



2003 AFCEE Technology Transfer Workshop

San Antonio, Texas

Promoting Readiness through Environmental Stewardship

Practical Use of Risk Assessment Results

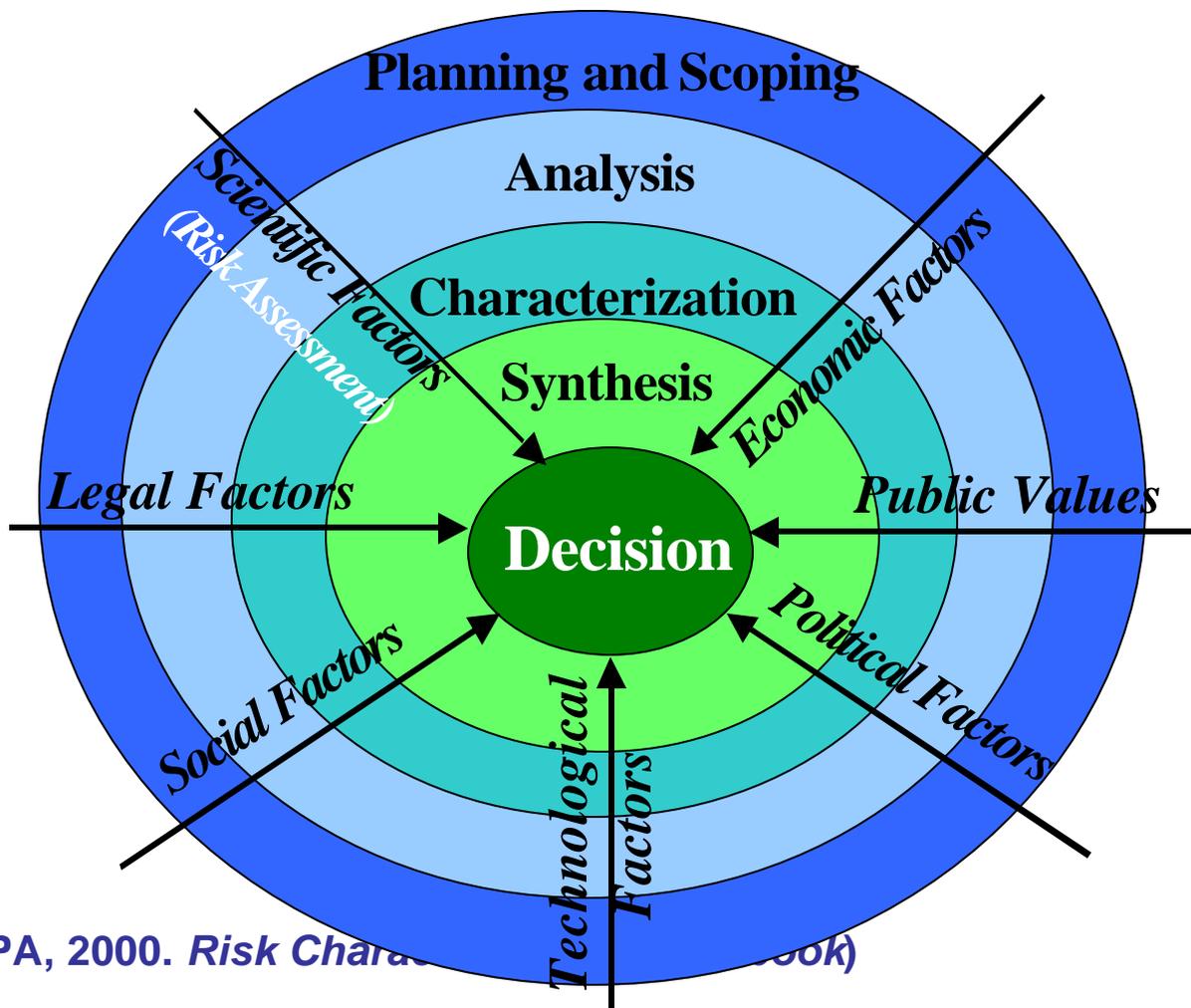
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MWH Global

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The Components of Risk-Based Decision Making (RBDM)



(From: USEPA, 2000. *Risk Characterization Handbook*)



Practical Uses: Forward Risk Assessments

- **Concentration** ® **Exposure** x **Toxicity** = **Risk**
- **Human Health**
- **Ecological**
- **Types of Quantitative Risk Assessments:**
 - ◆ Prospective or Retrospective
 - ◆ Deterministic
 - ◆ Probabilistic (one- and two-dimensional)
 - ◆ Screening -- Default, Prescriptive
 - ◆ Refined -- Site-specific, Customized, Focused



Practical Uses: Reverse Risk Assessments

- **Target Risk** , **Toxicity** = **Exposure** ® **Concentration**
- **Example Regulatory Standards:**
 - ◆ **Water:** MCLs, HAs, AWQCs
 - ◆ **Air:** NAAQS, EIs
 - ◆ **Soil:** PRGs
 - ◆ **Workplace:** OSHA Standards, NIOSH Standards, ACGIH Standards
- **Example Site/Facility/Product-Specific Concentrations:**
 - ◆ **Media-specific:** RBCLs, SSLs
 - ◆ **Facility-specific:** Permissible Emission Levels
 - ◆ **Product-specific:** RBCs (Ex. Fertilizers), Pesticide Tolerance Levels, NSRLs (Prop 65)



Keys to Maximizing the Benefits of Risk Assessment Results

- Follow the RBDM paradigm
- Begin with the end in mind:
 - ◆ Initial planning, establish objectives, involve stakeholders
- Apply the iterative risk assessment process:
 - ◆ Screening, deterministic, probabilistic
- Effectively use “best” science and available tools:
 - ◆ Be proactive, don't be afraid to venture outside the box
- When negotiating with agencies, be prepared



Case Example: Residential Development on Contaminated Land

■ Property Features:

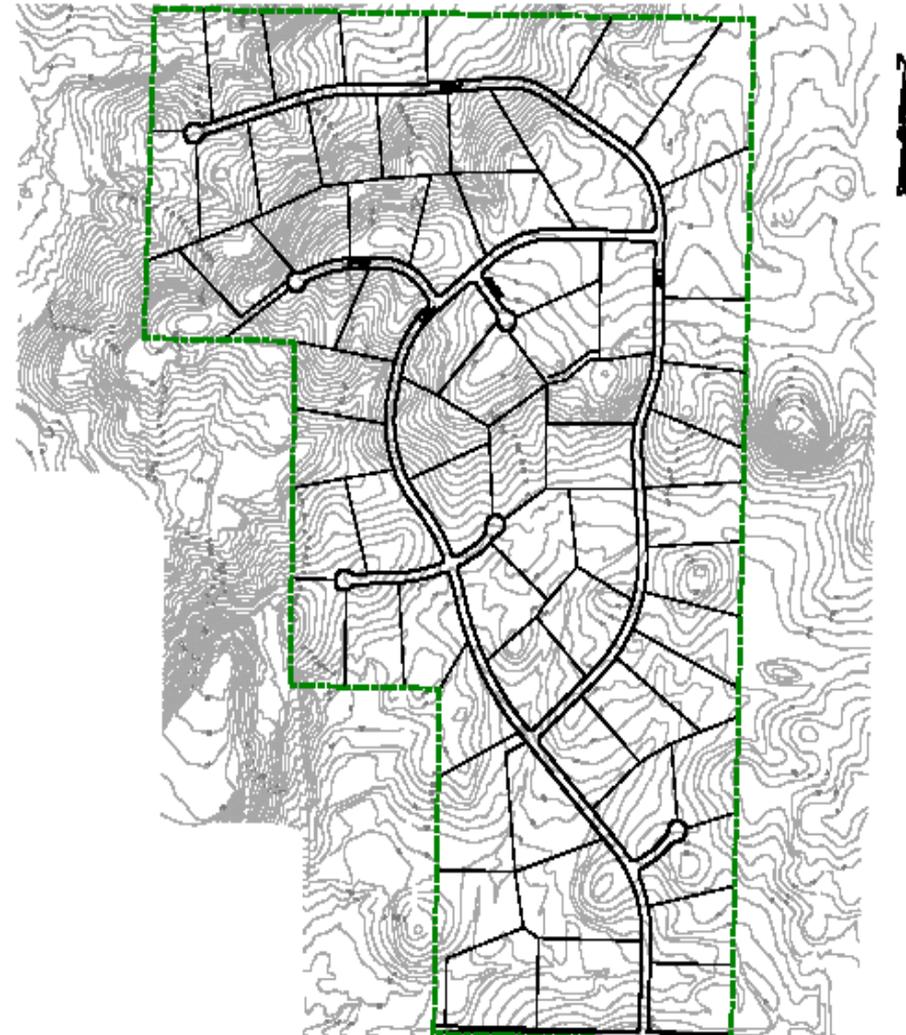
- 180 acres
- former orchard (1930s-1980s)
- Pesticides - organochlorines, arsenicals
- Property has high value

■ Development Plan:

- 65 lots
- Rural residential

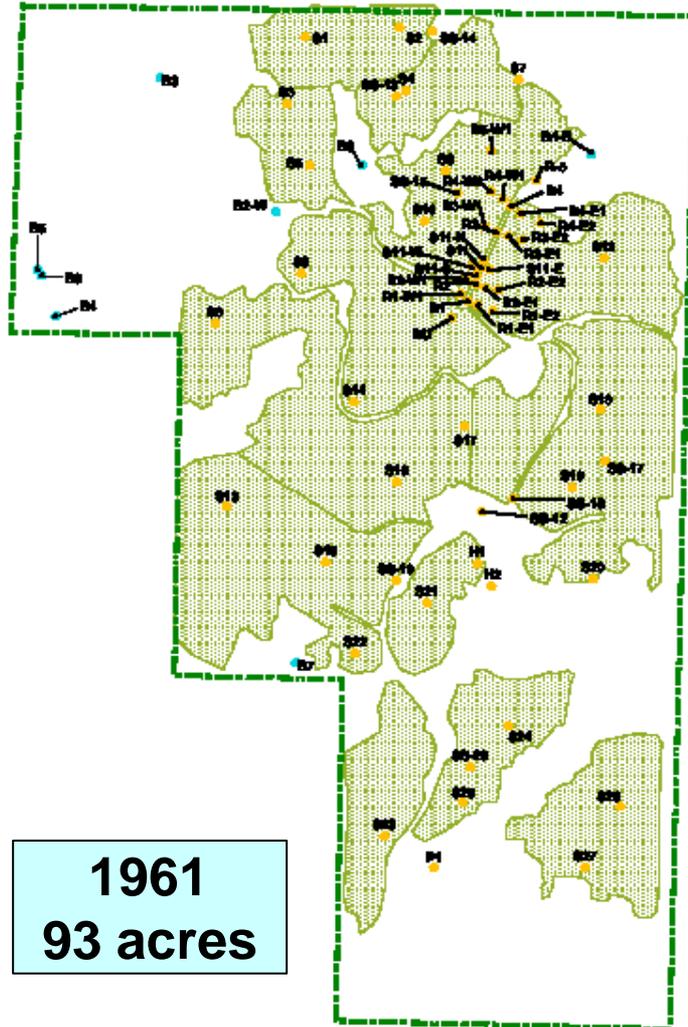
■ Regulatory Status:

- County unwilling to be RM
- Entered State Voluntary Cleanup Program

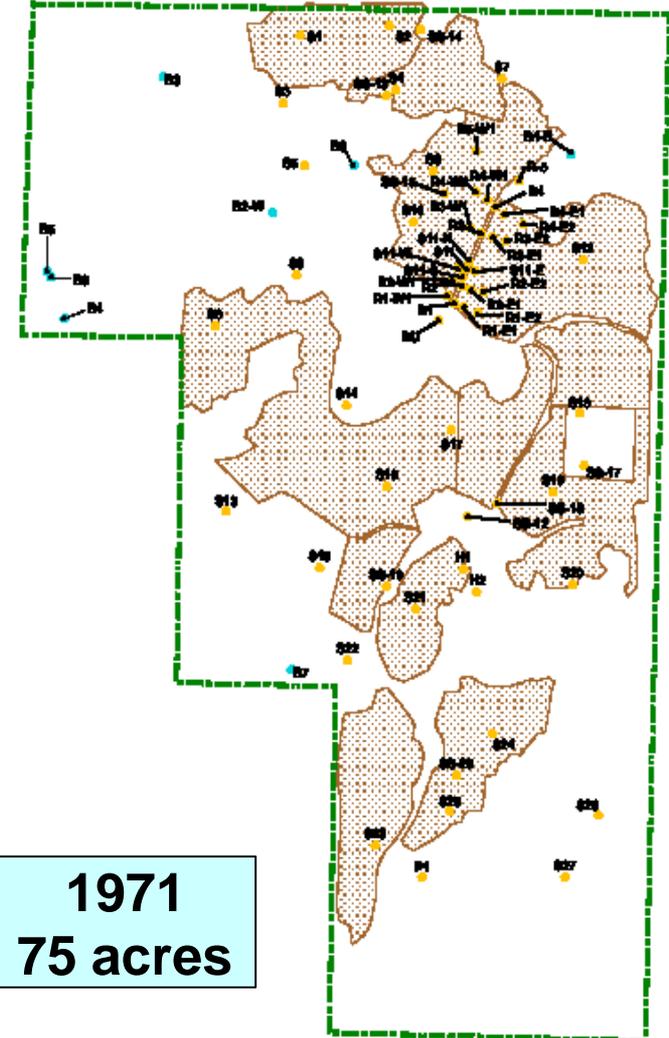




Agricultural Areas



1961
93 acres



1971
75 acres



Keys to Success

- **Result:** integration of essential tools and strategies identified cost-effective cleanup approach
- **Strategies:**
 - Redevelopment plan developed first
 - Risk-based approach determined from the get-go
 - Sampling plan developed to support risk assessment
 - Early stakeholder interaction
- **Essential tools:**
 - Toxicology (arsenic)
 - Geostatistics (GIS platform)
 - Tiered risk assessment
 - Strategic study (bioavailability)



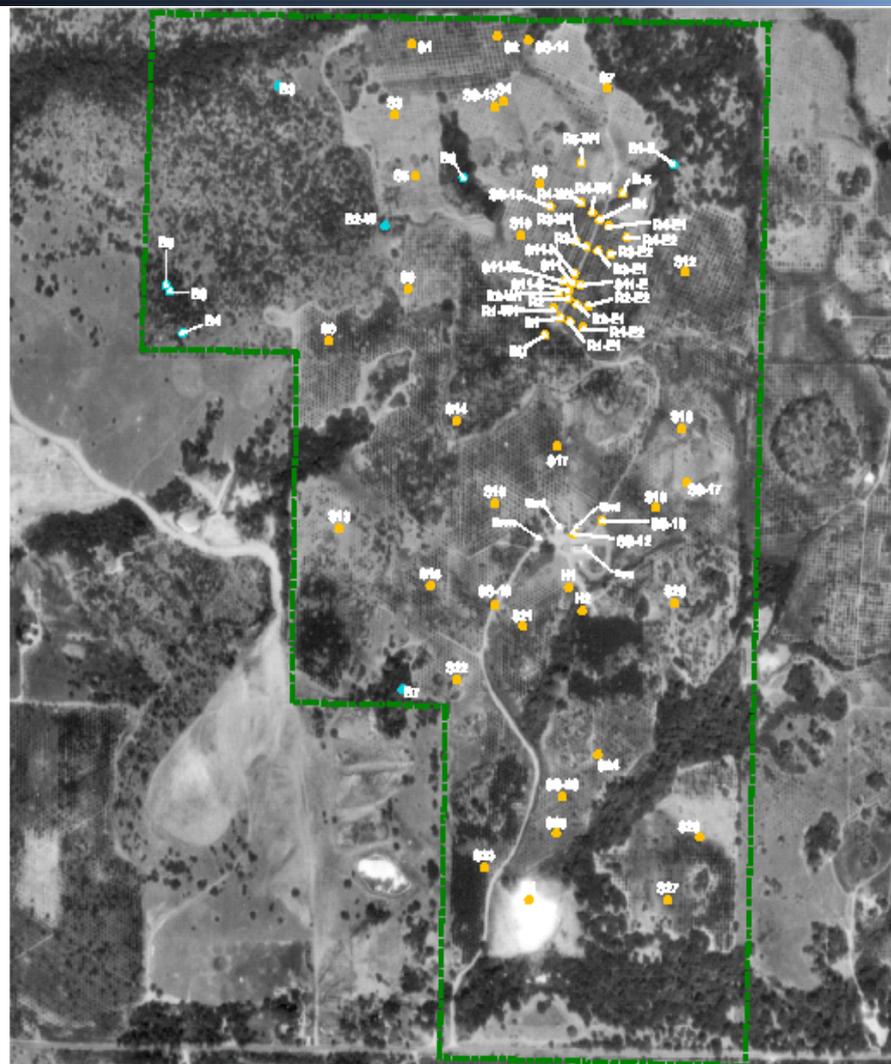
Site Characterization

■ Soil:

- Phased sampling approach
- orchard area: 88 soil samples taken - mostly surface -
- non-orchard: 7 background samples

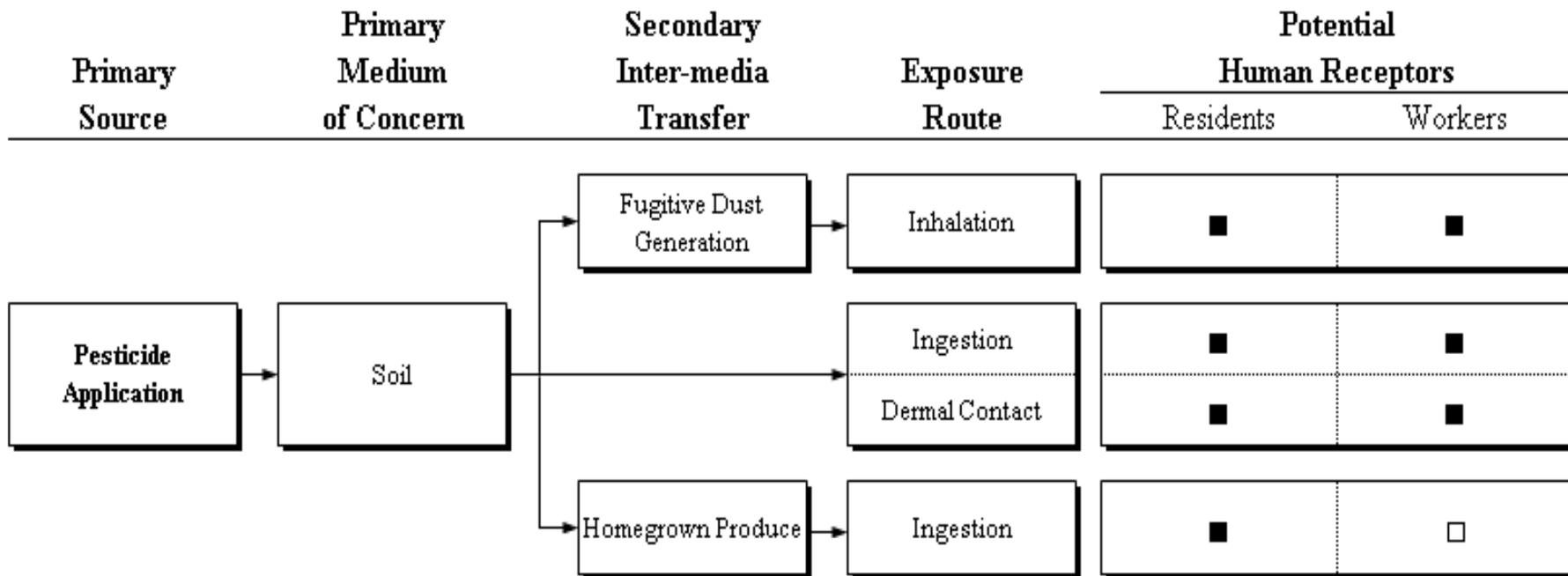
■ Findings:

- **Three areas:** Orchard, non-orchard, filling area
- **COPCs:** OC pesticides, lead, arsenic
- **Arsenic:** ND - 124 ppm
- **Background:** ~20 ppm As
- **Bioavailability:** As, Pb in soil





Conceptual Site Model



■ Complete exposure pathway.

□ Incomplete or insignificant exposure pathway.



Summary of Tier 1 (Screening) Risk Assessment

Receptor	Surface Soils		
	Non-Cancer Hazard Index	Theoretical Cancer Risks	Blood Lead Level (ug/dL)
Child Resident	7.9	3 E-4	15.4
Age-Adjusted Resident	2.9	5 E-4	6.3
Construction Worker	2.9	2 E-5	3.9



Summary of Tier 2 (Deterministic) Results

Receptor	Orchard Area (Area 1)		
	Theoretical Cancer Risks	Non-Cancer Hazard Index	Blood Lead ($\mu\text{g}/\text{dL}$)
Construction Worker	1 E-6	0.20	3.9
Child Resident Age-Adjusted Resident	9 E-5	0.90	5.1
	1 E-4	0.51	6.3
Remote Filling Area (Area 2)			
Construction Worker	7 E-6	1.0	3.9
Child Resident Age-Adjusted Resident	3 E-4	3.1	9.8
	3 E-4	1.7	6.3



Summary of Tier 3 (Probabilistic) Results

Receptor	Remote Filling Area Soils					
	ILCR			Non-Cancer Hazard Index		
	50 th	90 th	95 th	50 th	90 th	95 th
Child Resident	3 E-6	1 E-5	2 E-5	0.30	1.1	1.9
Age-Adjusted Resident	5 E-6	2 E-5	5 E-5	0.18	0.80	1.5
Receptor	Orchard Area Soils					
	ILCR			Non-Cancer Hazard Index		
	50 th	90 th	95 th	50 th	90 th	95 th
Child Resident	5 E-7	2 E-6	4 E-6	0.084	0.35	0.58
Age-Adjusted Resident	1 E-6	7 E-6	1 E-5	0.052	0.24	0.48



Risk-Based Cleanup Levels: Options

Method	Remote Filling Area 95% UCL (mg/kg)	Resident Adult ILCR	Resident Child HI	Cancer Soil Target Range ^a		Non-Cancer Soil Target ^b
Tier 1 Deterministic	124.0 (max)	3 E-4	6.9	0.41	41	18
Tier 2 Deterministic	65.4	3 E-4	3.0	0.22	22	22
Tier 3 50 th Percentile	65.4	4 E-6	0.3	16	1,600	230
Tier 3 90 th Percentile	65.4	2 E-5	1.1	2.8	280	61
Tier 3 95 th Percentile	65.4	4 E-5	1.8	1.5	150	36
Tier 3 99 th Percentile	65.4	2 E-4	4.9	0.4	40	13

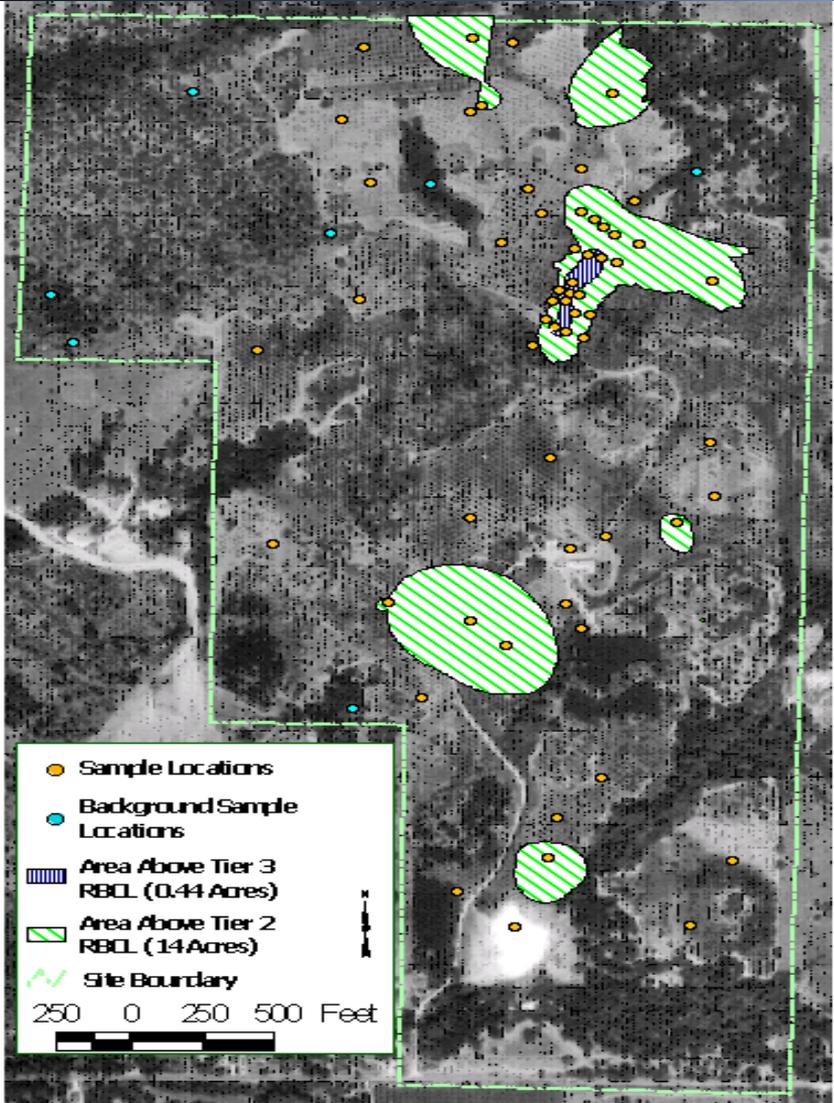
^aTarget Cancer Risk Range is 1×10^{-6} to 1×10^{-4}

^bTarget HI is 1.0



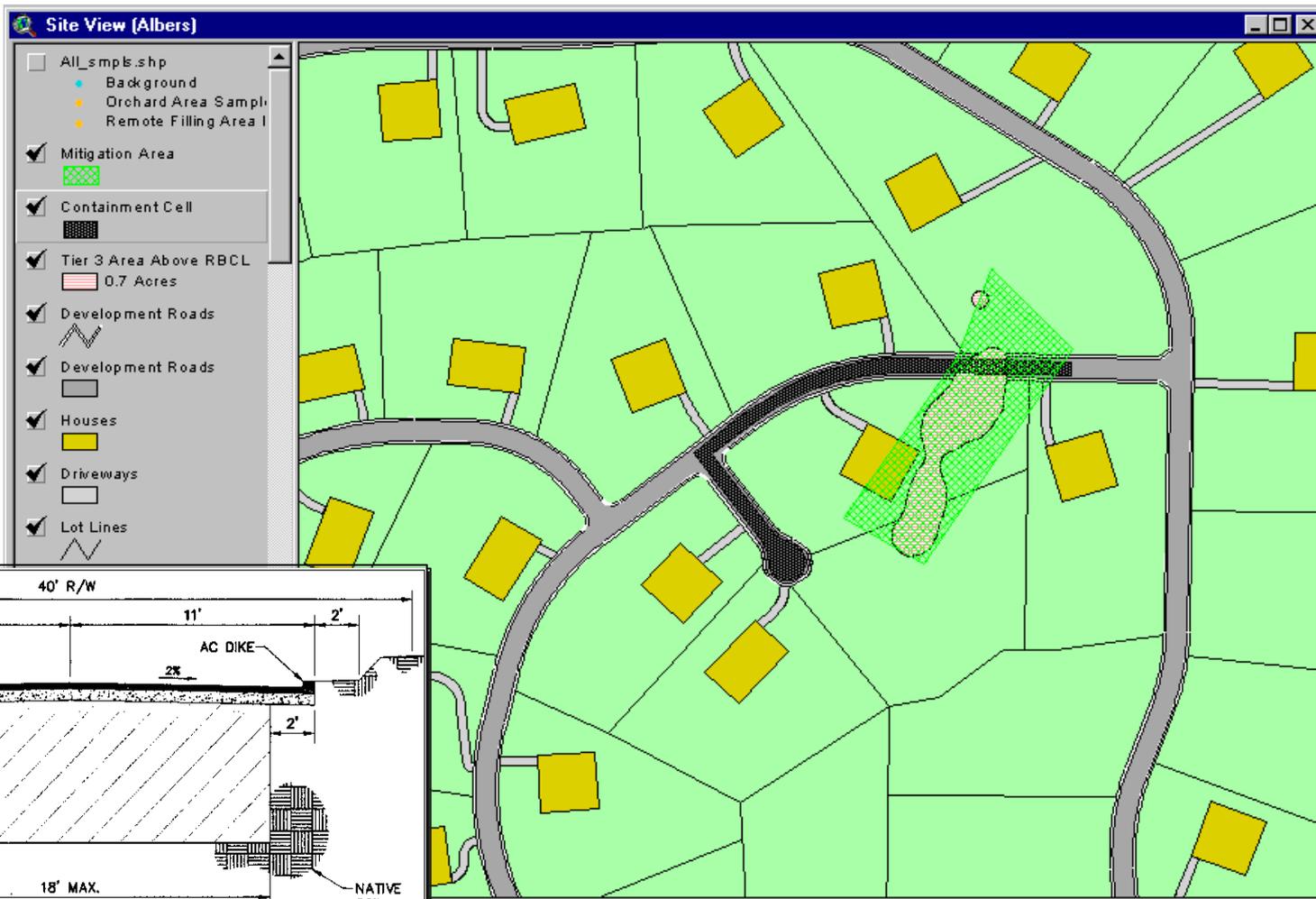
Tier 2 vs Tier 3

- **Results:**
 - Remediation area reduced ~97%
 - Significant cost savings
 - Stakeholder acceptance





The Selected Remedial Alternative



Promoting Readiness through Environmental Stewardship



Summary

- Redevelopment plan developed first
- Risk-based approach established at outset
- Site characterization plan developed to support RBDM
- Early stakeholder interaction
- Proactive regulatory negotiation
- Integrated application of essential tools:
 - Toxicology (arsenic)
 - Geostatistics (GIS platform)
 - Tiered risk assessment
 - Site-specific bioavailability study