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FINAL

UNEXPLODED ORDNANCE AND GEOPHYSICAL QUALITY ASSURANCE/QUALITY CONTROL PLAN

Munitions and Explosives of Concern Verification and Clearance
NASA Crows Landing Flight Facility
Crows landing, California

Environmental Remedial Action
Contract No. N62474-98-D-2076
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Response to Comments on the Draft Unexploded Ordnance and Geophysical Quality Assurance/Quality Control Plan, Munitions and Explosives of Concern Verification and Clearance, NASA Crows Landing Flight Facility, Crows Landing, California
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Comments by: Jim Austreng, P.E., State Unexploded Ordnance Coordinator, Office of Military Facilities, Department of Toxic Substances Control, June 13, 2005			
Comment No.	**Section, Figure, Tables**	**Comment**	**Response**
1	Page 3-3, Section 3.3	Text states "The QA Geophysicist will report to the UXOQCS and liaison with the Project Geophysicist." Comment: Quality Assurance is typically what the Government does to assure project objectives are achieved. To this matter, DTSC has pursued use of a third party QA to ensure project audits are performed consistent with auditing standards. Having the QA report to QC is inconsistent with this protocol. In addition, the description of reporting channels for audits do not address how DTSC will be informed.	A project organization chart will be added to the plan that includes the reporting structure for the QA geophysicist, UXOQCS, and SUXOS. The chart will indicate that the QA Geophysicist reports directly to the NAVY ROICC office (Navy's QA/QC) with indirect liaison with the UXOQCS and Project Geophysicist. DTSC will be provided with the meeting minutes from the weekly QC meeting that will indicate progress of work, problems that arise, and problem resolution. The meeting minutes will be checked and approved by the QA Geophysicist and the UXOQCS.
2	Page 6-7, Section 6.6.3 Blind Seeding	Text states "The frequency of blind QA items shall be one (1) per data set or one per four (4) acres of contingency surveyed area, whichever is greater." Comment: 1 item per 4 acres or per data set, which ever is greater, seem insufficient. DTSC typically requires one stimulant per acre. In addition, the plan to bury the seed to a lesser depth than evaluated as part of the geophysical prove-out is inappropriate given the prove-out is use to assist in establishing performance thresholds.	The plan will be modified to indicate that the frequency of blind QA items shall be one (1) per data set or one per acre of contiguously surveyed area, whichever is greater. The text will also indicate that the seed items will be buried to a depth equal to the depth evaluated as part of the geophysical prove-out.
3	Appendix A, Forms	Historically, many complications have resulted in confusion of grids and whether each grid has been signed off by appropriate personnel. To help reduce the confusion, I suggest the following (assuming the site, or sites are divided into grids). It would be helpful if the a data recording was developed utilizing the GIS system that tracks work on individual grids. Information included should note the UXO Team members who performed the geophysical survey, reacquisition/digging team members, results of digs, confirmation mapping, the Team leader and SUXOS. Once the Team Leader and SUXOS consider the grid, or group of grids to be complete, the information is transferred to the QC for sign off. Subsequent to sign off from QC, QA is provided the data/information for purposes of evaluating whether project objectives have been met. Results of any QC actions should be recorded as well. The intent of the above is to provide a streamline process for evaluating grid status and work performed. While the Forms of Appendix A provide some of the requested information, there doesn't appear to be any system integrating the information.	The MEC Verification and Clearance activities will be conducted over a total area of less than 20 acres from June through October 2005 using one geophysical team and one UXO team. Based on the size of the area cleared, the duration of the project, and limited personnel involved, the proposed forms and tracking process will be sufficient to ensure the data/information required for signoff is properly managed. Although a GIS system could simplify the process, the development of a GIS system for the relatively small project is not necessary.

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Table 1 DGM QC Frequency and Acceptance Criteria

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Acronyms and Abbreviations

%	percent
AAR	After Action Report
CQC	Construction Quality Control
DGM	Digital Geophysical Mapping
DQO	data quality objective
DTSC	California Department of Toxic Substance Control
EM	electromagnetic
EM61	Geonics EM61-MK2 time domain EM sensor
EM61HH	Geonics EM61-MK2 time domain EM sensor, handheld variant
G858G	Geometrics G-858G magnetometer
GIS	Geographical Information System
GPO	Geophysical Prove-out
GPS	Global Positioning System
Hz	hertz
IRP	Installation Restoration Program
MEC	munitions and explosives of concern
mm	millimeter
NAD83	1983 North American Survey Datum
NASA	National Aeronautical and Space Administration
NOSSA	Naval Ordnance Safety and Security Activity
nT	nanoTeslas
PC	personal computer
PQCP	Project Quality Control Plan
PQCM	Program Quality Control Manager
PM	Project Manager
QA	Quality Assurance
QA/QC Plan	Unexploded Ordnance and Geophysical Quality Assurance/Quality Control Plan
QC	Quality Control
QCPP	Quality Control Program Plan
ProXRS	Trimble ProXRS GPS
SOP	Standard Operating Procedure
SUXOS	Senior UXO Supervisor
TDEM	time domain EM
US	United States
UXO	unexploded ordnance
UXOQCS	Unexploded Ordnance Quality Control Specialist

1.0 Introduction

This Unexploded Ordnance (UXO) and Geophysical Quality Assurance (QA)/Quality Control (QC) Plan (QA/QC Plan) has been prepared to describe the geophysical QA and QC actions that Shaw Environmental, Inc. will implement during the performance of verification and clearance of munitions and explosives of concern (MEC). This work was performed at several sites at National Aeronautics and Space Administration (NASA) Crows Landing Flight Facility near Crows Landing, California. This QA/QC Plan will be used in conjunction with the Project Quality Control Plan (PQCP) and the Quality Control Program Plan (QCPP) that Shaw has prepared for work under Remedial Action Contract Number N62474-98-D-2076, in accordance with Shaw's Standard Operating Procedures (SOPs), which are included in the QCPP. The QA/QC Plan is organized as follows:

- Section 2.0: Project Background and Scope of Work
- Section 3.0: QA/QC Personnel and Responsibilities
- Section 4.0: Submittal Management
- Section 5.0: QC Inspections and Audits
- Section 6.0: Geophysical QA/QC
- Section 7.0: Equipment Calibration and Maintenance
- Section 8.0: Lessons Learned
- Appendix A: Forms

2.0 Project Background and Scope of Work

The overall approach will involve investigation, removal, and clearance of MEC and related scraps in locations where available information suggests or indicates historical usage, disposal, and/or mere presence of munitions items. The types of MEC of particular interest in this clearance effort are UXO and discarded military munitions.

Completion of clearance activities will be used to support closure of these areas, by Naval Ordnance Safety and Security Activity (NOSSA), which pertain to former ordnance and explosives material storage and usage. In addition to the locations noted by NOSSA, other areas for potential MEC investigations have since been identified. The sites to be addressed with geophysical investigations are described as follows:

- Installation Restoration Program (IRP) Site 11: Former Magazine/Disposal Pits Area
- IRP Site 11B: Debris Area
- Site A: Small Arms Firing Range (formerly IRP Site 18 North)
- Site B: "Live Ammunition" Area (formerly IRP Site 18 South) and Dredged Soil Berm

20-millimeter (mm) projectiles have been found at Site B. Possible storage and/or usage of 20-mm cartridges in practice training may have occurred at the other sites in the past.

Shaw UXO and geophysical personnel, as appropriate, will perform or assist in performing the following MEC site tasks:

- Establish survey control for the sites
- Perform a Geophysical Prove-out (GPO)
- Perform brush removal utilizing a brush (bush hog type) cutter and hand held trimming equipment
- Bury and record QA seed items.
- Perform a geophysical survey to locate anomalies potentially representing MEC
- Investigate and resolve all significant anomalies discovered during the geophysical survey
- Identify all MEC items discovered and safely collect and dispose of all MEC scrap

3.0 QC Personnel Organization and Responsibilities

The overall project organization and reporting structure are included in the Work Plan. This section addresses QA/QC personnel, organization, qualifications, and responsibilities. All geophysical investigations will be managed by qualified personnel. A project organization chart describing the reporting structure for the key QA/QC personnel is presented in Figure 1.

3.1 UXO Quality Control Specialist

The Unexploded Ordnance Quality Control Specialist (UXOQCS) has authority to enforce the procedures detailed in this plan, including authority to stop work. This authority applies equally to all project activities, whether performed by Shaw, a subcontractor, or a supplier.

The UXOQCS is responsible for planning and executing UXO QC oversight of project conditions and ensuring compliance with specified UXO QC requirements. He will also assist and monitor the activities of the Site Geophysicist and QA Geophysicist. Specifically, the UXOQCS is responsible for the following:

- Developing, assessing the effectiveness of, and maintaining the QA/QC Plan and related procedures
- Reviewing and approving the qualifications of proposed technical staff and subcontractors
- Planning and ensuring the performance of preparatory, initial, follow-up, and completion inspections for each definable feature of work
- Identifying quality problems and verifying that appropriate corrective actions are implemented
- Ensuring that the requisite QC records, including submittals, are generated and retained as prescribed
- Coordinate activities with the onsite Project Construction QC (CQC) Manager to maintain the overall project QC Program

The UXOQCS will be physically on site whenever geophysical or intrusive project-related work is in progress. If the UXOQCS is absent from the site, an alternative UXOQCS will be designated and will be given equivalent responsibilities and authority.

During pre-intrusive or non-intrusive project activities (where MEC avoidance support is not needed), an on-site Construction QC (CQC) Manager will assume these responsibilities as defined in the PQCP.

The UXOQCS, or his designee, will submit a Daily QC Report each morning of the following work day to the Navy along with a Daily Activity Report and Team Assignment Roster. The UXOQCS will report independent of project management to the Shaw Program QC Manager (PQCM). This individual, Eric Watabayashi, is responsible for ensuring that the overall QC procedures and objectives of the project are met.

3.2 Project Construction QC Manager

Shaw will have a Project CQC Manager on-site, to assist for non-intrusive or non-MEC project activities where the UXOQCS is not required on-site. This individual, Mark Vennemeyer, will be given equivalent responsibilities and authority as the UXOQCS and will report independent of project management to the Shaw PQCM.

3.3 Quality Assurance Geophysicist

The QA Geophysicist, Mr. Kent Boler, is responsible for overall geophysical survey quality assurance. He will not be involved with the MEC investigation activities, but will perform independent data review, review QC documentation, assist in QA audits, and administer the QA seeding program. He has a degree in geophysics and a minimum of five (5) years of directly related geophysical experience. The QA Geophysicist has authority to enforce the procedures detailed in this plan, including authority to stop work.

The QA Geophysicist is responsible for planning and executing independent QA oversight of geophysical activities and ensuring compliance with geophysical QC requirements. Specifically, the QA geophysicist is responsible for the following:

- Reviewing and approving the qualifications of proposed geophysical staff and subcontractors
- Assisting the UXOQCS in planning and ensuring the performance of preparatory, initial, follow-up, and completion inspections for the definable geophysical features of work
- Reviewing the geophysical QC and digital geophysical mapping (DGM) data, target lists, and dig results as specified in the Work Plan
- Insuring the acceptable performance and completion of all geophysical QC activities are performed and that the requisite geophysical QC records, including submittals, are generated and retained as prescribed
- Establishing and administering a known and blind seed location item program for QA of geophysical activities
- Identifying quality problems and verifying that appropriate corrective actions are implemented for geophysical activities

The QA Geophysicist will have daily access to all geophysical QC and DGM data, but may only be present on-site intermittently as needed after the completion of the initial inspections for geophysical activities.

The QA Geophysicist will have indirect liaison with the UXOQCS and the Project Geophysicist.

3.4 Project Geophysicist

The Project Geophysicist will be Mr. Martin Miele, a registered California Geophysicist. He has a degree in geophysics and a minimum of ten (10) years of directly related geophysical experience. He has overall responsibility for design, implementation, and management of all geophysical investigations and geophysical deliverables. However, day-to-day operations will be overseen by the on-site Site Geophysicist.

3.5 Site Geophysicist

The Site Geophysicist will be Mr. Jeremy Flemmer. He has a degree in geophysics and a minimum of five (5) years of directly related geophysical experience. The site geophysicist will be on site-and will coordinate all activities associated with the collection, processing, and analysis of geophysical sensor and navigation data. He is responsible for the collection and documentation of geophysical QC procedures as specified in this QA/QC Plan. He will also coordinate the detection of targets, creation of dig sheets, and relocation of anomalies. The site geophysicist will review all data processing steps, filtering procedures, data modeling results, and intrusive sampling results. The Site Geophysicist reports to the Project Geophysicist.

3.6 Personnel Qualifications and Training

Project staff will be qualified to perform their assigned tasks in accordance with terms outlined by the contract. Resumes and/or UXO Data Base Numbers for proposed MEC personnel will be maintained on site. The UXOQCS will maintain records documenting the required qualifications and training for each site worker. The UXOQCS will monitor expiration dates in order to advise employees of the need for refresher training or other requirements. The UXOQCS will maintain training records for personnel and visitors, as required by this plan. All required records will be maintained on site for audit purposes. A field QC logbook will be maintained by the UXOQCS to document details of field activities during QC monitoring activities.

4.0 Submittal Management

The Project Manager (PM) is responsible for overall management and control of project submittals.

The Project CQC Manager is responsible for ensuring that submittals are in compliance with applicable contract specifications. The Project CQC Manager is also responsible for ensuring that a project document/records file is established and maintained in accordance with the contract. The UXOQCS will assist the Project CQC Manager with the management and control of the MEC and geophysics project submittals.

5.0 QC Inspections and Audits

The UXOQCS is responsible for assisting the QA Geophysicist in maintaining compliance with this QA/QC Plan through implementation of a three-phase process. This section specifies the minimum requirements that must be met and to what extent QA/QC monitoring must be conducted by the UXOQCS.

5.1 Three-Phase Inspections

The three-phase inspection process will be implemented by the Project CQC Manager and the QA Geophysicist (as the UXOQCS's designee for geophysical phases of work). Three-Phase Inspection Report Forms are included in Appendix A.

5.1.1 Preparatory-Phase Inspection

The Project CQC Manager and UXOQCS or his designee will perform a preparatory-phase inspection prior to beginning each definable feature of work. Client notification of the preparatory-phase inspections is required at least 24 hours in advance. The purposes of this inspection are to review applicable specifications and to verify that the necessary resources, conditions, and controls are in place and compliant before the start of work activities. The UXOQCS will document this inspection on the Daily QC Report.

The UXOQCS will review Work Plans and operating procedures to ensure that they describe pre-qualifying requirements or conditions, equipment and materials, appropriate sequence, methodology, hold/witness points, and QC provisions. He will verify that the required plans and procedures have been prepared and approved, and are available to the field staff; field equipment is appropriate for its intended use, available, functional, and properly calibrated; staff responsibilities have been assigned and communicated; staff have the necessary knowledge, expertise, and information to perform their jobs; arrangements for support services have been made; and prerequisite site work has been completed.

Project staff must correct or resolve discrepancies between existing conditions and the approved plans/procedures identified by the UXOQCS during a preparatory-phase inspection. The UXOQCS must then verify that unsatisfactory and nonconforming conditions have been corrected prior to granting approval to begin work. Results will be documented in the Daily QC Report.

5.1.2 Initial-Phase Inspection

The UXOQCS or his designee is to perform an initial-phase inspection the first time a definable feature of work is performed. The UXOQCS will utilize the Daily QC Report to check

preliminary work for compliance with procedures and processes, and resolve differences of interpretation. Initial inspection results will be documented by the UXOQCS in the QC logbook and summarized in the Daily QC Report. Discrepancies between site practices and approved plans/procedures are to be resolved and corrective actions for unsatisfactory and nonconforming conditions or practices are to be verified by the UXOQCS prior to granting approval to proceed.

5.1.3 Follow-up-Phase Inspection

The UXOQCS or his designee will perform a follow-up inspection each day a definable feature of work is performed. The purpose of the follow-up inspections is to ensure compliance with work standards. The follow-up inspections will be recorded on the Daily QC Report and in the UXOQCS logbook.

5.1.4 Additional Inspections

Additional inspections may be performed on the same definable feature of work at the discretion of the client or the UXOQCS with approval by the client. Completion and acceptance inspections will also be performed to verify that project requirements, relevant to the feature of work, are satisfied.

5.1.5 Conformance/Non-Conformance Criteria

During the course of QC inspections, any MEC and/or inert/expended munitions that resemble MEC found shall constitute a non-conformance for that area. Any non-conformance will constitute a grid or process non-conformance, and will require corrective action(s) and root cause analysis. During the course of Shaw's QC surveillance and inspection activities, any process or product not in conformance shall constitute a failure of that respective surveillance or inspection, and cause Non-Conformance/Corrective Action procedures to be initiated.

5.2 Quality Audits

Audits are a formal assessment tool to determine the degree of conformance with project and external requirements. Audits of various project functions will be accomplished by the UXOQCS or his designee. These functions include, but are not limited to, explosive inventory, site documentation, scheduled reports, MEC accountability, and administrative support activities. Audit reports are typically a rich source of feedback information. .

5.3 Corrective Measures

Shaw's quality program is based on adherence to its Internal Standards Organization 9001:2000 quality management standard, which is based on root cause analysis and corrective action implementation. Any non-compliance/conformance must be documented and reported. Non-conformance includes both failure of the quality standard as revealed by QC inspection (e.g., discovery of a MEC item or MEC look-alike item) or deficiencies in workmanship, which

may cause concerns that such quality failures are occurring but have not been detected by inspections.

Immediately upon discovery of a Non-Compliance/Conformance item, the UXOQCS will take the following actions:

- Initiate a Non-Conformance/Corrective Action Report in accordance with the Shaw Non-Conformance/Corrective Action SOP
- In coordination with the QC Manager, assign a responsible individual and a corrective action due date

After approval by the PM (and senior management if deemed necessary), immediately upon receipt of a Non-Conformance/Corrective Action Report, the SUXOS will take the following actions:

- Identify the impact the non-conformance may have on other project activities
- Identify and implement the actions required to bring the project/activity back into compliance

6.0 Geophysical QC

QC testing will be performed to ensure that MEC removal is being performed according to the performance standards of this project.

6.1 Geophysical Data Quality Objectives

The following data quality objectives (DQOs) and investigation program objectives have been identified for this project.

6.2 MEC Detection

The performance goals for MEC detection are based upon proper execution of the most appropriate geophysical technology as determined in the GPO. The performance objective is to locate all MEC and MEC-like targets of 20mm or larger to a depth of 11 diameters of the object or to the demonstrated depth of detection. This is done to document the removal of all required MEC. Performance goals for representative items are as follows:

Item	11 diameters
• .50 caliber	5.5-inches
• 20mm	8.6-inches
• MK23 bomb	21.4-inches
• 2.25-inch rocket	24.8-inches

Actual detection depths (to be documented in the GPO) may vary within the site based on specific circumstances, such as the following:

- Item orientation
- Site background/noise levels
- Masking effects from adjacent metallic items
- Item shape
- Material composition of buried targets
- Weathering effects on the magnetic conductivity of item materials

6.2.1 Seed Item Detection

6.2.1.1 Known Location QC Items

Ground flush rebar hubs will be established at known locations for data QC. At least one known location item must be surveyed each day. Temporary "hubcap test" QC locations may also be established as needed to meet the frequency requirements. All known QC locations must be detected to within 2 feet of their known locations.

6.2.1.2 Blind Seed QA Items

All blind (unknown location) seed items must be detected to within 2 feet of their known locations. These items will be buried to the lesser of the depths that were reliably detected during the GPO. Blind QA items will not be smaller or buried deeper than those emplaced during the GPO.

All blind seed items must also be recovered during intrusive anomaly verification.

6.2.2 Other Data Quality Objectives

The following DQOs are believed to provide sufficient metrics to quantify the quality of the DGM data collected in association with the Crows Landing Flight Facility. It is stressed that these DQOs are intended as objectives only, and will be used to monitor and evaluate the quality of data collected.

- **Along Track Sampling:** < 0.5 feet.
- **Across Track Sampling:** <= 2.5 feet, excluding data gaps due to trees, terrain features, structures, or other obstacles that preclude the survey platform from providing complete coverage. This metric is intended to control data gaps associated with inconsistent track plots that are not associated with trees or other obstructions. Across track line deviations not due to obstructions will not be accepted if they exceed 3.0 feet.
- **Latency Correction:** No visible chevron effects in the data or pseudo-color plots. The use of appropriate color scaling will be maintained throughout the project.
- **Data Leveling:** Consistent parameters and processing methods will be used for all channels within each dataset. Consistent processing routines will be used for all datasets throughout the project. Select low and high amplitude anomalies will be reviewed for pre- and post-processing amplitudes above background to confirm that leveling and other data processing functions do not adversely impact the character of the responses. This will be documented in the GPO report.
- **Anomaly Selection:** The Site Geophysicist and Project Geophysicist will verify that all anomaly selections for a given dataset are reasonable and should identify all MEC or MEC-like items.
- **Positioning Errors:** Cumulative navigation positioning errors are not to exceed 2 feet. A functionality test will be performed each morning and evening to quantify the accuracy of the positioning/navigation system.
- **Reacquisition:** Reacquisition of target anomalies must be successful to within 2 feet of their interpreted location. Additionally, 95 percent (%) of all anomalies must lie within a 1-meter radius of their original surface location as marked on the dig sheet.

6.3 Geophysical Investigation

The geophysical technology utilized on this site has three main components: sensors, navigation, and deployment system. Based on the results of the GPO, it is anticipated that either Geonics EM61 or the Geometrics G858G magnetometer will be deployed. The system will be positioned with a Trimble Pro XRS differentially corrected global positioning system (GPS). Technical aspects of these components are summarized below.

6.3.1 Geophysical Sensors

The GPO prove-out test results will provide site-specific data to support the final deployment form factor to be used on the entire site in terms of sensor implementation and to achieve optimal results of the geophysical investigation. The deployment platform will be determined in the GPO. It is anticipated that the GPO will result in the selection of either the Geonics EM61 Mark II (EM61) time domain electromagnetic (EM) (TDEM) sensor or the Geometrics G858G (G858G) magnetometer for DGM in the clearance areas. For steep slope areas, such as the embankments of Little Salado Creek at site B, an EM61 handheld (EM61HH) instrument may be used.

6.3.2 Geophysical Navigation Methods

A Trimble Pro XRS GPS (ProXRS) will be used for DGM navigation and feature location. The Pro XRS is a single frequency, differentially corrected GPS system with real-time accuracy with 0.5-foot. GPS accuracy depends on both the availability of satellites and clarity of view of the sky. Since there are no overhead obstructions and these sites are in a flat valley, it is anticipated that the GPS signal should be clear and accurate. In past geophysical surveys at the Facility, the GPS data was of excellent quality. Collecting both the geophysical and positional data sets concurrently ensures accurate locations for each geophysical data point.

Field survey methods will involve high-frequency data collection along lines spaced approximately 2.5 feet for either the EM61 or the G858G. The instrument will be connected to the ProXRS GPS system in order to collect real-time locational data concurrently with geophysical data. This will allow the geophysical data to have the most accurate ground locations possible. Data will likely be collected along the long axis of each site. Traverses will be marked with paint, wooden stakes, and/or pin flags in order to ensure consistent data density and line spacing.

In addition to mapping geophysical data, ProXRS will be used for other location tasks including the following:

- **Feature Identification:** The GPS will be used to augment geophysical data and improve geophysical mapping through capture of visual observations made during site

walk-over. During this process, GPS will be used for position-stamping debris piles, unidentified fences, soil changes, vegetation, burn areas, craters, etc.

- **Target Relocation**: GPS will be used in "waypoint mode" for target relocation.
- **MEC Location Documentation**: GPS will be used to document the final position of any MEC found.

GPS navigational data may be collected in convenient coordinate system, but will be presented in 1983 North American Survey Datum (NAD83) California State Plane Zone 3 coordinates in United States (U.S.) Survey Feet units.

6.3.3 Data Processing

The raw survey data will be recorded in the field using Geonics (for the EM61) or Geometrics (for the G858) supplied software. The field sensor and navigation data will be downloaded to field personal computers (PCs) for processing. Shaw uses a combination of data processing software for data processing, depending on the geophysical system(s) used, as shown below:

- Geonics DAT-61 MK2 software for reviewing and converting EM sensor data files.
- Geometrics MagMap/MagMapper software for data merging, sensor offset calculations and base-station corrections.
- Shaw's proprietary software scripts, which use a variety of MatLab functions, provide a robust framework to spatially configure sensors relative to each other and with respect to the prism location, resulting in accurate spatial representation of all collected data. This software is used for merging the sensor and navigation data, determining precise clock slews from calibration data, making latency corrections, and generating accurate XYZ data output files.
- Geosoft Oasis/Montaj and UXDetect Software

Geosoft Oasis Montage and UX-Detect software will be utilized for most data processing tasks and to perform review and QC checks on the DGM and QC data. Shaw has also developed Matlab based routines for specialized data processing and analysis techniques which may be utilized. Data processing and analysis methods are provided in Section 6.5.

6.3.4 Sampling Frequency

For the DGM surveys, the sampling frequency will be no less than 1 hertz (Hz) for the navigation data stream and 4 Hz for the geophysical sensor data. As specified in the DQOs, along track sampling densities will be less than or equal to 0.5 feet and across track sampling densities will be approximately 2.5 feet. Exception will be taken where physical obstructions (trees, wells, structures, etc.) are encountered in the field.

6.3.5 Geophysical Survey Modes

Several survey modes can be used to collect geophysical data for the detection, location, and characterization of MEC. These modes include full surveys, grid surveys, transects, and meandering paths. Given the objectives of the project, a full survey will be executed. Full coverage will be achieved through deployment of the sensor system through the collection of sub-parallel survey lines or swaths. All data traverses will be brought into the Geographical Information System (GIS) for verification of full coverage.

Procedures for Full Coverage Survey Mode include the following:

- Define the bounds of the site that requires full coverage. This is accomplished by reviewing the topographic, vegetative, or access conditions of the parcel via the GIS and identifying issues that may affect the selection of the most appropriate technology.
- Review the site. The area requiring full coverage will be reviewed through a site walk-over during which the geophysical survey conditions will be reviewed by the site geophysicist.
- Set up the GPS at a convenient control point of known location to confirm location control.
- Place temporary location control QC items in the survey area as needed using the GPS as needed to document navigation precision. At least one location QC item (either permanent locations or temporary items) will be present in each data set.
- Set up a replicate data line location and collect the pre-survey data line.
- Systematically survey the site in the most effective pattern. The survey pattern will consist of consecutive multi-sensor passes with some overlap between passes. To ensure that full, overlapping coverage is obtained over the entire survey area, the system will navigate through several methods, including 1) observing the tracks of previous lines and offsetting the new line to obtain overlapping coverage; or 2) the use of spray paint or portable markers to mark the position of lines and then offsetting the new lines.
- Collect the post-survey replicate data line.
- Collect and maintain field logs to document the conditions of the data collections. The field logs will include information and observations of the data collection area, field conditions, data acquisition parameters, and QC performed.
- Field geophysical data and GPS navigation data will be periodically downloaded throughout the data to a field PC. The electronic files will be organized on an office PC dedicated to geophysical investigation management.

- Review all traverse data and overlay on the survey grid layout as QC and to identify any missed areas. A Survey Rework Form (Form 6-3) will be filled out whenever any survey has resulted in a significant missed area.

For the EM61HH, no GPS will be used when surveying over the creek embankments. Instead, a UXO technician will be present and physically mark the location with pin flags or stakes where an anomaly is detected using the hand-held instrument. The site geophysicist will walk the entire embankment to provide full coverage of the areas.

6.3.6 Instrument Standardization and QC

Instrument standardization procedures are implemented to ensure accuracy and repeatability of all collected field data. Requirements for instrument standardization, minimum test frequency, and acceptance criteria are outlined in Table 1.

6.3.1.1 Equipment Function Verification

Equipment function verification will be performed at the site to ensure that the geophysical survey equipment is working according to manufacturer's specification and is appropriate for the intended survey activities. The QA Geophysicist will review and approve each Sensor QC Verification Log (Form 6-1) and Navigation QC Verification Log (Form 6-2) daily to document the proper equipment function.

6.3.1.2 Calibration Site Establishment

One or more calibration test areas will be established at convenient locations. Each calibration site will consist of the following marked, reference areas where calibration and QC tests may be performed.

Table 1
DGM QC Frequency and Acceptance Criteria

Test	Acceptance Criteria	Frequency of Testing			
		Start of Day	Start & End of Day	First Day of Project Only	Equipment Change
Equipment Warm-up	Equipment Specific – typically 5 minutes	On each power-up			
Record Sensor Position	+/- 1 inch	X			X
Personnel Test	EM: 2 mV p-p Mag: 1 nT p-p	X			X
Vibration Test (Cable Shake)	Data spiking not evident in profile	X			X
Static Background Test	EM: 2.5 mV p-p Mag: 1 nT p-p		X		X
Static Spike Test	+/- 20% of standard response after background correction		X		X
Azimuthal Test (magnetics only)	Sensor orientation minimizes drop outs			X	
Height Optimization (magnetics only)	Maximum signal/noise ratio that reliably detects smallest target objective			X (and on geology change)	
6 Line Test	Repeatability of response amplitude +/- 20%, Positional accuracy +/- .5 foot			X	X
Octant Test (magnetics only)	Document heading error for post-processing correction			X	X
2 Line Repeat Data	Repeatability of response amplitude +/- 20%, Positional accuracy +/- .5 foot		X		

A number of QC tests and will be performed as indicated in Table 1. Forms are located in Appendix A. QC test descriptions and frequency are as follows:

- **Equipment Warm-Up**: Most instruments require a few minutes to warm up before data collection begins to minimize sensor drift due to thermal stabilization effects. All instruments will be allowed to warm up for at least 5 minutes before data collection. This procedure will be followed each time the instrument is powered up (e.g. at the start of the day, after breaks, etc.).
- **Record Sensor Position**: At the beginning of the survey, and thereafter at any changes in form factor, or when a sensor is reattached to a pole or cart, the relative

positions of the sensors and the sensor heights off the ground will be measured and recorded.

- **Static Background Test**: The Static Background Test and Spike Test monitors the instrument background readings, monitor for electronic drift, and identify potential interference. With the instrument held in static position, measurements are recorded for a period of at least 3 minutes. The test is performed twice daily, prior to collecting data and after completion of data collection. Static background readings for the EM61 should remain within 2.5 mV of background. Static background readings for the G858G should remain within 1 nanoTeslas (nT) of background. The results of the Static Background Test are documented on the Sensor QC Verification Form (Form 6-1).

- **Static Spike Test**: The Static Spike Test monitors the impulse response and repeatability of measurements over a standard test item. The standard test item is a standard 2-inch diameter steel trailer hitch ball. For the EM61, EM61HH and the G858G, the test item is placed on the ground centered below the sensor. At least one minute of data is recorded. Readings for the response of the standard test item should be within 20% after subtraction of the sensor baseline response. The test is performed twice daily, prior to collecting data and after completion of data collection. The results of the Static Spike Tests are documented on the Sensor QC Verification Form (Form 6-1).

- **Personnel Test/Cable Shake Test**: The Personnel Test is performed to check the influence of personnel carried metallic items (e.g. keys, boots, belt buckles, etc.) on the sensors. With the instrument held in static position, the operator(s) walk around the sensors while measurements are being recorded for a period of at least 1 minute. The cable shake test documents any cable or connection problems. With the instrument motionless and recording, each data cable is shaken to test for shorts or bad connections. Data collected during the Cable Shake Test should be free from spikes or variations. Cable problems generally require replacement. Connection problems are generally fixed either by cleaning or reconnection. The Personnel/Cable Shake test is performed twice daily, prior to collecting data and after completion of data collection. The results of the Personnel Cable Shake Tests are documented on the Sensor QC Verification Form (Form 6-1). No data spiking should be evident. In general, the EM61 should remain within 2 mV of background and the G858G should remain within about 1 nT of background.

- **Azimuthal Test (magnetics only)**: For the azimuthal test, an area free of geophysical noise is selected. A measurement point and the four cardinal directions are marked on the ground. A sensor head is fixed on the form factor to be deployed. Data is then recorded in a variety of sensor head orientations such that the orientation which minimizes drop outs can be selected. This test is performed once for each system deployed.

- **Octant Test (magnetics only):** For the Octant Test, a total of eight lines of magnetic data are collected, passing over the same central point. The arrangement of lines is N-S, NE-SW, E-W, and NW-SE arranged radically over a marked central point. The

difference in the response over the central point documents heading effects. This is the recommended test for establishing heading correction parameters. Typically, this test is performed once for each system deployed, however, small changes in heading errors from the same deployed system have been observed to over short periods of time. Therefore, in most instances, the actual heading corrections applied to any given set of data will need to be optimized during data processing.

- **Height Optimization (magnetics only)**: A test line is established with at least one test object along its length. Data are collected with the instrument using a minimum of three different sensor heights. The goal is to optimize the target signal to noise ratio, and maintain adequate sensitivity. This test may also be performed in different geology conditions, if differing geology conditions are found throughout the project area. If magnetometers are not deployed more than 6 inches above ground surface this test is not necessary.

- **6 Line Test**: A 50 foot test line is set up and well marked such that the same path can be repeatedly surveyed. Background conditions are evaluated on Lines 1 and 2. Heading effects, repeatability of response amplitude, positional accuracy and latency are evaluated in Lines 3-6. The test line is then surveyed as follows:

  Lines 1 and 2: Survey up and back on the test line at a normal speed.

  A standard 2-inch trailer hitch ball is placed at the center of the line for Lines 3-6. For multi-sensor form factors, a hitch ball is used for each sensor tack.

  Lines 3 and 4: The line is surveyed up and back at a normal speed.

  Line 5: The line is surveyed at a fast speed.

  Line 6: Coming back, the line is surveyed at a slow speed.

- **2 Line Repeat Data:** The repeatability of geophysical mapping data is monitored by the collection of replicate data. Replicate data will be collected for each data set. Generally, a replicate data line is established about 10 feet outside of the area to be surveyed, 50- or 100-foot long and oriented in the general direction of planned traverses. Start and endpoints of the line are marked with pin-flags and a measuring tape line. A standard test items (2-inch trailer hitch ball) is placed at the center of the line located such that each sensor will pass over one. For multi-sensor systems an appropriate length of rebar may be substituted for the hitch ball. The line is recorded, up and back, at the start and again at the completion of each data set. The amplitudes of the standard test items should be within 20%. The on-line offset of the locations is used to calculate instrument latency.

Additional function tests may be performed as the operator deems necessary. The data from each sensor will be compared with the data collected on previous days. If there is a significant change in results, the instrument will be rechecked. If the difference in data cannot be accounted for, the instrument will be taken out of service until repaired. In the event that a significant

change is made to the towed-array system, a GPO survey will be required prior to approving the system for full-scale mapping.

6.3.6 QC Logs

Standardization for geophysical mapping is ensured through adherence to standard procedures and full documentation. The following logs are used to maximize standardization, repeatability, and control of mapping activities:

- **Sensor QC Verification Log**: This log (Form 6-1) will document the daily calibration of each field sensor. This form documents the results and analysis of the pre- and post-survey Static Test, Static Spike Tests, and Cable Shake Test.
- **Navigation QC Verification Log**: This log (Form 6-2) will document daily calibration of the GPS navigation system. Pre-and post-survey results of the 6 Line Test, latency calculation, and detection of location test points and blind seed items are documented.
- **Survey Rework Log**: This log (Form 6-3) will document any data recollection necessary and the reasons why.
- **Data Processing Log**: All DGM data from the field will be run through a standard data-processing procedure. This procedure will be the same for all data and will be tracked with the Data Processing Log (Form 6-5). This log documents all coordinate transformations, visual data-quality checks, statistical data-quality checks, statistics, interpolation parameters, etc. The Data Processing Log references the Sensor and Navigation QC Verification Logs for each data set.
- **Field Activity Log**: This log (Form 6-6) will be filled out by each crew chief and will detail all activities of the survey. This is a daily log and contains observations about crew performance, sensor performance, site conditions, and weather changes.
- **Anomaly Tracking Sheet**: This log (Form 6-7) will document the relocation and intrusive verification of anomalies.
- **False Negative Report Form**: This log (Form 6-8) is utilized to document a false positive event (e.g., the intrusive excavation does not result in an apparent geophysical target).
- **Target Analysis and QC Form**: This log (Form 6-9) documents the target selection and QC for each site. The component data and processing QC forms for each component dataset are referenced.

6.3.7 Location Surveying

If first order control points (survey monuments) are not present to establish location control for the Crows Landing Flight Facility, one or more permanent concrete monuments or semi-

permanent survey pins and caps will be installed by a California Licensed Professional Land Surveyor. NAD83, California State Plane Zone 3 coordinates in U.S. Survey Feet will be used.

6.3.8 Production Rates

Geophysical mapping production rates are highly variable and depend on several factors, including topography, vegetation, site access, proximity of survey area, and weather conditions. Additionally, the selection of the sensor suite (sensor type and form factor, defined during the GPO, affects productivity. Single sensor DGM mapping production rates are generally 1-3 acres per day per team, depending on the terrain and site conditions.

6.4 Location Surveying, Mapping, and Navigation

Location control for the Crows Landing Flight Facility clearance areas will be referenced to first order control points (survey monuments). If no first order control points are present, permanent concrete monuments and semi-permanent survey pins and caps will be installed by a California-Licensed Professional Land Surveyor.

Semi-permanent rebar pins with survey caps may be installed for the purpose of locating individual survey and clearance grids and for use as QC anomalies for navigation location control.

All sensor data will be correlated with navigational data based upon a local first-order control point. Any changes made to the proposed sizes, locations, or orientations will be coordinated with the Navy. All coordinates will be in NAD83, California State Plane Zone 3 coordinates in U.S. Survey Feet.

6.5 Geophysical Data Processing

Shaw's standard data processing includes data leveling, statistical data assessment, grid generation, and non-customized data filtering to accentuate target signatures. Shaw will use software from the equipment manufacturers, in-house software, and Geosoft's Oasis Montage and UX-Detect Software to complete all tasks. Subsequent to the processing and review of the data, all data grids and target detections will be loaded into the GIS.

Collected field data will be downloaded in the field directly from the data-logger to a laptop computer for processing. Appropriate Geonics or Geometrics software will be used to download the data. The vendor software will also be used for initial review and editing of the data as necessary, for generation of profile lines, and for conversion of the survey line data to (X, Y) coordinates for contouring and analysis. The initial steps taken in the data processing flow will include the following:

6.5.1 Data Pre-Processing and Review of Data Sets

The data interpretation process begins by verifying the validity of the collected data sets. This will be accomplished by reviewing the QC data associated with the data. Insuring that the sensor and navigation equipment is functioning properly, that the data are accurately positioned along the predetermined survey lines, that they match the site dimensions, and properly fit within the predefined survey site. All validation results will be noted in the Data Processing Log (Form 6-5).

6.5.2 Review of QC Data

Vendor-supplied software will be used to make initial review of the data. This step validates that the data collected fall within prescribed recording ranges, and that no data outliers or null-values are present. Data statistics will be developed to measure compliance with the DQOs.

- **Review of Sensor QC Data:** Sensor QC test results (equipment warm-up, sensor position, static background and spike tests, cable shake test, personnel test) will be reviewed to ensure proper sensor function. Geonics/Geometrics and Geosoft software will be used to make initial review of the data. This step validates that the data collected fall within prescribed recording ranges, background noise and signal-to-noise-ratios fall within acceptable ranges, and that standard responses to known items are consistent with known values. Minimum, maximum, mean, and standard deviations of the pre- and post-survey Sensor QC tests will be calculated and reported into the Sensor QC Verification Log (Form 6-1). Standard values and ranges will be determined, in consultation with Navy, based on GPO results.

- **Review of Navigation QC Data:** Vendor-supplied software will be used to make initial review of the navigation QC and to ensure that the navigation system is functioning properly. Geonics/Geometrics, Trimble, and Geosoft supplied software will be used to make initial review of the data. Navigation offset distances and latency factors will be calculated based on the test results and compared to the DQO objectives. The QC location and blind seed item locations will be reviewed. Cumulative positioning errors are not to exceed 2.0 feet. Navigation QC data parameters will be entered into the Navigation QC Verification Log (Form 6-2).

6.5.3 Initial Data Review and Preprocessing

The Site Geophysicist will review sensor and navigation data for accuracy, completeness, and data fidelity. The geophysicist will also verify that the data are complete and fall within the prescribed survey area.

The operator will examine the quality of the data and define additional filtering or reprocessing of the data that may be necessary. Additionally, one-dimensional line data will be reviewed in Geosoft's Oasis Montage UXDetect software that has a profile display mode. All observations related to data review will be fully documented in the Data Processing Log (Form 6-5).

The vendor software will also be used for initial review and editing of the data as necessary, for generation of profile lines, and for conversion of the survey line data to (X, Y) coordinates for contouring and analysis. Each sensor record has an associated time stamp. Preprocessing involves synchronization of the GPS navigation data stream coordinates with the sensor output data streams. All data will be converted into XYZ files in NAD83, California State Plane Zone 3 coordinates in U.S. Survey Feet. All activities will be documented on the Data Processing Log (Form 6-5). The initial steps taken in the data processing flow will include the following:

- **Initial Review of Collected Data:** Geometrics/Geonics supplied software will be used to make initial review of the data. This step validates that the data collected fall within prescribed recording ranges, and that no data outliers or null-values are present. During this step, all data collection and downloading parameters will be entered into the Data Processing Log (Form 6-5).
- **GPS Navigation Data Review:** Positional information collected via GPS is designed to provide real-time XYZ location solutions at about one (1) time per second, concurrent with collection of the sensor data. However, circumstances can arise where the GPS data require post-processing to remove errors in coordinate locations. If positional errors are detected, they will be documented in the Data Processing Log (Form 6-5). If post-processing is required, Trimble software will be utilized to recalculate the GPS solutions.
- **Data Merge/Offset Calculation:** During this step, the sensor data will be integrated with navigation data to create sensor data files with coordinate positions using MagMap or Shaw's proprietary software. Form factor adjustments of each sensor location (offset) with respect to the GPS receiver (if any) are made. Latency corrections based on the navigation QC data are also performed. For the latency correction, the DQO specifies no visible chevron effects in the data or pseudo-color plots.
- **Base Station Correction:** For data leveling, validated magnetometer data are corrected for diurnal fluctuations using Geometrics MagMap or MagMapper software. This software is designed to remove the ambient background from each sample collected by the G858G sensor. The resultant data set represents only the magnetic

field changes that are caused by anomalous objects contained within the survey area. After the previously stated steps are executed and documented in the Data Processing Log (Form 6-5), the data are ready for target detection and analysis.

- **Coverage Assessment:** To verify that complete coverage has been achieved during survey activities, all navigation traverses will be reviewed and documented during the data processing and analysis steps. The areas surveyed and areas missed will be calculated and documented on the Navigation QC Verification Log (Form 6-2). If missed surveyable areas are present, Survey Rework Form (Form 6-3) will be completed and provided to the Site Geophysicist.

- **Deletion of Extra or Erroneous Data:** Extra or erroneous data such as instrument run-ons at the ends of lines, data collected in turnaround areas, data spike, nulls, etc. will be deleted.

- **Site Feature Check:** Additionally, the geophysicist will examine the data with respect to site cultural or natural features (wells, trees, utilities, etc.) observed on site or mapped in the GIS.

- **Analysis of Data Sampling:** Data sampling statistics will be calculated in Geosoft and entered on the Navigation QC Verification Log (Form 6-2). These statistics include: velocity, along-track and across-track data spacing, area surveyed, and area of data gaps. Along-track sampling error will be < 0.5 feet. Across-track sampling error will be <=2.5 feet excluding data gaps due to trees or other obstacles that preclude the survey platform from providing complete coverage. This metric is intended to control data gaps associated with inconsistent track plots that are not associated with trees or other obstructions. For the purposes of this project, minor occurrences will be accepted but will not be accepted if they exceed 3.0 feet.

- **Analysis of Replicate Data:** The pre-and post-survey replicate data lines will be reviewed for each data set. Data sampling statistics will be calculated in Geosoft and entered on the Navigation QC Verification Log (Form 6-2). The amplitudes of the responses over standard test items should be within 20%, the location accuracy should be within 2.0 feet, and the latency calculation should check with the Navigation Function Test results.

6.5.4 Data Processing

UXO geophysical data analysis will begin after execution of standard data pre-processing steps (discussed above in Section 6.5.3) where field data are verified, cataloged, reviewed, and converted into XYZ files in NAD83, California State Plane Zone 3 coordinates in U.S. Survey Feet. All activities will be documented on the Data Processing Log (Form 6-5).

The digital data will be an ASCII-delimited XYZ file suitable for input into the Geosoft programs. Successive data processing steps include:

- **Statistical Analysis:** All XYZ files will be processed to calculate statistics describing survey coordinates and sensor values. These statistics will be calculated to assist the site geophysicist in the assessment of data quality.
- **Data Leveling:** Based on the initial review of the data, the statistical assessment results, and the calibration data, data leveling will be applied to the data. Consistent parameters and processing methods will be used for all channels within each dataset. Consistent processing routines will be used for all datasets throughout the project.
- **Data Cataloging:** After leveling of the XYZ files is completed, all XYZ's will be cataloged into an Access database. Information in the database will document the sensor types, deployment configurations, navigation methods, crew members, statistical analysis results, etc.
- **Data Gridding:** XYZ files will be interpolated onto right-rectangular, evenly spaced grids. Gridding will initially be performed using the Geosoft minimum curvature function with an initial grid cell size of no larger than 0.5 feet. Interpolated grids will be reviewed by the data processor to determine the completeness and accuracy of prior data manipulation steps. Gridding parameters will be adjusted based on the sampling intervals actually achieved in the data.
- **Data Filtering:** Initial assessment of the data will be performed on grids with no filtering applied to the data. However, a suite of simple data filters is available to enhance target signatures by reducing the effects of high frequency and/or low frequency noise sources. If filtering is needed, the filtering will be optimized to minimize the signal-to-noise-ratio on both weak and strong anomalies. Filter selections and all filtering parameters will be recorded.

The raw data, digital records, and field notes for each data set will be provided by the Site Geophysicist to the Navy within five days of collection for independent interpretation/evaluation.

6.5.5 Target Detection

Targets are detected in a two-step process: (1) initial automated detection, and (2) operator-aided detection by a qualified geophysicist. The first step is automated target detection based on threshold analyses. Geosoft's UX Detect will be used for simple threshold detection and will be augmented by in-house methods utilizing a region-growing algorithm for more sophisticated auto-detection and feature extraction. Parameters controlling the selection of targets include proximity of adjacent targets, signal power density, collocation of targets on other channels of data, area size, and distribution of anomaly amplitudes.

The second step is manual detection of targets based on systematic visual search of raw and filtered data, on single or multiple channels. This will be accomplished within the Oasis Montage/UXDetect software system. At this stage, automatic target detections will be modified, deleted, and/or added by the operator. The automated and operator target detection steps will result in a target list and a set of target parameters, including X, Y, area, proximity to other targets, and signal strength statistics.

The steps of the target detection process are documented in the Target Analysis Log (Form 6-9) to facilitate replication of the target analysis results during QC. Analysis of Blind Seeds will also be documented on Form 6-9.

6.5.6 Anomaly Selection and Decision Criteria

For each data set, Site Geophysicist will assess each of the following factors prior to generating an anomaly list:

- The local background conditions of the EM or magnetic field response (the threshold values used for target detection will be based on the minimum signals recorded as part of GPO)
- Data completeness and accuracy
- Data quality
- Field notes on site and survey conditions and observations
- The boundary conditions, utilities and/or other cultural features present, and unsurveyable areas (beneath roads, trees, buildings, etc.)
- The shape and amplitude of the response of known targets buried in the GPO test plots
- The shape and amplitude of the response of relevant anomalies encountered in previous MEC removal grids
- The extent and boundaries of metal-rich fill areas, if any

Target selection procedures and parameters will be finalized in the GPO. It is anticipated that Geosoft UXDetect will be utilized to automate the initial anomaly selection process.

A manual review of the anomalies and target lists will be performed to QC the anomalies and to optimally locate the target location on the anomaly as needed. Targets will be removed if caused by cultural anomalies (roads, fences, wells, etc.) or are due to obvious artifacts (drop outs, etc.) in the data. For EM data, a review of channel decay profiles will be performed at all suspect and/or low amplitude anomalies to remove anomalies not exhibiting the response characteristics of buried metallic objects.

6.6 Dig Sheet Development

The target analysis process culminates in the creation of standardized Dig Sheets (Form 6-4), which contain target location, depth, and weight estimates. Following the identification of potential target anomalies from the geophysical data evaluation, the anomalies will be assigned to the appropriate area for development of the dig sheets.

6.6.1 Dig Sheet

The dig sheet will contain the following information:

- Facility (Crows Landing Flight Facility)
- Area
- Responsible geophysicist
- Site identification
- Unique anomaly identification numbers
- Anomaly coordinates in NAD83, California State Plane Zone 3 U.S. Survey Feet
- Sensor target amplitude values for each target anomaly

6.6.2 Location QC Seed Items

As part of the QC program, The QA Geophysicist will plant "known location" seed item at each of the four DGM survey areas prior to performance of the DGM. These items will consist of 1-foot sections of ½-inch rebar, emplaced vertically in the ground from the ground surface and marked with an adjacent flagged witness post. The location of the known location seeds will be given to the DGM survey team(s) prior to the surveys. The frequency of known location QC seed items will be one (1) per DGM site or one per 4 acres of contiguously surveyed area, whichever is greater. The QA Geophysicist will review the final data and target lists to confirm that these QC target(s) have been acquired. A QC failure shall result if the Contractor does not detect this item, or the item is not detected within 2 feet of its known location.

6.6.3 Blind QA Seed Items

The QA Geophysicist will plant a total of at least 1 "blind" seed items at known locations within each of the DGM survey areas prior to performance of the DGM. The location of the blind seeds will be restricted to the UXOQCS, the QA Geophysicist and Department of Toxic Substances Control (DTSC). These items will be buried to the depths that were reliably detected during the GPO. Blind QC items will consist of simulants of the specified target MEC, which will not be buried deeper than those emplaced during the GPO. The frequency of blind QA items shall be one (1) per data set or one per one (1) acre of contiguously surveyed area, whichever is greater.

The QA Geophysicist will review the final data and target lists to confirm that these QC target(s) have been acquired and will report the results to the UXOQCS, the Navy, and DTSC. A QA

failure shall result if the Contractor does not detect this item, or is not detected within 2 feet of its known location, or is not selected as an anomaly, during the geophysical mapping and evaluation. The UXOQCS will evaluate the success or failure of the dig team to excavate the items.

6.7 Anomaly Location Reacquisition

Before intrusive activities can be performed, the geophysical anomalies identified on the digital geophysical surveys must be reacquired. Anomaly reacquisition is a two-step process. The first step is to locate the ground position of the anomaly coordinates as specified on the Dig Sheet (Form 6-4). This will be performed using the GPS in Waypoint Location mode. A non-metallic pin flag, labeled with the unique anomaly number, will be placed in the ground at the indicated coordinates.

The same instrument/sensor used to detect the target will be used to identify the peak location of the anomaly (i.e., the precise location on the ground where the excavation should occur). The sensor will be moved back and forth over the general area of the anomaly coordinates until the peak value of the anomaly is located. If more than one peak is located, all peaks will be flagged. If no unique peak value is present (i.e., the same peak value is measured over an area), the center of the maxim area will be selected. If no peak value is located at the indicated location, the white anomaly location flag will be left in place, and the site geophysicist will be consulted.

The reaquisition team will be provided an image plot of each target to assist in the localization of the center of the target. This will assist in area where multiple anomalies are present or where the target is a compound anomaly comprised of multiple sub-anomalies.

The peak value measured over the anomaly will then be recorded and the dig location will be marked with a colored flag labeled with the anomaly number. The specified relocation process serves three purposes:

- It focuses the excavation over the actual anomaly peak, instead of an interpolated location between the survey measurement points.
- It reduces measurement errors.
- It provides a QC ground check for the dig locations.

Per Data Item Description MR-005-05, 95% of all anomalies must lie within a 1-meter radius of their original surface location as marked on the dig sheet.

6.8 Feedback Process

The feedback of ground-truth excavation data via the Anomaly Tracking Sheet and the Dig Sheets (Forms 6-4 and 6-7) is one of the most important ways to ensure effective geophysical mapping. Excavation data collected during each intrusive activity will be captured to document the item location, weight, shape, orientation, and depth. This data will be electronically entered into a ground-truth database, reviewed by the Site geophysicist, and incorporated within the MEC item database.

QC codes for feedback for MEC removal grids with respect to resolution of anomalies will be assigned as follows (with appropriate comments):

Good correlation, anomaly removed

Anomaly removed or not present, minimal metal or hot rock recovered (false positive)

Dig terminated due to bedrock (false positive due to geology)

Dig terminated at the maximum clearance depth

Dig terminated due to non-movable subsurface feature (utility, foundation, etc)

All other results result in return to the excavation for additional action.

Excavation results for each MEC removal grid/area will be reported to Navy within one week of grid/area completion. The Site Geophysicist or designate will review the excavation results with respect to the anomaly selection criteria, QC dig results, actual MEC encountered, and any DQO performance criteria failures and provide a weekly progress report with recommendations.

6.8.1 Intrusive Anomaly Verification

After anomaly locations have been reacquired, the following procedures will be utilized for the intrusive verification and reporting of the selected target anomalies. The Site Geophysicist will report the anomalies to the Senior UXO Supervisor (SUXOS) as ready for excavation and identification. The SUXOS will assign a UXO team to excavate and identify the anomaly and record the required information in the Excavation Log Sheet (Form 6-7).

An Anomaly Tracking Sheet will be used to record discrepancies between the dig sheet location and the actual reacquired location, and to note any anomalies that could not be reacquired. The reacquisition location will be measured and logged. The reacquisition coordinates will be used as the official dig location for location QC assessment.

After the UXO team has completed the excavation the geophysical reacquisition team will return to the excavation location and record the post-excavation anomaly peak values to QC test that the source of the anomaly has been removed. Every excavation within a given grid will be QC tested. After the excavation is completed, the geophysical sensors will survey each excavation location. The same geophysical instrumentation used to obtain geophysical data and generate geophysical maps and target lists will be used for the geophysical QC testing (Geonics EM61 or Geometrics G858G). Data will be obtained in real-time and the sensor data will be noted and recorded on a QC form (hard copy or electronic). If the sensor data are determined to be within background range, as determined by the Site Geophysicist, the QC test is completed and the excavation can be backfilled. If the sensor data is determined to be above background range, the excavation will continue down to the maximum clearance depth for the area.

6.8.2 False Positives and Negatives

False Positives

False positives are anomalies reacquired by the contractor that result in no detectable metallic material during excavations. These targets would be logged on the Dig Sheets (Form 6-4), but upon reacquisition resulted in no evidence, either by instrumentation or excavation, of an MEC-related target. False positives result from effects in the data caused by topographic conditions, low amplitude signals associated with background noise, and subsurface soil conditions. False positives will be minimized to the extent possible through use of the best available geophysical practices executed by qualified staff.

False positive excavations are different from "False Alarms," which result when an anomaly is detected at a given location and posted to a Dig Sheet, and the intrusive activity results in a target that is not an apparent MEC item (UXO or scrap). The objective at this site is to minimize false positives while achieving the MEC detection specifications.

False Negatives

A false negative is defined as a target not detected or listed on the Dig Sheet. These "missed targets" are those that fall within the detection limits of the deployed geophysical sensor systems and therefore, should be detected and included in the dig list. False negatives can be caused by operator error, instrument error, navigation inaccuracy, or procedural errors where data are lost, distorted, or made inaccurate through erroneous manipulation. False negatives will be assessed via the use of blind and known location QC targets.

False negatives are difficult to identify, as they are undetected targets. These targets can be identified during reacquisition where new anomalous signatures are identified in the field. Additionally, false negatives can be identified during execution of other site activities such as

MEC removals and other excavation activities. In any of these cases, the following procedures will be executed:

- A False Negative Report Form (Form 6-8) will be completed by the site geophysicist and submitted to the QC Manager with copies provided to the PM.
- The QC Manager will forward this information to the UXOQCS, who will investigate and provide a memo report describing the activities associated with the discovery. This report will provide recommendations for further action. Technical information for this memo will be provided, upon request from the UXOQCS and site geophysicist.

6.8.3 Horizontal Accuracy

Cumulative positioning errors shall not exceed 2-foot. A navigation functionality test will be performed each morning and evening to quantify the accuracy of the positioning system. All known location and blind QC items will be detected to within 2 feet of their known locations.

6.9 Confirmatory (QA) Geophysical Survey and Final Clearance

Upon completion of MEC removal and excavation backfill, a geophysical survey will be conducted over the excavated areas to confirm the removal of anomalies identified during the initial investigation. The survey will use the same geophysical equipment previously used during initial investigation and real-time data will be collected to locate any additional significant anomalies that may remain. Missed or new anomalies found in the confirmatory survey will be investigated as previously described. This process will continue until all suspected anomalies detected by the geophysical equipment at each site have been investigated or removed.

6.10 Corrective Measures

The objectives of the geophysical investigations are to accurately locate and record the location of anomalies (potential MEC). In the event of a DQO failure or a QA failure (failure to locate or recover a blind seed item), Shaw's Site Geophysicist will perform a root-cause analysis to identify the reason for the failure, to identify how much data has been affected, and whether corrective actions can be taken to correct, mitigate or eliminate the cause of the failure. This will include examining the ability to meet the metric for any DQO given the site conditions where the data was collected. The root-cause analysis will be submitted to the QA Geophysicist by the end of the next working day.

In the event that a particular geophysical method, instrument, or procedure is not generating meaningful results or advancing the project goals, Shaw will convene a review team consisting of the Shaw's PM, Project Geophysicist, and QA Geophysicist, and a Navy representative, by the next working day to investigate the cause and recommend corrective action.

Specific corrective measures are dependent on the type of geophysical equipment used during an operation and will be developed on a site-specific basis. However, the following are the basic corrective measures Shaw will employ for digital geophysical mapping:

- Replacement of sensors if they fail to meet calibration requirements
- Replacement of navigation equipment if daily check of location accuracy is not met
- Re-survey grids/areas where data quality specifications are not met
- Re-survey grids/areas where blind seed items were not detected/recovered
- Reprocess all geophysical data collected during a survey day
- Evaluation of survey parameters and QC procedures for sufficiency
- Re-excavation of targets if the excavated targets are not associated with the initial target anomaly

Basic corrective measures will be implemented as part of day-to-day activities (i.e., replacing faulty equipment). The QA Geophysicist will receive written notification of all actions taken. If an instrument or process cannot be corrected to meet a DQO, Shaw will cease using that instrument or process and make recommendations to the QA Geophysicist. These recommendations may include modifications to the Work Plan. Shaw will implement the amended plan upon approval from the Navy and DTSC.

6.11 Geophysical Records Management

The geophysical records management plan includes three components: field survey records management, DGM data management, GIS records management, and data processing/analysis records management.

6.10.1 Field Survey Records Management

Paper files will be organized in the office trailer and be filed by individual day. Photocopies of all paper documents will be made and filed at an off-site location. Paper documents with significant information not captured digitally will be scanned and archived. Electronic files and forms will be organized on an office PC dedicated to geophysical investigation management. File directory structures for field data will be organized by day of year, with subdirectories for specific field activities (navigation data, survey data, etc.). All directories will also have README files describing directory contents and chain of custody history. All field data will be backed up onto CD ROM, removable hard drive, or data stick/card on a daily basis. Backup data will be transferred to an off-site Shaw location on a weekly basis.

6.10.2 DGM Data Management

Field geophysical data and navigation data will be periodically downloaded throughout the day to a field PC. The electronic files will be organized on an office PC dedicated to geophysical investigation management. Electronic files include, but are not limited to, G858G and/or EM61 data files, GPS position files, sensor calibration files, and QC test data files. Standardized file naming conventions and directory names will be used. File directory structures for field data will be organized by day of year, with subdirectories for specific field activities (navigation data, survey data, etc.). All directories will also have README files describing directory contents and chain of custody history. All field data will be backed up onto CD ROM, removable hard drive, or data stick/card on a daily basis. Backup data will be transferred to an off-site Shaw location on a weekly basis.

6.10.3 GIS Records Management

All generated and developed GIS files will be managed by the GIS Manager and stored on an off-site GIS PC. The data will be stored within the standard GIS subdirectory structure with README files in each directory containing a description of the contained files. All GIS data will be backed up onto CD ROM, removable hard drive, or tape on a daily basis as well as transferred to an off-site Shaw server location. Data on the off-site server will be backed-up onto tape as part of the data server archiving process.

The GIS Manager will review the GIS for conformity with Navy standards and specifications, completeness of stored data, and conformity of input data with the GIS databases.

6.10.4 Data Processing and Analysis Record Management

All data files and Data Processing Logs (Form 6-5) generated during the processing and analysis of geophysical field data will be managed by the Site Geophysicist. Paper files will be organized in the office trailer and will be filed by individual day. Photocopies of all paper documents will be made and filed at an off-site location. Electronic files will be organized on an office PC dedicated to geophysical investigation management. File directory structures will be organized by day-of-year, with subdirectories for specific field activities (navigation data, survey data, QC data etc.). All field data will be backed up onto CD-ROM, removable hard drive, or data stick/card on a daily basis as well as transferred to an off-site Shaw location.

All data, (field data, geophysical processing and analysis data) will be backed up as a complete system on a weekly basis onto CD. Two copies of the CD will be created with one copy stored in the office trailer and one copy sent to the off-site GIS Manager.

6.12 Interim Reporting and Submittals

All data files and field logs generated during the field operation will be managed by the Site Geophysicist and provided to the Navy on a weekly basis. The reports will include the field activity daily logs, completed field forms, photos of field activities, and any other paperwork pertinent to the project. The weekly reports will not include interpretation of the data collected. Interim reports may be prepared and submitted periodically to present preliminary findings with interpretation of the data. The progress reports will be submitted for information only.

Access to interim geophysical survey and navigation data and all QC reports will be provided weekly. All digital data will be provided in formats compatible with the Navy computer systems. Interim data will include the following:

- Draft and final geophysical data for all data sets
- All raw, interim, and processed XYZ and grids files, with associated README files
- Grid data and QC reports for all MEC removal grids in Word format
- Draft and final anomaly lists for all MEC removal grids in Excel format
- Dig lists and relocation coordinates for all MEC removal grids in Excel format
- Anomaly excavation reports for all MEC removal grids in Excel format
- QA dig lists and excavation reports for all MEC removal grids in Excel format

6.13 Final Reports and Maps

At the completion of the MEC verification and clearance activities, a Final Report, in the format of an After Action Report (AAR) in accordance with NOSSA Instructions 8020.15, will be prepared to summarize activities conducted, observations made, site findings and field test results obtained. Photo documentation of the field activities will also be included in the report. Other information requested in the AAR will also be provided as appropriate. This report will be submitted to the Navy and NOSSA after the completion of the clearance activities.

Finalized DGM data will be transmitted along with a letter of transmittal conveying explanations and pertinent information, and will include all QC reports, summaries, and supporting data.

All sensor data will be preprocessed for sensor offsets, latency effects, etc., and correlated with navigation data. The geophysical mapping technology will digitally capture the instrument readings into a file coincident with in NAD83 California State Plane Zone 3 coordinates, in U.S. Survey Feet. This field data will be checked, corrected, and processed into ASCII files in the XYZ file format. Corrections such as for navigation and instrument bias will be applied, but there will be no filtering or normalization of the data. All corrections will be documented.

The data will be presented in delineated fields as X, Y, Z1, Z2, Z3..., where X and Y are State Plane Coordinates in East and North and Z1, Z2, Z3, ... are the instrument readings. Each

of the fields will be separated by a space (not a comma). Geophysical field data will consist of files in column format. Header information will be included in each file. Each grid of data will be logically and sequentially named so that the file name can be easily correlated with the grid name used by other project personnel.

A digital planimetric map of each geophysical survey grid will be prepared as part of the final deliverable. These maps will reflect the current site conditions after site preparation work (removal of vegetation, fencing, dumpsters, debris, etc.) has been completed. ArcView format GIS maps will be provided including the locations of all targets and excavation results. Geophysical image maps will be provided for each site with the geophysical data displayed in color with overlaid target data. These maps will be in California State Plane Zone 3 coordinates in U.S. Survey Feet, and will be coincident with the location of the geophysical survey data.

Prior to client delivery or use, project submittals are to be reviewed and approved by Shaw. Depending on the submittal, the UXOQCS or the Project Geophysicist will review and if acceptable, certify each submittal prepared by Shaw, subcontractors, and suppliers for completeness and compliance with the specifications of the Task Order and contract.

Prior to submittal to the UXOQCS for certification, technical documents (e.g., reports, plans, and engineering drawings) are to be reviewed by qualified staff. Although part of the QC process, technical reviewers may include but are not limited to the QA/QC staff.

7.0 Calibration and Maintenance

Calibration/maintenance of geophysical instruments, radios/cell phones, vehicles/machinery, and other project equipment will be performed per manufacture's specifications. Geophysical detection equipment will be tested daily on the test plot as described in the Work Plan. Records of these activities will be maintained by the UXOQCS.

8.0 Lessons Learned

Lessons learned on the project will be captured in the monthly reports.

Figures

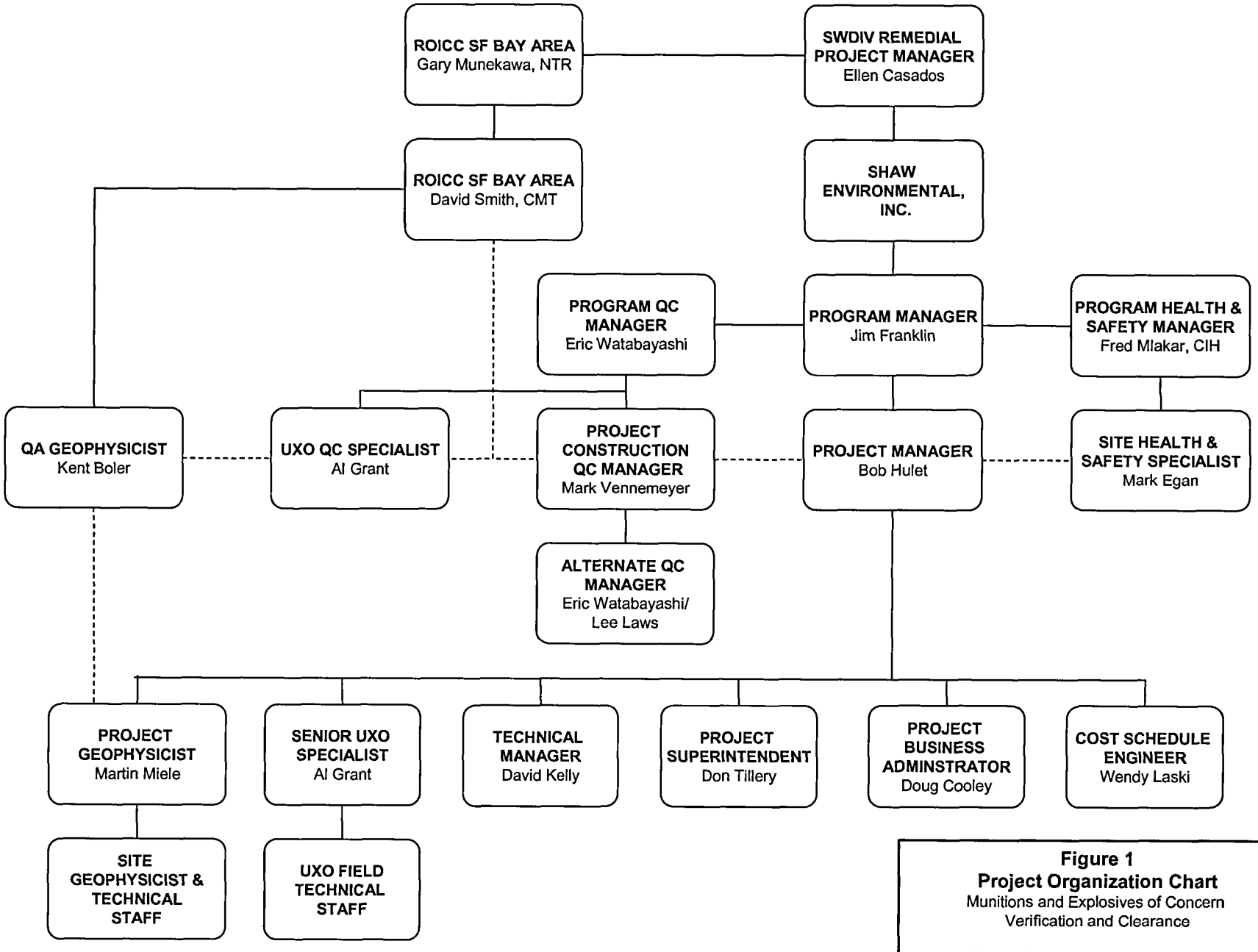

Figure 1
Project Organization Chart
Munitions and Explosives of Concern
Verification and Clearance

NASA Crows Landing Flight Facility

Crows Landing, California

Appendix A
Forms

Daily QC Report Form
3-Phase Inspection Forms
Form 6-1: Sensor Verification QC Log
Form 6-2: Navigation Verification QC Log
Form 6-3: Survey Rework Form
Form 6-4: Example Dig List
Form 6-5: Data Processing Log
Form 6-6 Field Activity Daily Log
Form 6-7: Anomaly Tracking Sheet
Form 6-8: False Negative Report Form
Form 6-9: Target Analysis and QC Log

Shaw
Shaw E & I, Inc.

Report No. _____

DAILY QUALITY CONTROL REPORT

DATE_____

DAY	S	M	T	W	TH	F	S

CLIENT REPRESENTATIVE_____

PROJECT_____

DELIVERY ORDER NO._____

CONTRACT NO._____

WEATHER	Sunny	Clear	Overcast	Rain	Snow
TEMP: H/L	To 32	32-50	50-70	70-85	85 up
WIND	Still	Moderate	High		
HUMIDITY	Dry	Moderate	High		

1. Contractor/Subcontractor Personnel and Areas of Responsibility:

Number	Trade	Hours	Employer	Location & Description of Work

2. Operating Equipment (Not hand tools):

Equipment	Quantity	Rental Y/N	Total Hours

3. Work Performed Today: (Indicate location and description of work performed by prime and/or subcontractors. When network analysis is used, identify work by NAS activity number).

_____
_____
_____
_____
_____
_____
_____

4. Control Activities Performed: (Specify feature of work/NAS number and indicate whether P for Preparatory, I for Initial, or F for Follow-Up Phase. For Preparatory Inspections: Identify feature of work and attach completed checklist, list RFIs issued and responses. For Initial Inspections: Identify feature of work and attach completed checklist. For Follow-Up Inspections: List inspection milestones reached (hold/witness points), inspections performed, results of inspection compared to specification requirements, CARs issued/closed, and corrective actions taken.)

5. Tests Performed and Test Results: (Identify test requirements by paragraph number in specifications and/or sheet number in plans).

6. Material Received: (Note inspection results and storage provided).

7. Submittals Reviewed:

Submittal No.	Spec/Plan Reference	By Whom	Action

8. Off-site Surveillance Activities, Including Action Taken:

9. Job Safety: (List items checked, results, instructions and corrective actions taken).

Shaw
Shaw E & I, Inc.

Report No. _____

10. Remarks: (Instructions received or given. Conflict(s) in Plans and/or specifications. Delays encountered).

_____
_____
_____
_____
_____
_____
_____
_____

11. List of Attachments: (List all attachments to this report, include date and reference number where applicable. Attachments are to include copies of inspection checklists, test reports, data reports, and field measurement/calculation sheets.)

_____
_____
_____
_____

Contractor's Verification: On behalf of Shaw E&I Corporation, I certify this report is complete and correct, and all materials and equipment used and work performed during this reporting period are in compliance with the contract plans and specifications, to the best of my knowledge, except as may be noted above.

_____
Shaw E&I QC Specialist Date

Shaw
Shaw E & I Inc.

PREPARATORY PHASE INSPECTION CHECKLIST
NASA CROWS LANDING

ver. 10-31-00

Date: _____
Contract No: _____
Task Order No: _____
Government Representative Notified ___ *Hours in Advance.*

Definable Feature of Work:
_____

1. Preparatory Meeting Attendes:

Name	*Title*	*Organization*

2. Review/Discussion Items:

	Check, NA,or Comment No.
Review of Applicable Plans	
Receipt of permits, licenses, and clearances	
Receipt of equipment and materials	
Inspection of equipment and materials (material certification submittals)	
Review of requests for information (status/conclusions)	
Review and discussion of work scope and specific tasks	
Discussion of procedures, requirements, and specifications	
Review of health and safety issues	
Identification and review of sampling and testing procedures and requirements	

3. Discrepancies and Deficiencies:

Elaborate upon any conflicts or problems with review/discussion items noted in Item 2.

4. Corrective Actions:

QC Reviewer: _____
Date QC Complete: _____
QC Control Check:

FORM 6-1
SENSOR QC VERIFICATION LOG
EM-61 MK2 OR G858 DATA

Area: _____ Location I.d.: _____ QC Check by: _____
Dataset: _____ Survey Date: _____ Date: _____

Static Test

Sensor #1

	Pre Survey					Post Survey					Metric
	CH 1	CH 2	CH3	CH4	G858	CH 1	CH 2	CH3	CH4	G858	
File Name	.gdb					.gdb					
Line #:											
Min:											
Max:											
Mean:											TBD
Std:											TBD

Comments: _____

Static Spike Test

Sensor #1

	Pre Survey					Post Survey					Metric
	CH 1	CH 2	CH3	CH4	G858	CH 1	CH 2	CH3	CH4	G858	
File Name	.gdb					.gdb					
Line #:											
Min:											
Max:											
Mean:											TBD
Std:											TBD

Comments: _____

Cable Shake Test

Sensor #1

	Pre Survey					Post Survey					Metric
	CH 1	CH 2	CH3	CH4	G858	CH 1	CH 2	CH3	CH4	G858	
File Name	.gdb					.gdb					
Line #:											
Min:											
Max:											
Mean:											TBD
Std:											TBD

Comments: _____

FORM 6-2
NAVIGATION QC FUNCTION LOG

QC Check: _____
Date: _____

Area.: _____
Dataset: _____
Location ID: _____
Survey Date: _____

2-Line Repeat Data Test

Comments:

	Pre Survey		Post Survey		Metric
	Latency Correction		Latency Correction		TBD
Sensor #1					
Sensor #2					
	Anomaly Amplitude mV/nT	Distance Offset (ft)	Anomaly Amplitude mV/nT	Distance Offset (ft)	
Sensor #1					TBD
Sensor #2					TBD

Known Location QC Points Detected

Comments:

Location ID	
Easting	
Northing	
Anomaly Offset	
Dist. (ft)	
Direction	

Location ID		Metric
Easting		
Northing		
Anomaly Offset		
Dist. (ft)		<=2-ft
Direction		

Data Sampling

Comments:

Along Track / Across Track Sampling		Metric
Along Track (ft)		<=0.5-ft
Across Track (ft)		<=3-ft
Total Area Surveyed (acres)		
This Data Set		

FORM 6-3
SURVEY REWORK FORM

AREA: _____
DATA SET: _____
DATE: _____

SITE GEOPHYSICIST

_____
Signature Date

Tracking	Reason For Rework
Survey Crew:	Equipment Failure/Malfunction
Survey Instrument:	Data error/Loss
Navigation:	Navigation Error
Orig. Survey Date:	Survey Error
Area to Rework:	Other

Comments:

Description of Rework Requested

Attachment: Data Coverage Map Showing Area For Rework

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Area / Grid
Example Dig List Form
NASA Crows Landing

SW Corner:	Dates of Survey: Dig List Date: Shaw GP Approval:

Coordinates in California State Plane (NAD83) US Survey Feet

Easting(X)	Northing(Y)	Target Peak Response (units)	Target ID	QC Code

Pick List Cut Line:

FORM 6-5
DATA PROCESSING LOG

SITE:_____ Survey Date:_____

Sensor:_____

AREA:_____ Crew:_____

Shaw GP _____ Init. Date	
Shaw QC _____ Init. Date	
Sensor Verification QC Log	Log files
Navigation Verification QC Log	
Initial Review	Field data files
Navigation Correction	Initial (x,y,z) files
Data Leveling / Diurnal Correction	
Data Cataloging and Coordinate Conversion	Processed (x,y,z) files
Data Filtering	
Data Location Plot Review	
Comments	

FIELD ACTIVITY DAILY LOG

DAILY LOG		
	DATE	
	NO.	
	SHEET	

PROJECT NAME	PROJECT NO.
FIELD ACTIVITY	
DESCRIPTION OF DAILY ACTIVITIS AND EVENTS:	
VISITORS ON SITE:	CHANGES, ORDERS, DECISIONS:
WEATHER CONDITIONS:	PHONE CALLS:
SHAW E&I PERSONNEL ON SITE:	
SIGNATURE:	DATE:

FORM 6-7
ANOMALY TRACKING SHEET

Page ____ of ____
Area_____
Sector_____ Grid_____
Survey Instrument _____ Instrument ID _____ Units _____ Background_____

Anomaly ID.	Original Survey			Relocation Survey			QC Clearance					Notes
	East (ft)	North (ft)	Peak Amp	Offset (ft)	Direction	Peak Amp	Final Amp	Code	Crew Initials	QC Initials	Date	

Reacquisition metric: 2.0 feet offset. Clearance Code: 1- Good correlation; 2-Anomaly removed - hot rock or minimal metal; 3- Terminated at bedrock; 4-Terminated at max clearance depth; 5- Terminated due to non-movable subsurface feature (specify).

FORM 6-8
FALSE NEGATIVE REPORT FORM

SITE:_____
AREA:_____

Date:_____

SITE GEOPHYSICIST

_____
Signature Date

CC: Shaw UXOQCS
Shaw QA Geophysicist
Shaw Project Geophysicist
Shaw Project Manager

Item type, Location, Depth, Orientation, Weight, Etc.

Circumstances of Discovery and Disposition of Item

Relevant Site Conditions (Culture, Noise, Geology, Terrain, etc.)

Review of Relevant Survey Design, Site Survey and Navigation Data, Data Processing, Anomaly Selection, and Detection Limits

Recommendations

Shaw

FORM 6-9
TARGET ANALYSIS AND QC LOG
EM61 OR G858G DATA

Area: _____
Grid: _____
Component Data: _____

Target List Approval

	Init	Date
Shaw GP		
Shaw QC		
Target QC		

Area Excluded by Site Boundary? _____
Grid Features (List) _____
DGM Exclusions Mapped? (List) _____

	Date Performed		File Names	Comments
Final Data Segregation by Quad		Matlab	.xyz	
Regrid by Quad		Geosoft	grd	
Initial Target Pick		UXDetect	.gdb (targets_i)	
Review Targets, Assign QC codes		UXDetect	.gdb (QC)	
Final Target List and		UXDetect	.gdb (targets)	
Plot Map		Geosoft	map	

Summary Target Picking Information:

Targets picked down to: _____ mV (sum)
Total Targets (final): _____
Cut Line Selection: _____ mV (sum)

Auto Pick Merge: _____
Other Processing: _____

Comments: _____

Blind Seed Anomaly Analysis (To be performed by the QA GP after completion of the Target List)

Blind Seed	
Seed ID	
Seed Location	
Easting	
Northing	
Dist. & Direction from Seed Loc.	
Target ID	
Dist. (ft)	
Direction	

Blind Seed		Metric	Comments
Seed ID		Detected	
Seed Location			
Easting			
Northing			
Dist. & Direction from Seed Loc.			
Target ID			
Dist. (ft)		<=2-ft	
Direction			