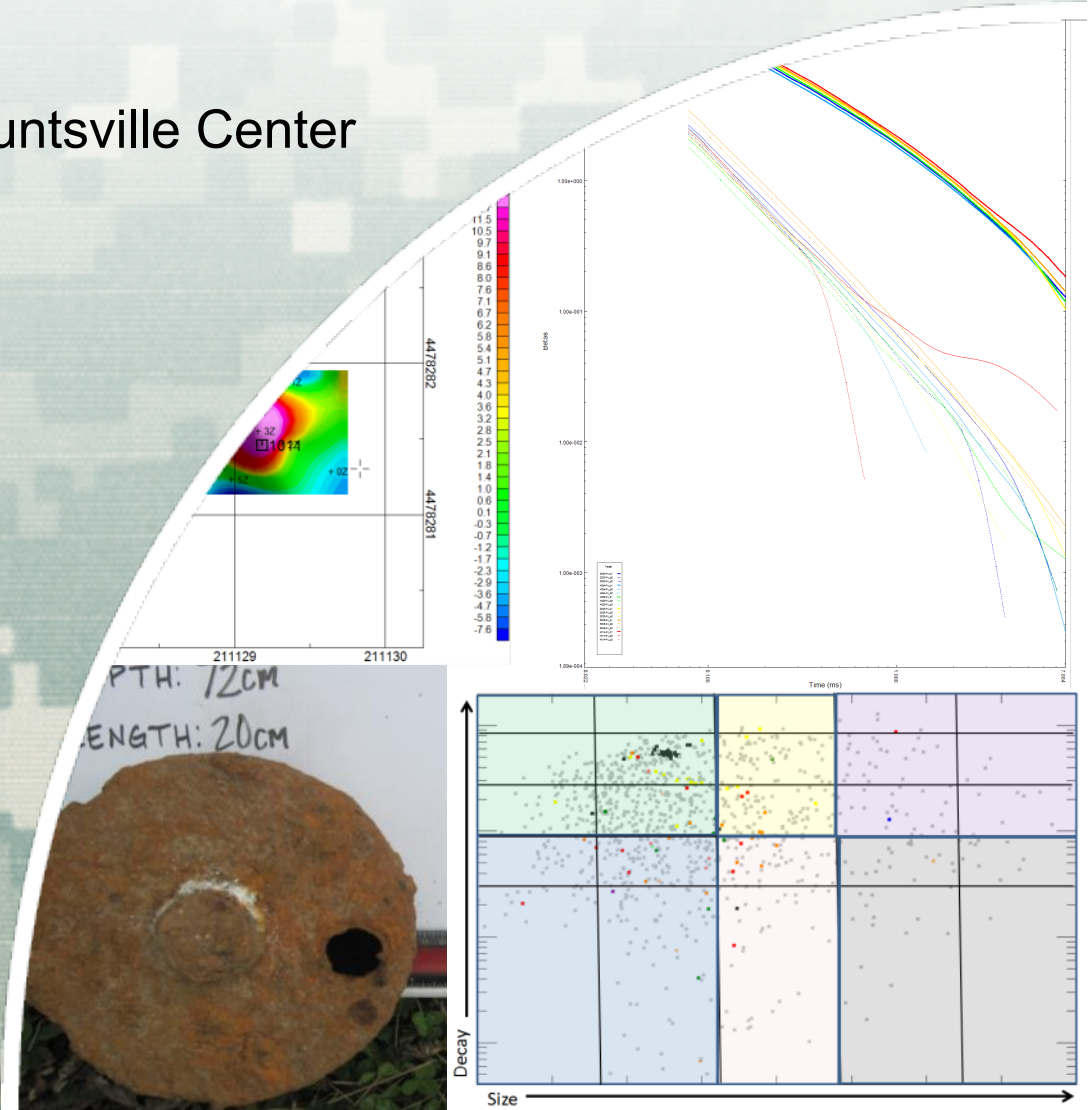


Characterization of Nature through Classification

Elise Goggin, Geophysicist

US Army Corps of Engineers Huntsville Center

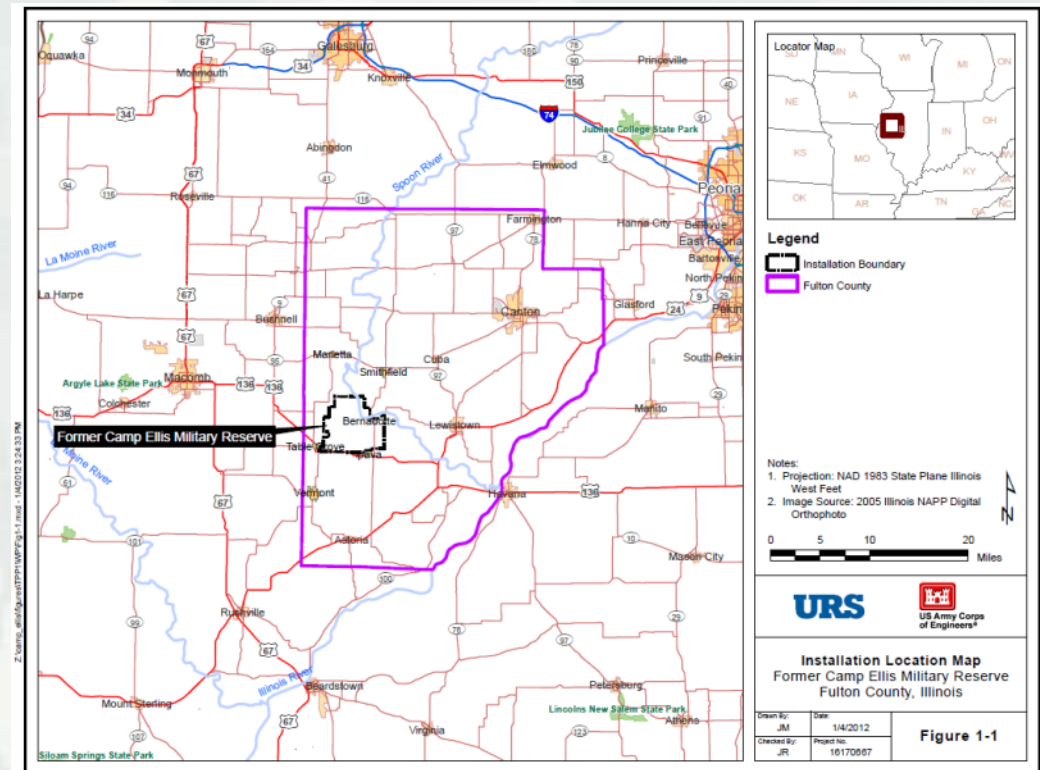


US Army Corps of Engineers
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Demo at Camp Ellis

Purpose

- Determine nature of MEC contamination using classification
- Reduce the amount of digs necessary for a Remedial Investigation while gathering more information about all targets



RI Summary

Former Camp Ellis Military Reserve contains one MRS composed of 43 Potential Areas of Interest. For this study we focused on 7 of these areas. These seven areas were selected based on data needs, terrain, and anomaly densities.

Area	ASR	Acres	Removal Action	Previously 100% Mapped	RI Coverage* (acres)	Targets Identified
A	Rocket, Rifle and Hand Grenade Training Range	52			0.8	88
E	Rocket and Mortar Impact Area	486			0.25	121
G	Demolition Area	163			3	151
I	German Village	43		In open areas	3	496
M	Obstacle Course	104	2 M1 AT Mines		3	19
P	Decontamination Training	8		In open areas	0.25	52
Q	Chemical Training	15		In open areas	1	134

* This value only reflects the grids where MetalMapper data was collected



Contractor/Government Roles

URS

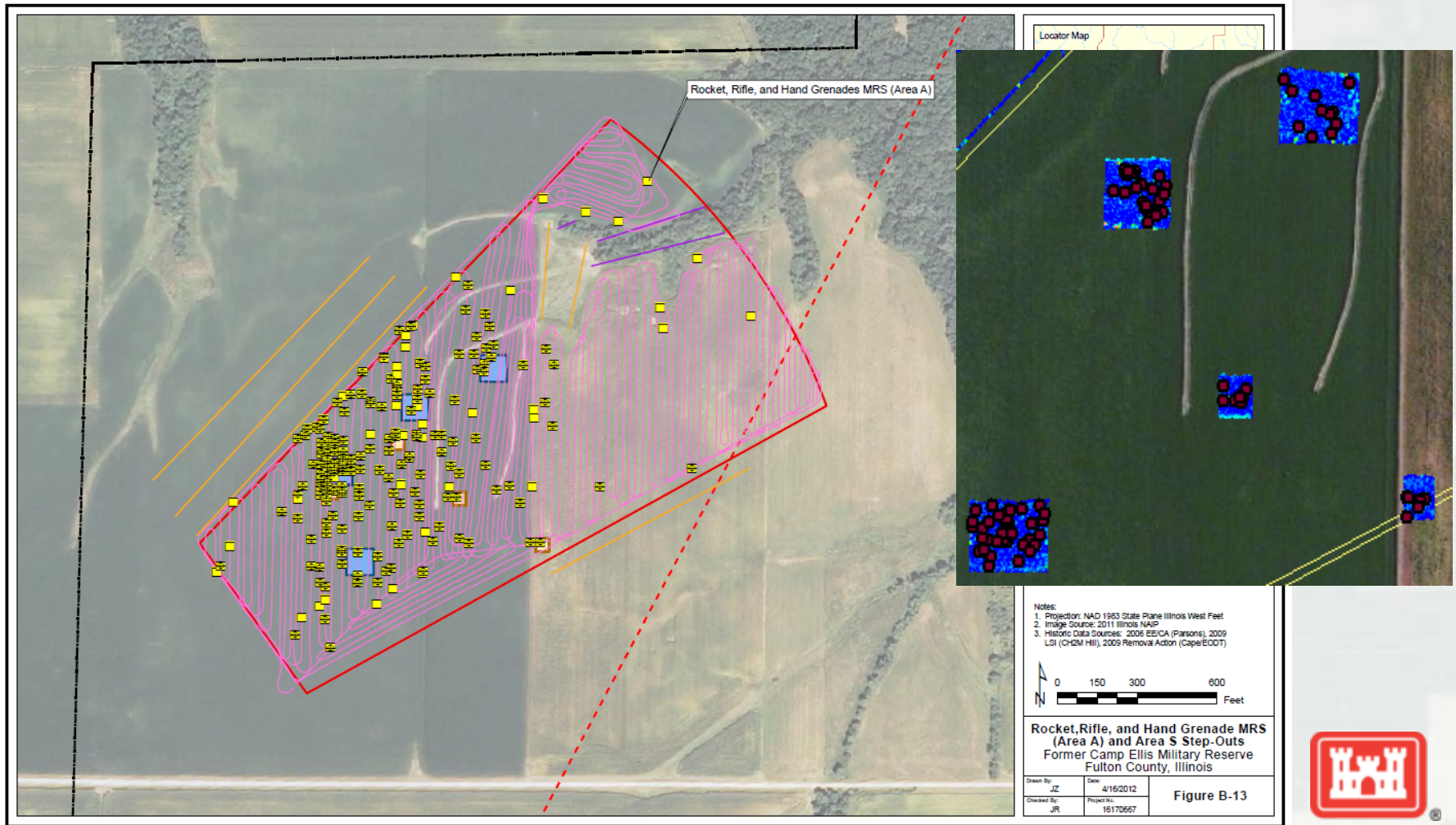
- Selected grid locations based on previous data
- Collected EM61 data for grids and transects
- Characterized the site based on digging a high percentage of anomalies from EM61 data
- Collected MetalMapper(MM) data over targets in a select number of grids

Corps of Engineers

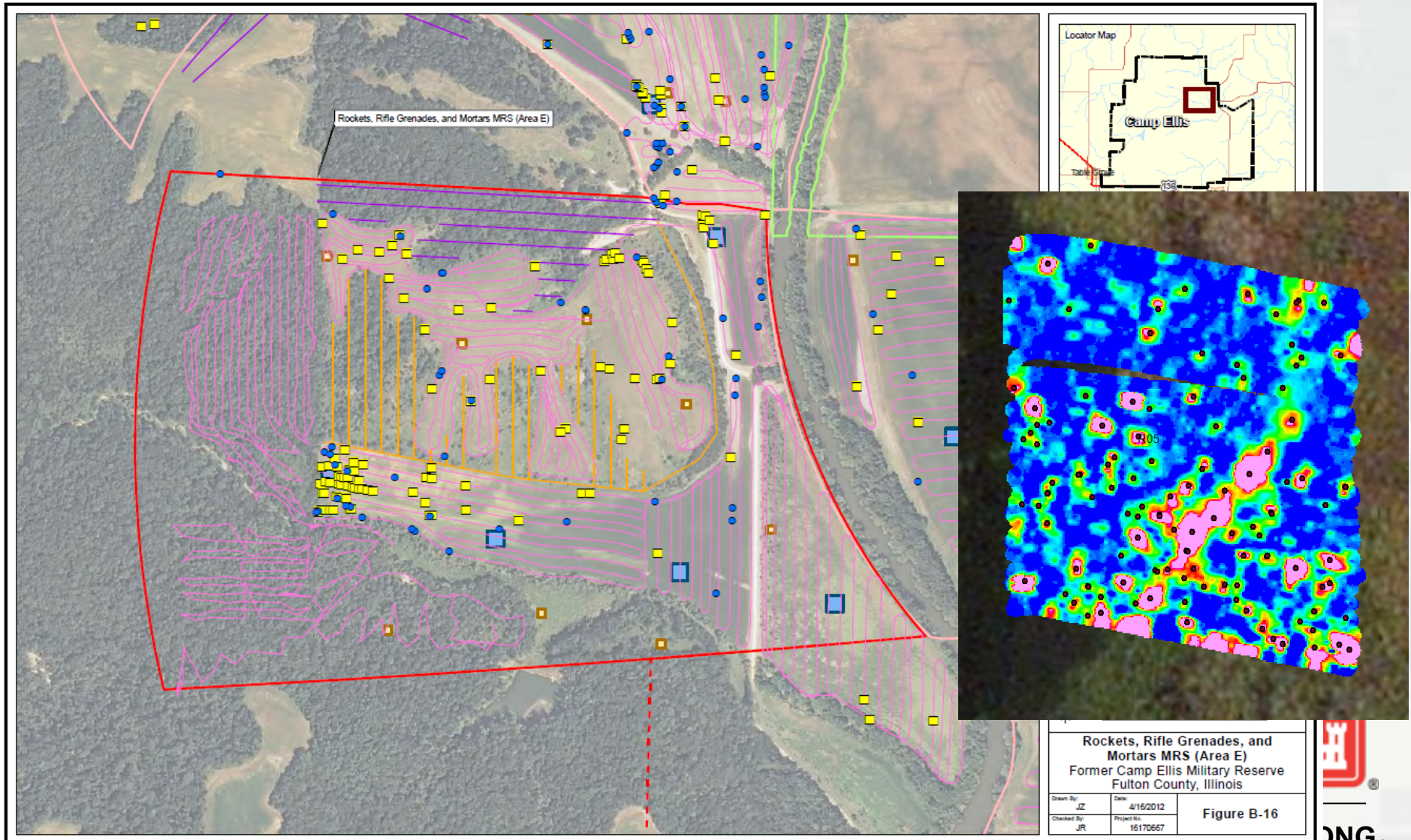
- Processed MM Data
- Requested Ground Truth for specific targets
- Characterized the site based on digging a small percentage of anomalies based on MM data analysis



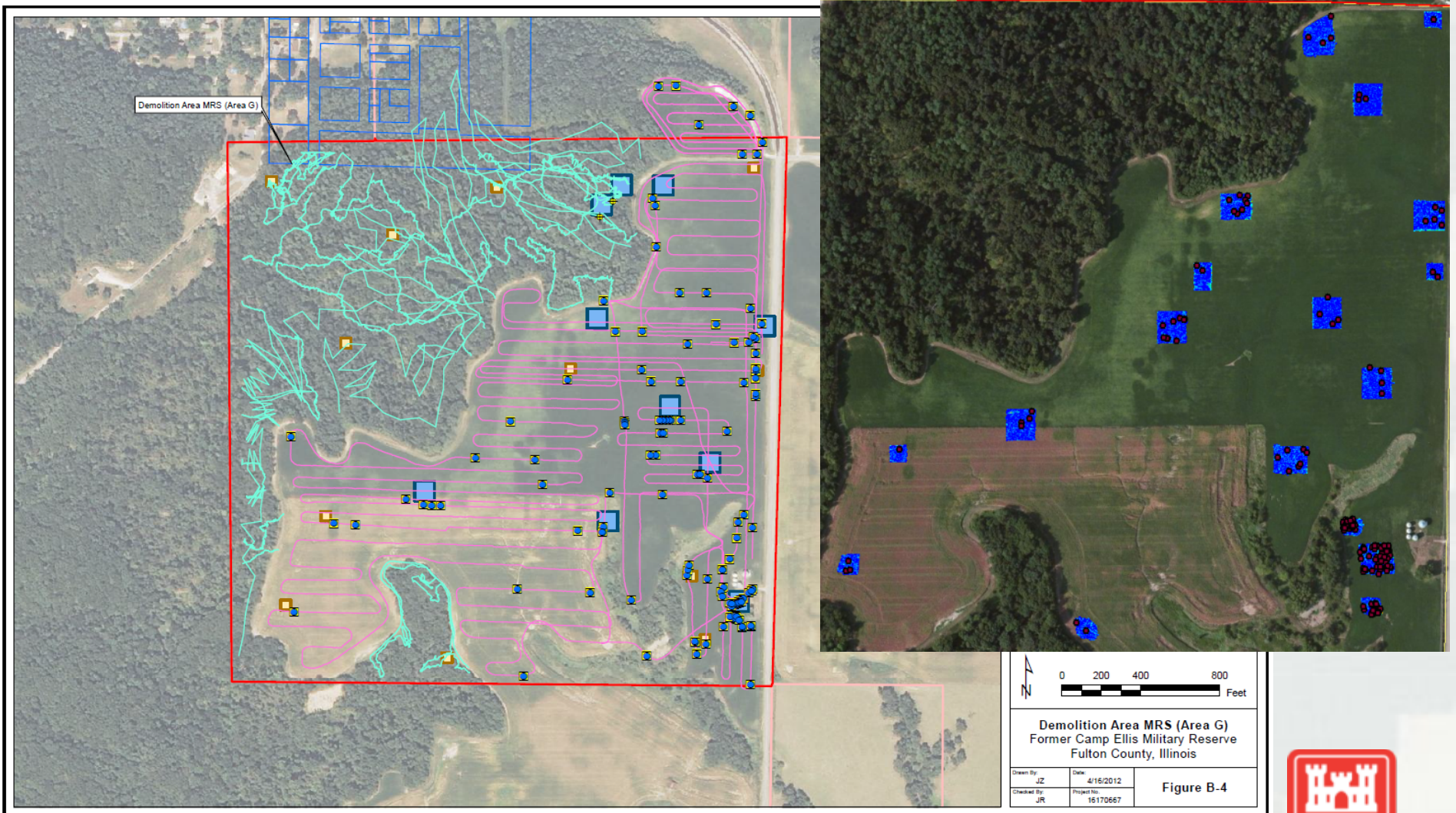
Area A



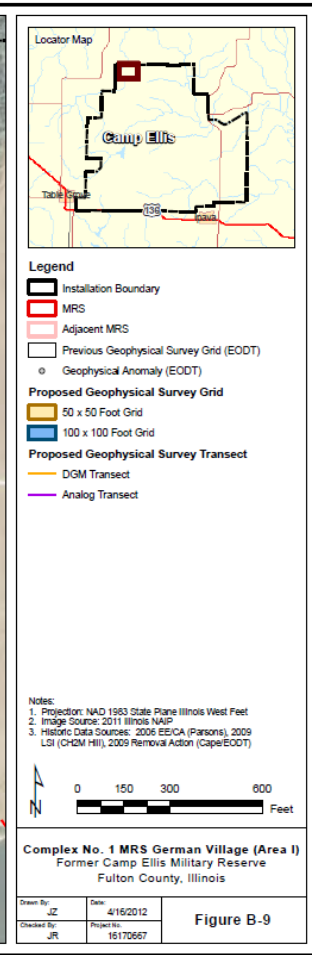
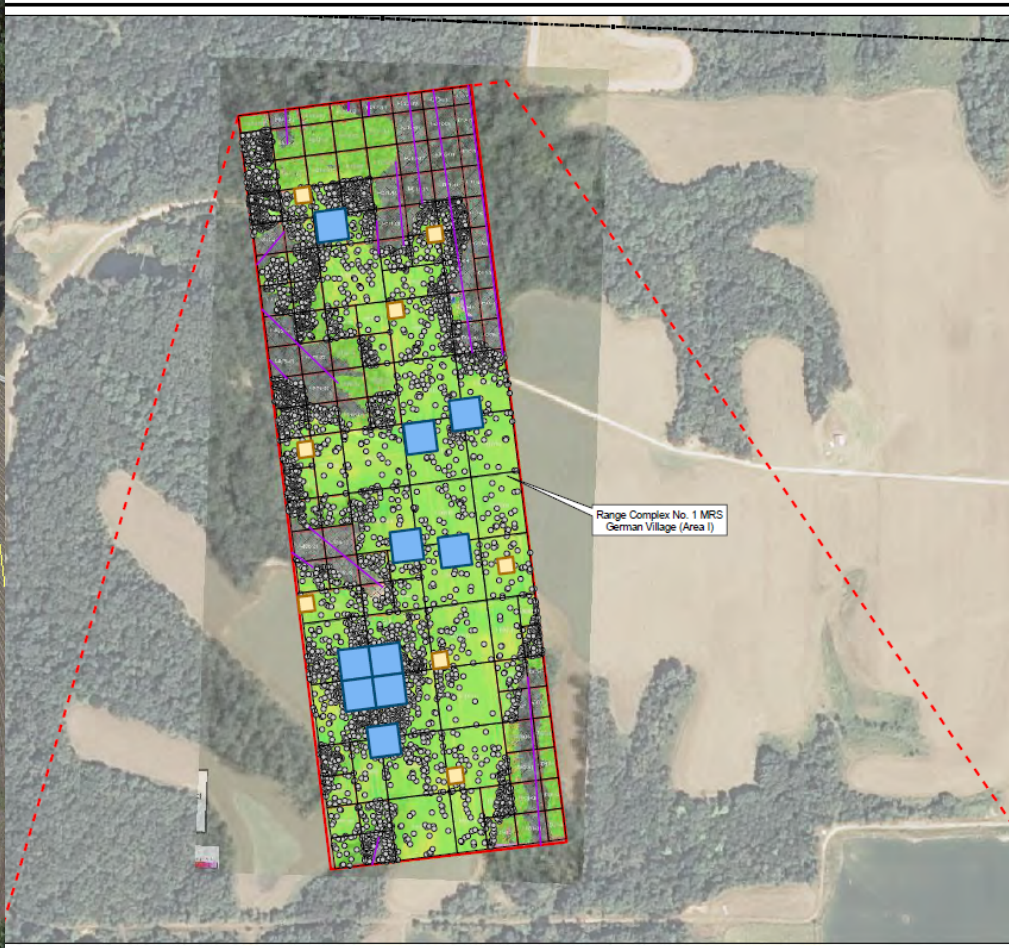
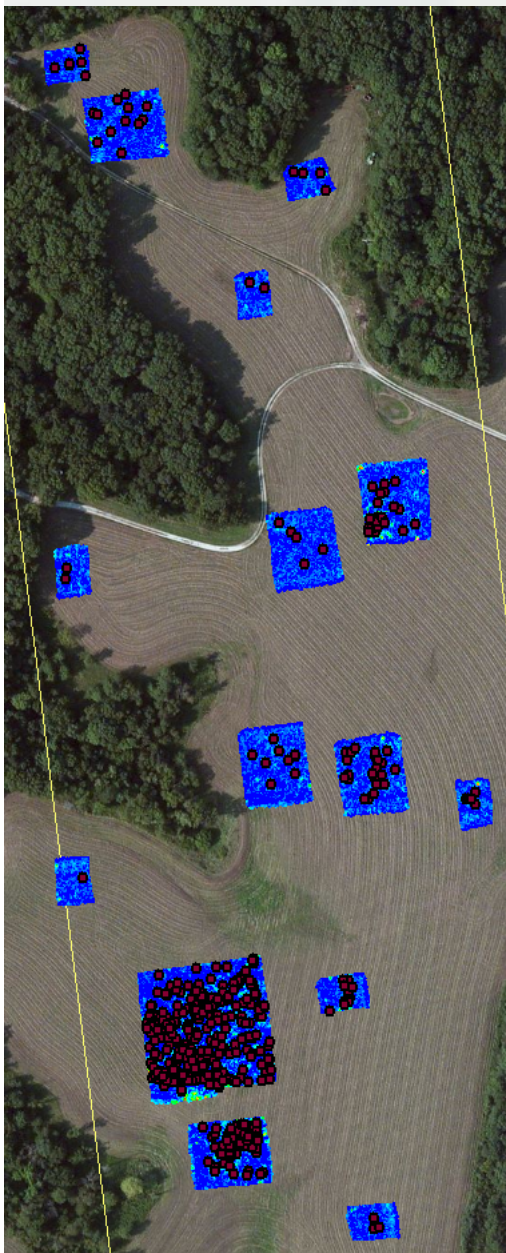
Area E



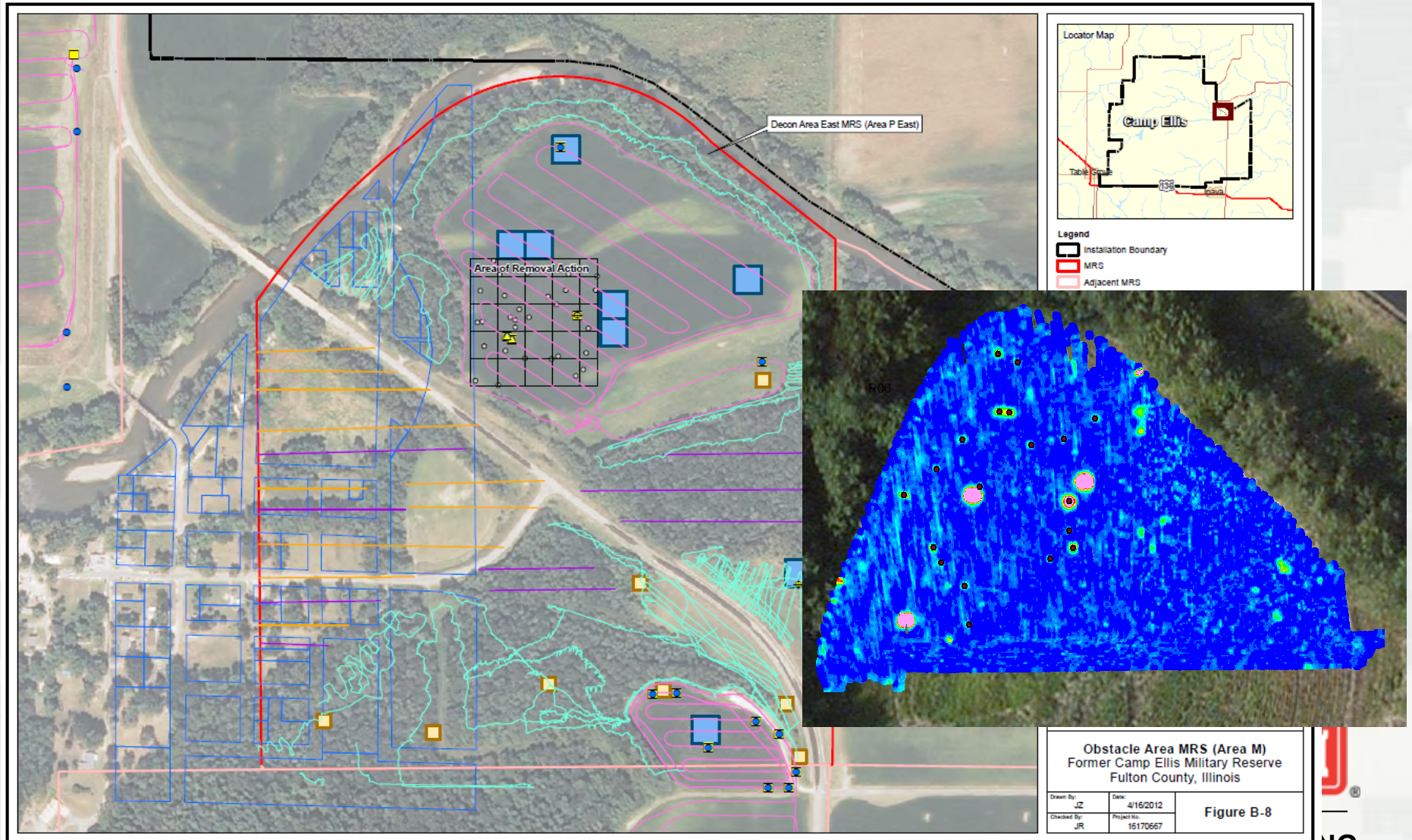
Area G



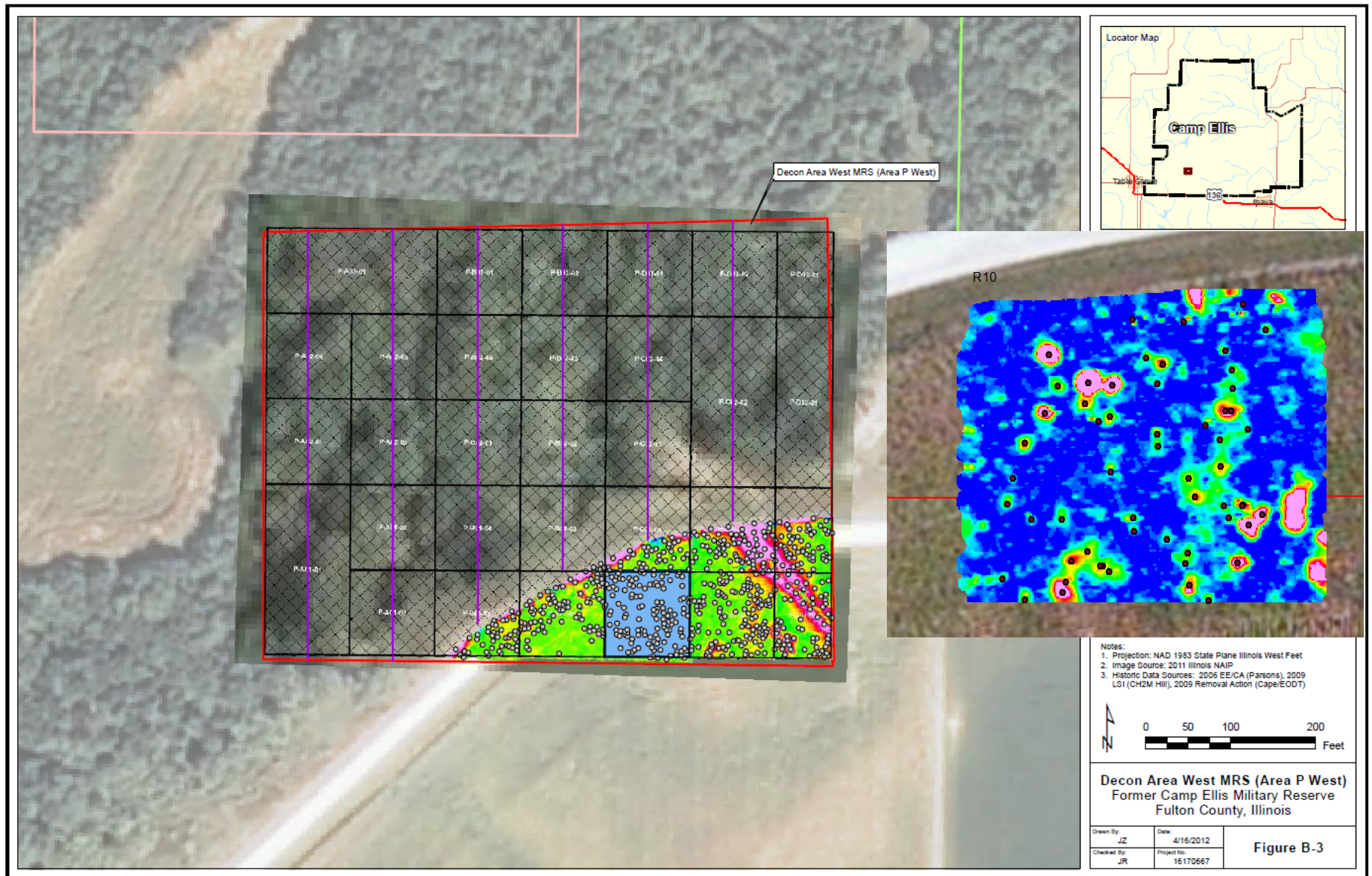
Area I



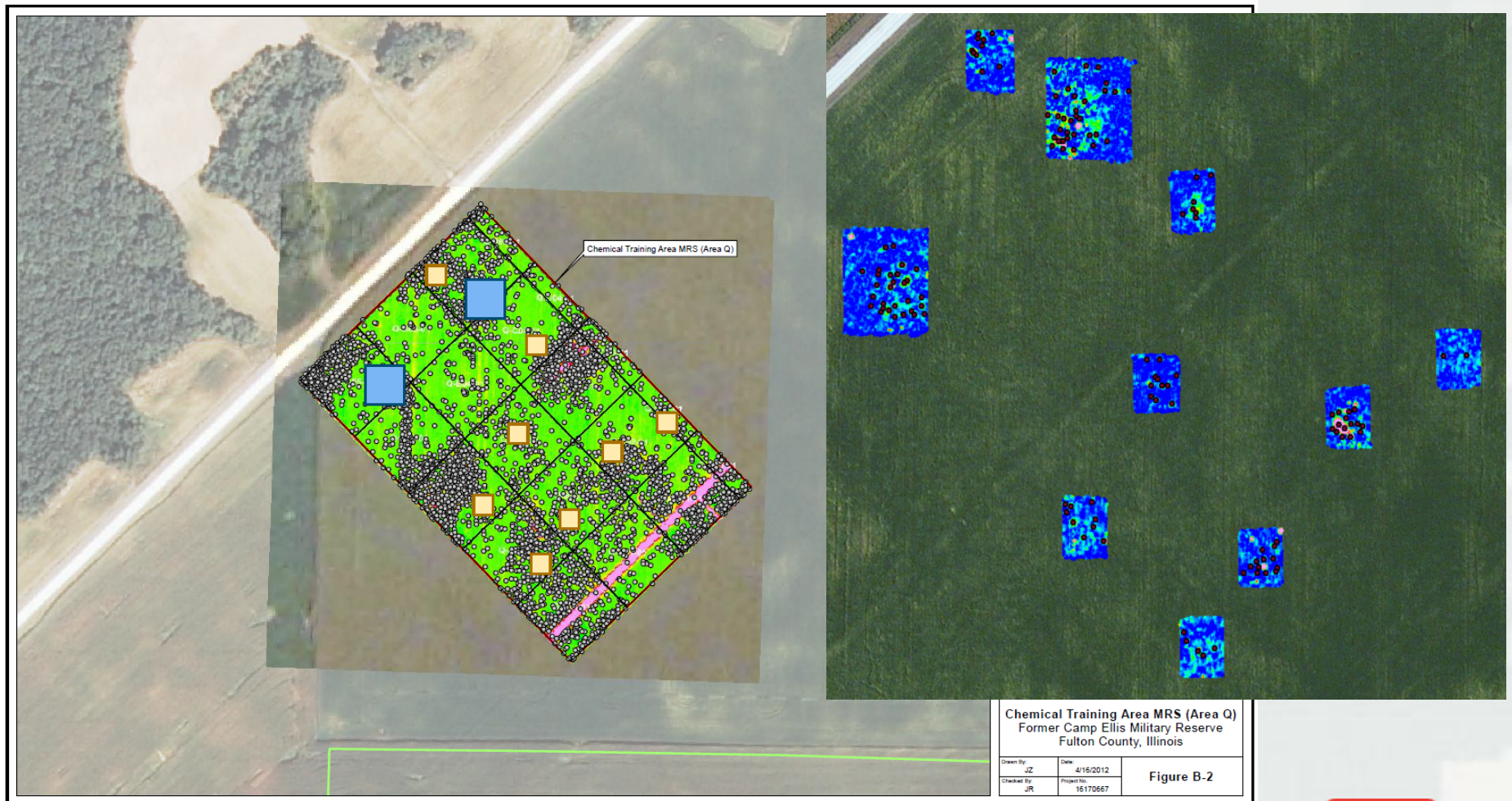
Area M



Area P



Area Q



Classification Strategies

- Clustering (self-match)
- Library Match
- Feature space sampling

Potential Difficulty

- Identifying Frag and other evidence of MEC

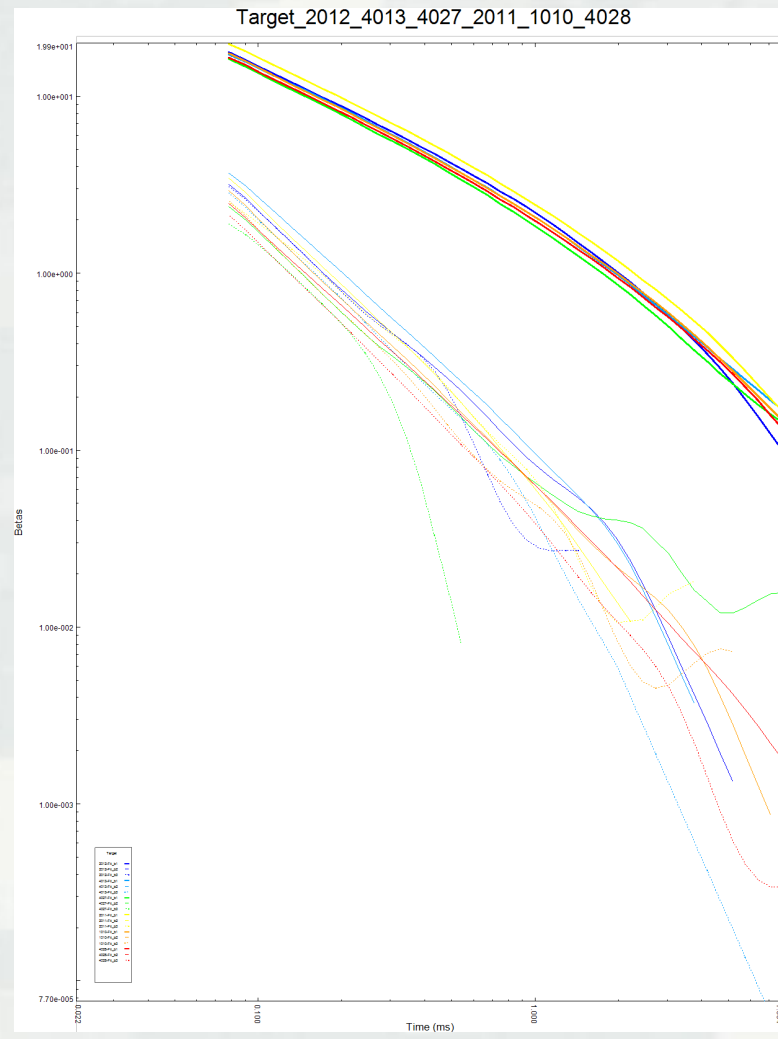
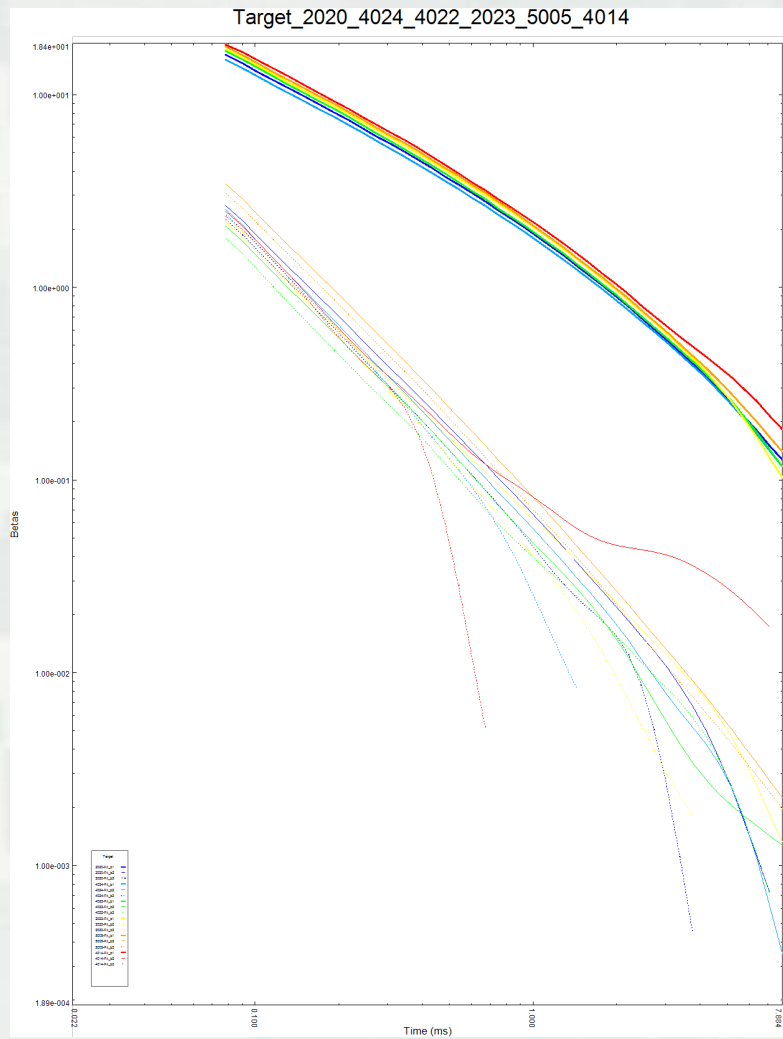


Clustering

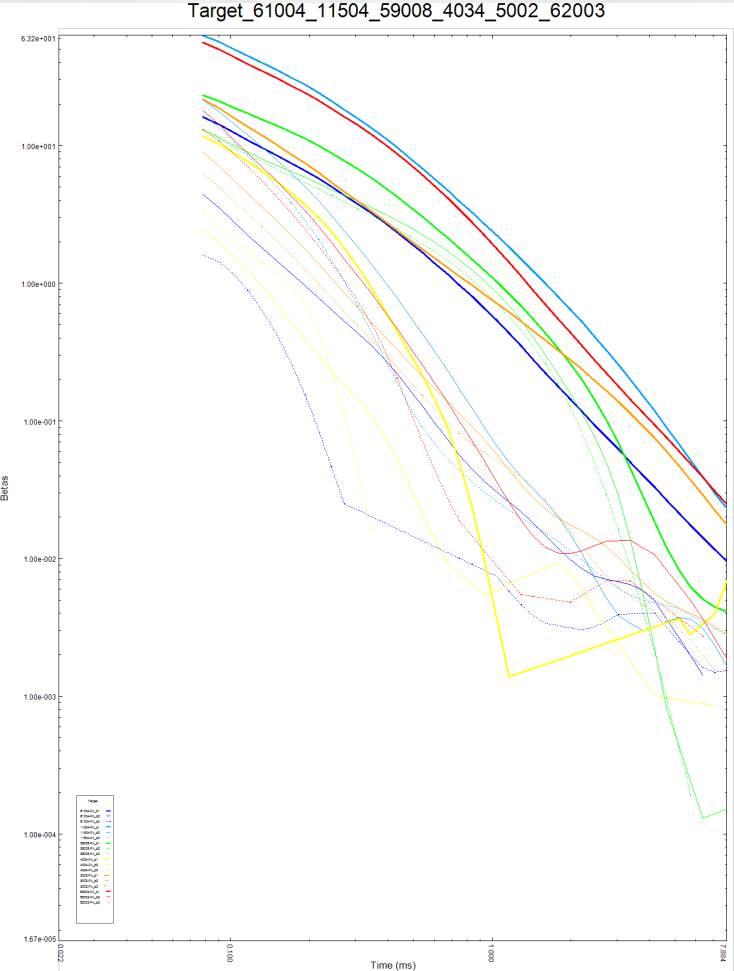
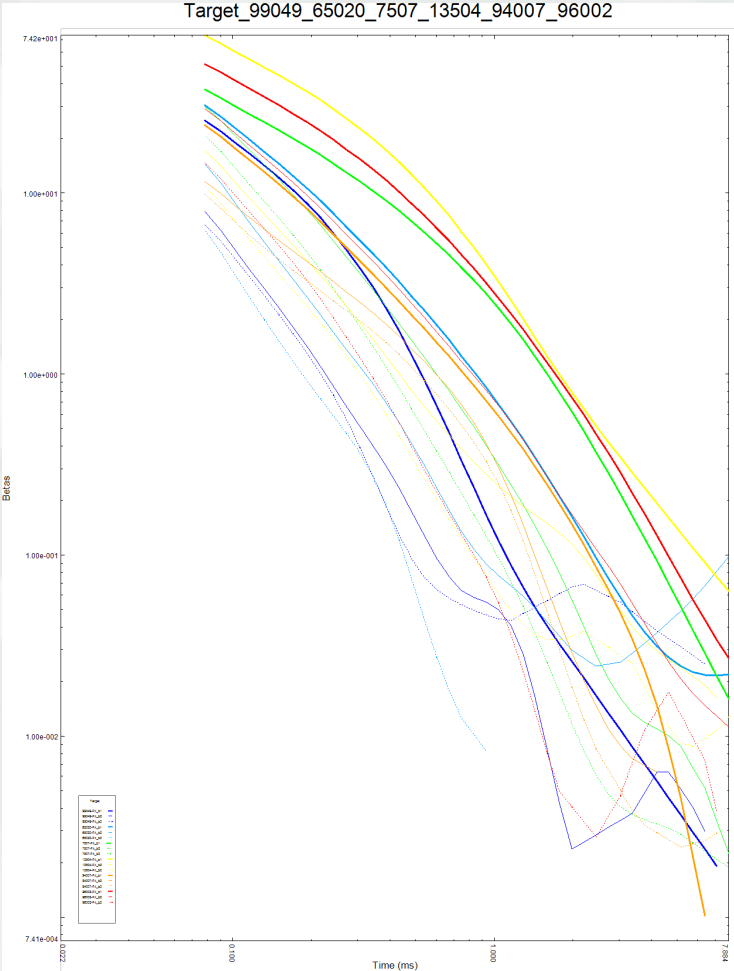
- Match the target database to itself
 - ▶ Who looks like me?
- Current tools in Geosoft make this very difficult
 - ▶ There is no easy way to see top matches
 - ▶ New tools are coming!
- Only had one large cluster of over 40 targets in Area A



Area A Cluster



Rifle Grenades



Library Match

- Ft. Sill Library
 - ▶ 2.36" rockets
 - ▶ Rifle Grenades
 - ▶ MKII Hand Grenades
 - ▶ 3.5" Rockets, 2.75" Rockets
 - ▶ AT Mines
 - ▶ 40mm grenades (removed later)
- Ft. Sill Data
 - ▶ Includes frag and MD

Decision Rules:

- Designed to locate most MEC/ MD-like objects
- 3-curve to Sill Library, Fit Metric $>.65$
- 3-curve to Sill Data (w/ frag) $>.75$
- If one secondary beta is noisy:
 - ▶ 2-curve to Sill Library or Sill data $>.9$
- Take the most conservative answer

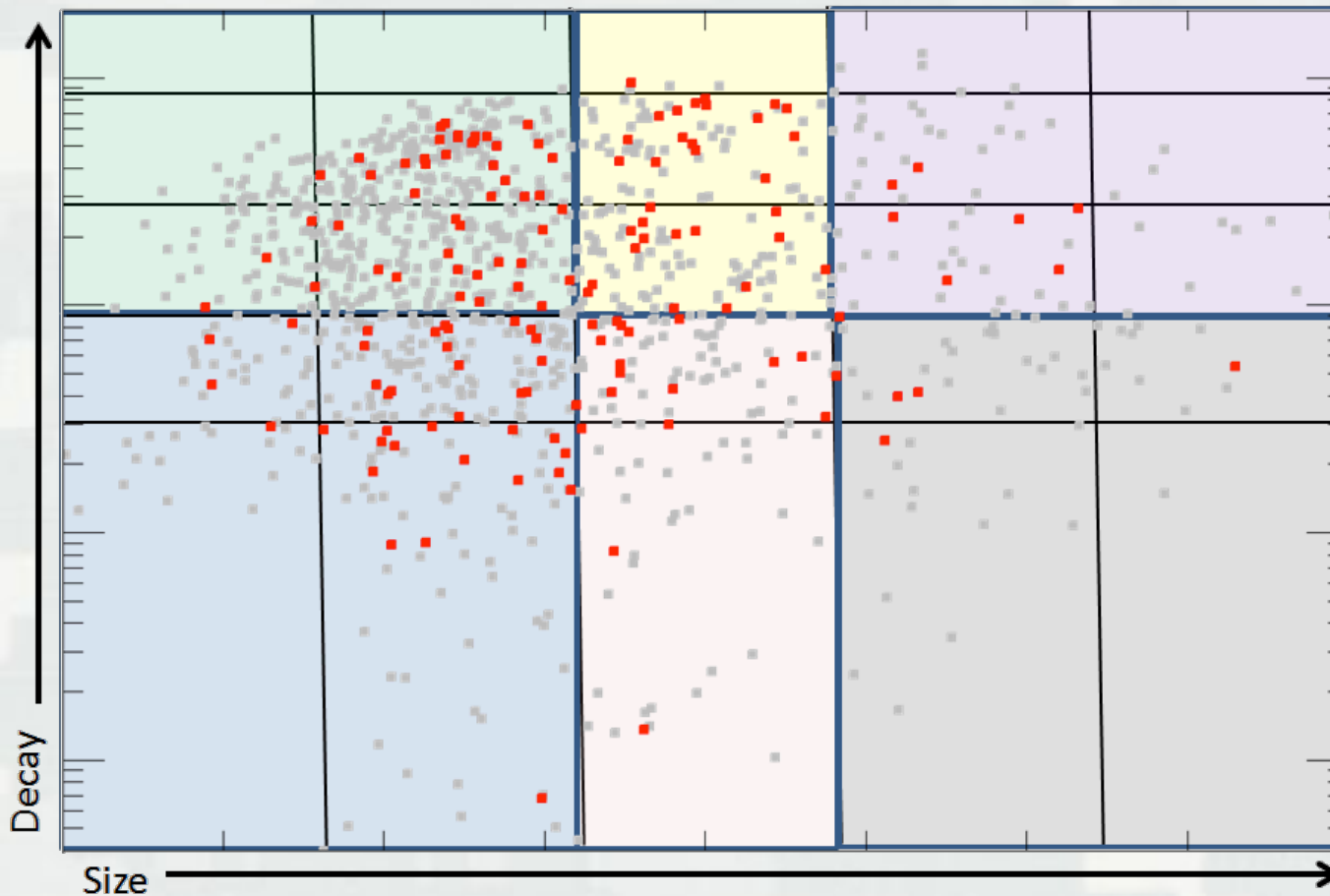


Feature Space Sampling

- Divide Size Decay Feature Space into 6 bins
- Sample $>15\%$ of each general bin
- Sample a high percentage of items that match frag and MD
- Sample axial-symmetric, plate-like, and non-symmetric targets
- Sample shallow and deep targets
- Spread digs out geographically



Feature Space



>15% per colored bin

Placed a priority on matches to frag and MD

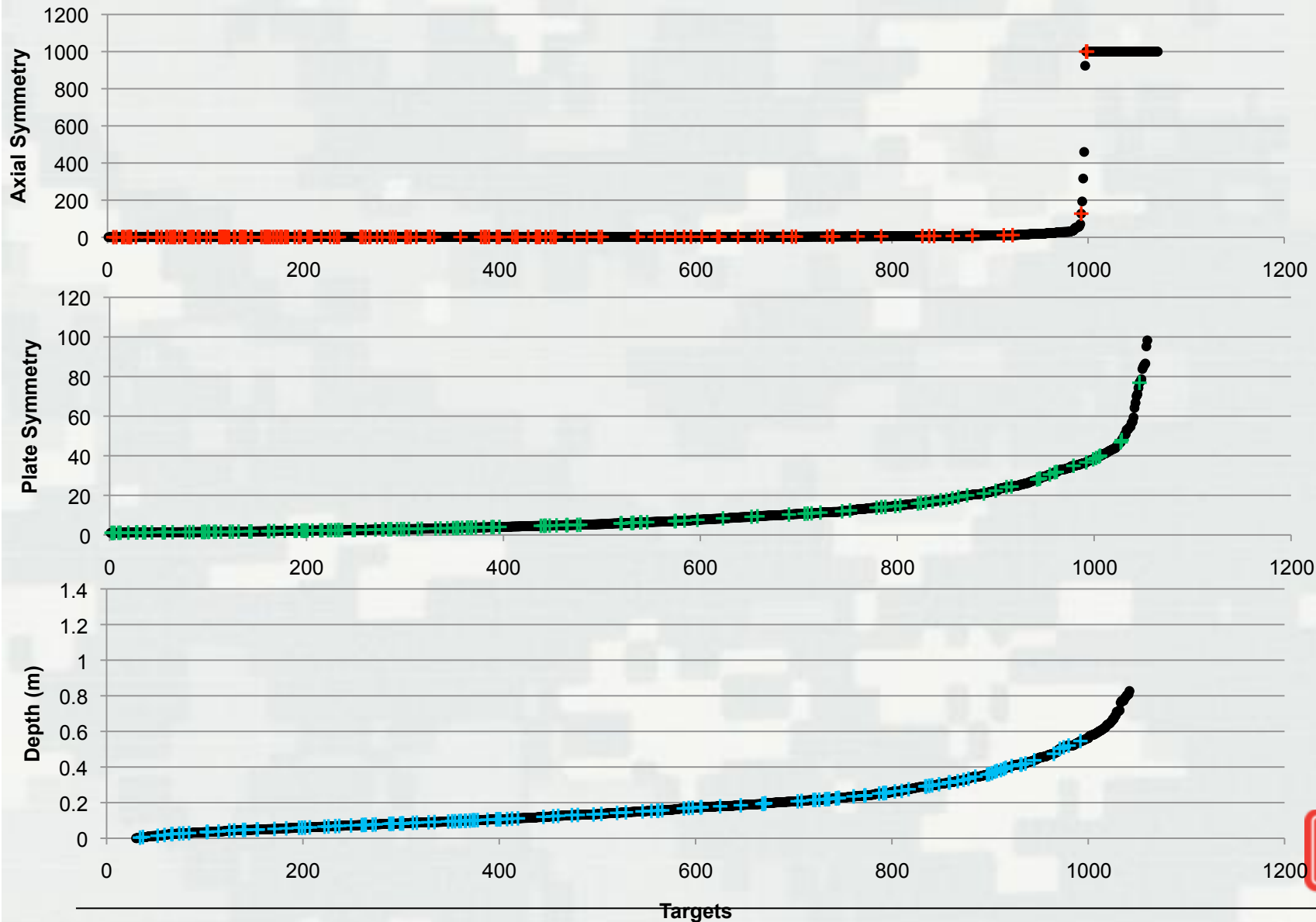
Added matches to TOI after seed items were checked

■ = Requested Ground Truth



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Other Feature Sampling



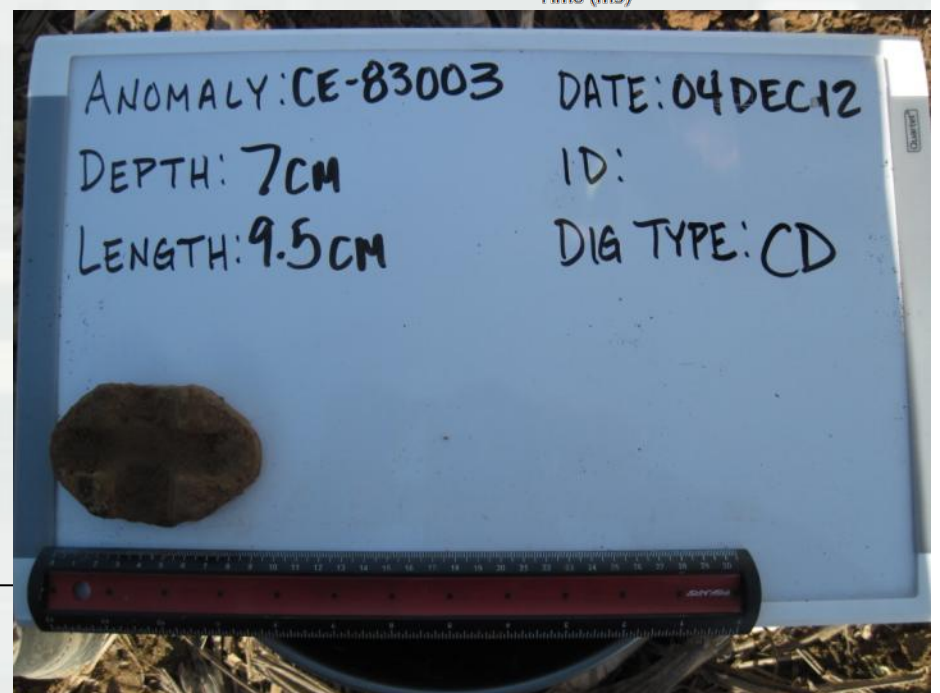
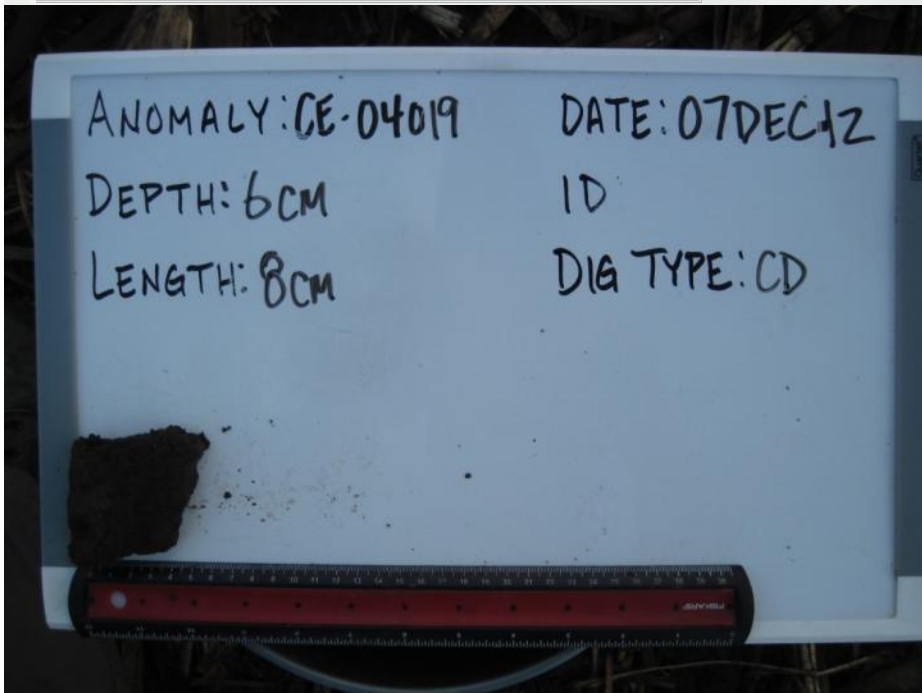
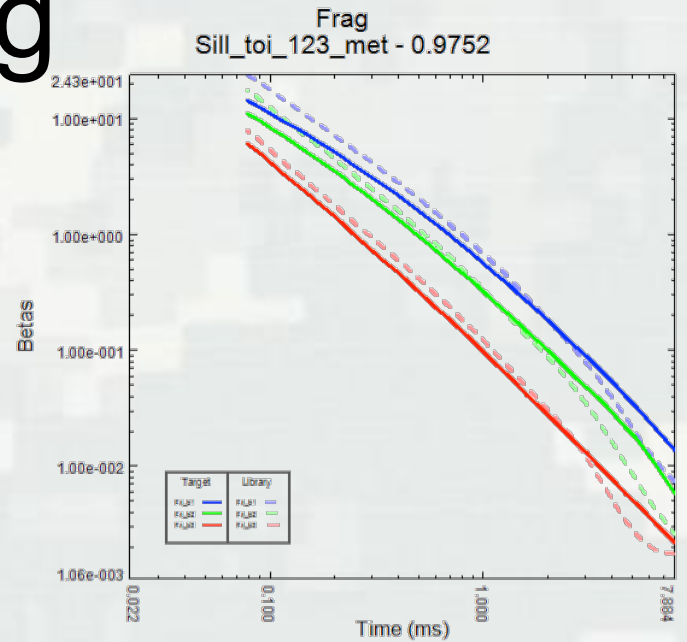
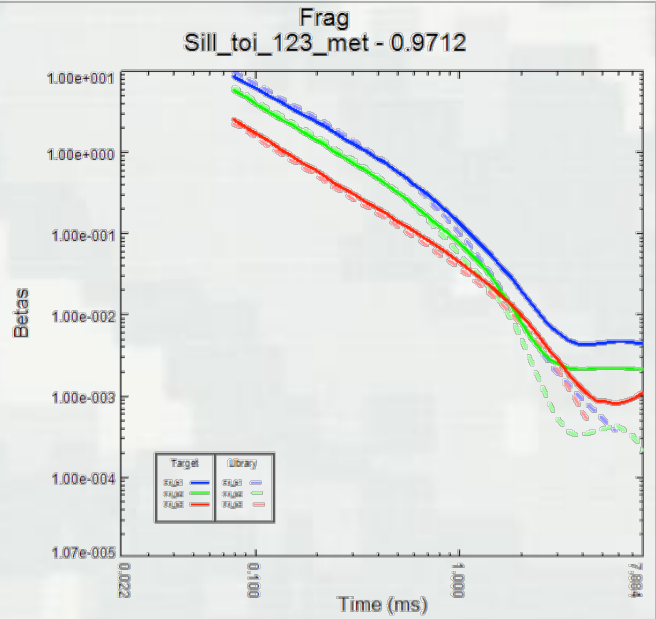
Targets

Ground Truth Request

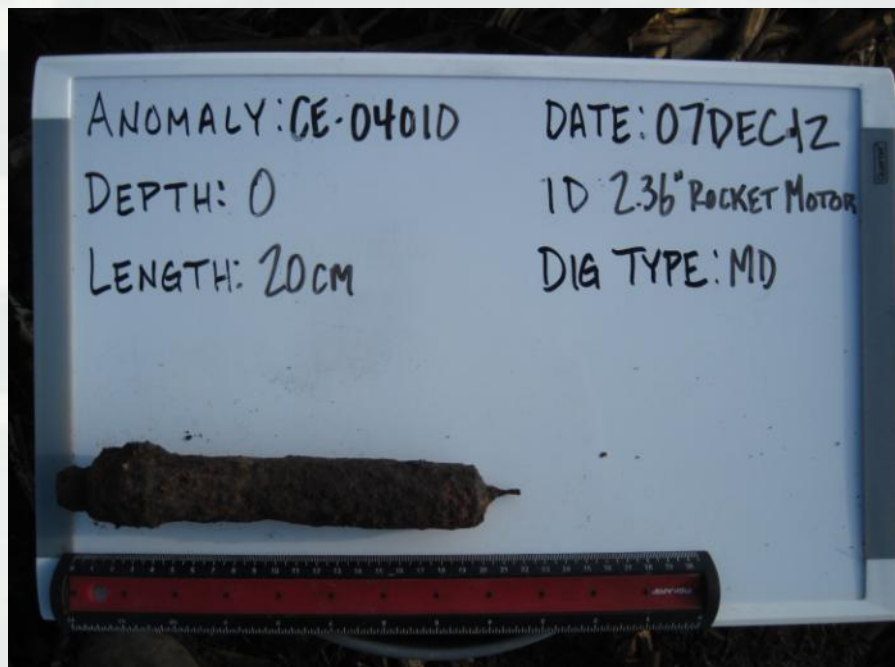
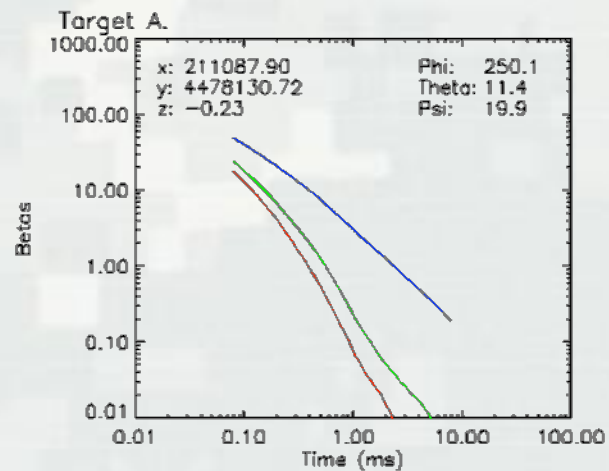
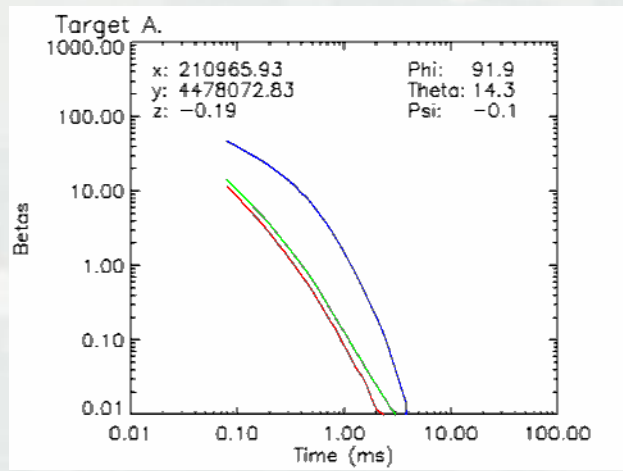
- Focused on:
 - ▶ Matches to Frag
 - ▶ Matches to MD (motors, warheads, etc.)
 - ▶ Cluster in Area A
 - ▶ Library matches to MEC near threshold
 - ▶ Symmetric items that didn't match library
 - ▶ Verification of good matches
 - ▶ Sampling each bin within Size/Decay Feature Space



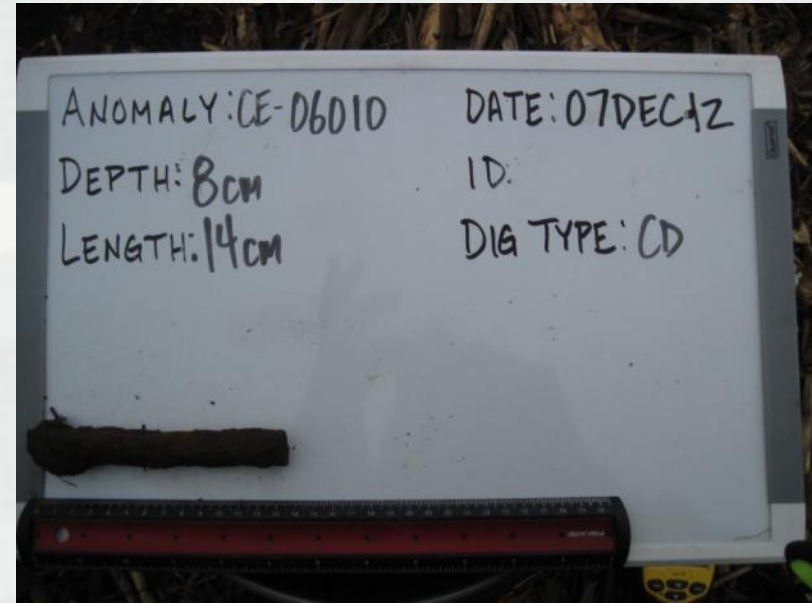
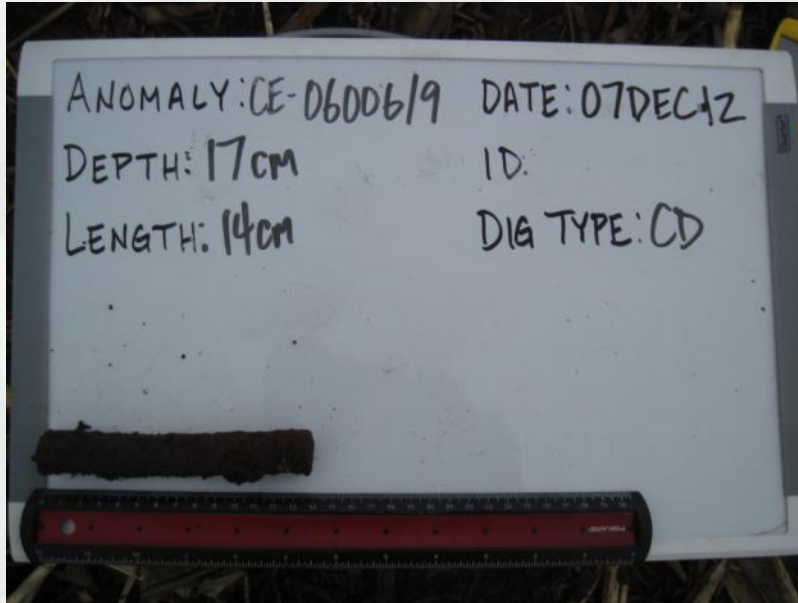
No Frag



MD in Area A



Cluster in Area A



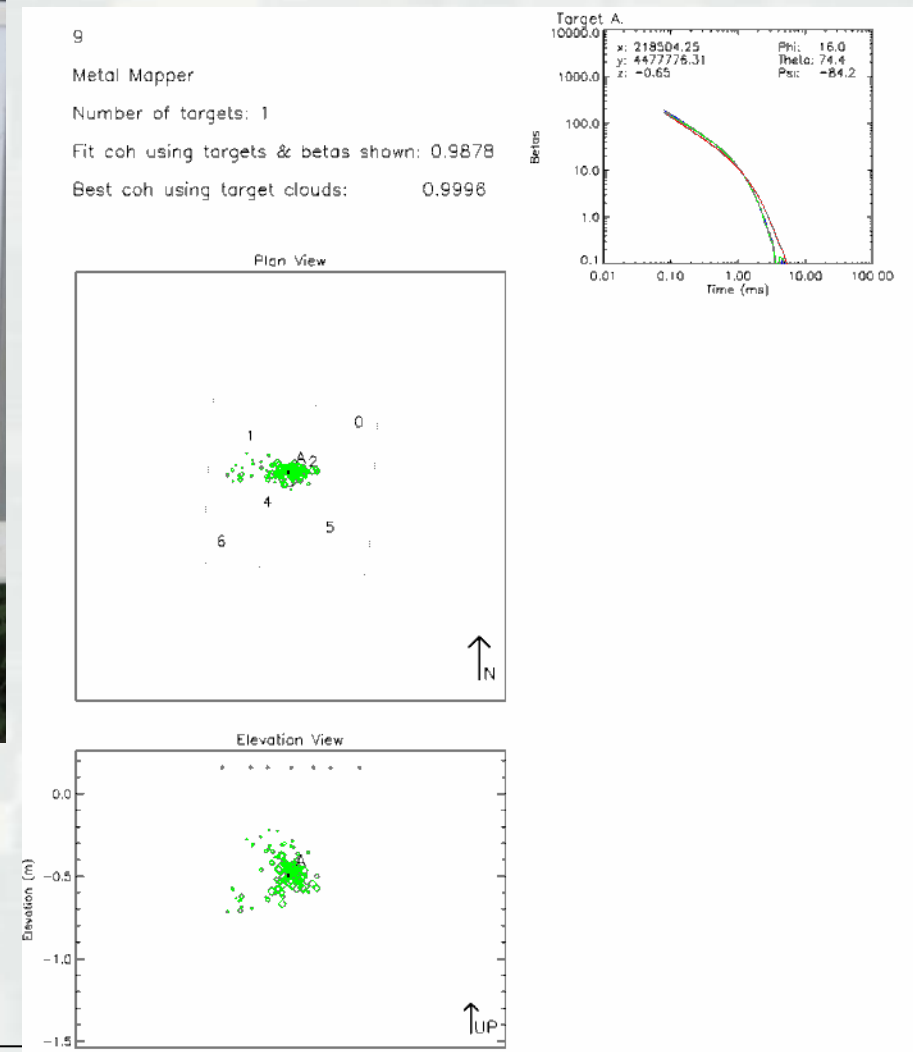
These were initially classified as CD but have since been reclassified as MD. They are weight bars from 2.36" practice rockets.



M4 Land Mine with Live Fuze



- Classified as Disc Shroud
- Placed on Dig List because of its size/decay-group and plate-like symmetry
 - Large and Thick, Group 14
 - Plate Symmetry = 1.03



Characterization Comparison

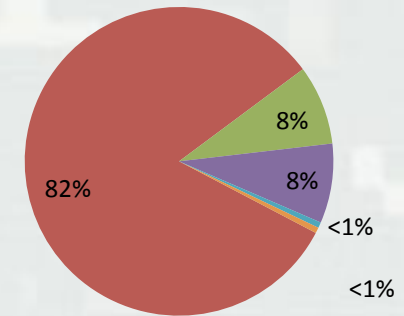
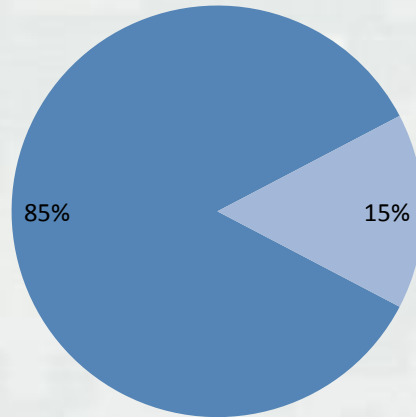
Area	Targets	URS Results					COE Results				
		Digs	MEC	MD	CD	Characterization	Digs	MEC	MD	CD	Characterization
A	88	87	0	60	19	Practice 2.36" Rocket Range, no MEC Hazard	19	0	6	12	Practice 2.36" Rocket Range, no MEC Hazard
E	121	111	0	0	110	No MEC hazard	31	0	0	31	No MEC hazard
G	151	151	0	1	124	1 small arms cartridge, no MEC hazard	32	0	0	27	No MEC hazard
I	499	222	0	0	19	No MEC hazard	62	0	0	59	No MEC hazard
M	19	19	1	0	17	Practice Mines, possible live fuzes	3	1	0	2	Practice Mine, possible live fuzes
P	58	57	0	0	50	No MEC hazard	13	0	0	12	No MEC hazard
Q	134	83	0	0	83	No MEC hazard	23	0	0	22	No MEC hazard



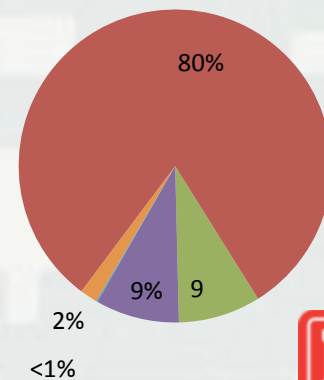
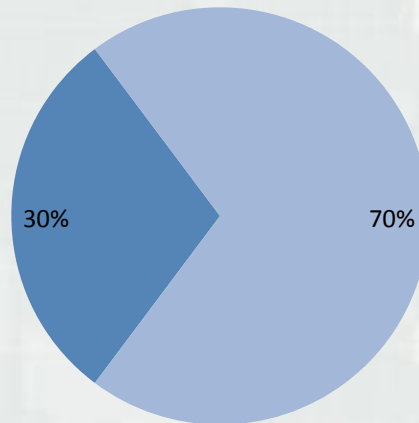
Ground Truth Comparison

No Dig CD Seed MD MEC No Contact

Characterization through Classification



Traditional Characterization



Conclusions

- Sampling based on a combination of library matches and features of modeled targets produced the same conclusions as digging
- This process identified MEC and MD that was not in my Library
- Frag is difficult if not impossible to differentiate from CD
 - ▶ The self-match idea didn't work as well as we thought
 - ▶ Expect it could work better for different munitions

