PARSONS

ESTIMATING SITE-SPECIFIC EFFECTIVE CUED CLASSIFICATION DEPTH

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NEW ORLEANS, LA

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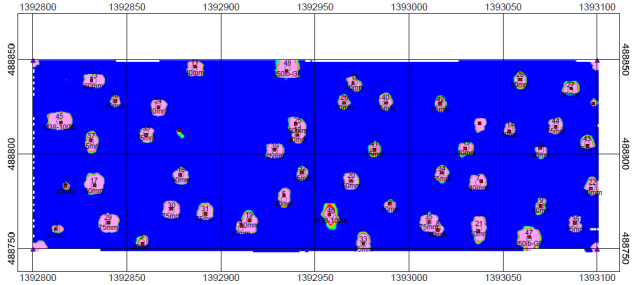
- Detection Depth vs Classification Depth
- Cued Classification Depth Estimate Method
- Lalamilo Project Background
- Lalamilo Effective Classification Depth
- Comparison between Depth Estimates and Physical Seed Results
- Finding sources deeper than effective classification depth
- Conclusions
- Questions

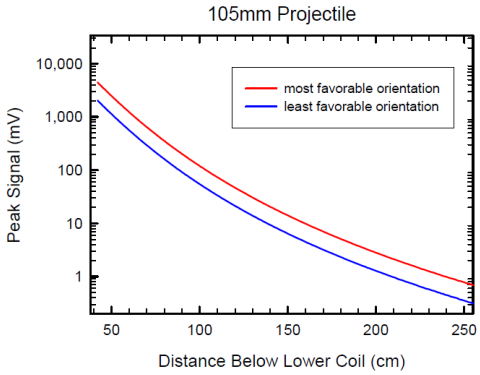
DETECTION DEPTH ESTIMATES

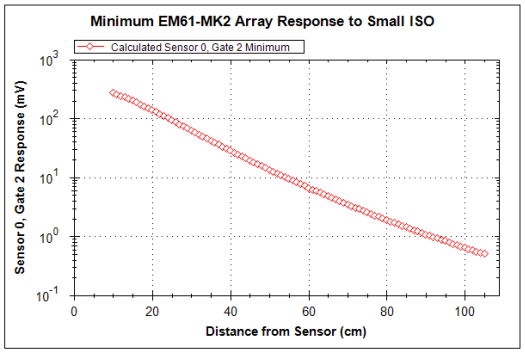
Geophysical Prove-out



11x Diameter

NRL Reports and Software





Forward Modeling in UX-Analyze, BTField, and EMCLASS or test stand measurements

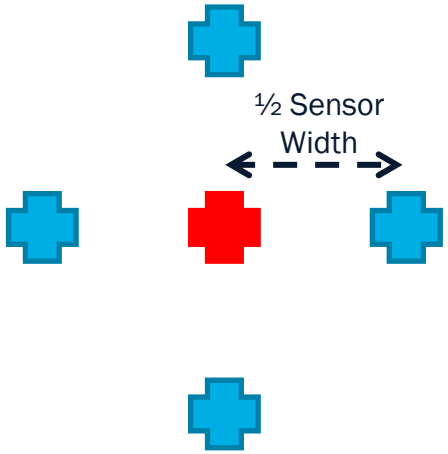
DETECTION DEPTH VS CLASSIFICATION DEPTH ESTIMATES

- **Detection depth is relatively simple to estimate if you have**
  - A well characterized Item (polarizabilities)
  - Sensor characteristics and height
  - Site noise levels
- **Cued classification depth estimating is more challenging because**
  - Classification decisions are made on model-library comparison statistics, not responses
  - Background removal effectiveness depends on sensor drift, environmental factors and site-specific ground response variability
  - Estimates must take into account a variety of item orientations and offsets from the cued sensor
- **Classification Depths are typically shallower than detection depths**

Current Options for Estimating Classification Depth		
Method	**Pros**	**Cons**
Physical Seeding	• Directly tests classification • Appeals to non-geophysicists	• Large level of effort • Delayed estimates
Synthetic Seeding	• Low level of effort • High spatial resolution	• Delayed estimates • Applicability to cued classification? • May be viewed as “hocus-pocus” • Limited software availability

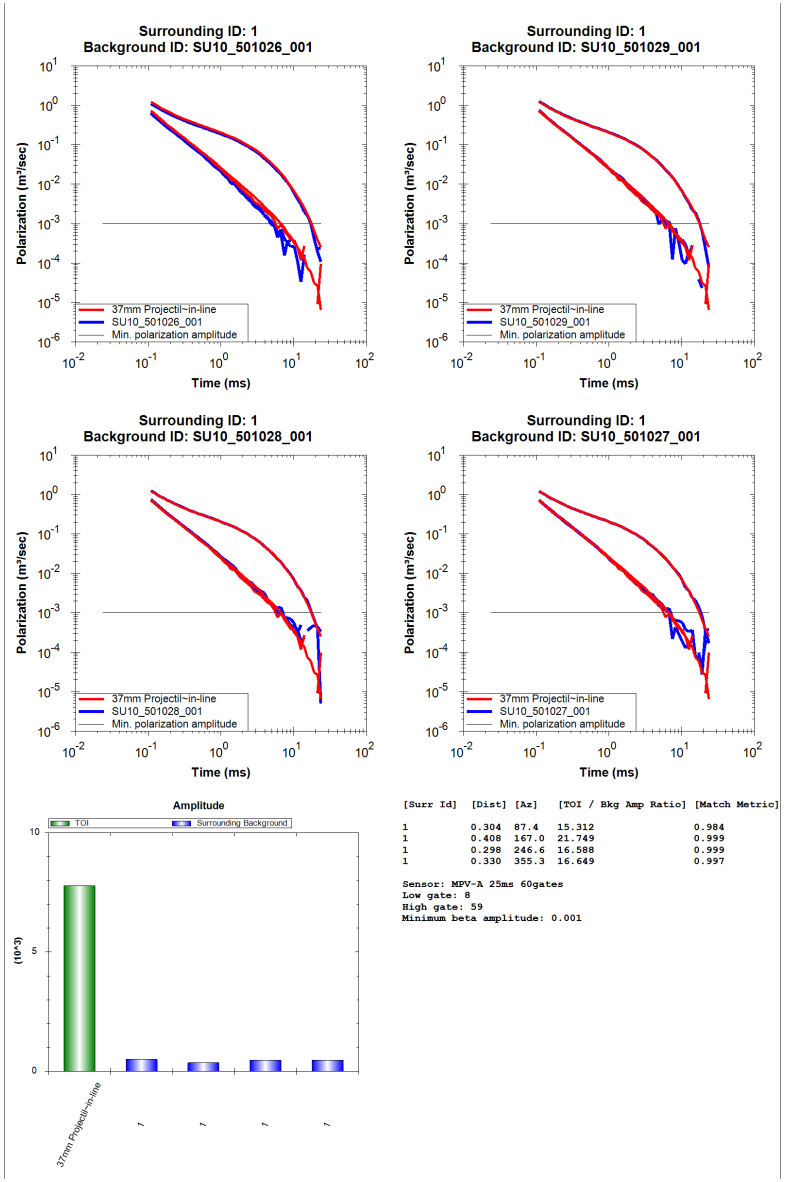
UX-ANALYZE BACKGROUND VALIDATION TOOL

- **Designed to be used to validate background locations as suitable**
  - There are no metallic items in the vicinity
  - A TOI is classifiable above the background noise level



- **Subtracts the center measurement from each of the four surrounding measurements**
- **Adds the TOI response data to the surrounding measurements**
- **Determines the combined library match (decision statistic) for the surrounding measurements**
- **Use the smallest TOI at the deepest depth**

UX-ANALYZE BACKGROUND VALIDATION TOOL

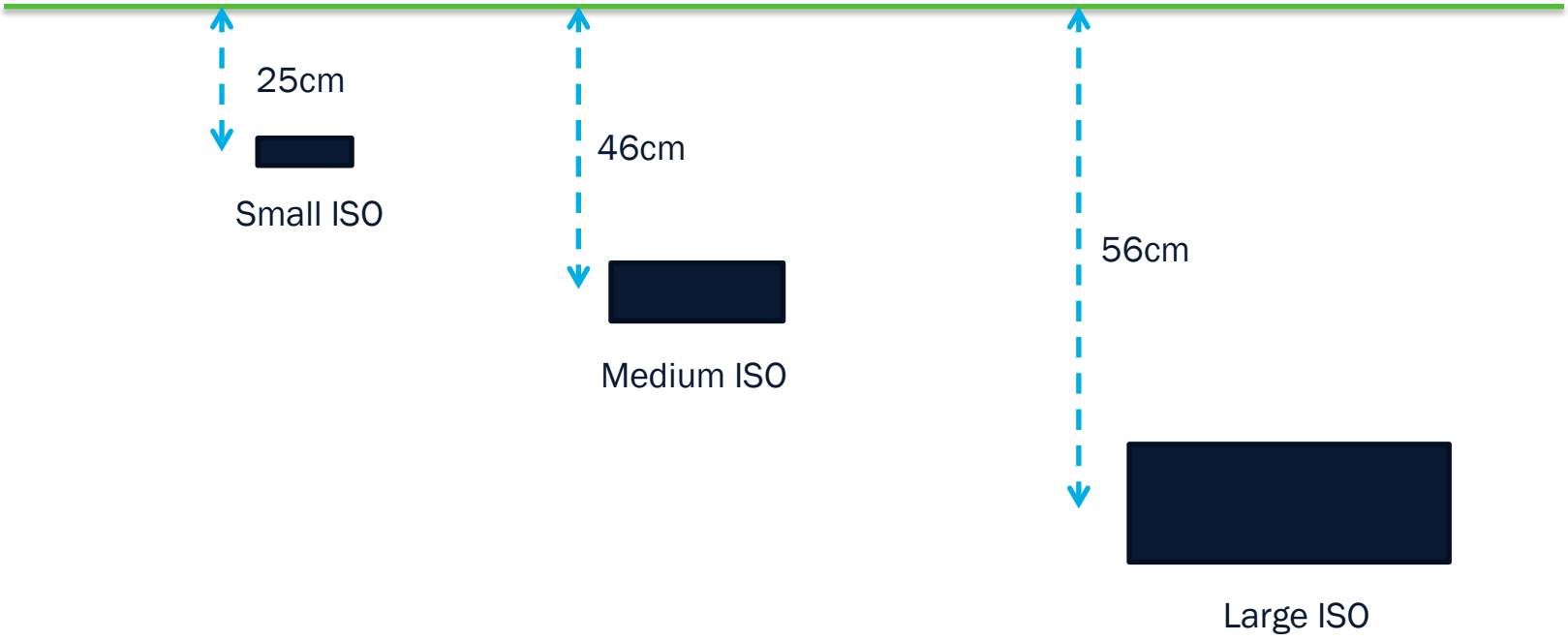


[Surr Id]	[Dist]	[Az]	[TOI / Bkg Amp Ratio]	[Match Metric]
1	0.304	87.4	15.312	0.984
1	0.408	167.0	21.749	0.999
1	0.298	246.6	16.588	0.999
1	0.330	355.3	16.649	0.997

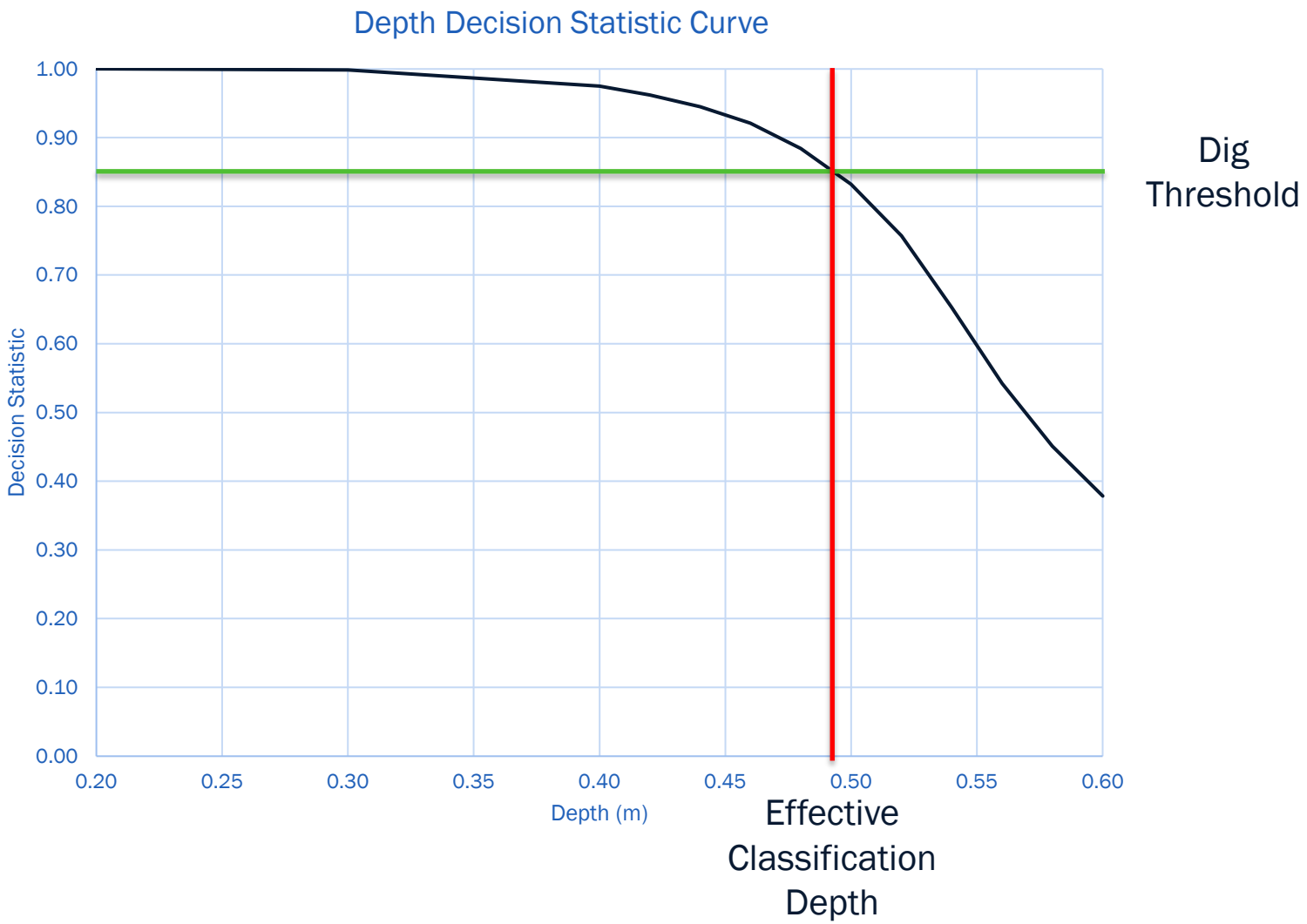
Sensor: MPV-A 25ms 60gates
Low gate: 8
High gate: 59
Minimum beta amplitude: 0.001

UX-ANALYZE BACKGROUND VALIDATION TOOL

- The Background Validation Tool can be utilized to determine decision statistics for other TOI expected at the site and at different depths



DEPTH DECISION STATISTIC CURVE



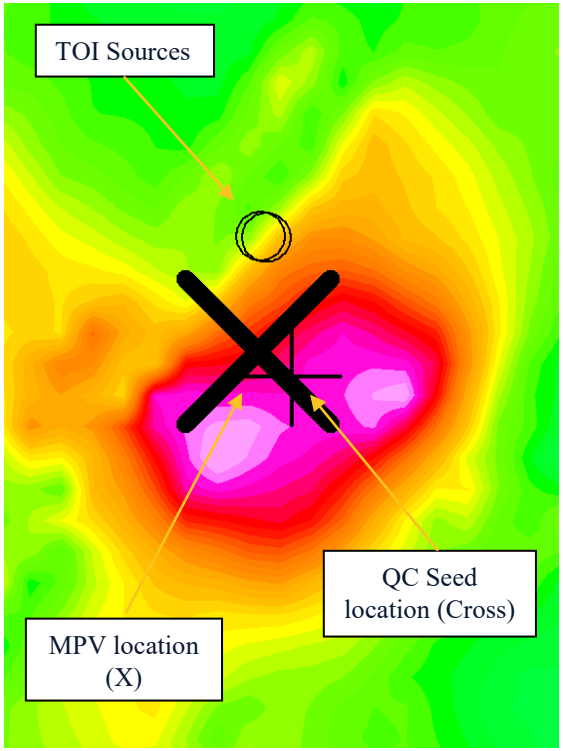
LALAMILO REMEDIAL ACTION PROJECT

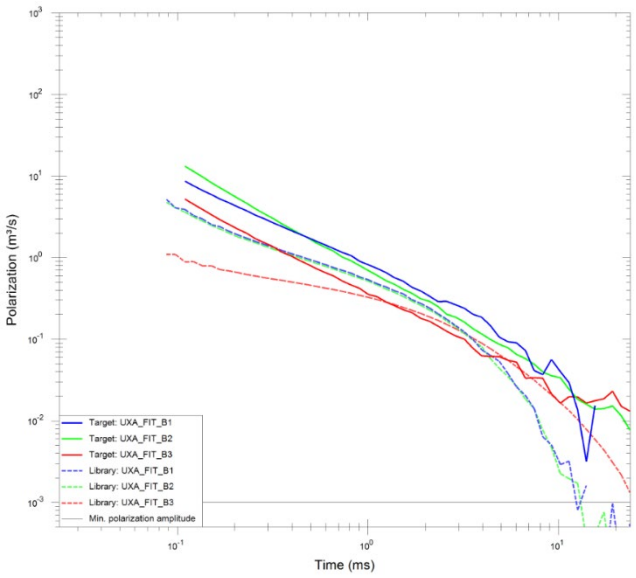
- 120 acres of Detection/Screening followed by cued classification
- UltraTEM screener with PDM8® used in challenging terrain
- Detection depths estimated based on BTField forward modeling and PDM8® test stand measurements
- Smallest TOI: Small ISOs at 25 cm bgs
  - Estimated Medium ISO detection depth of 46cm
  - Estimated Large ISO detection depth of 56cm
- Cued data collection with MPV
  - Cued classification with UX-Analyze

Confirmed or Suspected Munitions	Estimated Detection Depth (inch bgs) [1]	
	PDM8®	UltraTEM
M1 land mines	26^{3}	26
Fuzes (Mk137, M48, M54)	10^{2}	11.8
4.5-inch barrage rockets	26^{3}	34.3
2.36-inch rockets (HE)	14^{3}	16.9
M9A2 rifle grenades (HE)	11^{3}	11
M18 smoke grenades	10^{2}	11.8
Mk15 WP grenades	10^{2}	19.7
Mk II hand grenades (HE)	10^{2}	11.8
60mm M49A2 mortar (HE)	18^{3}	16.1
60mm M83A1 mortars (illumination)	18^{3}	20.9
37mm M63 projectiles (HE and armor piercing)	10	10
75mm M48 projectile (HE)	22^{3}	26.4
75mm Tracer (armor piercing)	22^{3}	26.4
81mm mortars (HE)	22^{3}	23.6
105mm projectile	26^{3}	31.9
2-inch Japanese mortar	10^{2}	10^{2}
Type 97 Japanese hand grenade	10^{2}	10^{2}
Type 99 Japanese hand grenade	10^{2}	10^{2}

MEDIUM ISO CLASSIFICATION DEPTH

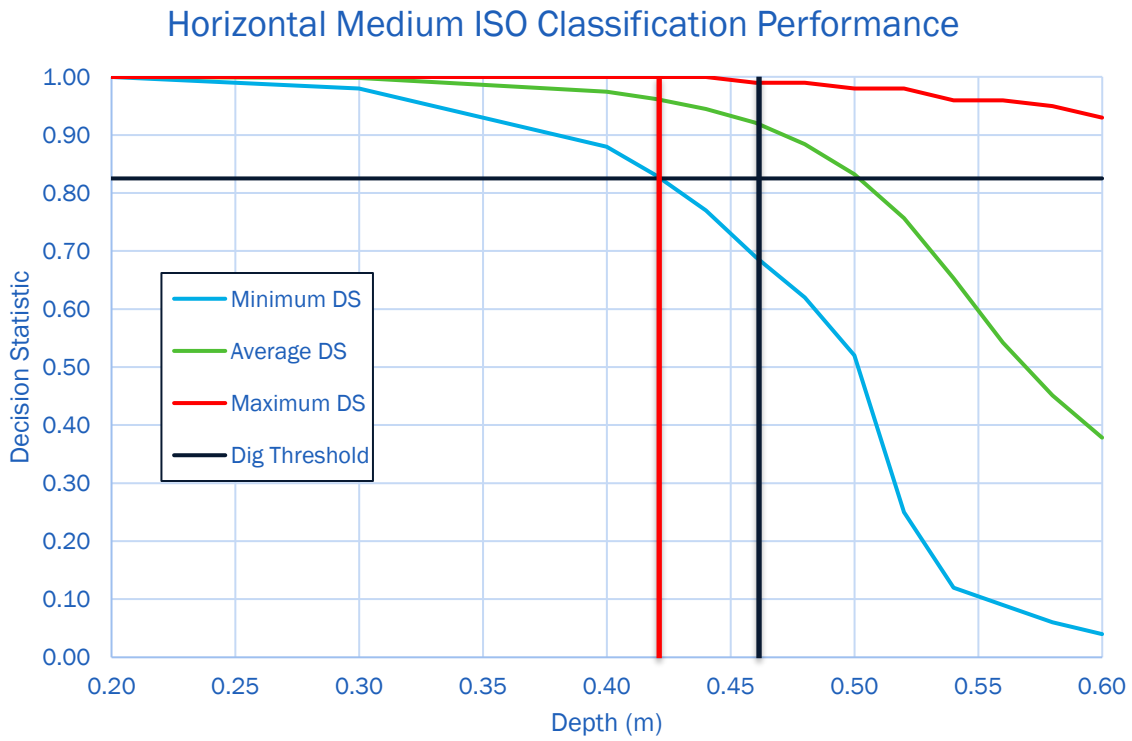
- Medium ISO QC Seed at 46 cm bgs was detected
- Cued MPV predicted location was offset 0.46 m from ground truth
- The closest TOI sources have marginal decision statistics and polarizability curves similar to geologic sources
- Conclusion: There was insufficient signal in the MPV cued data given background geologic variability to classify the seed as TOI with accurate coordinates





MEDIUM ISO CLASSIFICATION DEPTH

- For Background Location Validation a small ISO at 25cm depth was used
- The Background Location Validation Tool Method was used to estimate the effective classification depth for medium ISOs
- 10 different validated background locations were used to determine decision statistics for medium ISOs at a variety of depths between 20 and 60 cm bgs

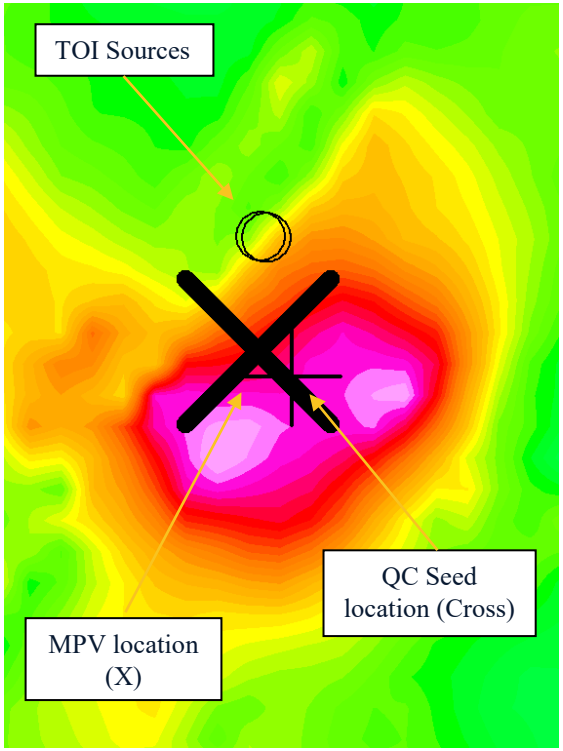


EFFECTIVE CLASSIFICATION DEPTH VS PHYSICAL SEED RESULTS

- **300 QC seeds and a similar number of QA seeds**
  - 25 Medium ISOs at 46 cm bgs
  - 16 horizontal Medium ISOs at 46 cm bgs
- **Small ISOs**
  - Maximum Burial Depth = 25 cm
  - 100% cued were included on the dig list
- **Medium ISOs**
  - Maximum Burial Depth = 46 cm
  - 87% of cued horizontal Medium ISOs buried at 46 cm were classified as TOI
  - 100% of cued Medium ISOs at < 42cm were included on the dig list
- **Large ISOs**
  - Maximum Burial Depth = 56 cm
  - 100% cued were included on the dig list
- **Physical seed results consistent with estimates**

DETECTION DEPTH > CLASSIFICATION DEPTH

- **Include dig for items below effective classification depth**
- **UltraTEM Screener results**
  - Response of 8.5 μV/A, above the threshold of 2.0 μV/A
  - Library Match 0.98
- **MPV results**
  - Low signal strength
  - Large offset from UltraTEM Source (>0.25 m)
- **Add Sources to dig list if:**
  - MPV signal strength low,
  - UltraTEM response was above threshold,
  - At least one MPV source classified added to dig list, and
  - Offset between UltraTEM and MPV sources > 0.25 m
- **Added 1.5 digs/acre**
- **Increased dig rate of Medium ISO QC Seed items at 46 cm depth to 100%**
- **DUA stated removal depth for Medium size items was 42 cm**



CONCLUSIONS

- **Background Validation Tool can be used to estimate effective cued classification depth**
- **Estimated effective cued classification depth was consistent with physical seed results**
- **Developed a method for increasing probability of including deep Medium ISOs dig list**
- **Deepest medium size UXO found at the site was a 60mm Mortar found 25 cm bgs, significantly shallower than the estimated effective classification depth of 42cm**

Estimating Cued Classification Depth with UX-Analyze Background Validation Tool

Pros	Cons
Software Tool Exists	Not scriptable – time consuming
Can estimate for any TOI in library	Does not identify problem areas (power line noise, high ground response, etc)
Implement early in cued data collection process	Only accounts for variable response at background locations
Estimates are site-specific	Does not account for effects of high metal density
Can be used for cued classification	Not applicable to dynamic classification

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