



INTERSTATE TECHNOLOGY & REGULATORY COUNCIL

Regulatory Acceptance for New Solutions

Risk Assessment Resources Team

ELECTRONIC RISK RESOURCE SHEET

The Interstate Technology Regulatory Council (ITRC) Risk Assessment Resources Team (Risk Team) prepared this resource sheet* of internet-based resources. This document is divided into seven sections:

- (1) [Understanding Risk Assessment](#),
- (2) [Human Health Risk Assessment \(HHRA\)](#),
- (3) [Ecological Risk Assessment \(ERA\)](#),
- (4) [Special Topics](#),
- (5) [Risk Communication](#),
- (6) [Risk Management](#), and
- (7) [Additional Risk-related Links](#).

Most links connect to databases, tools, and topics that address risk assessment. This document is not intended to be comprehensive and does not address such issues as tribal risk assessment, chemical-specific data, and uncertainty.

To access a link, scroll the mouse over the keyword. The URL Web site will pop up with directions. Simultaneously press the "Ctrl" button on the keyboard and left-click the keyword hyperlink with the mouse, and the webpage should automatically be displayed.

*Note: The web links and materials within this document do not represent any type of endorsement or preferentiality by the ITRC Risk Team. All web links contained herein are checked periodically to ensure current availability. However, there is no guarantee of each URL's accessibility.

Table of Contents

1. Understanding Risk Assessment

1.1 Definitions

1.2 General Risk Assessment Resources

2. Human Health Risk Assessment (HHRA)

2.1 General Resources

2.2 Problem Formulation

2.2.1 *Planning and Scoping*

2.2.2 *Data Usability*

2.3 Analysis of Stressor Response and Exposure

2.3.1 *Dose-Response Assessment*

2.3.2 *Exposure Assessment*

2.4 Risk Characterization

2.5 Databases

2.6 Guidelines

3. Ecological Risk Assessment (ERA)

4. Special Topics

4.1 Child Risk Assessment

4.2 Hot Spots

4.3 Lead

4.4 Asbestos

4.5 Perchlorate

4.6 Deterministic Risk Assessment

4.7 Probabilistic Risk Assessment (PRA)

4.8 Radiation Risk Assessment

4.9 Vapor Intrusion

5. Risk Communication

6. Risk Management

7. Additional Risk-Related Links

7.1 Interstate Technology Resource Council (ITRC)

7.2 Seminars, Conferences, Training Opportunities

1. Understanding Risk Assessment

1.1 Definitions

Risk and risk-related terminology have numerous definitions. Visit the following resources for additional definitions of *risk* and *risk-related* terms:

- [The U.S. Environmental Protection Agency \(EPA\) Terminology Reference System \(includes a comprehensive resource of risk terms\)](#)
- [EPA's Waste and Cleanup Risk Assessment Glossary](#)
- [The Society for Risk Analysis \(SRA\) Glossary of Risk Analysis Terms](#)
- [EPA's Integrated Risk Information System Glossary](#)
- [EPA's Terms of Environment: Glossary, Abbreviations and Acronyms](#)
- [The Agency for Toxic Substances and Disease Registry \(ATSDR\) Glossary of Terms](#)
- [Risk Assessment Information System \(RAIS\) Glossary](#)

1.2 General Risk Assessment Resources

[Oak Ridge National Laboratory's \(ORNL\) Risk Assessment Information System \(RAIS\)](#) provides a number of useful resources for developing an understanding of risk assessment. Links to three RAIS resources are provided below.

- [Introductory](#)
ORNL's RAIS provides a minicourse that serves as a good introduction to risk assessment for both layperson and professional.
- [Intermediate](#)
This more in-depth tutorial is available for people that know the basics about risk assessment.
- [Advanced](#)
This RAIS Web site allows users to perform calculations of exposure doses and risks.

[Risk Assessment: A Conceptual Introduction](#)

This presentation provided by the University of Alberta provides a good overview of the Risk Assessment process, keeping the concepts simple and easy to understand for the novice risk assessor.

[The ABC's of Risk Assessment](#)

This web-based fact sheet ([PDF](#)) was based on a presentation at Travis Air Force Base. This fact sheet is an excellent resource for individuals with no prior knowledge of risk assessment.

[The ABCs of Risk Assessment: The Basics](#)

This article by Dorothy Patton is written from the EPA's point of view, describing how risk and risk assessment pertain to the federal government. It is intended for those with more knowledge of risk assessment, but uses graphics to explain more complicated concepts.

[EPA's Research in Risk Assessment-Risk Paradigm](#)

This document briefly describes how risk assessors seek to understand the fundamental processes that underlie human health problems that are caused by pollutants in the environment.

[Understanding Risk Assessment Fact Sheet](#)

The Ohio Environmental Protection Agency introduces the concept of risk assessment and how risk is used to determine potential concerns and causes that affect human health.

[Understanding Risks and Building Partnerships](#)

This chapter in EPA's [Guide for Industrial Waste Management](#) introduces risk assessment, including a discussion of several types of risk and the methods used to assess these risks.

[Principles of Risk Assessment](#)

This chapter from the U.S. Coast Guard's [Risk-based Decision-making Guidelines](#) provides an overview of basic risk assessment principles that play a key role in the risk-based decision-making process. Novice users will find the follow sections very useful: [Elements of Risk](#), [Characterizing Risk](#), and [Risk Assessment Methods](#). The Coast Guard also offers interactive learning modules to accompany the text:

[Principles of Risk Assessment – Understanding How Losses Occur](#)

[Principles of Risk Assessment – Characterizing Risk and Risk Assessment Methods](#)

[Understanding Risk: Informing Decisions in a Democratic Society](#)

National Research Council's Committee on Risk Characterization's free, on-line book addresses a central dilemma of risk decision-making in a democracy: detailed scientific and technical information is essential for making decisions, but the people who make and live with those decisions are not scientists. This resource:

- Frames fundamental questions about what risk characterization means.
- Reviews traditional definitions and explores new conceptual and practical approaches.
- Explores how risk characterization should inform decision-makers and the public.
- Examines risk characterization in the context of the entire decision-making process.

[EPA's Waste and Cleanup Risk Assessment Web Site](#)

Web site provides basic information about EPA's approach to waste and cleanup risk assessment, including individual risk assessment approaches are described on the [Waste and Cleanup Programs' Risk Assessment](#) webpage.

2. Human Health Risk Assessment (HHRA)

Links to resources from a variety of federal agencies are listed below that address human health risk assessment, the first part of risk assessment.

2.1 General Resources

[A Guide to Health Risk Assessment](#)

This California Environmental Agency's booklet provides a basic explanation of risk assessment for laypeople involved in environmental health issues, including policymakers, businesspeople, community groups, news reporters, and others with an interest in the potential health effects of toxic chemicals.

[What is Human Health Risk Assessment?](#)

EPA's fact sheet provides an easy to understand description of human health risk assessment and the four steps of risk assessment.

[Human Health Risk Assessment Fact Sheet](#)

Alaska Department of Environmental Conservation's fact sheet introduces human health risk assessment to people without any knowledge of the subject.

[Assessing Risks to Human Health from Chemicals in the Environment](#)

This chapter from *Handbook of Environmental Risk Assessment & Management* outlines a process to assess the human health risks from exposure to chemicals in the environment. This overview includes information on toxicity analysis, exposure analysis, and risk characterization.

[Human Health Risk Assessment Topics](#)

EPA's Office of Solid Waste provides a brief overview and related guidance on [Planning and Scoping](#), [Toxicity: Hazard Identification & Dose Response](#), [Exposure Assessment](#), [Risk Characterization](#), and [Risk Management](#).

[Superfund Human Health Risk Topics](#)

EPA's Web site provides guidance, tools and databases that might be useful in preparing human health risk assessments on the types of hazardous waste sites addressed by OSWER programs, such as [Planning and Scoping](#), [Exposure Assessment](#), [Acute Hazards](#), [Toxicity \(Hazard Identification and Dose Response\)](#), and [Risk Characterization](#).

[Human Health Risk Assessment](#)

The EPA Region 8 Web site outlines the key components of the human health risk assessment process; click on a topic for more detailed information, related resources, tools and guidance documents: [Site Conceptual Model](#), [Exposure Assessment](#), [Toxicity Assessment](#), [Risk Characterization](#), and [Uncertainty Analysis](#).

EPA's *Risk Assessment Guidance for Superfund, Volume I - Human Health Evaluation Manual* provides a method by which the risk assessment will inform regulatory and program decision makers of the need to protect human health and the environment from the risks of contamination.

- [Part A: Baseline Risk Assessment](#)
Provides guidance on the human health evaluation activities that are conducted during the baseline risk assessment, which is an analysis of the potential adverse health effects caused by hazardous substances.

[Risk Assessment Handbook Volume I - Human Health Evaluation](#)

The U.S. Army Corps of Engineers' (USACE) *Handbook* provides technical guidance to risk assessors and risk assessment support personnel for planning, evaluating, and conducting Human Health Risk Assessments.

[U.S. Navy Human Health Risk Assessment Guidance](#)

This document provides detailed guidance on how Human Health Risk Assessments are conducted for the U.S. Navy.

2.2 Problem Formulation

In this step, specific stressors and receptors ([hazard identification](#)) are identified. A [conceptual model](#) can be developed to represent how particular stressors are expected to behave in the environment. Visit the following resources for more information:

[Guidance on Cumulative Risk Assessment Part 1-Planning and Scoping](#)

EPA's *Guidance* directs each office to take into account cumulative risk issues in scoping and planning major risk assessments and to consider a broader scope that integrates multiple sources, effects, pathways, stressors and populations for cumulative risk analyses in all cases for which relevant data are available. The guidance includes [Lessons Learned](#).

[National Library of Medicine \(NLM\) Hazardous Substances Data Bank](#)

The US National Library of Medicine Division of Specialized Information Sources has developed a collection of toxicology and environmental health databases that includes the Hazardous Substances Data Bank (HSDB). The HSDB is a database of potentially hazardous chemicals that provides detailed toxicity and fate and transport information on each substance.

[What Is a Conceptual Site Model?](#)

The Massachusetts Department of Environmental Planning presentation reviews why, when, and how to use a conceptual site model.

[Site Conceptual Model Web Site](#)

EPA Region 8 Office's Web site provides an overview of the conceptual site model, providing users with example conceptual site models.

[Site Conceptual Models for Exposure Pathway Analysis](#)

This University of Texas presentation introduces the purpose of developing a conceptual site model and the process of developing a model. The presentation uses case studies and example spreadsheets to walk through each step of conceptual model development.

2.2.1 Planning and Scoping

Planning a Human Health Risk Assessment

Chapter 2 of [USACE's Risk Assessment Handbook Volume I](#) provides detailed guidance on planning a risk assessment.

Guidance on Cumulative Risk Assessment Part 1-Planning and Scoping

EPA's *Guidance* directs each office to take into account cumulative risk issues in scoping and planning major risk assessments and to consider a broader scope that integrates multiple sources, effects, pathways, stressors, and populations for cumulative risk analyses in all cases for which relevant data are available. A [Lessons Learned](#) sheet is also available.

2.2.2 Data Usability

Data usability is the process of determining whether the quality of data generated meets the intended use. Visit the following resources for more information:

EPA Guidance for Data Usability in Risk Assessment

This *Guidance* tries to set a nationally consistent basis for making decisions about the minimum quality/quantity of environmental data. The [Quick Reference Fact Sheet](#) provides an overview of the guidance. [Part A](#) of the guidance addresses the minimum quality and quantity of environmental analytical data that are sufficient to support Superfund risk assessment decisions, regardless of which parties conduct the investigation. [Part B](#) of this guidance addresses radioanalytical issues. For further radiological risk assessment information, see [Section 4.8](#).

A Summary of General Assessment Factors for Evaluating the Quality of Scientific and Technical Information

This EPA document was prepared under the auspices of the Science Policy Council (SPC) to describe the assessment factors and considerations generally used by the Agency to evaluate the quality and relevance of scientific and technical information.

2.3 Analysis of Stressor Response and Exposure

This risk assessment step establishes to what degree receptors are exposed ([dose-response assessment](#)) and what level of exposure is likely or not to cause harmful effects to humans or the environment ([exposure assessment](#)).

2.3.1 Dose-Response Assessment

[Dose-response assessment](#) examines shifts in toxicological responses of an individual (such as alterations in severity) or populations (such as alterations in incidence) that are related to changes in the dose of any given substance. Visit the following resources for more information:

Toxicology ABC's

Northwest Coalition for Alternatives to Pesticides' (NCAP) fact sheet provides basic, easy-to-understand definitions and explanations of Frequency and Duration of Exposure, Routes of Exposure, and the Dose-Response Relationship.

[Toxicology Tutor](#)

This is an on-line tutorial that covers the basic principles of toxicology and is written at the introductory college student level produced by the Toxicology and Environmental Health Information Program of the National Library of Medicine. It includes [Dose and Dose Response](#), [Toxic Effects](#), [Exposure and Interactions](#), and [Toxicity Testing Methods](#). It also includes [Risk Assessment](#) module with an animated diagram showing the relationship between risk assessment and risk management

[Dose Response Concepts](#)

This lecture presentation introduces users to the concept of dose-response the causal relationships between exposure and effect.

[Toxicology Information Brief](#)

In this electronic fact sheet, Cornell University, Michigan State University, Oregon State University, and the University of California at Davis examine the relationship between the *dose* of a chemical received by a receptor and the receptor's resulting *response*.

[Toxicity Assessment Fact Sheet](#)

This fact sheet introduces toxicity assessment by asking: *What does the contaminant do to the receptor?* and *What potential adverse effects might the contaminants of concern cause and at what concentration?* This resource also provides an overview of acute and chronic toxic effects, the determination of safe levels, and carcinogenesis bioassay.

[Toxicity Assessment Fact Sheet - Advanced Details](#)

Landcare Research's fact sheet addresses the need for the extensive literature review of obtain up-to-date information regarding the properties of the chemical, the site, and receptor organisms.

2.3.2 Exposure Assessment

An [exposure assessment](#) estimates the intensity (how much), frequency, and duration (how long) of human exposure to a chemical. Visit the following resources for more information:

[Exposure Assessment Basics](#)

This chapter from [A Journalist's Handbook on Environmental Risk Assessment](#) provides a comprehensive, yet simple introductory overview of exposure assessment and its role in risk assessment.

[What is An Exposure Assessment?](#)

EPA's webpage provides members of the public with a detailed overview of the concept and processes of an exposure assessment. Users will learn about the use of models, monitoring data, and fate and transfer properties in exposure assessment.

[Exposure Assessment: Contaminant Transport in Environmental Systems](#)

This presentation provides a technical review of exposure assessment for contaminant transport in environmental systems.

[EPA's Guidelines for Exposure Assessment](#)

EPA's *Guidelines* describe the general concepts of exposure assessment including definitions and associated units. It also provides guidance on the planning and conducting of an exposure assessment.

[EPA's Exposure Factors Program](#)

The National Center for Environmental Assessment's Web site provides a focal point where the most current information and data on exposure factors can be found. At this Web site, users can find: [Exposure Factor Handbook](#), [Example Exposure Scenarios Assessment Tool](#), [Child-Specific Exposure Factors Handbook](#), [Guide to Current Literature](#), and [Frequently Asked Questions](#).

[EPA's Factor Finder CD-ROM](#)

A user-friendly, searchable tool used to locate exposure factors and sociodemographic data for user-defined populations.

[Risk Assessment Guidance for Superfund – Human Health Evaluation Manual – Supplemental Guidance: Standard Default Exposure Factors](#)

EPA's *Supplemental Guidance* attempts to reduce unwarranted variability in the exposure assumptions used to characterize potentially exposed populations in the baseline risk assessment. This *Guidance* builds on the technical concepts discussed in [HHEM Part A](#) and should be used in conjunction with Part A.

[Identifying Exposure Pathways](#)

This online learning program provides information on the basic concepts used by ATSDR staff and agents of ATSDR in conducting public health assessments, specifically how to identify pathways of exposure. This online learning program is intended to assist environmental public health professionals understand the basic steps and coordination necessary to identify exposure pathways. The program provides learn-by-doing steps on how ATSDR's cooperative agreement partners (agents of ATSDR), ATSDR staff, and other environmental and public health professionals can identify how persons come into contact with hazardous and toxic substances. This program is an interactive simulation involving internal and external communications, site document review, mock site review, video clip review, community involvement activities, and completion of an exposure pathway table.

2.4 Risk Characterization

[Risk characterization](#) is the last step of the risk assessment process. Information gathered in previous steps is used to estimate potential for adverse health or ecological effects to occur from exposure to a stressor and evaluates the uncertainty involved. Visit the following resources for more information:

[Risk Characterization Handbook](#)

This EPA *Handbook* has two parts. The first is the Risk Characterization Guidance itself. The second part comprises the Appendices which contain the Risk Characterization Policy, the risk characterization case studies and references.

[Guidance for Risk Characterization](#)

This EPA *Guidance* contains principles for developing and describing EPA risk assessments, with a particular emphasis on risk characterization.

[Guidance on Risk Characterization for Risk Managers and Risk Assessors \(1992\)](#)

This *Guidance* is intended for managers and assessors on describing risk assessment results in EPA reports, presentations, and decision packages. The *Guidance* addresses a problem that affects public perception regarding the reliability of EPA's scientific assessments and related regulatory decisions. It includes specific sections on [Exposure Assessment and Risk Descriptors](#) and [Risk Assessment - Risk Management Interface](#).

[Risk Assessment Calculations](#)

Based on ASTM's training workshop, this slide presentation provides a review of risk assessment calculations, including toxicity assessment, exposure assessment, and risk characterization calculations.

2.5 Databases

[Integrated Risk Information System \(IRIS\)](#)

IRIS is a database of human health effects that may result from exposure to various substances found in the environment. Initially developed for EPA staff, IRIS is intended for those without extensive training in toxicology. For additional information follow this link to the IRIS home page.

[Provisional Peer Reviewed Toxicity Values \(PPRTV\)](#)

EPA's Office of Research and Development/National Center for Environmental Assessment/Superfund Health Risk Technical Support Center (STSC) develops PPRTVs on a chemical-specific basis when requested by EPA's Superfund program. The PPRTV Web site is restricted to EPA users only. For more information or to get access please contact EPA's Superfund Office.

[California Department of Toxic Substances Control \(DTSC\)](#)

DTSC Environmental Science and Technology webpage offers several links to programs and risk assessment resources. Another useful chemical database from Cal/EPA Office of Environmental Health Hazard Assessment (OEHHA) is the [Toxicity Criteria Database](#).

[Agency for Toxic Substances and Disease Registry \(ATSDR\)](#)

This Web site is an excellent source of information on public health related activities and databases regarding human health exposure to hazardous substances. Also visit ATSDR's [ToxFAQs](#), a series of summaries about hazardous substances developed by the ATSDR Division of Toxicology.

[Health Effects Assessment Summary Tables \(HEAST\)](#)

HEAST tables were developed by EPA's Office of Radiation and Indoor Air (ORIA) to assist with risk-related evaluations and decision-making at various stages of remediating radionuclides.

[Preliminary Remediation Goals \(PRGs\)](#)

PRGs are preliminary goals based on readily available information for specific chemicals in a specific medium and land use combination. Risk managers typically use the PRGs as long-term targets during the analysis and selection of remedial alternatives.

[Toxics Release Inventory \(TRI\)](#)

EPA's TRI contains information about releases and transfers of more than 650 toxic chemicals and compounds to the environment.

[TOXNET](#)

Part of National Library of Medicine's (NLM) Specialized Information Services (SIS) that provides a collection of databases on hazardous chemicals, toxic releases, and environmental health. Other useful SIS Web sites include: [Chemical Information](#), [Outreach Activities and Resources](#), and [Directory of Health Organizations](#).

[ChemID Plus](#)

The National Library of Medicine maintains this comprehensive dictionary of over 370,000 chemicals with links to other databases.

2.6 Guidelines

[National Center for Environmental Assessment \(NCEA\)](#)

The NCEA is EPA's resource center for human health and ecological risk assessment. NCEA conducts risk assessments, carries out research on the science of risk assessment, and provides guidance and support to risk assessors.

[Risk Assessment Guidance for Superfund \(RAGS\)](#)

RAGS provides EPA guidance on the human health evaluation activities that are conducted during a baseline risk assessment, including: data collection and analysis; exposure assessment; toxicity assessment; and risk characterization.

[Risk Assessment Information System \(RAIS\)](#)

RAIS covers risk assessment, regulatory guidance, and useful risk assessment analysis tools, including: Risk-Based Preliminary Remediation Goal (PRG) calculations, a Toxicity data base, Risk Calculations, and Ecological Benchmarks.

[The International Toxicity Estimates for Risk \(ITER\) database](#)

On-line database that provides side-by-side comparisons of risk values and/or cancer classifications from organizations around the world, including: Health Canada, EPA, RIVM—The Netherlands, IARC (in progress), ATSDR, and independently developed risk values that have undergone peer review.

[EPA Region 6 Corrective Action Strategy \(Region 6 CAS\)](#)

This link connects to a Microsoft PowerPoint-based overview of Region 6 CAS by Daniel Clayton, Arkansas Department of Environmental Quality.

[Framework for Cumulative Risk Assessment](#)

EPA's *Framework* is the first step in a long-term effort to develop cumulative risk assessment guidance. Building on EPA's growing experience with cumulative risk assessment, the *Framework* identifies the basic elements of the cumulative risk assessment process and provides a flexible structure for conducting and evaluating cumulative risk assessment, and for addressing scientific issues related to cumulative risk.

[Contaminated Sediment Remediation Guidance for Hazardous Waste Sites](#)

This *Guidance* is designed to assist EPA staff managing sediment sites by providing a thorough overview of methods that can be used to reduce risk caused by contaminated sediment.

3. Ecological Risk Assessment (ERA)

ERA is a process that evaluates the occurrence of adverse ecological effects due to exposure to one or more stressors. As the second part of a risk assessment, the ERA addresses wildlife and plant life. The following links describe the process for performing an ERA as well and provide links for useful analysis tools.

[EPA's Ecological Risk Assessment and the Ecological Technical Center](#)

This Web site provides a number of useful resources including:

- [What is ERA?](#)
- [Guide to eight-step ERA process](#)
- [Guidance to the Screening ERA Process](#)
- [ERA Tools](#)
- [Screening Benchmarks](#)
- [Case Studies](#)
- [Toxicity Profiles](#)

[Ecological Risk Assessment Guidance for Superfund](#)

Provides EPA guidelines for the process of designing and conducting ERAs.

[National Ambient Water Quality Criteria Chronic Values \(NAWQC chronic\)](#)

The NAWQC chronic values represent concentrations of chemicals that should be protective against chronic effects occurring in 95% of all species.

[Oak Ridge National Laboratory \(ORNL\)](#)

ORNL provides conservative estimates of protective concentrations to chronic effects to aquatic organisms.

[EPA Region 4 Ecological Risk Assessment Bulletin](#)

This site provides a table of preliminary ecological screening values for use at remediation sites to determine if further evaluation of ecological risk is required. The values are based on conservative endpoints and sensitive ecological effects data.

[EPA Region 5 RCRA Corrective Action Ecological Screening Levels](#)

A compilation of ecological screening levels for 223 chemicals for water, sediment, and soil. These values represent protective benchmarks and are intended to be used as an initial screening level for ERA.

[Ecological Risk Assessments Fact Sheet](#)

Alaska Department of Environmental Conservation's fact sheet answers: What Is an Ecological Risk Assessment? What is the Ecological Risk Assessment Process? How Are the Results Used?

[EPA Ecological Risk Assessment Training](#)

EPA's training Web site includes a [What is ecological risk assessment?](#) introductory section, five course modules, and interactive components to teach users about ecological risk assessment step by step, while giving the user control over the depth of the investigation.

[EPA's Tools for Ecological Risk Assessment](#)

EPA's Web site provides guidance, tools and databases that might be useful in preparing ecological risk assessments on the types of hazardous waste sites addressed by OSWER programs, such as [General Guidance Information](#), [Problem Formulation](#), [Characterization of Exposure](#), [Characterization of Ecological Effects](#), [Risk Characterization](#), and [Risk Management](#).

[Developing a Scope of Work for Ecological Assessments](#)

This EcoUpdate bulletin helps Remedial Project Managers to plan and manage ecological assessments as part of the Remedial Investigation/Feasibility process.

[EPA's Risk Assessment Guidelines –Ecological Risk Assessment](#)

EPA's *Risk Assessment Guidelines* were developed to help guide EPA scientists in assessing ecological risks to human health from chemicals or other agents in the environment. They also inform EPA decision-makers and the general public about these procedures. Below is a list of current *Ecological Risk Assessment Guidelines*:

- [Guidelines for Ecological Risk Assessment](#)
These Agency-wide *Guidelines* are provided to improve the quality and consistency of EPA's ecological risk assessments. The *Guidelines* expand on and replace the 1992 report, *Framework for Ecological Risk Assessment*. A major theme of the guidelines is the interaction among risk assessors, risk managers, and interested parties at the beginning (planning and problem formulation) and end (risk characterization) of the risk assessment process.
- [Stressor Identification Guidance Document](#)
This *Guidance* document describes the organization and analysis of available evidence to determine the cause of biological impairment.
- [Exposure Factors Handbook](#)
The *Handbook* provides a summary of the available statistical data on various factors used in assessing human exposure. It is addressed to exposure assessors inside the Agency as well as outside, who need to obtain data on standard factors to calculate human exposure to toxic chemicals.
- [Wildlife Exposure Factors Handbook](#)
This *Handbook* provides data, references, and guidance for conducting exposure assessments for wildlife species exposed to toxic chemicals in their environment.

[Framework for Ecological Risk Assessment](#)

EPA's report describes basic elements, or a framework, for evaluating scientific information on the adverse effects of physical and chemical stressors on the environment. The *Framework* offers starting principles and a simple structure as guidance for current ecological risk assessments and as a foundation for future EPA proposals for risk assessment guidelines.

[Generic Ecological Assessment Endpoints \(GEAE\) for Ecological Risk Assessment](#)

This document builds on existing EPA guidance and experience in ecological risk assessment and provides guidance to risk assessors involved in conducting an ecological assessment. The document describes a set of endpoints, known as generic ecological assessment endpoints, which can be considered and adapted for specific assessments.

[Using Toxicity Tests in Ecological Risk Assessment](#)

This EcoUpdate Bulletin describes the purpose and process of toxicity testing in ecological risk assessments.

[EPA Ambient Water Quality Criteria Update for Methyl Tertiary-Butyl Ether \(MTBE\)](#)

EPA is now providing an update on aquatic life ambient water quality criteria development for methyl tertiary-butyl ether (MTBE). Since 1999, EPA conducted a careful review of 33 toxicity studies and a national survey of MTBE occurrence in surface waters. EPA has determined that MTBE typically is found in the aquatic environment at levels far below those that are toxic to aquatic life. Consequently, EPA does not intend at this time to publish new ambient water quality criteria for MTBE under Section 304(a) of the Clean Water Act.

[Sediment Quality Guidelines](#)

Published by Ontario, Canada's Ministry of the Environment, the purpose of the *Sediment Quality Guidelines* is to protect the aquatic environment by setting safe levels for metals, nutrients and organic compounds. The guidelines are designed to help environmental managers make decisions on a whole range of issues that affect the quality of sediment.

[NOAA Screening Quick Reference Tables \(SQuiRTs\)](#)

NOAA has developed a set of Screening Quick Reference Tables, or SQiRTs, that present screening concentrations for inorganic and organic contaminants in various environmental media. The SQiRTs also include guidelines for preserving samples and for analytical technique options.

[Guidance for Developing Ecological Soil Screening Levels.](#)

This EPA/OSWER document describes the process used to derive a set of risk-based ecological soil screening levels (Eco-SSLs) for many of the soil contaminants that are frequently of ecological concern for plants and animals at hazardous waste sites and provides guidance for their use.

[Screening Benchmark Reports](#)

This ORNL Web site presents and analyzes alternate toxicological benchmarks for screening chemicals for aquatic, wildlife, terrestrial plant, sediment, soil invertebrates and microbial processes ecological effects.

[EPA Soil Screening Levels \(Eco-SSL\)](#)

The Ecological Soil Screening Level (Eco-SSL) derivation process represents the collaborative effort of a multi-stakeholder workgroup consisting of federal, state, consulting, industry and academic participants led by the U.S. EPA Office of Emergency and Remedial Response. It is emphasized that the Eco-SSLs are soil screening numbers, and as such are not appropriate for use as cleanup levels. Screening ecotoxicity values are derived to avoid underestimating risk. The Eco-SSL Web site provides an overview of the contaminant. Separate discussions are provided for each receptor group including a comprehensive list of literature evaluated under the effort, and a summary of data used in deriving Eco-SSL values.

4. Special Topics

Links are provided below regarding some current issues in the rapidly changing field of risk assessment.

4.1 Child Risk Assessment

- [Cal/EPA OEHHA Children's Health](#) and [Children's Health References](#)
- [ATSDR Office of Children's Health](#)

4.2 Hot Spots

[Guidance for Identification of Hot Spots](#)

The definition of a "hot spot" of contamination remains a contentious issue for sampling environmental media and estimating risk. The objective of this Oregon Department of Environmental Quality document is to assist in identifying hot spots.

4.3 Lead

[EPA Guidance Manual for the IEUBK Model for Lead in Children](#)

EPA developed an uptake/biokinetic model known as the Integrated Exposure Uptake Biokinetic Model (IEUBK) to evaluate the risks posed by lead exposures. This model predicts potential blood lead levels for children from 0 to 7 years of age.

[Adult Lead Methodology](#)

EPA recommendations of the "Technical Review Workgroup for Lead for an Approach to Assessing Risks Associated with Adult Exposures to Lead in Soil." It contains downloads and FAQs.

[Assessing Intermittent or Variable Exposures at Lead Sites](#)

This EPA/OSWER document should be consulted when using the IEUBK or the ALM. Provides guidance and recommendations for the assessment of lead risks when exposures are not continuous and chronic (e.g., day care, recreation, or trespass scenarios). This guidance is intended to augment existing guidance pertaining to the IEUBK model and Adult Lead Methodology. This methodology is not intended to replace the approaches recommended for assessing standard residential or continuous non-residential exposure scenarios, which are the most common applications for the IEUBK model and the ALM respectively.

[EPA Lead Workgroup Web Site](#)

Lead contamination at Superfund sites presents a threat to human health and the environment. This Web site describes EPA's approach to addressing those risks, and the challenges of remediating lead contamination at Superfund sites.

4.4 Asbestos

[EPA Asbestos Working Group Web Site](#)

Asbestos is the name given to a number of naturally occurring fibrous silicate minerals that have been mined for their useful properties such as thermal insulation, chemical and thermal stability, and high tensile strength. Asbestos is used in many commercial products, including insulation, brake linings, and roofing shingles. Past practices have led to environmental contamination and subsequent action under the Superfund (CERCLA) program. This Web site describes EPA's approach to addressing those risks, and the challenges of remediating lead contamination at Superfund sites.

4.5 Perchlorate

This chemical compound, made up of chlorine and oxygen atoms, is used primarily as an ingredient of rocket propellant, and can also be found in airbag systems, fireworks, flares, and certain agricultural fertilizers. The EPA has recently detected perchlorate in several drinking water sources across the United States, although a federal Maximum Contaminant Level (MCL) has not been set for drinking water standards.

[NAS Health Implications of Perchlorate Ingestion](#)

[The NAS Perchlorate Review: Questions Remain About the Perchlorate RfD](#)

4.6 Deterministic Risk Assessment

[Deterministic risk assessment](#) involves the calculation and expression of health risks as single numerical values, or "single point" estimates of risk. In risk assessments, the uncertainty and variability are discussed in a qualitative manner. Visit the following resource for more information:

[Deterministic Risk Assessment Guidance](#)

Arizona Department of Health Services' document provides guidance for parties using risk assessment to develop site-specific health-based cleanup levels. The approach uses simplified default equations while still allowing the flexibility to consider site-specific conditions at the site. The approach uses a summary document that describes the methodology used to calculate the standards, but does not require the development of a complete human health risk assessment.

4.7 Probabilistic Risk Assessment (PRA)

In contrast to deterministic risk assessment, which includes single data points in equations to describe the risk to exposed population, PRA utilizes a range of values. Links to useful PRA Web sites are provided below.

[Risk Assessment Guidance for Superfund Vol. 3 Part A: Process for PRA \(RAGS 3A\)](#)

RAGS 3A provides technical guidance on the application of probabilistic methods to human health and ecological risk assessment. This *Guidance* focuses on Monte Carlo analysis (MCA) as a method of quantifying variability and uncertainty in risk. See also EPA's [Guiding Principles for Monte Carlo Analysis](#).

[Handbook of Parameter Estimation for Probabilistic Risk Assessment](#)

A document prepared for the Division of Risk Analysis and Applications from the Office of Nuclear Regulatory Research.

[NIST/SEMATECH Engineering Statistics Handbook](#)

This is an on line statistics handbook useful for PRA evaluation.

[Using Probabilistic Risk Assessment to Further Characterize Risks](#)

This chapter of the [U.S. Navy Human Health Risk Assessment Guidance](#) presents the technique of how to conduct a probabilistic risk assessment using a range of estimates to calculate the risks. This results in a range of risks and highlights the predominant contributing factors.

[Probabilistic Analysis in Risk Assessment](#)

EPA's policy and associated documents have been developed to provide greater clarity on the use of probabilistic risk assessment techniques.

4.8 Radiation Risk Assessment

The links below address some of the unique issues that arise during the assessment of risk due to exposure of radiation.

[International Agency for Research on Cancer](#) (IARC)

IARC's mission is to coordinate and conduct research on the causes of human cancer, and to develop scientific strategies for cancer control. The Agency is involved in both epidemiological and laboratory research, and disseminates scientific information through meetings, publications, courses and fellowships.

[Guidelines for Carcinogen Risk Assessment](#)

This Web site contains EPA's National Center for Environmental Assessment (NCEA) initial cancer guidelines, draft revisions, and contacts. Also refer to EPA's [Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens](#) for background, history, and downloads of NCEA cancer guidelines.

["Risk-Based Screening of Radionuclide Releases from the Savannah River Site"](#)

This document is the final phase of the Dose Reconstruction Project led by the Center for Disease Control and Prevention (CDC). It has a very good section on risk and uncertainty, which focuses on health operations of the surrounding populations within the SRS.

4.9 Vapor Intrusion

[Vapor Intrusion to Indoor Air](#)

EPA issues a draft guidance that provides current technical and policy recommendations on determining if the vapor intrusion pathway poses an unacceptable risk to human health at cleanup sites.

[Vapor Intrusion Pathway: A Practical Guideline](#)

This ITRC document consists of four chapters: an overview of vapor intrusion, preliminary screening of sites, site investigation, and mitigation. Appendix H provides guidance on the development of Screening Levels using standardized risk calculations.

[Vapor Intrusion Pathway: Investigative Approaches for Typical Scenarios—A Supplement to *Vapor Intrusion Pathway: A Practical Guideline*](#)

This ITRC supplement describes applicable approaches for evaluating the vapor intrusion pathway in six typical scenarios.

[Johnson and Ettinger Model for Subsurface Vapor Intrusion into Buildings](#)

The above link connects to a fact sheet and users guide to the Johnson and Ettinger Model.

5. Risk Communication

The goal of an effective risk communication effort is to produce an informed public and not just to defuse public concerns. Below is a list of Web sites that may be helpful in developing a risk communication plan.

[A Primer on Health Risk Communication Principles and Practices](#)

This ATSDR site provides a framework of principles and approaches for the communications of health risk information to diverse audiences.

[Evaluation Primer on Health Risk Communication Programs and Outcomes](#)

This primer presents ATSDR's key principles and techniques to assist federal decision-makers and health risk communicators to improve their overall effectiveness in evaluating health risk messages and materials. This primer is also available in [Spanish](#).

[EPA RCRA Public Participation Manual](#)

This Web site is a good basic resource for developing a public information plan.

[Emergency and Risk Communication from the CDC](#)

While written for dealing with a crisis or emergency situation, much of the guidance is applicable to remediation sites. The site is written for science or public health professionals that need to provide information to an individual, stakeholders or an entire community. A companion publication entitled, "[Communication in a Crisis: Risk Communication Guidelines for Public Officials, 2002](#)" was published by the U.S. Department of Health and Human Services. The [DH&HS webpage](#) contains additional information about communicating risk.

[The United States National Library of Medicine National Institutes of Health \(NIH\)](#)

This site has a comprehensive Web site with links to most topics related to risk communication including, 1) public understanding of science, 2) public perception of risk, 3) ethics of risk communication, and 4) government and other agency's role in risk communication.

[Principles of Risk Communication](#)

This chapter from the U.S. Coast Guard's [Risk-based Decision-making Guidelines](#) provides an overview of basic risk communication principles that play a key role in the risk-based decision-making process.

[Risk Communications](#)

On the U.S. Army Center for Health Promotion and Preventive Medicine Web site, users will find a variety of resources on risk communication, including [Risk Communication Guidelines](#), [Principles](#), [Resources](#), and [Tools](#). In addition, users will find the presentation, [A Risk Communication Revolution: Process vs. Event](#), which examines the need for early issue identification, analysis, and planning.

[Risk Communication Principles and Techniques](#)

Chapter 11 from the [U.S. Navy Human Health Risk Assessment Guidance](#) presents basic concepts and techniques for effective risk communication.

[Risk Communication: Working with Individuals and Communities to Weigh the Odds](#)

The Office of Disease Prevention and Health Promotion's document focuses on the Principles of Risk Communication, the Foundation of Risk Communication, and the Benefits and Barriers Associated with Risk Communication in addition to ideas to overcome such barriers.

[Risk Communication Basics](#)

Chapter 6 from [A Journalist's Handbook on Environmental Risk Assessment](#) reviews risk communication principles and provides examples of risk communication obstacles and techniques.

[Risk Communication](#)

This presentation provides an overview of risk communication, stakeholder identification, community involvement, and assessment.

[Communicating in a Crisis: Risk Communication Guidelines for Public Officials](#)

The U.S. Department of Health and Human Services' document reviews risk communication fundamentals and principles and provides valuable tools for communicating risk.

[Risk Communication Guidelines](#)

The Maxwell-Gunter U.S. Air Force Base Air University's fact sheet presents concise guidelines for communicating risk.

[Risk Communication in Action: The Risk Communication Workbook](#)

EPA's workbook describes concepts of risk communication based on perceptions, value differences, persuasion, and presentation of factual material. It includes sample EPA risk communication documents; communication tools and techniques; case studies; and workbook exercises.

[Risk Communication - A Guide to Regulatory Practice](#)

This document, by the U.K.'s Inter-Departmental Liaison Group on Risk Assessment, sets out four simple principles to help governmental departments look critically at what they do and improve the way they communicate about risks.

[Communicating Risk, UK Resilience](#)

Administered through the Civil Contingencies Secretariat, UK Resilience is the United Kingdom's emergency preparedness Web site. The tool kit found on this site was developed to help users plan communication strategies, develop their understanding of risk, and improve their knowledge of its likely effects.

6. Risk Management

In the [risk management](#) process, the results of the risk assessment are integrated with other considerations, such as economic or legal concerns, to reach decisions regarding the need for and practicability of implementing various risk reduction activities. The term "risk management" essentially describes a type of decision making process. First, a decision must be made as to whether an assessed risk needs to be reduced to protect public health and the environment. Next, if it is decided that action is necessary, a decision must be made about the way to reduce that risk. Risk managers use risk assessment results as a basis for communicating risks to interested parties and the general public. Visit the following resources for more information:

[The NAS Risk Assessment Paradigm](#)

The National Academy of Sciences (NAS) concluded that risk assessment and risk management are "two distinct elements" between which agencies should maintain a clear conceptual distinction. [Click here](#) for an animated version of this paradigm diagram.

[Risk Assessment as a Risk Management Tool](#)

This University of Pittsburg presentation reviews some of the tools available to risk managers, and decision-makers.

[Principles of Risk Management](#)

This chapter from the U.S. Coast Guard's [Risk-based Decision-making Guidelines](#) provides an overview of risk management principles that play a key role in the risk-based decision-making process.

[Envirorisk](#)

Developed by University of Illinois at Chicago's School of Public Health, this free, web-based interactive tutorial is a case-based, problem-solving program in environmental risk assessment and risk communication.

Tutorial users gain or improve skills in:

- gathering information about specific hazards,
- gathering information about adverse health effects,
- evaluating the health effects of a chemical toxin,
- partnering with public health agencies in addressing community needs, and
- applying principles of risk communication to inform and educate your constituency.

[Framework for Environmental Health Risk Management](#)

The Presidential/Congressional Commission on Risk Assessment and Risk Management developed this *Framework* to guide investments of valuable public sector and private-sector resources in researching, assessing, characterizing, and reducing risk. The authors set forth principles for making good risk management decisions and for actively engaging stakeholders in the process. The Commission's *Framework* defines a clear, six-stage process for risk management.

[Risk Assessment and Risk Management in Regulatory Decision-Making](#)

The Presidential/Congressional Commission on Risk Assessment and Risk Management's report discusses the dependence of human health on a healthy environment, the applicability of the general approaches of health risk assessment to ecological risk assessment, and the need for benefit-cost analyses of proposed actions to assess benefits beyond those to human health.

[Risk Management - Information Needed for Decision- Making](#)

Chapter 2 of [USACE's Risk Assessment Handbook Volume I](#) establishes a framework for managing risk on a site-specific basis by considering the strengths, limitations, and uncertainties inherent in the risk assessment as well as in other non-risk factors.

[Understanding Risk in Everyday Policy Making](#)

This document, developed by the United Kingdom's Department for Environment, Food and Rural Affairs, examines the complex relationship between public trust and science-based assessments of risk.

[Ecological Risk Assessment and Risk Management Principles for Superfund Sites](#)

EPA developed this guidance intended to help Superfund project managers to make ecological assessment decisions that are consistent across the United States and are transparent to the public.

[Policy, Risk, and Science: Securing and Using Scientific Advice](#)

A report prepared by Oxford Economic Research Associates for the UK Government's Health and Safety Executive. The study aims to improve the quality of scientific advice received by government and used in policy development.

[Risk Management](#)

Chapter 12 from [U.S. Navy Human Health Risk Assessment Guidance](#) presents guidelines that risk managers should consider when evaluating risk assessment information in order to make risk management decisions at a site.

[Science and Judgment in Risk Assessment](#)

The Board on Environmental Studies and Toxicology (BEST) explores how EPA can improve its risk assessment practices under the 1990 Clean Air Act Amendments and other regulatory statutes. It examines the assumptions made in risk analysis, how to deal with uncertainty, and other basic concepts, such as "inference assumptions", "default options", and the historical, social, and regulatory contexts of risk assessment and risk management.

7. Additional Risk-Related Links

7.1 Interstate Technology Resource Council (ITRC)

ITRC is a state-led coalition working together with industry and stakeholders to achieve regulatory acceptance of environmental technologies. The Risk Team seeks to expand understanding of the variety of methods, assumptions, and issues surrounding risk assessment and management in corrective actions.

[ITRC Home Page](#)

[ITRC Risk Team Web site](#)

[ITRC Risk Team White Paper](#)

[ITRC Risk Team Internet-Based Training](#)

ITRC Risk Team Case-Study Document

(In publication. Visit the [ITRC Web site](#) to access the document, which will be available on September 15, 2008).

7.2 Seminars, Conferences, Training Opportunities

[ITRC Internet-Based Training](#)

ITRC develops and delivers training courses via the Internet to reach a geographically dispersed audience of regulators, consultants, and other members of the environmental community. A list of courses and schedules is provided. These courses can also be accessed through the [EPA Hazardous Waste Clean-Up Information \(a.k.a. CLU-IN\)](#) webpage.

[Midwestern States Risk Assessment Symposium](#)

The above is a link to the 2006 Symposium Presentation Report (agenda, presentations, and abstracts). The MSRAS event is biannual, and the host institution and logistics may change with each new conference.

Regional Risk Assessors' Conference (EPA and State Risk Assessors co-event).

[EPA Science Forum](#)

- Demonstrates EPA's commitment to quality science;
- Highlights high-priority topics and accomplishments;
- Facilitates dialogue among EPA scientists and their partners, clients, customers, stakeholders, and colleagues from across government, the private sector, academia, and the scientific community; and
- Demonstrates how the EPA provides the right science for the right questions.

[The Training Exchange Web Site](#)

The above link connects to descriptions, schedules and online registration links for EPA courses and additional links to government and non-government training opportunities.

The ITRC Risk Team is comprised of risk assessors and toxicologist from various states. Below are the links to these member's state agency Web sites containing policies and procedures:

[Alaska](#), [Alabama](#), [Arizona](#), [Arkansas](#), [California](#), [Colorado](#), [Connecticut](#), [District of Columbia](#), [Florida](#), [Georgia](#), [Idaho](#), [Kansas](#), [Maryland](#), [Missouri](#), [Mississippi](#), [Nevada](#), [New Jersey](#), [Ohio](#), [Oklahoma](#), [Oregon](#), [Nebraska](#), [Pennsylvania](#), [South Carolina](#), [Tennessee](#), [Texas](#), [Utah](#), [Virginia](#), [Washington](#), and [Wisconsin](#).

A complete listing of State Environmental Agencies can be found on the [U.S. Environmental Protection Agency \(EPA\) Web site](#).

Besides state regulators, the Risk team also has members from [EPA](#), [Department of Energy](#), [Department of Defense](#), [US Army Corps of Engineers](#), [US Army](#), [US Navy](#), state stakeholders, and private industry.