIR/O_2								2	**6**	13:20		
20	4:20	AIR							3	6	24	38:00	1	M
		AIR/O_2							3	**3**	**12**	23:20		
25	4:00	AIR						1	7	7	41	60:40	1	O
		AIR/O_2						1	7	**4**	**20**	37:00		
Exceptional Exposure: In-Water Air Decompression ------------- In-Water Air/O_2 Decompression or SurDO_2 Required -----------														
30	4:00	AIR						5	7	7	77	100:40	1.5	Z
		AIR/O_2						5	7	**3**	**30**	50:00		
35	3:40	AIR					2	6	6	15	120	153:20	2	Z
		AIR/O_2					2	6	6	**8**	**37**	68:40		
40	3:40	AIR					4	6	9	25	158	206:20	2.5	Z
		AIR/O_2					4	6	9	**12**	**44**	84:40		
Exceptional Exposure: In-Water Air/0_2 Decompression ------------- SurDO_2 Required---														
45	3:40	AIR					5	7	16	28	197	257:20	2.5	Z
		AIR/O_2					5	7	16	**14**	**53**	109:40		
50	3:20	AIR				1	5	11	23	28	244	316:00	3	
		AIR/O_2				1	5	11	23	**14**	**66**	134:20		
55	3:20	AIR				2	7	16	26	28	289	372:00	3.5	
		AIR/O_2				2	7	16	26	**14**	**77**	156:20		
60	3:20	AIR				2	11	21	26	28	344	436:00	4	
		AIR/O_2				2	11	21	26	**14**	**88**	181:20		
Exceptional Exposure: SurDO_2 ---														
70	3:20	AIR				7	19	24	25	39	454	572:00	5	
		AIR/O_2				7	19	24	25	**20**	**109**	228:20		
80	3:20	AIR				17	22	23	26	53	525	670:00	6	
		AIR/O_2				17	22	23	26	**27**	**128**	267:20		
90	3:00	AIR			8	19	22	23	37	66	574	752:40	7	
		AIR/O_2			8	19	22	23	37	**33**	**148**	319:00		
120	2:40	AIR		9	19	20	22	42	60	94	659	928:20	9	
		AIR/O_2		9	19	20	22	42	60	**46**	**198**	454:40		
180	2:20	AIR	10	18	19	40	43	70	97	156	703	1159:00	11.5	
		AIR/O_2	10	18	19	40	43	70	97	**74**	**229**	648:00		

Table 9-9. Air Decompression Table (Continued).

(DESCENT RATE 75 FPM—ASCENT RATE 30 FPM)

180 FSW

Bottom Time (min)	Time to First Stop (M:S)	Gas Mix	DECOMPRESSION STOPS (FSW) Stop times (min) include travel time, except first air and first O_2 stop									Total Ascent Time (M:S)	Chamber O_2 Periods	Repet Group
			100	90	80	70	60	50	40	30	20			
6	6:00	AIR									0	6:00	0	E
		AIR/O_2									**0**	6:00		
10	5:20	AIR									8	14:00	0.5	G
		AIR/O_2									**4**	10:00		
In-Water Air/O_2 Decompression or SurDO_2 Recommended --														
15	4:40	AIR							2	3	14	24:20	0.5	K
		AIR/O_2							2	**2**	**7**	16:40		
20	4:20	AIR						1	5	7	29	47:00	1	M
		AIR/O_2						1	5	**3**	**15**	29:20		
25	4:20	AIR						5	6	7	57	80:00	1.5	O
		AIR/O_2						5	6	**4**	**24**	44:20		
Exceptional Exposure: In-Water Air Decompression ------------- In-Water Air/O_2 Decompression or SurDO_2 Required -----------														
30	4:00	AIR					3	6	6	7	95	121:40	1.5	Z
		AIR/O_2					3	6	6	**4**	**34**	63:00		
35	3:40	AIR				1	5	6	6	22	144	188:20	2	Z
		AIR/O_2				1	5	6	6	**11**	**41**	79:40		
Exceptional Exposure: In-Water Air/0_2 Decompression ------------- SurDO_2 Required--														
40	3:40	AIR				2	6	5	13	28	178	236:20	2.5	
		AIR/O_2				2	6	5	13	**14**	**48**	97:40		
45	3:40	AIR				4	5	10	20	28	235	306:20	3	
		AIR/O_2				4	5	10	20	**14**	**63**	130:40		
50	3:40	AIR				4	8	13	25	29	277	360:20	3.5	
		AIR/O_2				4	8	13	25	**15**	**75**	154:40		
55	3:40	AIR				5	11	19	26	28	336	429:20	4	
		AIR/O_2				5	11	19	26	**14**	**87**	181:40		
Exceptional Exposure: SurDO_2 --														
60	3:20	AIR			1	8	13	23	25	31	406	511:00	4.5	
		AIR/O_2			1	8	13	23	25	**16**	**100**	205:20		
70	3:20	AIR			4	12	21	24	25	48	499	637:00	5.5	
		AIR/O_2			4	12	21	24	25	**24**	**119**	253:20		

Table 9-9. *Air Decompression Table (Continued).*

(DESCENT RATE 75 FPM—ASCENT RATE 30 FPM)

Bottom Time (min)	Time to First Stop (M:S)	Gas Mix	**DECOMPRESSION STOPS (FSW)** Stop times (min) include travel time, except first air and first O_2 stop									Total Ascent Time (M:S)	Chamber O_2 Periods	Repet Group
			100	**90**	**80**	**70**	**60**	**50**	**40**	**30**	**20**			
190 FSW														
5	6:20	AIR									0	6:20	0	D
		AIR/O_2									**0**	6:20		
10	5:20	AIR								2	8	16:00	0.5	H
		AIR/O_2								1	**4**	11:00		
In-Water Air/O_2 Decompression or SurDO_2 Recommended ---														
15	4:40	AIR						1	3	3	16	28:20	0.5	K
		AIR/O_2						1	3	**2**	**8**	19:40		
20	4:20	AIR					1	2	6	7	34	55:00	1	N
		AIR/O_2					1	2	6	**4**	**17**	35:20		
Exceptional Exposure: In-Water Air Decompression ------------- In-Water Air/O_2 Decompression or SurDO_2 Required -----------														
25	4:20	AIR					2	6	7	7	72	99:00	1.5	Z
		AIR/O_2					2	6	7	**3**	**28**	51:20		
30	4:00	AIR				1	6	5	7	13	122	158:40	2	Z
		AIR/O_2				1	6	5	7	**7**	**38**	74:00		
Exceptional Exposure: In-Water Air/0_2 Decompression ------------- SurDO_2 Required--														
35	4:00	AIR				4	5	6	8	26	165	218:40	2.5	Z
		AIR/O_2				4	5	6	8	**13**	**45**	91:00		
40	3:40	AIR			1	5	5	8	17	28	217	285:20	3	
		AIR/O_2			1	5	5	8	17	**15**	**58**	123:40		
45	3:40	AIR			2	5	6	12	24	29	264	346:20	3.5	
		AIR/O_2			2	5	6	12	24	**15**	**71**	149:40		
50	3:40	AIR			3	5	10	17	26	28	324	417:20	4	
		AIR/O_2			3	5	10	17	26	**14**	**85**	179:40		
Exceptional Exposure: SurDO2 ---														
55	3:40	AIR			4	8	10	24	25	30	397	502:20	4.5	
		AIR/O_2			4	8	10	24	25	**15**	**99**	204:40		
60	3:40	AIR			5	10	16	24	25	40	454	578:20	5	
		AIR/O_2			5	10	16	24	25	**20**	**109**	233:40		
90	3:20	AIR		11	19	20	21	28	51	83	626	863:00	8.5	
		AIR/O_2		11	19	20	21	28	51	**41**	**178**	408:20		
120	3:00	AIR	15	17	19	20	37	46	79	113	691	1040:40	10.5	
		AIR/O_2	15	17	19	20	37	46	79	**55**	**219**	551:00		

Table 9-9. Air Decompression Table (Continued).

(DESCENT RATE 75 FPM—ASCENT RATE 30 FPM)

Bottom Time (min)	Time to First Stop (M:S)	Gas Mix	DECOMPRESSION STOPS (FSW) Stop times (min) include travel time, except first air and first O_2 stop									Total Ascent Time (M:S)	Chamber O_2 Periods	Repet Group
			100	90	80	70	60	50	40	30	20			
200 FSW														
Exceptional Exposure --														
5	6:40	AIR									0	6:40	0	E
		AIR/O_2									**0**	6:40		
10	5:40	AIR								3	8	17:20	0.5	H
		AIR/O_2								**2**	**4**	12:20		
15	5:00	AIR						2	3	5	19	34:40	0.5	L
		AIR/O_2						2	3	**3**	**9**	23:00		
20	4:40	AIR					2	4	6	7	43	67:20	1	O
		AIR/O_2					2	4	6	**4**	**20**	41:40		
25	4:20	AIR				1	5	6	6	7	85	115:00	1.5	Z
		AIR/O_2				1	5	6	6	**4**	**32**	64:20		
30	4:20	AIR				4	6	5	7	19	145	191:00	2	Z
		AIR/O_2				4	6	5	7	**10**	**42**	84:20		
35	4:00	AIR			2	5	5	6	13	28	188	251:40	2.5	
		AIR/O_2			2	5	5	6	13	**14**	**51**	106:00		
40	4:00	AIR			4	5	5	11	21	28	249	327:40	3.5	
		AIR/O_2			4	5	5	11	21	**14**	**68**	143:00		
45	3:40	AIR		1	4	5	10	14	25	28	306	397:20	3.5	
		AIR/O_2		1	4	5	10	14	25	**14**	**81**	168:40		
50	3:40	AIR		2	4	8	10	21	26	28	382	485:20	4.5	
		AIR/O_2		2	4	8	10	21	26	**14**	**97**	201:40		
210 FSW														
Exceptional Exposure --														
4	7:00	AIR									0	7:00	0	D
		AIR/O_2									**0**	7:00		
5	6:20	AIR									2	9:00	0.5	E
		AIR/O_2									**1**	8:00		
10	5:40	AIR							2	3	9	20:20	0.5	I
		AIR/O_2							2	**2**	**4**	14:40		
15	5:00	AIR					1	3	3	6	24	42:40	1	M
		AIR/O_2					1	3	3	**3**	**12**	28:00		
20	4:40	AIR				1	3	5	6	7	57	84:20	1	O
		AIR/O_2				1	3	5	6	**4**	**23**	47:40		
25	4:40	AIR				3	6	5	7	8	110	144:20	2	Z
		AIR/O_2				3	6	5	7	**4**	**38**	73:40		
30	4:20	AIR			2	5	6	6	6	26	163	219:00	2.5	Z
		AIR/O_2			2	5	6	6	6	**13**	**45**	93:20		
35	4:00	AIR		1	4	5	6	7	18	28	223	296:40	3	
		AIR/O_2		1	4	5	6	7	18	**14**	**60**	130:00		
40	4:00	AIR		2	5	5	7	11	26	28	278	366:40	3.5	
		AIR/O_2		2	5	5	7	11	26	**14**	**76**	161:00		
45	4:00	AIR		4	4	6	11	18	26	28	355	456:40	4	
		AIR/O_2		4	4	6	11	18	26	**14**	**91**	194:00		
50	3:40	AIR	1	4	5	10	12	23	26	36	432	553:20	5	
		AIR/O_2	1	4	5	10	12	23	26	**18**	**105**	223:40		

Table 9-9. *Air Decompression Table (Continued).*
(DESCENT RATE 75 FPM—ASCENT RATE 30 FPM)

220 FSW

Bottom Time (min)	Time to First Stop (M:S)	Gas Mix	DECOMPRESSION STOPS (FSW) Stop times (min) include travel time, except first air and first O_2 stop												Total Ascent Time (M:S)	Chamber O_2 Periods	Repet Group
			130	120	110	100	90	80	70	60	50	40	30	20			
Exceptional Exposure																	
4	7:20	AIR												0	7:20	0	E
		AIR/O_2												**0**	7:20		
5	6:40	AIR												3	10:20	0.5	E
		AIR/O_2												**2**	9:20		
10	6:00	AIR										3	4	10	23:40	0.5	J
		AIR/O_2										3	**2**	**5**	17:00		
15	5:20	AIR								3	2	4	7	28	50:00	1	N
		AIR/O_2								3	2	4	**4**	**14**	33:20		
20	5:00	AIR							2	4	6	6	7	70	100:40	1.5	Z
		AIR/O_2							2	4	6	6	**4**	**26**	54:00		
25	4:40	AIR						1	5	6	6	6	14	133	176:20	2	Z
		AIR/O_2						1	5	6	6	6	**7**	**41**	82:40		
30	4:20	AIR					1	4	5	6	6	10	28	183	248:00	2.5	
		AIR/O_2					1	4	5	6	6	10	**14**	**50**	106:20		
35	4:20	AIR					3	5	5	5	10	22	28	251	334:00	3.5	
		AIR/O_2					3	5	5	5	10	22	**14**	**68**	147:20		
40	4:00	AIR				1	4	5	5	9	15	26	28	319	416:40	4	
		AIR/O_2				1	4	5	5	9	15	26	**14**	**84**	183:00		

250 FSW

Bottom Time (min)	Time to First Stop (M:S)	Gas Mix	DECOMPRESSION STOPS (FSW) Stop times (min) include travel time, except first air and first O_2 stop												Total Ascent Time (M:S)	Chamber O_2 Periods	Repet Group
			130	120	110	100	90	80	70	60	50	40	30	20			
Exceptional Exposure																	
4	7:40	AIR												4	12:20	0.5	F
		AIR/O_2												**2**	10:20		
5	7:40	AIR												7	15:20	0.5	G
		AIR/O_2												**4**	12:20		
10	6:20	AIR								2	2	4	3	15	33:00	0.5	L
		AIR/O_2								2	2	4	**2**	**7**	24:20		
15	5:40	AIR						2	2	3	4	6	7	53	83:20	1	O
		AIR/O_2						2	2	3	4	6	**4**	**22**	49:40		
20	5:20	AIR					2	2	4	6	6	6	11	125	168:00	2	Z
		AIR/O_2					2	2	4	6	6	6	**6**	**39**	82:20		
25	5:00	AIR				1	4	4	5	6	6	10	28	189	258:40	2.5	
		AIR/O_2				1	4	4	5	6	6	10	**14**	**51**	112:00		
30	4:40	AIR			1	4	4	4	5	6	9	25	28	267	358:20	3.5	
		AIR/O_2			1	4	4	4	5	6	9	25	**15**	**72**	160:40		
35	4:40	AIR			3	4	4	5	5	10	19	26	28	363	472:20	4	
		AIR/O_2			3	4	4	5	5	10	19	26	**14**	**93**	203:40		

Bottom Time (min)	Time to First Stop (M:S)	Gas Mix	DECOMPRESSION STOPS (FSW) Stop times (min) include travel time, except first air and first O_2 stop												Total Ascent Time (M:S)	Chamber O_2 Periods	Repet Group
			130	**120**	**110**	**100**	**90**	**80**	**70**	**60**	**50**	**40**	**30**	**20**			
300 FSW																	
Exceptional Exposure --																	
4	9:00	AIR											3	7	19:40	0.5	G
		AIR/O_2											**2**	**4**	15:40		
5	8:40	AIR										3	3	8	23:20	0.5	I
		AIR/O_2										3	**2**	**4**	18:40		
10	7:20	AIR						2	3	2	3	4	7	35	64:00	1	N
		AIR/O_2						2	3	2	3	4	**4**	**18**	44:20		
15	6:20	AIR			1	2	2	3	3	5	6	7	11	125	172:00	2	Z
		AIR/O_2			1	2	2	3	3	5	6	7	**6**	**39**	86:20		
20	6:00	AIR		2	2	2	4	5	5	5	6	16	28	219	300:40	3	
		AIR/O_2		2	2	2	4	5	5	5	6	16	**14**	**59**	137:00		
25	5:40	AIR	1	3	4	4	4	5	5	5	18	26	28	324	433:20	4	
		AIR/O_2	1	3	4	4	4	5	5	5	18	26	**14**	**85**	195:40		

ATTACHMENT 11

EQUIPMENT CHECKLISTS

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ATTACHMENT 11

GENERAL DIVE EQUIPMENT LOADOUT

PROJECT NAME: ______________________________________ **DATE:** _________________

General Dive Equipment

Item	Quantity	Inspected for operation and Loaded
DIVE FLAG (CIVILIAN AND CODE ALPHA)		
LOST DIVER BUOY		
TENDING LINES AND HARNESSES		
HANDHELD GPS		
BUDDY LINES		
DIVE SYSTEM(S)		
AIR SUPPLY/ BOTTLES		
CELLULAR PHONE (ON AND CHARGED)		
VHF RADIO		
DRINKING WATER		
PERSONAL DIVE GEAR		
DIVE OPS WORK PLAN		
DIVE SAFE PRACTICES MANUAL		
U.S. NAVY DIVE MANUAL		
EMERGENCY CONTACT LIST (POSTED)		
REQUIRED LINES, BUOYS, ANCHORS		

ATTACHMENT 11

GENERAL DIVE EQUIPMENT LOADOUT

Medical Equipment

<table>
<tr><th>Item</th><th>Quantity</th><th colspan="2">Inspected for operation and Loaded</th></tr>
<tr><td>FIRST AID KIT/ TRAUMA KIT</td><td></td><td colspan="2"></td></tr>
<tr><td>EMERGENCY OXYGEN SYSTEM</td><td></td><td>PSIG</td><td>PSIG</td></tr>
<tr><td>STRETCHER OR BACKBOARD</td><td></td><td colspan="2"></td></tr>
<tr><td></td><td></td><td colspan="2"></td></tr>
<tr><td></td><td></td><td colspan="2"></td></tr>
<tr><td></td><td></td><td colspan="2"></td></tr>
</table>

Tools, UXO Related Equipment, Explosive Materials

Item	Quantity	Inspected for operation and Loaded

Loadout Checked (Name) Signature

Diving Supervisor Name Diving Supervisor Signature

ATTACHMENT 11

GENERAL DIVE EQUIPMENT LOADOUT

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ATTACHMENT 11

BOAT PRE-OPERATION CHECKLIST

Project Description:	**Date:**
Project Location:	**Job#:**

Step No.	Description	Check Completed (Initials)
1	**Inspect exterior of vessel** ☐ Inspect for visible damage ☐ Boat registration ☐ POL leaks ☐ Hull plugs in place ☐ Maintenance issues	
2	**Inspect propulsion system** ☐ a. Engine (propeller, oil, fuel level and extra fuel on board, hours since last maintenance, functional, and adequately secured to vessel) ☐ b. Steering system (functional, forward/reverse gears) ☐ c. Batteries (charged, water in cells, contacts clean)	
3	**Inspect all communication equipment** ☐ a. Perform VHF radio check with a base station ☐ b. Perform cellular phone check with a base station ☐ c. Perform dive communication check with radio and dive hats ☐ d. Have spare batteries charged and within reach of all comm. equip.	
4	**Inspect electrical systems and all other communication equipment** Ensure the following are on board and in work order ☐ a. Dive flags (Alpha and Recreational) and pole ☐ b. Sound signaling device (vessel horn, hand horn, whistle) ☐ c. Flares (rocket/parachute, hand held, smoke) ☐ d. Water dye canister, flash light, signaling mirror, EPIRB, and strobe lights for PFDs ☐ e. Deck and Navigation lighting (port, starboard, fore/aft, search, and cabin) ☐ f. Bilge pump	
5	**Inspect mooring systems** ☐ a. Anchor secured to line/chain and functional ☐ b. Line/chain in working order and ready for use ☐ c. Fenders secure and ready for use ☐ d. Extra line available for use	
6	**Ensure navigational equipment is functioning** ☐ a. GPS (locked on 4 satellites, correct datum, power source) ☐ b. Compass and binoculars ☐ c. Charts / maps	
7	**Place copies of the following in cabin near helm** ☐ a. Emergency procedures plan ☐ b. Safe diving practices and operations manual ☐ c. Air decompression tables	

ATTACHMENT 11

BOAT PRE-OPERATION CHECKLIST

Step No.	Description	Check Completed (Initials)
8	**Inspect lifesaving equipment** ☐ a. Ensure 1 PFD per person and 1 throw ring (USCG approved, in working order and properly fitted with strobe, whistle and knife attached) ☐ b. First aid kit (stocked, non-expired contents), First aid book, back board ☐ c. Fire extinguisher (charged, current inspection, accessible)	
9	**Inspect tool box** ☐ a. Spare parts for engine and other vessel systems ☐ b. Tools (clean and in working order) for repairing vessel systems and dive equipment	
10	**Alternate propulsion systems** ☐ a. Hand paddles (2) ☐ b. Spare outboard engine (complete, working, with spare fuel source)	
11	**Personal comfort equipment** ☐ a. Water ☐ b. Food ☐ c. Sunscreen/motion sickness medicine ☐ d. Clothing as required by conditions/locations (hard hat, sun glasses, ball cap, extreme weather, steel toed boots, change of clothes)	

NOTES:

1. File completed checklist in daily job log.
2. Record any maintenance issues in vessel log and report to Project Manager.
3. Complete dive boat safety checklist after completing this checklist.

ATTACHMENT 11

SCUBA CHECKLISTS

PROJECT NAME: ____ **DATE:** __________________

SCUBA EQUIPMENT INSPECTION

Cylinders				FFMs/ Regulators/ Gauges		Buoyancy Compensators	
Primary		Emergency Bail-Out					
Pre-Dive	Post Dive	Pre-Dive	Post Dive	Pre-Dive	Post Dive	Pre-Dive	Post Dive
Serial # Inspect	Clean and Charge (PSIG)	Serial # Inspect	Clean and Charge (PSIG)	Serial # Inspect /Test	Clean and Inspect	Serial # Inspect /Test	Clean/Inspect

Notes:

1. Fill-in and initial each block prior to and after each dive. Place PSI level in block as indicated.
2. Ensure cylinders are gauged at minimum 90% capacity ***(2700 PSI)*** following charge. *(**NOTE**: Gauge after bottles are cool).*

Specific Pre-Dive Procedures:

FFM

- Inspect – Nose pad/ one-way/ comms/ purge/ ABV/ seal/ straps/test breathe

Specific Post Dive Procedures:

Cylinders

- Rinse cylinders with fresh water.
- Leak check cylinders during charging.

Masks / Regulators / Gauges

- Rinse with fresh water and sterilize regulator.
- Inspect mask, regulator and hoses.
- Rinse & inspect gauges.

Buoyancy Compensators

- Rinse with fresh water and clean BC.
- Inspect BC inflation and dump valves.
- Empty any water in BC, Inflate and leave overnight for drying and leak check

_______________________________________ _______________________________________

Diving Supervisor Name Diving Supervisor Signature

ATTACHMENT 11

SCUBA CHECKLISTS

PROJECT NAME: ______________________________________ **DATE:** _________________

ALL ITEMS WILL BE CHECKED IN APPROPRIATE BLOCKS AS FOLLOWS:

1. **ALL PERSONNEL MUST WEAR SAFETY GLASSES WHEN WORKING WITH HP AIR**
2. **Initial for each completed and satisfactory check.**
3. **When completed, person completing the checks will sign as appropriate (blocks 1 thru 4) and then turn in to the Diving Supervisor for his checks, review and signature.**

Set Number	Diver Signature	Dive Supervisor Signature

Initial	Procedure	Remarks
Air Cylinders		
	Cylinders – inspect for current hydro and visual	
	O ring and valve – inspect condition	
	Pressure – adequate for days operations	
	Bail-Out Bottles - *Repeat above steps	
Buoyancy Compensator (BC)		
	Straps / Buckles / Harness – inspect condition and adjust for fit	
	Air bladder – leak check	
	Cylinder and bail-out – mount securely	
	Inflator fitting and hose – inspect condition	
	Dump valves – check for proper function	
Regulator(s)		
	Hoses / Connectors – inspect condition	
	1st and 2nd stages – inspect condition	
	Cylinder yoke assembly – secure	
	Bail-out regulator(s) – repeat above checks	
	Regulator assemblies – attach to cylinders	
	Inflation whip – attach to BC	
	Valves – open / leak check cylinder O ring	
	Pressure gauge – reading properly	
	Dive Computer – inspect, check batt, function	
	BC inflation – check proper function	
	Primary regulator / bail-out regulator - test	
	Fittings - Check for leaks	
	FFM – Nose pad/ one-way valves / comms/ pp/ ABV**/** seal/straps	
Notes:		

ATTACHMENT 11

SCUBA CHECKLISTS

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ATTACHMENT 11

PRE-DIVE: SSA DIVE HELMET CHECKOFF SHEET

PROJECT NAME/NUMBER: ______________________ DATE: ______________________
TENDER/DIVER: ____

NOTE: ALL ITEMS WILL BE CHECKED IN APPROPRIATE BLOCKS AS FOLLOWS:

1. **An initial for each completed and satisfactory check.**
2. **An N/A for each item not applicable to the Dive Helmet being pre-dove.**
3. **An “R” for any repairs made. A brief description in the remarks section. If more space required use the “notes” section for continuation.**
4. **When completed, person completing the checks will sign as appropriate (blocks 1 thru 4) and then turn in to the Diving Supervisor for his checks, review and signature.**

Helmet/Mask Type	Serial No.	Checked By:	Signature	Dive Supe Signature
1.				
2.				
3.				
4.				

	Procedure	1	2	Remarks
1	Test non-return valve (suck and blow)			
2	Check helmet for damage / deterioration			
3	Check neck dam seal (lube if required)			
4	Check oral nasal mask			
5	Check side block assembly – ensure secure			
6	Check 2nd stage regulator			
7	Check inhalation diaphragm			
8	Check exhaust valve			
9	Check neck dam for damage			
10	Check neck dam assembly			
11	Check locking mechanism			
12	Check 1st stage assembly			
13	Check HP and LP hoses			
14	Check face plate secure and not damaged *(DO NOT use screwdriver)*			
15	Check harness assembly			
16	Check bailout PSIG *(2700 minimum)*			PSIG 1: PSIG 2: PSIG 3:
17	Check air spread OP’s completed			
18	Check to ensure flow restrictor in place			
19	Stow flow restrictor plug in safe place			
20	Connect hoses			
21	Adjust dial-a-breath			
22	Check free-flow			
23	Check purge			
24	Check EGS valve			
25	Check communications OK			

Notes:

ATTACHMENT 11

POST-DIVE: SSA DIVE HELMET CHECKOFF SHEET

PROJECT NAME/NUMBER: ______________________ DATE: _____________________
TENDER/DIVER: ____

NOTE: ALL ITEMS WILL BE CHECKED IN APPROPRIATE BLOCKS AS FOLLOWS:

1. **An initial for each completed and satisfactory check.**
2. **An N/A for each item not applicable to the Dive Helmet being pre-dove.**
3. **An "R" for any repairs made. A brief description in the remarks section. If more space required use the "notes" section for continuation.**
4. **When completed, person completing the checks will sign as appropriate (blocks 1 or 2) and then turn in to the Diving Supervisor for his checks, review and signature.**

Helmet/Mask Type	Serial No.	Checked By:	Signature	Dive Supe Signature
1.				
2.				
3.				
4.				

	Procedure	1	2	Remarks
1	Secure system and emergency air			
2	Bleed and disconnect hoses			
3	Make sure flow restrictor remains on helmet when using dry suit inflator whip			
4	Install flow restrictor plug			
5	Disconnect comms: 2-wire or MM plug			
6	Cap helmet and umbilical fittings			
7	Check helmet for damage			
8	Check neck dam O-ring for damage (lube)			
9	Check neck dam assembly for damage			
10	Check locking mechanisms for damage			
11	Remove head liner			
12	Check oral nasal mask			
13	Check side block assembly - secured			
14	Check 2nd stage regulator			
15	Check inhalation diaphragm			
16	Check LP and HP hoses (1st stage)			
17	Check face plate secure and not damaged *(DO NOT use screwdriver)*			
18	Wash with soap and water. Then dry.			
19	Disinfect with antibacterial wipes			
20	Open all valves – back of ¼ turn			
21	Remove covers from ear speakers / comms pod			

Notes:

Number of dives:

ATTACHMENT 11

PRE-DIVE: SURFACE SUPPLIED LIGHTWEIGHT (FFM)

PROJECT NAME/NUMBER: ______________________ DATE: ______________________

TENDER/DIVER: ____

ALL ITEMS WILL BE CHECKED IN APPROPRIATE BLOCKS AS FOLLOWS:

1. **ALL PERSONNEL MUST WEAR SAFETY GLASSES WHEN WORKING WITH HP AIR**
2. **Initial for each completed and satisfactory check.**
3. **When completed, person completing the checks will sign as appropriate (blocks 1 THRU 3) and then turn in to the Diving Supervisor for his checks, review and signature.**

Mask/ Type	Serial No.	Diver Signature	Dive Supervisor Signature
1.			
2.			
3.			

Initial	Procedure	Remarks		
	Ensure HP Air Bottles secured; Check cylinder pressures; Record cylinder pressures	#1:	#2:	#3:
	Ensure ACS on solid surface and secured			
	Inspect ACS condition			
	Check Umbilical condition and secured			
	Ensure all ACS valves are SECURED (closed); regulator valve low pressure (*all the way counterclockwise*)			
	Attach HP whips to bottles			
	Open bottles slowly; record HP Supply Pressure	1 HP PSIG:	2 HP PSIG:	
	Attach Divers supply/ pneumo hoses/ comm wires and mic to ACS			
	Open 1 HP supply (slowly)			
	Set required OB pressure on ACS	OB PSIG:		* *Initial set @ 135 PSIG*
	Check harness assembly			
	Check bailout bottle PSIG (90% @ min 2700)	PSIG DVR:	PSIG STBY:	
	Attach bailout first stage to pony bottle			* *Attach QD (first stage to KM block)*
	Check KM Manifold Block (*Suck and blow*)			
	Blow down diver's umbilical's			
	Connect umbilical hose to KM blocks			
	Connect comms (Hi-use connector)			* *Secure dummy plugs/ tape connector*
	Inspect Full Face Mask (FFM) - Nose pad/ one-way/ comms/ pp/ ABV/ seal / straps			
	Connect FFM to Block			
	Air to Masks			
	Check air to FFM; purge mask			
	Check comms – DV to console; DV to DV			
	Check pneumo for both umbilical's			
	Check all air spread OP's completed			

Notes:

ATTACHMENT 11

POST-DIVE: SURFACE SUPPLIED LIGHTWEIGHT (AGA)

PROJECT NAME/NUMBER: ______________________ DATE: _____________________
TENDER/DIVER: ____

ALL ITEMS WILL BE CHECKED IN APPROPRIATE BLOCKS AS FOLLOWS:

1. **ALL PERSONNEL MUST WEAR SAFETY GLASSES WHEN WORKING WITH HP AIR**
2. **Initial for each completed and satisfactory check.**
3. **When completed, person completing the checks will sign as appropriate (blocks 1 or 2) and then turn in to the Diving Supervisor for his checks, review and signature.**

Mask/ Type	Serial No.	Diver Signature	Dive Supervisor Signature
1.			
2.			
3.			

Initial	Procedure	Remarks
	Secure HP air; bleed down both HP whips and umbilical's	
	Disconnect FFM air / comms	
	Check FFM for damage/ post dive	
	Disinfect with antibacterial wipes	*Note: Contact time is 5 minutes.*
	Wash with soap and water. Then dry.	
	Bleed down EGS; Disconnect QD	
	Remove B/O first stage from pony	
	Bleed and disconnect hoses from KM block, inspect block and harness	
	Cap all fittings on block and umbilical	** Use dummy plugs/ tape connector.*
	Remove umbilicals from ACS/ stow	
	Cap all fittings on umbilical and ACS	
	Remove mic from ACS/ stow	
	Ensure all air system fittings capped and valves are secured; regulator valve backed out; ACS power OFF	
	Place ACS on charge or stow	

Notes: