Former Kirtland Air Force Base Precision Bombing Ranges (N-2 & NDA) FUDS ID K06NM0445

Innovative Remedial Design: Gaining Regulator Acceptance for VSP and UXO Estimator

M2S2 Webinar

24 June 2014

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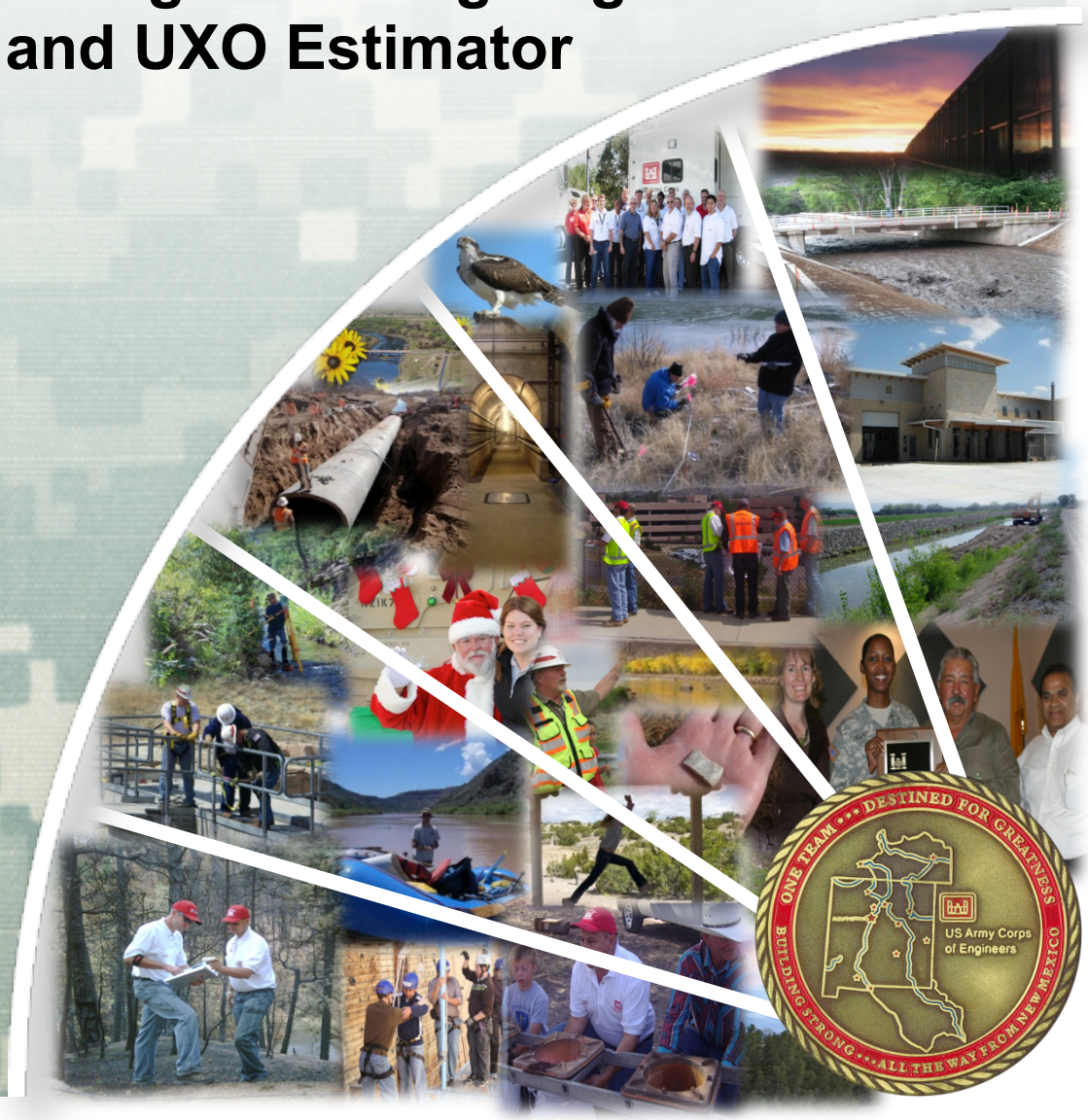

RANGE SUPPORT CENTER

US Army Corps of Engineers
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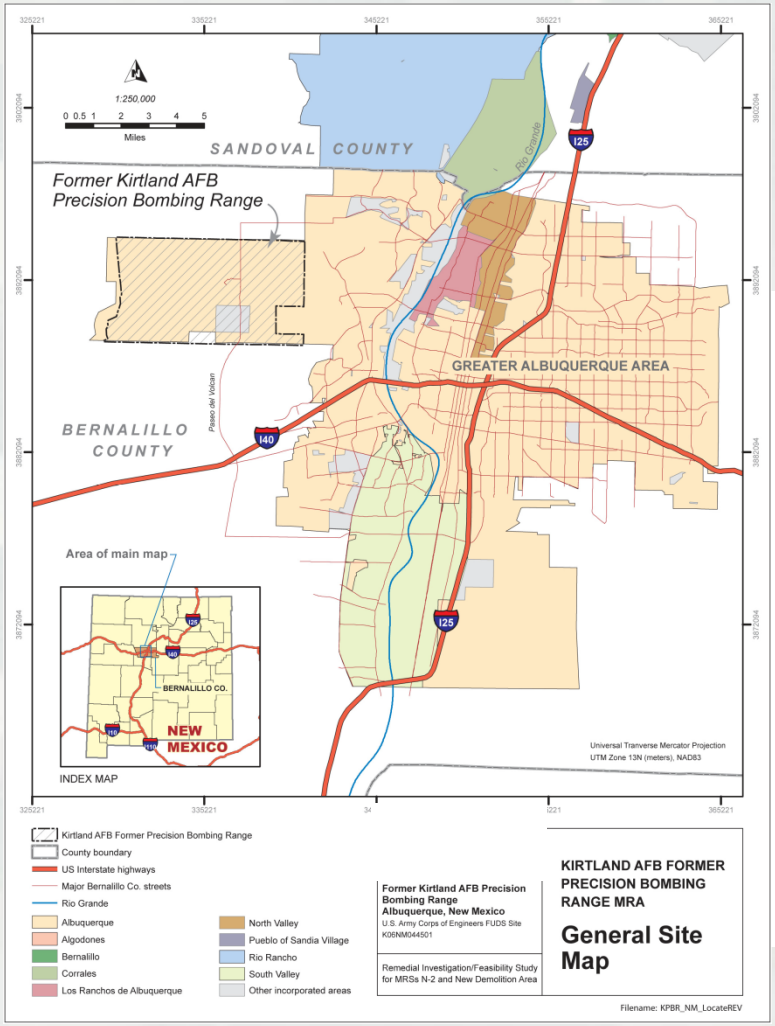
Historical Site Use & Activities

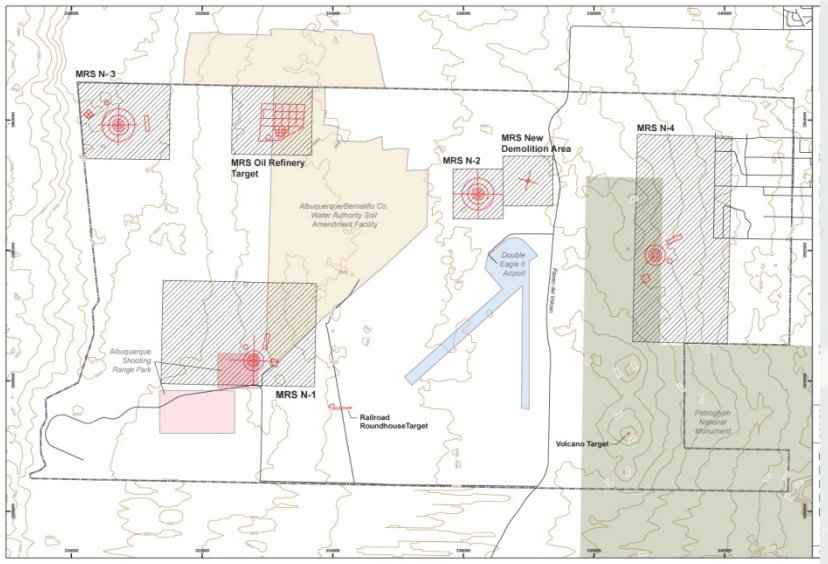
- 1942: 15,135 acres leased for use as precision bombing ranges for Kirtland Field
  - ► Students attending the bombardier training school at Kirtland Field used these ranges
  - ► Documentation and munitions related items found include 100 lb practice bombs, 100lb HE general purpose bombs, M1A1 spotting charges, aircraft flares, M100 series fuzes
  - ► There are 8 targets within the 15K acres; we are focused on the two adjacent targets N-2 and NDA
- 1947: All acreages were declared surplus and leases were cancelled
- 1952: 9800 Training Support Unit conducted various surface clearance activities within the property

Background

- MRS NDA/N2 Historical Investigations
  - Characterized the density of anomalies
  - Extensive debris from 100# practice bombs is present throughout the area
  - Less extensive fragments from 100# HE bombs is restricted to an area around the NDA.
- No MEC has been found in intrusive investigations
- A single 100# HE bomb was encountered E or SE of the NDA during construction of roadside drainage ditches in 1996.

A Drill Down of Where We Are in 2014





Typical Ordnance Items

Remedial Action Objective

"Reduce the potential for receptors to come into direct contact with MEC items potentially remaining in MRS"

Selected Remedial Alternative Cont.

1. Excavation of 100% of selected anomalies to depths that can be achieved with existing industry standard technologies in the high-density areas
   - ► Demonstrate MetalMapper technology on selected areas
2. 100% surface metal anomaly and MEC clearance in high- and medium-density anomaly areas
3. A geophysical survey of a statistically derived sample area in medium- and low-density anomaly areas (to confirm the probability of remaining subsurface MEC is adequately low), and implementation of LUCs.
   - ► Use of MetalMapper to investigate anomalies

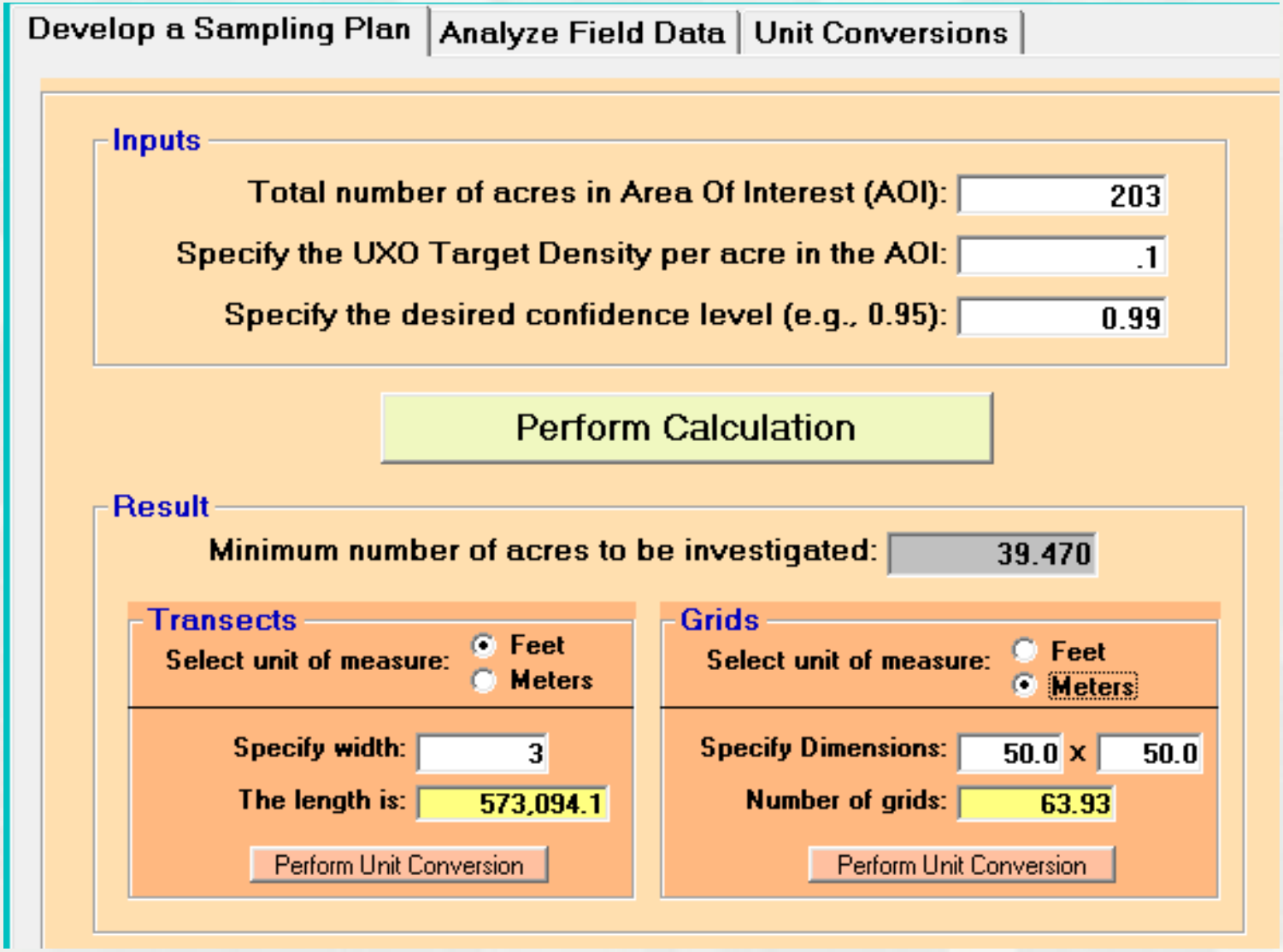
Factors to take into account in design

- Anomaly density
- Pattern of observed craters
- Flight path
- Wind Direction
- Soil characteristics (caliche impact on penetration depth)
- Practice bombing might have similar but less precise pattern of "misses" as HE bombing
- Larger number of practice bombs dropped

Example Designs

- UXO Estimator (equivalent spec)
  - 95 or 99% confidence < .1/ac
- VSP
  - Verification sampling- Verify 99% of all transects free of MEC w/ 95 or 99% confidence
- Random vs/ Probabilistic sample allocation

Use of UXO Estimator (Med + Crater)



Use of VSP

- Import map, but exclude high anomaly density (using combine feature)
- Select verification sampling, establish grid size (4 ac), set confidence and % of transect specifications, allow for aggregated transects
- Select sample area (med density + crater) and apply design – then deselect, and select low density and reapply)

Example VSP: Med Anomaly Density and Crater Area

Verification Sampling for UXO

Transect Verification Sampling | Transect Placement | Costs | UTL on PRV (beta)

Total possible number of non-overlapping 127.2 meters by 6 feet transects: 6325

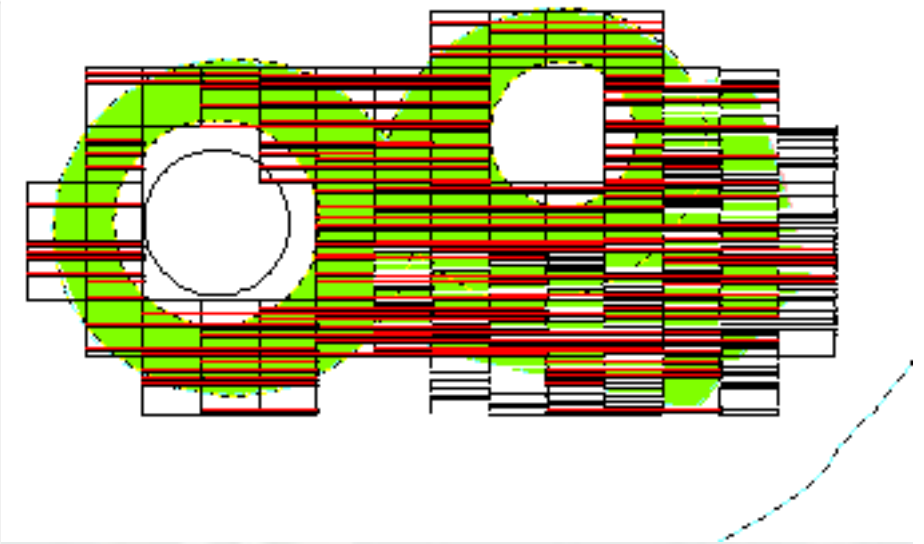
I want 99 % confidence that at least 99 % of the transects in the selected areas are acceptable (no targets of interest (TOI) identified).

Number of transects that must be randomly selected, surveyed, and identified as acceptable to achieve desired confidence: 442

Number of aggregated transects (636 meters by 6 feet) to be surveyed: 89

Therefore, if 442 of the 6325 possible transects (127.2 meters by 6 feet) are randomly selected and all 442 are identified as acceptable, then you will be 99% confident that at least 99% of the total possible transects within the selected areas are acceptable.

- (•) Calculate number of transects
- ( ) Calculate % confidence based on number of transects
- ( ) Calculate % acceptable based on number of transects and % confidence

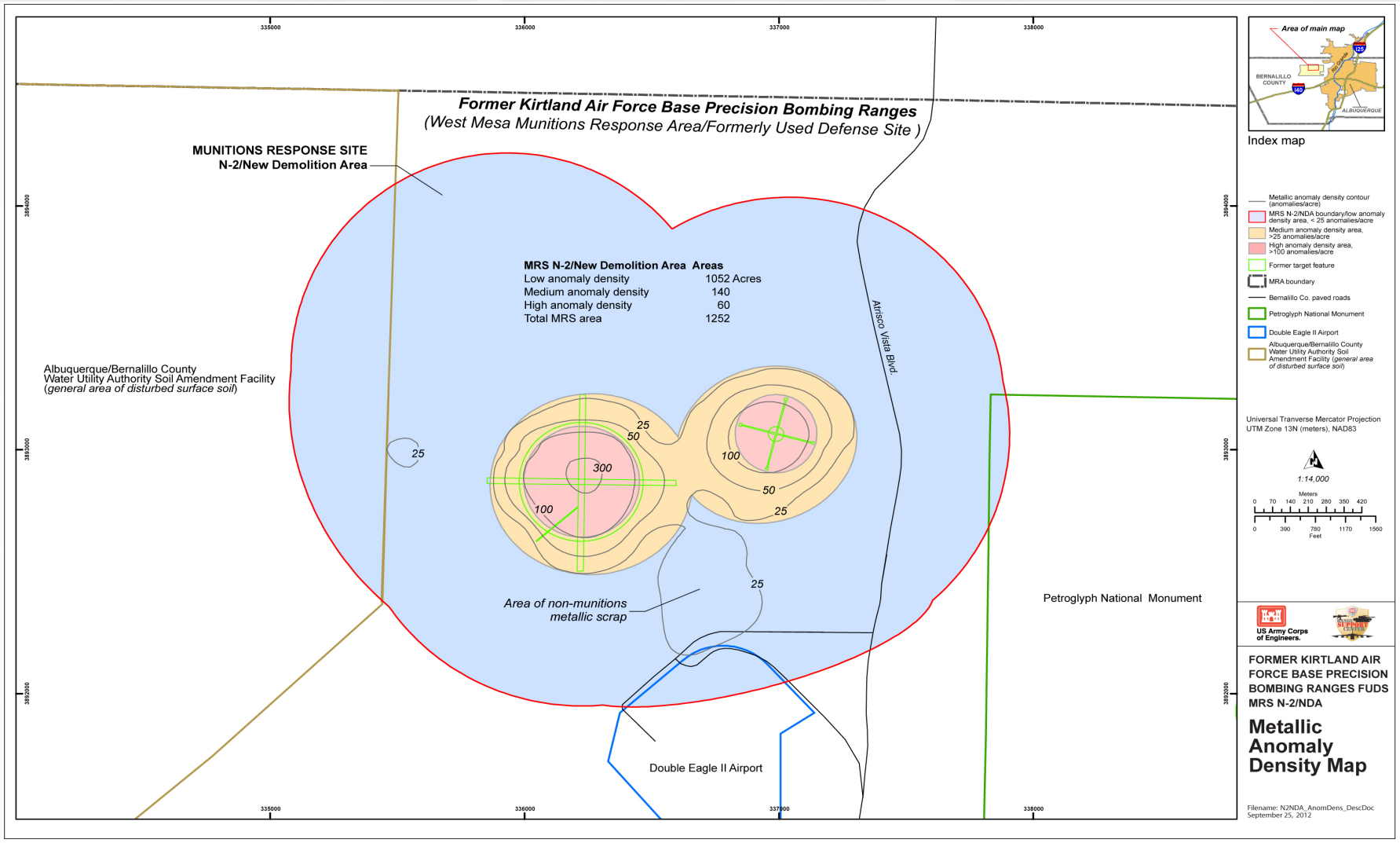


- 15.9% of 267 ac area surveyed
- 42.3 ac

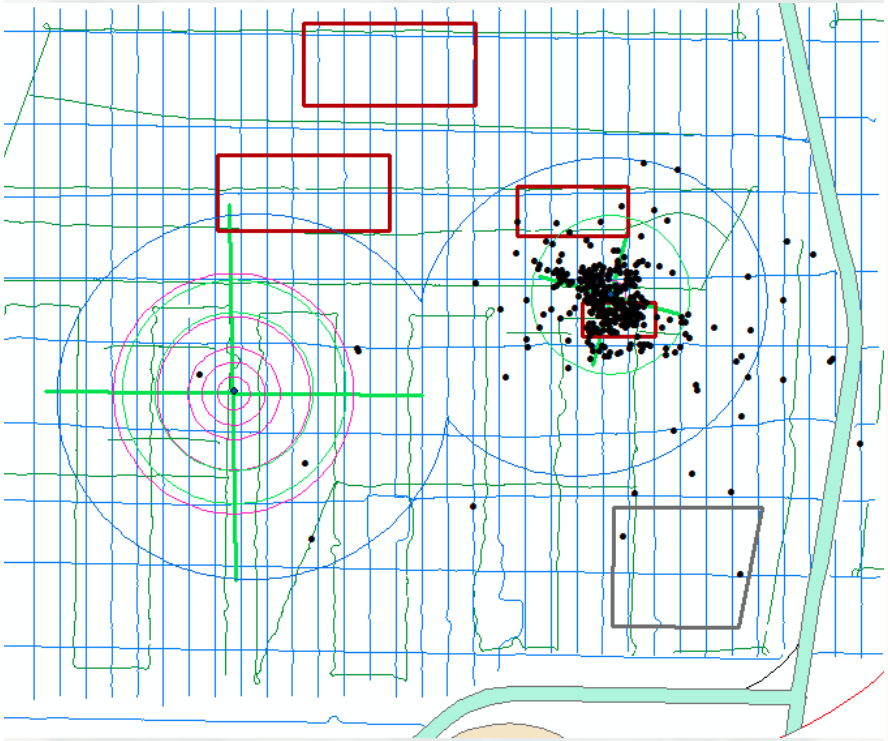
VSP Designs to Achieve 95 and 99% Confidence

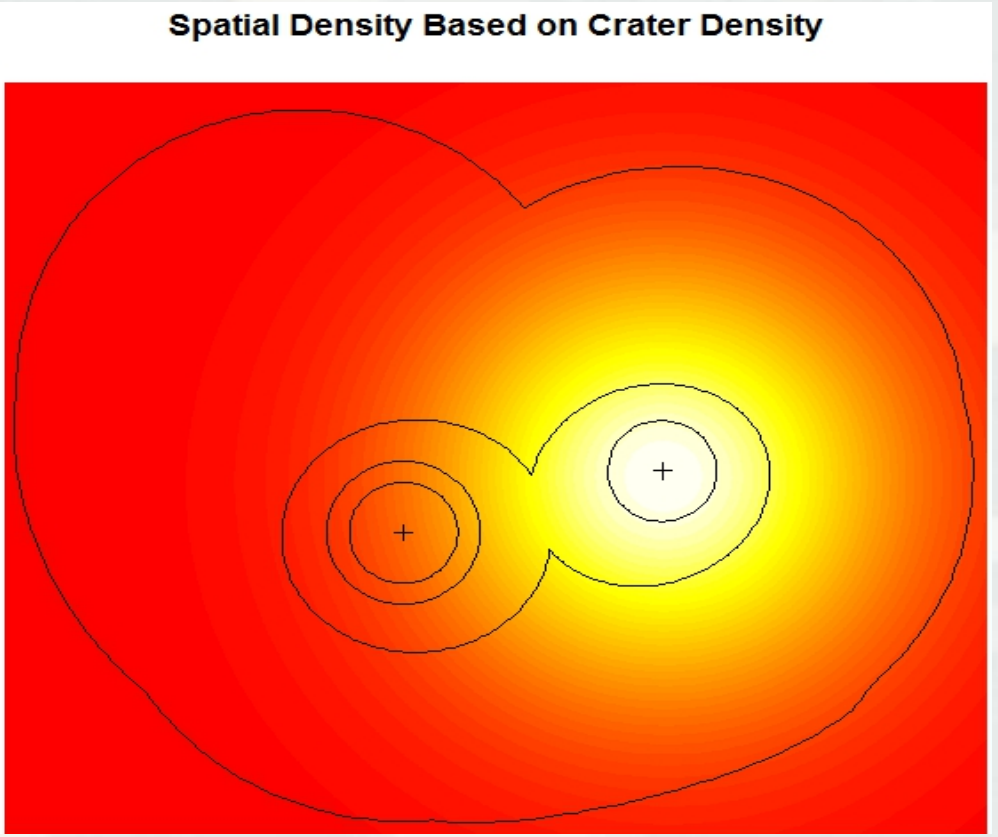
Area	Acres	Transect Length	Grid Size (acres)	Confidence	% of Transects	% Coverage	Acres Surveyed
Low Density	988	127	4	99	99.375	45.3	
Med Density + Crater	203	127	4	99	99.375	42.3	87.7
Low Density	988	127	4	95	99.375	30.1	
Med Density + Crater	203	127	4	95	99.375	28.5	58.7

Low, Med, High Anomaly Densities

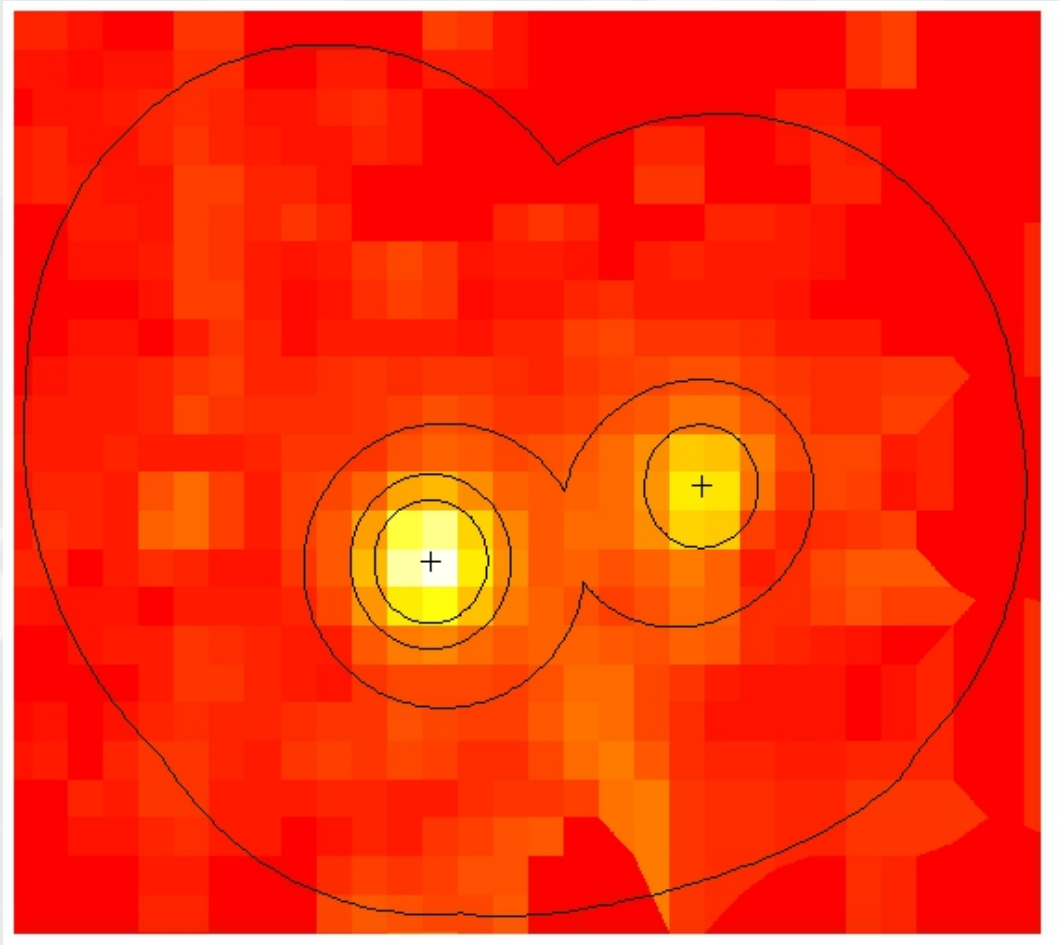


Crater Patterns

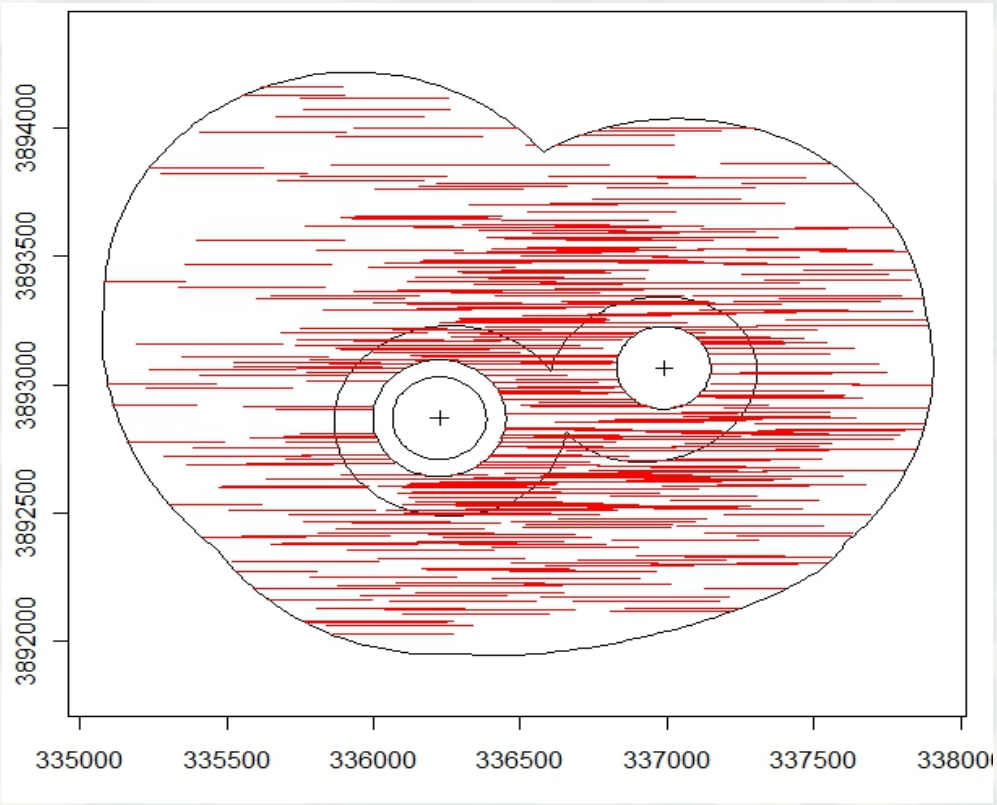


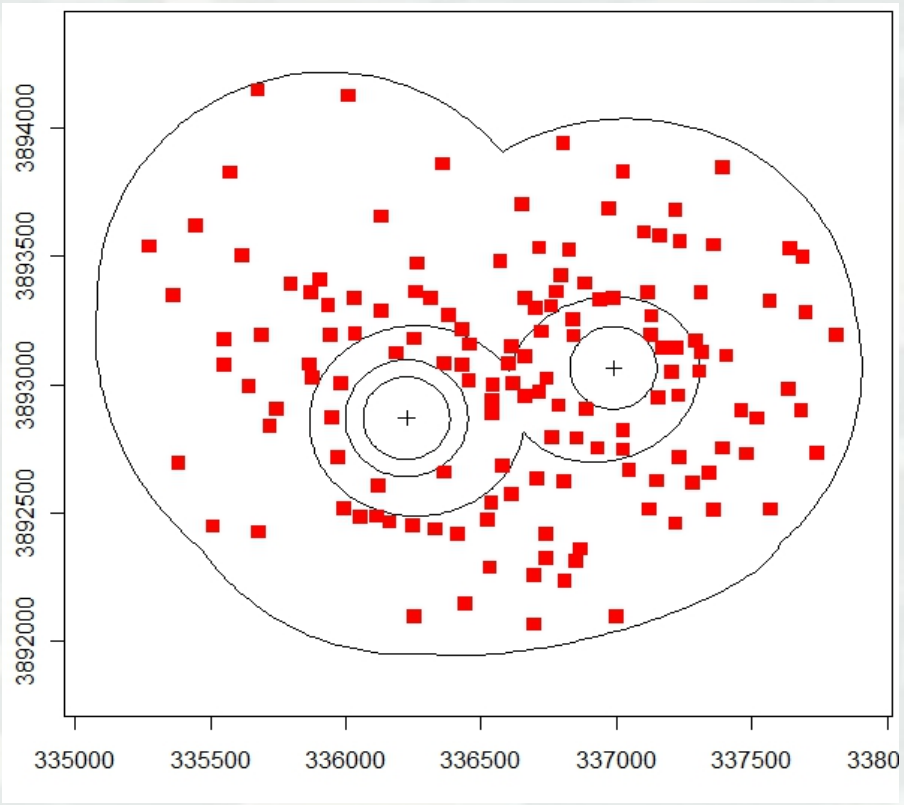


Combined Spatial Density Based on Anomalies and Craters

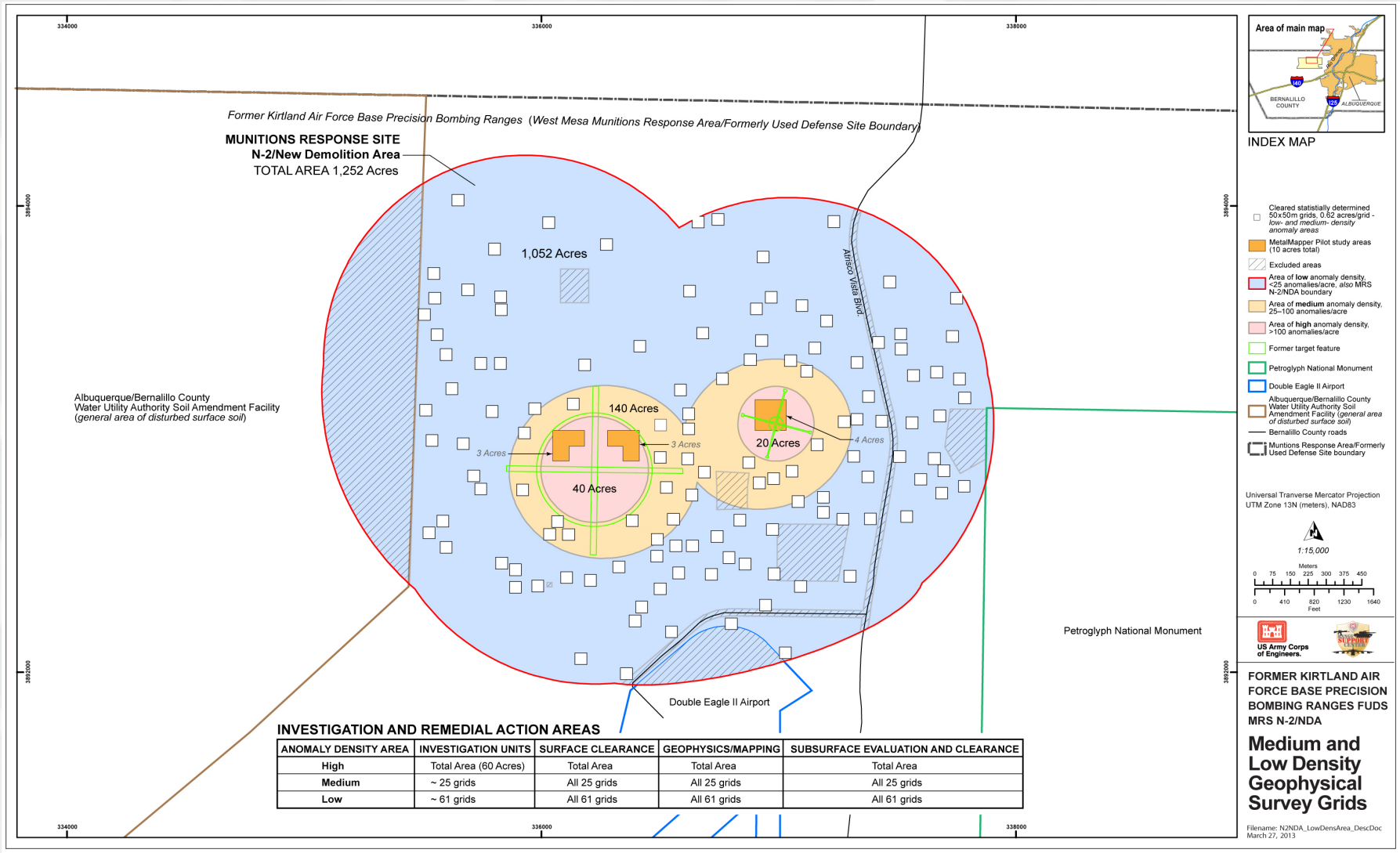


Probabilistic Sample Allocation of Required Acreage (99% Confidence)





Probabilistic Grid Design



Remedial Action: High Anomaly Density Areas:

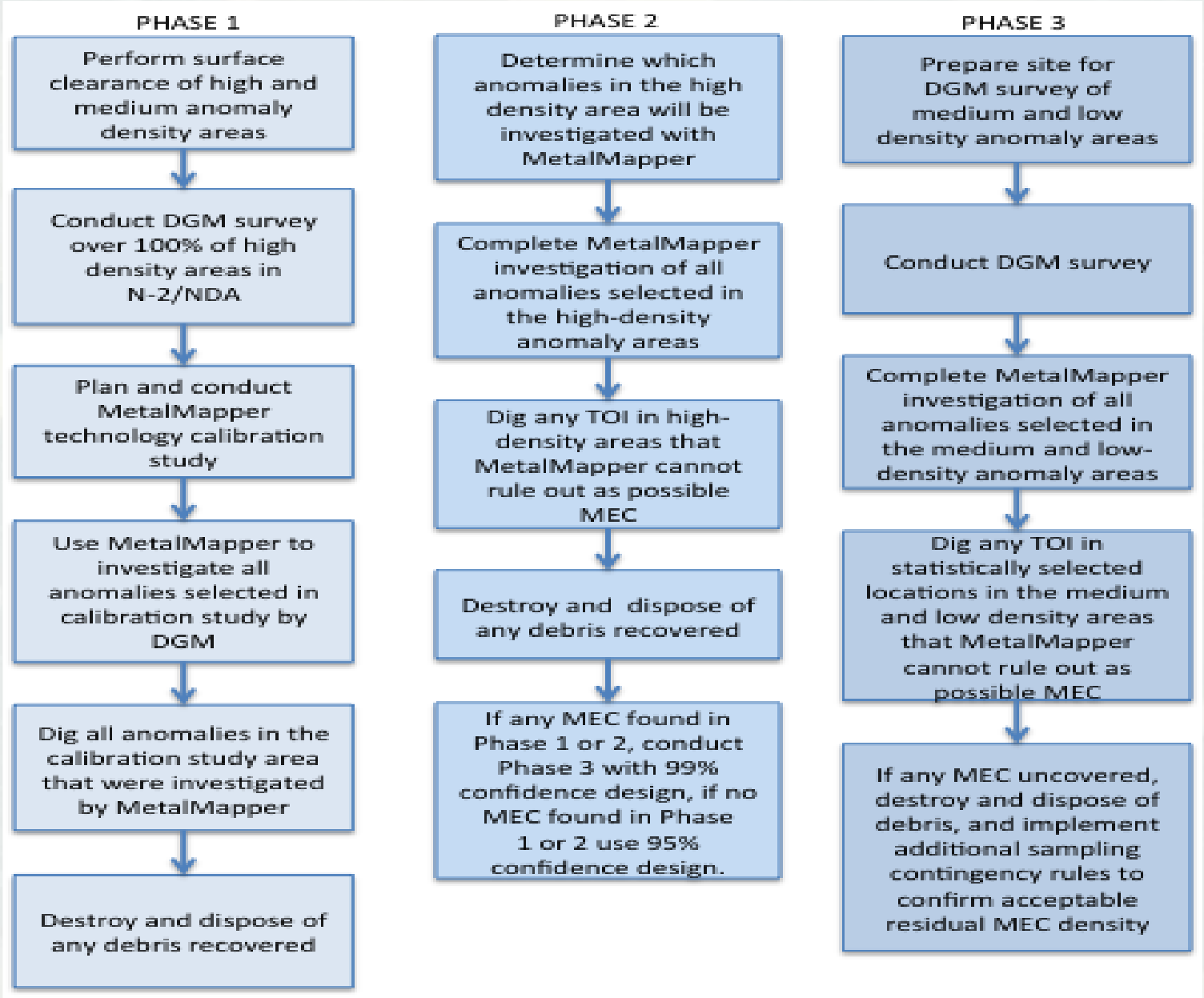
- Perform a surface clearance of all metallic debris
- Determine the location, and intrusively investigate, all subsurface anomalies that are suspected of being targets of Interest (TOI).
- Remove and destroy any MEC.
- Confirm that the probability of MEC remaining below the surface is adequately low to conclude no further remedial action is needed, beyond continued land use controls.

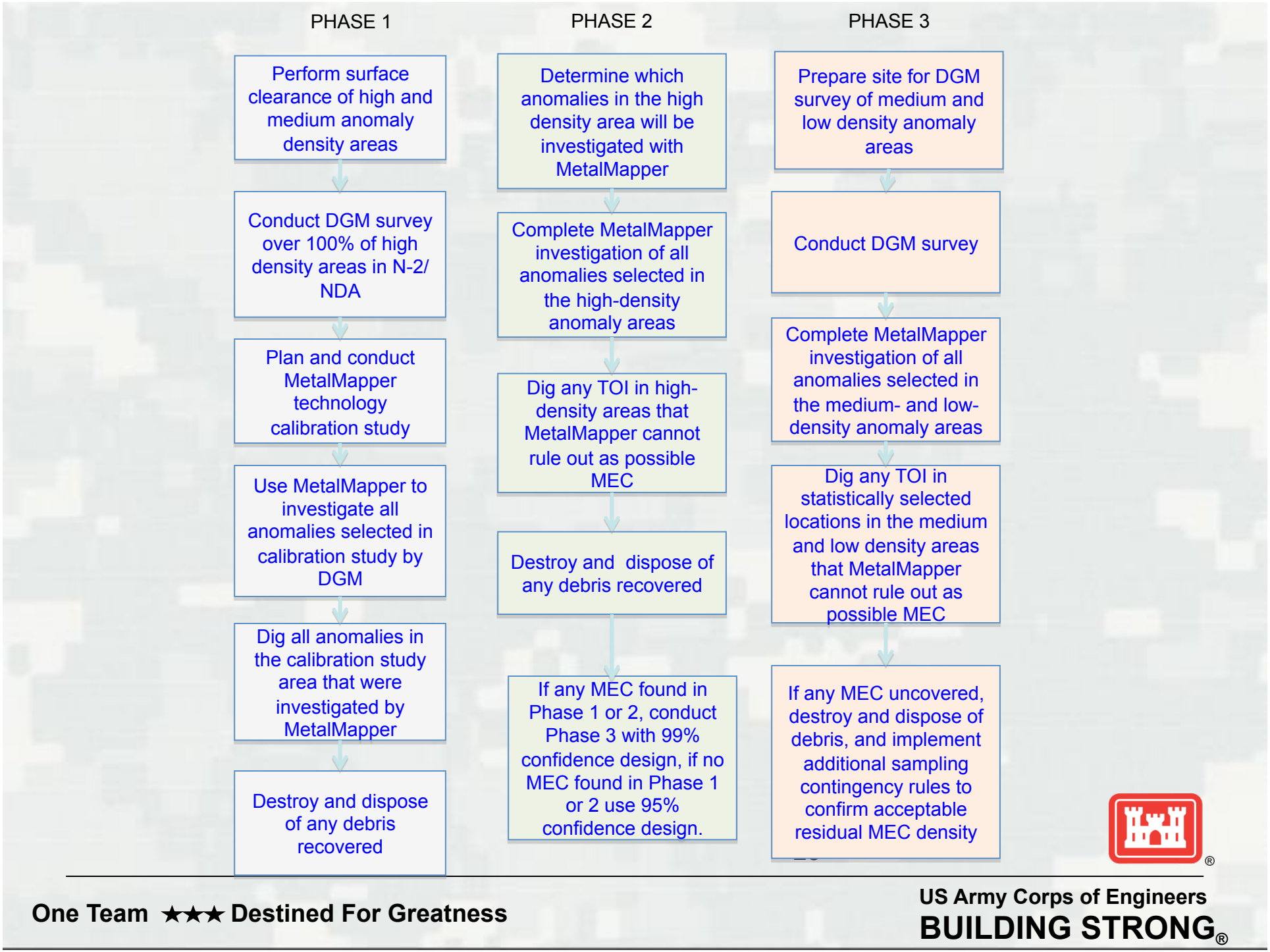
Remedial Action: Med Anomaly Density Areas:

- Perform a surface clearance of all metallic debris
- Confirm that the probability of MEC remaining below the surface is adequately low to conclude no further remedial action beyond continued land use controls is needed.

Remedial Action: Low Anomaly Density Areas

- Perform surface clearance of selected grid cells
- Confirm that the probability of MEC remaining below the surface is adequately low to conclude no further remedial action beyond continued land use controls is needed.


PHASE 1
Perform surface clearance of high and medium anomaly density areas
Conduct DGM survey over 100% of high density areas in N-2/NDA
Plan and conduct MetalMapper technology calibration study
Use MetalMapper to investigate all anomalies selected in calibration study by DGM
Dig all anomalies in the calibration study area that were investigated by MetalMapper
Destroy and dispose of any debris recovered
PHASE 2
Determine which anomalies in the high density area will be investigated with MetalMapper
Complete MetalMapper investigation of all anomalies selected in the high-density anomaly areas
Dig any TOI in high-density areas that MetalMapper cannot rule out as possible MEC
Destroy and dispose of any debris recovered
If any MEC found in Phase 1 or 2, conduct Phase 3 with 99% confidence design, if no MEC found in Phase 1 or 2 use 95% confidence design.
PHASE 3
Prepare site for DGM survey of medium and low density anomaly areas
Conduct DGM survey
Complete MetalMapper investigation of all anomalies selected in the medium and low-density anomaly areas
Dig any TOI in statistically selected locations in the medium and low density areas that MetalMapper cannot rule out as possible MEC
If any MEC uncovered, destroy and dispose of debris, and implement additional sampling contingency rules to confirm acceptable residual MEC density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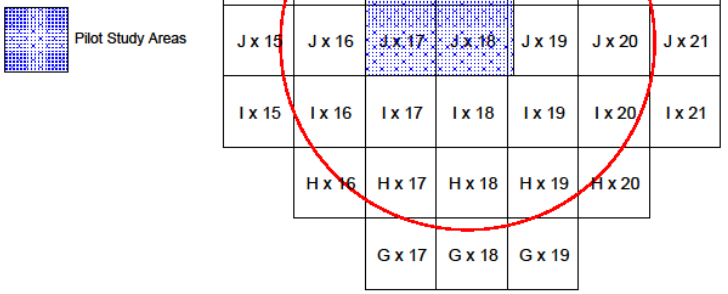
Dig any TOI in statistically selected locations in the medium and low density areas that MetalMapper cannot rule out as possible MEC
If any MEC uncovered, destroy and dispose of debris, and implement additional sampling contingency rules to confirm acceptable residual MEC density

Adaptive Rules

- TOI
  - If no intact 3lb spotting charges or fuzes are found during clearance of High Density area, these items will not be TOI for Med and Low density areas
- Statistical Confidence
  - If no MEC is found in the High Density area, the statistical survey that provides 95% in the Med and Low Density areas will be selected.
  - If any MEC is found in high density area, a statistical survey that provides 99% confidence in the Med an Low Density areas will be selected.

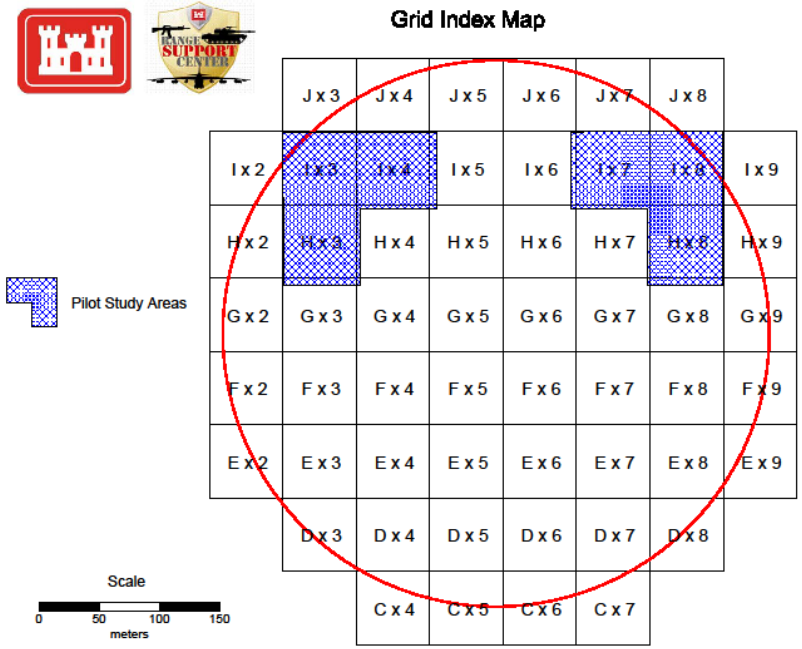
NDA High Density Area

Grid Index Map



N-2 High Density Area

Grid Index Map



Statistical Design Transition

- UXO estimator – first tool to determine sampling requirements for MEC studies
  - Simple algorithm based on one objective
- VSP – alternative sampling designs to meet different objectives
  - Now incorporates UXO estimator as one option
- Probability risk-based sampling design: optimal value base sampling

Design Comparisons

Both the UXO estimator and VSP provide similar results as far as total acreage

- VSP 99% Conf 99.375% of all transects are clean
- Requires 87 ac to be surveyed, and find no MEC
  - Plots random transects across grid cells
- UXO Est. 99% Conf <.1/ac
- Requires 84 ac be surveyed and find no MEC
  - Does not provide a map
  - Requires you to specify the acceptable number per acre
  - Requires a separate software package to develop maps of transect/grid placement

Probabilistic Risk-Based Sampling Design

- Prioritize locations that have highest risk
- Risk depends on potentially many factors
  - ► Density (i.e. prevalence rate) of MEC
  - ► Accessibility (e.g. depth, public access)
  - ► MEC stability (e.g. sensitivity, degradation)
  - ► Individual behavior of finder (difficult to model)
    - Typically considered identical across a site, but could vary with respect to different MEC
  - ► MEC danger (i.e., result of explosion)

Evidence of MEC Density

- Historical use indicates decreasing density moving away from target areas
- Crater record shows evidence of target hit/miss behavior of HE bombs
- Previous sampling efforts show location of high densities of anomalies
  - ► Evidence of behavior of combination of HE and practice bombs

Probabilistic, Risk-Based Sample Designs

- Utilize crater information only
  - Focuses on 100-lb HE bombs
- Utilize anomaly density only
  - More emphasis on 100-lb practice bombs and associated spotting charges, but includes HE frag
- Utilize both
  - Apply risk considerations to decide on balance between

Current Design

- Hybrid
  - Used VSP to determine sampling intensity needed
  - Allocated samples based on Bayesian allocation to incorporate information on density, craters, flight patterns
- Created avoidance areas where grids would not be placed

Project Website

Project documents, meeting schedules, meeting minutes, maps, and other information is available on the West Mesa Project Website:

http://westmesaproject.com/

SAFETY REMINDER

Remember the 3Rs of Military Munitions Safety:

Recognize:
you may have encountered a munitions item.

Retreat:
from munitions item. Do not touch or disturb it; instead move away carefully, walking out the same way you entered the area. Do not use two-way radios or cell phones within 100 feet of the item.

Report:
what you saw and where you saw it by calling 911.

Questions

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