INTERGOVERNMENTAL DATA QUALITY TASK FORCE

Uniform Federal Policy for Quality Assurance Project Plans Template

Geophysical Classification for Munitions Response

Revised Beta Draft
2/10/2015

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Preface

This Geophysical Classification for Munitions Response Quality Assurance Project Plan (GCMR-QAPP) template has been produced by the Intergovernmental Data Quality Task Force (IDQTF) to assist project teams in planning for the investigation of buried munitions and explosives of concern (MEC) at Department of Defense (DoD) installations and formerly used defense sites (FUDS). The template documents the systematic planning process steps leading to *in-situ* detection and classification of MEC and other debris. This template was developed following extensive research and development of geophysical classification technology under the Environmental Security Technology Certification Program (ESTCP). It is based on requirements and guidance contained in the Uniform Federal Policy for Quality Assurance Project Plans (UFP-QAPP), (IDQTF, 2005). It also draws upon similar efforts by the Interstate Technology & Regulatory Council (ITRC) Geophysical Classification for Munitions Response Team. Use of this template will help project teams generate a complete QAPP, i.e., a stand-alone document addressing all elements of the national consensus standard ANSI/ASQ E4, *Quality Systems for Environmental Data and Environmental Technology Programs.*

DoD has used military munitions for live-fire testing and training to prepare the United States military for combat operations. As a result, MEC, including unexploded ordnance (UXO) and discarded military munitions (DMM) may be present on former ranges and other facilities (such as production and disposal areas). During a traditional cleanup, a site is typically mapped using either a magnetometer or electromagnetic induction (EMI) sensor, and the locations of all signals above a stated detection criterion are excavated, because this technology does not provide a validated means to discriminate between MEC and nonhazardous metallic debris. Experience has shown that most of the costs to remediate munitions-contaminated sites have been spent excavating items that pose no threat. Remediation of the entire inventory of munitions-contaminated sites in this manner would be cost-prohibitive, and estimated completion dates for munitions response at many sites would be decades away.

Geophysical classification uses geophysical sensors to detect metal items beneath the ground surface followed by the use of advanced sensors and geophysical classifiers to estimate physical properties of the item (e.g., depth, size, aspect ratio, wall thickness, symmetry) and determine whether the item is a target of interest (TOI) (i.e., highly likely to be MEC) or non-TOI (highly unlikely to be MEC). Using this information in a structured decision-making process, documented in a project-specific QAPP, project teams will be able to make informed decisions about whether an item should be excavated or can be left in place. Following more than a decade of research and development, the technology has been successfully demonstrated on several live sites under the ESTCP, even as it continues to evolve. Use of this technology has the potential to save billions of dollars in the unnecessary and costly excavation of non-hazardous debris, and expedite the cleanup and reuse of federal facilities.

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The GCMR-QAPP template follows the format of the Optimized UFP-QAPP Worksheets (IDQTF, 2012); however, use of the original UFP-QAPP Workbook (IDQTF, 2005) is also acceptable. The information and examples in this template have been provided to facilitate the systematic planning process (SPP) and not replace it. Use of the template will result in a more rigorous, transparent, and better documented investigation. It should be noted there are some distinct differences between the SPP used for geophysical classification and that used for typical environmental (i.e., chemical) investigations:

1. Unlike typical chemical investigations where a sample of the soil is taken from the field and sent to an off-site laboratory for analysis, geophysical classification measurements for target identification and classification are taken *in-situ*. Data processing may take place either in the field or off-site.
2. The geophysical classification process is performed dynamically, allowing decision-making to occur while project teams are in the field; therefore, a structured process for evaluating data quality and subsequently making decisions is vital to the success of meeting project objectives.

Because of these differences, the GCMR-QAPP does not require all of the worksheets contained in either the original Workbook or the Optimized Worksheets. Table 1 identifies worksheets not used in the template and explains why they have been excluded.

The worksheets in this template include green text, which provides instructions and guidance on completing each worksheet. Certain worksheets also include blue text, which provides examples of the types of information typically needed. Green and blue text should be removed before completing a project-specific QAPP. Where applicable, minimum recommended requirements are presented in black text. Guidance, examples, and minimum recommended requirements contained in this template are based on the Remedial Action (RA) phase of investigation; therefore, they will not apply to every situation. Project teams should modify this template as needed to suit other phases of investigation and their project-specific data quality objectives (DQOs). Project teams must provide the rationale for changes to black text. A convenient and efficient way to do this is to provide an appendix describing any changes and providing the rationale.

The following limitations should be noted:

- This template addresses detection and classification only. It does not address the intrusive investigation (removal of items) or associated explosives safety operations.
- Although modern classification technologies have dramatically increased the accuracy and sensitivity of geophysical investigations, it cannot be assumed that 100% of all MEC can be identified and removed at all sites.
- Geophysical classification does not evaluate potential risks from munitions constituents (MC).
- Wherever possible, a global positioning system (GPS) with centimeter-level precision, or other high-precision positioning system, should be used for referencing sample locations. The examples in this template cannot be used for line and fiduciary positioning.

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- Geophysical classification may not be suitable for use at all sites. Readers should refer to the ITRC document on geophysical classification (under development) for further guidance on its uses and limitations.
- Users of this QAPP template must comply with any applicable State, Federal, or DoD Component-specific requirements, policies, and procedures.

Table1. Crosswalk: Optimized UFP-QAPP Worksheets to GCMR-QAPP Template

Optimized UFP-QAPP Worksheets		**GCMR-QAPP Template**
1 & 2	Title and Approval Page	Included
3 & 5	Project Organization and QAPP Distribution	Included
4 , 7 & 8	Personnel Qualifications and Sign-off Sheet	Included
6	Communication Pathways and Procedures	Included
9	Project Planning Session Summary	Included
10	Conceptual Site Model	Included
11	Project/Data Quality Objectives	Included
12	Measurement Performance Criteria	Included
13	Secondary Data Uses and Limitations	Included
14 & 16	Project Tasks & Schedule	Included
15	Project Action Limits and Laboratory-Specific Detection / Quantitation Limits	Not applicable – no chemical testing being performed
17	Sampling Design and Rationale	Included – Title changed to “Survey Design and Project Work Flow”
18	Sampling Locations and Methods	Not applicable – No environmental samples being collected
19 & 30	Sample Containers, Preservation, and Hold Times	Not applicable – No environmental samples being collected
20	Field QC	Worksheet not included. Field QC procedures are included on Worksheet #22
21	Field SOPs	Worksheet not included. SOPs are referenced on Worksheet #22

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Optimized UFP-QAPP Worksheets		**GCMR-QAPP Template**
22	Field Equipment Calibration, Maintenance, Testing, and Inspection	Included – Title changed to "Equipment Testing, Inspection, and Quality Control
23	Analytical SOPs	Not applicable – no laboratory analysis being performed
24	Analytical Instrument Calibration	Not applicable – no laboratory analysis being performed
25	Analytical Instrument and Equipment Maintenance, Testing, and Inspection	Not applicable – no laboratory analysis being performed
26 & 27	Sample Handling, Custody, and Disposal	Not applicable – no samples being collected
28	Analytical Quality Control and Corrective Action	Not applicable – no laboratory analysis being performed
29	Project Documents and Records	Included –title changed to "Data Management, Project Documents and Records"
31, 32 & 33	Assessments and Corrective Action	Included
34	Data Verification and Validation Inputs	Included – title changed to "Data Verification, Validation, and Usability Inputs"
35	Data Verification Procedures	Included – title changed to "Data Verification and Validation Procedures"
36	Data Validation Procedures	Included – title changed to "Geophysical Classification Process Validation"
37	Data Usability Assessment	Included

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Abbreviations and Acronyms

[Note: Final draft will include definitions]

(A) Ampere

(A/E/C) Architecture, Engineering, and Construction

(bgs) Below Ground Surface

(CA) Corrective Action

(CAR) Corrective Action Request

(CSDGM) Content Standard for Digital Geospatial Media

(CSM) Conceptual Site Model

(DDESB) Department of Defense Explosives Safety Board

(DFW) Definable Feature of Work

(DGM) Digital Geophysical Mapping

(DMM) Discarded Military Munitions

(DoD) Department of Defense

(DQI) Data Quality Indicator

(DQO) Data Quality Objective

(DUA) Data Usability Assessment

(EMI) Electromagnetic Induction

(EPA) U.S. Environmental Protection Agency

(ESRI) Environmental System Research Institute

(ESTCP) Environmental Security Technology Certification Program

(FGDC) Federal Geographic Data Committee

(FUDS) Formerly Used Defense Sites

(GCMR-QAPP) Geophysical Classification for Munitions Response Quality Assurance Project Plan

(GIS) Geographic Information System

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(GPS) Global Positioning System

(HAZWOPER) Hazardous Waste Operations and Emergency Response

(IDQTF) Intergovernmental Data Quality Task Force

(IMU) Inertial Measurement Unit

(ISO) Industry Standard Object

(ISO 80) Schedule 80 small Industry standard object

ISO/IEC International Organization for Standardization/International Electrotechnical Commission

(ITRC) Interstate Technology Regulatory Council

(IVS) Instrument Verification Strip

(MC) Munitions Constituents

(MEC) Munitions and Explosives of Concern

(MPC) Measurement Performance Criteria

(MQO) Measurement Quality Objective

(NSSDA) National Standard for Spatial Data Accuracy

(PA) Preliminary Assessment

(pdf) portable document format

(PM) Project Manager

(QA) Quality Assurance

(QC) Quality Control

(QAPP) Quality Assurance Project Plan

(RA) Remedial Action

(RCA) Root Cause Analysis

(RI/FS) Remedial Investigation/Feasibility Study

(RPM) Remedial Project Manager

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(SDSFIE) Spatial Data Standards for Facilities, Infrastructure, and Environment

(SI) Site Inspection

(SNR) Signal to noise ratio

(SOP) Standard operating procedure

(SPP) Systematic Planning Process

(SUXOS) Senior UXO Supervisor

(TBD) to be determined

(TPP) Technical Project Planning

(TOI) Target of Interest

(Tx/Rx) transmit/receive

(UFP QAPP) Uniform Federal Policy for Quality Assurance Project Plans

(USACE) U.S. Army Corps of Engineers

(UXO) Unexploded Ordnance

(UXOQCS) Unexploded Ordnance Quality Control Specialist

(UXOSO) Unexploded Ordnance Safety Officer

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QAPP Worksheet #1 & 2: Title and Approval Page
(UFP-QAPP Manual Section 2.1)
(EPA Guidance QA/G-5, Section 2.1.1 and 2.1.4)

This worksheet identifies the principal points of contact for all organizations having a stakeholder interest in the project. Signatories usually include the DoD Remedial Project Manager (RPM) and Quality Assurance (QA) Manager, contractor Project Manager (PM) and QA Manager, and individuals with oversight authority from regulatory agencies. Signatures indicate that officials have reviewed the QAPP, have had an opportunity to provide comments, and concur with its implementation as written. If separate concurrence letters are issued, the original correspondence should be maintained with the final, approved QAPP in the project file. It is the lead organization's responsibility to make sure all signatures are in place before work begins.

1. Project Identifying Information
    a. Site name/project name
    b. Site location/number
    c. Lead Agency
    d. Contractor
    e. Contract number

2. DoD Organization
    a. DoD RPM

    _____
    (name/title/signature/date)

    b. DoD QA Manager

    _____
    (name/title/signature/date)

3. Contractor
    a. Contractor PM

    _____
    (name/title/signature/date)

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b. Contractor QA Manager

_____
(name/title/signature/date)

4. Federal Regulatory Agency

_____
(name/title/signature/date)

5. State Regulatory Agency

_____
(name/title/signature/date)

6. Other Stakeholders (as needed)

_____
(name/title/signature/date)

7. List plans and reports from previous investigations relevant to this project

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QAPP Worksheet #3 & 5: Project Organization and QAPP Distribution
(UFP-QAPP Manual Section 2.3 and 2.4)
(EPA Guidance QA/G-5, Section 2.1.3 and 2.2.4)

This worksheet identifies key project personnel, as well as lines of authority and lines of communication among the DoD organization, prime contractor, subcontractors, and regulatory agencies. Two examples follow. Figure 3-1 provides an example of the organizational structure for the geophysical survey organization, and Figure 3-2 provides an example of the organizational structure for the Explosives Safety Operations organization. [Note: Although this template does not address explosives safety per se, including a copy of the organizational structure for the Explosives Safety Operations Organization is useful for facilitating project communications.] For the purpose of the draft QAPP, it is permissible to show "to be determined" (TBD) in cases where roles have not been assigned; however, all key personnel must be identified in the final, approved QAPP. If the Explosives Safety Operations Organization is addressed in a separate submittal, that document may be referenced.

For the purpose of document control, this worksheet also can be used to document recipients of controlled copies of the QAPP. The draft QAPP, final QAPP, and any changes/revisions must be provided to all QAPP recipients shown on this chart. Use asterisks or other symbols to designate QAPP recipients. [Alternatively, a list of QAPP recipients along with their contact information may be attached.] Contractors and subcontractors shown on this chart are responsible for document control within their organizations.

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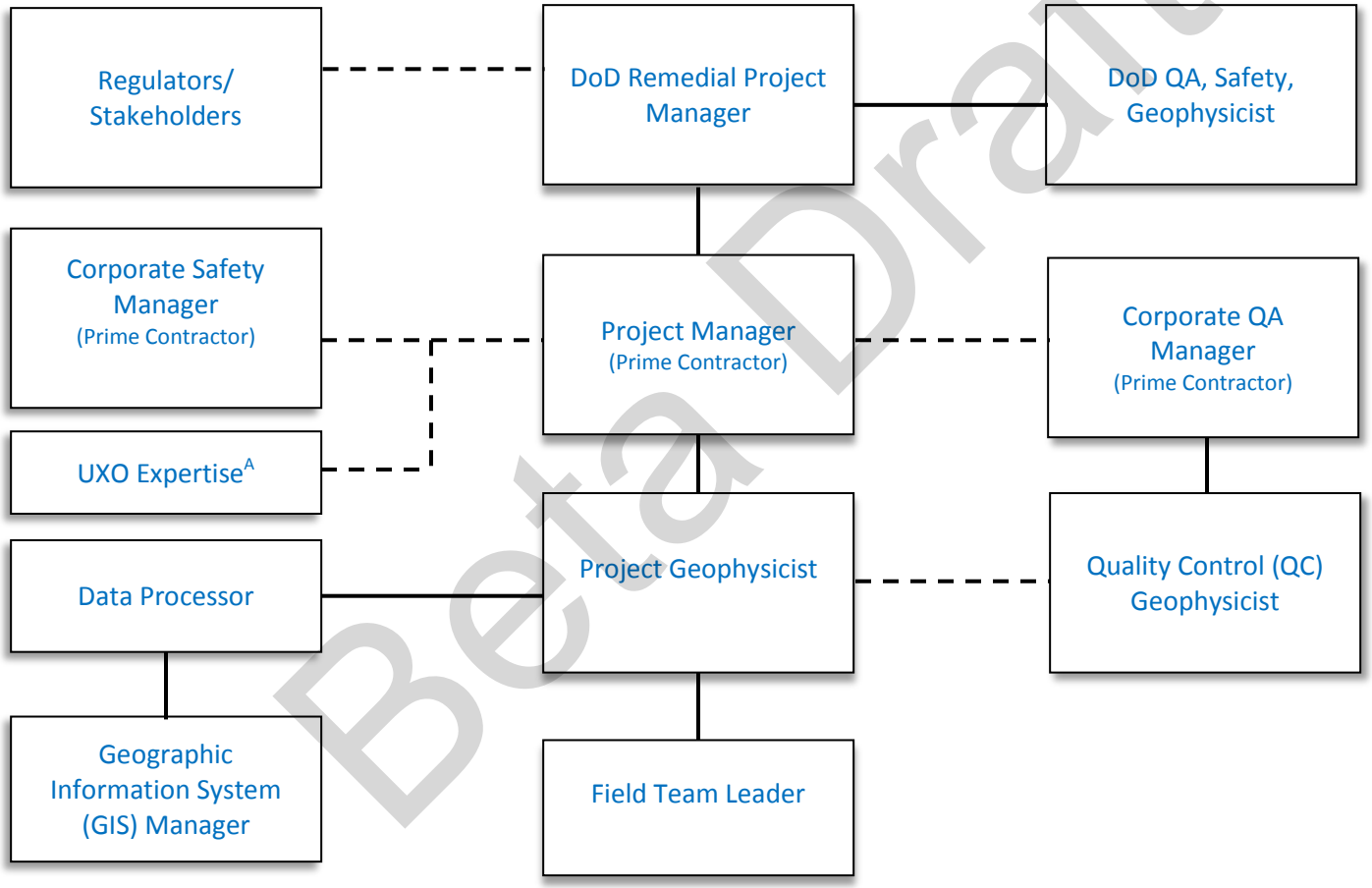
Lines of Authority ——— Lines of Communication - - -

Figure 3-1: Geophysical Survey Organizational Structure



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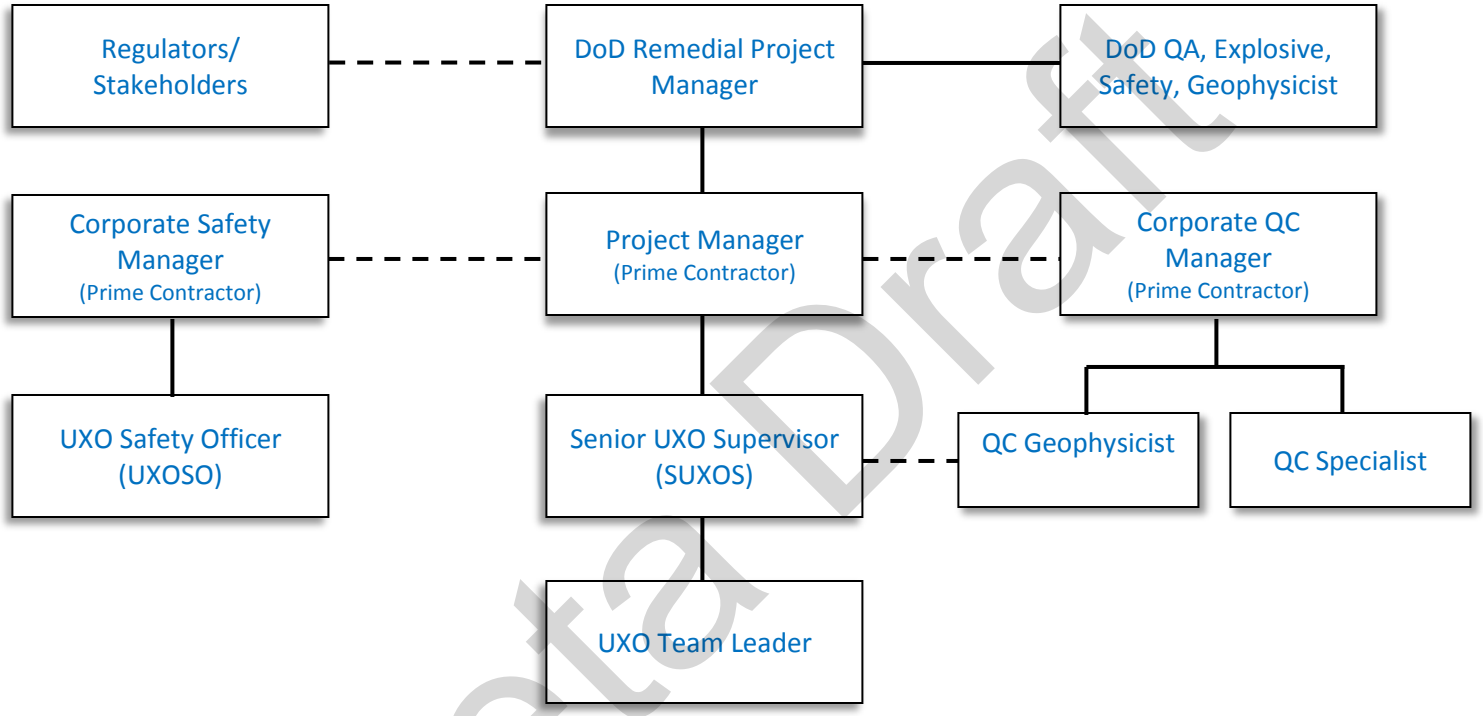
[A] UXO expertise is required to make sure the TOI, which can range from intact munitions to sub-components or fragments with residual explosive and/or chemical constituents, are defined.

Figure 3-2: Explosive Safety Operations Organizational Structure



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QAPP Worksheet #4, 7 & 8: Personnel Qualifications and Sign-off Sheet
(UFP-QAPP Manual Section 2.3.2 – 2.3.4)
(EPA Guidance QA/G-5, Section 2.1.8)

This worksheet identifies key project personnel for each organization performing tasks defined in this QAPP and summarizes their title or role; qualifications (e.g. training and experience); and any specialized training, licenses, certifications, or clearances required by the project. With the appropriate qualifications, personnel may fill more than one role. Examples are provided in blue text. It is outside the scope of this document to establish minimum qualifications for personnel. Users of this template should add spaces for additional organizations and personnel as needed. Resumes or documentation of relevant experience and training should be contained in an appendix to the QAPP. Signatures indicate personnel have read the QAPP and agree to implement it as written.

Table 4-1: Geophysical Survey Organization

Name/ Contact Information	Project Title/Role	Education/Experience[1]	Specialized Training	Required Licenses/Certifications[2]	Signature/Date
	Project Manager	M.S. Chemistry __ years Managing munitions response projects PM for __ advanced classification projects			
	Corporate QA Manager	B.S. Civil Engineering Corporate QC manager for __ years Oversight of __ munitions response projects			
	Corporate Safety Manager	M.S. Industrial Engineering		Certified Industrial Hygienist	

[1] Resumes should be included in an appendix.
[2] This column should include any State-specific requirements.

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Name/ Contact Information	Project Title/Role	Education/Experience[1]	Specialized Training	Required Licenses/Certifications[2]	Signature/Date
	Project Geophysicist	M.S. Physics Project Geophysicist on ESTCP Geophysical Classification demonstration at __	Oasis Montaj Geophysical Data Processing for UXO 3-day UX-Analyze instruction by ESTCP		
	QC Geophysicist	M.S. Physics Project Geophysicist on ESTCP Geophysical Classification demonstration at __	Oasis Montaj Geophysical Data Processing for UXO 3-day UX-Analyze instruction by ESTCP		
	Field Team Leader	B.S. Engineering Field Geophysicist on ESTCP Geophysical Classification demonstration at __	Oasis Montaj Geophysical Data Processing for UXO Working with UX-Analyze		
	Data Processor	B.S. Physics Project Geophysicist on ESTCP Geophysical Classification demonstration at __	Oasis Montaj Geophysical Data Processing for UXO 3-day UX-Analyze instruction by ESTCP		
	GIS Manager	M.S. in Geoinformatics and Geospatial Intelligence			

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Table 4-2: Explosive Operations Organization

Name/ Contact Information	Project Title/Role	Education/Experience	Specialized Training	Required Licenses/Certifications	Signature/ Date
	Project Manager	M.S. Geology __ years managing munitions response projects PM for __ advanced classification projects	Project Management Professional		
	Corporate QC Manager	B.S. Civil Engineering Corporate QC manager for __ Years Oversight of __ munitions response projects			
	Corporate Safety Manager	M.S. Industrial Engineering		Certified Industrial Hygienist	
	Senior UXO Supervisor (SUXOS)	Graduate Naval EOD School Qualified Senior UXO Supervisor i/a/w DDESB TP-18	Hazardous Waste Operations and Emergency Response (HAZWOPER)		
	UXO QC Specialist (UXOQCS)	B.S. Civil Engineering Qualified UXOQCS i/a/w DDESB TP-18	HAZWOPER		
	QC Geophysicist	M.S. Physics Project Geophysicist on ESTCP Geophysical Classification demonstration at __	Oasis Montaj Geophysical Data Processing for UXO 3-day UX-Analyze instruction by ESTCP		
	UXO Safety Officer	B.S. Civil Engineering Qualified UXOSO i/a/w DDESB TP-18	HAZWOPER		
	UXO Team Leader	Qualified UXO III i/a/w DDESB TP-18	HAZWOPER		

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QAPP Worksheet #6: Communication Pathways and Procedures
(UFP-QAPP Manual Section 2.4.2)
(EPA Guidance QA/G-5, Section 2.1.4)

This worksheet documents specific issues (communication drivers) that will trigger the need for formal (documented) communication with other project personnel or stakeholders. Its purpose is to ensure there are procedures in place for providing notifications, obtaining approvals, and generating the appropriate documentation when handling important communications, including those involving regulatory interfaces, approvals to proceed from one Definable Feature of Work (DFW) to the next, field changes, emergencies, non-conformances, and stop-work orders. Communication pathways and procedures should be agreed upon by the project team during project planning. Examples are provided below; additional communication drivers and procedures should be added as needed.

Communication Driver	Initiator (name, project title)	Recipient (name, project title)	Procedure (timing, pathway, documentation)
Regulatory agency interface	Name, DoD RPM	Name, Regulatory Organization	DoD RPM provides weekly project update memorandum to Regulator via email
Stop work due to safety issues	Name, Contractor SUXOS	Name, Contractor PM	As soon as possible following discovery, the SUXOS informs Contractor PM by phone of critical safety issues and generates follow-up Stop Work Memorandum
Minor QAPP changes during project execution	Name, QC Geophysicist	Name, Corporate QC Manager and Name, Project Geophysicist	Minor QAPP changes will be noted on the Daily QC reports and forwarded to the Project Geophysicist and the Corporate QC Manager at the end of each day
Major QAPP changes during project execution	Name, Contractor PM	Name, DoD RPM Name, Contractor QA manager	Within 24 hours, Contractor PM submits field change request form to Corporate QA Manager and DoD RPM for approval. Following approval, DoD RPM informs regulator via email.
Mobilization and surface clearance activities are complete	Name, Contractor SUXOS	Name, Contractor PM	Upon completion of surface clearance activities, the SUXOS informs the Contractor PM via Surface Clearance Memorandum.

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Communication Driver	Initiator (name, title/role, and contact info)	Recipient (name, title/role, and contact info)	Procedure (timing, pathway, documentation)
Field progress reports	Name, Contractor PM	Name, DoD RPM	At end of each day/week of field work, Contractor PM provides daily/weekly QC reports to the DoD RPM via email
Geophysical QC variances	Name, Contractor QC Geophysicist	Name, Project Geophysicist and Name, Corporate QC Manager	QC Geophysicist generates Corrective Action Request (CAR) form and transmits to Project Geophysicist and Corporate QC Manager. Project Geophysicist notifies PM by email.

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QAPP Worksheet #9: Project Planning Session Summary

The GCMR-QAPP worksheets will be completed in a series of project planning sessions, and a copy of this worksheet should be completed for each session, whether the session involves internal project teams (contractor and lead agency only) or includes regulators and other stakeholders. It is used to provide a concise record of participants, key decisions or agreements reached, and action items. Multiple planning sessions typically are required to complete the QAPP, and sessions should involve key technical personnel and decision-makers needed for that specific stage of planning and documentation.

Regardless of planning session format (e.g., phone conference, web-conferencing, or face-to-face meeting), all project planning sessions should be documented. Meeting minutes can be included as attachments if necessary, or referenced. Project teams will find it helpful to have a copy of the entire draft GCMR-QAPP template on hand for all planning sessions, in whatever state of completion it may be. The following table may be modified to suit project-specific documentation requirements.

Date of planning session:
Location:
Purpose:
Participants:

Name	Organization	Title/Role	Email/Phone

Notes/Comments:

Consensus decisions made:

Action Items:

Action	Responsible Party	Due Date

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Geophysical Classification QAPP Worksheet #10: Conceptual Site Model

This worksheet presents a concise summary of the project's conceptual site model (CSM) as it relates to the proposed investigation. The CSM is a working, iterative model of site conditions used to assist in the visualization and communication of available information and development of data quality objectives (DQOs). The CSM may include text, figures, and tables to depict the current understanding of site conditions. [Note: The ITRC is developing detailed technical/regulatory guidance on the development of CSMs for geophysical classification projects. This document is expected to be complete by _____.]

A key component of the CSM for geophysical classification projects is a geographical information system (GIS), which should be used to maintain and manage all project and geospatial data. The GIS is a "living" repository that is refined throughout the life of the project as new data are assimilated.

At a minimum, the CSM for the RA phase should include the following information:

- RA objectives (if decision document has been signed);
- Site history and uses;
- Types and quantities of MEC known or suspected to be present;
- Expected distribution of MEC present (area, expected maximum depth, depth distribution, anomaly density, etc.);
- The basis for dividing the site into survey units[3]
- Topography, geology, vegetation;
- Land use considerations;
- Reasonably anticipated future uses;
- Current and future receptors;
- Exposure pathways;
- Access restrictions or other obstacles to investigation;
- Endangered species, sensitive habitats, and historic or cultural resources that could be affected by traffic or other disturbances occurring during the geophysical classification process; and
- Data gaps and uncertainties associated with any information.

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[3] A survey unit is a portion of the site for which geophysical survey data, including QC results and results for blind QC seeds and validation seeds, will be collected and reported as a unit, for evaluation by the project team. (It is analogous to an analytical batch in chemical testing). The survey unit is not necessarily a geographically contiguous unit, and survey units for the detection phase may not be the same as those for the cued phase. The survey units should be designed such that data reporting and evaluation occurs at regular (e.g. weekly) intervals as agreed upon during project planning.

QAPP Worksheet #11: Data Quality Objectives
(UFP-QAPP Manual Section 2.6.1)
(EPA Guidance QA/G-5, Section 2.1.7)

This worksheet is used to document DQOs, which are developed during project planning sessions using an SPP. Examples of SPP include: 1) the DQO Process[4], and 2) the U.S. Army Corps of Engineers' Technical Project Planning (TPP)[5] process. A well-developed, up-to-date CSM is essential to the development of appropriate DQOs. Regardless of the type of SPP applied, the QAPP must document the environmental decisions that need to be made, the type and quantity of data, and level of data quality needed to ensure that those decisions are based on sound scientific data. The following guidelines are based on EPA's 7-step DQO process. The example is based on the RA phase. DQOs can be presented in tabular format.

Step 1: State the Problem. Define the problem that necessitates the study. Examine budget and schedule issues.

Site-specific problem statement: (Example) Previous investigations (list) have indicated that MEC in the form of DMM and UXO including (x, y, and z) are present at site _____, resulting from its use between (years) _____and_____ as a (describe the type of facility and its uses). As shown in the CSM these materials present an unacceptable risk from explosive hazards to (describe current receptors and potential future receptors based on anticipated land use.) During a traditional cleanup, a site is typically mapped using either a magnetometer or EMI sensor, and the locations of all signals above a stated detection criterion are excavated, because this technology does not provide a validated means to discriminate between MEC and nonhazardous metallic debris. Experience has shown that most of the costs to remediate munitions-contaminated sites have been spent excavating items that pose no threat. Remediation of the entire inventory of munitions-contaminated sites in this manner would be cost-prohibitive, and estimated completion dates for munitions response at many sites would be decades away.

Geophysical classification uses geophysical sensors to detect metal items beneath the ground surface followed by the use of advanced sensors and geophysical classifiers to estimate physical properties of the item (e.g., depth, size, aspect ratio, wall thickness, symmetry) and determine whether the item is a TOI or non-TOI. Using this information in a structured decision-making process, project teams will be able to make informed decisions about whether an item should be excavated or can be left in place.

Step 2: Identify the goals of the data collection. State how data will be used in meeting objectives and solving the problem. Identify study questions. Define alternative outcomes.

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[4] Guidance on Systematic Planning Using the Data Quality Objectives Process, U.S. EPA, EPA QA/G-4, February 2006
[5] Technical Project Planning Process, U.S. Army Corps of Engineers, EM 200-1-2, August 1998

Identify the principal study question: (Example) Based on current and anticipated future land use scenarios, which detected subsurface anomalies must be removed, and which ones may be left it place?

Identify alternative outcomes: (Example) To classify an anomaly as a TOI and remove it, or to classify it as non-TOI and leave it in place.

State how the data will be used in solving the problem: (Example) Advanced geophysical classification will be used to 1) detect anomalies resulting from DMM, UXO, and other metallic debris and 2) classify anomalies so that informed decisions can be made as to whether the anomaly is a TOI and should be removed, or is a non-TOI and may be left in place. Geophysical data collected using advanced electromagnetic induction (EMI) sensors in a dynamic mode will be used to initially detect and document the locations of subsurface anomalies. Geophysical data collected using advanced EMI sensors in a cued (static) mode will then be used to classify each anomaly as follows: 1) TOI, i.e., highly likely to be DMM or UXO; 2) Non-TOI, i.e., highly unlikely to be DMM or UXO; or 3) Inconclusive. Detected items classified as "TOI" and "inconclusive" will be targeted for removal. Items classified as non-TOI will be left in place. The results of geophysical detection and classification and the subsequent intrusive investigation must meet established DQOs to allow the anticipated land reuse to take place after the removal of TOI.

Step 3: Identify information inputs. Identify data and information needed to answer the study questions.

(Example)

- Up-to-date CSM summarizing site conditions based on previous studies (e.g., Preliminary Assessment (PA), Site Inspection(SI) and Remedial Investigation/Feasibility Study (RI/FS)), including:
    - RA objectives
    - Site history and uses
    - Range boundaries
    - Types and quantities of MEC known or suspected to be present
    - Expected distribution of MEC present (area, expected maximum depth, depth distribution, anomaly density, etc.)
    - MEC incident reports (if any)
    - Topography, geology, vegetation
    - Land use considerations
    - Reasonably anticipated future uses
    - Current and future receptors
    - Exposure pathways
    - Access restrictions or other obstacles to investigation

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    - Endangered species, sensitive habitats, and historic or cultural resources that could be affected by traffic or other disturbances occurring during the investigation or subsequent removal action
    - Assumptions, data gaps, and sources of uncertainty
- Detection survey results, including:
    - Areas covered
    - System QC test results
    - Instrument Verification Strip (IVS) results
    - Surveyed validation seed and QC seed locations
    - Data collection point responses and locations
    - Data analysis results, including
        - Anomaly locations
        - Unique anomaly identification numbers
        - Z-component amplitude and dipole response for each anomaly
        - Detection survey data validation report
        - Detection survey data usability evaluation
        - Updated CSM
- Cued survey results, including:
    - System QC results
    - IVS results
    - Background data
    - Surveyed validation seed and QC seed locations and types
    - Unique anomaly identification numbers and locations
    - Site-specific munitions library
    - Definition of items representing unacceptable explosive hazard
    - Classification of anomalies with confidence metric
    - Cued survey data validation report
    - Cued survey data usability evaluation
    - Updated CSM
- Intrusive investigation results, including
    - Excavation results (database)
    - Photos
    - Disposal records
    - Stop-Dig Threshold verification
    - Comparison of excavated “validation digs” to predictions
    - Final data usability evaluation
    - Final CSM

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Step 4: Define the boundaries of the project. Specify the target population and characteristics of interest. Define spatial and temporal boundaries.

Target population: (Example) The target population for this study includes the following MEC confirmed or suspected to exist in the study area:

Confirmed Munitions (including nomenclature, if known)	**MEC Type (UXO, DMM, or both)**	**Expected Depth of Penetration**	**Expected Detection Threshold**
37mm (unknown mark/mod)	UXO		
75mm (unknown mark/mod)	UXO		
Suspected Munitions (including nomenclature, if known)	**MEC Type (UXO, DMM, or both)**		
60 mm mortar, M49A3	UXO		
155mm, M107	UXO		

Characteristics of interest: (Example) The characteristics of interest are those characteristics (e.g., size, symmetry, aspect ratio, object density, and wall thickness) that will allow classifiers to determine whether an anomaly is a likely TOI or non-TOI.

Spatial and temporal boundaries: Spatial boundaries include both the horizontal area and vertical depth of the study. Establishing the vertical boundary considers the maximum expected depth that objects are buried, the maximum predicted depth of future excavations and disturbances based on anticipated future land use, and detector limitations, i.e., the maximum depth at which sensors can collect meaningful data for specific munitions. Establishing spatial boundaries should consider any areas that will be inaccessible to investigation for any reason (e.g., presence of power lines, structures, ponds, sensitive habitats, historic sites, and forested areas). Establishing temporal boundaries should consider seasonal conditions that could limit site access (e.g., periods of high rainfall, nesting seasons, etc.) Spatial and temporal boundaries should be depicted in the CSM (Worksheet #10).

(Example) This study is designed to detect and correctly classify all TOI exceeding the detection threshold and meeting measurement criteria within the established spatial boundaries. The detection threshold is a horizontal 37 mm projectile at 0.3 m below ground surface (bgs), which has been determined to be in the range of __ to __ mv/amp. This represents an anticipated minimum signal to noise ratio (SNR) of __.

The horizontal boundaries of the project are defined by the boundary of the 7-acre treatability study area shown on Figure _, excluding [list any areas excluded from the investigation]. The vertical

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boundary for each munition is the munition-specific maximum depth of detection based on the detection threshold discussed above. Vertical boundaries for each munition are shown on Figure _.

Step 5: Develop the Project Data Collection and Analysis Approach. Define the parameter of interest, specify the type of inference (i.e., what criteria define anomaly detection and what criteria will distinguish between TOI and non-TOI), and develop the logic (decision rules) for drawing conclusions from findings.

(Example) This project will use the results from advanced geophysical sensors (decay curves or signatures) and specialized geophysical modeling to classify target anomalies detected during the geophysical detection survey. Geophysical data from advanced sensors will be interpreted with physics-based models to estimate the physical attributes of the anomalies, and classifier models will be used to evaluate the likelihood that the anomalies are intact munitions. Anomalies will be classified into one of three categories described in Step 2 above. The final product will be a "ranked anomaly list" that classifies each anomaly, justifies the classification, and identifies whether a detected object will be removed or left in place. Anomalies on the list will be ranked in order of greatest likelihood to be a TOI to greatest likelihood to be a non-TOI, based on their confidence metrics.

Detection Phase

Parameters of interest: (Example) Measurements with an amplitude ≥__ and a SNR ≥ __.

Type of inference: (Example) Measurements meeting the criteria noted above will be considered to be potential TOI and selected as anomalies for further evaluation during the Cued Phase.

Decision rules: (Examples)

- If a response amplitude of ≥__ mv/amp is present in the dynamic data, and the signal to noise ratio is ≥__, the anomaly will be selected and placed on the Amplitude Response Anomaly List

Cued Phase

Parameters of interest: (Example) Spatial extent of detected anomaly, cued measurement SNR, inversion fit coherence, and inversion outputs of β1, β2, β3, x, y, and z.

Type of inference: (Example) If any of the following three criteria are met, the anomaly will be selected as a TOI: 1) the polarizability matches (within specifications established on Worksheet #22) that of an item in the project-specific TOI library, 2) estimates of the size, shape, symmetry, and wall thickness calculated from the polarizability, indicates the item is a long, cylindrical, and thick-walled, or 3) there is a group of x or more anomalies having similar polarizabilities that, after investigation, are discovered to be TOI. Anomalies with poor inversion fit coherence that, after considering all available information, cannot be ruled as non-TOI will be added to the TOI list.

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Decision rules: (Examples)

- If all or a portion of the study area is determined to have an anomaly density too high for cued analysis, then an alternative approach will be developed (factors for evaluating anomaly density are discussed in Worksheet #17).
- If the object is classified as TOI (highly likely to be a munition), then the object will be excavated.
- If the object is classified as non-TOI (highly unlikely to be a munition), then the object will be left in place.
- If the object is classified as inconclusive, then the object will be excavated.

Step 6: Specify Project-specific Measurement Performance Criteria (MPC). Considering Steps 1-5, derive project-specific MPCs that collected data will need to achieve to minimize the possibility of making erroneous decisions (i.e., concluding that a TOI is a non-TOI, or concluding that a non-TOI is a TOI). MPCs are the qualitative and quantitative specifications for precision, accuracy, sensitivity, representativeness, completeness, and comparability that collected data must meet to satisfy the DQOs described in Steps 1 through 5, above. MPCs guide the development of the geophysical survey design (which is developed during Step 7 and presented in Worksheet #17), and they are the criteria against which data usability will be evaluated at the end of the study. Project-specific MPCs are presented in Worksheet #12.

(Example) Project-specific MPCs are presented in Worksheet #12. Project-specific MPCs are the criteria that collected data must meet to satisfy the DQOs. Failure to achieve the MPCs may have an impact on end uses of the data, which will be discussed in the Data Usability Assessment Report.

Step 7: Survey Design and Project Work Flow. Develop a resource-effective design for collecting data that will meet the project-specific MPCs criteria developed during Step 6. This step usually refers to Worksheet #17, which should describe the geophysical classification process design and work flow in detail.

(Example) The MPCs established during Step 6 of the DQO process (documented in Worksheet #12) were used to develop the sample design, which is described in Worksheet #17. The sample design is broken down into a series of specific processes and data collection steps, termed DFW. Figure 17-1 provides a decision tree that will be used in the execution of the sample design, to evaluate the conformance of specific DFW to established MPC.

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QAPP Worksheet #12: Measurement Performance Criteria
(UFP-QAPP Manual Section 2.6.2)
(EPA Guidance QA/G-5, Section 2.1.7)

This worksheet documents the project-specific MPC in terms of data quality indicators (DQI) (i.e., precision, accuracy, sensitivity, representativeness, completeness, and comparability) for geophysical classification projects. MPCs are the minimum performance specifications that the geophysical survey design, including instruments and procedures, must meet to ensure collected data will satisfy the DQOs documented in Steps 1-5 on Worksheet #11. They are the criteria against which the data usability assessment (DUA) will be conducted at the end of the project. Minimum recommended MPCs applicable to the RA phase are presented in black text. Project teams may revise these MPCs or establish additional MPCs if necessary to achieve project-specific DQOs. The project-specific QAPP must explain and justify any changes to black text. An appendix may be used for this purpose.

Measurement Performance Activity (or DFW)	Data Quality Indicator	Specification	Activity Used to Assess Performance
QC Seeding	Representativeness	Blind QC seeds will be placed at the site by the contractor. Blind QC seeds must be detectable as defined by the DQOs and located throughout the horizontal and vertical survey boundaries defined in the DQOs. [The blind seed plan should describe the number and types of blind QC seeds.] Blind QC seeds will be distributed such that the field team can be expected to encounter between one and three seeds per day per team.	Review of blind seed plan
Detection Survey	Completeness	100% of the site is sampled.	Verification of conformance to measurement quality objectives (MQOs) for in-line spacing and cross-line spacing (see Worksheet #22)

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Measurement Performance Activity (or DFW)	Data Quality Indicator	Specification	Activity Used to Assess Performance
Detection survey	Sensitivity	This worksheet must describe the project-specific detection threshold. (Example) A detection threshold of ≥1.7 mV/A and SNR ≥ 5 is required to detect a [37 mm projectile] lying horizontally at a depth of [0.3 m].	Initial and ongoing Instrument Verification strip (IVS) surveys Blind seed detection Analysis of background variability across the site
Detection survey	Accuracy/ Completeness	100% of validation seeds must be detected.	Review of validation seed detection results per survey unit
Detection survey	Completeness/ Comparability	Complete Geosoft® databases and target lists delivered.	Data verification/data validation
Classification survey	Completeness/ Comparability	Library must include signatures for all munitions known or suspected to be present at the site, as listed in the CSM.	Verification of site-specific library
Classification survey	Representativeness/ Accuracy	Background data will be collected at least once every two hours of cued survey data collection. Background locations will be selected such that background data will be representative of the various subsurface conditions expected to be encountered within each survey unit at the site.	Data verification/data validation
Classification survey	Completeness	All detected anomalies classified as: 1. TOI 2. Non-TOI 3. Inconclusive	Data verification
Classification survey	Accuracy/ Completeness	Cued survey must correctly classify 100% of all validation seeds.	Review of validation seed classification results
Intrusive Investigation	Accuracy	100% of predicted non-TOI that are intrusively investigated are confirmed to be non-TOI.	Visual inspection of recovered items

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Measurement Performance Activity (or DFW)	Data Quality Indicator	Specification	Activity Used to Assess Performance
Intrusive Investigation	Accuracy	Inversion results correctly predict one or more physical properties (e.g. size, symmetry, or wall thickness) of the recovered non-TOI item (specific tests and test objectives established during project planning).	Visual inspection and qualitative evaluation of recovered items from the validation digs
Intrusive Investigation	Completeness/ Comparability	Complete Geosoft® database [Describe specifications for inversion results].	Data verification Data validation

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QAPP Worksheet #13: Secondary Data Uses and Limitations
(UFP-QAPP Manual Section 2.7)
(EPA Guidance QA/G-5, Chapter 3)

This worksheet should be used to identify sources of secondary data (i.e., data generated for purposes other than this specific project or data pertinent to this project generated under a separate QAPP) and summarize information relevant to their uses for the current project. This worksheet should be supplemented by text describing specifically how all secondary data will be used. The project team needs to carefully evaluate the quality of secondary data (in terms of precision, accuracy, representativeness, comparability, and completeness) to ensure they are of the type and quality necessary to support their intended uses. Secondary data can include the following: sampling and testing data collected during previous investigations, historical data, background information, interviews, modeling data, photographs, aerial photographs, topographic maps, and published literature. When evaluating the reliability of secondary data and determining limitations on their uses, consider the source of the data, the time period during which they were collected, data collection methods, potential sources of uncertainty, the type of supporting documentation available, and the comparability of data collection methods to the currently proposed methods. Examples are provided below.

Data type	Source	Data uses relative to current project	Factors affecting the reliability of data and limitations on data use
Meteorological	National Weather Service	Estimations of seasonal fluctuations in storm water runoff.	Published data are available for past 20 years. No known limitations.
Topographic	USGS	Surface water drainage pathways.	Topography in area X has been altered by grading activities between 2008 and 2009.
Range history			
Munitions use and disposal			

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QAPP Worksheet #14/16: Project Tasks & Schedule
(UFP-QAPP Manual Section 2.8.2)
(EPA Guidance QA/G-5, Section 2.1.4)

The QAPP should include a project schedule showing specific tasks, the person or group responsible for their execution, and planned start and end dates. The following template may be used or a Gantt chart can be attached and referenced. Examples of activities that should be listed include key on-site and off-site activities. Any critical steps and dates should be highlighted.

DFW	Activity	Responsible party	Planned start date	Planned completion date	Deliverable(s)	Deliverable due date
1	Site Preparation					
2	Seeding & IVS Construction					
3 & 4	Detection Survey					
5	Data Processing (Detection Phase)					
5	Data Verification and Validation (Detection Phase)					
5	Data Usability Assessment (Detection Phase)					

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DFW	Activity	Responsible party	Planned start date	Planned completion date	Deliverable(s)	Deliverable due date
6 & 7	Cued Survey					
8	Validate Advanced Sensor Data					
9	Conduct Data Processing					
10	Anomaly Classification					
10	Data Usability Assessment (Cued Phase) & Dig/no-Dig Decisions					
11	Intrusive Investigation					
12	Threshold Verification					
12	Process Validation					
13	Data Usability Assessment (Final)					

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DFW	Activity	Responsible party	Planned start date	Planned completion date	Deliverable(s)	Deliverable due date
13	Final Report Preparation					

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QAPP Worksheet #17: Survey Design and Project Work Flow
(UFP-QAPP Manual Section 3.1.1)
(EPA Guidance QA/G-5, Section 2.2.1)

This worksheet describes and justifies the design for both the dynamic and cued surveys. It documents Step 7 of the DQO process. If a munitions response site consists of multiple areas to be surveyed, then a separate survey design section or worksheet should be completed for each area. Factors that will influence the survey design include the size of the site, types and expected distribution of munitions and other debris present, the terrain, and other site conditions that could limit the ability of field teams or equipment to access portions of the site.

The survey design and project work flow must include the following:

1. A map showing physical boundaries for the area(s) under study.
2. The basis for dividing the site into survey units.
3. A decision-logic diagram (See Figure 17-1 for an example)
4. Concise descriptions for each DFW (Standard Operating Procedures (SOPs) containing detailed procedures must be included in an appendix to the project-specific QAPP)
5. Contingencies in the event field conditions are different than expected and could have an effect on the survey design (e.g. a portion of the site is inaccessible at the time the site work is planned to occur.)
6. Points in the process at which lead agency, regulatory, and stakeholder interface will occur, as agreed upon during project planning.

<u>Project Work Flow:</u> This section should provide concise descriptions for each DFW and highlight government (lead agency and/or regulatory) inspection/oversight activities, key deliverables, and decision points, as they have been agreed upon during project planning. Worksheet #17 should reference other worksheets or SOPs containing detailed procedures. (In all cases, SOPs must be provided in an appendix to the project-specific QAPP.) Project teams may modify this work flow description to consolidate DFW or provide further break-down of DFW, as necessary to accommodate project-specific specifications.

<u>DFW 1: Conduct site preparation (contractor and lead agency):</u> Describe activities that must be completed prior to conducting site work (e.g., surface clearance, surface sweep, construction of silt fences or other barriers, if needed (for example, to prevent access by or exposure to potential receptors during site activities), and activities to preserve cultural resources or sensitive habitats, if needed. Describe procedures used to establish and document survey boundaries, including the use of control points for data positioning, and the establishment of survey units.

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Documentation: Surface Sweep Technical Memorandum

[Example] Contractor: The contractor will conduct site preparation activities in the survey area as well as any areas needed for equipment ingress/egress. The contractor will conduct a surface sweep to remove all exposed or partially exposed metallic objects that are equal to or greater than 5.0 cm in length in any direction. The contractor will document the type, quantity, and estimated mass of objects removed. Following the lead agency inspection and acceptance of the surface sweep, the contractor will [describe remaining site preparation activities]. Detailed procedures are contained in SOP(s) __ [list relevant SOPs].

Lead agency: Following the surface sweep, the lead agency (or designee) will review the Surface Sweep Technical Memorandum and visually inspect the site.

DFW 2: Conduct Validation Seeding, QC seeding, and construct IVS (contractor and lead agency):
Contractor: Describe the contractor's placement of both surface and subsurface blind QC seeds, and construction of the IVS. Provide the rationale for the types, number, and placement of seeds. Describe procedures for constructing the IVS, including the number, descriptions, depths, and orientation of targets. This step should reference the draft Verification and Validation Plan, which should be provided as an appendix to the QAPP.

Lead agency: Describe the placement of validation seeds by or on behalf of the lead agency.

Documentation: QC Seeding Plan, IVS Plan, Draft Verification and Validation Plan

DFW 3: Assemble and verify correct operation of geophysical sensor to be used for the detection survey (contractor): Describe procedures to be used to assemble and verify correct operation of the detection instrument (initial function test). Describe procedures for conducting the initial IVS detection survey.

Documentation: Instrument Assembly QC Checklist; IVS Memorandum

Decision point: Have MQOs been achieved?

DFW 4: Conduct detection survey (contractor): Describe the equipment and procedures that will be used to conduct the detection survey, including ongoing field QC activities (e.g. ongoing function tests). Describe requirements for detection and positioning. Describe and provide the rationale for coverage (based on sensor geometry and sizes of targets).

Documentation: Daily IVS Summaries; Daily QC Reports

DFW 5: Conduct data processing and document locations of anomalies (contractor and lead agency):
Contractor: Describe the procedures that will be used to process the dynamic data, validate the

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dynamic data (Worksheet #35 may be referenced), document locations to be used for background data collection during cued data collection, and select anomalies for cued data collection.

Lead agency: Because the cued data collection will be performed only at the locations of anomalies selected during this step, it is critical that the dynamic data validation be accepted by the lead agency, before the cued data collection begins. (Data validation is discussed in Worksheet #35). Once the lead agency has accepted the data validation report, the project team should conduct a detection survey DUA before proceeding to the cued phase. The DUA is discussed in Worksheet #37.

Documentation: Target Selection Technical Memorandum (data analysis, anomaly density, list of selected anomalies, recommended background locations), maps (depicting data and coverage, anomaly density, and selected anomalies), Weekly QC reports, and Detection Survey DUA Report

Decision point: Is anomaly density acceptable for cued survey? Have MQO's been achieved?

DFW 6: Assemble advanced geophysical sensor and test sensor at IVS (contractor): Describe procedures to be used to assemble the advanced geophysical sensor, and verify its correct operation (initial function test and initial cued survey IVS). Reassess the appropriateness of the IVS.

Documentation: Instrument Assembly Checklist; Cued Survey IVS Memorandum

Decision point: Have MQOs been achieved?

DFW 7: Collect cued data (contractor): Describe procedures for locating each anomaly identified for cued data collection, positioning the sensor, collecting the cued data, and conducting field inversions (i.e., quick checks by field personnel to confirm the acquired signal is representative of the target anomaly). Describe the procedures and frequency for conducting ongoing function tests and collecting cued background data. Describe procedures and frequency for verifying ongoing operations at the IVS and conducting field QC.

Documentation: Daily IVS Summaries; Daily QC Reports

Decision point: Have MQOs been achieved?

DFW 8: Validate advanced sensor data (contractor and lead agency): Contractor: Describe the procedures for validating cued survey data prior to inversion. The contractor typically conducts validation each day of data collection and generates a weekly QC report for review by the lead agency.

Lead agency: Review and accept weekly QC reports

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Documentation: Database (raw data and metadata), Weekly QC Reports

Decision point: Have MQOs been achieved?

DFW 9: Conduct data processing (contractor): Describe procedures for removing the effects of background signals on the advanced sensor data to isolate the signature from the buried metal object. Describe the software and procedures for inverting the data to generate polarizability decay curves that will be the basis for 1) library matching, 2) identifying clusters, and 3) predicting the size, shape, and wall thickness of buried objects.

Documentation: Database (Inversion Results)

Decision point: Have MQOs been achieved?

DFW 10: Classify anomalies and make dig/no-dig decisions (contractor and lead agency) Contractor: Describe procedures and factors considered in classifying anomalies. The classification process considers how well the signature matches the library data (Worksheet #22 contains specifications for library fit coherence). In cases where the signature does not match library data but appears to either 1) fit that of a cluster (i.e., numerous similar signatures consistent with a potential TOI not contained in the library) or 2) predict properties consistent with those of a munition, the contractor will use information in the CSM (e.g., site history and uses, and known types and distribution of munitions) to assist with the classification process.

Objects will be classified into one of the following three categories, and a dig/no-dig decision is made on each by the project team:

1. TOI (Highly likely to be MEC);
2. Non-TOI (Highly unlikely to be MEC);
3. Inconclusive (Data cannot be analyzed).

Objects will be placed on a ranked anomaly list, arranged in order from highest likelihood the object is a TOI to highest likelihood the object is a non-TOI. Objects classified as inconclusive will be included on the ranked anomaly list as potential TOI, and therefore, will be included on the Dig List. The contractor identifies the stop-dig threshold between TOI and non-TOI (i.e., the last TOI on the Dig List), an additional 200 “threshold verification” targets, and an additional 200 process validation targets to add to the Dig List.

Lead agency: The lead agency reviews and accepts the classification results. The project team conducts the cued survey DUA, reviews the draft Verification and Validation Plan and makes and changes as necessary.

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Documentation: TOI/non-TOI classification spreadsheet; library match results, figures and maps, Dig List, Cued Survey DUA Report, Final Verification and Validation Plan

Decision point: Are all QC seeds on the dig list? Are all validation seeds on the dig list correctly classified? Have MPCs been achieved?

DFW 11: Excavate buried objects (contractor): Describe procedures to reacquire and flag anomalies selected for intrusive investigation and investigate anomalies. This includes selecting the threshold verification targets and the validation targets.

Documentation: Database of excavation results, photographs, weekly QC reports, disposal reports

DFW 12: Verify the threshold and verify recovered non-TOI validation targets are consistent with predictions based on advanced sensor data (contractor and project team): Describe procedures for comparing excavated objects against the classification spreadsheet. If necessary, adjust the threshold and identify additional threshold and validation targets.

Documentation: Comparison results

Decision point: Was the stop-dig threshold correct? Are non-TOI (validation targets) consistent with predictions?

DFW 13: Conduct Final DUA: Briefly describe procedures to conduct the final DUA. (Refer to Worksheet #37 for detailed procedures.

Documentation: Updated CSM, Final DUA, Final Report

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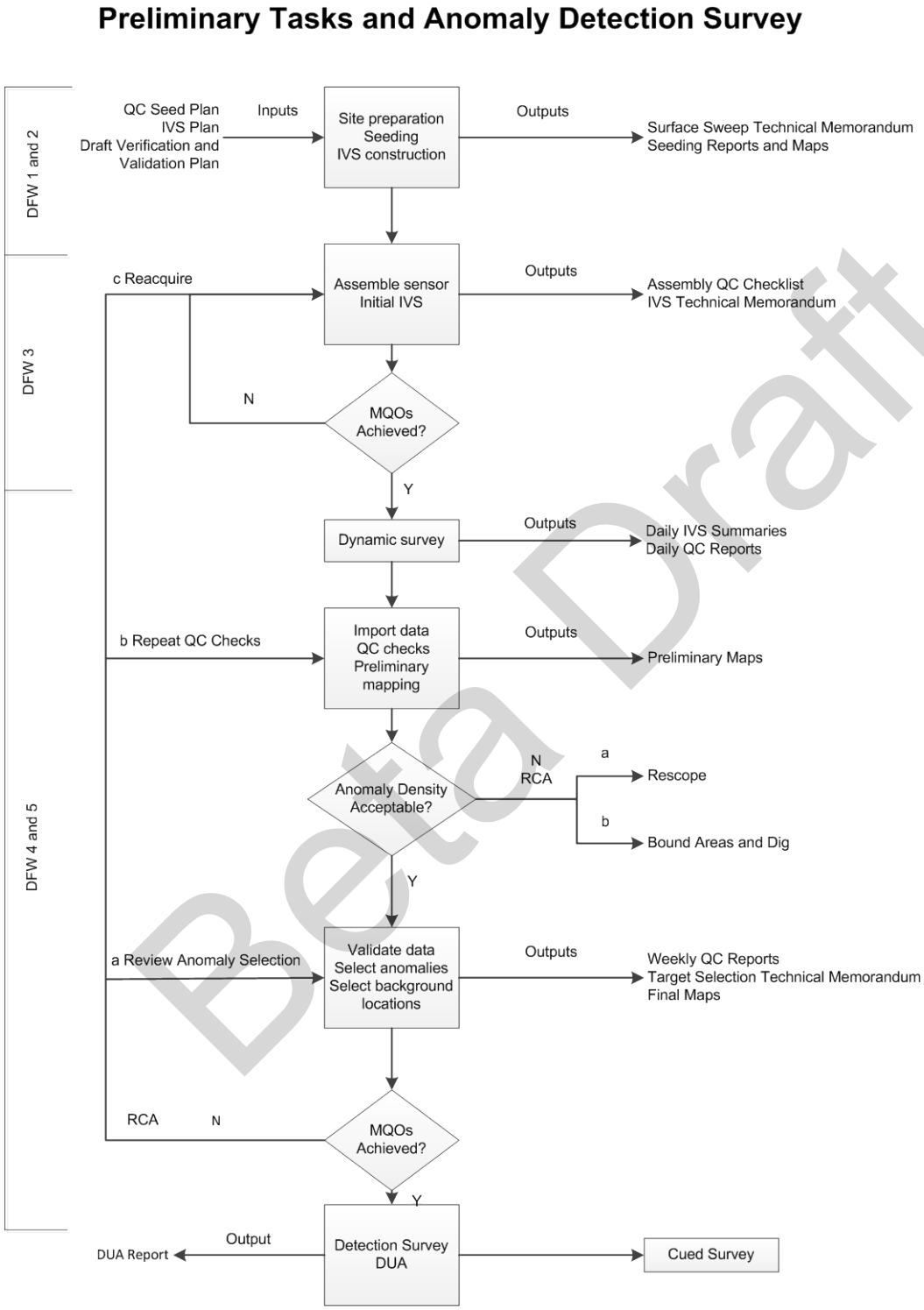
Figure 17-1: Geophysical Classification Decision Tree



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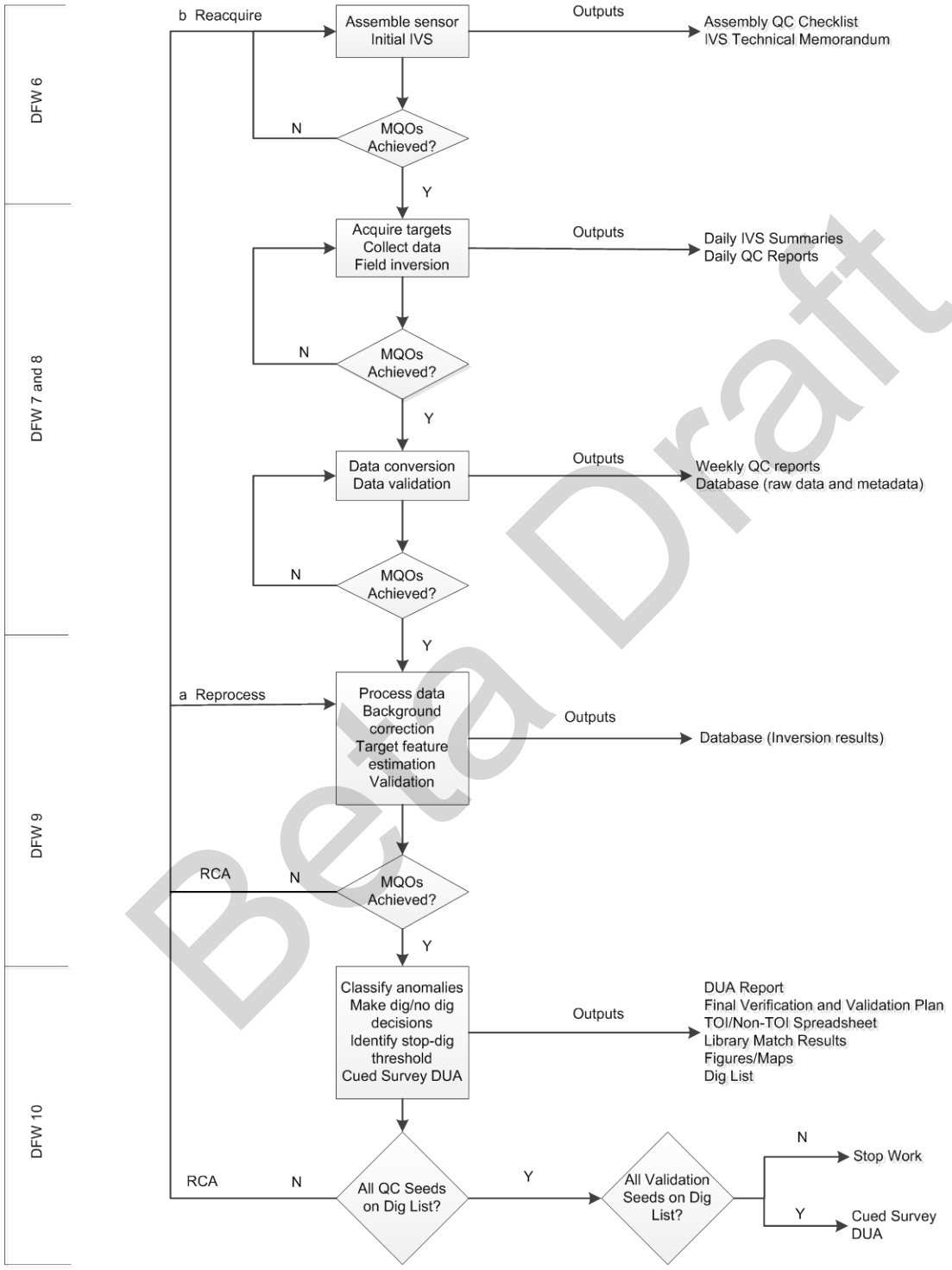
Cued Survey



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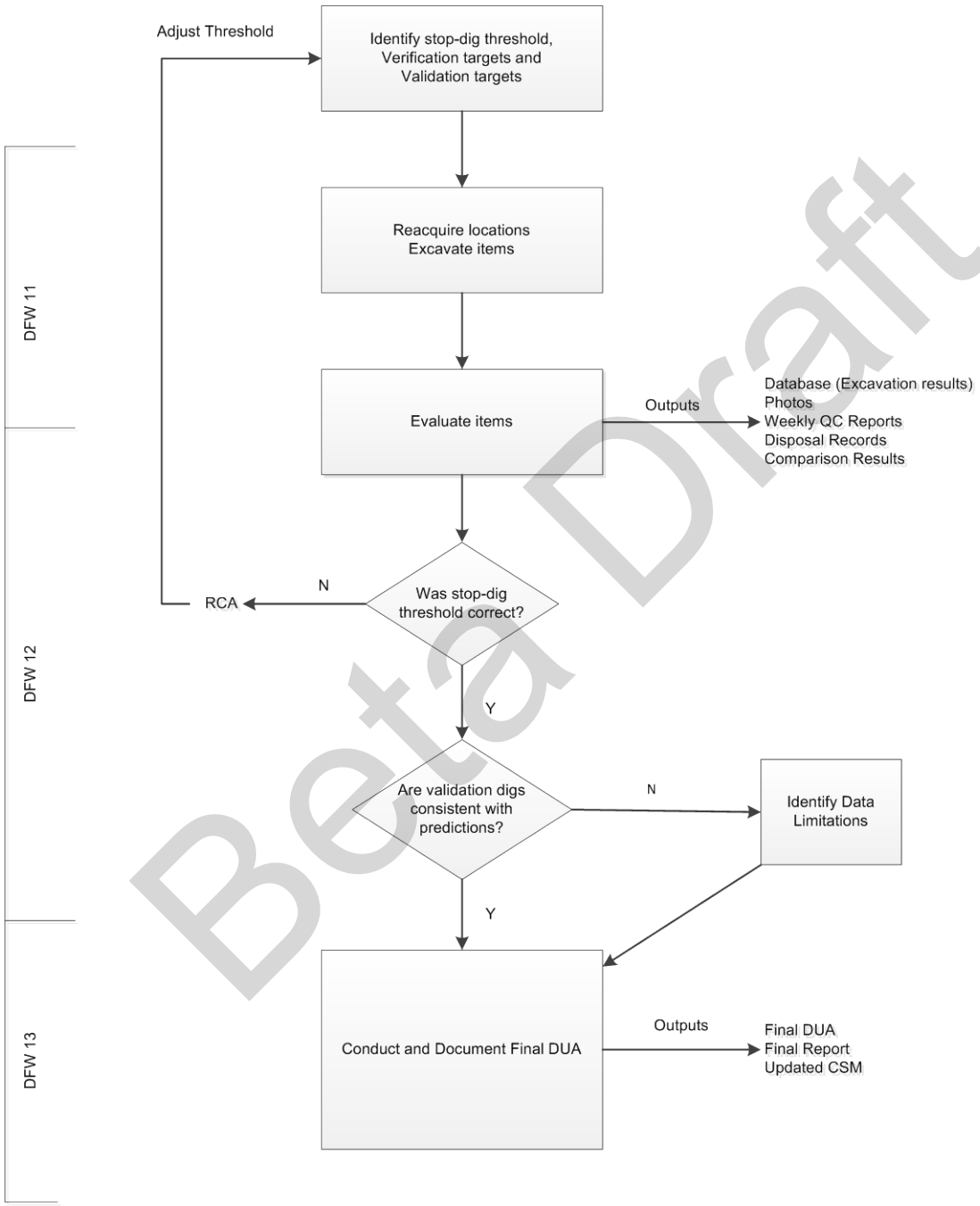
Intrusive Investigation



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QAPP Worksheet #22: Equipment Testing, Inspection, and Quality Control
(UFP-QAPP Manual Section 3.1.2.4)
(EPA Guidance QA/G-5, Section 2.2.6)

This worksheet documents procedures for performing testing, inspections and quality control for all field data collection activities. References to the applicable definable feature of work (DFW) and standard operating procedures must be included. Where appropriate the failure response will prescribe a corrective action (CA). Otherwise a root cause analysis (RCA) will be conducted to determine the appropriate CA. Examples are provided in blue text. Minimum recommended specifications are provided in black text. The project-specific QAPP must explain and justify any changes to black text. An appendix may be used for this purpose.

Table 22-1: Dynamic Survey (instrument: _____)

Measurement Quality Objective	DFW/SOP Reference	Frequency	Responsible Person/ Report Method/ Verified by	Acceptance Criteria	Failure Response
Verify correct assembly		Once following assembly	Field Team Leader/ instrument assembly checklist/Project Geophysicist	As specified in SOP-X, Assembly checklist	CA: Make necessary adjustments, and re-verify
Initial Instrument Function Test (Instrument response amplitudes)		Once following assembly	Field Geophysicist / Initial IVS Memorandum/ Project Geophysicist	Response (mean static spike minus mean static background) within 20% of predicted response for all monostatic Tx/Rx combinations	CA: Make necessary adjustments, and re-verify
Initial dynamic positioning accuracy (IVS)		Once prior to start of dynamic data acquisition	Project Geophysicist/ IVS Memorandum/QC Geophysicist	Derived positions of IVS target(s) are within 25 cm of the ground truth locations	CA: Make necessary adjustments, and re-verify

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Measurement Quality Objective	DFW/SOP Reference	Frequency	Responsible Person/ Report Method/ Verified by	Acceptance Criteria	Failure Response
Initial dynamic detection response amplitudes (IVS) TEMTADS		Once prior to start of dynamic data acquisition	Project Geophysicist/ IVS Memorandum/ QC Geophysicist	Response amplitudes within 25% of predicted amplitudes	CA: Make necessary adjustments, and re-verify
Initial dynamic detection response amplitudes (IVS) MetalMapper		Once prior to start of dynamic data acquisition	Project Geophysicist/ IVS Memorandum/ QC Geophysicist	Sum of 5 inner cubes response amplitude within 25% of predicted amplitude	CA: Make necessary adjustments, and re-verify
Ongoing Instrument Function Test (Instrument response amplitudes) TEMTADS		Beginning and end of each day and each time instrument is turned on	Field Team Leader/ running QC summary (Excel/Geosoft) /Project or QC Geophysicist	Response (mean static spike minus mean static background) within 20% of predicted response for all monostatic Tx/Rx combinations	CA: make necessary repairs and re-verify
Ongoing Instrument Function Test (MetalMapper)		TBD	Field Team Leader/ running QC summary/Project or QC Geophysicist	TBD	TBD
Ongoing dynamic positioning precision (IVS)		Beginning and end of each day	Project Geophysicist / running QC summary/QC Geophysicist	Derived positions of IVS target(s) within 25 cm of the average locations	RCA/CA
Ongoing dynamic detection response amplitudes (IVS)		Beginning and end of each day	Project Geophysicist/ running QC summary/QC Geophysicist	Response amplitudes within 10% of initial response	RCA/CA
In-line measurement spacing (TEMTADS)		Verified for each survey unit using [describe tool to be used] based upon monostatic Z coil data positions	Project Geophysicist/ running QC summary/ QC Geophysicist	100% ≤ 0.20m between successive measurements	RCA/CA CA assumption: data set fails, (recollect portions that fail)

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Measurement Quality Objective	DFW/SOP Reference	Frequency	Responsible Person/ Report Method/ Verified by	Acceptance Criteria	Failure Response
In-line measurement spacing (MetalMapper)		Verified for each survey unit using [describe tool to be used] based upon monostatic Z coil data positions	Project Geophysicist/ running QC summary/ QC Geophysicist	100% ≤ 0.25m between successive measurements	RCA/CA CA assumption: data set fails, (recollect portions that fail)
Coverage (TEMTADS)		Verified for each survey unit using existing UX Detect tools based upon monostatic Z coil data	Project Geophysicist/running QC summary and survey unit validation report/QC Geophysicist	100% at ≤0.7m cross-track measurement spacing (excluding site specific access limitations, e.g., obstacles, unsafe terrain)	RCA/CA CA assumption: Gaps require fill-in lines to achieve required coverage
Coverage (MetalMapper)		Verified for each survey unit using existing UX Detect tools based upon monostatic Z coil data	Project Geophysicist/running QC summary and survey unit validation report/QC Geophysicist	100% at ≤0.7m cross-track measurement spacing (excluding site specific access limitations, e.g., obstacles, unsafe terrain)	RCA/CA CA assumption: Gaps require fill-in lines to achieve required coverage
Sensor TX current (TEMTADS)		Per measurement	Field Team Leader/running QC summary/Project Geophysicist	Current must be ≥5.5A	CA: out of spec data rejected
Sensor TX current (MetalMapper)		Per measurement	Field Team Leader/running QC summary/Project Geophysicist	Current must be ≥4.0A	CA: out of spec data rejected

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Measurement Quality Objective	DFW/SOP Reference	Frequency	Responsible Person/ Report Method/ Verified by	Acceptance Criteria	Failure Response
Dynamic detection performance		Evaluated by survey unit	QC Geophysicist/ survey unit validation report/ lead agency QA Geophysicist	All blind seeds must be detected and positioned within 40 cm radius of ground truth	RCA/CA
Valid position data (1)		Per measurement	Field Team Leader/running QC summary/Project Geophysicist	GPS status flag indicates RTK fix	Out-of-spec data rejected
Valid position data (2)		Per measurement	Field Team Leader/running QC summary/Project Geophysicist	Orientation data valid	Out-of-spec data rejected

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Table 22-2: Cued Survey (instrument: _____; classification tool: _____)

Measurement Quality Objective	DFW/SOP Reference	Frequency	Responsible Person/ Report Method/ Verified by:	Acceptance Criteria	Failure Response
Verify correct assembly		Once following assembly	Field Team Leader/ instrument assembly checklist/Project Geophysicist	As specified in SOP-X, Assembly checklist	CA: Make necessary adjustments, and re-verify
Initial sensor function test (TEMTADS)		Once following assembly	Field Team Leader/ instrument assembly checklist/Project Geophysicist	Response (mean static spike minus mean static background) within 20% of predicted response for all monostatic Tx/Rx combinations	CA: make necessary repairs/ adjustments and re-verify

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Measurement Quality Objective	DFW/SOP Reference	Frequency	Responsible Person/ Report Method/ Verified by:	Acceptance Criteria	Failure Response
Initial system functionality test (MetalMapper) (five measurements over a small ISO80 target, 1 each directly under each coil and 1 directly under center of array). Derived polarizabilities for each measurement are compared to the library using UX-analyze		Once following assembly	Field Team Leader/ instrument assembly checklist/ Project Geophysicist	Library match metric ≥ 0.95 for each of the five sets of inverted polarizabilities	CA: make necessary repairs/ adjustments and re-verify
Initial IVS background measurement (five background measurements, one centered at the flag and one offset 40cm in each cardinal direction)		Once during initial system IVS test	Field Team Leader/ Initial IVS memorandum/ Project Geophysicist	All decay amplitudes lower than project threshold (threshold dependent upon soil response)	CA: reject/replace BG location
Initial derived polarizabilities accuracy (IVS)		Once during initial system IVS test	Project Geophysicist/ Initial IVS memorandum/ QC Geophysicist	Library Match metric ≥ 0.9 for each set of inverted polarizabilities	RCA/CA
Derived target position accuracy (IVS)		Once during initial system IVS test	Project Geophysicist/ Initial IVS Memorandum/QC Geophysicist	All IVS item fit locations within 0.25m of ground truth locations	RCA/CA
Ongoing IVS background measurements		Beginning and end of each day as part of IVS testing	Project Geophysicist/ tracking summary/QC Geophysicist	All decay amplitudes lower than project threshold	RCA/CA CA assumption: rejection of BG measurement (unless RCA indicates system failure)

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Measurement Quality Objective	DFW/SOP Reference	Frequency	Responsible Person/ Report Method/ Verified by:	Acceptance Criteria	Failure Response
Ongoing derived polarizabilities precision (IVS)		Beginning and end of each day as part of IVS testing	Project Geophysicist/ tracking summary/QC Geophysicist	Library Match to initial polarizabilities metric ≥ 0.9 for each set of three inverted polarizabilities	RCA/CA
Ongoing derived target position precision (IVS)		Beginning and end of each day as part of IVS testing	Project Geophysicist/ tracking summary/QC Geophysicist	All IVS items fit locations within 0.25m of average of derived fit locations	RCA/CA
Initial measurement of production area background locations (five background measurements: one centered at the flag and one offset 40cm in each cardinal direction)		Once per background location	Field Team Leader/ background location report/Project Geophysicist	All decay amplitudes lower than project threshold	CA: reject BG location and find alternate
Ongoing production area background measurements		Background data collected a minimum of every two hours during production	Field Team Leader/failures noted in field log and tracking summary/Project Geophysicist	All decay amplitudes lower than project threshold	CA: BG measurement rejected and recollected
Ongoing instrument function test (TEMTADS)		With each background measurement and each time instrument is restarted	Field Team Leader/tracking summary/Project Geophysicist	Response (mean static spike minus mean static background) within 20% of predicted response for all monostatic Tx/Rx combinations	CA: make necessary repairs and re-verify
Ongoing instrument function test (MetalMapper)		TBD	Field Team Leader/ tracking summary/ Project Geophysicist	TBD	TBD

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Measurement Quality Objective	DFW/SOP Reference	Frequency	Responsible Person/ Report Method/ Verified by:	Acceptance Criteria	Failure Response
Transmit current levels (TEMTADS)		Evaluated for each sensor measurement	Field Team Leader/ tracking summary/ Project Geophysicist	Peak transmit current between 5.5 and 8A	CA: stop data acquisition activities until condition corrected
Transmit current levels (MetalMapper)		Evaluated for each sensor measurement	Field Team Leader/ tracking summary/ Project Geophysicist	Peak transmit current between 4.0 and 4.5A	CA: stop data acquisition activities until condition corrected
Confirm all background measurements are valid		Evaluated for each background measurement	Project Geophysicist/ Background summary/ QC Geophysicist	Develop threshold	CA: BG measurement rejected and removed from active BG measurements
Confirm adequate spacing between units (TEMTADS)		Evaluated at start of each day (or grid)	Field Team Leader/ Field Logbook/ Project Geophysicist	Minimum separation of 50 m	CA: Recollect all coincident measurements
Confirm adequate spacing between units (MetalMapper)		Evaluated at start of each day (or grid)	Field Team Leader/ Field Logbook/ Project Geophysicist	Minimum separation 25 m	CA: Recollect all coincident measurements
Confirm inversion model supports classification (1 of 2)		Evaluated for all models derived from a measurement (i.e. single item and multi-item models)	Project Geophysicist/ Measurement QC summary/ QC Geophysicist	Derived model response must fit the observed data with a fit coherence ≥ 0.8	Follow procedure in SOP or RCA/CA
Confirm inversion model supports classification (2 of 2)		Evaluated for derived target	Project Geophysicist/ Measurement QC summary/ QC Geophysicist	Fit location estimate of item ≤ 0.4m from center of sensor	Follow procedure in SOP or RCA/CA
Confirm inversion model supports classification (3 of3)		Evaluated for all seeds	QC Geophysicist/ Measurement Inversion model QC summary/lead agency QA Geophysicist	100% of predicted seed positions ≤ 0.25 m from known position (x, y, z).	RCA/CA

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Measurement Quality Objective	DFW/SOP Reference	Frequency	Responsible Person/ Report Method/ Verified by:	Acceptance Criteria	Failure Response
Confirm reacquisition GPS precision		Daily	UXO tech or field tech/ Daily QC Report/ Project Geophysicist	Benchmark positions repeatable to within 10cm	RCA/CA

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Table 22-3: Intrusive Investigation

Measurement Quality Objective	DFW/SOP Reference	Frequency	Responsible Person/ Report Method/ Verified by:	Acceptance Criteria	Failure Response
Confirm derived features match ground truth (1 of 3)		Evaluated for all recovered items	Project Geophysicist/ Measurement QC Summary or intrusive database/QC Geophysicist	100% of recovered (excluding inconclusive category) item positions ≤ 0.25 m from predicted position (x, y).	RCA/CA
Confirm derived features match ground truth (2 of 3)		Evaluated for all recovered items	UXO Dig Team/ Dig List and intrusive database/ Project or QC Geophysicist	100% of recovered object size estimates (excluding inconclusive category) qualitatively match predicted size	RCA/CA
Verification of TOI/non-TOI threshold		Dig 200 anomalies beyond last TOI on Dig List	Project Geophysicist/ Verification and Validation Report/QC Geophysicist	100% of predicted non-TOI intrusively investigated are non-TOI	Adjust threshold
Classification validation		Random selection of 200 non-TOI	Project Geophysicist/ Verification and Validation Report/ QC Geophysicist	100% of predicted non-TOI qualitatively matches predictions	Document in DUE

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QAPP Worksheet #29: Data Management, Project Documents, and Records
(UFP-QAPP Manual Section 3.5.1)
(EPA Guidance QA/G-5, Section 2.1.9)

This worksheet provides 1) minimum specifications for all data management tasks and deliverables, and 2) procedures for controlling project documents, records, and databases. Where applicable, specific versions or dates of software used should be documented. Its purpose is to ensure data completeness, data integrity, traceability and ease of retrieval. Examples are provided in blue text.

Part 1: Data Management Specifications

Geographic Information System (GIS): [Example] A project-specific GIS will be used to store and manage all relevant geospatial-related data and information. All geospatial data will conform to the Federal Geographic Data Committee (FGDC) Geospatial Positioning Accuracy Standards, Part 2: National Standard for Spatial Data Accuracy (NSSDA), and Part 4: Standards for Architecture, Engineering, and Construction (A/E/C) and Facility Management. Each GIS data set will be accompanied by metadata conforming to the FGDC Content Standard for Digital Geospatial Metadata (CSDGM) and provided in a database that complies with the Spatial Data Standards for Facilities, Infrastructure, and Environment (SDSFIE). The final GIS submittal will contain all required ArcGIS.mxd files and layout files for all drawings contained in the final report.

Unless otherwise noted, land surveyor data will meet or exceed the Third Order, Class II specification. Horizontal GPS data will be repeatable to within 3 cm. The horizontal accuracy of GIS data will be tested in accordance with the National Standards. In addition, the location, identification, coordinates, and elevations of all established control points will be plotted on one or more site maps. Each control point will be identified on the map by its name and number and the final adjusted coordinates.

Environmental System Research Institute, Inc. (ESRI)-compliant formats (shapefiles, coverages, or geodatabases) will be used to present GIS data, with supporting tabular data provided in Microsoft Excel, Microsoft Access, or both, as needed.

Computer Files and Digital Data: [Example] All final document files, including reports, figures, and tables, will be submitted in electronic format (both Microsoft Office ___ or later, and portable document format (.pdf)) on CD-ROM. CDs containing .pdf files will also include Adobe™ Acrobat Reader®.

TOI Library: This worksheet should document the version (date) of the TOI library used and describe or reference procedures to be used to update the library. It should also describe how the site-specific library will be developed and documented. The CSM must

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provide the rationale for items included in/excluded from the site-specific library. Detailed library update and maintenance procedures should be contained in an SOP.

Part 2: Control of Documents, Records, and Databases

Field Records [much of the following is captured in the software]			
Record	**Responsible Party for Generation**	**Responsible Party for Verification**	**Format/ Storage Location/ Archive Requirements**
SOP Checklists			
Field Logbook (raw field notes)	Field Geophysicist	Project Director	Project File
Surface Clearance Memorandum			
Seeding Report and Map			
Photographs			
Daily IVS Summaries			
Daily QC Reports			
Weekly QC Reports			
Digital Field Notes			
Function test results			

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Deliverables (Plans, Technical Memoranda, Reports, Databases)			
Record	**Generation**	**Verification**	**Format/ Storage Location/ Archive Requirements**
Blind Seed Firewall Plan			
Quality Assurance Surveillance Plan			
MEC Anomaly Avoidance Plan			
Surface Sweep Technical Memorandum			
Production Area QC Seeding Report and Map			
Geographic Information System			
Mapped detection metric data			
IVS Technical Memoranda			
Detected target anomaly list			
Data processing logs			
Final detected anomaly grids			

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Deliverables (Plans, Technical Memoranda, Reports, Databases)			
Record	**Generation**	**Verification**	**Format/ Storage Location/ Archive Requirements**
Detection survey data processing log			
Target Selection Technical Memorandum			
Inversion Results			
Target Anomaly Classification Report			
Supporting classification images (pdf)			
TOI/non-TOI spreadsheet			
Library match results			
Dig list			
Validation Plan (Initial, Revised, Final)			
Disposal records			
Final Report			
Final data archives, including site-specific TOI library			
Updated CSM			

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Deliverables (Plans, Technical Memoranda, Reports, Databases)			
Record	**Generation**	**Verification**	**Format/ Storage Location/ Archive Requirements**
Project website			
Project Assessments			
Record	**Generation**	**Verification**	**Format/ Storage Location/ Archive Requirements**
Field audit checklists			
Verification checklists			
Data validation report			
Data usability assessment report			

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QAPP Worksheet #31, 32 & 33: Assessments and Corrective Action
(UFP-QAPP Manual Sections 4.1.1 and 4.1.2)
(EPA Guidance QA/G-5, Section 2.3 and 2.3.2)

This worksheet is used to document responsibilities and procedures for conducting project assessments, documenting assessments, responding to assessment findings, and implementing corrective action. Appropriately scheduled assessments during each group of related project activities allow management to identify problems while the activities are being implemented, thereby allowing processes to be corrected before they have a negative impact on the achievement of DQOs and MPCs. This worksheet should reference assessment checklists and include them in an appendix to the QAPP.

For this project, related activities are grouped as follows:

1. Site preparation (DFW 1-2)
2. Detection survey (DFW 3-5)
3. Cued survey (DFW 6-10)
4. Intrusive investigation (DFW 11-13)

[Example] For each group of related activities, assessment activities will occur during the following phases:

Preparatory Phase: Comprises the planning and design process leading up to field activities. The UXOQCS will perform a Preparatory Phase assessment before beginning each group of activities. The purpose of this assessment is to review applicable specifications and plans to verify that the necessary resources, conditions, and controls are in place and comply with specifications before field work begins.

Initial Phase: Occurs at the startup of field activities. The purpose of this phase is to check preliminary work for compliance with specifications, check for omissions, and resolve differences of interpretation.

Follow-up Phase: Covers the routine, day-to-day activities at the site. One or more follow-up assessments will be conducted during each related group of activities, depending on the duration of field activities, and the nature of any assessment findings.

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Table 31-1: Assessment Schedule

Assessment Type	Responsible Party	Schedule	Assessment Deliverable	Deliverable due date
Site Preparation Preparatory phase			Preparatory Phase Inspection Checklist	
Site Preparation Initial phase			Initial Phase Inspection Checklist	
Site Preparation Follow-up phase			Follow-up Phase Inspection Checklist	
Detection Survey Preparatory phase				
Detection Survey Initial phase				
Detection Survey Follow-up phase				
Cued Survey Preparatory phase				
Cued Survey Initial phase				
Cued Survey Follow-up phase				
Intrusive Investigation Preparatory phase				
Intrusive Investigation Initial phase				
Intrusive Investigation Follow-up phase				

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Table 31-2: Assessment Response and Corrective Action

Assessment Type	Responsibility for responding to assessment findings	Assessment Response Documentation	Timeframe for Response	Responsibility for Implementing Corrective Action	Responsible for monitoring Corrective Action implementation
Site Preparation All phases					
Detection Survey All phases					
Cued Survey All phases					
Intrusive Investigation All phases					

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QAPP Worksheet #34: Data Verification, Validation, and Usability Inputs
(UFP-QAPP Manual Section 5.2.1 and Table 9)
(EPA Guidance QA/G-5, Section 2.4)

This worksheet is used to list the inputs that will be used during data verification, validation, and usability assessment. Inputs include all requirements documents (e.g. contracts, SOPs, planning documents), field records (both hard-copy and electronic), and interim and final reports. Data verification is a completeness check that all specified activities involved in data collection and processing have been completed and documented and that the necessary records (objective evidence) are available to proceed to data validation. Data validation is the evaluation of conformance to stated requirements. Examples of requirements documents as well as records subject to verification and validation are listed below in blue text.

Requirements/Specifications:

Contract No. _____
Quality Assurance Project Plan, (Title)
SOPs (see Appendix __)

Item	Description	Verification (completeness)	Validation (conformance to specifications)	Usability (achievement of DQOs and MPCs)
Field Records				
	QC Seeding Records	X	X	
	Surface Sweep Seeding QC Checklist	X	X	
	Production Area Seeding QC Checklist	X	X	
	Field logbooks	X		
	Photographs	X		
	Instrument Assembly Checklist (Detection Survey)	X	X	
	Sensor Function Test Results (Detection Survey)	X	X	
	IVS Construction Details	X	X	
	IVS Checklists (Detection Survey)	X		
	Dynamic Data Collection QC Checklist	X	X	

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Item	Description	Verification (completeness)	Validation (conformance to specifications)	Usability (achievement of DQOs and MPCs)
	Dynamic Data Processing QC Checklist	X	X	
	Digital Field Notes	X		
	Daily QC Reports	X		
	Instrument Assembly Checklist (Cued Survey)	X	X	
	Sensor Function Test Results (Cued Survey)	X	X	
	IVS Checklists (Cued Survey)	X	X	
	Cued Data Collection QC Checklist	X	X	
	Cued Data Processing QC Checklist	X	X	
Electronic Data				
	Raw data files (EMI, GPS, and IMU)	X	X	
	Converted data files	X	X	
	Data Processing Log (Detection Survey)	X		
	Digital Field Notes	X		
	Mapped Detection Metric Data	X	X	
	Target Anomaly List	X	X	
	Final Data Archive (for each delivered area subset)	X	X	
	Cued Measurement Data (Target Measurement Data, Background Measurement Data, and Target Features Database)	X	X	
	Classification Images (pdf files)			
Interim & Final Reports/Deliverables				
	Production Area Seed Report			X
	IVS Memorandum (Detection Survey)			X

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Item	Description	Verification (completeness)	Validation (conformance to specifications)	Usability (achievement of DQOs and MPCs)
	Dynamic Data Processing Letter Report (data validation report)			X
	IVS Memorandum (Cued Survey)			X
	Site-specific library			X
	Cued Survey QC Report (data validation report)			X
	Prioritized Target List			X
	Target Classification Report			X
	Revised Validation Plan			X
	Final Validation Plan			X

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QAPP Worksheet #35: Data Verification and Validation Procedures
(UFP-QAPP Manual Sections 5.2.2 and __)
(EPA Guidance QA/G-5, Sections 2.4.1 and __)

This worksheet documents procedures that will be used to verify and validate project data. Data verification is a completeness check to confirm that all required activities were conducted, all specified records are present, and the contents of the records are complete. Data validation is the evaluation of conformance to stated requirements. [Some examples are provided in blue text; however, this is not a comprehensive list.]

Activity and Records Reviewed	Requirements/ Specifications	Process Description/Frequency	Responsible Person	Documentation
Field logbook/electronic files	QAPP	All information is complete for each day of field activities. Any changes/exceptions are documented and have been reported in accordance with requirements. Required signatures are present.	Project Geophysicist	Daily QC Report
Instrument Assembly	SOP X	Instrument Assembly has completed according to SOP X. MQOs have been achieved, with any exceptions noted. If appropriate, corrective actions have been completed. Signatures and dates are present.	Project Geophysicist	SOP X Checklist Daily QC Report
Initial IVS Survey	SOP X	Initial IVS Survey has been conducted according to SOP X. Checklist X has been completed. All specifications have been achieved, or exceptions noted. If appropriate, corrective actions have been completed. Signatures and dates are present.	Project Geophysicist	SOP X Checklist Daily QC Report

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QAPP Worksheet #36: Geophysical Classification Process Validation
(UFP-QAPP Manual Section)
(EPA Guidance QA/G-5, Section)

Worksheet #35 documents data verification and validation procedures that are implemented during field work for Geophysical Classification projects. This worksheet documents procedures that will be used to validate the overall anomaly detection and classification approach as it is implemented at a specific site. The purpose of process validation is to provide added confidence in the ability of the sample design to 1) select anomalies meeting the project-specific detection threshold for further investigation, and 2) correctly classify anomalies to distinguish between TOI and non-TOI.

The validation approach involves testing the thresholds for both anomaly detection and anomaly classification in two ways: 1) Placing "blind" validation and QC seeds at the site before the project begins, to confirm that the seeds can be detected and correctly classified; 2) Conducting "threshold verification digs", i.e., the excavation of additional anomalies (non-TOI) just beyond the thresholds used for detection and classification, to verify selection of the appropriate threshold; , and 3) Conducting validation digs, which involves a qualitative evaluation of how well the classification process predicted physical properties of the non-TOI. Validation digs are conducted at the end of the project, following the intrusive investigation. The results of the validation digs will be considered during the data usability assessment described in Worksheet #37.

Process validation approach:

[Example] The draft Verification and Validation Plan is included in Appendix _ to this QAPP. The draft Verification and Validation Plan describes how each of the decision-making thresholds for detection and classification will be tested and identifies how anomalies will be selected for the threshold verification and validation digs. It addresses the contractor's QC seeding plan, the threshold verification digs, and validation digs. [Note: The placement of Government validation seeds is addressed in the Government's Quality Assurance Surveillance Plan.] The number, type, and placement of QC seeds depend on project-specific DQOs. The final number and distribution of threshold verification digs and validation digs depends on the DQOs, as well as actual performance in the field against established MPCs. For that reason, the validation approach evolves as the project is implemented. The Verification and Validation Plan is finalized following cued data processing.

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QAPP Worksheet #37: Data Usability Assessment (DUA)
(UFP-QAPP Manual Section 5.2.3 including Table 12)
(EPA Guidance QA/G-5, Section 2.4)

This worksheet documents procedures that will be used to perform the DUA. The DUA is performed at the conclusion of data collection activities, using the outputs from data verification and data validation (Worksheets #35, #36 and the Final Validation Dig Report). It involves a qualitative and quantitative evaluation of environmental data against the MPCs and DQOs to determine if the project data are of the right type, quality, and quantity to support the decisions that need to be made. It involves a retrospective review of the systematic planning process to evaluate whether underlying assumptions are supported, sources of uncertainty have been managed appropriately, data are representative of the population of interest, and the results can be used as intended with an acceptable level of confidence.

Identify personnel (organization and position/title) responsible for participating in the data usability assessment:
DoD RPM
Project Manager
Project Quality Assurance Manager
Project Geophysicist
QC Geophysicist
Field Geophysicist (Lead)

Identify documents used as input to the data usability assessment:
Quality Assurance Project Plan
Contract Specifications
Quality Assurance Surveillance Plan
Final Verification and Validation Plan
Weekly QC Reports
Assessment Reports
Corrective Action Reports
Production Area Seed Report
IVS Memoranda

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Dynamic Data Validation Report
Site-Specific Library
Cued Survey Validation Report
Prioritized Target "Dig" List
Target Classification Report
Validation Dig Report

Describe how the usability assessment will be documented: The data usability report will be included as an appendix to the Final Report.

Step 1	**Review the project's objectives and sampling design** *Review the data quality objectives. Are underlying assumptions valid? Were the project boundaries appropriate? Review the sampling design as implemented for consistency with stated objectives. Were sources of uncertainty accounted for and appropriately managed? Summarize any deviations from the planned sample design.*
Step 2	**Review the data verification/validation outputs and evaluate conformance to MPCs documented on Worksheet #12** *Review the site-specific project library for completeness. Review available QA/QC reports, including weekly QC reports, assessment reports, corrective action reports, and the data verification/validation reports. Evaluate the implications of unacceptable QC results. Evaluate conformance to MPCs documented on Worksheet #12. Summarize the impacts of non-conformances on data usability.*
Step 3	**Document data usability, update the CSM, and draw conclusions** *Determine if the data can be used as intended, considering implications of deviations and corrective actions. Assess the performance of the sampling design and Identify any limitations on data use. Update the conceptual site model and document conclusions.*
Step 4	**Document lessons learned and make recommendations** *Summarize lessons learned and make recommendations for changes to DQOs or the sampling design for future similar studies. Prepare the data usability summary report.*

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Appendix A
Placeholder ONLY Beta Draft

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