



Ministry of  
Environment and  
Climate Change Strategy

# ***PROTOCOL 4*** ***FOR CONTAMINATED SITES***

## Establishing Local Background Concentrations in Soil

Version 11

Prepared pursuant to Section 64 of the  
*Environmental Management Act*

Approved:

Kevin Butterworth  
Director of Waste Management

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Date

Effective Date: February 1, 2021

## 1.0 Definitions

Terms defined in the *Environmental Management Act* (EMA) and the Contaminated Sites Regulation (CSR) apply to this protocol, with the addition of the following:

**“local background concentration”** means the naturally occurring concentration of a substance as determined in accordance with a director’s protocol in an environmental medium in a geographic area.

**“regional estimate of background concentration in soil”** means the naturally occurring concentration of a substance as determined in accordance with a director’s protocol in an environmental medium in a geographic area. See section 4 below.

## 2.0 Introduction

This protocol describes options for establishing a local background concentration in soil for use in the investigation and remediation of a contaminated site and to carry out soil relocation, where naturally occurring substance concentrations exceed the applicable numerical soil standards of the Contaminated Sites Regulation (CSR). A local background concentration can be established by either directly applying regional background concentration estimates provided by the ministry for specified inorganic substances or by using the procedures outlined in this protocol for determining site-specific background concentrations in soil.

Approval of the use of local background concentrations in soil provides relief from the requirement to remediate naturally occurring substances but does not eliminate the need to remediate a contaminated site which has been contaminated through anthropogenic point or non-point sources. For example, applications for approval of local background concentrations for heavy metals in soil in Trail and Castlegar, B.C. will not be considered by the director due to the long history of smelter operations in the area.

## 3.0 Regulatory basis for a director’s approval

### 3.1 Deciding if a site is a contaminated site or has been satisfactorily remediated

Soil that contains a substance at concentrations above the applicable numerical soil standard at a site, but below the local background concentration for that substance as determined under this protocol, would not be considered contaminated under section 11 (3) of the CSR. Similarly, soil that has been remediated for a substance to concentrations above the applicable numerical soil standard for the site but below the local background concentration for that substance as determined under this protocol would be considered satisfactorily remediated under section 17 (2) (b) of the CSR. This protocol is also used to determine the local background concentration for use in the application of risk-based standards for remediation under Sections 18 and 18.1.

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Regional estimates of background concentrations in soil for substances listed in Table 1 are considered equivalent to local background concentrations in soil for the purposes of sections 11 (3), 17 (2) (b), 41 (3) and 46.1 (3) (a) of the CSR.

### **3.2 Deciding if contaminated soil is suitable for relocation**

Soil to be relocated from a site that contains a substance at concentrations above an applicable numerical soil standard for the receiving site, but below the local background concentration for that substance at the receiving site as determined under this protocol, is considered acceptable for deposit at the receiving site in accordance with sections 41 (3) and 46.1 (3) (a) of the CSR.

## **4.0 Options, procedures and reporting requirements**

This protocol may be used for sites that have received fill; however, samples representative of local background concentrations must be collected from within native materials. Preference is given to samples taken from undeveloped or vacant land, naturally wooded areas, parks or larger residential lots.

### **4.1 Option 1 – Establishing local background concentrations in soil based on ministry data**

Local background concentrations of substances in soil can be established using ministry data for either a region or a locale. This data is presented in two ways:

- Table 1 provides regional estimates of background concentrations in soil. Each value has been calculated as the 95<sup>th</sup> percentile of the data collected for all of the locales within each region; and
- The Background Concentrations Database provides the individual data points for each sample location, sorted by locales and regions.

The regional background concentration estimates in soil listed in Table 1 may be used without prior approval from a director as those concentrations are considered representative of local background concentrations in soil at any site located in a particular region. The Table 1 estimates are based on near surface soil samples obtained at ministry background sites. However, these regional background estimates may also be used as background concentrations in soil as applicable for the geological units at the same site.

Regional boundaries are shown in Figure 1. For sites located within the Metro Vancouver area (see Figure 2), the Metro Vancouver area regional estimates of background concentrations in soil applies. Sites located within the Lower Mainland but outside the Metro Vancouver area, should use the Region 2 estimates of background concentrations in soil.

Data provided in the Background Concentrations Database may also be used to determine local background concentrations in soil for a particular locale without prior approval from a director. However, due to the limited number of data points (i.e. sampling results) available for each locale, the estimate of background concentrations in soil must be calculated using the median value of all of the substance-specific data for that locale.

The use of Option 1 to determine local background concentrations in soil does not require an approval from the director. Rather, investigation reports prepared in support of applications to the ministry must clearly indicate the use of this approach and the local background concentrations in soil that were applied. Furthermore, the establishment of a local background concentration must be referenced in the Summary of Site Condition report and the schedule of any instruments issued for the site.

For substances not listed in Table 1, site-specific local background concentrations in soil must be established using Option 2, below.

## **4.2 Option 2 – Establishing local background concentrations in soil based on supplemental data and reference sites**

### **4.2.1 Process overview**

This option allows for the calculation of site-specific local background concentrations in soil using supplemental data and reference sites by either:

- Option 2a.** Augmenting ministry background soil data relevant to the site with additional pertinent data obtained from the literature or from direct background soil sampling at the site of interest; or
- Option 2b.** Direct background soil sampling conducted at an appropriate local reference site relevant to the site in question.

The use of Option 2 requires the submission of a full report (see section 4.2.3 below) detailing the rationale and methods used to determine local background concentrations in soil in an application to the ministry for approval by a director. This report may be stand alone or may be a distinct section in another report for the site.

#### 4.2.2 Procedures

##### ***Option 2a - Establishing local background concentrations in soil based on supplemental data***

Under this option ministry background soil data can be supplemented with relevant background data obtained from reports or databases available from other sources such as the [National Geological Survey of Canada](#) and the [BC Ministry of Energy and Mines Mining Survey data](#) or from direct background soil sampling.

##### ***Option 2b - Reference site procedure***

Site-specific local background concentrations in soil may be established by comparing site characteristics to a representative background reference site or sites. The emphasis in the reference site procedure is on the estimation of representative substance concentrations in soil that can be shown to be attributable solely to natural origin (i.e. not due to anthropogenic sources). This is achieved by careful site selection, analysis and comparison of reference site concentrations in soil to those observed at the site of interest.

The reference site must closely match (i.e., be substantively similar to) the subject site in question with respect to:

- a) geographical characteristics (e.g., location, topography, size/area, etc.),
- b) soil physical/chemical characteristics (see soil maps, [Geological Survey of Canada](#) information, etc.),
- c) hydrology and hydrogeology<sup>1</sup>, and
- d) soil sampling depth within the geological unit.

Reference site(s) may be identified at unimpacted areas of the subject property and will be considered on a case by case basis.

Additionally:

- a) samples must be collected from within native materials (i.e. not from the fill layer), preferably in undeveloped or vacant land, naturally wooded areas and/or parks or large residential lots,
- b) reference sites must not be impacted by contaminant sources,
- c) reference sites with any obvious vegetation damage or indications of contamination presence should be avoided, and

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<sup>1</sup> Note that if the hydrology and hydrogeology at the reference site is not substantively similar to that at the subject property, it must be demonstrated that they have not impacted soil in a manner that reduces its acceptability as a reference site.

- d) the history of the reference site and adjacent land, including current and previous activities must be considered to a level of detail consistent with Background Concentrations and a preliminary site investigation (PSI).

Once a suitable local reference site has been located and if needed, permission to sample has been obtained, the following minimum information should be collected:

- a) name and address of the property owner,
- b) current land use,
- c) surrounding land uses,
- d) any previous land uses (site history),
- e) potential contaminant sources (both natural, e.g. areas with natural mineralization, and anthropogenic),
- f) latitude and longitude, and
- g) a diagram of sampling plot locations within the overall property boundary.

Additional detailed information related to soil sampling methodology and the nature of the soil samples obtained at the reference site should also be documented. For example, additional information should be recorded concerning the soil samples:

- a) collection,
- b) storage,
- c) preparation,
- d) archiving,
- e) physical characterization, and
- f) chemical analysis.

Sampling procedures and chemical analytical requirements differ for inorganic and organic substances. Soil sampling must be performed in accordance with ministry requirements as per the [BC Field Sampling Manual](#).

Ideally, soil samples taken from the reference site and the site of interest should be subjected to identical analytical methods, using whenever possible the same analytical laboratory. Samples must be analyzed using ministry approved analytical methods as detailed in the latest version of the [BC Environmental Laboratory Manual](#) or alternate methods acceptable to the director.

Soil samples should be chemically analyzed for all potential contaminants of concern relevant to the site of interest. Samples should be analyzed only by laboratories registered under the [Environmental Data Quality Assurance Regulation](#).

#### **4.2.3 Reporting requirements**

An application for a director's approval of local background concentrations in soil developed under Option 2 must be accompanied by a [Contaminated Sites Services Application Form](#) and include a report containing at a minimum, details relevant to:

- a) identification of the region in which the site is located, or in the case of proposed soil relocation, the region of the proposed receiving site,
- b) the selection of the reference site(s),
- c) the geographical location of the reference site(s) (i.e., latitude and longitude, PIDs, etc.),
- d) a complete history of land use(s) at the reference site(s),
- e) physical characterization of the reference site(s),
- f) soil sampling procedures used,
- g) soil sampling locations used (i.e. a map showing sampling locations),
- h) soil depths sampled,
- i) documentation of the soil contaminants of concern considered (including the presence of natural mineralization),
- j) analytical results obtained,
- k) demonstration that background data fall within a single statistical population, and statistical analysis of the data set using the 95<sup>th</sup> percentile,
- l) if unable to meet the requirements of k), conservative estimates should be used to determine local background concentrations (consult [Technical Guidance 12, "Statistics for Contaminated Sites"](#)), or additional background sampling should be conducted, and
- m) conclusions based on the assessment of reference site background soil quality and the comparison of reference site background soil quality to the soil quality of the site of interest.

#### **4.3 Environmental management areas**

For Option 2 described above, to establish a site-specific local background concentration in soil based on additional data and sampling, it is necessary to closely match the site of interest with a local background reference site(s) of suitable geologic type and geographic area and scope. This is problematic in the case of contaminated sites which have been designated environmental management areas (EM areas) under the CSR.

EM areas tend to be larger, complex sites which typically encompass considerable geographic area and geologic complexity. While it may be possible to select a reference site(s) of sufficient size, scope and geological complexity to apply the Option 2 approach for an EM area, the sampling time, effort and analysis required to adequately characterize both the contaminated EM area and its corresponding local reference site would likely be prohibitively expensive and onerous.

For this reason, the ministry does not recommend the application of site-specific local background concentrations in soil for use at EM areas. Rather, it is recommended that background concentrations in soil at such sites be assessed using Option 1.

## 5.0 Director's approval on local background concentrations – notification on site registry

Applications for a director approval on local background concentrations in soil are subject to ministry service fees as indicated in Schedule 3 of the CSR. The director will provide information relating to approval of local background concentrations in soil for a site to the Registrar in compliance with Section 43 of EMA.

## 6.0 Alternate approaches

Scientifically defensible modifications to the options outlined in this protocol for establishing background concentrations in soil may be considered by the director. Such requests must be accompanied by a completed [Contaminated Sites Services Application form](#) and a supporting technical report prepared by a qualified professional that, at a minimum, meets the intent, technical rigor and documentation requirements of the options set out above.

### Revision History

Approval Date	Effective Date	Document Version	Notes
Oct 1, 1999	Oct 1, 1999	Version 1	
Oct 12, 2010	Oct 12, 2010	Version 2	
Nov. 1, 2017	Nov. 1, 2017	Version 9	Stage 11 CSR amendment
Jan. 9, 2019	Jan. 9, 2019	Version 10	Change to Section 4.0
Feb. 1, 2021	Feb. 1, 2021	Version 11	Align with Stage 13 CSR amendment, harmonize with Protocol 9

**Table 1. Regional estimates for background concentrations in soil for inorganic substances<sup>1,2,3,4</sup>**

Substance	Region 1 Vancouver Island	Region 2 Lower Mainland	Metro Vancouver <sup>7</sup>	Region 3/8 Thompson/Nicola/ Okanagan	Region 4 Kootenay <sup>8</sup>	Region 5 Cariboo	Region 6 Skeena	Region 7 Omineca/ Peace
aluminium	55 000	35 000	35 000	30 000	25 000	25 000	40 000	40 000
antimony	(4)	(4)	(4)	(4)	(4)	(4)	(4)	(4)
arsenic	(4)	8.5	8.5	15	(4)	10	10	10
barium	250	150	90	200	350	250	300	500
beryllium	0.7	0.7	0.7	0.5	0.8	0.3	0.6	1
boron	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
cadmium	0.95	(0.4)	(0.4)	(0.4)	(0.4)	(0.4)	(0.4)	(0.4)
chromium <sup>5</sup>	65	55	50	70	35	100	40	50
cobalt	30	15	15	20	15	20	15	25
copper	100	75	150	75	35	60	50	70
iron	70 000	30 000	30 000	30 000	30 000	30 000	30 000	40 000
lead	40	200	300	15	120	15	20	25
manganese	5 000	900	1 000	1 000	2 000	850	1 500	1 500
mercury <sup>6</sup>	0.15	0.3	0.35	0.075	0.085	0.09	0.15	0.09
molybdenum	(1)	4	6	2	(1)	(1)	3	3
nickel	50	75	40	85	50	200	40	60
selenium	(4)	(4)	(4)	(4)	(4)	(4)	(4)	(4)
silver	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
strontium	100	60	55	250	150	250	100	70
sulfur	1 000	2 000	3 000	550	950	800	2 500	450
tin	(4)	(4)	(4)	(4)	(4)	(4)	(4)	(4)
vanadium	200	80	75	85	40	75	85	95
zinc	150	100	90	100	200	85	150	150

**Footnotes:**

1. All values are in µg/g unless otherwise stated. All values have been rounded in accordance with [Protocol 28, "2016 Standards Derivation Methods."](#) Values in brackets indicate that greater than 50% of values were less than the mean detection concentration (MDC) for the substance, consequently tabled regional estimate is one-half the MDC.
2. Each estimate represents the 95<sup>th</sup> percentile value obtained for a substance in the region or area.
3. All soil samples were subject to the strong acid leachable metals (SALM) method summarized in the [British Columbia Environmental Laboratory Manual](#).
4. ND – no data available.
5. Chromium = total chromium
6. Mercury = inorganic mercury
7. Listed estimates for local background concentrations in soil may be used within the Metro Vancouver area only. The Metro Vancouver area (see Figure 2) includes the University of British Columbia, Stanley Park, Queen Elizabeth Park, Richmond West, Richmond Central, Burnaby Lake Regional Park, Burnaby North, North Vancouver, New Westminster, and Coquitlam.
8. All results from Castlegar and Trail locales were removed from the data set as they are related to anthropogenic contamination. The regional estimate for lead has been established by a director.

Figure 1. Boundaries to determine regional background concentrations in soil



Figure 2. Geographic limits for Metro Vancouver area

