TestAmerica

THE LEADER IN ENVIRONMENTAL TESTING

Better Site Characterization Through Incremental Sampling Methodology – Status Report on ITRC Guidance

Mark Bruce

©2011, TestAmerica Laboratories, Inc. All rights reserved.
TestAmerica & Design ™ are trademarks of TestAmerica Laboratories, Inc.

January 19, 2011

Chasing Uncertainty Sources

- Instrumental analysis

- Sample preparation

- Laboratory sub-sampling

- Field sample collection

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

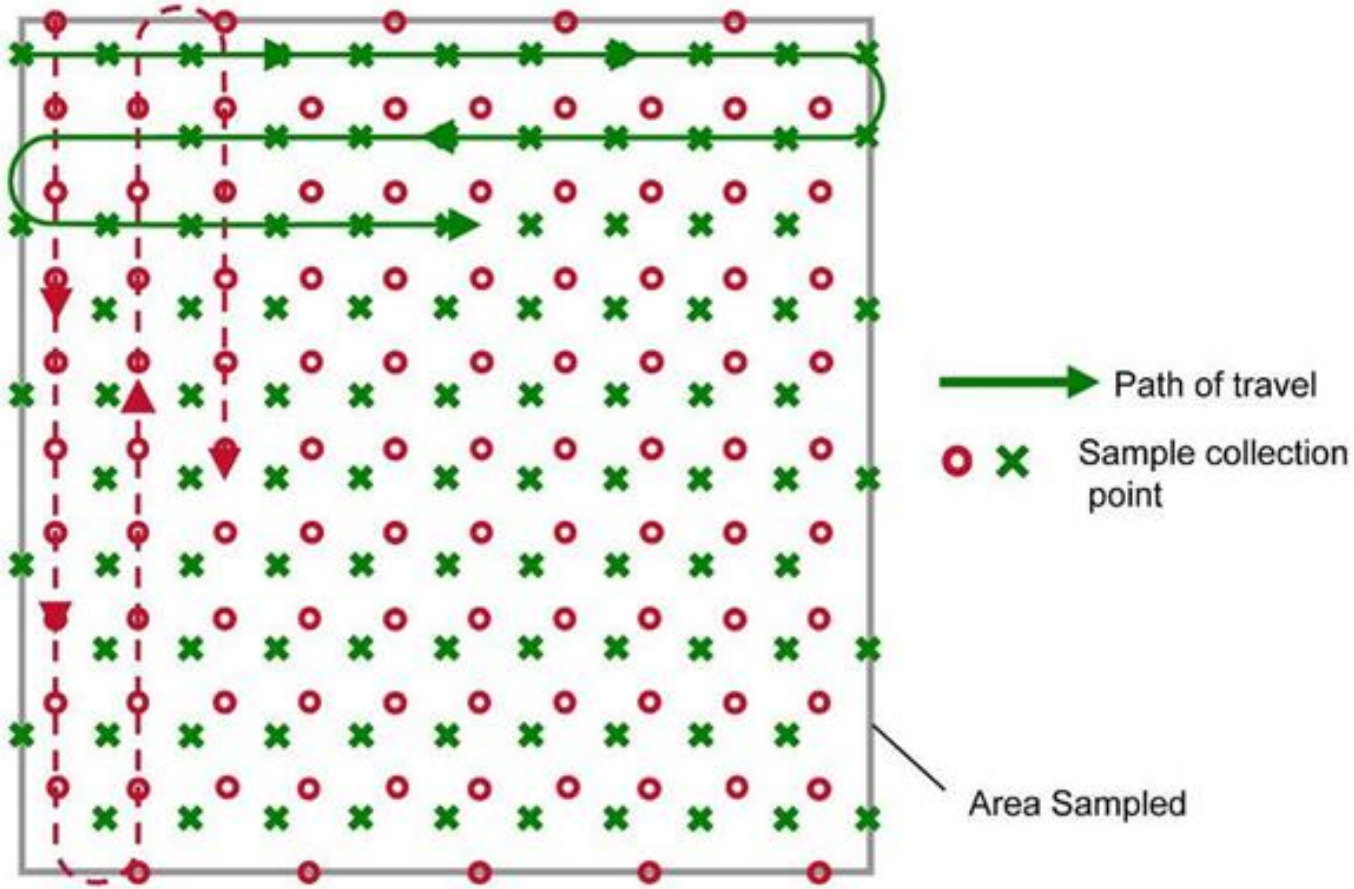
Does the decision unit fit in the sample jar?

Representative subsampling

Incremental Sampling

- Systematic Random Design

Random starting locations in first grid



ITRC Developing Guidance

- **Incremental Sampling Methodology Team**
  - ~ www.itrcweb.org/teampublic_MIS.asp
  - ~ Formed Jan. 2009

Disclaimer: Most of the material in this presentation has been derived from the Dec. 2010 draft guidance developed by the ITRC ISM team. ITRC does not endorse the use of specific vendors or technologies. This presentation is not official ITRC sanctioned training material. It has been reviewed by ITRC for compliance with the ITRC usage policy.

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

ISM Guidance

INTERSTATE TECHNOLOGY & REGULATORY COUNCIL
Advancing Environmental Solutions

- Introduction
- ISM Principles
- Systematic Planning
- Statistical ISM Design
- Sample Collection
- Laboratory Analysis
- Data Assessment
- Regulatory Concerns
- Case Studies

ISM Principles

- The Concept of Representativeness
- Mean Concentration as Parameter of Interest
- Nature of Soil & Interaction with Contaminants
- Small & Large Scale Heterogeneity
- Sampling Errors & Data Variability
- Pierre Gy Sampling Theory
- Sampling Approaches (Discrete, Composite, Incremental)

ISM Principles

Nature of Soil
&
Interaction of Contaminants With Soil

Results In

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

ISM Principles

Heterogeneity

Sampling w/o addressing leads to

ISM Principles

Sampling Errors

Manifested (observed) in

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

ISM Principles

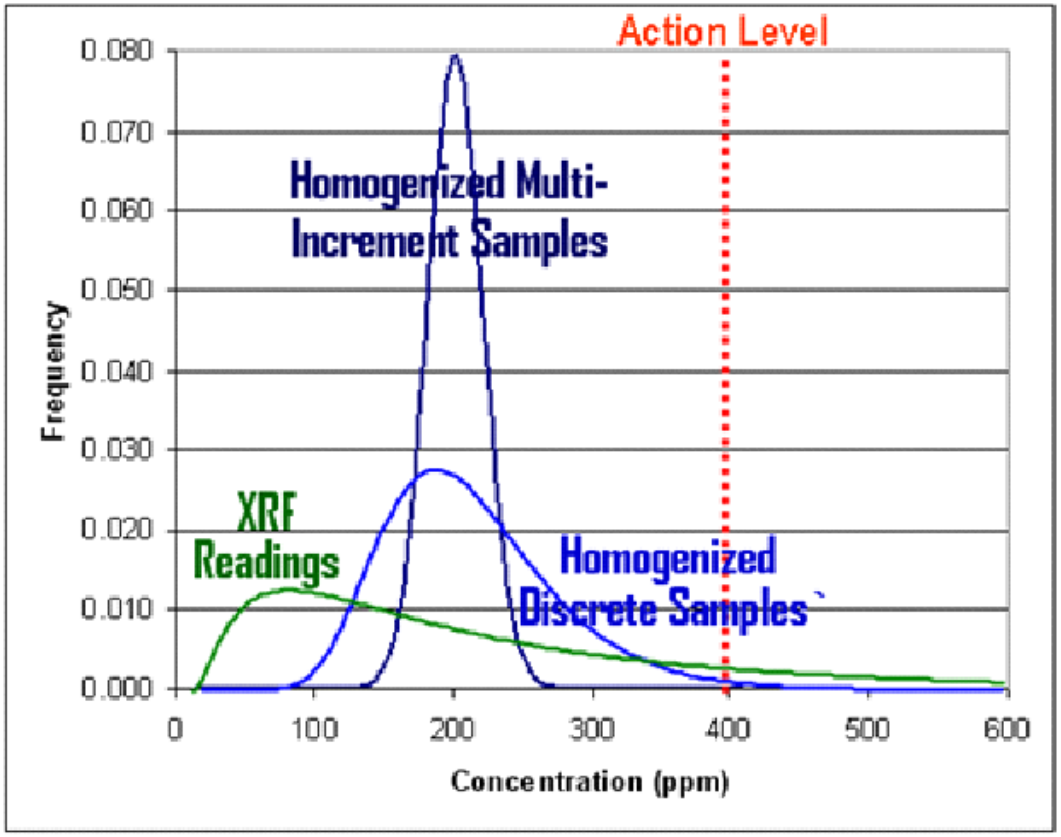
Data Variability

which can lead to

Decision Errors

ISM Principles

- Sample size affects the data distribution

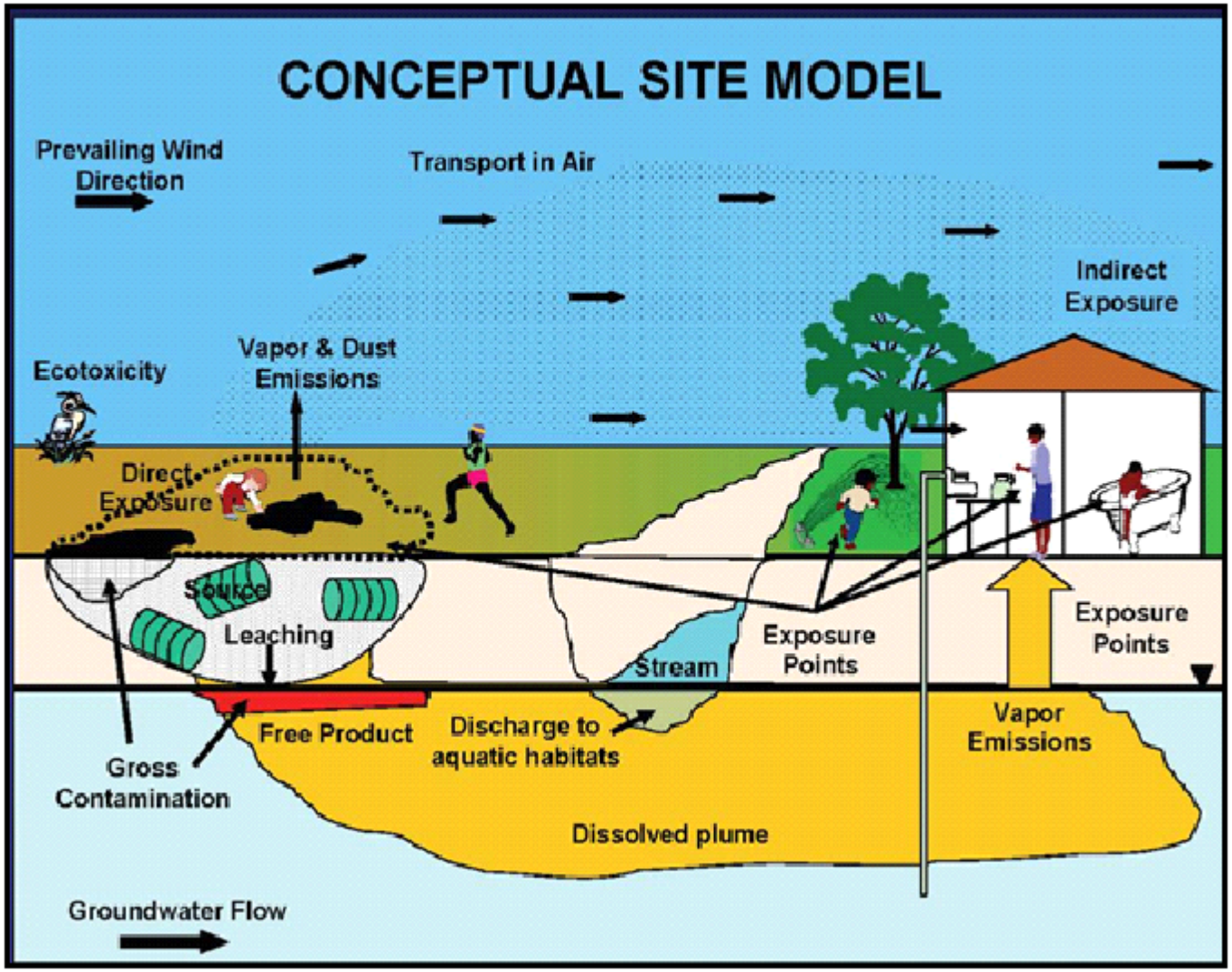


Uranium results , Argonne National Laboratory, Robert Johnson

Systematic Planning Approach

- State the Problem: Draft a Conceptual Site Model (CSM)
- Identify the Objectives & Chemicals of Potential Concern
- Identify Data Information Needs
- Define Decision Units (DU)
- Develop Decision Statement(s)
- Develop & Implement the Sampling & Analysis Plan
- Assess Data Quality
- Identify Potential Environmental Hazards
- Refine the CSM & Recommend Further Actions

Systematic Planning Approach



Statistical ISM Design

- Estimating the Mean Concentration
- Calculating Upper Confidence Limits on the Mean
- Evaluating the Performance of Sampling Approaches
- Areas for Further Study
  - ~ Combining Decision Units
  - ~ Extrapolating from Decision Units
  - ~ Comparing Decision Units
  - ~ Site-to-site comparisons
  - ~ Site to background comparisons
  - ~ Oversized Decision Units

Field Sample Collection

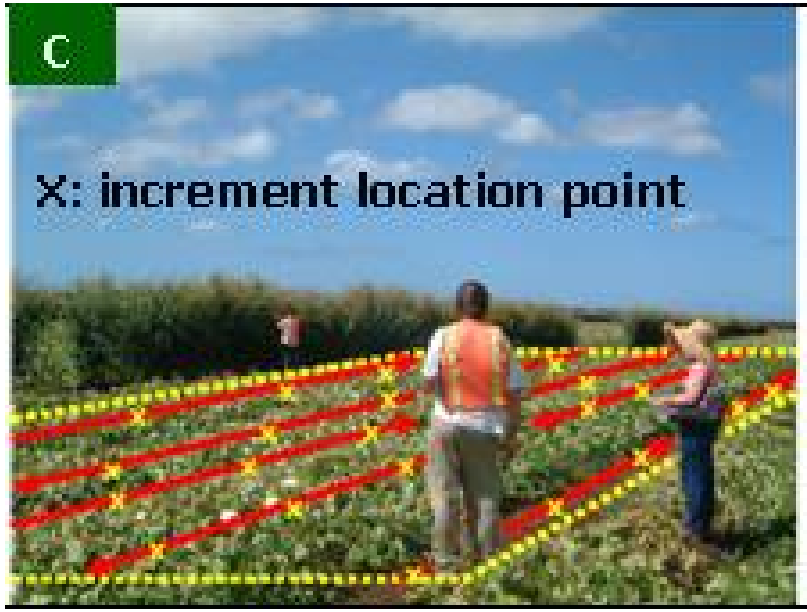
- Sampling Tools
- Surface Samples
- Subsurface Samples
- Stockpile Samples
- Replicate Samples
- Volatile Organic Compound Sampling
- Field Processing Options

Field Sample Collection

- Sampling Tools

Field Sample Collection

- Surface Samples



Field Sample Collection

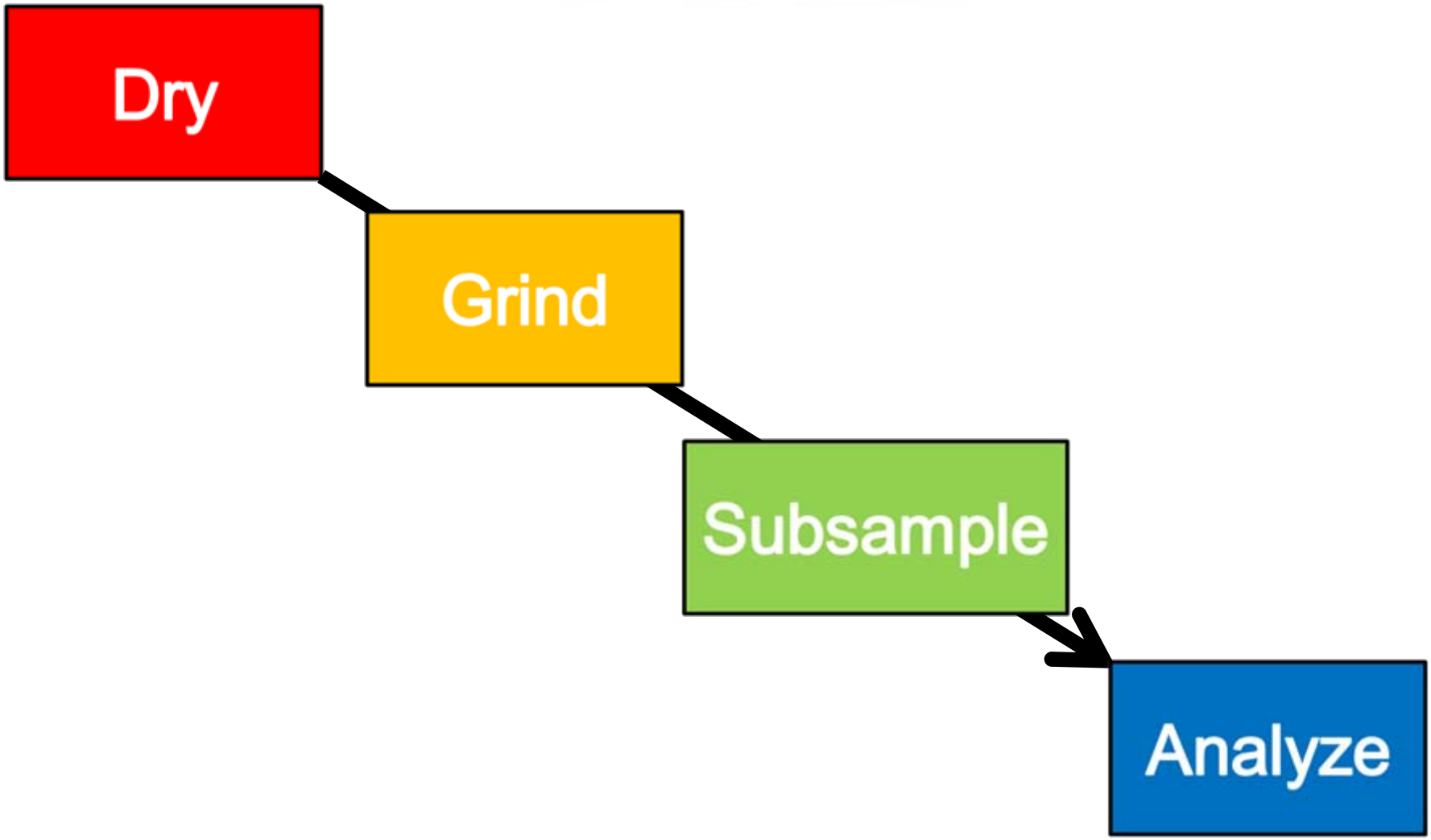
- Volatile Organic Compound Sampling

Laboratory Processing & Analysis

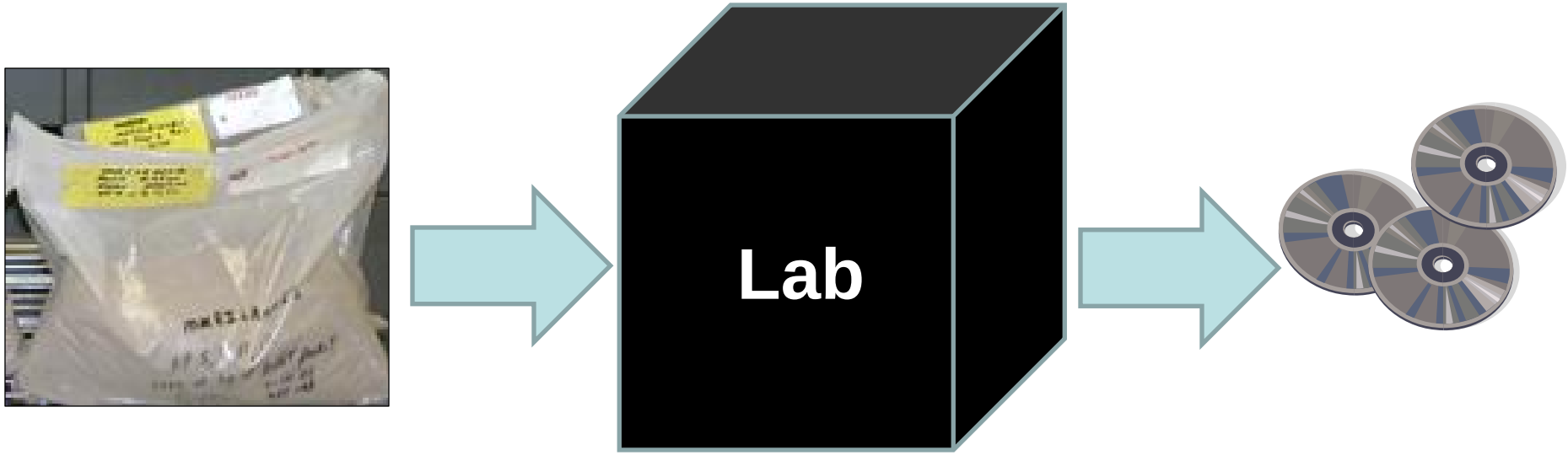
- Optimum Processes for various analyte groups
- Sample Splitting
- Sample Conditioning (dry & disaggregate)
- Particle Size Reduction (milling)
- Particle Size Selection (sieving)
- Analytical Subsampling
- Analytical Method Modifications for ISM Subsamples
- Quality Control Procedures

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

No Universal Lab Sample Processing



Include Lab Processing in Project Planning



Sample Conditioning

- Air drying
  - ~ Room temperature - most common
  - ~ Ventilation hood
  - ~ Consider volatilization losses
    - ° Boiling point
    - ° Binding to soil particles (lower conc. > higher binding > lower losses)
    - ° Loss risk table
      - – naphthalene
      - – 2-methylnaphthalene
      - – acenaphthene
      - – dibenzofuran
    - ° Loss risk test
  - ~ Goal: Crushable agglomerates

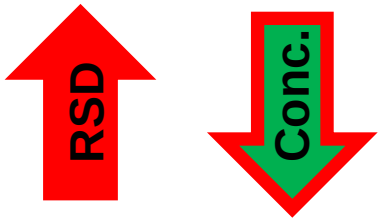
R&D

Defining Terms

- Grinding:
  - Generic term for soil disaggregation or milling. The grinding type or equipment must be specified to select a particular laboratory process.

Defining Terms

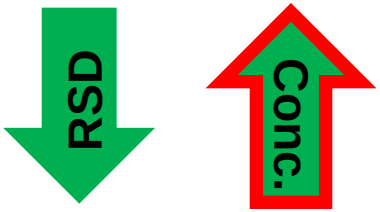
- Disaggregating:
  - ~ Breaking the soil clumps into individual small particles, but keeping the small pebbles and hard crystalline particles intact.



Defining Terms

- Milling:
  - ~ Complete particle size reduction of all soil components including hard crystalline materials to a defined maximum particle size (e.g. < 250 um or < 75 um).

Picture from USACE-Alan Hewitt



Sub-sampling Options

- 2-Dimensional Japanese Slabcake

Dry

Wet

Data Assessment

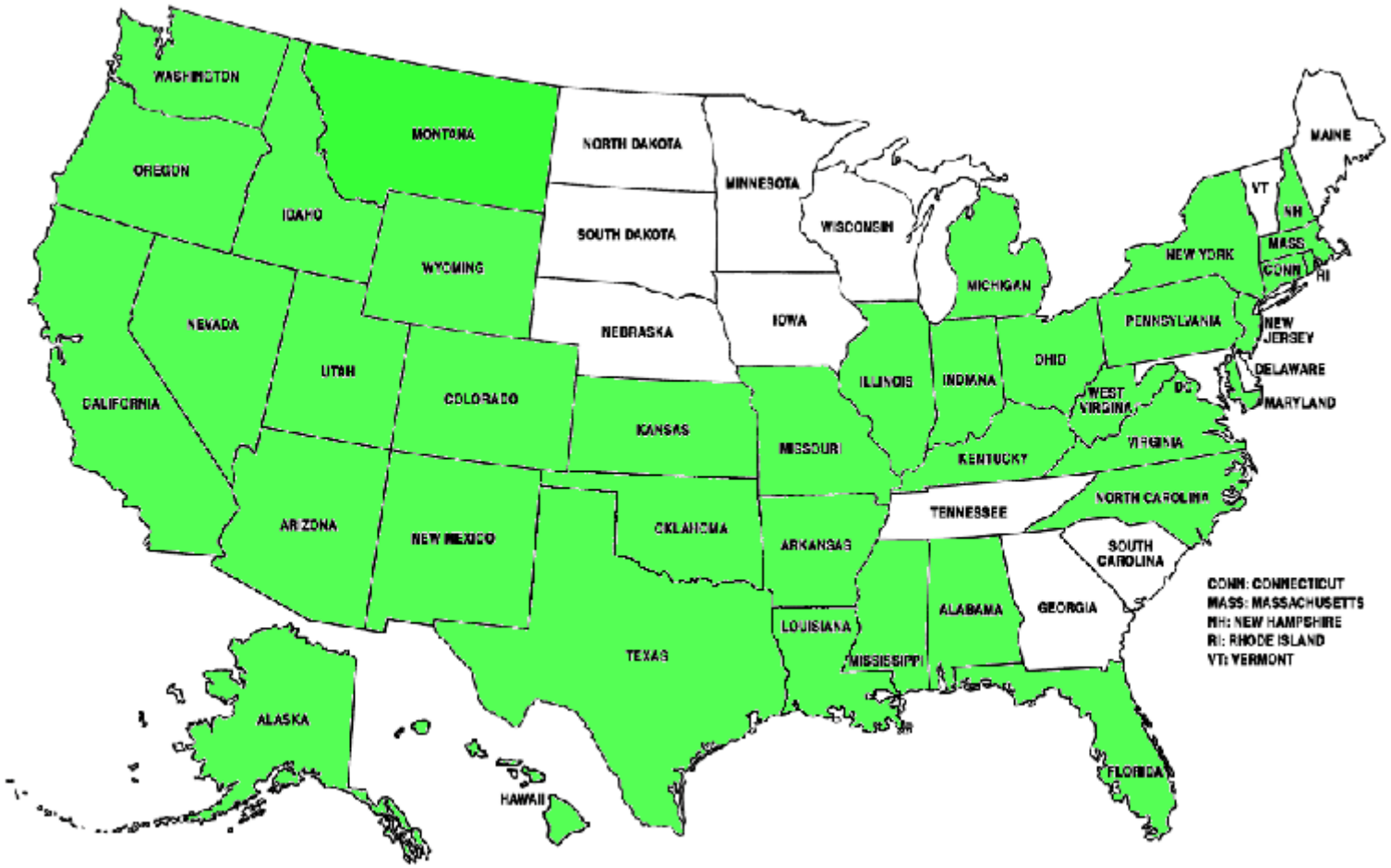
- Decision Mechanism Options
  - Conceptual site model
  - Project goals
  - Scale of the decision
  - Requirements for precision, total error and decision quality
  - Assumptions of the statistical method(s)
  - Anticipated degree of variability within the DU.

Regulatory Concerns

- Regulatory Hurdles
- Implementation Issues
- State of Knowledge, Experience and Training
- Perception Issues

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

States with Incremental Sampling Projects



Use of ISM does not constitute state regulatory acceptance. Results based on ITRC ISM survey 2009

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

Case Studies

- PCB Contaminated Landfill
- TCE Vadose Zone Investigations
- Petroleum Contaminated Soil Stockpile
- Uranium Enrichment Facility

Site Specific Lessons Learned from Case Studies

- 60 – 90 increment samples needed to ensure incorporation of isolated hot spots
- Discrete sampling missed two layers where TCE > 1%
- Stockpile was compacted & difficult to use hand tools
- Hot spot detection improved from 50% to 85% probability
- Reduced overall analytical costs significantly

Guidance Document Projected Schedule

- Final team review – Jan. 24, 2011
- Full ITRC (non-DoD) review – Mar. 17, 2011
  - OH EPA Point of Contact – Tom Schneider
- DoD review – May 1, 2011
- Final to ITRC communications – Oct. 2011
- Web based guidance posted – Nov. 2011

Internet Based Training Projected Schedule

- Train the trainers – May 1, 2011
- Develop & Practice training – Jun. to Aug. 2011
- ITRC review of training – Fall, 2011
- Public internet based training – Q1 to Q2 2012
- Classroom training – interest??
  - Two day, hands on field demonstration

Acknowledgements

- Alan Hewitt, Tom Jenkins, Marianne Walsh

- Ligia Mora-Applegate
  Mark Malinowski
  Michael Stroh
  Kelly Black

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

Contact Information

Mark L. Bruce Ph.D.
Technical Director

TestAmerica
4101 Shuffel St. NW
North Canton, OH 44720
Tel: 330-966-7267
Email: mark.bruce@testamericainc.com
www.testamericainc.com