Environment and Climate Change Canada
Environnement et Changement climatique Canada

Federal Contaminated Sites Action Plan (FCSAP)

Aquatic Sites Classification System. Detailed User Guidance Manual.

Version 3.3
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Canada

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Document change control

Revision Number	Date of Issue	Author(s)	Brief Description of Change
1.1	October 2009	Franz Environmental Inc. and the Aquatic Sites Working Group	Spreadsheet created (ASCS 2009).
	March 2010		User manual created.
2.1	July 2012	Franz Environmental Inc. and the Aquatic Sites Working Group	Spreadsheet updated based on feedback after one year trial (ASCS 2012). User manual has also been updated to reflect the revisions.
3.1	May 2014	Franz Environmental Inc. and Fisheries and Oceans Canada	Fixes to the spreadsheet (ASCS 2014) and edits to the user manual.
3.2	February 2015	Fisheries and Oceans Canada	Edits to the spreadsheet (ASCS 2015) and user manual.
3.3	May 2018	Fisheries and Oceans Canada	Edits to the spreadsheet (ASCS 2018) and user manual. • Corrected formatting and grammar • Surficial sediments changed from upper 5 cm to upper 10 cm • Added notes to pre-screening checklist to better align with NCSCS • Removed link between pre-screening checklist and summary score sheet • Revised description of “Site Common Name”

Table of Contents

LIST OF TABLES:

LIST OF FIGURES:

List of Acronyms

ASCS	Aquatic Sites Classification System
BTEX	Benzene, toluene, ethylbenzene and xylenes
ºC	Degree Celsius
CCME	Canadian Council of Ministers of the Environment
CEPA	*Canadian Environmental Protection Act*
COC	Contaminant of concern
COPC	Contaminant of potential concern
COSEWIC	Committee on the Status of Endangered Wildlife in Canada
CSMWG	Contaminated Sites Management Working Group
DDT	Dichlorodiphenyltrichloroethane
DFO	Fisheries and Oceans Canada
ECCC	Environment and Climate Change Canada
EDI	Estimated daily intake
EQG	Environmental quality guidelines
ESA	Environmental site assessment
EF	Exceedance factor
F1	C6 to C10 (carbon fraction)
F2	C10 to C16 (carbon fraction)
F3	C16 to C34 (carbon fraction)
F4	C34 (greater than) (carbon fraction)
FCSAP	Federal Contaminated Sites Action Plan
FCSI	Federal Contaminated Sites Inventory
Ha	Hectares
HC	Health Canada
HI	Hazard index
HQ	Hazard quotient
IDEA	Interdepartmental Data Exchange Application
IJC	International Joint Commission
ISQG	Interim Sediment Quality Guidelines
K_{ow}	Octanol-water partition coefficient
m	Metre
NAPL	Non-aqueous phase liquid
NCSCS	National Classification System for Contaminated Sites
PAHs	Polyaromatic hydrocarbons
PCBs	Polychlorinated biphenyls
PELs	Probable effect levels
PHCs	Petroleum hydrocarbons
PID/PIN	Property Identification Number

PWGSC	Public Works and Government Services Canada
SARA	*Species at Risk Act*
TEL	Threshold Effect Level
UTM	Universal Transverse Mercator
µg	Microgram
US EPA	United States Environmental Protection Agency

1.0 OVERVIEW

1.1 Introduction to the Aquatic Sites Classification System (ASCS)

In Canada, there are thousands of contaminated sites on federal lands, or for which the federal government has accepted responsibility, that require attention. To coordinate the management of these sites among the custodial federal departments in an efficient and consistent manner, the Contaminated Sites Management Working Group (CSMWG) was established in 1995.

Under the guidance of this working group, the Federal Contaminated Sites Action Plan (FCSAP) was developed with the goal of assessing and remediating or managing risk at federal contaminated sites deemed to have the highest levels of risk. The action plan has a time horizon of 30 years and aims to reduce federal financial liability associated with these contaminated sites.

The CSMWG established a common approach to the management of contaminated sites under federal custody. In the ten-step federal approach to contaminated sites (CSMWG, 2005), classification of a site is required at Step 4 in order to prioritize the site for future investigations and/or remediation/risk management actions. Re-classification is also required at Step 6 to update the ranking based on results of detailed site investigations. For terrestrial sites, classification is performed using the Canadian Council of Ministers of the Environment (CCME) revised National Classification System for Contaminated Sites (NCSCS) (2008 version).

The NCSCS is geared towards terrestrial sites, and is not readily applicable to sites that are predominantly aquatic. The Aquatic Sites Classification System (ASCS, 2014), presented in these worksheets, was designed to be similar to the NCSCS, but specifically for aquatic sites, to aid in classifying and prioritizing these sites. The ASCS, therefore, is to be used for aquatic sites, as they are defined in Section 1.3 below. Terrestrial sites should be classified using the NCSCS.

The ASCS was released in its pilot stage in 2009, and subsequently reviewed and revised in 2012 and 2014 on the basis of feedback received from custodians.

Users are advised that the ASCS is a tool for site classification and prioritization of contaminated sites, and not for risk assessment or risk management. The ASCS is to be used, along with the most recent and available information from each site, to inform the prioritization of sites for FCSAP funding for remediation and/or risk management. Aquatic habitat in industrial areas can be expected to receive higher scores, indicating that further action is required. “Further action” may involve additional study of the site (e.g., risk assessment or additional environmental investigations), risk management measures or remediation of site media. Decisions regarding the specific nature of further action would be made after FCSAP eligibility is established. Site- or

province-specific information will be considered in any decision regarding the nature of the required action.

1.2 Purpose of the Detailed User Guidance Document

The ASCS spreadsheet tool includes instructions embedded in each worksheet, and general instructions in its introduction. Due to space and format limitations in the spreadsheet, a Detailed User Guidance Document was developed to accompany the ASCS. This document follows the sequence of the ASCS worksheets. It presents all instructions included in the spreadsheet tool, as well as elaboration on many points, and a full explanation of scoring for each section and overall summary scoring and site classification. Examples are given to illustrate structure and data entry requirements.

1.3 Definition of an Aquatic Site

For the purposes of the ASCS, an aquatic site is defined as a water lot, or land or part of land that is completely, partially or occasionally submerged by water. This includes the zones where shallow groundwater and surface water mix, but excludes deep-seated groundwater, and applies to both freshwater and marine sites. Exceptions to the above definition may be established, on a case-by-case basis, using professional judgment.

The ASCS was designed to address aquatic sites, as defined above. Terrestrial portions of primarily aquatic sites should be scored and classified separately from water lots, using the NCSCS (CCME, 2008).

1.4 Overview of ASCS Contents

The ASCS includes a Flowchart, a Site Description page, a Pre-Screening checklist, a Summary Score and Final Classification Sheet, and three worksheet pages for the user to complete: “Contaminant Characteristics”, “Receptors & Exposure”, and “Physical & Other”. Instructions regarding methods to be used in evaluating site characteristics are included in each worksheet. Reference material is also provided to assist with the evaluation. A brief description of each sheet follows.

Home Provides basic ASCS information, including version date and number.

Worksheet (Tab) 1: Flowchart– Illustrates the step-by-step process of scoring an aquatic site (see Figure 1, below).

Worksheet (Tab) 2: Instructions– Presents an overview of the ASCS, with general instructions and an explanation of the structure and functioning of the spreadsheet tool.

Worksheet (Tab) 3: Site Description– Summarizes basic information about the site and relevant environmental conditions including known and potential contaminants of concern and affected media. Assesses the level of information available to the user to support the classification system evaluation and assigns a site letter grade, as outlined in Table 1, section 3.3.

Worksheet (Tab) 4: Pre-Screening - Used to determine whether or not a preliminary Class 1 designation (High Priority for Action – see section 1.5), or Class N designation (Not a Priority for Action – see section 1.5) can be assigned. In either case, all scoring sheets need to be completed, regardless of any preliminary designation.

Worksheet (Tab) 5: Contaminant Characteristics - Worksheet which identifies contaminants of concern and assesses associated hazards and significance of chemical impact. The worksheet contains instructions and explanations to assist users in evaluating chemical impacts.

Worksheet (Tab) 6: Receptors and Exposure - Worksheet which identifies both human and ecological receptors that are known or likely to be present at the site on a permanent or temporary basis. Evaluates potential exposure pathways by which receptors may come into contact with identified contaminants. Instructions, explanations, and references are included to guide users in characterizing receptors at the aquatic site and scoring potential exposure pathways.

Worksheet (Tab) 7: Physical and Other - Worksheet which identifies non-chemical environmental impacts at the aquatic site and assesses the significance of their impact.

Worksheet (Tab) 8: Summary Score – Generates a total site score by summarizing scores generated on each of the three preceding worksheets and assigns the resulting site classification.

Worksheet (Tab) 9: Reference Material– Additional information that may be useful to refer to when conducting the evaluation.

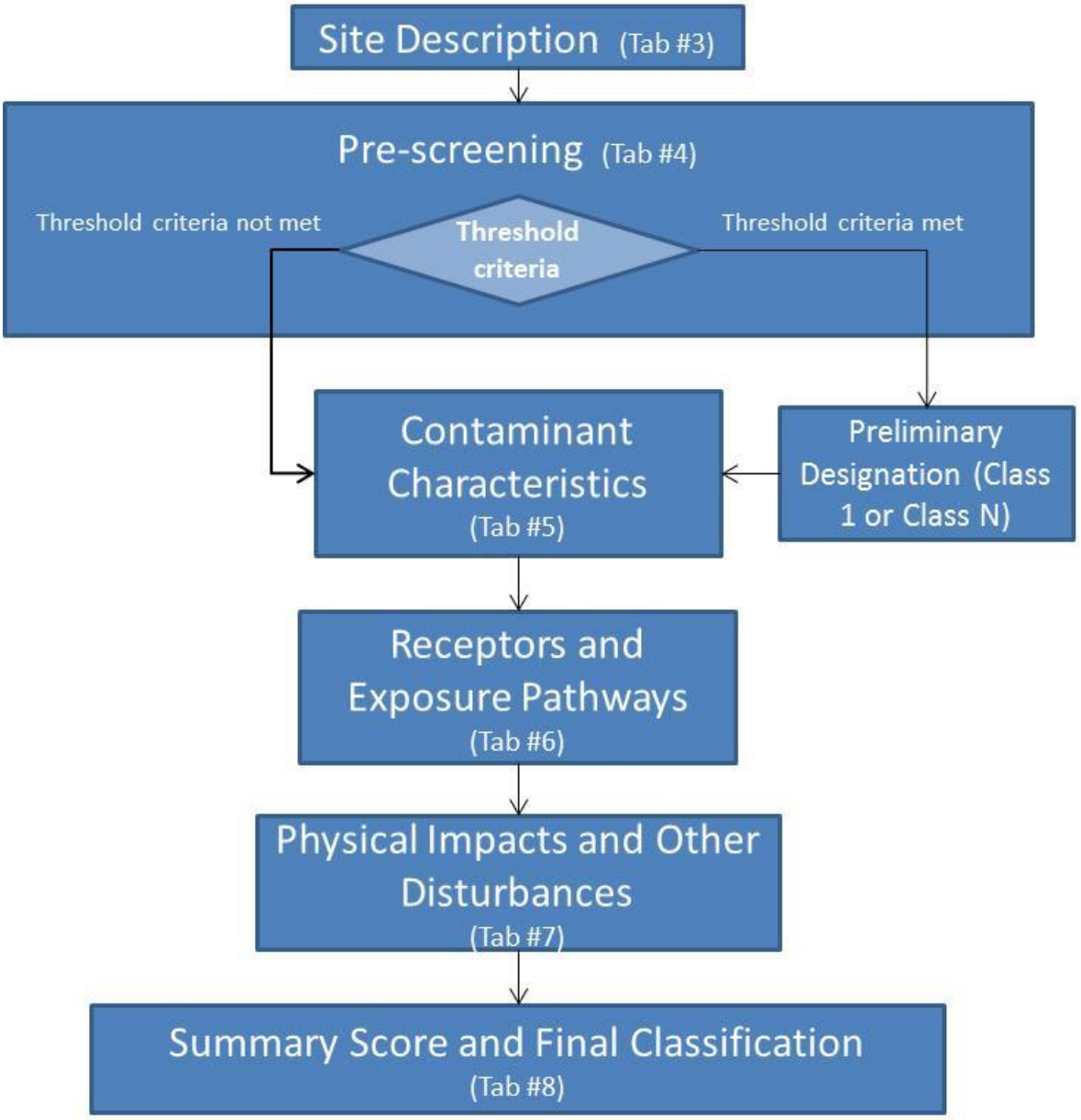


Figure 1: Flowchart of Aquatic Sites Classification System (2018)

1.5 Classification Categories

Sites should not be ranked relative to one another; they must be assessed independently on the basis of their individual site characteristics to determine the appropriate classification (Class 1, 2, 3, or N) with respect to their priority for action. Class INS (Insufficient Information) is reserved for sites that require further information before they can be classified. The classification groupings are as follows:

Class 1 - High Priority for Action (Total ASCS score greater than 70)

The available information indicates that action (e.g., further site characterization, risk management, remediation, etc.) is required to address existing concerns. Typically, Class 1 sites indicate high concern for several factors, and measured or observed impacts have been documented.

Class 2 - Medium Priority for Action (Total ASCS score between 50 and 69.9)

The available information indicates that there is high potential for adverse impacts, although the threat to human health and the environment is generally not imminent. Off-site contamination may not have been detected, however, the potential impacts for this contamination were rated high, and therefore some action is likely required.

Class 3 - Low Priority for Action (Total ASCS score between 37 and 49.9)

The available information indicates that this site is currently not a high concern. However, additional investigative work may be carried out to confirm the site classification, and some form of action may be required.

Class N - Not a Priority for Action (Total ASCS score less than 37)

The available information indicates there are probably no significant environmental impacts or human health threats. There is likely no need for action unless new information becomes available indicating greater concerns, in which case the site should be re-examined.

Class INS - Insufficient Information (>15% of cumulative responses in Worksheets 5, 6, and 7 are “Do Not Know”)

There is insufficient information to classify the site. In this instance, additional information is required to address data gaps.

2.0 GENERAL INSTRUCTIONS

2.1 Format of the Tool

The ASCS spreadsheet tool is an electronic form that will prompt the user for information. Based on the answers provided in Worksheet 5 (Contaminant Characteristics), 6 (Receptors and Exposure Pathways), and 7 (Physical Impacts and Other Disturbances), a score will be calculated for the contaminated site in question.

2.2 Level of Effort

Completion of ASCS scoring for an aquatic site should take approximately 1/2 a day of work for an experienced professional familiar with the site. Depending on the experience of the user and their familiarity with the site, more time may be required to complete the scoring.

2.3 Information Needed to Complete Scoring

To facilitate scoring, the user should obtain copies of all environmental site assessment reports and/or risk assessments previously compiled for the site. If possible, chemical data from previous investigations should also be obtained in excel or other spreadsheet software format prior to scoring. This will facilitate identification of data to be used in the Contaminant Characteristics worksheet (Worksheet 5).

2.4 How to Use the Spreadsheet Tool

The following paragraphs describe general procedures for completing the worksheets in the ASCS spreadsheet tool.

1. **Orange boxes require input from the user:** Either as text or as a selection from a drop-down menu. The user should click on each orange box. If an arrow appears to the right of the box, select an option from the drop-down menu. If no arrow appears, manually enter the required data.

2. **Scores are calculated automatically in the pink score boxes:** No manual calculation is required.

3. **To clear the information from a box:** Select the box and press the delete key. This will remove the contents of the box without changing automated formatting or data entry options.

4. **"Rationale" cells:** When assigning scores for each factor, it is *mandatory* to give a rationale for each selection. Orange cells have been provided for this purpose in the scoring worksheets. Information to help justify assigned scores could include a statement of assumptions, a description of site-specific information, and references to data sources (e.g., site visit, personal interview, site assessment reports, or other documents consulted). The user should enter this information manually in the columns provided. Without this information, expert support reviewers cannot verify scoring decisions

5. **Reference cells:** It is *mandatory* to provide a reference for the rationale given (as described in item 4 above) for each selected response. Without this information, expert support reviewers cannot verify scoring decisions.

6. **"Do Not Know" option:** Many drop-down boxes include a "Do Not Know" option. When this option is selected, up to half the maximum number of points for the corresponding question are awarded. At the same time, one point is added to the total number of "Do Not Know" responses. This cumulative number is converted to a percentage of questions that showed the "Do Not Know" response. If the percentage of responses that are "Do Not Know" exceeds 15%, the ASCS will automatically designate the site "Class INS", meaning that insufficient information is available to classify the site.

   On the Pre-Screening checklist (Tab 4), the "Do Not Know" option does not contribute to the percentage of responses that are "Do Not Know" on the Summary Score Sheet (or to site classification as INS); this option is simply provided for the purpose of gathering complete information from the user.

   NOTE: Throughout this detailed user guidance document, examples (screenshots) are provided to illustrate specific aspects of the scoring tool. Look for the blue arrows (⇨) that indicate which cells contain the information being discussed in each example.

3.0 SITE DESCRIPTION (WORKSHEET #3)

3.1 Purpose

The Site Description worksheet summarizes basic information about the site and relevant environmental conditions including known and potential contaminants of concern and affected media. It assesses the level of information available to the user to support the classification system evaluation and assigns a site letter grade.

3.2 Test Site and Location

Generally, the test site and location refer to the more specific location(s) of sampling that were used in scoring the contaminated site under evaluation. This information will automatically be repeated at the top of each subsequent worksheet. However, the site name or project name as it appears in the Interdepartmental Data Exchange Application (IDEA – see section 3.5 below) should be the primary reference, with other descriptors or names being subordinate to it. In many cases the site common name is already descriptive enough to reflect the test site(s) and location(s).

For example, where Miller Bay is the Site common name, the user can further describe where contamination exists on the site. Miller Bay – Staff house, storage tank, and radio tower. If no further descriptor is used then the test site and location can be left the same as the common name.

3.3 Site Letter Grade

A letter grade (A to F, see Table 1) is assigned by the user according to the level of available information about the site. The purpose of the letter grade is to indicate the degree of completeness of information, depending on the level of investigative and remedial work that has been carried out at the site. Descriptions of each grade are given in Worksheet #2 Instructions in the ASCS spreadsheet tool.

If the letter grade is F, the site is automatically classified as INS on the Summary Score Sheet (Worksheet 8), as sufficient data are not available to score the site, and the user should discontinue scoring. At least a Phase I environmental site assessment (ESA) or equivalent should be used as the basis for scoring. If Phase II or III ESA reports or risk assessment reports are available, they should also be used in scoring the aquatic site.

Note that if the site letter grade appearing in the orange box in cell B14 (top of the page) is F, a corresponding message appears instructing the user to not continue because of insufficient information.

More detailed descriptions of the letter grades are provided below.

Table 1: Site letter grade/completeness of information

Site Letter Grade	Detailed Description
F	Pre-Phase I ESA – No environmental investigations have been conducted or Phase I ESA information is incomplete. It is not recommended to continue through the classification system when insufficient data are available. In this instance, it will generally be necessary to conduct a Phase I ESA or other site investigation study before scoring the site using the ASCS.
E	Phase I ESA – A preliminary desk-top study has been conducted, involving non-intrusive data collection to determine the potential for the site to be contaminated and to inform any subsequent intrusive investigations. Data collection may include a review of available information on current site conditions and the history of the property, a site inspection, and/or interviews with personnel familiar with the site. [Note: This stage is the "Phase I: Site Information Assessment" as described in the document entitled "Guidance Document on the Management of Contaminated Sites in Canada" (CCME 1997).
D	Phase II ESA – An initial intrusive investigation and assessment of the site has been conducted. Phase II ESAs generally focus on potential sources of contamination to determine whether contaminants exceed relevant screening guidelines or criteria, and to broadly define sediment and surface water conditions. At this stage, samples have been collected and analyzed to identify, characterize, and quantify contamination in surface water, sediments, biological tissues, or other materials/ substances at the site. [Note: This stage is the "Phase II: Reconnaissance Testing Program" as described in the Guidance Document on the Management of Contaminated Sites in Canada (CCME 1997).
C	Phase III ESA – Further intrusive investigations have been conducted to characterize and delineate contamination, to obtain detailed information on sediment and surface water conditions, to identify contaminant pathways, and to acquire other information to support the development of a remediation plan. [Note: This stage is the "Phase III: Detailed Testing Program" as described in Guidance Document on the Management of Contaminated Sites in Canada (CCME 1997).
B	Risk Assessment with or without a Remedial Plan or Risk Management Strategy – A risk assessment has been completed, and if the risk associated with contamination was found to be unacceptable, a site-specific remedial action plan has been designed to mitigate environmental and health concerns associated with the site, or a risk management strategy has been developed.
A	Confirmation Sampling – Remedial work, monitoring, and/or compliance testing have been conducted and confirmatory sampling has been carried out to demonstrate whether contamination was removed or stabilized and whether clean-up or risk management objectives were met.

3.4 Civic Address (or other description of location)

The user should enter the civic address (street name and number, lot number, municipality, province) of the water lot or body in cell B19. The address may include a lot number, rural route number, or other applicable identifying information.

3.5 Site Common Name

The Site Common name is the generic descriptor of the contaminated site and may be reflective of the federal property name or geographic location. The user should use the terms in IDEA as the primary reference, such as the Site Name or Project Name. More detailed descriptors may be added to the test sites and location field.

3.6 Site Owner or Custodian (organization and contact person)

The name and organization of the site owner and/or custodian department or agency should be listed in cell B21.

3.7 Federal Contaminated Sites Inventory (FCSI) Number

The FCSI is hosted by the Treasury Board Secretariat and contains information on key characteristics of contaminated sites, their location, and how they are being managed. Only one FCSI number per contaminated site should be assigned.

3.8 Custodian Site ID

Each custodial department has its own internal system of identification numbers for sites under its responsibility. The ID number assigned to the site by the custodial department should be entered in cell B23.

3.9 Approximate Area of Site (in hectares - ha)

The user should consult site plans and/or previous environmental investigation reports and record the approximate area of the site in hectares in cell B24.

3.10 Parcel Identifier(s) (PID) (or Parcel Identification Numbers (PIN)) if untitled Crown land)

The PID or PIN is the parcel number or lot number of the site. The site's PID/PIN number can be found on an official survey or legal plan (cadastral plan) of the site that can be obtained from the municipality or from the custodial department.

3.11 Centre of Site

Universal Transverse Mercator (UTM) coordinates and latitude/longitude corresponding to the most accurate location of the specific contaminated site, or the centre of the property where the contaminated site is located should be entered in cell B27 and D27 respectively.

3.12 Aquatic Site Use

This section should indicate the past, current, and proposed (if any) federal use of the aquatic site. Examples of site use include industrial shipyard, commercial harbour with mixed light industrial boat building, etc.

3.13 Adjacent Land Use

This section should indicate the past and present land use for land bordering the aquatic site by including a land-use category (e.g., residential/parkland, agricultural, commercial, or industrial) and/or a brief description. If the proposed land use is known, this information should also be included.

3.14 Site Plan

To delineate the boundaries of the site, a site plan MUST be attached. The plan must be drawn to scale indicating the boundaries in relation to well-defined reference points and/or legal descriptions. Water bodies must be shown and named on the site plan. Delineation (area and depth) of contamination should also be indicated on the site plan, and the plan should include a north arrow direction.

3.15 Water Bodies/Watercourses on the Site

All water bodies on the site should be listed and described in this section, including their name and type (e.g. lake, river, wetland, bay, pond, etc.), their approximate surface area (except for very large water bodies), and whether they represent freshwater, marine, or brackish habitat.

3.16 Provide a Brief Description of the Site

This section should include a brief history of the site, a brief overview of site characteristics (including water bodies, streams, wetlands, and floodplains) the ecological significance of water bodies (i.e., habitat and fish use), any known/suspected contamination events/sources, and the

estimated volume of contaminated sediment present. The methodology used to estimate volume should also be mentioned.

3.17 Affected Environmental Media and Chemical Class of Potential Contaminants

In this section, the user should list potential contaminant chemical classes next to each potentially affected medium.

Example:

14. Affected Environmental Media and Chemical Class of Potential Contaminants:	Medium	Potential contaminant classes (e.g., metals, PAHS, PCBs, etc.)
	Surface Water ⇨	metals
	Sediment ⇨	metals, PAHs
	Groundwater ⇨	metals
	Biological Tissues	n/a

Chemical classes typically include metals (or inorganic substances), polyaromatic hydrocarbons (PAHs), petroleum hydrocarbons (PHCs; CCME fractions F1, F2, F3, and F4) and BTEX compounds (benzene, toluene, ethylbenzene, and xylenes), polychlorinated biphenyls (PCBs), organic pesticides and organochlorine compounds, dioxins and furans, nonylphenol and ethoxylates and isotopes.

3.18 Information About the User

The remaining questions summarize information about the individual who will complete the scoring worksheets, including:

- Name and company or federal government department/agency of the user
- Project role of
    - The user should choose “Consultant” or “Custodian” from the drop-down box, depending on whether the scoring has been contracted to a consulting company or will be done by a government employee.
- Address
- Telephone number
- Fax number
- E-mail address
- Date scoring completed

4.0 PRE-SCREENING (WORKSHEET 4)

4.1 Purpose

The Pre-Screening checklist is included in the ASCS to allow quick evaluation of some key indicators of a Class 1 (High Priority for Action) or Class N (Not a Priority for Action) status. *Regardless of any preliminary Class 1 or Class N score assigned during Pre-Screening, all scoring worksheets must be completed.*

The score included on the Summary Score and Final Classification Worksheet should be the normalized sum of scores calculated from Worksheets 5, 6, and 7. However, a site can currently qualify as a Class 1 or Class N site due to a preliminary Class 1 or Class N designation, solely through this Pre-Screening checklist. These questions still need to be reviewed and considered. Discuss with Expert Support if "Yes" is answered for any of the Preliminary Class 1 Designation Criteria and the score from Worksheets 5-7 do not result in a Class 1.

4.2 Detailed Instructions and Rationale for Pre-Screening

4.2.1 General Instructions

For each question, the user should choose "Yes", "No", or "Do Not Know" from the drop-down box in column C. Note that "Do Not Know" options are included on the Pre-Screening checklist only as an alternative to definitive answers and are not used in the overall calculation in the Summary Score Sheet.

For each answer, it is important that the source of information on which the selected option was chosen be listed in the "Reference" column, and that the justification for this selection be briefly described in the "Rationale" column. *Without this information, scoring cannot be verified.*

Note that for some questions, selecting "Yes" from the drop-down box automatically generates a message in red with instructions pertaining to the Receptors and Exposure Worksheet (Worksheet 6). These instructions should be followed regardless of the preliminary Class 1 designation. See below for an example.

	Question	Response (yes / no)	Reference	Rationale
3.	Is there direct and significant evidence of **impacts to ecological receptors** at the site, or off site due to migration of contaminants from the site? Examples of impacts to ecological receptors could include: •loss, reduction or impact (chemical or physical) of fish or wildlife populations; •severely stressed biota or absence of biota; •fish tumours or other deformities; •bird or animal deformities or reproduction problems; •degradation and/or deformation of benthos; •eutrophication or undesirable algae; •degradation of phytoplankton and zooplankton populations; •loss of fish and/or wildlife habitat.	Yes Select option A on Tab #6 Receptors & Exposure Question 4a		

Specific instructions and notes corresponding to each question are listed in columns F and G, respectively.

4.2.2 Preliminary Class 1 Designation Criteria

Questions 1 through 5 evaluate criteria that can result in the preliminary designation of a site as Class 1 (High Priority for Action).

4.2.2.1 Question 1. Is there any evidence that radioactive material, severe bacterial contamination, or biological hazards are likely to be present at the site?

If radioactive materials, bacterial contaminants, or biological hazards are known or strongly suspected to be present at levels that could cause harm to humans or ecological receptors, contact the applicable regulatory agency immediately and answer "Yes" to this question, thereby designating the site as Class 1. If not, answer "No".

Professional judgement should be used to determine whether the severity of the situation merits a Class 1 designation. Any such designation must be justified in the "Rationale" column, and references provided in the "Reference" column.

Note: Sites with radioactive contamination are not automatically considered a Class 1 site. The CCME provides guidelines for potentially radioactive substances that assess chemical toxicity but not radiotoxicity. When assessing the radiotoxicity of radioactive substances, a comparison to background would be appropriate. Please note, if radioactive substances are identified, it is recommended that agencies such as the Canadian Nuclear Safety Commission be contacted for additional information.

4.2.2.2 Question 2. Is there direct and significant evidence of impacts to humans at the site or off-site due to migration of contaminants from the site?

If any impacts to human health and/or safety as a result of chemical, biological, radiological, or physical hazards at the site have been documented, answer "Yes" to this question and designate the site as Class 1. If not, answer "No". If insufficient information is available to answer this question, choose the "Do Not Know" option.

If a Class 1 designation is assigned using this criteria, rationale and references must be provided.

Note that a Class 1 designation ("Yes" response) on Question 2 of the Pre-Screening checklist should correspond with the selection of option A on Question 3a of the Receptors and Exposure Pathways worksheet (Worksheet 6).

4.2.2.3 Question 3. Is there direct and significant evidence of impacts to ecological receptors at the site or off-site due to migration of contaminants from the site?

Examples of impacts to ecological receptors could include the following:

- loss of, reduction of, or impact on fish or wildlife populations;
- severely stressed biota or the absence of biota;
- fish tumours or other deformities;
- bird or animal deformities or reproduction problems;
- degradation and/or deformation of benthos;
- eutrophication or undesirable algae;
- degradation of phytoplankton and zooplankton populations; and/or
- loss of fish and/or wildlife habitat.

The list of impacts to ecological receptors is primarily based on the International Joint Commission *Great Lakes Water Quality Agreement* (IJC, 1978) definition of "beneficial use(s) impairments -- ecological components," which is described as a change in chemical, physical or biological integrity of the Great Lakes System, thus resulting in any of the impacts listed above.

If, in your professional judgement, any of the listed ecological impacts are evident/documented and severe, and there is sufficient evidence that such impacts are related to contamination on the site, the site should be categorized as Class 1, regardless of the numerical score. For the purposes of the classification system, effects that would be considered severe include observed impacts on survival, growth, or reproduction, which could threaten the viability of a population of ecological receptors at the site. Other evidence that qualifies as severe adverse effects may be

determined based on professional judgement and in consultation with the relevant Expert Support department.

If some evidence of the listed ecological impacts is documented, but the effects are localized or relatively minor, the site should not be automatically designated as Class 1. In this instance, the user should choose "No" from the drop-down menu, and give justification for this decision.

Degradation of biological communities (e.g., fish, benthos, etc.) can include a significant decline in populations, changes in community structure, or death or impaired health of a large number of individuals.

Include results of any sediment toxicity testing or benthic community analysis that indicate statistically significant toxic effects or community-level effects (compared to reference sediments).

Note that a Class 1 designation ("Yes" response) on Question 3 of the Pre-Screening checklist should correspond with selection of option A on Question 4a of the Receptors and Exposure worksheet (Worksheet 6).

If none of the listed impacts are evident, answer "No". If insufficient information is available to answer this question, choose the "Do Not Know" option.

4.2.2.4 Question 4. Are there readily detectable indicators of significant contamination in the exposure zone (i.e., the zone in which receptors may come into contact with contaminants)?

Examples of indicators of significant contamination in the exposure zone could include the following:

- significant and persistent sheen/NAPL (non-aqueous phase liquid) originating from identified or unidentified hydrocarbon source in sediments or upland soils; or
- presence of material on/in sediment with suspected high concentration of contaminants such as ore tailings, sandblasting grit, slag, or coal tar.

If there is documented evidence of significant contamination corresponding to the above list, the user should answer "Yes" and rate the site as Class 1, a priority for remediation or risk management. If none of the effects listed in cell B14 are evident or if the effects are not severe, the user should answer "No". For example, small-scale and/or temporary sheens (e.g., sheen from a boat motor in a small-craft harbour) would not be considered sufficient to support a Class 1 designation.

4.2.2.5 Question 5. Do measured concentrations of volatiles or unexploded ordnances represent an explosion hazard?

If there is documented evidence of these substances on the site, the user should answer "Yes". Scoring should not continue until the safety risks have been addressed.

Users are advised to consult their jurisdiction's occupational health and safety guidance or legislation on explosive hazards and measurement of lower explosive limits.

Note: The presence of unexploded ordnances (UXOs) at a site does not warrant an automatic Class 1 ranking. The explosive hazards from UXOs are of a different nature than hazards from chemical contaminants, and are not compatible with the ASCS. Any legacy chemical contamination resulting from UXOs that may pose a risk to human health or ecological receptors should be reflected in the ASCS score, and will be addressed by FCSAP (if eligible). FCSAP would fund the removal of UXOs only as an indirect cost, and only if they are present on eligible sites.

4.2.3 Preliminary Class N Designation Criteria

Questions 6 and 7 evaluate criteria that can result in the preliminary designation of a site as Class N (Not a Priority for Action).

4.2.3.1 Question 6. Are there any chemical exceedances or physical impacts to aquatic habitat on the site (known or suspected)?

An exceedance occurs when measured concentrations in the exposure zone are higher than both 1) background or reference concentrations and 2) environmental quality guidelines (EQGs). Appropriate EQGs are 1) CCME Canadian Environmental Quality Guidelines (to be used if available), 2) *equivalent* provincial/territorial guidelines/standards if no CCME guideline exists for a specific chemical in a relevant medium, or 3) background/reference values. Equivalent guidelines or standards must offer at least the same level of protection for aquatic receptors as the CCME guidelines.

If there are any statistically significant exceedances and/or known or suspected physical impacts to fish habitat on the site, the user should answer "Yes" to this question. Otherwise the user should answer "No" and thereby designate the site as Class N, "Not a Priority for Action".

If a sufficiently comprehensive environmental site assessment has been completed at the site, beginning with a Phase I ESA and including subsequent intrusive investigation phases, and these investigations have detected no exceedances (known or suspected) of the relevant CCME or provincial/territorial guidelines/standards at the site (and chemicals for which there are no guideline/standard do not exceed defensible toxicity benchmarks), the user should answer "No".

Where background/reference concentrations exceed guidelines, the nature of the background samples should be taken into account. Ideally, background/reference samples should be collected from sites that are similar in as many ways as possible to the water lot samples, but with the absence of apparent sources of contamination. If the entire surrounding area is highly polluted, the use of local background levels is not recommended and the Class N designation is not appropriate.

4.2.3.2 Question 7. Please indicate whether a risk assessment conducted using the Triad Approach, outlined in the Framework for Addressing and Managing Aquatic Contaminated Sites under FCSAP, has concluded that sediments can remain in place with no further work required.

Answer "Yes" to this question if the specified risk assessment was completed with the conclusion that sediments can remain in place with no further work required (preliminary Class N designation).

If no such risk assessment has been completed for the site, or if conclusions from the risk assessment indicate that further work is required, answer "No" to this question.

Guidance regarding the recommended approach to risk assessment is presented in the following: FCSAP, 2018a. Framework for Addressing and Managing Aquatic Contaminated Sites Under the Federal Contaminated Sites Action Plan (FCSAP). Golder Associates Ltd, Burnaby (BC), Canada, Table 2.

5.0 CONTAMINANT CHARACTERISTICS (WORKSHEET 5)

5.1 Purpose

The Contaminant Characteristics worksheet identifies contaminants of concern and assesses associated hazards and the significance of chemical impact. The worksheet contains instructions and explanations to assist users in evaluating chemical impacts.

The score from this worksheet represents 50% of the total ASCS score for the site.

5.2 Overview

This worksheet requires the user to enter the results of intrusive testing with respect to contaminants in surficial sediments (top 10 cm) and surface water. *Note that sediment data is essential, i.e., sites should not be scored on the basis of surface water chemistry alone. Also, deeper sediments (>10cm) will be addressed in section 5.6.4).* The worksheet is divided into three questions:

1) Quantitative Assessment of Surficial Sediment and Surface Water Characteristics
2) Qualitative Considerations, and
3) Significance of Geographic Extent of Chemical Impact.

Detailed instructions and explanation of all calculations are provided in the following sections.

5.3 Questions 1a and 1b. Sediment and Surface Water Data

The user is instructed to enter the following information in the appropriately labelled column for *each parameter that exceeded either CCME guidelines or another, user-defined risk-based guideline*:

1) Highest concentration detected for the parameter,
2) Number of samples tested for the parameter,
3) Number of samples exceeding criteria (CCME or user-defined) for the parameter, and
4) Any background or reference concentrations, if applicable.

The user is not required to enter information for each of the parameters listed in the spreadsheet. Only data for those substances with concentrations exceeding their corresponding criteria (CCME or user-defined) are to be entered.

Be sure to select either “freshwater” or “marine” at the beginning of Question 1a and Question 1b as this will automatically populate CCME criteria for each medium and each chemical class.

The information provided in Questions 1a and 1b is automatically used in the Calculation Tables (row 243 to row 269) to calculate a score representing the contamination present on the site. Explanations of the formulas used to calculate this score are provided in section 5.3.3.

5.3.1 A Word About User-Defined Criteria and Reference Values

CCME guidelines should be used preferentially, if they exist, to ensure that different sites are evaluated against the same criteria, to the extent possible. Where appropriate provincial/territorial standards or guidelines exist, they should be used for substances for which no CCME guideline exists for the medium being evaluated. *Equivalent guidelines or standards must offer at least the same level of protection for aquatic receptors as the CCME guidelines.* If provincial/territorial sediment guidelines are substituted due to the lack of a federal guideline, the lower tier of any multi-tier system should be used. See Worksheet 9 for references to guideline documents.

When entering a user-defined criterion (in column H), *it is essential that the source of the criterion be documented in the last column of the data entry table.* For this reason, when a user-defined criterion is entered, the corresponding cell in column O will be highlighted in yellow. Enter the source of the criterion (e.g., British Columbia Ministry of Environment (BC MOE), Ontario Regulation 153/04 (O. Reg. 153/04), etc.), and the yellow warning highlight will disappear.

In the absence of a CCME or provincial/territorial criterion, a background or reference value (column J) can be used and cells in the "User-defined criterion" column should be left blank. A score will be calculated on the basis of the entered reference concentration.

Where no criterion is specified, or where the reference value is higher than the criterion value, reference values (if provided) are automatically used in the calculation tables to compute exceedance factors (see section 5.3.3). Reference values should represent natural background levels, i.e., those measured in media unaffected by human activity. Verify that reference values are derived from areas unaffected by human activity to the extent reasonable.

Where multiple reference values are available, enter the maximum measured reference concentration corresponding to the substance and medium being evaluated. If no reference data is available for a given substance, leave the corresponding cell blank, and the calculation table will use the specified criterion.

Metals such as iron and manganese, which are essential nutrients and relatively non-toxic, may be evaluated using the ASCS if their concentration is high enough to warrant concern. Such elements are only toxic in very high doses, and any environmental guidelines or standards that

exist for them should be verified to determine that they were set on the basis of toxicological data. If so, the standard or guideline can be listed under "User-defined criterion", and the element can be evaluated in the same manner as other contaminants.

5.3.2 Entering Sediment and Surface Water Data

Parts a and b of Question 1 are similarly structured. The user is instructed as follows:

- Four chemical classes are defined for contaminants in each medium (sediment and surface water): inorganic elements, PAHs, organic pesticides and organochlorine compounds, and other organic compounds (including PCBs, dioxins and furans, etc.). Both medium type and chemical class are colour coded to assist the user in navigating the tables.
- For each medium, each chemical class has a list of parameters for which CCME criteria exist (the CCME criteria will be automatically provided based on the user's selection of "freshwater" or "marine" at the beginning of Question 1a and Question 1b).
- For parameters that do not appear in the lists provided, the user can enter additional parameters by either selecting from the drop-down lists provided or by typing the name of each parameter of interest directly into the spaces provided for each chemical class.
- Spaces for five user-defined parameters are provided in each chemical class for each medium.
- For each parameter that requires data entry, the user must ensure that each of the following data are specified: maximum criterion used (if not automatically generated), highest concentration, number of samples tested, and number of samples exceeding criterion. As this data is entered, the corresponding row will be highlighted in yellow. The yellow warning highlight will disappear when mandatory data are entered.

Sediments include wetland soils and sediments that are periodically or seasonally dry. Surficial sediment refers to the top 10 cm of sediment; samples collected using petite ponars, etc. would be considered "surficial", even though under some conditions, they may penetrate 10 cm or more into the sediment (CCME 1999a). *Note that surficial sediment data is essential; aquatic sites should not be scored solely on the basis of surface water chemistry.*

The CCME has established two levels of guidelines for contaminants in sediments: the Canadian Interim Sediment Quality Guidelines (ISQGs), representing concentrations below which adverse biological effects will rarely occur (i.e. Threshold Effect Levels – TEL), and the probable effect levels (PELs), above which biological effects will probably occur. *ISQGs (derived from TEL), rather than PELs, should be selected as EQGs for sediments when completing Questions 1a and 1b.* The ISQGs are used in evaluating sites to determine their relative levels of contamination;

therefore, a consistent approach is necessary. However, it is not reasonable to expect contaminant concentrations in sediments to be remediated to levels below ISQG values for some sites, e.g., working harbours. The need for a practical alternative regarding screening criteria for working harbour sites was identified by the Harbour Management Working Group and managers of working harbours (FCSAP 2018b). The FCSAP Aquatic Sites Classification System allows for adjustment of the default screening criteria (CCME ISQGs) used in the worksheets as long as a written rationale is provided. Remediation or risk management strategies would be addressed after determination of FCSAP eligibility; such strategies and target clean-up values are independent of scoring results.

For the surface water data in Question 1b, water chemistry variables (i.e., pH and hardness) are required as CCME guideline values for some substances are calculated on the basis of these parameters.

5.3.3 Automatic Calculation of Score for Question 1a and 1b

The approach taken in scoring chemical impacts at the site is to evaluate, for each combination of medium and chemical class, the substance with the highest exceedance over the corresponding CCME recommended value (or other suitable guideline if no CCME guideline is available) and the "most prevalent" substance, which is the one that exceeds the corresponding guideline value in the largest number of samples. This approach was designed to capture information about "hot spots", or small areas with particularly high concentrations of one or more contaminants, as well as widespread, lower-level contamination. An aquatic site may encompass hot spots, or widespread, lower-level contamination, or both. In this model, both are evaluated on an equal footing. The substance with the highest exceedance over guidelines would normally represent the "hot spot" with the highest level of contamination, and calculations involving the most prevalent (exceeding) substance would allow evaluation of more widespread, lower-level contamination.

The spreadsheet automatically assigns a score for each of these substances. The overall score for each combination of medium and chemical class is the sum of the scores for the highest exceeding substance and the most prevalent substance, plus additional points for exceedance over criteria of a biomagnifier or persistent organic chemical in this medium/chemical class, and for the number of substances exceeding criteria divided by the total number of substances tested.

If two or more elements have the same number of exceedances per samples taken, the first parameter in the list is recorded as the most prevalent. Similarly, if the exceedances of applicable criteria for two or more different parameters in a chemical class are numerically equivalent, the

parameter appearing first in the list will be returned as the highest exceedance. A single parameter can both be the most prevalent and have the highest exceedance.

5.3.3.1 Highest Exceedance and Most Prevalent Contaminant of Concern (COC)

As mentioned above, the spreadsheet tool accommodates the evaluation of "hot spots" as well as widespread, lower-level contamination. The chemical with the highest exceedance would represent the most important "hot spot" on a given site, and the chemical that exceeded the applied criterion in the greatest proportion of samples for a given medium and chemical class would be selected as the most prevalent COC.

For each combination of medium and chemical class, the first calculation table evaluates the highest exceedance COC, which is identified by dividing the maximum value for each substance in the medium being evaluated by its corresponding guideline or reference value. For substances with no specified criteria, or where the reference value exceeds the criterion, the calculation table uses the corresponding reference value. In order to evaluate widespread, lower-level contamination, the second calculation table captures data regarding the most prevalent COC in each medium/chemical class combination.

The formulas used in the two calculation tables are identical; only the substances have the potential to differ between them. The calculation tables automatically identify the highest exceedance COC and the most prevalent COC, based on the data provided in Questions 1a and 1b. The name, number of samples analyzed, maximum concentration, criterion value, and number of exceeding samples are automatically copied from the input tables into the calculation tables. For sediments and surface water, exceedance factors (EF) are computed for the highest exceedance and the most prevalent COC in each chemical class, as shown below:

$$\mathrm{EF} = \left[\ln\left\{\frac{\text{Minimum of}\left(\left(\text{Max Concentration}\right)\text{ or }\left(100 * \text{Criterion Value}\right)\right)}{\text{Criterion Value}}\right\} + \mathrm{C}\right] * 2 * \text{Score A or B}$$

Where EF	= Exceedance factor (contribution to overall raw score)
Max Concentration	= Maximum measured concentration of the substance in sediment or surface water
Criterion Value	= Maximum value selected from a CCME guideline, user-defined guideline/standard, or background/reference value (the measured concentration of the substance in a reference location)
C	= Constant (equal to 5 minus the natural logarithm of 100)
Score A or B	= Multiplier (reflecting the number of exceeding samples

compared to the number of samples tested; see the next section).

In the above equation, the natural logarithm of the maximum concentration divided by the criterion value is used in order to attenuate the inflation of scores by outliers. Further, the numerator is capped at 100 times the criterion used (consistent with the NCSCS approach). The constant C, equal to 5 minus the natural logarithm of 100, ensures that the maximum value of the first term of the equation is 5. Since the maximum value of Score A (for the highest exceedance) or Score B (for the most prevalent COC) is 10, the maximum EF for each line in the calculation tables is 100 (5 x 2 x 10).

5.3.3.2 Score A and Score B

Scores A and B are automatically calculated as the number of samples in which a substance exceeded its corresponding criterion, divided by the total number of samples analyzed for the substance (in the same medium), and multiplied by 10. These scores are used as multipliers to compute the overall total for each row being evaluated.

Note that if the number of samples tested for a specific contaminant within a given medium and chemical class (e.g., surface water, metals/inorganics) is less than 4, Score A or B is set equal to 0.1 (out of a possible 10 points) to avoid assigning inflated scores where very few samples were tested and at least one exceedance was detected.

5.3.3.3 Question 1a and 1b Subtotals

Subtotals, to a maximum of 200 points each, are calculated for the highest exceeding COC and the most prevalent COC by adding together the exceedance factors for all rows in each of the calculation tables.

5.4 Question 1c. Number of Substances Exceeding Criteria in Each Chemical Class

Score C is automatically calculated as the number of substances exceeding criteria for each combination of medium and chemical class, divided by the total number of substances tested for the same combination of medium and chemical class, and multiplied by 15.

If the number of substances tested within a given medium and chemical class (e.g., surface water, metals/inorganics) is less than 4, Score C is set equal to 1 (out of a possible 15 points) to avoid assigning inflated scores where very few substances were tested and at least one exceedance was detected. For example, PCBs are sometimes tested collectively rather than individually,

therefore environmental assessment reports may only indicate that total PCBs exceeded the corresponding guideline value. In this instance, and without any other substance tested in that chemical class, without the adjustment described above, Score C would be 1/1 * 15 = 15, which is the maximum score. The adjustment for small numbers of tested substances circumvents this problem.

5.5 Question 1. Total Score

The total score for all chemical classes in both sediments and surface water evaluated in Questions 1a-1c are summed in cell M289. This total is the sum of the total scores for the highest exceeding COC, the most prevalent COC, and Score C.

5.6 Question 2. Qualitative Considerations

In Question 2, a number of qualitative considerations related to chemical impacts are evaluated, as described below. *It is essential that rationale and/or references be documented in the "Rationale" boxes provided for each question.*

5.6.1 2a. Were sediments analyzed for petroleum hydrocarbons (CCME fractions F1 to F4)?

Question 2a has been included in order to qualitatively assess the presence or potential presence of petroleum hydrocarbons in sediments as, at the time the spreadsheet tool was developed, no risk-based sediment guidelines had yet been developed. Note that if you respond yes, there are provincial guidelines (e.g., Atlantic Risk Based Corrective Action (RBCA) guidelines Version 3) that can be included as user-defined criteria in question 1.

5.6.2 2b. Is there reason to suspect the presence of contaminants which have not yet been analyzed in sediment or surface water?

In Question 2b, the user is asked to provide information regarding any suspected contamination for which chemical analysis has not yet been completed. Again, rationale must be provided to support the selected response.

5.6.3 2c. Are any of the contaminants exceeding guidelines in any media known or suspected to be persistent, bioaccumulating, or biomagnifying substances?

In Question 2c, consideration is given to the presence of bioaccumulating and persistent substances. Reference material regarding these substances is included in the Reference Material worksheet (Worksheet 9).

5.6.4 2d. Are deeper sediments (>10 cm) known or suspected to be contaminated?

Since there are no criteria against which to evaluate contaminant concentrations in deep sediments (i.e., deeper than 10 cm), Question 2d has been included to ensure that any contamination in these sediments is taken into account in the scoring of chemical impacts.

5.6.5 2e. Does groundwater discharging to an aquatic habitat exceed applicable Federal Interim Groundwater Quality Guidelines?

To help clarify the definition of groundwater in aquatic habitats, the Guidance Document on Federal Interim Groundwater Quality Guidelines for Federal Contaminated Sites (2012) states:

"The transition between groundwater and surface water is not a sharp or distinct boundary; rather, there is a dynamic transition zone from groundwater to surface water. This transition zone is considered to be an important component of the surface water ecosystem (United States Environmental Protection Agency (US EPA) 2008). Transition zones beneath streams and rivers are referred to as hyporheic zones, while those beneath lakes and wetlands are referred to as hypolentic zones (US EPA 2008). The transition zone includes the sediment-water interface and sediment beneath and adjacent to the surface water where surface water conditions may affect groundwater and where surface water biota (particularly invertebrates, larvae, and microbial communities) spend at least part of their time. The transition zone plays a major role in nutrient and energy cycling in surface water bodies (Hayashi and Rosenberry 2002), and in some cases has been shown to contribute significantly to the biodegradation of contaminants (US EPA 2008). Since groundwater typically has a more stable temperature than surface water, the transition zone can provide a thermal refuge for fish in summer or winter (Hayashi and Rosenberry 2002). The extent of the transition zone can vary over time; since groundwater and surface water often have very different chemical characteristics, the extent can often be determined from water chemistry (Hayashi and Rosenberry 2002).

Groundwater is also present beneath surface water bodies ... water beneath the hyporheic zone or beneath the hypolentic zone is considered to be groundwater (i.e., the transition zone is not considered as groundwater)."

Groundwater concentrations of contaminants at the point of contact with an aquatic receiving environment can be estimated in three ways:

1) by using existing nearshore groundwater data (this will be a conservative comparison, as contaminant concentrations in groundwater often decrease between nearshore wells and the point of discharge);

2) by conducting groundwater modeling to estimate the concentration of groundwater immediately before discharge; or
3) by analyzing groundwater at the point where it will come into contact with aquatic receptors, usually within the top 1 m of sediments.

5.6.6 2f. Are contaminated sediments located in an erosional zone?

If contaminated sediments are situated in an erosional zone (as opposed to depositional), they are more likely to become suspended in the water column and transported away from the source. Question 2f has therefore been included to ensure that points are added for erosional zone contaminants.

5.6.7 2g. Have there been upstream or upgradient contamination events of soils, surface water, or groundwater?

If upstream or upgradient contamination events have occurred in the past, transport of the contaminating substances to the aquatic site may be taking place or may take place in the future. Question 2g captures this information. The score should be based on a review of environmental site assessment reports, as well as federal and provincial/territorial databases on spills, contaminated sites, violations, etc. See the Provincial/Territorial Spills Regulations and/or Databases in the Reference Material worksheet (Worksheet 9) for more information.

5.6.8 2h. Is there evidence of migration of COCs from terrestrial sources to surface water in run-off?

The potential for contaminants to mobilize from terrestrial sources to surface water in run-off should be determined based on knowledge of containment measures, the distance from terrestrial contamination to surface water, topography, run-off potential, and flood potential.

5.7 Question 3. Significance of Geographic Extent of Chemical Impact

In order to assess the significance of the geographic extent of the chemical impacts evaluated in Questions 1 and 2, the user is instructed to choose “Negligible”, “Low”, “Moderate”, or “High” as defined below:

Selection	Definition	Multiplier
Negligible	Impact is limited to a very small portion of the site or within the boundaries of a very small site, such as a navigational marker.	0.5
Low	Impact is most likely to be limited to the area within site boundaries.	1
Moderate	Impact is likely to extend into areas adjacent to the site boundaries.	1.5
High	Impact is likely to extend into areas beyond those adjacent to the site boundaries.	2

The approach adopted here in rating the significance of potential chemical impacts at the site is from criteria used by various federal government departments (e.g., Transport Canada, Environment and Climate Change Canada) in assessing the significance of the geographic extent of potential impacts for the purpose of conducting environmental assessments.

The selected response should be recorded in cell C337, and justification must be documented in the rationale box provided. The corresponding multiplier will be automatically entered in cell G337.

5.8 Total Score: Contaminant Characteristics

In cell M289, a combined score is calculated for Questions 1a-1c. This score is added together with the score from Question 2 (cell G324) to produce a total unadjusted score out of 250 for the Contaminant Characteristics worksheet (cell G340).

The multiplier from Question 3 is then applied to the unadjusted score to produce an adjusted score (out of 250) that reflects both the concentrations and potential significance of contaminants on the site (cell G343).

6.0 RECEPTORS AND EXPOSURE PATHWAYS WORKSHEET (WORKSHEET 6)

6.1 Purpose

The Receptor Characterization and Exposure Pathways worksheet identifies both human and ecological receptors that are known or likely to be present at the site on a permanent or temporary basis. It evaluates potential exposure pathways by which receptors could or may have come into contact with identified contaminants. Instructions, explanations, and references are included to guide users in characterizing receptors at the aquatic site and scoring potential exposure pathways.

The score from this worksheet represents a maximum of 40% of the total ASCS score for the site.

6.2 Characterization of Receptors

6.2.1 Question 1. Characterization of Human Receptors

6.2.1.1 1a. Human use of the aquatic site and aquatic environments within site boundaries and in the area immediately adjacent to or downgradient of site boundaries.

This question is intended to evaluate human use of the aquatic environment at or in the vicinity of the site. The user is instructed to choose the activity for which the site is used by humans from the drop-down list in cell C9. “Subsistence” implies that the site is used as a source of food, medicinal plants, drinking water, or irrigation water by local human populations. “Aquaculture or Fishery” applies to sites where fish harvesting occurs. “Recreational” encompasses sites used for recreational boating, sport fishing, swimming, or other leisure activities. “Commercial” and “Industrial” activities are those related to buying, selling, or trading of merchandise or services (commercial), or to the production, manufacture, or storage of materials (industrial).

If more than one category applies, the highest-scoring applicable option should be selected. Aquatic site use is the main human receptor factor used in site scoring. A higher score implies greater exposure and/or exposure of more sensitive human receptors (e.g., children).

A score is automatically assigned for the selected category as follows:

Category	Score
Subsistence	20
Aquaculture or Fishery	20
Recreational	15
Commercial	5
Industrial	2
Do Not Know	10

The rationale and references supporting the selection should be documented in columns D and E.

6.2.2 Question 2. Characterization of Ecological Receptors

Question 2 evaluates the sensitivity of organisms and habitats at the site. It is important that all selections be accompanied by a brief rationale and the source documents referenced (columns D and E, respectively).

6.2.2.1 2a. How many watercourses and/or water bodies are contaminated on the site?

If the site encompasses more than one flowing watercourse (river, stream, ephemeral watercourse) and/or water body (marine, lake, pond, or portion thereof), the user should choose "2" or ">2", as appropriate. Two points are assigned for two water bodies and three are assigned for >2 water bodies, while the selection of "Do Not Know" assigns one point.

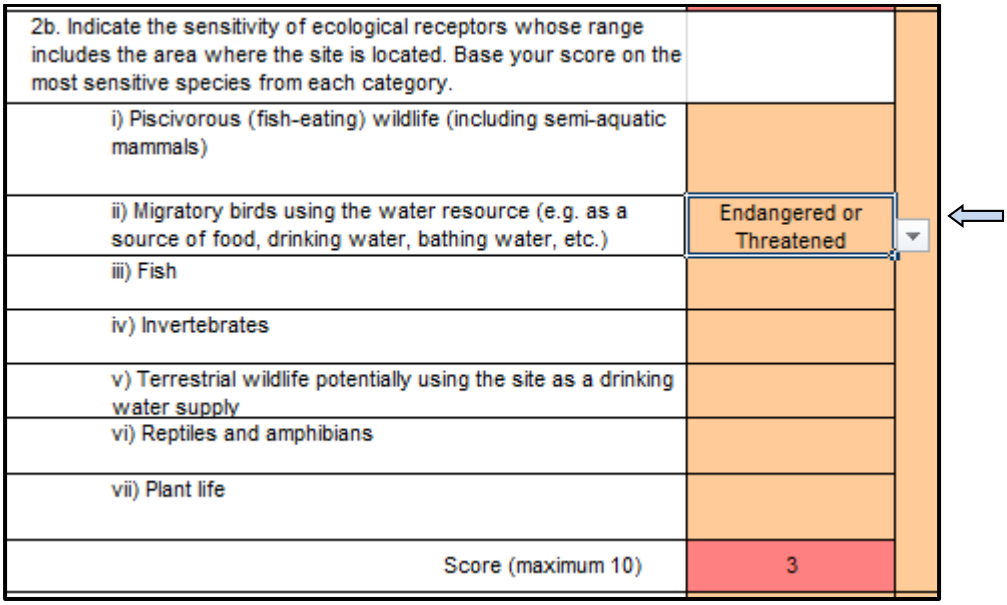
6.2.2.2 2b. Indicate the sensitivity of ecological receptors whose range includes the area where the site is located. Base your score on the most sensitive species from each category.

For each listed category of receptors, the user may make a selection from the corresponding drop-down box to indicate the sensitivity of receptors in that category, as indicated by their status under the federal *Species at Risk Act* (SARA) or another similar list. Species at risk include those that are extirpated, endangered, threatened, or of special concern. For a list of species at risk, consult Schedule 1 of the federal *Species at Risk Act*.

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) is an independent advisory organization that evaluates Canada's wild species and maintains a searchable database of their designated species. Many provincial/territorial governments also provide regionally applicable lists of species at risk.

Example:

If there is a threatened species of migratory bird using the water on the site as a source of food, drinking water, bathing water, etc., the user would choose "Endangered or Threatened" from the corresponding drop-down box, as shown below.



For each selection, a score is automatically assigned as follows:

Category	Score
Endangered or Threatened	3
Special Concern	2
Unlisted Species Only	0
Inappropriate Habitat	0
Do Not Know	1.5

The user should review site assessment reports to determine whether the specified types of ecological receptors are likely to be present on the site, or to use the site as a source of food, or as temporary or permanent habitat (e.g., migration habitat, spawning habitat). Site-specific information, local knowledge, and professional judgement should be utilized to the extent possible when responding to this question.

The definition of "fish" under the *Fisheries Act* includes:

(*a*) parts of fish,

(*b*) shellfish, crustaceans, marine animals and any parts of shellfish, crustaceans, or marine animals, and

(*c*) the eggs, sperm, spawn, larvae, spat and juvenile stages of fish, shellfish, crustaceans and marine animals.

"Inappropriate Habitat" should be selected if the types of water bodies present on the aquatic site would not normally be expected to be used by the organism being evaluated, without taking into consideration anthropogenic alterations to the habitat (physical impacts to aquatic sites are evaluated in Worksheet 7). However, inappropriate habitat also includes sites where habitat would not be appropriate due to high levels of disturbance or situations where a site is developed to the extent that it would prevent settlement by the species of concern (e.g., harbours). Site-specific information, local knowledge, and professional judgement should be utilized to the extent possible when answering this question.

6.2.3 2c. Sensitivity of the aquatic habitat on the site.

The user is asked to make a selection from the drop-down box in cell C25 to indicate whether the aquatic habitat on the site is "SARA Critical Habitat", "Highly Sensitive", or "Less Sensitive". A "Do Not Know" option is also provided.

Critical habitat under SARA is the habitat necessary for the survival or recovery of a listed endangered, threatened, or extirpated species on Schedule 1 of SARA. The habitat must be identified as the species' critical habitat in the recovery strategy or in an action plan for the species.

Highly sensitive habitats are those that are rare, host species that are highly sensitive to perturbations (e.g., many salmonids), and/or are critical to survival of the species (e.g., spawning habitat). Less sensitive habitats tend to be prevalent, host species that are resilient to change, and/or are not used by fish. Habitats are less sensitive if minor changes would not result in a measurable effect on species that use them. Migratory corridors and feeding habitat may be less sensitive than spawning or rearing habitat.

The user should review site assessment reports to determine the sensitivity of the ecological habitat. Consult with DFO Expert Support.

6.2.4 Scoring: Characterization of Receptors

Scores associated with characterization of human and ecological receptors are summed in cell C30. The maximum total score for this section is 40.

6.3 Current and Past Exposure

Questions 3 and 4 evaluate exposure of human and ecological receptors to site contaminants. The structure of both questions is similar, consisting of an initial matrix to evaluate whether exposure is A) known and documented, B) strongly suspected, based on observations or indirect evidence, or C) not documented or suspected at the site. A "Do Not Know" option (D) is also provided in each case.

If the user selects option A, B, or C in Question 3a or 4a, there is no need to score the remaining sections of the question (i.e., Questions 3b through 3g or 4b through 4d, respectively). If the user selects option D, "Do Not Know" for Question 3a or 4a, the subsequent sections of the question should be completed.

6.3.1 Question 3. Exposure of Human Receptors to Contaminants in Site Media

6.3.1.1 3a. Choose A, B, C, or D.

The user is instructed to choose A, B, C, or D from the list by selecting the desired letter from the drop-down list in cell C43, as illustrated below. The rationale behind the selection must be provided.

	A	B	C	D
34	**CURRENT AND PAST EXPOSURE**			
35	**3. Exposure of Human Receptors to Contaminants in Site Media**			
36	**3a. Choose A, B, C or D from the list below by selecting the desired letter from the drop-down list in cell C43:**			
37	**A**	Documented adverse impact or quantified exposure level which has or will likely result in an adverse effect on, injury or harm to, or impairment of the safety of humans as a result of the contaminated site. (Class 1 Site)		
38				
39	**B**	Same as above, but "Strongly Suspected" based on observations or indirect evidence.		
40	**C**	No quantified or suspected exposures/impacts in humans.		
41	**D**	Do Not Know		
43		**Selected option:**	**B**	⇦
44		Score:	12	(maximum 22)

The options presented in Question 3a and their respective scores are explained below.

A. Documented adverse impact or quantified exposure level which has or will likely result in an adverse effect on, injury or harm to, or impairment of the safety of humans as a result of the contaminated site. (Class 1 Site, 22 points)

This option should be selected if there are documented adverse effects to human receptors, for example, if a human health risk assessment indicates a hazard quotient (HQ) (or hazard index - HI) >> 1.0 and/or an incremental lifetime cancer risk (ILCR) that considerably exceeds levels defined by the jurisdiction (e.g., HQ > 10 or ILCR > 10^{-4}) for direct and indirect surface water

and/or sediment exposure pathways and/or the seafood ingestion pathway. Other known adverse effects could include blood test results (e.g., blood lead > 10 µg/dL) or results of other health-based studies and tests. In addition, this option should be selected if there are human health-based fisheries advisories and closures for the site and if bioaccumulative and/or biomagnifying chemical contaminant(s) exceeding the applicable aquatic media criteria (or background) at the site are linked to the chemical contaminant(s) identified in the advisory or closure. Sanitary, biotoxin, and other non-chemical contaminant advisories or closures are not applicable.

Known adverse impacts also include impacts to domestic and traditional food sources. Adverse effects based on a food chain transfer to humans and/or animals can be scored in this category, but the weight of evidence must show a direct link between a contaminated food source/supply and subsequent ingestion/transfer to humans. Any adverse effects to ecological receptors are scored separately in question 2 of this worksheet.

A person with demonstrable experience in the assessment of human health risks must provide a thorough description of the sources researched to evaluate and quantify the exposure/impact (adverse effect) in the vicinity of the contaminated site.

If this option is selected, the "Not Scored" option is automatically included for Questions 3b through 3g and the site will be assigned a Class 1 designation (High Priority for Action).

Selected References:

Health Canada. Federal Contaminated Site Risk Assessment in Canada Parts 1 and 2: Guidance on Human Health Preliminary Quantitative Risk Assessments (PQRA) and Toxicological Reference Values (TRVs).

US EPA. ECOTOX database.

B. Same as above, but "Strongly Suspected" based on observations or indirect evidence. (12 points)

This option should be selected if the outcome of a human health risk assessment indicates a HQ (or HI) > 0.2 (excluding the estimated daily intake - EDI) or > 1.0 with EDI and/or ILCR that exceeds acceptable levels defined by the jurisdiction ($\leq 10^{-5}$ for federal sites) for direct and indirect surface water and/or sediment exposure pathways and/or the seafood ingestion pathway. If this option is selected, the "Not Scored" option is automatically included for Questions 3b through 3g.

C. No quantified or suspected exposures/impacts in humans. (0 points)

This option should be selected when the human health risk assessment indicates a HQ (or HI) ≤ 0.2 (excluding the EDI) or ≤ 1.0 (including the EDI) and/or ILCR are within acceptable levels as defined by the jurisdiction (≤10^{-5} for federal sites) for direct and indirect surface water and/or sediment exposure pathways and/or the seafood ingestion pathway. If this option is selected, the "Not Scored" option is automatically included for Questions 3b through 3g.

D. Do Not Know. (0 points)

If "Do Not Know" is selected, Questions 3b through 3g must be scored.

6.3.1.2 Questions 3b through 3g: Potential for Human Exposure

For Questions 3b through 3g, the user makes a selection from the drop-down box next to the question. The maximum total score for Questions 3b through 3g is 22 points (equivalent to option A in Question 3a).

6.3.1.2.1 3b. What is the frequency of human land and water use within site boundaries and in the area immediately adjacent to or downgradient of site boundaries?

The user should select an option from the drop-down box, based on the interpretation of each category, as listed in the below table. The following table also presents the number of points awarded for each option.

Option	Interpretation	Score
Regular	Frequent (at least weekly) use of the site by humans, year-round.	5
Seasonal	Site use by humans primarily during specific times of the year, e.g., summer or winter months only.	3
Infrequent	Humans use the site only occasionally.	0
Do Not Know		2
Not Scored	Option A, B, or C was selected in Question 3a, therefore further scoring is not required for Question 3. No penalty is assigned.	0

If A, B, or C was selected in Question 3a, the "Not Scored" option was automatically included for Question 3b.

6.3.1.2.2 3c. Are surface waters on the site or in the area immediately adjacent to or downgradient of the site used as a source of drinking water?

Phased ESA reports should be consulted to determine whether potential human receptors use waters at or near the site as a source of drinking water. When scoring a marine site, "Not Applicable" should be selected. The scoring for each option is shown below.

Option	Score
Yes	6
No	0
Do Not Know	2
Not Applicable	0
Not Scored	0

If A, B, or C was selected in Question 3a, the "Not Scored" option was automatically included for Question 3c.

6.3.1.2.3 3d. Is surface water on the site or in the area immediately adjacent to or downgradient of the site used as a source of irrigation water?

Phased ESA reports should be consulted to determine whether potential human receptors use water at or near the site as a source of irrigation water. When scoring a marine site, "Not Applicable" should be selected. The scoring for each option is shown below.

Option	Score
Yes	5
No	0
Do Not Know	1.5
Not Applicable	0
Not Scored	0

If A, B, or C was selected in Question 3a, the "Not Scored" option was automatically included for Question 3d.

6.3.1.2.4 3e. Is surface water on the site or in the area immediately adjacent to or downgradient of the site used as a source of water for manufacturing processes?

Phased ESA reports should be consulted to determine whether potential human receptors use waters at or near the site as a source of water for manufacturing. The scoring for each option is shown below.

Option	Score
Yes	2
No	0
Do Not Know	0.5
Not Scored	0

If A, B, or C was selected in Question 3a, the "Not Scored" option was automatically included for Question 3e.

6.3.1.2.5 3f. Is site contamination located such that it has affected or could potentially affect a swimming area?

Phased ESA reports should be consulted to determine whether potential human receptors use waters at or near the site as a swimming area. The scoring for each option is shown below.

Option	Score
Yes	5
No	0
Do Not Know	1.5
Not Scored	0

If A, B, or C was selected in Question 3a, the "Not Scored" option was automatically included for Question 3f.

6.3.1.2.6 3g. Is site contamination located such that it has affected or could potentially affect fish harvesting areas (including aquaculture sites)?

The user should select the appropriate option from the drop-down box. The scoring for each option is shown below.

Option	Score
Yes	5
No	0
Do Not Know	1.5
Not Scored	0

The definition of "fish" under the *Fisheries Act* is given in Section 6.2.2.2.

Under the *Fisheries Act*, the definition of "fishery" includes the area, locality, place or station in or on which a pound, seine, net, weir or other fishing appliance is used, set, placed or located, and the area, tract or stretch of water in or from which fish may be taken by the said pound, seine, net, weir or other fishing appliance, and also the pound, seine, net, weir, or other fishing appliance used in connection therewith, while that of "fishing" means fishing for, catching or attempting to catch fish by any method.

If A, B, or C was selected in Question 3a, the "Not Scored" option was automatically included for Question 3g.

6.3.2 Question 4. Exposure of Ecological Receptors

6.3.2.1 Question 4a. Choose A, B, C, or D.

The user is instructed to choose A, B, C, or D from the list by selecting the desired letter from the drop-down list in cell C75, as illustrated below. The rationale behind the selection must be provided.

	A	B	C
65	**4. Exposure of Ecological Receptors**		
66	**4a. Choose A, B, C or D from the list below by selecting the desired letter from the drop-down list in cell C75:**		**Rationale**
67–70	**A**	Documented adverse impact or high quantified exposure to contaminated water, sediments, foods, vapour or dust which has or will result in an adverse effect, injury or harm or impairment of the safety to terrestrial or aquatic organisms as a result of the contaminated site. (Class 1 Site)	
71	**B**	Same as above, but "Strongly Suspected" based on observations or indirect evidence.	
72	**C**	No quantified or suspected exposures/impacts in ecological receptors.	
73	**D**	Do Not Know	
74			
75		**Selected Option:**	**B** ⇦
76		**Score:**	8 (maximum 18)

Ecological effects should be evaluated at a population or community level, as opposed to at the level of individuals, with the exception of SARA-listed species. For example, population-level effects could include reduced reproduction, growth, or survival in a species. Community-level effects could include reduced species diversity or relative abundances. Further discussion of ecological assessment endpoints is provided in the Federal Contaminated Sites Action Plan (FCSAP) Ecological Risk Assessment Guidance (2012).

A person with demonstrable experience in the assessment of risks to ecological receptors must provide a thorough description of the sources researched to classify the environmental receptors in the vicinity of the contaminated site. This information must be documented in the worksheet including contact names, phone numbers, e-mail addresses (to be listed in the "Rationale" column) and reference maps, reports, internet links, and/or other resources (to be referenced in the "Reference" column).

References that may be useful in completing Question 4 include:

- CCME. 1999b. Canadian Water Quality Guidelines for the Protection of Aquatic Life
  CCME. 1999c. Canadian Water Quality Guidelines for the Protection of Agricultural Water Uses
- Canadian Council on Ecological Areas.
- US EPA. ECOTOX database

The options presented in Question 4a and their respective scores are explained below.

A. Documented adverse impact or high quantified exposure to contaminated water, sediments, foods, vapour, or dust which has or will result in an adverse effect, injury or harm, or impairment of the safety to terrestrial or aquatic organisms as a result of the contaminated site. (Class 1 Site, 18 points)

With the exception of SARA species, which are protected at the individual level rather than the population level, some low level effects to ecological receptors may be considered acceptable where sites are used for commercial or industrial purposes. However, if ecological effects are deemed to be severe, the site may be categorized as Class 1 (i.e., High Priority for Action) on the Pre-Screening checklist (Tab 4), regardless of the total ASCS score. For the purposes of the ASCS, effects that would be considered severe include observed effects on survival, growth, or reproduction that could threaten the viability of a population of ecological receptors at the site. Alternately, severe adverse effects may be determined based on professional judgement and in consultation with the relevant jurisdiction.

A score is provided for this option for use in the event that a score is desirable for comparison purposes, even if ecological effects are deemed severe and the site is automatically designated as Class 1.

If option A is selected, the “Not Scored” option is automatically included for Questions 4b through 4d.

B. Same as above, but "Strongly Suspected" based on observations or indirect evidence. (8 points)

This option can be selected based on the outcomes of risk assessments. It applies to studies that have reported hazard quotients > 1. Alternatively, known impacts can be evaluated based on a weight-of-evidence assessment involving a combination of site observations, tissue testing, toxicity testing, and quantitative community assessments.

Ecological risk assessment decisions should not be based solely on the hazard quotient. There are many examples of federal ecological risk assessments that have hazard quotients exceeding 1.0 but based on site-specific observations and professional judgment concluded that risks were acceptable. The following is a more detailed rationale used in DFO (Central and Arctic Region) terms of reference documents on ecological risk assessment to provide context to the argument:

There is a need for analysis beyond the hazard quotient results for ecological risk assessment. In ecological risk assessments of contaminated sites, there is almost always an exceedance of the hazard quotient for invertebrates and especially plants due to the low toxicity reference values available in the literature. The toxicity reference values for these surrogate receptors are sometimes limited to few toxicological studies and can involve test specimens that are not relevant to the site of interest. More importantly, it is a common and well-justified concern that the laboratory settings in which the toxicology tests are conducted do not properly replicate the field conditions where contaminants are found. Laboratory toxicity tests commonly use such practices as the spiking of soil with inorganic salt forms of metals, which tends to increase the bioavailability (Suter 2007). Field conditions can alter the speciation of chemicals, which also alters the bioavailability. Lastly, the hardiness of populations of organisms in the real environment may not be accurately represented. This is often reflected in sites that have hazard quotient exceedances containing lush and flourishing plant life, and thus creating a problem for the risk assessor. It is not always feasible or warranted (based on the size of the contamination) to embark on detailed studies that would be required to establish if an adverse effect was present. While such observations such as "a flourishing plant life" or "no evidence of stressed vegetation" are not quantitative and would not display more subtle impacts that may be occurring due to the contaminants, this fact has to be weighted against the size of the contaminated site and potential for "population" level effects to the area.

Other factors such as the mobilization of contaminants such as metals from solid phases by rhizosphere microbes and the potentially higher rate of degradation of organic chemicals in the rhizosphere zone (Suter 2007) make it clear that the solution that a plant is exposed to may be different than the bulk soil concentrations measured during environmental site assessments (ESAs). This serves to add additional uncertainty.

Therefore, it is critical that the analysis of the ecological risks not just rely on the hazard quotients, but utilize the site observations in combination with professional judgment and an understanding of the limitations of toxicity tests to reach more realistic conclusions. In some cases, analysis of plant tissues may be warranted depending on the size and nature of the site and the contamination.

The scoring of adverse effects on individual specimens of rare or endangered species should be completed on a case-by-case basis with full scientific justification.

If this option is selected, the "Not Scored" option is automatically included for Questions 4b through 4d.

C. No quantified or suspected exposures/impacts in ecological receptors. (0 points)

This option may be selected based on the outcomes of risk assessments and applies to studies that have reported hazard quotients < 1 and no other observable or measurable sign of impacts. Alternatively, it can be based on a combination of other lines of evidence showing no adverse effects, such as site observations, tissue testing, toxicity testing, and quantitative community assessments.

If this option is selected, the "Not Scored" option is automatically included for Questions 4b through 4d.

D. Do Not Know. (0 points)

If "Do Not Know" is selected, Questions 4b through 4d must be scored.

6.3.2.2 Questions 4b through 4d: Potential for Significant Ecological Exposure

For Questions 4b through 4d, the user makes a selection from the drop-down box next to the question. The maximum total score for Questions 4b through 4d is 18 points (equivalent to option A in Question 4a). The approach adopted here in rating the ecological significance of potential impacts at the site is from ecological significance criteria used by various federal government departments for the purpose of conducting environmental assessments.

6.3.2.2.1 4b. Site setting: Indicate the degree of anthropogenic disturbance in the area where the site is located.

Question 4b requires the user to estimate the extent to which the site is located in an area characterized by anthropogenic disturbance, according to the criteria set out below.

Option	Score
Area of anthropogenic disturbance	0
Relatively pristine	2
Pristine (not affected by human activity)	5
Do Not Know	1
Not Scored	0

An area of anthropogenic disturbance is one where there is evidence of environmental effects by human activities in the general area, such as an agricultural, residential, commercial, or industrial area. A pristine area is one where human activity has had very little or no observable impact on the site. A relatively pristine area is a location where human activity is evident, but the area is relatively unpopulated and only occasionally used by humans.

If A, B, or C was selected in Question 4a, the "Not Scored" option was automatically included for Question 4b.

6.3.2.2.2 4c. What is the significance of ecological impact of site contaminants in terms of potential disruption of ecological functions and relationships in the affected area?

Question 4c requires the user to assess the significance of site contamination in terms of the magnitude of potential disruption to ecological functions and relationships, and the nature of the functions and relationships that may be affected. Scoring criteria are listed below.

Option	Score
Negligible Disruption	0
Some Disruption of Non-Critical Ecological Functions and Relationships	3
Disruption of Critical Ecological Functions and Relationships	10
Do Not Know	1
Not Scored	0

If A, B, or C was selected in Question 4a, the "Not Scored" option was automatically included for Question 4c.

6.3.2.2.3 4d. Is site contamination located such that it has affected or could potentially affect spawning, rearing and migration habitat of fish populations?

Under the *Fisheries Act*, fish habitat means spawning grounds and any other areas, including nursery, rearing, food supply and migration areas, on which fish depend directly or indirectly in order to carry out their life processes. Fish habitat includes ephemeral streams that may be wetted only at certain times of the year and may include artificial watercourses.

The user should consult ESA reports to determine the likelihood that site contamination could affect fish habitat, and select the appropriate option from the drop-down box. Consult with DFO Expert Support.

A score is automatically assigned for the selected option as shown below.

Option	Score
Yes	3
No	0
Do Not Know	1.5
Not Scored	0

If A, B, or C was selected in Question 4a, the "Not Scored" option was automatically included for Question 4d.

6.4 Total Score: Receptors and Exposure

The total raw score for the Receptors and Exposure worksheet (Worksheet 6) is automatically calculated in cell C88 as the sum of scores for Questions 1 through 4. The maximum raw score for this worksheet is 80 points. This score is then automatically entered on the Summary Score Sheet (Worksheet 8).

7.0 PHYSICAL IMPACTS AND OTHER DISTURBANCES

7.1 Purpose

The Physical Impacts and Other Disturbances Worksheet identifies non-chemical environmental impacts at the aquatic site and assesses the scale of their impact. The maximum raw score for this worksheet is 45 points. The score for physical impacts and other disturbances represents 10% of the total ASCS score for the site.

The structure of this worksheet is similar to the Receptors and Exposure worksheet (Worksheet 6), i.e., users choose from options presented in a drop-down box beside each question. Columns are provided for the documentation of rationale and references, and specific instructions are given in column F.

7.2 Question 1. Physical Impacts

Question 1 focuses on the evaluation of physical impacts to aquatic habitat on the site. Although physical impacts may not typically be considered "contamination", given the potential for detrimental changes to aquatic habitat from anthropogenic construction or debris, it is considered important that any evaluation of an aquatic site include an assessment of physical impacts.

While aquatic sites are considered eligible for FCSAP funding on the basis of chemical impacts, they are being managed (and ranked) according to their overall human/ecological risk. Two sites with identical chemical contamination will pose varying degrees of ecological risk based on many variables including summative physical impacts.

The maximum score for Question 1 is 25 points.

7.2.1 Question 1a. Please rate the severity of known or potential geotechnical failure scenarios that have taken place or could potentially affect site habitat, based on documented conditions.

This question is intended to evaluate the likelihood that aquatic habitat is or could in the future be compromised by geotechnical failure of nearby structures. Examples of failures include dam breaches, erosion or collapse of embankments, reservoir dikes, retaining walls, or other structures that could result in the release of suspended solids, contaminated water, or toxic substances to the aquatic environment at the site.

The user should evaluate the severity of known or potential geotechnical failures based on the results of geotechnical investigations, and using professional judgement, and select the option that best corresponds to the severity of any such failure or potential failure.

A score is automatically assigned for the selected option as shown below.

Option	Score
Severe	10
Moderate	5
Limited	0
Do Not Know	2
Not Applicable	0

7.2.2 Questions 1b through 1k

Questions 1b through 1k are all "Yes"/"No"-type questions. A score is automatically assigned as for the selected option as shown below.

Option	Score
Yes	5
No	0
Do Not Know	0.5
Not Applicable	0

7.2.2.1 Question 1b. Is there evidence of debris in or near the water that has or could potentially affect site habitat, for example, docks, buildings, or other structures that have fallen or may fall into a watercourse or water body?

The user should score this question based on results of any site inspections documenting indications of debris in the water (e.g., evidence of failed structures in watercourse/water bodies, or the potential for structures to fall into the water in the future).

7.2.2.2 1c. Is there evidence of sunken vessels with contamination potential?

The user should evaluate whether any sunken vessels may potentially act as a source of contamination to the water or sediment of the site, for example, fuel tanks, lead-based paint, solvents, etc.

7.2.2.3 1d. Is there evidence of disposal of dredged or excavation material on the site?

This question should be answered on the basis of site inspection reports and/or information from local, provincial/territorial, or federal agencies regarding the potential for past dredgate disposal on the site.

7.2.2.4 1e. Is water flow obstructed in a river or stream as a result of site use?

The user should review results of site inspections documenting any evidence of obstructions to water flow.

7.2.2.5 1f. Has fish habitat been destroyed by infilling, shoreline armouring, elimination, or unauthorized diversion of watercourses?

Site inspection reports should be reviewed to determine whether the shoreline has been altered or watercourses have been diverted at the site (e.g., the presence of smooth concrete or metal shoreline erosion walls, significant cement/pavement deposited on the bottom of the water body (e.g., for boat ramps), etc.). A fisheries expert should be consulted to determine whether fish habitat would have otherwise been present.

7.2.2.6 1g. Is there evidence that deeper contaminated sediment may be unstable?

Site inspection reports should be reviewed to determine whether evidence has been documented of physical impacts to or instability of contaminated sediments deeper than 5 cm.

7.2.2.7 1h. Has fish passage been obstructed as a result of site use?

Results of site inspections should be reviewed to determine whether evidence of obstructions to fish passage has been documented or appears likely based on evidence of debris or alterations that would affect benthic environments or other zones important to fish habitat.

7.2.2.8 1i. Are there potential hazards to navigation resulting from site use?

The score is based on results of site inspections documenting any evidence of obstructions to navigation or of obstructions or alterations that occur in a navigable area or channel.

7.2.2.9 1j. Is there documented evidence of actual or potential activities that would disturb sediment, for example, prop wash, navigational dredging of harbours/waterways, pier or seawall construction and maintenance?

The score is based on results of site inspections documenting any evidence of factors that could disturb sediment. The biophysical conditions of the site govern contaminant fate and transport and provide insight into factors that may contribute to potential risk of recontamination.

7.2.2.10 1k. Is there evidence of stream channelization on the site?

Stream channelization refers to efforts to increase the flow in rivers, creeks, and other drainage channels. By cutting a straighter channel, the effective fall, and therefore the flow velocity, is increased. Such alterations may be undertaken in an effort to eliminate or reduce flooding of adjacent land after rainfall events. Channelization may lead to the scouring of stream beds and deepening of channels, resulting in unstable stream banks and reductions in the amount of vegetation along stream banks. This in turn means less food and cover for fish and wildlife. The increased velocity of a stream means less habitat for fish that cannot tolerate fast-moving water. (http://www.thisland.illinois.edu/60ways/60ways_25.html)

7.3 Question 2. Other Disturbances

Since the questions below address site disturbances that are less likely to be documented in environmental investigation reports, questions are worded so that *the user may answer "No", rather than "Do Not Know", if there is no documented evidence of a given type of disturbance*, in order to avoid inflating the percentage of "Do Not Know" answers unnecessarily, while capturing any evidence of these disturbances that may be reported for the site. The maximum score for question 2 is 5 points and the scoring for each option is shown below.

Option	Score
Yes	2
No	0
Do Not Know	0.5
Not Applicable	0

7.3.1 2a. Do previous reports document any water temperature impact resulting from site use?

Assess water temperature relative to comparable sites that are not impacted by any influences on water temperature (i.e., discharges of warmer- or colder-than-ambient water from industrial or other anthropogenic sources.) The CCME recommends that:

"Human activities should not cause changes in ambient temperature of marine and estuarine waters to exceed ±1ºC at any time, location, or depth. The natural temperature cycle characteristic of the site should not be altered in amplitude or frequency by human activities. The maximum rate of any human-induced temperature change should not exceed 0.5ºC per hour." (CCME 1999d). Similar recommendations, however, have not been made by federal authorities for freshwater environments.

7.3.2 2b. Has evidence of excessive plant or algal growth been documented in previous reports?

A distinct increase in plant or algal growth in an aquatic environment may suggest nutrient enrichment in the aquatic habitat. Nutrients (e.g., nitrogen and phosphorous) released to an aquatic body act as fertilizers and promote eutrophication, i.e., depletion of oxygen levels due to the increased activity of aerobic organisms consuming decaying organic material.

7.3.3 2c. Do previous reports mention total suspended sediments exceeding Canadian Water Quality Guidelines?

Guidelines pertaining to particulate matter in surface water can be obtained from the Canadian Water Quality Guidelines for the Protection of Aquatic Life (CCME 1999b).

7.3.4 2d. Is there evidence in previous reports that fish or meat taken from or adjacent to the site smells or tastes unpleasant (i.e., unusual smell or odour)?

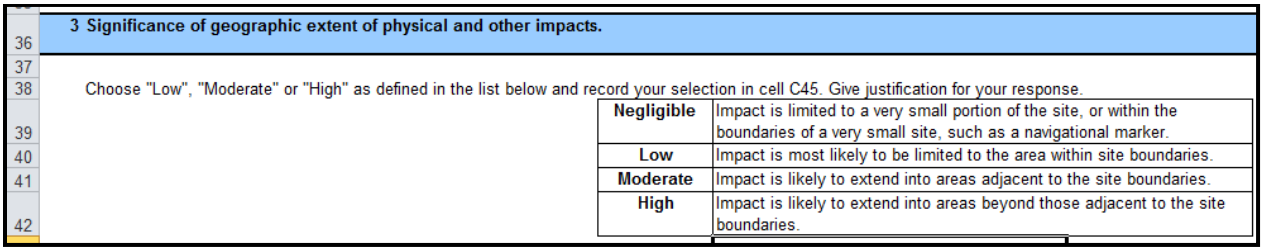
Some contaminants can result in a distinct change (tainting) in the way food gathered from the site tastes or smells. Record in the rational/reference column any documents supporting evidence of olfactory impacts to food species.

7.3.5 2e. Is there any previously recorded olfactory impact (unpleasant smell) to water or sediments as a result of anthropogenic activity?

Examples of olfactory change can include the smell of a contaminant of potential concern (COPC; e.g., petroleum hydrocarbons) or of decaying vegetative or other organic material in an aquatic habitat.

7.4 Question 3. Significance of Geographic Extent of Physical or Other Impacts

The user is asked to estimate the significance of the physical or other non-chemical impacts at the site, and assign a score based on the extent of impact by choosing Negligible, Low, Moderate, or High from the drop-down box, located below the table. The reference(s) and rationale for the selected option can be documented in column D.



The approach adopted here in rating the significance of potential physical impacts and other disturbances at the site is from criteria used by various federal government departments (e.g., Transport Canada, Environment Canada) in assessing the significance of the geographic extent of potential impacts for the purpose of conducting environmental assessments.

A score is automatically assigned for the selected option as shown below.

Option	Multiplier
Negligible	0.5
Low	1
Moderate	1.5
High	2

8.0 SUMMARY SCORE SHEET

8.1 Overview

Scores from the individual worksheets are automatically tallied on this page. The Summary Score Sheet automatically calculates the final score for the site based on the Contaminant Characteristics (Worksheet 5), Receptors and Exposure (Worksheet 6), and Physical and Other Disturbances (Worksheet 7) worksheets. Raw scores for each worksheet are summarized and converted to scores out of 50, 40, and 10 for Worksheets 5, 6 and 7, respectively. These scores are added together to produce a total site score out of a maximum of 100 points.

The user is not required to enter any data on this sheet; all raw scores are automatically copied from the previous worksheets.

8.2 Site Letter Grade

In cell F24, the site letter grade assigned on the Site Description worksheet (Worksheet 3) is automatically entered.

8.3 % Responses that are "Do Not Know"

In cell F25, the number of "Do Not Know" responses from Worksheets 5, 6, and 7 are added together, divided by the total possible number of "Do Not Know" responses, and the result is converted to a percentage. If this percentage is higher than 15%, the site will be assigned the INS classification, meaning that insufficient information is available to assign one of the other classifications.

8.4 Total ASCS Score for the Site

In cell F27, the total score is automatically included. For a Class 1 designation, the score in cell F27 will be calculated from Worksheets 5, 6, and 7 as 70 or higher. For a Class N designation, the score will be 36 points or lower.

8.5 Site Classification Category

The site classification category is automatically assigned in cell F28.

In categorizing a site, the ASCS takes into account the following considerations:

- If maximum scores have been assigned on the Receptors and Exposure worksheet for exposure of either human and/or ecological receptors to site contaminants, the site is designated as Class 1 (High Priority for Action);
- If the % responses that are "Do Not Know" is ≥ 15%, the site is designated as Class INS (Insufficient Information);
- If the site letter grade is F, the site is designated as Class INS;
- If the total score in cell F27 is ≥ 70, the site is designated as Class 1;
- If the total score in cell F27 is ≥ 50 and ≤ 69.9, the site is designated as Class 2;
- If the total score in cell F27 is ≥ 37 and ≤ 49.9, the site is designated as Class 3; and
- If the total score in cell F27 is < 37, the site is designated as Class N.

Full explanations of the significance of each classification category are presented in Section 1.5 above.

9.0 REFERENCE MATERIAL

9.1 Persistent Substances

Persistent chemicals, e.g., PCBs, chlorinated pesticides, etc., either do not degrade or degrade very slowly, and therefore may be available to cause effects for long periods of time. The *Canadian Environmental Protection Act, 1999* (CEPA 1999) classifies a chemical as persistent when it has at least one of the following characteristics:

(*a*) in air,

(i) its half-life is equal to or greater than two days, or

(ii) it is subject to atmospheric transport from its source to a remote area;

(*b*) in water, its half-life is equal to or greater than 182 days;

(*c*) in sediments, its half-life is equal to or greater than 365 days; or

(*d*) in soil, its half-life is equal to or greater than 182 days.

Elements do not degrade, therefore treat any metal, metalloid, or halogen COPC as Persistent.

Examples of Persistent Substances:					
aldrin		dieldrin		PCBs	
benzo(a)pyrene		hexachlorobenzene		PCDDs/PCDFs (dioxins and furans)	
chlordane		methylmercury		toxaphene	
DDT		mirex		alkylated lead	
DDE		octachlorostyrene			

9.2 Bioaccumulating and Biomagnifying Substances

Under CEPA, a substance is bioaccumulative:

(*a*) when its bioaccumulation factor is equal to or greater than 5000;

(*b*) if its bioaccumulation factor cannot be determined in accordance with a method referred to below, when its bioconcentration factor is equal to or greater than 5000; and

(*c*) if neither its bioaccumulation factor nor its bioconcentration factor can be determined in accordance with a method referred to below, when the logarithm of its octanol-water partition coefficient is equal to or greater than 5.

Acceptable methods under CEPA include “generally recognized methods of the Organisation for Economic Co-operation and Development (OECD) or of some other similar organisation or, if no such methods exist, in accordance with generally recognized methods within the scientific community and taking into account the intrinsic properties of the substance, the ecosystem under consideration and the conditions in the environment.” (refer to CEPA 1999 Persistence and Bioaccumulation Regulations).

The term "biomagnification" has been summarized by Gobas and Morrison (2000) as "the process in which the chemical concentration in an organism achieves a level that exceeds that in the organism's diet, due to dietary absorption."

9.2.1 Examples of Bioaccumulating and/or Biomagnifying Substances

Some substances are bioaccumulative or biomagnifying, for example, dichlorodiphenyltrichloroethane (DDT), methylmercury, PCBs with octanol-water partition coefficients (log K_{ow}) between 5.0 and 5.6 and some PAHs. For additional information regarding bioaccumulation or biomagnification potential of specific organic substances, refer to the CCME factsheets.

9.2.2 Table of Chemical-Specific Properties

A table of chemical-specific properties (adapted from the US EPA (1996) Soil Screening Guidance: Technical Background Document) has been included in the ASCS spreadsheet tool (Tab 9) as supplementary reference material.

9.3 Provincial/Territorial Guidance on Contaminated Sites

Alberta: Government of Alberta, Environment and Sustainable Resource Development. 2014. Alberta Soil and Groundwater Remediation Guidelines.

British Columbia: British Columbia Ministry of Environment (BC MOE). 2009. Site Remediation.

Manitoba: Government of Manitoba. 2009. *The Contaminated Sites Remediation Act*.

New Brunswick: Government of New Brunswick, Department of Environment and Local Government. 2003. Guideline for the Management of Contaminated Sites Version 2.

Newfoundland and Labrador: Government of Newfoundland and Labrador, Department of Environment and Conservation. 2014. Guidance Document for the Management of Impacted Sites.

Northwest Territories: NWT Department of the Environment and Natural Resources. 2003. Environmental Guideline for Contaminated Site Remediation.

Nova Scotia: Government of Nova Scotia. 2014. Contaminated Sites Regulations and Associated Protocols.

Nunavut: Government of Nunavut, Department of Environment. 2009. Environmental Guideline for Site Remediation.

Ontario: Government of Ontario, Ministry of the Environment. 1997. Guideline for Use at Contaminated Sites in Ontario.

Prince Edward Island: Legislative Counsel Office. 2007. Contaminated Sites Registry Regulations.

Prince Edward Island: Legislative Counsel Office. 2013. PEI Regulatory Approach to Management of Petroleum Contaminated Sites.

Quebec: Department of Sustainable Development, Environment and the Fight Against Climate Change. 2002. Soil Protection and Contaminated Sites Rehabilitation.
Saskatchewan: Saskatchewan Petroleum Industry/Government Environmental Committee. 2000. Saskatchewan Upstream Petroleum Sites Remediation Guidelines.

Yukon: Government of Yukon, Environment Yukon, Environmental Programs Branch. 2010. Contaminated Sites Regulation.

9.4 Species at Risk References (Relevant to Worksheet 6 "Receptors & Exposure")

BC MOE. Endangered Species and Ecosystems, Provincial Red and Blue Lists

Government of Canada. *Species at Risk Act*
Government of Canada. *Species at Risk Act*, SCHEDULE 1 (Subsections 2(1), 42(2), and 68(2)) List of Wildlife Species at Risk
Government of Canada. Committee on the Status of Endangered Wildlife in Canada (COSEWIC).

9.5 Provincial/Territorial Spills Regulations and/or Databases

Government of British Columbia. Ministry of Justice, Emergency Management BC. Incident Summaries.

Government of Manitoba, Innovation, Energy and Mines, Petroleum Branch. Manitoba's Upstream Petroleum Industry 2012 Spill Statistics and Report.
Government of NWT, Department of Environment and Natural Resources. Hazardous Materials Spill Database.
Government of Saskatchewan, Ministry of the Economy. Upstream Oil and Gas Sites Spill Notification Database
Government of Yukon, Environment Yukon. 2006. Spills Regulations.

9.6 Additional References Cited in the Scoring Worksheets and the User Guidance Document

Arnot JA, Gobas FA. 2006. A review of bioconcentration factor (BCF) and bioaccumulation factor (BAF) assessments for organic chemicals in aquatic organisms. Environ Rev 14(4):257-297.

Canadian Council of Ministers of the Environment (CCME). 1997. Guidance Document on the Management of Contaminated Sites in Canada.

CCME. 1999a. Protocol for the Derivation of Canadian Sediment Quality Guidelines for the Protection of Aquatic Life.

CCME. 1999b. Canadian Water Quality Guidelines for the Protection of Aquatic Life.

CCME. 1999c. Canadian Water Quality Guidelines for the Protection of Agricultural Water Uses

CCME. 1999d. Canadian Water Quality Guidelines for the Protection of Aquatic Life: Factsheets - Temperature (marine).

CCME. 2001. Canadian Sediment Quality Guidelines for the Protection of Aquatic Life: Introduction. Updated. In: Canadian Environmental Quality Guidelines, 1999. Canadian Council of Ministers of the Environment, Winnipeg.

CCME. 2008. National Classification System for Contaminated Sites Guidance Document. Canadian Council on Ecological Areas.

Contaminated Sites Management Working Group (CSMWG). 1999. A Federal Approach to Contaminated Sites.

CSMWG. 2005. Taking Action on Federal Contaminated Sites: An Environmental and Economic Priority.

Environment Canada and Ministère du Développement durable, de l'Environnement et des Parcs du Québec. 2008. Criteria for the Assessment of Sediment Quality in Quebec and Application Frameworks: Prevention, Dredging and Remediation.

Federal Contaminated Sites Action Plan (FCSAP). 2012. Guidance Document on Federal Interim Groundwater Quality Guidelines for Federal Contaminated Sites.

FCSAP. 2012. Guidance on Assessing Ecological Risks Associated with Contaminated Sites

Fisheries and Oceans Canada (DFO). Fisheries Protection Program Website.

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FCSAP. 2018b. Federal Contaminated Sites Action Plan Guidance for Assessing and Managing Aquatic Contaminated Sites in Working Harbours.

Gobas FA, Morrison HA. 2000. Bioconcentration and biomagnification in the aquatic environment. In: Boethling RS and Mackay D, editors. Handbook of Property Estimation Methods for Chemicals, Environmental and Health Sciences. Boca Raton (FL): CRC Press. p. 189-231.

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Health Canada. 1999. Summary of Information Critical to Assessment of "Toxic" under CEPA 1999.

Health Canada. Federal Contaminated Site Risk Assessment in Canada Parts 1 and 2: Guidance on Human Health Preliminary Quantitative Risk Assessments (PQRA) and Toxicological Reference Values (TRVs).

International Joint Commission (IJC), Canada and United States. 2012. Great Lakes Water Quality Agreement (https://www.ec.gc.ca/grandslacs-greatlakes/default.asp?lang=En&n=45B79BF9-1).

Suter GW, III. 2007. Ecological Risk Assessment, 2nd ed. CRC Press, Taylor & Francis Group; Boca Raton, FL.

United States Environmental Protection Agency (US EPA). 1996. Soil Screening Guidance: Technical Background Document. Office of Solid Waste and Emergency Response, Washington, DC. EPA-540-R95-128 (https://www.epa.gov/superfund/superfund-soil-screening-guidance).

US EPA. 2008. Evaluating Ground-Water/Surface-Water Transition Zones in Ecological Risk Assessments. Office of Solid Waste and Emergency Response, Washington, DC. EPA-540-R-06-072.

US EPA. ECOTOX Database (http://cfpub.epa.gov/ecotox/ecotox_home.cfm).