AGC AT JOINT BASE CAPE COD, A HIGH-ANOMALY DENSITY SITE.

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Abstract

Joint Base Cape Cod (JBCC), which includes Camp Edwards, Otis Air National Guard Base, Cape Cod Spce Force Station and Coast Guard Air Station Cape Cod, was used by the military beginning in the early 1900s. The Camp Edwards Central Impact Area (CIA) was used between 1930 and 1997 as an impact area for artillery and mortars. Various types of munitions have been found there, including 37-mm to 155-mm projectiles, mortar rounds, and rockets.

The Source Response for Unexploded Ordnance (UXO) at JBCC is not a munitions response project but a Hazardous, Toxic and Radioactive Waste project executed under the auspices of the Safe Drinking Water Act with explosives and propellants in groundwater as the primary COCs. The primary concern is the potential for groundwater contamination due to the energetic filler within the munitions. The Decision Document (DD) describes the selected response actions to address the source areas contributing to groundwater contamination, including both soil and unexploded ordnance (UXO). Specifically, the DD addresses high explosive-containing UXO items that remain in the CIA that pose a long-term threat to groundwater. According to the decision document for this site the goal is to remove 75% to 95% of the UXO, maximizing removal of net explosive weight. Our classification goals are to correctly identify 95% of the UXO and UXO-like items (Targets of Interest (TOI)), while reducing clutter dug by >70%.

A unique approach to Advanced Geophysical Classification (AGC) has been implemented at this site due to the high spatial density of subsurface metal and large expected munitions (e.g. 105 and 155mm projectiles). Indian Eyes Weston Joint Venture (IEWJV) has been working on the site since 2021, with previous work done by Parsons, USACE, , and Tetra Tech. This presentation will focus on the unique AGC approach along with the results from work conducted from the past 4 years (2021 – 2024).

EM61s have been used at this site for the dynamic phase of detection to obtain the increased detection depth necessary to find the larger sized munitions at depths of three to four feet below ground surface. The EM61 anomaly density observed over the past 4 field seasons was 2,372 anomalies per acre. The seed detection radius MQO was set to 65 cm, which is higher than is typical for AGC sites due to the high anomaly density.

Instead of using the typical dig/no dig decision statistic threshold, the classification was done using size and decay thresholds, library matches and significant manual review. This approach was based on one developed by United States Army Corps of Engineers (USACE) during the AGC demonstration at the site in 2014 (ESTCP, 2014) and modified for the Metal Mapper 2x2 by Parsons (Parsons, 2018). Typical AGC processing was done in UX-Analyze up to and including the Classify and Rank bundle. However, following that, the UX-Analyze classification results were ignored and sources on the "Targets_final" list were classified as "likely TOI" if they fulfilled any of the following criteria:

1. Size (gate 14) > 0.7, early decay (gate 62, 1.284 ms) > 0.035 and late decay (gate 85, 4.186 ms) > 0.004
2. Size > 1.6, and early decay > 0.020 and late decay > 0.002
3. 111, 110, 011 and 100 library match metrics all > 0.9

Additionally, any sources that were near these thresholds were flagged for manual review of the decay curves by the data analyst. The data analyst also reviewed any sources that corresponded to large footprint and/or high amplitude EM anomalies that were not otherwise marked to dig. Some of the UX-Analyze

default settings were also modified to allow for sources up to 70 cm from the array center. Any "cannot analyze" sources were also added to the dig lists; however, these were minimal.

A 1 m dig radius was used to account for the inaccuracies in classification due to the high anomaly density, and sources within an 80 cm radius were merged into one dig. While the seed classification radius MQO was 30 cm, the failure response was updated such that a failure was reported but an RCA was not required unless the seed was not within 80 cm of a dig location. There were several RCAs where seeds were missed due to the high anomaly density observed across the areas of interest at the site. Accurate classification was not always possible due to these high densities, however the 95% classification goals were attainable.

Saturated Response Areas were also identified in areas where individual EM peaks could not be reliably selected. Typically, these were areas saturated above 100 mV in channel 2.

Traditional validation and verification digs are not done at this site. Instead, each season verification and validation of the full classification process was accomplished via the excavation of 100% of the EM targets in one grid for every six acres investigated. Over the past four field seasons, IEWJV has investigated 1996 TOI digs and 3,920 verification digs in the eight grids selected for verification and validation. Within the 1,996 TOI digs, 261 were UXO, UXO-like (items we would expect to produce a TOI-like signal in the AGC cued data) or seeds, and 1735 were clutter. Within the 3,920 verification digs, 3,912 resulted in clutter, and eight UXO, UXO-like or seeds were recovered. Overall, 97% of TOI were classified correctly, however only 69.3% of clutter were correctly classified, meaning more items were removed than necessary. The 97% correctly classified TOI was above the goal of 95% however the 69% of clutter was below goal.

Conclusions

Work performed as part of the Source Response for UXO at JBCC is an example of how AGC classification techniques have been modified for use at a site with high anomaly densities

References

ESTCP, 2014, Final Reports Live Stie Deomstrations Massachusetts Military Reservation, ESTCP

Parsons, 2018, MetalMapper 2x2 Data Classification Technical Memorandum Revision 0