

US EPA ARCHIVE DOCUMENT



# Overview of 3MRA Technical Approach

Science Advisory Board  
Review of the 3MRA Modeling System

Presented by:

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August 26, 2003

# Presentation

U.S. Environmental Protection Agency

EPA Office of Research and Development  
National Exposure Research Laboratory  
Ecosystems Research Division

- State the Regulatory Problem
- Describe the thinking that went into the development of the 3MRA solution
- Describe the elements of the Technical Solution
- Describe the implementation process
- Introduce the speakers for the day



# The Problem Statement

To determine nationally applicable, risk-based, constituent-specific wastestream concentrations that represent a threshold below which Subtitle C (hazardous) disposal will not be required and thus the wastestream may “exit” the hazardous waste management system and can be managed in a Subtitle D (non-hazardous) waste management system. The risk-based constituent concentrations must be protective of human and ecological receptors that may experience exposure via multiple environmental pathways.

# Critical Elements of Problem Statement

- nationally applicable
- risk-based
- constituent-specific wastestream concentrations
- managed in Subtitle D waste management unit
- protective of human and ecological receptors
- chronic exposure via multiple environmental media/pathways

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1995



OSW proposes first multi-media modeling approach to address national regulatory problem...

It was not well received.

# Primary Comments from 1995 Review

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- Disconnect between MPRA and GW Methods
- MPRA not an “integrated” multimedia approach
- Inconsistent means of parameterizing high-end exposures and risks
- Ecological assessment flawed
- Model validation not conducted
- Documentation lacked clarity
- Impacts of episodic events not addressed
- Quality assurance was lacking
- Science support from Agency scientists and outside peer review was lacking
- Detailed module-specific comments also received



# The Response

A formal partnership between OSW and ORD  
for the purpose of revising the 1995 technical  
approach



# Goals

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There were two primary goals associated with this partnership effort.

**OSW** First and foremost was the development of a science-based human and ecological exposure and risk assessment methodology/technology that was responsive to the SAB

**ORD** A second goal (a relatively longer term goal) was to establish an comprehensive and integrated risk assessment technology that could be used to conduct technical assessments for regulatory development and implementation across the Agency, and to provide Agency scientists a centralized multi-media modeling technology for conducting research and developing new models.

# The Continuum Principle

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“To adequately support modern regulatory decisions, it is necessary to establish seamless connectivity from core research to applied research to technology to regulatory assessment to the regulatory action itself.”

# The National Assessment Question

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**At what waste stream concentration ( $C_w$ ) will wastes, when placed in a non-hazardous waste management unit over the unit's life, result in:**

1. At least (**99%**) of the people living within (**2 km**) of facility experiencing a risk less than ( **$10^{-6}$** ), and
2. At least (**90%**) of the habitats within (**2 km**) of facility experiencing an ecological hazard index less than (**1**),
3. at a minimum of (**95%**) of facilities nationwide?



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EPA



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# The Answer

A fully integrated national assessment methodology expressed within a state-of-the-art multi-media modeling system.

# The 3MRA Methodology

- Statistical sample of industrial sites
- Site-based human and ecological exposure/risk assessment
- Multi -contaminants, -media, -pathway, -receptor
- Tiered data (site-specific – regional – national)
- Population-based site level risk estimates
- National roll-up of risks
- Alternative measures of protection
- 2-stage Monte Carlo
- Probability-based design to facilitate UA & SA tasking
- Externally peer reviewed and independently tested

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- Tiered data (site-specific – regional – national)
- Population-based site level risk estimates
- National roll-up of risks
- Alternative measures of protection
  - Probability of protection (% of population, % of sites)
  - Protection as a function of distance from facility
  - Protection per receptor type
  - Protection per combination of receptor and pathway
- 2-stage Monte Carlo
- Probability-based design to facilitate UA & SA tasking
- Externally peer reviewed and independently tested

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# Major Features of 3MRA Approach

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- Integrated assessment strategy
- Site-based
- Cumulative exposures across pathways and time
- Conservation of mass in source
- Human health impacts to subpopulations
- New ecological risk assessment methodology
- Probability-based design to facilitate UA & SA tasking
- Computationally efficient science modules
- Externally peer reviewed and independently tested



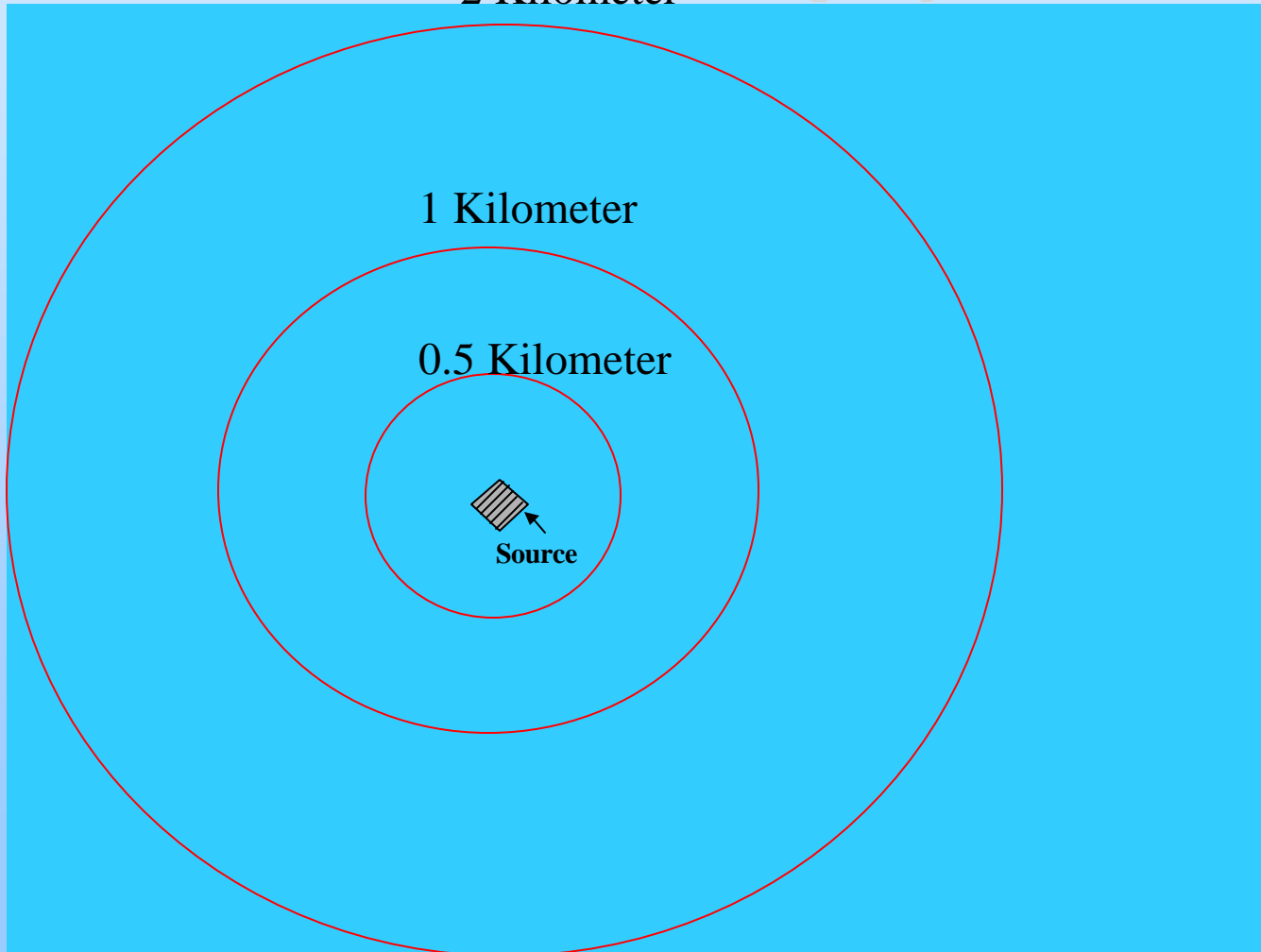
# The Site-based Modeling



# The 3MRA Site-based Area of Interest

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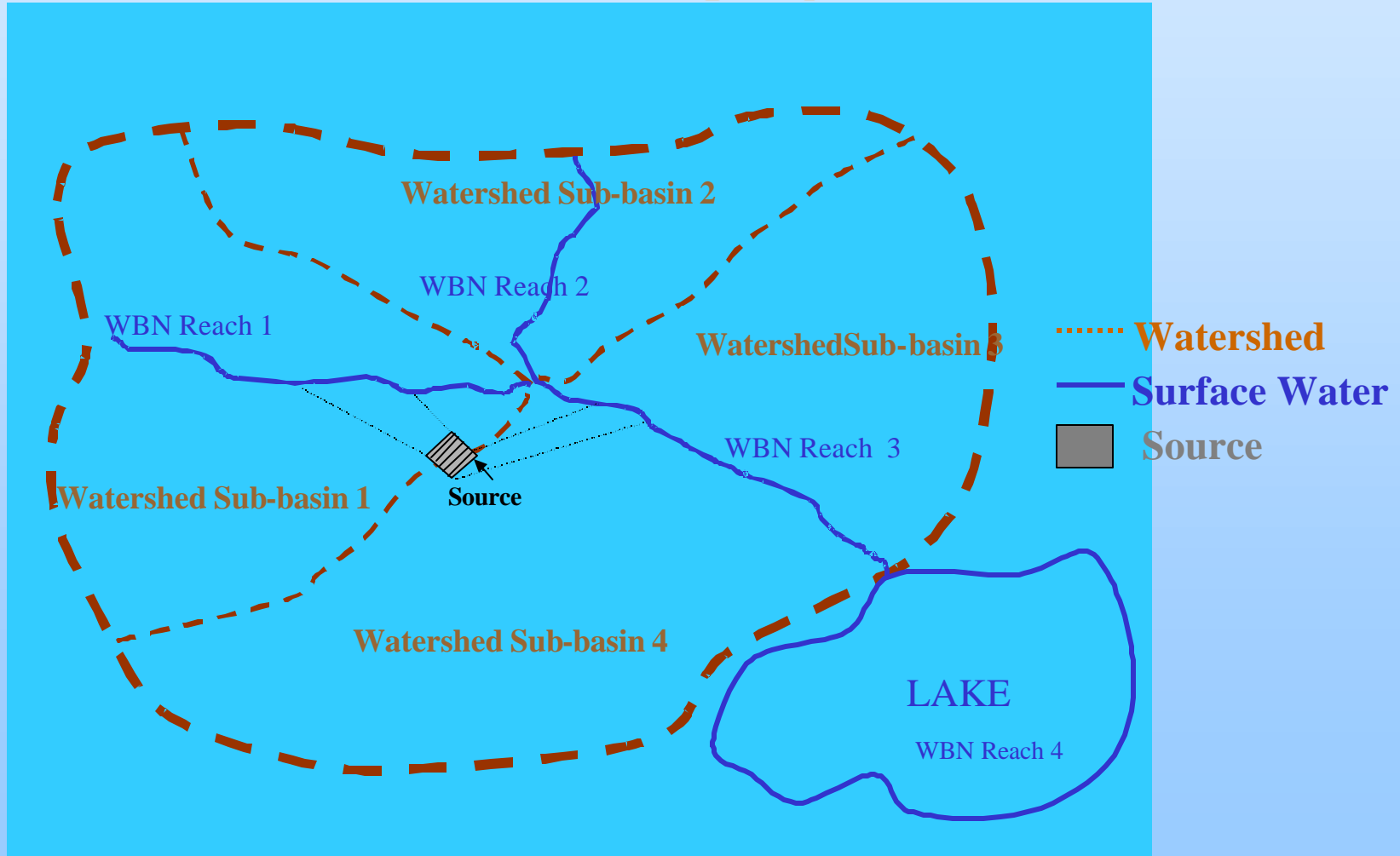
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# 3MRA Watershed and Surface Water Network

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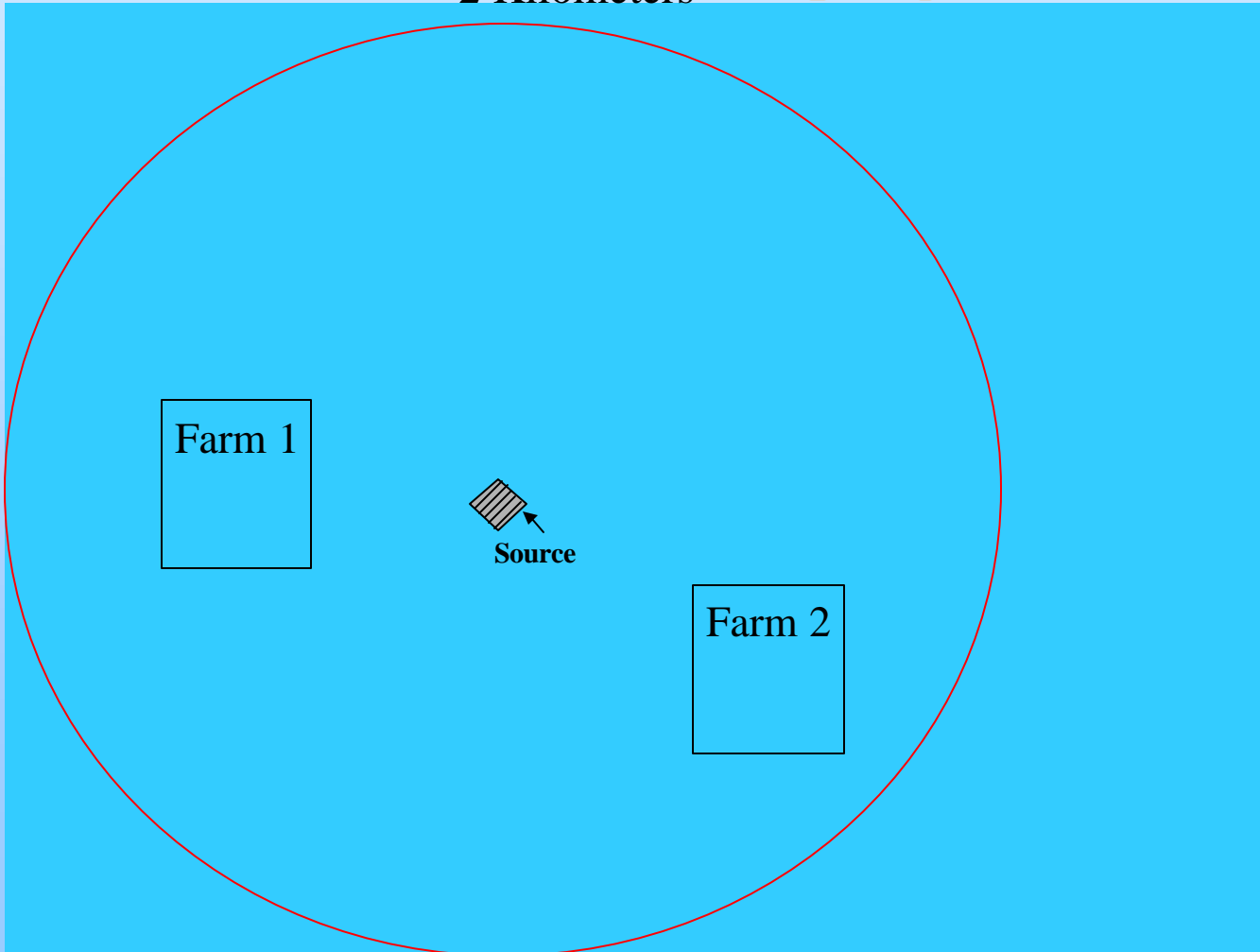


# 3MRA Location of Farms in AOI

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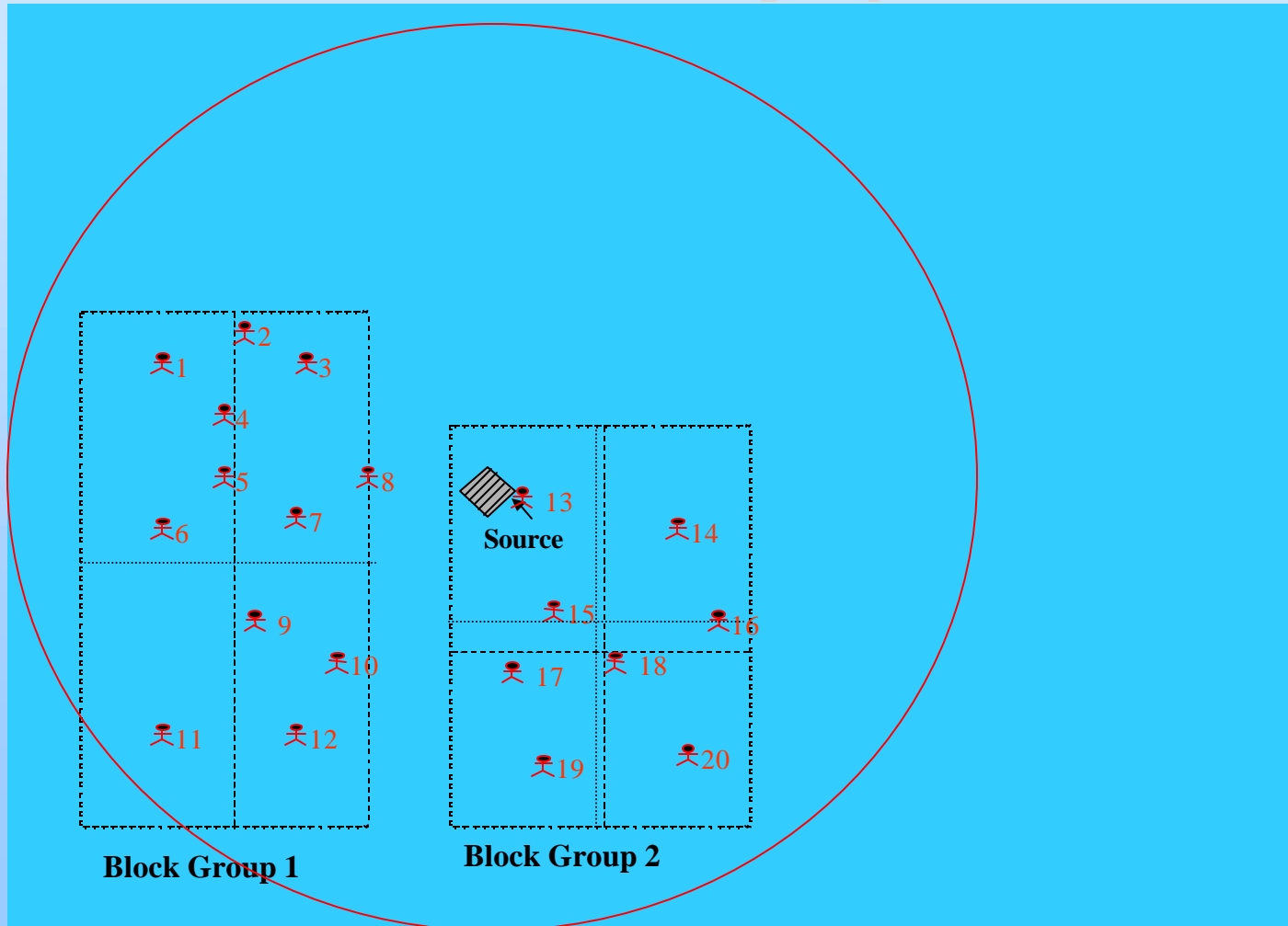
2 Kilometers



# 3MRA Human Population Distribution

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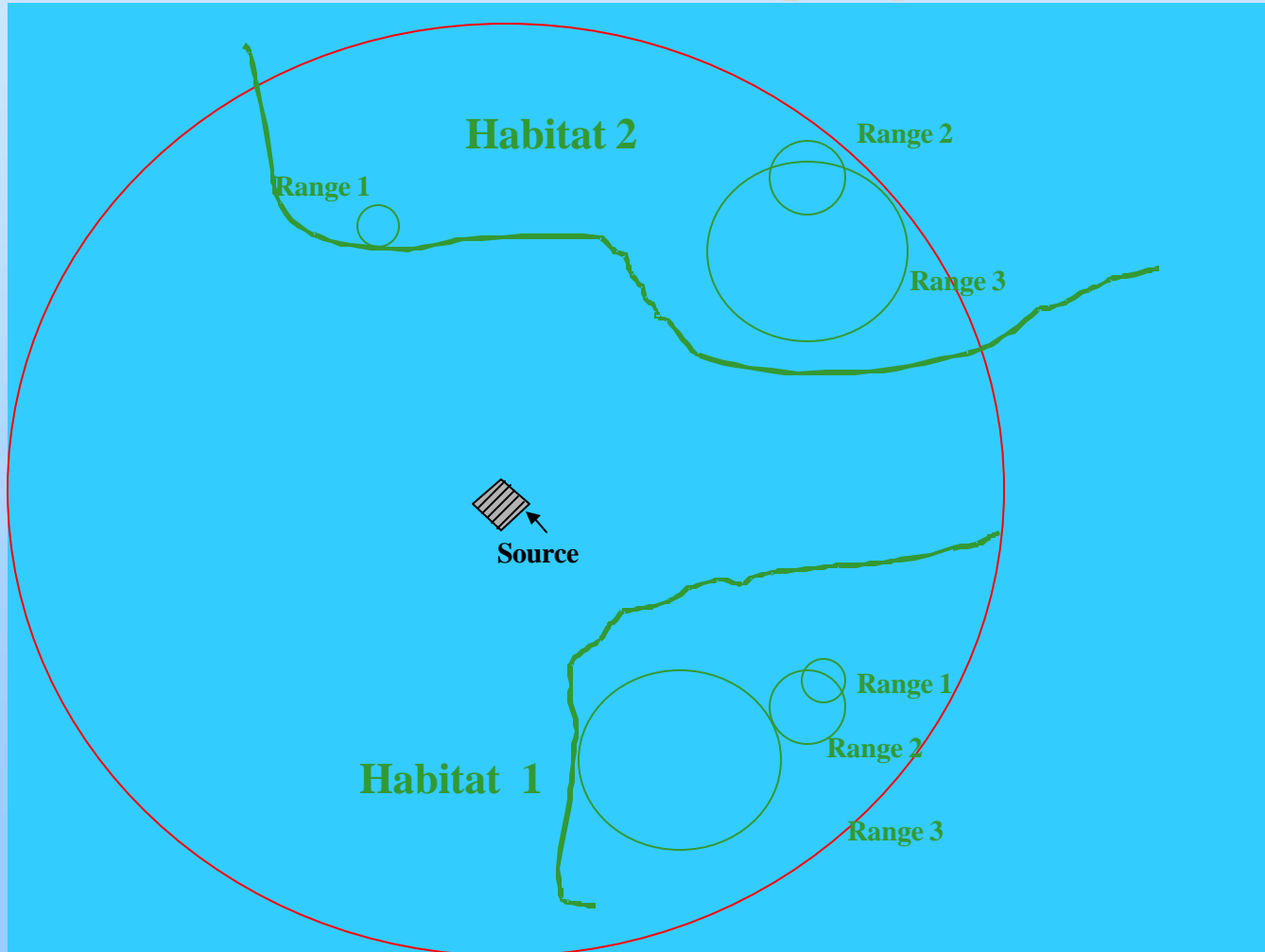
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# 3MRA Ecological Habitat Layout

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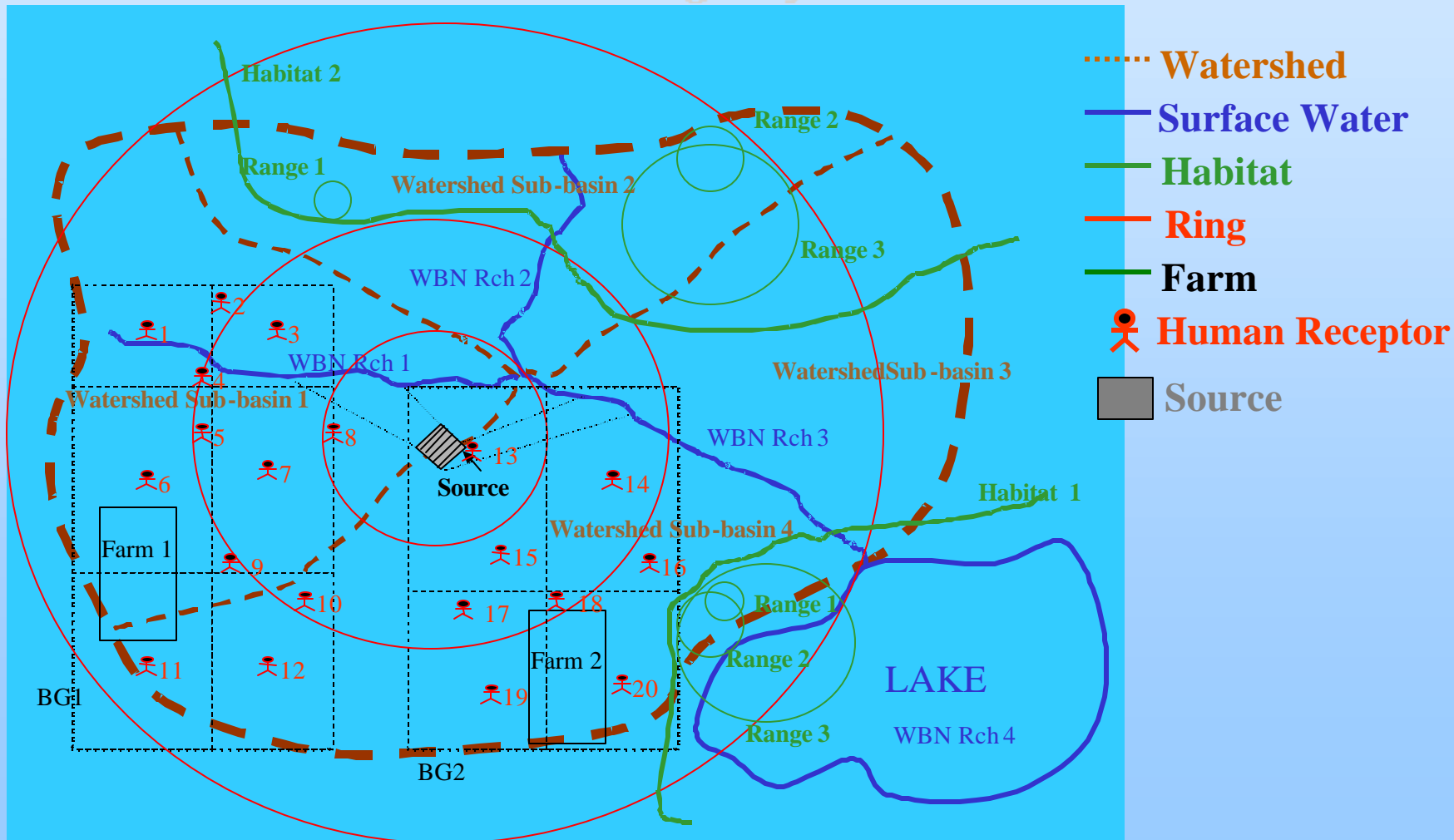
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# The 3MRA Integrated Site Layout

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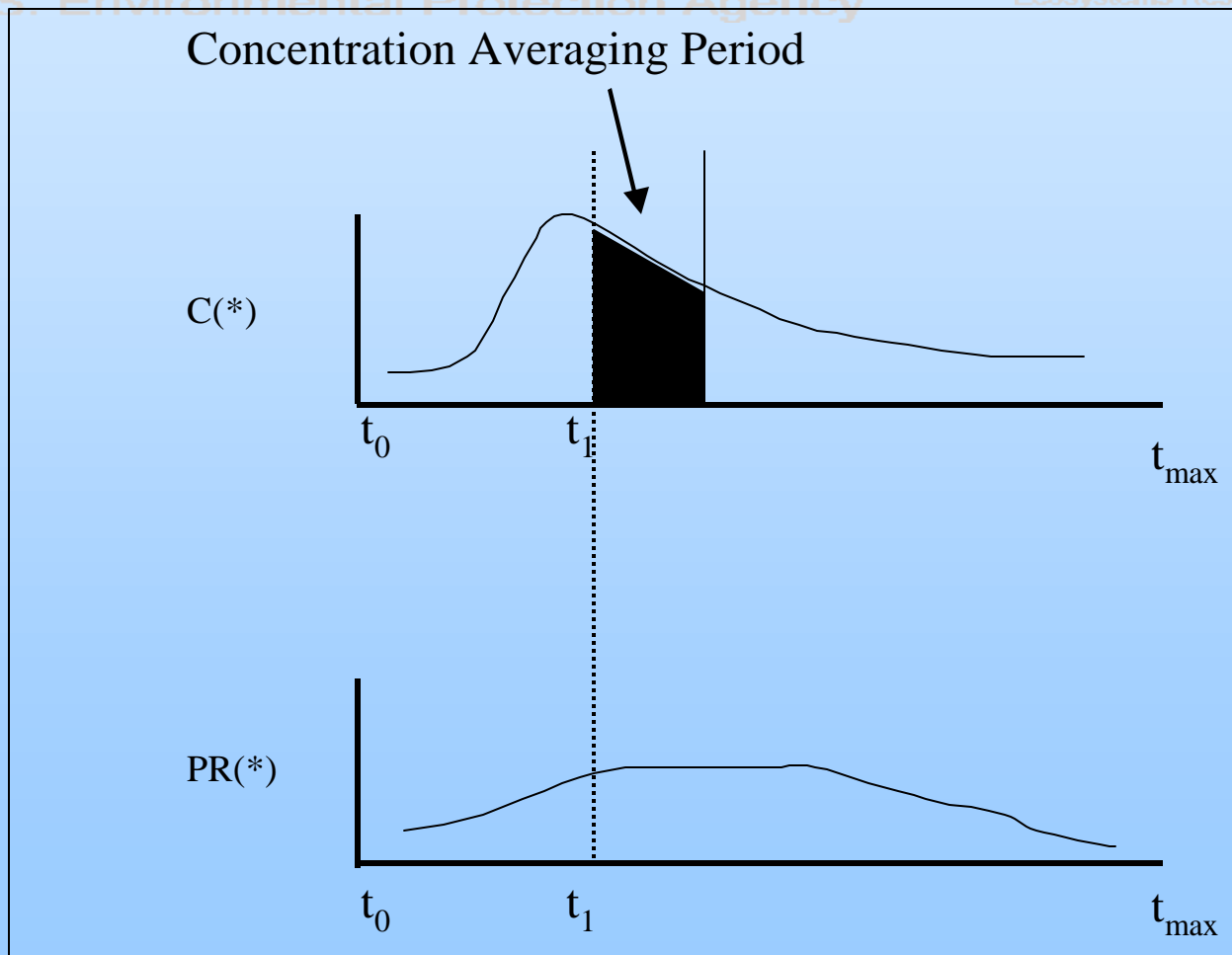
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# Relationship Between Exposure Concentration and Pathway Risk

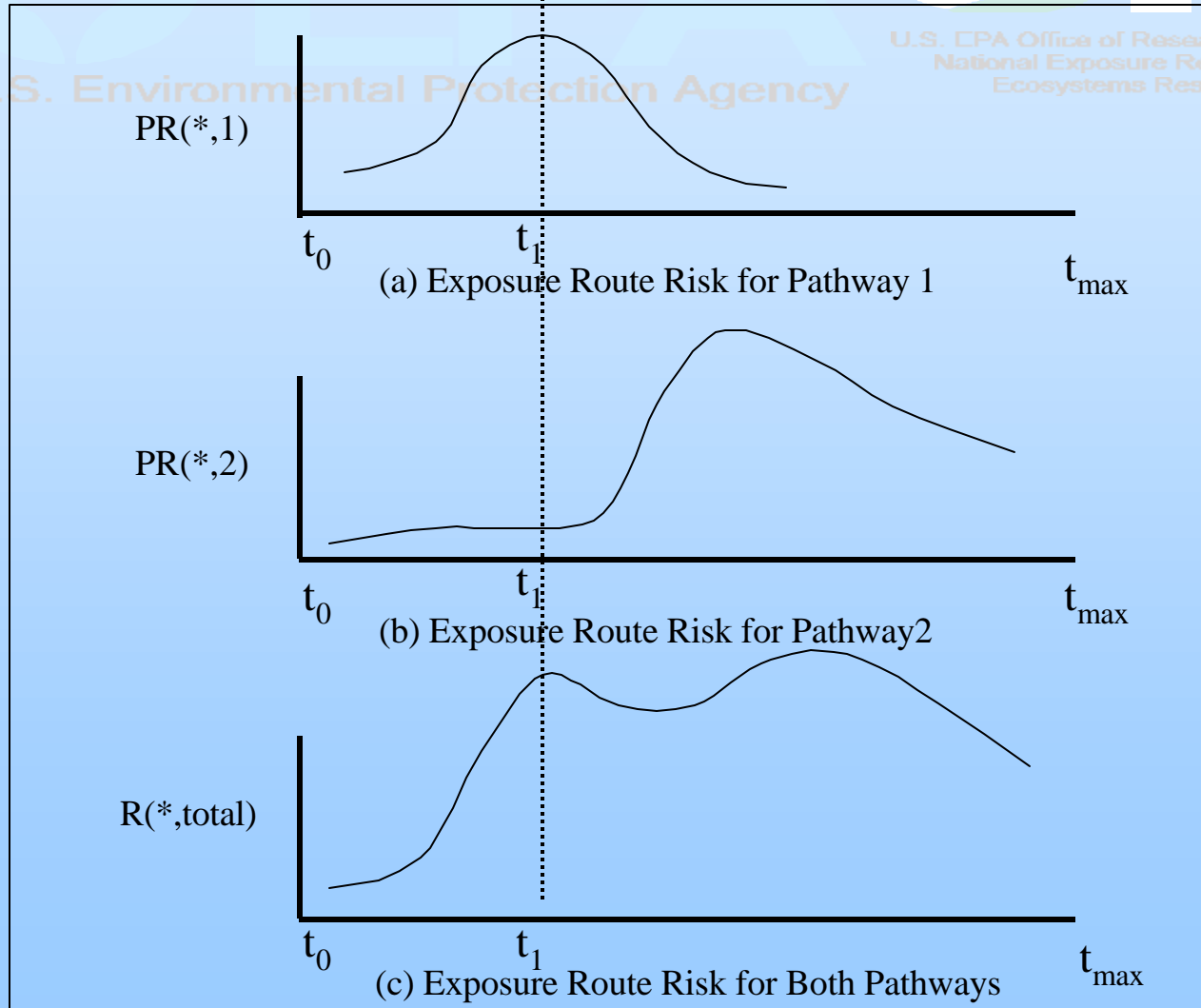
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(\*)  
Receptor  
Cohort  
Exposure route  
Contact medium  
Chemical  
Site  
WMU

# 3MRA Site-based Risk Output



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(\*)  
Receptor  
Cohort  
Exposure route  
Contact medium  
Chemical  
Site  
WMU

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# The 3MRA Data

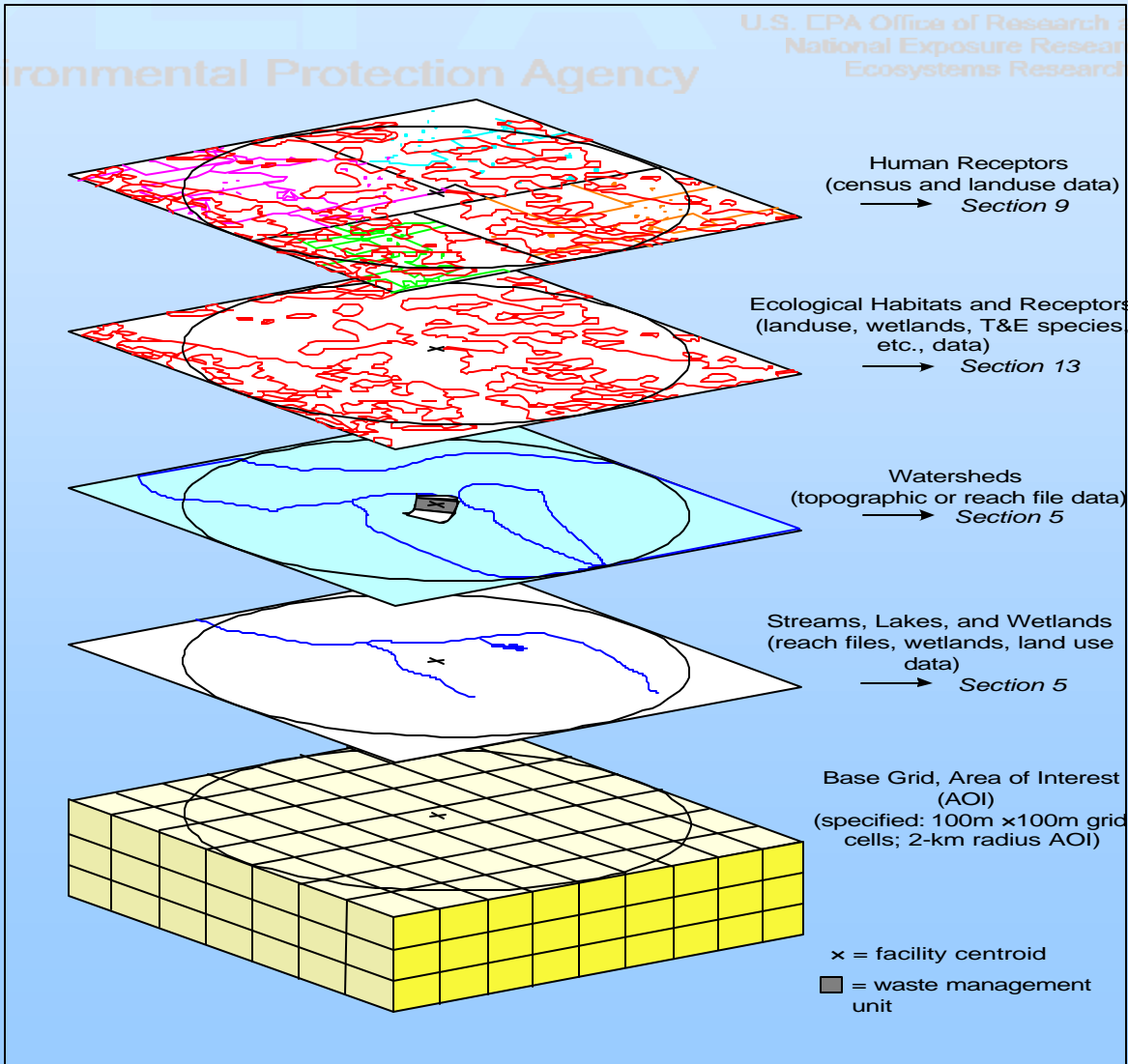
# 3MRA Site/Environmental Setting Data

- WMU characteristics (S,N)
- Waste properties (N)
- Meteorological data (R)
- Surface water & watershed layout and characteristics (S)
- Soil (including vadose zone) properties (S,N)
- Aquifer properties (R,N)
- Food chain/web characteristics (N)
- Human and ecological exposure factors (R,N)
- Human receptors (types and locations) (S,N)
- Ecological receptors and habitats (S,N)

# 3MRA Site Layout Data – GIS based

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# 3MRA Chemical Data

- Chemical properties
- Bio-uptake and bioaccumulation factors
- Human and ecological health benchmarks

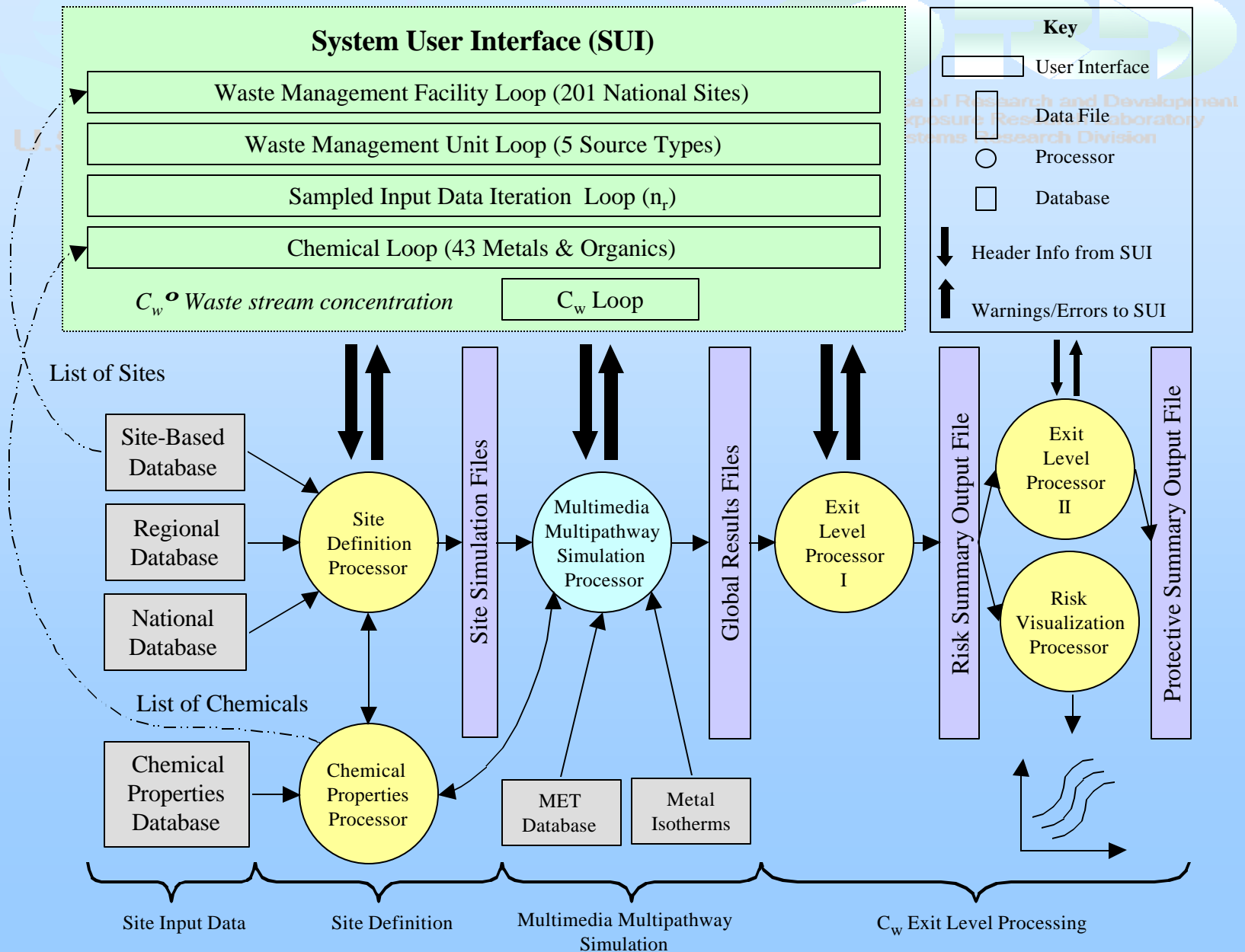


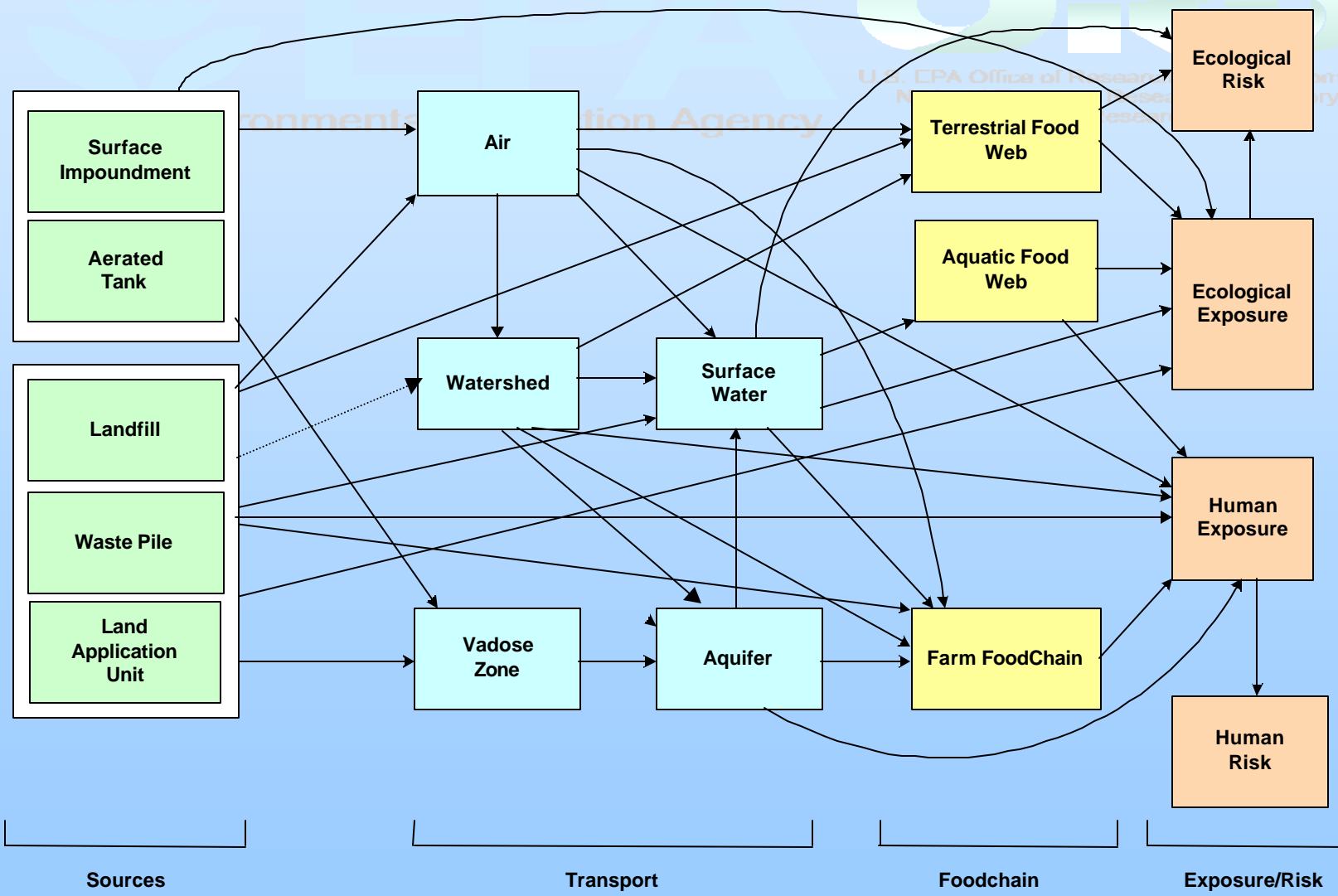
# Tremendous Plan and Implementation Effort to Ensure Data Quality



# The 3MRA Integrating Technology

# 3MRA Modeling System









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# How was it done?

A clear goal

A capable team

A solid implementation plan

A commitment to quality



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# The Goal



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A fully integrated national assessment methodology expressed within a state-of-the-art environmental modeling system.

# Team 3MRA

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National Exposure Research Laboratory  
Ecosystems Research Division

OSW

ORD

NERL

NCEA

NRMRL

NHEERL

PNNL

RTI

HydroGeologic

Ambiotec

PES

Allison Geoscience

CSC

TetraTech

6 Modeling Teams

6 Locations across the US

# The Implementation Strategy

## ESTABLISH and EXECUTE ROLES

- Overall direction and coordination
- Software development protocols and standards
- Software design and implementation (system/modules)
- Data collection design and quality standards
- Data collection implementation
- Peer review and independent testing/verification
- Documentation

## COMMUNICATE and RESOLVE ISSUES

- Email
- Teleconference
- Face-to-face meetings

# 3MRA Approach to Quality Assurance

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- Planning
  - Documentation
  - Peer Review
  - Standards-based Implementation
  - Verification
  - Validation
- System Level
- Methodology
  - Integrated System Software
- Component Level
- Module/DB Design
  - Module Software
  - System Components



# Final Points

# Benefits of an Integrated Multimedia Modeling Technology (Regulatory Perspective)

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- Consistent view of environmental concerns across Federal and State landscape
- Consistent use of science via modeling throughout regulatory process (regulation, implementation, compliance, enforcement)
- Focal point for facilitating stakeholder involvement
- Platform for quantifying impacts of differing scientific assumptions and opinions
- Streamlining of regulatory process
- Redirect resources from redundant technology development to data collection

# Benefits of an Integrated Multimedia Modeling Technology (Research Perspective)

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- Vehicle to facilitate greater scientific collaboration
- Efficient and timely assimilation of new science for regulatory application
- A technology design within which individual science models can be compared, evaluated, and used together
- A technology that can be used by researchers, regulators, the regulated community, and other stakeholders
- Allow greater resources to be devoted to science and model development rather than technology

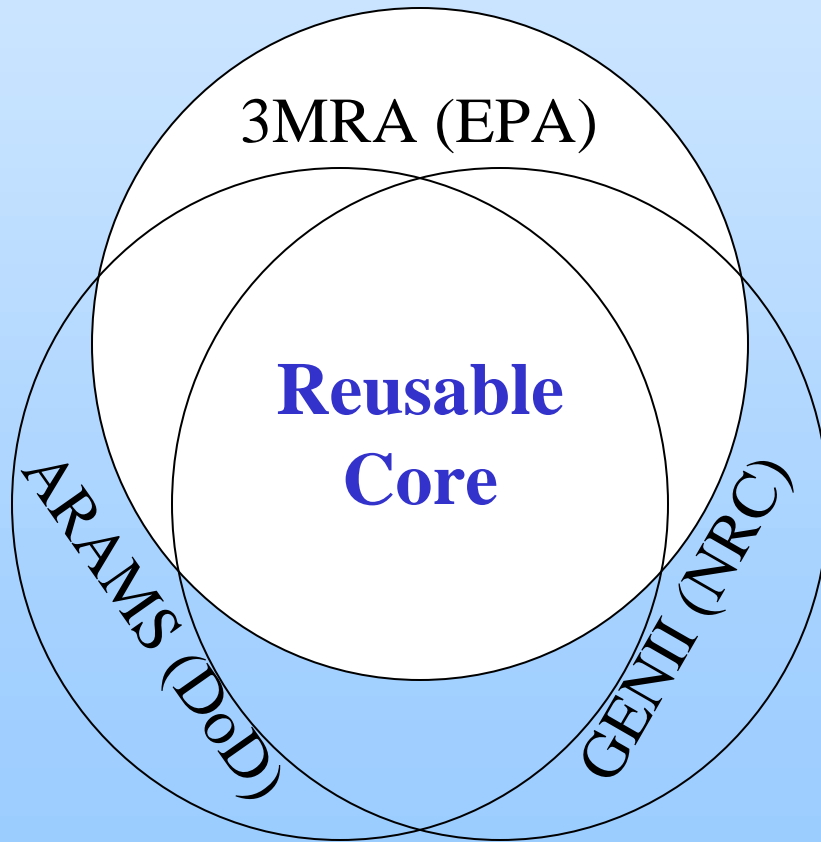


# Interagency MOU on Multi-media Modeling : Statement of Purpose

The purpose of the MOU is to establish a framework for facilitating cooperation and coordination among participating Agencies (EPA, DoD, DoE, USDA/ARS, USGS, NRC) on :

- research and development (R&D) of multi-media environmental models,
- software and related databases,
- development, enhancement, applications and assessments of site-specific, generic, and process-oriented multi-media environmental models as they pertain to human and environmental health risk assessment.

# Emerging Picture of Inter-Agency Collaboration



- Continued leveraging efforts within EPA and across government agencies
- Modeling systems will share core components but still be constructed for specific needs
- Maintenance of core should be by a community of concerned users of technology
- More power for a smaller price