Environmental Site Assessment, Remediation and Management Guideline

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Notice: The Professional Standards Committee has a policy of reviewing guidelines every five years to determine if the guideline is still viable and adequate. However, practice bulletins may be issued from time to time to clarify statements made herein or to add information useful to those engineers engaged in this area of practice. Users of this guideline who have questions, comments or suggestions for future amendments and revisions are invited to submit these to PEO using the standard form included in the following online document: http://peo.on.ca/index.php/ci_id/23427/la_id/1.htm

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1. INTRODUCTION

1.1 Purpose

This document is a guideline for Ontario professional engineers providing environmental site assessment (ESA), site remediation, and environmental risk assessment and management services. Its purpose is to highlight the professional and ethical responsibilities and to provide a benchmark to evaluate the level of professional practice and quality of work required of a professional engineer practicing in this field.

The guideline recognizes the multidisciplinary nature of such work, and that other professionals may be involved to provide complementary skills and knowledge as required for certain sites and/or stages in the remediation work.

This guideline is intended to assist engineers but does not replace existing legislation, regulations, policies or other guidelines, nor does it obviate the need for required appropriate education, training and experience.

For more information on the purpose of practice guidelines, the guideline development and maintenance processes, including the Professional Engineers Ontario (PEO) standard form for proposing revisions to guidelines, please read our document:

http://peo.on.ca/index.php/ci_id/23427/la_id/1.htm

To view a list of the PEO guidelines, please visit the Publications section of the PEO website:

http://peo.on.ca/index.php/ci_id/1834/la_id/1.htm

1.2 Responsibilities

1.2.1 Engineers

Engineers involved in ESAs and remediation should be familiar with federal, provincial and municipal legislation, regulations, policies and guidelines that apply to their projects, sites, contaminants of concern, and to their particular area of practice.

Permitting processes, approval requirements and compliance issues will vary, depending on the site location and proposed work plan. It is advisable that the engineer leading a project interact with the applicable regulator(s)/stakeholder(s) early in the planning stages and throughout the project to ensure that the method and interpretation of the regulator's policy, guidelines, and acts are consistent and clear to all parties. Differences or concerns raised by the regulator should be clarified.

Beyond these responsibilities, engineers are also required to conduct themselves in a manner consistent with the *Professional Engineers Act* including, among other things, the duty to protect the public and the duty to conduct their work to the appropriate standard of care.

Where a multi-disciplinary team structure or oversight of others is required on a project, the engineer's responsibilities will vary depending on their role. For example:

- Engineers who are undertaking a specific portion of the work that contributes to part of an overall project should ensure they understand their role on the project, that they are

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competent and qualified to undertake the work, and that they sign-off on their completed work;
- Engineers overseeing the work of others, who may or may not be members of a professional organization, and who will ultimately sign off on the final report(s), should provide overall guidance and review of the results of others' work.

For more information, refer to the PEO "*Supervising and Assuming Responsibility for Engineering Work*" guideline and "*Use of the Professional Engineer's Seal*" guideline.

1.2.2 The Client and/or Property Owner

To achieve the desired goal and implement a reliable ESA, remediation, and/or risk assessment, the engineer should consider undertaking the following activities, as a minimum, with the client/property owner:

- Define the objectives, scope of work and deliverables with the client/property owner;
- Clarify the roles and responsibilities of the various professionals and contractors that the client/property owner has retained and are involved with the project;
- Ensure that a signed written agreement with the client/property owner is in place prior to commencing work. The agreement should be prepared in consultation with legal counsel. The agreement should outline the scope of work, the compensation, terms and conditions, insurance requirements, schedule for the services, and any other details on the project that were agreed upon or that of which the client/property owner should be made aware;
- Ensure that the client/property owner provides all relevant documentation in their possession that would benefit the undertaking of the ESA or risk assessment/remediation such as, utility maps, previous ESA reports, and historical uses of the site, including where applicable, providing letters of reliance as detailed in Section 1.8;
- Require that the client/property owner grants unimpeded access to the project site or document the site access limitations; and
- Maintain communication with the client/property owner on the progress of the project and deviations or changes to the project. Changes to the scope of work or the terms of the written agreement should be documented and signed off by both parties to avoid conflicts or misunderstandings.

1.3 Sealing Requirements

Use of the seal is governed by section 53, O. Reg. 941, which requires every engineer to seal documents prepared by them, that are within the practice of professional engineering, and that are issued to the public as part of the professional engineering service.

Engineers should determine what should be sealed based on policies and procedures that are outlined in the "*Use of the Professional Engineer's Seal*" guideline.

1.4 Qualifications

An engineer shall possess a combination of formal education, skill, experience and training appropriate to provide technically sound:

- Phased ESAs;

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- Remedial options analysis;
- Site remediation design;
- Risk assessment; and/or
- Environmental risk management design.

A qualified engineer practicing in this field should also be knowledgeable of the federal, provincial, and municipal government legislation, regulations and guidelines, and approval-specific requirements that apply to site investigations and/or remediation. Applicable codes, by-laws, statutes, and rules in connection with work being undertaken should be followed and engineers should also ensure that their skills are consistent with industry standards. For more information on some of the applicable regulations, guidelines and industry standards, refer to Appendix 2.

To comply with their professional obligations, engineers should only perform or take responsibility for work in which they are certain they are competent. Section 72(2)(h) of *Regulation 941/90* states: "*Professional misconduct means undertaking work the practitioner is not competent to perform by virtue of the practitioner's training and experience".*

In addition to the above, Engineers should:

- Be aware of the role and contributions of engineering, geoscience, and other disciplines required to assess and remediate a site;
- Be able to identify when additional specialized knowledge not already included in the project team is required; and
- Recognize the value of team skills including project management, shared goals, team make-up, team operations, shared knowledge of accountability, and limitations of other team members.

Finally, engineers practicing in Ontario should be aware that a Phased ESA completed to support the filing of a Record of Site Condition (RSC) shall be conducted or supervised by a "Qualified Person" (QP), as defined under Ontario Regulation (O. Reg.)153/04. An engineer can be a QP if they hold a licence, limited licence or temporary licence under the *Professional Engineers Act*.

1.5 Conflict of Interest

O. Reg. 941/90 made under the *Professional Engineers Act* describes the circumstances that create a conflict of interest. Section 72(2)(i) states that "*failure to make prompt, voluntary and complete disclosure of an interest, direct or indirect, that might in any way be, or be construed as, prejudicial to the professional judgment of the practitioner in rendering service to the public, to an employer or to a client*" shall constitute professional misconduct. To know when disclosure is appropriate, a clear understanding of what causes a conflict of interest is needed.

The simplest and most effective way to deal with potential conflicts of interest is to be forthright and communicate with the appropriate parties about any circumstances that could reasonable lead those parties to question the engineer's judgment.

For more information on the "Conflict of interest" refer to the "*Professional Engineering Practice"* guideline.

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1.6 Duty to Report

The duty to report is an essential component of an engineer's commitment to professionalism. Each engineer "*shall regard the practitioner's duty to protect the public welfare as paramount*" (section 77(2).i, O. Reg. 941/90). For more information on the "Engineer's Duty to Report" please refer to the "*Professional Engineering Practice*" guideline.

1.7 Professional Liability Insurance and Certificate of Authorization

Engineers who offer services to the public or engage in the business of providing services to the public within the practice of professional engineering shall hold a Certificate of Authorization and carry liability insurance in accordance with the provisions in section 74(1) of Regulation 941/90 and other applicable Acts and Regulations.

1.8 Reliance

It is common when undertaking Phased ESAs, risk assessments, and/or remediation work to rely on reports and data prepared by others for consideration and incorporation into one's own project. As well, for a variety of purposes, the final report(s) prepared for the client/property owner may also be used and distributed to other third parties who may seek reliance on the use of the report(s). As such, engineers should consider the following under each circumstance.

1.8.1 Extending Reliance to Others

In situations where an engineer has prepared a report and an individual or company other than the client/property owner is seeking or requesting reliance on the use of that report, the following should be considered:

- Engineers are not obliged to provide reliance letters. Engineers should use their professional judgement to decide whether to provide a reliance letter. The decision factors may include but are not limited to, conflict of interest, business relationships with the client/property owner and recipient, the age of the report and the potential that conditions on the site may have changed in the intervening time, and legal considerations;
- The engineer should ensure the client/property owner who commissioned the scope of work is made aware of the request and has provided their approval to extend reliance on the report to a third party;
- The engineer should ensure all parties are in agreement with the terms, conditions, and limitations provided by the reliance letter and original report including the purpose for which the parties intend to use the report; and
- The engineer should ensure a written reliance letter that accounts for the bulleted items described above is prepared and signed by all parties involved. It is recommended that the engineer seek the advice of legal counsel to assist with preparing a reliance letter.

1.8.2 Relying on third party documents or information (with and/or without reliance)

The engineer should carefully review data and results from a third party to satisfy themselves that they are relevant and consistent with professional industry and regulatory standards, and that no systematic or intentional bias exists with the data. If possible, the engineer should request a reliance letter from the original author for the use of the documents or information.

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2. PHASE I ENVIRONMENTAL SITE ASSESSMENTS

In general, a Phase I ESA identifies potential contaminating activities and areas of potential environmental concern on a property through desktop study review of background documents and maps, interviews, and site reconnaissance.

In Ontario, the Phase I ESA process generally falls into one of two categories:

1. Phase I ESAs completed for due-diligence purposes; and
2. Phase One ESAs completed to support the filing of a Ministry of the Environment, Conservation and Parks (MECP) RSC under O. Reg. 153/04.

For the purposes of this document, the term "Phase I ESA" will be used to describe both Phase I ESA and Phase One ESA.

2.1 Objective

The objectives of a Phase I ESA are to determine:

- If the property is subject to actual contamination or potential sources of contamination;
- If there are potential off-site sources of contamination to the property;
- The locations on the property where contaminants are potentially present; and
- If additional assessment, such as a Phase II ESA is recommended or required; and
- Under O. Reg.153/04, the specific objectives of:
  - Identifying Potentially Contaminating Activities (PCAs) (as defined under O. Reg.153/04) on the property or off-site within the defined study area; and
  - Identifying Areas of Potential Environmental Concern (APECs) on the property as a result of the PCAs.

A Phase I ESA may be completed to:

- Establish the basis for further investigative work;
- Identify potential environmental risks or environmental liabilities;
- Assist in meeting regulatory, legislative or policy requirements;
- Assist in making informed decisions about property transactions or financing;
- Assist in identifying baseline conditions;
- Support legal action or defense;
- Serve as an initial step in the preparation of a site remediation;
- Support the completion of a risk assessment; and/or
- Support the filing of a RSC.

Engineers should ensure that the type of report that is being prepared will meet the overall project or study objectives which should be determined at the beginning of the ESA process.

2.2 Study Considerations

The specific requirements, methods, and practices for a Phase I ESA are more fully described in Canadian Standards Association (CSA) Standard Z768-01. The mandatory requirements for a Phase I ESA to support the filing of an RSC are outlined in Part VII of O. Reg.153/04.

The scope of work for a Phase I ESA should consider the following:

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- A project study area is defined for the collection of off-site information;
- Access agreement or permits are in place;
- Reasonably attainable information is collected for the project site and properties within the scope of the project study;
- Reasonable steps are taken to obtain interviews with persons knowledgeable about the project site; and
- Site reconnaissance is conducted by an individual with the appropriate level of knowledge, skill and experience.

Sufficient information should be obtained, evaluated, and presented to support the engineer's conclusions. Engineers are required to use sound judgment and avoid speculation when identifying on-site and off-site environmental concerns and consider the relative degree of uncertainty associated with historical information, data gaps and conflicting information.
For example, be cautious in eliminating off-site environmental concerns based solely on an assumed groundwater flow direction, subsurface stratigraphy, aquitards, etc.

3. PHASE II ENVIRONMENTAL SITE ASSESSMENTS

In general, a Phase II ESA involves intrusive investigations (e.g., boreholes/monitoring wells, test pits) and assessment through sampling, monitoring, and chemical analysis of applicable media (i.e., soil, groundwater, sediment, and/or vapours) on areas of the property identified in the Phase I ESA where contaminants are potentially present.

In Ontario, the Phase II ESA process generally falls into one of two categories:

1. Phase II ESAs completed for due-diligence purposes; and
2. Phase Two ESAs completed to support the filing of a MECP RSC under O. Reg. 153/04.

For the purposes of this document, the term "Phase II ESA" will be used to describe both Phase II ESA and Phase Two ESA.

3.1 Objective

The objectives of a Phase II ESA are:

- To determine the location and concentration of contaminants in the land and/or water on, in, or under a specific property;
- To determine if applicable standards[1] for contaminants on, in or under the property have been met;
- To collect data to inform other decisions such as data supporting the evaluation and design of remediation programs and supporting the development and/or completion of a risk assessment; and
- Under O. Reg.153/04, the specific objectives of:
    - Investigating APECs on the property identified in the Phase I ESA as a result of the on-site and/or off-site PCAs; and
    - Confirming that the concentration of identified contaminants in the land and/or water on, in or under a specific property, meet the applicable site condition standards or property specific standards.

[1] In this document, the term "standards" is used to represent regulatory guideline values, criteria and standards.

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A Phase II ESA may be completed to:

- Confirm potential environmental risks or environmental liabilities;
- Assist in meeting regulatory, legislative or policy requirements;
- Assist in making informed decisions about property transactions or financing;
- Assist in identifying baseline conditions;
- Support legal action or defense;
- Assist in site remediation plan preparation;
- Support the completion of a risk assessment; and/or
- Support the filing of a RSC.

Engineers should ensure that the type of report that is being prepared will meet the overall project or study objectives which should be determined at the beginning of the ESA process.

It is the engineer's responsibility to plan and execute a detailed intrusive site investigation and to prepare a report that includes the review and evaluation of information gathered during the site investigation. The site investigation should identify, characterize, and/or delineate the nature and extent of contamination on, in or under the property.

3.2 Study Considerations

The principal components of a Phase II ESA include:

- Developing investigation and sampling work plans based on APECs (as identified by the owner, client, and/or previous ESAs conducted for the site);
- Retaining licensed and/or qualified contractors such as utility locators, daylighting, drillers, and excavators to conduct intrusive investigations as required;
- Undertaking investigations and inspections when they can be done safely (e.g. utility locate, overhead clearance, traffic control, etc.);
- Recovering soil, groundwater, surface water, sediment, and/or soil vapour samples to characterize property conditions, including consideration for quality assurance/quality control (QA/QC) of data;
- Retaining an appropriately accredited analytical laboratory to conduct laboratory analysis of samples collected;
- Obtaining access agreement or permits; and
- Interpreting and reporting sampling results to the client/property owner of the property.

The specific requirements, methods, and practices for a Phase II ESA are more fully described in CSA Z769-00. The mandatory requirements for a Phase II ESA to support the filing of an RSC are outlined in Part VIII of O. Reg.153/04.

A Phase II ESA should be as detailed as necessary for the purpose of the study. It should be guided by such information as:

- The types of activities, processes and practices that have occurred on the site and on neighbouring sites that have resulted in APECs for the property;
- Legislation and published guidelines that apply to the property;

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- The amount and quality of pre-existing information on the site's potential contamination;
- Such site-specific conditions as soil type, soil vapour, depth to groundwater, direction and rate of groundwater flow, groundwater quality, surface water quality, sediment quality and depth to bedrock;
- The type and quantity of information required to design an appropriate remediation and/or risk management program; and
- The potential presence of designated substances, solid, liquid or hazardous wastes, raw materials, products and other dangerous goods.

3.2.1 Inherent Limitations

The client/property owner and other stakeholders should be apprised of the limitations of the Phase II ESA which may include:

- Uncertainty of subsurface conditions between sampling points;
- Inadequate background information;
- Errors by third parties;
- Limitations of use of the report in its entirety by the client/property owner;
- Limitations of third party reliance on the report;
- Unknown off-site environmental concerns;
- Detection/Delineation limited by budget, access and/or time;
- The site's nature and constraints at the time of the investigation; and
- Other considerations such as environmentally sensitive areas, access control, safety concerns, and operational limitations.

3.3 Phase II ESA Practices

When preparing, undertaking and completing a Phase II ESA, the engineer should consider the following subsections to ensure the investigation meets the desired objectives.

3.3.1 Investigation and Sampling Work Plan

The engineer should develop a work plan detailing the investigation, sampling and handling procedures, monitoring, and applicable health and safety considerations to be conducted during a Phase II ESA.

Specifically, the work plan should:

- Identify and incorporate site limitations;
- Be designed to avoid adverse impact on the environment, including creating preferential pathways for contaminants to migrate. In particular, special consideration should be given to well-head protection areas or other designations identified by a regulatory authority for the protection of groundwater and/or source water protection areas;
- Clearly state the objectives of the investigation or sampling effort;
- Identify the number of samples to be collected and analyzed;
- Identify the location of each sample or measurement on a site map in relations to fixed geographical site features and/or use of global positioning system coordinates;
- Include anticipated site conditions such as soil, groundwater, surface water, sediment and/or soil vapour conditions) based on background review;

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- Include specific sampling or measuring methods, the number of samples or measurements to be taken, the parameters being sampled or measured, a description of the objectives for each sampling or measuring activity, and details of the methods to be used for sample or measurement collection, preservation, transportation and analysis; and
- Incorporate considerations for a field and laboratory QA/QC program.

The sampling methods used will be influenced by the types and concentrations of contaminants encountered or suspected to be present, and by the environmental media to be sampled. Specific methods can range from non-intrusive field screening to more complex, intrusive media sampling.

Since the nature and extent of potential contamination may not be identified from file review and site observation, field screening techniques may provide an indication of the presence or absence of contaminants. The objective of field screening is not to quantify the magnitude and define the extent of contamination precisely, but rather to provide data in sufficient amount and quality to determine whether contamination is present and to guide the implementation of intrusive sampling methods and the submission of samples for analysis.

Engineers require sound judgment to determine the types and numbers of samples and measurements to be taken during a Phase II ESA. Established regulatory requirements and published guidelines should be referenced where possible/applicable to assist in this determination.

3.3.2 Undertaking Site Investigations

The Occupational Health and Safety Act requires all site work be conducted with appropriate regard for the health and safety of the individuals and workers at the site and the public in the vicinity. It is best practice to prepare and implement a site specific health & safety plan.

Environmentally sensitive features should be identified and appropriately addressed before any physical work is undertaken with due consideration for applicable regulatory requirements.

The site investigation should be documented using appropriate methods, including but not limited to, field logbooks or forms (hardcopy or electronic), photographs, and/or videos. Logbooks, forms and records can be in hardcopy or electronic format. Electronic documents should have secure back-up copies.

During a site investigation, conditions may be discovered that require deviations from the sampling plan. The deviation and its rationale should be documented. Discussions with the client/property owner and regulatory agencies may be necessary to decide how to respond to deviations.

Proper collection, transportation and analysis of samples in a manner consistent with the investigation's requirements and applicable regulations, standards and guidelines is ultimately the engineer's responsibility.

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3.3.3 Interpretation and Reporting of Sampling Results

The engineer should evaluate the information obtained during site investigation and present it in a manner designed to help the client/property owner understand its significance. To do this, the engineer should:

- Compare analytical data with the applicable standards;
- Summarize data and describe general trends or patterns;
- Use maps and site cross sections to show spatial patterns of contamination;
- Draw attention to data that indicate conditions of concern;
- Point out possible inconsistencies or anomalies in the data;
- Indicate the relative degree of uncertainty associated with evidence of contamination, and/or if the data are statistically reliable; and
- Identify any limiting conditions that arose during the investigation.

If the client/property owner specifies, the engineer may also:

- Identify any further investigation, sampling, or inspection required to delineate the extent of contamination or to develop a proper remedial action plan; and
- Provide a preliminary scope of work and cost estimate for possible remedial activities.

The engineer or the individuals in charge of the team that performs the Phase II ESA should provide signatures confirming the performance of the study, its findings and conclusions. They should declare in the report any conflict of interest. A statement of the qualifications of the engineer responsible for the Phase II ESA should be included, as well as representations and warranties.

4. OTHER SPECIFIC OR LIMITED-SCOPE INVESTIGATION

For due diligence purposes, a limited or specific-scope environmental investigation may be sufficient to meet a project or client/property owner's objectives. A limited scope investigation is often conducted to evaluate a specific potential environmental concern or to evaluate one or more concerns identified by a Phase I ESA that are considered to have a higher potential to result in site contamination. Limited or specific-scope investigations are typically completed when regulatory oversight or the completion of a CSA Phase I ESA or Phase II ESA is not required to make the appropriate conclusions to meet project objectives.

Examples of limited or specific-scope environmental investigations include:

- Historical document review (in lieu of a Phase I ESA);
- Client/property owner designed pre-screening study or form (in lieu of a Phase I ESA);
- Contaminant overview study;
- Limited scope Phase II ESA involving the investigation of a specific medium, stratigraphy, or location (e.g., sediment, imported fill, impacts underneath a building foundation, etc.);
- Environmental baseline study;
- Excess soil management investigation;
- Groundwater sampling/monitoring report;
- Soil stock pile sampling;
- Spill response sampling; and
- Underground storage tank investigation.

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A limited or specific-scope subsurface investigation should be conducted following similar principles as a Phase I ESA and/or Phase II ESA but may have a less structured reporting requirement. The use of Phase I ESA and/or Phase II ESA principles such as sampling program design will provide the engineer with industry accepted methods and standards for quality when completing other types of environmental investigations.

5. SITE REMEDIATION

This section provides general overview of roles and responsibilities of engineers designing, planning, and/or conducting site remediations. For additional resources, refer to *Engineers Canada National Guideline on Site Remediation for Professional Engineers* (March 2018).

5.1 Site Assessment Information

The results of the Phase II ESA or limited scope investigation outlined in Sections 3 and 4, respectively, should be sufficient enough so as to provide a representative description of the media/materials requiring remediation or management, by defining the contamination's nature, and preliminary quantity, area, vertical distribution and location. However, additional investigations may be necessary to develop a fuller understanding of the contaminant's three-dimensional distribution to support the evaluation and design of remediation options.

5.2 Objectives

The objective of remediation is most often to return an impacted property/site to an environmental condition that will sustain its intended reuse. Alternatively, the objective can be to secure the site in a manner that mitigates or prevents future on-site or off-site adverse impacts.

5.3 Clean-up Targets

Generally, there are three approaches that can be used to determine the clean-up level to be achieved during site remediation. These three options, as described by MECP, are:

1. Clean-up to background condition standards;
2. Clean-up to generic standards; or
3. Clean-up to site-specific standards developed using risk assessment techniques.

In principle, clean-up to background can be used for any site. It is essentially a remedial strategy that restores the property to an environmental condition consistent with the ambient or background conditions. Background conditions can be defined by standards, surveys, studies, or through the completion of a site-specific study.

Clean-up standards have been developed by several government agencies to assist in establishing criteria that are protective of human health and/or the environment. Generic standards are most commonly developed for such media as soil, groundwater, surface water, air and sediment. "Generic" standards have been developed for a range of applications, including different land uses, land-use sensitivity, depth of contamination, and surface water or groundwater use. The engineer should be aware of the limitations of generic standards, including the assumptions made in their development, and advise the client/property owner of the relative merits of this approach to site remediation.

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A site management or remedial approach based on risk assessment may be used to develop site remediation or site management targets for a particular site, based on conditions at that site. For further information on the risk assessment approach, refer to Section 6 of this guideline.

The selection of clean up targets will depend on a number of factors, including:

- Whether the clean-up is voluntary or compliance-driven;
- Whether filing a RSC is an objective or a requirement; and
- The nature of contamination and feasibility of various remedial alternatives (refer to Section 5.4).

The decision process and logic used to select clean-up targets should be noted as part of the documentation on site clean-up and remediation and form part of a remedial action plan.

5.4 Identification and Evaluation of Remedial Alternatives

Once remediation objectives and targets are established, the next step is to identify and select site remediation alternatives for detailed review and consideration.

Remediation alternatives may involve one or more of the following activities:

- Excavation and offsite removal (e.g., landfill disposal, relocation to alternative suitable receiving site);
- Elimination or destruction of contaminants through in-situ or ex-situ methods;
- Prevention of exposure to contaminants through engineering or institutional controls.

On sites requiring immediate action due to unacceptable risks such as active spills, a comprehensive remedial alternatives identification and evaluation process may not be prudent. In these situations, where time is of the essence, the timely selection of a known and proven option, approach or technology may be the appropriate next step for implementation. Where there is only one method that is feasible or obvious due to a remote location, or unique site condition, the engineer may proceed directly to the preparation of a remedial action plan.

In the remaining situations, remediation alternatives capable of achieving the remediation goals are selected for evaluation and are evaluated using technical and economic analyses. A preferred alternative is selected by weighing the advantages and disadvantages of the various alternatives, the trade-offs among alternatives, and the relative risk the client/property owner is willing to accept. This often involves striking a balance between a number of factors, including but not limited to:

- Implementation time and time required to reach remediation objectives;
- Capital costs, long-term operating and maintenance costs, and available budgets;
- Regulatory approval requirements and likelihood of obtaining approvals;
- Accessibility limitations and presence of infrastructure;
- Potential for impacts to off-site receptors;
- Public safety;
- Sustainability;
- Stakeholder consultation, and
- Client/property owner and regulatory risk tolerance.

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Alternatives may need to be refined based on the results of further site characterization or pilot study and should provide decision makers with the necessary information to select a preferred alternative.

Bench-scale and pilot-scale testing of remediation technologies may be prudent but not necessary in the evaluation of remediation options. The value of conducting these studies and pilot tests should be weighed against the available budget and time required. If significant cost savings can be achieved, or if uncertainties can be reduced to tolerable levels, then treatability studies and/or pilot studies would be warranted.

5.5 Remedial Action Plans

Once a preferred remediation method is selected, a remedial action plan (RAP) should be prepared which:

- Provides a description of the project to the preliminary design stage;
- Defines the desired outcomes and appropriate remediation requirements and targets;
- Describes the plans and defines the sequence of activities for implementing the selected remediation alternative that responds to stakeholder concerns;
- Identifies approaches to mitigate the off-site effects of the remediation program; and
- Establishes monitoring and confirmatory requirements.

The RAP also serves as the basis for discussing implementation of the remediation work with the client/property owner, government regulatory authorities, and/or other stakeholders such as adjacent property owners, community groups, and indigenous groups.

The RAP normally includes the following elements:

- Description of objectives and remediation targets, including any specific clean-up standard to be achieved;
- Description of the stakeholder concerns;
- Overview of the site contamination and site conditions affecting remediation, including soil and stratigraphy, soil vapour, surface water, groundwater, and aquifers;
- Description of the media/materials to be remediated;
- Description of the management of excess soils, sediment and groundwater such as movement, disposal, and quantities during remediation from source site to receiving sites in compliance with local guidelines and regulations;
- Description and review of options that appear to be best suited to remediate specific conditions;
- Description of the remediation strategy and the sequence of activities for remediation, including specific reference to each area to be remediated in terms of lateral and vertical extents, overall surface area, and overall volume, as well as volumes to be remediated with respect to each class of contamination typically based on soil or sediment standards;
- Requirements for a site-specific health and safety plan;
- Description of risk management plans;
- Description of the issue resolution process with third party stakeholders;
- Descriptions of types of pilot-scale tests to confirm the viability of specific options, including treatment equipment, if any;

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- Description of government regulatory approval requirements;
- Description of the public communications plan;
- Descriptions of mobilization and site preparation;
- Description of methods to manage accumulated water, dust, noise, odour, and traffic;
- Descriptions of the management of by-products;
- Requirements for on and off-site air quality/emission monitoring;
- Descriptions of contingency plans;
- Identification of the fate of residual contaminants;
- Descriptions of remediation verification and long-term monitoring plans;
- Site restoration and closure process including reporting and documentation requirements; and
- Closure and sign-off.

In cases where risk assessment becomes part of the remedial approach for a site, the description of risk management plans may be included in the RAP. For further details on risk assessment and risk management measures, refer to Section 6.

In addition to the above, depending on project needs and complexity, detailed construction/remediation specifications and drawings are typically developed at this stage for implementing the project and potentially for government regulatory approvals. The plan may include applying for permits and approvals for decommissioning or demolition of building structures and/or equipment in addition to the remediation of solid, liquid, or gaseous matrices.

The importance of contingency planning for site remediation cannot be overemphasized. There are many occasions where additional information not previously identified or obtained during the site assessment process is discovered during a site remediation activity, especially where excavation is part of the remedial activity. Contingency items may be needed to address:

- Site characterization uncertainties including vertical and lateral delineation or previously unknown contaminants;
- The potential for unknown infrastructure, such as underground storage tanks; and
- The potential for off-site impacts.

The engineer should ensure that the client/property owner is aware that contingent measures may be necessary to complete the remedial objective if unknown conditions are encountered. Reference to other potential contingencies in the plan may be useful in alleviating project delays or disputes (e.g., unexpected water inflows, previously unidentified or abandoned utilities, additional underground storage tanks, etc.).

In association with the RAP, the engineer should also compile the following information at this stage of a project:

- Key contact information;
- Construction schedule estimates;
- Estimated cost to initiate and complete remediation; and
- Recommendations for contingency allowances.

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This information may be confidential for the client/property owner and does not necessarily need to be included in the RAP, which is frequently shared with the public agencies and third-party stakeholder groups.

5.6 Implementation of Remedial Action Plan

The successful implementation of the RAP should consider addressing both technical and project management functions.

5.6.1 Notifications, Permits, and Approvals

Regulatory requirements shall be considered during implementation of the RAP. The engineer should allow adequate time to obtain required permits in the schedule for the RAP.
Due to the dynamic nature of site remediation, requirements for notifications, permits, and/or approvals may deviate from the details provided in the RAP. The engineer overseeing RAP implementation shall be knowledgeable of regulatory requirements so that any such deviations may be addressed. As a best practice, engineers should retain copies of any notifications, permits, and/or approvals completed by the contractor.

5.6.2 Preparation of Specifications and Tender Documents, Contractor Selection

A wide range of strategies for contractor selection are available for remediation projects. The engineer should be knowledgeable of applicable procurement standards and best practices. The conventional approach involves the preparation of specifications and/or tender documents, issuing the tender for bid, review of bids, and contractor selection.

Typically, specifications provide a thorough description of the remediation work to be performed. Specifications may be in the form of written instructions, engineering drawings, or both, or other documentation models. The client/property owner may have their own standard operating procedures for procurement. Detailed specifications are used when the remediation method is well defined and not open to alternatives developed by the remediation contractor. A performance specification is used when the end goal is well defined, but there are numerous ways to achieve the goal, any of which is considered acceptable to the client/property owner. Combinations of detailed and performance specifications can also be used as appropriate. The RAP, or components of the RAP, should form the basis for the development of the detailed technical or performance-based specifications.

5.6.3 On-site Supervision

On-site supervision is essential during remediation operations to confirm the client/property owner's interests are addressed; that the contractor is executing the RAP as specified in the contract; and that remediation verification information is obtained (e.g., through confirmatory sampling and testing).

In some cases, the engineer may act as the client/property owner's representative to coordinate the implementation of the RAP. The role may include:

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- Periodic or continuous supervision requiring various field methods (e.g., field screening techniques, progress sampling, conducting quality assurance/quality control activities, verification sampling of various waste streams, etc.);
- Advising the client/property owner If activities deviate from the RAP or objectives and targets are not achieved;
- Documenting further approved or corrective actions;
- Compliance with applicable regulations;
- Compliance with the health and safety program;
- Monitoring/addressing issues that may arise during progression of remediation (e.g., off-site plume migration, air quality/odour issues, dust control, etc.). This may include implementing contingency measures as outlined in the RAP or developing and implementing additional contingency measures;
- Documenting the nature and progress of the remediation; and
- Performing contract administration duties.

Consideration should be given to the risks in assuming responsibility for and/or supervising engineering work. For more information, refer to the "*Assuming Responsibility and Supervising Engineering Work*" practice guideline.

5.7 Verification, and Documentation

Verification sampling of the remediated areas/materials should be carried out to monitor progress or completion of the RAP. The engineer shall follow relevant regulatory requirements and should follow established engineering and scientific practices in designing verification sampling programs. Key considerations include the following:

- The target media and contaminants of concern;
- Appropriate sampling and QA/QC plan; and
- The potential for concentrations to rebound. This is particularly a concern for in-situ remediation methods, and pump and treat groundwater remediation.

The activities completed during remediation and verification sampling results should be thoroughly documented including:

- A description of the remedial works and their satisfactory completion supported by verification data. Documentation should be sufficient to demonstrate that the remedial objectives were achieved;
- Signatures and statement of the qualifications of the engineer or individuals who assumes responsibility for the performance of the RAP, its findings, and conclusions; and
- Fulfillment of reporting requirements under the permit and/or regulatory authority, if they are within the scope of work.

6. RISK ASSESSMENT AND RISK MANAGEMENT MEASURES

6.1 Risk Assessment

A risk assessment is a scientific process used to evaluate the potential for adverse impact to human health or the health of ecological receptors.

A risk assessment approach to managing site contamination may be the preferred option when:

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- Full remediation to the applicable criteria is not financially feasible or is not technically practical or warranted;
- Remediation is required over a longer period of time and risk assessment is required to ensure health and safety of users of the site; or
- It supports sustainable practices such as, minimizing the transportation and disposal of soil.

The risk assessment should consider the following but not be limited to:
- Evaluation of the potential risks to human health or ecological receptors based on site-specific contaminants and exposure pathways;
- Development of site-specific criteria for a contaminant (which may or may not have a published criteria);
- Development of risk-based remediation targets;
- Prioritization of remediation efforts;
- Reduction in quantity of excess soils generated during redevelopment; and
- Determination of appropriate risk management measures (RMMs).

Similar to ESAs, risk assessments can be completed for due-diligence purposes or to support the filing of an RSC under O. Reg.153/04. Risk assessments completed to support the filing of an RSC shall be completed following the specific requirements outlined in O. Reg.153/04.

Risk assessments can develop site specific standards, which consider specific information (such as geology, hydrogeology, site physical characteristics, exposure pathways and receptors) that may be more relevant to the site than the assumptions used to develop applicable generic standards. The application of site specific standards may be contingent on the implementation of RMMs.

Risk Assessments are often multidisciplinary in nature and the engineer should confirm those contributing have the necessary level of education, knowledge and experience.

6.3 Risk Management Measures

RMMs can be implemented to eliminate or control potential contaminant exposure pathways. RMMs are designed to achieve the same target level of risk as the applicable generic criteria and may include administrative and/or engineered solutions.

Examples of administrative RMMs include:
- Land uses restrictions;
- Groundwater use restrictions;
- Building restrictions and building use restrictions;
- Soil and groundwater management plans; and
- Worker health and safety plans.

Examples of engineered RMMs include:
- Physical barriers to eliminate contact with contaminated media;
- Vapour intrusion mitigation systems; and
- Control of contaminated groundwater flow.

Engineers recommending and designing engineered RMMs require an appropriate level of education and experience, and familiarity with applicable regulations and codes.

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RMM designs should:

- Have appropriate and measurable performance objectives;
- Consider the level of uncertainty that may be inherent in the risk assessment;
- Have the appropriate means to measure that the objective has been achieved;
- Include provisions for the short and long term monitoring and maintenance of the RMM;
- Include contingency plans should the RMM fail to meet the performance objective; and,
- Consider regulatory requirements, approvals, and/or notifications which may be required.

7. EXCESS SOIL

Excess soil is often generated through construction activities or through the course of remedial activities. As best practice, engineers are encouraged to consider the beneficial reuse of excess soil, where appropriate, in a matter promoting sustainability and the protection of the environment. Soil conservation and management should be a consideration throughout a project where excess soil is expected to be generated.

For further information on excess soil, refer to applicable municipal and provincial requirements and guidelines.

8. QUALITY ASSURANCE / QUALITY CONTROL

QA/QC programs are an essential part of the ESA and remediation processes. A QA/QC program provides a measurable standard of quality of engineering services and also provides a safeguard to public safety.

A site-specific QA/QC program may include but is not limited to the following:

- Assurance that data of sufficient quality is obtained to make proper decisions for the property and/or remediation design;
- Consideration for both field and laboratory data quality which may include the use of standard statistical methods;
- Establishment of data quality objectives (DQOs) and evaluating the data for conformance with DQOs;
- Monitoring staff and contractor performance;
- Verification of data quality relative to expectations of the regulatory agency;
- Use of standard field tests and assessment protocols, including the use of standard analytical tests by accredited laboratories; and
- Development of and adherence to standard operating procedures including, but not limited to:
  - Borehole drilling;
  - Excavating;
  - Soil sampling;
  - Field screening measurements and calibration procedures;
  - Monitoring well installation and development;
  - Field measurement of water quality indicators and calibration procedures;
  - Sediment sampling; and
  - Groundwater sampling.

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DQOs are included as part of a good QA/QC program. DQOs outline the overall level of uncertainty that an engineer will accept when evaluating collected data. DQOs are set to assess precision, accuracy, representativeness, comparability, and completeness for field and/or laboratory data, with each specifically defined as:

- Precision is the measure of reproducibility of a measurement;
- Accuracy is the measure of how close the measured result is to the true value;
- Representativeness is the degree to which the results are indicative of true site conditions;
- Comparability is the confidence to which one data set can be compared to another; and
- Completeness denotes the amount of data planned to be collected to the amount of data actually collected.

DQOs can be viewed as the overall project design constraints that determine if the project work completed is acceptable.

The engineer should have an active role in reviewing and validating all QA/QC for the project, including but not limited to field, laboratory, data, and document control aspects of the QA/QC program.

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8.1 Field Quality Assurance

A field QA/QC component should be included in the Phase II ESA and/or remediation sampling and analysis plan. The following, as a minimum, should be included in the field QA/QC:

- Specification on the minimum requirements for the number, type and frequency of field quality control measures including field blanks, trip blanks, equipment blanks, and/or field duplicates and calibration checks on field instruments;
- A minimum of 10% of field duplicate samples should be collected and submitted for laboratory analysis in each medium being sampled and submitted for laboratory analysis;
- Properly labelled and sealed samples in order to prevent lost, broken, or exposure to conditions that may affect the sample's integrity;
- Samples submitted to laboratories for analysis shall be accompanied by a chain-of-custody form to ensure that the transport of samples are documented, analyzed for the appropriate parameters, received by the laboratory, and analyzed within the prescribed laboratory holding times;
- The chain-of-custody form, completed at the time of sampling, should contain at least the sample number, date and time of sampling, and the name of the sampler. Contact information should also be provided. The engineer should confirm that the chain-of-custody document be signed and dated when transferring the samples during shipment or upon relinquishing the samples to the analytical laboratory; and
- All non-dedicated sampling and monitoring equipment be decontaminated following each use.

8.2 Laboratory Data Quality Assurance

As discussed in Section 8, DQOs set the acceptable level of uncertainty of collected data. The engineer should review and validate the laboratory certificates of analysis, including the laboratory supplied QA/QC data. Validation includes an evaluation of data for the following:

- Precision: Relative percent difference between parent sample data to field duplicate data;

- Accuracy: Review of method blanks, spiked blanks, and matrix spikes, and surrogate recovery results;
- Representativeness: That the analytical results are consistent with field screening measurements and/or previous investigations;
- Comparability: Confirmation that sample integrity, sample preservation, holding times, etc. are consistent; and
- Completeness: That the certificate of analysis is in agreement with the chain of custody documentation.

It is the engineer's responsibility to use their professional judgement to analyze the QA/QC data in context of the DQOs for the investigation to determine their suitability for use in making decisions for the investigation and/or subsequent phases of the project.

8.3 Document Control

Engineers are responsible for the documents and records that they create. A document control process should also be part of the QA/QC program. The documents included as part of an ESA, remediation, and/or risk assessment such as field notes, records, meeting minutes, project specific correspondence, report deliverables, should be managed and archived in a system that allows for validation and traceability. Where it pertains to report deliverables that may be under regulatory or legal scrutiny, these controls are essential to ensure that technical review/senior approval, updates, changes have been conducted and adequately recorded. The retention and disposal of these documents shall be in line with legislative requirements and best practices.

9. SPECIAL SERVICES

9.1 Expert Testimony

The process of ESA, remediation and management sometimes requires the expert testimony of engineers at regulatory hearings, courts of law, inquest hearings and discoveries, through interrogatories, and before committees. The purpose of expert testimony is to provide unbiased truthful information to assist the trier of fact such as a judge, board, tribunal, or jury in reaching a sound decision. Engineers should refer to PEO's guideline "*The Professional Engineer as an Expert Witness*" for further guidance on this subject.

9.2 Presentation at Public Meetings

The engineer requires a comprehensive understanding of the subject to present information in a manner the public can readily understand. Information shall be truthful and unbiased.

When a significant public process is required, the engineer should ensure effective public communication with a team approach, such as use of a lawyer, planner or media consultant(s).

9.3 Advisory/Peer Review Services

Engineers may be retained to provide advisory or peer review services to stakeholders objecting or seeking another professional opinion on an ESA, remediation, risk assessment or management project. Engineers shall be aware of their responsibilities under the Code of Ethics when reviewing another engineer's work and shall comply with these responsibilities. Other engineers may have similar responsibilities.

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In cases where the advisory services or peer review is for a third party such as community groups, prospective property buyers, regulatory agencies, or property owners, the engineer's role is to independently verify the work of other engineers, and to provide an independent report to the client/property owner.

For more information on the Peer Review, please refer to the "*Professional Engineers Reviewing Work Prepared by Another Professional Engineer*" guideline.

APPENDIX

Appendix 1 - Definitions

Where such definitions conflict or differ from what is in applicable legislation, the regulatory definition replaces the one used in this guide. For the purposes of this guideline:

"**Client**" is the party who engages the engineer, coordinating engineer, and/or in some cases, the contributing engineer(s) to provide the required professional services. The client may be the property owner, a potential buyer of the property or an affected third party which could include government.

"Contaminants" means any organic or inorganic substance that, when released into the environment, causes or may cause an adverse effect.

"**Contamination**" for the purposes of this document is generally considered to be the presence of a substance in soil, sediment, air, ground water, and/or surface water, that results in a chemical parameter exceeding acceptable levels of an applicable criteria.

"**Criteria**" is an established numerical limit, a risk-based limit, or narrative statement. Criteria may be adopted directly from generic values or formulated to account for site-specific conditions.

"**Due Diligence**" is the care that a reasonable engineer exercises under the circumstances to avoid harm for their client, to other persons, property and the environment.

"**Engineer**" means an engineer who is registered as a member in good standing with Professional Engineers Ontario. References in this guideline to "engineers" apply equally to professional engineers, temporary licence holders, provisional licence holders and limited licence holders.

"Equipment blanks" are field blanks that are used to check for contamination from filtering equipment or any other equipment that is used in sample collection.

"Field blanks" are defined as matrices that are prepared by the analytical laboratory that have negligible amounts of the substance(s) or contaminant(s) of interest. They are prepared by transferring analyte free media from one vessel to another or by exposing the media to the sampling environment at the sampling site. Field blanks are used to test the purity of chemical preservatives, check for contamination of sample containers, detect contamination that occurs during sampling, and to detect other systematic and random errors that may occur during sampling.

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"**Monitoring**" is the routine sampling of water, sediment soil or air samples at an appropriate frequency and location; the analyses of the samples for contaminants; and the collection or reporting of the methodology and interpretation of the results.

"**Phased ESA**" is the systematic environmental assessment process to determine whether a property is or may be subject to potential or actual contamination. A Phase I ESA generally involves desktop study review of background documents and maps, interviews, and site reconnaissance. A Phase II ESA involves intrusive investigations (e.g., boreholes/monitoring wells, test pits) including monitoring, sampling, and chemical analysis for applicable contaminants of concern.

"**Project**" is the total work contemplated.

"**Property**" comprises land, buildings, equipment, and installations and the improvement of any physical object with some degree of permanence.

"**Property Owner**" includes a lessee, a person in charge, a person who has care and control, and a person who holds him or herself as having the powers and authority of ownership or who for the time being exercises the powers of ownership.

"**Quality assurance**" means evaluating overall project performance on a regular basis to provide confidence that the project will satisfy the relevant quality standards.

"**Quality control**" means monitoring specific project results to determine if they comply with relevant quality standards and identifying ways to eliminate causes of unsatisfactory results.

"**Remediation**" means the development and application of a planned approach to treat, remove, or destroy contaminants present in the soil and/or groundwater for the purpose of reducing their concentration or availability to acceptable levels.

"**Risk**" means the probability or threat of damage, injury, liability, loss, or any other negative occurrence that is caused by external or internal vulnerabilities, and that may be avoided through preemptive action. For the purposes of this document, it generally refers to a measure of the severity of human health and/or ecological health effects arising from potential exposure to contamination and the probability of the occurrence.

"**Risk Assessment**" scientifically examines the risk posed to humans and the natural environment from exposure to a contaminant. The purpose of a Risk Assessment is to develop property specific standards that will protect the uses that are being proposed to take place on the property.

"**Risk Management**" means the actions implemented to eliminate or control potential contaminant exposure pathways.

"**Stakeholder**" means a person or organization who is directly involved with or affected by a project, product, or activity thereby having an interest in it.

"**Standards**" is used to represent regulatory guideline values, criteria and standards

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"Trip blanks" (also known as Travel blanks) are field blanks that accompany sample bottles for the duration of the sample period and return to the laboratory without ever being opened.

Appendix 2 - References

The engineer should be knowledgeable of all relevant federal, provincial and municipal legislation, guidelines and policies relating to environmental site assessment, remediation, and management. The following documents were used in the development of this guideline and provide additional information that can be referenced; however, it is noted that this is not an exhaustive list and the engineer should ensure that the appropriate and most up to date documents are utilized:

- Canadian Council of Ministers of the Environment. [2016]. *Guidance Manual for Environmental Site Characterization in Support of Environmental and Human Health Risk Assessment, Volume 1 Guidance Manual.*
- Canadian Standards Association (CSA). [2018]. *Z769-00 (R2018) – Phase II Environmental Site Assessment*
- Canadian Standards Association (CSA). [2016]. *Z768-01 (R2016) – Phase I Environmental Site Assessment.*
- Engineers Canada. [March 2018]. *National guideline on site remediation for professional engineers.*
- Ministry of the Environment. [October 2004]. *Records of Site Condition. A Guide on Site Assessment, the Cleanup of Brownfield Sites and the Filing of Records of Site Condition.*
- Ministry of the Environment, Conservation and Parks. [August 2017, Updated March 2019]. *Procedures for the Use of Risk Assessment under Part XV.1 of the Environmental Protection Act*

  Retrieved from the Government of Ontario website:
  https://www.ontario.ca/page/procedures-use-risk-assessment-under-part-xv1-environmental-protection-act
- Ministry of the Environment. [November 2010]. *Draft Technical Guidance: Soil Vapour Intrusion Assessment.*
- Ministry of the Environment. [April 2011]. *Soil, Ground Water and Sediment Standards for Use Under Part XV.1 of the Environmental Protection Act.*
- Ministry of the Environment, Conservation and Parks. [September 2016 updated: March 2019]. *Guide for Completing Phase One Environmental Site Assessments under Ontario Regulation 153/04.*

  Retrieved from the Government of Ontario website:
  https://www.ontario.ca/page/guide-completing-phase-one-environmental-site-assessments-under-ontario-regulation-15304
- Ministry of the Environment, Conservation and Parks. [March 2016, updated March 2019]. *Guide for Completing Phase Two Environmental Site Assessments under Ontario Regulation 153/04.*

  Retrieved from the Government of Ontario website:
  https://www.ontario.ca/page/guide-completing-phase-two-environmental-site-assessments-under-ontario-regulation-15304
- Ministry of the Environment. [March 2004 amended July 2011]. *Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act.*
- Ontario Ministry of the Environment. [April 2011]. *Rationale for the Development of Soil and Ground Water Standards for Use at Contaminated Sites in Ontario.*

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- Ontario Ministry of the Environment. [January 2014]. *Management of Excess Soil – A Guide for Best Management Practices.*
- Ministry of the Environment, Conservation and Parks. [April 2016, updated June 2017]. *Management of Excess Soil – A Guide for Best Management Practices.*
  Retrieved from the Government of Ontario website:
  https://www.ontario.ca/page/management-excess-soil-guide-best-management-practices
- Ministry of the Environment, Conservation and Parks. [2004, current date 2017]. *Ontario Regulation 153/04: Records of Site Condition – Part XV.1 of the Act*
  Retrieved from the Government of Ontario website:
  https://www.ontario.ca/laws/regulation/040153
- Ontario Society of Professional Engineers (OSPE), the Greater Toronto Sewer and Watermain Construction Association (GTSWCA) and the Residential and Civil Construction Alliance of Ontario (RCCAO) [2016]. *Excess Soil Management: Ontario is Wasting a Precious Resource.*
- Professional Engineers Ontario [July 2005. Revised November 2008] *Use of the Professional Engineer's Seal* Guideline.
- Professional Engineers Ontario [October 2011]. *Professional Engineers Reviewing Work Prepared by Another Professional Engineer Guideline*.
- Professional Engineers Ontario [February 2018]. *Assuming Responsibility and Supervising Engineering Work Guideline*.
- Professional Engineers Ontario. [August 2017]. *Professional Engineering Practice Guideline.*
- Professional Engineers Ontario. [September 2011]. *The Professional Engineer as an Expert Witness Guideline*.
- Engineers Canada. [March 2018]. Public *Guideline on Site Remediation for Engineers*.

Appendix 3 - Acronyms

- APEC: Area of potential environmental concern
- CSA: Canadian Standards Association
- DQO: Data quality objectives
- ESA: Environmental site assessment
- MECP: Ministry of the Environment, Conservation and Parks
- PCA: Potentially contaminating activities
- QA/QC: Quality assurance/quality control
- QP: Qualified person
- RMMs: Risk management measures
- RSC: Record of site condition
- RAP: Remedial action plan
- PEO: Professional Engineers Ontario

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