Environmental Programs

Contaminated Sites Regulation

Risk Assessment

Risk assessment is a method of predicting the impacts of contaminants on human and environmental health. It provides a basis for managing contaminants onsite when removal or other permanent remediation is impractical.

Risk assessment has been used to manage contaminated sites in British Columbia since 1987. It has also been used by the federal government at some sites in the Yukon, including Brooks Brook and the Snag Airstrip, and is now available as a management option for all Yukon sites.

Management Options

The best way to clean up a contaminated site is to use a permanent remediation method such as off-site removal. Permanent solutions are preferred and encouraged by the Yukon Government 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 onsite 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.

Under the Contaminated Sites Regulation, permits are required to use risk-based restoration standards at a site. Contact the Environmental Programs Branch to discuss whether risk assessment may be appropriate for a given site, or to obtain a permit application.

Determination 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 basic conditions must be met:

- **contaminants** must be present;
- these contaminants must be able to cause **toxic or adverse biological effects**; and
- **exposure pathways** must exist by which **receptors** may be exposed to the contaminants. A receptor could be any person, animal or plant. An exposure pathway is a route a contaminant may take to come in contact with a receptor. A single contaminant may follow a number of potential exposure pathways – for example, contaminants in soil may be inhaled, absorbed through the skin, ingested directly, or ingested indirectly after accumulating in food grown onsite.

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

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Risk Assessments

Each risk assessment is unique and applies only to the site for which it was prepared. All risk assessments, however, provide the following information:

- a list of contaminants at the site, their location and their extent on- and off- site;
- an estimate of the size and likelihood of risks to human and non-human receptors on- and off- site; and
- a description and evaluation of the measures proposed to manage contamination in place.

Receptor Impacts

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 percentage 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 risk-based standards specified in the Contaminated Sites Regulation. If the risk estimates exceed the standards, the site may need to be managed to reduce the estimated impacts. This is called a risk-managed site. Risk-managed sites usually require special monitoring and inspection to ensure the continuing effectiveness of remedial solutions.

Environmental Impacts

At risk-managed sites, the predicted effects on human health must be reported using the mathematical modeling described above. Effects on the environment may also be reported in mathematical terms or, alternatively, a more general qualitative environmental impact report may be prepared. A qualitative report may be necessary when the environmental impacts are complex and impossible to measure in mathematical or quantitative terms.

At a minimum, all environmental impact reports must assess:

- the potential on- and off- site environmental impacts arising from contaminants before and after site remediation or redevelopment; and
- procedures, including monitoring requirements, designed to reduce significant environmental health impacts identified either on- or off- site.

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

Environmental Programs Branch
Department of Environment (V-8)
Box 2703
Whitehorse, YT
Y1A 2C6

Phone: (867) 667-5683
Toll free: 1-800-661-0408 ext. 5683
Fax: (867) 393-6205
email: envprot@gov.yk.ca