



Ministry of  
Environment and  
Climate Change Strategy

# ***PROTOCOL 19*** ***FOR CONTAMINATED SITES***

## Site Investigation and Reporting

Version 2

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

Approved:

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Director of Waste Management

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Date

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## Protocol Implementation

| <b>Section</b>                                      | <b>Status</b>             |
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| 2 – Introduction                                    | Effective August 12, 2024 |
| 3 – Qualified professionals                         | Effective August 12, 2024 |
| 4 – Sample and analysis methods                     | Effective August 12, 2024 |
| 5 – Sampling and analysis plans for soil relocation | Effective August 12, 2024 |
| 6 – Exemptions from the Protocol                    | Effective August 12, 2024 |
| 7 – Soil Investigation and Remediation              | Under development         |
| 8 – Groundwater Investigation and Remediation       | Under development         |
| 9 – Vapour Investigation and Remediation            | Under development         |
| 10 – Sediment Investigation and Remediation         | Under development         |
| 11 - Reporting                                      | Under development         |

## 1.0 Definitions

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

“**acid rock drainage**” means low pH surface or ground water that results from the oxidation of sulfide minerals, elemental sulfur, or the dissolution of acid generating minerals found in rocks.

“**non-waste soil**” means soil with substance concentrations less than CSR soil and vapour standards applicable at a receiving site.

“**qualified professional**”, in relation to a duty or function under this Part, means an individual who

- (a) is registered in British Columbia with a professional organization, acts under that organization’s code of ethics and is subject to disciplinary action by that organization, and
- (b) through suitable education, experience, accreditation and knowledge may reasonably be relied on to provide advice within the individual’s area of expertise, which area of expertise is applicable to the duty or function;

“**soil**” includes

- (a) unconsolidated mineral or organic material,
- (b) rock,
- (c) fill, and
- (d) sediment deposited on land,

but does not include the following, which are applied to land for a beneficial purpose in compliance with the Organic Matter Recycling Regulation or an authorization given under the Act:

- (e) sewage sludge;
- (f) composted organic materials;
- (g) products derived from the materials described in paragraph (e) or (f);

## 2.0 Introduction

This protocol is made under the authority of EMA section 64 and builds on requirements for site investigations and reporting set out in the CSR 49(2)(b), 58 and 59.

Consistent with EMA and the CSR, this protocol specifies requirements for investigation, analysis and interpretation, and assessment for soil relocation activities.

The requirements described in this protocol must be met when relocating non-waste soil from a source site with historical and/or current CSR Schedule 2 industrial and commercial use(s) to a receiving site.

This protocol must be used in conjunction with other ministry's policies, protocols, and guidance.

### **3.0 Qualified professionals**

All aspects of this protocol must be completed by or under the supervision of qualified professionals. It is the responsibility of the site owner or operator to retain qualified professionals with demonstratable experience, to ensure that the soil quality at the source site is properly characterized prior to relocation while adhering to applicable BC legislation, regulations, standards, protocols, procedures, and guidance.

### **4.0 Sample collection and analysis**

Sampling methodologies and quality control/quality assurance procedures must follow the B.C. Field Sampling Manual, the MEND Report 1.20.1-Prediction Manual for Drainage Chemistry from Sulphidic Geologic Materials or any applicable methods and/or procedures prescribed in protocols.

1. Subject to paragraph 2, substances must be analyzed by a "qualified laboratory", as defined in the Environmental Data Quality Assurance Regulation using methods specified in:
  - a. the B.C. Environmental Laboratory Manual; or
  - b. if no methods are specified for the required analysis in the B.C. Environmental Laboratory Manual, a method approved in writing by the director on a case-by-case basis.
2. If a director is satisfied that either a method specified in the B.C. Environmental Laboratory Manual is not appropriate in the circumstances or that another method will provide more accurate results, the director may require an alternative method under this paragraph in writing and on a case-by-case basis.

### **5.0 Sampling and analysis plans for relocation of non-waste soil**

This section describes requirements for the investigation and characterization of non-waste soil that is to be relocated from a source site with historical and/or current CSR Schedule 2 industrial and commercial uses to a receiving site. The sampling requirements in this section are not considered appropriate for the classification of soil suspected to be waste quality. Sampling and analysis plans must include accountable and defensible rationale for the identification of potential contaminants of concern (PCOCs) and for the collection methods used for soil and vapour samples.

## **5.1 Identifying potential contaminants of concern for non-waste soil**

To identify PCOCs for non-waste soil, the following actions must be completed:

1. Review site historical use and records, including a search of the site registry, to determine current and past activities or uses, accidents and spills, and practices and management relating to potential contamination at the site and neighbouring sites.
2. One or more site reconnaissance visits with visual inspection of buildings, property, equipment, land, surface water and biota for indicators or presence of contamination.
3. Interviews with current or former owners, occupants, neighbours, directors, employees and government officials who can, with reasonable attempts, be contacted respecting information on activities that may have caused contamination.

PCOCs must be selected based on the historical and/or current CSR Schedule 2 industrial and commercial uses identified at the source site.

## **5.2 Soil and soil vapour sampling and analysis plans**

A qualified professional must prepare a sampling and analysis plan that applies to the soil to be relocated from the source site. The sampling and analysis plan must:

1. Identify each location where soil is to be excavated for relocation.
2. Include a site plan with site buildings, areas of potential environmental concern (APECs), PCOCs identified from historical reviews, and areas where soil is to be removed.
3. Ensure an appropriate level of sampling and analysis is carried out to determine the concentration of PCOCs and contaminants of concern (COCs) in the soil to be excavated for relocation and identify the soil from the source site that meets the quality for relocation to the receiving site.
4. Determine the location, concentration, and distribution of substances in the soil to be excavated by sampling soil and vapour using sampling methods described in section 5.3.
5. Provide rationale to justify the sampling locations selected.
6. Be retained, with rationale for sampling PCOCs and COCs, for at least 10 years to provide to the Ministry of Environment and Climate Change Strategy if requested for compliance purposes.

## **5.3 Collection of soil and soil vapour samples**

- 5.3.1 When collecting soil samples from native soil to be relocated from the source site two soil samples, at a minimum, are required to be collected and analyzed for metals (aluminum, antimony, arsenic, barium, beryllium, boron, cadmium, chromium, cobalt,

copper, lead, lithium, manganese, molybdenum, nickel, selenium, silver, strontium, tin, uranium, vanadium, and zinc).

5.3.2 When collecting soil and soil vapour samples from non-waste soil to be relocated from the source site and the PCOCs are known:

1. Determine the location, concentration, and distribution of PCOCs and COCs in the soil to be excavated by sampling undisturbed soil (in-situ sampling).
2. A qualified professional must use scientifically defensible sampling densities to determine the location, concentrations and distribution of PCOCs and COCs.
3. The number of samples collected and analyzed must be sufficient to give a high degree of confidence to characterize PCOCs and COCs in all soil to be relocated.
4. Where there is information regarding the location of PCOCs within an APEC that is within the excavation area, sample locations must be identified with the objective of locating the maximum concentration. Soil and vapour samples must be collected from representative depths and locations to characterize substances in the soil that is to be relocated.

5.3.3 When collecting soil and soil vapour samples from non-waste soil to be relocated from the source site and the PCOCs are not known:

1. At a minimum, every soil sample, required to be collected, must be analyzed for the following parameters:  
polycyclic aromatic hydrocarbons (PAH); and,  
metals (aluminum, antimony, arsenic, barium, beryllium, boron, cadmium, chromium, cobalt, copper, lead, lithium, manganese, molybdenum, nickel, selenium, silver, strontium, tin, uranium, vanadium, and zinc).
2. At a minimum, every soil vapour sample, required to be collected, must be analyzed for the following parameter:  
naphthalene.
3. Conduct targeted sampling at select depths with the potential for maximum concentrations of parameters.
  - a. In-situ soil sample depth selection must include:
    - i. Surface soil samples collected from a maximum depth of 0.5 m below the site surface.
    - ii. Samples collected at a depth immediately above fine-grained soil units.
    - iii. Samples from the water table elevation, if applicable.
    - iv. For homogeneous soil units, soil samples collected at vertical intervals of 1 to 2 m spacing.

- b. In-situ soil vapour sampling must target locations nearest the source zone and must be collected at a depth of 1 m or greater below the site surface. While in-situ soil vapour sampling is preferred, for sites with shallow groundwater, an alternate soil vapour sampling method may be necessary such as soil vapour sampling of ex-situ stockpiles or estimating from in situ soil samples using scientifically acceptable partitioning equations.
4. The following additional requirements apply to soil samples collected using an in-situ sampling approach (in relation to the area identified where sampling is required):
  - a. For non-volatile parameters, discrete samples from the same formation may be collected from several locations, mixed together, and submitted as a composite sample. The use of composite samples does not change the minimum number of samples specified for analysis.
  - b. A minimum of three soil samples must be analyzed if less than 600 cubic metres of soil will be relocated.
  - c. If more than 600 cubic meters of soil will be relocated, at least three samples must be analyzed for the first 600 cubic meters, with one additional sample analyzed for each 200 cubic metres of soil up to 10,000 cubic metres of soil to be relocated.
  - d. At least one additional soil sample must be analyzed for each 450 cubic metres after the first 10,000 cubic metres of soil to be relocated up to 40,000 cubic metres.
  - e. At least one additional soil sample must be analyzed for each additional 2,000 cubic metres after the first 40,000 cubic metres of soil to be relocated.
5. The following additional requirements apply to soil samples collected using a stockpile sampling approach:
  - a. Samples must be collected at different depths within a stockpile to characterize the depth profile and the spatial variation, laterally and vertically, of the parameters within the stockpile.
  - b. Soil samples must be collected from a depth of greater than 0.3 m below the stockpile surface.
  - c. For non-volatile parameters, discrete samples can be collected from stockpiles and combined to provide composite samples for characterization, as described in TG1. The use of composite samples does not change the minimum number of samples specified for analysis.
  - d. A minimum of three soil samples must be analyzed if less than 130 cubic metres of soil will be relocated.
  - e. If more than 130 cubic metres of soil will be relocated, at least three samples must be analyzed for the first 130 cubic meters, with one soil sample analyzed for each additional 130 cubic metres of soil up to 2,600 cubic metres of soil to be relocated.
  - f. At least one additional soil sample must be analyzed for each 200 cubic metres after the first 2,600 cubic metres of soil to be relocated.

6. The following additional requirements apply to soil vapour samples collected using an in-situ sampling approach (in relation to the area identified where sampling is required):
  - a. A minimum of two soil vapour samples must be analyzed if less than 600 cubic metres of soil will be relocated.
  - b. If more than 600 cubic meters of soil will be relocated, at least two soil vapour samples must be analyzed for the first 600 cubic meters, with one additional sample analyzed for each additional 2,500 cubic metres of soil.
7. The following additional requirements apply to soil vapour samples collected from a stockpile:
  - a. A minimum of three soil vapour samples must be analyzed if less than 250 cubic metres of soil will be relocated.
  - b. If more than 250 cubic metres of soil will be relocated, at least three soil vapour samples must be analyzed for the first 250 cubic meters, with one soil vapour sample analyzed for each additional 250 cubic metres of soil up to 2,500 cubic metres of soil to be relocated.
  - c. At least one additional soil vapour sample must be analyzed for each 500 cubic metres after the first 2,500 cubic metres of soil to be relocated.

5.3.4 In preparing and implementing the sampling and analysis plan, the qualified professional must ensure that the following requirements are satisfied in all circumstances, if applicable:

1. Soil vapour samples must be collected at source sites where the soil to be relocated contains prescribed volatile chlorinated substances above detectable limits or contains a volatile substance concentration in soil greater than the generic numerical soil standard for low density residential land use (RL<sub>LD</sub>) or the lowest value of the matrix numerical soil standards for RL<sub>LD</sub>.
2. Field logs must be recorded and finalized for all sampling locations to document the soil and soil vapour conditions within the project area.
3. The following additional requirements apply to soil vapour samples collected from a stockpile:
  - a. Samples must be collected from the approximate centre of the stockpile or to best characterize the PCOCs within the stockpile.
  - b. The vapour sampling probe may be installed vertically, horizontally, or diagonally. For stockpiles with a height of 3 m or greater, vapour samples may be collected at a height of 1 m from the ground surface.
  - c. Place a surface seal such as a plastic sheet over the portion of stockpile being sampled to minimize ambient air leakage.



- d. The vapour sample must be collected after equilibration of vapour within the stockpile. Use a photoionization detector to confirm equilibration. The minimum equilibration time is one week after placement of the stockpile.
- e. Complete leak testing at each sample probe location.

If soil vapour cannot be sampled in situ (e.g., due to shallow groundwater) or from a stockpile (due to site-specific technical limitations), then concentrations may be estimated from in situ soil samples using scientifically acceptable partitioning equations (e.g. Exhibit 1 of the Federal Contaminated Site Risk Assessment in Canada: Supplemental Guidance for Soil Vapour Intrusion Assessment at Federal Contaminated Sites, Version 2.0, 2023). A sample calculation must be provided.

4. A 0.02 vapour attenuation factor (VAF) may be applied to soil vapour sample analytical results to characterize parameter concentrations in soil vapour (see Protocol 22 for the application of VAFs to characterize vapour contamination).
5. A sufficient number of soil samples must be collected and analyzed to determine the representative pH of soil at the receiving site to evaluate matrix numerical soil standards for soil to be relocated.
6. The soil analytical data must be compared to site specific factors applicable to the receiving site for matrix numerical soil standards.

#### **5.4 Quarried material sampling and analysis plans**

For quarried material derived from the mining and crushing of bedrock at quarries and other source sites, the original deposits are to be evaluated for potential metal leaching and acid rock drainage (ML/ARD). These procedures for evaluating the potential for ML/ARD are based upon static tests, site specific factors and the interpretation of these parameters by a qualified professional. ML/ARD evaluation must be performed in advance of materials being mined where volumes to be relocated exceed 1000 m<sup>3</sup>, or greater than 100 m<sup>3</sup> where the mined rock is to be relocated adjacent to sensitive habitat.

Samples are to be collected of representative rock samples for testing. Discrete sampling of unweathered rock is preferable. The qualified professional must provide justification for the sampling of weathered rock and/or for composite sampling. The samples must be collected using professionally acceptable sample collection methods and must be taken by or under the supervision of a qualified professional.

At a minimum, three samples must be collected per rock unit . The qualified professional must provide justification about the number of rock units present at a site.

Every sample must be analyzed for the following parameters:

- From Acid-Base Accounting (ABA) test: Neutralization Potential Ratio (NPR) –Neutralization Potential (NP)/Acid Potential (AP)

- Sulfide sulfur, total sulfur and sulfate sulfur
- Paste pH
- Total Inorganic Carbon
- Four Acid Digestion Total Metals Analysis (Four Acid metals) or aqua regia digestion method

The qualified professional must determine which samples require the following analyses:

- X-ray diffraction analysis
- Shake Flask Extraction Test (SFE) – indication of leachable oxidation products for current condition of material: acidity, metals.

Based upon the sample results, the following applies to the potential relocation of the quarried material.

1. If the rock sample has an NPR less than 1, this result indicates that the sample has a high potential to produce ARD and is unsuitable for relocation to a receiving site. An NPR value of less than 1 suggests that the rock should not be further disturbed or exposed.
2. If the rock sample has an NPR between 1 and 2, this result indicates a level of uncertainty with the sample to produce ARD. Site-specific factors must be considered and results of the sulphide, Four Acid metals, and SFE analysis methods must be used to evaluate the potential for ARD to occur from this source prior to determining the final use of the material.
3. If the rock sample has an NPR value greater than 2, this result indicates that the sample has a low potential to produce ARD, however, it could still contribute to near-neutral pH metals drainage. The site-specific factors must be considered and results of the sulphide, Four Acid metals, and SFE analysis methods must be used to evaluate the potential for ARD to occur from this source prior to determining the final use of the material.

## **6.0 Exemptions from the Protocol**

This protocol does not apply to:

1. Sites with a Final Determination that the site is not contaminated or a numerical-based Certificate of Compliance if the soil to be relocated from the site:
  - a. has no new contamination caused since the certification document was issued; and
  - b. has no soil and vapour at concentrations exceeding the current CSR land use standards applicable to the receiving site (including soil at depths greater than 3 m).

2. Soil leaving sites that are authorized soil treatment facilities if:
  - a. these facilities have soil sampling, analysis and storage requirements, that are consistent with soil relocation requirements, in an EMA waste discharge authorization; and
  - b. the EMA waste discharge authorization requirements have been met.
3. Quarries with a CSR Schedule 2 use if:
  - a. the site has a Mines Act Permit; and
  - b. the CSR Schedule 2 use has not contaminated the quarried material leaving the site.
4. Transitory sites with a CSR Schedule 2 use that store soil if:
  - a. the soil stored onsite was already sampled at and analyzed from the CSR Schedule 2 use site of origin or the soil stored onsite did not originate from a CSR Schedule 2 use site; and
  - b. the soil has not been contaminated by the CSR Schedule 2 use on the transitory site.

The soil relocation notice requirements in EMA and the CSR still apply for sites that are exempt from this protocol. Copies of certification documents (i.e., numerical-based Certificate of Compliance and Final Determination the site is not contaminated) and qualified professional assurance with respect to the above exemptions must be provided with the Soil Relocation Notification form.

#### Revision history

| <b>Approved Date</b> | <b>Effective Date</b> | <b>Document Version</b> | <b>Notes</b>  |
|----------------------|-----------------------|-------------------------|---|
| January 24, 2023     | March 1, 2023         | 1                       | New protocol – Phase 1 includes requirements necessary for implementation of CSR Stage 14 soil relocation amendments. |
| August 12, 2024      | August 12, 2024       | 2                       | Edits to Phase 1  |