EXCESS SOIL REUSE GUIDANCE

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TABLE OF CONTENTS

TABLES

FIGURES

GLOSSARY

Beneficially reused soil: Excess soil that has been repurposed following the principles and recommendations outlined in this document.

Contaminant of potential concern: Any chemical substance that may potentially occur in concentrations that have an adverse impact on human health or the environment.

Contaminated site: A location at which substances occur at concentrations above background levels such that they pose an immediate or long-term hazard to human health or the environment, or exceeding levels specified in policies or regulations.

Excess soil: Soil generated during site works or construction that can be beneficially reused on the source site or at a suitable receiving site that is not expected to pose any unacceptable risk to human health or the environment.

Fill management plan: A plan that shows the receiving site's soil quality characterization results; documents the quantity, quality and physical properties of excess soils that may be received; specifies their proposed reuse; and ensures that appropriate environmental protection measures are implemented during receipt, including audit sampling of received soils.

Background concentration: Concentration of compounds that are expected in soils that have not been contaminated by a point source and are representative of surrounding conditions.

Qualified person: There is provincial and territorial variation in the definition of a qualified person. Therefore, for the purposes of managing excess soil, the "qualified person" designation is expected to be consistent with the definition used in the province or territory in which the soil management activities are undertaken.

Receiving site: A location where excess soils can be beneficially reused.

Soil management plan: A plan elaborated at the source site that indicates the location of the source site, the volume of soil generated, information on contaminants of concern, the soil characterization results, instructions for handling the soil, and the purpose for which the soil will be reused at the receiving site. The locations of the receiving site or of the waste site are also indicated. The soil management plan may prescribe the conditions for soil storage at temporary soil storage sites.

Source site: A location where excess soil is generated.

Stringency of land use: Refers to CCME (or equivalent) generic land use guidelines (e.g., residential quality is more stringent than commercial or industrial quality).

Temporary soil storage site: Site at which soil is stored on a temporary basis, before being sent to a receiving site for beneficial reuse.

Waste soil: Soil that cannot be beneficially reused due to a lack of a receiving site or to one or more substance concentrations above those specified in policies or regulations.

LIST OF ACRONYMS

APEC	area of potential environmental concern
CCME	Canadian Council of Ministers of the Environment
CEQG	Canadian Environmental Quality Guideline
COPC	contaminant of potential concern
CWS	Canada-wide standards
DNAPL	dense non-aqueous phase liquid
EC	electrical conductivity
ESA	environmental site assessment
FMP	fill management plan
MAC	maximum allowable criteria
MWMP	Meteoric Water Mobility Procedure
LNAPL	light non-aqueous phase liquid
P1ESA	phase 1 environmental site assessment
P2ESA	phase 2 environmental site assessment
PCA	potentially contaminating activity
PFAS	per- and polyfluoroalkyl substances
QP	qualified person
RS	receiving site
RU	reasonable use
SAR	sodium adsorption ratio
SMP	soil management plan
SPLP	Synthetic Precipitation Leaching Procedure
SS	source site
TCLP	Toxicity Characteristic Leaching Procedure
WS	waste site

1. PURPOSE OF THE GUIDANCE DOCUMENT

The purpose of this guidance document is to provide a reference tool for jurisdictions implementing excess soil management policies. It includes principles that should be considered in such a policy, circumstances under which they might be applied, and pros and cons related to the application of these principles. The guidance document provides elements that should be included in a traceability protocol intended to track beneficially reused soil and discusses the responsibilities of both source and receiving sites in projects involving the reuse of excess soils. An illustration of the document framework is provided in Figure 1.

The guidance may be adopted in its entirety by jurisdictions. Government organizations—such as ministries of transportation, ministries of environment, ministries involved in territorial development, ministries of natural resources—and municipalities may have an interest in excess soil management guidance. In the private sector, environmental consultants working in site remediation, brownfields redevelopment and general construction may also have an interest in such guidance. The guidance document may also be of use to Indigenous communities that are moving excess soil to and from their lands. In anticipation of potential implementation questions, a document map is provided in Table 1 to guide the reader through potential excess soil management implementation.

The movement of excess soil may be subject to permits or approvals from multiple orders of government and agencies. Compliance with these requirements would be in addition to the concerns about excess soil quality that this document is meant to address. Potential concerns that may require approval could include construction work within aquatic habitats, shore infilling, invasive species, geotechnical considerations and soil fertility. Examples of federal legislation that may apply to the movement of excess soil include the *Impact Assessment Act*, the *Migratory Birds Convention Act*, the *Species at Risk Act*, the *Fisheries Act* and the *Great Lakes Water Quality Agreement* legally binding treaty.

For the purpose of this document, excess soils include materials generated during site works that can be beneficially reused on the source site (SS) or at a suitable receiving site (RS). This document does not address soils that are considered waste (i.e., cannot be beneficially reused) as separate guidance and legislation exist for waste management.

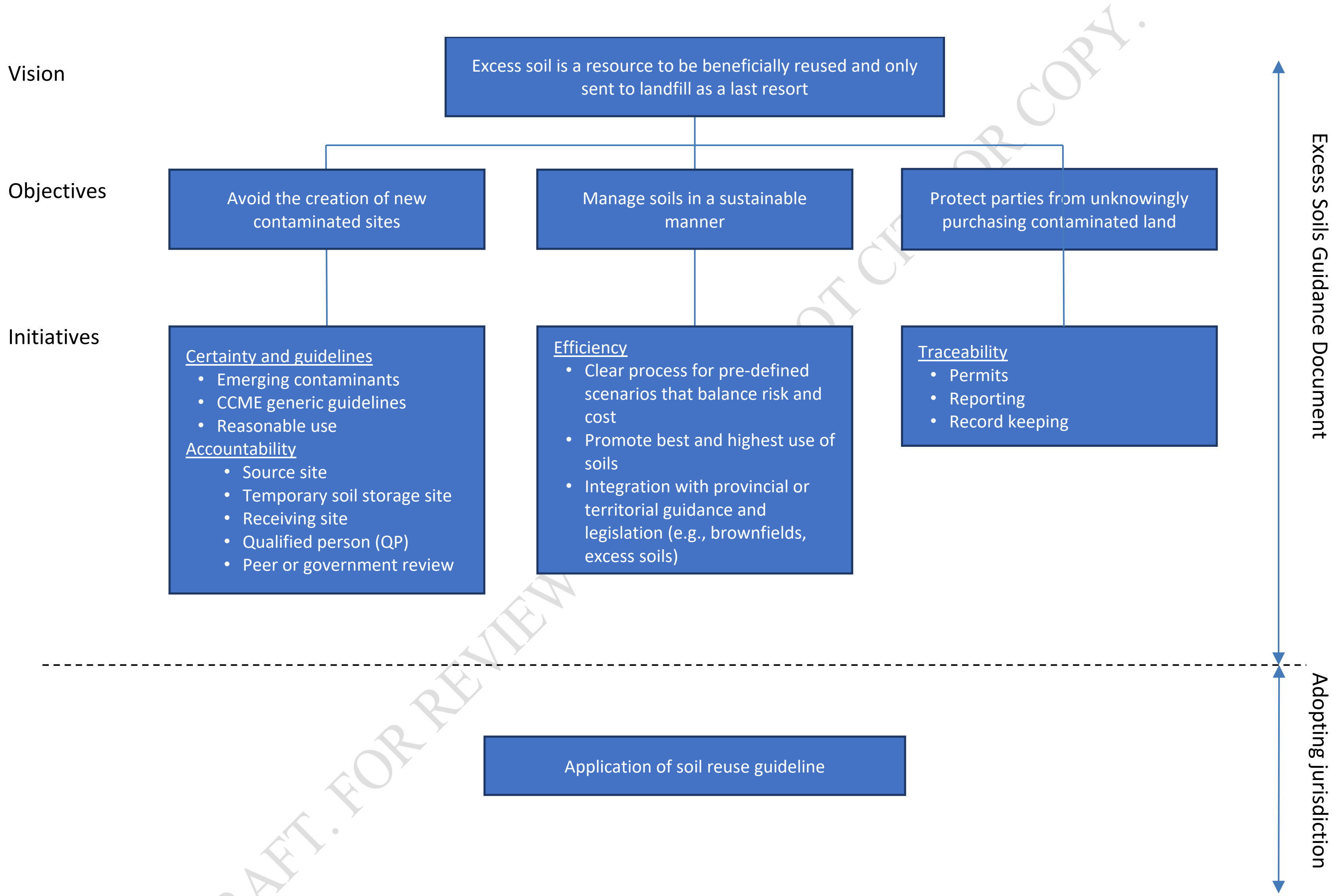

Figure 1: Excess soil management framework

Table 1: Excess soil implementation document roadmap

Question, query or action	Comment or resolution	Who is responsible?	Document reference section
Determine if excess soil will be generated	Evaluate SS project scope and options: • Have the design team complete a soil balance calculation to estimate the net difference between the amount of soil generated and the amount required to achieve the final site grading plan. • Identify the areas of the site that will generate excess soil and determine the volume from each area. • Determine if excess soil is of suitable quality for reuse on SS. • Separate work to address contamination/remediation; this should be done under the direction of a QP.	SS owner	4.0, 4.3, 5.1
Determine if the volume of excess soil requiring removal can be reduced	Work with project design team to optimize soil conservation. This can be done by reducing the soil requiring excavation or by identifying opportunities for on-site reuse.	SS owner, contractor or consultant	5.1
Consider whether to retain a qualified person (QP)	Retain a QP whenever excess soil is moved from an SS to a RS in order to be reused. The extent of the QP's review is project-specific, based on past site use, PCA and APEC. • The SS QP is responsible for characterizing the soils (determining what is representative of the quality on site) and identifying the applicable site condition guidelines. This forms the basis of a SMP. • The RS QP characterizes soil at the RS and determines the appropriate RS condition guidelines. This forms the basis of an FMP.	SS owner	5.1, 5.2, 5.3, 5.4
Evaluate soil quality	Characterize the SS and RSs based on current best practices applicable to your jurisdiction: • Submit the soil to the laboratory for environmental analyses • Compare the results to the applicable soil quality guidelines • Assess the representativeness of the results including considerations of variability in soil quality across the site.	SS QP	4.1, 4.2, 4.4, 5.0, 5.1
Identify environmental concerns	Review the soil characterization results and current or previous environmental testing of the SS.	SS QP	4.0, 5.0
Prepare an SMP	The SMP should include information on COPCs, soil characterization results, source of the soil, instructions for handling the soil, and location of RS(s), temporary soil storage sites and WSs.	SS QP	4.0, 4.4, 7.0
Identify suitable RS(s)	The RS(s) should be certain how the quantity and quality of soil being provided from the SS will be used.	SS QP	3.0, 4.2, 4.3, 5.0, 6.0, 8.0

Question, query or action	Comment or resolution	Who is responsible?	Document reference section
Prepare an FMP at the RS	The FMP should characterize the RS soil quality; document the quantity, quality and physical properties of excess soils that may be received; specify their proposed reuse; and ensure appropriate environmental protection measures are implemented during receipt, including audit sampling of received soils.	RS QP or RS owner	4.1, 4.2, 4.3, 4.4, 5.2, 7.0, 11.0
Implement traceability protocol	The traceability protocol comprises auditable documents intended to record information regarding the movement of excess soils from SS to RS for beneficial soil reuse and should also note any use of any temporary soil storage sites (if applicable).	SS QP or SS owner	7.0
Confirm the soil hauling contractor (trucking company) in the SMP	Review the plan with the hauling contractor: • Confirm partitioning or management areas of SS soil (if it is not all of uniform quality) to ensure that the contractor recognizes differing handling requirements across the site (if applicable). • Confirm the identity of temporary soil storage site and/or RS(s) (if chosen by the contractor) and ensure that the supporting documentation and analytical data support the receipt of soils from the SS. • Understand the RS audit requirements to ensure that the SS soil is properly characterized (i.e., number of samples and type of analysis per given volume).	SS QP or SS owner	4.1, 4.2, 4.3, 4.4, 5.1, 7.0, 11.0
Track the soil loads leaving the site and their destination(s)	Monitor the contractor's work in progress to ensure that the SMP is being followed and to confirm that trucks are delivering soil to approved temporary soil storage site and/or RSs.	SS owner or SS QP	5.1, 5.2, 5.3, 5.4, 7.0, 11.0
Retain records and prepare for audit	Both the SS and RSs should prepare summaries of soil volumes removed and received with supporting documentation (i.e., bills of lading, results of lab analyses). Information may be managed as follows: • Retained on file by SS and RS owners and QPs. • Submitted to a government agency or other third party (where applicable).	SS QP	7.0

Notes: SS = source site; QP = qualified person; RS = receiving site; PCA = potentially contaminating activity; APEC = area of potential environmental concern; SMP = soil management plan; FMP = fill management plan; COPCs = contaminants of concern; WSs = waste sites.

2. INTRODUCTION

This guidance document provides a set of tools that are intended to promote the responsible and beneficial reuse of excess soils. Good stewardship of excess soils can promote resource conservation, reuse, recycling and recovery. The proposed hierarchy of excess soil management, promoting these principles, is summarized in Figure 2.

Poor management of excess soils may lead to increased human and ecological health risks, as well as liability for SS and RS owners. An incomplete understanding of excess soil options can cause projects to incur unnecessary costs and can impact their financial feasibility.

In many cases, practitioners and site owners generating excess soils are hesitant to reuse soil due to perceived current or future risk (changing guidelines[1], emerging contaminants of concern) and the associated potential liability. These current practices contribute to the suboptimal use of landfill capacity when soils are sent to landfill instead of being beneficially reused. Secondary impacts, such as increased greenhouse gas emissions and infrastructure deterioration, may occur as licensed landfills are often located relatively distant from urban areas where most excess soil is generated.

With proper evaluation, management and testing, excess soil may be beneficially reused for landfill cover, as fill at development sites or to meet a functional need at existing properties (swale or berm creation, site levelling) rather than using quarry-derived materials.

2.1 Objectives of the Guidance

Soil conservation and management should be considered at every stage of a project. All aspects of the planning and development process, from the initial concept through permitting, construction, transportation and reuse of excess soil, should consider soil conservation and sustainability.

[1] For the purpose of this document, the term *guideline* refers to both standards and criteria, among others when referring to CCME Canada-Wide Standards.

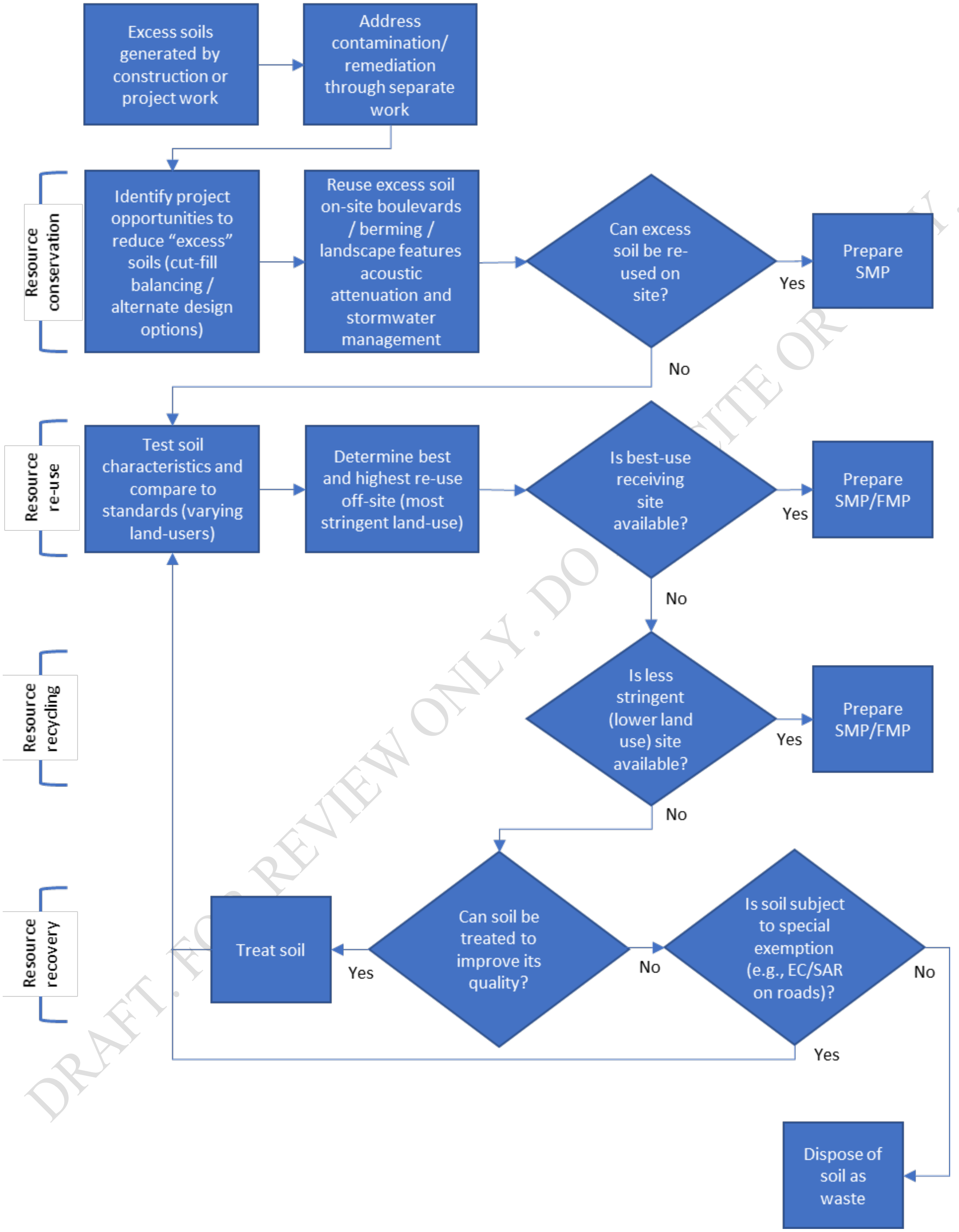

Figure 2: Proposed hierarchy of excess soil reuse

Notes: EC = electrical conductivity; SAR = sodium adsorption ratio.

The main objectives of the excess soil reuse guidance of the Canadian Council of the Ministers of the Environment (CCME) are to facilitate beneficial soil reuse and expand options for soil management to improve the efficiency of resource utilization. Other objectives of this guidance include:

- Avoid the creation of new contaminated sites. The guidance will ensure that excess soil is reused in a way that protects human and ecological health and prevents the occurrence of soil, air and water (i.e., groundwater and surface water) pollution, notably by disallowing the reuse of contaminated soil over the guideline value applicable to a given site.
- Manage soil in a sustainable manner in order to maintain a healthy economy (cost-effective approach) while protecting the environment. Reusing excess soil:
    - Is potentially more cost-effective than the use of pristine soil.
    - Promotes soil conservation by providing an alternative to disturbing pristine sites (i.e., pits and quarries) to obtain fill materials.
    - May reduce greenhouse gas emissions by reducing the distance soil is transported.
    - Preserves landfill capacity for waste materials that have no potential for reuse.
- Protect parties acquiring land from unknowingly purchasing contaminated land. The guidance recommends elements to include in a tracking system (traceability protocol) for excess soil movement, so the current and future owners of a given site are aware that such soil was placed on their property.

3. PRINCIPLES

The principles for this document are based on the concepts of conserving resources, especially soil quality and landfill space, and reducing environmental impacts, which means protecting the environment by controlling the distribution of toxins when they occur in soil and reducing greenhouse gas emissions by reducing the unnecessary trucking of soils. Excess soils should be reused while respecting the three main principles, presented below along with their implications.

Principle 1. The reuse of excess soils should provide a benefit and not be a way of getting rid of waste.

This principle implies that:

- The application of excess soil at an RS will fulfill a specific function. To do this, the soil must have a certainty of use (i.e., it will be used within a predetermined timeline) and be of a quantity that is consistent with the needs of the RS project. This will help avoid waste burial or depositing in disguise.
- The excess soil should be utilized as a substitute for material that would otherwise be imported to the site from a pit or quarry to fulfill a specific function. Among other things, this may include berming, infilling and geotechnical material uses where applicable.
- Mixing the excess soil with higher quality soils for the purpose of dilution is not acceptable.

Principle 2. Excess soil should be managed without endangering human health or harming the environment, and in particular without imposing risk to water, air, soil, plants, animals and humans.

This principle implies that:

- The guidance is not a “pollute up to” permission and should not result in the creation of new contaminated sites.
- Pathways for which generic soil quality guidelines are not available (e.g., soil-to-groundwater pathways for inorganics), if present, may need to be assessed through other means such as leachate testing or groundwater monitoring to ensure they are protected. Groundwater monitoring may be required in situations where the addition of the soil represents a significant alteration of a site setting (e.g., depositing excess soils as fill in a pit or quarry).
- Soil movement should not cause a nuisance in the form of noise, dust or odours.

Principle 3. The soil quality (i.e., the physical and chemical properties) should be consistent with the current and future use of the site. This principle implies that:

- Soil reuse must not prevent any permitted land use on a given site, and the quality of the site receiving the excess soil should not be negatively affected (see Section 4). As such, depending on the situation, the applied soil should be of equal (i.e., within a reasonable variation; see Section 4.3) or better quality than the current soil quality or natural background soil quality at the RS.

Where it is determined necessary to disregard any of these principles, jurisdictions or proponents should have a full understanding of the potential environmental and legal implications of doing so and should document this understanding as part of the project record.

4. EVALUATING SOIL TRANSFER POSSIBILITIES

Any evaluation of a soil transfer should begin with characterization of the source and RS conditions. Site characterization should be overseen by a QP (see Section 5.4 following existing best practices that include existing CCME documentation (1994 and 2016) and draw from provincial or territorial guidance as well. In addition, some jurisdictions may have legislative and regulatory requirements. Site characterization provides important information about potential contaminants of concern and areas of an SS that may contain soils unsuitable for reuse due to their chemical or physical properties.

As further described in the subsections that follow, the movement of excess soil requires consideration of soil quality and quantity. The location and volume of soil to be moved, and variations in soil quality across a site, must be considered in evaluating the risks associated with soil reuse and the type and volume of sampling required. Ultimately the goal is to develop a conceptual site model and to be confident that the results of sampling are representative of soil conditions within the areas that will be managed under an SMP. Soil taken to an RS should have a planned reuse before it arrives at the RS.

4.1 Use of Numeric Guidelines

CCME has developed numeric Canadian Environmental Quality Guidelines (CEQGs) and Canada-Wide Standards (CWS) for contaminants of concern in soil based on available toxicological data. The guidelines were developed to guide the management and clean-up of contaminated sites and as such they should not be considered pollute-up-to values. Further, the guidelines were developed using a specific set of assumptions and models and these should be considered to confirm that applying the guidelines is appropriate. One assumption used for both the CEQGs and CWS is a source volume of 10 m x 10 m x 3 m, which may be much smaller than the volume of excess soil brought to an RS. The guideline values calculated for the soil-to-groundwater protection pathways will vary depending on source size, and care should be taken in an excess soil context to ensure these pathways are protected.

The CEQGs represent generic guidelines which are modelled to be protective of the most sensitive receptors based on a given site use and based on currently available science that is subject to change. CCME defines four generic site uses: agricultural, residential or parkland, commercial and industrial. The generic guidelines also consider soil texture—fine-grain (< 75μm) and coarse-grain (> 75μm). The generic guidelines (CCME 2006) make several assumptions about contaminant pathways associated with coarse- and fine-grain soils. These assumptions should be understood when applying the guidelines in situations where coarse-grain soils are placed on a fine-grain site or vice versa.

CCME has also facilitated the development of Canada-wide standards for petroleum hydrocarbons in soil that have been developed to balance human and ecological risk with technical and economic feasibility (CCME 2008). These guidelines have been adopted by most jurisdictions. Like the CEQGs, they were developed to guide the management and clean-up of contaminated sites and as such are not considered pollute-up-to values.

Risk management measures and site-specific guidelines considerations

In addition to generic guidelines, site-specific guidelines may be derived through a risk assessment process that considers contaminants of concern as well as site-specific pathways and receptors. This process may also require the use of risk management measures. If such measures are required as part of a site-specific guideline to manage or remove a pathway or receptor, additional regulatory requirements within jurisdictions (e.g., instruments, or site-specific approvals) should be considered. Guidelines derived through a site-specific risk approach should consider provincial and territorial legislation, be consistent with the current and future use of the property and consider the ongoing operational measures that will be required to mitigate risk.

If a jurisdiction considers allowing excess soil reuse at sites that went through a risk assessment process, it must be aware that there is a risk associated with the abuse of the site-specific risk management or guidelines in that context. To ensure that the excess soils are reused appropriately, jurisdictions should ensure that they have:

- Regulations in place governing if, how and when excess soils can be reused at such sites.
- A policy regarding excess soil beneficial reuse that describes how it relates to site-specific guidelines and risk managed properties.

Jurisdictions may want to consider pre-defined acceptable risk-based scenarios for soil transfer in circumstances where a SS soil exceeds a generic RS guideline. For example, many jurisdictions use road salt to keep roadways and parking lots free of ice. This commonly results in exceedances of the guidelines for conductivity and sodium adsorption ratio (SAR). Under current practices these materials are often considered contaminated soil and can neither be reused at the SS nor transferred to another roadway or parking lot. An exemption promoting the reuse of SAR and conductivity-impacted soils beneath roadways and parking lots in non-potable areas would prevent the contamination of imported clean fill by road salting practices and would promote beneficial reuse with minimal risk. Salt poses a risk to plant health and growth, but plants are not likely to be exposed to salt-contaminated material that has been placed under roadways and parking lots. Consideration should also be made to avoid impacting potable groundwater supplies.

Depending on the circumstances and the intended use of the site, it is important to be aware of the appropriate provincial or territorial numeric guidelines or standards and methodologies. Some provincial and territorial legislation includes generic guidelines or standards and requirements for determining site-specific standards, in addition to or instead of those identified by CCME, for sites that are in areas of potable or non-potable water use, shallow soil conditions and proximity to surface water bodies. These regulations may also identify minimum sampling requirements for fill imported to a site; this has implications for RSs that may require certification (e.g., record of site condition).

4.2 Types of Guidelines

CCME generic guidelines are effects-based (CCME 2006) and consider land use. Effects-based guidelines are based on toxicological data for each parameter and the frequency of effects, from no effects to serious ones, observed at varying concentrations of a given parameter. CCME generic guidelines list four categories of land use as follows:

- Agricultural,[2] where the primary activity is growing crops or tending livestock and includes farm residences as well as agricultural land providing habitat for resident and transitory wildlife as well as native flora.
- Residential or parkland, where the primary activity is residential or recreational. Parkland includes urban parks and recreational areas and excludes wild lands such as national and provincial parks.
- Commercial, where the primary activity is commercial (e.g., shopping mall), not residential or manufacturing, and does not include zones where food is grown.
- Industrial, where the primary activity involves the production, manufacture or construction of goods, and public access to the property is restricted.

The ecological component of the agricultural, residential and parkland land use guidelines is based on thresholds at which only minimal effects on ecological function would be observed (CCME 2006). The commercial and industrial land use guidelines are based on low-level effects and assume that adverse effects would be expected to occur in less than half of the species of the terrestrial community (CCME 2006). The human health component is based on tolerable risk and hazard (deemed essentially negligible) and conservative exposure assumptions.

[2] Note for wildlands and for national and provincial parks, application of the agricultural guidelines is recommended as a conservative approach; alternatively, site-specific exposure scenarios should be considered (CCME 2006).

Generic guidelines are based on pre-defined exposure scenarios. Where the ecological health and human health receptor guidelines vary, the more conservative value is applied (CCME 2006). Soil concentrations that exceed generic site condition guidelines may be considered as part of a site-specific risk-based approach (e.g., controlling length of exposure or the presence or absence of a sensitive receptor on which the generic guideline is based). Further explanation of this specific application is provided in Section 5.0.

Background site conditions are concentrations of compounds that are expected in soils that have not been contaminated by a point source and are representative of surrounding conditions. For some contaminants of concern there can be considerable variation in background concentrations due to regional variations in geology or generalized industrial or urban activity. Some provincial and territorial legislation defines regional background concentrations for sites that are not impacted by anthropogenic activities but defining background conditions in an urban or industrial area has traditionally required a site-specific assessment.

In evaluating a SS for soil reuse or potential RSs, in most circumstances it is anticipated that background or land use guidelines would be applied as follows:

- Land use guidelines would be applied in the case of reuse of soil on an impacted site (e.g., soils respecting the residential or parkland guidelines could be used on an RS impacted up to commercial guidelines).
- Background (local, regional, provincial or territorial) conditions would be applied in the case of reuse of soil that are at the local background or to confirm that soils removed from a site can safely be placed at any other type of site within the locale, region, province or territory.

4.3 Suitability of Types of Guidelines for Differing Scenarios

Classification of the source and receiving sites, and characterization of their soils, should draw on the best practices for site characterization (Section 4.0) which is consistent with a Phase 1 and 2 environmental site assessment (ESA). The professional judgement of a QP should be applied (see Section 5.3) in classifying the source and receiving sites.

Wherever possible and practical, excess soil should be reused on the SS as this is typically the most sustainable approach, both environmentally and economically, and the lowest-risk in terms of liability.

When movement to an off-site RS is required, soils may be moved according to the quality (Section 4.1) of the SS and RS soils, as summarized in Table 2. Quality of soil in Table 2 is determined with respect to CCME Soil Quality Guidelines.

Table 2: Summary of soil transfer scenarios

Source Site	Receiving Site					
	Quality of Soils	Background	Agricultural	Residential/Parkland	Commercial	Industrial
	Background	RU	Y	Y	Y	Y
	Agricultural	N	RU	Y	Y	Y
	Residential/Parkland	N	N	RU	Y	Y
	Commercial	N	N	N	RU	Y
	Industrial	N	N	N	N	RU

Notes:
N transfer not permitted
Y transfer permitted
RU transfer permitted if meets reasonable use limits

In an ideal scenario the physical properties and environmental quality of source and receiving sites would be an exact match, as this would optimize beneficial reuse while minimizing the risk of future impact. However, this expectation is impractical considering the number of parameters which would need to be matched and the probability of finding a local site that is an exact match. In the absence of an agreed-upon policy or mechanism for defining equal quality, practitioners will either conservatively transfer higher-quality soils to lands where less stringent guidelines apply or rely solely on existing guidelines and pollute up. Neither of these outcomes is desirable as they do not promote the most efficient use of soil resources.

The concept of reasonable land use is introduced as a mechanism for moving soils between similarly classified sites (e.g., commercial to commercial) to promote soil reuse and discourage polluting up to a guideline. Ideally the SS soils should be of equal or better quality than the RS soils; however, in circumstances where an SS parameter falls below the target guideline but exceeds the concentrations of the RS, some variation is permitted, recognizing that there is inherent variability in soil quality data. The reasonable use concept is based on an Ontario guideline (MOEE 1994) that was developed to protect groundwater quality and mitigate the potential of certain land uses (septic waste disposal, solid waste disposal) to impact or limit downstream users.

Reasonable use could be based on the following calculation used in evaluating reasonable use of groundwater in Ontario (MOEE 2008):

$$Cm = Cb + x(Cr-Cb)$$

Where:

Cm is the maximum concentration of a particular parameter that would be acceptable.

Cb is the background or existing concentration of a particular parameter at the RS. This number would be the lowest observed concentration of a parameter at the RS based on the available information and must be below the generic guideline (Cr).

Cr is the generic guideline concentration of a particular parameter.

x is a constant that reduces the target concentration to a level that will only have a negligible effect on the use of the site. As an example, the Ontario Reasonable Use Calculation (MOEE 2008) uses 0.25 for health-based guidelines and 0.5 for aesthetic guidelines in groundwater.

An example of application of the reasonable use calculation is as follows:

> In a scenario where movement of commercial quality soils from one site to another (i.e., both meet commercial guidelines), assume that the lowest observed concentration of nickel at the RS is 57 mg/kg (Cb) and the SS soils have a concentration of 60 mg/kg. The CEQG is 89 mg/kg (Cr) for commercial sites. Therefore:
>
> $$Cm = 57 + 0.25\ (89 - 57)$$
>
> $$Cm = 65 \text{ mg/kg}$$
>
> Based on the information above, the RS could reasonably receive soils with a nickel concentration of up to 65 mg/kg and the SS soils are below this threshold. One would conclude that the transfer of soils to the proposed RS is acceptable based on the available information.

However, it is acknowledged that if a concept such as reasonable use or a similar approach is used to discourage movement of soil up to an applicable standard (generic or site-specific), this may limit the potential reuse of the soil. Jurisdictions will need to consider many factors when assessing whether to apply additional precautionary constraints on soil quality.

The generic land use guidelines are suitable as an initial screening tool for an RS as these guidelines are generally conservative with respect to assumed pathways and receptors. A simplistic consideration is that soils from an agricultural or residential land use would generally be considered to meet commercial or industrial land use guidelines. Characterization of the RS and SS is recommended to confirm that the condition of SS soils is consistent with the land use (e.g., a residential site may have historically received fill that exceeds residential soil quality guidelines).

Similarly, simply because an undeveloped site is zoned for commercial or industrial use, this does not provide permission to "pollute up" soils. An example of these considerations applied to anticipated common scenarios is provided in Table 7 (see Section 7.0). However, some pathways are not protected for certain chemicals through the use of the generic soil guidelines, such as the transport of inorganics from soil to groundwater. The protection of these pathways may need to be assessed through other means (e.g., leachate tests or groundwater monitoring).

4.4 Failure Policies and Their Implications in Excess Soil Management

The previous sections discuss the identification of an applicable numerical guideline when characterizing soil. Soil characterization must also consider whether the samples collected are representative. A failure policy is used to identify the number of samples required to represent a specific volume of soil, and the criteria by which a volume of soil meets or fails the numerical guideline.

A failure policy should at a minimum describe:

- The guidelines the soil must meet.
- The number of soil samples that must be collected for a given volume of soil and the number of soil samples that must meet the guidelines (see Section 4.4.1).
- The process for managing soils that do not meet the guidelines.

The implications of failure policies, meaning the process by which a volume of soil is deemed to meet or exceed a guideline, and anticipated implementation challenges are discussed further below.

4.4.1 Implications of Failure Policies

Soil is inherently heterogeneous, which can contribute to considerable variation in soil chemistry. In determining how soil can be used, the representativeness of the soil samples and their results are critical in ensuring that soil is properly characterized. Soil characterization ensures that the core principles of excess soil management (Section 3.0) are supported.

A number of statistical methods and failure policy approaches may be employed. A discussion of various approaches to soil characterization and the collection of representative samples is provided in documentation prepared by CCME (2016), the Interstate Technology Regulatory Council (ITRC 2012) and the United States Environmental Protection Agency (USEPA 1991). A summary of the various methods available is provided in Appendix A. Across Canada, a commonly used protective trigger is one in which any single parameter exceeding the guideline for the RS results in the failure of the batch or volume of soil in question. When applying this failure policy, several jurisdictions have identified minimum numbers of samples for a given volume of soil (see Table 3). These policies generally consider stockpile composite sampling (ex situ), but minimum sample requirements could also be applied for in situ sampling of soil that is intended for reuse.

Table 3: Example soil sample failure policies

Jurisdiction	Type of policy	Summary of policy
British Columbia	Mean or single number fails batch	Technical Guidance on Contaminated Sites: Site Characterization and Confirmation Testing (MOEBC 2009a): In situ sampling is preferred. One discrete in situ sample is considered to represent a volume of 10 m^3 of material designated as waste, industrial or commercial quality, or 5 m^3 of material designated as hazardous waste. Generally, material that has been tested in situ cannot be reclassified with ex situ sampling unless the batch testing protocol for the *ex-situ* testing is statistically more rigorous than for the *in-situ* protocol. The proposed ex situ sampling protocol is as follows: for suspect hazardous waste, collect one sample for each 10 m^3 (i.e., a representative cell). For suspect waste, collect one sample for each 30 m^3, and for industrial quality material, collect one sample for each 50 m^3. The maximum stockpile size for suspect hazardous waste is 50 m^3, 150 m^3 for suspect waste and 250 m^3 for industrial-quality material. In determining how to manage stockpiles, a combination of representative cell analyses and a calculated value are used to determine whether or not the stockpile meets the numerical quality criterion. The calculated value is the composite sample value plus the absolute value of the difference between the composite value and the mean of the representative cell samples analyzed. British Columbia's statistical approach for failure policy can be found in the technical guide "Statistical Criteria for Characterizing a Volume of Contaminated Material" (MOEBC 2009b).
Ontario	Single point compliance or statistical method	On-Site and Excess Soil Management Regulation (O.Reg. 406/19; MECP 2022): Ontario's excess soil regulation provides two methods for meeting an excess soil quality standard, single point compliance or the statistical method. For single point compliance the applicable excess soil quality standard must be met at each sampling point. The regulation allows the results of two or more in situ soil samples taken from the same sampling location (as defined in regulation) to be averaged. To use the statistical method a minimum of 20 discrete soil samples are required and the following statistical tests must be met: the 90th percentile of the data set and the upper 95% confidence limit of the mean concentration must be less than or equal to the applicable excess soil quality standard; and no single sample concentration can exceed the corresponding ceiling value. The excess soil regulation requires minimum soil sampling frequencies under certain conditions. For in situ soil characterization the required minimum sampling frequencies are: for soil volumes of 600 m^3 or less 3 samples, for soil volumes > 600 and < 10,000 m^3, 1 sample for each 200 m^3, for soil volumes >10,000 m^3, at least one soil sample for each additional 450 m^3, for soil volumes > 40,000 m^3, at least one soil sample for each additional 2000 m^3. For characterization of soil in stockpiles, the regulation requires minimum sampling frequencies of 3 samples

Jurisdiction	Type of policy	Summary of policy
		for 130 m^3 or less, 4 samples for > 130 to 220 m^3, 5 samples for > 220 to 320 m^3, 6 samples for > 320 to 430 m^3, 7 samples for > 430 to 550 m^3 etc. up to 32 samples for > 4700 to 5000 m^3 (as shown in Table 2 of Schedule E of O.Reg 153/04 (Ontario Ministry of the Environment [MOE] 2011)). For stockpile volumes greater than 5000 m^3, the minimum number of samples is determined in accordance with the following formula $N = 32 + (V – 5000) / 300$. A reduced sampling frequency is allowed for stormwater pond sediment that is segregated by zone from within the stormwater pond (e.g., inlet, outlet).
Vancouver Park Board	Single number fails batch	Best management practice for importing fill material (VPB 2015): • one sample per 250 yd^3 (191 m3) up to 1,000 yd^3 (765 m^3) • one sample for each additional 500 yd^3 (382 m^3) up to 5,000 yd^3 (3,824 m^3) • one sample for each additional 1,000 yd^3. If there are detectable concentrations of compounds of concern, the material should be evaluated by the consultant for risk in accordance with city or province's environmental assessment guidelines.
Québec	Single number fails batch	In Québec, soils must, if possible, be characterized in situ (i.e., not in pile) in order to be managed in or off-site once excavated (MENV 2003). The minimum accepted frequency for sampling a site under characterization is one sample every 625 m^2 (25 m x 25 m). If excavated soils must be characterized in piles, the sampling frequency for excavated soils in piles (CEAEQ 2010) is: • one soil sample for each 30 m^3, up to 60 m^3 • three samples for more than 60 m^3, up to 100 m^3 • four samples for 100 m^3, up to 200 m^3; plus one sample every 100 m^3, up to 1000 m^3 • 12 samples plus one sample for every 250 m^3 up to 2,000 m^3 • 16 samples plus one sample for every 500 m^3 for volumes greater than 2,000 m^3. Best management practices for soil management are presented in Annexe 5: Grille de gestion des sols excavés (Appendix 5, excavated soil management grid) of the "Guide d'intervention – Protection des sols et réhabilitation des terrains contaminés" (the Québec government's guide to soil protection and contaminated site rehabilitation, Beaulieu 2021). The management grid identifies four contaminant levels with varying management options that range from unrestricted use to optimal decontamination in an authorized treatment site, requiring management according to the level reached or final disposal at a secure landfill. In general, the failure policy in Québec for soil placement is that the placed soil, whether on the SS or off-site, has to be of equal or better quality than the receiving soil. This is applied on a contaminant-contaminant and concentration-concentration basis (i.e., no new contaminant can be brought onto the RS).

Jurisdictions may also consider allowances for QP judgement, for instance in evaluating whether environmental site characterization data are representative in the undertaking of a Phase 1 and 2 ESA. QP judgement is particularly important when evaluating potential RSs and in defining a site-specific background concentration such as in a reasonable use type application (Section 4.3).

4.4.2 Anticipated Implementation Challenges

Many provincial and territorial regulations identify minimum sampling requirements for excess soils and soils associated with remedial excavation or backfill. There also may be separate sampling requirements under waste management regulations. A successful excess soil management policy will need to complement and integrate with these existing regulations.

Current regulations have poorly defined policies and verification procedures for evaluating soil for emerging contaminants of concern and for considering potential daughter products that may emerge in treated soils or lightly contaminated soils. Presently, it is up to site owners and QPs to be familiar with current science and emerging contaminants of concern in order to make a judgement about the potential risks of new or changing soil quality guidelines.

5. RESPONSIBILITIES OF THE PERSON IN CONTROL OF THE SITE

The sites in question in this section include both the SS and RS. These responsibilities relate to the three principles defined in Section 3.0.

5.1 Source Site

- Ensure that the soil to be reused is well characterized using methods and personnel acceptable to the jurisdiction.
- Ensure that the analyses include all of the contaminants reasonably expected to be present in the soil that is to be reused, with respect to the activities that take place or took place on the site. This evaluation should consider potential emerging contaminants of concern.
- Prepare an SMP that includes the following:
  - a rationale for selecting contaminants of concern
  - a summary of the soil's physical characteristics (i.e., texture, organic matter content, moisture content)
  - sampling methodology and locations
  - environmental quality results
  - a figure clearly depicting the location of all the excess soil to be managed and, where applicable, describing the dimensions of the excess soil volume(s) (length, width and depth or height)
  - a summary of the volume of soil that is excavated and intended for reuse
  - instructions for handling the soil, including a summary of appropriate RSs based on the quality of the soil and how the soil will be tracked and records kept.

- Separate work may be required to address contamination/remediation under the direction of a QP, where applicable
- Prior to the transfer of excess soils, ensure that the following information is transmitted to the RS:
    - rationale for selecting contaminants of concern, and the applicable guidelines
    - physical characteristics of the soil
    - sampling methodology
    - environmental quality results
    - source of the soil (i.e., site location and area(s) from within the SS).
- Know the RS address(es) for each load of soil removed from the site.
- Ensure that the RS provides documentation confirming quantity and quality of soil it is able to receive, what it will be used for and where on the RS it will be placed.
- Ensure that the hauler only transports soils to RSs approved by the SS owner. As a best practice the transfer of soil from the SS to the RS should include a manifest system which tracks information such as truck number and hauler to confirm that the soil is accounted for.
- Information on temporary soil storage sites and movements through off-site soil processors and soil banks (if applicable).
- Confirm that the RS is operating under the guidance or supervision of a QP and confirm the intended use of the soil to ensure that it is consistent with the quality of the soil. The SS can confirm this by asking for a copy of the FMP and documentation confirming where and how the excess soils will be placed and used.

5.2 Receiving Site

- Demonstrate the utility of the soil reuse project (i.e., define the volume needed, purpose and certainty of use).
- Know the quality of the existing soil at the RS.
- Know the identity of the reused soil's site of origin (the SS) and where on the RS the reused soil has been placed.
- Know the quantity and quality of the soil to be received at the site in advance (e.g., obtain certificates of analysis and ensure that geotechnical requirements are met), and confirm that principle 3, placed soil quality, is respected (see Section 3.0). Provide documentation confirming quantity and quality of soil suitable for RS to the SS.
- Where appropriate, undertake audit sampling of received soils to validate the SS results and to ensure the integrity of the soil transportation process. Ensure that the received soils are reused for the purpose that was authorized.
- Ensure that appropriate environmental protection measures are implemented at the site, including but not limited to dust control measures, runoff and erosion control measures, noise control measures and the prevention of adverse effects at the RS and neighbouring properties.

5.3 Temporary Soil Storage Responsibilities

- Confirm the level of contamination of the excess soil to be stored at the site based on the chemical analysis certificates provided by the soil owner.
- Store excess soil with respect to level of contaminations (e.g., < residential guidelines, < industrial guidelines).
- Ensure that excess soil is stored in such a way that it cannot transfer contaminants to the surrounding environment (i.e., storage on impermeable pads, cover the soils with tarps, runoff collection/treatment, etc.).
- Avoid proximity to sensitive receptors (human health and ecological).

5.4 Responsibilities of the Qualified Person

There is provincial and territorial variation in the definition of a QP[3] across Canada. Therefore, for the purposes of managing excess soil, the QP designation is expected to be consistent with the provincial or territorial definition in which the soil management activities are undertaken. A QP's primary responsibility is to ensure that there is no harm to human or ecological health. A QP must have the proper training and experience to apply professional judgement for the purpose of managing the movement of excess soils such that the public may have confidence that this work is being undertaken with appropriate care and control for protection of human health and the environment.

The QP should confirm the appropriateness of reuse and that the people in control of the RS and SS understand the implications of soil transfer and receipt (i.e., potential for liability to arise). A QP should see to the design and implementation of the SS characterization (in the SMP) and RS characterization (in the FMP).

Jurisdictions may consider whether movement of excess soil is governed by a permit process, a peer review process or some hybrid of the two. The pros and cons of each approach are summarized in Table 4. In addition, jurisdictions may want to consider whether they want to provide any exemptions for certain types of soil transfers, such as small volumes.

In a peer review process, the SS and RS each retain a QP to confirm the appropriateness of soil transfer and to assume care and control of the source and RS responsibilities (Sections 5.1 and 5.2). The QPs then review each other's site documentation (i.e., the SS QP confirms the RS is appropriate based on the information provided and the RS QP confirms that the source soil can be received based on the information provided).

In a permit-style process, an existing government agency, or one to be established, receives a formal application to move soil supported by a SMP and FMP(s) and determines whether or not to grant a

[3] The involvement of a QP is recommended but may not be practical in every situation. Jurisdiction may determine the circumstances under which a QP would not be necessary.

permit for transfer of the soils. A permit process may or may not require QP involvement based on how much control and liability a jurisdiction chooses to assume. Online registries and permit-by-rule processes may also be used to facilitate the responsible relocation of excess soil.

A hybrid approach can include elements of both options. For example, a peer review process might be considered below a minimum threshold or have less stringent site characterization requirements than a permit process imposed on movements of larger quantities of soil. Some low-risk excess soil movements could be managed using permit by rule, combined with an online publicly accessible registry for tracking excess soil movements (reuse site locations, volume of soil received and hauling records) to provide transparency.

Table 4: Pros and cons of permit vs peer review

Approach	Pros	Cons
Peer review	• No government staffing or document or permit tracking; this reduces implementation costs for jurisdictions. • Peer review process encourages technical rigour. • Shares liability and responsibility amongst SS and RS.	• Lack of oversight may lead to a lack of accountability. • Lack of resources and centralized tracking system make it difficult to monitor soil movement.
Permit	• Government oversight promotes accountability through a formal permit process that is auditable. • Centralized tracking of soil movement ensures transparency for future site owners and neighbouring properties. • May reduce the need for QP involvement, which will reduce costs for source and receiving site owners.	• Imposes costs on enacting jurisdictions due to staffing needs and to maintain a permit tracking and enforcement system. • May limit innovation if the permit process is too restrictive or lengthy, negating the desired benefits of promoting excess soil reuse.
Hybrid	• Required resources for permit process can be mitigated by limiting government involvement in permit process to higher risk soil transfers (e.g., commercial- and industrial-quality soils). • QPs submit documentation to a centralized registry, promoting traceability. A registry would also facilitate periodic auditing to promote accountability.	• Exemptions may promote "gaming" of the system to bypass the need for permits. • Some cost incurred by jurisdictions based on the level of involvement and the volume of the permit process.

5.5 Anticipated Implementation Challenges

The characterization of the source and receiving sites can be financially costly and lead to extended project timelines. This may reduce the availability of appropriate RSs and dissuade SSs from choosing excess soil reuse options.

The retention of a QP may lead to increased project costs but could generate substantive cost savings if local beneficial reuses are identified. This may provide flexibility of judgement that reduces the regulatory burden through the assignment of responsibility, analogous to the process that is employed by current brownfield legislation in many provinces. More specifically, legislation and regulation do not have to predict every potential scenario. Jurisdictions may promote excess soil reuse on smallerscale projects by considering the implementation of a risk-based approach that only requires QP involvement in soil movements exceeding a specified volume.

In the absence of a clear framework of best practices for excess soil reuse and relocation, QPs may be hesitant about the potential liabilities associated with excess soil reuse, which may lead to the ongoing disposal of excess soil at landfills. This is due to an inability to predict changing guidelines and emerging contaminants. It may also lead to inappropriate dumping at environmentally sensitive sites, especially if QP oversight is not required in a particular jurisdiction.

6. RECORD-KEEPING AND TRACEABILITY

Record-keeping and traceability are necessary components of any excess soil movement to reduce future liability for both the source and receiving sites, confirm compliance with local rules and regulations, and facilitate identification when operational controls are required. Table 5 lists general information to include in a traceability document as well as issues and considerations related to traceability protocols.

Table 5: Elements to be included in an excess soil reuse traceability protocol

Document	Elements to include
Traceability document – general information	• Identification of the site from which the soil was excavated, or of the treatment facility • Nature of the contaminants found in the excavated soil • Level to which the excavated soil is contaminated • Volume of soil to be reused • Identification of the site where the soil is to be reused and the exact location of the placed soil on the site • Land use at the RS • Soil quality guideline applicable for the RS • Names of the people responsible for the SS and RS • Approval for the soil reuse project from the relevant authority in the jurisdiction concerned (where applicable).
Traceability document – possible further information	• Presence of invasive species • Content of stones, stony material and other non-soil material • Consideration for soil that is made into products for sale and how that fits or does not fit into excess soil management.
Transport document	• Full addresses of both source and receiving sites • Volume and weight of soil • Carrier (trucking) information • Pollutant-tabulated concentrations of SS COPCs, presented with comparison to applicable guidelines.

The traceability protocol should be auditable and should include a mechanism to retain audit records. This may be implemented by requiring the involvement of an independent QP or a registration or permit through a regulator. Examples of auditable records include:

- Bills of lading or a transfer ticket process. This process would identify the hauler, truck-specific details (e.g., truck number, license plate), volume, SS and RS. One copy of the ticket would be associated with the SS and one copy with the RS.
- A summary of load volumes and a description of the site area where each load was deposited or the associated use.
- Laboratory certificates of analyses associated with verification sampling at the source or receiving site. These data should be associated with figures depicting the location of verification samples (at the source or receiving site) or describing a unique stockpile or truck load identifier.
- Summary of inspection procedures and results at the SS and RS.

The traceability protocol should be managed by a QP who will prepare a document summarizing the auditable records and confirming inspection procedures and the soil's compliance with the applicable guidelines.

When considering a traceability protocol, consideration should also be given to records keeping. A summary of pros and cons for records-keeping options is provided in Table 6.

Some jurisdictions may consider situations in which soil traceability is unnecessary. Exemptions to a traceability protocol could include:

- Soil used in waste management facilities, such as daily cover in landfills. Many jurisdictions have regulations regarding soil eligible to be used for such purposes.
- Soil with concentrations lower than the most stringent guidelines in the jurisdiction (e.g., background or agricultural guidelines.
- Soil with naturally occurring concentrations higher than typical background which meet appropriate guidelines or are used at a site with a similarly elevated background.
- Soil reused on the site of origin.
- Cut-off volume of soil under which the traceability protocol would not be required, in order to reduce the reporting burden and costs for excess soil reuse that is considered low-risk.

7. POTENTIAL SOIL REUSE SCENARIOS

The previous sections describe excess soil reuse principles, list potential approaches for managing excess soil source and receiving sites, and outline site owners' responsibilities. Table 7 provides examples of excess soil reuse.

If excess soils are transferred to an RS that is under site-specific risk assessment or risk management, the quality and quantity of the imported soil must be consistent with the risk assessment or risk management plan assumptions or subjected to local oversight.

Table 6: Summary of records-keeping approaches

Approach	Pros	Cons
Government agency	• Many jurisdictions already have environmental agencies equipped to issue permits, receive and review records and enforce legislation. • Managing excess soil is complementary to other activities such as site remediation and waste management, which promotes integration.	• Potentially a significant increased demand on government resources as environmental agencies are typically managing many different activities. • Competing demands for resources may lead to delays in the approvals process, which may dissuade site owners from applying an excess soil reuse approach.
Not-for-profit organization	• A not-for-profit can have a board comprised of private- and public-sector stakeholders allowing the organization to respond and adapt quickly to ensure that excess soil reuse remains a viable option. • Minimal financial and human resource burden on existing government agencies.	• A not-for-profit will require start-up funding or, depending on their scope, a consistent source of funding. Could be annual grants from a government agency or subsidized in part by user fees, which may limit excess soil reuse if the financial burden is too high. • The structure must consider records accessibility, meaning whether or not the public will be guaranteed access to records the way it would be with a government agency.
No centralized records	• Legislation or regulations could be developed to require formal preparation of documents in support of excess soil management, which could then be required by existing environmental protection agency officers to ensure compliance. • Largely driven by complaints and concerns. This would require minimal resources to implement and would also reduce barriers (time and expense) for the private sector to undertake excess soil management activities.	• Lack of a centralized permit or records repository may make it difficult for future property owners to evaluate a potential liability associated with a site that has received excess soil or to evaluate the degree of contamination, which contradicts one objective of this excess soil guidance document. • In the absence of a centralized body monitoring excess soil reuse, illegal or harmful soil movement may occur.

8. ISSUES SPECIFIC TO DREDGE MATERIAL REUSE ON LAND

Dredging is undertaken to remove sediment and debris from locations that are either partially underwater or in shallow marine or freshwater environments or stormwater ponds, typically in order to install or maintain infrastructure and maintain navigable waterways. CCME (1995) defines sediment as “the bottom deposits in aquatic environments that are composed of particulate matter (of various sizes, shapes, mineralogy) from various sources (e.g., terrigenous, biogenic, authigenic).”

8.1 Dredge Material Characterization

Natural and anthropogenic processes concentrate background elements and contaminants into sediment; many different potential parameters of the sediment must be tested. A list of potential contaminants of concern must be developed based on the potential contaminant sources up gradient from the dredge site. For example, characterization should specifically consider that sodium and chloride may be contaminants of concern for marine sediment deposited on land. Sediment testing should consider analyzing for the presence of persistent contaminants in the environment, such as metals, long-chain or multi-ring organics (polychlorinated biphenyls [PCBs], polycyclic aromatic hydrocarbons [PAHs] and halogenated pesticides) and tributyltin, among others. Depending on the source of the dredged material, additional parameters may need to be considered.

CCME (2016) has provided guidance on the characterization of sediment and has developed recommended generic guidelines for marine and freshwater sediment. These guidelines suit an aquatic environment which is generally considered to be more ecologically sensitive than a terrestrial environment.

Sediment may be excavated and reused in terrestrial environments. However, the material should be considered in the context of the generic guidelines for the soil and of the potential impacts that may arise specifically from the physical or chemical properties of sediment (e.g., salt leaching from marine sediment) when placed on land. Functionally, sedimentary material becomes soil when it is removed from an aquatic environment, dried and deposited in a terrestrial environment.

The following should be considered when evaluating the reuse of sediment as a soil:

- Appropriate sediment sampling methods must be used to pre-characterize the dredge material.
- Dredged material must be dewatered and desalinated (marine sediment).
- The material’s organic content may require treatment.
- Additional characterization or assessment may be required following dewatering (geotechnical, contaminant concentrations).
- Composition, grain size distribution and geotechnical properties must be considered as key factors in determining options for beneficial use.
- If desalination is not undertaken, precautions must be taken to avoid salt contamination of freshwater resources.

Table 7: Examples of soil reuse scenarios

Contaminant concentrations at SS	Soil quality at RS	Restrictions on use	Tracking	QP involvement	Notes
Falls within the province's typical background concentration range and does not exceed health-based guidelines	RS has background conditions consistent with SS.	No restriction	Not required, but could be recommended	Optional	Jurisdiction may provide typical background concentration range, e.g., Ontario's typical range.
Falls within site-specific background concentration range	RS has background concentrations consistent with SS	No restriction	Not required, but recommended	Yes	Jurisdiction may have protocols for determining site-specific background concentrations. Concentrations may vary with depth. In some cases, background concentration may be higher than health-based guidelines and may required input from the health authority.
Meets most stringent soil quality guidelines of agricultural or residential land uses.	Agricultural and residential – single family dwellings with yards or gardens	Apply reasonable use concept	Yes	Yes	The receiving site is considered to be sensitive and comes with increased liability if the SS is mischaracterized.
	Residential – apartment or condominium towers	Apply reasonable use concept	Yes	Yes	Less sensitive than a single-family dwelling or agricultural use from liability perspective. Guidelines may change. Tracking would allow problems to be traced.
	Urban parkland	Apply reasonable use concept	Yes	Yes	Operational controls possible to limit liability. Changing guidelines possible. Tracking would allow problems to be traced.

Contaminant concentrations at SS	Soil quality at RS	Restrictions on use	Tracking	QP involvement	Notes
Meets most stringent soil quality guidelines of agricultural or residential land uses (continued).	Commercial and industrial	No restriction	Yes	Yes	Changing guidelines unlikely to result in exceedance of C/I guidelines. Potential risk associated with emerging contaminants of concern.
Meets commercial or industrial guidelines	Commercial and industrial	Apply reasonable use concept	Yes	Yes	Future remediation may be needed if redeveloped to a more sensitive land use. Guidelines may change. Tracking would allow problems to be traced.
Exceeds soil quality guideline	Road construction	Encapsulate within road base, must ensure contaminants will be immobile	Yes	Yes	Road authority must take responsibility to manage the site appropriately if excavation is required. Restrictions may apply on where the material is placed, e.g., avoid wetland crossings.
	Landfill daily or intermediate cover	Must be non-hazardous and meet required landfill waste characteristics	Yes	Optional—as required by jurisdictional waste management regulations	Relatively straightforward to manage provided that the soil meets the landfill permit requirements for cover material.
	Landfill final cover	Must meet soil quality guidelines for final land use	Yes	Optional—as required by jurisdictional waste management regulations	Relatively straightforward to manage provided that the soil meets the landfill permit requirements for cover material.

8.2 Dredge Material Reuse Scenarios

Assuming that project-specific physical and chemical quality requirements are met, the options for beneficial reuse of sediment may include near-shore land creation (shore protection, berm creation, wharves), beach nourishment and wetlands restoration. Other reuse applications may include adding sediment as an organic-rich amendment to low-organic soil to improve plant growth or as cover over highly mineralized areas (e.g., tailings impoundments).

9. CONDITIONS REQUIRING LEACHING TESTS TO BE PERFORMED

For most applications, analyses of the bulk chemistry of soil quality should allow for protective reuse of soils as outlined in the preceding sections. In situations where leaching of inorganic contaminants into groundwater is an issue (e.g., shallow groundwater, particular use of groundwater), leaching tests should be undertaken on a case-by-case basis. When excess soil exceeds its relative maximum allowable criteria (MAC) for different specific contaminants, a QP may review the impact of migrating those contaminants by performing a leachate extraction test on the soil. A number of static and kinetic leachate testing methods are currently in practice to evaluate the rate of contaminant desorption under different physical and chemical conditions. Examples of these methods are summarized in Table 8.

The selection or design of an appropriate leachate testing method should consider the source of the materials, regional and local regulatory requirements and acceptability of reference criteria in the jurisdictions, the nature of the materials and the final placement. The QP may then make a professional judgement based on the presence or absence of COPCs in the leachate produced from the soil and recommend appropriate reuse applications before considering the soil to be waste for disposal at a licensed site. In all cases, the QP must follow the precautionary principle to ensure that soil reuse remains protective of the receiving environment and human users at the RS.

Table 8: Commonly used leaching procedures

Method	Summary
Static testing	
Toxicity Characteristic Leaching Procedure (TCLP) – USEPA Method 1311[a]	The TCLP is designed to determine the mobility of both organic and inorganic analytes present in liquid, solid and multiphasic wastes. The TCLP is designed to simulate material sitting inside a landfill. The liquid, if any, is separated from the solid phase and stored for later analysis. The solid-phase leachate is extracted with an extraction fluid at a ratio of 20:1 (20 parts liquid to one part solid) by weight. The extraction fluid employed is a function of the alkalinity of the solid phase of the waste. If compatible (i.e., multiple phases will not form on combination), both liquids are analyzed together. If incompatible, the liquids are analyzed separately, and the results are mathematically combined to yield a volume-weighted average concentration.
Synthetic Precipitation Leaching Procedure (SPLP) – USEPA Method 1312[a] – ASTM D6234 – 13	The SPLP is designed to determine the mobility of both organic and inorganic analytes present in liquid, soil and waste. The SPLP is designed to simulate material sitting in situ. The liquid phase, if any, is separated from the solid phase and stored for later analysis. The solid-phase leachate is extracted with an extraction fluid at a ratio of 20:1 (20 parts liquid to one part solid) by weight. The extraction fluid employed is a function of where the soil sample site is located. If incompatible, the liquids are analyzed separately, and the results are mathematically combined to yield a volume-weighted average concentration. Ontario has adopted a modified version of the SPLP for use when leachate analysis is required as part of the excess soil quality standards developed for Ontario Regulation 406/19, On-Site and Excess Soil Management.
Meteoric Water Mobility Procedure (MWMP) [b] ASTM E2242 – 13	The MWMP is designed to evaluate the potential for the dissolution and mobility of constituents from a mine rock sample by using meteoric water. The procedure consists of a single-pass column leach over a 24-hour period using a 1:1 solids-water ratio. The extraction fluid Type II reagent grade water (i.e., simulated meteoric water). The leachate is collected for analysis.
Shake flask extraction[c] ASTM D3987 – 12	The shake flask extraction test is designed to determine the mass of soluble constituents in solid materials and is the procedure recommended[c] for higher water-to-solids ratios. The test material is mixed with water at a ratio of 3:1 (three parts liquid to one part solid) by weight. The water-solid ratio may be adjusted on a case-by-case basis. It is recommended to use water that is characteristic of the site, if available; otherwise, the standard procedure is to use deionized water. The sample is gently agitated for 24 hours and allowed to settle for at least three hours. The leachate is extracted for analysis.
United States Geological Survey (USGS) Field Leach Test (FLT)[d]	The USGS FLT is designed to determine the potential for material to release metals and acid when exposed to natural waters. The test material is mixed with deionized water at a ratio of 20:1 (20 parts liquid to one part solid) by weight. The mixture is shaken vigorously for five minutes and allowed to settle for approximately 10 minutes. The leachate is extracted for analysis.
Colorado Division of Minerals and Geology (CDMG) Leach Test[d]	The CDMG leach test is designed to determine the potential for soils to release metals when exposed to natural waters. The test material is mixed with deionized water at a ratio of 2:1 (two parts liquid to one part solid) by weight. The mixture is stirred vigorously for 15 seconds and allowed to settle for approximately 90 minutes. The leachate is extracted for analysis.

Method	Summary
Compliance Test for Granular Waste Materials and Sludges[e] EN 12457	The compliance test is designed to assess leachability under mild extraction conditions for waste disposal or material reuse options. The test has four different procedures depending on the nature of the material and the site. The liquid-solid ratios range between 2:1 and 10:1, with the latter being more commonly applied.
MA.100-Lix.com.1.1[f]	The procedure is designed to evaluate the mobility of both organic and inorganic analytes present in liquid, soil and waste. The procedure uses a combination of other methods, namely the TCLP and SPLP listed above, outlining their appropriate usage in Québec.
Kinetic testing	
Humidity cell testing[c] ASTM D5744 – 13e1	The humidity cell test procedure is designed to predict primary reaction rates under aerobic weathering conditions, providing data on the rates of elemental release, acid generation and acid neutralization for geochemical conditions encountered in the test. Approximately 1 kg of test material is placed in the humidity cell. The test material should be analyzed pre- and post-testing. The humidity cell is subjected to seven-day cycles, with three days of dry air, three days of humid air and flushing with 500 ml of deionized water on the seventh day. The rinse water is allowed to interact with the sample for at least two hours before being drained for analysis. The cycles repeat until the sample is geochemically stable, which often takes 40 weeks but may take more than 60 weeks.
Trickle leach columns[c]	Trickle leach columns are designed to measure the impact of weathering and secondary mineral formation on drainage chemistry. Subaerial leach columns may be used to predict the drainage chemistry from well-drained materials, while subaqueous columns may be used to predict the drainage chemistry from submerged materials. Trickle leach column test procedures are created to be site-specific and should match field conditions as much as possible (e.g., rate of precipitation, pH of leachate). Test materials placed in the column should be analyzed pre- and post-testing.

* It is recommended that all chemical analyses be undertaken by a laboratory certified with an internationally recognized accreditation body (e.g., Standards Council of Canada (SCC) or Canadian Association for Laboratory Accreditation (CALA)) and in accordance with the International Standard ISO/IEC 17025 General Requirements for the Competence of Testing and Calibration Laboratories.

Table notes:

[a] United States Environmental Protection Agency (USEPA). 2015. Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, EPA publication SW-846, Third Edition, Final Updates I (1993), II (1995), IIA (1994), IIB (1995), III (1997), IIIA (1999), IIIB (2005), IV (2008) and V (2015).

[b] ASTM. (2013). Standard Test Method for Column Percolation Extraction of Mine Rock by the Meteoric Water Mobility Procedure. ASTM Int.

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10. CONSIDERATIONS RELATED TO SITE LIABILITY

Risk management plays, and will continue to play, a significant ongoing role in the development and adoption of any excess soil policy. We anticipate that in the absence of clear legislative or regulatory guidance for source and receiving sites, the following common concerns will limit the adoption of an excess soil reuse approach and the availability of RSs:

- Poor SS characterization may result in unevaluated contaminants of concern or biased results. The representativeness of verification samples must be considered. For example, sampling method bias can occur when soil samples are collected from below a smear zone at a light non-aqueous phase liquid (LNAPL) site. Conversely, only shallow soils may be collected at a dense non-aqueous phase liquid (DNAPL) site. Poorly characterized soils may lead to increased liability at the SS or the RS.
- Potential daughter (breakdown) products associated with imported soil fill may arise. For example, even if soil meets the guidelines at a given point in time, daughter product exceedances may occur as a result of changes in physical chemistry, bio-transformation or interactions with other compounds (e.g., oxidants or reductants) after the soil is relocated. This may impose a liability on the SS or RS and limit future site use at the RS.
- Regulatory guidelines may change. For instance, if the current guideline is 150 μg/kg and soil meets the guideline with an upper range concentration of 140 μg/kg, a contaminated site may result if the guideline changes to a lower maximum concentration. This would create a liability for the RS and may limit future site use.
- Soil arriving at an RS may be poorly controlled. Some materials, such as quarry- or pit-derived materials, can be traced with a bill of lading and the material is traditionally relatively consistent, which allows for relatively simple visual confirmation that the material is from the expected source. In circumstances where soil is being received from excess soil sites, the material may be non-homogeneous, creating challenges when it comes to meeting chemical and physical specifications. There are also concerns with traceability (i.e., receipt of unwelcome loads from unknown sites) and accountability (i.e., that SS characterization was properly completed, and the SS chemistry provided is representative of all the soil being delivered). This can be addressed with proper operational controls; however, the additional cost of managing such a process may limit the adoption of an excess soils approach.
- Emerging contaminants of concern for which there are no generic guidelines present a risk that a site might be later designated contaminated as guidelines evolve. Emerging contaminants of concern are a particular issue at sites with anthropogenic activities that result in a discharge to the environment (e.g., per- and polyfluoroalkyl substances substances (PFAS) associated with fire-fighting foam). It is not possible to predict all potential future contaminants or concentrations of concern; therefore, the RS bears some risk of future liability as a direct result of the potential future contaminants of concern. A QP or an SS may also assume some liability and may be hesitant to assume this risk if a contaminant is measurable but there is not yet an accepted guideline. A QP may use judgement to balance the benefits of an excess soil application and landfilling. One risk mitigation strategy might be to prioritize SS reuse of the highest-risk soils or to identify RSs with activities that generate similar contaminants of concern.

11. CONCLUSION

The objective of this guidance is to cover the many aspects for jurisdictions to consider in the implementation of an excess soil policy or guidance. It highlights that excess soil reuse should not be a "pollute up to" permission, and that it has to be done without endangering human health, harming the environment or removing any permitted land use on a given site. The quality of the site receiving the excess soil should not be negatively affected. Applying the principles of this guidance will help ensure that excess soil reuse will not cause problems and will be done in a beneficial way. From a sustainable development perspective, excess soil reuse can be very beneficial when soil is used as a substitute for material that would otherwise be imported to the site from a pit or quarry for such purposes as berming, infilling, or geotechnical material uses.

Excess soil reuse projects should include both an SMP and an FMP, produced at the SS and the RS respectively. These plans, completed under the supervision of a QP, will ensure that the excess soil is reused in a proper way, given its level of contamination, the contamination level of the soil at the RS, the permitted land uses at the RS and the proposed use of these soils. Soil traceability and site liability are also very important aspects to consider in order to ensure that the soil is sent to the proper site for the proper use, that the excess soil is carefully handled, and that the RS owner is fully aware of both the conditions under which the soil should be reused and of its responsibilities related to excess soil reuse.

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APPENDIX A: ALTERNATE FAILURE POLICY APPROACHES

Possible Types of Failure Policies

Based on a single parameter:

- Any single parameter exceeding the guideline results in the failure of the batch or volume of soil in question.
- Any single parameter exceeding the guideline results in the failure of the volume of soil represented by that sample up to the next sample point that passes.
- A statistical representation of the material volume exceeding the guideline results in failure of the volume of soil in question. Examples of statistical representations are:
    - Mean or average
    - An upper confidence level of the mean
    - An upper percentile value, whether non-parametric or parametric. For instance, the 95th percentile of site distribution must be lower than guideline or mean plus two (or three) guideline deviations must be lower than guideline.

Based on multiple parameters:

- Use of any of the above with additional leniency added for every additional parameter reported:
    - When one parameter is measured, all samples must meet the guideline.
    - When two are measured, one sample can fail one parameter for every 10 samples taken, but by no more than 10%.
    - When three are measured, there can be two failures of parameters, one by no more than 20% and one by no more than 10%.
- Same as above but with additional limits on leniency (e.g., no sample can fail a guideline focused on human health effects).

A brief discussion of the pros and cons of example failure policies is provided in Table A.

Table A: Pros and cons of failure policy scenarios

Policy	Pros	Cons
Based on single parameter only	Reasonably simple and easy to administer.	Can be more stringent than anticipated if there are multiple chemicals measured. For background-based numbers, failure rate increases along with the number of parameters measured.
Single number fails batch	Very protective.	Too stringent where actual exposure is an average over an area.
Mean	More representative than a single number failing a batch where exposures are an average of the area in question.	Not suitable for the protection of sessile organisms or where exposure is not well represented by a mean value. Does not account for errors of mean estimate.
Upper confidence limit of mean (UCLM)	Same benefit as mean, but accounts for error of estimate of mean. Available on spreadsheets (Excel, LibreOffice).	Same as mean, but more complicated to calculate.
Upper percentile	Appropriate where exposure is not averaged over the area of sampling (e.g., for sessile organisms). Reasonably simple and available on spreadsheets (Excel, LibreOffice).	Stringent where exposure is averaged over the area of sampling.
Based on multiple parameters	Can maintain roughly the same failure rate with an increasing number of parameters. Good for background-based numbers.	More complicated to determine. May be difficult to incorporate into regulations and to enforce.
Based on a single parameter with additional leniency per parameter added	Can keep overall failure rate in line with background.	May not be sufficiently protective if numbers are based on meaningful adverse effects levels.
Based on a single parameter with limits on leniency	Can be designed to protect for all meaningful adverse effects.	May not keep failure rate at the desired level where background levels are the drivers of the numbers.

Discussion

Ideally, a failure policy would vary with the type of guideline against which the sampling results are being compared.

Where guidelines are background-based, use an upper percentile and account for multiple parameters being measured by allowing a limited number of results to be slightly above the guideline when there is more than one parameter measured. The degree of leniency should be designed to keep the failure rate at the desired level in comparison to the background sampling regardless of the number of parameters measured.

Where guidelines are effects-based (e.g., based on generic or site-specific soil quality guidelines) and not driven by background, use a single-parameter approach that is appropriate for the exposure scenario of the receptor driving the guideline. That is, for sessile receptors, use a maximum measured value, or at least an upper percentile, and for mobile receptors where exposure will be an average exposure over the area of concern, use a UCLM or similar statistic. However, this may be highly impractical, as there could be different approaches used for different contaminants at the same site and would therefore be extremely difficult to track and to enforce. As a result, a practical compromise specific to the requirements and principles of the policy will likely be needed.