Wide Area Assessment Technology Demonstration to Characterize Munitions Density at Closed Castner Firing Range

Technical Project Planning Meeting
16 October 2009

Agenda

- Introductions
- Meeting Goals
- Site Overview
- Munitions Response Program
- Project Objectives
- Wide Area Assessment Technologies & Study Questions
- Project Schedule
- Future TPP Meetings

Meeting Goals

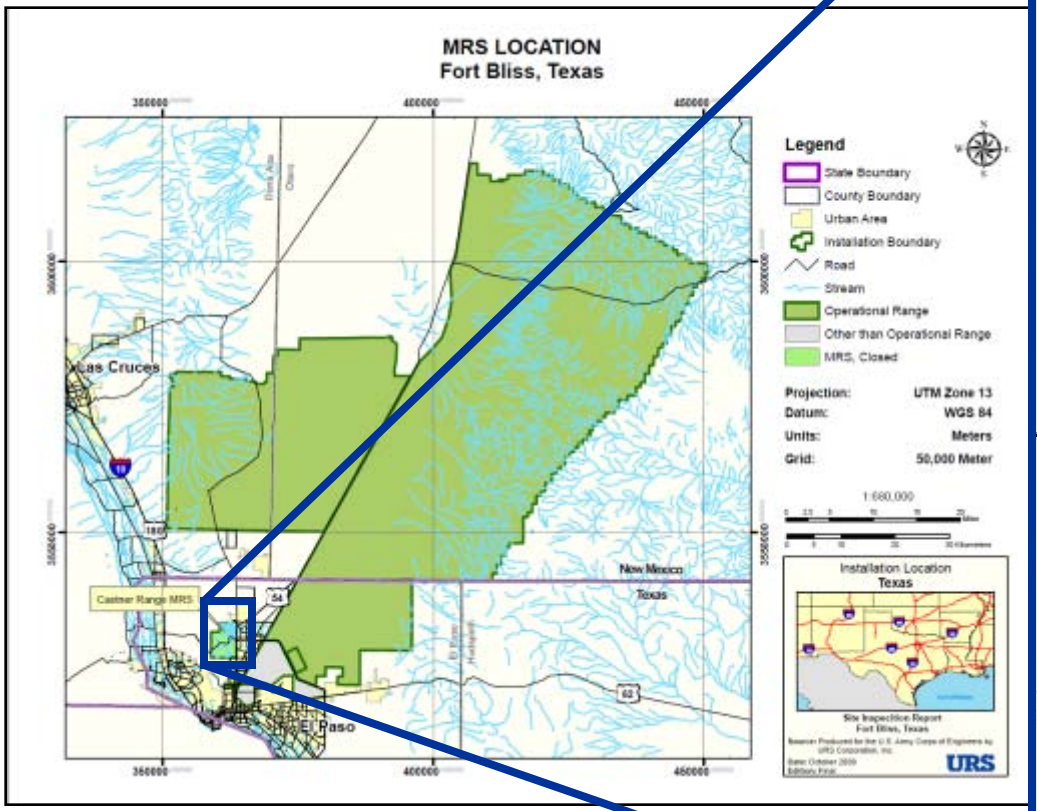
- Establish and foster the TPP Team
- Create venue for exchange of information & stakeholder perspectives
- Outline project objectives & data needs
- Achieve common understanding of technical approach
- Understand project constraints/dependencies
- Understand next steps

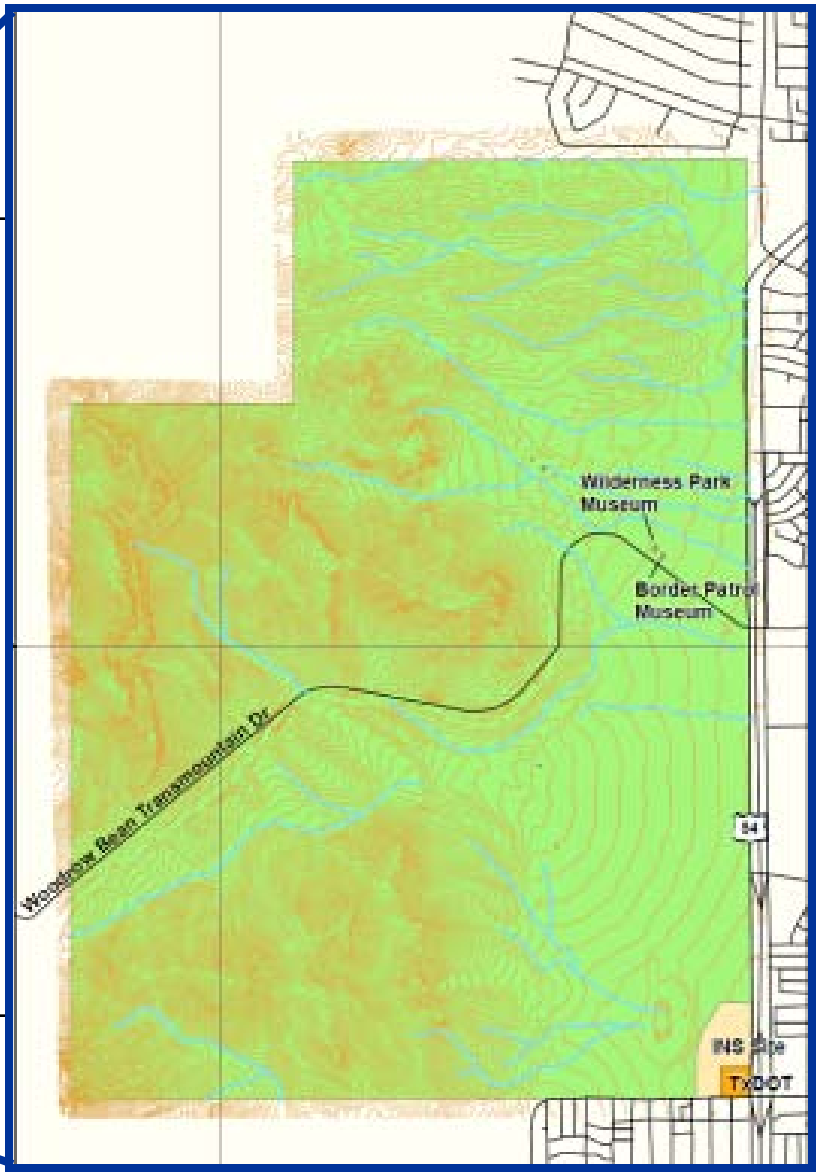
Existing Site Information

Site History

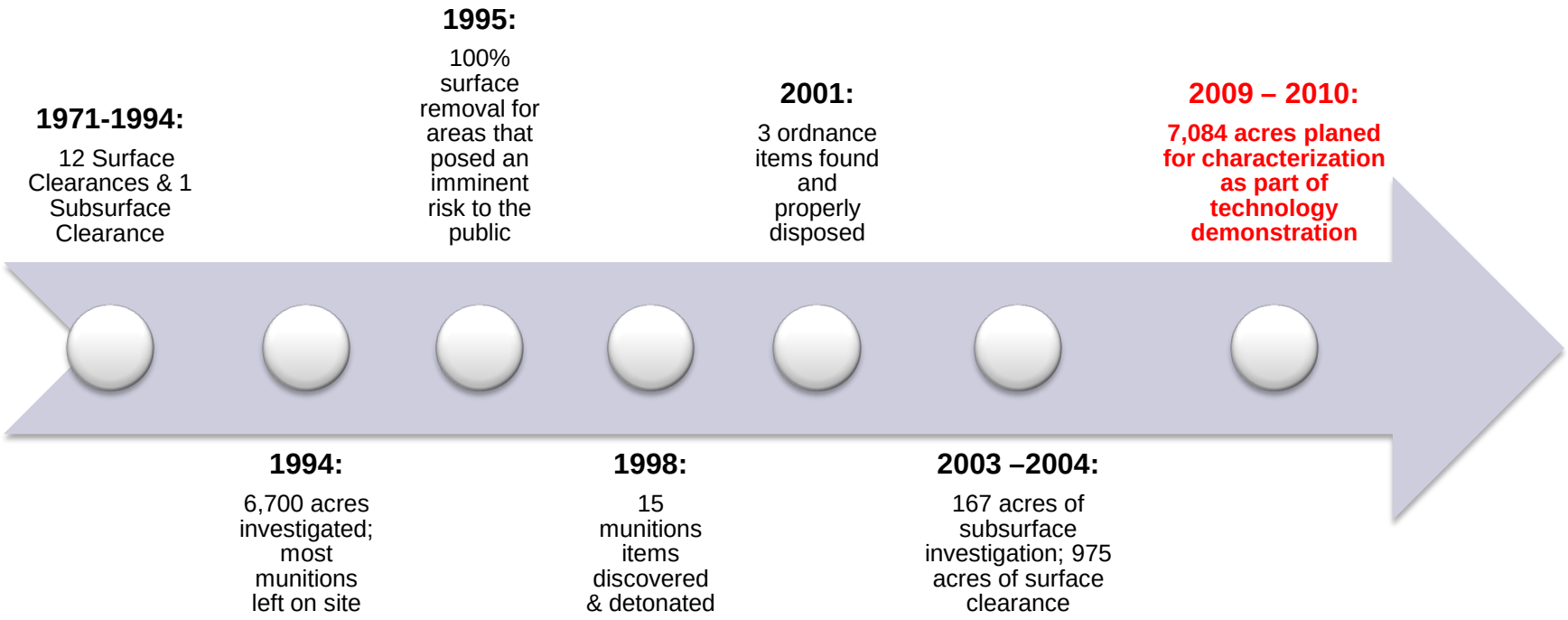
- **1926:** Land acquisition begins; initially encompassing approximately 3,500 acres
- **1939:** Additional land acquired; total of 8,328 acres
- **1926 – 1966:** Castner Range used as small arms and artillery firing range
- **1972:** Department of the Army declares Castner Range surplus; transfer parcels (primarily east of US 54) to non-DoD entities (1,244 acres transferred)

Site Location





Previous Site Investigations



Ordnance Found on Castner Range

Artillery: 105mm projectile

Ordnance Found on Castner Range

Rockets: 2.36 inch rocket

Ordnance Found on Castner Range

Anti-tank/Anti-aircraft: 37mm projectile

Ordnance Found on Castner Range

Grenades: Smoke Grenade

Natural & Cultural Resources

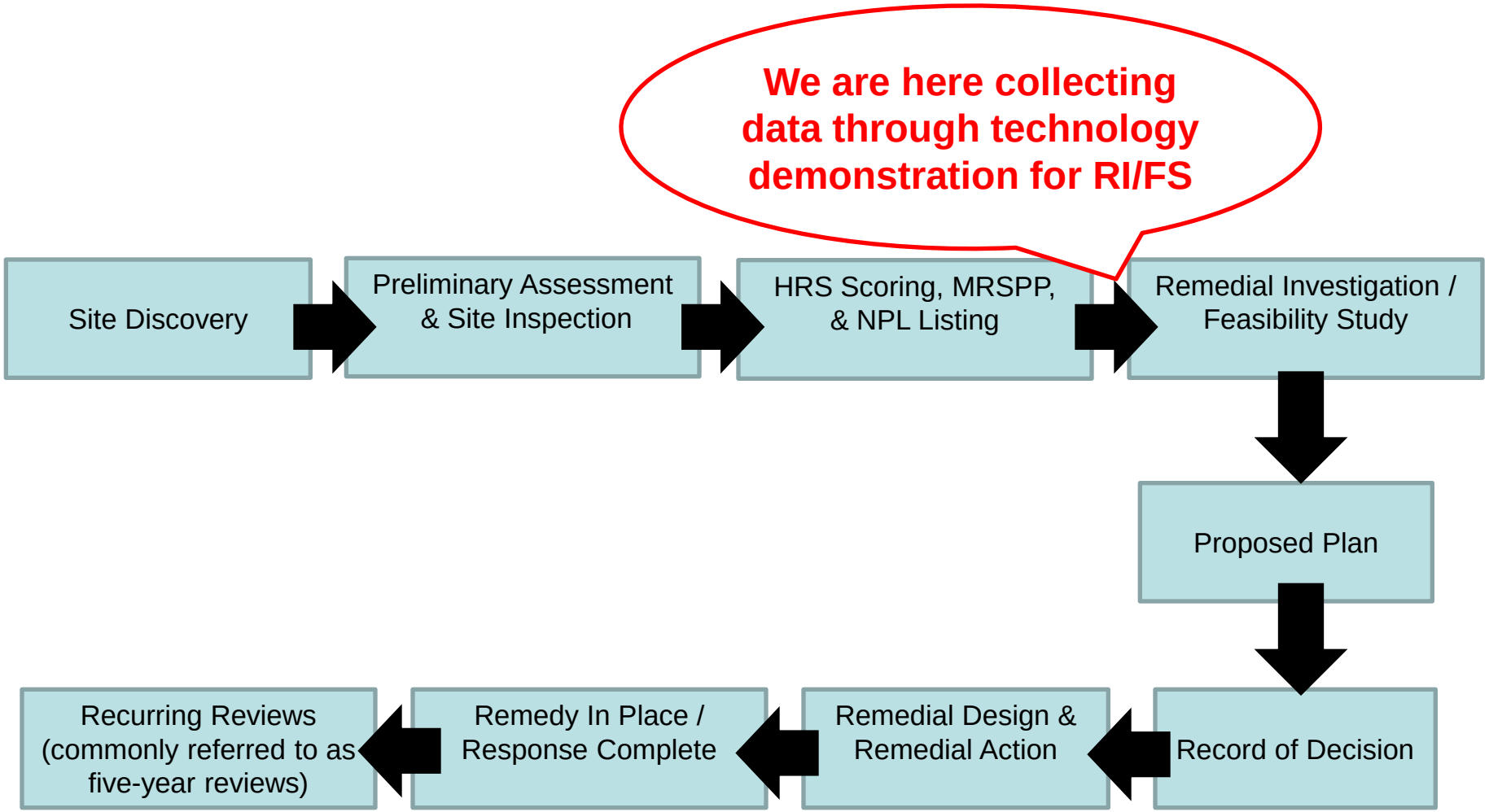
- Fauna
  - Texas Horned Lizard
  - Texas Lyre Snake
- Flora
  - Sneed Pincushion Cactus
  - Mexican Gold Poppies
- Cultural Resources
  - Fusselman Canyon Petroglyph Site
  - White Rock Shelter

Military Munitions Response Program

Military Munitions Response Program (MMRP)

- Part of Defense Environmental Restoration Program (DERP)
- Manages environmental, health, and safety issues presented by:
  - Unexploded Ordnance (UXO)
  - Discarded Military Munitions (DMM)
  - Munitions Constituents (MC)
- Castner Range = Munitions Response Site (MRS) within the MMRP

CERCLA Process



Technology Demonstration Project Objectives

Characterization Challenge

- Millions of acres of closed ranges in MMRP site inventory
- Many acres may not contain UXO
- Need methods to cost effectively:
  - Focus characterization efforts on areas used for munitions related activities
  - Eliminate areas with no indication of munitions use

Full Coverage: "Mag and Flag"

Technology Demonstration

- Provide technology solutions to support to the Army's Military Munitions Response Program
  - Use New Technologies
  - Collect Environmental Data
- Support advancements in UXO detection/discrimination technologies

WAA on Closed Castner Firing Range is a Technology Demonstration project

Project Purpose

- Field test the WAA methods and conclusions included in the *Wide Area Assessment Cost-Benefit Analysis: Active Army Military Munitions Response Program (USAEC 2009)*
- Collect site characterization data using a variety of WAA methods in a manner to ensure usable data for subsequent MMRP investigations (i.e., RI/FS)

WAA Definition

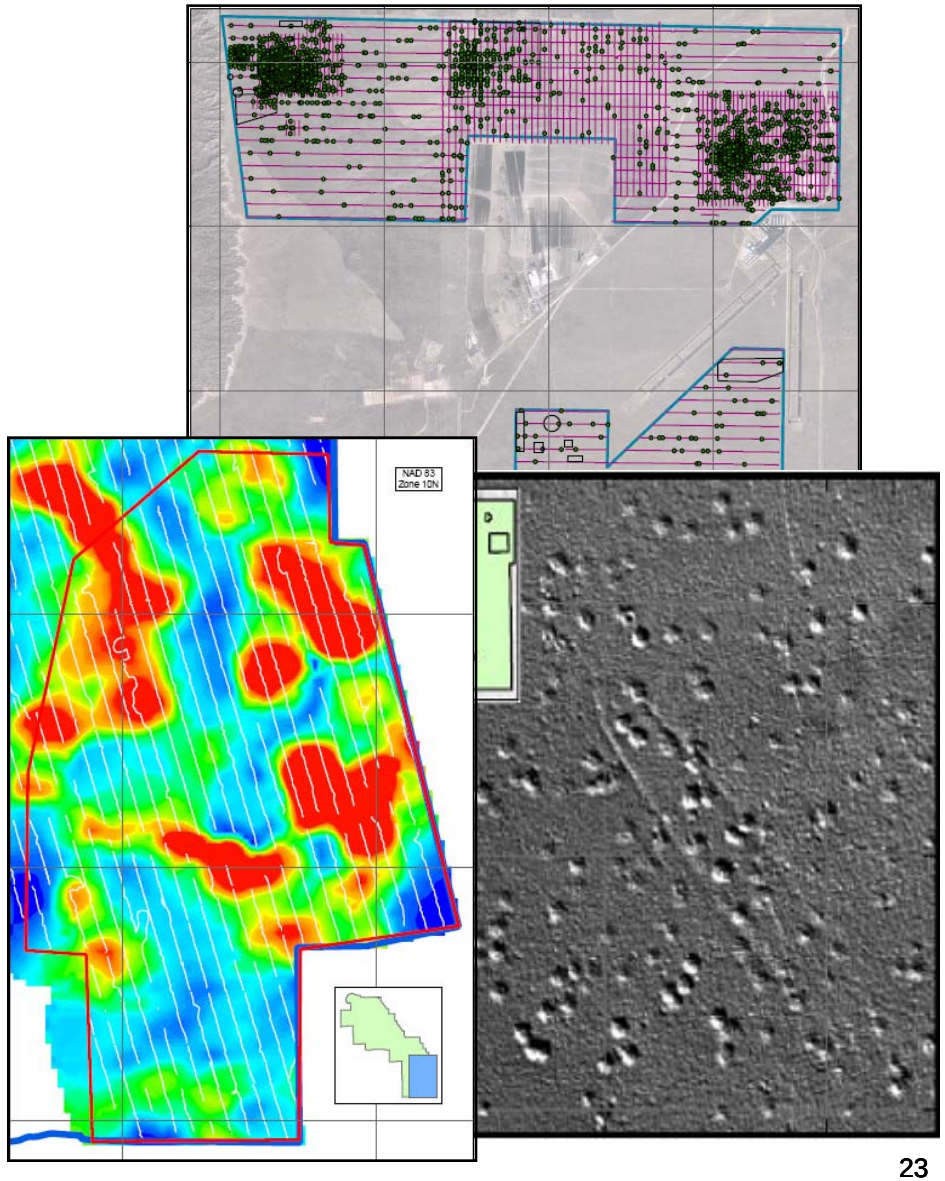
- WAA is not a technology. It is a method of applying technologies to quickly and cost effectively gather large amounts of data about a site.
- WAA goals:
  - Identify areas of concentrated munitions use
  - Provide measures of relative munitions densities within a site
  - Support decisions on areas with no indication of munitions presence

What is not included…

- Remedial Investigation
- Decisions about future land use
- Decisions about transferring the property
- Decisions about developing the property
- Decisions about mapping individual ordnance items
- Decisions about cleaning-up all the munitions

What is included…..

- Collecting data about the distribution and density of munitions on Closed Castner Range
- Demonstrating costs and benefits of innovative detection & discrimination technologies. (Trying to get the most accurate data as fast and cost-effectively as possible)



Project Approach

- Employ innovative Wide Area Assessment (WAA) munitions detection technologies
  - Lidar & Orthophotography
  - Helicopter-borne Magnetometry
  - Ground-based Geophysics
- Answer study questions for each technology

WAA Technologies & Data Derived From Each Technology

Site Coverage

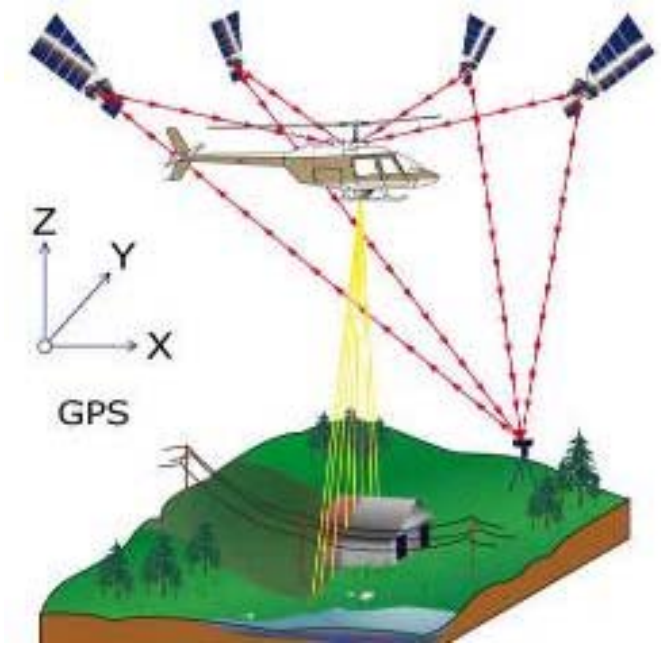
- Full coverage
  - Collect data over all accessible area
- Transect-based coverage
  - Collect data over only a sample (transects) of the accessible area

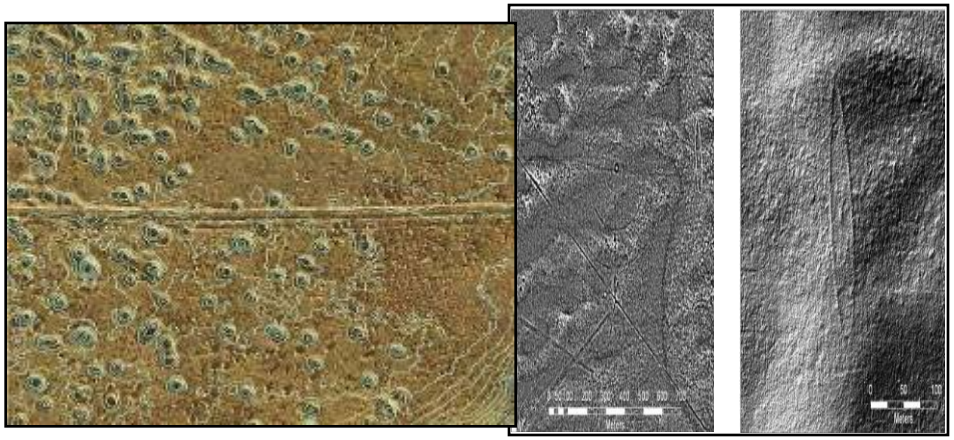
Key Definitions:
The **surveyed area** is the acreage over which instruments are actually run and data are collected.

The **characterized area** is the acreage about which valid conclusions can be drawn.

Lidar & Orthophotography

- Light Detecting and Ranging (Lidar): Airborne technology for modeling ground surface
- Orthophotography: Georeferenced digital aerial photos
- Both detect surface features, not UXO
- Data and point density are key to detection capabilities
- Both ~5,000 acres/day



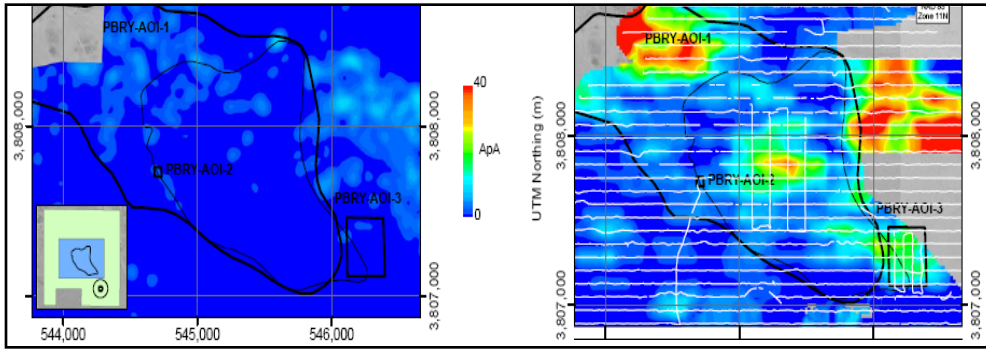


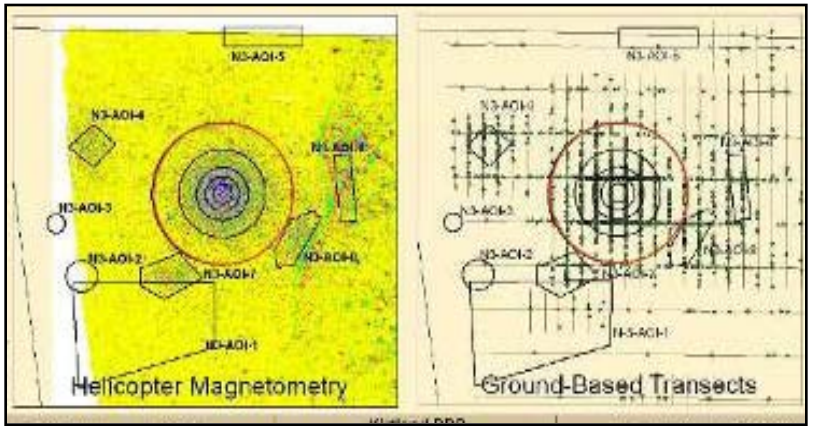
Lidar & Orthophotography Study Questions

- To what degree do lidar/ortho detect surface features indicative of munitions related activities?
  - Craters/Crater fields
  - Target Features
  - Berms
  - Demolition Pits
  - Burial Pits
- Do lidar/ortho images provide sufficient evidence to:
  - Reliably identify areas of concentrated munitions use?
  - Reliably identify areas with no indication of munitions use?
  - Improve the understanding of relative densities and distributions of MEC across the MRS?
- How confident are stakeholders in these conclusions?
- To what degree do lidar/ortho data make subsequent characterization steps (e.g., helicopter-borne magnetometry) more cost effective?
- What are the total cost, cost per characterized acre, and cost per surveyed acre associated with lidar/orthophotography?

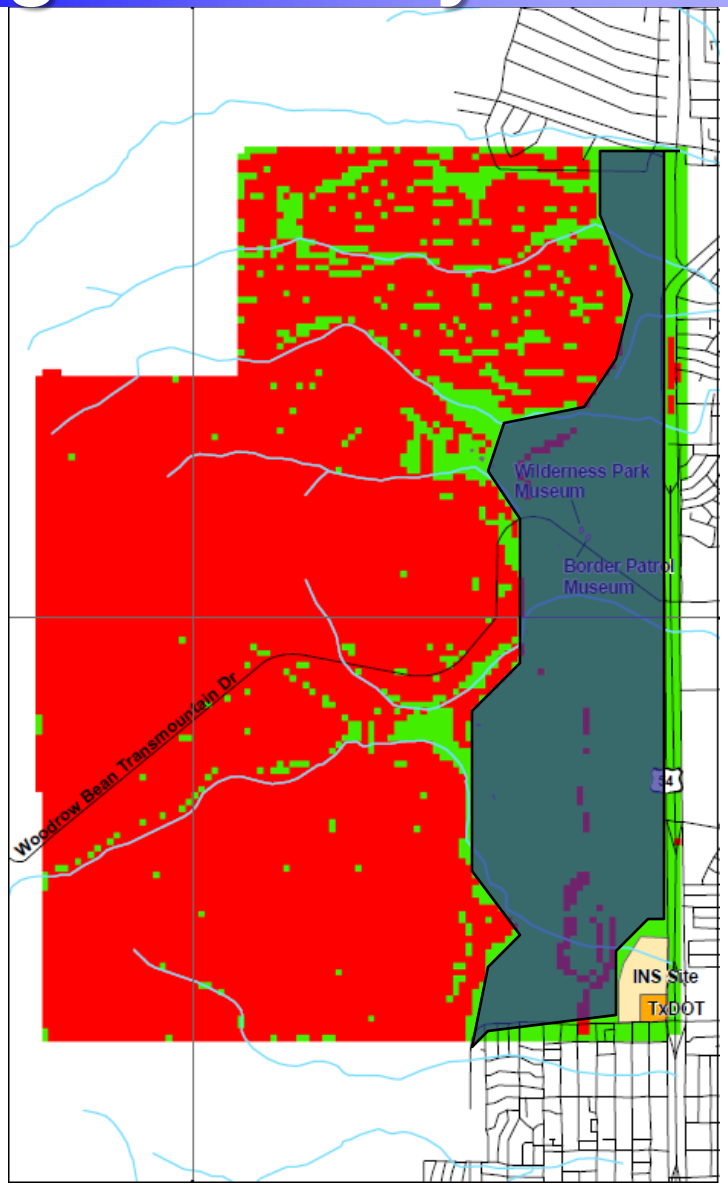
Helicopter-Borne Magnetometry

- Full coverage of accessible acreage
- 1-3 m altitude
- Detection capability
  - Large (>60mm) and concentrations of smaller UXO
  - Decreases with distance from items
- ~500 acres/day





Proposed Helicopter-Borne Magnetometry Survey Area



= Inaccessible terrain (>5% slope)

= Flat and Gently rolling terrain (<5% slope)

= Proposed area of full-coverage with helicopter-borne magnetometry

TAKE AWAY:

Characterized Acreage = Surveyed Acreage

Sample is not representative of entire site.

Helicopter-Borne Magnetometry Study Questions

- Can helicopter-borne magnetometry reliably detect each of the munitions types expected on the MRS (i.e., 37mm projectile, 2.36in rockets, 60mm mortar, 75mm projectile)?
- Can helicopter-borne magnetometry:
  - Reliably identify areas of concentrated munitions use?
  - Reliably identify areas with no indication of munitions use?
  - Improve the understanding of relative densities and distributions of MEC across the MRS?
- How confident are stakeholders in these conclusions?
- To what degree does helicopter-borne magnetometry data make subsequent characterization steps (i.e., ground-based geophysics) more cost effective?
- Over what percentage of the MRS can we collect helicopter-borne magnetometry data?
- For what percentage of the MRS are we able to draw statistically valid conclusions based on helicopter-borne magnetometry data?
- What are the total cost, cost per characterized acre, and cost per surveyed acre associated with helicopter-borne magnetometry?

Towed Array

- Electromagnetic Induction EMI
- Transect-based survey ~1.5-3% of site
- Limited by vegetation and terrain
- Good probability of detection to 11X diameter depth
- 5-20 acres/day (21,500–87,000 linear feet of transect)

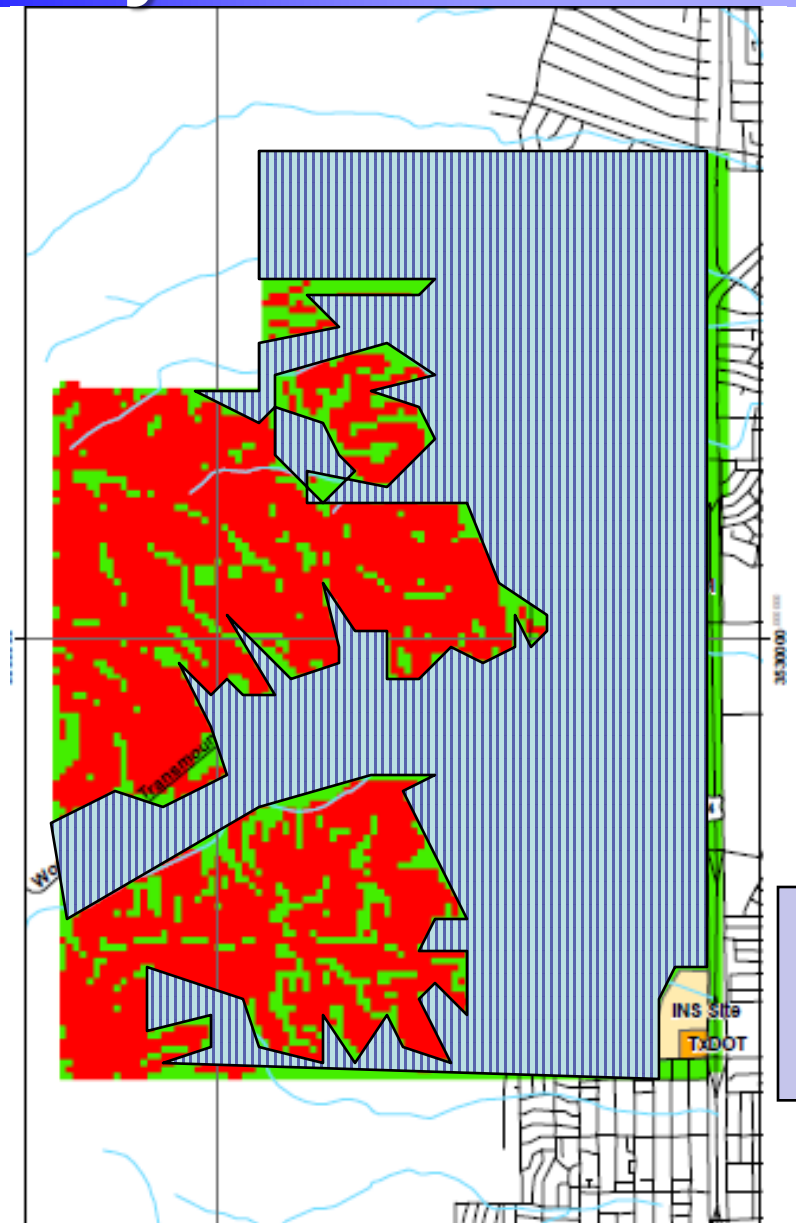
Towed Electromagnetic Induction Study Questions (NOT APPLICABLE)

- Can towed EMI arrays reliably detect each of the munitions types expected on the MRS (i.e., 37mm projectile, 2.36in rockets, 60mm mortar, 75mm projectile)?
- Can towed EMI arrays:
  - Reliably identify areas of concentrated munitions use?
  - Reliably identify areas with no indication of munitions use?
  - Improve the understanding of relative densities and distributions of MEC across the MRS?
- How confident are stakeholders in these conclusions, particularly based on the transect survey approach?
- Over what percentage of the MRS can we collect towed EMI array data?
- For what percentage of the MRS are we able to draw statistically valid conclusions based on towed EMI array data?
- What are the total cost, cost per characterized acre, and cost per surveyed acre associated with towed EMI array?

Man-Portable

- Ground-based Mag and EMI
- Transect-based survey ~1.5-3% of site
- Ability to access all vegetation and terrain
- Good probability of detection to 11X diameter depth
- 1-5 acres/day
  - 6,600–33,000 linear feet of transect

Proposed Man-Portable Survey Area



= Mostly inaccessible terrain (>18% slope)

= Accessible terrain (<18% slope)

= Proposed area of transect coverage with man-portable

TAKE AWAY:

Characterized Acreage > Surveyed Acreage

Sample is representative of entire site.

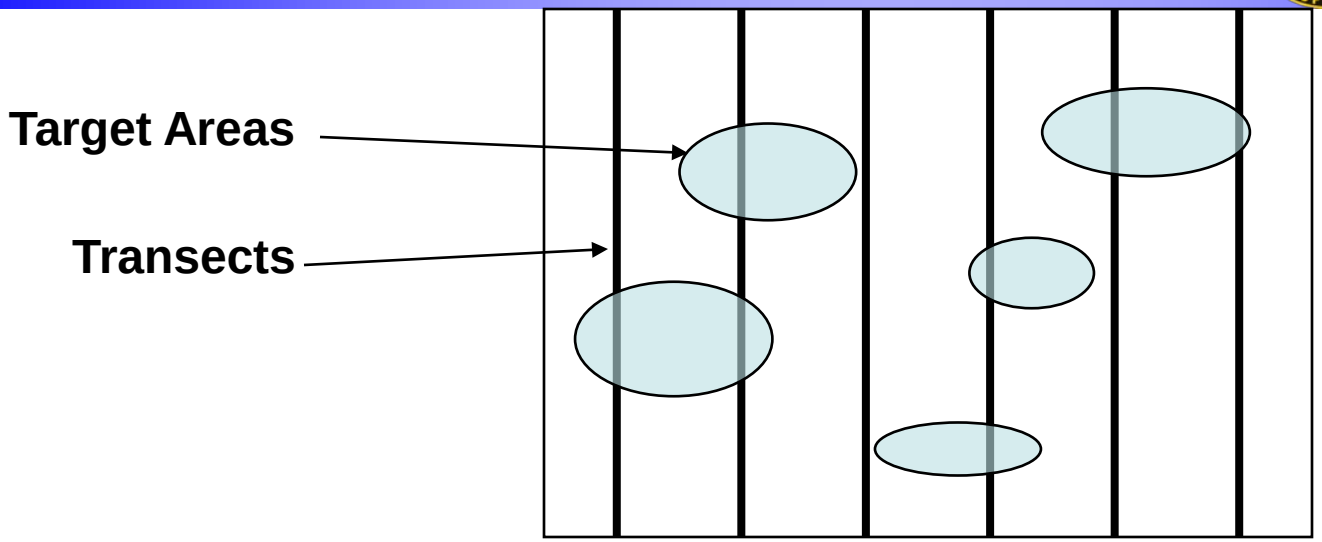
Man Portable Electromagnetic Induction Study Questions

- Can man-portable EMI arrays reliably detect each of the munitions types expected on the MRS (i.e., 37mm projectile, 2.36in rockets, 60mm mortar, 75mm projectile)?
- Can man-portable EMI arrays:
  - Reliably identify areas of concentrated munitions use?
  - Reliably identify areas with no indication of munitions use?
  - Improve the understanding of relative densities and distributions of MEC across the MRS?
- How confident are stakeholders in these conclusions, particularly based on the transect survey approach?
- Over what percentage of the MRS can we collect man-portable EMI array data?
- For what percentage of the MRS are we able to draw statistically valid conclusions based on man-portable EMI array data?
- What are the total cost, cost per characterized acre, and cost per surveyed acre associated with man-portable EMI array?

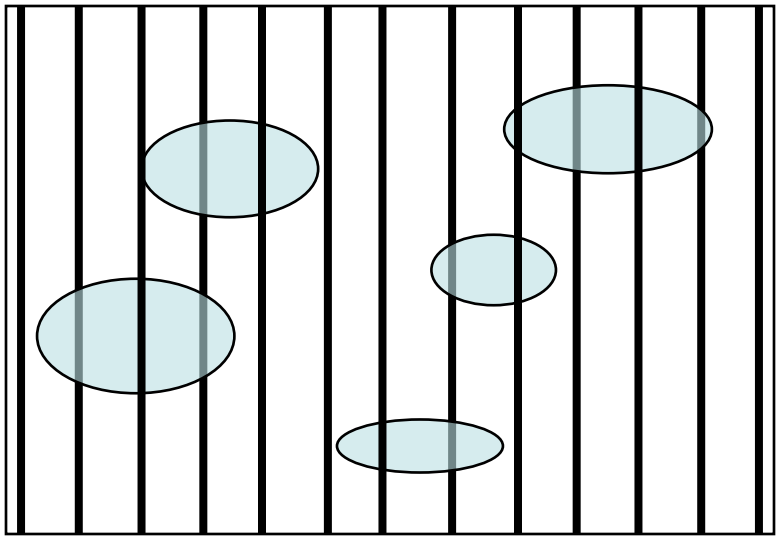
Establish Transect Spacing using Visual Sampling Plan (VSP)

- Recommended as a WAA tool by the Interstate Technical & Regulatory Council
- Assumes non-uniform munitions distribution across the MRS
- High densities of munitions considered "target areas"
- Statistical tool to calculate transect spacing based on size, shape, and orientation of targets
- Transects spaced for high confidence (>95%) that target areas traversed

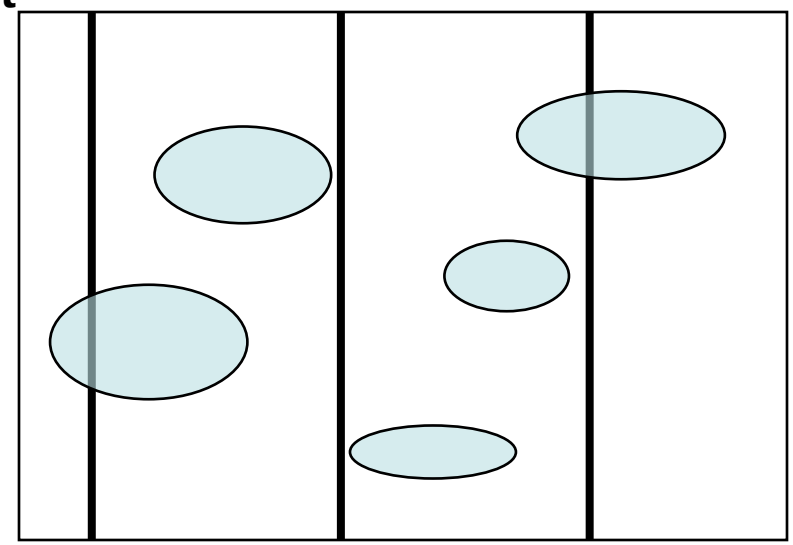
Optimized Transect Spacing



Just Right



Too Narrow



Too Wide

Determining Target Size/Shape

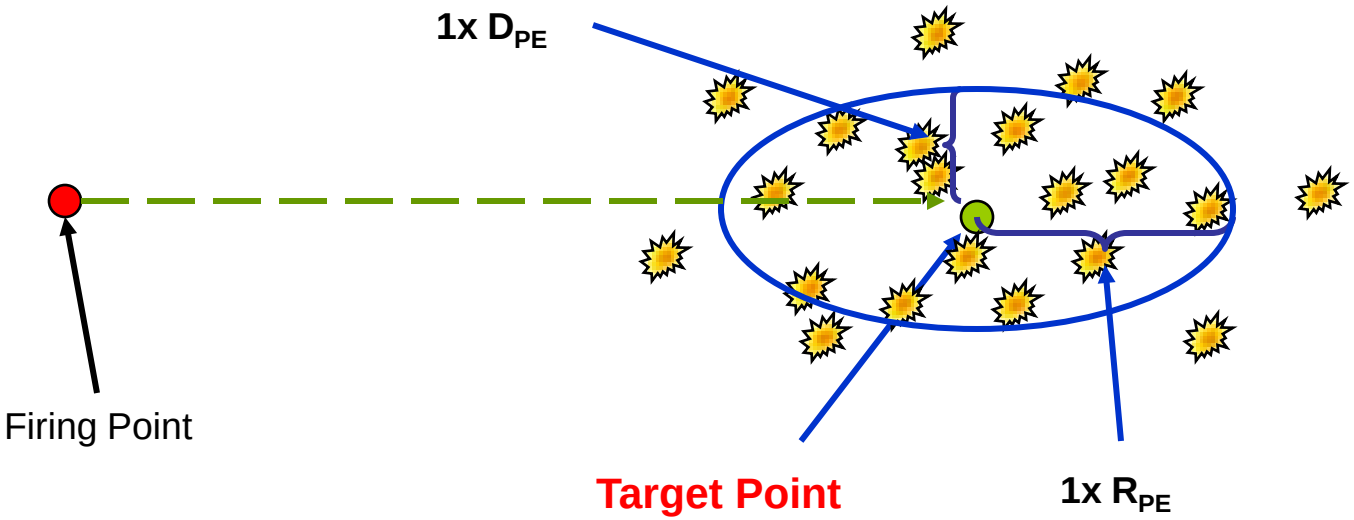
Size/Shape of target is based on two factors:

1. Distribution of rounds around an aiming point
2. Distribution of detectable fragments around each impact point

Target Size/Shape: Factor 1

Distribution of rounds based on "probable error" associated with a weapon

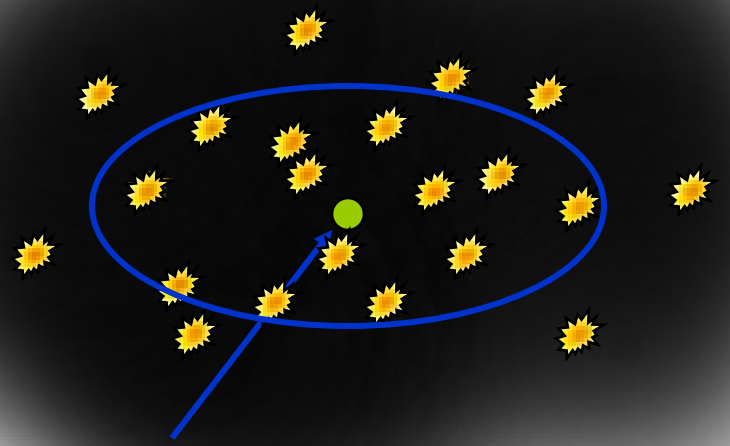
- Range probable error (R_{PE})
- Deflection probable error (D_{PE})



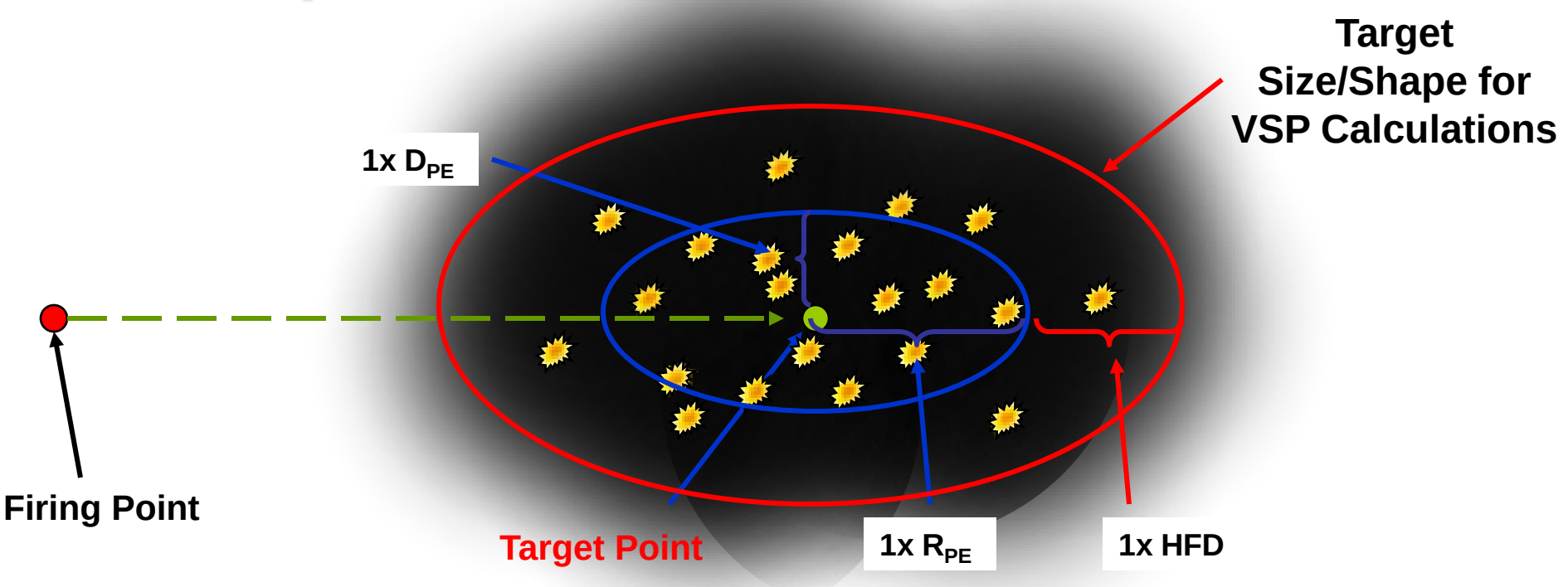
50% of rounds fired will land within one R_{PE} and one D_{PE} from the target point.

Target Size/Shape: Factor 2

- Typically, 95-99% of rounds function (detonate) distributing fragments (frag)
- Frag radius around each round effects target size/shape



Determining Target Size/Shape



Munitions Item	R_{PE}	D_{PE}
60mm mortar	20m	7m
75mm projectile	16m	2m
2.36in rocket	6m	2m
37mm projectile	61m	8m

Munitions Item	Hazardous Frag Radius
60mm mortar	50m
75mm projectile	71m
2.36in rocket	38m
37mm projectile	27m

VSP Data Inputs

- Transect pattern: Perpendicular to historical firing line
- Transect width
  - 3 m for Towed Array **(Not Applicable)**
  - 1 m for Man-portable
- Target size and Pattern:
  - Length of semi-major axis: R_{PE} + Fragment radius of the smallest expected munitions
  - Length of semi-minor axis: D_{PE} + Fragment radius of the smallest expected munitions
- Random target orientation

2.36" Rocket

Semi-major Axis: 6m + 38m = 44

Semi-minor Axis: 2m + 38m = 40

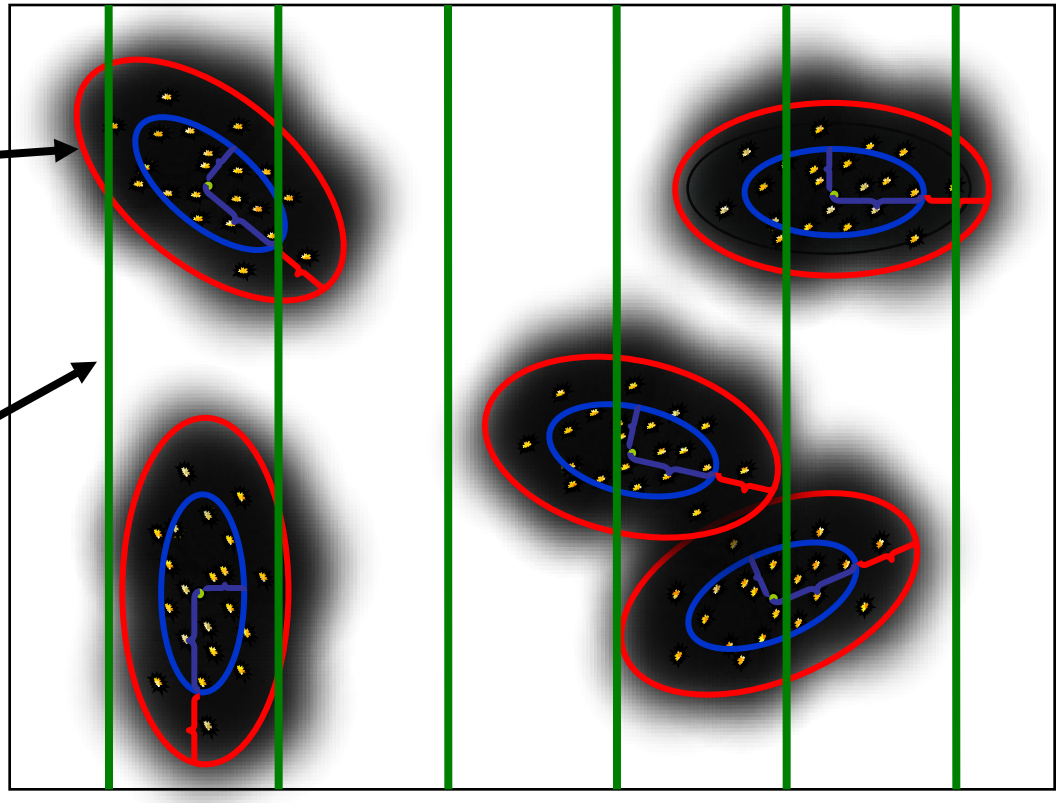
Target Orientation

- Confident that firing direction was east to west
- "Random" target orientation results in conservative transect spacing

Target Areas:

- **R_{PE}/D_{PE} + HFD**
- **Random Orientation**

Transects:
As calculated by VSP



Data Requirements to Address Study Questions

- Historical information on the munitions that may have been used at the MRS (i.e., 37mm projectile, 2.36in rockets, 60mm mortar, 75mm projectile)
- Information on the locations, types, and depths of MEC and/or material potentially presenting an explosive hazard (MPPEH) reported during the Site Investigation
- Results of collection, processing, and analysis of lidar and orthophotography data
- Results of collection, processing, and analysis of helicopter-borne magnetometry data
- Results from the application of VSP to determine appropriate transect spacing for ground-based geophysics
- Results of transect-based data collection, processing, and analysis of Towed EMI array data **(Not Applicable)**

Data Requirements to Address Study Questions (cont'd)

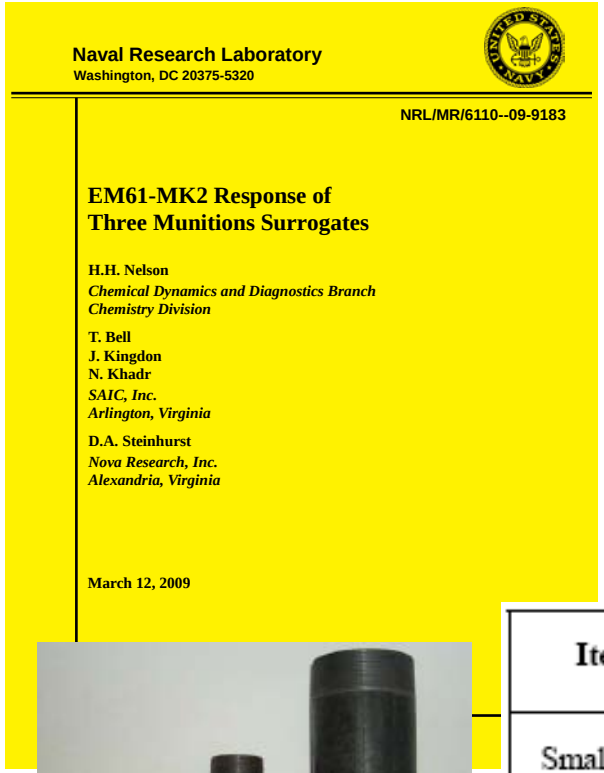
- Results of transect-based data collection, processing, and analysis of Man-portable EMI array data
- Results of intrusive investigations performed to verify anomalies detected during the geophysical surveys
  - Verify whether munitions were present
  - Depth and orientation of discovered objects
  - To the extent possible, what type of munitions found
- Actual cost data associated with each of the WAA methods
- Stakeholder perceptions and confidence levels associated with results from each WAA method

Site Preparation

Site Preparation

- Site Survey
- Transect Marking
- Instrument Validation Strip
  - Industry Standard Objects (ISOs) (i.e., metal pipe) planted at discreet intervals to demonstrate the detection capability of each geophysical method (airborne & ground-based systems)
  - Twice daily validations of each system's detection capability to ensure equipment calibration
  - Establish anomaly characteristics for expected munitions
- Seed ISOs in the production site (along transects)

Industry Standard Objects



Naval Research Laboratory
Washington, DC 20375-5320

NRL/MR/6110--09-9183

EM61-MK2 Response of Three Munitions Surrogates

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March 12, 2009

- Readily available, similar in size and shape to common munitions items
- Documented response curves
- Repeatable, consistent EM signals for calibration and performance validation

Item	Nominal Pipe Size	Outside Diameter	Length	Part Number[1]	ASTM Specification
Small ISO	1"	1.315" (33 mm)	4" (102 mm)	44615K466	A53/A773
Medium ISO	2"	2.375" (60 mm)	8" (204 mm)	44615K529	A53/A773
Large ISO	4"	4.500" (115 mm)	12" (306 mm)	44615K137	A53/A773

1. Part number from the McMaster-Carr catalog.

Anomaly Identification, Reacquisition, & Intrusive Investigation

Anomaly Identification & Reacquisition

- Develop target lists (i.e., “dig sheets”) for the reacquisition of sampling locations using the outputs from Helicopter-Borne Magnetometry & Ground-Based Geophysics
- Identify 3,000 items for excavation
- Graphically display items on the geophysical transect surveys

Intrusive Investigation

- Coordinate dig list with natural and cultural resources staff to minimize disturbance of sensitive areas
- Section 106 Consultation through Fort Bliss Programmatic Agreement with continued consultation with the Tribes
- Excavate anomalies
  - If ordnance, detonate using explosives
  - If range debris, inspect, certify as “safe”, and dispose as scrap metal

Project Schedule

Project Schedule

- Oct 2009 – Apr 2010: Site Characterization
- Apr 2010 – Jul 2010: Data Analysis
- Oct 2010 – Dec 2010: Anomaly Identification and Intrusive Investigation
- Jan 2011 – May 2011: Report Writing

Future TPP Meetings

- January 2010:
  - Discuss information gathered from airborne systems
  - Discuss execution of ground-based systems
- June 2010: Discuss information gathered from ground-based systems
- October 2010: Discuss proposed approach for Intrusive Investigation
- February 2011: Discuss findings from Intrusive Investigation
- June 2011: Discuss project results, Stakeholder confidence in results, and WAA costs/benefits

QUESTIONS?