



Risk Assessment and Risk Management

The best way to clean up most contaminated sites is to use a permanent remediation method such as off-site removal. Permanent solutions are preferred and encouraged by Environment Yukon for the remediation of contaminated sites. At some sites, however, it is impractical to remove contaminants because of technological, physical or financial constraints and they must be managed on site to ensure they do not threaten human or environmental health.

In these situations, risk assessment can provide an estimate of the risks to human and environmental health associated with leaving the contaminants in place. This information can then be used to design solutions to eliminate the risks or reduce them to acceptable levels.

The Nature of Risk

It is important to recognize that the mere presence of a contaminant at a site does not necessarily constitute a risk. In order for a risk to exist, three things need to be present:

- **contaminants** that can cause toxic or adverse biological effects;
- **receptors** – any person, animal, or plant that may be vulnerable to the effects of the contaminant; and
- **exposure pathways** by which receptors may be exposed to the contaminants.

A risk assessment evaluates the interaction between these three basic components at a specific site and determines the resulting risk to the receptors.

The Risk Assessment Process

Risk assessment uses mathematical models to predict the dose of a contaminant that will be received by a receptor through a specific exposure pathway. The doses expected from all potential pathways can be added up and compared with the dose considered safe for that contaminant. If the safe dose is not exceeded, there is little risk that the contaminant will affect the health of receptors.

The risk calculated for a site can be expressed mathematically as a hazard quotient or a risk estimate:

- **Hazard quotients** are calculated for contaminants that do not cause cancer. A hazard quotient is the dose of a contaminant received from a site (the estimated daily intake) divided by the safe dose for the contaminant (the reference dose).
- **Risk estimates** are calculated for cancer-causing contaminants. Risks estimates are expressed as the probability of cancer occurring in an individual from exposure to a substance.

Hazard quotients and risk estimates calculated for a site are compared to the acceptable risk levels specified in the Contaminated Sites Regulation. If the risk exceeds acceptable levels, risk-based standards will be derived to address it. This may entail establishing cleanup goals, or it may mean putting in place risk management measures.

Risk Management

When a site is found to have an unacceptable level of risk from contaminants, one method of reducing the risk is to apply risk management measures. Risk management is a broad category of actions that may be used as an alternative to cleaning up the contamination when doing so would not be practical.

Risk management typically involves blocking or reducing the exposure pathway that allows contaminants to contact receptors. Some examples include:

- installing a vapour barrier or vapour extraction system to keep harmful vapours from getting into a building;
- putting in pavement to prevent people or animals from coming into contact with contaminated soils;
- using groundwater monitoring to verify that contaminants aren't migrating towards receptors; or
- restricting the land use of the contaminated site to prevent exposure to the most vulnerable receptors.

Sites using risk management will often be required to undergo continual monitoring and maintenance to ensure that the risk management measures remain intact and effective.

Screening-Level Risk Assessments

Risk assessments are typically a complicated process, requiring very detailed characterization of the site and complex modeling to properly quantify the risks. In some cases, it may be possible to bypass this process by performing a **screening-level risk assessment**, or SLRA. Rather than calculating the magnitude of the risk, the purpose of an SLRA is to determine whether a risk exists at all.

In order to determine whether a risk is present, a person conducting an SLRA completes a checklist to verify the three components of risk: contaminants, receptors, and most importantly, exposure pathways. If there is no active exposure pathway, the risk to the receptors is considered negligible, and the site "passes" the SLRA.

Similarly, if a site "fails" an SLRA, it may be possible to simply interrupt the exposure pathway by applying risk management measures to the site. If that is not possible, then the site will need to proceed to a full risk assessment.

Regulatory Approvals

Under the Contaminated Sites Regulation, permits are required to use risk-based restoration standards at a site. If you are relying on the results of a risk assessment (including screening-level risk assessments) to leave contamination on site in excess of the regular numerical standards, you will need a permit. All risk assessments, other than screening-level risk assessments, will be subject to review by a third-party expert, and the cost of this review must be paid by the applicant.

Contact the Environmental Programs Branch to discuss whether risk assessment may be appropriate for your site, or to obtain a permit application.

For more information about risk assessment and contaminated sites, please contact:

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Copies of Yukon regulations may be viewed online at <http://environmentyukon.gov.yk.ca/monitoringenvironment/> under the "Standards & Approvals" section, or at any Yukon Public Library, territorial agent, territorial representative or regional services office. You may purchase copies at the Inquiry Centre, Yukon Government Administration Building, 2071-2nd Avenue in Whitehorse, or by mail from the Subscriptions Clerk, Yukon Government Queen's Printer, Box 2703, Whitehorse, Yukon, Y1A 2C6 (phone (867) 667-5783 or toll free 1-800-661-0408 extension 5783).