

DISTRIBUTION AND FATE OF ENERGETICS AT THE MMR IMPACT AREA



Jay Clausen
Senior Hydrogeologist/
Geochemist

Presented at SERDP/ESTCP Team Meeting for the Distribution and Fate of Energetics on DoD Test and Training Ranges, April 15, 2002, at CRREL in Hannover, NH.

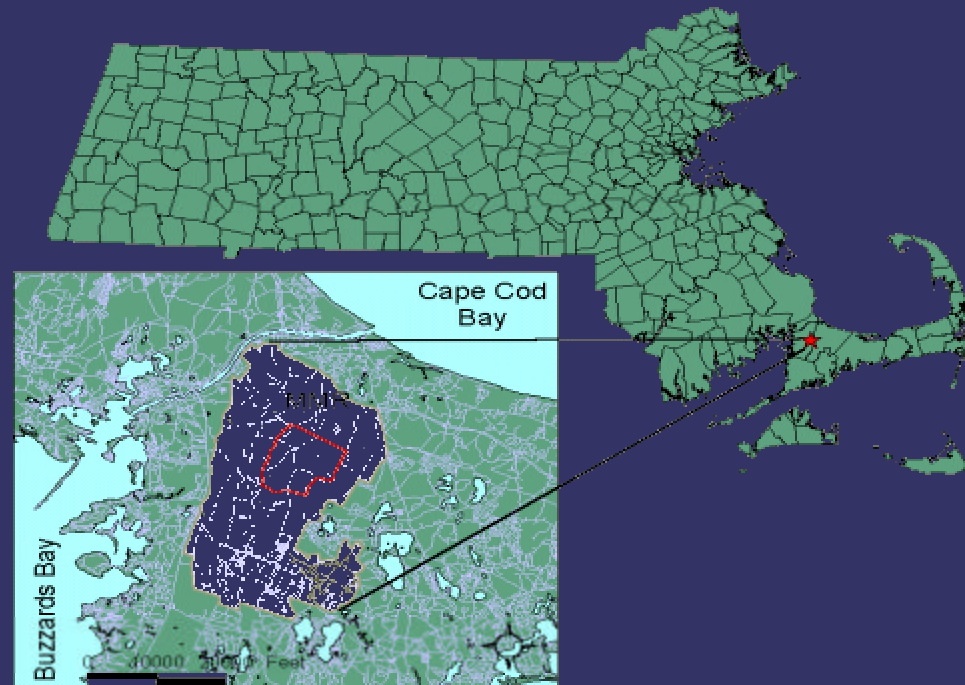
Introduction

- Military training ranges under scrutiny
 - Potential impacts to ecology and environment
 - Complex issues and problems
- Major ranges receiving attention
 - Massachusetts Military Reservation (MMR) - ARNG
 - NoMan Island
 - Vieques, Puerto Rico - U.S. Navy

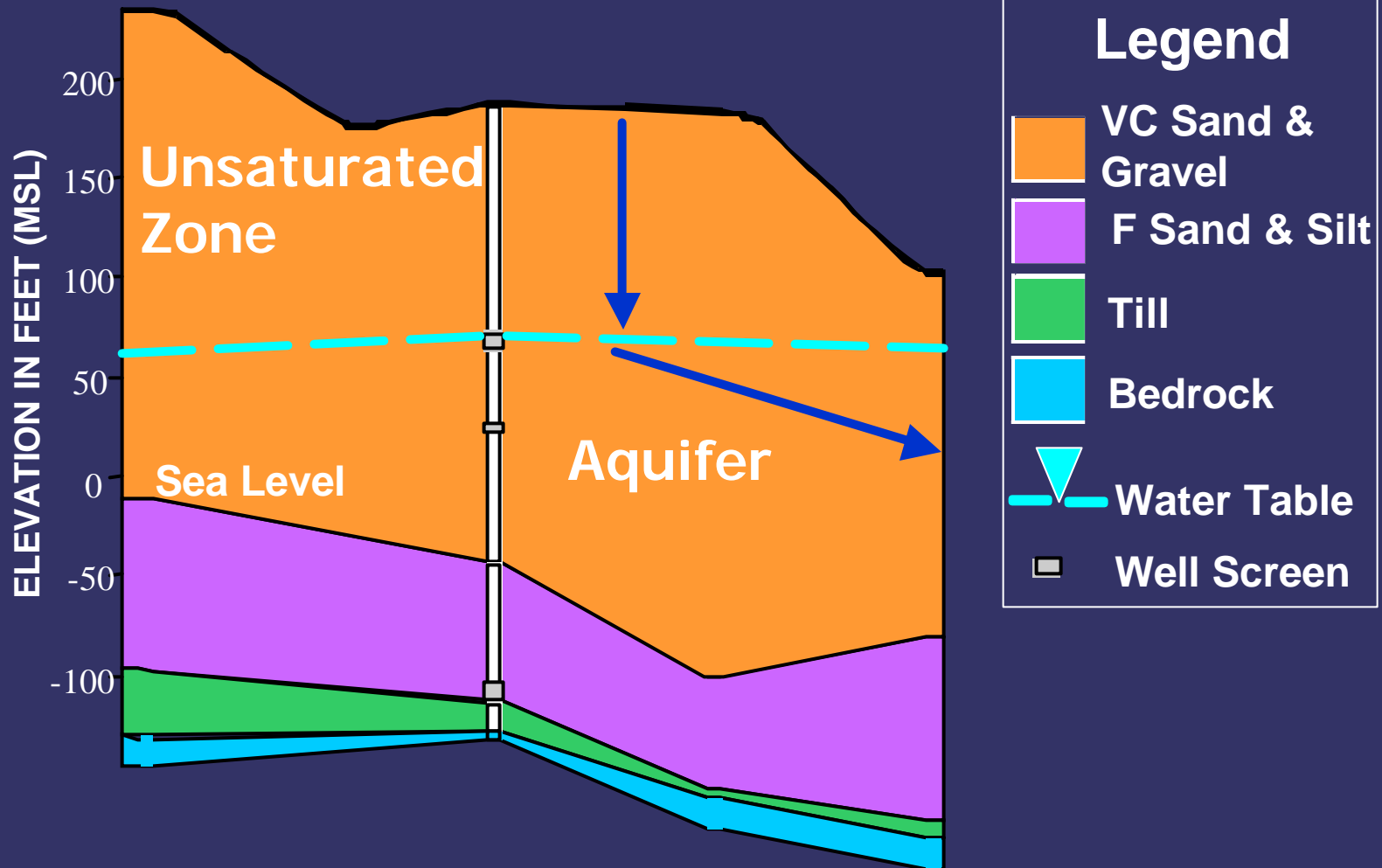


Camp Edwards - Site History

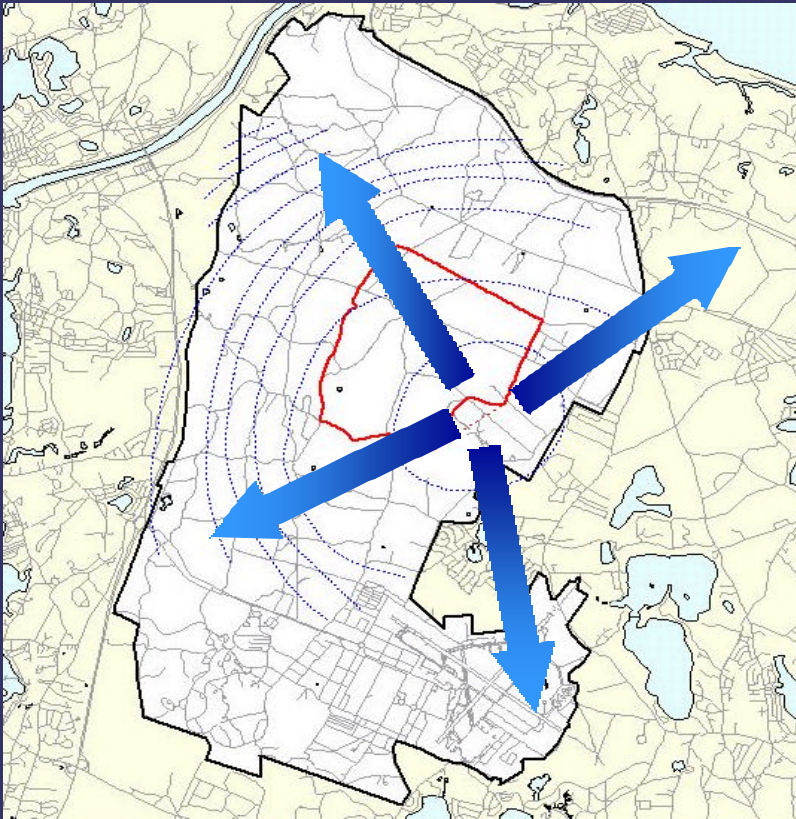
- Training and Impact Areas used since 1911
- Designed to house 30,000 troops during WWII
- USEPA banned training in 1997 through an administrative order



Site Lithology

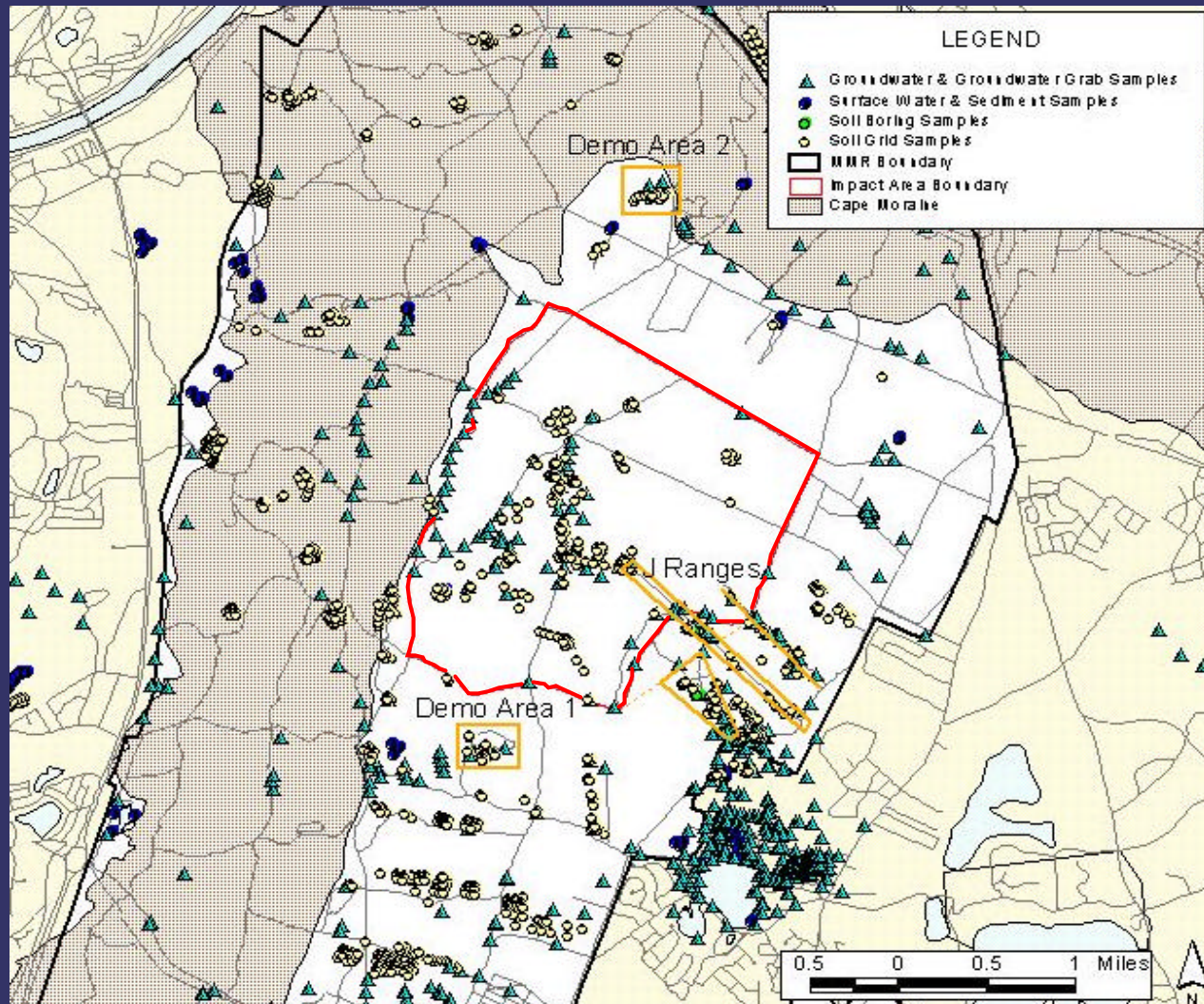


Hydrogeologic Model

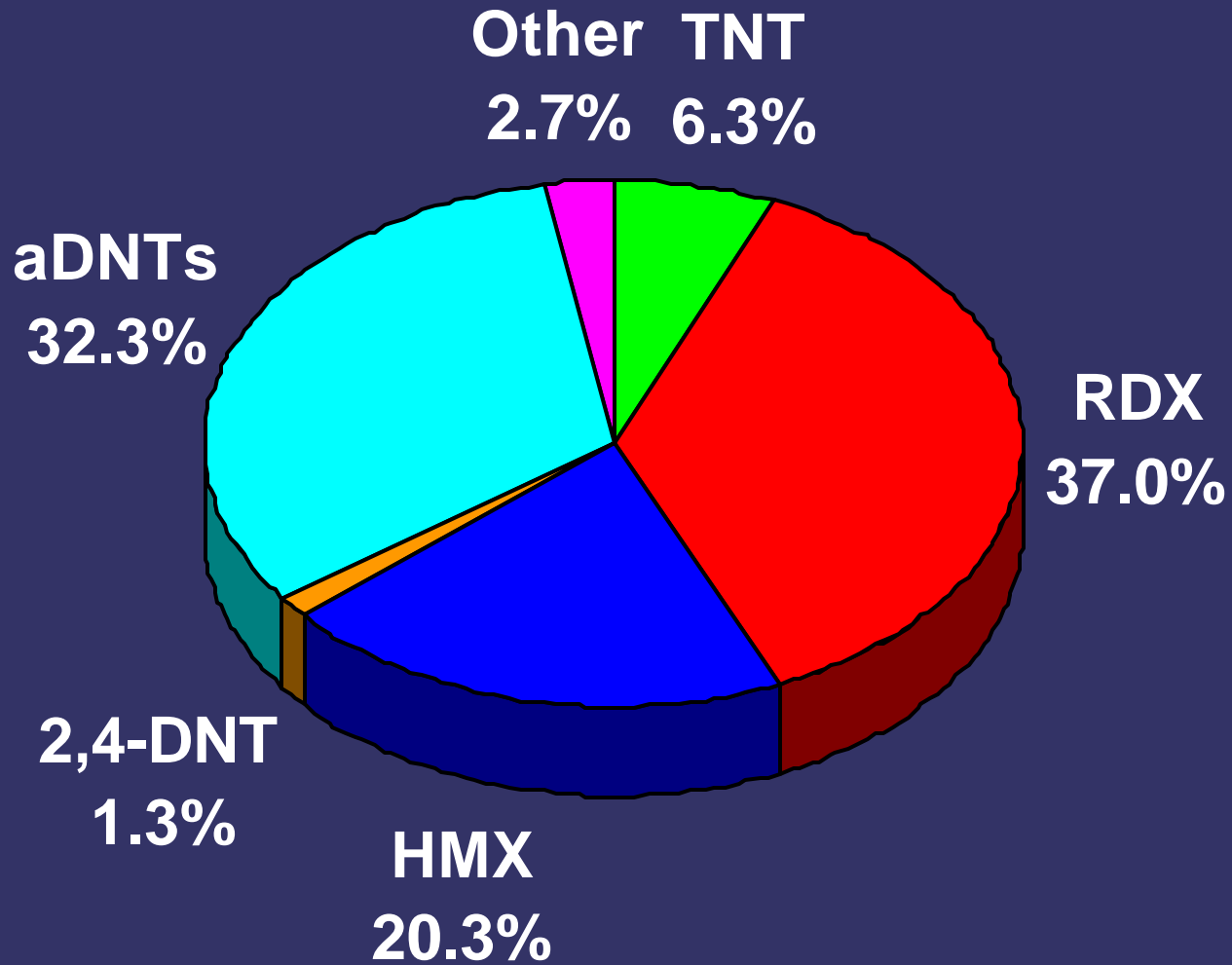


- Groundwater flow is radial with the mound to the southeast of the Impact Area in the J Range Area
- Groundwater flow is approximately one foot per day

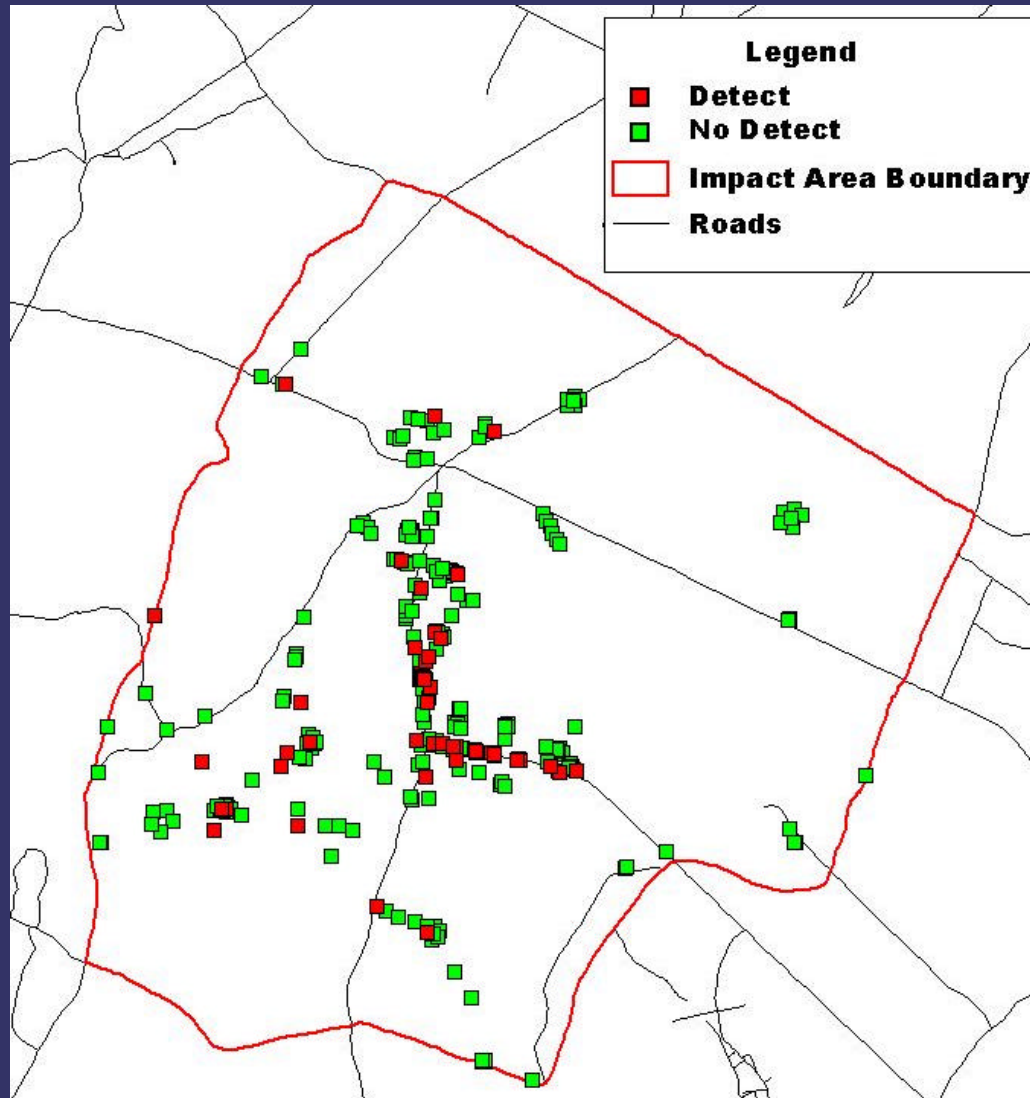
Areas of Investigation



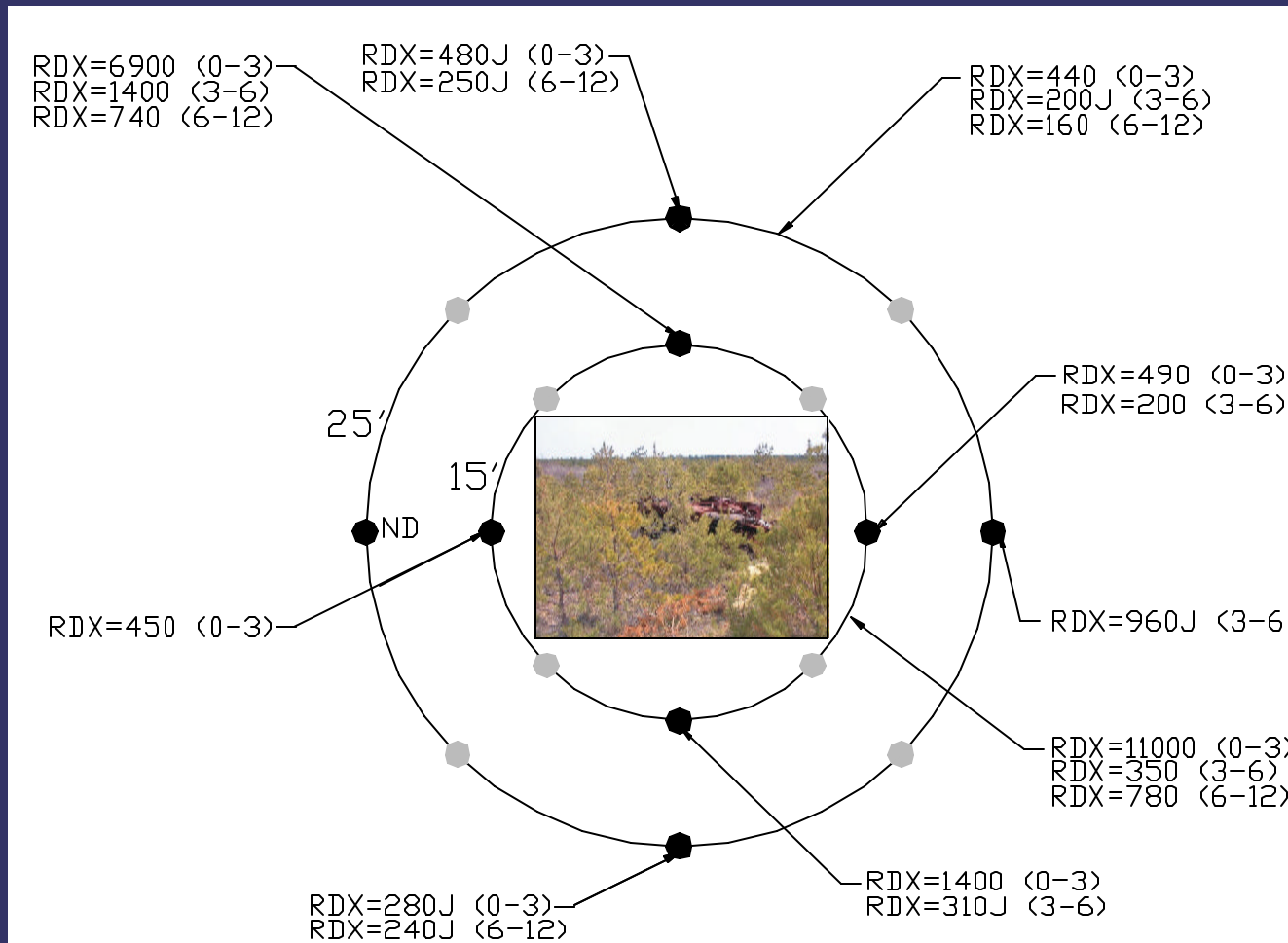
Surface Soil Findings



Soil Results (explosives)



Soil Results at Artillery Target 42



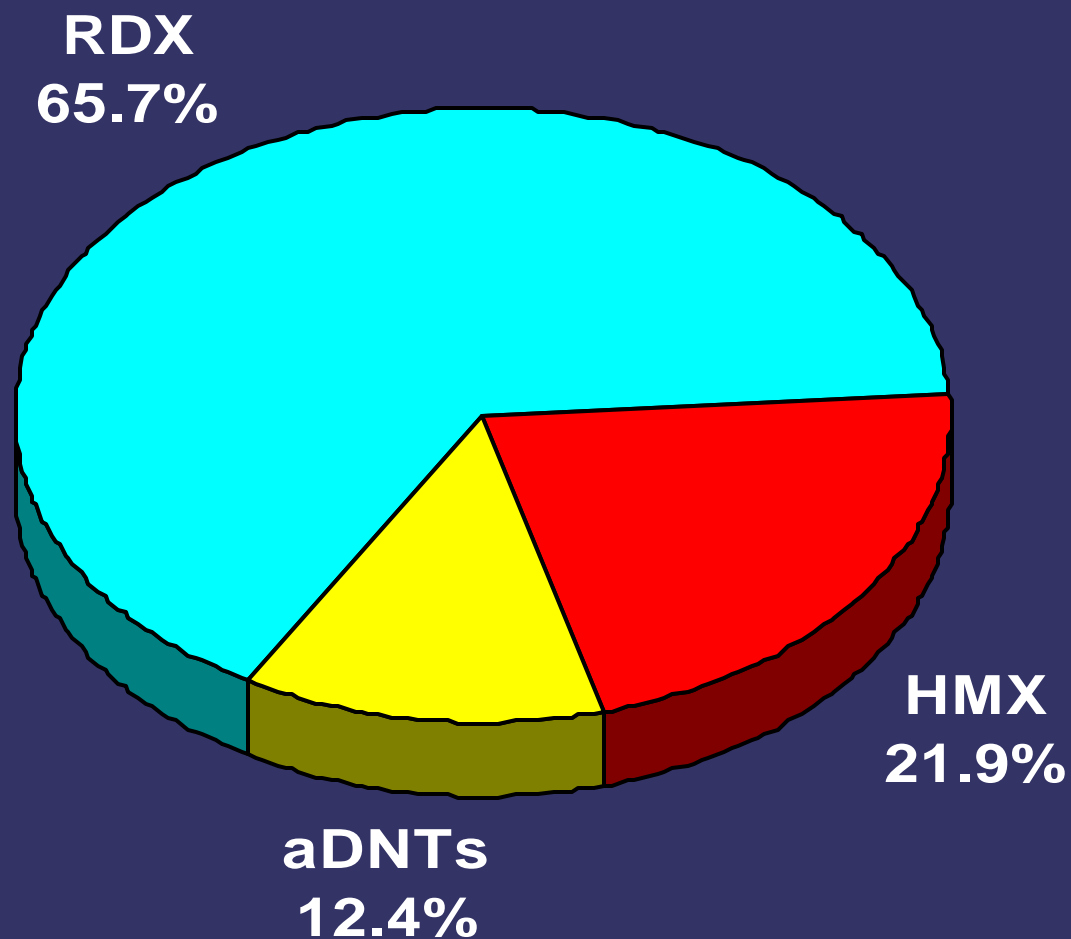
● COMPOSITE ONLY (PPB)
 ● DISCRETE & COMPOSITE (PPB)
 DEPTH = INCHES

Other Soil Results

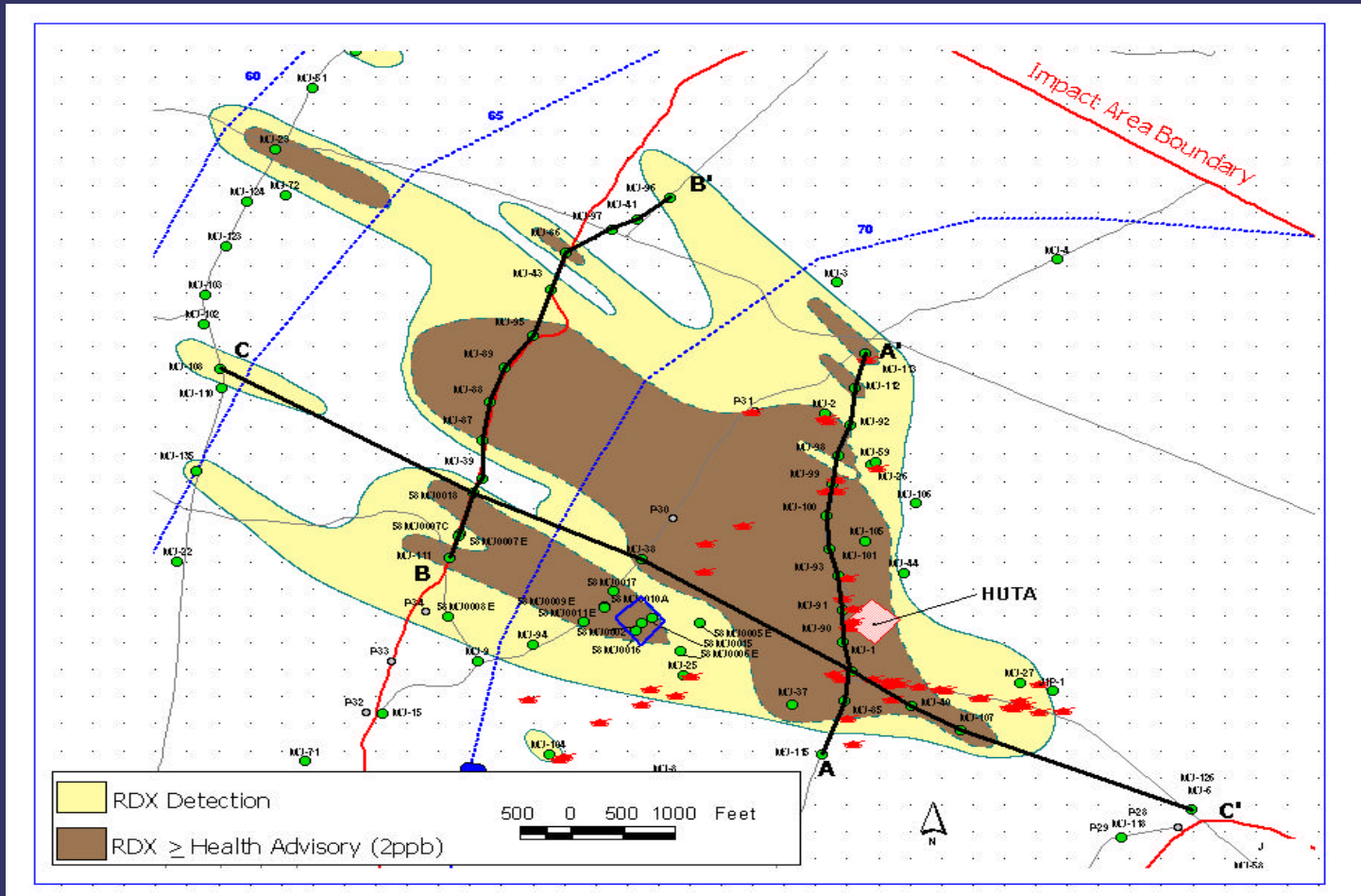
- Elevated metals evident (0 – 3 inches below ground surface)
 - Al, Fe, Mo
- PAHs
- PCNs ?
- Perchlorate ?



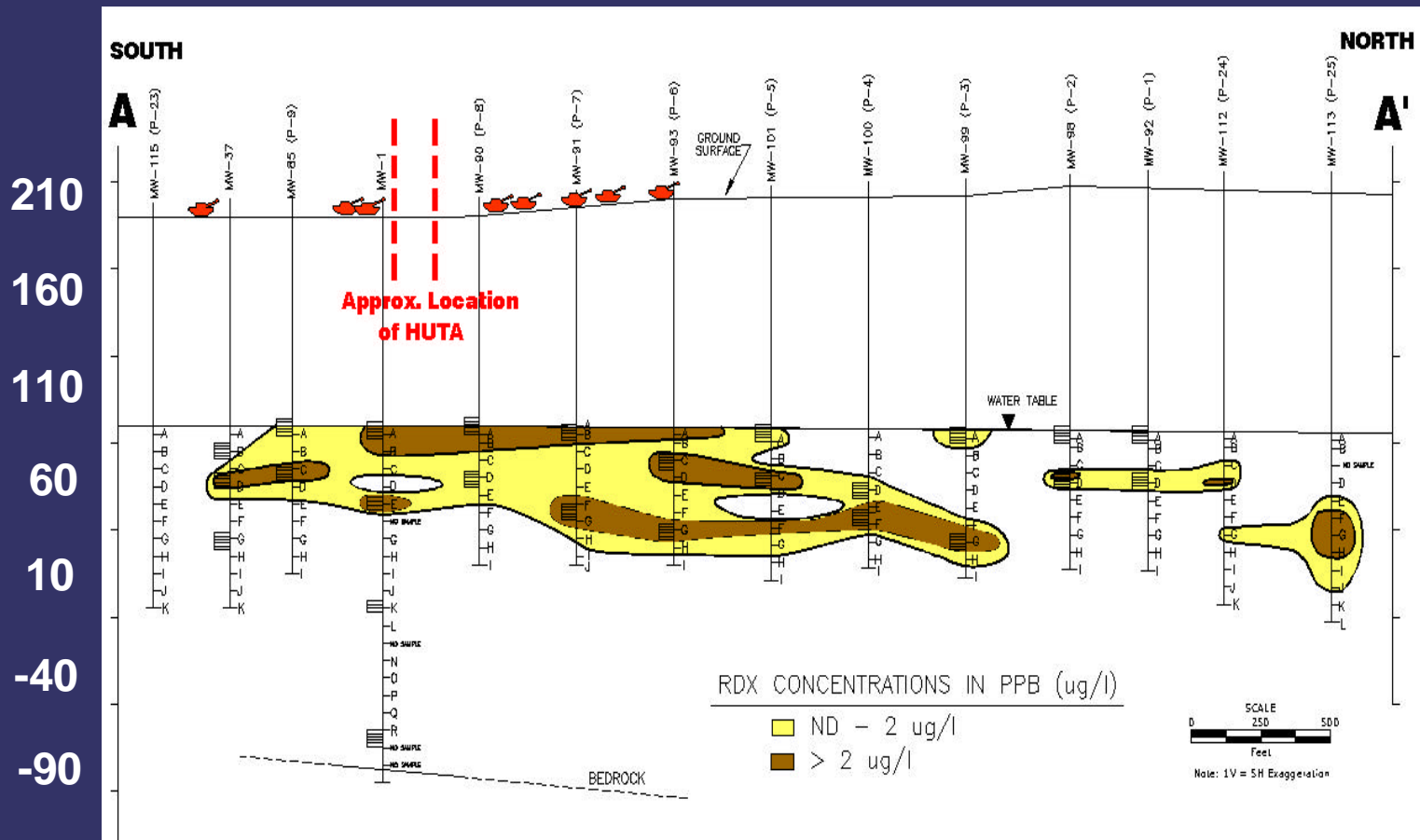
Groundwater Findings (explosives)



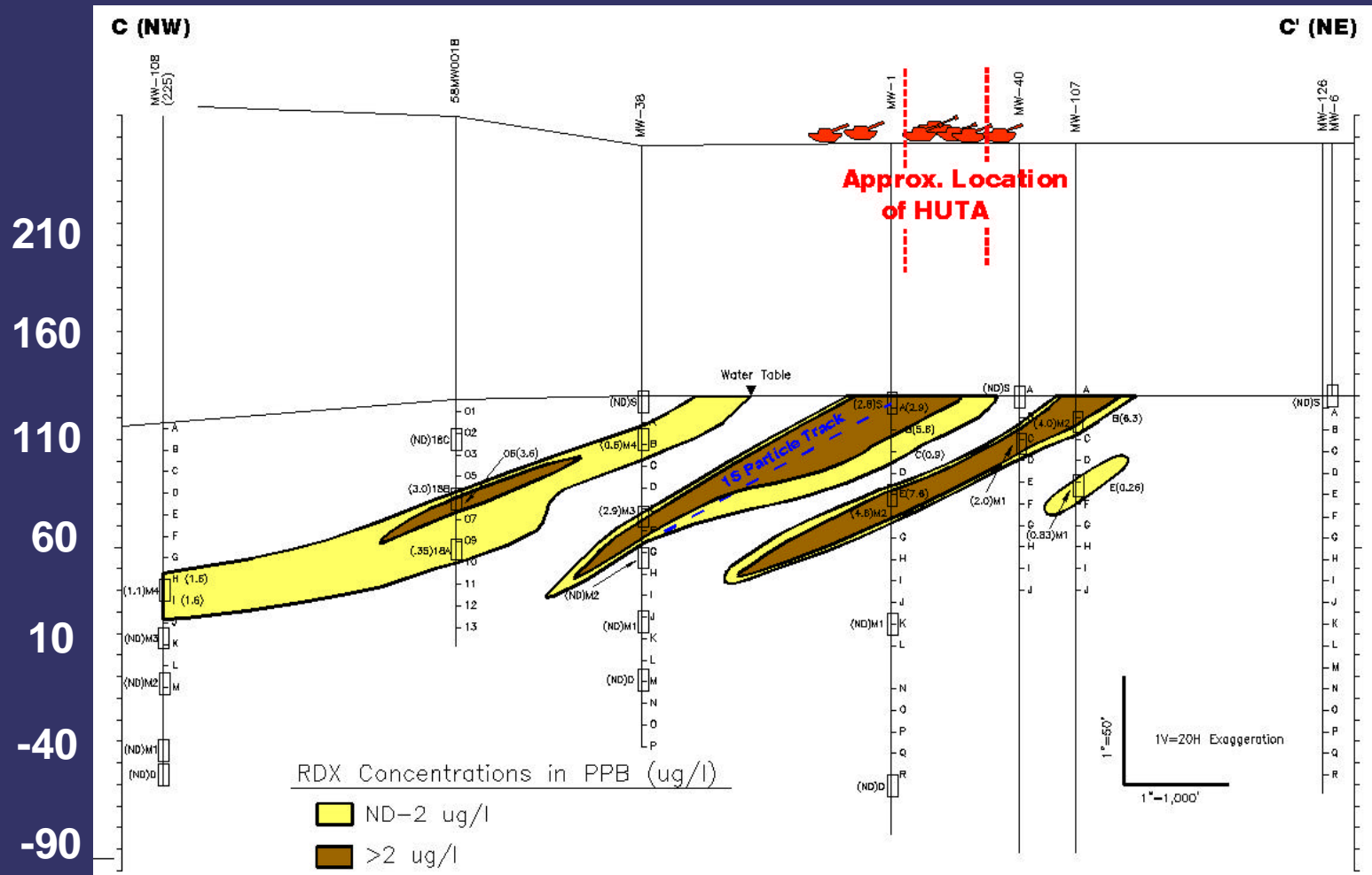
Plan View of RDX Detections in the Impact Area



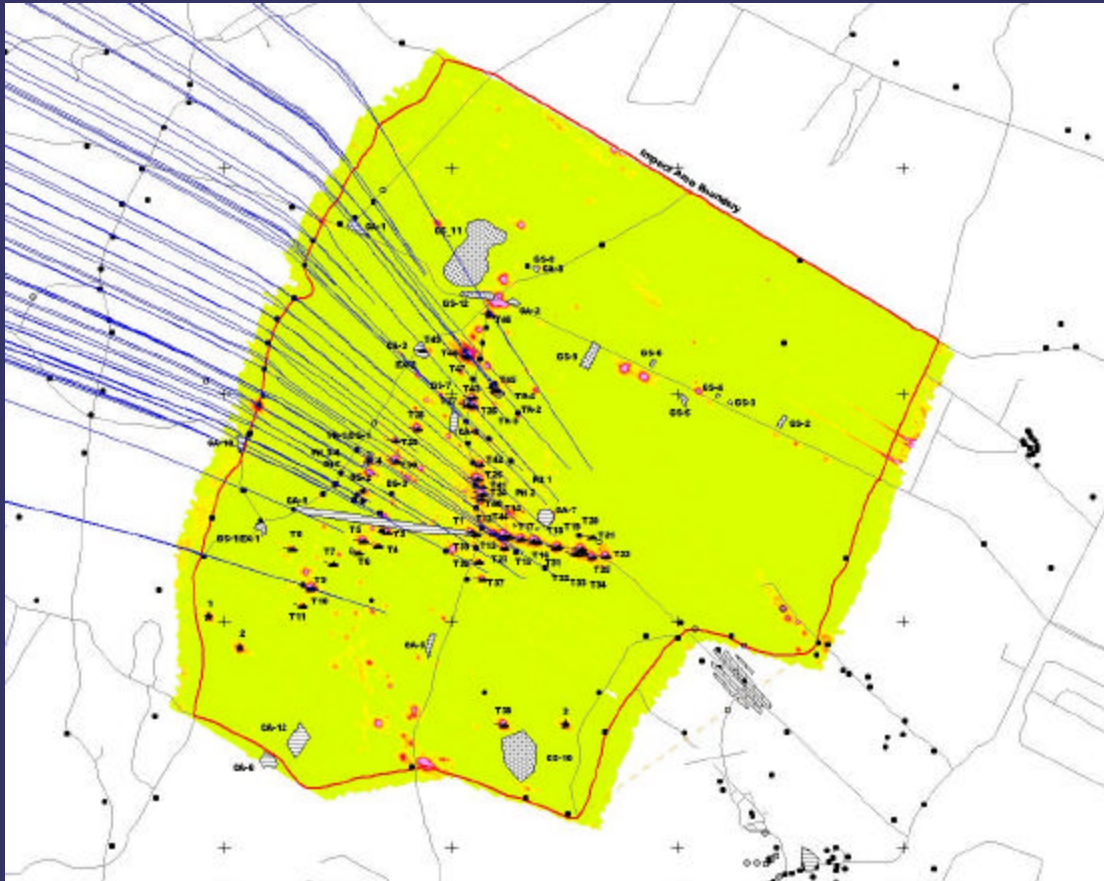
Inner Groundwater Transect within the Impact Area



Longitudinal Cross-Section through the Impact Area



Potential Source Area

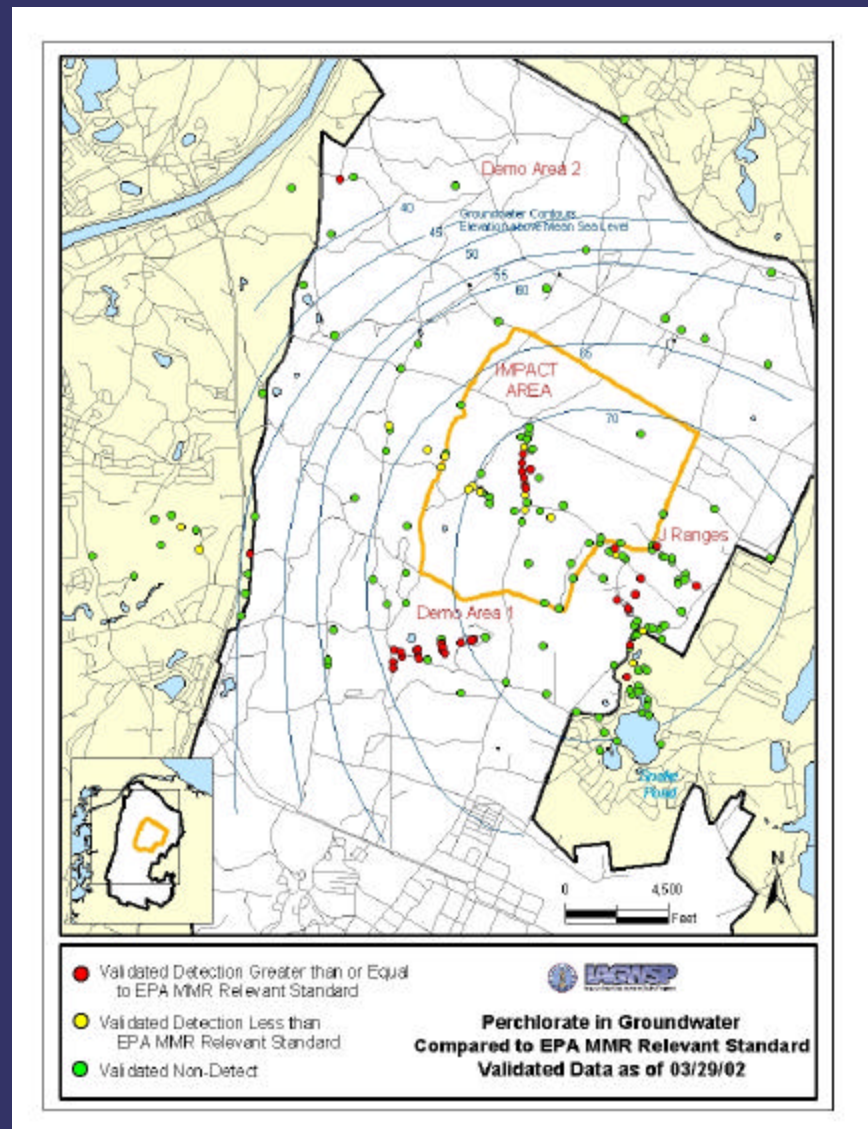


- High-order detonations
- Low-order detonations
- UXO
- EOD activities at the J Range
- Disposal/Burial sites
- Washout

Explosive Fate-and-Transport Conceptual Model

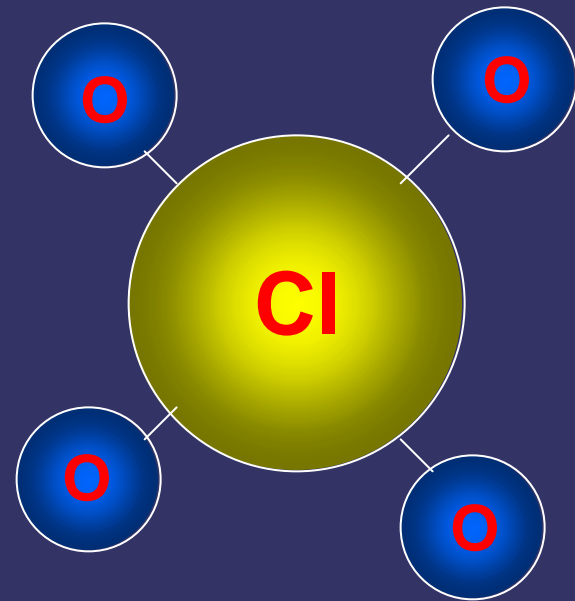
- Deposition of particulates to ground surface
- Slow dissolution of particulates
- Rapid movement of dissolved explosives through unsaturated zone, leaving little residual contamination (RDX and HMX)
- Introduction to groundwater results in rapid transport away from source

Location of Perchlorate In Groundwater at MMR



What is Perchlorate ?

- anion: ClO_4^-
- Ammonium perchlorate is in solid propellant for rockets and missiles
- Current MDL of 0.35 $\mu\text{g}/\text{L}$



Health/Ecological Concerns

- Soluble - Mobile – Persistent – Clean-up Challenge
- Human Health - No exposures
 - If exposed - disrupts normal thyroid function and uptake of iodine
- Ecological Risks – No exposures
 - Little information available on ecological effects

Where Is It ?

Groundwater – with explosives

- Demo Area 1 (< 300 ppb)
- Central Impact Area (< 5 ppb)
- Southeast Corner of Ranges (< 310 ppb)
- Off-Post In Bourne WD Area (< 1 ppb)

Where Did It Come From ?

- Demo 1 and J Range Primary source
 - Disposal of rockets and propellants
 - Burning of fireworks
- Central Impact Area Potential Sources
 - Spotting charges for artillery rounds
 - Illumination Rounds
 - Fuzes for many munitions
 - Pyrotechnics
 - Grenades

Clean – up Standard ?

- No National or State Drinking Water Standard – Inter-agency Perchlorate Steering Committee
- Groundwater Study Program was using 4 to 18 ppb (EPA Provisional Action Level)
- July 27, 2001 EPA Letter –Groundwater Study Program should use 1.5 ppb
- October 4, 2001 Groundwater Study Program/ Department of Defense Letter – Concerns...use 4 to 18 ppb until national standard set
- April 16, 2002 MADEP recommends 1 ppb guideline

Summary

- Perchlorate levels are a concern
- Occurs in groundwater with explosives
- Requires unconventional clean-up technologies
- Working with EPA to establish national standard

Conclusions

- RDX and HMX present in surface soil adjacent to artillery and mortar targets
- RDX and HMX present in groundwater downgradient of primary target area (i.e. Tank Alley) within the Impact Area
- TNT which is a component of the munitions appears to be degraded before reaching groundwater



Conclusions (cont.)

- Training using HE artillery and mortar rounds (UXO, detonation, or both) appears to have resulted in an explosive impact to groundwater at MMR
- Some metals, PAHs, and pesticides/herbicides present in surface soil but no evidence of impacts to groundwater
- PCNs may be an issue for soil and perchlorate may be an issue for groundwater
- MMR findings are potentially applicable to other bombing ranges and battlefields



Lessons Learned

- Compositing explosive soil samples is necessary
- Modifications to explosive analytical methods may be needed
 - expanded analyte list
 - changes to sample preparation
 - lower detection limits
- Perchlorate (OB/OD) and PCNs for ranges may be issues