THE ABC'S OF RISK ASSESSMENT

Restoration Advisory Board Fact Sheet | Travis Air Force Base, California | October 2003

This fact sheet is based on a recent presentation to the Travis AFB Restoration Advisory Board (RAB) by Elizabeth Allen, an environmental toxicologist from TechLaw, Inc. The presentation consisted of responses by Ms. Allen to a series of questions from several members of the Travis RAB. Ms. Allen provides technical support to the U.S. Environmental Protection Agency.

What is risk?

Risk is defined as the likelihood of adverse health effects arising from exposure to a hazard in a human population. Health risks, put simply, are a measure of the chance that you will experience health problems. Conceptually, it is expressed as the product of two factors: the probability of exposure and the severity of the consequences.

What is risk assessment?

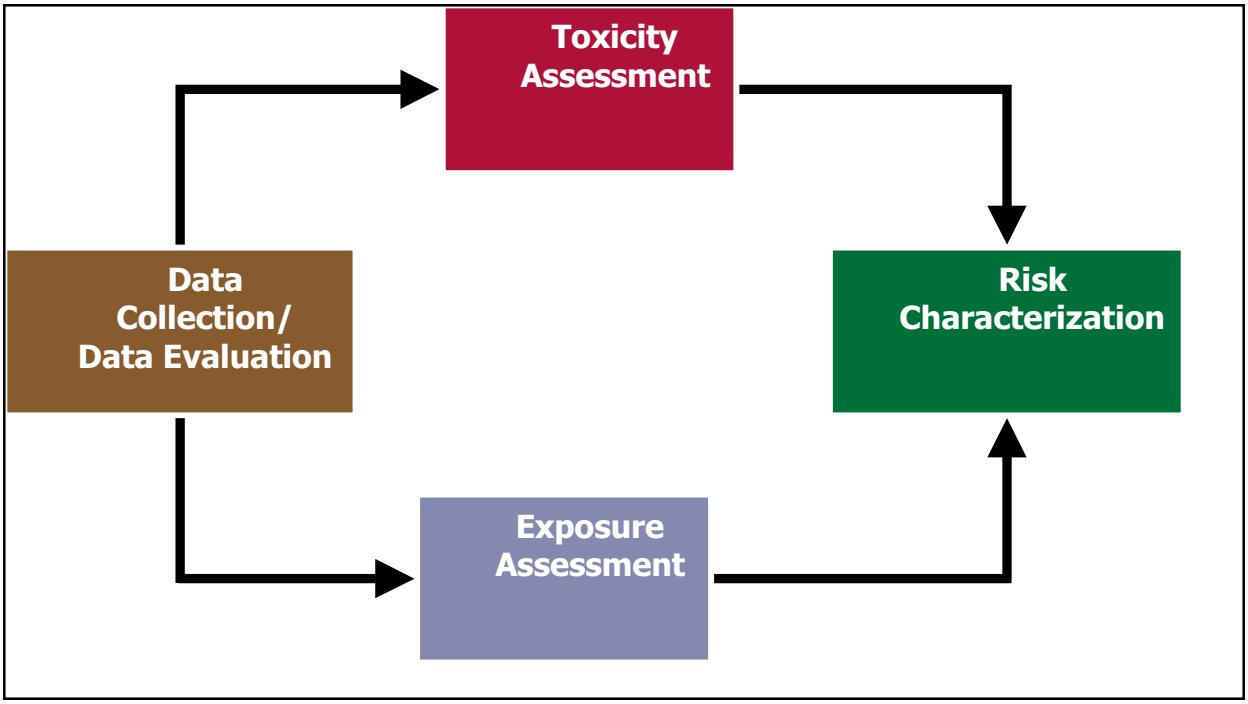
Risk assessment is the process used to estimate how people might be exposed to chemicals in the environment, the amount of this exposure, and how and to what degree their health may be affected as a result of the exposure to these chemicals.

Risk assessment consists of four steps:

Data collection and evaluation: We find out what has happened at the site and where contamination may be present. From the samples that are collected, we can identify the contamination that is present, its location, and its concentrations.

Exposure assessment: In the exposure assessment we take the information gathered in the first step and combine it with what we know about the activity patterns of people who will be at the site. From this information, we can make a determination of who might be exposed, and how they might be exposed. In the exposure assessment, we make assumptions about the activities that people engage in to estimate the degree of the exposure.

Figure 1. The Four Steps of Risk Assessment



To learn more about the Travis Air Force Base Environmental Restoration Program, visit ***http://public.travis.amc.af.mil/pages/enviro/***

Information gathered from various sources for the exposure assessment includes answers to the following questions:

1. Who are the people that are likely to be present at the site (e.g., are they residents, schoolchildren, persons who work at a facility?)

2. Where is the contamination located? Is it in soil, groundwater or surface water, in the air?

3. How often, and for how long could someone be exposed?

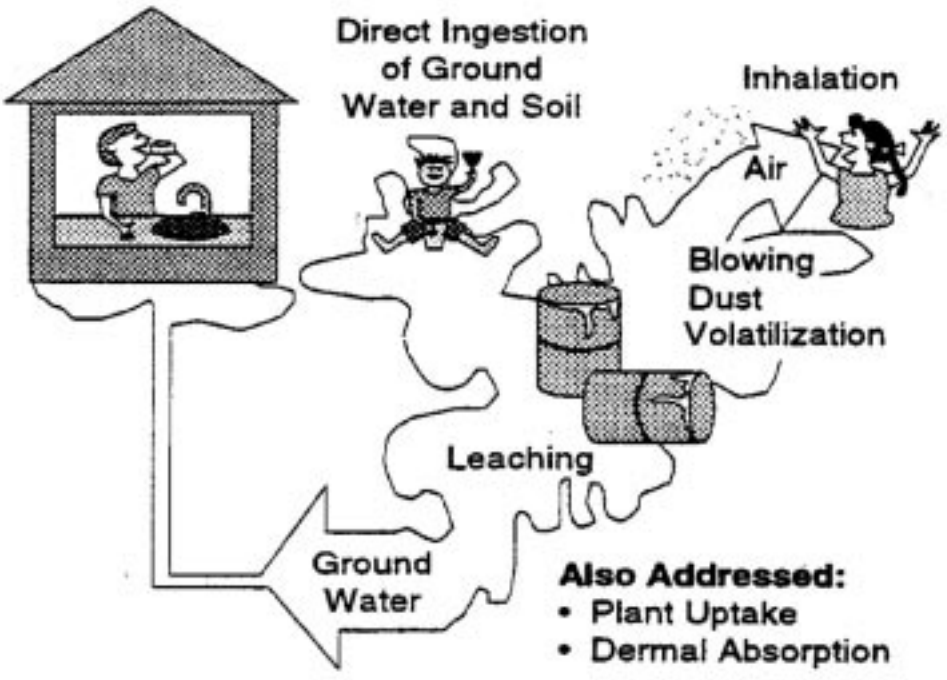
What are the specific ways that exposure to contamination can occur? There are several common ways that this can happen.

For soil contaminants, we can be exposed by eating the soil. This may sound strange, but if our hands are dirty, every time we touch our mouths, or lick our fingers-we are eating (or ingesting) a little bit of soil. Soil contaminants can also be absorbed through the skin when we have dirt on us, even if the amount of soil on our skin seems negligible. We also breathe in dust particles that are suspended in the air from wind erosion or from the movement of vehicles or other equipment. We actually also swallow some of these "inhaled" particles without even realizing it. Chemicals that are volatile (those that evaporate quickly, such as alcohol) can be present as vapors in the air that we breathe.

For contamination in water, we can be exposed by drinking the water, using it to bathe or shower (or swimming if the contamination is present in surface water). For those chemicals that volatilize readily, we can also breathe in those chemicals as they volatilize from the water that we use for showers or bathing, running the dishwasher, or even cooking.

For all of these exposure pathways, risk assessors use what are called "exposure factors" to estimate the actual degree of exposure. These values are compiled from various studies, and are listed in EPA's Exposure Factors Handbook (*http://cfpub.epa.gov/ncea/cfm/recordisplay.cfm?deid=12464*). Typical values that may be used include how much soil we accidentally ingest (as much as 100 milligrams per day, or mg/day), how much air we breathe (typically 20 cubic meters per day (m^3/day), and how much water the typical person drinks in a day (2 liters). We also need to know how long the exposure might be. For example, the median length of time (50th percentile) that people in the United States live in the same house is 9 years; the 90th percentile is 30 years. Because we want to be protective of the greatest number of people, we generally use the 30-year values. From this information, and knowing the concentration of the contamination in soil, air, and water, we can

Figure 2. Exposure Pathways



estimate the amount, or the dose, of the contaminant a person is receiving. This is presented in terms of milligrams of chemical per kilogram of body weight per day (mg/kg-day).

Toxicity assessment: This is the process through which we identify what health effects are caused by various chemicals, and how much, or what dose, is needed to cause these effects. The toxicity assessment is composed of two steps: (1) hazard identification and (2) dose-response assessment. Hazard identification is the process of determining whether an exposure to a chemical may result in an adverse health effect in humans. It consists of characterizing the nature of the effect, and the strength of the evidence that the chemical will cause the adverse effect. Dose-response assessment characterizes the relationship between the dose and the incidence and/or severity of the adverse health effect in the exposed population.

For risk assessment purposes, chemicals are generally separated into categories based on their toxicologic endpoints. Examples of toxicologic endpoints are low white blood cell production, liver disorders, and tumors. The primary basis of this categorization is whether a chemical exhibits potentially carcinogenic (cancer-related) or noncarcinogenic (not cancer-related) health effects. Because chemicals that are suspected carcinogens may also give rise to noncarcinogenic effects, they must be evaluated separately for both effects. The numerical expression of the toxicity assessment is known as a cancer slope factor (CSF) when we are evaluating cancer risks. A CSF is an estimate of the statistical probability of a carcinogenic response per unit intake of a chemical over a lifetime.

The toxicity information most often used to evaluate noncarcinogenic effects for purposes of risk assessment is the reference dose (RfD). An RfD is an estimate of a daily exposure level for humans including sensitive individuals that are likely to be without an appreciable risk of an adverse health effect during a lifetime. These are expressed in units of milligrams per kilogram per day (mg/kg-day).

The EPA's toxicity criteria database is known as the Integrated Risk Information System (IRIS) and can be found at *www.epa.gov/IRIS*. Another good source of information is the Cal EPA Toxicity Criteria Database that can be accessed through the Office of Environmental Health Hazards Assessment's web site at *www.oehha.ca.gov/risk.html*.

Risk characterization: This is the final step of the process. It combines the results of the exposure assessment and toxicity assessment to estimate the likelihood of a person (or a population) experiencing adverse health effects due to the contamination. Cancer risks are calculated by multiplying the CSF and the estimated dose. Noncarcinogenic risks are estimated by taking the ratio of the dose to the RfD. If this ratio is less than 1, then the dose is less than the safe level, and the chemical exposure is considered unlikely to be associated with any heath effects, even for sensitive persons. Conversely, chemicals with a hazard quotient that is greater than 1 may pose a risk of adverse health effects.

What is risk management?

For CERCLA, risk management is the process through which the results of the risk assessment, including the overall confidence in the accuracy, are considered along with other factors such as cost, technical practicability, legal requirements, and public acceptance. The purpose of risk management is to decide whether cleanup of contamination is needed, and if so, how much contamination (if any) is safe to leave in place.

What is immediate risk? What is potential risk?

Immediate risk usually refers to acute effects. Examples include something that causes your eyes to burn and water or makes it difficult to breathe. Usually these effects are short-lived. Potential risk is what we generally consider in Superfund because people may not be exposed to the contamination today, but exposure may take place some time in the future, or they are exposed to levels that may not result in an immediate or observable health effect in the short term, but that may become apparent over time. We want to know about this possibility now so that we can prevent these health effects from happening.

How can a chemical in the soil or groundwater hurt me? Can a site hurt me or my family if I walk on it?

We use the risk assessment to answer the first question. It depends on the type and level of contamination, but it can only cause harm if you are exposed. The levels of contamination in soil at Travis AFB are not high enough to cause acute effects, and even for those sites that are being cleaned up, short-term exposures are safe. We are still cleaning them up, because there is the possibility that if someone were exposed over a long period of time, there is a potential for adverse health effects.

Is the drinking water on Travis AFB safe?

Travis AFB gets most of its drinking water from the City of Vallejo, so it is the same clean and safe water that Vallejo residents get in their homes and at work.

How do you know when a site is clean?

First, we use the information we collect to perform the risk assessment. Then, by deciding what level of risk is acceptable (or what level of contamination would not cause noncarcinogenic health effects), and by using a little high-school algebra, we can rearrange the equation so that we calculate a concentration in soil. When the site contamination is cleaned up to those levels, we can be fairly certain that the site is safe.

What is a compliance level? Who is the point of contact for compliance levels for EPA? For the California Department of Toxic Substances Control (DTSC)?

There really aren't any compliance levels for contamination in soil. That's why we use the risk assessment to calculate chemical concentrations in soil that will not result in adverse health effects. The points of contact are the remedial project managers for Travis AFB, US EPA, DTSC, and the Regional Water Quality Control Board (RWQCB).

Where can I learn more about contaminated sites at Travis AFB?

Travis AFB has a very good website that provides a brief description of each of the sites and the type of contamination present. There is also a photo of each site. The web address is *http://public.travis.amc.af.mil/pages/enviro/projects/index.html*. You can also look in the information repository at the Vacaville Public Library.

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or view our web site at http://public.travis.amc.af.mil/pages/enviro

For more information about Travis AFB's restoration program, please contact:

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