



Overview of Risk Assessment Approach

Northern New Mexico Citizens Advisory Board

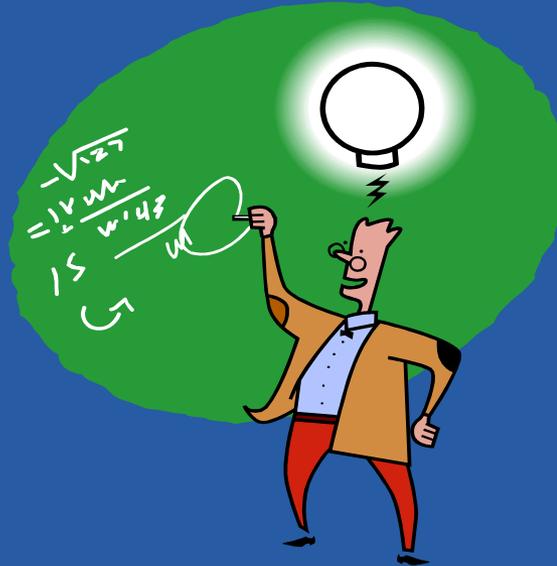
Presented by

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What is Risk?

Risk = Likelihood of an Effect given certain Conditions

(Is contamination from a site likely to cause health/environmental problems?)



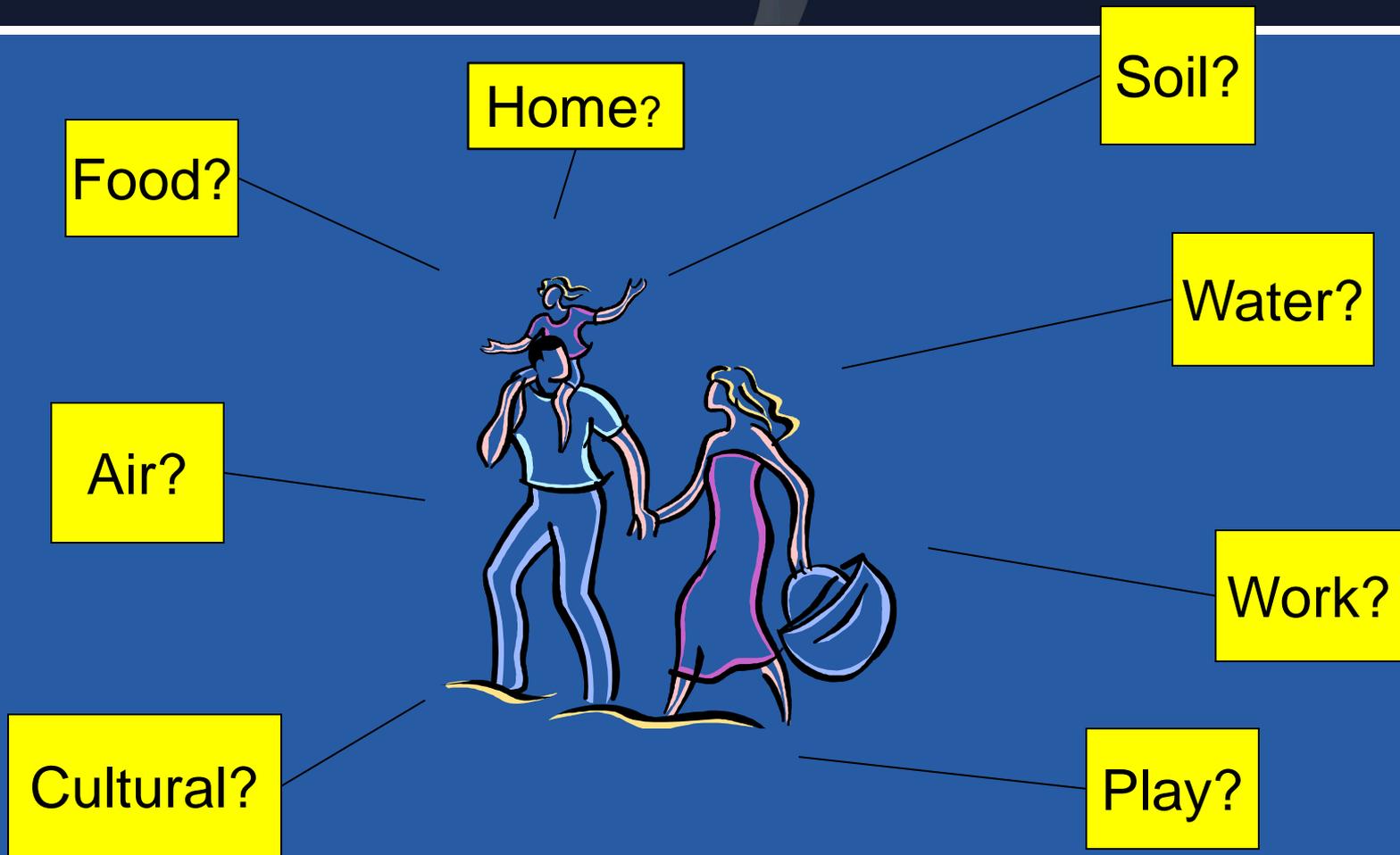
Risk Assessment Asks

- What is there that may pose a potential risk?
- Is it toxic (poisonous) and how toxic is it?
- Who is/might be exposed? To how much? How often? For how long? Where?
- What is the calculated (estimated) potential for harm if conditions remain the same?
- Is there a potential risk to human health and the environment?
- Is that potential acceptable?

What is evaluated for Human Health?

- Potential Risk
 - Cancer risk
 - Noncancer risk
- Potential Dose
- In addition to what a person may normally be exposed to
- Expressed as a probability of cancer occurring
- Ratio of concentration to a threshold level
 - If exceeds then potential for health effect
 - Does not exceed then assume no effect
- Ratio of activity to target dose activity
 - Same assumptions

Exposed?



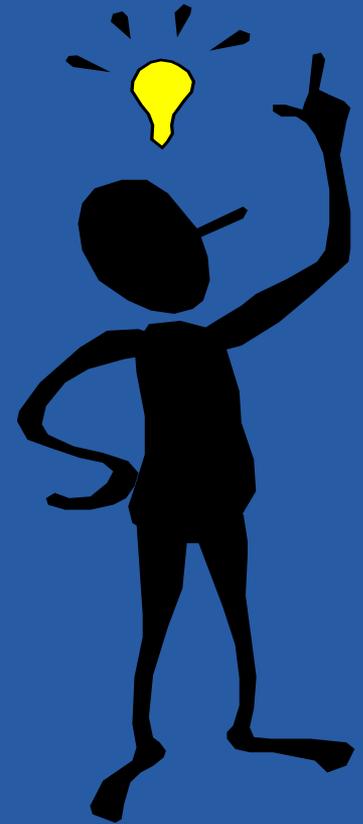
Type, Depth, Quantity, Frequency, Duration, Activity Level, Area?

Effects Depend On

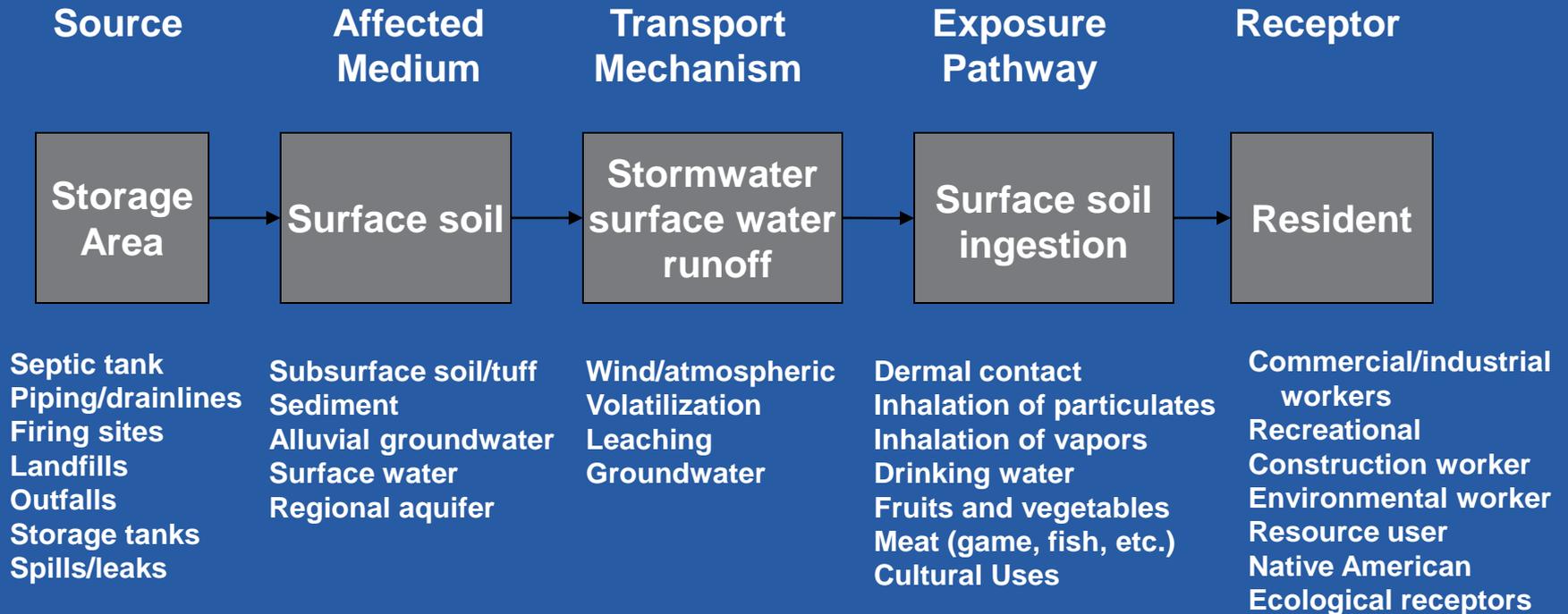
- Contaminants present
- Concentration in environment
- Toxicity of contaminant(s)
- Amount of exposure to contaminant
- Route of exposure
- Length of time of exposure
- Frequency of exposure
- Sensitivity of exposed individual

Conceptual Site Model

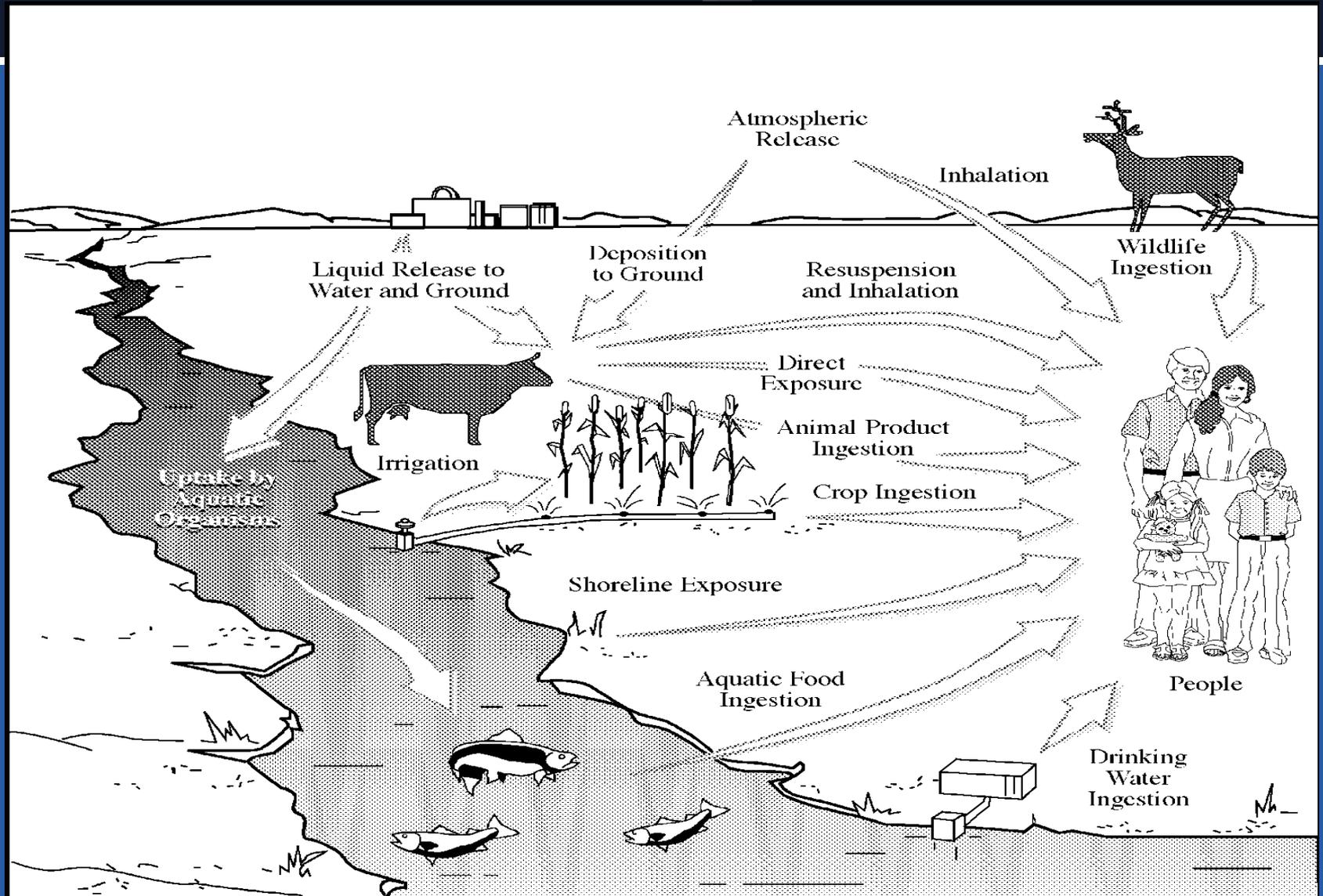
- Picture of site conditions that conveys what is known or suspected about the site.
- Should be documented by written descriptions of site conditions and supported by maps, analytical data, etc.
- Preliminary model built on existing data/knowledge and developed before any field activities.
- Model is dynamic, i.e., tested and refined as more data/information about site is obtained.



Conceptual Site Model



Conceptual Site Model



Risk Assessment Process

- Collect environmental and exposure data
- Compare with background
- Calculate exposure concentrations
- Determine exposure conditions
- Obtain toxicity data
- Estimate potential risk or dose



Data Collection and Evaluation

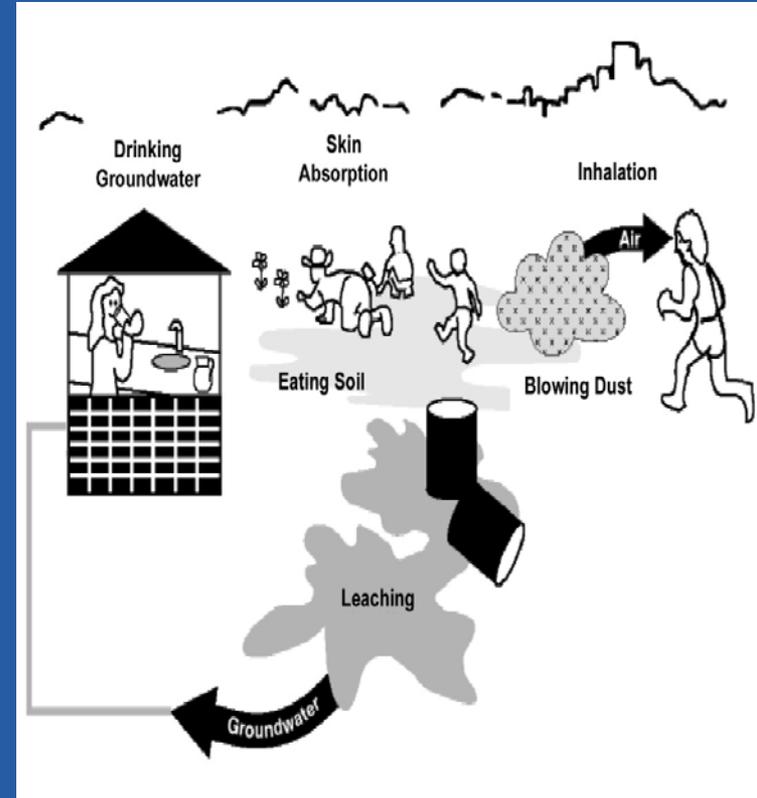
- Sampling and analysis plan developed; objective of sampling, what to analyze for, what media to analyze.
- Samples collected following established protocols to ensure quality and integrity of data.
- Determine what chemicals are present, how much, and where detected (nature of contamination).
- Determine area affected and, if possible, where it has migrated to (extent of contamination).
- Evaluation identifies chemicals of potential concern (COPCs); does not indicate that there is a risk.
- Risk assessment determines if there is a concern using exposure and toxicity information.

Background

- Consists of data sets collected from uncontaminated areas
- Distributions of data for medium of interest, e.g., soil
- Can calculate statistic to represent data set, i.e., 95% upper tolerance limits (UTL)
 - background value (BV)
- Compare background data set to site data set

Exposure Routes

- Incidental soil ingestion
- Inhalation dust and vapors
- Dermal absorption
- External irradiation
- Drinking water
- Ingestion of fruit and vegetables
- Ingestion of meat
- Other exposures as appropriate



Exposure Scenarios

- Residential (child and adult)
 - living on-site
- Industrial (adult)
 - Laboratory or commercial/industrial
- Construction worker (adult)
 - construction/excavation
- Recreational (child and adult)
 - hiker/jogger
 - extended backyard



Exposure Parameters

- Values used to describe the amount of contaminated medium a receptor comes in contact with
 - Default values vs. site-specific values
 - Literature-based versus actual surveys/measurements
- Want to estimate a reasonable maximum exposure (RME)
- Use values obtained from definitive source, e.g., EPA
- Community information can be used to modify assumptions
- May use professional judgment
- Provide rationale/source of values used

Exposure Concentration

- Determine concentration to represent exposure.
 - Based on number of samples collected
 - Based on data.
- Maximum concentration used when appropriate.
 - Use when only a few samples collected.
 - Use if majority of results nondetects.
 - Not ideal.
- 95% upper confidence limit (UCL) of the mean
 - Used to represent contaminant concentration across the site if enough data available.
 - Considered “true” mean exposure.
 - Preferred exposure concentration.

Health Effects

- Cancer (carcinogens)
“no matter how low the dose, there is still a chance that exposure will cause a cancer”
- Effects other than cancer (non-carcinogens), e.g., liver damage, brain damage
“there is a level of exposure (a threshold) below which an effect will not occur”
- Dose (radionuclides) Radiation deposits **energy** as it passes through matter; biological material absorbs energy leading to possible chemical changes that can result in harm
Small doses do not cause easily measured effects.

Risk Screening

- Based on the Consent Order (Section VIII)
 - Human health and ecological risk
- Human health scenarios
 - Residential, industrial, construction worker, recreational
 - Evaluate decision scenario(s) or present for comparison purposes
- Screening level assessments
 - Soil screening levels (SSLs) for chemicals
 - Screening action levels (SALs) for radionuclides

Risk Screening

Human Health Screening Values

- SSLs are from NMED/EPA regional values, except for recreational [hazard quotient (HQ) = 1; 1×10^{-5} risk]
 - calculated if not available (e.g., construction worker)
- Recreational SSLs derived by LANL approved by NMED (HQ = 1; 1×10^{-5} risk)
- SALs derived by LANL using RESRAD per DOE Order 458.1
 - has been 15 mrem/yr; new order can be up to 25 mrem/yr
 - provide equivalent total cancer risk to NMED
- Values for each scenario

Risk Screening

- Exposure concentration(s) compared to SSL(s)/SAL(s)
 - Excess cancer risk
 - HQ
 - Individual dose
- Sum of risks/hazards/dose
 - Total excess cancer risk
 - Hazard index (HI)
 - Total dose

Calculation Examples

Concentration ÷ screening value

Barium at 3000 mg/kg; screening level = 15,600 mg/kg

$$\text{HQ} = 3000 \div 15,600 = 0.2$$

Benzene at 0.4 mg/kg; screening level = 10.3 mg/kg

$$\text{Cancer risk} = 0.4 \div 10.3 = 0.04 \times 10^{-5} \text{ or } 4 \times 10^{-7}$$

Plutonium-239 at 3 pCi/g; screening level = 33 pCi/g

$$\text{Dose} = 3 \div 33 = 0.09 \times 15 \text{ mrem/yr} = 1 \text{ mrem/yr}$$

Uncertainty

- Risk is estimated based on numerous assumptions that have certain degree of uncertainty.
- Uncertainty is associated with data collection, sample results, land use, receptors, exposure assumptions, toxicity.
- Uncertainty analysis presents a qualitative assessment of all issues that may potentially affect the results of the risk assessment and assists in the interpretation of the results.
- Indicates level of confidence in results and assists in risk management decisions.
- The more information that is available the less uncertainty surrounds the assessment.
- No matter how much information is available/collected still have certain level of uncertainty.

Areas of Uncertainty

- Definition of the physical setting (likelihood that the chosen receptor and pathways are appropriate);
- Data quality issues (high/low bias);
- Analytical methods used;
- Environmental transport models;
- Chemicals having elevated detection limits;
- Additivity, antagonism, synergism of effects;
- Availability and quality of toxicity data;
- Toxicity values used (e.g., surrogate chemicals);
- Intake/exposure parameters and their assumed values;
- Multiple pathway exposure assumptions; and
- Differences in the toxic endpoints (target organs) among noncarcinogens.

Risk Characterization

- Determine risk/hazard/dose.
- Must put risk in context; tied to a scenario, pathways, and set of exposure conditions.
- Assume additivity if more than one contaminant present (unless information available that indicates otherwise).
- Presented in context of uncertainty.
 - Quantitative (measurement error)
 - Qualitative (how good are the data)

ALARA

As Low As Reasonably Achievable:

- DOE Order 458.1, *Radiation Protection of the Public and the Environment*
- Goal: Ensure levels are as low as is reasonable taking into account social, technical, economic, practical, and public policy considerations.
- Not a dose limit in itself but a process to attain doses as far below the applicable limit as reasonably possible to achieve.

Potential Site Decisions

LANL recommends – Regulator decides

- Nature and Extent not defined
 - Primary historical issue with NMED
 - Additional sampling required
- Corrective action complete (extent defined and passes HH and eco risk)
 - Complete without controls passes residential
 - Complete with controls passes other scenarios
- Corrective action required (fails decision scenario)
 - Remediation
 - Corrective measure
 - Monitoring



Risk Management

- **Risk assessment results and other factors basis for decisions**
 - social
 - economic
 - political
 - legal
- **Dependent on degree of confidence in results**
 - data gaps?
 - uncertainty?
 - representative?
- **Corrective action implementation**
 - environmental impact
 - cost-effective
 - monitoring requirements

