Technical Alternatives For Subsurface Removal In Areas Of High Anomaly Densities Associated With Impact Areas Where Military Munitions with Sensitive Fuzes Were Fired.

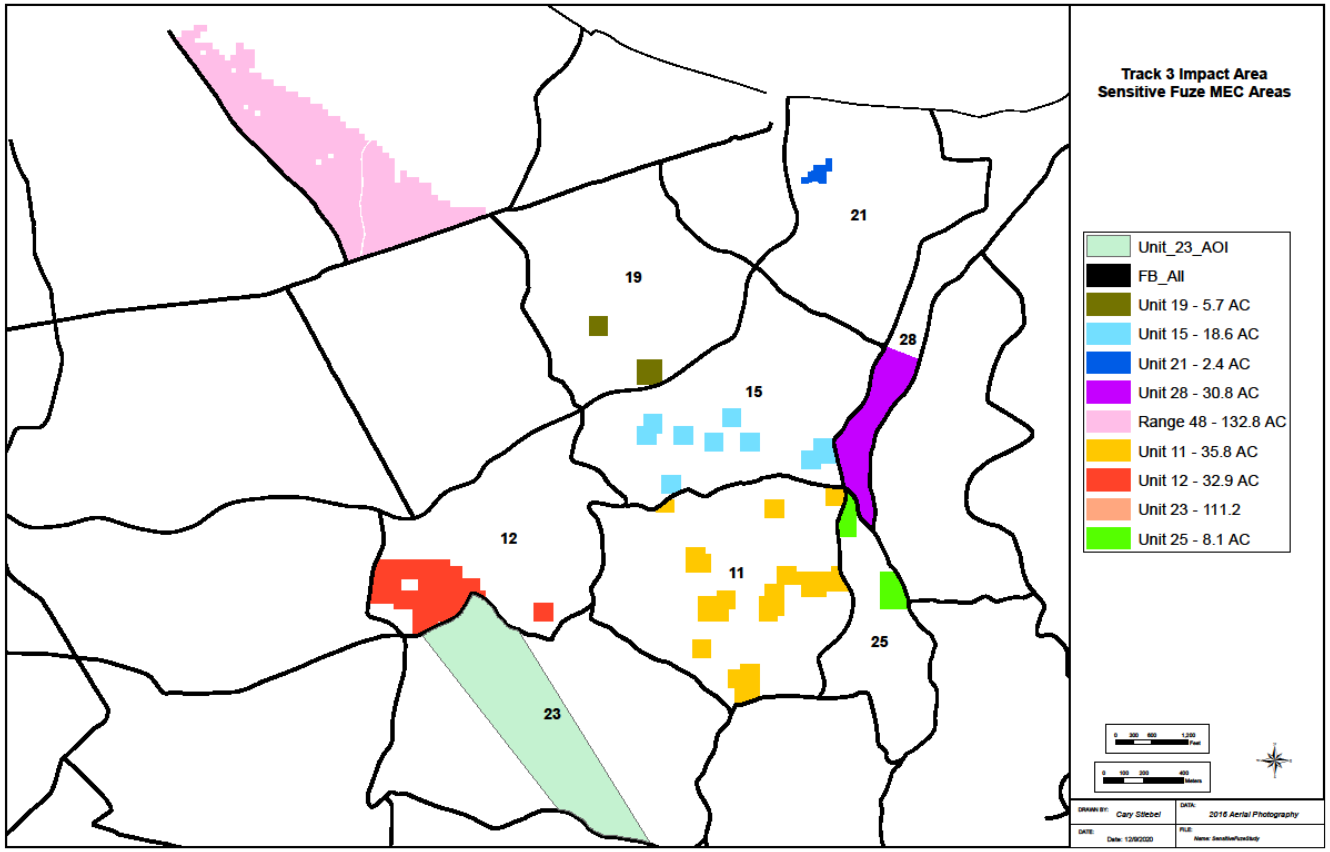
Track 3 Impact Area Munitions Response Area

Former Fort Ord, California

Fort Ord BCT Meeting September 17, 2021

Presentation Outline

- Recap from February BCT presentation.
- Summary of evaluation to date
- Summary of Technical Alternatives
- Additional phase of field study (planned) and next steps



Acronyms

- **AGC**: advanced geophysical classification
- **BCT**: BRAC cleanup team
- **BLM**: Bureau of Land Management
- **CSM**: Conceptual Site Model
- **DGM**: digital geophysical mapping
- **EMI**: electromagnetic induction
- **ESTCP**: Environmental Security Technology Certification Program
- **HE**: high explosive
- **MRA**: Munitions Response Area
- **MRS**: Munitions Response Site
- **MSFFS**: Munitions with Sensitive Fuzes Field Study
- **RI/FS**: Remedial Investigation/Feasibility Study
- **ROD**: Record of Decision
- **UXO**: unexploded ordnance

Recap from February BCT presentation

Under Track 3 ROD: "…subsurface removal will be conducted in selected areas identified to address specific risk and/or land use needs."

Where We Started

A total acreage of ≈ 380 acres that met:

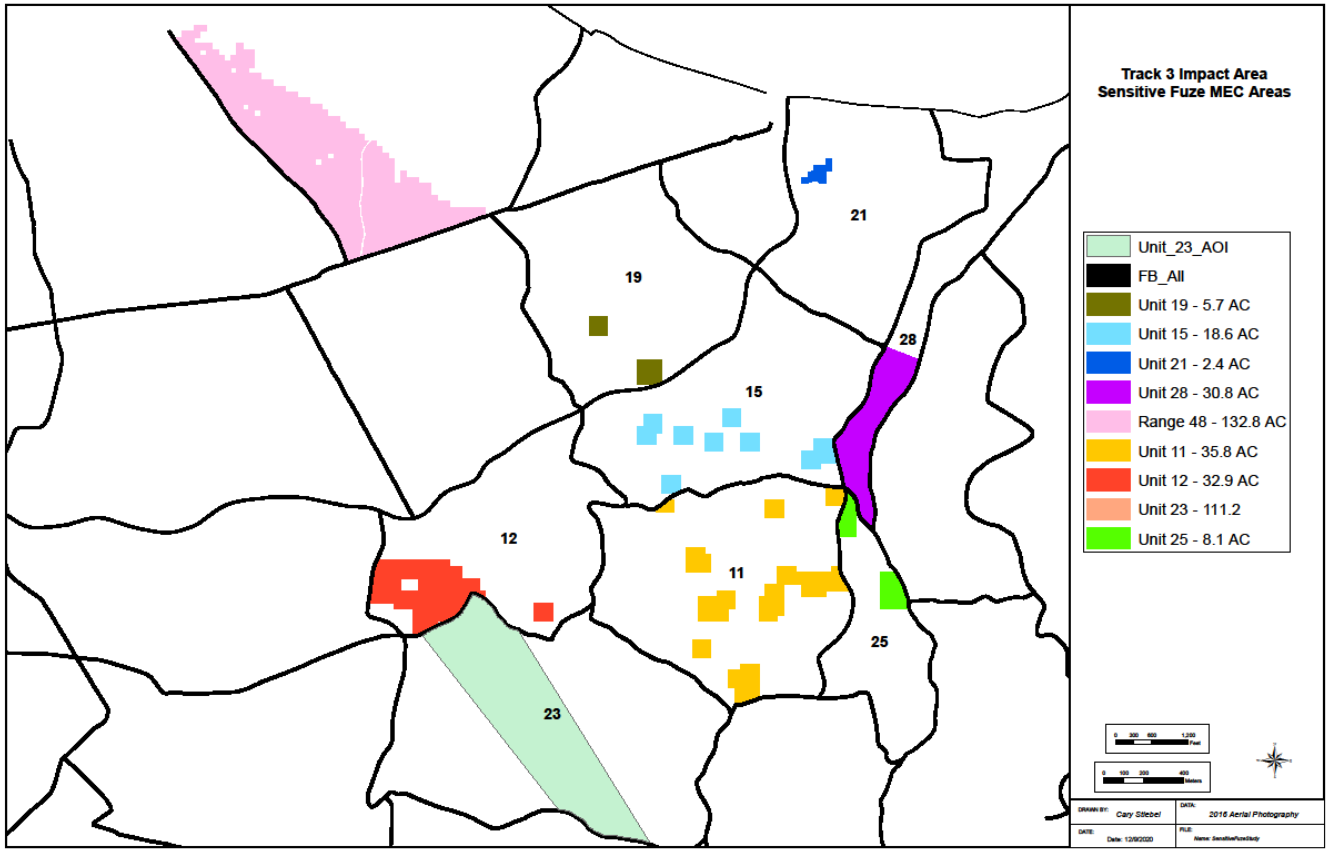
1. UXO of sensitive fuze-type were recovered during surface removal
2. DGM data show a high density of subsurface anomalies (> 900 anomalies/acre)

What Was Needed

1. A well-defined risk to be addressed:
   - BLM workers potentially encountering sensitive fuze-type UXO that could have become exposed from erosion or changes in site conditions.
2. Evaluation of the CSM at each of the areas identified
3. Anomaly density estimates to evaluate feasibility of subsurface removal alternatives

Progress Since February BCT Presentation

1. Further evaluated site-specific CSM and relative priorities based on the potential for subsurface sensitive fuze-type UXO to be present.
2. Evaluated AGC as a technical alternative to sifting based on regulatory feedback from February BCT meeting.

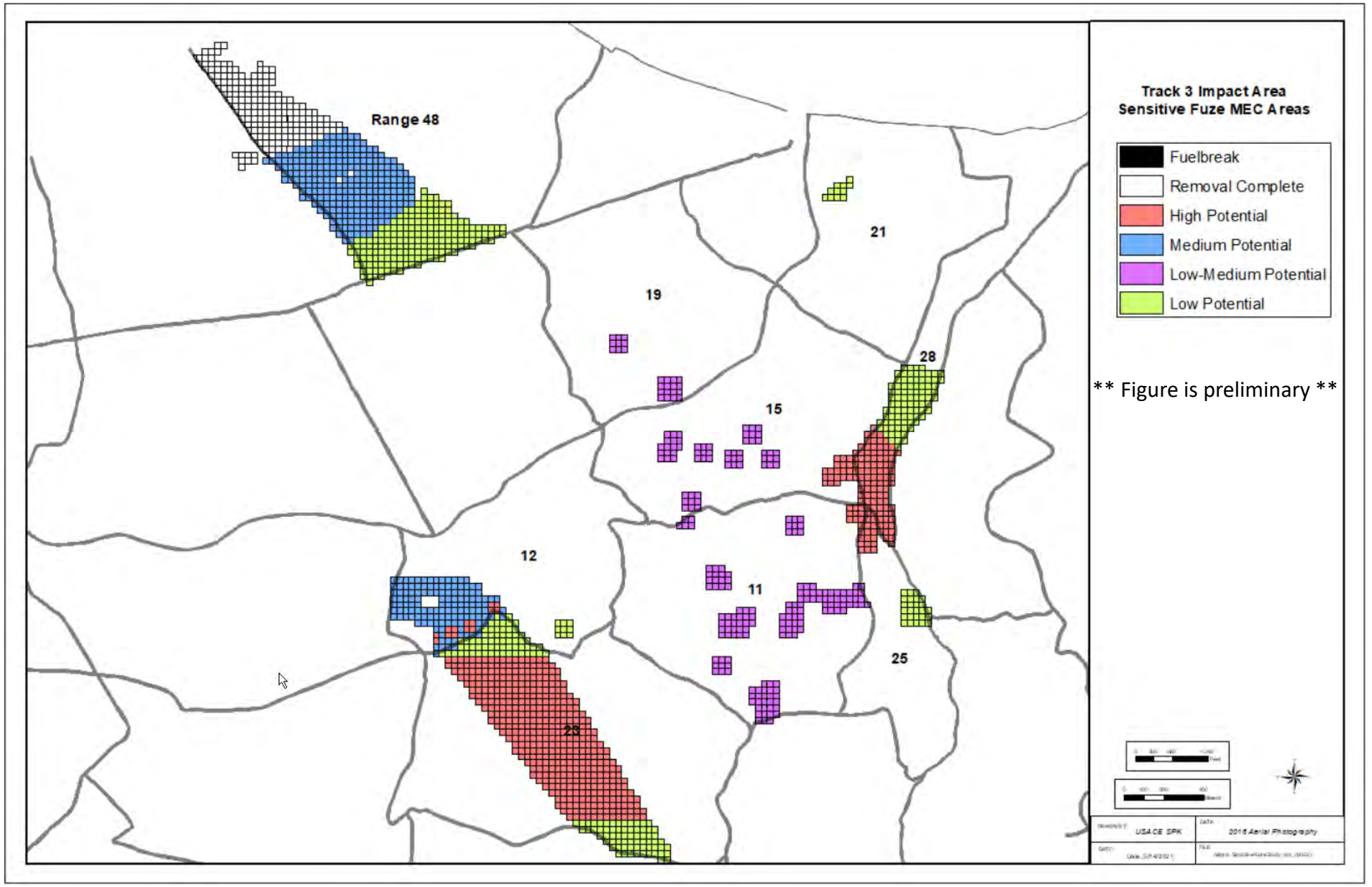


Site-Specific CSM and Potential for Sensitive-Fuze Type UXO

- Due to the historical overlapping uses of ranges, high density of anomalies in the preliminarily identified areas is not directly indicative of elevated likelihood of subsurface presence of sensitive fuze-type UXO.
- Identified areas are largely consistent with CSMs described in the RI/FSs (no new range that used sensitive fuze-type munitions).
- Outside of dedicated, constructed 40mm ranges, the majority of subsurface sensitive fuze-type 40mm UXO items (if present) would be expected to be near the surface, no deeper than 6-in. depth.
- Areas were further broken down based on their **potential for subsurface sensitive fuze-type 40mm UXO items to be present**.

Range	Area	Relative Potential for Subsurface Sensitive Fuze-Type UXO
Range 30A	Firing point to 400m target area	Low
	400m to 1,100m target area	High
	1,100m target area to Nowhere Road	Low
	1,500m target area in southwest portion of Unit 12	High
	Beyond the 1,500m target areas in Unit 12	Medium
Range 32 Attack Helicopter Ranges	Target areas at intersection of Riso Ridge x Hawkeye	High
	Southern portion of U28	High
	Grids in downrange areas in Units 11, 15, and 19	Low-Medium
Range 48	South of near-surface removal area (previously recovered sensitive-fuze type 40mm UXO)	Medium
	South of near-surface removal area (no previously recovered sensitive-fuze type 40mm UXO)	Low
Range 38	Group of units in U21 near Range 38	Low
Other Areas	Groups of grids in U12 remaining	Low
	Group of grids in Mercury Hill area U11	Low
	Group of grids in U25 across from Steep Road	Low

Site-Specific CSM and Relative Potential for Sensitive-Fuze Type UXO



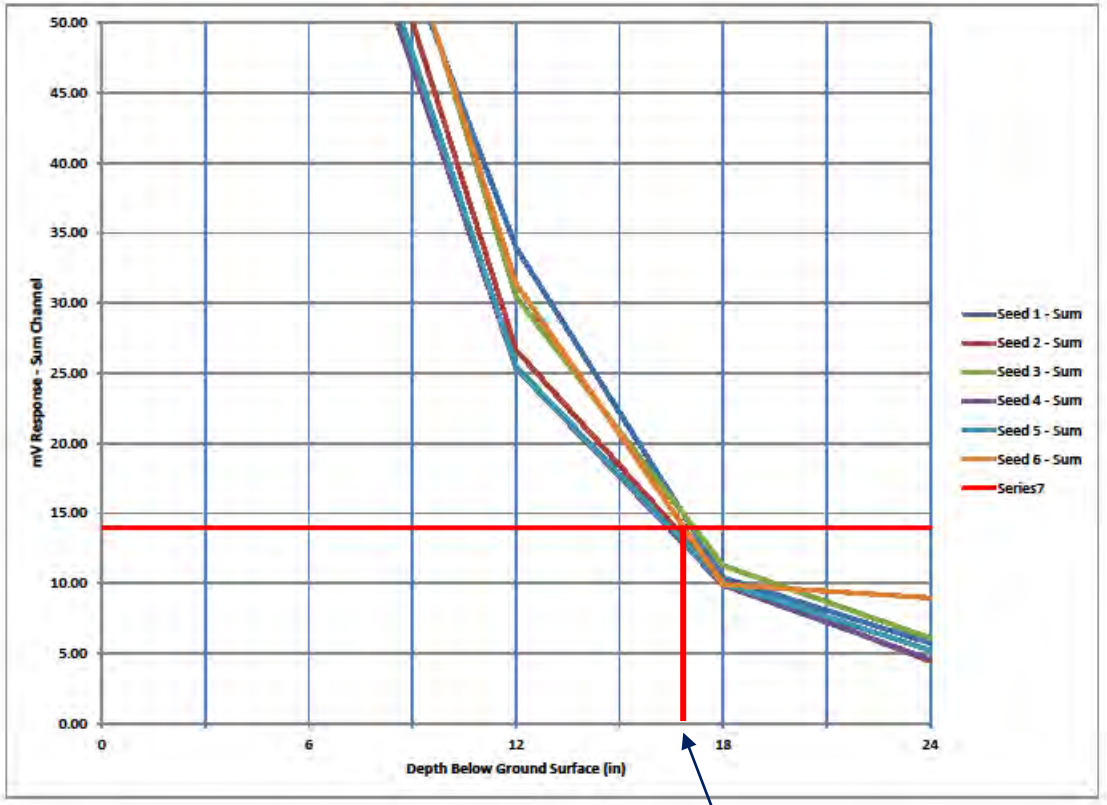
Detection Threshold

"Conclusion: the threshold of **14.0 mV** (Sum4) equates to a **37mm projectile** (horizontal) being at a depth of approximately **16.8 inches** below ground surface." (*Basis for detection threshold for MEC removal at Fort Ord* (OE-0884A))

- Raising threshold to **24.5 mV** (Sum4) equates to a **37mm projectile** (horizontal) at **12 inches** below ground surface.

- A threshold of **24.5 mV** (Sum4) equates to a **40mm projectile** (horizontal) at approximately **7 inches** below ground surface.

- Detection threshold of **24.5 mV** (Sum4) can be used for 40mm projectiles at 0-6in. depth range.



From *Attachment F: mV Threshold Discussion 14.0 mV (sum 4)* in MEC-QAPP (OE-0884A).

16.8 inches

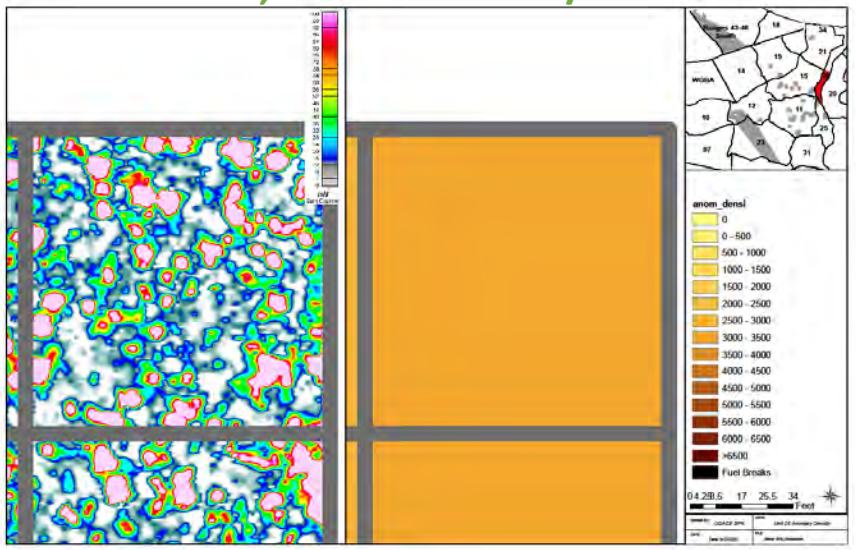
Density Threshold @ 24.5 mV (sum channel)

Threshold estimates come from MSFFS and other projects across the industry

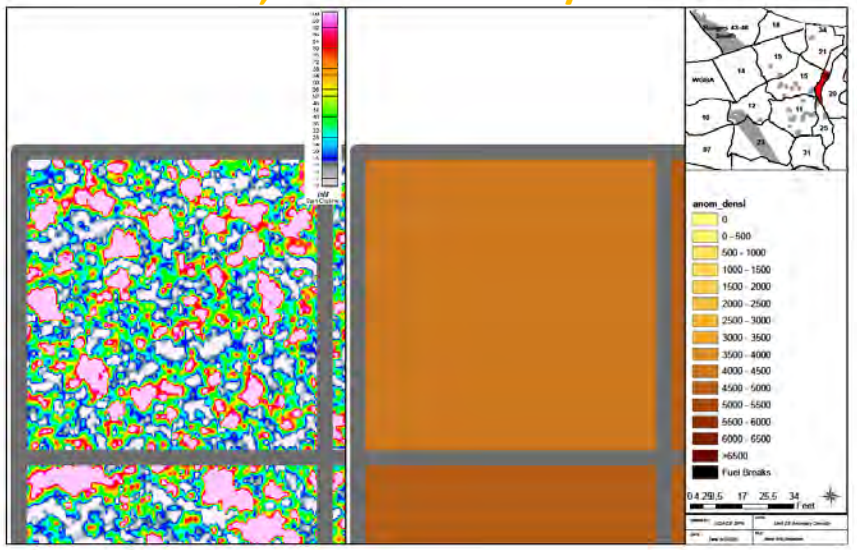
- **Candidate for AGC. High confidence in classification (<3,400 anomalies/acre).**
- **Candidate for "risk reduction" AGC. Potential for missed TOI (3,400 anomalies/acre < 5,500 anomalies/acre).**
- **Candidate for analog removal (>5,500 anomalies/acre). Large portions of area saturated.**

MSFFS identified Grid B2I6J2 where anomaly densities were 5,000-6,000 anomalies/acre and classification was unsuccessful.

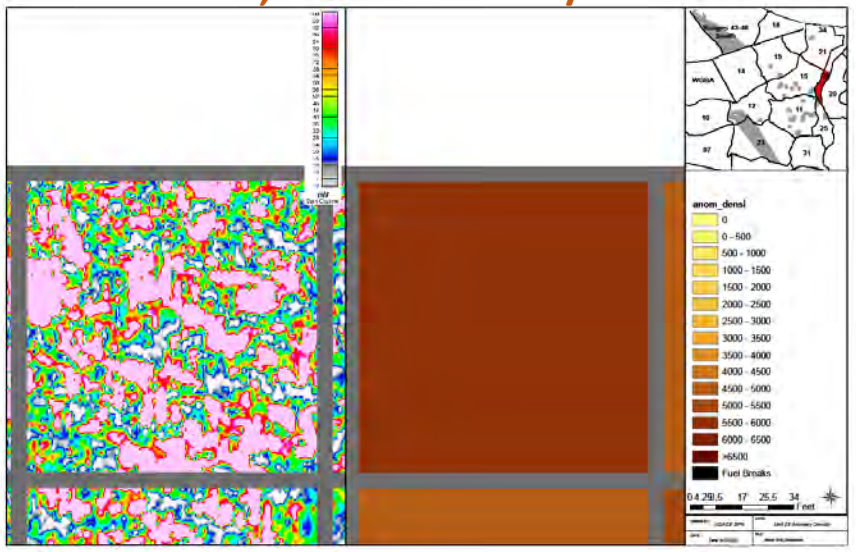
~3,400 Anomalies/Acre



~4,500 Anomalies/Acre



~5,500 Anomalies/Acre



*Grids are 100'x100'

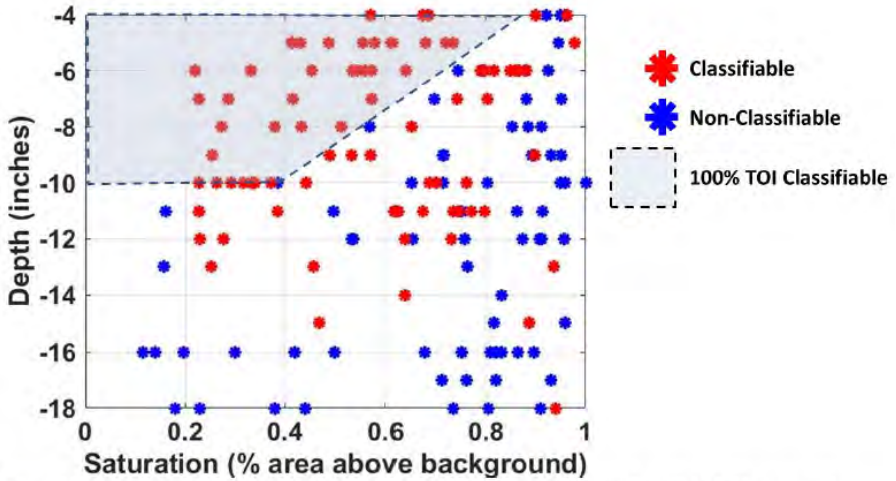
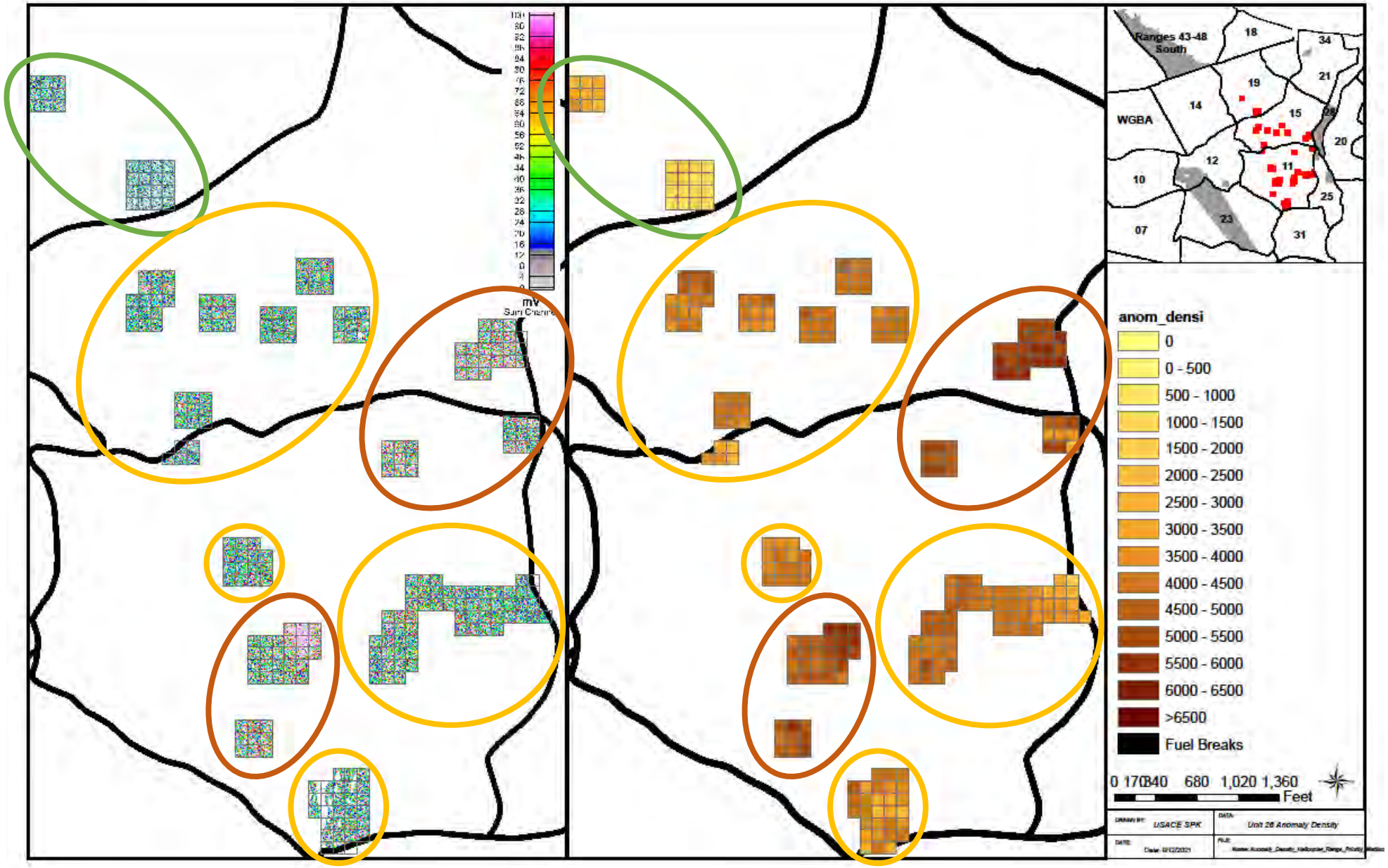


Figure 30. Feature space plot showing distribution of seeds. Red represents seeds with high library match (classifiable) and blue represents seeds with low library match (non-classifiable). The shaded region in the upper left represents the conditions where 100% of seeds were correctly classified.

From *Field Study Report* (OE-0960A)

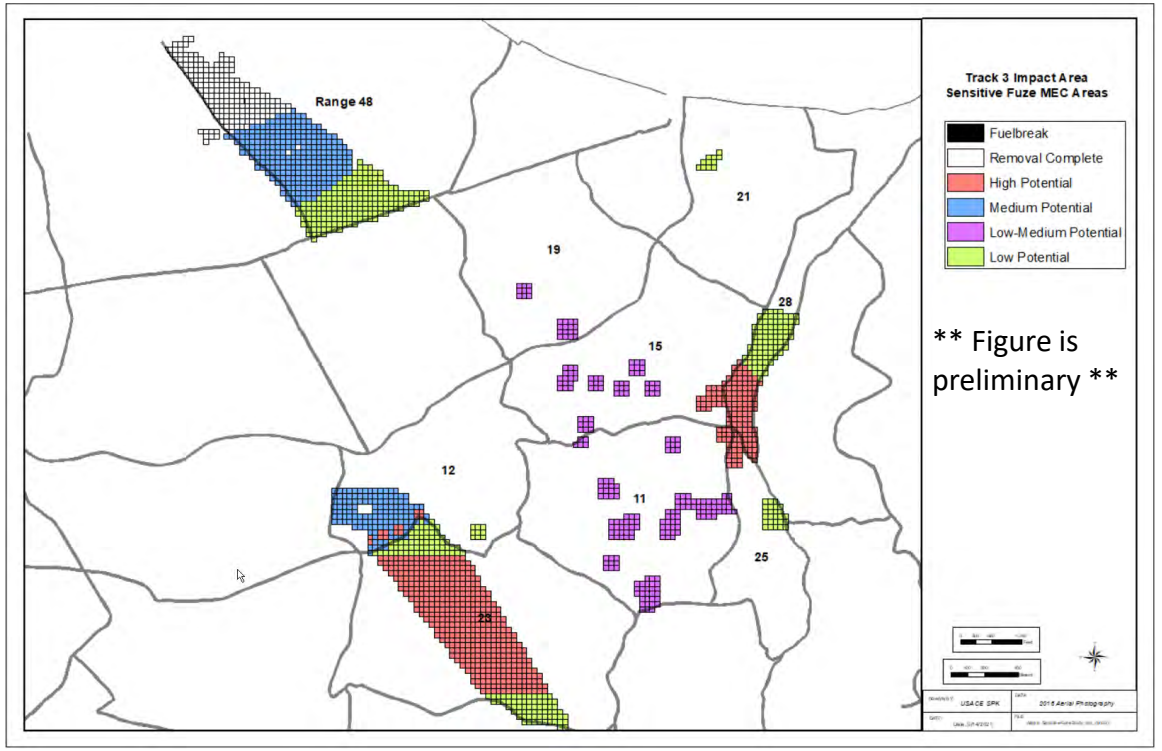
Low-Medium Priority – Attack Helicopter Range (Groups of Grids in Downrange Areas in Units 11, 15, and 19)

- **Candidate for AGC. High confidence in 100% classification (<3,400 anomalies/acre).**
- **Candidate for "risk reduction" AGC. Potential for missed TOI (3,400 anomalies/acre < 5,500 anomalies/acre).**
- **Candidate for analog removal (>5,500 anomalies/acre). Large portions of area saturated.**



Summary

Range	Area	Relative Priority	AGC Usability
Range 30A	Firing point to 400m target area	Low	Candidate for AGC (most of site is <3,400 anomalies/acre)
	400m to 1,100m target area	High	Candidate for AGC (most of site is <3,400 anomalies/acre)
	1,100m target area to Nowhere Road	Low	Candidate for AGC (most of site is <3,400 anomalies/acre)
	1,500m target area in southwest portion of Unit 12	High	Candidate for "risk reduction" AGC. (3,400 anomalies/acre < 5,500 anomalies/acre).
	Beyond the 1,500m target areas in Unit 12	Medium	Candidate for AGC (most of site is <3,400 anomalies/acre)
Range 32 Attack Helicopter Ranges	Target areas at intersection of Riso Ridge x Hawkeye	High	Candidate for analog removal (>5,500 anomalies/acre). Large portions of area saturated.
	Southern portion of U28	High	Candidate for analog removal (>5,500 anomalies/acre). Large portions of area saturated.
	Grids in downrange areas in Units 11, 15, and 19	Low-Medium	Candidate for "risk reduction" AGC. (3,400 anomalies/acre < 5,500 anomalies/acre).
Range 48	South of near-surface removal area (previously recovered sensitive-fuze type 40mm UXO)	Medium	Candidate for "risk reduction" AGC. (3,400 anomalies/acre < 5,500 anomalies/acre).
	South of near-surface removal area (no previously recovered sensitive-fuze type 40mm UXO)	Low	Candidate for "risk reduction" AGC. (3,400 anomalies/acre < 5,500 anomalies/acre).
Range 38	Group of units in U21 near Range 38	Low	Candidates for analog removal. Grids as whole are <5,500 anomalies/acre, but isolated saturated areas are present.
Other Areas	Groups of grids in U12 remaining	Low	Candidate for AGC (most of site is <3,400 anomalies/acre)
	Group of grids in Mercury Hill area U11	Low	Candidate for "risk reduction" AGC. (3,400 anomalies/acre < 5,500 anomalies/acre).
	Group of grids in U25 across from Steep Road	Low	Candidate for AGC (most of site is <3,400 anomalies/acre)



We now have:

1) A relative prioritized list
2) AGC usability "guide"

AGC is viable alternative in lieu of sifting

ESTCP Demonstration – 2015 (Dynamic followed by cued AGC w/ MetalMapper)

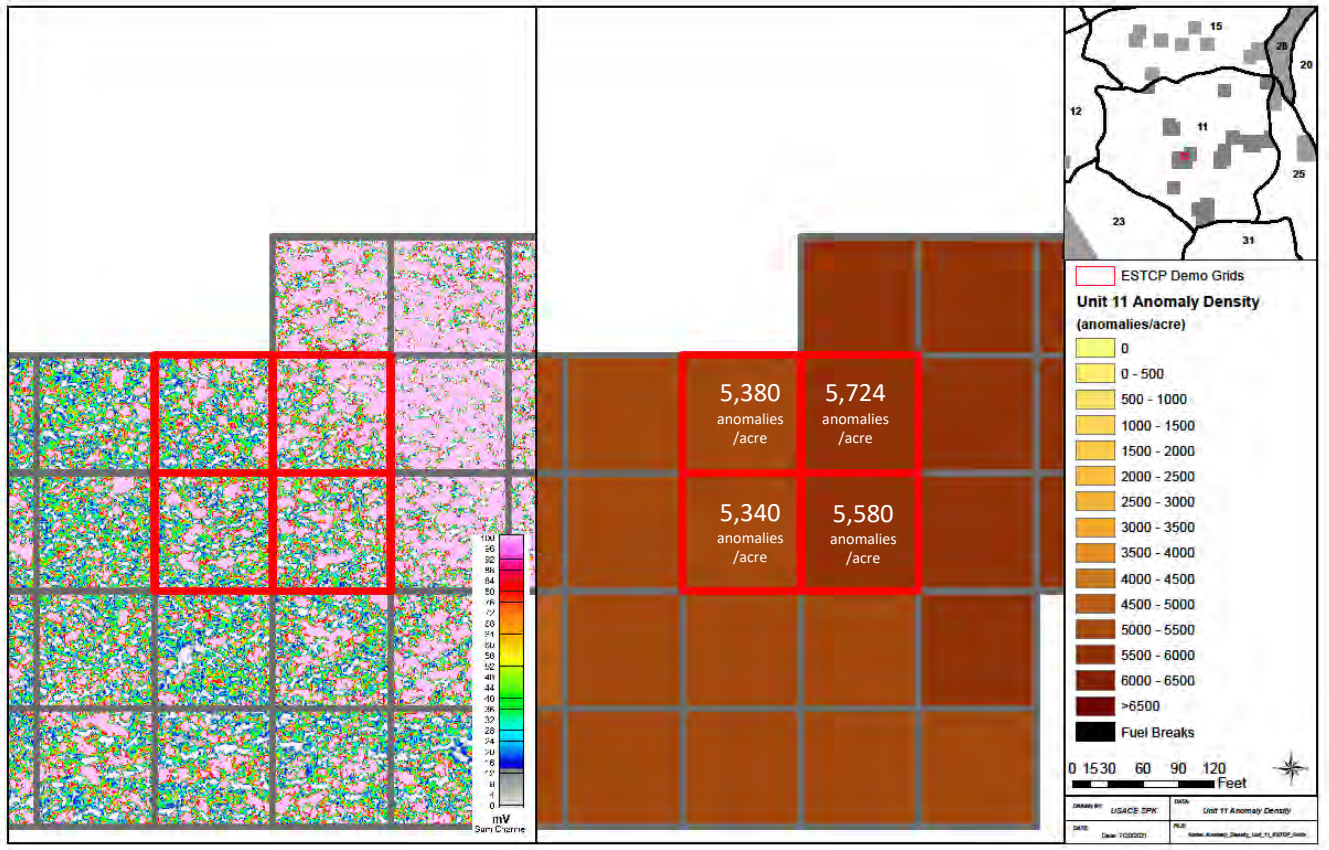
Primary Objective: Classify large TOI to 2 feet = EASY
Secondary Objective 1: Classify large TOI to 4 feet = DIFFICULT but DOABLE
Secondary Objective 2: Classify all TOI to depth of detection = CLOSE but NOT POSSIBLE

11 missed TOI (including four 40mms):

Table 4. List of Eleven Missed TOI Ordered by Dig Number.

All munitions except the 60mm illumination round are practice rounds.

Anomaly	Depth (cm)	Identification	Dig Number
FO-10738	19	40mm M918	989
FO-10228	2	40mm M918 (nose only)	1167
FO-20164	3	40mm M781 + frag	1251
FO-20633	10	35mm subcaliber rocket M73	1318
FO-10808	1	40mm M918 (nose only) + frag	1322
FO-40546	3	20mm M99	1688
FO-40655	6	20mm M99	1886
FO-20504	8	35mm subcaliber rocket M73	2045
FO-40771	12	20mm M99	2384
FO-10032	23	60mm illumination round M83	2459
FO-20569	12	35mm subcaliber rocket M73	2552



Demonstrated correct classification of 96.7% of smaller TOI with ~50% reduction in digs

Technical Alternatives

Objective: Address risk to BLM workers conducting ground-disturbing activities (e.g., erosion repair).

- All alternatives require vegetation cutting, likely mechanical.

- All alternatives require invasive species control for multiple years.

Site-specific factors (technical, implementation and cost) that should be considered when selecting a technical alternative for specific implementation area

- Potential for sensitive fuze-type UXO to be present in the shallow subsurface
- Anomaly density level
- Potential for ground-disturbing activity to be necessary in the future (i.e., identified for future erosion repair or erosion is being monitored)
- Terrain (e.g. lack of EM-61 data means likely inaccessible for AGC unit)
- Size
- Access
- Potential for vegetation cutting and intrusive investigation to add to erosion concerns
- Impacts to the habitat (consistency with the Habitat Management Plan and Biological Opinions)
- Cost

Preliminary Technical alternatives	Feasible anomaly density levels		
	<3,400 anomalies/acre	3,400-5,500 anomalies/acre	> 5,500 anomalies/acre
AGC • cued survey on 24.5mV anomalies (targeting 40mm at 7in. or larger); • classify for all munitions types as TOI; • intrusive investigation of cued anomalies	x		
"Risk reduction" AGC • cued survey on 24.5mV anomalies (targeting 40mm at 7in. or larger); • classify for all munitions types as TOI; • intrusive investigation of cued anomalies	x	x	
AGC with dynamic survey • Advanced dynamic survey • cued survey on anomalies [detection threshold TBD]; • classify for all munitions types as TOI; • intrusive investigation of cued anomalies (One-pass similar to OPTEMA is optional)	x	x	x
Intrusively investigate DGM targets (tiled)	x	x	x
Analog near-surface removal (6in)	x	x	x
Analog removal to depth	x	x	x (possibly in combo w/ EM-based removal)
Excavation and sifting incl. • subsurface removal in excavated areas • habitat restoration and monitoring			x

Additional Phase of Field Study (Planned)

Area	Anomaly Density @ 14 mV (anomalies/acre)	Anomaly Density @ 24.5 mV
1	4,200	3,400
2	4,800	4,200
3	5,400	5,000
4	5,300	4,800

1) **Dynamic one-pass classification**

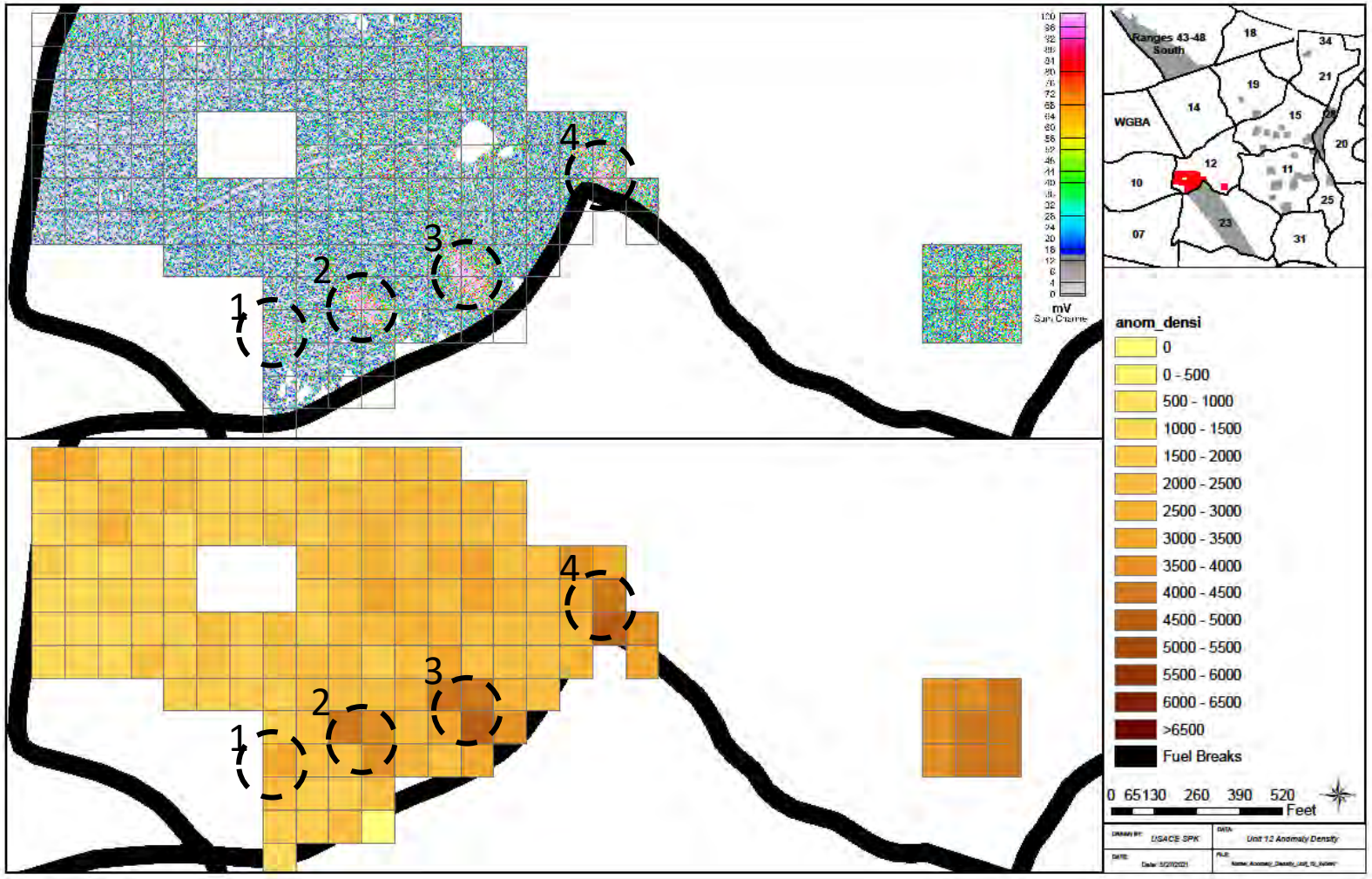
2) **Cue on remaining targets**

3) **Dig all targets in at least one area**

What did we get confidently and to what depth?

What did we miss with one-pass?

What did we miss with one-pass and cued?

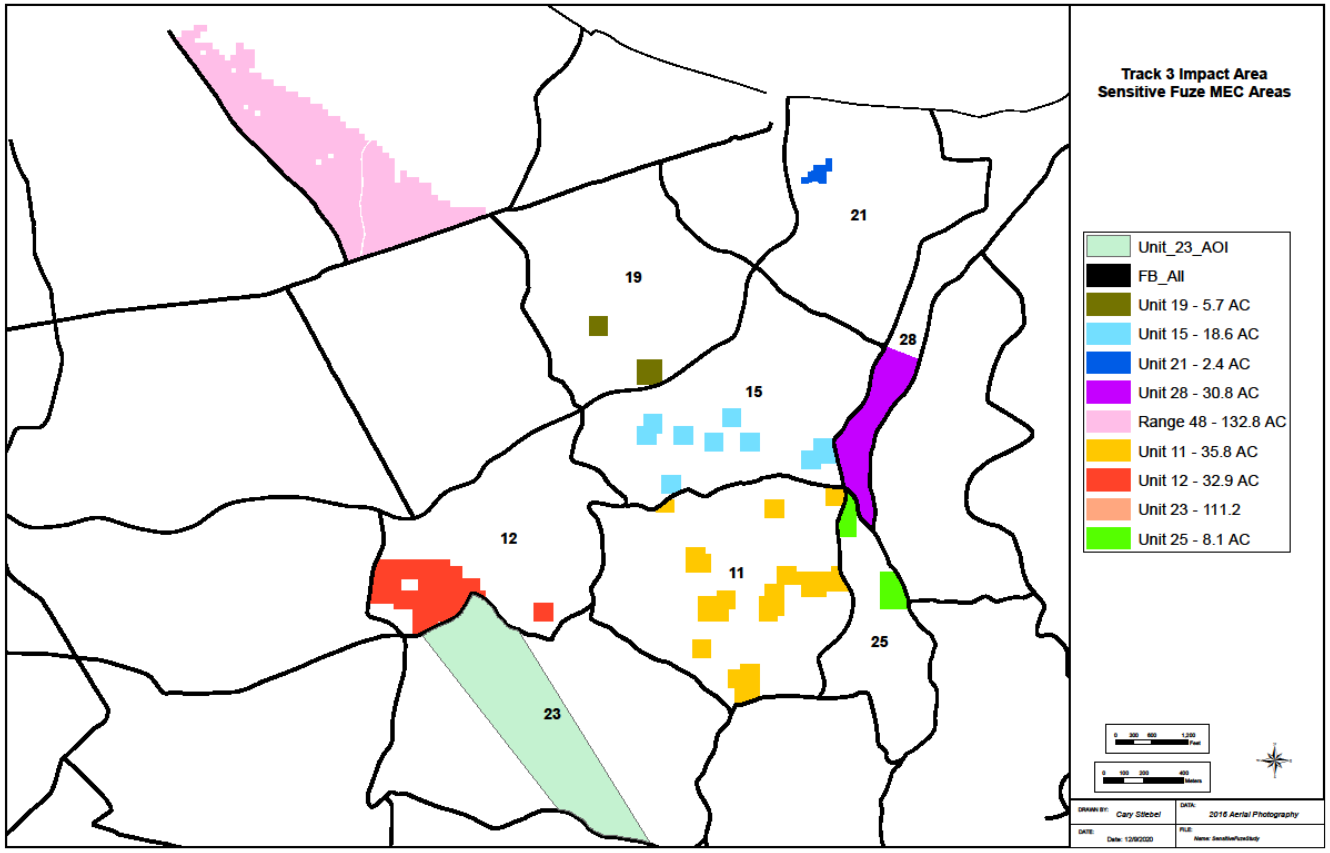


Will Help Quantify "What are we potentially leaving behind and to what depth, based on estimated anomaly density and subsurface removal methodology?"

Next Steps

Army to implement the AGC alternative to specific areas as an additional phase of the Munitions with Sensitive Fuzes Field Study:

- Additional phase would provide data that would inform future actions that would be applied to other identified areas
- Additional phase would be contracted with the Interim UXO contract (before next major UXO contract). A detailed work plan would be developed to describe the objectives and detailed technical approaches.



Questions/Open Discussion/Regulatory Feedback?