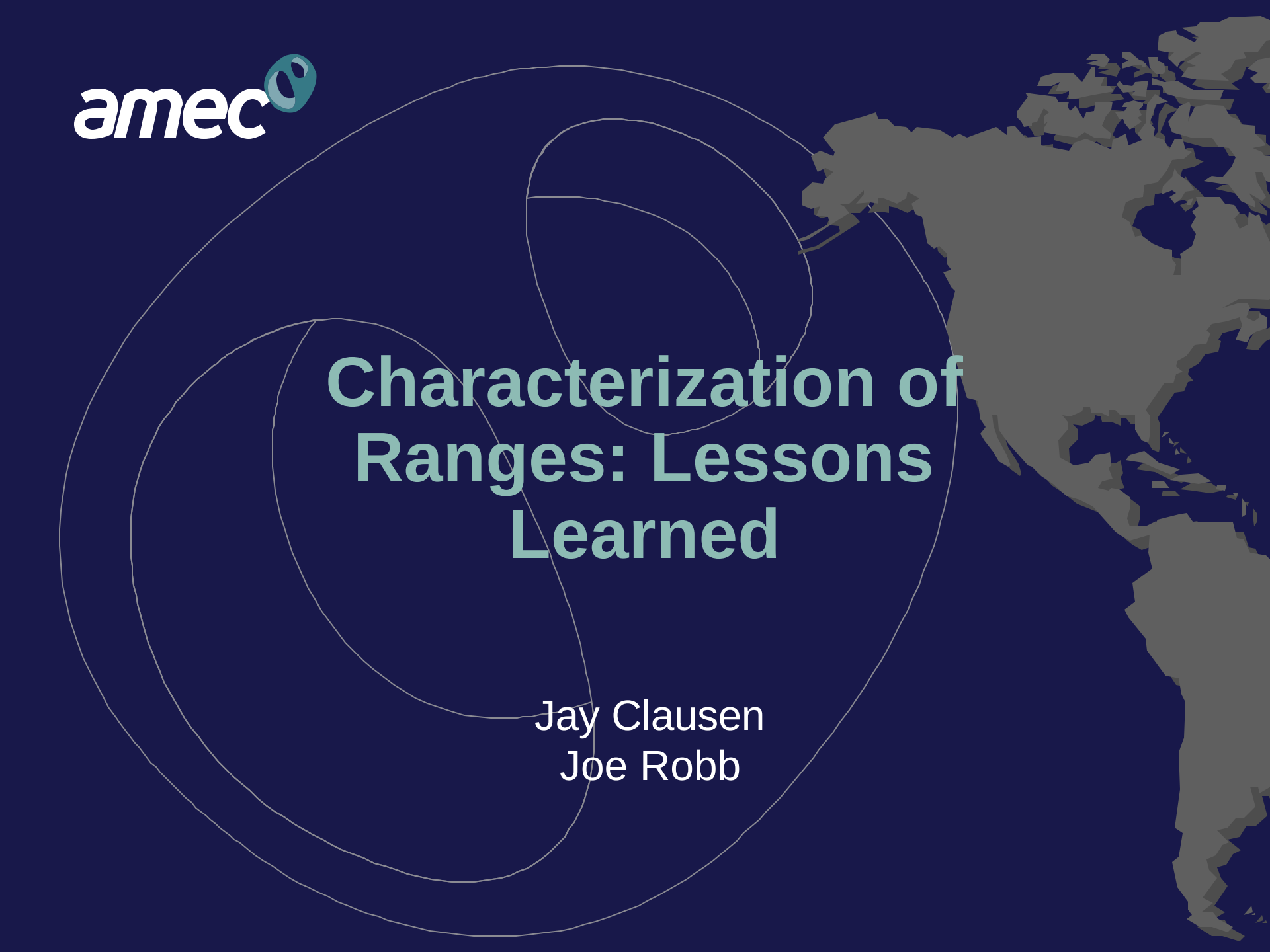
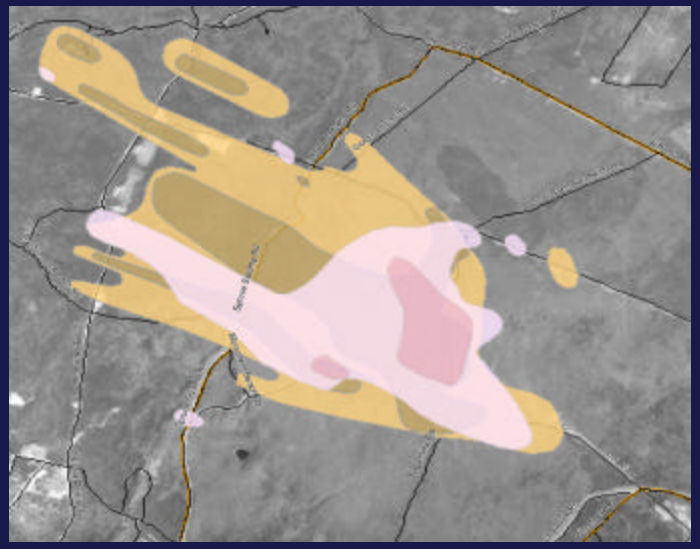


Characterization of Ranges: Lessons Learned

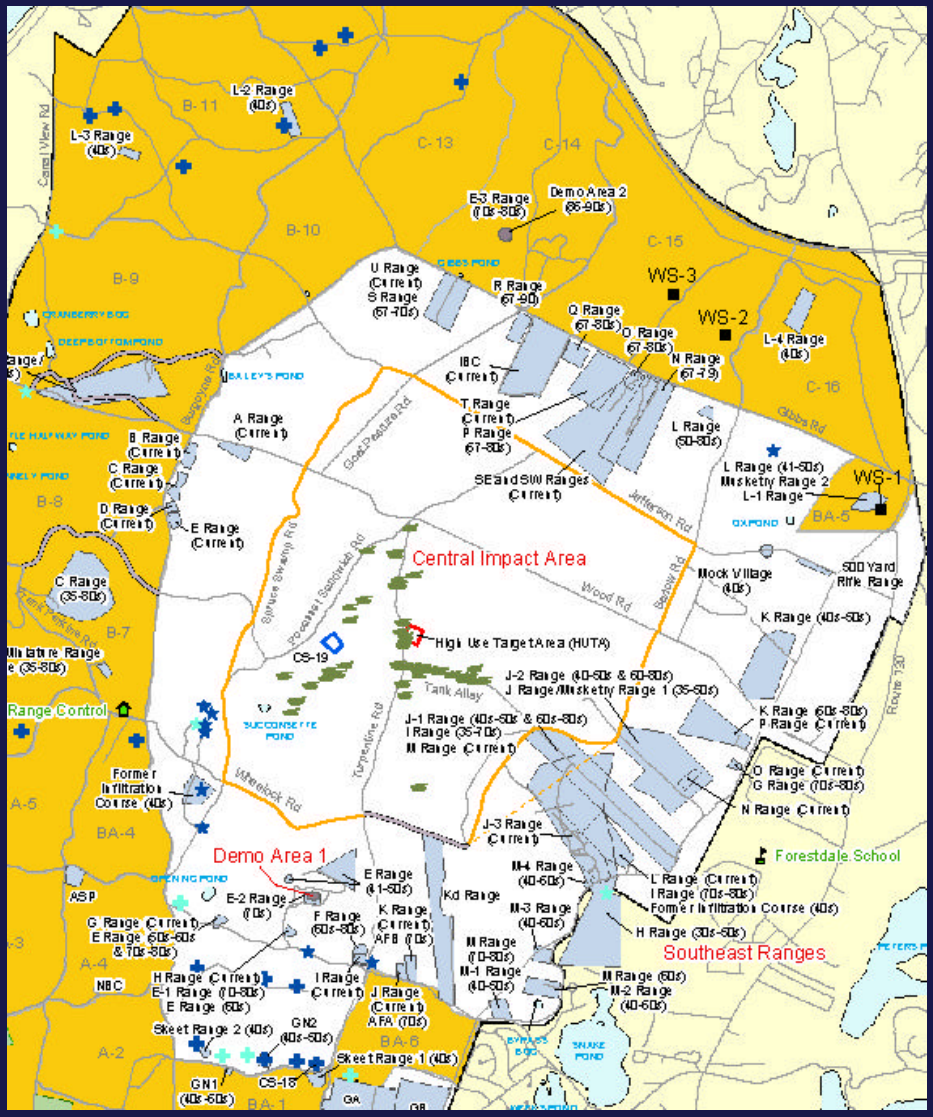
Jay Clausen
Joe Robb

Lessons Learned

- Analytical
- Soil Sampling
- Groundwater Sampling
- Contaminants of Concern
- Geophysical
- Fate-and-Transport
- Modeling
- Remediation



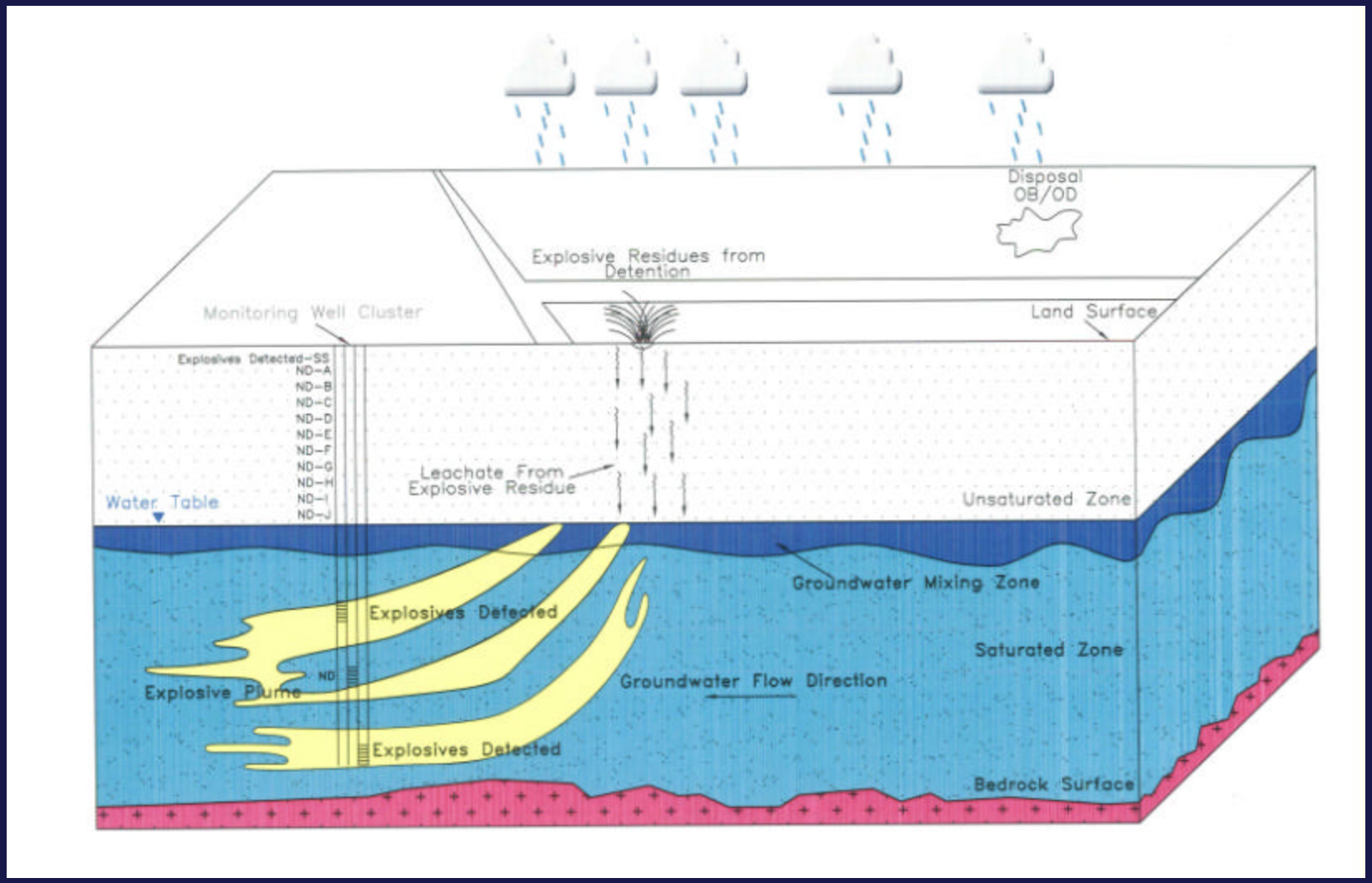
Training Areas



MEC F&T 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, HMX, perchlorate)
- Introduction to groundwater results in rapid transport away from source
- Significant sorption and/or transformation of TNT, aDNTs, DNT, EC, and NG in unsaturated zone
- WP rapidly oxidized in unsaturated zone

MEC F&T Conceptual Model



Introduction

- Over 200 compounds analyzed
  - Explosives and Metals
  - Volatile organic compounds (VOCs)
  - Semi-volatile organic compounds (SVOCs)
  - Pesticides/Herbicides
  - Polychlorinated biphenyls (PCBs)
  - Polychlorinated napthalenes (PCNs)
  - Dioxins/Furans
  - Other (White Phosphorous, Cyanide, Dyes, Anions)
- Tentatively identified compounds (TICs) exhaustively evaluated

Samples Collected by Media

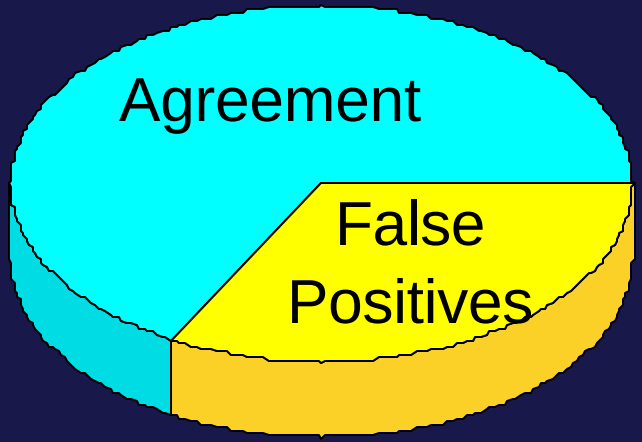
- > 10,000 surface soil samples (0 to 2 ft)
- > 1,600 soil boring profile samples (10 to 300 ft)
  - > 150 individual locations
- 69 sediment samples from 19 water bodies
- 64 surface water samples from 19 water bodies
- 5 storm water samples from perimeter of the Impact Area
- > 6,000 groundwater profiling samples from > 400 borings
- < 10,000 groundwater samples
  - > 700 monitoring wells at > 400 locations

Analytical - Explosives

- If rocket firing positions are investigated Method 8330 should be modified to improve the sensitivity to NG
- Explosive field analytical methods are not suitable for low concentrations anticipated on ranges
- Modifications to explosive analytical methods may be needed
  - expanded analyte list
  - changes to sample preparation
  - lower detection limits
- Photo diode array is a necessity for Method 8330 analysis
- Larger sample aliquots should be used

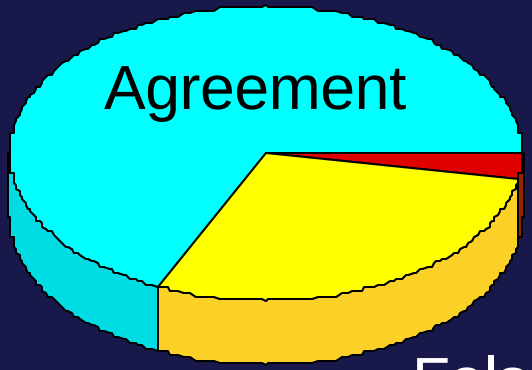
Field vs Laboratory Results for RDX

Surface Soil



33%

Subsurface Soil



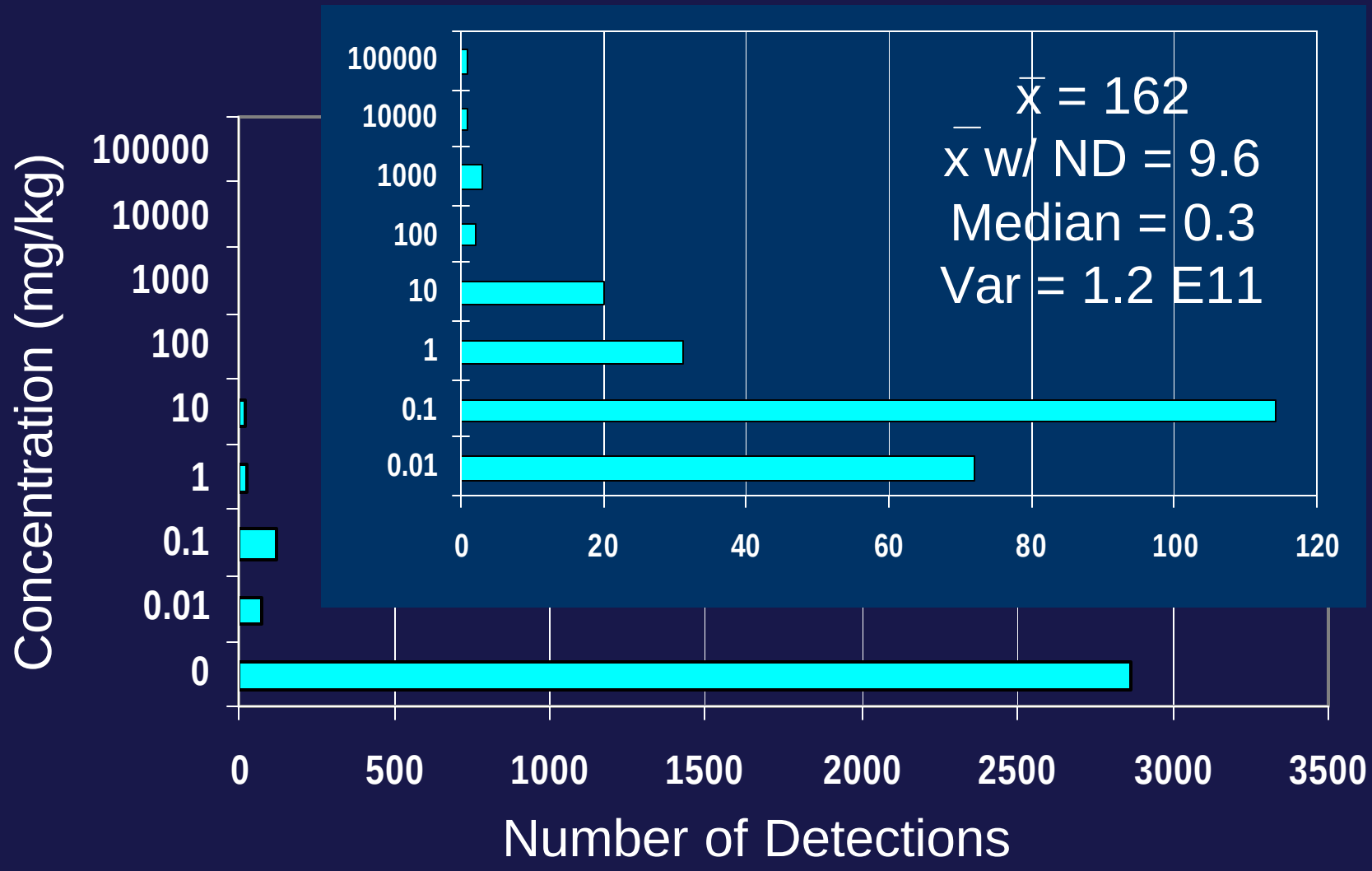
False Negatives 3%

False Positives 29%

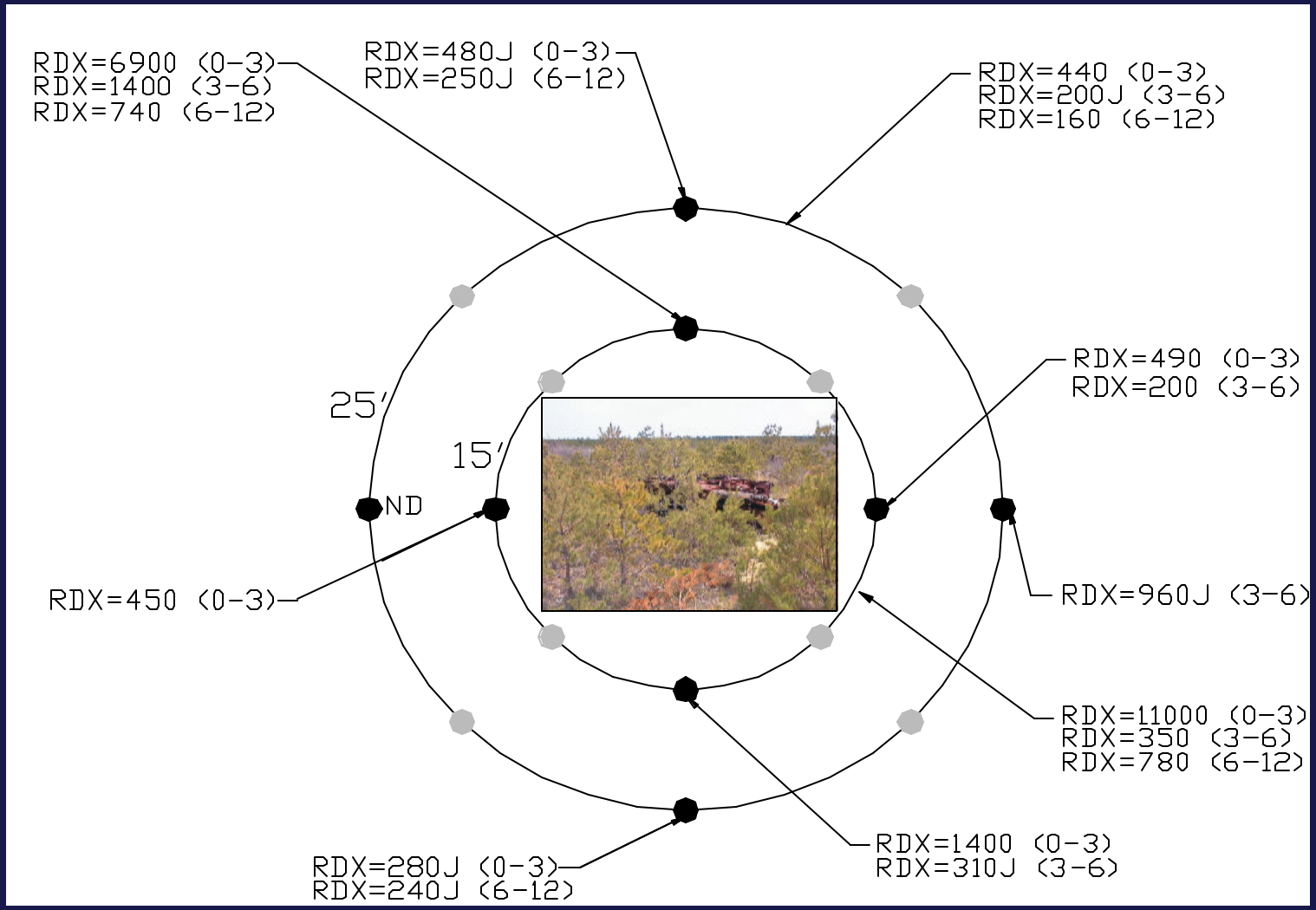
Soil Sampling

- Explosives on ranges and propellants at firing positions are very heterogeneously distributed
- Composite soil sampling is necessary to determine mass of contaminants present
- Discrete samples are inappropriate (maximum concentrations)
- Sample homogenization in the field and lab is a must
- Soil sampling is not useful for finding source release “hotspots” on ranges, i.e # of samples

MEC Heterogeneity Issue

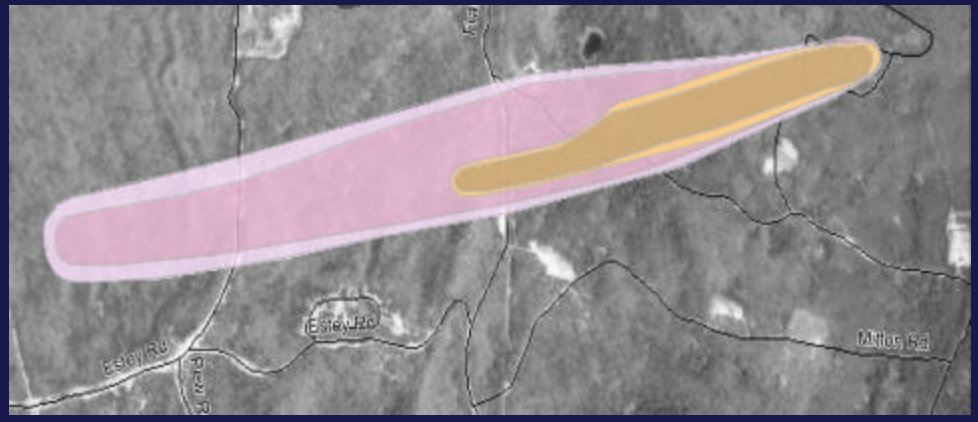


RDX Soil Distribution @ T42

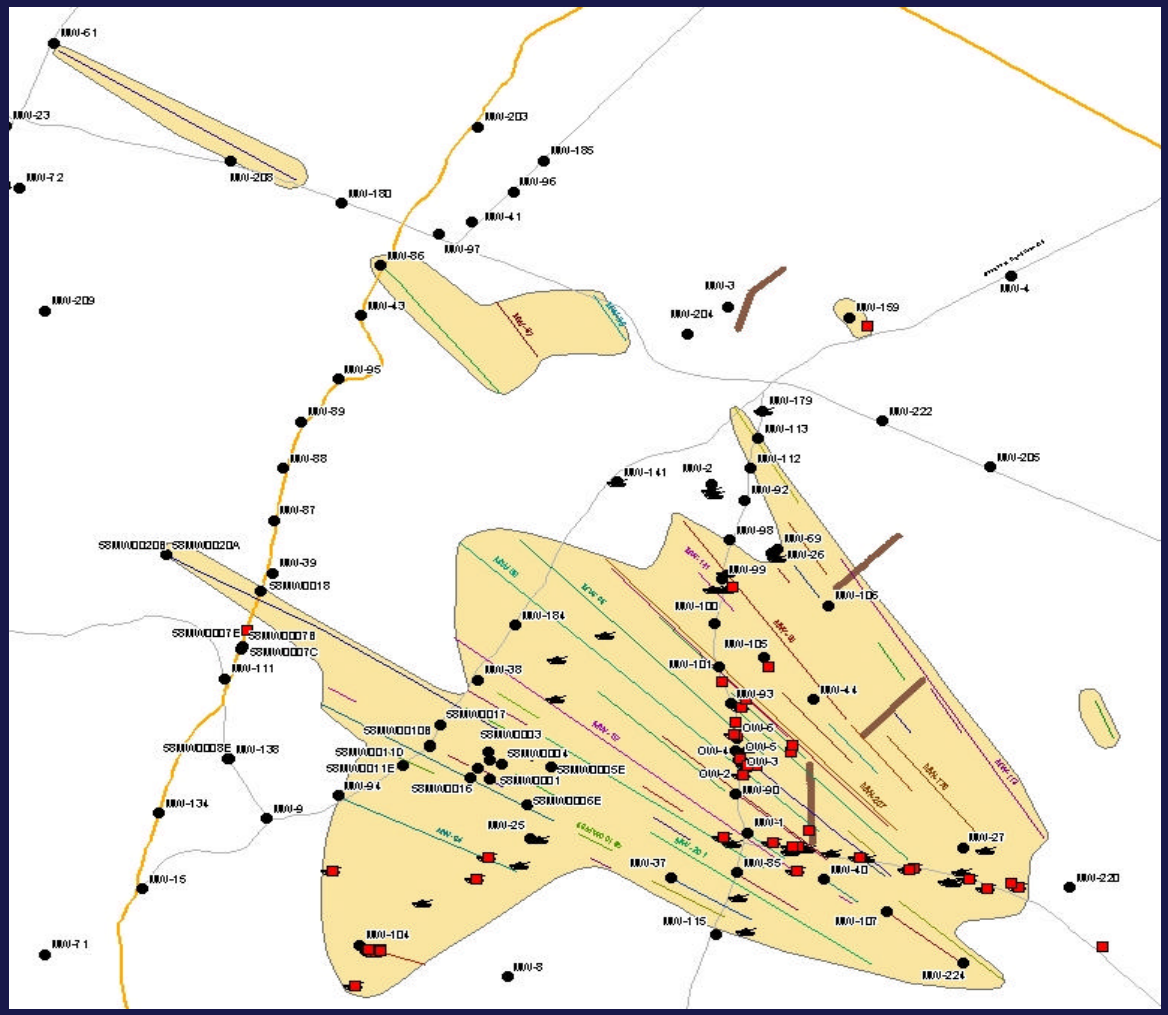


Groundwater Sampling

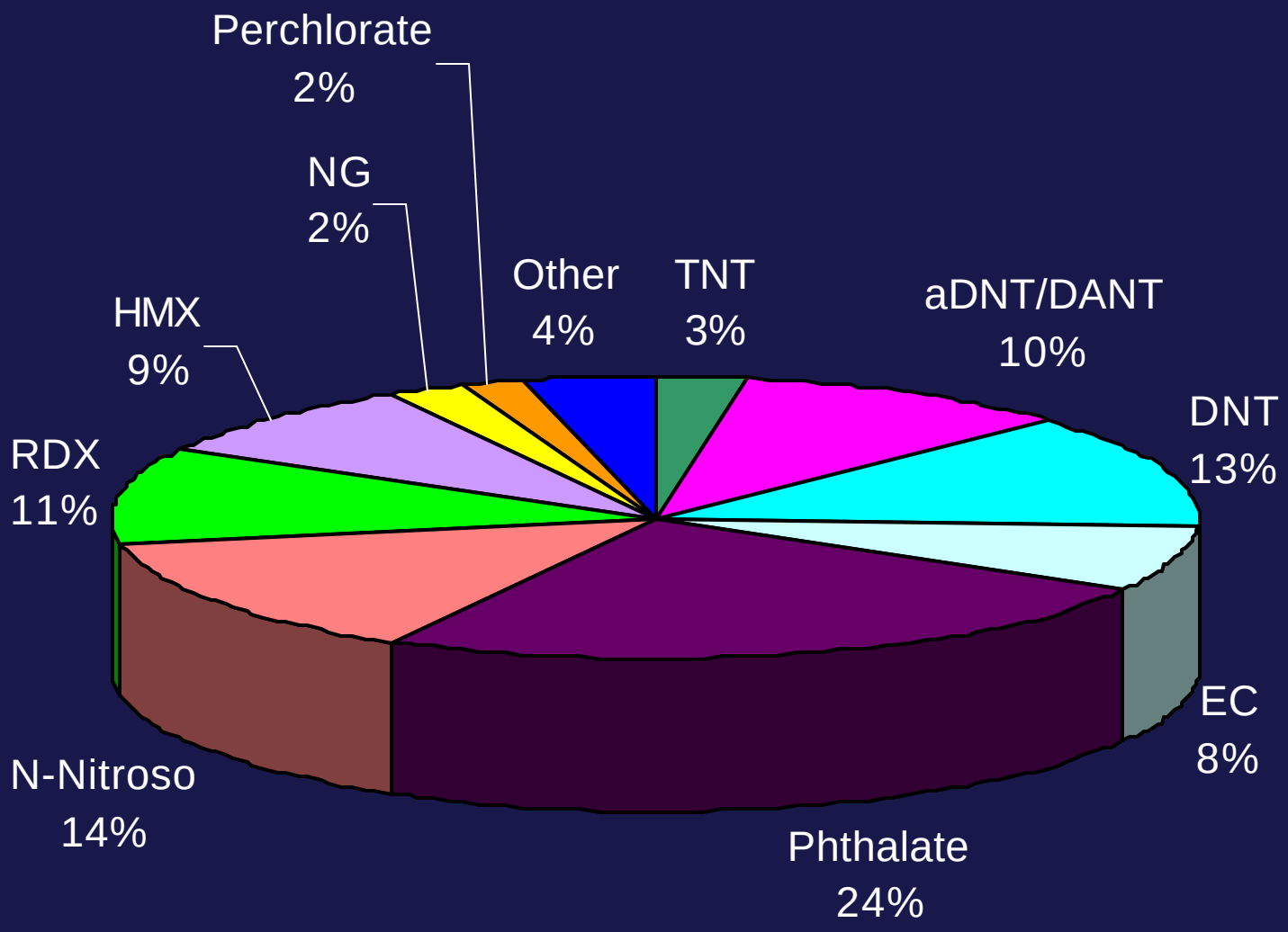
- Ideal way for determining the release point of contaminants on ranges
- Some drilling greases and turbidity produce interferents with Method 8330
- Low flow sampling is important to reduce turbidity, especially for metals



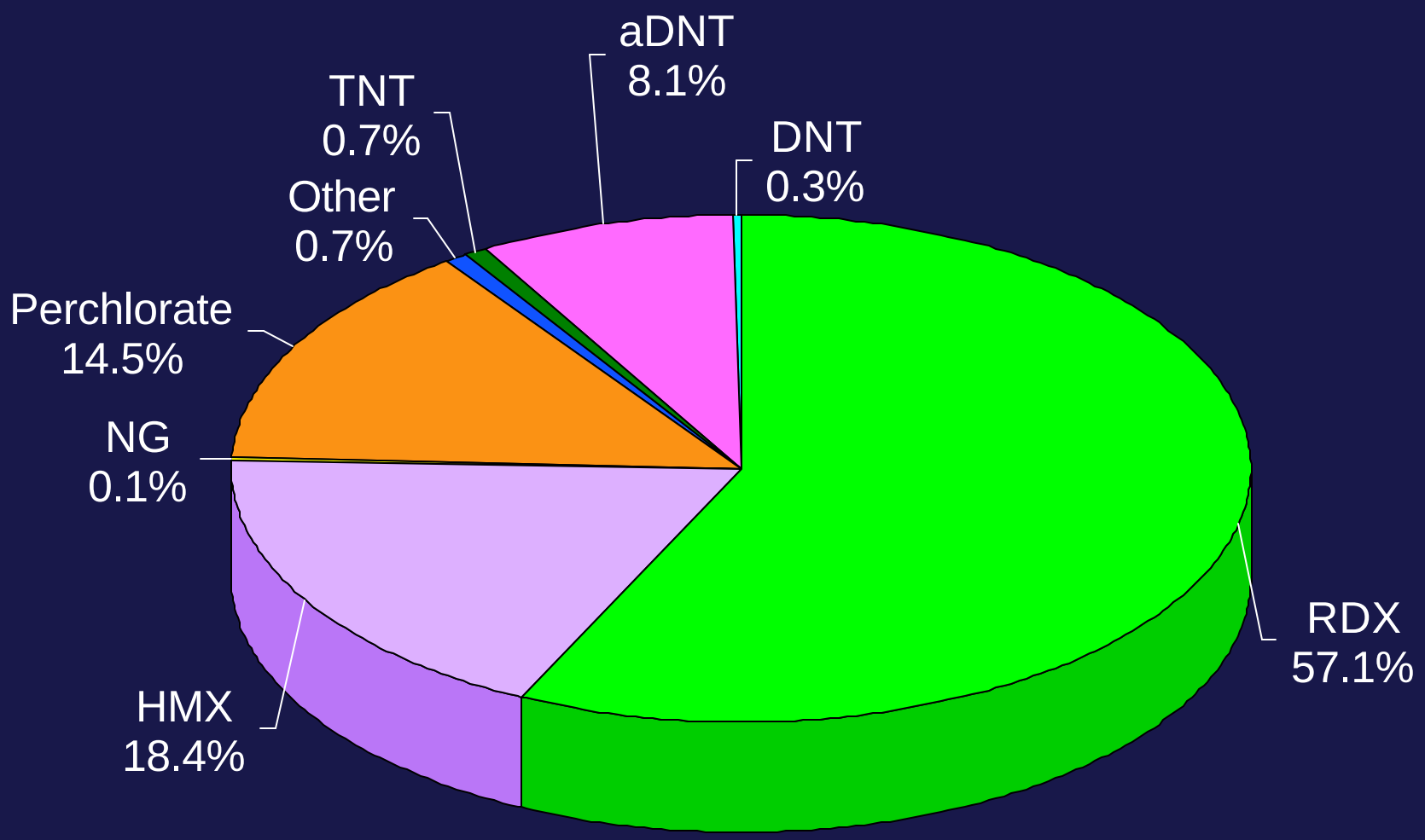
Probable RDX Source Area(s)



MEC Distribution In Soil



MEC Distribution in Groundwater



MEC Distribution by Range Activity

Range Activity	MEC Anticipated
Artillery/Mortar Impact Area	RDX, HMX, TNT, 2a-DNT, 4a-DNT, perchlorate
Artillery/Mortar Firing Position	2,4-DNT, 2-6DNT, NC, diethyl phthalate, di-n-octyl phthalate, N-nitrosodiphenylamine
Rocket Target	RDX, HMX, TNT, NG
Rocket Firing Point	NG, NC, EC
Demolition Area	Explosives, metals, PAHs, perchlorate, PCNs, dioxins
Weapons Test Ranges	Explosives, perchlorate, PCNs, dioxins