Final

July 2014

Quality Assurance Surveillance Report
Non-Time Critical Removal Action at Operable Unit B-2

Former Adak Naval Complex

Adak, Alaska

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ACRONYMS AND ABBREVIATIONS

AHA	Activity Hazard Analysis
BIP	blow in place
BSI	blind seed item
CA	Corrective Action
CERCLA	Comprehensive Environmental Response Compensation and Liability Act
DFW	definable feature of work
DGM	digital geophysical mapping
FCA	function check area
FCR	field change request
GPO	geophysical prove-out
GSV	geophysical system verification
GTI	geologic and terrain-induced
HALSA	High Amplitude Large Spatial Anomalies
ISO	industry standard object
IVS	instrument verification strip
MDAS	material documented as safe
MDEH	material documented as an explosive hazard
MEC	munitions and explosives of concern
MPC	measurement performance criteria
MPPEH	material potentially presenting an explosives hazard
MTDU	mobile thermal destruction unit
NAF	Naval Air Facility
NCR	non-conformance report
NOFA	No Further Action
NTCRA	non-time critical removal action
NTR	Navy Technical Representative
OU	operable unit
QA	quality assurance
QADB	QA database
QAPP	Quality Assurance Project Plan
QASP	Quality Assurance Surveillance Plan
QASR	Quality Assurance Surveillance Report
QC	quality control
RAA	remedial action area
Rcrit	critical radius

RPM	Remedial Project Manager
SOP	Standard Operating Procedure
TFU	Thermal Flashing Unit
USA	USA Environmental, Inc.
UXO	unexploded ordnance

Section 1.0: GENERAL QUALITY ASSURANCE PROJECT INFORMATION

1.1 Introduction

This Quality Assurance Surveillance Report (QASR) presents the actions and results of the quality assurance (QA) activities performed by Battelle Memorial Institute (Battelle) as the independent Government QA contractor for the 2013 field season of the Non-Time Critical Removal Action (NTCRA) in Operable Unit (OU) B-2, Former Naval Air Facility (NAF) Adak, Adak Island, Alaska.

1.1.1 Project Location. Adak Island is located approximately 1,200 air miles southwest of Anchorage, Alaska, in the Aleutian Island chain, and at 280 square miles, it is the largest of the Andreanof Group of the Aleutian Islands. OU B-2 is located within the Navy-controlled section of the island identified as Parcel 4 and is subdivided into five remedial action areas (RAAs). Figure 1-1 shows the locations of the RAAs within Parcel 4 on Adak.

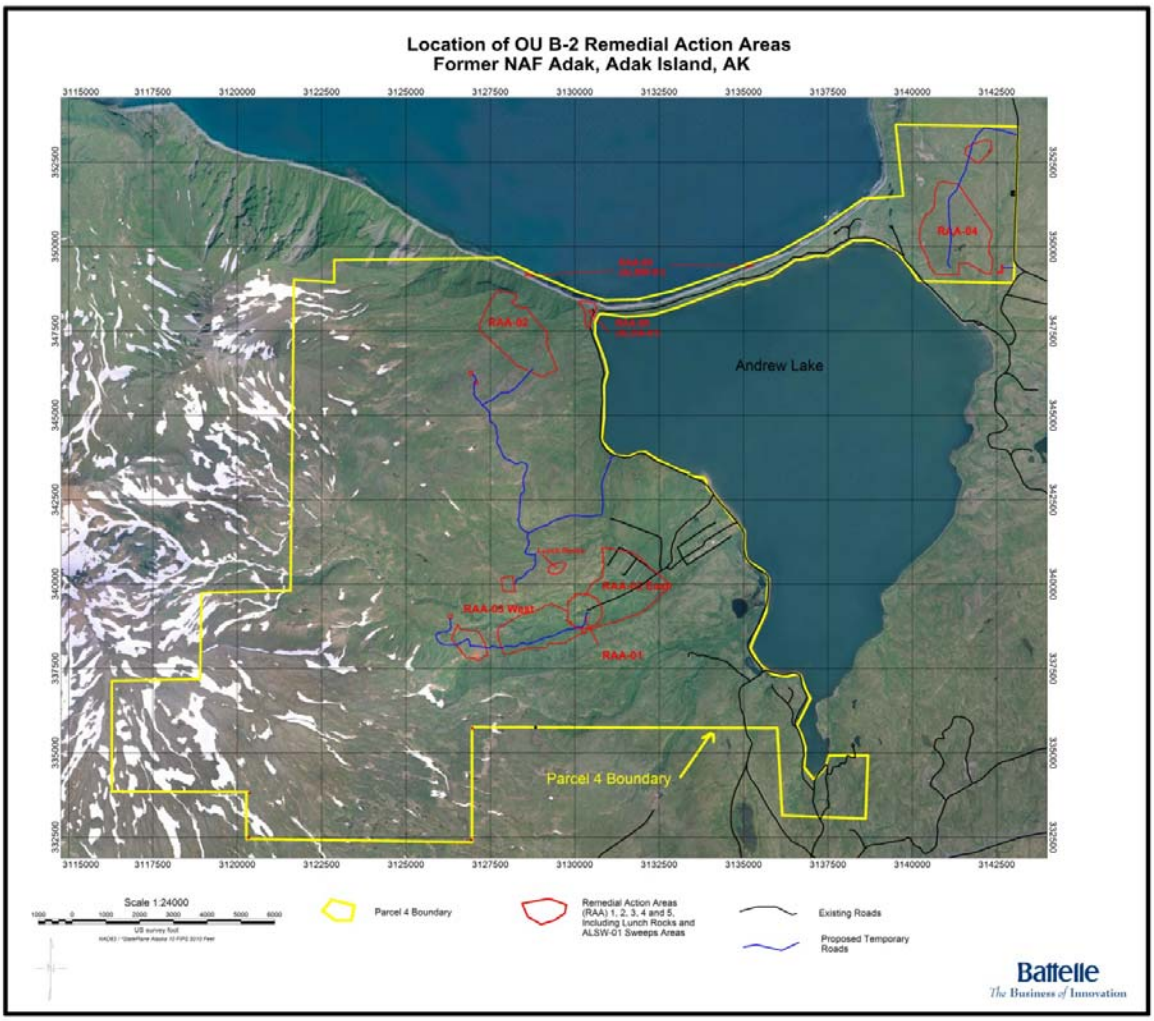


Figure 1-1. General Location of RAAs

1.1.2 Scope and Objective. The scope for QA in the 2013 field season included project management, updating the 2008 Quality Assurance Surveillance Plan (QASP) for the 2013 field work, performing QA in accordance with the QASP, preparing the 2013 field season QASR and providing review and comments on the production contractor's field season report.

The objective was to provide independent QA as the government representative for the NTCRA and QA support as needed during the development of planning documents and closure reports associated with the effort. This work is associated with the Comprehensive Environmental Response Compensation and Liability Act (CERCLA) environmental restoration and closure of OU B-2 at the former NAF Adak, Adak Island, Alaska. Table 1-1 shows the work scheduled for each of the RAAs. All of the QA work was guided by an approved QASP (Battelle, 2013).

Table 1-1. Scheduled Work in RAAs: Summary Information

RAA	Scheduled Activity	Acreage (Approximate)
01	Surface sweep/removal, DGM, select targets, investigation of targets to 2 feet.	17
02	Surface sweep/removal, DGM, select targets, investigation of targets to 2 feet.	74
03W	Surface sweep/removal, DGM, select targets, investigation of targets to 2 feet.	70
03E	Surface sweep/removal, DGM, select targets, investigation of targets to 2 feet.	77
04	Surface sweep/removal, DGM, select targets, investigation of targets to 4 feet.	104
05	Monthly surface sweeps on the seawall portions.	N/A
	Excavation of soil to 2 feet (4 feet in debris areas) and removal of MEC or MPPEH.(1)	4.7

DGM = digital geophysical mapping
MEC = munitions and explosives of concern
MPPEH = material potentially presenting an explosives hazard
Note: Work in RAA-01 and RAA-05 will be completed at a later date.
(1) The activities for RAA-05 were changed after the beginning of the field season. Excavation was only conducted in the northernmost sections of the RAA and was not completed in 2013. The southern portion is undergoing analog detection and removal to a depth of six inches to be followed by digital geophysical mapping in 2014.

1.2 Organization of the Quality Assurance Team

Figure 1-2 illustrates the structure and staffing of the quality team that supported the 2013 field season. Five QA staff resided on island. The geophysics QA staff was at the project site during mobilization and during the initial DGM activities. Because of the backlog of QA inspection work toward the end of the field season, additional QA staff and a geoscientist were brought to the island to help complete the field QA activities (e.g., relocation and investigation of targets from the QA DGM transect data and to reacquire and inspect excavations in contractor completed grids).

1.3 Quality Assurance Actions

The QA actions taken during the 2013 field season included:

- Attendance at and oversight of all preparatory phase and initial phase quality control (QC) inspections;
- QA of the DGM which included:
  - oversight of the selection of locations and installation of the instrument verification strips (IVSs) supporting the geophysical systems verification (GSV) process;
  - the installation of QA blind seed items (BSIs);

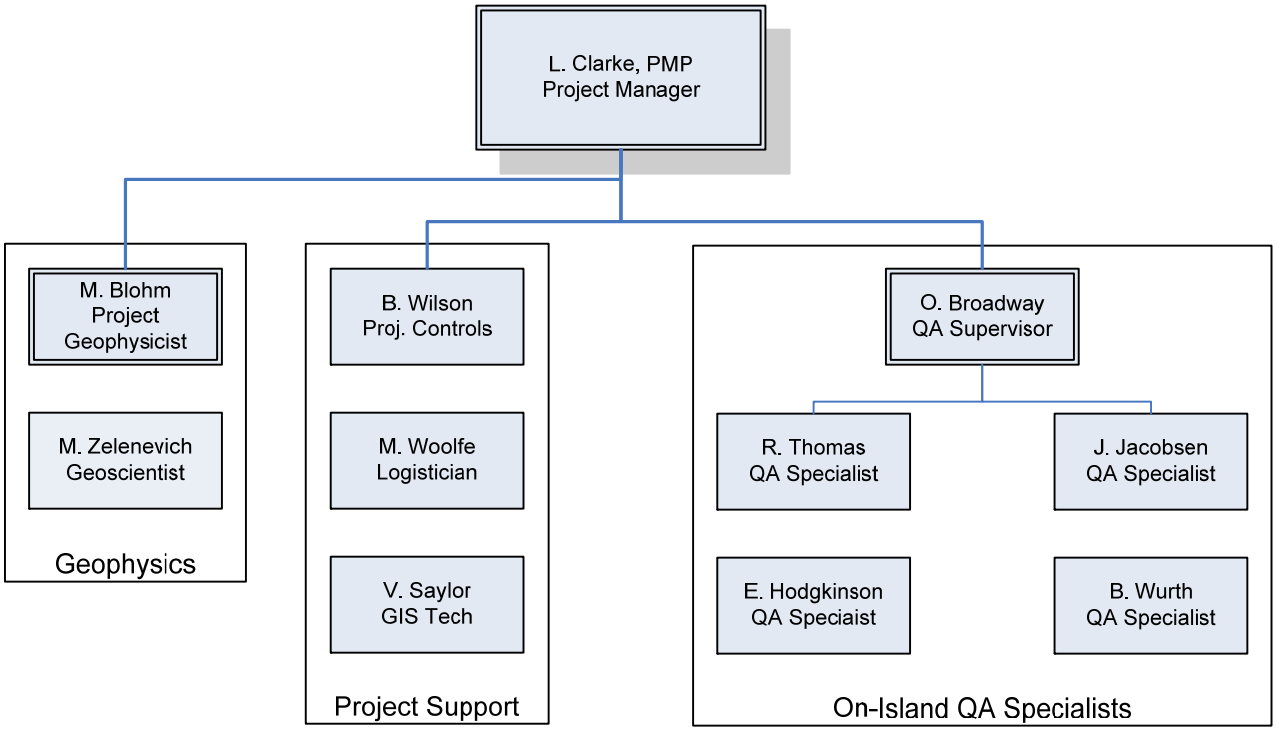


Figure 1-2. 2013 Initial Project QA Team Organization

- oversight of the installation of the QC BSI;
- daily QA surveillances of DGM data collection;
- reprocessing of 100% of the contractor DGM data and concurring with the contractor's target lists;
- independent review of the production contractor's dig results for alignment with the DGM data;
- independent collection of DGM data along transects within each RAA, selection of targets from the transect DGM data and intrusive investigation of the transect DGM data targets.

- QA of the contractor intrusive investigations and other field activities, which included:
  - daily QA surveillances of the field-work-related definable features of work (DFWs) according to the frequency approved in the QASP;
  - independent post-intrusive investigation checks of contractor investigations to verify removal to project standards;
  - a review of the field-work-related QC documentation to verify compliance with the frequency requirements and adequacy standards in the approved Quality Assurance Project Plan (QAPP) and Standard Operating Procedures (SOPs);
- Management of non-conformance reports (NCRs) issued by QC or QA to include performing root cause analysis and determining appropriate corrective actions, conducting follow-up inspections of the corrective action (e.g., re-work) including

verification of required re-inspections and documentation by QC and ensuring timely close-out of open NCRs.

- Additional investigations, research, process analysis and/or other quality functions which were determined necessary to support the field effort and aid in achieving the project's goals.

1.3.1 Digital Geophysical Mapping Data Validation and Target Concurrence. During the 2013 field season, Battelle reprocessed the production DGM data and provided target list concurrence for 418 grids which comprises all of the grids in RAA-02, RAA-03E, RAA-03W and RAA-04. Note that this number exceeds the number of physical grids as some required reevaluation. Included in this activity was reprocessing and validation of the twice daily IVS tests and the static-standard tests which were instituted during production data collection as an additional quality metric.

Field QA personnel conducted 191 surveillances on DGM teams. The frequency for these surveillances was once per team per day for the first week of production and then each DGM team once per week. Surveillances were scheduled so that various aspects of the DGM survey were viewed (e.g., equipment start up, IVS, DGM, etc.). The average turnaround time for QA reprocessing of production DGM data, daily IVS and static-standard tests and providing target list concurrence was less than 24 hours.

Details for the DGM QA activities are provided in Section 2.0 of this report.

1.3.2 Quality Assurance for Field Activities. Battelle field QA personnel conducted 489 surveillances for field activities other than DGM during the 2013 field season for the following DFWs: vegetation clearance/surface sweep, reacquisition, intrusive investigations, disposal of MEC, site restoration and seawall sweeps using the inspection criteria from the respective QC inspection checklist for the DFW being inspected. QA conducted daily surveillances of each team during the first week in which that DFW was being performed and on each team once per week thereafter. The QA checks of the management and disposal of material documented as safe (MDAS) DFWs were accomplished by observing the thermal treatment process at the Thermal Flashing Unit (TFU) and inspecting the final product as it was being containerized. The checks were accounted for by using logbook entries and the totals were tracked with dual signature turn in documents (1348-1). The surveillance total listed above does not include these checks.

QA generated detailed records indicating the date and scope of each inspection of contractor QC surveillance checks and field surveillances. The metrics documented included:

- Whether the agreed upon number and frequency of inspections occurred;
- Whether the inspections covered each of the DFWs being performed;
- Whether all deviations or incomplete work identified by QC were reported within one day of the identification;
- Whether the QC record showed that corrective actions were implemented to address identified deviations in a timely manner and any required re-work was performed;
- Whether QA was notified of non-conformances so that root-cause analysis could be performed;
- Whether follow-up inspections were implemented in a timely manner on activities where non-conformities (deficiencies or non-conformances) were noted.

The QA surveillance forms are provided in Appendix A. Details for the QA for field activities are provided in Section 3.0 of this report.

1.3.3 Quality Assurance Grid Approval. The purpose for performing QA on the completed grids was to provide an independent review of production contractor records and provide some field validation checks to establish that the NTCRA work required for identifying and removing MEC from any individual production grid was complete.

The inspection sequence comprised two elements. One element was a review and verification of documentation and results for all the production and QC work for the grid. The other was independent verification through inspection. The independent verification through inspection consisted of both hole checks of completed digs and QA DGM transects.

QA personnel reviewed all of the production and QC data for the grid. Documentation review consisted of:

- Intrusive dig sheet results;
- mV comparison of intrusive finds to DGM data;
- QC close-out documentation, targets checked, inaccessible areas (standing water, slopes, cultural features, etc.), targets below required clearance depths, no finds, etc.;
- QA documentation for the grid;
- QA-placed BSIs identified by number;
- Disposal of all MEC and management of MPPEH from the grid.

QA personnel selected a subset of targets from the target list to verify clearance. QA re-inspected a minimum 5 percent combined total of dig targets and no-finds selected in each grid. Selection of digs and no-finds for QA inspection was not completely random. After reviewing the grid data, QA selected targets and no-finds using a blend of biased and random sample selection techniques.

1.3.4 Deficiencies and Non-Conformances. Two types of non-conformances were issued during the 2013 field season on the OU B-2 NTCRA: process NCRs and product NCRs. Process NCRs were issued when QC/QA surveillances identified process or procedural breakdowns prior to the fieldwork being completed. There were nine process-related NCRs issued during the 2013 field season (i.e., NCR 1, 2, 3, 4, 5, 6, 7, 9, and 10). Product NCRs were issued when QC/QA inspection of completed work identified non- conforming conditions. Ten product-related NCRs were issued during the 2013 field season (i.e., NCR 8, 11, 12, 13, 14, 15, 16, 17, 18, and 19).

Of the 19 non-conformances, six were related to the DGM efforts and the remaining 13 non-conformances were related to other field activities.

Eleven NCRs were issued by QA staff for the following:

- No preparatory QC phase for intrusive work on RAA-05 (NCR-02);
- QC audit frequency not being met as specified in the QAPP (NCR-04);
- Incomplete documentation of obstacles and inaccessible areas by field teams (NCR-05);

- Lack of QC follow up when non-conformance of surface clearance was observed by QC and also during a QA audit (NCR-06 and -07);
- Grid failures due to items larger than the failure criteria being identified during target rechecks and QA transects (NCR-11, -18, and -19)
- Incomplete site restoration and no action by QC when failure criteria items were found in completed grids (NCR-12); and
- QA and QC BSIs missed during intrusive investigation (BSI selected as a DGM target) (NCR-13 and -14).

Eight of the 19 non-conformances were issued by the contractor QC staff. Non-conformances issued by QC were for:

- IVS test exceedance (NCR-01);
- QC seed items not picked in the DGM data (NCR-03, -09, and -10);
- Discovery of a MEC item during a QC check of Grids O27, T09, and J04 (NCR-08,-16, and -17); and
- Discovery of multiple items larger than the failure criteria in Grids G16 and F16 during QC checks (NCR-15).

1.4 Quality Assurance Communicating and Reporting

Battelle's QA Team used two communication tools during the field effort for problem resolution. The first tool was dialogue, which is an informal problem resolution tool involving consultation with the contractor QC and/or field management staff to discuss and resolve problems. The second tool was NCRs, which is a formal problem resolution tool.

1.5 Summary

1.5.1 Quantitative Summary of Quality Assurance Activities for the 2013 Field Season.

Battelle attended preparatory inspections for each field activity and issued one NCR for no preparatory phase for intrusive operations (see Section 3.5 for NCR details). Battelle completed 680 field QA surveillances on the following activities: vegetation removal and surface clearance, grid setup, DGM, target reacquisition, intrusive investigation, and MEC/material documented as an explosive hazard (MDEH) disposal operations. In addition to surveillances, Battelle observed the treatment of 15,669 pounds of MDAS in the TFU during the 2013 field season.

During the 2013 field season, Battelle reprocessed the production DGM data and provided target list concurrence for 418 grids, which comprises all of the grids in RAA-02, RAA-03E, RAA-03W and RAA-04.

In addition to preparatory inspections and surveillance checks, Battelle also performed QA checks on completed grids. Grids from RAA-03E, RAA-03W, and RAA-04 were reviewed and between 50% and 75% of the grid packages were found to be deficient. Battelle submitted comments to USA Environmental, Inc. (USA) for grid packages from RAA-03E and RAA-03W. The discrepancies for these RAAs have been addressed by USA and the revised grid packages have been approved by Battelle.

Field QA staff completed inspections on 230 grids in RAA-03E, RAA-03W, and RAA-04. Of the grids inspected in 2013, 165 grids passed the inspection and 35 grids failed.

1.5.2 Summary of Field Change Requests. A total of 33 field change requests (FCRs) were submitted during the 2013 field season. Five of the FCRs (-10, -14, -16, -18, and -20) were in response to NCRs related to DGM activities. Two additional FCRs (-30 and -33) were related to DGM activities but not in response to NCRs. The remaining FCRs were related to other activities that took place during the 2013 field season on the OU B-2 NTCRA. The documentary changes in the FCRs have been incorporated into the 2014 QAPP and relevant SOPs. FCR 34 was developed following the 2013 field season as the method of incorporating other updates into the revised 2014 QAPP.

1.5.3 Summary Status of 2013 Quality Assurance Activities by Remedial Action Area. There were 680 surveillance checks conducted during the 2013 NTCRA field season on the following DFWs: vegetation removal/surface clearance, grid setup, DGM, anomaly reacquisition, intrusive investigation, and MEC/MDEH disposal. Table 1-2 summarizes the QA surveillances performed in each RAA.

Table 1-2. Number of Surveillance Checks Performed in Each RAA in 2013

RAA	Surveillance Checks						
	Vegetation Removal/ Surface Clearance	Grid Setup	DGM	Anomaly Reacquisition	Intrusive Investigation	MEC/MDEH Disposal	Total
RAA-01	0	0	1	0	0	5	6
RAA-02	11	4	44	0	0	1	60
RAA-03E	37	10	80	57	95	15	294
RAA-03W	21[(a)]	6[(a)]	26[(a)]	51[(a)]	59[(a)]	19[(a)]	182[(a)]
RAA-04	8	4	40	15	21	5	93
RAA-05	3	3	0	0	35	4	45
Total	**80**	**27**	**191**	**123**	**210**	**49**	**680**

(a) Two surveillances from vegetation clearance/surface removal, one surveillance from grid setup, three surveillances from DGM, four surveillances from anomaly reacquisition, one surveillance from intrusive investigation, and one surveillance from MEC/MDEH disposal were from grids which have been transferred to RAA-01.

Section 2.0: QUALITY ASSURANCE OF DIGITAL GEOPHYSICAL MAPPING

2.1 Introduction

During the 2013 field season, DGM was completed in RAAs -03E, -03W, -02 and -04 of the NTCRA. Figure 2-1 shows the locations of the NTCRA RAAs and the DGM completed portions of the RAAs, and Table 2-1 tabulates the DGM acreage and status of the RAAs at the end of the 2013 field season.

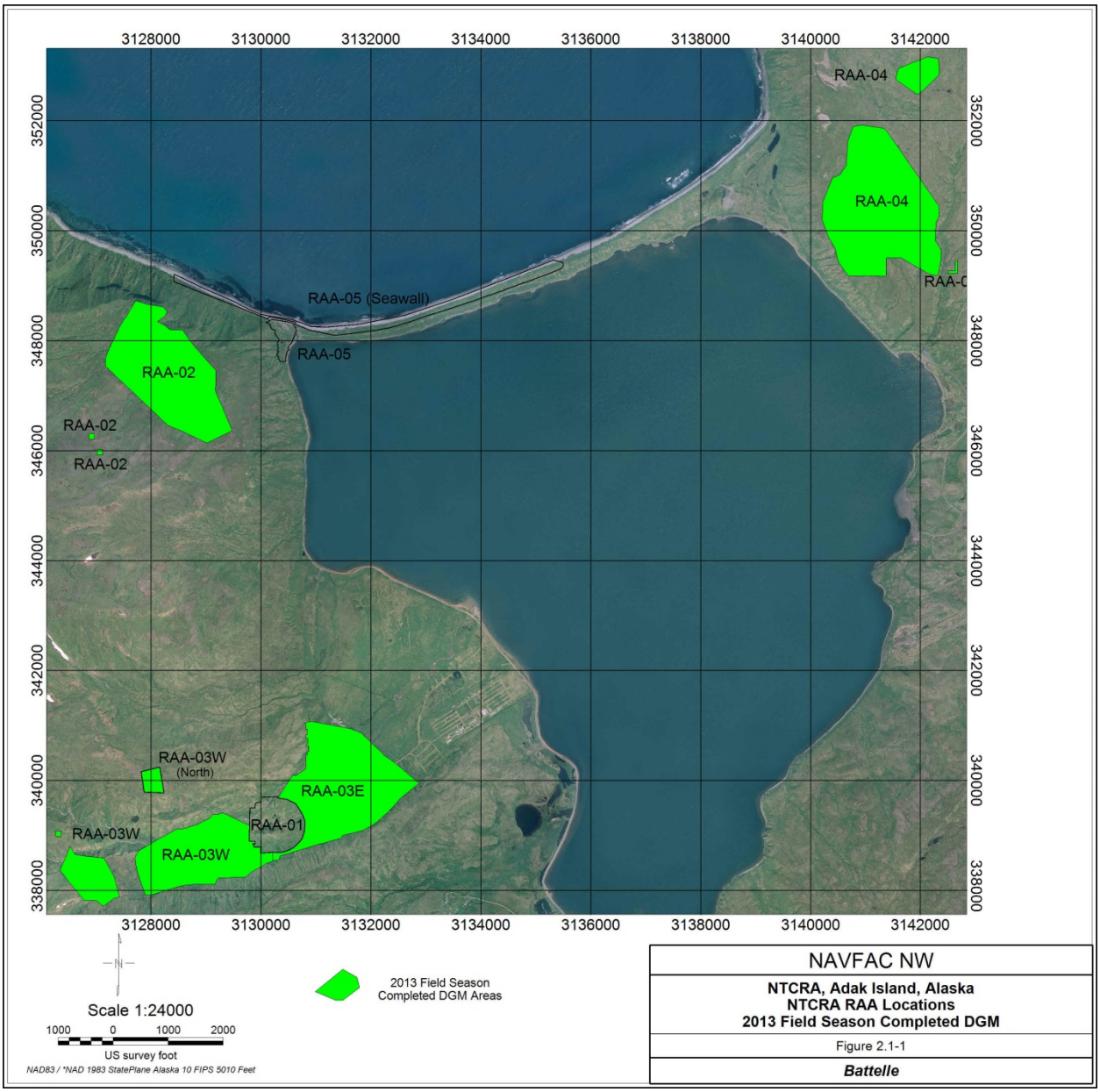


Figure 2-1. Location of NTCRA RAAs and Completed DGM Surveys in 2013 Field Season

Table 2-1. Acreage and DGM Status of NTCRA RAAs at End of 2013 Field Season

RAA	Sub-Areas	Acres	DGM Status	Comments
-01	Primary Area	19.37	Not Complete	Scheduled for 2014 Field Season
-02	Primary Area	73.23	Complete	
	30 m by 30 m Grid	0.24	Complete	
	30 m by 30 m Grid	0.23	Complete	
	Total	**73.7**	**Complete**	
-03E	Primary Area	76.14	Complete	
	Total	**76.14**	**Complete**	
-03W	Primary Area	51.72	Complete	
	Secondary (West) Area	15.37	Complete	
	30 m by 30 m Grid	0.22	Complete	
	North Area	3.41	Complete	
	Total	**70.72**	**Complete**	
-04	Primary Area	95.68	Complete	
	Southeast Area	0.37	Complete	
	North Area	7.92	Complete	
	Total	**103.97**	**Complete**	
-05	Main Area	4.73	Not Complete	Scheduled for 2014 Field Season
	Total DGM Completed in 2013 Field Season	**324.53**		

The figure and table show that DGM surveys were completed across 323.53 acres completing RAAs -02, -03E, -03W and -04 in the 2013 field season. RAA-01 (19.37 acres) and -05 (approximately 4.73 acres) are scheduled for DGM surveys at a later date. The RAA-05 seawall (~21.4 acres) is currently experiencing monthly sweeps (during the field seasons) and will not be mapped. Note that based on intrusive results analysis there are several anticipated step-outs for the RAAs, some of which may require DGM surveys in 2014.

2.1.1 Digital Geophysical Mapping Quality Assurance Objectives. The objective of the DGM QA program is to ensure that the contractor DGM surveys and data meet the pre-work performance measures and metrics provided in the project plans, and to provide reporting to the Navy of any contractor work that deviates from the approved project plans or is not completed, in whole or in part, as required by the approved project plans. Specific QA DGM tasks that were identified as critical to the success of the project are:

1. Perform QA audits of DGM field activities.
2. Reprocess and evaluate 100% of contractor IVS data, the first component of the GSV plan.
3. Reprocess and evaluate 100% of contractor DGM production data, and compare the QA target picks against contractor target picks deriving a final approved DGM target list.
4. Evaluate the contractor QC BSIs, the second component of the GSV plan. In addition, QA installed independent BSIs were also evaluated.
5. Acquire and evaluate independent QA DGM transect data.

Task 1 was conducted by QA unexploded ordnance (UXO) specialists on site and is described in Section 3 of this report. Tasks 2 through 4 were conducted by QA geophysicists entirely off site. Task 5 involved both on-site and off-site geophysical work. Tasks 2 through 5 are described and summarized in the subsequent sections (2.2 through 2.5).

2.1.2 Execution of the Digital Geophysical Mapping Quality Assurance Tasks. Off-site DGM QA tasks were conducted by Battelle's Project Geophysicist and Geoscientist. These off-site tasks were DGM data processing and evaluations tasks and were primarily conducted with the software Oasis Montaj (Geosoft) using specialty routines within UX-detect. This software and routines were identical to those used by the contractor. Figure 2-2 illustrates the general sequencing for the QA DGM activities.

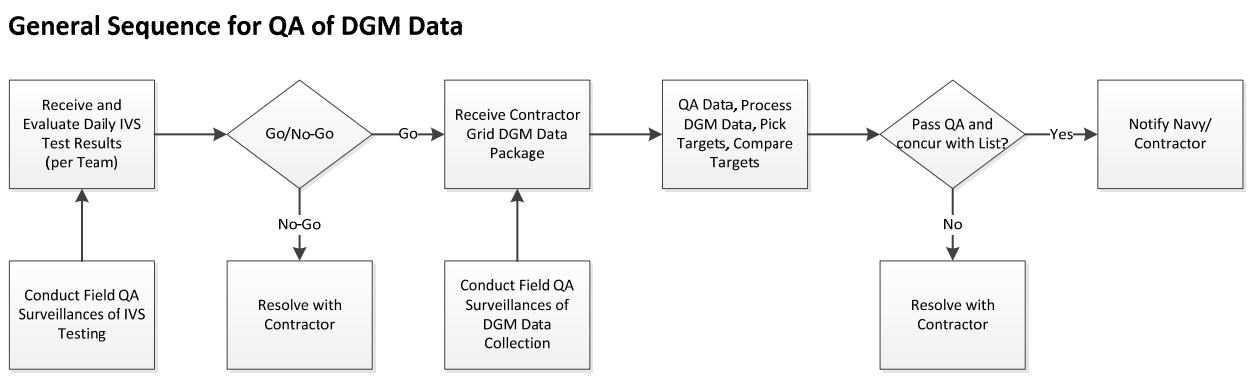


Figure 2-2. General Sequence of QA DGM Activities (2013 Field Season)

Figure 2-2 shows that QA of contractor DGM activities began with QA surveillances of contractor IVS tests. QA surveillances were also conducted during contractor production data acquisition. Once contractor QC had approved the IVS test data, these data were delivered to QA for evaluation. This evaluation was a critical step in the process as production DGM data were not accepted if this metric failed. Once the IVS data were approved, QC delivered a DGM package including a DGM submittal form (certifying that the data passed QC tests), the raw and processed DGM data, QC approved target picks, and backup information (survey area report forms, inaccessible area documents and photos, data processing checklist, etc.). Note that in most cases the IVS and DGM package were delivered to QA simultaneously. QA conducted a review of the package information, reprocessed 100% of the data and created an independent target list. The independent QA target list was compared to the QC target list and if additional QA targets were noted, they were provided to the QC geophysicist in a separate file. Also, at this point QA evaluated the detection, position and amplitudes of QC and QA blind seeds, and the detection and position of grid corner nails. If all metrics passed, QA provided contractor QC with a formal notification that the DGM data were acceptable, along with a file containing additional QA targets (if applicable). Following contractor intrusive operations, QA acquired independent DGM data over completed grids. These data were processed by QA and targets were picked and investigated by QA as part of the grid completion package.

2.1.3 Summary of Digital Geophysical Mapping Quality Assurance Activities for 2013. Table 2-2 provides a summary of QA DGM activities conducted during the 2013 field season. DGM work was completed and approved by QA in RAAs -02, -03E, -03W and -04 in the 2013 field season. Contractor intrusive operations were completed in RAAs -03E, -03W and -04. Table 2-2 shows that RAAs -02, -03E, -03W and -04 comprised an initial total of 450 grids in 324.5 acres. DGM data were not acquired in one of the grids in RAA-02 (J08), and seven of the grids in RAA-03W (D17, E18, F17, F18, G17, G18 and H18) were realigned with the RAA-01 remediation process. Thus, the DGM data and targets for these eight grids do not have official QA approval. In addition, the target selection threshold for RAA-02 was raised from 3 to 5 mV around July 23, 2013. Since the modification of the target selection threshold to 5 mV was retroactive, all target lists have been windowed in this report and the revised target list tallies 18,600.

The remaining 442 grids all received QA approval, along with the 78,347 (QC and QA) targets contained in these grids. Overall, QA added very few DGM targets (~2.4% of total) to the contractor QC target lists. During the course of the 2013 field season there were changes made to the DGM target selection criteria that will impact the DGM target lists used for intrusive operation in RAA -02.

- FCR-33 (Subsampling of Geologic and Terrain Induced DGM Targets) will be applied to the DGM target lists in RAA-02. This action will be the responsibility of the contractor prior to the start of intrusive operations in RAA-02.
- There were significant “boulder field” areas within RAA-02 where DGM data were not acquired. The contractor provided maps of these areas, and QA performed a subsequent analysis of the boulder fields. The QA analysis expands the contractor boulder field areas, and thus some previously approved DGM targets may be eliminated if the expanded boulder field boundaries are utilized.

Table 2-2. Summary of QA DGM Activities for the 2013 Field Season

RAA	Sub-Areas	Acres	Grids	# of QA Surveillances of DGM Activities	QA Acceptance of DGM Grids	QA DGM Targets Approved	Comments
-02	Primary Area	73.2	100*	44	99	18,387	Original target selection threshold was 3 mV (EM61 MK2 Ch. 1). Raised to 5 mV on July 23, 2013 and used in this table. No DGM data acquired in Grid J08.
	30m by 30 m Grid	0.24	1	0	1	91 (Grid A02)	
	30m by 30 m Grid	0.23	1	0	1	122 (Grid C01)	
	Total	**73.7**	**102***	**44**	**101**	**18,600**	
-03E	Primary Area	76.1	106	80	106	21,941	7 mV (EM61 MK2 Ch. 1) target selection threshold.
	Total	**76.14**	**106**	**80**	**106**	**21,941**	
-03W	Primary Area	51.7	70**	20	63	16,569	4.8 mV (EM61 MK2 Ch. 1) target selection threshold. Seven grids (D17, E18, F17, F18, G17, G18 and H18) realigned to RAA-01.
	Secondary (West) Area	15.4	25	3	25	2,988	
	30m by 30m Grid	0.22	1	0	1	3	
	North Area	3.41	4	2	4	1,333	
	Total	**70.72**	**100****	**25**	**93**	**20,893**	
-04	Primary Area	95.7	127	36	127	15,573	3.4 mV (EM61 MK2 Ch. 1) target selection threshold.
	Southeast Area	0.37	1	0	1	102	
	North Area	7.9	14	4	14	1,238	
	Total	**103.97**	**142**	**40**	**142**	**16,913**	
Grand Totals RAAs -02, -03E, -03W and -04		***324.5***	***450***	***189***	***442***	***78,347***	

* One of these grids did not have any DGM data collection.
**Seven of these grids were realigned into the RAA-01 remediation process.

2.2 Geophysical Systems Verification

A GSV was utilized in the NTCRA to ensure that the geophysical (EM61 MK2) systems utilized were performing according to manufacturer's specifications and met the project objectives on an ongoing basis. The GSV process was used in lieu of a Geophysical Prove-out (GPO) process which was used in most of the previous DGM work on Adak. The GSV comprises two elements:

- An IVS
- A BSI program

The GSV process in the NTCRA was governed primarily by the GSV Installation Plan, which was included in the MEC QAPP as Appendix G.

2.2.1 Instrument Verification Strip Installation Quality Assurance. IVS and BSI installation was conducted during the week of September 20-27, 2012. The contractor installed three IVSs for the NTCRA in OU B-2 as shown on Figure 2-3. Three IVSs were utilized to improve logistics for production DGM work in the widely separated RAAs. During this same period, QC installed 368 BSIs in RAAs -02, -03E, -03W and -04, and QA installed BSIs in RAAs -01, -02, -03E, -03W and -04.

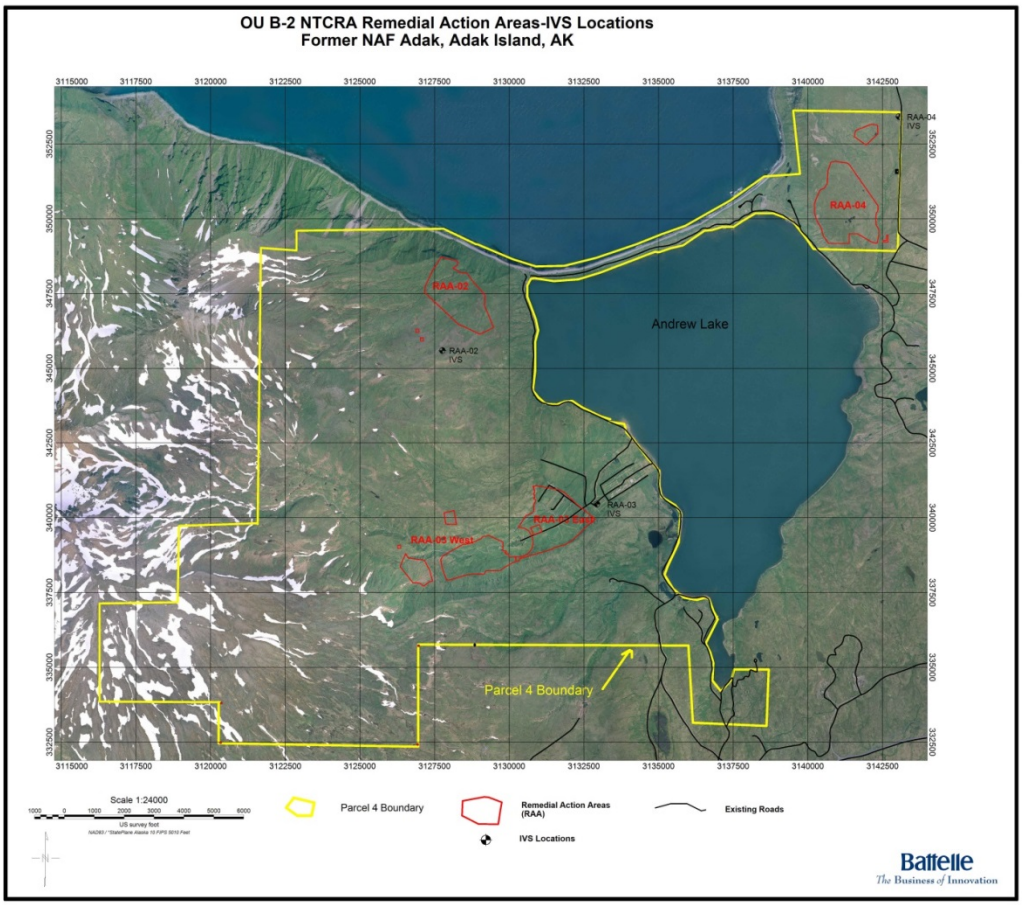


Figure 2-3. IVS Locations

In early 2013, the contractor provided a GSV Report which covered the IVS installation processes and provided an analysis of initial DGM tests (Industry Standard Object [ISO] amplitudes and positions). This report also described the QC BSI installation.

During the contractor IVS and BSI installation, QA performed surveillances and installed independent QA BSIs. QA utilized a separate plan (Appendix B: Abbreviated QASP and QA BSI Plan for Contractor BSI and GSV) to guide the surveillances and QA BSI installations. Following the contractor IVS and BSI installations and the QA BSI installations, QA submitted a surveillance and QA BSI report (Appendix C). All contractor IVS and BSI installations were performed in accordance with the approved plans.

To verify all DGM data collected during the 2013 field season, an IVS was utilized both before and after data collection occurred each day. The purpose of the IVS is to verify that the geophysical systems are working according to the manufacturer's specification.

Each IVS was built to the same specifications, disregarding azimuth, all following the GSV plan. The IVS consisted of five separate ISOs buried at varying depths, separated by 15 feet. The ISOs used in the IVS were all considered small ISOs, which were 1 in. by 4 in. steel pipe nipples. The first three ISOs were oriented cross-track while the last two were oriented along-track, all buried at a depth of 4 in. (3x diameter), 6.6 in. (5x diameter) or 9.2 in. (7x diameter). Located parallel at a 10 foot offset from the IVS line, an IVS background noise strip was surveyed. All actual depths and surveyed locations are provided in the GSV Report (MEC QAPP Appendix G [USA, 2012]).

The intention of the IVS was to serve DGM processes in their respective RAAs. Each team would collect data from the IVS before and after data collection for the day. The IVS was utilized by both the production teams and the QA DGM teams to establish uniform data verification. All of the IVSs are still in place and can be used to provide instrument verification for DGM work that may occur in the NTCRA during the future field seasons.

The initial IVS metrics that needed to be passed in each run include interpreted positional accuracy and amplitude response consistency:

- The positional accuracy metric for the interpreted location of each ISO was not to exceed +/- 9.8 in. (25 cm)
- The measured amplitude response of the ISO anomaly was no greater than the larger of 20% or two times the standard deviation of the previous week's average.

Procedures required that if the morning IVS run failed any of these metrics, the IVS would be recollected until it passed to ensure the instrument was working properly for the rest of the day. If the evening IVS run failed these metrics, the Navy was notified and all data collected that day was evaluated. The contractor fielded up to six DGM teams that often worked in different RAAs in a day. Contractor QC and QA evaluated the IVS results independently. The QC DGM data submittal certified that each team that collected production DGM data had passed the IVS. QA did not typically analyze any IVS or production DGM data until this submittal was received. Thus, production teams that had obvious IVS failures were typically identified, and the data remedied by contractor QC prior to data submittal to QA.

During the first week of DGM collection, all IVS data were compared internally for determination of amplitude metrics since this was the first collection of IVS for each team. Because of this, in the first week (April 10-13, 2013), almost all teams easily passed the amplitude metrics

(particularly the two times standard deviation), with the only exception being DGM Team 4 on April 10, 2013 for ISO #4 (+27.5% of the average). Following the first week, week 2 (April 15-20, 2013) statistics were compared against week 1, and week 3 (April 22-27, 2013) against week 2 as per the plan. During week 2 and week 3 statistic evaluations, 17 and 16 amplitude failures (respectively) were recorded. An example of the amplitude analysis plot for Team 6 (ISO #3) during week 2 is shown on Figure 2-4. This figure shows two instances of amplitude failures (higher than the metric) on April 15 and 19, 2013.

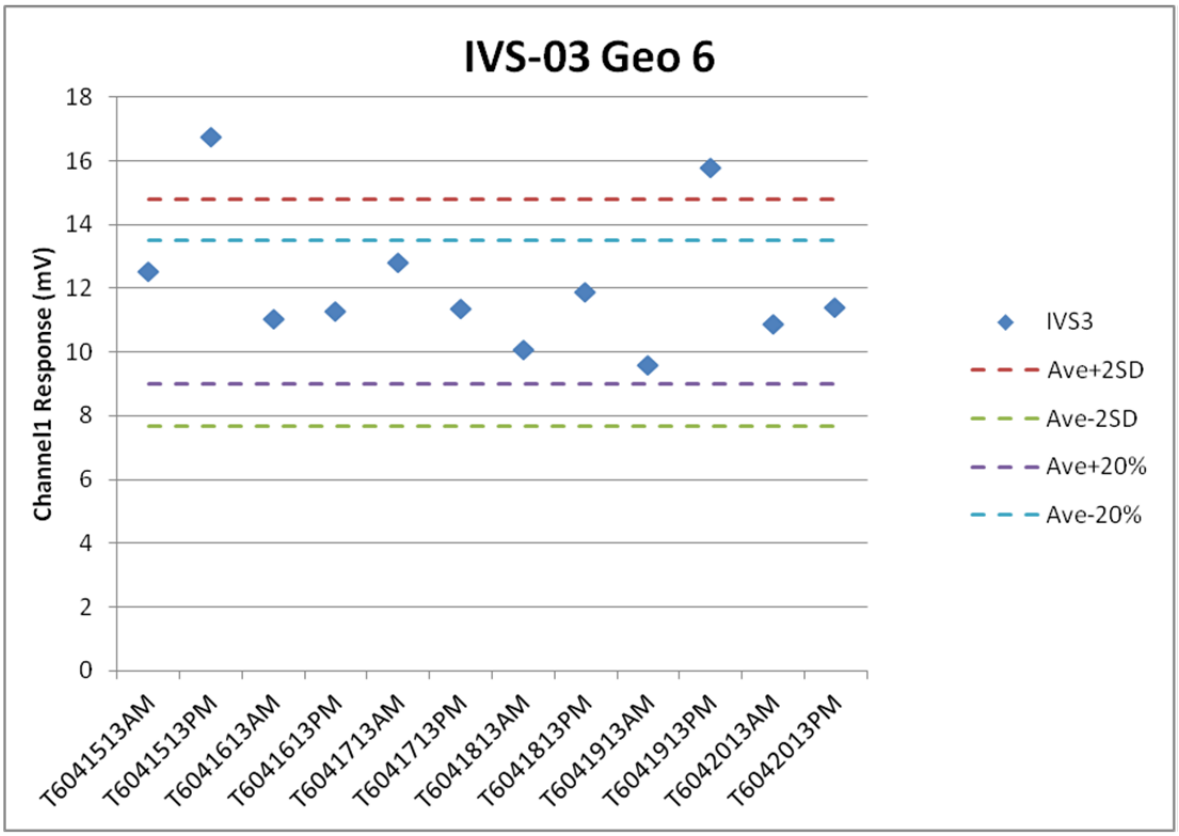


Figure 2-4. Team #6 IVS #3 Results

Because of the high number of failures, an NCR (-01) was issued, in which the IVS amplitude metrics were determined to be too strict for DGM systems given the conditions on Adak. The corrective action for this NCR was to relax the amplitude metrics, and supplement the IVS tests with a static spike test as follows:

- Positional error the same (no greater than +/- 9.8 in. offset down track), but based on two runs, forward and backward, of the IVS line.
- A minimum of three ISOs not exceeding +40% to -35% of the previous week's average for all teams, changed from the larger of +/-20% or two times the standard deviation of the previous week's average.
- Implementation of a static spike test, where:
  - Measured values of each time-gate channel to be within +/-10% of initial response
  - All teams must measure within +/-25% of the average of all teams' initial response

- A failure in either of these metrics results in all data from the respective team to fail for that day's collection.

Figure 2-5 is an example of the plot used to analyze the static spike data for Team #6 (EM61 MK2, Channel 3), demonstrating that the data pass the test.

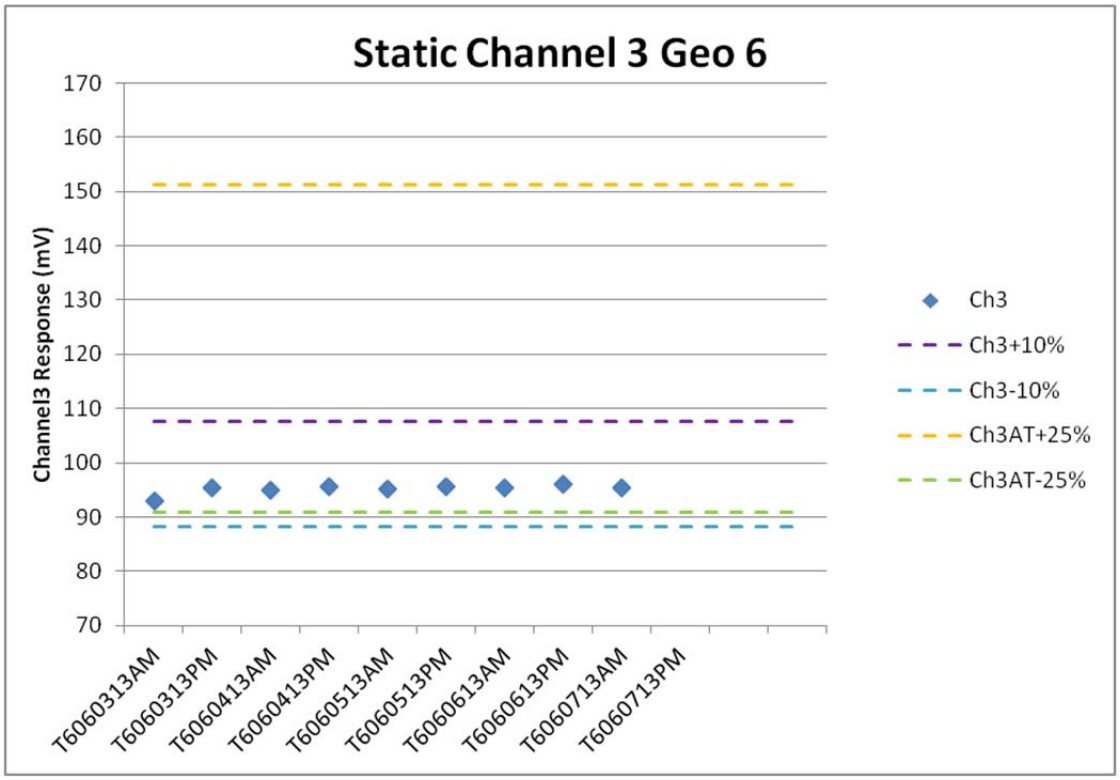


Figure 2-5. Example Static Spike Test, Team #6

Once the corrective actions for NCR-01 were implemented, there were no significant IVS amplitude failures noted by QA. It should be noted that there were extremely few positional failures (interpreted location of ISO within +/- 9.8 in.) for the six production teams using the three IVSs throughout the entire 2013 field season. All IVS results are provided in Appendix D.

2.2.1.1 Summary Instrument Verification Strip Test Results. The IVS metrics were complex in that each DGM team had to run the IVS twice daily, meet the positional metrics (+/- 9.8 in.) for all five ISOs, and meet the amplitude metrics (a minimum of three ISOs not exceeding +40% to -35% of the previous week's average for all teams) for all five ISOs for Channel 1 of the EM61 MK2. These metrics were cataloged separately for each RAA (i.e., -02, -03 and -04).

Table 2-3 shows the average amplitudes, standard deviations and minimum/maximum EM 61 MK2 amplitudes (mV) for all six DGM teams over the five ISOs in the RAA-02 IVS. To provide a summary overview of the IVS results the field season averages were used.

Table 2-3. Summary of IVS Results in RAA-02 for the 2013 Field Season

ISO #	Team	ISO Measurements (mV)		
		Ave.	Std. Dev.	Min/Max
1 (Across-track, 4 inch depth, 3X diameter)	1	15.29	0.96	13.74/17.03
	2	16.72	1.20	14.8/18.73
	3	14.92	1.33	12.42/16.38
	4	13.54	1.50	9.62/18.22
	5	13.07	1.51	9.99/17.13
	6	15.72	1.90	12.3/20.85
	All	14.88	1.40	12.15/18.06
2 (Across-track, 9.2 inch depth, 7X diameter)	1	5.61	0.59	4.63/7.08
	2	6.83	0.76	5.67/8.28
	3	6.68	1.06	4.7/7.94
	4	5.92	0.83	4.25/8.21
	5	5.66	0.71	3.57/7.67
	6	6.92	1.12	5.12/9.85
	All	6.27	0.85	8.17/18.06
3 (Across-track, 6.6 inch depth, 5X diameter)	1	24.93	1.68	20.41/27.8
	2	23.70	3.54	17.85/31.17
	3	25.20	2.79	20.77/29.51
	4	24.03	2.76	17.93/30.92
	5	22.21	2.85	15.84/27.8
	6	27.75	3.52	21.24/35.96
	All	24.64	2.86	19.01/30.53
4 (Along-track, 4 inch depth, 3X diameter)	1	22.20	2.27	18.68/26.08
	2	22.24	2.94	18.28/27.99
	3	21.96	2.61	17.38/25.75
	4	19.73	2.14	15.33/25.25
	5	17.97	2.22	13.01/24.6
	6	21.93	3.41	14.83/33.67
	All	21.00	2.60	16.25/27.22
5 (Along-track, 9.2 inch depth, 7X diameter)	1	9.58	1.02	7.86/11.52
	2	8.26	1.44	6.46/12.18
	3	8.15	1.09	6.59/10.08
	4	7.69	0.86	4.73/10.27
	5	6.71	1.27	4.27/9.6
	6	8.17	1.19	5.49/11.48
	All	8.10	1.15	5.90/10.86

Figure 2-6 shows a plot of the six DGM teams' average amplitudes for the five ISOs in the RAA-02 IVS. Also shown on this plot are the average for all of the teams and the value for two times the standard deviation.

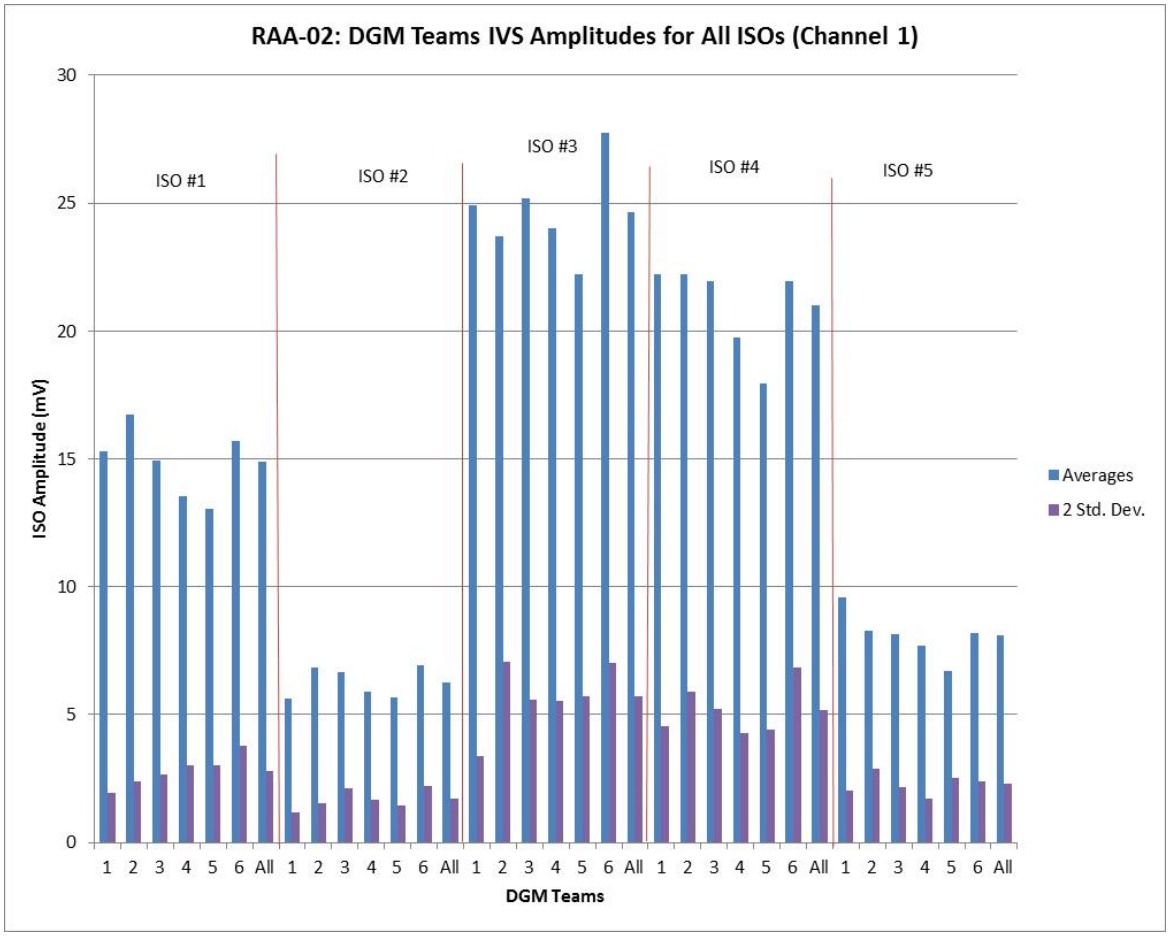


Figure 2-6. Plot of the Six DGM Teams' Average Amplitudes for the Five ISOs in the RAA-02 IVS

The table and figure show that ISOs #2 and #5 had the lowest average amplitudes (6.27 and 8.1 [of all team averages]). These ISOs were buried at the deepest depths (7X diameter or 9.2 in.). ISO #2 was oriented across-track, which is typically more difficult to detect (expected lower amplitude). ISOs #1 and #3 were buried at the same depth (3X diameter or 4 inches) and show average amplitudes of 14.88 and 21 mV, respectively. ISO #1 was oriented across-track and thus had a lower amplitude. The average amplitude of ISO #3 was 24.64 mV. This higher amplitude was unexpected, as this ISO was buried deeper (5X diameter or 6.6 inches) than ISO #1 (or #4). This apparent discrepancy is likely caused by differences in tundra thickness at the ISO burial locations affecting the overall distance between the sensor and the ISO. All ISOs were buried with respect to the mineral surface, and typical tundra variations of several inches can be expected within the IVS. Figure 2-6 also shows that Team #5 generally showed lower average amplitudes for all ISOs. Team #4 showed slightly lower average amplitudes as compared to the remaining teams. Table 2-4 provides a summary of average amplitudes, standard deviations and minimum/maximum EM 61 MK2 amplitudes (mV) for all six DGM teams over the five ISOs in the RAA-03 IVS.

Table 2-4. Summary of IVS Results in RAA-03 for the 2013 Field Season

ISO #	Team	ISO Measurements (mV)		
		Ave.	Std. Dev.	Min/Max
1 (Across-track, 4 inch depth, 3X diameter)	1	8.98	0.92	6.94/11.28
	2	11.28	2.28	7.88/17.644
	3	10.27	1.34	6.98/13.74
	4	10.57	1.20	8.46/15.02
	5	8.91	0.96	6.4/10.82
	6	11.52	1.78	8.85/18.06
	All	10.26	1.41	6.50/12.37
2 (Across-track, 9.2 inch depth, 7X diameter)	1	4.16	0.50	2.5/5.784
	2	4.83	0.98	2.35/7.475
	3	4.32	0.58	3.19/5.79
	4	4.64	1.43	3.17/13.66
	5	3.80	0.71	1.95/5.93
	6	4.76	0.71	3.64/6.816
	All	4.42	0.82	2.40/6.49
3 (Across-track, 6.6 inch depth, 5X diameter)	1	9.41	1.44	7.39/14.43
	2	10.97	3.50	6.13/19.43
	3	10.21	1.46	6.91/13.96
	4	10.33	1.56	7.03/13.927
	5	7.98	1.06	5.94/11.094
	6	11.14	1.60	8.34/16.739
	All	10.01	1.77	5.96/12.80
4 (Along-track, 4 inch depth, 3X diameter)	1	14.51	1.79	11.64/20.22
	2	17.37	4.96	10.11/27.947
	3	15.82	2.63	10.17/23.1
	4	16.24	2.69	12/23.6
	5	15.88	1.61	11.65/20.57
	6	17.45	2.94	12.86/30.605
	All	16.21	2.77	9.78/20.86
5 (Along-track, 9.2 inch depth, 7X diameter)	1	7.09	1.01	5.66/10.64
	2	8.02	2.12	4.35/12.603
	3	7.09	1.57	1.33/10.32
	4	7.45	1.20	5.54/10.41
	5	7.40	0.82	4.79/9.17
	6	7.82	1.26	5.63/13.088
	All	7.48	1.33	3.90/9.46

Figure 2-7 shows a plot of the six DGM teams' average amplitudes for the five ISOs in the RAA-03 IVS.

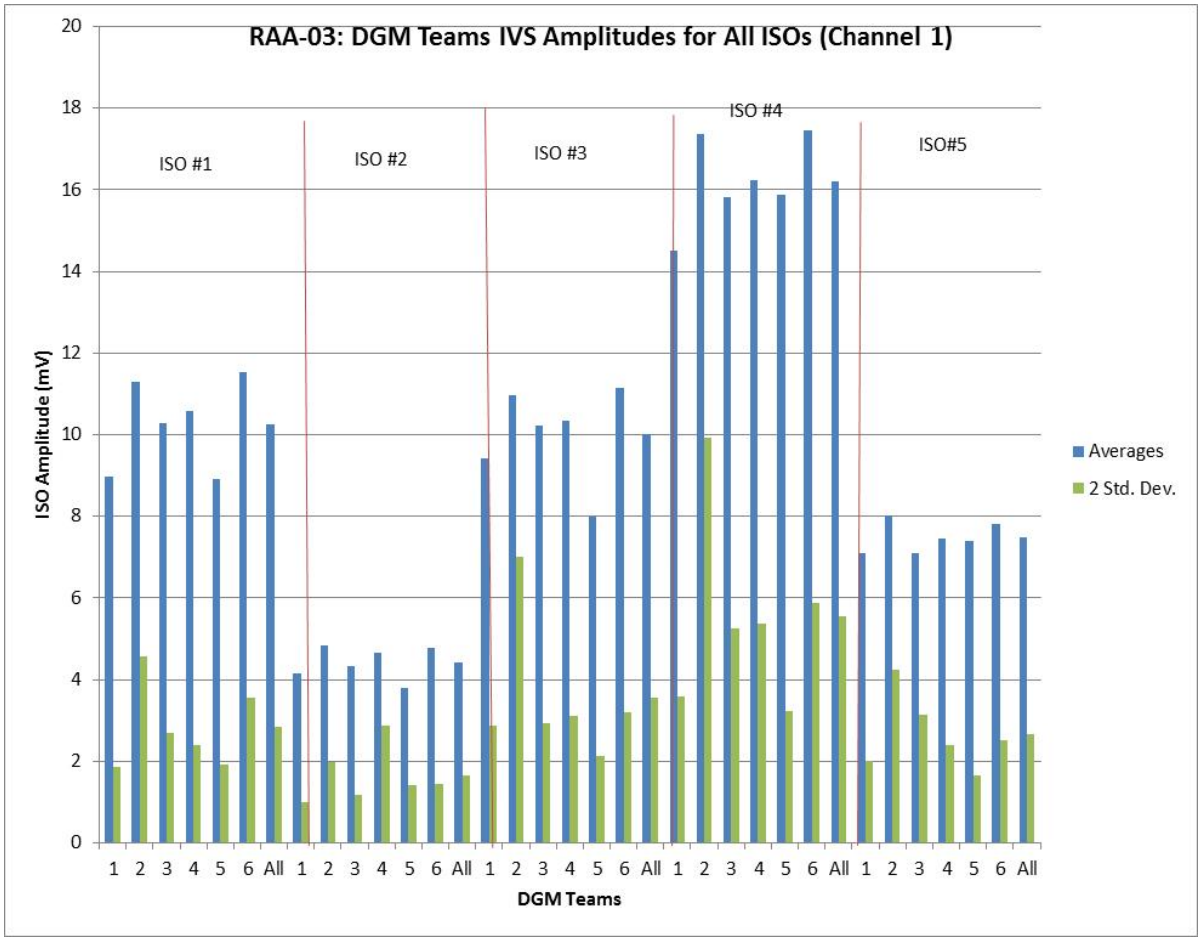


Figure 2-7. Plot of the Six DGM Teams' Average Amplitudes for the Five ISOs in the RAA-03 IVS

Table 2-4 and Figure 2-7 show that the expected relative amplitudes for the ISOs appear consistent, that is the deeper and/or more difficult to detect ISOs (#2 and #5) show lower average amplitudes than the shallower and/or easier to detect ISOs (#4 and #1). In comparing teams' averages, Team 5 appears to show lower relative amplitudes over ISOs #1, #2 and #3. However, this team's averages for ISOs #4 and #5 appear to correlate well with the other teams. Team #2 generally obtained higher amplitudes over all ISOs, along with higher standard deviations.

Table 2-5 provides a summary of average amplitudes, standard deviations and minimum/maximum EM 61 MK2 amplitudes (mV) for all six DGM teams over the five ISOs in the RAA-04 IVS.

Table 2-5. Summary of IVS Results in RAA-04 for the 2013 Field Season

ISO #	Team	ISO Measurements (mV)		
		Ave.	Std. Dev.	Min/Max
1 (Across-track, 4 inch depth, 3X diameter)	1	12.43	1.15	10.57/15.48
	2	15.18	1.36	12.44/19.35
	3	13.21	1.43	10.04/16.9
	4	13.80	2.11	8.833/17.01
	5	12.35	1.18	10.06/14.96
	6	14.90	1.60	12.26/18.26
	All	13.65	1.47	10.7/16.99
2 (Across-track, 9.2 inch depth, 7X diameter)	1	3.31	0.40	2.6/4.25
	2	3.90	0.48	2.702/4.88
	3	3.49	0.34	2.85/4.12
	4	3.69	0.58	2.316/4.93
	5	3.06	0.46	2.196/4.12
	6	3.70	0.44	2.81/4.5
	All	3.52	0.45	2.58/4.47
3 (Across-track, 6.6 inch depth, 5X diameter)	1	9.56	1.14	7.61/12.76
	2	12.60	1.45	9.804/16.02
	3	9.99	1.08	8.04/12.75
	4	10.94	1.54	7.933/13.74
	5	9.24	1.02	7.013/11.2
	6	11.08	1.13	8.82/13.17
	All	10.57	1.23	8.2/13.27
4 (Along-track, 4 inch depth, 3X diameter)	1	20.07	2.11	16.53/24.5
	2	23.10	3.02	15.94/28.4
	3	21.65	2.66	4.3/8.79
	4	23.75	4.98	13.75/30.99
	5	24.49	2.45	19.10/29.85
	6	22.90	2.87	17.9/28.67
	All	22.66	3.01	16.74/28.35
5 (Along-track, 9.2 inch depth, 7X diameter)	1	7.14	0.73	5.55/8.65
	2	7.72	1.09	5.53/10.29
	3	7.10	1.23	4.3/8.79
	4	7.77	1.31	5.16/9.88
	5	8.32	0.85	6.36/9.781
	6	7.61	1.40	2.05/9.708
	All	7.61	1.10	4.83/9.52

Figure 2-8 shows a plot of the six DGM teams' average amplitudes for the five ISOs in the RAA-04 IVS.

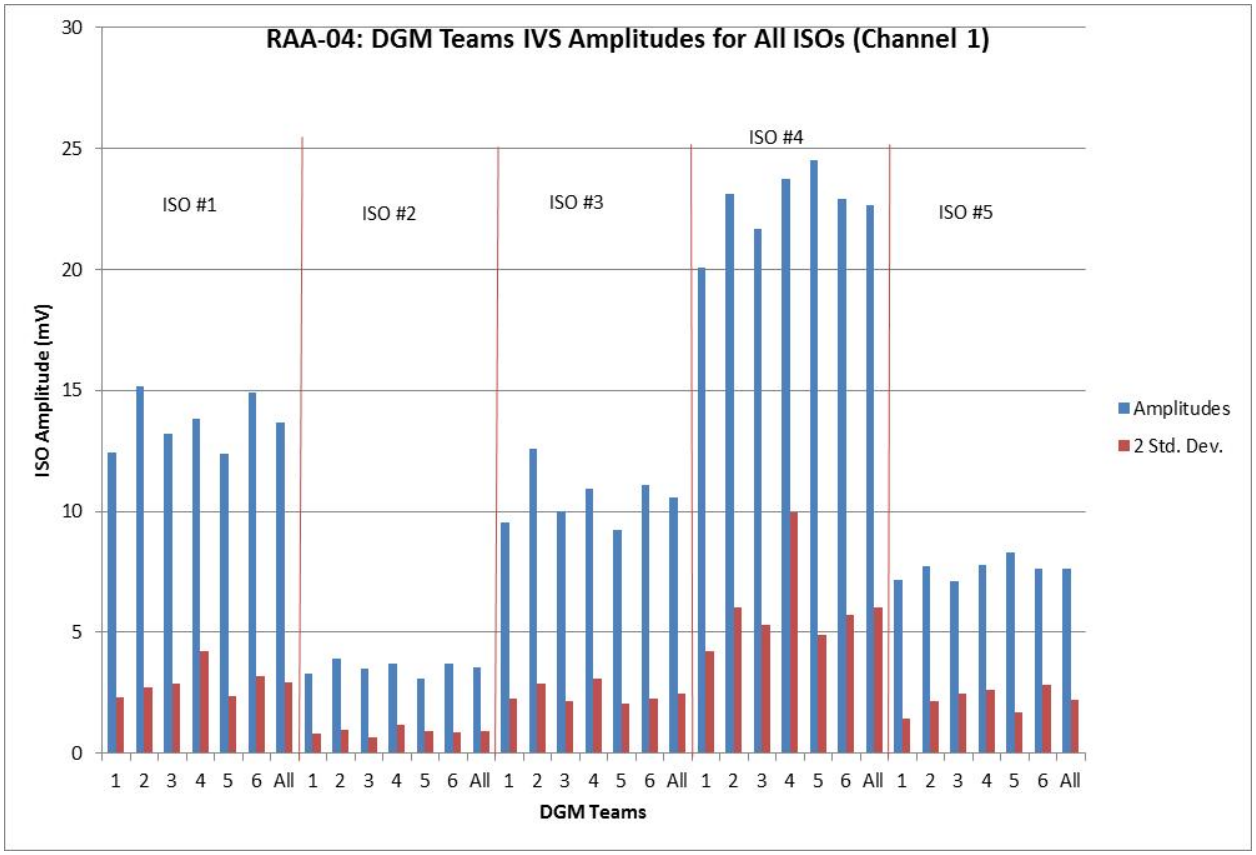


Figure 2-8. Plot of the Six DGM Teams' Average Amplitudes for the Five ISOs in the RAA-04 IVS

Table 2-4 and Figure 2-8 show that the expected relative amplitudes for the ISOs appears consistent, that is the deeper and/or more difficult to detect ISOs (#2 and #5) show lower average amplitudes than the shallower and/or easier to detect ISOs (#4 and #1). In comparing teams' averages, all of the teams show remarkably consistent amplitudes for the ISOs. Team #4 appears to show somewhat higher standard deviations, primarily over ISOs #1 and #4.

Figure 2-9 compares the average (all teams) ISO amplitudes for RAAs -02, -03 and -04. This figure shows that the averages for all teams for similar ISOs in the different RAAs are not very consistent except for ISO #5. In general, the ISO averages for RAA-02 are higher than for the other RAAs. This might be due to the relatively thinner tundra mat found in this RAA. The variations in average amplitudes within individual ISOs could be due to variations in tundra or small errors in ISO emplacement. This figure illustrates the difficulty in utilizing an IVS in the variable terrain conditions on Adak, particularly if the amplitude data are compared to model computations.

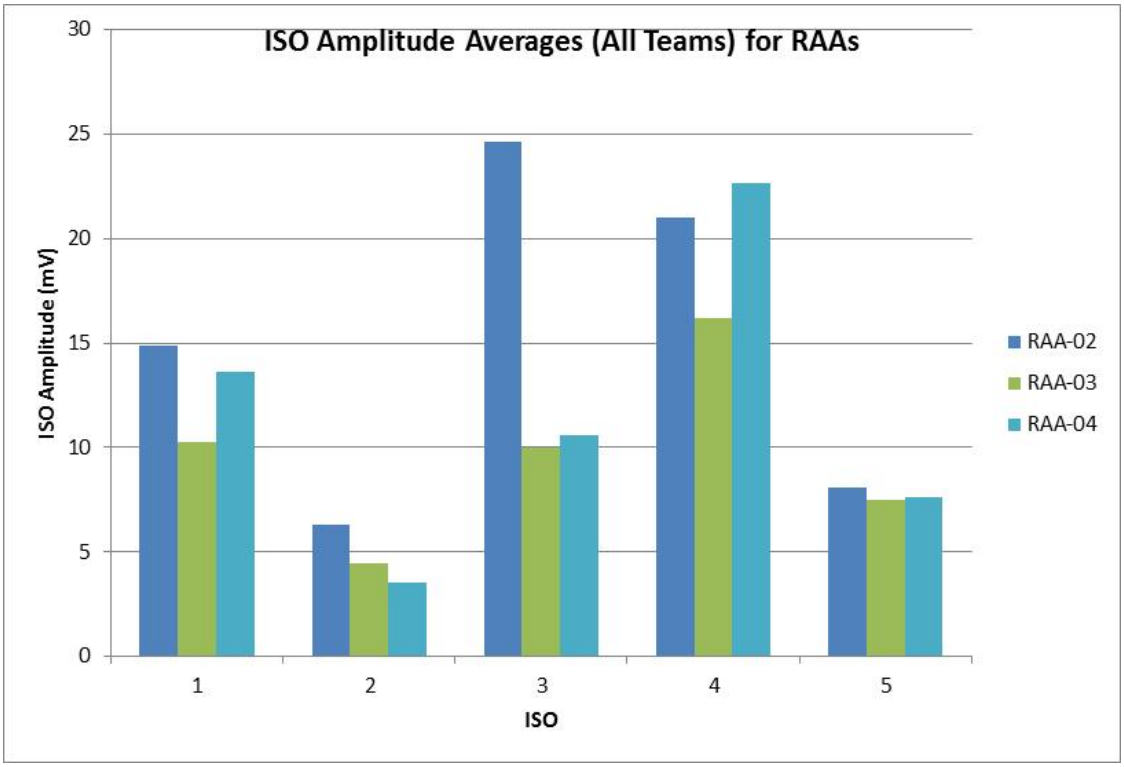


Figure 2-9. All Teams' ISO Average Amplitudes for RAAs -02, -03 and -04

2.2.1.2 Summary Static-Spike Test Results in RAAs-02, -03 and -04. Table 2-6 provides a summary of the six DGM teams' average static spike measurements. The table shows that overall the standard deviations for most teams were about 1-3% of the average. This low standard deviation shows that most teams easily met the internal criteria (+/- 10% of initial static-spike response for each individual team). Even teams with relative higher standard deviations, such as Team #6 in RAA-02 (29.54), met the internal criteria with only a few exceptions. For example, the minimum/maximum recorded for this team in RAA-02 was 231/298, indicating that at least a few measurements likely failed (+/-10% of 263.6 = 237 minimum, 290 maximum limits).

Table 2-6. Summary of DGM Teams' Average Static Spike Measurements in RAAs -02, -03 and -04

		RAA-02 Static-Spike Measurements			RAA-03 Static-Spike Measurements			RAA-04 Static-Spike Measurements		
Channel	**Team**	**Ave.**	**Std. Dev.**	**Min/Max**	**Ave.**	**Std. Dev.**	**Min/Max**	**Ave.**	**Std. Dev.**	**Min/Max**
1	1	319.69	2.75	312.81/324.47	313.30	10.45	285.43/324.36	309.66	12.02	288.99/323.7
	2	305.29	3.07	298.19/309.29	299.02	11.18	265.12/306.46	310.65	8.39	269.5/308.84
	3	310.28	4.66	302.59/316.44	307.18	8.06	268.58/314.81	308.91	2.91	300.64/313.53
	4	311.90	14.22	280.62/325	285.64	2.56	280.81/297.05	285.53	1.84	282/290.05
	5	288.54	2.69	280.11/294.1	288.76	2.23	284.61/294.92	288.83	2.77	285.04/300.42
	6	263.56	29.54	230.83/298.04	211.07	6.38	198.43/223.65	219.61	12.20	202.67/237.48
	All	299.88	9.49	284.19/311.22	284.16	6.81	226.14/251.61	287.20	6.69	232.69/253/43
2	1	223.44	1.54	220.63/226.12	221.09	5.31	208.28/227.3	219.23	6.16	209.72/227.06
	2	214.37	2.26	209.34/217.42	212.34	4.81	197.82/217.63	213.43	3.41	199.59/216.98
	3	218.26	3.60	213.08/223.13	217.48	3.26	205.88/221.95	218.03	2.11	212.04/221.59
	4	219.14	9.66	197.96/228.41	202.25	0.96	199.96/204.19	202.08	1.02	199.5/203.99
	5	203.78	2.49	198.62/209.7	206.53	1.49	203.44/209.37	206.29	1.50	203.39/212.29
	6	185.30	20.57	162.62/209.31	155.35	2.12	149.12/159.45	159.14	5.28	152.61/167.35
	All	210.71	6.69	200.38/219.02	202.51	2.99	166.36/177.13	203.03	3.25	168.12/178.47
3	1	129.66	0.97	128.05/131.35	129.73	2.34	124.54/133.12	129.11	2.69	124.96/132.7
	2	126.59	1.51	123.4/128.49	126.22	1.65	120.19/128.69	126.75	1.02	122.92/128.25
	3	128.80	2.22	125.92/131.73	128.87	1.49	124.59/131.22	129.00	1.36	125.53/131.25
	4	129.31	5.24	117.66/134.57	120.63	0.58	119.13/121.64	120.55	0.57	118.97/121.77
	5	121.18	1.76	118.12/125.36	123.97	0.97	121.49/125.82	123.78	0.73	122.34/126.22
	6	109.34	12.03	95.56/122.65	95.39	0.61	93.12/96.21	96.53	1.51	94.46/47.96
	All	124.15	3.96	118.12/129.03	120.80	1.27	100.44/105.24	120.95	1.31	101.31/105.61
4	1	62.72	0.65	61.46/63.67	63.61	1.03	61.64/65.26	63.52	1.11	61.49/65.4
	2	60.47	0.96	58.49/61.81	60.69	0.72	57.65/61.99	61.13	0.40	60.06/61.97
	3	62.99	1.27	61.42/64.63	63.32	0.83	60.77/64.63	63.46	0.76	61.74/64.66
	4	62.65	3.17	55.63/65.72	57.61	0.42	56.58/58.24	57.60	0.44	56.39/58.58
	5	57.70	1.54	55.63/60.87	60.43	0.51	59.45/61.43	60.39	0.37	59.53/61.2
	6	52.07	5.57	45.29/58.54	47.33	0.45	46.26/48.15	47.51	0.27	46.91/47.96
	All	59.77	2.20	56.32/62.54	58.83	0.66	48.91/51.39	58.94	0.56	49.45/51.4

Figure 2-10 shows a graph of the EM61 MK2 Channel 1 static spike data for RAAs -02, -03 and -04 and shows that Team #6 consistently recorded lower average static spike amplitudes; however, when compared to the average of all teams, this team passed this metric (+/- 25% of average of all teams).

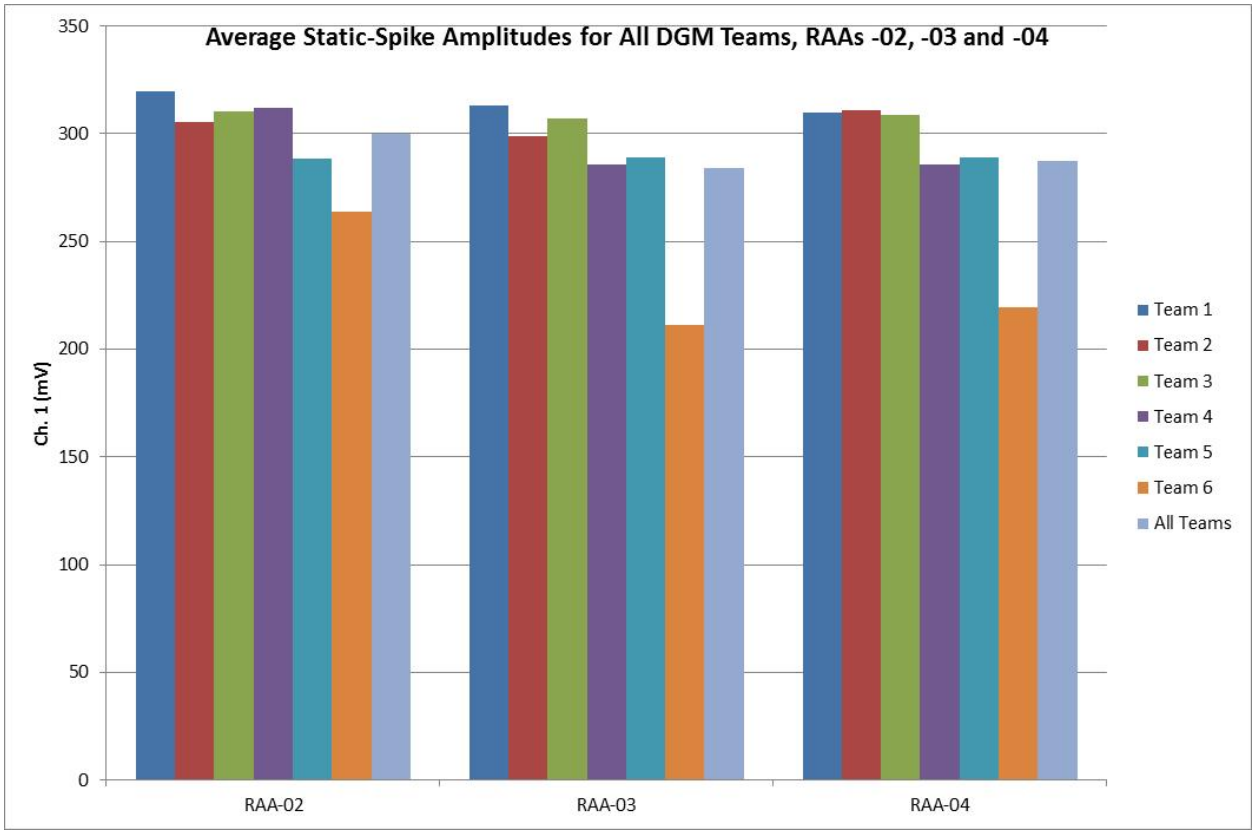


Figure 2-10. Plot of DGM Teams Average Static Spike Amplitudes for RAAs -02, -03 and -04

2.2.2 Quality Assurance Blind Seed Installation and Quality Assurance of the Contractor Blind Seed Installation. BSIs are a component of the GSV Plan used in the NTCRA. BSIs are targets buried in the production site at surveyed locations that are blind to the data collection and processing teams. Seeds provide ongoing monitoring of the quality of the geophysical data collection, target selection, and anomaly resolution process as it is performed in the production survey areas. In this project both contractor QC and QA BSIs were utilized. Both QC and QA BSIs were installed in accordance with the GSV Plan (Appendix G of the MEC QAPP). This installation was performed during the period of September 21-29, 2012. Following installation, the contractor provided a GSV report which presents the installation process and provides guideline metrics for QC BSI detection. During this same period, QA performed surveillances of QC BSI installation and also installed independent QA BSIs. A report of these QA activities is provided in Appendix C.

QC BSIs were installed at a rate of one per full DGM grid (60 m by 60 m, ~0.89 acre) in RAAs -02, -03 (-03E and -03W) and -04. In areas where partial grids occurred, typically on edges of the RAAs, the partial grid areas were combined and seeded at the same equivalent rate (i.e., one seed per combined full grid). Thus, some partial grids may not contain a QC seed. QA BSIs were installed randomly in RAAs -01, -02, -03 and -04. At the time of this report, DGM data acquisition and target selection had been completed and passed QA in RAAs -02, -03 and -04. Appendix E contains QC and QA BSI tracking spreadsheets for these RAAs.

The contractor GSV report developed minimum expected BSI responses (EM61 MK2, Channel 1) from repeat IVS tests as shown in Table 2-7. This was appropriate as the IVS seeds (small ISOs) were buried at the same depths (3X, 5X and 7X diameter) and orientation (horizontal) as the BSIs. The small ISO is a 1.315 in. diameter pipe, 4 in. long. Thus, the burial depths were 4, 6.6 and 9.2 in. (3X, 5X and 7X diameter, respectively). BSIs were buried with reference to the top of the mineral soil surface. The amplitude metrics were used as a guideline to evaluate BSIs detected in the production DGM data.

Table 2-7. Expected BSI Responses Based on IVS Tests

RAA	BSI Depth	Mean (mV)	Std. Dev. (mV)	2x Std. Dev. (mV)	Minimum Expected BSI Response (mV)
RAA-02	3X Diameter	19.03	3.04	6.08	12.9
	5X Diameter	22.88	2.24	4.47	18.4
	7X Diameter	6.24	1.48	2.96	3.3
RAA-03	3X Diameter	14.65	1.77	3.54	11.1
	5X Diameter	15.51	1.83	3.66	11.8
	7X Diameter	6.72	0.68	1.37	5.4
RAA-04	3X Diameter	18.94	1.34	2.67	16.3
	5X Diameter	14.83	2.37	4.73	10.1
	7X Diameter	4.71	1.66	3.32	1.4

The measurement performance criteria (MPC) provided in the MEC QAPP (Worksheet #12, Table 12-1) are:

- Detection of the BSI in the DGM data, and selection as a DGM target
- Interpreted position within 2.5 ft of the known (surveyed) location
- BSI amplitude should be equal to or greater than 3 mV

Figure 2-11 shows the location and status of the QC and QA BSIs in RAA-02. There were 83 QC BSIs emplaced in the 102 total grids in RAA-02 (total area of 73.7 acres). Fifty-nine of the BSIs were buried at 3X diameter (4 in.), 19 were buried at 5X diameter (6.6 in.) and five were buried at 7X diameter (9.2 in.). RAA-02 has significant inaccessible and boulder field areas where DGM data were not acquired as shown in Figure 2-11. Eleven of the QC BSIs were emplaced in these non-DGM areas (primarily boulder fields) and thus were not detected in the DGM data. The grids affected were: E12, F11, F12, I05, I06, I07, I08, I12, J07, J08 and K08. All of the remaining 72 QC BSIs met the MPC for this project.

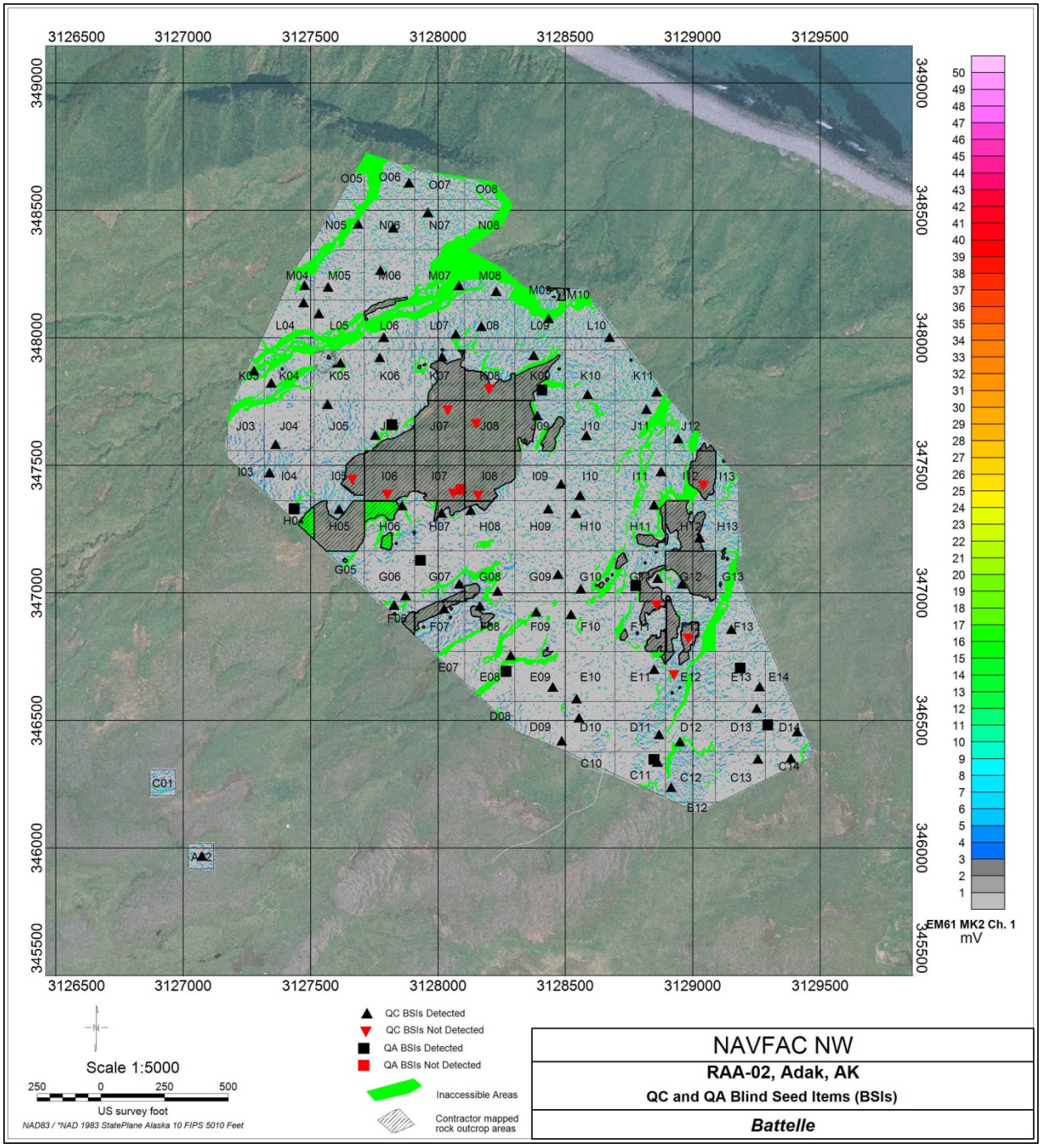


Figure 2-11. RAA-02 BSI Locations and Status

Tables 2-8 and 2-9 summarize the QC and QA BSI detection results (respectively) in RAA-02. The average detection amplitude for the 3X BSIs was 20.4 mV with a standard deviation of 12 mV. It is interesting to note that the average amplitude of the 5X BSIs is higher (23 mV), however the standard deviation is also higher. The average amplitude for the 7X BSIs is 12 mV. Since only two 7X QC BSIs were utilized in RAA-02, the standard deviation was not computed.

Table 2-8. Summary of QC BSI Detection in RAA-02

BSI Depth	Total Number of BSIs	Number BSIs in Inaccessible/Boulder Fields (not mapped with DGM)	BSIs Mapped with DGM	BSIs Detected within MPCs	Average Amplitude (Ch. 1 mV)	Amplitude Standard Deviation (mV)
3X	59	4	55	55	20.4	12
5X	19	4	15	15	23	17
7X	5	3	2	2	12	N/A
Totals	83	11	72	72	20.7	N/A

Table 2-9. Summary of QA BSI Detection in RAA-02

BSI Depth	Total Number of BSIs	Number BSIs in Inaccessible/Boulder Fields (not mapped with DGM)	BSIs Mapped with DGM	BSIs Detected within MPCs	Average Amplitude (Ch. 1 mV)	Amplitude Standard Deviation (mV)
3X	3	0	3	3	12.3	8.8
5X	4	0	4	4	18.1	13.2
7X	3	1	2	2	6	N/A
Totals	10	1	9	9	13.5	N/A

Table 2-9 shows that there were 10 QA BSIs emplaced in RAA-02. One of these BSIs was located in a boulder fields area, Grid I07 (reference Figure 2-11) and thus was not mapped or detected with DGM. The remaining QA seeds were detected within the MPC. The QA seeds buried at 3X showed an average amplitude of 12.3 mV with a 8.8 mV standard deviation. Similar to the QC seeds, the QA seeds at 5X showed a higher amplitude of 18.1 mV and a larger standard deviation. The QA seeds at 7X showed an average amplitude of 6 mV. Comparing the QA and QC BSI amplitudes at the same burial depths shows that the QA seeds are lower amplitude. This may be caused by slight differences in burial procedure between QA and QC; however, the QA seed statistics are not as reliable due to the small sample size.

Figure 2-12 shows the location and status of the QC and QA BSIs in RAA-03E. There were 88 QC BSIs emplaced in the 106 total grids in RAA-03E (total area of 76.1 acres). Thirty-six of the BSIs were buried at 3X diameter (4 in.), 41 were buried at 5X diameter (6.6 in.) and 11 were buried at 7X diameter (9.2 in.). One of the QC BSIs at 3X (Grid P24) was not detected in the DGM data. This BSI was placed in close vicinity to a high-amplitude, large spatial anomaly (HALSA), and was also affected by an Argo track/rut which was directly over the BSI. QA surmised that the Argo track/rut, which occurred after BSI placement, pushed the BSI into the ground to a greater depth than could be detected. In this one case, QA accepted the DGM data without successful detection of the QC BSI. All of the remaining 87 QC BSIs met the MPC for this project.

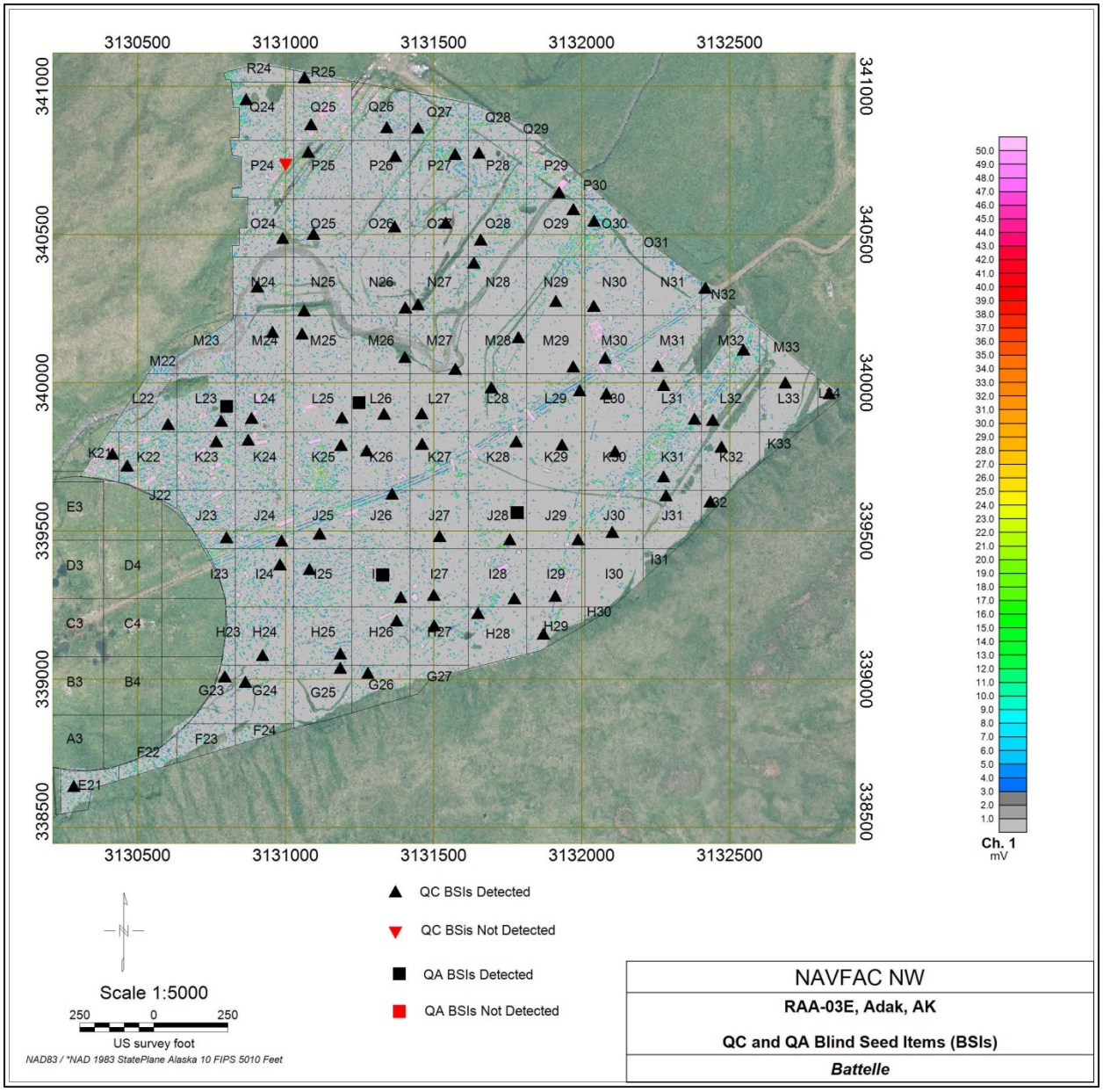


Figure 2-12. RAA-03E BSI Placement and Status

Tables 2-10 and 2-11 summarize the QC and QA BSI detection results (respectively) in RAA-03E. The average detection amplitude for the 3X BSIs was 27.9 mV with a standard deviation of 19.7 mV. The average amplitude of the 5X BSIs was only slightly lower (25.9 mV) and the standard deviation was also higher (29.8 mV) compared to the 3X BSIs. The average amplitude for the 7X BSIs was 18.9 mV and the standard deviation was 8.9 mV.

Table 2-10. Summary of QC BSI Detection in RAA-03E

BSI Depth	Total Number of BSIs	BSIs Mapped with DGM	BSIs Detected within MPCs	Average Amplitude (Ch. 1 mV)	Amplitude Standard Deviation (mV)
3X	36	36	35	27.9	19.7
5X	41	41	41	25.9	29.8
7X	11	11	11	18.9	8.9
Totals	88	88	87	25.8	N/A

Table 2-11. Summary of QA BSI Detection in RAA-03E

BSI Depth	Total Number of BSIs	BSIs Mapped with DGM	BSIs Detected within MPCs	Average Amplitude (Ch. 1 mV)	Amplitude Standard Deviation (mV)
3X	1	1	1	69	N/A
5X	2	2	2	25.5	N/A
7X	1	1	1	15.1	N/A
Totals	4	4	4	33.8	N/A

Table 2-11 shows that there were four QA BSIs emplaced in RAA-03E. All of the QA seeds were detected within the MPC. The QA seed buried at 3X showed an amplitude of 69 mV, the two QA seeds at 5X showed an average amplitude of 25.5 mV, and the QA seed at 7X showed an amplitude of 15.4 mV. Standard deviation calculations were not done due to the small number of BSIs. Comparing the QA and QC BSI amplitudes at the same burial depths shows that the QA seed at 3X was much higher amplitude (68.96 mV versus 27.8 mV). Since there was only one QA seed at this depth, the statistics are poorly determined; however, the QA seed amplitude is reasonably close to the QC seed amplitude plus one standard deviation. The QA seeds at 5X and 7X depths compare well with the QC seed amplitudes for the same depths.

Figure 2-13 shows the location and status of the QC and QA BSIs in RAA-03W. There were 79 QC BSIs emplaced in the 100 total grids in RAA-03W (total area of 70.72 acres). Twenty-three of the BSIs were buried at 3X diameter (4 in.), 45 were buried at 5X diameter (6.6 in.) and 11 were buried at 7X diameter (9.2 in.). Three of the QC BSIs at 5X (Grids G17, G18 and F18) were not detected in the DGM data. All of these QC seeds were located within grids that will be realigned with the RAA-01 remediation process. Two of the grids (grids G17 and G18) were realigned prior to completion of the DGM analysis process and thus BSIs in these grids were not analyzed. The seed in grid F18 was analyzed and found to exceed the positional MPC. Since this grid will be realigned, this failure is not significant. All of the remaining 76 QC BSIs met the MPC for this project.

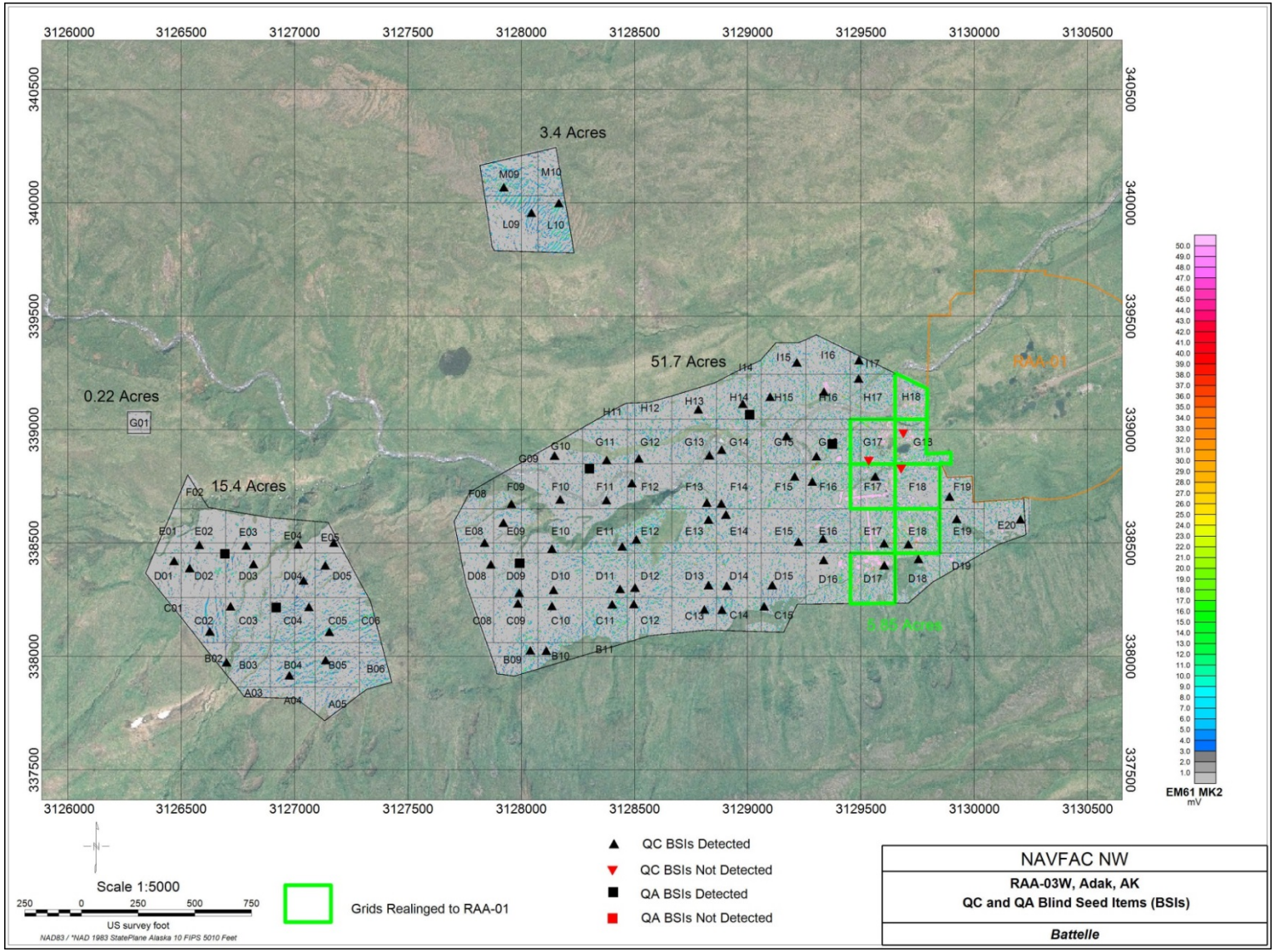


Figure 2-13. RAA-03W BSI Placement and Status

Tables 2-12 and 2-13 summarize the QC and QA BSI detection results (respectively) in RAA-03W. The average detection amplitude for the 3X BSIs was 27.6 mV with a standard deviation of 10.1 mV. The average amplitude of the 5X BSIs is slightly higher (30.1 mV) and the standard deviation is also higher (24.9 mV) compared to the 3X BSIs. The average amplitude for the 7X BSIs is 19.2 mV and the standard deviation is 10.2 mV.

Table 2-12. Summary of QC BSI Detection in RAA-03W

BSI Depth	Total Number of BSIs	BSIs Mapped with DGM	BSIs Detected within MPCs	Average Amplitude (Ch. 1 mV)	Amplitude Standard Deviation (mV)
3X	23	23	23	27.6	10.1
5X	45	45	42	30.1	24.9
7X	11	11	11	19.2	10.2
Totals	79	79	76	27.8	N/A

Table 2-13. Summary of QA BSI Detection in RAA-03W

BSI Depth	Total Number of BSIs	BSIs Mapped with DGM	BSIs Detected within MPCs	Average Amplitude (Ch. 1 mV)	Amplitude Standard Deviation (mV)
3X	0	0	0	N/A	N/A
5X	4	4	4	36.1	N/A
7X	2	2	2	18.2	N/A
Totals	6	6	6	30.2	N/A

Table 2-13 shows that there were six QA BSIs emplaced in RAA-03W. All of the QA seeds were detected within the MPC. There were no QA seeds buried at 3X in RAA-03W. There were four QA seeds at 5X which showed an average amplitude of 36.1 mV, and the two QA seeds at 7X which showed an average amplitude of 18.2 mV. Standard deviation calculations were not done due to the small number of QA BSIs. Comparing the QA and QC BSI amplitudes at the same burial depths shows that the QA seeds at 5X showed slightly higher average amplitudes (36.1 mV versus 30.1 mV), and the QA seeds at 7X showed similar amplitudes (18.2 versus 19.2 mV) compared to the QC seeds. However these comparisons are general due to the low number and thus poor statistics for the QA seeds.

Figure 2-14 shows the location and status of the QC and QA BSIs in RAA-04. There were 118 QC BSIs emplaced in the 127 total grids in RAA-04 (total area of 95.68 acres). Seventy-six of the BSIs were buried at 3X diameter (4 in.), 41 were buried at 5X diameter (6.6 in.) and one was buried at 7X diameter (9.2 in.). All of the 118 QC BSIs in RAA-02 were detected within the MPC.

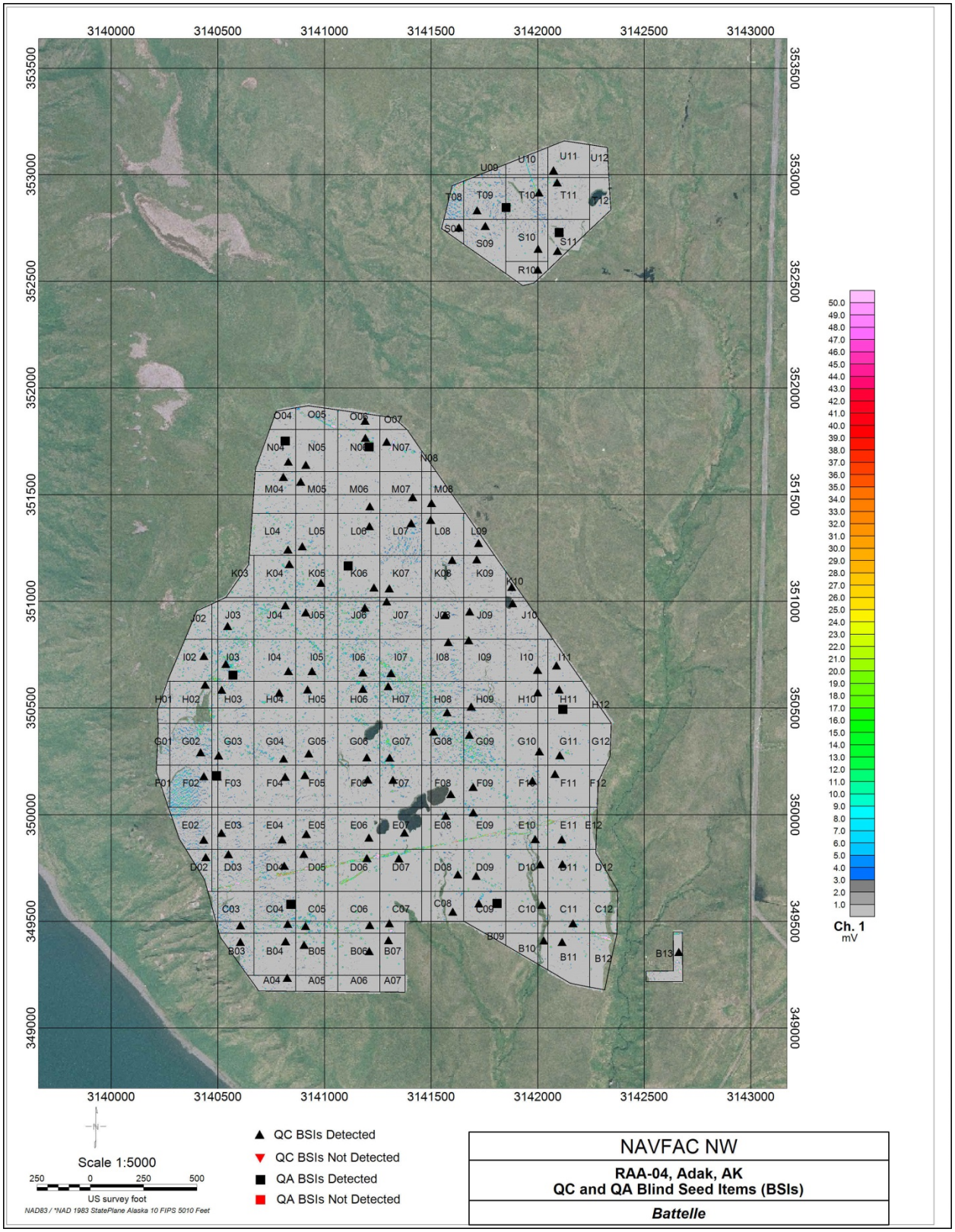


Figure 2-14. RAA-04 BSI Placement and Status

Tables 2-14 and 2-15 summarize the QC and QA BSI detection results (respectively) in RAA-04. The average detection amplitude for the 3X BSIs was 30.4 mV with a standard deviation of 14.6 mV. The average amplitude of the 5X BSIs is 25.5 mV and the standard deviation is 11.9 mV. The amplitude for the single 7X BSI is 14.9 mV.

Table 2-14. Summary of QC BSI Detection in RAA-04

BSI Depth	Total Number of BSIs	BSIs Mapped with DGM	BSIs Detected within MPCs	Average Amplitude (Ch. 1 mV)	Amplitude Standard Deviation (mV)
3X	76	76	76	30.4	14.6
5X	41	41	41	25.5	11.9
7X	1	1	1	14.9	N/A
Totals	118	118	118	27.8	N/A

Table 2-15. Summary of QA BSI Detection in RAA-04

BSI Depth	Total Number of BSIs	BSIs Mapped with DGM	BSIs Detected within MPCs	Average Amplitude (Ch. 1 mV)	Amplitude Standard Deviation (mV)
3X	4	4	4	38.1	20.4
5X	4	4	4	13.4	5.6
7X	2	2	2	22.5	N/A
Totals	10	10	10	25	N/A

Table 2-15 shows that there were 10 QA BSIs emplaced in RAA-4. All of the QA seeds were detected within the MPC. There were four QA seeds buried at 3X with an average amplitude of 38.1 mV (standard deviation of 20.4). There were four QA seeds at 5X which showed an average amplitude of 13.4 mV (standard deviation of 5.6), and two QA seeds at 7X which showed an average amplitude of 22.5 mV. Standard deviation calculations were not done for the QA 7X BSIs due to the small number of BSIs.

Table 2-16 provides an overall summary of the detection of QC and QA BSIs over the RAAs where DGM was completed (RAAs -02, -03E, -03W, and -04) in the 2013 field season. This table shows that 368 QC BSIs and 30 QA BSIs (total 398) were installed in the 2013 RAAs. Fifteen of the QC BSIs were not detected in the DGM data. Eleven were installed in RAA-02 in areas where DGM data were not taken due to boulder fields. One was disturbed by Argo activities in RAA-03E, and three were located in RAA-03W realignment grids and are not significant. The only significant failure was the QC BSI in RAA-03E (Grid P24) and the reason for non-detection (disturbance by Argo activities) was deemed acceptable by QA. Only one of the QA BSIs was not detected (RAA-02), and this BSI was located in an area were DGM data were not acquired due to boulder fields. It should be noted that all of the detected QC and QA BSIs easily met the MPC for location (within 2.5 ft Rcrit), with an average location offset of 1.2 ft. For all QC seeds, the average amplitude was 26.1 mV (standard deviation = 18.3mV). There were only three QC BSIs showing relative low amplitudes at 3 to 5 mV. Most of the QC seeds were installed at either 3X or 5X depth (342 of the total 368 or 93%). Thus, the QC seed average amplitude (26.1 mV) is biased to these depths. This average amplitude compares reasonably well with the 3X and 5X averages used as BSI amplitude guidelines established in Table 2-3.

Table 2-16. Summary of QC and QA BSI Detection for the 2013 Field Season

QC BSIs				
RAA	**BSIs Installed**	**BSIs Not Detected**	**Comments**	**BSIs Detected within MPC**
-02	83	11	Missed BSIs in boulder fields areas: not mapped with DGM	72
-03E	88	1	Missed BSI in Argo Rut, likely too deep to detect.	87
-03W	79	3	All missed BSIs in RAA-01 realignment.	76
-04	118	0	-	118
QC Sub Totals	368	15		353
QA BSIs				
-02	10	1	Missed BSI in boulder fields areas: not mapped with DGM	9
-03E	4	0	-	4
-03W	6	0	-	6
-04	10	0	-	10
QA Sub Totals	30	1		29
QC and QA Totals	**398**	**16**	**-**	**382**

2.3 Digital Geophysical Mapping Data Validation and Target List Concurrence

QA was required to reprocess 100% of contractor production DGM data, generate an independent target list based on approved picking criteria, match the QA target picks with the production target picks and resolve differences with the production contractor. The subsections below describe how this requirement was fulfilled during the 2013 field season.

2.3.1 Methodology for Digital Geophysical Mapping Data Quality Assurance. Contractor production DGM data were not evaluated by QA until the morning and evening IVS tests were evaluated and passed QA. For each grid, contractor QC provided a DGM submittal form certifying that the data had been reviewed by QC and passed DGM QC tests as listed in the MEC QAPP. The grid sizes varied to encompass the RAA shapes: full grids were 60 m by 60 m or 0.89 acre. Figure 2-15 shows a sample DGM submittal form for Grid F10 in RAA-03W. QC also submitted the following DGM components (via SharePoint) for each grid as part of the submittal package:

- Raw (fundamental or unprocessed) DGM data
- Processed DGM data (including QC target list and data processing checklist)
- IVS data
- Images/photos
- Field sheets (Survey area report forms and field notes)
- Obstructions (photographs and polygon files of inaccessible areas).

Page 1 of 2

GRID F10 GEOPHYSICAL DATA (DGM) SUBMITTAL

Date: 7-20-13

OPERABLE UNIT B-2, Remedial Action Area 03W

FORMER NAVAL AIR FACILITY
ADAK, ALASKA

USA

CONTRACT NO. N44255-12-R-3003

Team Name	Team 4
Survey Grid	F10
Survey Date(s)	5-29, 5-30-13
Target Picking Threshold	4.8 mV Leveled Time Gate 1

I certify that the above DGM collection team and this grid have been processed and QC'ed according to the project plans, standard operating procedures (SOPs) and data quality objectives (DQOs). 100% of the DGM data (including IVS data, raw and processed production data, including maps and target lists, and QC information (see SOP 03 section 7.4.3)) deliverables were reviewed by the QC Geophysicist and have been posted to Sharepoint. All QC tests pass except as noted below.

QC Tests	Pass	Fail
AM and PM IVS Tests	✓	
Footprint Coverage	✓	
Velocity	✓	
Sample Separation	✓	
Seed Items Identification, Amplitude and Positional Accuracy	✓	
Grid Corner Identification and Positional Accuracy	✓	
Number of QC picks within 10% of the Initial Picks.	✓	
Other (Identify):		

Explanation of failures or discrepancies:

Grid F10
Page 2 of 2 RA03W
7-20-13

Provided by: QC Geophysicist Brad Newlin / Brad Newlin
Phone Number: (720) 469-0232
Email: bknewlin@aol.com
UXOQCS Joe Rivers
Phone Number: (907) 592-0695
Email: joeriversq@hotmail.com

Figure 2-15. Example QC DGM Submittal Form for Grid F10, RAA-03W

QA reprocessed 100% of the DGM data checking the same metrics provided in the MEC QAPP. A general description of this reprocessing follows.

QA loaded the raw DGM data into Oasis Montaj and performed the following basic data processing steps:

- Conversion of latitude and longitude to Alaska State Plane (Zone 10, U.S. survey feet) coordinates.
- Data latency correction (typically 0.3 sec)
- Median filter to compute data bias and drift (150 and 400 point). Subtraction of median from data (demedian).
- Gridding of 150 and 400 point demedian data (minimum curvature, 0.5 ft. grid cell size, 1.65 ft blanking distance, 0.9 internal tension).
- Target selection using 150 point demedian data, Channel 1(Blakely test, 3 passes of smoothing filter, normal peak detection, grid value cutoff level=RAA threshold value). Designation of limits of High Amplitude Large Spatial Anomalies (HALSAs) using the 400 point demedian data.

For the NTCRA, the RAA target selection thresholds were predetermined (Reference Appendix F, MEC QAPP) using Channel 1 of the EM61 MK2 and are listed in Table 2-17.

Table 2-17. Target Selection Thresholds

RAA	Threshold (Ch. 1, mV)
-02	Initial=3, Raised to 5 mV on July 23, 2013
-03E	7
-03W	4.8
-04	3.4

Note that the target selection threshold for RAA-02 was increased from 3 to 5 mV on July 23, 2013. Most of the QA DGM analysis and target selection (at 3 mV) in RAA-02 was completed prior to this change. However, this RAA has not been intrusively investigated and thus the target list will be windowed to the increased threshold prior to the investigations scheduled for 2014.

After the data processing steps listed above were completed, DGM color grid maps were prepared. Surveyed grid corners, QC/QA BSIs, and inaccessible areas were plotted on the maps and evaluated. The QC and QA target lists were plotted on the maps and evaluated using a routine within Oasis Montaj UX-detect. This routine automatically compares the QC and QA target lists. Significant targets found by independent QA analysis, and not found by QC analysis were compiled and sent to QC for inclusion in the final target list.

Figure 2-16 shows a DGM color grid map for grid F10, RAA-03W and Figure 2-17 shows the QA DGM grid approval submittal back to QC. The color grid map shows the QC targets plotted as circles with a 5 ft diameter. This diameter accommodates the 2.5 critical radius (Rcrit) used for excavating targets per the MEC QAPP. The QA DGM grid and target approval submittal shows that QA

did not recommend any additional targets to the QC target list. It should be noted that both QC and QA used identical DGM data processing and target selection processes. Nonetheless, there were typically many additional targets added to the list by the contractor QC compared to the QA target selections. In this example, the QC target list contained 157 targets and the QA target analysis yielded 142 targets. Thus, the QC target list contained an additional 15 (~11%) more than the QA analysis. The additional QC targets were presumed to be interpreter selections.

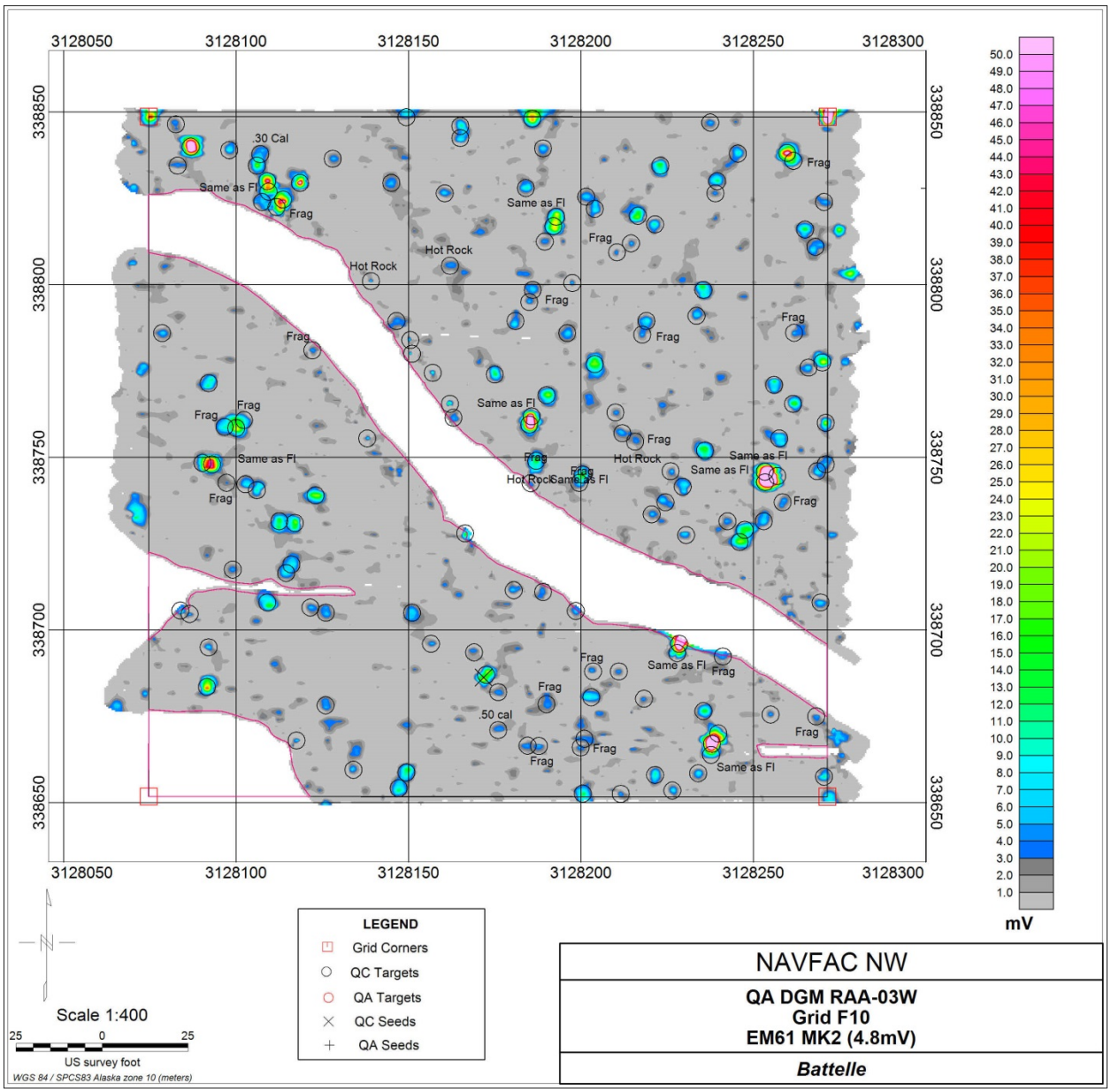


Figure 2-16. QA DGM Color Grid Map for Grid F10, RAA-03W

This discrepancy was commonly noted during QA analysis of QC target lists. Due to the short turn-around required for QA analysis and the aggressive schedule for contractor intrusive

operations, QA decided to not de-sample or reject the QC target lists. Rather,QA would only add obvious targets missed by QC. This decision was also prompted by the fact that several NCRs and the subsequent corrective actions addressed this occurrence of excessive targets retroactively.

QA DGM Target List Comparison

Location: RAA-03W, Grid F10

By: M Zelenevich Date: 7/22/2013

Team # 4 Contractor Target List: RAA03_F10_Diglist.csv

Team Reference Information: RAA03-F10_Readme.txt

Additional QA Targets				
Easting	Northing	Battelle Target #	EM61 MK2, Ch 1 Amplitude	Comments
None	None	None	None	

Rcrit=2.5 feet

Concur with List: Yes | No

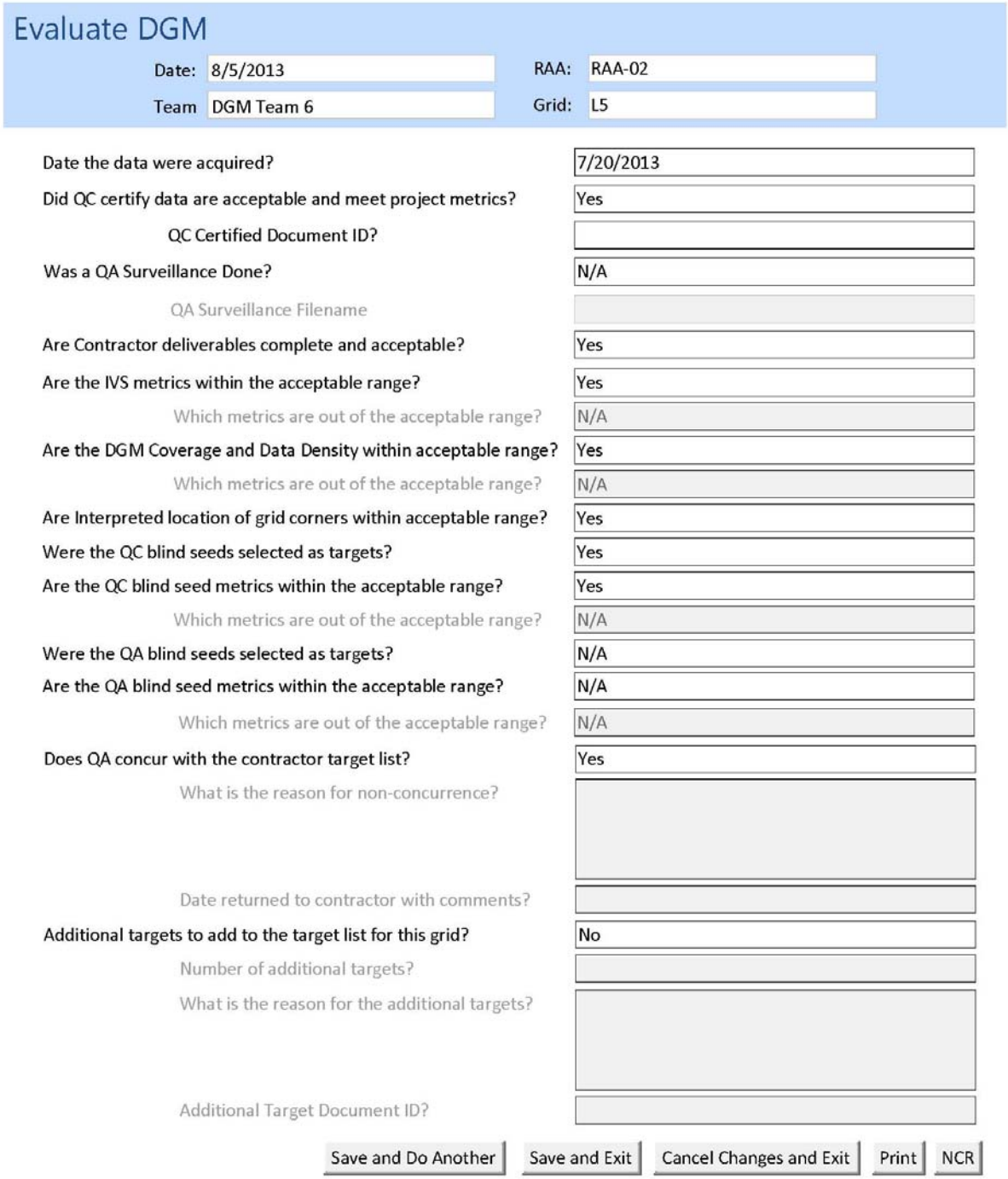
Comments: Use contractor target list, WITH NO ADDITIONAL QA TARGETS

QA Additional Targets File Name: RAA3W_F10_QA_Add_Targs_4.8mV_NONE.csv

Figure 2-17. QA DGM Grid and Target Approval Submittal to QC

This grid has been dug and the additional (excess) targets selected by QC are labeled on Figure 2-16. These targets resulted in frag, hot rocks, small arms and “same as” (i.e., same source as adjacent target). Section 2.3.2 discusses processes developed during the course of the project to de-sample excess targets selected by QC.

QA geophysicists also entered QA DGM checks and other information into the Battelle project database which stores, compiles and tracks relevant QA DGM inspections and information. Figure 2-18 shows a sample DGM entry for RAA-02, Grid L05.



Evaluate DGM

Date:	8/5/2013	RAA:	RAA-02
Team	DGM Team 6	Grid:	L5

Date the data were acquired?	7/20/2013
Did QC certify data are acceptable and meet project metrics?	Yes
QC Certified Document ID?	
Was a QA Surveillance Done?	N/A
QA Surveillance Filename	
Are Contractor deliverables complete and acceptable?	Yes
Are the IVS metrics within the acceptable range?	Yes
Which metrics are out of the acceptable range?	N/A
Are the DGM Coverage and Data Density within acceptable range?	Yes
Which metrics are out of the acceptable range?	N/A
Are Interpreted location of grid corners within acceptable range?	Yes
Were the QC blind seeds selected as targets?	Yes
Are the QC blind seed metrics within the acceptable range?	Yes
Which metrics are out of the acceptable range?	N/A
Were the QA blind seeds selected as targets?	N/A
Are the QA blind seed metrics within the acceptable range?	N/A
Which metrics are out of the acceptable range?	N/A
Does QA concur with the contractor target list?	Yes
What is the reason for non-concurrence?	
Date returned to contractor with comments?	
Additional targets to add to the target list for this grid?	No
Number of additional targets?	
What is the reason for the additional targets?	
Additional Target Document ID?	

Save and Do Another | Save and Exit | Cancel Changes and Exit | Print | NCR

Figure 2-18. Example QA DGM Data Entry Screen, RAA-02 Grid L05

Figure 2-19 shows the DGM coverage and targets approved during the 2013 field season in RAA-02. Intrusive work in this RAA is scheduled for the 2014 field season. During the 2013 field season, all DGM work in this RAA was completed.

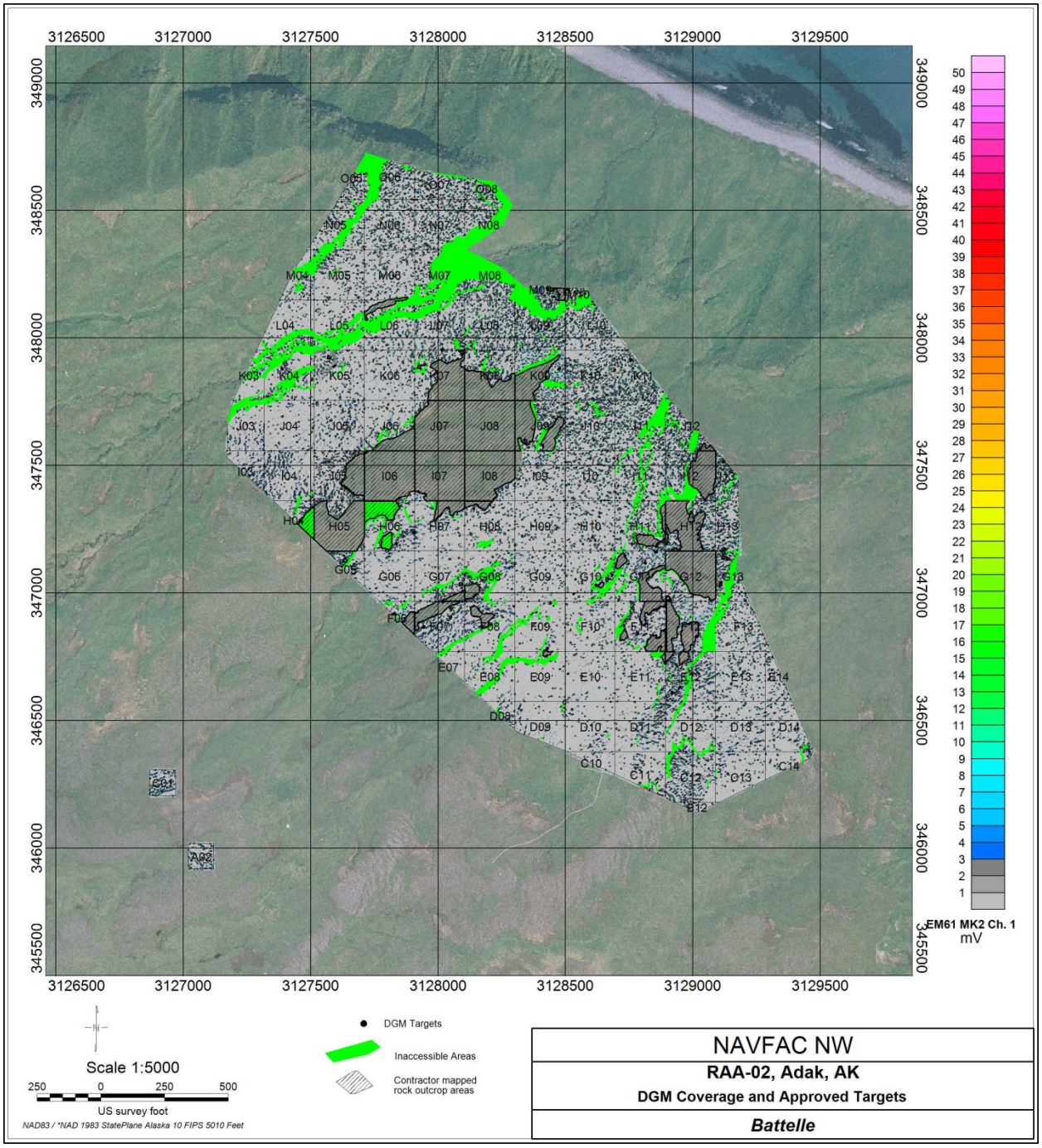


Figure 2-19. DGM Coverage and Approved Targets for RAA-02

Figure 2-19 shows that DGM data were not acquired, and thus no targets selected, in areas designated by the contractor as inaccessible or within boulder fields. The inaccessible areas were verified by QA during the field season. Subsequently, the boulder field limits were reevaluated by both QA and the contractor and modifications have been proposed. These proposed new limits encompass those initially proposed by the contractor, and so no additional DGM surveys would be required. The boulder fields are areas where an inordinate number of geologic anomalies were expected to be detected with DGM methods. These areas are scheduled to be investigated by mag and dig methods in 2014. The total area of RAA-02 is 73.7 acres, comprising 102 grids. One hundred of the grids are in the main survey area, and two of the grids (~0.23 acres each) are located somewhat remotely (~1,300 ft) to the west/southwest of the main area. The contractor mapped boulder fields are about 10 acres, and the inaccessible areas are about 7 acres. Thus, approximately 56.7 acres (77% of the total) were mapped with DGM. The total QA approved DGM targets in this RAA during the 2013 field season used a combination of selection thresholds: 3 mV prior to July 23, 2013 submittal date, and 5 mV after. This total was 22,786 (22,609 QC, 177 QA). Since the modification of the target selection threshold to 5 mV was retroactive, the target lists prior to July 23 have been windowed in this report and the revised target list tallies 18,600 (18,555 QC, 45 QA). The change in threshold reduced the initial total target count by 4,186 or 18%.

Prior to intrusive operations in 2014 there are potentially two additional DGM processes that could be applied to the data:

- On July 26, 2013, the contractor proposed a sub-sampling approach in areas with geologic and terrain-induced DGM targets (FCR-33, Appendix M of the After Action Report, 2013 Field Season, USA, 2014). This approach should be applied to the RAA-02 target lists by QC.
- QA and the contractor conducted independent evaluations of the boulder fields in RAA-02 (Section 2.5) which proposes to expand the boulder field boundaries. These boulder field areas will be addressed with mag and dig operations. The modified area polygons should be used to window the DGM target lists.

The QA DGM checklist used to evaluate the contractor DGM data and target selection for the MEC QAPP metrics is provided in Appendix F. This checklist shows that all metrics passed. It should be noted that there were many QC seeds that were not detected in the DGM data, due to no DGM coverage at the seed locations primarily due to boulder field exclusions. No NCRs were issued by QA on the DGM surveys in RAA-02.

Figure 2-20 shows the DGM coverage and targets approved during the 2013 field season in RAA-03E. All DGM and intrusive work in this RAA were completed in the 2013 field season. This figure shows the DGM coverage as a color grid. There were substantial inaccessible areas on the north part of the RAA due to Moffett creek and its tributaries, and to a lesser extent some man-made features such as berms and ditches. The eastern part of the RAA also shows substantial inaccessible areas due to wetlands and man-made features. The total area of RAA-03E is 76.1 acres, and comprises106 grids. The total QA approved DGM targets in this RAA during the 2013 field season were 21,941 (20,845 QC, 1096 QA) using a 7 mV (EM61 MK2, Channel 1) threshold.

There were several NCRs which pertain to the DGM data and targets in RAA-03E. The NCRs relevant to this work are covered in Section 2.6. Some of these NCRs modified the DGM target selection criteria and were retroactive (i.e., modified the original 21,941 target count). A discussion of these modifications is provided in Section 2.3.2.

The QA DGM checklist used to evaluate the contractor DGM data and target selection for the MEC QAPP metrics is provided in Appendix F. This checklist shows that ultimately all metrics passed and all DGM data and target lists for all grids were approved by QA.

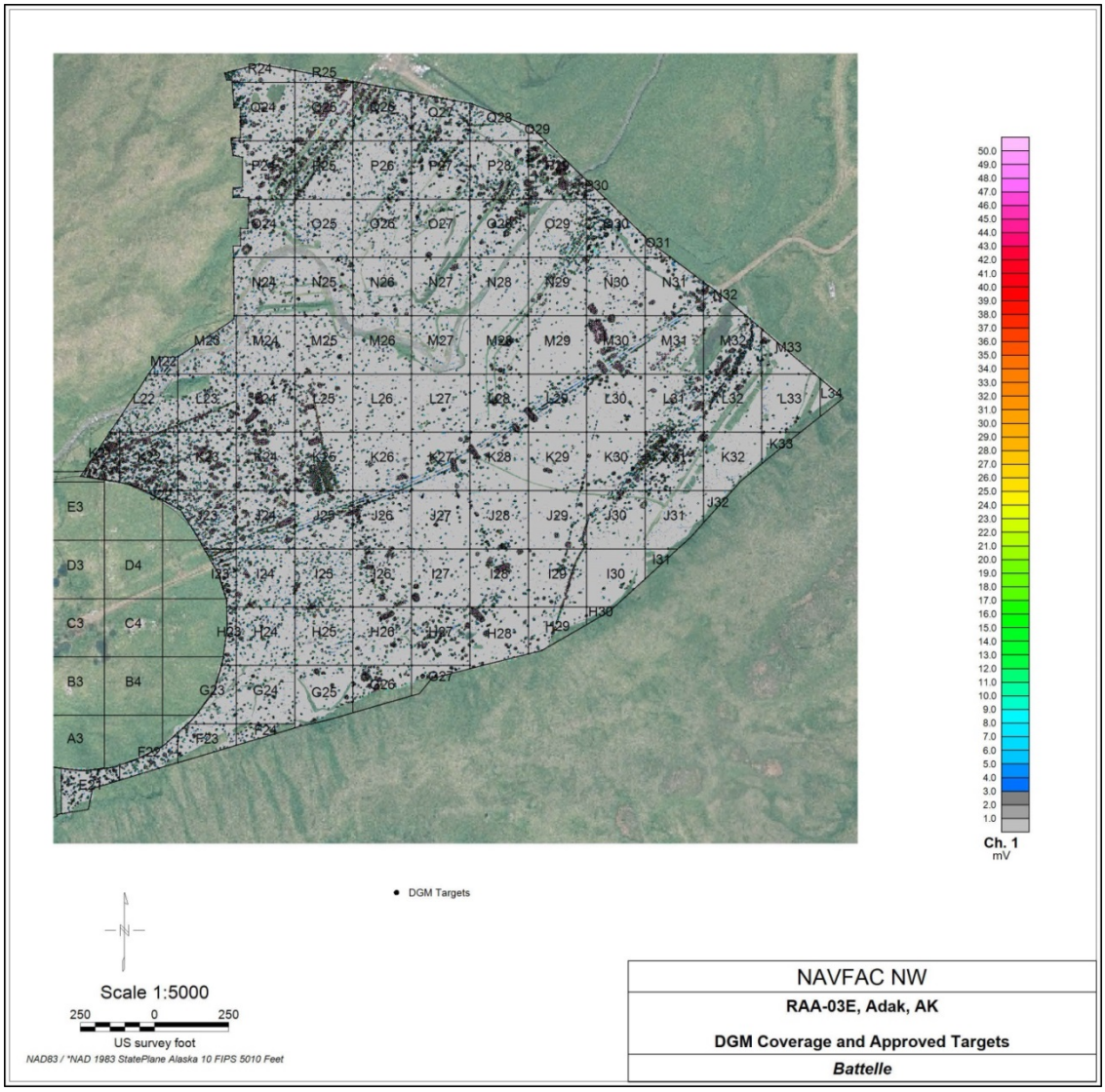


Figure 2-20. DGM Coverage and Approved Targets for RAA-03E

Figure 2-21 shows the DGM coverage and targets approved during the 2013 field season in RAA-03W. All DGM and intrusive work in this RAA were completed in the 2013 field season. This figure shows the DGM coverage as a color grid. This RAA is comprised of four separate areas: a larger (51.7 acres: 70 grids) area that abuts RAA-01 on the west, a smaller (15.4 acres: 25 grids) area further west up the Moffett valley, a very small mini-grid (0.22 acres: one grid) on the far west of the valley, and a small area (3.4 acres: four grids) on a ridge, north of the valley. The total area of RAA-03W is 70.72 acres comprised of 100 grids. Substantial inaccessible areas were located in the two areas in the Moffett valley due to Moffett creek and steep (inaccessible) or wet areas within the survey areas. The initial total QA approved DGM targets in this RAA for all grids during the 2013 field season was 26,204 (25,572 QC, 632 QA) using a 4.8 mV (EM61 MK2, Channel 1) threshold.

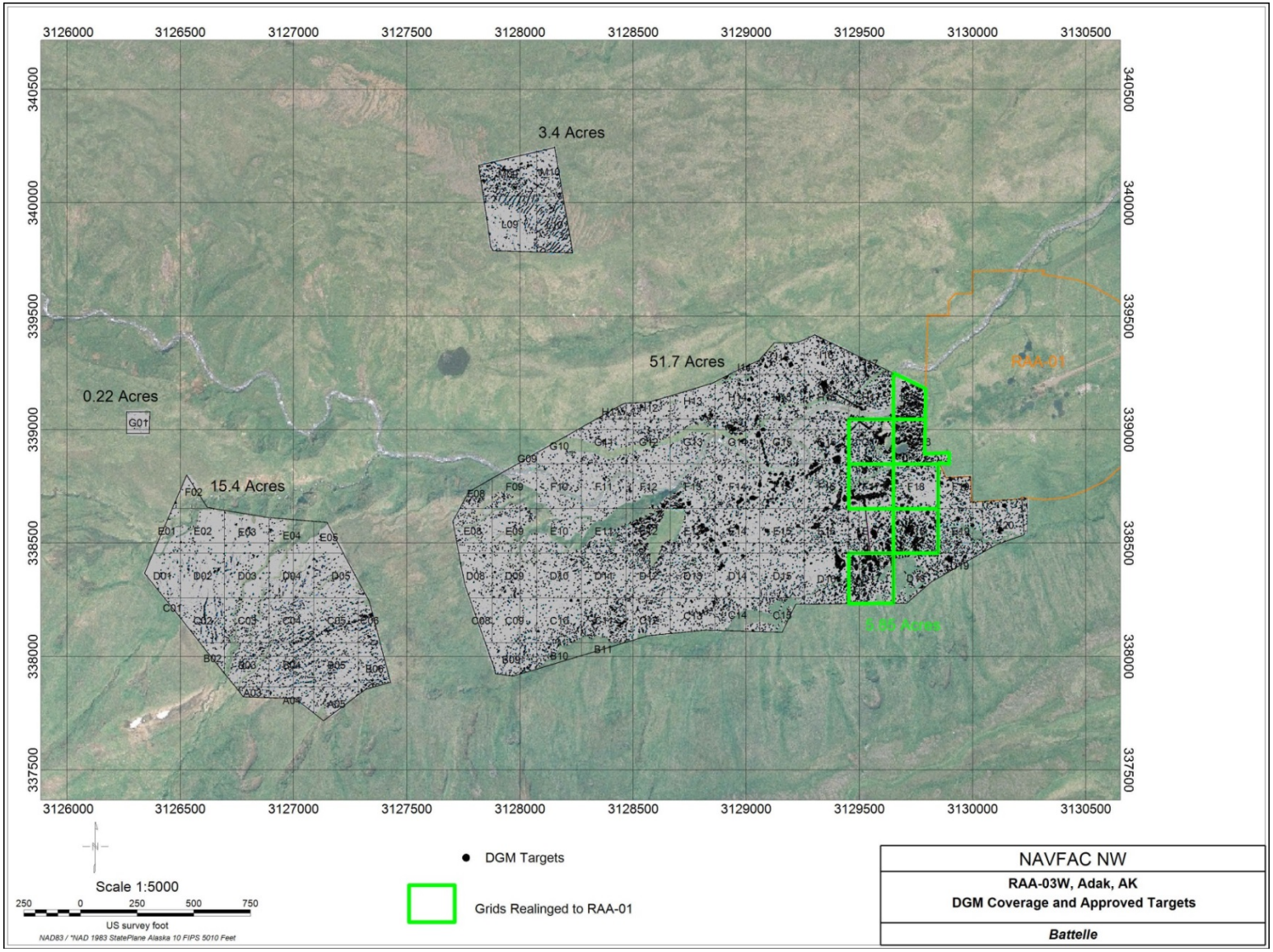


Figure 2-21. DGM Coverage and Approved Targets for RAA-03W

Several NCRs were issued relating to the DGM data and targets in RAA-03W. The NCRs relevant to this work are covered in Section 2.6. Some of these NCRs modified the DGM target selection criteria and were retroactive (i.e., modified the original 20,893 target count). A discussion of these modifications is provided in Section 2.3.2. NCR-010 resulted in removing several grids (D17, E18, F17, F18, G17, G18 and H18) from RAA-03W prior to intrusive work and realigning them with the remediation approach proposed for RAA-01, scheduled for 2014. This realignment occurred after QA approval of most of the DGM target lists for these grids. Table 2-18 and Figure 2-21 show the grids that will be aligned and DGM targets picked in these grids.

Table 2-18. RAA-03W Grids Realigned for Remediation Approach for RAA-01

Grid	Area (acres)	QA Approved DGM Targets
D17	1	909
E18	0.89	970
F17	0.89	782
F18	0.89	396
G17	0.89	752
G18	0.74	852
H18	0.55	650
Totals	*5.85*	*5,311*

After this realignment the total area of the RAA was reduced from 70.72 acres to 64.87 acres, and the QA approved DGM target list was changed to 20,893 (20,448 QC, 445 QA) targets using a 4.8 mV (EM61 MK2, Channel 1) threshold.

The QA DGM checklist used to evaluate the contractor DGM data and target selection for the MEC QAPP metrics is provided in Appendix F. This checklist shows that ultimately all metrics passed and all DGM data and target lists for all grids were approved by QA.

Figure 2-22 shows the DGM coverage and targets approved during the 2013 field season in RAA-04. All DGM and contractor intrusive work in this RAA were completed in the 2013 field season. QA of the intrusive work is in progress.

This figure shows the DGM coverage as a color grid. This RAA is comprised of three separate areas: a large (95.68 acres: 127 grids), central area on the west; a smaller (7.92 acres: 14 grids) area on the north; and a very small mini-grid (0.37 acres: 1 grid) on the southeast part of the area. The total area of RAA-04 is 103.97 acres comprised of 142 grids. Relative small inaccessible areas were in the main area due to ponds and creeks in the central part, and steep (inaccessible) areas primarily on the west part of this area. The initial total QA approved DGM targets in this RAA for all grids during the 2013 field season was 16,913 (16,705 QC, 208 QA) using a 3.4 mV (EM61 MK2, Channel 1) threshold.

There were several NCRs which pertain to the DGM data and targets in RAA-4. The NCRs relevant to this work are described in Section 2.6. Some of these NCRs will likely modify the DGM target selection criteria and are retroactive (i.e., will modify the original 16,913 target count). These criteria have not been applied to the RAA-04 DGM target count as of this time.

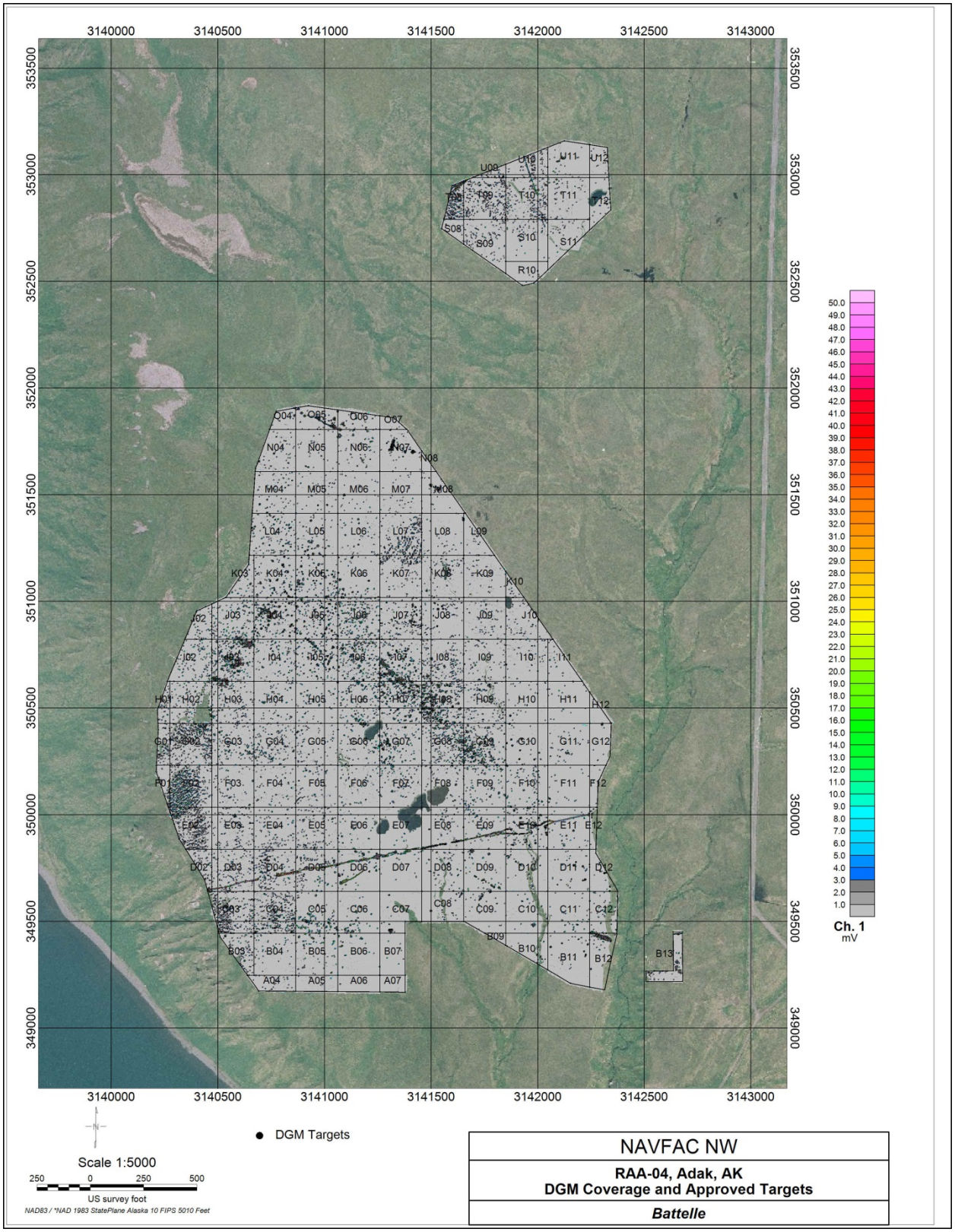


Figure 2-22. DGM Coverage and Approved Targets for RAA-04

The QA DGM checklist used to evaluate the contractor DGM data and target selection for the MEC QAPP metrics is provided in Appendix F. This checklist shows that ultimately all metrics passed and all DGM data and target lists for all grids were approved by QA.

During the 2013 field season, DGM data collection and target selection were completed in RAAs -02, -03E, -03W and -04. Table 2-19 provides a summary of this work. This table shows that QA performed a total of 450 DGM grid approvals, comprising a total of 87,844 initial approved DGM targets. Overall, QA added very few DGM targets to the contractor QC target lists (total of 2,113 or 2.4% of total). During the course of the 2013 field season, changes were made to the DGM target selection criteria in RAAs -02 and -03W, which reduced the initial approved DGM target lists as shown in the table:

- RAA-02: The target selection threshold for this RAA was raised from 3 to 5 mV around July 23. Since the modification of the target selection threshold to 5 mV was retroactive, all target lists have been windowed in this report and the revised target list tallies 18,600 (18,555 QC, 45 QA). The change in threshold reduced the initial total DGM targets in this RAA by 4,186 or 18%.
- RAA-03W: The corrective action for NCR-10 resulted in removing several grids (D17, E18, F17, F18, G17, G18 and H18) from RAA-03W prior to intrusive work and realigning them with the remediation approach proposed for RAA-01. This realignment reduces RAA-03W from 70.72 acres to 64.87 acres, and the QA approved DGM target list was changed to 20,893 (20,448 QC, 445 QA), a reduction of 5,311 targets or 20%.

A total of six NCRs were issued for deficiencies in DGM data and targets in RAAs -02, -03E, -03W and -04. The NCRs relevant to this work are covered in Section 2.6. Some of these NCRs modify the DGM target selection criteria and are retroactive (i.e., will modify the initial and final target counts shown in Table 2-19). QA has applied these criteria to RAAs -03E and -03W (Section 2.3.2), but has not applied them to the RAA -02 and -04 DGM target counts as of this time.

Table 2-19. Summary of DGM Data Collection and Target Selection in 2013 Field Season (RAAs -02, -03E, -03W and -04)

RAA	mV Threshold	Acres	Grids	QA of Grid DGM and Targets	Initial QC DGM Targets	Initial QA DGM Targets	Total Initial Approved Targets	% QA Targets added to Diglist (compared to total)	Comments (Modifications to DGM areas, target lists during field season)	Acres Removed	Acres Remaining	Targets Removed	% Targets Reduced from Initial	Targets Remaining
-02	3mV	73.7	102	102	22,609	177	22,786	0.78%	Target selection threshold changed from 3 to 5 mV.	0	76.24	4,186	18%	18,600
-03E	7mV	76.1	106	106	20,845	1096	21,941	5%	N/A	0	76.1	0	0	21,941
-03W	4.8mV	70.72	100	100	25,572	632	26,204	2.4%	Realigned Grids D17, E17, F17, F18, G17, G18, H18.	5.85	64.87	5,311	20%	20,893
-04	3.4mV	103.97	142	142	16,705	208	16,913	1.2%	N/A	0	103.97	0	0	16,913
	Totals	***324.49***	***450***	***450***	***85,731***	***2,113***	***87,844***	***2.4%***	***See Above***	***5.85***	***321.18***	***9,497***	***11%***	***78,347***

2.3.2 Adjustments to Digital Geophysical Mapping Target List Results. During the 2013 field season several NCRs were associated with FCRs and other documents and independent FCRs that impacted the manner in which DGM targets were expected to be de-sampled or sub-sampled prior to intrusive investigations. All NCRs and associated documents are provided in Appendix M of the After Action Report, 2013 Field Season (USA, 2014). The primary NCRs and FCRs that impacted the expected number of intrusive investigations were:

- NCR-03: A BSI in the vicinity of a HALSA was not detected (or picked) in the DGM data. This NCR resulted in FCR-14, specifying DGM processing methods to pick targets in HALSAs.
- NCR-07: QA noted that the surface clearance DFW was not conducted to the standard of the project metrics as specified in the QAPP. This NCR resulted in an attachment (A) specifying procedures to account for surface metal that was detected in the DGM target lists. This NCR also resulted in FCR-20, which specifies procedures for optimally sub-sampling HALSAs, long linear anomalies, former building foundations and small arms firing lines and bullet traps.
- FCR-30: The DGM target selection threshold for RAA-02 was raised from 3 mV (EM61 MK2, Channel 1) to 5 mV.
- FCR-33: A methodology was proposed to sub-sample DGM anomalies/targets detected that were suspected to be caused by geologic features, or created by terrain features.

Most of these NCRs and FCRs were approved post QC and QA approval of the DGM target lists. Most of the documents required that the production contractor perform additional analysis (i.e., determination of primary and secondary targets within HALSAs, remove targets picked closer than 5 ft separation, etc.) on the DGM dig lists prior to intrusive investigations; however, this was not done uniformly. Thus, the final target and dig lists often contain targets that should have been de-sampled or sub-sampled, and not investigated.

During the 2013 field season, QA prepared a matrix of the NCRs/FCRs and associated documents that pertain to sampling, de-sampling and sub-sampling of the DGM targets. This matrix was provided to the production contractor in early August 2013 for reference, and is shown on Figure 2-23. This matrix was used by QA to evaluate contractor DGM target lists and dig lists for potential adjustments. The matrix shows that many of the processes are tied to dig dates, and that they are also not applied uniformly over all of the RAAs. The following sections provide a more thorough description of the NCRs/FCRs (and other guiding documents) listed above, and applies the processes listed in the matrix to the production contractor dig lists. At the time of this report the processes have been applied to RAAs -03E and -03W. None of the processes have been applied to RAA-04, and only the change in target selection amplitude (5 mV) has been applied to RAA-02. Some of these processes may also be applied to RAAs -01 and -05, which are scheduled for field work in 2014 or later.

DGM/Dig Review Table (HALSAs, Linears due to Culture, Geologic Linears, and RAA-02 mV Threshold Changes)

RAA: _____ Grid:_____ Dig Date: _____QC Targets:_____ QA Targets: _____ Total Digs_____ QA Removed Targets: _____

QA Remaining Targets: _____By:_____

Dig Date	1) All Dates	2)June 8 or before	3)June 8-July 18	4)July 18 or Later	5)July 23 or Later (RAA-02 Only)	6)July 26 or Later
Description	NCR-07, Attachment A. Excessive saturation DGM targets (i.e. targets picked closer than 5-ft separation) will be de-sampled to a 5-ft separation. The excessive saturation and de-sampling will be inspected by the Lead QC Geophysicist and the target count potentially adjusted prior to a complete grid being turned over for QA analysis (QA_Mask_1).	Surface HALSAs and Surface Metal were not designated on Digsheets with "Surface". Some unknown amount of surface metal was removed after DGM surveys (QA_Mask_1).	On June 8, USA directs field crews to utilize "Surface" on PDAs and Digsheets (QA_Mask_3).	Surface and Subsurface HALSAs and linears interpreted due to fences, cables, pipes, etc. will be optimally picked (subsampled) per NCR-07, FCR-20 (QA_Mask_4).	Target Selection Threshold raised from 3 mV to 5 mV (QA_Mask_5).	FCR-33, Subsampling of Geologic and Terrain-Induced DGM Targets. USA to designate and subsample interpreted geologic linears (QA_Mask_6).
Action(s)	1) Excessive Targets (i.e. <5ft centers) will be removed from target list.	2) USA to evaluate % of targets due to "Surface" post June 8 and apply to these diglists. % for low (<100 DGM Targets), medium (<250 DGM Targets) and High (>250 DGM Targets) will determined and utilized to reduce target list numbers. 3) "No Finds" >10mV in HALSAs not counted.	1) Targets ID'ed as "Surface" and "Same As" a surface target do not count towards total. 2) "No Finds" >10mV in HALSAs not counted.	1) If Primary DGM targets on HALSAs/Linears are non-MEC/MDEH, feature is considered done. Only primary targets will count. 2) If Primary DGM targets on HALSAs/Linears are MEC/MDEH, secondary targets will be dug and count towards total. 3) Targets ID'ed as "Surface" and "Same As" a surface target do not count towards total. 4) For ID'ed Surface targets: After they are removed, the subsurface will be checked. If subsurface targets are found, only targets >3 inches will count.	1) All targets (except seeds) will be windowed to >5mV.	1) Interpreted geologic linears will be manually subsampled.
Comments	All RAA's	Primarily RAA-03E	RAA-03	All RAA's	RAA-02 Only	All RAA's

Figure 2-23. Matrix Used to Make Adjustments to DGM Target Lists and Dig Lists

2.3.2.1 High Amplitude Large Spatial Area Anomalies. HALSAs were recognized very early in the 2013 field season during analysis of DGM target lists in RAA-03E. As the acronym implies, these are typically large spatial areas (>10 ft wide) that can show DGM (EM61 MK2, Channel 1) amplitudes many times greater than the target selection threshold. For example, in RAA-03E, the target selection threshold is 7 mV. Some of the HALSAs found in this RAA exhibit DGM amplitudes >10,000 mV. It was initially presumed that HALSAs were not pervasive throughout RAA-03, and that they were most likely caused by cultural (man-made) structures or non-munitions debris. Using the standard DGM data processing and target selection processes for Adak, only a few DGM targets would be selected within a typical HALSA, at the anomaly peaks. NCR-03 was issued because of a missed BSI that was located in the near vicinity of a HALSA. This BSI could not be detected using the standard DGM data processing and target selection process, due to the extremely high DGM amplitudes observed in the HALSA. Because the BSI represents a potential MEC item, a method was needed to be able to detect this type of target in the vicinity of a HALSA. The root cause analysis of the NCR and corrective action resulted in an additional DGM data processing step, and selection of targets in saturation (5 ft centers) within the boundary of the HALSA. As the 2013 field season continued, HALSAs were identified throughout RAAs -03E, -03W and to a lesser extent in RAA-04. No HALSAs were observed in RAA-02. NCR-03 was initiated on April 29, 3013 and corrective actions via FCR-14 were approved on May 4, 2103. All grids with HALSAs were reprocessed and targets picked using the revised processes provided by FCR-14 by QC and submitted to QA for approval.

Later in the 2013 field season, QA observed that the surface clearance DFW had not been conducted to the standard of the project metrics as specified in the QAPP. QA suspected that some of the HALSAs being found in the DGM data were attributable to surface metal that should have been removed. QA's proposed corrective action to this non-conformance was to re-evaluate the surface clearance and re-do this DFW and follow-on DFWs as appropriate, in failing grids. NCR-07 was issued on June 12, 2013. The contractor proposed an alternative to re-working the surface clearance DFW and this alternative was approved on July 18, 2013, almost a month later. Also, by this time, QA observed that the tenants of NCR-03 (e.g., selecting targets at 5 ft centers) were not always adhered to (i.e., targets were being selected so that their investigation radii overlapped by sometimes as much as half).

Critical actions for DGM target selection that were derived from NCRs -03 and -07 are shown on Figure 2-24 and reiterated here, as follows:

1. NCR-03 (and related documents) specified that <u>additional DGM data processing was to be applied only to HALSAs</u>, and <u>targets were to be selected at 5 ft centers within HALSAs</u>. Since the critical radius of intrusive investigation is 2.5 ft, target selection at 5 ft centers results in essentially saturation target picking<u>. Targets not identified as HALSAs were to be identified and selected using the standard data processing and target selection processes</u>.
2. **Column 1 in Figure 2-123**: NCR-07 (and related documents) reiterated that DGM targets picked closer than 5 ft. centers should be de-sampled. This process was the responsibility of the contractor QC geophysicist and was to be applied to all grids regardless of submittal status and date and applies to all RAAs.
3. **Column 2 in Figure 2-23**: NCR-07 (and related documents) specifies that for grids dug prior to June 8 that the contractor will de-sample DGM target/digs for the presumed presence of "surface" metal using percentages determined from post June 8 dig results. This process was primarily associated with suspected HALSA's and applies primarily to RAA-03E due to the Date association. The contractor did not perform this analysis, and

so QA conducted this analysis independently. The results of this analysis are provided in Appendix G.

4. **Column 3 in Figure 2-23**: NCR-07 (and related documents) specifies that the contractor will designate "surface" metal found during intrusive investigations in their data loggers, and these targets will not count toward the dig totals. This action partially accounts for metal left on the surface in the grids, and this action applies for all RAAs dug after June 8. Note that this item is also reiterated in Column 4 in Figure 2-23.

5. **Column 4 in Figure 2-23**: NCR-07 (and related documents) specifies that for grids dug post June 18, the contractor will optimize targets/digs within HALSAs and linears interpreted to be due to fences, cables, pipes, etc. This action applies to all RAAs.

All of the actions were the responsibility of the contractor; however, they were not always performed. Figure 2-24 shows an example of the final DGM targets and dig results for a portion of Grid I15 in RAA-03W. The targets in this grid were dug during the time frame from July 19 to August 13, 2013, and thus the targets and dig list are subject to processes in Columns 1, 3 and 4 in Figure 2-23 (removal of excessive targets, removal of surface targets and subsampling of HALSAs).

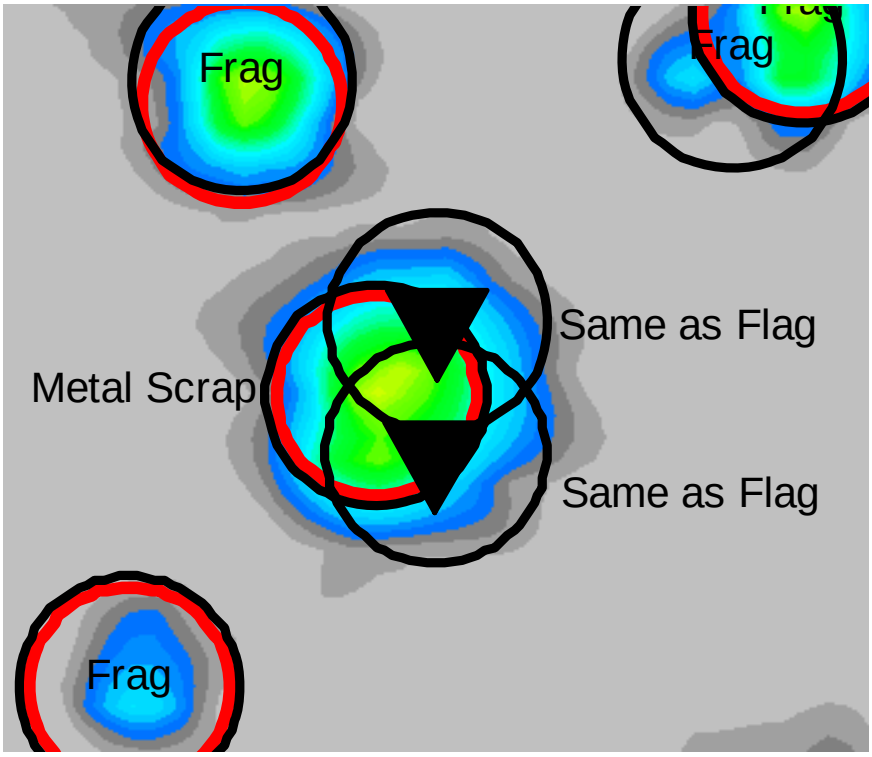


Figure 2-24. Example of DGM Targets and Dig Results for Portion of Grid I15 in RAA-03W

In Figure 2-24 the final QC DGM targets are shown as black circles and the independent QA target picks are shown as red circles. The QC target circles are 5 ft in diameter and the QA target circles are slightly smaller to better visualize. The background color grid is the DGM (EM61 MK2, channel 1) amplitude. In this example, QA has selected a single target (red circle) and the amplitude of this anomaly is 22 mV. At this location a piece of metal scrap (10 in. long) was found at a depth of 6 in. QC had

selected this anomaly location along with an additional two targets. These additional two targets each overlap the primary target location (and each other) by about 50%. The description for these two targets is "same as flag," indicating that nothing (only the original metal scrap) was found from these additional targets. These two additional targets should not have been included in the target/dig lists as they are not at 5 ft centers, and in addition this target is clearly not a HALSA. Removal of these targets from the dig list in the QA evaluation is identified by the inverted triangle symbols.

Figure 2-25 shows an example of improper de-sampling of a HALSA in Grid H14, RAA-03W.

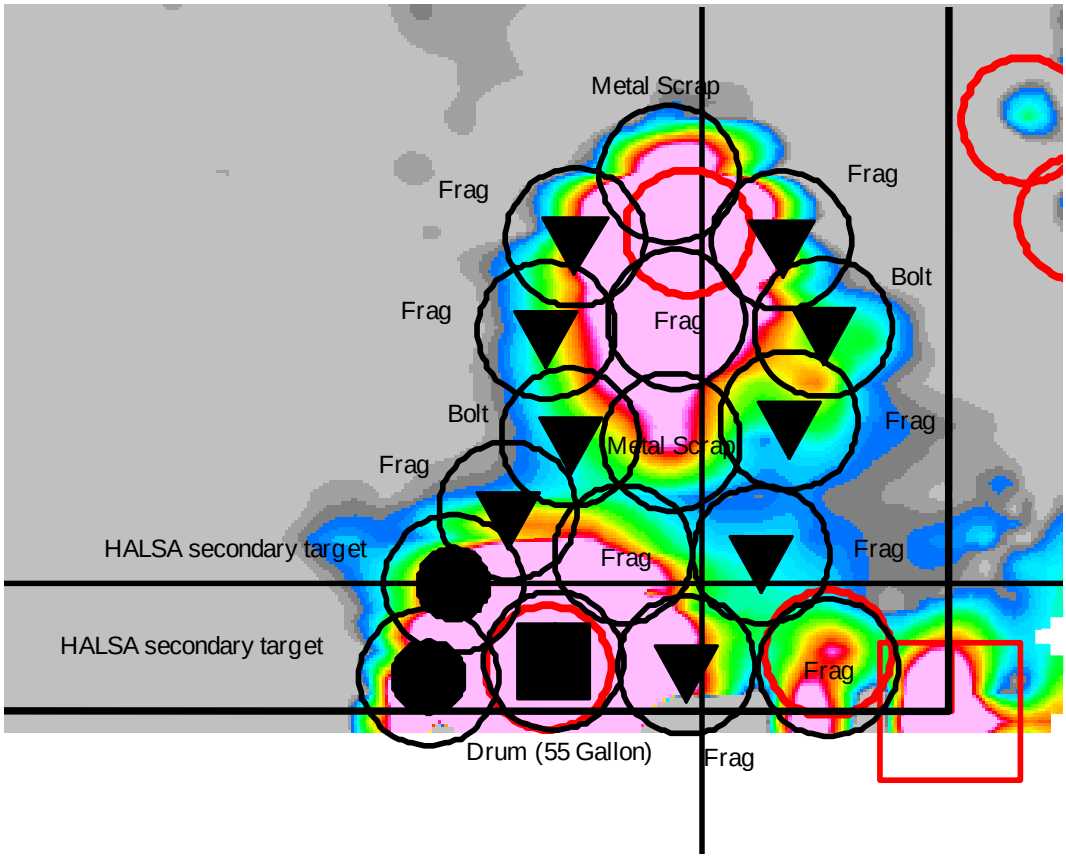


Figure 2-25. Example of DGM Targets and Dig Results for Portion of Grid H14 in RAA-03W

All targets in this grid were dug post August 2, 2013 and thus are subject to processes in Columns 1, 3 and 4 (removal of excessive targets, removal of surface targets and subsampling of HALSAs) in Figure 2-23. The contractor had identified that the 55-gallon drum was found on the surface (identified by black square), and had associated two secondary HALSA targets that were not dug (black filled circles) with this target/dig. However, the contractor did not identify or optimize the digging of the remainder of the HALSA targets north of the drum. At a minimum, these should have been optimized in accordance with FCR-20 and many of them would not have needed to have been dug. In addition, it is apparent that some of the contractor DGM target picks are overlapping (<5 ft centers) and should have been de-sampled or adjusted. The inverted triangles show targets/digs that have been removed by the QA analysis as they should have been secondary targets and not been dug.

In the root cause analysis for NCR-07, QA performed a surface sweep audit of RAA-03E and -03W to gauge the effectiveness of the contractor surface sweep DFW. This audit was a walk-through of the grids and not comprehensive; however, it found surface metal on about 27% of the grids in RAA-03. The grids identified by QA as having surface metal items remaining should show correlation with "surface" metal finds by the contractor intrusive teams (and not counted toward the target totals, Reference Columns 2 and 4 in Figure 2-23), however this was not always the case. Grids where QA observed surface metal in the audit but the contractor did not note any surface metal in the intrusive results are K23 (metal pipe), E20 (metal marsh matting) and G15 (one 55-gallon drum). In these grids there were surface targets that should have been removed from the total dig list but were not.

2.3.2.2 Geologic and Terrain Induced Data Features. Late in the 2013 field season, when most of the DGM surveys in RAAs -02, -03 and -04 had been completed, contractor QC and QA observed DGM anomaly trends (linears) that were suspected to be due to geologic/terrain features. These features were noted in the higher elevations of RAA-03W, in parts of RAA-04 and were relatively pervasive throughout RAA-02. QC submitted and received approval (July 15, 2013) for FCR-33, which provided a process to sub-sample these geologic and terrain-induced (GTI) DGM anomalous linears (Reference Column 6, Figure 2-23, and Appendix M of the After Action Report, 2013 Field Season [USA, 2014]). In the FCR, this sub-sampling process was applied to several grids and a reduction of about 60% in total DGM targets was shown. However, the example grids had not been excavated to validate this reduction.

Some of the grids with interpreted GTI DGM linears, although not the FCR example grids, were sub-sampled and excavated. The excavation results revealed that the FCR did not have a clear decision tree to accommodate several scenarios:

- A decision when no GTI feature is found in the excavations, and
- A decision when MEC/MDEH are found within a GTI.

Subsequently, the contractor has revised FCR-33, and the revised FCR is in the process of final approval.

2.3.2.3 Final Digital Geophysical Mapping Target Count. Using the matrix shown in Figure 2-23 and processes described in this section, QA made adjustments to target lists for all grids in RAA-03E and -03W. The results of this analysis are summarized in Table 2-20.

Table 2-20. Final Digital Geophysical Mapping Target Count, RAA-03

	RAA-03 Digsheet Review and DGM Target comparisons									
RAA	QC Targets	QA Targets	Total Digs	Target Count Adjustments (# Targets removed)						
				1) <5ft Centers	2) % Removed for Surface	3) Surface/Same As	4) Optimization, Surface/SameAs	6) Geologic Linears	Total Removed	Adjusted Total
RAA-03E	20910	1090	22000	2339	1266	966	139	0	4710	17290
RAA-03W	18891	410	19311	2366	26	263	1306	0	3961	15350
Totals	*39801*	*1500*	*41311*	*4705*	*1292*	*1229*	*1445*	*0*	*8671*	*32640*
	Note: RAA-03W Grids B03, L09, L10, M09 and M10 pending revised FCR33 implementation:not included in spreadsheet.									

This table shows that there are a total of 41,311 targets in the initial target lists in RAA-03. After all adjustments, 8,671 targets were removed (~21% of initial total), resulting in an adjusted total of 32,640 targets.

2.4 Quality Assurance Digital Geophysical Mapping Transects

QA conducted independent DGM surveys as part of the final QA of grids in RAA-03E, -03W and -04. These surveys were conducted after contractor intrusive work had been completed. These surveys were conducted on semi-random transects through each grid in these RAAs. In RAA-03E and -03W, DGM targets detected were investigated. In RAA-04 targets detected from these transects have not yet been investigated. QA DGM transects have not been conducted in RAA-02 at this time as contractor intrusive work has not been performed.

The QA DGM team utilized identical geophysical equipment (EM61 MK2), transport method (stretcher mode) and DGM processing and target selection thresholds as was used by the contractor for production work in these RAAs. The QA DGM team performed (and passed) morning and evening IVS and static-standard tests of the equipment to ensure proper operation of the DGM system.

The QASP suggested that one QA DGM transect be acquired within each grid. To provide a better statistical sample of the grid, QA decided to acquire the equivalent of two transects within each grid. The QA DGM transects were located in the field, in real time, to attempt to accomplish two transects within each grid, while avoiding locally inaccessible areas. There was no conscious attempt to locate the QA DGM transects over particular DGM targets found in the contractor DGM grid data.

2.4.1 QA DGM Transect Mapping in RAA-03E. Figure 2-26 shows the locations of the QA DGM transects in RAA-03E. The background on this map is the contractor DGM grid data (grey colored grid) and approved DGM targets. QA DGM transects are color coded by acquisition date.

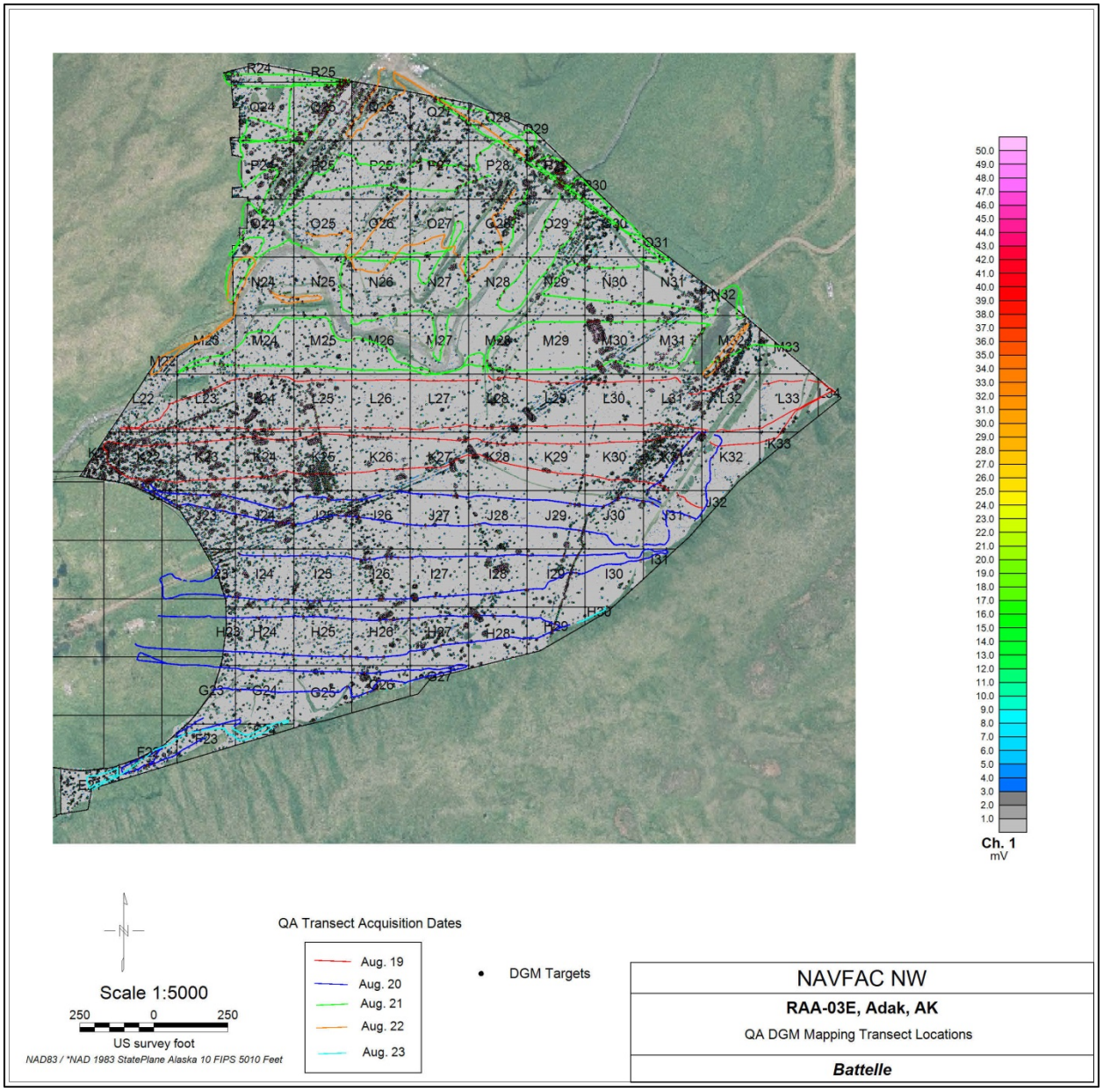


Figure 2-26. Locations of QA DGM Transects in RAA-03E

Figure 2-26 shows that some QA DGM transects crossed beyond the RAA boundaries. The portions of transects that lie outside of the RAA boundaries were not used for analysis. The total QA DGM transect coverage in RAA-03E is 48,404 linear feet (9.2 linear miles). Figure 2-27 shows a detailed view of the QA DGM transects in Grid L28.

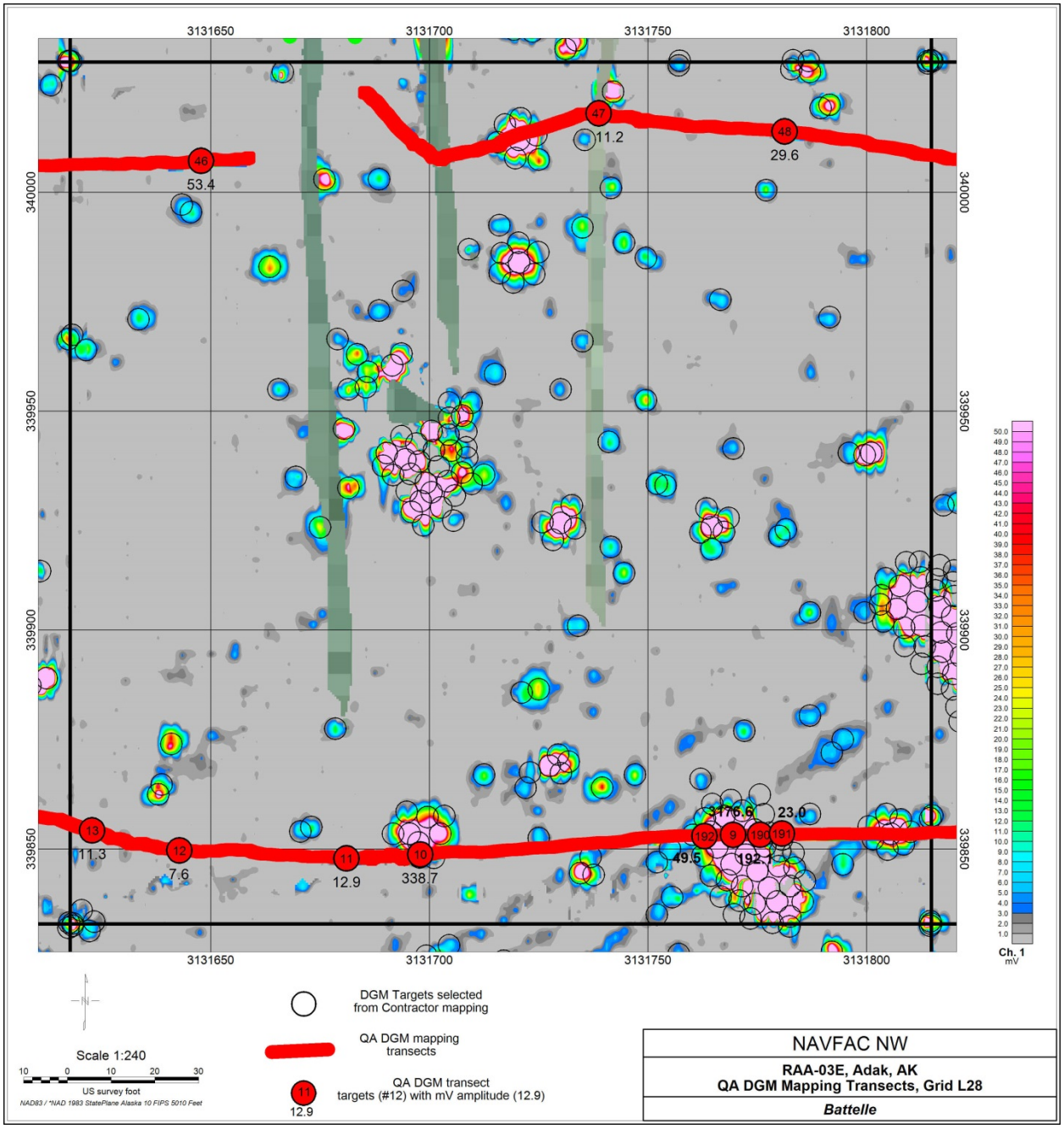


Figure 2-27. Detailed View of QA DGM Transects in Grid L28, RAA-03E

Figure 2-27 shows the DGM targets selected from the fundamental contractor DGM surveys as black, open circles. These circles are 5 ft in diameter which represents the Rcrit of 2.5 ft. The QA DGM transects are plotted to scale with the width of the transect equal to the width of the EM61 MK2 coil (1 meter or 3.3 ft). Targets selected from the QA DGM transects are labeled and also show the anomaly amplitude. These targets were based on the target selection threshold of 7 mV used for production DGM target selection in this RAA. This map shows that, in some cases, the QA DGM transects were acquired in areas previously deemed inaccessible by the contractor DGM production

teams. An example of this case is on the northern QA DGM transect, west of target #47, at about coordinate 3,131,700 west. In some cases, QA DGM targets were detected in these formerly inaccessible areas.

QA UXO personnel investigated all targets detected on the QA DGM transects within the RAA boundaries, including those found in previously inaccessible areas. A listing of the QA DGM targets and investigation results is provided in Appendix H. QA DGM targets within the Rcrit of original contractor DGM targets were correlated. In RAA-03E there were a total of 663 targets selected and investigated from the QA DGM transects. From the QA DGM target investigations in RAA-03E, 13 failure items (2% of total) were found. A listing of the failure items is provided in Table 2-21.

Note that most of the failure items were not MEC/MPPEH, however were of significant size to indicate a process failure. Also, if multiple significant items were found in a single grid, this triggered a failure. These failure items resulted in NCR-018 (Appendix M of the After Action Report, 2013 Field Season [USA, 2014]), which recommended rework of the intrusive investigation of seven grids (K21, K24, M31, O28, O29, P25 and Q25). Rework of these grids was completed. Follow-up QC and QA checks found the work to be satisfactory.

2.4.2 QA DGM Transect Mapping in RAA-03W. Figure 2-28 shows the locations of the QA DGM transects in RAA-03W. The background on this map is the contractor DGM grid data (grey colored grid) and approved DGM targets. QA DGM transects are color coded by acquisition date.

Table 2-21. Failure Items Found from QA DGM Transect Targets, RAA-03E

Grid	Target_ID	X	Y	Grid Value	USA Target_Matched	Item(s) found (QA)	Size (in)	Depth (in)	Comments	USAE Find
K21	127	3130403	339800.6	14.1	RAA03-K21_0446	pull type firing device	4	2		Metal Scrap
K21	134	3130427	339707.3	14.1	RAA03-K21_0139	sheet metal	3	4		Roofing
K24	105	3130920	339811.6	19.2	RAA03-K24_8233	MK13 MOD 0 Flare		3		Frag
M31	298	3132385	340145	320.1	RAA03-M31-0049	Lid ring	24	0	2 ea.	Barrel
M31	300	3132375	340130.1	269.1	RAA03-M31-0026	Lid ring	24	2	Flagged and investigated	Barrel w/Bands
O28	384	3131776	340572.2	95.1	RAA03-O28_0204	Bolt	8	2		Grenade
O28	386	3131773	340552.1	118	RAA03-O28_0153	Scrap, steel	10	4		Bolt
O29	374	3131987	340531	94.3	RAA03-O29-108	40mm M715		3		40mm Projectile
P25	434	3131091	340703.1	134.6	RAA03-P25_0143	Bolt	18	6		Telephone Pole
P25	450	3131048	340804.5	12.1	RAA03-P25_0396	Metal bracket/nuts	3	8		Metal Scrap
Q25	469	3131142	340911.5	14.2	RAA03-Q25_0202	Slag	12	1		Metal Scrap
Q25	470	3131143	340916.2	12434.6	RAA03-Q25_0218	Barrel lid, 55 gallon		0		Metal Scrap
Q25	486	3131153	341004	171.8	RAA03-Q25_0408	40mm white star case	4	2		Metal Scrap

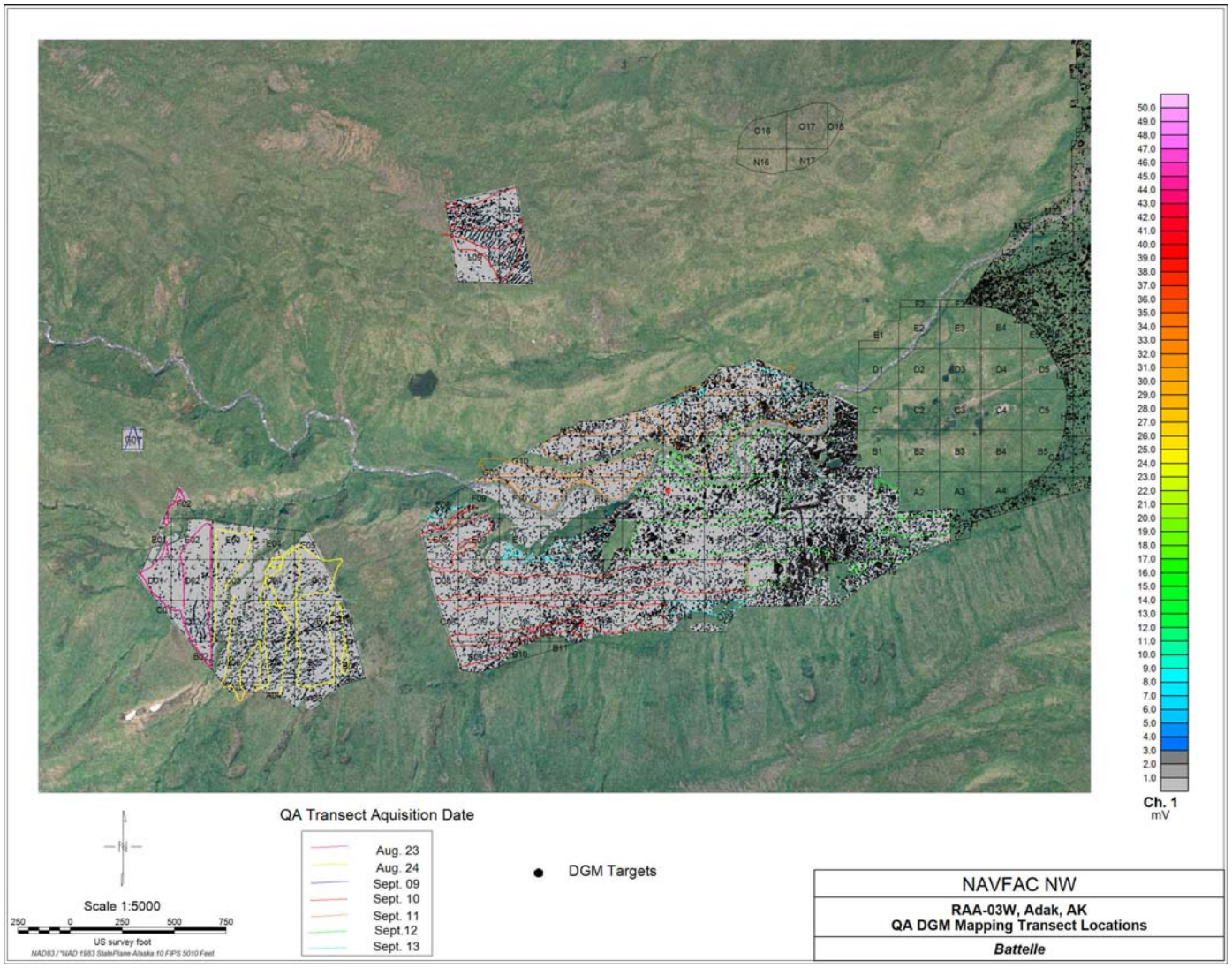


Figure 2-28. Locations of QA DGM Transects in RAA-03W

Figure 2-28 shows that some QA DGM transects crossed beyond the RAA boundaries. Portions of transects that lie outside of the RAA boundaries were not used for analysis. The total QA DGM transect coverage in RAA-03W is 42,920 linear feet (8.1 linear miles).

QA UXO personnel investigated all targets detected on the QA DGM transects within the RAA boundaries, including those found in previously inaccessible areas. A listing of the QA DGM targets and investigation results is provided in Appendix H. From the QA DGM target investigations in RAA-03W, 24 failure items (~4.3% of total) were found. A listing of the failure items is provided in Table 2-22.

Table 2-22. Failure Items Found from QA DGM Transect Targets, RAA-03W

Grid	Target_ID	X	Y	Grid Value	USA Target_Matched	Item(s) found (QA)	Size (in)	Depth (in)	Comments	USAE Find
B04	36	3126927	337939.2	15.23	RAA03-B04_0109	81 tail boom and nose fuze		12		1" Frag
C10	103	3128200	338246.1	6.27	RAA03-C10_0232	81mm tail boom		22		.50 cal
C14	136	3128970	338251.9	21.09	RAA03-C14_0182	Mechanical part	5	6		MDAS
D05	49	3127126	338275.6	19.43	RAA03-D05_0009	81 tail boom and fuze		12		Hot rock
D13	169	3128801	338420.4	10.69	RA3W-D13_0223	40mm AA		15	Live	2" Frag
D19	207	3130012	338442.6	66.05	RAA03-D19_0167	Pipe	3	3		9" Frag
E12	241	3128559	338494	64.46	RAA03-E12_0092	81mm tail boom, fuze		2		60mm Mortar
E12	255	3128505	338572.4	56.58	RAA03-E12_0263	Frag	5	4		6" frag
E17	281	3129581	338511.8	10.14	RAA03-E17_0270	Rifle grenade, smoke		8		3" Frag
E19	286	3129988	338495.5	10.96	RAA03-E19_0113	Metal	8	3		2" Frag
E20	296	3130240	338662.7	6.17	RAA03-E21_0137	Frag	4	5		60" Scrap
F02	10	3126479	338676.9	28.7	RAA03-F02_0006	40mm AA		18		40mm MK2
F09	308	3127984	338657.3	8.12	RAA03-F09_0005	81mm tail boom and fuze		18		1" Frag
F09	311	3127927	338714	11.3	RAA03-F09_0059	40mm AA		12		81mm Mortar
F11	322	3128279	338802.8	16.63	RAA03-F11_0092	81mm tail fin		12		2" Frag
F19	373	3129891	338777	15.71	RAA03-F19_0212	AT4 Nose		12		7" Frag
F19	375	3129989	338679.4	22.83	RAA03-F19_0041	1/2 fuze		24		3" Frag
G13	394	3128701	338875	12.36	RAA03-G13_0016	81mm tail fin and fuze		15		1" Frag
G13	398	3128795	338908.7	32.59	RAA03-G13_0048	60mm tail fin		4		Hot rock
H13	462	3128846	339068.7	8.75	RAA03-H13_0071	Post metal	4	2		SAA
H13	465	3128854	339131.6	7.5	RAA03-H13_0133	Scrap	4	14		SAA

Note that a total of 14 (~58%) of the failure items were MEC/MPPEH, with the rest of them being of a size significant enough to indicate a process failure. Also, if multiple significant items were found in a single grid, this triggered a failure. These failure items resulted in NCR-019 (Appendix M of the After Action Report, 2013 Field Season [USA, 2014]), which recommended rework of the intrusive investigation of seven grids (G13, E17, F19, F09, E12, D13 and C10) and a repeat of the QC and QA field checks for the remaining nine grids (F02, B04, D05, C14, F11, E19, D19, H13, and E20). QA examination of the reworked and QC rechecked NCR-19 grids found the work to be satisfactory.

2.4.3 QA DGM Transect Mapping in RAA-04. Figure 2-29 shows the locations of the QA DGM transects in RAA-04. The background on this map is the contractor DGM grid data (grey colored grid) and approved DGM targets. QA DGM transects are color coded by acquisition date. This figure shows that some QA DGM transects crossed beyond the RAA boundaries. Portions of transects that lie outside of the RAA boundaries were not used for analysis. The total QA DGM transect coverage in RAA-04 is 58,781 linear feet (11.13 linear miles).

Investigation of all targets detected on the QA DGM transects has not yet occurred and is scheduled for the 2014 field season by QA UXO personnel. A listing of the QA DGM targets is provided in Appendix H.

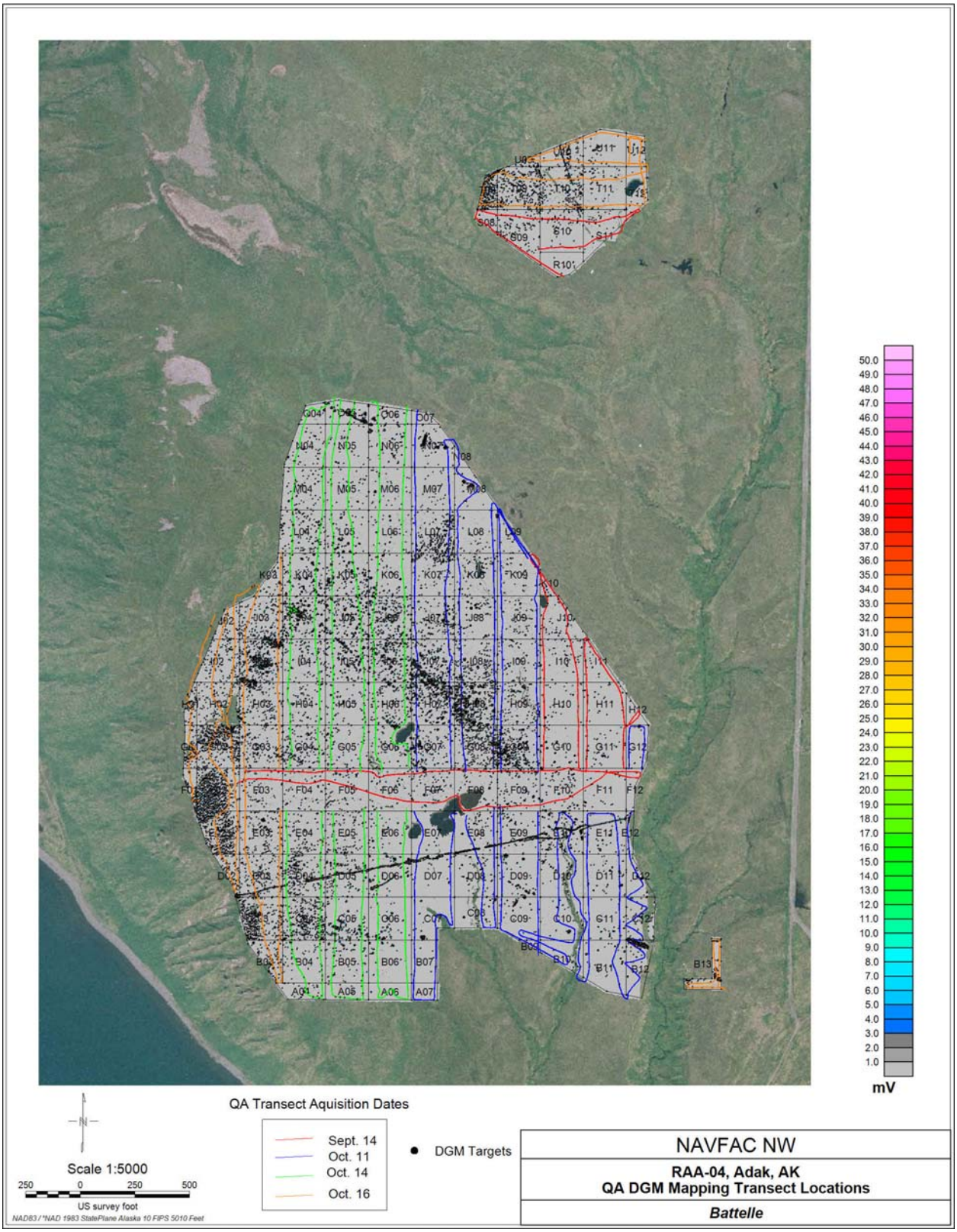


Figure 2-29. Locations of QA DGM Transects in RAA-04

2.5 Quality Assurance Digital Geophysical Mapping-Related Memos

During the 2013 field season, QA conducted several technical DGM studies and submitted the results as memos to the Navy. Some of these memos became the basis for corrective actions (CAs) and FCRs for NCRs issued to the contractor. Table 2-23 lists and summarizes the studies/memos. The full documents are provided in Appendix G.

Table 2-23. Listing and Summary of QA DGM Related Studies and Memos provided to the Navy during the 2013 Field Season

Date	Title	Description
June 14, 2013	Preliminary Approach to Optimizing Target Selection and Excavation in RAA-03.	Memo proposes a method to optimize DGM target selection and intrusive investigations for HALSAs. Optimization method involves picking and investigating primary targets in HALSAs (150 and 400 point demedian filter target picks). The remainder of targets within the HALSA are secondary and only investigated if primaries result in MEC or MDEH. ***Memo is component of contractor FCR-20.***
July 1, 2013	DGM Target Picking Threshold Analysis for RAA-02.	Memo provides an analysis of the DGM target picking threshold for RAA-02. Memo recommends increasing threshold from 3 to 5 mV to help reduce DGM targets due to geologic conditions. ***Memo is basis for contractor FCR-30.***
July 31, 2013	RAA-04 DGM Target Inconsistencies between Adjacent Grids.	Memo investigates inconsistencies between adjacent grids in RAA-04. Some adjacent grids in this RAA showed high variability in DGM target numbers. Some higher density grids exhibit DGM target patterns consistent with those caused by geologic or terrain features. No systemic problems were identified with DGM teams or geophysical systems.
September 19, 2013	Geologic Induced DGM Anomalies and Boulder Fields in RAA-02	Memo evaluates contractor derived boundaries of boulder fields in RAA-02, and proposes new boundaries based on airphoto analysis. This memo led to work/memo of October 10, 2013 (below).
September 30, 2013	Percentages of Surface Targets for Grids dug Prior to June 8, 2013.	Memo provides an analysis of the percentage of "Surface" targets found in grids in RAA-03. These percentage values were 6% for low DGM target densities (<100), 12% for medium (100-250) and 10% for high (>250). QA conducted this analysis because QC failed to provide the analysis as part of NCR-07 and FCR-20.
October 10, 2013	Field Check of Airphoto Interpreted Boulder Fields in RAA-02.	Memo discusses results of field checks of airphoto interpreted boulder fields in RAA-02. Field checks validate that the interpreted boulder fields are generally very accurate. Recommended boulder fields boundaries are modified slightly and provided.

2.6 Digital Geophysical Mapping Non-Conformance Reports and Field Change Requests

During the 2013 field season there were several NCRs related to DGM surveys or target selection. The full listing of NCRs (and related FCRs) submitted during the 2013 field season is provided in Appendix M of the After Action Report, 2013 Field Season (USA, 2014). Table 2-24 tabulates and summarizes the NCRs related to the DGM DFW.

Four of the NCRs were issued by contractor QC and the remaining two were issued by QA. For all NCRs, the initial root cause analysis and CA were developed by QA. In all cases, except for NCR-07, the CAs were accepted by the contractor and FCRs or other documents were developed to address the CA. For NCR-07, the initial QA-generated CA recommended significant contractor rework of the surface clearance DFW in all RAAs. The contractor proposed an alternative CA for NCR-07, which was accepted. This CA, which is described in Section 3, Attachment A of the NCR documentation, addressed the recognized inadequate surface clearance, proposed changes to intrusive investigation methods, and modified, summarized and expanded DGM target selection and intrusive investigations on HALSAs and long linear anomalies suspected to be due to wire, cables, etc. not removed during the surface clearance. At this time of the NCR/CA, the DGM and intrusive work in the RAAs was ongoing. Because of this, parts of this CA were to be applied retroactively to the DGM target lists and/or dig lists. Because of the importance and wide scope of this NCR/CA it had arguably the greatest impact on DGM and intrusive activities in the 2013 NTCRA. Some of the salient processes of the NCR-07 CA are summarized below:

- For grids where DGM had not been conducted: contractor DGM teams were directed to assess if surface metal objects were present in grids prior to DGM work. If surface metal objects were present, they were to be removed (prior to DGM) by contractor Senior UXO Supervisor (SUXOS).
- For grids where the DGM had already been conducted: the intrusive teams were directed to record surface metal objects as “surface” in their data loggers. “Surface” and DGM targets associated with “surface” items (i.e., “same as” targets) would not be counted toward the target totals.
- For grids where the DGM and intrusive DFWs had already been completed: A percentage for low (e.g., <100 DGM targets), medium (e.g., <250 DGM targets), and high (e.g., >250 DGM targets) density grids will be established and applied to the grids that were investigated previously (prior to “surface” implementation). This process required an evaluation of percentages of “surface” targets for grids investigated post CA (i.e., second bullet above), to be accomplished by the contractor.
- For grids where the DGM DFW was completed, but not the intrusive DFW: all HALSAs would be sub-sampled and intrusive work would be optimized/prioritized. In addition, long linear anomalies suspected to be due to wires, cables, etc. will be subsampled and intrusive work would be optimized/prioritized. Both of these processes were to be governed by FCR-20 (see next section).
- Excessive saturation DGM targets (i.e., targets picked closer than 5 ft separation) will be desampled to a 5 ft separation.

The DGM related NCRs were remedied by CAs and typically associated contractor FCRs as shown in Table 2-24. In addition, the contractor issued several DGM related FCRs that were not associated with NCRs. A listing and summary of DGM related FCRs not related to NCRs is provided in Table 2-25. All FCRs are provided in Appendix M of the After Action Report, 2013 Field Season (USA, 2014).

Table 2-24. Non-conformance Reports Related to the Digital Geophysical Mapping Definable Features of Work

NCR	Date Approved/Submitted By	Related RAA	Description	Root Cause and Corrective Action (CA)	
-01	May 4, 2013/QC	All	Some of the Contractor DGM teams exceeded the IVS test metrics. All of the exceedances were due to ISO amplitude variations over the GSV plan metrics of +/- 20% or 2 times standard deviation of the previous week's average.	The root cause of the failure was expected to be due to measurement (amplitude) variations caused by coil motion inherent with the stretcher mode EM system transport when used in the rough terrain at the NTCRA IVS sites. The corrective action was to change the amplitude metrics to +40% to -35% of the previous week's all teams' average, and to implement the static-spike test as a supplemental test. ***CA implemented as FCR-10.***	
-03	May 14, 2013/QC	All	A QC BSI was not detected in the DGM data or picked as a target in Grid N30, RAA-03E.	The likely root cause for the failure is that the BSI was placed too close to a very high amplitude and very broad anomaly to be detected using standard data processing. The corrective action was to modify the data processing to include a 400 point demedian filter, and to select targets within HALSAs at 5 ft centers. Standard data processing (150 point demedian filter) will be used outside of HALSAs. ***CA implemented as FCR-14.***	
-05	June 1, 2013/QA	All	The required documentation for areas inaccessible to DGM coverage is not being provided to QA	The likely root cause for the failure is that the contractor field teams are not documenting inaccessible areas within the grids in accordance with the approved plans. The corrective action was to direct the contractor field teams to follow the approved plans using forms and procedures described in the plans. Contractor QC to verify this action, and DGM teams to be re-briefed on the appropriate SOPs and plans ***CA implemented as FCR-16.***	
-07	July 18, 2013/QA	All	The Contractor failed to conduct the surface clearance DFW to the standard of the project metrics as specified in the approved plans.	**QA** Root Cause: QC surveillance reports on surface clearance note that work did not conform to the performance metrics in the MEC QAPP. CA: Where DGM has not yet taken place, the surface clearance should be reevaluated for adequacy and redone if the performance metric was not met. In areas where DGM or intrusive work DFWs have already been done, the recommended CA is to redo the surface clearance and DGM.	**QC: Alternative CA.** DGM teams to perform surface assessment prior to surveys, and notify SUXOS for removal of surface metal (if present). Contractor to identify "surface" metal during intrusive operations and these will not count toward target totals. In grids where intrusive operations have been completed, a percentage based on statistics from not completed grids will be used to revise target lists. HALSA targets will be optimized (subsampled). Excessive saturation targets (picked closer than 5 ft) will be desampled to 5 ft separation. ***CA implemented as FCR-20 and changes to SOPs#2, 3 and 8.***
-09	July 15, 2013/QC	-02	QC BSIs in two grids in RAA-02 were not detected in the DGM data.	The root cause of this failure was that DGM data were not collected in the vicinity of the BSIs. The corrective action was to have contractor provide procedures, via an SOP and revisions to other relevant documents, for marking and investigating areas which are inaccessible to DGM, but can be investigated by hand-held methods. QC and QA procedures for checking this work will be developed. ***CA implemented as changes to FCR-18. SOP19 to be developed for analog and dig procedures (TBD).***	
-10	July 22, 2013/QC	-03W	A QC BSI was not selected as a DGM target in grid G-18.	The root cause of this failure was that the standard DGM data processing and target selection procedures were not effective in detecting the BSI due to extremely high target densities in this grid (>850 targets). The corrective action is to remove this grid and others in the vicinity with extremely high target densities from the remediation approach established for RAA-03W and to re-align them into the remediation approach established for RAA-01. ***CA implemented without plans changes.***	

Table 2-25. FCRs Related to DGM Not Associated with an NCR, 2013 Field Season

FCR	Date Approved	Related RAA	Description
-30	July 23, 2013	-02	DGM target selection threshold was raised from 3 to 5 mV in RAA-02.
-33	July 25, 2013 Revised January 14, 2014	All	DGM anomalies suspected to be caused by geology or be induced by terrain will be subsampled and prioritized. The contractor data processor/QC geophysicist will select priority targets along the feature for investigation. All DGM targets picked along the feature will be retained in the target database and can be used for additional investigation if necessary.

During the 2013 field season, FCR-33 was applied to RAAs -03W and -04. As mentioned previously, QA has completed evaluation of contractor work in RAA-03E and -03W only. In RAA-03W, FCR-33 was applied to five grids (B-03, L-09, L-10, M-09 and M-10). QA evaluation of the application of this FCR showed that the FCR did not contain enough information or a decision tree to account for improper applications or unexpected discoveries of MEC/MPPEH. The FCR was revised after the field season to incorporate the decision tree and these grids are scheduled to be re-evaluated.

Section 3.0: QUALITY ASSURANCE OF FIELD ACTIVITIES OTHER THAN DIGITAL GEOPHYSICAL MAPPING

3.1 Introduction

In addition to evaluating DGM procedures and data as discussed in Section 2.0, Battelle provided QA on all other field activities conducted during the 2013 NTCRA field season. Field activities included vegetation removal and surface clearance, grid setup, DGM, target reacquisition, intrusive investigation, MEC/MDEH disposal, MDAS management and disposal, and site restoration.

This section describes the QA objectives, the tasks completed by Battelle during the 2013 NTCRA field effort, the results of the tasks, and a summary of non-conformances issued and any resulting field change requests.

3.2 Intrusive Investigation and Other Field Activity Quality Assurance Objectives

The QA objectives for field activities conducted during the 2013 NTCRA on Adak were to ensure all provisions of the QAPP were being properly implemented and to verify all completed field work. Battelle achieved these objectives by conducting surveillances and audits on field work activities, ensuring the contractor QC was conducting all required checks, and conducting field inspections on completed work to ensure that the quality requirements of the QAPP were achieved.

3.3 Execution of Intrusive and Other Field Activity Quality Assurance Tasks

The responsibility for establishing that routine work was performed according to established procedures rested primarily with the production contractor. The production contractor conducted preparatory, initial and follow-on inspections of all DFWs and established procedures for handling non-conformities (e.g., deficiency notices and NCRs).

QA personnel attended all preparatory inspections. The role of QA was to determine if routine QC inspections occurred (e.g., by evaluating QC surveillance check lists and related documentation), determine what non-conformities QC identified and review how the non-conformities were handled. QA personnel also conducted root cause analysis for all NCRs that were issued and determined the need for re-work based on the analysis. Table 3-1 identifies the required QC inspections, the frequency for those inspections and the QC documentation for those inspections. QA performed a daily check of routine QC inspections and documented the DFW, team, RAA, grid and inspection results by reviewing the QC documentation identified in Table 3-1.

QA provided periodic, random spot checks (audits and surveillances) of all DFWs throughout the field season to provide additional assurance to the Navy that work was being performed according to plan.

Battelle was responsible for notifying the Navy of production/QC contractor work that deviated from approved project plans or was not completed. This was a critical QA component. Deviations from SOPs or incomplete performance of work elements were considered to be a serious problem. Mechanisms for implementing this requirement included reviewing the results of routine QC checks and periodic QA field audits.

Table 3-1. QC Inspection Requirements Table

DFW	QC Inspection Frequency	Contractor Documentation to Review
Vegetation Clearance/Surface Sweep	Daily/DFW	Daily Safety Briefing Team Leader Log – Tailgate QC Inspection Form
DGM	Daily/Team	Daily Safety Briefing Team Leader Log – Tailgate QC Inspection Form
Reacquisition	Daily/DFW	Daily Safety Briefing Team Leader Log – Tailgate QC Inspection Form
Intrusive Investigation	Daily/DFW	Daily Safety Briefing Team Leader Log – Tailgate QC Inspection Form
Materials Management	Daily/DFW	MEC Movement Authorization MPPEH Inspection Forms
Demolition Operations	Per Demo Event	Demo Operations Form SUXOS Log, UXOSO Log, QC Log, DS Log
Site Restoration (backfilling)	Daily after QC grid certification	QC Inspection Form
Site Restoration (roads)	Daily after RAA QC certification	QC Inspection Form

3.3.1 Surveillances of Field Operations. Battelle conducted field surveillances of contractor field operations, which included vegetation clearance/surface sweep, DGM, reacquisition, intrusive investigations, disposal of MEC, management and disposal of MDAS, site restoration and seawall sweeps using the inspection criteria from the respective QC inspection checklist for the DFW being inspected. QA conducted daily surveillances of each team during the first week which that DFW was performed. After the first week, QA conducted a surveillance on each team once per week. The purpose for the surveillances was to ensure that the contractor was performing field operations according to project approved SOPs and QAPP documents. Prior to conducting field surveillances of contractor work, QA personnel reviewed the contractor's QC documentation (e.g., team leader logs, QC logs, QC inspection checklists) for the DFW(s) being inspected and:

- Documented that Team Leader activities (such as tailgate safety briefings), QC spot checks which are documented by logbook entries and QC inspections were performed at the frequency specified; and
- Noted any remarks made during the inspections.

QA maintained detailed records indicating the date and scope of each inspection of contractor QC surveillance checks and field surveillances. Metrics documented included:

- Whether the agreed upon number and frequency of inspections has occurred;
- Whether the inspections covered each of the DFWs being performed;

- Whether all deviations or incomplete work identified by QC were reported within one day of the identification;
- Whether the QC record shows that corrective actions were implemented to address identified deviations in a timely manner and any required re-work was performed;
- Whether QA was notified of non-conformances so that root cause analysis could be performed;
- Whether follow-up inspections were implemented in a timely manner on activities where non-conformities (deficiencies or non-conformances) were noted.

3.3.2 MEC and MDEH Disposal. QA verified the disposal of MEC and MDEH located by the production contractors using two pieces of information. First, QA reviewed the contractor's production and QC documentation to verify the tracking was documented from discovery through disposal. Then, QA visited the blow-in-place (BIP) or consolidated munitions disposal site(s) to verify that the munition(s) were completely destroyed and that the disposal site(s) was properly restored.

3.3.3 MPPEH. QA monitored the collection and processing of MPPEH by reviewing the contractor's production and QC documentation. MPPEH which was removed from production areas was recorded by weight at the end of each workday. QA reviewed the production reports documenting thermal flashing of these MDAS materials and verified that the weights reported pre- and post-flashing were consistent. Finally, after the MDAS materials were flashed, QA personnel participated in inspection, certification and verification that the materials were safe to ship off site for recycling at the contractors' selected recycling facility.

3.3.4 Final QA Inspection of Grids. The purpose for performing QA on the completed grids was to provide an independent review of production contractor records and provide some field validation checks to establish that the NTCRA work required for identifying and removing MEC from any individual production grid was complete. All information that increases confidence that the work within a production grid is considered complete is critical to improving the likelihood that the NTCRA is adequate to be the final action for the RAA.

Final acceptance of the work depended on the outcome from the final QA inspection of the respective grid. It was the responsibility for contractor QC to provide QA with the following information for each grid at the time they determine the property is ready for inspection:

- Final dig sheets;
- All QC documentation for the grid;
- Documentation of disposal of MEC, MPPEH and any other material removed from the grid;
- Written acknowledgement that the grid has passed contractor QC and is ready for QA.

The inspection sequence comprised two elements. One element was a review and verification of documentation and results for all the production and QC work for the grid. The other was independent verification through inspection. The independent verification through inspection consisted of both hole checks of completed digs and QA DGM transects. The results of the QA DGM transects are described in Section 2.4.

QA personnel reviewed all the production and QC data for the grid. Documentation review consisted of:

- Intrusive dig sheet results, QC final inspection record, and intrusive results review;
- mV comparison of intrusive finds to DGM data;
- QC close out documentation, targets checked, inaccessible areas (standing water, slopes, cultural features, etc.), targets below required clearance depths, no finds, etc.;
- QA documentation for the grid;
- QA-placed blind seed items identified by number;
- Disposal of all MEC and management of MPPEH from the grid.

The documentation review included the following:

- Determine whether all required documents were present in the grid packages provided by the contractor;
- Verify that all values reported on the QC final inspection report and intrusive results review match the final dig sheet results (e.g., no finds, inaccessible targets, left in place targets);
- Verify that a 10% recheck of all targets was conducted by QC;
- Verify that the BSI matched on all records;
- Verify that all “same as” targets matched an actual item on the intrusive dig sheets results;
- Verify that all MEC/MDEH was properly disposed of and included on the MEC/MDEH accountability log.
- Note any other issues or inconsistencies noted during review (e.g., missing dates or depths, incorrect categorization).

The results of the documentation review were recorded on an Excel spreadsheet and provided to USA for corrections.

QA personnel selected a subset of targets from the target list to investigate to verify clearance. Verification comprised the following actions:

- Note the anomaly amplitude and the dig results for the target.
- Reacquire the target.
- Perform a metal detector search of a 2.5 ft radius around the target location coordinates using a Vallon VMX3 metal detector to verify clearance. If there is any question whether the hole was properly cleared, the hole was re-excavated by QA. QA personnel documented the results of each target re-inspection including photographing and logging any metal found.
- Reacquired the target location of a subset of the no-finds.

- Performed a metal detector search of a 2.5 ft radius around the no-find location to verify there is no anomaly present.
- Inspected the location of all targets left below the required clearance depth and verify the purpose for abandoning the dig.
- Verified areas determined to be inaccessible (standing water/slopes/debris, cultural features, etc.).
- Investigated targets that had a suspect mV comparison issue discovered during document review.

3.3.5 Verification of Intrusive Investigations. QA re-inspected a minimum 5 percent combined total of dig targets and no-finds selected in each grid. Selection of digs and no-finds for QA inspection were not completely random. After reviewing the grid data, QA selected targets and no-finds using a blend of biased and random sample selection techniques.

3.3.6 QA Activity Documentation and QA Database. QA activities were documented electronically using the QA database (QADB). The QADB provides access, storage and backup of all project QA data. The data entry screens are used to log the following types of information:

- Evaluation of Contractor DGM
- Evaluation of Contractor QC Activities
- QA Surveillances
- Final Grid Inspections
- An Administrative Section

Each data entry activity included the date, RAA, grid, team, DFW and initials of the QA Specialist performing the activity. An example data entry screen is provided as Figure 3-1.

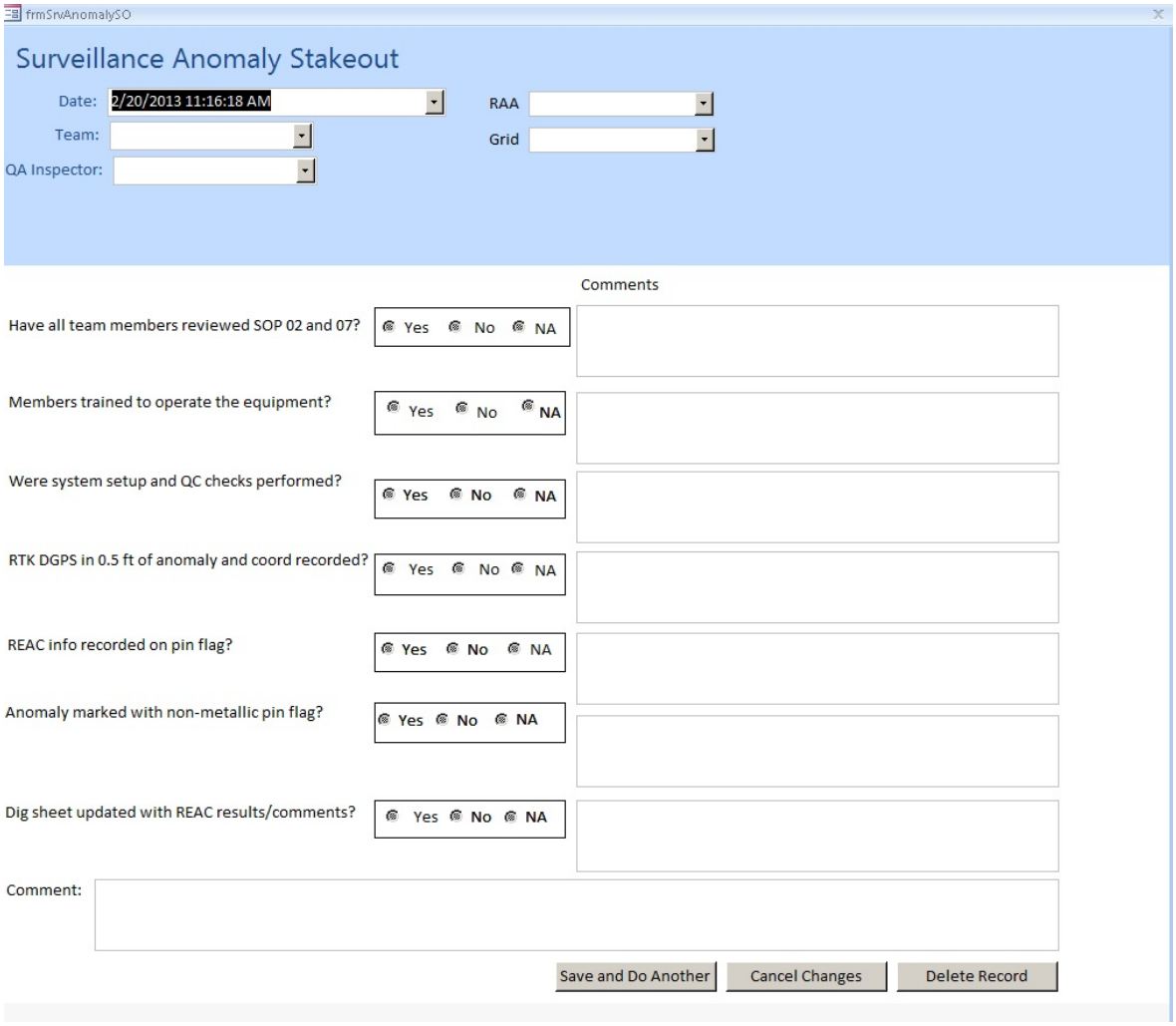


Figure 3-1. Data Entry Screen Example

3.4 Summary of the Intrusive and Other Field Activity Quality Assurance Activities for 2013

Battelle attended preparatory inspections for each field activity and issued one NCR for no preparatory phase for intrusive operations (see Section 3.5 for NCR details). Battelle completed 680 field QA surveillances on the following activities: vegetation removal and surface clearance, grid setup, DGM, target reacquisition, intrusive investigation, and MEC/MDEH disposal operations. Table 3-2 summarizes the QA surveillances performed in each RAA during the 2013 field season and QA surveillance forms are provided in Appendix A.

MDAS management and disposal operations were also observed; however, the inspections were not recorded on surveillance forms inputted into the database. Battelle staff observed the TFU operations, noted observations in a field notebook, and signed off that MDAS was properly treated prior to off-site disposal. A total of 15,669 pounds of MDAS was treated in the TFU during the 2013 field season and has been shipped off site. Additional MDAS items that were too large to fit into the TFU

were inspected in accordance with the approved project plans and shipped off island for further treatment and disposal

Table 3-2. Number of Surveillance Checks Performed in each RAA in 2013

RAA	Surveillance Checks					
	Vegetation Removal/ Surface Clearance	**Grid Setup**	**DGM**	**Anomaly Reacquisition**	**Intrusive Investigation**	**MEC/MDEH Disposal**
RAA-01	0	0	1	0	0	5
RAA-02	11	4	44	0	0	1
RAA-03E	37	10	80	57	95	15
RAA-03W	21[(a)]	6[(a)]	26[(a)]	51[(a)]	59[(a)]	19[(a)]
RAA-04	8	4	40	15	21	5
RAA-05	3	3	0	0	35	4
Total	**80**	**27**	**191**	**123**	**210**	**49**

(a) Two surveillances from vegetation clearance/surface removal, one surveillance from grid setup, three surveillances from DGM, four surveillances from anomaly reacquisition, one surveillance from intrusive investigation, and one surveillance from MEC/MDEH disposal were from grids which have been transferred to RAA-01.

In addition to preparatory inspections and surveillance checks, Battelle also performed QA checks on completed grids as discussed in Section 3.3. All grid packages developed by the contractor included the following paperwork for each grid: intrusive dig sheet results; QC inspection forms; and intrusive results reviews. All forms were reviewed by Battelle to ensure all required information was present and that there were no discrepancies or inconsistencies on the documents as described in Section 3.3.4. Grids from RAA-03E, RAA-03W, and RAA-04 were reviewed and between 50% and 75% of the grid packages were found to be deficient.

The main deficiencies noted on the grids included:

- Less than 10% of targets rechecked in a grid by QC;
- Inconsistency in values between documents such as no finds and left in place targets;
- Blind seed items missing from documentation or BSI number reported incorrectly;
- Same as targets not matching an actual item;
- Final disposition of MEC/MDEH items improperly documented;
- MEC/MDEH items not documented on the MEC/MDEH accountability log.

Battelle submitted comments to USA for grid packages fror RAA-03E and RAA-03W. The discrepancies for these RAAs have been addressed by USA and the revised grid packages have been approved by Battelle. Results of the QA review of grid packages are provided in Appendix I.

QA performed a total of 4,717 hole checks in RAA-03, of which 350 were rechecks of grids that required rework. In RAA-03E, QA performed 2,288 hole checks that resulted in five grid failures and an additional 98 rechecks, resulting in a total of 2,386 investigations. In RAA-03W, QA performed 2,079 grid hole checks that resulted in five grid failures and an additional 252 rechecks resulting in a total

of 2,331 investigations. Note that the QA rechecks were done to verify the satisfactory completion of NCR directed rework. Appendix J lists all QA investigations including what was discovered at each location by Battelle QA and USA intrusive teams. Table 3-3 summarizes the failure items discovered in the QA grid investigations. The items listed for Grid F16 were identified during the QA inspection of the completed grid following the rework directed in NCR 15. The items were found outside of the reworked portion of the grid and necessitated an amendment to the NCR. The amendment required rework of the portion of the grid not originally subject to the CA. This rework was successfully completed.

Table 3-3. Summary of Failure Items Discovered in QA Grid Investigation in RAA-03 in 2013

RAA	Grid	Target ID	Failure Item(s)	NCR
RAA-03E	O27	27	40 mm Practice Parts	8
	J25	20	2 in. x 3 in. metal	11
		198	tent pole w/ 18 in. x 1 in. metal (not investigated)	
	J28	54	3 lb melted lead	11
	K30	18	14 in. x 1 in. steel cable (not investigated by dig team)	11
	M23	60	12 in. x 6 in. heavy sheet metal, listed as hot rock on intrusive results	11
RAA-03W	D18	251	3 in. x 6 in. frag	11, Rev 3
		265	1 in. x 3 in. frag	
		294	3 in. x 4 in. frag	
		312	rifle smoke grenade	
	F11	70	2 in. x 5 in. frag	11, Rev 2
		98	piece of fuze 1 in. x 2.5 in.	
	F14	182	mortar tail fin @ 10 in.	11, Rev 3
		228	2"x4" frag @ 6 in.	
		297	mortar tail fin @ 24 in.	
	F16	339	Cartridge Activated Device (CAD) - MDEH	15, Rev 1, Att A
		263	6 in. Pipe	
	F19	33	8 pieces of frag, up to 3 in. x12 in. undug	11, Rev 3
	G14	20	M84 PTTF nose piece	11, Rev 3
		351	Frag 2 in. x 5 in.	
		393	Frag 2 in. x 5 in.	
		240	CAD JAU-22	

3.5 Intrusive Investigation and Other Field Activity Non-Conformances and Field Change Requests

3.5.1 Intrusive Investigation and Other Field Activity Non-Conformances. There were a total of 19 non-conformances issued during the 2013 field season and 33 FCRs have been submitted to the

Navy (see M of the After Action Report, 2013 Field Season [USA, 2014]). Of the 19 non-conformances, six were related to the DGM efforts and are discussed above in Section 2.6. Table 3-4 describes the NCR issued for non-conformances in intrusive investigation and other non-DGM field activities performed during the 2013 field season. A Memorandum for the Record was generated for RAA 03W Grid B03 where a QC BSI was not recovered during the intrusive investigation after having been administratively eliminated from the target list. The memorandum is included in Appendix K.

Of the remaining 13 non-conformances not related to DGM, four were initiated by QC and nine were initiated by QA. The four non-conformances initiated by QC were from items being found by QC during QC 10% re-inspections and no find checks. NCRs 02, 04, and 06 were initiated by QA based on field observations during surveillances and audits. Observations of non-conformances include not holding a preparatory phase meeting and not completing DFWs according to specification (e.g., surface clearance). The remaining six NCRs issued by QA were due to grid failures during QA checks of completed grids. All CAs have been completed on the NCRs issued in 2013.

3.5.2 Intrusive Investigation and Other Field Activity Field Change Requests. There were a total of 33 field change requests submitted during the 2013 field season. Five of the FCRs (-10, -14, -16, -18, and -20) were in response to NCRs related to DGM activities. Two additional NCRs (-30 and -33) were related to DGM activities but not in response to NCRs. The remaining FCRs are related to other activities that took place during the 2013 field season on the OU B-2 NTCRA. Table 3-5 summarizes the 33 FCRs.

Table 3-4. Non-Conformance Reports Issued for Intrusive Investigations and Other Non-DGM Field Activities in 2013

NCR	Date Approved/Submitted By	Related RAA	Description	Root Cause and Corrective Action (CA)
-02	April 24, 2013/QA	-05	No Preparatory Phase or Initial Phase Inspections were held on a new DFW.	The root cause was that USA instituted a completely different procedure for RAA-05 than was in the approved work plans (i.e., the work plans called for scraping the entire RAA to 2 feet using heavy equipment and USA decided to do an analog and dig procedure), and did not have an approved SOP, nor conduct the required three-phase inspections to be doing the changed procedure. The corrective action was to conduct the preparatory inspection and initial inspection and to prepare an SOP with a QC inspection checklist so that the work would be done correctly.
-04	April 30, 2013/QA	All	QC was not conducting audits/surveillances at the frequencies required by the QAPP.	The likely root cause is that USA underestimated the level of effort that would be needed to conduct all of the required inspections, especially at the beginning of the field season when the inspection schedule was heaviest. The QA, Remedial Project Manager (RPM) and Navy Technical Representative (NTR) met with the USA QC Manager and helped them update their documentation and develop a tracking tool which would make sure they assigned their resources as efficiently as possible to meet the QAPP requirements.
-06	June 12, 2013/QA	All	QC failed to issue an NCR for work which was identified and documented as non-conforming.	The likely root cause for the failure is that the contractor QC personnel that noted the work did not have the authority to issue an NCR and the QC Manager failed to act for some undetermined reason. The corrective action focused on making sure that USA had an adequate number of staff assigned (an additional QCS was assigned), that those staff were qualified to assume the QC responsibilities by having their qualifications reviewed and re-certified, that the QC staff were adequately trained by conducting additional training that focused on them understanding their role and responsibilities.
-08	July 21, 2013/QC	-03	A MPPEH item was found in a grid (RAA-03, O27) during QC checks.	The likely cause was a breakdown in procedures by the intrusive team. The corrective action was to point out the failure to the team and then conduct additional training, emphasizing the necessity to investigate the entire critical radius around the target flag location. Verification of the effectiveness of the training was attained through additional QC inspections of the team's work.
-11	September 23, 2013/QA	-03	During QA inspection of completed grids, metallic items were found which exceeded the removal criteria.	The root cause was indeterminate, however, a likely contributing factor was having more than one team responsible for anomaly investigations in a grid and the intrusive work was not done using a 'start-to-finish' routine. Instead, one team might work a partial day, another team might work another partial day, sometimes the days could be weeks apart. The corrective action was a re-work of the intrusive investigation within the grid, re-QC of the work with the results submitted as a supplemental dig sheet and QC report.
-12	September 16, 2013/QA	-03	No action by QC when their QC results showed non conforming conditions (e.g., QC noted site restoration was incomplete in multiple grids and in one grid, MDEH was found during the QC inspection).	The root cause was indeterminate; however, this NCR illustrates the continued substandard performance by the USA QC component. The corrective action required re-work of the intrusive investigations for six of the non-conforming grids and re-inspection by QC with the results submitted as a supplemental dig sheet and a new QC inspection report. In the grids requiring completion of the site restoration, QC was to issue a deficiency notice and follow up by inspection when notified that the deficiency was corrected.
-13	September 6, 2013/QA	-03	A QA blind seed was missed during intrusive investigation of RAA 03E grid L23. The blind seed was detected in the DGM data and reported as a target. After noting that the seed was not listed on the final dig sheet, QA verified that it was still in place in the grid.	The root cause was indeterminate as the records review of the intrusive team's work and the grid history indicated no prior problems. The corrective action required re-work of the intrusive investigation and re-inspection by QC with the results reported as a supplemental dig sheet and QC inspection report.
-14	September 18, 2013/QA	-03	QC blind seed items were not recovered during the intrusive investigation in two grids (K32, M30). The items were detected in the DGM data and were selected as targets for the intrusive teams.	K32 – the NCR was issued because it appeared from the paperwork submitted that the intrusive teams had missed the blind seed and during QC review of the dig results, the team was sent back specifically to recover the seed. In this grid, the target that was the blind seed was called out in the Intrusive Results Review form because the data was incomplete for the target (depth, orientation, etc.). In M30, the seed item was also called out on the review form for reinvestigation and the reason given was that the excavation was halted on that target 'in progress' and the investigation was incomplete because of reassignment of Primary and Secondary designations to HALSA targets. In M30, the team was determined to have missed the seed and re-work of the intrusive investigation in that grid was determined as the proper corrective action. No action was mandated for K32, pending the results of the QA inspection.
-15	September 11, 2013/QC	-03	During QC inspection of two grids (F16, G16) items exceeding the failure criteria were found at multiple target locations.	The root cause analysis pointed out that there may have been some confusion on the part of the dig teams on how to proceed within a HALSA, particularly dealing with Primary and Secondary targets (FCR 20) and in a couple of cases, the team simply didn't investigate the targets thoroughly enough. The corrective action required some re-work in the HALSA areas to make sure nothing remained behind. Additional training for the intrusive teams on HALSA procedures was provided to resolve any confusion on how to proceed when those were encountered. The corrective action was modified by QA on 10/17/13 to require rework of the entire grid as additional items exceeding the failure criteria were found by QA outside of the HALSAs
-16	September 18, 2013/QC	-04	During QC inspection, a MEC item was found in grid T09.	The root cause analysis determined that the projectile (90 mm) found during the QC check was located underneath where a BIP operation had taken place on another 90 mm projectile. The initial determination was that the demo team, or other responsible party, had failed to check the disposal hole after the shot. QC checks of other demo holes in RAA-04 identified that more 90 mm projectiles were located beneath other demolition operations. The BIP process being used required that when a BIP item was found it was not moved from the 'found' location. The 90 mm projectiles were not BIP for safety reasons but for company policy reasons. With these incidents, USA changed policy to where when a 90 mm projectile was found, it was moved from the 'found' location a short distance and the ground beneath and around was checked for additional projectiles. In many cases, additional projectiles were found. Since QC cleared this target location, no additional actions were required.

Table 3-4. Non-Conformance Reports Issued for Intrusive Investigations and Other Non-DGM Field Activities in 2013 (Continued)

NCR	Date Approved/Submitted By	Related RAA	Description	Root Cause and Corrective Action (CA)
-17	September 17, 2013/QC	-04	During QC inspection, munitions were found at previously cleared target locations.	The root cause analysis evaluated whether the detector used for intrusive investigation (White's) was inadequate for the task given the depths that the munitions were found (40 and 46 inches). The data did not support that the detector contributed to the failure. Therefore, it was concluded that the failure was most likely due to poor post-demolition clearance. The corrective action required that QC identify and re-check every demolition location in RAA-04.
-18	October 3, 2013/QA	-03	Failure-sized items were found as a result of QA DGM transects at previously cleared target locations in multiple grids.	The root cause was determined to be failure of the intrusive teams to adequately recheck and clear the location after an object had been detected and removed (i.e., poor field craft). The corrective action required re-work of the intrusive investigations in all the grids with the results submitted as a supplemental dig sheet and re-QC of the completed grids.
-19	October 14, 2013/QA	-03	Failure-sized items were found as a result of QA DGM transects at previously cleared target locations in multiple grids.	The root cause was determined to be failure of the intrusive teams to adequately recheck and clear the location after an object had been detected and removed (i.e., poor field craft). The corrective action required re-work of the intrusive investigations in all the grids with the results submitted as a supplemental dig sheet and re-QC of the completed grids.

Table 3-5. Field Change Requests Associated with the Non-DGM Field Activities during the 2013 Field Season

FCR #	Date	Purpose
-01	4/10/13	Add the Schonstedt (magnetometer) to the list of approved instruments to use to pinpoint subsurface ferrous objects (targets).
-02	4/11/13	Document the addition of two additional survey control points for the project.
-03	4/11/13	Document a change to the QC audit frequency for the field DGM teams from once per team per day to once per team per week after the first week of work.
-04	5/8/13	Remove the requirement for placing a guard on a MEC item when disposal operations cannot be conducted the same day as discovery.
-05	4/24/13	Document the addition of Function Check Areas (FCAs) for testing the handheld metal detectors instead of using the IVS used by the DGM teams.
-06	5/2/13	Document the change of requiring the UXO III Team Leader to give the tailgate safety briefing to allow a UXO II to give the briefing for activities not supervised by a UXO III Team Leader (i.e., DGM).
-07	N/A	This number was voided after it was determined that the change proposed in FCR 07 was not needed.
-08	5/1/13	Document a change to various project documents requiring work to stop when the wind speed reaches 20 mph. It leaves the decision on when to suspend work up to the UXO Safety Officer.
-09	5/2/13	Removes the requirement to utilize anomaly avoidance when reacquiring and marking target locations with a plastic pin flag.
-11	5/13/13	Removes the requirement that MDAS remain within the RAA until it can be fed directly into the TFU. Further, it removes the requirement to process large MDAS (e.g., 55-gallon drums) through the TFU. Allows MDAS to be stored in a lockable container at the contractor lay down yard next to the harbor.
-12	5/4/13	Removes the requirement that equipment operators be UXO qualified and allows non-UXO personnel to operate heavy equipment on the project.
-13	7/19/13	Clarifies that the Mobile Thermal Destruction Unit (MTDU) will be used only for flashing MDAS, not for destroying energetic materials as is currently allowed by SOP 10.
-15	5/20/13	Clarifies and aligns the requirement for fire extinguishers in vehicles transporting explosives with the requirements in NAVSEA OP 5 and EMM 385-1-1.
-17	5/22/13	Documents revision to a checklist in SOP 8 to adjust the equipment list.
-18	5/22/13	Adds QC audit criteria and failure criteria to the QAPP for inspection of Analog and Dig procedures.
-21	7/2/13	Approves use of the ‘slim’ search head for the Vallon in addition to the ‘large’ search head. Establishes the sensor settings for use of the different search heads.
-22	6/13/13	Adds an Activity Hazard Analysis (AHA) for the thermal flashing unit to the Site Safety and Health Plan.
-23	6/14/13	Provides additional documentation on performing the static spike test when new equipment or personnel are brought to the site.
-24	7/10/13	Documents a revision to the Explosive Disposal Log.
-25	7/13/13	Revises the project plans to make the dewatering decision process consistent.
-26	7/1/13	Provided clarification language regarding the placement of QC mini-grids into the project work plans.
-27	7/10/13	Adds the safe to move form to the SOP 8, Intrusive Investigation.

Table 3-5. Field Change Requests Associated with the Non-DGM Field Activities During the 2013 Field Season (Continued)

FCR #	Date	Purpose
-28	7/10/13	Provided changes to project documentation to remove inconsistencies between documents regarding the requirements for explosive-laden vehicles.
-29	7/17/13	Provided a modification to the Daily Quality Control Report form to make it more appropriate to the Adak project.
-31	8/6/13	Changed the location for the second of the three inspection points for MDAS and modified the QC checklist to reflect the change. Also added QC inspection points for HALSAs to the QC checklist.
-32	7/19/13	Modified the plans to allow the Team Leader to perform final checks using the Standard Slim Head Vallon metal detector.
-34	TBD	In process. Provided the means to document other changes to the work plans which were deemed necessary by the project team but were not required or specified elsewhere (e.g., as a result of an NCR or operational requirement). Most of the FCR 34 changes are administrative in nature and focus on adjusting the documents for use during the 2014 field season.

Section 4.0: REFERENCES

Battelle Memorial Institute (Battelle). 2013. Final Quality Assurance Surveillance Plan (QASP), Non-Time Critical Removal Action (NTCRA), Operable Unit B-2 (OU B-2), Former Naval Air Facility, Adak, Alaska. February.

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USA Environmental, Inc. (USA). 2014. Draft After Action Report, 2013 Field Season, Non-Time Critical Removal Action (NTCRA), Operable Unit B-2 (OU B-2) Various Remedial Action Areas, Former Naval Air Facility, Adak, Alaska. January.