Ecological Risk Assessment For Superfund

Protection of the Environment
Role of Ecological Risk Assessment (ERA)

- Evaluate hazards to ecology (plants/animals)
- Guidance documents
  - Ecological Risk Assessment Guidance for Superfund (ERAGS)
  - BTAG EcoUpdates
- Begin with Screening Level Ecological Risk Assessment (SLERA)
- Move to Baseline Ecological Risk Assessment (BERA), if warranted
- Intermediate/alternative steps possible
ERA Participants

- Biological Technical Assistance Group (BTAG)
- USEPA ecological risk assessors
- USEPA wetland and cross-cutter staff (cultural resources, ARARs)
- Trustees
  - Federal – NOAA, USFWS, USGS, DOI, Bureau of Indian Affairs as applicable.
  - State – NJDEP
- Others as needed
ERAGS Process

Step 1: Problem Formulation and Ecological Effects Evaluation

Step 2: Exposure Assessment and Risk Characterization

Step 3: Problem Formulation

Step 4: Study Design and DQO Process

Step 5: Verification of Field Sampling Design

Step 6: Site Investigation and Data Analysis

Step 7: Risk Characterization

Step 8: Risk Management
**SLERA and BERA**

- **SLERA (Steps 1-2)**
  - Provides an early exit mechanism for completing an ERA at sites where there are no or minimal ecological concerns
  - Identifies an initial set of Contaminants of Potential Ecological Concern (COPECs) to be evaluated in the Baseline Ecological Risk Assessment

- **BERA (Steps 3-8)**
  - Provides a framework for conducting ecological investigations at Superfund sites to characterize the potential hazards to ecological receptors
Problem Formulation
- Develop conceptual site model to identify contaminants, exposure pathways, and ecological receptors
- Select screening-level endpoints

Ecological Effects Evaluation
- Toxicity reference values and benchmarks
- Usually derived from the most sensitive endpoint and species
Screening-level exposure estimate and risk calculation

Similar to Hazard Quotient for human health

Maximum concentration detected divided by the toxicity reference value or benchmark

If HQ is less than 1, ecological effects not likely, if HQ is greater than 1, ecological effects may be evident

First Scientific Management Decision Point (SMDP) #1

- There is adequate information to conclude that ecological risk is negligible (Stop)
- The information is not adequate to make a decision at this point (Continue to Step 3)
- The information indicates a potential for adverse ecological effects (Continue to Step 3)
SLERA – Newark Bay

- Historical data from Newark Bay
  - Sediment
  - Tissue data, including benthic invertebrate, bird eggs, crabs, mollusks and fish
- Exposure areas included the northern, middle, and southern bay, in addition to the entire bay
- Ecological receptors included
  - Benthic macroinvertebrates – invertebrates, blue crab and mollusks
  - Fish – mummichog, eel, winter flounder, striped bass, white perch and Atlantic menhaden
  - Birds – belted kingfisher, mallard duck, black- and yellow-crowned night heron, herring gull, great egret and spotted sandpiper
  - Mammals – raccoon and other (mink/river otter)
  - Reptiles – diamond-backed terrapin (considered but not evaluated in SLERA)
- Stringent screening criteria was used to select chemicals of potential ecological concern and to estimate potential risk to ecological receptors
As a result of the screening process, many chemicals were identified as COPECs in sediment, fish tissue, mollusk tissue, crab tissue, and other benthic invertebrates. These include 13 metals plus various forms of mercury; one VOC (ethylbenzene); four non-PAH SVOCs; 25 individual PAHs as well as the sums of high molecular weight (HMW), low molecular weight (LMW), and total PAHs; five individual Aroclors plus total PCBs; 29 pesticides/herbicides as well as the sum concentration of seven compounds; and 2,3,7,8-tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD) plus its toxic equivalents based on dioxin and dioxin-like PCB components.
First Scientific Management Decision Point (SMDP) #1

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- The information indicates a potential for adverse ecological effects (Continue to Step 3)
Baseline Ecological Risk Assessment (BERA) workshop

Goals of the workshop are:
- Refine the conceptual site model
- Identify the ecological receptors of concern
- Identify the assessment and measurement endpoints
- Identify the data needs for the ecological risk assessment

These issues will be documented in a Problem Formulation Document and a Field Sampling Work Plan
ERA – Step 3 (Beginning of BERA)

- Refine preliminary COPECs
- Further develop the conceptual site model
- Consider contaminant fate and transport
- Identify ecosystems potentially at risk
- Identify complete exposure pathways
- Select assessment endpoints
- Detailed literature search on known ecological effects
- Develop risk questions
  - Relate relationship of assessment endpoints to measurement endpoints, develop study design, and testable hypotheses and null hypothesis
ERA Step 3: SMDP

- SMDP #2
  - Agreement on contaminants of concern
  - Assessment endpoints
  - Exposure pathways
  - Risk questions
- BERA workshop will provide forum to complete this step
Identify measures of effect

- Measurable ecological characteristics that is related to the valued characteristic identified as the assessment endpoint

Example:

- Assessment endpoint: Reduction in species richness or abundance or increased frequency of gross pathologies in fish communities
- Measurement endpoint: Information gathered through biological surveys, biological indicator data, media toxicity tests, and single chemical toxicity tests
ERA Step 4

- Work plan and field sampling plan
- Bioaccumulation and field tissue residue studies
- Population/community evaluations
- Toxicity tests
- SMDP #3
  - Agreement on BERA work plan, including field sampling and analysis plan
ERA Step 5

Field verification of sampling design
- Verify that field sampling plan is appropriate and implementable
- Requires site visit
- If appropriate, select reference sites
- Field check proposed sampling locations
- SMDP #4 – Any changes in hypothesis, work plan, or endpoints
ERA Step 6

- Site investigation and analysis phase
  - Perform field work
  - Adhere to Data Quality Objectives
  - Characterize exposure
  - Characterize ecological effects
  - SMPD #5
    - Needed only if work plan or sampling plan need to be changed
Risk characterization integrates exposure and ecological effects data to evaluate likelihood of adverse ecological effects.

Consists of two major components:
- Risk estimation
- Risk description

Uncertainty analysis

Significant reliance on professional judgment

Metrics are not limited to HQs or HIs:
- Species richness, toxicity test results

Build on lines of evidence
Risk management integrates risk assessment results with other considerations to make and justify decisions

- Responsibility of risk manager, not risk assessor
- Risk manager should be involved throughout process
- Primarily part of the Feasibility Study (FS)
- Include risk assessment results, NCP criteria, available remedial technologies, ecological impacts of remedies, tradeoffs between human health and ecological impacts, and cost

SMDP #6 is finalized in Record of Decision (ROD)
- Must justify any residual contamination expected following selected remedy
The End