The (almost) No Dig Remedial Investigation

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Agenda

- Site Background
- Advanced Geophysical Classification
- Conclusions

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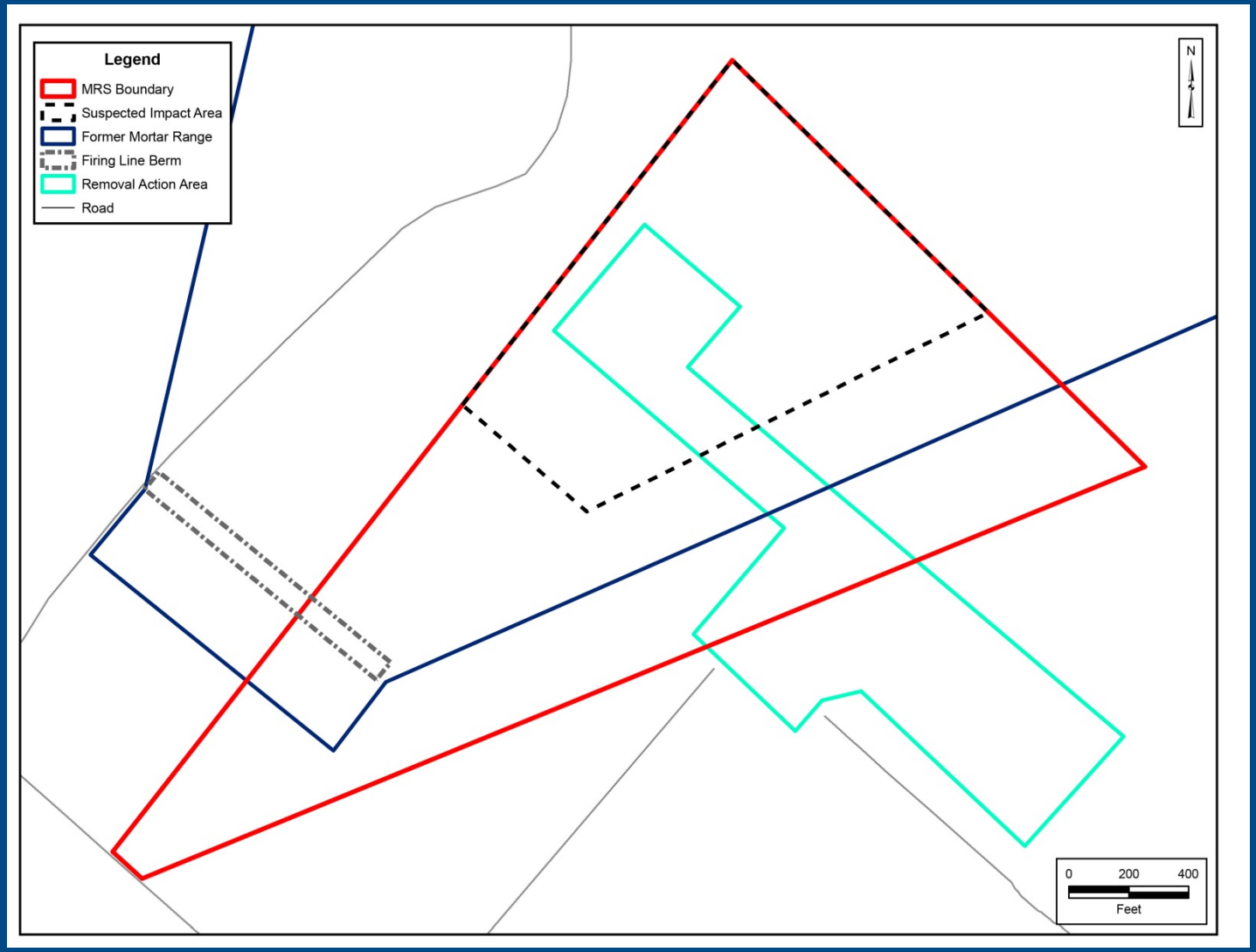
Site Background

Site Map



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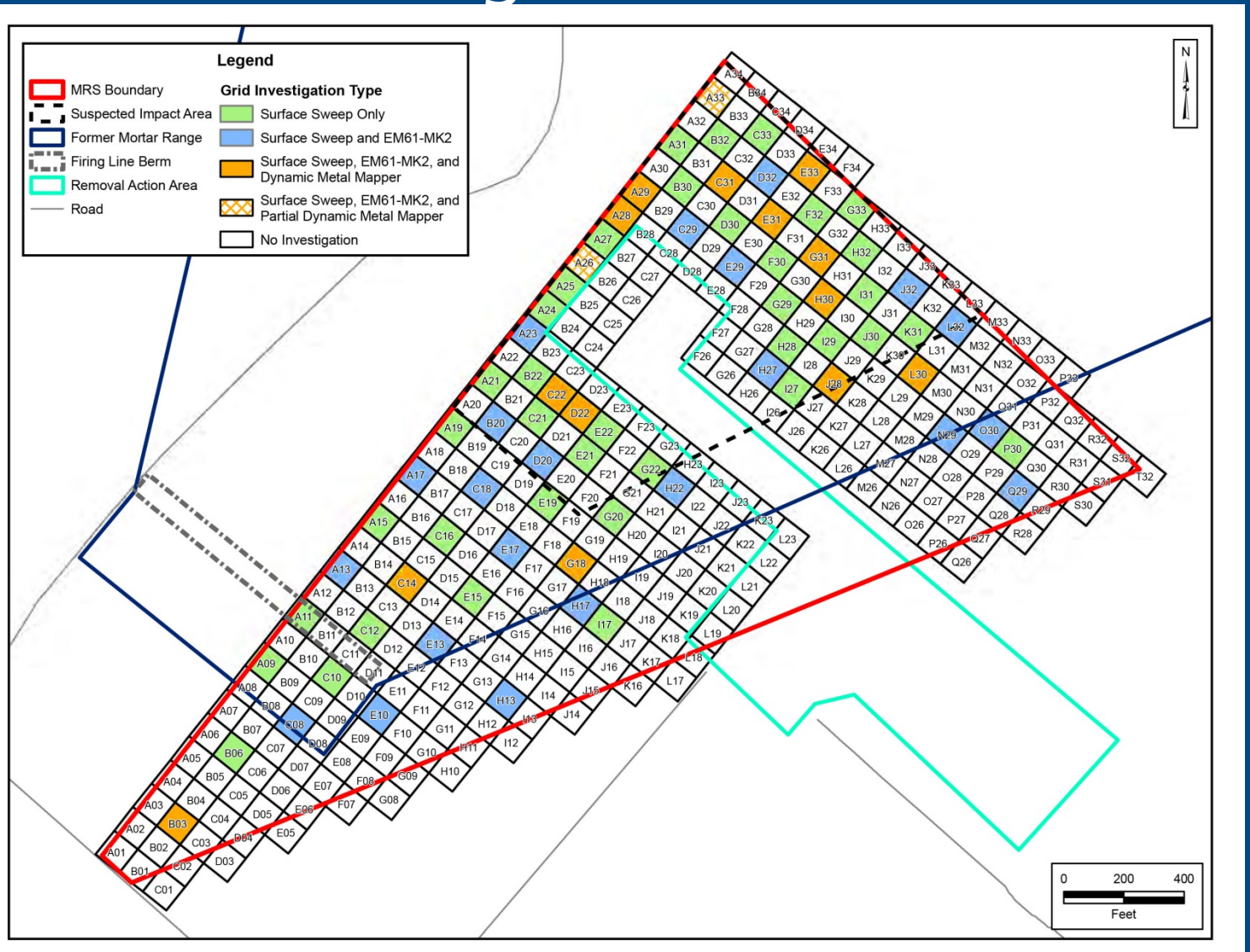
Project Requirements

- RI RFP requires, "Evaluation of DGM data and physical verification of the *lesser of 15 total or 1%* of subsurface anomalies identified"
- Use advanced geophysical classification to characterize nature and extent of MEC during an RI.

Tasks

- UFP-QAPP using GCMR UFP-QAPP template
- Site preparation: Surveying, vegetation removal
- Surface Sweep: 17.22 acres
- Dynamic Data Collection
  - EM61-MK2: 8.72 Acres
  - MetalMapper: 3.44 acres
- Cued TEMTADS Data Collection: 664 anomalies
- Advanced Geophysical Classification Analysis
- Target Reacquisition
- Intrusive Investigation: 42 anomalies
- MPPEH/MD Handling and MEC demolition

Investigation Areas



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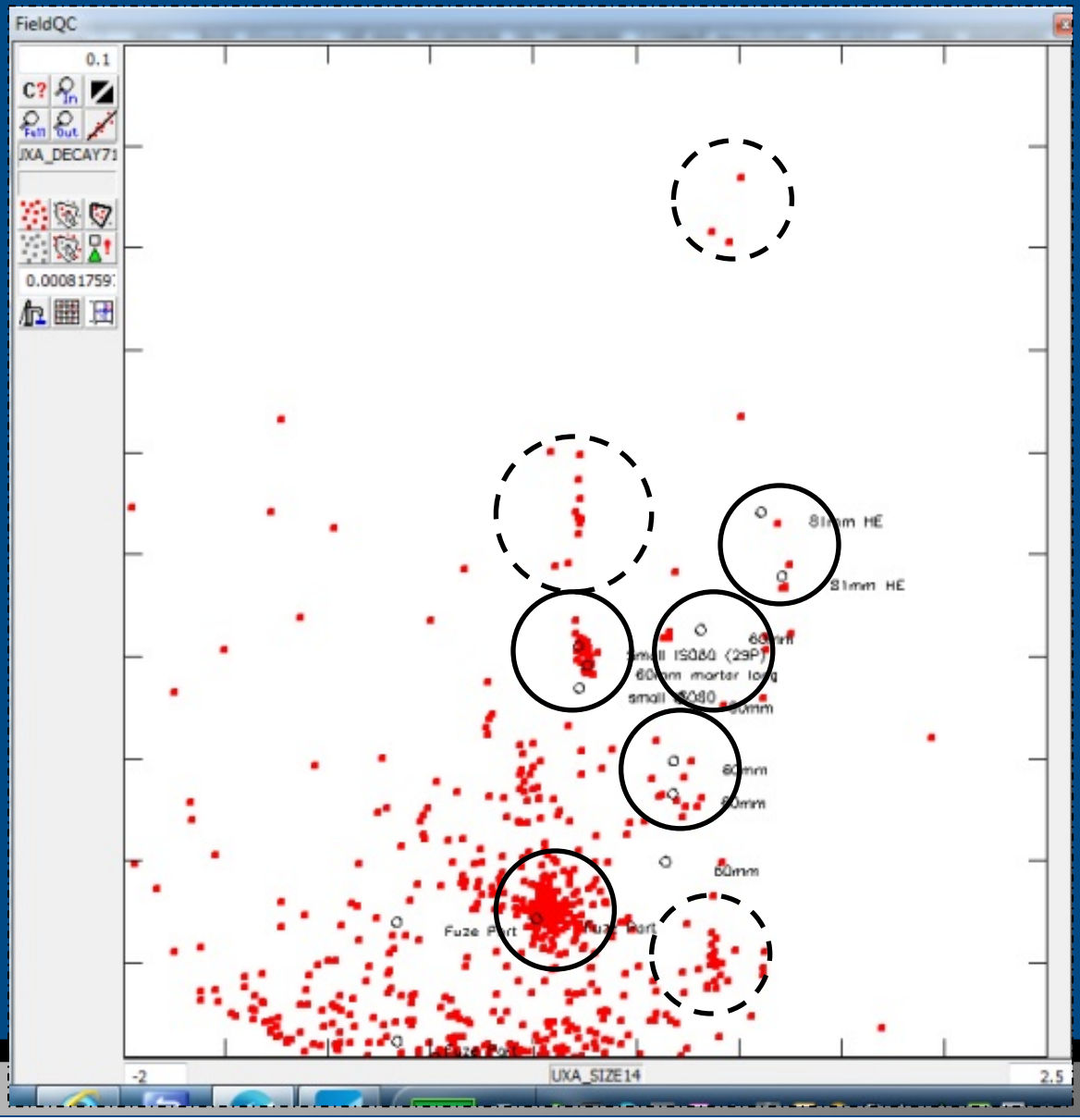
Advanced Geophysical Classification

Advanced Geophysical Classification Analysis Process

- IVS
- Test pit measurements: 60mm and 81mm mortars, small ISO80
- Cued TEMTADS Data Collection
- QC and Background Corrections
- Inversion / Library Match
- Library validation/Cluster Identification
- Anomaly Selection
- Dig Result Feedback Analysis

Cluster Identification



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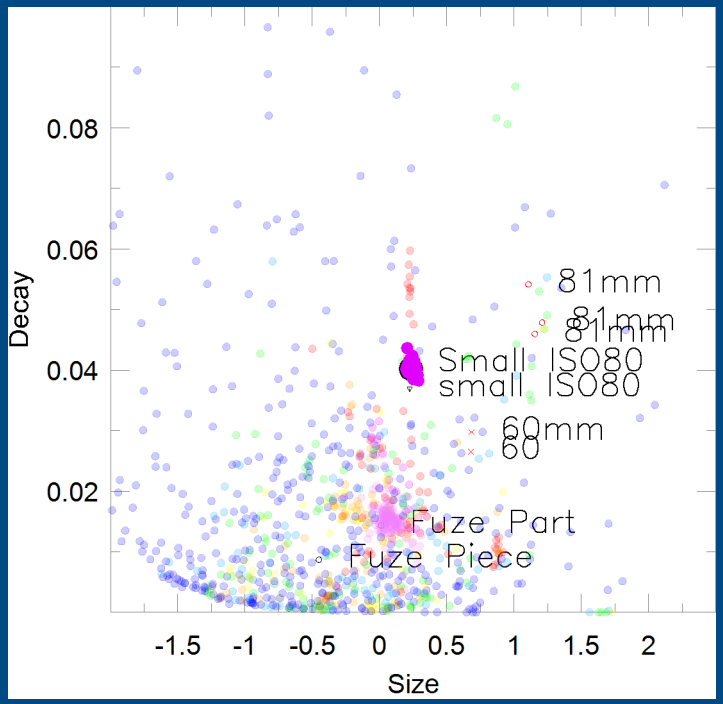
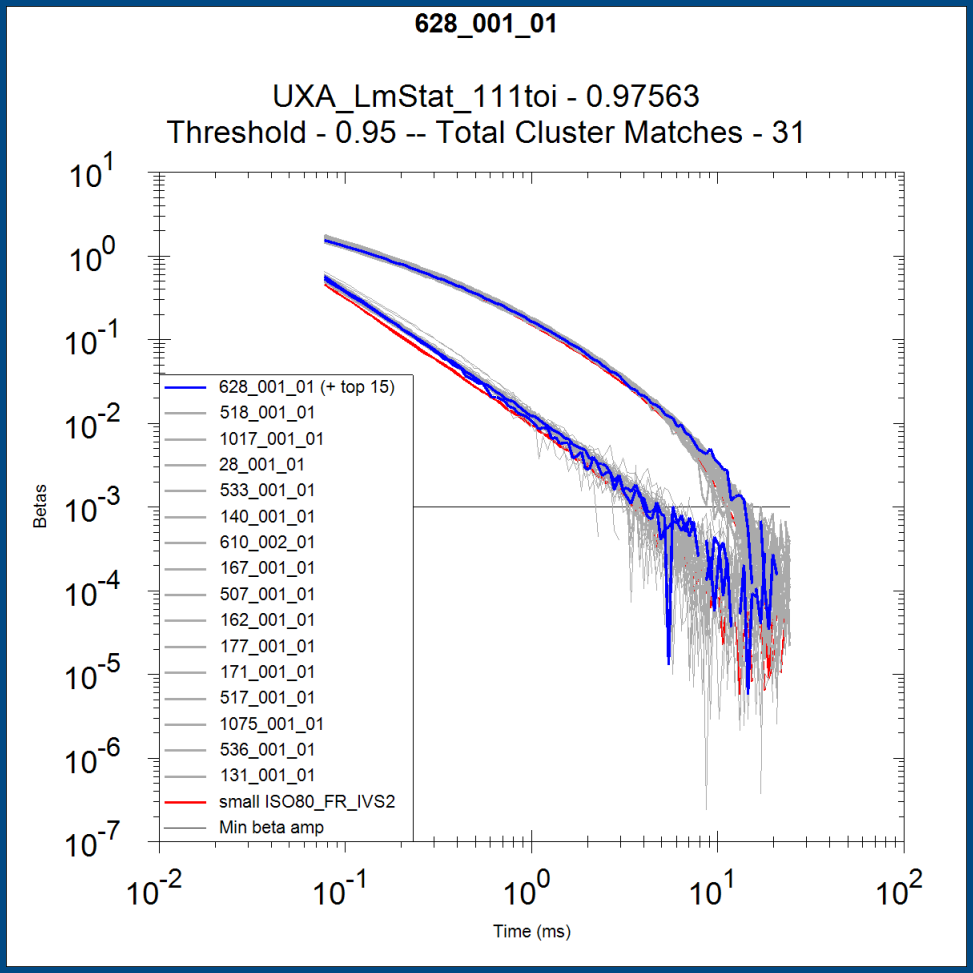
Anomaly Selection Criteria

- Known TOI Cluster Characterization
  - 1+ target within each anticipated TOI cluster to confirm TOI
  - Additional digs to determine stop-dig threshold
- Unknown Cluster Characterization
  - 1+ from other clusters to identify unanticipated TOI
  - Additional digs within newly identified TOI clusters to evaluate MEC hazard and determine stop-dig threshold

Small ISO80 Cluster





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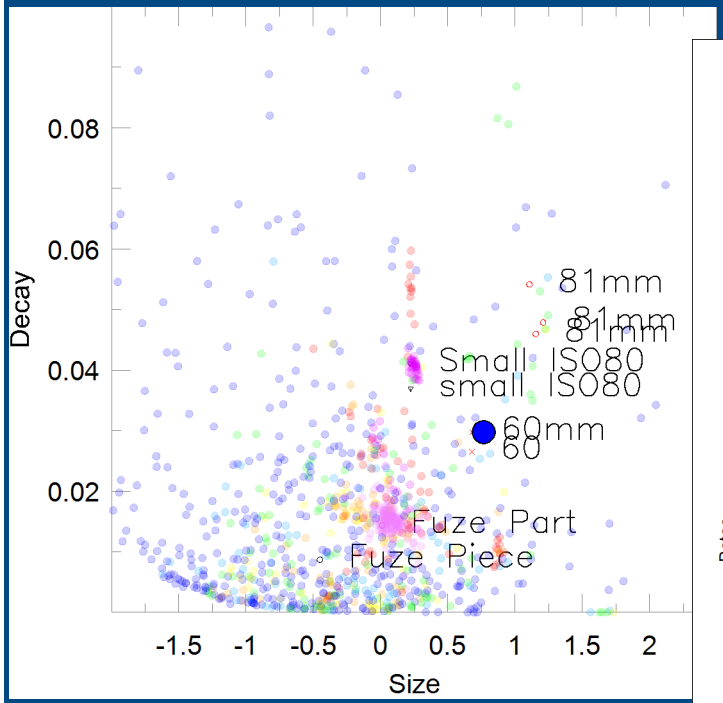
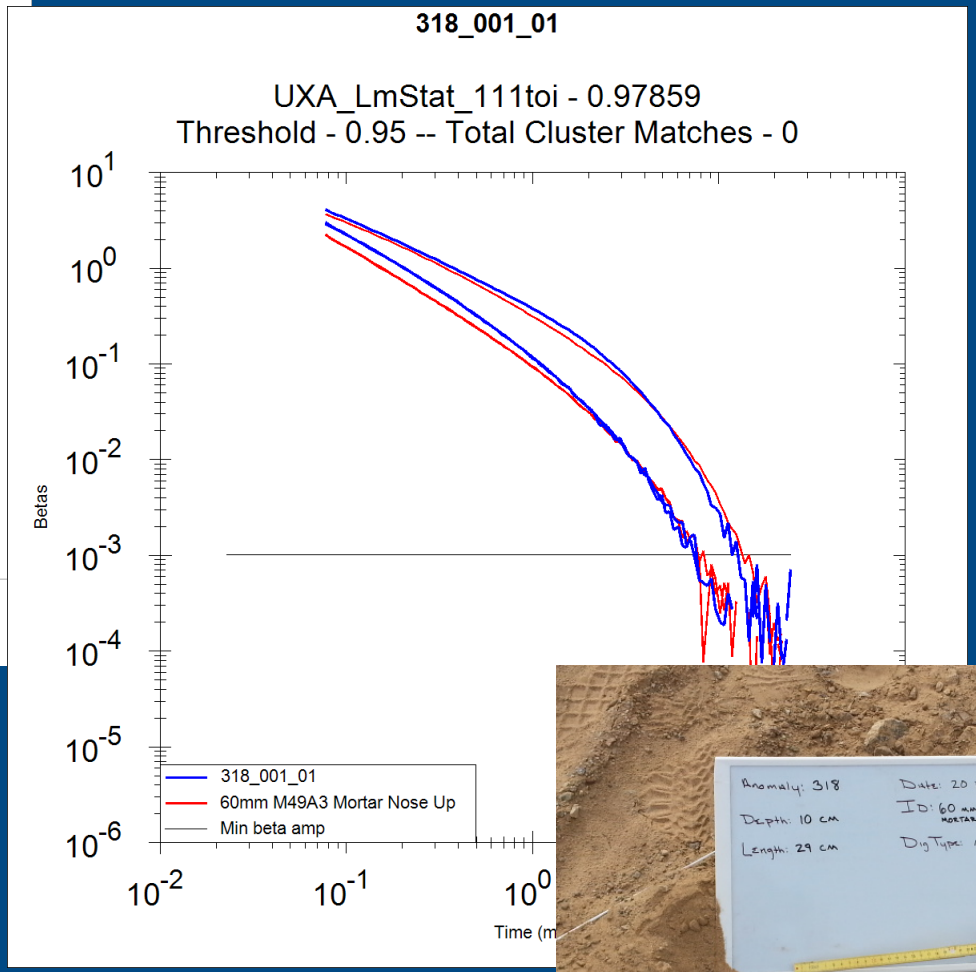
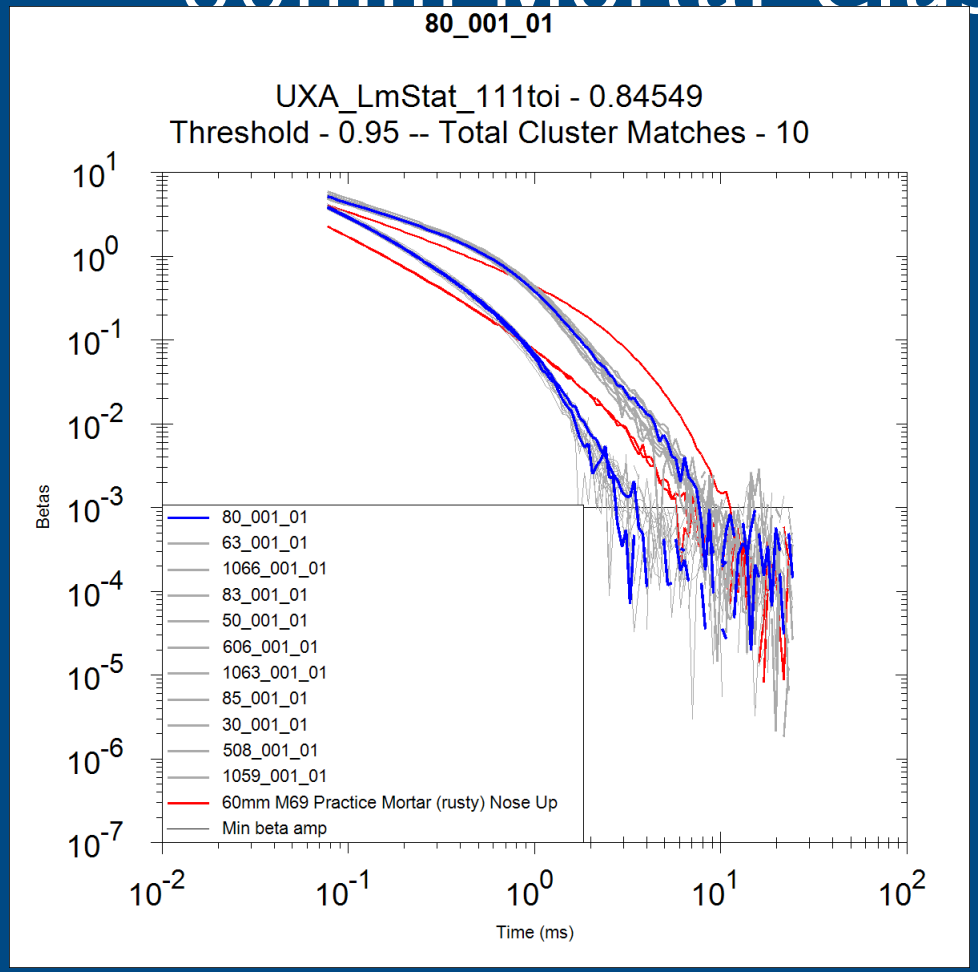
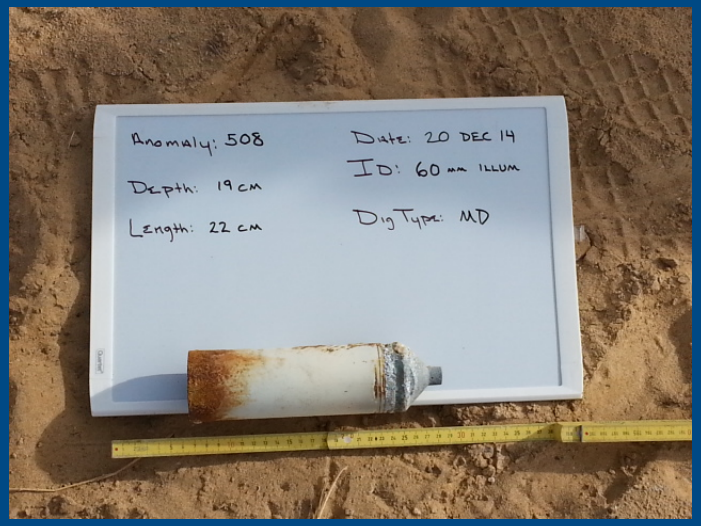
60 mm Mortar Cluster (Cluster 17)





60mm Mortar Cluster (Cluster 12)





Advanced Classification Results				Dig Results	
Cluster	**Number of Anomalies in Cluster**	**Number of Anomalies Selected for Intrusive Investigation**	**Suspected UXO**	**Number of UXO Found**	**Dig Results**
1	4	1	Doesn't match library well	0	Illum disk
2	4	1		0	Mortar Tail Boom
3	4	1		0	Frag
4	2	1		0	No Contact
5	3	1		0	Tail boom part
6	10	1		0	Tail boom part
7	7	1		0	Frag and fuze parts
8	11	3		0	60mm mortar tail booms
9	10	1	Fuze Part	0	Fuze Parts
10	11	1	Fuze Part	0	Tail boom part
11	99	7	Fuze Part	0	60mm tail booms and fins
12	**14**	**6**	**60mm Mortar**	**0**	**60mm Illumination Bodies**
13	15	2	Fuze Part	0	60mm and 81mm Mortar Parachute Assemblies
14	4	1	Hand Grenade	0	Fuze shipping clip
15	6	2	Fuze Part	0	81mm Mortar parachute assembly and frag
16	**10**	**3**	**81mm Mortar**	**1**	**81 mm M374 HE Mortar; 81mm illum body; scrap metal**
17	**13**	**8**	**60mm Mortar**	**4**	**4 60 mm HE M49 Mortar; Mortar tail boom part; 60mm Illum body; frag**
18	3	1	81mm Mortar	0	Drive Shaft
	230	42	0	5	0

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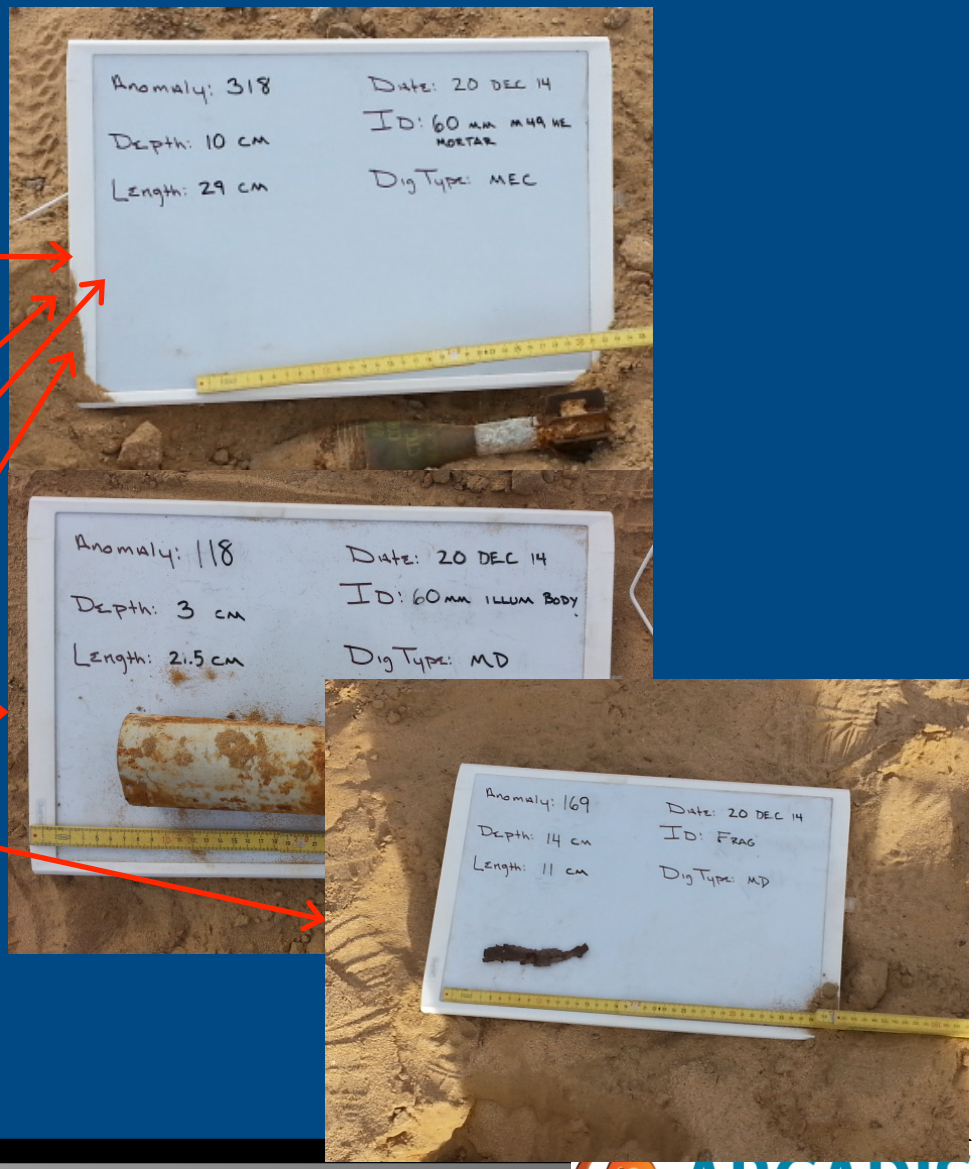
Stop-Dig Threshold: 60mm Mortars

Target ID	Decision Statistic	UXA_UXO TYPE	Dig Type	Dig Result
318	0.9807	60mm M49A3 Mortar	UXO	60 mm HE M49 Mortar
370	0.9564		MD	Tail Boom Part
372	0.9483		UXO	60 mm HE M49 Mortar
236	0.9453		UXO	60 mm HE M49 Mortar
373	0.9427		UXO	60 mm HE M49 Mortar
118	0.9192	60mm M69 Practice Mortar	MD	60mm Illumination Body
169	0.8627	NA	MD	Frag



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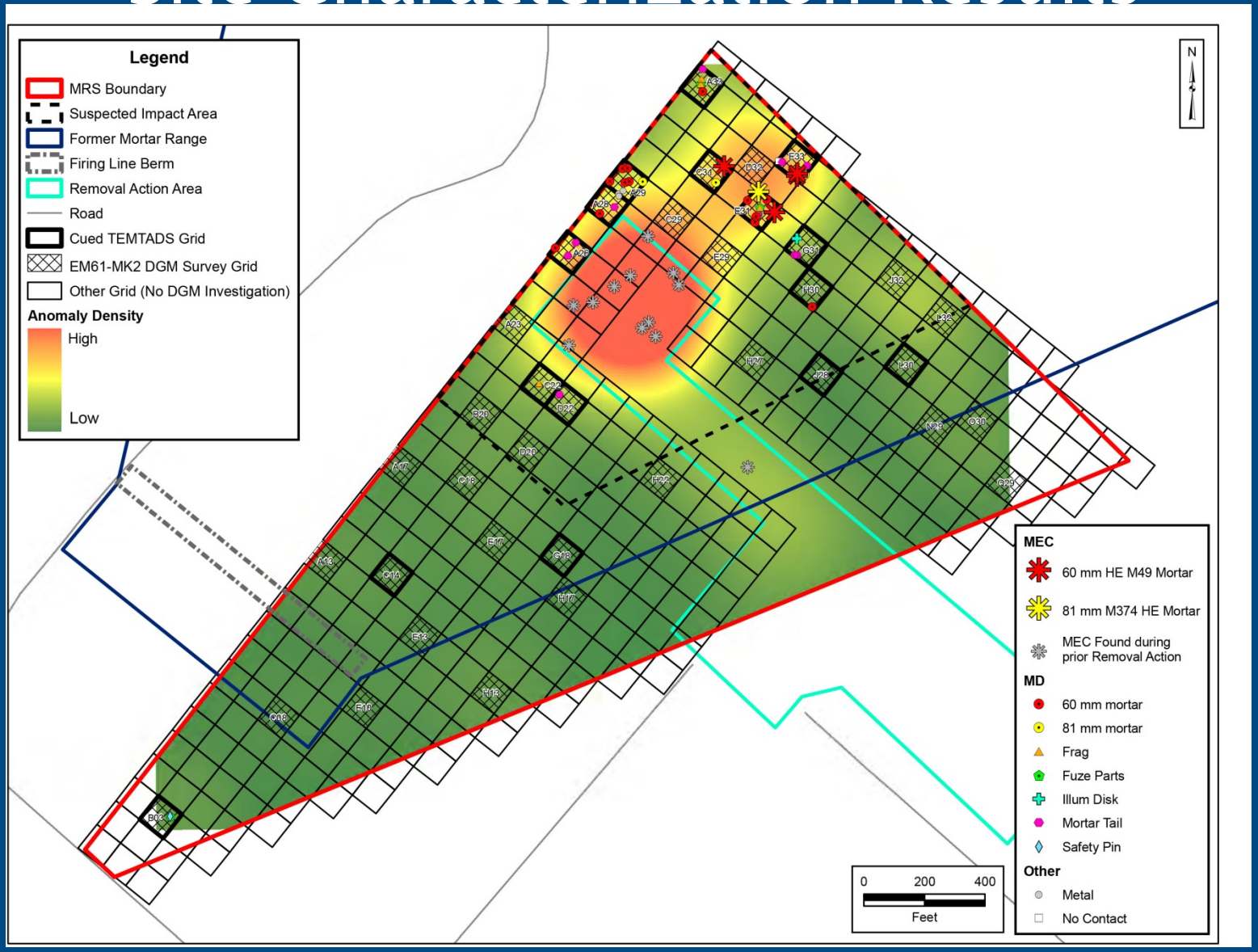
Site Characterization Results



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Conclusions

Conclusions

- Pros:
  - Limited intrusive investigation
    - Limit impacts (*e.g.*, T&E species)
    - Reduce evacuations (*e.g.*, residential, offices)
    - Limited funding
  - Can determine nature and extent of MEC
  - Sufficient to evaluate remedial alternative costs
- Cons:
  - No ROC curve – can't fully evaluate performance
  - AGC with more digs could better determine dig selection threshold
  - Helps to have anticipated TOI BSIs

Acknowledgements

- ESTCP – funded by project MR-201229
- US Navy
- CA DTSC
- CA RWQB
- Acorn SI

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Backup Slides

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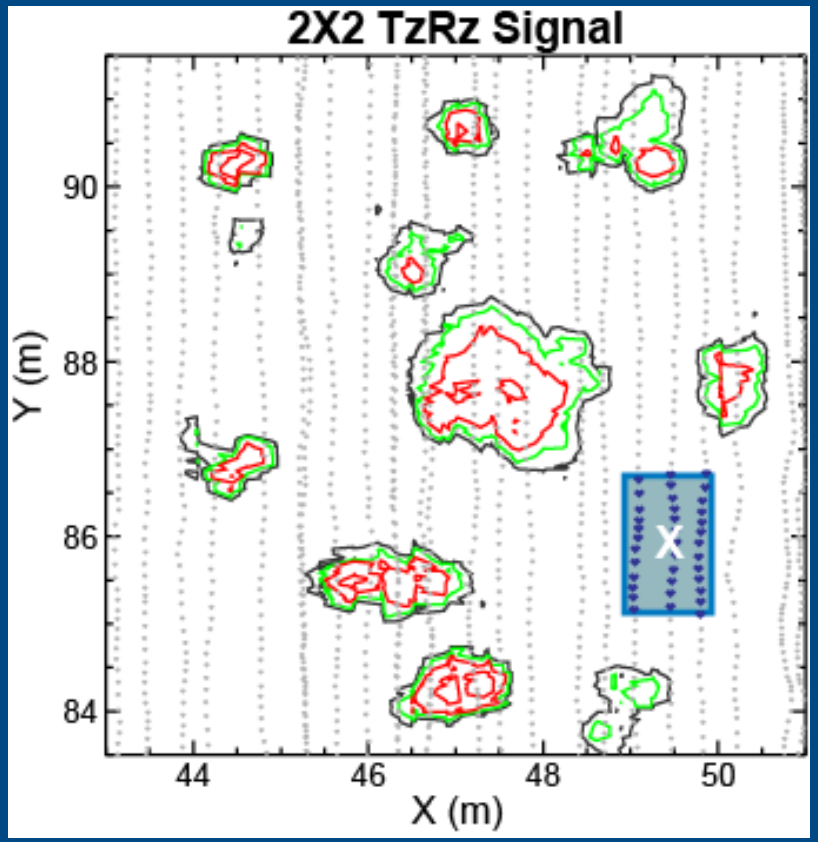
Detection Filter Analysis

Detection Filter Concept

- EMI sensor data from metallic objects can be fit with dipole model
- Model parameters:
  - Object Location, X_o, Y_o, Z_o
  - Dipole polarizations used to identify
- Given location, model inversion is linear and fast
- Detection Filter
  - Grid field with X_o, Y_o locations (0.1m)
  - Specify filter depth, Z_o (0.2m)
  - At each location, select window of data (1.6x1.8m) and apply linear inversion for polarizations
  - Filter output is "goodness-of-fit" between model and data at that location (coherence, 0.0 – 1.0)
  - Filter peaks indicate object locations



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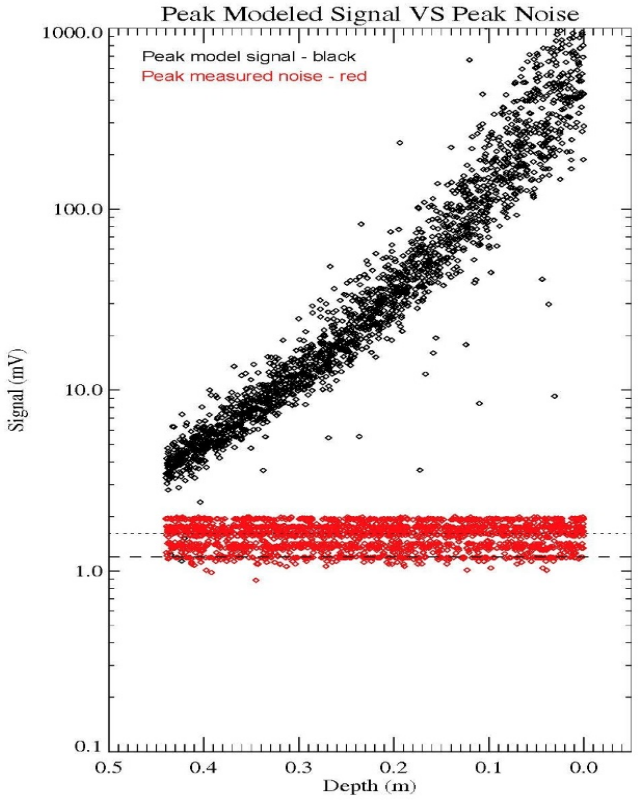
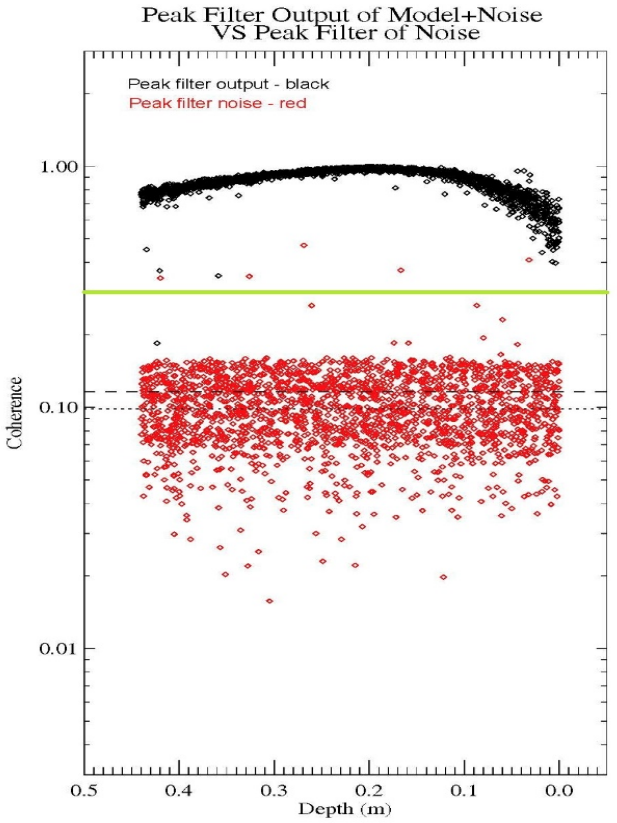
Setting Filter Threshold for TOI





- Traditional Threshold:
  - Model-based, minimum peak signal from small ISO at maximum depth of interest
  - Pick all signal peaks above this threshold

- Filter Threshold:
  - Embed model-based signal from small ISO in signal-free regions of measured data
  - Apply detection filter to *(Model+Noise)* and look at peak filter amplitude
  - Apply filter to just measured noise for SNR
  - Filter can detect to deeper depths than signal alone

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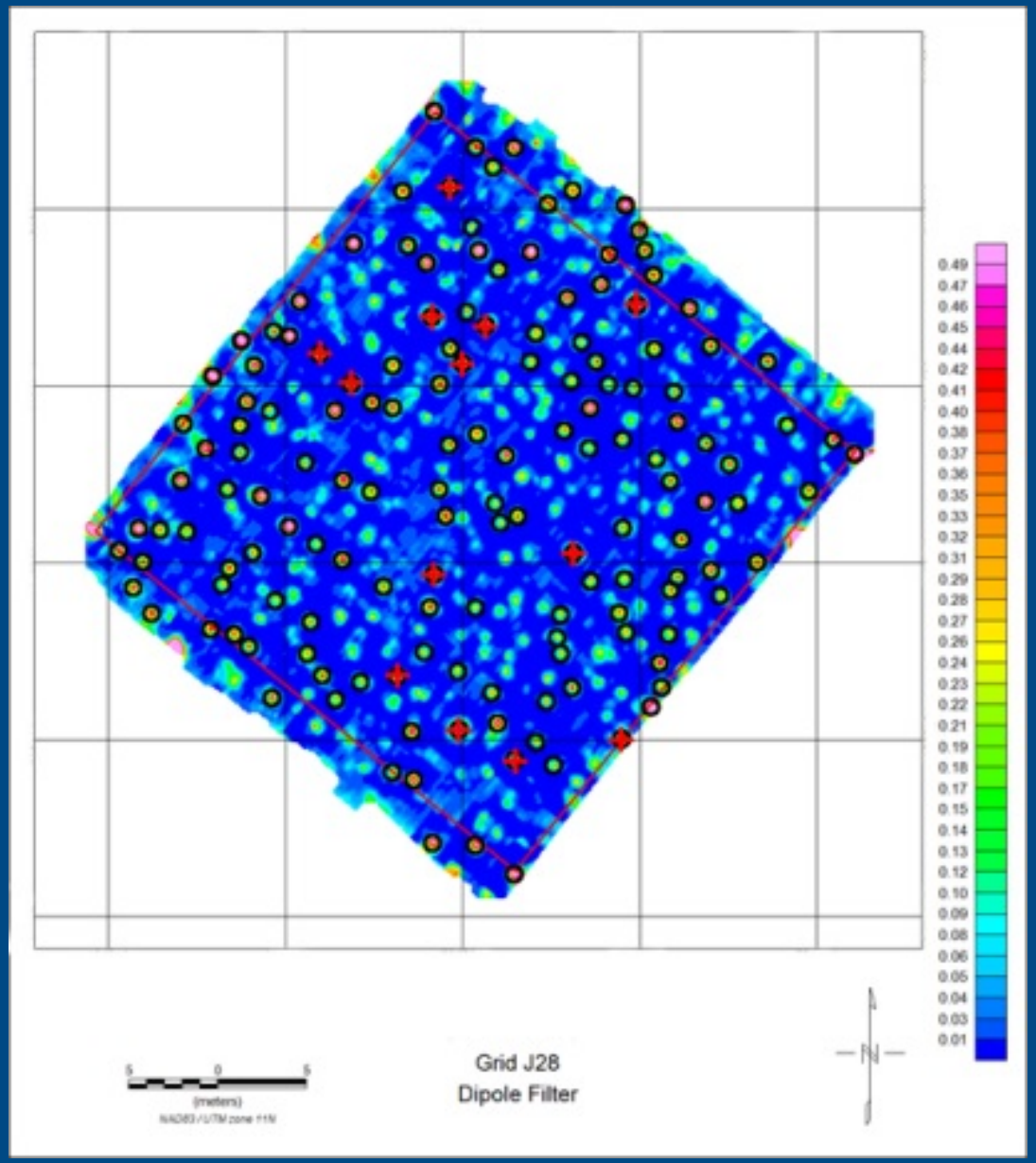
Inversion at Filter Peak Locations

- Detection filter may increase number of detections over simple peak signal (improved SNR)
- Use inverted polarizations to pre-screen locations
- 1,2 and 3-dipole inversion at filter peak (X_o, Y_o) to handle multiple objects at or near one location – if inversion produces additional sources >0.4m from original filter peak repeat inversion using data centered on new source locations
- Resulting sources are examined and culled based on size, decay and amplitude metrics to only sources that could be a 37mm or larger
- Fit locations from the inversions used as the final locations for the cued target list

Final Target List



+ – Final Detection
○ – Initial filter peak

Using the dipole filter Detection process reduced final target list from 134 amplitude based anomalies to 13 dipole filter anomalies

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