A Risk Management Framework for Contaminated Sites

A Discussion Paper

Contaminated Sites Management Working Group

By:
Soil Section, Guidelines Division,
Science Policy and Environmental Quality Branch,
Environment Canada
June 30, 1997

This document has been reviewed by the members of the federal interdepartmental Contaminated Sites Management Workshop Group (CSMWG), and approved for publication. Any reference to trade names or commercial products does not constitute recommendation or endorsement for use.

For a copy of this report, contact:

Environment Canada
Hazardous Waste Branch
Place Vincent Massey
351 St. Joseph Blvd., 12th Floor
Hull, Quebec K1A 0H3
Telephone: (819) 953-0458

OR

Environment Canada
Science Policy and
Environmental Quality Branch
Guidelines Division
Place Vincent Massey
351 St. Joseph Blvd., 8th Floor
Hull, Quebec K1A 0H3
Telephone: (819) 953-7919

A Publication of the CSMWG - Printed June 1997

The Contaminated Sites Management Working Group (CSMWG) is an interdepartmental committee established to investigate, propose and develop a common federal approach to the management of contaminated sites under federal custody.

Established under the auspices of the Federal Committee on Environmental Management Systems (FCEMS), the CSMWG also provides expert advice to the Environmental Accountability Partnership (EAP) sub-committee on contaminated sites.

The CSMWG is co-chaired by Environment Canada and the Department of Fisheries and Oceans with secretariat services provided by Environment Canada's Hazardous Waste Branch. Activities of the working group are cost shared between Environment Canada and the participating members.

Participating Departments

Agriculture and Agri-Food Canada
Canadian Heritage/Parks Canada
Fisheries and Oceans/Canadian Coast Guard
Indian and Northern Affairs Canada
Public Works and Government Services Canada
Solicitor General/Royal Canadian Mounted Police
Treasury Board Secretariat
Environment Canada
Department of Finance
National Defence
Natural Resources Canada
Revenue Canada
Transport Canada

Executive Summary

Risk management for contaminated sites is inevitably a balancing act of many diverse factors such as social, economic, political, legal, technical, and scientific issues. In the risk management framework presented in this document, risk management has been separated into two components which are integral to a coherent risk management framework: **Risk Evaluation** and **Management**. The discussion and guidance for these components are not definitive although the use of CCME (Canadian Council of Ministers of the Environments) scientific tools is explicitly explained. This discussion paper is intended to serve as a starting point for the further development of a comprehensive and more prescriptive framework for risk management at contaminated sites.

The planning stage of a risk management strategy is critical to the overall success of the remediation of the contaminated site. In the planning stage, site managers must articulate the departmental mandates and policies, identify the departmental roles and responsibilities, solicit public/stakeholder input, identify the problems, set protection goals and identify any logistic or resource restrictions. The scientific components of the planning phase include characterizing and classifying the site, and assessing the degree of contamination for the site's intended land/water uses. These management and scientific components are then integrated into a problem statement and goals for a remediation strategy.

The **Risk Evaluation** stage of the framework uses either risk-based environmental quality guidelines or a risk assessment to establish remediation objectives for the site.

The next step is the **Management** stage where management considerations are evaluated. Key issues for consideration will vary from site to site as will the degree of importance of any issue. In this stage of the framework, site managers should evaluate the remediation options available and their potential to increase risk at the site, the costs and benefits associated with each remediation option, the degree of uncertainty associated with the risk-based remediation objectives, and the balance between human and ecological health that can be achieved with remediation. Also, any remediation strategy should comply with any legal/regulatory obligations, address public/stakeholder concerns and suggestions, and ensure auditing and monitoring mechanisms are included in the strategy.

In the proposed framework, the final **Risk Management** decision for a contaminated site requires a balance between the many management considerations and the scientific evaluation of conditions required at the site for human health and environmental protection. To ensure that the best decision has been implemented at a site, all decisions and rationale need to be clearly documented and the results of any remediation strategy must be compared to the goals established for the remediation of the contaminated site. The auditing and/or monitoring mechanisms will indicate whether the goals for the site have been met, whether the risk management decisions should be re-evaluated and whether any residual risk at the site must be documented and managed.

At present, the role of science in risk management is relatively well developed. The suite of CCME scientific tools (such as the National Classification System, the 1991 Interim Criteria, the 1997 Soil Quality Guidelines, Guidance for Risk Assessment) can be used to characterize, classify, and assess sites, and to develop site-specific remediation objectives. These tools have been developed for application at most sites across the country and therefore are valuable for providing a consistent scientific basis for risk management decision-making.

It is much more difficult to achieve the same consistency when addressing the non-scientific issues associated with contaminated site management because not all issues will be a concern at all sites, and their relative significance can vary across sites and across departments. Therefore the guidance provided here on management considerations is necessarily general, but the integration of these considerations with a strong foundation of science in this risk management framework is important for effective and accountable decision-making.

A Risk Management Framework for Contaminated Sites
June 20, 1997

0.1 Introduction

This paper has been produced for the federal interdepartmental Contaminated Sites Management Working Group (CSWMG). The working group was established in the summer of 1995 to investigate and propose a common federal approach to the management of contaminated sites under federal custody. The working group provides a forum for the exchange of information and since its inception, the working group has identified needs and priorities and worked towards the development of a consistent federal approach to the management of contaminated sites.

This document presents a discussion paper on a risk management framework for contaminated sites. Figure 1 is a schematic of the framework and each component of the framework is expanded upon and explained in the text. The discussion and guidance provided for these components are not definitive although the use of CCME (Canadian Council of Ministers of the Environment) scientific tools is explicitly explained. This paper is meant to serve as a starting point for the further refinement of the components required to develop a comprehensive and more prescriptive framework for risk management at contaminated sites.

1.1 Risk-based decision-making at contaminated sites

Risk management is inevitably a balancing act of many diverse factors. Risk management decisions concerning contaminated sites often have to incorporate social, economic, political, legal, technical, and scientific issues. In the framework presented here, risk management has been separated into two components: risk evaluation, the scientific activity of establishing the actual risk and management which includes any other factors that are to be considered in risk based decision making.

1.2 Defining the roles of risk evaluation and management

Risk evaluation is the process that evaluates the likelihood that adverse effects may occur or are occurring as a result of exposure to a stressor. For example, the likelihood that the population of a fish species will be reduced because of metal contamination entering a water body. In the context of contaminated sites this is the scientific and technical activity that makes use of risk-based environmental quality guidelines or site-specific risk assessment to recommend a remediation level of contamination that will meet the goals of the site management strategy.

Risk management is the decision making process in which an action or a policy is developed once a remediation level has been determined. Risk management integrates the risk evaluation with technical, political, legal, social, and economic issues to develop risk reduction and prevention strategies.

1.3 Integrating risk evaluation and management in decisions

Most jurisdictions advocate the separation of the two roles in order to ensure that 'objective science' is provided for decision making and that the risk evaluation activity does not force a predetermined management decision. Although the separation of roles should be respected, risk evaluation and risk management are not intended to be mutually exclusive or devoid of any interaction or communication. Communication between the two is essential for arriving at a mutual understanding of the goals of the risk evaluation and in designing a remediation plan that will provide the best balance among the myriad of factors at the site.

2.0 Planning Stage

The planning stage of a risk management strategy is critical to the overall success of the remediation of the contaminated site. This stage helps to identify the major factors that must be considered in the decision making, to identify the problems at the site, and to establish the goals for any remediation action. The management and scientific components of the planning stage are discussed below.

2.1 Management

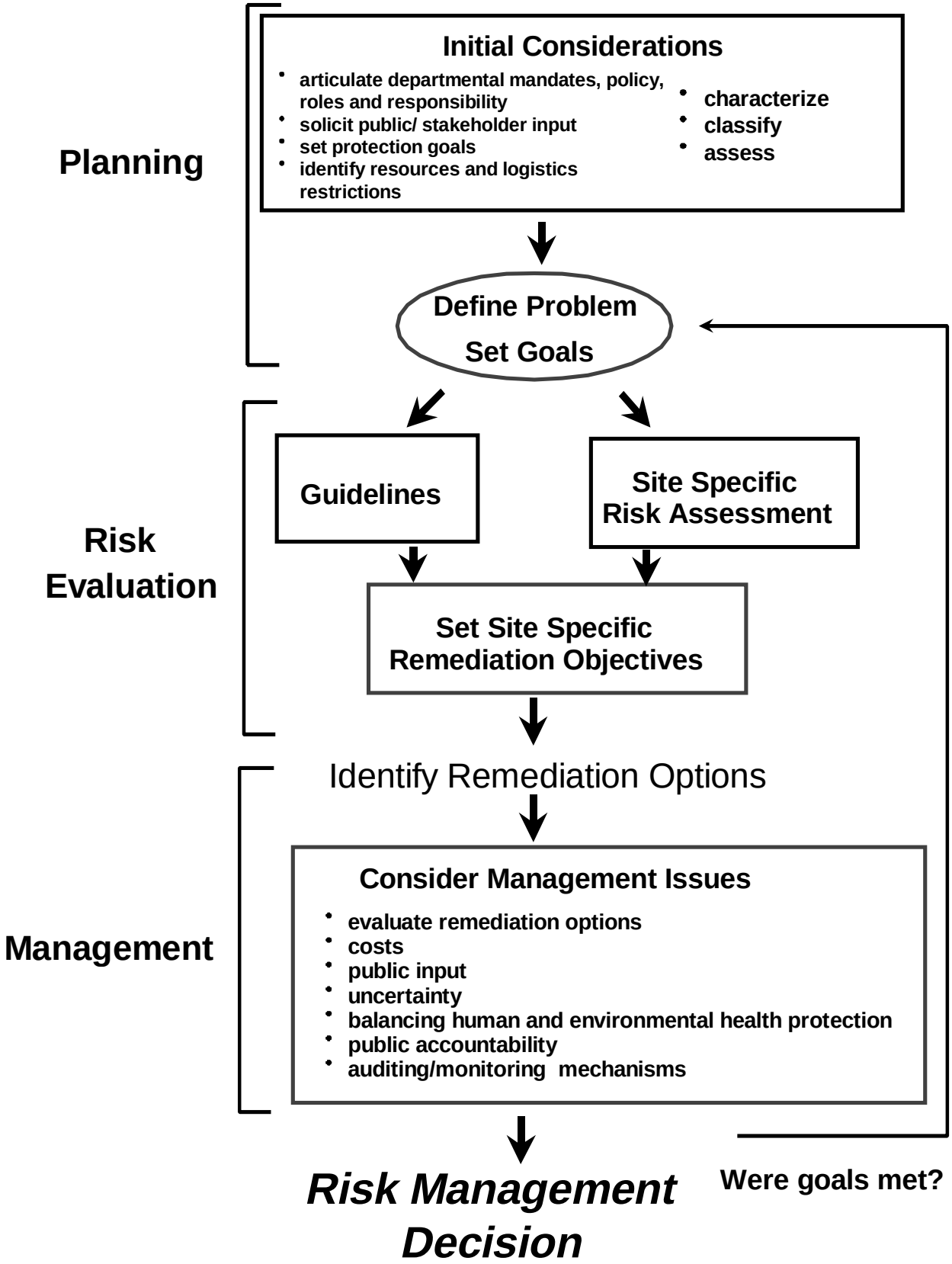
2.1.1 Articulate departmental mandates, policies, roles and responsibilities

The guiding principles for developing strategies for managing contaminated sites are often determined by departmental mandates and policy. Mandates and policies can vary across federal departments. For example, the Parks Canada mandate may emphasize environmental stewardship while Public Works may be more involved in the remediation of contaminated sites in preparation for transfer to other jurisdictions. These mandates and policies are important in setting the priorities and the overall objectives of site remediation. Therefore, the federal departmental policy must be clearly articulated in the initial planning stage.

The roles and responsibilities of federal departments can also affect the management strategy at a site. A federal department may be the custodian of a site, a stakeholder or a regulator. The departmental role will dictate the legal responsibilities and obligations to the public that the department may have when remediating contaminated sites and again must be clearly articulated at the onset of the planning stage.

While recognizing that departments have different operational mandates, the goal of the CSMWG is to develop consistency when implementing a risk management approach. This general framework is a first step towards such consistency.

Figure 1. Risk management framework for contaminated sites



2.1.2 Solicit public/stakeholder input

Not all contaminated sites raise public concerns and the degree of public/stakeholder participation in the remediation of contaminated sites can vary greatly across sites. Increasingly, site managers are recognizing that the public's perceptions and opinions are important. Public opinions can be solicited through polls and focus groups and further participation should be ensured when defining the parameters of the problem, framing the questions to be answered, deciding what information needs to be generated, interpreting the information and choosing among remediation options and the means of implementation. For risk managers the challenge is to give public participation activities the same priority and resources as technical studies (Lynn 1996). The need for and level of public/stakeholder input, will be, to some extent, related to 2.1.1 above.

Section 9 of the Guidance Document on the Management of Contaminated Sites in Canada (CCME 1997a draft) provides guidance on public involvement and community relations.

2.1.3 Set protection goals

An important step in contaminated site management is establishing the land/water use for a site. Site remediation does not always require the restoration of pristine conditions. Rather, the remediation of land and water can be to levels that support particular uses. The Canadian Water Quality Guidelines and the CCME Soil Quality Guidelines provide definitions for a variety of land and water uses that can be incorporated into the planning phase (See Table 1). The land use selected for protection may be the current or potential land uses and therefore may involve anticipating the consequences of possible changes in land use. Defaulting to the least restrictive use (i.e., industrial) may require the least amount of remediation but future uses will be limited. The importance of maintaining future use options must be considered when establishing land/water uses. Again, public input and departmental mandates may define the uses.

In some cases, where the costs of remediation and technology are not limiting, clean-up to background levels may be the most feasible option and will maintain future management options.

At some sites establishing the CCME land/water use may not be relevant if protection is required for a particular ecosystem component or sensitive human population, or a specialized land/water use exists which is not defined by the CCME. In this case, the site manager and the public/stakeholders need to establish what is to be protected and the degree of protection required.

Protection goals may also be related to legal liability at a site. For example, a potential infraction of the Fisheries Act may cause remediation strategies to focus on related water quality issues.

Table 1. Land and water uses protected by soil and water quality guidelines

Land Uses	Water Uses
Agricultural Residential/Parkland Industrial Commercial	Drinking Water Freshwater aquatic life Recreation Industrial Irrigation and livestock water

The Protocol for the Derivation of Environmental and Human Health Soil Quality Guidelines (CCME 1996b) provides the detailed definitions of each land use and the associated exposure pathways. Section 3.4 of the Guidance Document on the Management of Contaminated Sites in Canada (CCME 1997a draft) provides a brief discussion on remediation based on intended land use.

2.1.4 Identify logistic and resource restrictions

Financial restrictions and logistic restrictions, such as time frames and the urgency for a decision must be identified in the planning stages as these will limit the scope of the risk evaluation.

2.2 Scientific

The principle scientific activities within the planning stage are the site characterization, site classification and contamination assessment. Based on the information gathered during characterization the site can be classified and the degree of contamination can be assessed.

2.2.1 Characterize and classify the site. Which sites require action?

Often federal departments will have a number of sites that may potentially require action. One of the first steps in contaminated site(s) management is to determine which sites will require action. The CCME (1992) has developed a national classification system to provide a simple, consistent, risk-based, and reliable basis for classifying sites in terms of the potential risks they represent to the environment and human health. The system provides a convenient basis for assessing the need for remediation at individual sites, and for establishing the relative priority for implementing remedial measures among the sites that have been classified. This classification system was specifically developed for the classification of sites having contaminated soils and groundwater.

Depending on the final site score, contaminated sites are placed into one of five categories, namely:

- Class 1 - action required
- Class 2 - action likely required
- Class 3 - action may be required
- Class N - remedial action not needed
- Class I - insufficient data

Classification of contaminated sites in this manner provides an effective screening tool for determining the relative priority that should be placed on individual sites. In addition, the information collected and evaluated during the site classification process may be used to focus detailed investigations at high priority sites, such as those that might be associated with an environmental or human health risk assessment. Furthermore, this information may be used to identify use-protection goals and priority contaminants at the site, in the derivation of site-specific remediation objections, and in the development of the site management strategy. The more information that is known about the site the better the classification, consequently a site may be reclassified once a detailed assessment is done or when more information becomes available.

Phase I (Site Information Assessment) of the National Guidelines for Decommissioning Industrial Sites (CCME 1991a) also provides guidance useful in characterizing contaminated sites. Phase I consists of a review of all available information relating to the industrial site. The primary objective of Phase I is to assess if industrial practices on the site may have resulted in environmental contamination or unsafe conditions. Additional guidance can also be found in Section 5 of the Guidance Document on the Management of Contaminated Sites in Canada (CCME 1997a draft).

2.2.1 **Assess the degree of contamination. How contaminated is my site?**

The next step, after characterization/classification, is assessing the degree of contamination at the site. The CCME provides assessment criteria (CCME 1991b) which are approximate background concentrations or approximate analytical detection limits for contaminants in soil and water and serve as benchmarks to assess the degree of contamination at a site. If concentrations of contaminants at the site exceed assessment values, investigation action should be considered to assess the extent of contamination and the nature of any hazards at a site, and to determine the scale and urgency of further action, if required.

When using background levels for assessment purposes, regional information should be consulted. For example, the province of Ontario has identified background levels for substances occurring in that province (OMEE 1993).

If testing to determine contaminant concentrations at the site is required the CCME (1993) has developed a Guidance Manual on Sampling, Analysis, and Data Management for Contaminated Sites to provide:

- the principles of sample collection and preservation for soil, sediment, surface water, and groundwater
- the critical factors in selecting analytical and data management methods are explained in the manual
- recommended best analytical methods.

Useful guidance on testing and assessing the degree of contamination can also be found in Phase II (Reconnaissance Testing Program) of the National Guidelines for Decommissioning Industrial Sites (CCME 1991a) and in Section 5 of the Guidance Document on the Management of Contaminated Sites in Canada (CCME 1997a draft).

2.2.3 Assess contamination against remediation benchmarks. Will the site support the intended land/water use?

If the need for further action is indicated by the CCME assessment criteria or regional background levels, the next step is to determine whether or not the site will support the intended land/water use as defined.

The CCME Water Quality Guidelines (CCREM 1987) , CCME Soil Quality Guidelines (CCME 1997b), and CCME Sediment Quality Guidelines (CCME 1995; Smith et al. 1995) serve as remediation benchmarks for water, soil, and sediment, respectively. If the contaminant concentration at the site exceeds the soil or water quality guideline, for a particular use, then that land or water use cannot be supported and further action is required. If the contaminant concentration at the site is lower than the soil or water quality guideline then further action at the site may not be required.

Soil quality guidelines were introduced in 1991 as interim soil quality remediation criteria (CCME 1991b). The interim remediation criteria for 20 contaminants have been updated and are to be published as soil quality guidelines (CCME 1997b). The 1997 guidelines supersede the interim soil quality criteria as remediation benchmarks for those 20 contaminants.

Where land/water uses are outside those defined by the CCME, a site-specific risk assessment may be required. Alternatively, provincial jurisdictions may have criteria for a broader range of land/water uses and/or substances not addressed by the CCME. The British Columbia Ministry of the Environment and the Ontario Ministry of Environment and Energy have recently released soil quality guidelines (OMEE 1994).

2.3 State problem and refine goals

Once the initial management considerations have established the need for remediation and identified the specific problem(s) at the site, (e.g., substances exceed guidelines, receptors to be protected), a clear statement of the problem regarding further action should be formulated and the goals for site management identified. The problem statement documents the key issues, establishes the breadth and depth of the problem and the objective of the remediation. For example, if the goal is to ensure that the fishery is not impacted and the initial planning indicates a potential problem with PCBs in water, then this will become a major focus of the risk evaluation step. It will also provide a documented statement of the goals to which final risk management decisions can be compared to (i.e., have I met my goals). The information collected to date for the site is evaluated for its use in the decision-making process. The statement of problem identification should be reported in the management records.

It is critical that goals be established for the remediation of the contaminated site. The effectiveness of risk management decisions can only be judged when the results of the risk management decision are compared to the goals established for the site.

Goals are usually set by those who are responsible to the public and generally set with contributions from the public. Technical input may be incorporated but not completely relied upon, as goals depend on public values.

Stakeholder involvement in the process of setting goals and objectives begins in the initial planning stage and can be revisited or reaffirmed when refining the goals and problem statement. Public/stakeholder participation supplements scientific knowledge by incorporating societal values, needs, and priorities. Stakeholders use current scientific and other knowledge bases (including traditional knowledge and ecological, historical, economic, and cultural information in deriving their goals and objectives. Furthermore, where scientific information is incomplete, or where analytical science is limited in its ability to meet information needs, stakeholders can offer guidance for future knowledge acquisition and for interim decision making. Stakeholder involvement fulfills a requirement for competent environmental management identified by Miller (1993) as “the ability to combine the precision and clarity of analytical thinking with the breadth and imagination of holistic thought” (CCME 1996a).

3.0 Risk Evaluation Stage

Risk evaluation is the process of determining the level of contaminant at the site that will protect both human health and the environment. This site-specific remediation objective may be determined by:

- applying an environmental quality guideline directly
- modifying a guideline, as can be done with soil quality guidelines to accommodate a limited number of site specific parameters,
- conducting a site-specific risk assessment.

3.1 Establish remediation objectives for the site. What concentration of contaminant will be protective?

The objective of the risk evaluation exercise is to determine levels or concentrations of a substance in soil/water that should be achieved in order to protect and sustain the identified land use or receptors.

3.1.1 Environmental quality guidelines

If the goal of the site management strategy is to remediate a site to a particular land use, the application of environmental quality guidelines may be appropriate. These guidelines recommend levels of contaminants in soil, water, and sediment that protect human health and the environment for a variety of land and water uses.

Soil quality guidelines have been derived for the protection of agricultural, residential/parkland, commercial, and industrial land uses. The exposure scenarios for each land use are detailed in the Protocol for the Derivation of Environmental and Human Health Soil Quality Guidelines (CCME 1996b). The exposure pathways and receptors at a particular site can be compared with the exposure scenarios in the Protocol (CCME 1996b) to determine whether or not the soil guidelines are applicable. The guidelines can be applied directly as remediation objectives or modified, within prescribed limits, to take into account site-specific conditions. The circumstances under which the soil quality guidelines can be modified and the methods of modification are explained in the Guidance Manual for Developing Site-Specific Soil Quality Remediation Objectives for Contaminated Sites in Canada (CCME 1996c).

Sediment quality and water quality guidelines can also be the basis for remediation objectives. However, there is no available guidance for their application as objectives and professional judgment will be required.

3.1.2 Site-specific risk assessment

Environmental Quality Guidelines are not always applicable at the site, either directly or after modification. The site may be large, there may be little information available about the contaminants of concern, the land/water use categories may not accurately reflect the exposure pathways at the site, or there may be sensitive species or habitats present. Also, costs of remediation to guidelines may be so great that clean-up may not be considered feasible and risk assessment may be needed to refine objectives and focus efforts. Where Environmental Quality Guidelines are not appropriate, site-specific remedial objectives can be developed through site-specific risk assessment. To ensure the protection of both humans and the environment, an ecological risk assessment and a human-health risk assessment are required by most jurisdictions and is advocated by the CCME.

The CCME provides a Framework for Ecological Risk Assessment (CCME 1996d) for general guidance on how to perform an ecological risk assessment. The framework is iterative with three tiers:

- *Screening Assessment* is characterized by simple, qualitative, and/or comparative methods, and relies heavily on literature information and previously collected data. Within the ERA framework, all sites undergo a screening assessment.
- *Preliminary Quantitative ERA* is intermediate between Screening Assessment and Detailed Quantitative ERA, and provides more quantitative information.
- *Detailed Quantitative ERA* relies on site-specific data and predictive modeling to supply quantitative information, particularly on complex ecosystem responses.

Progression through the tiers depends on being able to adequately characterize the risk with an acceptable degree of uncertainty. The framework is quite general and can be applied at any site to improve the effectiveness and efficiency of the risk assessment.

Federal guidance on human health risk assessment is not yet available. Some provinces, and other jurisdictions, however, have developed frameworks and guidance manuals. British Columbia has developed a framework for conducting a human health risk assessment and Ontario has recently released a guidance document.

When compared to applying environmental quality guidelines, risk assessment is a more complex and involved method for establishing site-specific remediation objectives. Environmental quality guidelines incorporate many management decisions; they have been derived with specified exposure pathways for both human and ecological receptors, and specified levels of protection for both. In contrast, risk assessment is a departure from the guideline derivation process and management options, such as the species to be protected and the level of protection required, have to established for each site.

Phase III (Detailed Testing Program) of the National Guidelines for Decommissioning Industrial Sites (CCME 1991a) generally corresponds to the risk evaluation stage of this framework and provides additional guidance on setting remediation objectives. Guidance can also be found in Sections 5 and 6 of the Guidance Document on the Management of Contaminated Sites in Canada (CCME 1997a draft).

4.0 Identify Remediation Options

Once the site-specific remediation objectives have been established, the available remediation options need to be identified. Remediation options can include the technological methods to clean the site to meet the remediation objectives, methods that contain the contamination and eliminate exposure of the contaminant to site receptors and of course the no-action option. The no-action option needs to be included for further evaluation with the following management considerations in mind to ensure that cure is not worse than the disease.

5.0 Management Stage

5.1 Consider management issues

Having developed a risk-based remediation objective, or level of contaminant that will meet the overall goal at the site, other management considerations must be incorporated to develop a strategy for action at the site. Key issues for consideration will vary from site to site as will the degree of importance of any issue. Some of the more common issues are discussed below.

Further discussion on management considerations can be found in Phase IV (Preparation and Decommissioning and Cleanup Plan in the National Guidelines for Decommissioning Industrial Sites (CCME 1991a) and in section 7.0 (Development and Implementation of a Remedial Action Plan) of the Guidance Document on the Management of Contaminated Sites in Canada (CCME 1997a draft).

5.1.1 Evaluate remediation options

In many cases, there may be a number of remediation strategies and/or technologies that can be applied at the site. Where this is the case, each option should be part of a comparative risk analysis to determine how effectively each option will achieve your goals and to determine whether any of the options add risk when implemented.

Commonly, when asking how close a particular remedial option will bring you to your goal requires an estimate or evaluation of the risk of any residual chemical concentrations predicted for each remedial alternative, including the no-action option.

Also, to determine whether any options add risk requires evaluating the potential for each remedial alternative to contribute adverse effects at the site. For example, dredging sediments for removal may actually cause the redistribution of the contaminants if the dredging causes the contaminants to be resuspended in the water column.

5.1.2 Evaluate costs

Economic considerations are probably the most common issues across contaminated sites. Limited resources, both financial and human, often require trade-offs to be made. In many cases a cost/benefit analysis is performed to evaluate the cost and benefit of alternative remedial techniques and/or to evaluate the cost and benefit of the degree of risk reduction.

Some tools are available to put monetary values on some ecological resources, but it is likely that a large portion of the value may be represented only qualitatively.
Indirect market approaches evaluate the markets associated with the resource by relating relate the monetary value of ecological resources (such as good water quality

and healthy sport fishery) to the amount of money people spend on the resource (traveling to a fishing site, buying bait, etc.). Constructed market approaches calculate monetary values by using hypothetical market scenarios and asking people how much they would be willing to pay for ecological resources (U.S. EPA 1995).

Other ecological values and societal values are more difficult to associate with money such as biodiversity, sustaining resources for future generations, and the loss of future management options.

5.1.3 Evaluate uncertainty

Uncertainty is inherent in any risk assessment and can be differentiated by the various sources. Uncertainty, that results from the inherent randomness of the world is called stochasticity. This type of uncertainty can be described and estimated but cannot be reduced because it is a characteristic of the system being assessed. Uncertainty can also arise from human error in carrying out assessment activities and from imperfect or incomplete knowledge of things that could or should be known. Uncertainty from the last category is particularly characteristic of risk assessments because of the diversity and complexity of ecological systems, extrapolations from animal to humans.

Strategies for dealing with uncertainty when making management decisions include ensuring that multiple independent lines of investigation have been carried out to provide a "weight of evidence" for supporting decisions. Providing the resources necessary to fill data gaps and gather more information can also help to reduce uncertainty. Professional judgment plays an important role in dealing with uncertainty as does the application of the precautionary principle. The precautionary principle is applied when " the likelihood of a danger that is sufficiently serious that the costs of retaining it, to the point where proof of blame is incontrovertible, would be far greater than the costs of eliminating or controlling it now. Precaution is therefore the principle of proactivism, of acting with due care, of playing safe, of assuming the worst" (O'Riordan, 1995).

5.1.4 Solicit public/stakeholder participation

Public and stakeholder participation should continue throughout the decision making process. Stakeholder input during the management phase can be essential in the evaluation of remediation alternatives and achieving better public understanding of proposed remediation strategies.

Section 9 of the Guidance Document on the Management of Contaminated Sites in Canada (CCME 1997a draft) provides guidance on public involvement and community relations.

5.1.5 Balance human health and ecological risk

Contaminated sites pose risks to both human and non-human organisms. Until relatively recently, little attention was paid to the ecological risks. Most jurisdictions now require that both ecological and human health be protected either through the application of guidelines that are protective of both the environment and humans, like the CCME guidelines, or through the application of site-specific ecological risk assessment and human health risk assessment.

To date there is no system to integrate the results of ecological and human risk assessments. Various human health and ecological endpoints have qualitatively different values and there is no way to determine what level of ecological risk to some endpoint is equivalent to a one in a million human cancer risk (Suter et al. 1995).

Also, there are risks associated with remediation as well as risks associated with contaminants which may alter the relative significance of the ecological and human health risks (Suter et al. 1995). For example, the excavation of a site may reduce the risk of the contamination to both human and ecological receptors, but the risk to ecological receptors may be increased because of lost habitat.

5.1.6 Ensure public accountability

Public accountability refers to the documentation of site conditions and any actions taken so that the public has access to this information now and in the future. Two examples of systems in place that track contaminated sites come from British Columbia and Ontario.

British Columbia is setting up a central site registry as a depository of information about sites which is in effect a “record of decisions”. Information that is recorded in the registry includes:

- the basic characteristics of the site,
- any legal events involving the site,
- the milestones in the remediation process,
- whether remediation was by generic criteria, risk assessment, or risk

assessment with risk management; and
- the level (land use) to which the site was remediated.

The public will have access to the registry by computer through BC ONLine and the central registry linked will be linked to the land titles office.

Ontario has no central registry but will flag the land titles directly. If risk at the restored site is equal to the risk associated with generic criteria no tracking or notification is required on title. If the risk of the restored is site differs from the risk associated with the generic criteria as when contaminants are managed but are left in place, the site land title is flagged.

These tracking mechanisms provide a reality check on site conditions. Risk from a contaminated site can be reduced or eliminated simply by removing the possibility of exposure to the contaminants. In such a case, the contamination is contained somehow but still in place. The reality for future generations however, is that the site remains contaminated and retains the potential to pose a risk if the containment fails.

5.1.7 Evaluate auditing/monitoring mechanisms

Auditing and monitoring mechanisms are essential for risk management strategy at a contaminated site. Auditing, an immediate, confirmatory process enables the site manager and stakeholders to know whether or not the remediation option implemented has met the goal at the site. Monitoring, when necessary, is used to ensure that the site goal is being met over time.

5.1.8 Comply with regulatory/legal obligations

Regulatory and legal obligations associated with contaminated site remediation can vary across departments and may depend on the jurisdictions involved in the remediation, and the remediation option selected. For example, some remediation technologies may require impact assessments before they can be implemented, sites will have to comply with the Fisheries Act, and some sites may have to comply with provincial and/or municipal policies or regulations.

6.0 Make a Final Risk Management Decision

The final risk management decision for a contaminated site is a balancing act between the many management considerations discussed above and the scientific evaluation of the level of contaminant at the site required for human health and environmental protection. There is no absolutely right answer or decision because the management considerations will vary from site to site as well as from department to department.

To ensure that the best decision has been made and acted upon at a site, all decisions and rationale need to be clearly documented and the results of any remediation strategy must be compared to the goals of the contaminated site.

If the auditing and/or monitoring mechanisms show that the goals for the site have not been met, the risk management decisions should be re-evaluated and any residual risk at the site must be documented and managed. Residual risk may remain at the site because only a partial clean-up was achieved and contamination in excess of the stated goals is still present. Residual risk can also occur when the remediation strategy involves eliminating exposure to the contamination by containing and isolating the contaminants. The continued protection of the receptors at the site depends on the integrity and effectiveness of the containment technology and the residual risk is the risk of breakdown or failure of the technology.

Phase V (Implementation of Decommissioning and Cleanup Plans) and Phase VI (Confirmatory Sampling and Completion Reporting) of the National Guidelines for Decommissioning Industrial Sites (CCME 1991a) provide guidance on implementing and evaluation remediation strategies, and the documentation required.

7.0 Summary

The suggested risk management framework for contaminated sites clearly delineates the role of science and the role of management in making remediation decisions. Both of these processes are integral to a coherent risk management framework.

At present, consistency in the role of science is relatively well developed. There is a suite of scientific tools developed by the CCME that can be used to characterize, classify, and assess sites and to develop site-specific remediation objectives. These tools have been developed for application at most sites across the country and therefore are valuable for providing a consistent scientific basis for risk management decision-making.

It is much more difficult to achieve the same consistency for the non-scientific issues associated with contaminated sites. Not all management issues (technical, social, political, legal, and economic issues) will be a concern at all sites and their relative significance can vary greatly across sites and across federal departments.

Risk management at contaminated sites must integrate the technical, social, political, legal, economic, and scientific concerns to develop the best remediation strategy for protecting human and environmental health. Although guidance on management considerations is necessarily general to accommodate a potential range of situations, attention to the management considerations identified in the above framework is important for effective and accountable decision-making built on a strong foundation of science.

References

CCME (Canadian Council of Ministers of the Environment). 1991a. National Guidelines for Decommissioning Industrial Sites. Winnipeg, Manitoba. CCME-TS-WM-TRE013E.

CCME (Canadian Council of Ministers of the Environment). 1991b. Interim Canadian Environmental Quality Criteria for Contaminated Site. Winnipeg, Manitoba. The National Contaminated Sites Remediation Program. CCME-EPCCS34.

CCME (Canadian Council of Ministers of the Environment). 1992. National Classification System for Contaminated Sites. Winnipeg, Manitoba. CCME-EPC-CS39E

CCME (Canadian Council of Ministers of the Environment). 1993. Guidance manual on Sampling, Analysis and Data Management for Contaminated Sites. Volume 1: Main Report. Winnipeg Manitoba. CCME EPC-NCS62E.

CCME (Canadian Council of Ministers of the Environment). 1995. Protocol for the Derivation of Canadian Sediment Quality Guidelines for the Protection of Aquatic Life. Winnipeg, Manitoba. CCME EPC-98E.

CCME (Canadian Council of Ministers of the Environment). 1996a. A Framework for Developing Ecosystem Health Goals, Objectives and Indicators: Tools for Ecosystem-Based Management. Winnipeg, Manitoba.

CCME (Canadian Council of Ministers of the Environment). 1996b. A Protocol for the Derivation of Environmental and Human Health Soil Quality Guidelines. The National Contaminated Sites Remediation Program. Winnipeg, Manitoba.

CCME (Canadian Council of Ministers of the Environment). 1996c. Guidance manual for Developing Site-specific Soil Quality Remediation Objectives for Contaminated Sites in Canada. Winnipeg, Manitoba. En 108-4-9-1996E.

CCME (Canadian Council of Ministers of the Environment). 1996d. A Framework for Ecological Risk Assessment: General Guidance. Winnipeg, Manitoba. En 108-4-10-1996E.

CCME (Canadian Council of Ministers of the Environment). 1997a draft. Guidance Document on the Management of Contaminated Sites in Canada. Winnipeg, Manitoba.

CCME (Canadian Council of Ministers of the Environment). 1997b. Recommended Canadian Soil Quality Guidelines. Winnipeg, Manitoba.

CCME (Canadian Council of Ministers of the Environment). 1997c. A Framework for Ecological Risk Assessment: Technical Appendices. Winnipeg, Manitoba.

CCREM (Canadian Council of Resource and Environment Ministers). 1987. Canadian Water Quality Guidelines. Prepared by the Task Force on Water Quality Guidelines of the Canadian Council of Ministers of the Environment.

Lynn, F.M. 1996. Public Participation in Risk Management Decisions: The Right to Define, the Right to Know, and the Right to Act.

Miller, A. 1993. The role of analytical science in natural resource decision-making. Environ. Manage. 17(5):735–743.

OMEE (Ontario Ministry of the Environment and Energy). 1996a. Guideline for use at Contaminated Sites in Ontario. PIBS 3161E01. Toronto.

OMEE (Ontario Ministry of the Environment and Energy). 1996b. Guidance on Site Specific Risk Assessment for Use at Contaminated Sites in Ontario. Standards Development Branch. Toronto.

OMEE (Ontario Ministry of the Environment and Energy). 1993. Ontario typical range of chemical parameters in soil, vegetation, moss bags and snow. Version 1.0a. PIBS 2792. Phytotoxicology Section Standards Development Branch, Toronto.

OMEE (Ontario Ministry of the Environment and Energy). 1994. Proposed guidelines for the clean-up of contaminated sites in Ontario. PIBS 3161. Queen's Printer for Ontario. Toronto.

O'Riordan, T. 1995. Risk management approaches in industry. Industry and Environment. 18:45–47.

Suter, G.W., B.W. Cornaby, C.T. Hadden, R.N. Hu, M. Stack, and F.A. Zafran. 1995. An approach for balancing health and ecological risks at hazardous waste sites. Risk Analysis 15:221–231.

Smith, S.L., K.A. Keenleyside, and C.L. Gaudet. 1995. Interim Sediment Quality Guidelines. Guidelines Division, Science Policy and Environmental Quality Branch, Environment Canada, Ottawa.

U.S. EPA. 1995. Ecological risk: A primer for risk managers. Prevention, Pesticides, and Toxic Substances, U.S. Environmental Protection Agency. EPA 734-R-95-001.