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Comparison of Visual Sample Plan (VSP) Estimates to Final Site Data (Case Study)

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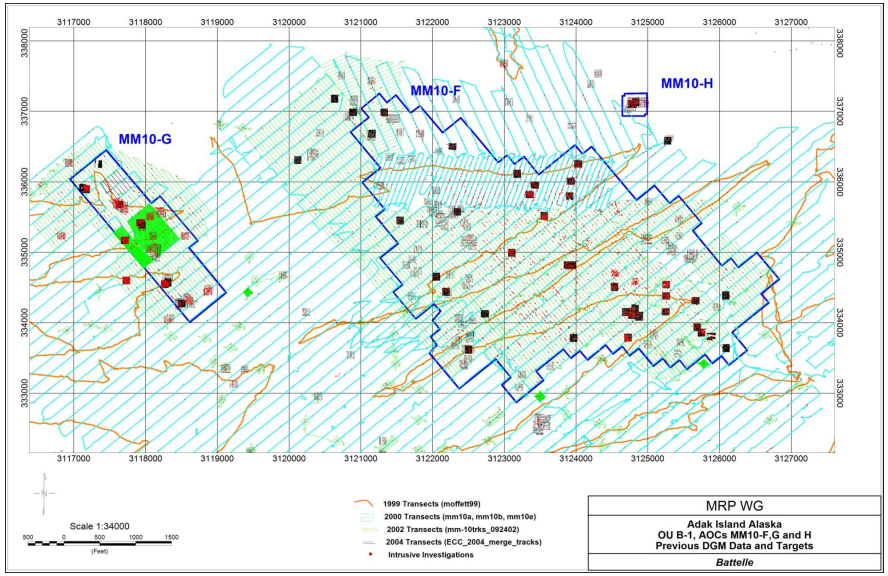
Introduction

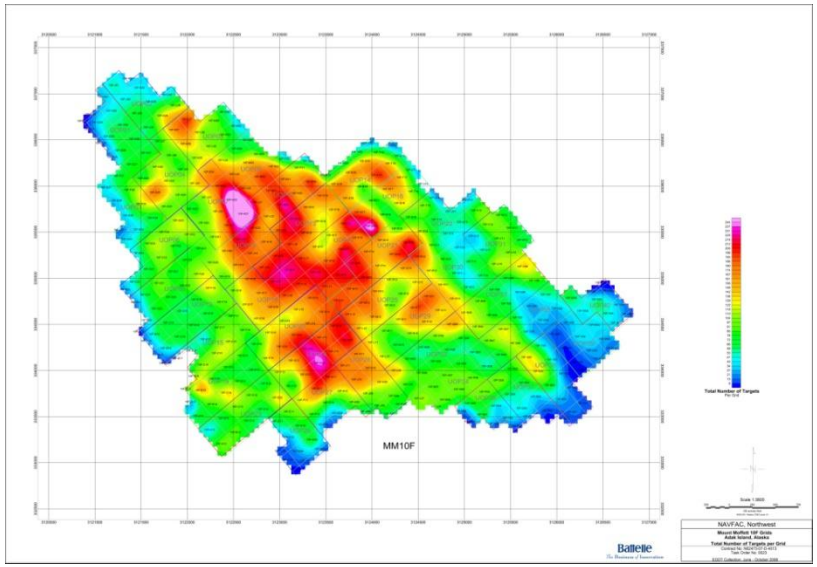
- What initiated the study?
  - In 2011, the MRP Workgroup was asked to support NAVFAC NW to respond to comments from the regulatory agencies on some calculations in a Feasibility Study – specifically, the anomaly count estimates used to develop the cost estimates
    - The FS used the method of estimating the number of target anomalies based on straight extrapolation from the RI data
      - How many anomalies/area during the RI
      - How much area in the RAA x anomalies/area equals estimate of targets
    - Agency comments suggested the use of VSP might give a more realistic number
      - VSP has several tools for statistical site characterization
      - Help identify and delineate potential target areas based on limited transect data
      - Couple of different methods to estimate count: Survey and Kriging
    - Workgroup identified that they had an excellent opportunity to compare a VSP estimate to final site data
      - OU-B1 Mount Moffett sites MM-10F, -10G and -10H

Introduction

- Why these sites?
  - Investigation data from 1999 through 2004
    - Transect and grid data
    - Dig Results
  - Remedial Action 2008 – 2010
    - 100% DGM data
    - 100% of targets were investigated
    - 100% dig results
    - Final anomaly counts and density maps were part of the project reporting



DGM Coverage 1999 - 2004



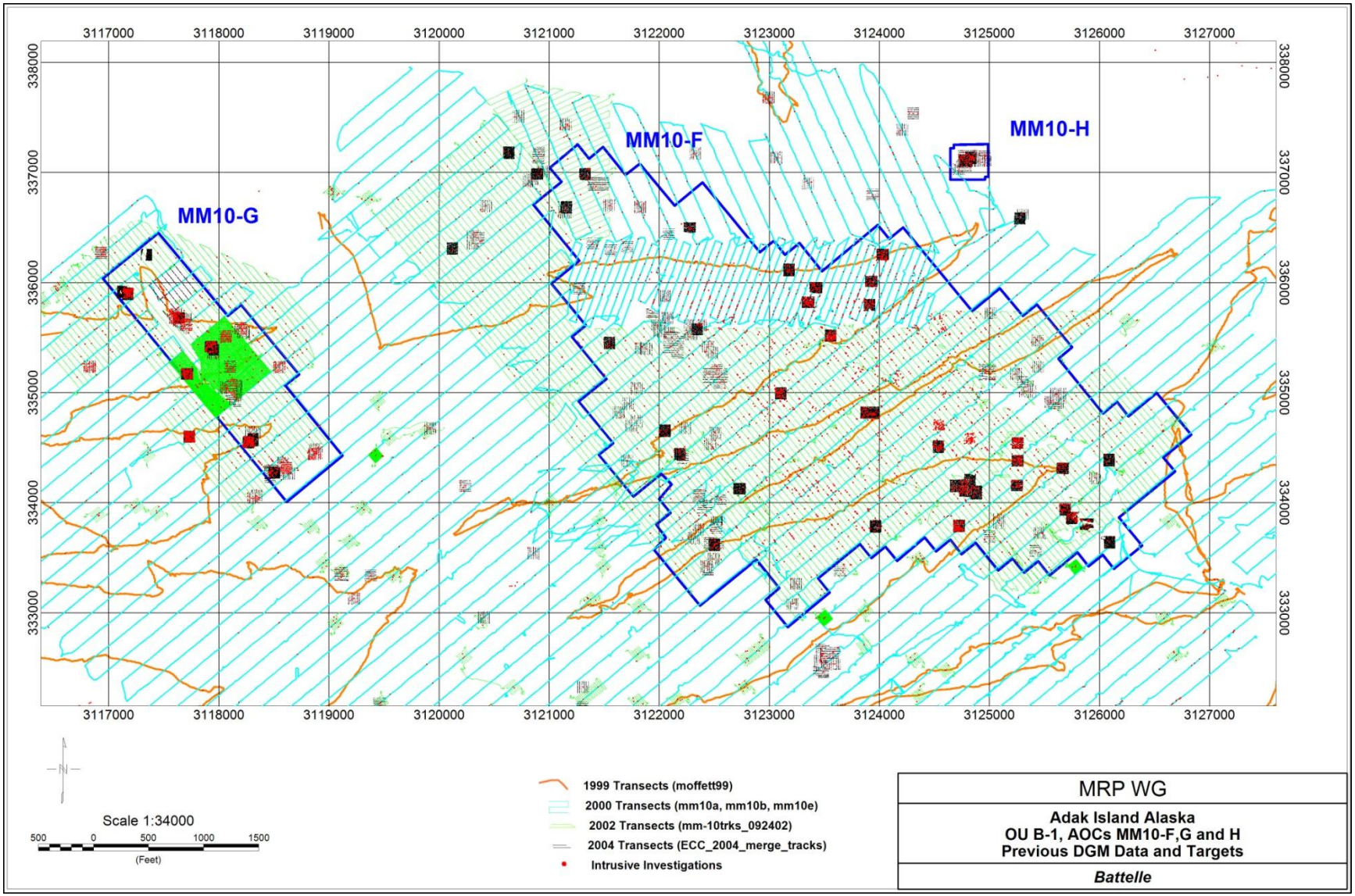
Anomaly Density – 2008 RA

Purpose

- The purpose for the study was to compare the VSP estimates – anomaly count and density distribution – to the results from the remedial action.
- Purpose for this presentation:
  - Walk you through the process
  - Show you the results
  - Discuss what was learned from the exercise

OU-B1 Sequence of Events

OU-B1 Sequence of Events				
	Year(s)	Primary Event(s)	DGM System	Comments
VSP Input Data	1999	DGM Surveys and target removal	Mk1, 2mV-3mV, Ch1	Semi-random, widely spaced transects (150m to 300m)
	2000	DGM Surveys and target removal	Mk1, 2mV-3mV, Ch1	Parallel transects (50m mainly, some at 20m)
	2002	DGM Surveys and target removal	Mk1, 2mV-3mV, Ch1	Parallel transects (20m), 30m x 30m mini-grids with either 1m or 5m lane spacing
	2004	DGM Surveys and target removal	Mk2, 3mV, Ch3	30m x 30m mini-grids with either 1m or 5m lane spacing
	2004	Surface sweep of MM-10F (TAVSC)	NA	At least 945 locations visited with multiple pieces of metal removed at each location
Ground Truth	2008-2010	Surface sweep of MM-10G, -10H; 100% DGM of all AOC	Mk2 Hybrid, 4mV – 4.4mV, sum Ch2,3,4	~3,500 lbs non-munitions debris and 61lbs MD removed during surface sweep; 100% DGM and investigation and removal of all targets above the threshold



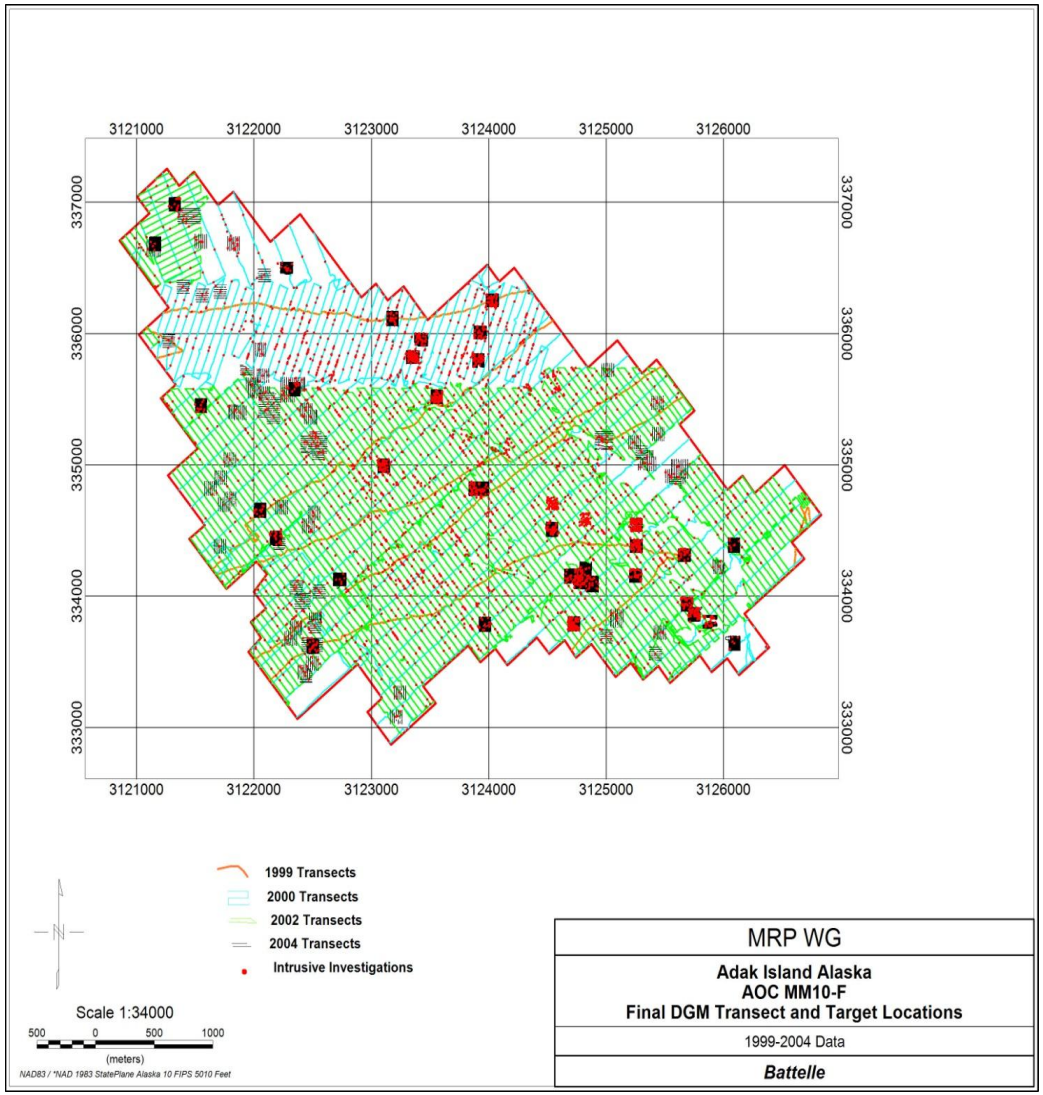
1999 to 2004 DGM Transect and Mini-grid Data

Process – Step 1

- Review Investigation DGM Data and Target Databases
  - DGM transects which were not processed were removed
  - Overlapping transects were removed
  - Only targets within the transect footprint were included – casual finds (visually acquired and removed, not in the DGM data) were removed from the databases
  - Excessive false positives (no finds) were de-sampled from the target databases (to achieve ~8% which was consistent with the historical rate at the site)

Process – Step 2

- Input the data into VSP
  - Map boundary of the study area
  - Coordinates of transect paths
  - Coordinates of targets

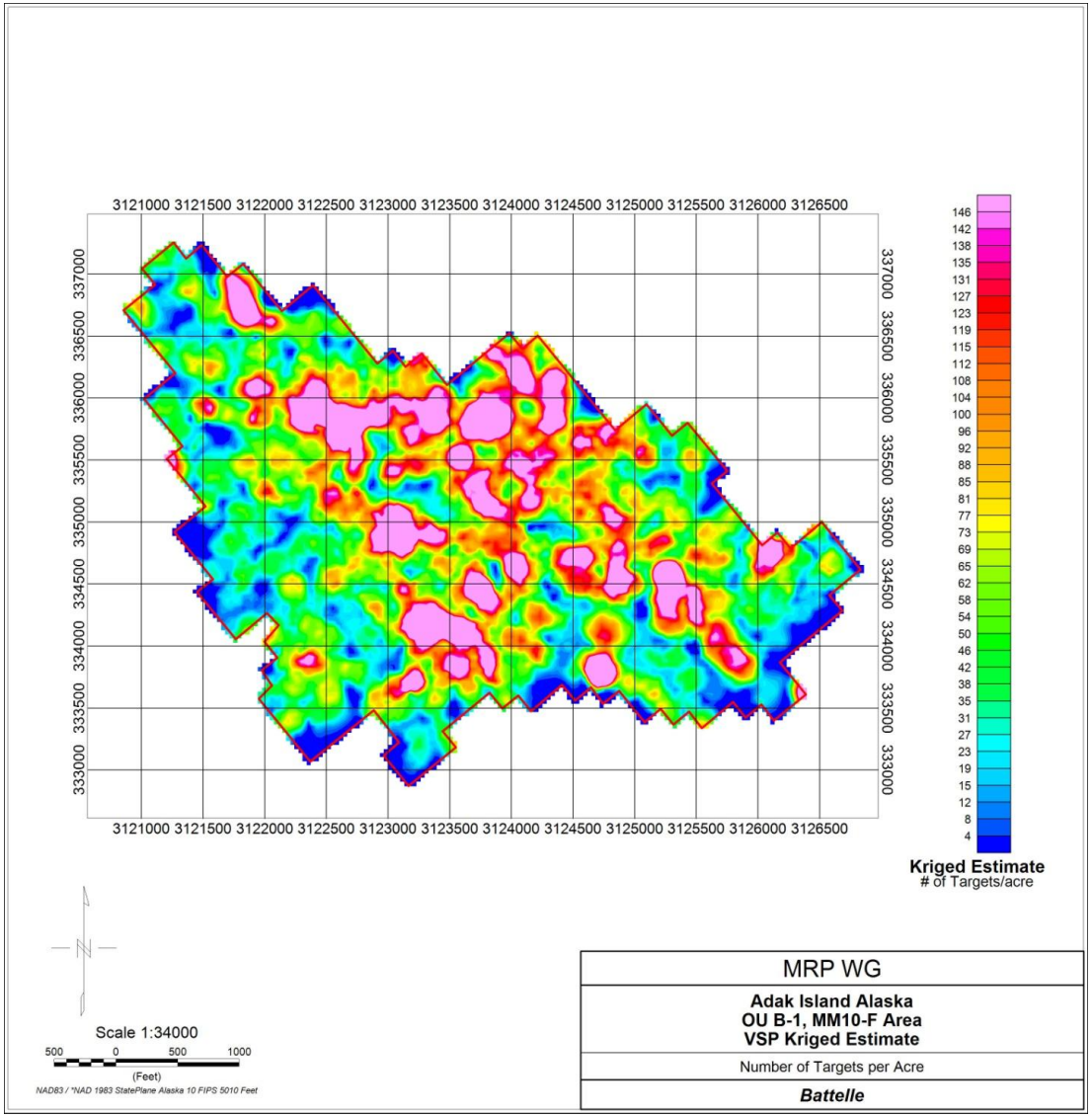


VSP Input Data for MM-10F

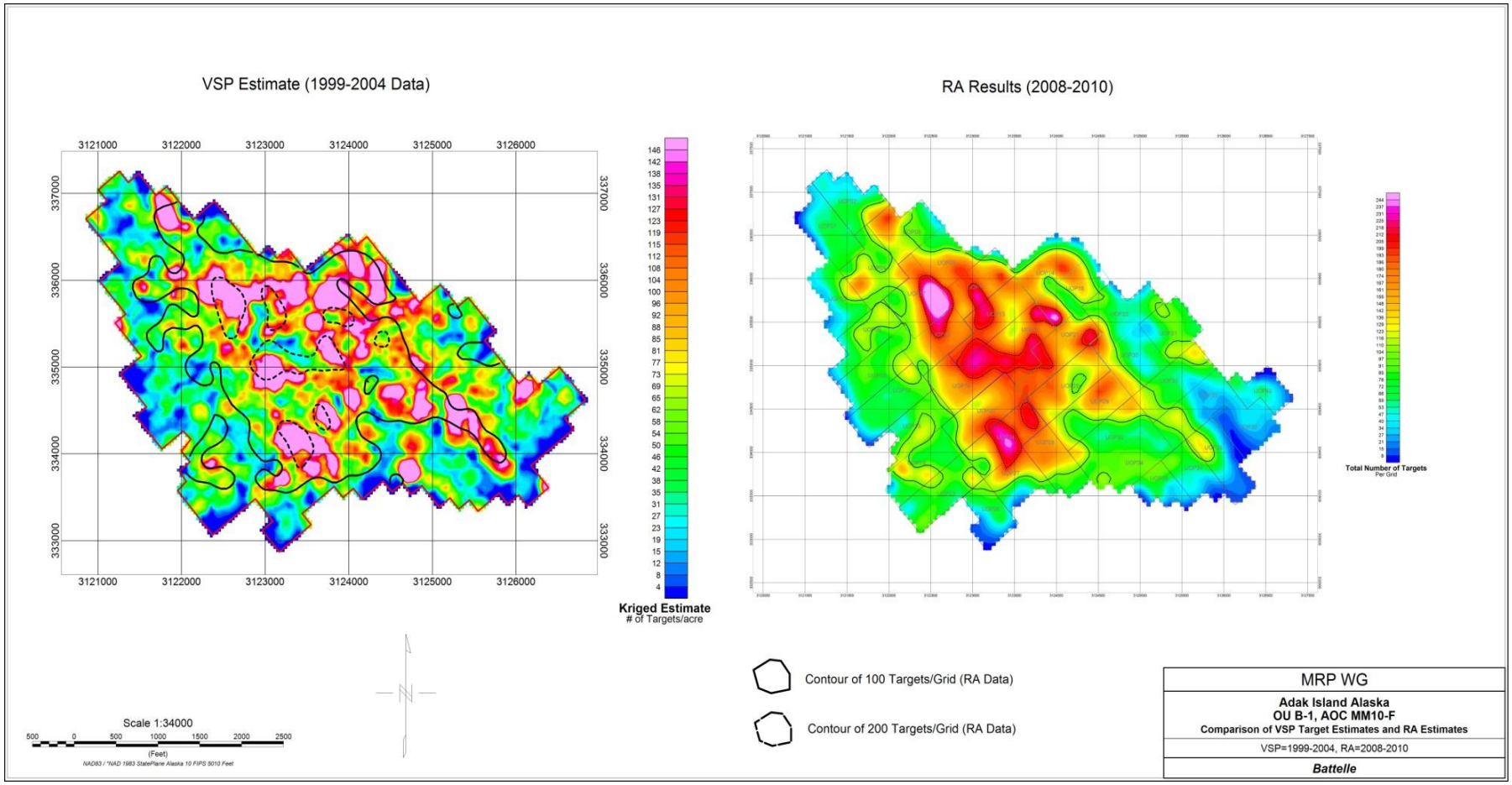
VSP Results

AOC MM-10F

Subject	Value
Total area of AOC (acres)	319.7
Transect area (acres)	43.84
Detected targets in transects	3,517
Average Density (Survey)	80.22
Total potential anomalies (Survey)	25,646
Average Density (Kriged)	71.085
Total potential anomalies (Kriged)	22,726



Comparison with RA Results



VSP Estimate (left) compared to RA results (right)

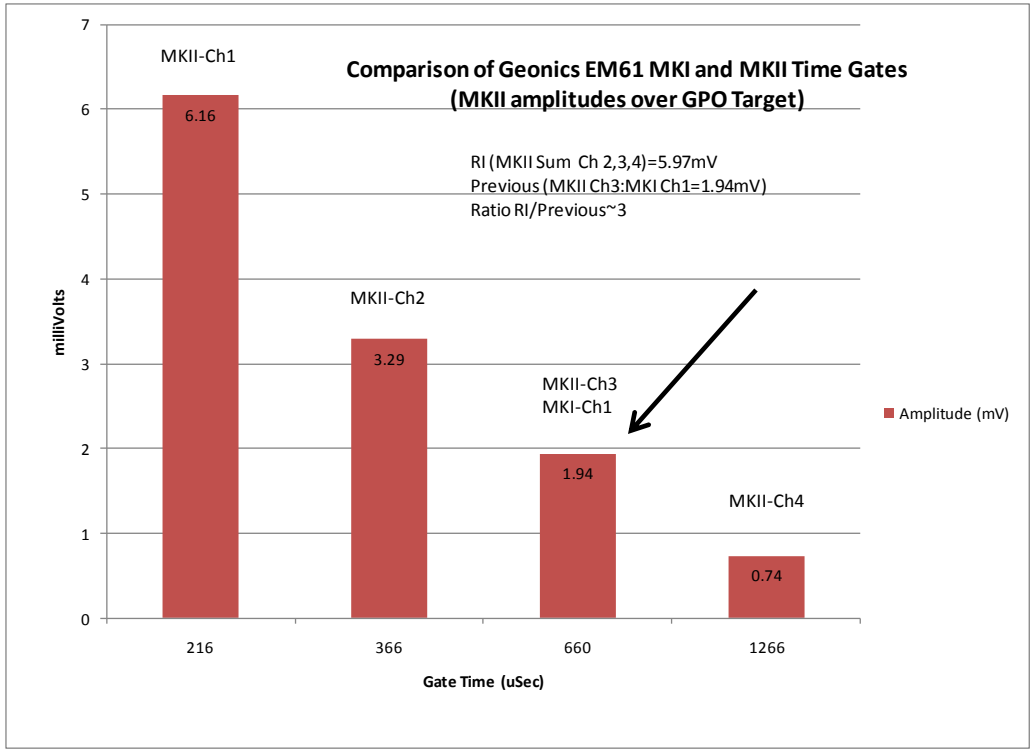
Analysis of MM-10F

- Total # targets detected and remediated in -10F was 34,534
- VSP estimated survey (25,646) or kriged (22,726)
- Why might that be?
  - Differences in DGM equipment ?
    - Investigation used 1999 – 2002 EM61 Mk1 data
    - RA used 2008 EM61 Mk2 Hybrid data
  - Differences in target selection thresholds?
  - Some other reason?

EM61 Mk2 Hybrid (1m x 1m coil)

Analysis of Equipment/Threshold

- Figure shows that Mk 1 Channel 1 is equivalent to Mk 2 Channel 3
- Likely that 1999-2002 DGM used 2mV to 3mV for target selection
- In 2004 used a Mk2 at 3mV on Channel 3
- During RA (2008) targets were selected using sum Channels 2, 3 and 4
  - Threshold was between 2.9mV and 4.4mV
  - MM-10F was primarily picked at 4mV and 4.4mV
- Using sum of 2, 3 and 4 is on average 3 times the amplitude of Channel 3



Plot of MKII Channel Amplitudes Over Small Seed Item in the Geophysical Prove Out (GPO) in OU B-1 (Note: gate time is not to scale.)

Analysis of DGM – MM-10F

- If: Target threshold average of 2mV is assumed for the 1999-2004 DGM data;
- Then: adjusted RA threshold would be approximately 6mV
- Applying a 6mV threshold to the 2008 RA data yields:
  - 15,016 targets
  - A reduction of 19,518 (~57%)
  - The VSP estimate of 22,726 overestimates by 7,710 (51%)

- So how do you ‘splain that?

Summary Info for all 3 sites

AOC	Area (acres)	'99 to '04 Transect area (acres)	'99 to '04 Targets	VSP Average Density (Survey)	VSP Total Potential Targets (Survey)	VSP Average Density (Kriged)	VSP Total Potential Targets (Survey)	RA Total Targets (Known)	RA Total Targets at 6mV
-10F	319.7	43.84	3,517	80.22	25,646	71.09	22,726	34,534	15,016
-10G	42.75	7.19	755	105	4,492	74.78	3,197	3,436	1,865
-10H	2.5	0.82	120	145.84	364	96.79	242	829	139
Total	364.95	51.85	4,392		30,502		26,165	38,799*	17,020

Navy estimate for bidding purposes was 27,150 targets
*Excludes blind seeds and survey corner pins

Possible Explanations

- Removal of Surface Metal after the Transect DGM
  - '99 to '04 DGM was conducted over the native terrain (e.g., no surface clearance)
  - In 2004, prior to the RA, a technology-aided surface clearance was performed in MM-10F.
    - The 2004 AAR shows that at least 945 locations were visited and often multiple metallic items were removed from each location
    - Conceivable, several thousand metallic objects (DGM targets) may have been removed from the AOC ahead of the RA DGM survey
  - In 2008, ahead of the RA DGM, surface clearance was conducted in MM-10G and -10H. ~3,500 lbs of metal debris were removed.
- Removal of Transect DGM Targets
  - All of the DGM targets identified in the transect surveys (4,392) were removed during the investigations
  - VSP does not subtract these targets from the estimate

Observations

- The VSP estimates (30,502 and 26,165) and the Navy estimate (27,150) are all within a reasonable range (<17%) of each other
- These estimates are well below the actual RA count (38,799)
  - RA had a much lower threshold 2.9mV – 4.4mV
  - RA used a more sensitive sensor (Mk2)
- At the 6mV threshold, the RA number decreases by > 50% and then the VSP estimate is high by >50%
  - Surface sweeps after the transect DGM but before the RA DGM may account for much of the difference
  - VSP does not remove the DGM targets that it uses from its estimate

Observations

- The ‘surface sweep’ discrepancy may be common on future projects
- The VSP estimate of target density showed good qualitative correlation with the actual RA data
  - These target density maps were used, in conjunction with other data, to develop the RAA boundaries for OU-B2 remedial action areas (this mornings’ presentation here at E2S2)
  - Questions?

Mount Moffett