RISK METHODOLOGY FOR FUDS

(AKA RAO SPEEDWAGON)

Assessing Risk and Defining the Remedial Objectives for Munitions Response Sites

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EPA RI/FS GUIDANCE

"The objective of the RI/FS process is not the unobtainable goal of removing all uncertainty, but rather to gather information sufficient to support an informed risk management decision regarding which remedy appears to be most appropriate for a given site."[1]

[1] *Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA, U.S. EPA, October 1988*

Note that the Remedial Investigation and Feasibility Study (RI/FS) share the same objective.

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AGENDA

- Important Factors in the Conceptual Site Model (CSM)
- New FUDS Risk Management Process
  - Developing the Remedial Action Objective (RAO)
- Post-Remedy Data Assessments

CSM DEVELOPMENT

What we need to know to make decisions…

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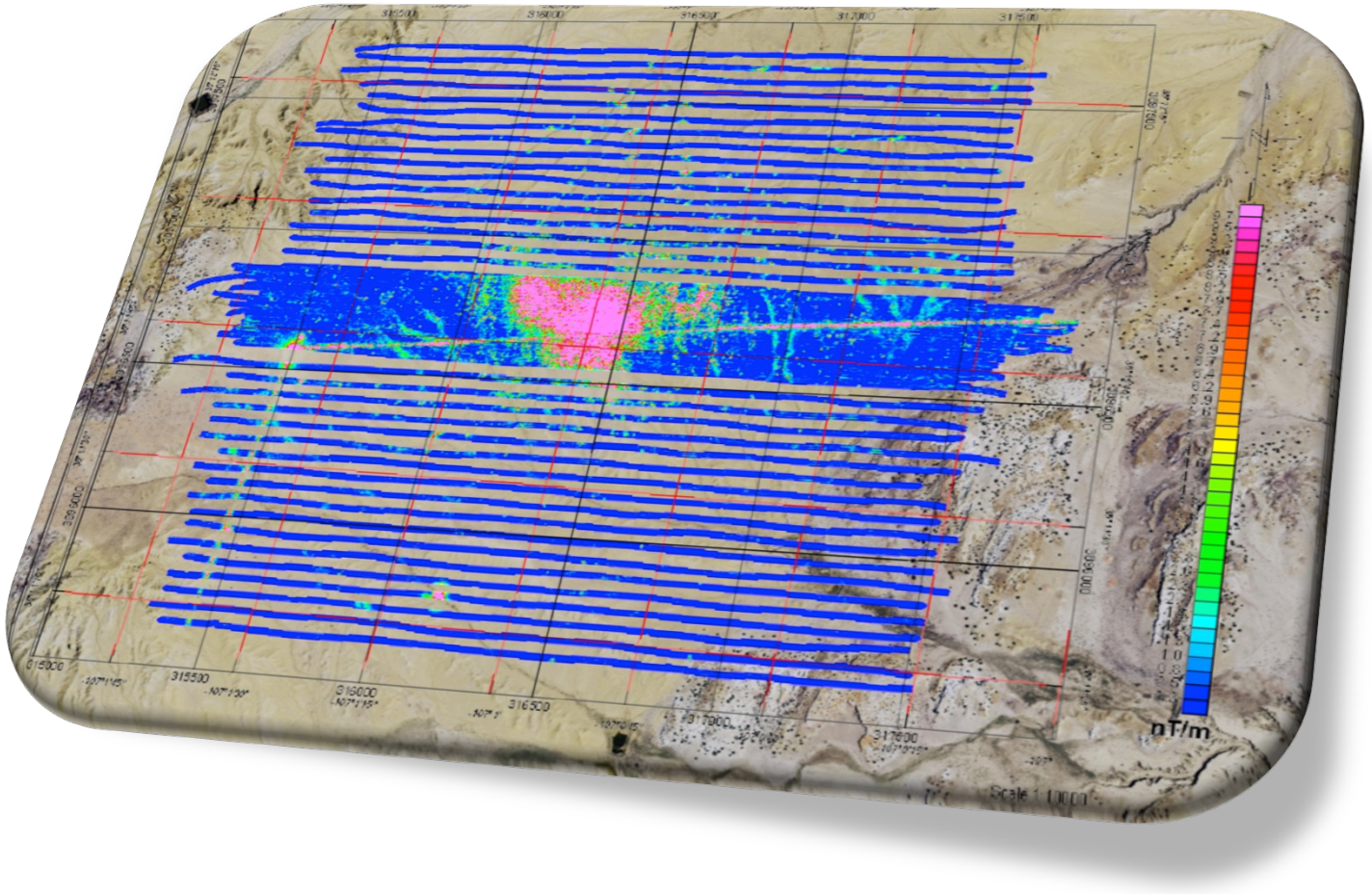
TYPICAL CHARACTERIZATION: FOCUS ON HORIZONTAL DISTRIBUTION



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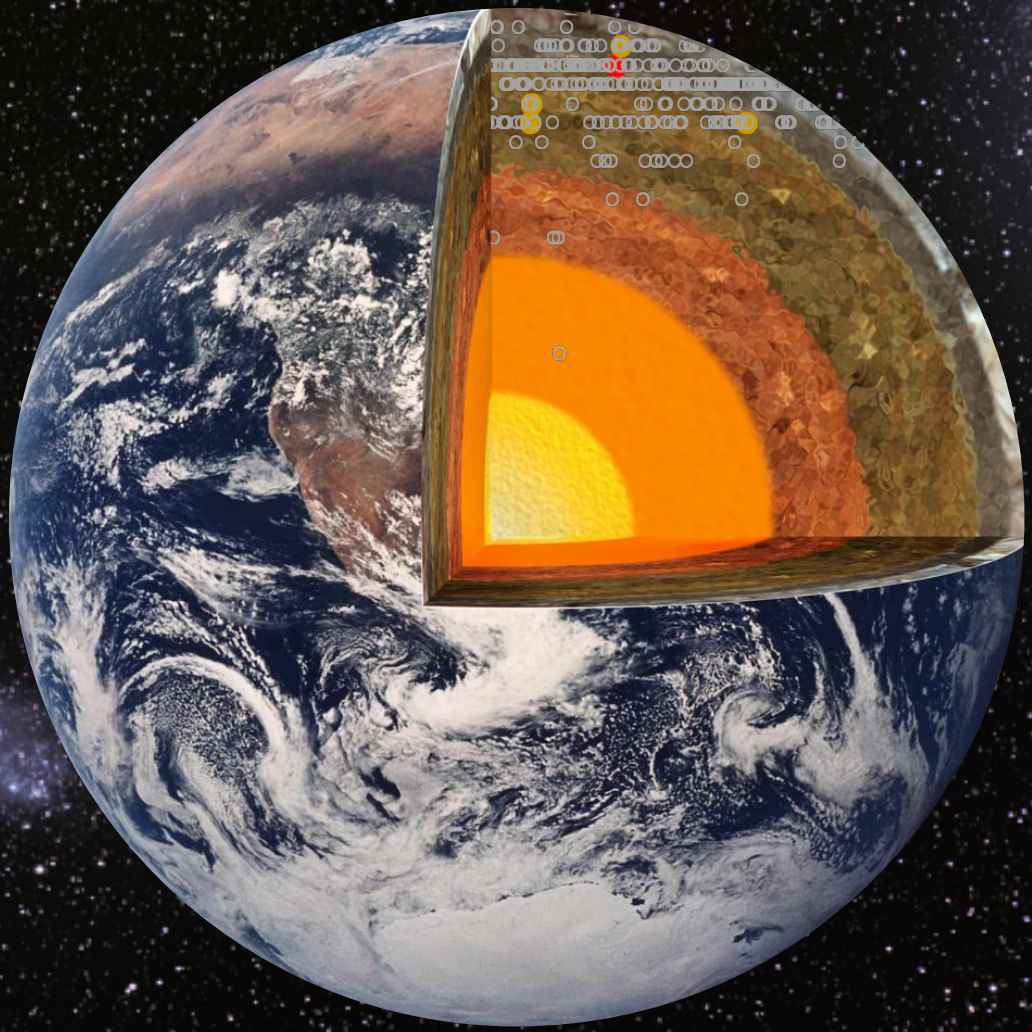
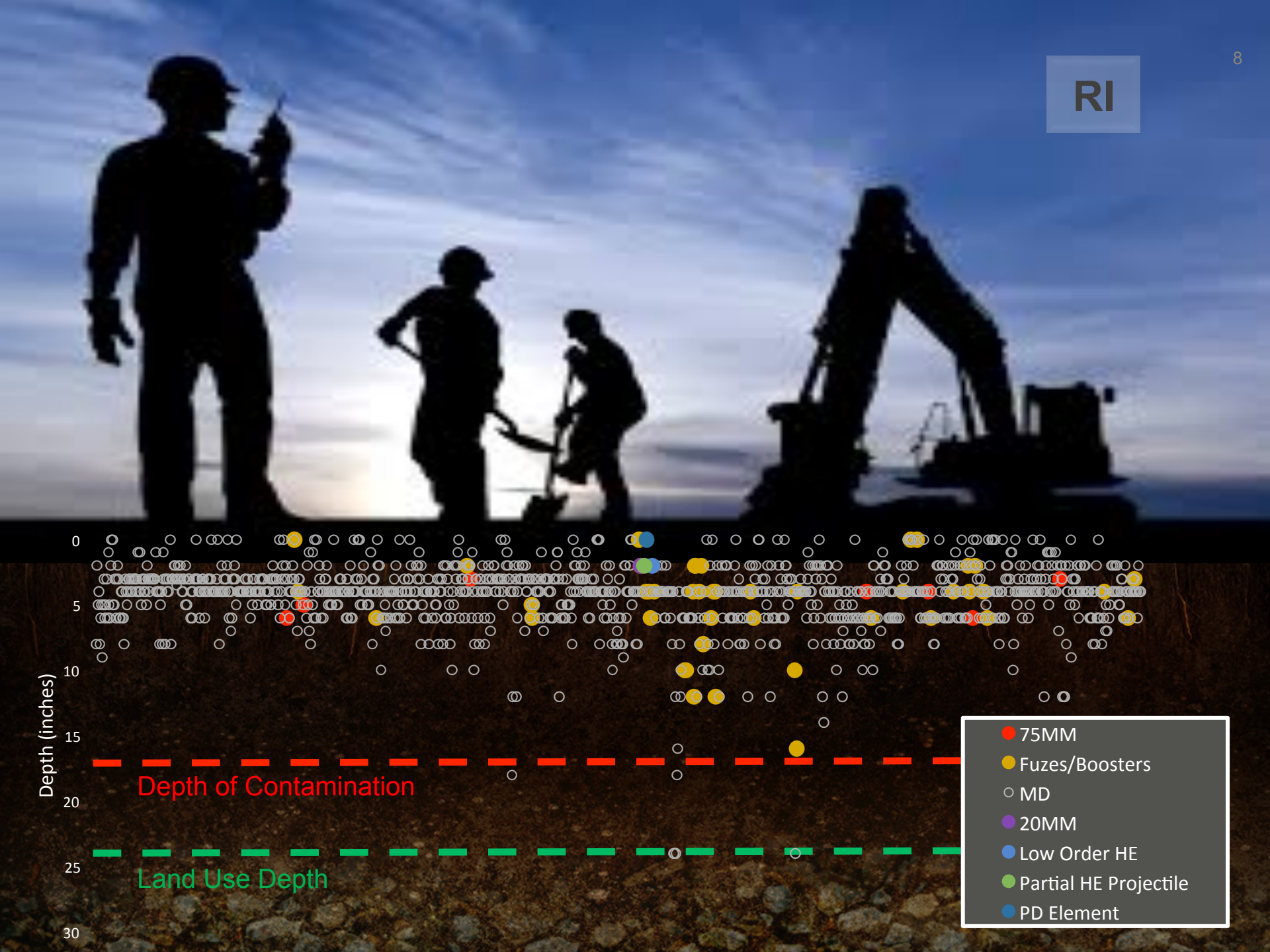


RI

CHARACTERIZATION: VERTICAL DISTRIBUTION

RI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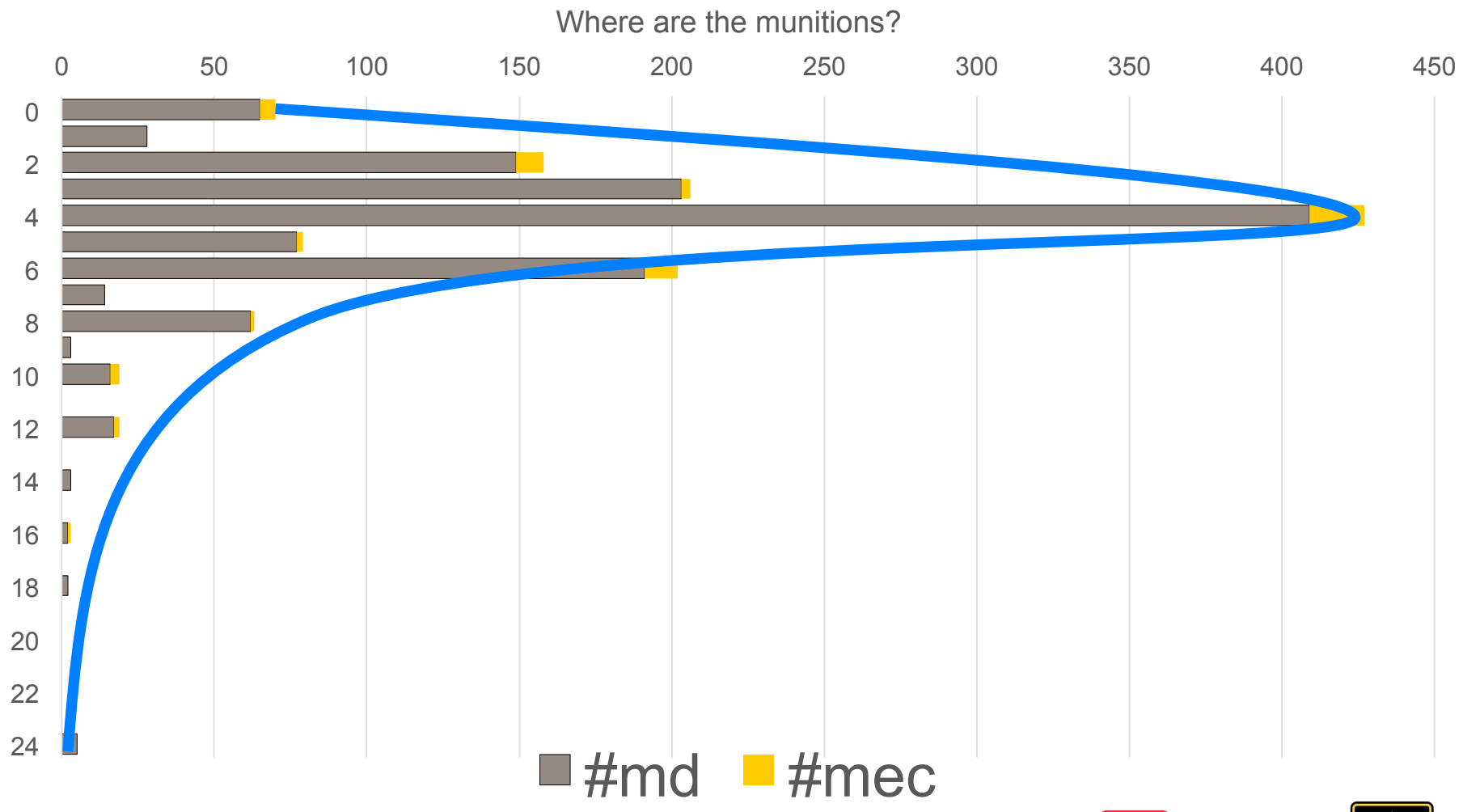
Depth (inches)
Depth of Contamination
Land Use Depth
75MM
Fuzes/Boosters
MD
20MM
Low Order HE
Partial HE Projectile
PD Element

HOW DO WE USE IT?

RI



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USING VERTICAL DISTRIBUTION

High Confidence

Increased Possibility of False Negatives

Reduction in Confidence

?

← Verified Detection Depth

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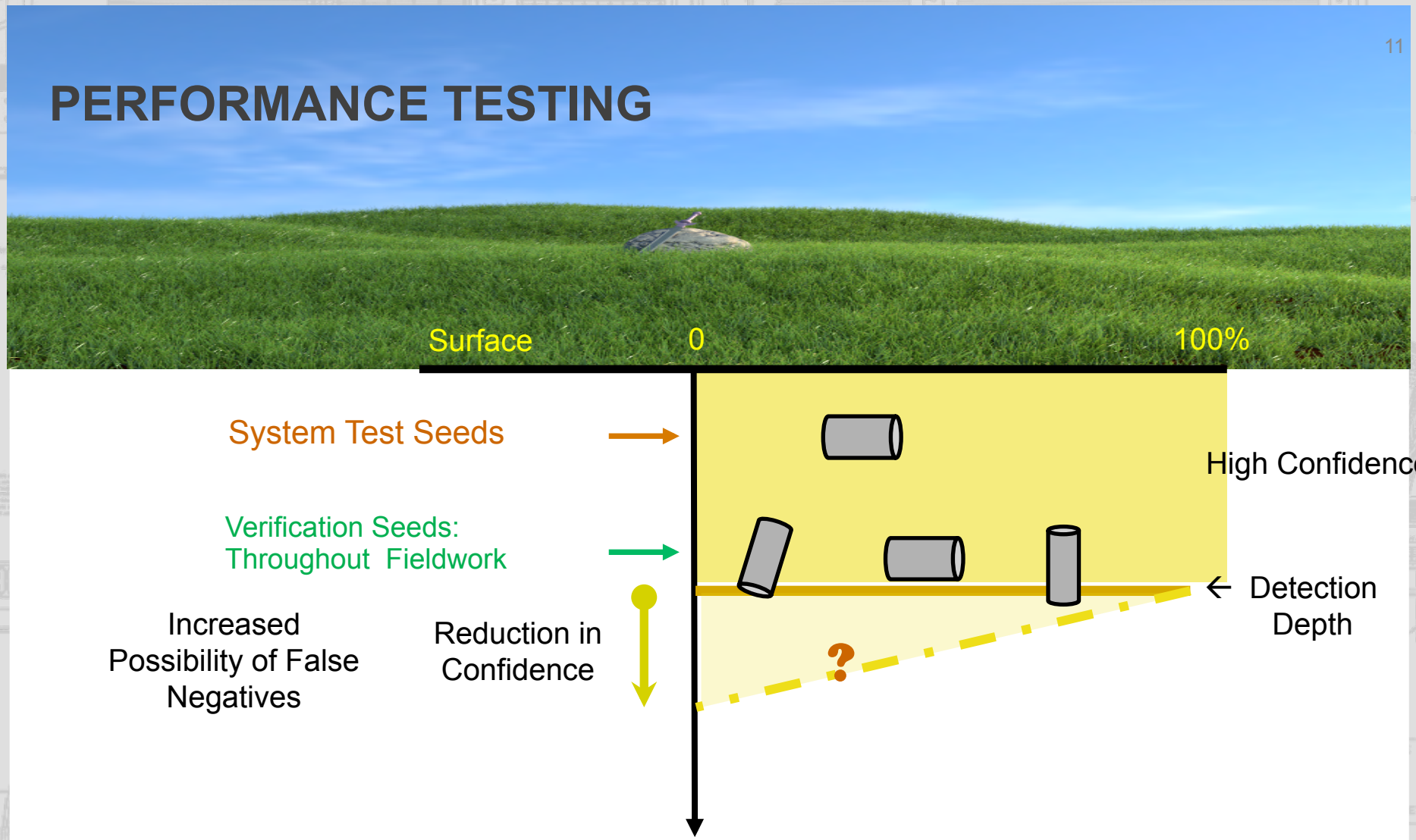
PERFORMANCE TESTING



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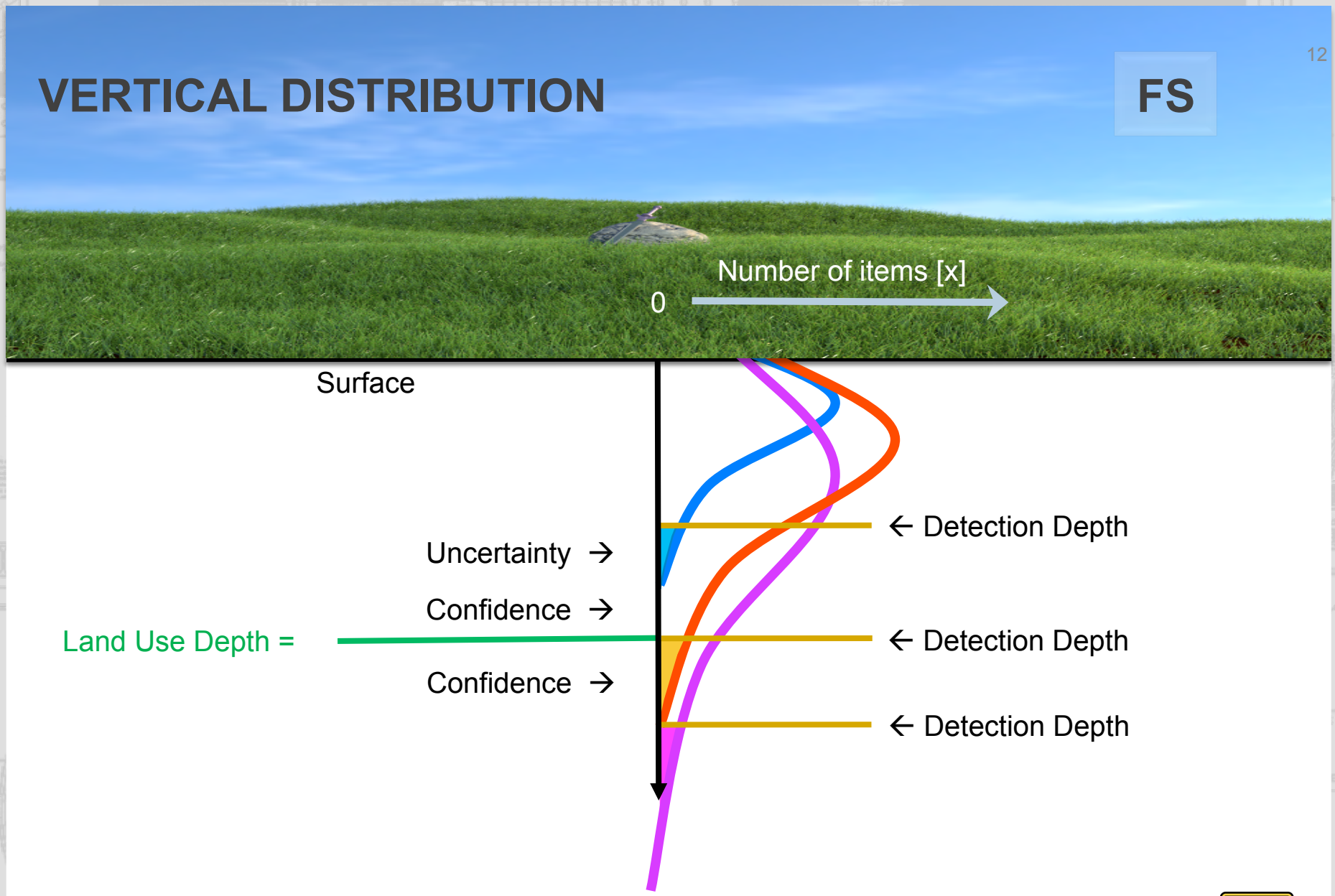
VERTICAL DISTRIBUTION

FS



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CSM SUMMARY

Historically, RI's focus on horizontal distribution only

-Depth of detection was not typically QC'd adequately, so communication of confidence in data was inadequate.

There are 3 critical vertical values to define in the RI

-verified detection depth from instrument

-land use depth

-vertical distribution depth of data

RAO TOOL

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BASELINE RISK ASSESSMENT

Purpose is to evaluate potential risk to human health and the environment *in the absence of any remedial action*.

- Toxicity and concentration of contaminants
- Fate and transport of contaminants
- Current and anticipated future land use
- Current and potential receptors (human and ecological)

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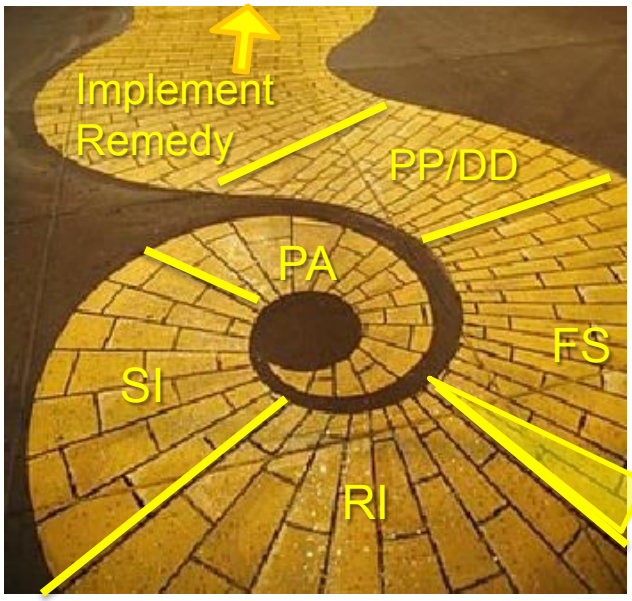
FRAME OF REFERENCE

CERCLA



MRSPP
(Throughout Project, until RC)

MEC HA
Supports Alternatives Analysis;
(Not a Risk Assessment)

We Are Here

Assess Risk & Develop Remedial Action Objectives (RAOs)

Emphasis on Site Specific Data Here

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THINK AHEAD:
PLAN FOR RAO DEVELOPMENT

In accordance with 40 CFR Part 300.430(e)(i), the Lead Agency shall "Establish Remedial Action Objectives (RAOs) *specifying contaminants and media of concern, potential exposure pathways, and remediation goals*".

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NOTICE!

*An acceptable remediation goal **cannot be defined** for an **unknown** or **undefined** risk!!*

Two choices:

1. *RI is incomplete, need more data*
2. *No evidence, No risk, RC*

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MATRIX RELATIONSHIPS

Designed to simplify relationships between:

- Quantity
- Accessibility
- Severity
- Sensitivity of Munitions
- Site Activities

Matrix 1: Frequency of Encounter

Matrix 2: Frequency with Severity of an incident

Matrix 3: Sensitivity of items with consideration of Site Activities

Matrix 4: Brings together all that is known about UXO or DMM that may remain

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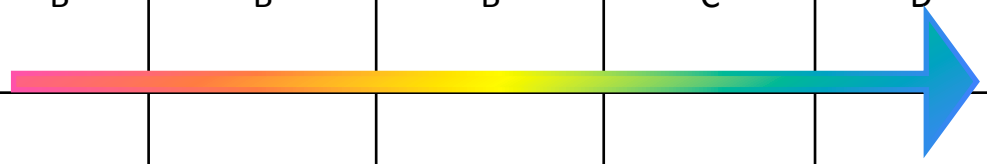
Likelihood of Encounter, Matrix 1: Amount of MEC vs. Access Conditions		MRS Frequency of Use (Access)			
		Regular (e.g., daily use, open access)	Often (e.g., less regular or periodic use, some access)	Intermittent (e.g., some irregular use, or access limited)	Rare (e.g., very limited use, access prevented)
		← Derived from MEC HA →			
Amount of MEC	• MEC is visible on the surface and detected in the subsurface.	Frequent	Frequent	Likely	Occasional
	• Investigation of the MRS characterized the area as a Concentrated Munitions Use Area (CMUA) where MEC is known or suspected (e.g., MD indicative of MEC) is identified).	Frequent	Likely	Occasional	Seldom
	• MEC presence based on physical evidence only (e.g., MD indicative of MEC), although the area is not a CMUA, or • The MEC concentration is below a project-specific threshold to support this selection (e.g., less than 1.0/acre at 95% confidence).	Likely	Occasional	Seldom	Unlikely
	• MEC presence is based on isolated historical discoveries (e.g., EOD report), or • A response action has been conducted to remove MEC and known or suspected hazard remains to support this selection, (e.g., surface removal where subsurface not addressed) or • The MEC concentration is below a project-specific threshold to support this selection (e.g., less than 0.5/acre at 95% confidence).	Occasional	Seldom	Unlikely	Unlikely
	• MEC presence is suspected based on historical evidence of munitions use only, or • A response action has been conducted to remove surface and subsurface MEC (UU/UE not achieved), or • The MEC concentration is below a project-specific threshold to support this selection (e.g., less than 0.25/acre at 95% confidence).	Seldom	Seldom	Unlikely	Unlikely
	• Investigation of the MRS did not identify evidence of MEC presence, or • A response action conducted to achieve UU/UE.	Unlikely	Unlikely	Unlikely	Unlikely

Severity of Incident, Matrix 2: Severity vs. Likelihood of Encounter		Likelihood of MEC Encounter				
		Frequent	Likely	Occasional	Seldom	Unlikely
Severity of Incident Associated with Specific Hazards	**Catastrophic/Critical:** May result in 1 or more death or permanent total disability	A	A	B	B	D
	Modest: May result in 1 or more injury resulting in emergency medical treatment, without hospitalization	B	B	B	C	D
	Minor: May result in 1 or more injuries requiring first aid or medical treatment	B	C	C	C	D
	Improbable: No injury is anticipated	D	D	D	D	D

← Defined in DA Pam 385-30 →



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Likelihood of Detonation, Matrix 3: Munitions Sensitivity vs. Likelihood of Energy to be Imparted		**Specific Land Use : Likelihood to Impart Energy**		
		High e.g., areas planned for development	***Moderate*** e.g., undeveloped, wildlife refuge, parks	***Not Likely*** e.g., not anticipated, prevented, mitigated
Sensitivity: Susceptibility to Detonation ← Grouped from MRSPP→	***High Sensitivity***	1	1	3
	Moderate Sensitivity High Explosive (HE) (used, unused, or Damaged); or Pyrotechnic (used or Damaged)	1	2	3
	Low Sensitivity Propellant; Bulk Secondary HE, Pyrotechnics or Propellant; Pyrotechnic (not used or damaged)	1	3	3
	Not sensitive	2	3	3

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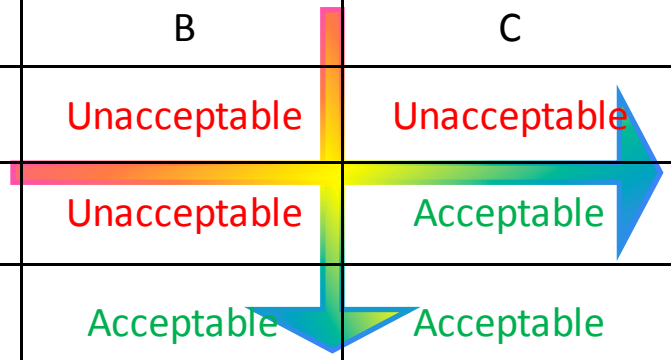
ACCEPTABLE VS. UNACCEPTABLE

Acceptable and Unacceptable Site Conditions		Result From Matrix 2			
		A	B	C	D
Result from Matrix 3	1	Unacceptable	Unacceptable	Unacceptable	Acceptable
	2	Unacceptable	Unacceptable	Acceptable	Acceptable
	3	Unacceptable	Acceptable	Acceptable	Acceptable



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DEFINING REMEDIAL OBJECTIVES

Decision Logic for Developing Acceptable End States for a Munitions Response Site

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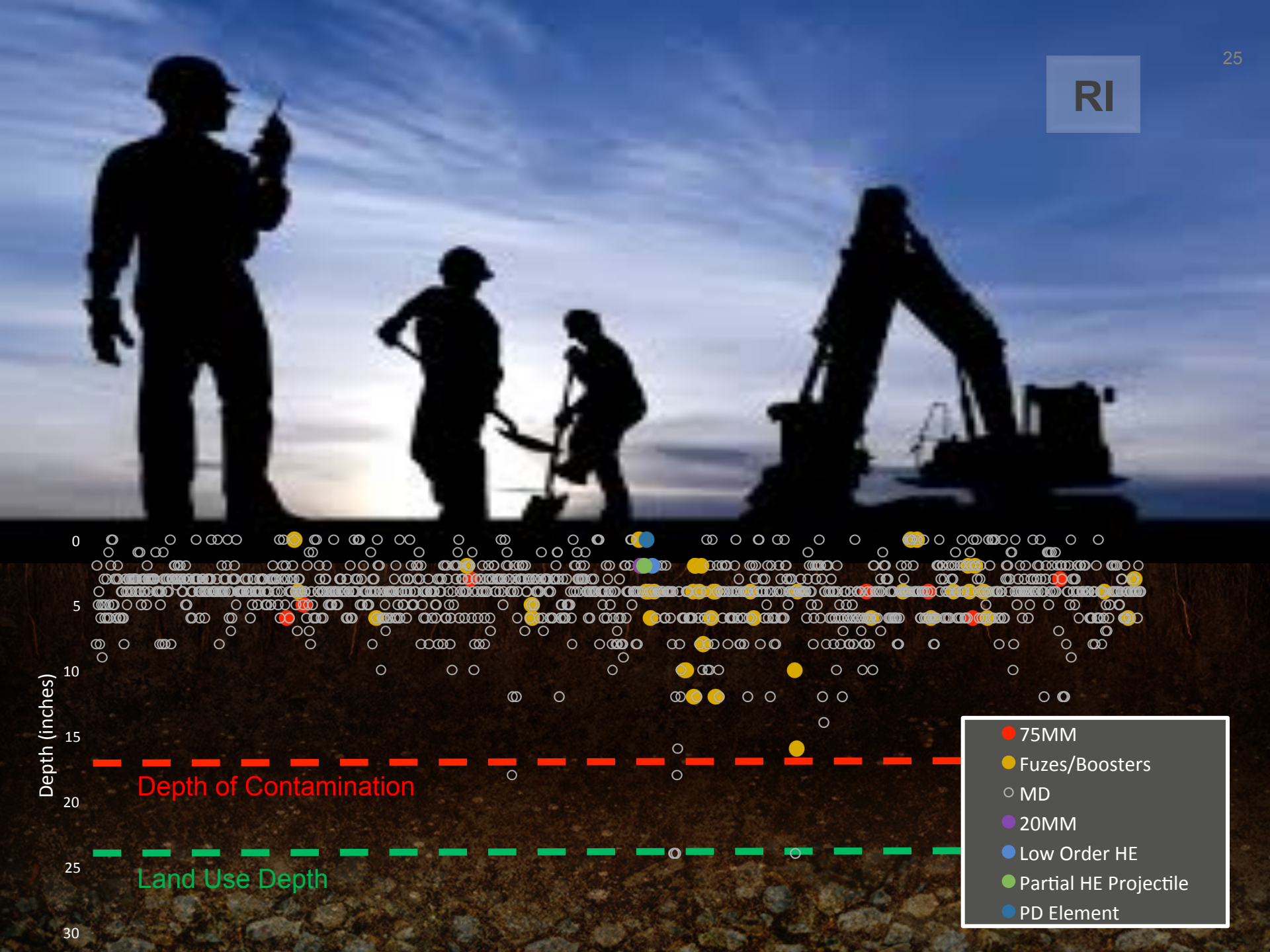
RI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Depth (inches)
Depth of Contamination
Land Use Depth
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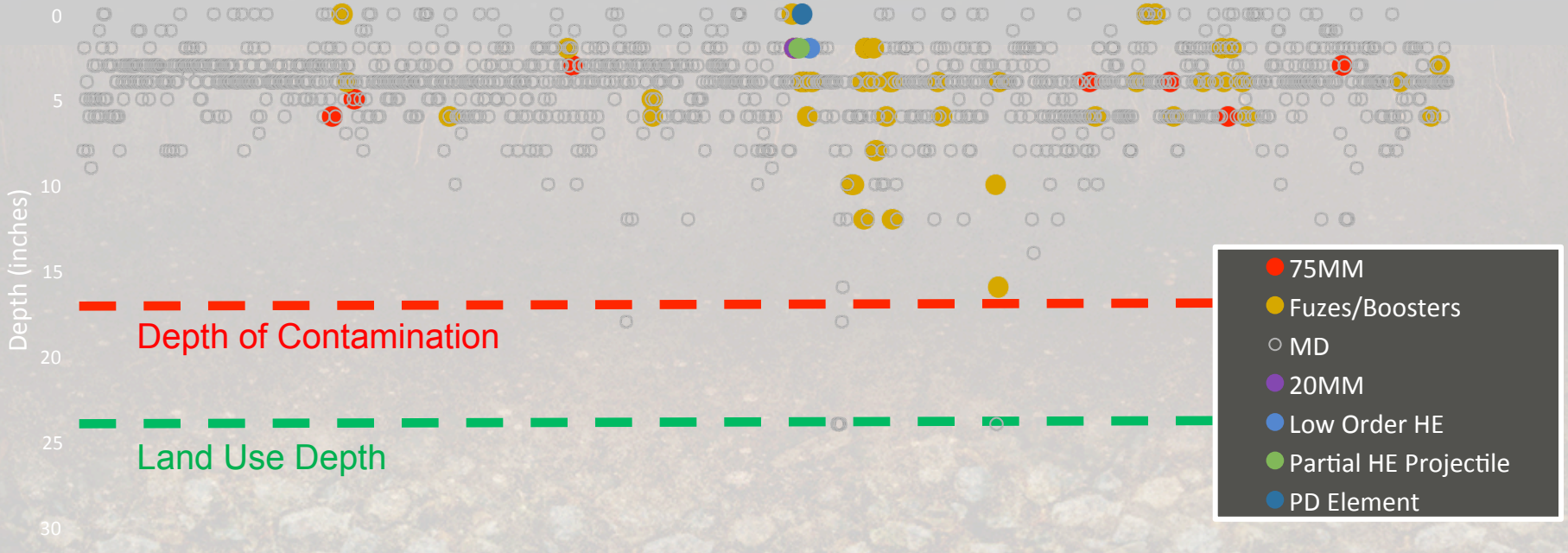
Fuzes/Boosters
MD
20MM
Low Order HE
Partial HE Projectile
PD Element

THE REMEDIAL ACTION OBJECTIVE (RAO) IS:

FS

"…to reduce the unacceptable risk due to the presence of [name specific munitions] within [horizontal boundary] and [depth] to address exposure to [receptors] via [pathway] such that an acceptable scenario, defined by Matrix 4, is achieved."



EXAMPLE M-1

Evidence of Hazard Present

- 1870 Acres
- RI Results
  - 13 76mm APHE
  - 2.36-inch Rockets
  - 105mm Smoke Canister
  - 155mm HE

Activities / Use

- 10,000 people per year
- Full Accessibility
- Recreational (i.e., camping, hunting, hiking, lake access)

Defined Exposure Pathway

Clearly Defined PRESENCE

- on surface
- likely subsurface

Potential for Encounter is Likely

Unacceptable Risk

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	Minor: May result in 1 or more injuries requiring first aid or medical treatment	B	C	C	C	D
	Improbable: No injury is anticipated	D	D	D	D	D

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MATRIX 3: MEC Sensitivity Matrix: Likelihood of Detonation

		Specific Land Use Site Activities: Relative Energy Imparted to Munitions During Encounter		
		High e.g., areas planned for development	***Moderate*** e.g., undeveloped, wildlife refuge, parks	***Not Likely*** e.g., not anticipated, prevented, mitigated
Sensitivity: Susceptibility to Detonation	***Sensitive***	1	1	3
	High Explosive (HE) (used, unused, or Damaged); or Pyrotechnic (used or Damaged)	1	2	3
	Propellant; Bulk Secondary HE, Pyrotechnics or Propellant; Pyrotechnic (not used or damaged)	1	3	3
	Practice or Riot Control	2	3	3

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Matrix 4: Defining Unacceptable Site Conditions

Acceptable and Unacceptable Site Conditions		Severity Category From Matrix 2			
		A	B	C	D
Sensitivity Category from Matrix 3	1	Unacceptable	Unacceptable	Unacceptable	Acceptable
	2	Unacceptable	Unacceptable	Acceptable	Acceptable
	3	Unacceptable	Acceptable	Acceptable	Acceptable

MUST DO Feasibility Study

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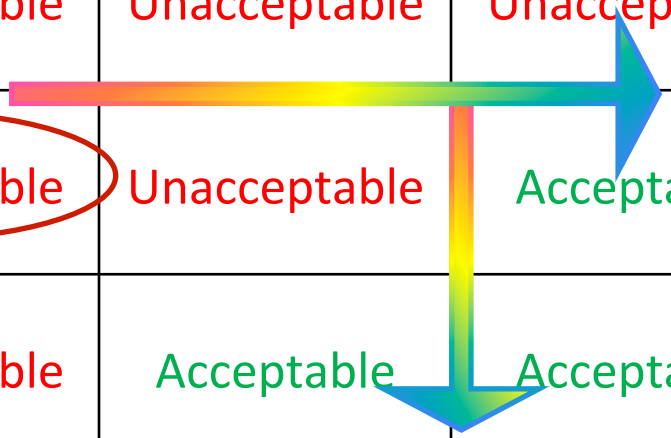
Matrix 4: Defining Unacceptable Site Conditions

Acceptable and Unacceptable Site Conditions		Severity Category From Matrix 2			
		A	B	C	D
Sensitivity Category from Matrix 3	1	Unacceptable	Unacceptable	Unacceptable	Acceptable
	2	Unacceptable	Unacceptable	Acceptable	Acceptable
	3	Unacceptable	Acceptable	Acceptable	Acceptable



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	Propellant; Bulk Secondary HE, Pyrotechnics or Propellant; Pyrotechnic (not used or damaged)	1	3	3
	Practice or Riot Control	2	3	3

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Alternative 1: Education Only,

where Likelihood of Encounter with something Catastrophic is "Frequent"

Acceptable and Unacceptable Site Conditions		Severity Category From Matrix 2			
		A	B	C	D
Sensitivity Category from Matrix 3	1	Unacceptable	Unacceptable	Unacceptable	Acceptable
	2	Unacceptable	Unacceptable	Acceptable	Acceptable
	3	Unacceptable	Acceptable	Acceptable	Acceptable

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MATRIX 1:
Accessibility Matrix: Likelihood of Encounter

Amount of MEC	MRS Access Conditions: Regular (e.g., daily use, open access)	Often (e.g., less regular or periodic use, some access)	Intermittent (e.g., some irregular use, or access limited)	Rare (e.g., very limited use, access prevented)
• MEC is visible on the surface and detected in the subsurface.	**Frequent**	**Frequent**	**Likely**	**Occasional**
• Investigation of the MRS characterized the area as a Concentrated Munitions Use Area (CMUA) where MEC is suspected.	**Frequent**	**Likely**	**Occasional**	**Seldom**
• Investigation supports MEC presence based on physical evidence only (e.g., MD indicative of MEC), although the area is not a CMUA, or • The MEC concentration is below a project-specific threshold to support this selection (e.g., less than 1.0/ acre at 95% confidence).	**Likely**	**Occasional**	**Seldom**	**Unlikely**
• MEC presence is based on isolated historical discoveries (e.g., EOD report), or • A response action has been conducted to remove MEC and known or suspected hazard remains to support this selection, (e.g., surface removal where subsurface not addressed) or • The MEC concentration is below a project-specific threshold to support this selection (e.g., less than 0.5/ acre at 95% confidence).	**Occasional**	**Seldom**	**Unlikely**	**Unlikely**
• MEC presence is suspected based on historical evidence of munitions use only, or • A response action has been conducted to clear surface and subsurface MEC (UU/UE not achieved), or • The MEC concentration is below a project-specific threshold to support this selection (e.g., less than 0.25/ acre at 95% confidence).	**Seldom**	**Seldom**	**Unlikely**	**Unlikely**
• Investigation of the MRS did not identify evidence of MEC presence, or • A response action conducted to achieve UU/UE.	**Unlikely**	**Unlikely**	**Unlikely**	**Unlikely**

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MATRIX 2: MEC Severity		Likelihood of MEC Encounter				
		Frequent	Likely	Occasional	Seldom	Unlikely
Severity of Incident Associated with Specific MEC items	**Catastrophic:** MEC that may result in 1 or more death or permanent total disability	A	A	B	B	D
	Modest: MEC that may result in 1 or more injury resulting in emergency medical treatment, without hospitalization.	B	B	B	C	D
	Minor: MEC that may result in 1 or more injuries requiring first aid or medical treatment	B	C	C	C	D
	Improbable: No injury is anticipated	D	D	D	D	D

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Alternative 2: Surface Clearance Only,

where Likelihood of Encounter with something Catastrophic is "Frequent"

Acceptable and Unacceptable Site Conditions		Severity Category From Matrix 2			
		A	B	C	D
Sensitivity Category from Matrix 3	1	Unacceptable	Unacceptable	Unacceptable	Acceptable
	2	Unacceptable	Unacceptable	Acceptable	Acceptable
	3	Unacceptable	Acceptable	Acceptable	Acceptable

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Alternative 3:
Surface Clearance and Education,

where Likelihood of Encounter with something Catastrophic is "Frequent"

Acceptable and Unacceptable Site Conditions		Severity Category From Matrix 2			
		A	B	C	D
Sensitivity Category from Matrix 3	1	Unacceptable	Unacceptable	Unacceptable	Acceptable
	2	Unacceptable	Unacceptable	Acceptable	Acceptable
	3	Unacceptable	Acceptable	Acceptable	Acceptable

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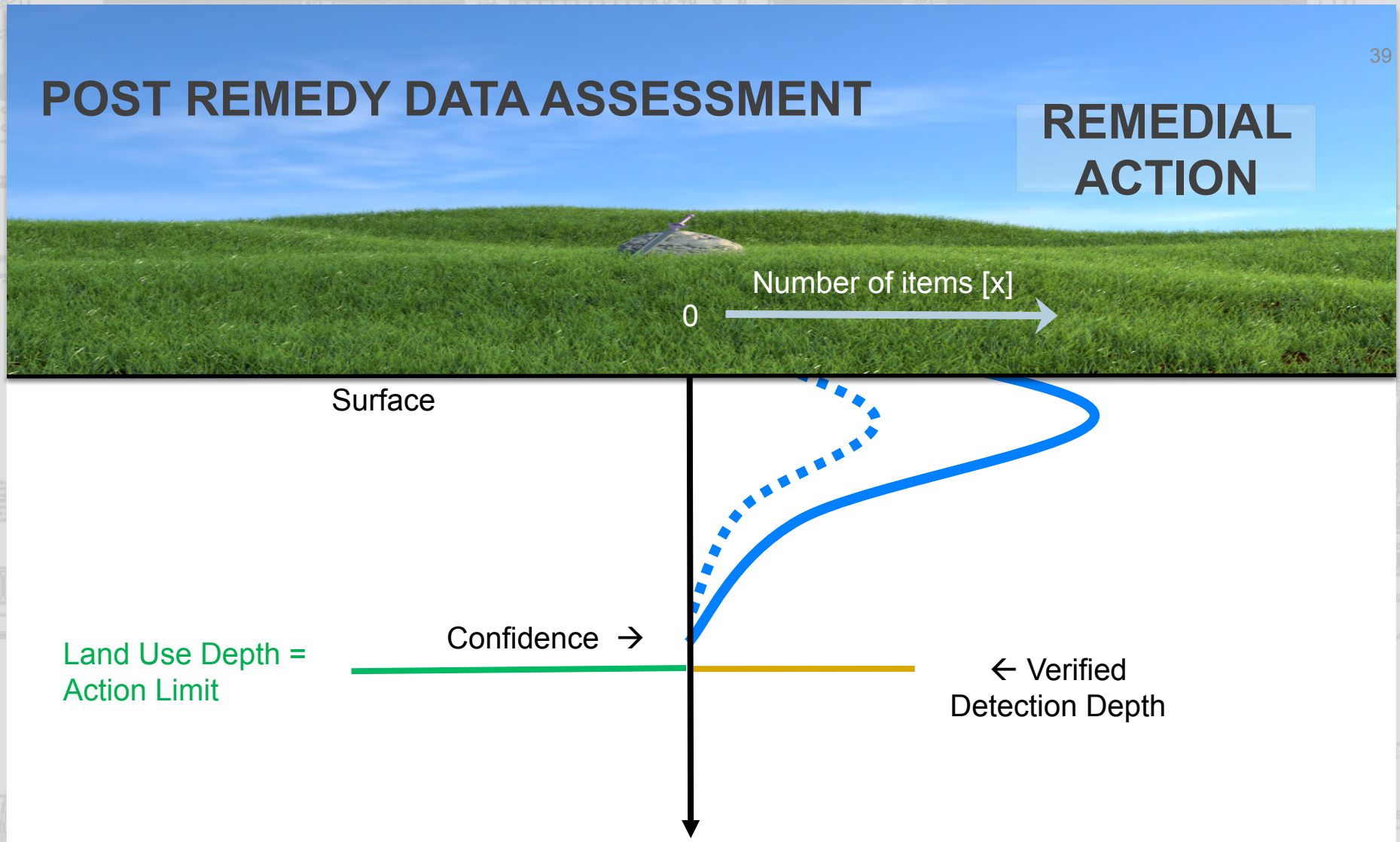
POST REMEDY DATA ASSESSMENT

REMEDIAL ACTION



Did we meet the RAO?

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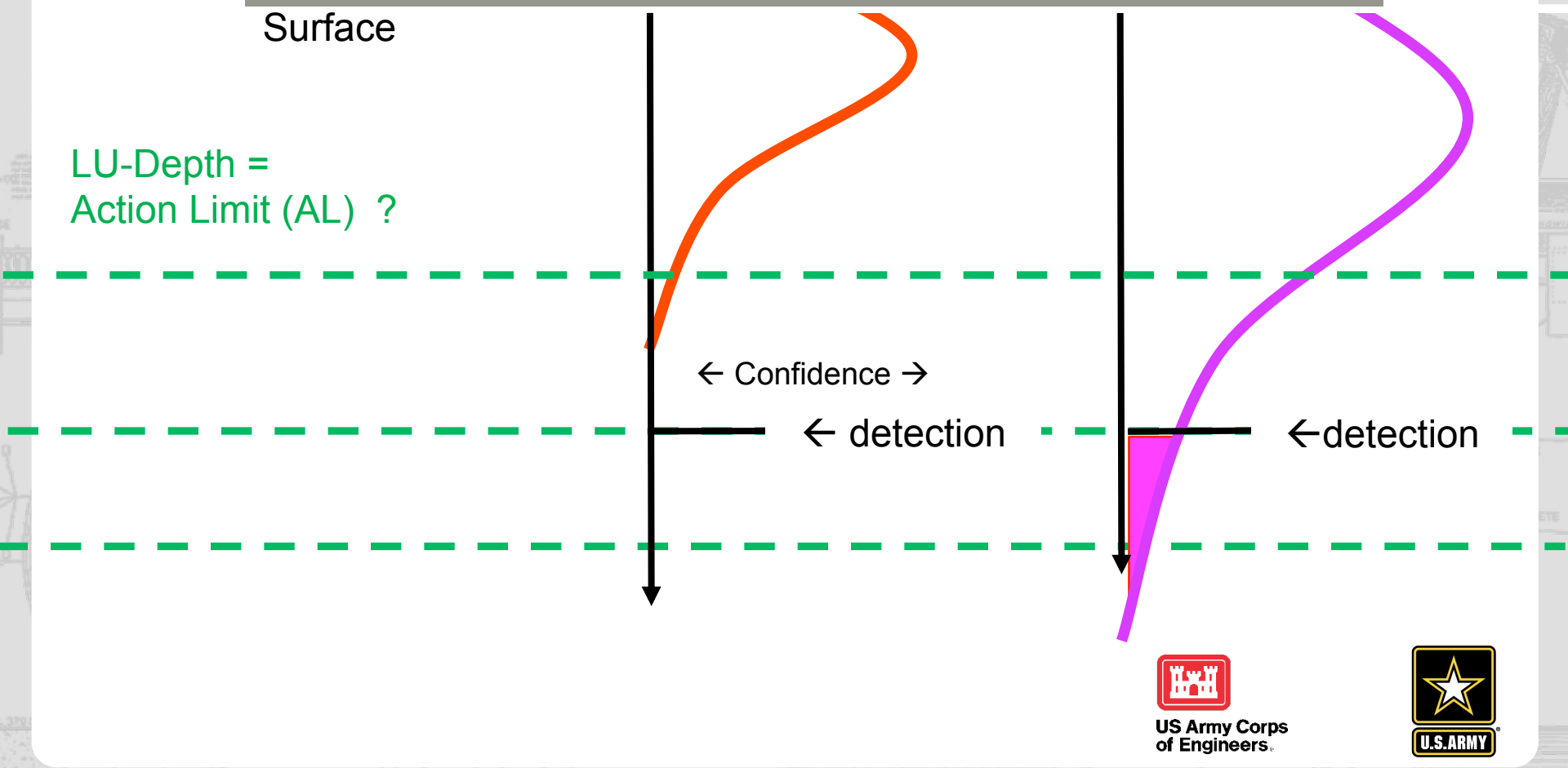
UNDERSTAND THE VERTICAL DISTRIBUTION



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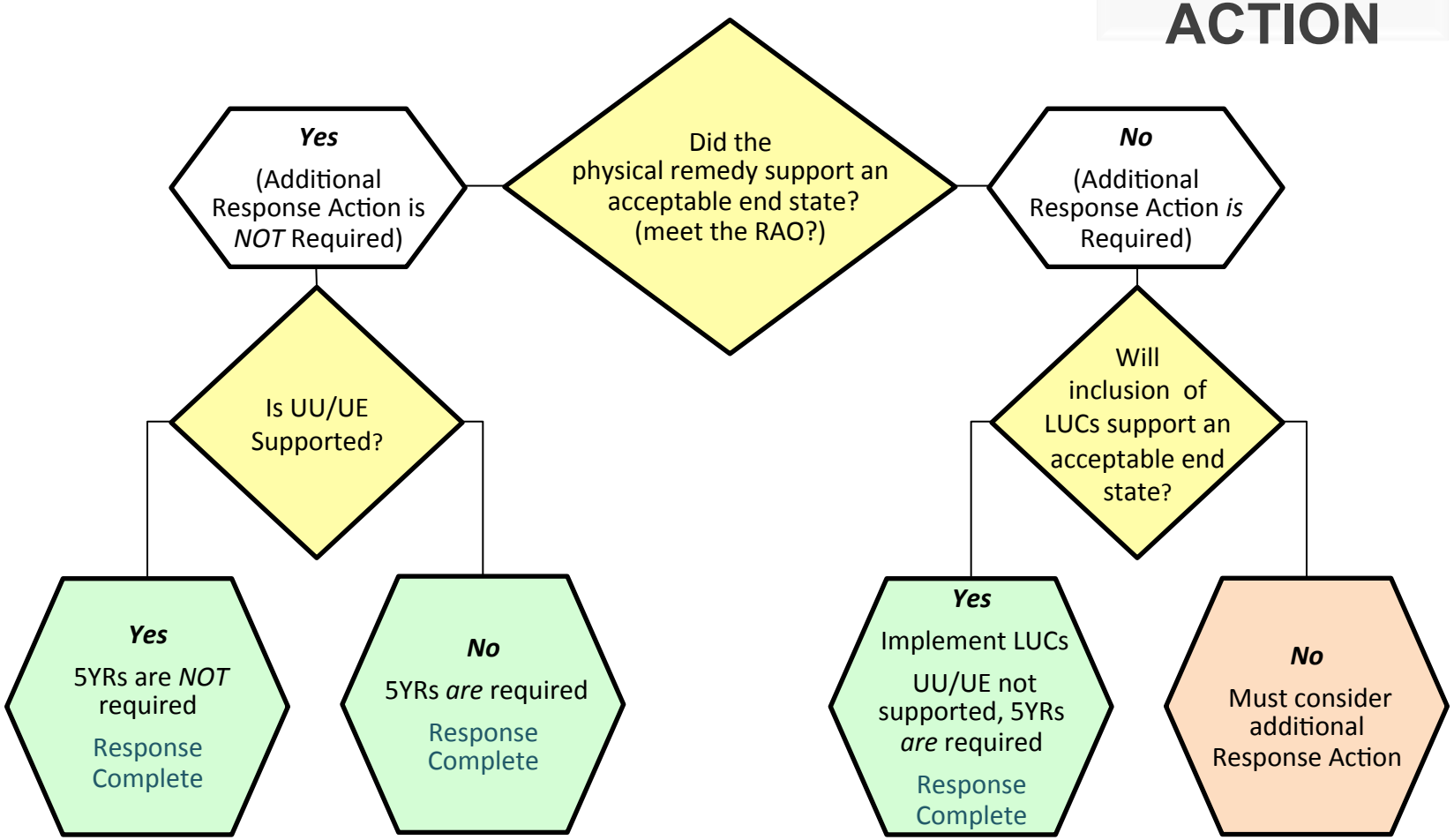
POST REMEDY DATA ASSESSMENT

REMEDIAL ACTION



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HOW DO WE GET BETTER?
CHARACTERIZATION!

- Better Characterization Data
  - Specify and Track Location & Depth (Model the CSM)
  - Report Types with Nomenclature (know sensitivity and severity)
- Establish QC and QA Criteria with Appropriate Documentation for the Data (not just a safety QC)
- Understand and Discuss Land Use Scenarios
  - Depth of Use
  - Detection Depths
  - Land Use Depths
  - Other Site Depth (e.g. to bedrock, etc.)

HOW DO WE GET BETTER?
PLAN FOR A POST REMEDY ASSESSMENT

- Better Tracking of Remediation Data
  - Specify and Track Location & Depth
  - Types with Nomenclature
- Establish QC and QA Criteria with Appropriate Documentation for the Data (not just a safety QC)
- Determine how the Achievement of the Remedial Action will be measured against the RAO to establish the “Acceptable End State”.

BOTTOM LINE: TECHNOLOGY IS CATCHING UP!

We can No Longer Say (before data):

"We CAN'T get it all"

or

"We'll NEVER get UU/UE"

or

"We'll NEVER get buy-in from the Regulator"

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THANK YOU

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