PROFESSIONAL PRACTICE GUIDELINES

BUILDINGS

GEOTECHNICAL ENGINEERING SERVICES FOR BUILDING PROJECTS

VERSION 2.0
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ENGINEERS &
GEOSCIENTISTS
BRITISH COLUMBIA

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PREFACE

These *Professional Practice Guidelines – Geotechnical Engineering Services for Building Projects* were developed by Engineers and Geoscientists British Columbia (the Association) to guide professional practice related to geotechnical engineering in the building design and construction industry.

The first version of these guidelines was published in 1998 and addressed the standard of practice for geotechnical engineering in the building sector and related requirements for the use of standard Letters of Assurance, as mandated in the *BC Building Code*.

This current revision provides additional clarity on the specific items related to geotechnical engineering for building projects in the Letters of Assurance and discusses the roles and responsibilities of Engineering Professionals, specifically the Geotechnical Engineer of Record, and other relevant parties. In addition, these guidelines were further updated to refer to the Association's Bylaws for quality management.

These guidelines complement the Association's *Guidelines for Legislated Landslide Assessments for Proposed Residential Developments in BC* (Engineers and Geoscientists BC 2010) and *Professional Practice Guidelines – Retaining Wall Design* (Engineers and Geoscientists BC 2020).

These guidelines outline the appropriate standard of practice to be followed at the time they were prepared. However, this is a living document that is to be revised and updated as required in the future, to reflect the developing state of practice.

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ABBREVIATIONS

ABBREVIATION	TERM
ACEC-BC	Association of Consulting Engineering Companies British Columbia
AIBC	Architectural Institute of British Columbia
BC	British Columbia
BCBC	*British Columbia Building Code*
CER	Civil Engineer of Record
CFEM	Canadian Foundation Engineering Manual
CRP	Coordinating Registered Professional
EIT	Engineer-in-Training
EOR	Engineer of Record
GER	Geotechnical Engineer of Record
MER	Mechanical Engineer of Record
NBC	*National Building Code of Canada*
P3	Public-Private-Partnership
QBS	Qualifications-Based Selection
RP	Registered Professional
RPR	Registered Professional of Record
SER	Structural Engineer of Record
SRP	Supporting Registered Professional
VBBL	Vancouver Building By-law

DEFINED TERMS

The following definitions are specific to these guidelines. These words and terms are capitalized throughout the document.

TERM	DEFINITION
Act	*Engineers and Geoscientists Act* [RSBC 1996], Chapter 116.
Agreement for Geotechnical Services	The contract, whether formal or informal, between the Client and the Engineering Professional or the firm that agrees to provide geotechnical engineering services.
Authority Having Jurisdiction	The jurisdictional body (usually municipal) with authority to administer and enforce the *British Columbia Building Code* (*BCBC*), the City of Vancouver Building By-law (VBBL), the *National Building Code of Canada* (*NBC*), or a local building bylaw or code, as well as government agencies that regulate a particular function in a building (for example, Technical Safety BC as a regulatory authority with respect to electrical installations and elevating devices).
Association	The Association of Professional Engineers and Geoscientists of the Province of British Columbia, also operating as Engineers and Geoscientists BC.
Building Code	Includes the *British Columbia Building Code*, the City of Vancouver Building By-law, and the *National Building Code of Canada*.
Bylaws	The Bylaws of the Association made under the *Act*.
Client	The party who enters into a contract to obtain geotechnical engineering services.
Coordinating Registered Professional	Defined in the *BCBC* as a Registered Professional retained to coordinate all design work and Field Reviews of the Registered Professionals who are required for a project.
Direct Supervision	The act of taking responsibility for the control and conduct of the engineering work of a subordinate, who could be an Engineer-in-Training (EIT), a person not registered or licensed to practice professional engineering, or another Engineering Professional.
Engineering Professional(s)	Professional engineers and licensees, who are registered or licensed by the Association and entitled under the *Act* to engage in the practice of professional engineering in British Columbia.
Engineers and Geoscientists BC	The business name for the Association.

TERM	DEFINITION
Field Review	The reviews conducted at the site of the implementation or construction of the engineering work by an Engineering Professional or his or her subordinate acting under his or her Direct Supervision, that the Engineering Professional in his or her professional discretion considered necessary to ascertain whether the implementation or construction of the work substantially complies in all material respects with the engineering concepts or intent reflected in the engineering documents prepared for the work. Defined in the *BCBC* as follows: "Field Review means a review of the work (a) at a building site, and (b) where applicable, at locations where building components are fabricated for use at the building site that a Registered Professional in his or her professional discretion considers necessary to ascertain whether the work substantially complies in all material respects with the plans and supporting documents prepared by the Registered Professional." The Field Reviews by a Geotechnical Engineer are for the purpose of ascertaining whether the subsurface conditions at a project site are consistent with those assumed in a project design and, in the event that unanticipated subsurface conditions are encountered, to allow for the recommendation of suitable measures to be provided for achieving the design objectives.
Geotechnical Engineer	An Engineering Professional who specializes in the art and science of estimating the response of the ground to changes, including those resulting from construction.
Geotechnical Engineer of Record	The Registered Professional who is responsible for the geotechnical aspects of the design and associated Field Reviews for the Subgrade Support of the Building or structure in a project, and issues Letters of Assurance for those items of direct responsibility. The Geotechnical Engineer of Record may also, under an agreed scope of service, be responsible for the geotechnical aspects of temporary conditions and features. Alternatively, such responsibility may be undertaken by another Geotechnical Engineer who acts as a Registered Professional of Record for the temporary conditions and features, and issues Letters of Assurance for those items.
Letters of Assurance	Uniform, mandatory documents that are intended to clearly identify the responsibilities of key individuals in a building project, and which are executed in accordance with the applicable Building Code.
Owner	Any individual, firm, or corporation controlling the property under consideration during the period of application of the Building Code.
Primary Structural Element	A beam, column, or other structural design element that, when combined with others, forms the Primary Structural System.
Primary Structural System	A combination of Primary Structural Elements that support a building's self-weight and applicable live loads based on occupancy, use of the space, and environmental loads such as wind, snow, and seismic forces.

TERM	DEFINITION
Registered Professional	Defined in the *BCBC* as: "a) a person who is registered or licensed to practice as an architect under the *Architects Act*, or b) a person who is registered or licensed to practice as a professional engineer under the *Engineers and Geoscientists Act*." For the purposes of the *Engineers and Geoscientists Act*, this can include professional engineers and licensees having the appropriate scope of practice, all of whom must be qualified by training or experience to provide designs for building projects.
Registered Professional of Record	Defined in the *BCBC* as a Registered Professional retained to undertake design work and Field Reviews in accordance with Subsection 2.2.7.3. of Division C.
Specialty Geotechnical Engineer	An Engineering Professional who designs and supervises the preparation of documents for special elements of subsurface work while acting as a Supporting Registered Professional providing supplementary supporting geotechnical engineering services to the Geotechnical Engineer of Record.
Structural Engineer of Record	An Engineering Professional with general responsibility for the structural integrity of the Primary Structural System. The Structural Engineer of Record takes overall responsibility as the Registered Professional of Record for all items under the structural discipline on Schedule B of the Letters of Assurance in the *British Columbia Building Code*.
Subgrade Support of the Building	A combination of soil, rock, and groundwater, either natural or processed, which reacts to the imposed loadings of the Primary Structural System of the building or structure as well as the weight of the ground.
Supporting Registered Professional	The Registered Professional providing supplementary supporting design and/or Field Review services to the Registered Professional of Record for a particular component or sub-component of a discipline, such as, for instance, a Specialty Geotechnical Engineer providing supplementary supporting services for select geotechnical aspects of the design and associated Field Reviews for the Subgrade Support of the Building or structure. It is recommended that a Geotechnical Engineer of Record obtain and retain in his or her project file Schedules S-B and S-C from any Supporting Registered Professional in the form provided in Appendix A of *Joint Professional Practice Guidelines – Professional Design and Field Review By Supporting Registered Professionals* (AIBC and Engineers and Geoscientists BC 2020). These schedules provide the Geotechnical Engineer of Record with assurance from the Supporting Registered Professional that the plans and supporting documents relating to the supporting engineering services for a particular geotechnical component, or subcomponent, substantially comply, in all material respects, with the applicable requirements of the applicable Building Code.

VERSION HISTORY

VERSION NUMBER	PUBLISHED DATE	DESCRIPTION OF CHANGES
2.0	September 17, 2020	Updated to provide for additional description of the current standard of practice for geotechnical engineering services, along with additional clarity as to how the *BCBC* Letters of Assurance are applied to such geotechnical work.
1.0	March 1998	Initial version.

1.0 INTRODUCTION

Engineers and Geoscientists British Columbia (the Association) is the regulatory and licensing body for the engineering and geoscience professions in British Columbia (BC). To protect the public, the Association establishes, maintains, and enforces standards for the qualification and practice of its members and licensees.

The Association provides various practice resources to its members and licensees to assist them in meeting their professional and ethical obligations under the *Engineers and Geoscientists Act*. One of those resources are professional practice guidelines, which establish the standard of practice for specific professional activities. The Association works with experts in their fields to develop professional practice guidelines where additional guidance is beneficial or required.

These *Professional Practice Guidelines – Geotechnical Engineering Services for Building Projects* provide guidance on professional practice for Engineering Professionals who carry out geotechnical engineering services related to building projects in British Columbia.

These guidelines were first published in 1998 for building projects and were revised in 2019 to provide clarity as to the standard of practice of geotechnical engineering services.

These guidelines further complement the Association's *Guidelines for Legislated Landslide Assessments for Proposed Residential Developments in BC* (Engineers and Geoscientists BC 2010) and *Professional Practice Guidelines – Retaining Wall Design* (Engineers and Geoscientists BC 2020), as well as other more general Engineers and Geoscientists BC professional practice guidelines.

1.1 PURPOSE OF THESE GUIDELINES

This document provides guidance on professional practice to Engineering Professionals who carry out geotechnical engineering services for building projects.

These guidelines provide a common approach for carrying out a range of professional activities related to geotechnical engineering services for building projects

Following are the specific objectives of these guidelines:

1. Describe the standard of practice that Engineering Professionals should follow when providing professional services related to these professional activities.
2. Specify the tasks and/or services that Engineering Professionals should complete to meet the appropriate standard of practice and fulfill their professional obligations under the *Act*. These obligations include the Engineering Professional's primary duty to protect the safety, health, and welfare of the public and the environment.
3. Describe the roles and responsibilities of the various participants/stakeholders involved in these professional activities. The document should assist in delineating the roles and responsibilities of the various participants/stakeholders, which may include the Registered Professional of Record, the Geotechnical Engineer of Record (GER), Owners, Authorities Having Jurisdiction, Supporting Registered Professionals, and contractors.
4. Define the skill sets that are consistent with the training and experience required to carry out these professional activities.

5. Provide guidance on the use of assurance documents, so the appropriate considerations have been addressed (both regulatory and technical) for the specific professional activities that were carried out.
6. Provide guidance on how to meet the quality management requirements under the *Act* and Bylaws when carrying out the professional activities identified in these professional practice guidelines.

1.2 ROLE OF ENGINEERS AND GEOSCIENTISTS BC

These guidelines were prepared by subject matter experts and reviewed at various stages by a formal review group and other stakeholders. The final draft of the guidelines underwent a final consultation process with various committees and divisions of the Association. These guidelines and the current revision were approved by the Association's Council and, prior to publication, underwent final legal and editorial reviews. These guidelines form part of Engineers and Geoscientists BC's ongoing commitment to maintaining the quality of professional services that Engineering Professionals provide to their Clients and the public.

An Engineering Professional must exercise professional judgment when providing professional services; as such, application of these guidelines will vary depending on the circumstances, including where site-specific conditions need to be addressed or in the event that there are changes in legislation, regulations or the Building Code subsequent to the publication of these guidelines. Where an Engineering Professional intends to substantially deviate from following or applying these guidelines, consideration should be made to obtain a second opinion on the merits of the deviation.

The Association supports the principle that appropriate financial, professional, and technical resources should be provided (i.e., by the Client and/or the employer) to support Engineering Professionals who are responsible for carrying out professional activities, so they can comply with the standards of practice provided in these guidelines. These guidelines may be used to assist in defining the level of service and terms of reference of an agreement between an Engineering Professional and a Client.

These guidelines are intended to assist Engineering Professionals in fulfilling their professional obligations, especially regarding the first principle of the Association's Code of Ethics, which is to "hold paramount the safety, health and welfare of the public, protection of the environment and promote health and safety in the workplace." Failure to meet the intent of these guidelines could be evidence of unprofessional conduct and lead to disciplinary proceedings by the Association.

1.3 INTRODUCTION OF TERMS

See the Defined Terms section at the front of the document for a full list of definitions specific to these guidelines.

1.4 SCOPE OF THESE GUIDELINES

These guidelines apply to the practice of geotechnical engineering for buildings and structures governed by Part 4 and Part 9 of the *BC Building Code* (*BCBC*), the City of Vancouver Building By-Law (VBBL), or the *National Building Code of Canada* (NBC). Encompassed in these guidelines are other commitments which municipalities may require from Engineering Professionals as set out in the Letters of Assurance of the *BCBC* and VBBL, along with other applicable guidelines and regulations (see Section 6.1 References).

These guidelines also outline the professional services generally provided by the Geotechnical Engineer of Record (GER) and, where applicable, the Specialty Geotechnical Engineer(s), for a project carried out under the requirements of those portions of the

Building Code, regulatory requirements, and the *Workers Compensation Act*.

These guidelines specify tasks performed by the GER to achieve designs in the best interest of the project and the public through coordination with the work of other design and construction team participants. These guidelines should assist in maintaining the integrity of the overall and detail designs. The GER often works in conjunction with the Structural Engineer of Record (SER) and/or other design team members or contractors on projects; these guidelines should assist in the delineation of responsibilities among these parties.

1.4.1 RESPONSIBILITY FOR TEMPORARY AND PERMANENT GEOTECHNICAL DISCIPLINES

In the Letters of Assurance of the *BCBC* and VBBL, responsibility for the geotechnical discipline may be split between temporary and permanent geotechnical components (Sections 7 and 8, respectively, of Schedule B) (BCBC 2018b). As such, different RPRs are often engaged on a building project for temporary and permanent geotechnical engineering.

When discussing the activities of the GER, these guidelines generally do not allocate one task or another to either RPR who is responsible for the temporary or permanent geotechnical disciplines noted in the Letters of Assurance. If two such geotechnical RPRs are engaged on a project, their tasks should be properly coordinated between the two responsibility areas to avoid overlaps or gaps in responsibilities, and to ensure the full intent of the *BCBC*, VBBL, and any other applicable legislation, regulation, or bylaws are satisfied by the designs.

1.5 APPLICABILITY OF THESE GUIDELINES

These guidelines provide guidance on professional practice for Engineering Professionals who carry out geotechnical engineering services for building projects. These guidelines are not intended to provide systematic instructions for how to carry out these activities; rather, these guidelines outline considerations that should be taken into account when carrying out these activities.

An Engineering Professional's decision not to follow one or more aspects of these guidelines does not necessarily mean a failure to meet his or her professional obligations. Such judgments and decisions depend upon weighing facts and circumstances to determine whether other reasonable and prudent Engineering Professionals, in similar situations, could have conducted themselves similarly.

1.6 ACKNOWLEDGEMENTS

The original version and this current revision of these guidelines were reviewed by groups of technical experts and external stakeholders, as well as by various committees and divisions of the Association. Authorship and review of these guidelines does not necessarily indicate the individuals and/or their employers endorse everything in these guidelines.

The Association thanks the authors and reviewers of the original document, as well as the authors and reviewers of this revision, for their time and effort in sharing their knowledge and experience.

2.0 ROLES AND RESPONSIBILITIES

This section summarizes the organization of various delivery models and delineates the roles and responsibilities for various parties involved in design and project delivery.

2.1 COMMON FORMS OF PROJECT ORGANIZATION

Project organization can vary according to the needs of a project and the contractual arrangements agreed to by the parties involved. The Geotechnical Engineer of Record (GER) is usually engaged by the Owner, but may be engaged by the Owner's Coordinating Registered Professional (CRP), the Structural Engineer of Record (SER), a design/build contractor, or other persons responsible for the delivery of part of or the entire project.

2.1.1 DESIGN-BID-BUILD DELIVERY

In the traditional design-bid-build model, the various project phases are procured and delivered under separate contracts. Under this delivery model, the design phase and the construction phase occur sequentially under separate contracts entered into by the Owner. In the design phase, the Owner or the Owner's representative directly engage design engineers as engineers of record (EORs) for the project. Therefore, there is typically a direct line of communication between an EOR responsible for geotechnical services and the Owner or Owner's representative.

2.1.2 DESIGN/BUILD DELIVERY

In the design-build model, there are no contractual relations between the EORs and the Owner. Instead, the EORs are typically subcontractors of the design-build contractor who enters into a contract with the Owner to design and build the project. Once substantial completion of the project is reached, the Owner takes over responsibility for operation and maintenance, but the design-build contractor may still have design and construction responsibilities through a warranty period under the terms of the design-build contract.

2.1.3 PUBLIC PRIVATE PARTNERSHIP (P3) DELIVERY

In the P3 delivery model, the public sector Owner typically enters a contract with a concessionaire, who takes overall responsibility for design, construction, finance (partial or complete) of a public facility, and, in some cases, operation and maintenance of the facility. The EORs for the project may be engaged indirectly by the concessionaire through a contractor responsible to the concessionaire. The concessionaire is responsible to the Owner for the term of concession, which could be as long as 25 to 35 years. The facility is then turned over to the Owner at the end of the concession.

Since this project delivery model does not put the EORs in direct communications with the Owner, the Owner's input for the design of the project will typically be in the form of design-build specifications that the Owner provides the concessionaire. Those specifications are typically prepared by consultants retained by the Owner who have appropriate technical expertise to prepare the specifications, and review the EORs' submittals for conformance with the specifications. Ongoing communication between the EORs and the Owner's consultant provides a way for overcoming challenges in interpreting the specifications, which by their nature will be non-prescriptive.

2.2 RESPONSIBILITIES

The following subsections outline the key roles in a building project.

2.2.1 OWNER

To ensure the design and construction of the project is carried out in a manner that meets appropriate standards of public safety and the requirements of applicable codes and regulations, the Owner should:

- implement Building Code requirements;
- ensure Registered Professionals (RPs) are retained with responsibility for the design of all aspects of the project, including a CRP to act as the prime consultant coordinating all of the RPs; and
- pay the costs of these services.

In particular, the Owner should:

- proceed with a building project only after securing adequate financing, recognizing that a reasonable contingency should be included;
- establish any desired building performance requirement that exceed Building Code requirements;
- engage with the CRP to develop an adequate written description of the project;
- confirm, with the support of the CRP, whether the project site is within defined archeologically sensitive or significant areas;
- ensure the role of the GER is properly defined for the project and includes
  - a written description of the scope of the GER's services, including deliverable outputs, and
  - a realistic schedule for the provision of the GER's services agreed to by the CRP and the GER;
- before commencement of services, ensure a written Agreement for Geotechnical Services is finalized with the GER and other relevant RPs, and that it specifies the agreed scope of services, schedules, deliverables, and associated compensation;
- authorize in writing any additional services that may be beyond the original scope of the GER's services, based on recommendations from the GER or other members of the project team;
- ensure all required approvals, licenses, and permits from the Authorities Having Jurisdiction are obtained;
- provide the GER with the right of entry onto the project site for exploration purposes;
- obtain encroachment agreements with neighbours;
- inform owners of adjacent properties of potential impacts;
- retain an environmental engineer to design management strategies for storage, treatment, and discharge of groundwater removed from the site;
- recognize that drawings, specifications, and other documents prepared by the GER are specific to the project and site and cannot be used or copied for other projects;
- recognize that the requirements of Authorities Having Jurisdiction may vary from project to project;
- recognize that, because Building Code interpretation by the Authority Having Jurisdiction may differ from that of the GER, changes to plans may be required;
- disclose fully and promptly any and all information that may affect the GER's analysis, work, scheduling of tasks, design, or payment for services, including, among other things, any existing geotechnical reports or data, any situations that may require special testing or equipment, and all known potential environmentally sensitive or hazardous site conditions;
- if no CRP is retained for a project, ensure that the duties normally assumed by a CRP are provided by the Owner or otherwise properly assigned to RPs, including ensuring that all professional services provided on the project are properly coordinated among all Registered Professionals of Record (RPRs) and any Supporting Registered Professionals (SRPs);

- recognize that, if the original GER is replaced, the change in the GER may require additional resources to those which were originally budgeted and scheduled; and
- ensure timely payment for completed work.

If the Owner does not undertake or perform the above responsibilities, RPs should:

- consider recommending to the Owner in writing that the Owner should undertake and perform the responsibilities, and provide an explanation for why the Owner should do so; or
- consider withdrawing from the building project, and informing the Authority Having Jurisdiction of the withdrawal where that would be necessary for the RP to comply with his or her professional obligations under the Building Code or the Association's Code of Ethics.

2.2.2 COORDINATING REGISTERED PROFESSIONAL

The role of the CRP, as described in the Letter of Assurance, Schedule A, Confirmation of Commitment By Owner and Coordinating Registered Professional, is to coordinate the design work and Field Reviews of the RPs required for the project in order to ascertain that the design will substantially comply with *BCBC* or VBBL, and other applicable enactments respecting safety.

The role of the CRP is clearly defined in the *BCBC*, Note A-2.2.7.2.(1)(a) of Division C.

It is not intended for the CRP to assume responsibility for the adequacy or accuracy of the technical designs prepared the RPs, or for subsequent Field Reviews of the RPs who provide design and Field Review services. However, the CRP should provide a level of administrative overview beyond simply obtaining sealed drawings and Letters of Assurance, whether or not the CRP has a contractual relationship with the RPs involved in the project.

To enable GERs to perform their duties properly, the CRP should:

- interpret and define the needs of the Owner so the designs will meet the intended functions and needs of the project;
- ensure the design team identifies any special design criteria, such as loads, settlement tolerances, seismic resistance, and other performance requirements that are stricter than those imposed by the Building Code, as well as additional geotechnical services not normally part of the scope of such projects, and advise the GER accordingly;
- outline the scope of assignment to the GER and each RP (including the Specialty Geotechnical Engineer, if applicable) for design, preparation of contract documents, review of work during construction, Field Reviews, and contract administration;
- provide timely and appropriately detailed information to permit the GER to adequately perform his or her duties;
- coordinate with the contractor to ensure the GER is informed of construction progress, and advise the GER when foundation and earthwork elements of the project are being prepared for geotechnical Field Reviews;
- recognize that, because Building Code interpretation by the Authority Having Jurisdiction may differ from that of the GER, changes to plans may be required;
- disclose fully and promptly any and all information that may affect the GER's analysis, work, scheduling of tasks, design, or payment for services, including, among other things, any existing geotechnical reports or data, any situations that may require special testing or equipment, and all known potential environmentally sensitive or hazardous site conditions;
- coordinate and review designs, drawings, and other contract documents prepared by RPs;

- coordinate communication of information between the Owner, the contractor, and the RPs, including the GER, so that work proceeds in a manner that complies with applicable codes and regulations and meets the Owner's needs;
- if the original GER is replaced, ensure that the transition is managed according to the procedures outlined in the *Guide to the Letters of Assurance in the BC Building Code* (Province of BC 2010), and that the incoming GER assumes responsibility for the geotechnical aspects of the project moving forward; and
- coordinate the implementation of risk mitigation strategies (such as design intents or covenants) identified during the development permit process by the project team involved with detailed design and construction.

2.2.3 STRUCTURAL ENGINEER OF RECORD

The Structural Engineer of Record (SER) is responsible for the structural integrity of the Primary Structural System of a building project. The SER should:

- identify any special structural design criteria such as loads, settlement tolerances, seismic resistance or other performance requirements and advise the CRP, Owner, and GER accordingly;
- provide timely information in sufficient detail as required to permit the duties of the GER to be adequately performed; and
- be responsible for the structural aspects of design, while the GER is responsible for the geotechnical aspects of the design for Subgrade Support of the Building.

The role of the SER is to advise on the structural aspects of the geotechnical design; however, where appropriate, a specialty structural engineer may be required if the SER is unable to provide the required services. Such aspects may include the surcharge loads imposed by adjacent structures which may affect the design, as well as structural review of proposed shoring elements.

2.2.4 GEOTECHNICAL ENGINEER OF RECORD

The GER should work with the Owner and/or the CRP to develop a scope of work that allows the GER to meet his or her professional obligations, including those discussed in these guidelines and those imposed by the applicable Building Code, WorkSafeBC, and other regulations. The scope of services should clearly delineate the responsibilities of the GER and any Specialty Geotechnical Engineer(s). Likewise, as noted in Section 1.4.1 Temporary and Permanent Geotechnical Engineers of Record, if different RPRs are responsible for the temporary and permanent geotechnical aspects of the project, the responsibilities of each professional must be clearly demarcated and reflected in the Letters of Assurance issued by the RPRs.

The GER is normally responsible for planning and executing the exploration program to characterize the subsurface conditions at the project site, including assessing soil, rock, and groundwater conditions relevant to the Subgrade Support of the Building and investigating the potential for off-site impacts from earthworks activities or changes to groundwater elevation. Unless the scope of services provides otherwise, the GER may rely upon recent topographic or boundary survey data and locations of underground structures and utilities supplied by the Owner, or on the advice of other members of the design team, to determine the suitable layout of test holes or other exploration methods. The GER must exercise reasonable professional judgment to determine whether the provided information is complete, accurate, and sufficiently recent to allow the GER to adequately assess the area of interest.

The GER is normally responsible for selecting exploration methods and testing soil or rock samples to assess physical characteristics or properties upon which geotechnical recommendations and designs will be based, such as strength and compressibility. The GER may rely upon the Owner or CRP to notify the GER of situations that may require special testing or special equipment. In such cases, the GER should determine if it is appropriate to involve a Specialty Geotechnical Engineer and work with that person to determine a

scope of work for supplementary supporting geotechnical engineering services.

The GER should inform the Owner that subsurface conditions may differ from those anticipated and vary among test locations. Therefore, the budget should include a reasonable amount for contingencies, along with adequate secured financing, in case designs must be adjusted to address variations.

The GER is responsible for the geotechnical aspects of the design for the Subgrade Support of the Building and the associated Field Reviews. If included in the scope of services, the GER may also provide recommendations for other elements of a building project or other types of projects requiring geotechnical expertise, such as land stability beyond the building project site itself, earthworks, pavement structures, and criteria for design of temporary or permanent earth-retention systems. Refer to *Guidelines for Legislated Landslide Assessments for Proposed Residential Developments in BC* (Engineers and Geoscientists BC 2010a) and *Professional Practice Guidelines – Retaining Wall Design* (Engineers and Geoscientists BC 2020) for more guidance on those topics.

The GER is solely responsible for the geotechnical aspects of the design of the Subgrade Support of the Building shown on project drawings, unless the scope of services states otherwise, and must sign and seal Schedule B, Assurance of Professional Design and Commitment for Field Review accordingly (see Appendix B: Letters of Assurance for Geotechnical Engineering). The GER may rely on Specialty Geotechnical Engineers to design and retain responsibility for certain elements of the geotechnical works, but the GER still has overall responsibility for ensuring the resulting geotechnical design work meets acceptable engineering standards. The GER must require Specialty Geotechnical Engineers to sign and seal the engineering documents for the elements for which they provide design services, and that they provide the GER with the appropriate accountability documents, such as the supporting Schedule S-B, Assurance of Professional Design and Commitment for Field Review By Supporting Registered Professional, and Schedule S-C, Assurance of Professional Field Review and Compliance By Supporting Registered Professional (see Appendix B), on which the GER will rely upon to sign off on the relevant Letters of Assurance.

When preparing recommendations and designs, the GER may rely upon project information and special structural design criteria provided by the Owner, CRP, SER, and/or other design professionals, such as loads, settlement tolerances, seismic resistance, or other performance requirements. However, if the geotechnical investigations or design analyses determine that errors or other changes must be addressed by conducting additional investigations and/or changing the design beyond what is anticipated in the scope of services, then extraordinary additional services may have to be undertaken, as described in Section 3.4.2 Extraordinary Additional Services.

Geotechnical aspects of construction should be performed under the supervision of the GER, to ensure situations that require the GER's professional judgment and interpretation are identified and addressed.

The GER should monitor the geotechnical effects of construction activities on items designed by one or more SRPs (including Specialist Geotechnical Engineers), as shown on the drawings prepared by the SER. As part of this monitoring, the GER should assess any SRP's design, in order to advise on the feasibility of planned construction activities and assess the impact of, or the risks associated with, this aspect of construction on the Subgrade Support of the Building or other structures, both on and off site. Such assessments may be made to assist the Owner and CRP, or the SER, in determining the suitability of a particular construction methodology and the associated risks.

The GER should perform supervisory, review, or monitoring activities, including when providing recommendations or directions, in close communication with the CRP, SER, and other appropriate members of the design and construction team, so they can understand the impact of the GER's activities on the planned project.

The GER's responsibilities during construction include conducting Field Reviews of geotechnical aspects of construction being installed by the prime contractor or subcontractors. The GER is primarily responsible for evaluating whether the geotechnical aspects of construction are generally being performed according to the project plans, specifications, and geotechnical design recommendations of the GER, and for confirming that subsurface conditions encountered during construction are consistent with the design assumptions. The GER should review the Field Review program of the Specialty Geotechnical Engineer (or other SRP supporting the GER), so that those activities can be coordinated with the monitoring of other geotechnical items during installation and during later phases of the project.

When required by the Authority Having Jurisdiction, the GER, in collaboration with the SER and CRP, will assist in preparing and submitting record drawings or documents for the project.

If the Owner fails or refuses to undertake or perform the responsibilities as set out in Section 2.2.1 Owner, the GER should:

- consider recommending to the Owner in writing that the Owner should undertake and perform the responsibilities, and provide an explanation for why the Owner should do so; or
- consider withdrawing from the building project, and informing the Authority Having Jurisdiction of the withdrawal where that would be necessary for the GER to comply with his or her professional obligations under the Building Code or the Association's Code of Ethics.

In all circumstances, the GER is obligated to comply with the intent of these guidelines and take any additional steps necessary to protect the safety, health, and welfare of the public (i.e., such as notifying the Authority Having Jurisdiction or WorkSafeBC of unsafe or substantially unforeseen conditions).

2.2.5 SPECIALTY GEOTECHNICAL ENGINEER OR SUPPORTING REGISTERED PROFESSIONAL

The Specialty Geotechnical Engineer generally acts as an SRP. The SRP may be involved in design of works that are outside of the expertise of the GER. The SRP is usually engaged by the Owner, but may be engaged by the GER, the Owner's CRP, the SER, a design/build-P3 contractor, or another entity responsible for the delivery of a project. For those items for which the SRP is engaged, the SRP will be responsible for all aspects of investigation, design, deliverable submissions (including Letters of Assurance, where applicable), and Field Reviews, similar to those for the GER, as discussed above. When engaging an SRP, it should be confirmed that the SRP carries liability insurance and is registered to engage in the practice of professional engineering in BC.

The SRP may take responsibility for some geotechnical elements of the project, including aspects of the Subgrade Support of the Building, as agreed with the GER and CRP. Therefore, the SRP must provide the GER with all relevant information on the loadings, deflections, and other performance criteria to permit the GER to carry out a review of the impact of the specialty work on the comprehensive geotechnical design, including the Subgrade Support of Buildings and other features both on and off site.

While such information may not include the specific means or methods of analyses and design of the specialty work, the SRP must identify conditions or characteristics that differ materially from conventional design methods and from the critical or limiting design assumptions associated with these conventional methods.

The GER may provide a concept review of the SRPs' designs for the Owner, but only to assess risks associated with proceeding with such specialty work. The GER's review does not consider the adequacy of the elements for which the SRP is responsible, the correctness of dimensions or quantities, the contractor's safety measures in or near the work site, or the contractor's methods of construction.

The SRP must provide the GER with assurance that the elements designed and constructed under the SRP's scope substantially comply in all material respects with applicable requirements of the Building Code. Such submissions typically include signed and sealed design documents, Field Review reports, and completed accountability documents, such as the supporting Schedule S-B, Assurance of Professional Design and Commitment for Field Review By Supporting Registered Professional, and Schedule S-C, Assurance of Professional Field Review and Compliance By Supporting Registered Professional (see Appendix B: Letters of Assurance for Geotechnical Engineering Practices).

Schedule S-B and Schedule S-C were jointly published by the Architectural Institute of British Columbia (AIBC) and the Association for use by the SRP, and their use is strongly recommended. Refer to *Joint Professional Practice Guidelines – Professional Design and Field Review By Supporting Registered Professionals* (AIBC and Engineers and Geoscientists BC 2020) for more guidance.

2.2.6 GENERAL CONTRACTOR

The general contractor has a contractual relationship with the Owner. This contract typically states that the general contractor is responsible for the labour, materials, and equipment for the work, as well as the construction methods, techniques, sequences, procedures, safety precautions, and programs associated with the construction work, as set out in the contract documents.

The general contractor is responsible for its own work, the supervision and coordination of the subcontractors' work, and the inspection of the subcontractor's work prior to Field Reviews by the GER, where applicable. The general contractor is responsible for providing reasonable notice to the Owner, CRP, or GER when components are ready for Field Review by the GER.

The general contractor should notify the Owner, CRP, and/or GER in a timely manner if there are material differences in the subsurface conditions or changes in site conditions that may have a detrimental effect on the project or the safety of the public.

The presence or observations of the GER during construction does not relieve the general contractor of responsibility for constructing the project in accordance with the contract documents and good engineering practices, or of the responsibility for providing construction methods, techniques, sequences, procedures, safety precautions, and programs necessary to ensure safety and suitability for the project.

2.2.7 AUTHORITY HAVING JURISDICTION

The Authority Having Jurisdiction receives signed and sealed permit submissions, including Letters of Assurance, from the CRP or the EORs at appropriate times during the building project. The Authority Having Jurisdiction should confirm that the submissions have been properly completed; and if deficiencies are identified, clearly communicate to the CRP and/or EORs the specific items that require further attention.

An Authority Having Jurisdiction may have experience and expertise relating to hazards, such as those arising from:

- slopes;
- soil movement (expanding, compressing, settling);
- seismic vulnerabilities;
- capacity of storm sewer;
- floods;
- high groundwater elevations or concentrated groundwater flow paths;
- artesian groundwater; and
- dewatering.

An Authority Having Jurisdiction will typically consider the regional ramifications of the implementation of solutions, such as groundwater cut-off structures, slope management systems, geothermal wells, groundwater wells, and municipal infrastructure, and may develop management policies for such items.

In situations where an Authority Having Jurisdiction has significant concerns regarding the technical nature of the permit submissions, it may require that an independent review be carried out, the costs of which may be borne by the project team. Responsibility for such costs may be addressed in contractual agreements between the Owner, CRP, and EORs, including the GER.

3.0 GUIDELINES FOR PROFESSIONAL PRACTICE

3.1 OVERVIEW

This section outlines the practice and services a Geotechnical Engineer of Record (GER) should explain and/or provide to Client(s). It is not intended to be exhaustive and should not be interpreted to limit the GER's responsibilities, as discussed in the other sections of these guidelines, or what the GER ought to do by exercising good professional judgment in the circumstances of a particular project. The GER should be aware of any additional requirements in the jurisdiction in which their project is located.

3.2 SCOPE OF SERVICES

Before commencing design services, the GER should meet with the Client, who is usually the Owner or Coordinating Registered Professional (CRP), but may also be the contractor in a design-build contract, to:

- determine the terms of reference and the scope of work for basic services and additional services (see Section 3.3 Basic Geotechnical Engineering Services and Section 3.4 Additional Geotechnical Engineering Services);
- clarify the required design lives of temporary (if different than two years) and permanent structures;
- determine and specify which geotechnical elements are to be designed by specialty engineers;
- clarify the professional responsibilities for geotechnical design and Field Review in order to satisfy WorkSafeBC requirements as they relate to excavation safety and shoring;
- reach agreement on fees, payment schedule, and professional liability insurance coverage; and
- reach agreement on other contractual terms and conditions.

Such discussions should result in an Agreement for Geotechnical Services. Forms and precedents providing contract language are available on the Association of Consulting Engineering Companies British Columbia (ACEC-BC) website under "Contract Language" (ACEC-BC 2018). (See Section 6.2 Related Documents and Resources.)

The GER has a professional responsibility to uphold the principles outlined in the Association's Code of Ethics, including protection of public safety and the environment. As such, the GER must use a risk-based approach to decision making when providing professional services, and one of the risk factors that must be considered is climate change implications. The GER has a responsibility to notify the Client of future climate-related risks, reasonable adaptations to lessen the impact of those risks, and the potential impacts should the client refuse to implement the recommended adaptations. The GER has a responsibility to be aware of and meet the intent of any climate change requirements imposed by the client or the Authority Having Jurisdiction.

3.3 BASIC GEOTECHNICAL ENGINEERING SERVICES

The typical components of the basic services, as summarized below, are generally organized according to the sequential stages of a particular project. The types of services required for a particular project for Subgrade Support of the Building will vary according to the project characteristics, such as foundation location, depth, structural loading conditions, site geology, site development, and proximate existing development.

Each stage of service should be carried out in general conformance with the Canadian Foundation Engineering Manual (Canadian Geotechnical Society 2006), and a documented rationale should be provided for any deviations.

Although each stage of the basic service generally contains items pertaining to the respective construction stage (often because of the requirements of a specific project), some of the basic service activities may be performed out of normal sequence or in different stages than those indicated below. Services that are required for a typical project are described in the subsections below.

3.3.1 PROJECT DEFINITION AND PERMITTING STAGE

During the project definition and permitting stage, the Owner requires services to support evaluation of the viability of the project and the subsequent production of submissions required to obtain a building permit for the project.

The GER may provide the following services during this stage of the project:

- Conduct an initial site visit and undertake a desktop review to ascertain available subsurface and construction information in the vicinity of the site.
- Define and execute a subsurface investigation program through drilling, geophysics, and other means to assist in characterizing subsurface conditions at the project site, including the following:
  - Collect in-situ strength data (equivalent N values), and install and monitor groundwater observation piezometers.
  - Classify soil and rock materials, groundwater levels, and other conditions (including subsurface), including at adjacent off-site areas that could affect or be affected by the project. The geotechnical description of the soil conditions should conform with the intent of relevant standards such as ASTM D2487, Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System) (ASTM 2017a), and ASTM D2488, Standard Practice for Description and Identification of Soils (Visual-Manual Procedures) (ASTM 2017b), or the methods listed in Chapter 3 of the Canadian Foundation Engineering Manual (Canadian Geotechnical Society 2006).
  - Ensure the subsurface investigation meets the requirements of the Canadian Foundation Engineering Manual (Canadian Geotechnical Society 2006) in terms of depth and quantity of test holes, unless a rationale for deviation is provided and documented in the geotechnical report.
    - The type and quantity of data collected during the subsurface investigation should be representative of the vulnerability, risk (e.g., seismic risk), and value of the project.
    - Subsurface investigation and data collection methodologies should be selected by consideration of the geology that is expected to be encountered based on the literature review and/or local experience.

        - The results of the investigation should be reconciled with the results of the literature review.
        - Installation and monitoring of groundwater observation piezometers should be carried out for all projects, unless it can be proven to be unnecessary.
    - Conduct additional investigation beyond the initially defined investigation program, if significantly varied subsurface conditions are encountered or the design requirements of the development must be refined; the GER's Agreement for Geotechnical Services should be amended accordingly to reflect these additional services (see Section 3.4.2 Extraordinary Additional Services).
    - Prior to beginning subsurface investigation, confirm with the Owner and/or CRP that the site is not within a defined archeological sensitive area or area of significance.
        - If ground-altering activities reveal the presence of potential archaeological artifacts, it must be reported to the Archaeology Branch of the BC Ministry of Forests, Lands and Natural Resource Operations and Rural Development, who protect archaeological sites under the *Heritage Conservation Act*. The Archaeology Branch advises engaging the services of a professional archaeologist to provide guidance with the archaeology assessment process.
- Conduct physical testing of recovered samples to assist in determining soil and rock parameters that inform design recommendations pertaining to foundations, excavation (shoring), and management of groundwater and interflow, and reconcile qualitative and quantitative results of subsurface investigations with published geologic information.
- Perform necessary engineering analyses in order to determine geotechnical parameters that are relevant to the project, which may include the following:
    - Perform analyses to determine expected material strength parameters and groundwater elevations.
    - Specify methodologies and software to be used for analysis of soil response to static, seismic, and other (as appropriate) loading conditions, and note the limitations of prescribed boundary conditions and other input parameter assumptions.
    - Determine factors of safety.
    - Conduct design sensitivity analyses and obtain optimization results.
    - Estimate vertical and horizontal displacement for the building.
- Coordinate with other participants on the design team to identify foundation loading conditions and viable geotechnical-related options for the Subgrade Support of the Building.
- Prepare a geotechnical report that provides an account of the geotechnical activities performed and includes recommendations that address the geotechnical items in the Letters of Assurance relevant to the project, including the following:
    - An account of the performed activities addressing the first four points above, including:
        - outcomes of the desktop study;
        - description of investigation methodology and results, including assumptions, encountered soil conditions, and test hole logs; and
        - analysis methods and results.
    - Recommendations, including:
        - geotechnical aspects of the foundation design;
        - earth and groundwater pressures on walls below grade;
        - floor slab support;

    - earthworks;
    - sub-drainage; and
    - seismic design considerations.
  - Estimates of probable (foundation) movement or differential movement and, depending on the engaged scope of services, recommendations for matters such as:
    - stability of slopes;
    - design of retention systems;
    - utility support;
    - pavement;
    - stormwater facilities;
    - off-site impacts, including in consideration of the *BCBC* or VBBL, Clause 4.2.4.9 (relating to changes in groundwater) and Clause 4.2.5.2 (relating to excavation);
    - temporary support options and their impact on building design and construction; and
    - permanent dewatering, among other subsurface-related matters.
  - If methodologies (e.g., subsurface investigation program, factors of safety for excavation shoring design) deviate from the best practices described in the Canadian Foundation Engineering Manual (Canadian Geotechnical Society 2006), provide a rationale for the deviations, and a discussion of the associated risks.
- For adjoining properties, carry out an appropriate level of analysis to support the GER's technical recommendations, and maintain proper documentation to demonstrate appropriate protection of the geologically proximate structures, properties, and infrastructure.
  - Documentation should include parameters and groundwater level used in analysis, and a rationale for their selection.
  - The GER should advise the Owner to notify adjacent landowners of potential impacts to geologically proximate properties from the development and its construction, including:
    - associated vibration, excavation, filling, and ground improvement;
    - altering of the ambient groundwater regime, such as lowering groundwater elevation or changing its flow path; and
    - where relevant, the requirement for encroachment agreements needed to address shoring or underpinning, dewatering, pre-loading, and filling.
  - Before carrying out the design for an excavation, fill, or ground improvement works, an appropriate level of due diligence must be followed when considering and documenting the:
    - geological setting;
    - vulnerability or sensitivity-to-movement of adjacent structures, elements, and/or infrastructure;
    - selection of soil parameters and stability calculations including proximate surcharge loads; and
    - sources of water which may reasonably influence performance.
- To satisfy WorkSafeBC requirements, when taking responsibility under Schedule B for Geotechnical – Temporary, item 7.1, Excavation, prepare a design and supporting documents for building permit applications that include excavations and/or shoring designs for excavations with one or more of the following attributes:
  - Over 1.2 metres (4 feet) deep with sides sloped at an angle steeper than 3/4 horizontal to 1 vertical.
  - More than 6.1 metres (20 feet) deep.
  - Adjacent to structures that apply loads to the soil in the excavated area.

- In soil subject to vibration (including from construction traffic) or hydrostatic pressure likely to result in ground movement hazardous to workers.
- Along natural or human-made side slopes that are steeper than 3 horizontal to 1 vertical.
- Shored in a different fashion from those shown in the tables of the *Occupational Health and Safety Regulation.*

This design should specifically address:

- the indication of the intended design life for the temporary works;
- the topography, geology, and existing structures and/or improvements of the area encompassing the subject site; and
- anticipated soil and groundwater conditions, including natural geology and groundwater, that may have been or could be affected by previous or existing utility and basement excavations, buildings, retaining walls, and stormwater infiltration facilities, especially those that are sensitive to movement.

If shoring or underpinning is to be constructed, a sequence to allow safe installation should be provided. The design drawings should limit construction loading (magnitude and/or offset). Routine monitoring of excavations, as required by the *Occupational Health and Safety Regulation*, should be carried out.

If a GER is terminated from a project prior to conclusion of the temporary works, the GER should inform the Authority Having Jurisdiction of the GER's disengagement from the project, so that the Authority Having Jurisdiction is aware that there is a change in monitoring of the temporary works.

- When addressing item 8.4 (Structural considerations of soil, including slope stability and seismic loading) of Schedule B, consider the associated geologic history and geologic model of the subject stratigraphy. The Registered Professional (RP) undertaking responsibility for this item should engage the services of an appropriate Supporting Registered Professional (SRP) if these activities are outside of the GER's expertise.
  - For example, a site-specific seismic ground response assessment of Site Class F sites would require an SRP to also carry out an independent concept review of geotechnical foundation recommendations. Services related to slope stability assessments should be conducted in accordance with the *Guidelines for Legislated Landslide Assessments for Proposed Residential Developments in BC* (Engineers and Geoscientists BC 2010a).

3.3.2 DESIGN DEVELOPMENT STAGE

During the design development stage of the project, the GER may provide the following services:

- Provide consulting services during development of design drawings and specifications, to assist other members of the design team in the proper interpretation of the geotechnical recommendations.
- Collaborate with the design team, including the environmental engineer, regarding management of groundwater removal from site (such as strategies to limit flows and volumes), so potential off-site impacts are fully investigated and addressed in the design.
- Review the project contract documents before tendering to ensure compatibility with the intent of the geotechnical design recommendations.
- Recommend special services appropriate for the project.

3.3.3 BUILDING PERMITTING STAGE

If a building permit is required, Letters of Assurance such as Schedule A, Confirmation of Commitment By Owner and Coordinating Registered Professional, and Schedule B, Assurance of Professional Design and Commitment for Field Review, of the *BCBC* or VBBL must be delivered to the Authority Having Jurisdiction.

Division C, Sentence 2.2.7.3.(3) of the *BCBC* or VBBL requires that an Engineering Professional "place his or her professional seal or stamp on the plans submitted by him or her in support of the application for a building permit, after ascertaining that they substantially comply with the *British Columbia Building Code* and other applicable enactments respecting safety." Engineering Professionals can, at their discretion, mark drawings submitted for permitting as "Not for Construction" or add a similar note.

For permitting purposes, in order to meet the intent of the relevant provisions in the *BCBC* and VBBL, the geotechnical report and associated drawings are required to, at minimum:

- be complete for their intended purpose;
- substantially comply with the Building Code and other applicable enactments respecting safety;
- take into account construction safety to the extent that the geotechnical report or associated drawings relate to temporary geotechnical components;
- contain sufficient detail to enable the design to be checked by another Engineering Professional for conformance to the Building Code;
- be appropriately checked, with records of the checks performed retained for a minimum of 10 years; and
- be sealed, signed, and dated.

3.3.4 CONSTRUCTION STAGE

During the construction stage, the GER does not typically have control over the following project activities and accordingly would not be responsible for any of their components (unless indicated otherwise below):

- Construction means, methods, techniques, or procedures.
- Safety precautions and programs in connection with the construction work.
- Acts or omissions of the contractor, the subcontractors, any of the contractor's or subcontractors' agents or employees, or any other persons performing any of the construction work.
- Failure of the prime contractor or subcontractors to carry out the construction work in accordance with the contract documents.

The GER may provide the following services during the construction stage of the project:

- When appropriate, provide recommendations on relative risks associated with various construction means, methods, techniques, or procedures.
- Conduct Field Reviews, including construction observation and testing that the GER deems necessary to form a professional opinion about the geotechnical aspects of the work undertaken by the contractor, and to appropriately complete the Letters of Assurance for the Authority Having Jurisdiction.
  - In cases where Field Review is required on a "continuous" basis as per Division B, Subsection 4.2.2.3(2) of the *BCBC* or VBBL, the GER must ensure that methods and techniques are defined and documented that meet the intent of continuous Field Review. This should include the identification of qualified person(s) who provide the necessary observations, the required records of such observations, and the nature of supervision provided by the GER.

- During Field Reviews, confirm that work quality is sufficient to support the design intent, promote safety, and limit movement, especially if any of these could affect off-site and/or vulnerable buildings.
- Provide observations, testing, advice, and recommendations to facilitate the successful completion of the geotechnical related aspects of the building.
  - The GER may rely on the Owner, the CRP, or the contractor to inform the GER of construction progress and advise the GER when excavation shoring, foundation, and earthwork elements of the project are ready for Field Review.
  - During construction, the CRP or other appropriate person should notify the GER in a timely fashion when Field Reviews (and evaluation) can be conducted to confirm site conditions are as anticipated or, if site conditions are materially different, to modify design recommendations.
- Assess the stability of temporary excavation during Field Review, as required by the *Occupational Health and Safety Regulation*. This assessment should consider and possibly limit equipment loading and other types of surcharges that could be imposed during construction. (See Appendix A: WorkSafeBC Occupational Health and Safety Requirements Related to Geotechnical Engineering.)
- Review the Specialty Geotechnical Engineer's drawings for general conformance with the contract documents and intent of the geotechnical recommendations.
  - Specialty Geotechnical Engineer drawings, if any, are prepared for construction of special elements of subsurface work of a project. These drawings should comply with the contract documents, recommendations contained in the geotechnical reports, and sound engineering and construction practices.
  - During this review, the GER is not expected to determine the adequacy of elements or confirm the correctness of dimensions or quantities; the Specialty Geotechnical Engineer is responsible for the accuracy of these items.
- Issue timely reports to inform the appropriate parties of geotechnical-related construction observations, defective work, and/or unanticipated conditions requiring interpretation and direction.

It should be noted that engaging a GER to conduct Field Reviews does not relieve the prime contractor of responsibility for construction of the project, controlling progress, correcting any deviations from project requirements, or, if materially different site conditions are encountered, implementing design changes recommended by the GER to ensure safe working conditions.

Furthermore, Field Reviews by the GER do not constitute approval of the contractor's safety measures in or near the work site or methods of construction.

However, if the GER has concerns about the safety, health, and welfare of the public that cannot be addressed satisfactorily amongst the project team (including the Owner, CRP, and contractor) and adjacent landowners, the GER should notify the Authority Having Jurisdiction and/or WorkSafeBC in a timely manner and in accordance with the GER's professional responsibility under the Association's Code of Ethics.

3.4 ADDITIONAL GEOTECHNICAL ENGINEERING SERVICES

Services beyond those outlined in Section 3.3 Basic Geotechnical Engineering Services are frequently required. The GER should consider whether any of the additional geotechnical engineering services outlined below should be provided, according to the needs of the specific project.

These services are generally not considered basic geotechnical engineering services but may be identified at the start of the project. When required, additional services should be included in the scope of services mutually agreed upon by the Client and the GER in the Agreement for Geotechnical Services.

Additionally, the GER must recognize his or her professional limitations and engage the services of other professionals where necessary. One example is flood assessment work to determine whether a proposed development would be "safe for the use intended," which is addressed in *Professional Practice Guidelines – Legislated Flood Assessments in a Changing Climate in BC* (Engineers and Geoscientists BC 2018). Although some legislation refers to the need for a report by a "geotechnical engineer," in practice this work is typically conducted by a specialist water resources engineer. Another example is development of a stormwater management plan for a proposed development. While such work may involve geotechnical work related to water infiltration to the ground, this work should be led by a specialist engineer.

In both of these examples, a multi-disciplinary approach is often appropriate, under the leadership of the pertinent specialist engineer. The GER should be knowledgeable of and in compliance with any applicable provisions of the *Water Sustainability Act* and *Groundwater Protection Regulation* in carrying out professional activities. Where appropriate, for any special or extraordinary additional services that are required for a project, the GER should engage and consult an environmental engineer to fulfill the applicable regulatory requirements.

3.4.1 SPECIAL SERVICES

Wherever possible, the GER should determine if the project would benefit from or require additional special services at the time the scope is negotiated with the Owner. However, special services are often either not normally included as basic services or, because of project-specific circumstances, their need could not have been foreseen when the scope of work was first developed.

Special services may include the following:

- Site selection services, including air photo interpretation, geophysical investigations, hydrogeological groundwater studies and site planning, and erosion and sediment control plans.
- Environmental site assessments, including
  - environmental testing to evaluate the possible presence of hazardous or toxic materials in soils or groundwater; and
  - design of mitigation measures.
- Performance of special laboratory or in-situ tests to assist in characterization of subsurface soil and rock parameters; for example, triaxial, unconfined, compressive test, or direct shear.
- Installation and monitoring of inclinometers.
- Testing for freeze thaw, wetting, drying of soil and/or rock materials, and soil resistivity.
- Corrosion studies, including corrosion potential testing.
- Design and Field Reviews during installation of ground improvements, soil gas management systems, foundations, and earthworks.
- Review of encroachment agreements and related services when adjoining structures or properties are or potentially could be impacted or encroached upon by geotechnical activities.
- Preconstruction investigations and surveys of existing structures, including buildings, roadways, and utilities.
- Vibration monitoring.
- Project management consulting services, such as
  - attending construction progress meetings;
  - providing the Owner with commentary on the advantages and disadvantages of various design alternatives and/or construction means and methods;
  - providing contract administration services, including preparation of contracts, tender designs, and supporting documents;
  - performing indicative construction cost estimation for geotechnical construction work; or

  - reviewing estimates of quantities and construction costs related to other disciplines.
- Stormwater management studies, for which the GER should engage the services of appropriate SRP(s) if these activities are, fully or in part, outside of the GER's expertise; this may include hydrogeologists, hydraulic (i.e., river) engineers, civil engineers, mechanical engineers, and/or environmental engineers.
- Groundwater management, including hydrogeological studies, for which the GER should engage, or recommend the engagement of, the appropriate SRP(s) if these activities are, fully or in part, outside of the GER's expertise; this may include hydrogeologists, civil engineers, and/or environmental engineers.
- On-site sewage disposal system studies and design.
- Quality control testing of engineered fill and backfill, including grading design and drawings.
- Blasting review, control, and/or monitoring.
- Permanent dewatering or hydrogeological studies and design, including assessment of expected flows, filtration or control requirements, impact on neighbouring properties, and/or impact on ambient groundwater regime.
- Identification of archeologically and environmentally sensitive areas in accordance with appropriate municipal, provincial, and federal regulations. The GER should engage other engineering disciplines as required to support alternative or substitute designs.
- Feasibility assessment of geothermal infrastructure.

3.4.2 EXTRAORDINARY ADDITIONAL SERVICES

Extraordinary additional services are provided when extra work is required of the GER due to changes or unforeseen events that could not have been anticipated when the scope of the services was first developed. The extraordinary additional services involve the GER spending extra time and resources in providing additional geotechnical engineering services that are not ordinarily within the scope of basic or special services.

Extraordinary additional services may be required to address:

- changes in the scope, design, location, or magnitude of the project as described and agreed to under the Agreement for Geotechnical Services, including those that may arise from unforeseen soil, groundwater, weather, or utility or infrastructure conditions;
- cost over-runs that are outside of the control of the GER;
- changes in codes, laws, or regulations;
- change orders that are beyond or inconsistent with original instructions given by the Client or Owner;
- errors, omissions, or poor quality work by the contractor, subcontractors, or other professionals on the project;
- extension of the schedule of design and/or construction;
- requirements for attending regulatory meetings, public hearings, or legal proceedings concerning the project;
- requirements for acting as an expert witness or fact witness in project-related disputes;
- issues resulting from man-made disasters or natural disasters affecting the project;
- requests to review and/or design substitute or alternate systems;
- requests for overtime work by the Client, Owner, or CRP.

4.0 QUALITY MANAGEMENT IN PROFESSIONAL PRACTICE

4.1 QUALITY MANAGEMENT REQUIREMENTS

Engineering Professionals must adhere to the applicable quality management requirements during all phases of the work, in accordance with the Association's Bylaws. It is also important to be aware of whether additional quality management requirements exist from Authorities Having Jurisdiction or through service contracts.

To meet the intent of the quality management requirements, Engineering Professionals must establish and maintain documented quality management processes for the following activities:

- The application of relevant professional practice guidelines
- Authentication of professional documents by the application of the professional seal
- Direct Supervision of delegated professional engineering activities
- Retention of complete project documentation
- Regular, documented checks using a written quality control process
- Documented Field Reviews of engineering designs/recommendations during implementation or construction
- Where applicable, documented independent review of structural designs prior to construction

4.1.1 PROFESSIONAL PRACTICE GUIDELINES

In accordance with the *Act*, s.4(1) and Bylaw 11(e)(4)(h), Engineering Professionals are required to comply with the intent of any applicable professional practice guidelines related to the engineering work they undertake. One of the three objectives of the Association, as stated in the *Act* is "to establish, maintain, and enforce standards for the qualifications and practice of its members and licensees". Practice guidelines are one means by which the Association fulfills this obligation.

These professional practice guidelines establish the standard of practice for geotechnical engineering services related to building projects. Engineering Professionals who carry out these activities are required to meet the intent of these guidelines.

4.1.2 USE OF SEAL

In accordance with the *Act*, s.20(9), Engineering Professionals are required to seal all professional engineering documents they prepare or deliver in their professional capacity to others who will rely on the information contained in the documents. This applies to documents that Engineering Professionals have personally prepared and those that others have prepared under their Direct Supervision.

Failure to seal these engineering or geoscience documents is a breach of the *Act*.

For more information, refer to *Quality Management Guidelines – Use of Seal* (Engineers and Geoscientists BC 2017).

4.1.3 DIRECT SUPERVISION

In accordance with the *Act*, s.1(1) and 20(9), Engineering Professionals are required to directly supervise any engineering work they delegate. When working under the Direct Supervision of an Engineering Professional, unlicensed persons or non-members may assist in performing engineering work, but they may not assume responsibility for it. Engineering Professionals who are limited licensees may only directly supervise work within the scope of their license.

With regard to Direct Supervision, the Engineering Professional having overall responsibility should consider:

- the complexity of the project and the nature of the risks;
- which aspects of the work should be delegated;
- the training and experience of individuals to whom work is delegated; and
- the amount of instruction, supervision, and review required.

Careful consideration must be given to delegating Field Reviews. Due to the complex nature of Field Reviews, Engineering Professionals with overall responsibility should exercise judgment when relying on delegated field observations, and should conduct a sufficient level of review to have confidence in the quality and accuracy of the field observations. (See Section 4.1.6 Documented Field Reviews During Implementation or Construction.)

For more information, refer to *Quality Management Guidelines – Direct Supervision* (Engineers and Geoscientists BC 2018b).

4.1.4 RETENTION OF PROJECT DOCUMENTATION

In accordance with Bylaw 14(b)(1), Engineering Professionals are required to establish and maintain documented quality management processes that include retaining complete project documentation for a minimum of ten (10) years after the completion of a project or ten (10) years after engineering documentation is no longer in use.

These obligations apply to Engineering Professionals in all sectors. Project documentation in this context includes documentation related to any ongoing engineering work, which may not have a discrete start and end, and may occur in any sector.

Many Engineering Professionals are employed by organizations, which ultimately own the project documentation. Engineering Professionals are considered compliant with this quality management requirement when a complete set of project documentation is retained by the organizations that employ them using means and methods that are consistent with the Association's Bylaws and guidelines.

For more information, refer to *Quality Management Guidelines – Retention of Project Documentation* (Engineers and Geoscientists BC 2018c).

4.1.5 DOCUMENTED CHECKS OF ENGINEERING AND GEOSCIENCE WORK

In accordance with Bylaw 14(b)(2), Engineering Professionals are required to perform a documented quality checking process of engineering work, appropriate to the risk associated with that work.

Regardless of sector, Engineering Professionals must meet this quality management requirement.

In this context, 'checking' means all professional deliverables must undergo a documented quality checking process before being finalized and delivered. This process would normally involve an internal check by another Engineering Professional within the same organization. Where an appropriate internal checker is not available, an external checker (i.e., one outside the

organization) must be engaged. Where an internal or external check has been carried out, this must be documented.

Engineering Professionals are responsible for ensuring that the checks being performed are appropriate to the level of risk. Considerations for the level of checking should include the type of document and the complexity of the subject matter and underlying conditions; quality and reliability of background information, field data, and elements at risk; and the Engineering Professional's training and experience.

For more information, refer to *Quality Management Guidelines – Documented Checks of Engineering and Geoscience Work* (Engineers and Geoscientists BC 2018d).

4.1.6 DOCUMENTED FIELD REVIEWS DURING IMPLEMENTATION OR CONSTRUCTION

In accordance with Bylaw 14(b)(3), Field Reviews are reviews conducted at the site of the construction or implementation of the engineering work. They are carried out by an Engineering Professional or a subordinate acting under the Engineering Professional's Direct Supervision (see Section 4.1.3 Direct Supervision).

Field Reviews enable the Engineering Professional to ascertain whether the construction or implementation of the work substantially complies in all material respects with the engineering concepts or intent reflected in the engineering documents prepared for the work.

In addition, during geotechnical Field Reviews, Engineering Professionals must take the appropriate steps to confirm that actual site conditions are consistent with those assumed during design. Where implementation of the work is sensitive to the quality of the work, the Engineering Professional should determine that the design intent is achieved.

For more information, refer to *Quality Management Guidelines – Documented Field Reviews during Implementation or Construction* (Engineers and Geoscientists BC 2018e).

4.1.7 DOCUMENTED INDEPENDENT REVIEW

Bylaw 14(b)(4) refers to an independent review in the context of structural engineering. An independent review is a documented evaluation of the structural design concept, details, and documentation based on a qualitative examination of the substantially complete structural design documents, which occurs before those documents are issued for construction. It is carried out by an experienced Engineering Professional qualified to practice structural engineering, who has not been involved in preparing the design.

Geotechnical engineering projects can pose great risk to public safety and the environment. Therefore, the GER must consider the risk related to the project and determine whether an independent review of the GER's design by a qualified professional is warranted. To maintain independence, the independent reviewer must not have been involved in preparing the design. The independent reviewer may, however, be a member of the same organization.

As per the *Professional Practice Guidelines – Retaining Wall Design* (Engineers and Geoscientists BC 2020), an independent review is required for retaining walls over 3.0 metres high.

For more information, refer to *Quality Management Guidelines – Documented Independent Review of Structural Designs* (Engineers and Geoscientists BC 2018f).

5.0 PROFESSIONAL REGISTRATION & EDUCATION, TRAINING, AND EXPERIENCE

5.1 PROFESSIONAL REGISTRATION

It is the responsibility of Engineering Professionals to determine whether they are qualified by training and/or experience to undertake and accept responsibility for carrying out geotechnical engineering services for building projects (Code of Ethics Principle 2).

5.2 EDUCATION, TRAINING, AND EXPERIENCE

Geotechnical engineering for building projects, as described in these guidelines, requires minimum levels of education, training, and experience in many overlapping areas of engineering. Engineering Professionals taking responsibility must adhere to the Association's Code of Ethics (to undertake and accept responsibility for professional assignments only when qualified by training or experience) and, therefore, must evaluate their qualifications and must possess the appropriate education, training, and experience to provide the services.

The Association recommends using a Qualifications-Based Selection (QBS) process to select the most competent and qualified consultant for a specific project. Information on the QBS selection process can be found on the dedicated website developed by the Association of Consulting Engineering Companies British Columbia (ACEC-BC 2015).

The level of education, training, and experience required of the Engineering Professional should be adequate for the complexity of the project. Typical qualifications for the lead Engineering Professional or a team of professionals on a geotechnical engineering project may include education, experience, and understanding in the following areas:

- Surficial and subsurface geology
- Groundwater conditions
- Requirements within the *BC Building Code* as per the Guide to the Letters of Assurance in the BC Building Code (particularly the section titled "Application of Letters of Assurance to Geotechnical Components") (Province of BC 2010)

The academic training for the above skill sets can be acquired by taking formal university or college courses or through continuing professional development. There may be some overlap in courses and specific courses may not correlate to specific skill sets. An Engineering Professional should also remain current with evolving topics, through continuing professional development. Continuing professional development can include taking formal courses; attending conferences, workshops, seminars, and technical talks; reading technical publications; doing web research; and participating in field trips.

6.0 REFERENCES AND RELATED DOCUMENTS

Documents cited in the main guidelines and the corresponding appendices appear in Section 6.1: References.

Related documents that may be of interest to users of this guideline but are not formally cited elsewhere in this document appear in Section 6.2: Related Documents and Resources.

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7.0 APPENDICES

APPENDIX A: WORKSAFEBC OCCUPATIONAL HEALTH AND SAFETY REQUIREMENTS RELATED TO GEOTECHNICAL ENGINEERING

The following aligns with the requirements of WorkSafeBC. The Geotechnical Engineer of Record (GER) submitting a Schedule B, Assurance of Professional Design and Commitment for Field Review, taking professional responsibility for Geotechnical – Temporary, item 7.1, Excavation, should include supporting documentation with detailed design and specifications for excavations with one or more of the following attributes:

- Over 1.2 metres (4 feet) deep with sides sloped at an angle steeper than 3 /4 horizontal to 1 vertical
- More than 6.1 m (20 ft) deep
- Adjacent to structures that apply loads to the soil in the excavated area
- In soil subject to vibration (including from construction traffic) or hydrostatic pressure likely to result in ground movement hazardous to workers
- Along natural or human-made side slopes that are steeper than 3 horizontal to 1 vertical
- Shored in a different fashion from those shown in the tables of the *Occupational Health and Safety Regulation*

For temporary excavation conditions, to avoid having an existing structure apply a load to the soil in an adjacent area, the structure should generally be behind a line rising 1 vertical to 1 horizontal from the toe of the proximate excavation. The actual gradient of this line would be a function of subsurface conditions.

These excavations will likely also require shoring; therefore, an Engineering Professional should also take responsibility for temporary shoring (item 7.2, Shoring) and provide detailed design drawings, specifications, and construction sequences to allow safe installation of the shoring system. Engineering Professionals should also sign off on item 7.3, Underpinning, if adjacent structures apply loads to shoring.

The Engineering Professional must assume full responsibility for assessing the stability of the soil (i.e., excavation, shoring, and underpinning) for the duration of work being carried out inside, or in the vicinity of, the excavation. The Engineering Professional must propose design specifications which, based on professional judgment, provide reasonable assurance that the excavation will remain stable.

The documents, signed and sealed by an Engineering Professional, must contain the following information:

- Drawings (preferably to scale) of the site, with no need for verbal clarification.
- Drawings (preferably to scale) of the excavation slope, depth, shoring, soil restraint anchors and braces, surface protection, and drainage, if applicable, along with a geotechnical description of the soil conditions.
- A description of any limitations regarding the presence of heavy machinery or other surcharge loads that will be permitted close to the top of the excavation, and the potential influence of changing weather conditions.
- In Field Review reports issued during construction, reference to the aforementioned drawings and a statement of professional opinion indicating the excavation is safe for work to be carried out inside or around the excavation.
- The date and time period to which the certification applies.

- The name of a designated person on the site who is authorized to determine changes in soil conditions, where applicable, along with a description of change thresholds that should trigger:
  - review by the Geotechnical Engineer of Record (GER), and;
  - evacuation of the excavation.

The following additional documents may be provided to supplement those listed above:

- Site plan, to scale, including:
  - property lines;
  - proposed subsurface development, accounting for footing depths, elevator pits, and pull pits sumps; and
  - existing structures within the 1 vertical to 1 horizontal line rising from the toe of the excavation, including related buried utilities and excavations and trenches.
- Sections, to scale, including the documents above, as well as assumed subsurface soil conditions and shoring elements; variations in subsurface soil should be indicated that account for weathering and previous proximate excavation and backfilling work.
- Specifications that include:
  - reference documents (including the results of a BC One Call);
  - testing results or proximate experience yielding information on subsurface soil conditions;
  - modelling software and soil strength parameters yielding design results associated with design slope cuts steeper than 4 vertical to 3 horizontal;
  - specifications for drainage, filter, fill, and protection materials;
  - specifications for shoring materials;
  - procedure for staged or sequenced installation;
  - description of proposed encroaching elements; and
  - requirements for decommissioning.

APPENDIX B: LETTERS OF ASSURANCE FOR GEOTECHNICAL ENGINEERING

B1 BACKGROUND AND OVERVIEW

The Letters of Assurance were introduced in 1990 in the *Vancouver Building Bylaw* (VBBL) and in 1992 in the *British Columbia Building Code* (*BCBC*), and they continue to be referenced in the current editions of the VBBL and the *BCBC*. Letters of Assurance were developed after discussions among the City of Vancouver, the British Columbia (BC) Building Policy Branch, the Architectural Institute of BC, and Engineers and Geoscientists BC, and in close consultation with the Building Officials Association of BC.

The intent of the Letters of Assurance is to assure the Authority Having Jurisdiction that for a particular building project:

- the activities of the various Registered Professionals of Record (RPRs) are coordinated;
- the design documents submitted in support of the application for a building permit substantially comply with the *BCBC* or VBBL;
- building designs substantially comply with the requirements of the *BCBC* or VBBL; and
- the RPR will undertake, and has undertaken, the necessary Field Reviews to determine that building construction substantially complies with the *BCBC* or VBBL.

Where unanticipated conditions are observed, the Engineering Professional should provide recommendations and additional Field Reviews to achieve the design objectives. An Engineering Professional is responsible for ensuring deficiencies identified in the Field Reviews for which he or she takes responsibility on a Schedule B are adequately addressed, prior to issuing a Schedule C.

Where the requirements of the *BCBC* or VBBL are at variance with standard practice, there are provisions for "generally accepted design" or "established local practice" to satisfy the requirements.

B1.1 SCHEDULE B

Schedule B, Assurance of Professional Design and Commitment for Field Review, identifies the various RPRs who take responsibility for their designs, and confirms that their designs substantially comply with the BCBC or VBBL respecting safety, except for construction safety aspects. Schedule B also provides a commitment that the RPRs will be responsible for the Field Reviews relevant to those items for which they take professional responsibility as is suitable for the project.

B1.2 SCHEDULE C-B

Schedule C-B, Assurance of Professional Field Review and Compliance, confirms that the necessary Field Reviews have been completed by the RPR and the finished project substantially conforms to the design and the *BCBC* or VBBL.

B1.3 SCHEDULES S-B AND S-C

An RPR acting as the Geotechnical Engineer of Record (GER) should only undertake design and Field Review for items identified on the Letter of Assurance for their discipline, based on their competency.

As such, an RPR or an Owner may require supplementary supporting engineering services for a particular component or subcomponent. When supporting engineering services are required, it is recommended that the relevant RPR obtains the appropriate assurances from the Supporting Registered Professional (SRP), specifically Schedule S-B,

Assurance of Professional Design and Commitment for Field Review By Supporting Registered Professional. The RPR or Owner, or a contractor, sub-trade, or supplier, may engage the SRP to provide supporting design service and corresponding Field Review service (e.g., Schedule S-B or S-C).

After receiving assurance from an SRP via Schedule S-C, Assurance of Professional Field Review and Compliance By Supporting Registered Professional, that a particular component or subcomponent substantially complies, in all material respects, with the applicable requirements of the *BCBC* or VBBL, the RPR can complete and submit the Letter of Assurance for his or her discipline.

Refer to *Joint Professional Practice Guidelines: Professional Design and Field Review By Supporting Registered Professionals* (AIBC and Engineers and Geoscientists BC 2020), which includes the model Schedules S-B and S-C that the AIBC and Engineers and Geoscientists BC recommend for use by a Registered Professional (RP) acting as an SRP.

B1.4 CODES, BYLAWS, AND GUIDANCE DOCUMENTS

More information on the Letters of Assurance in the *BCBC* and VBBL is available from the following sources (see also Section 6.0 References and Related Documents):

- *BC Building Code*, Letters of Assurance (BCBC 2018b)
- City of Vancouver Building By-law, Letters of Assurance (City of Vancouver 2014)
- Guide to the Letters of Assurance in the BC Building Code (Province of BC 2010)
- Bulletin K: BCBC – Letters of Assurance in the BC Building Code and Due Diligence (Engineers and Geoscientists BC 2010b)
- *Joint Professional Practice Guidelines: Professional Design and Field Review by a Supporting Registered Professional* (AIBC and Engineers and Geoscientists BC 2020).

The following table summarizes the schedules referred to in this appendix to these guidelines.

Table B - 1: List of Letters of Assurance Related to Geotechnical Engineering Services

SCHEDULE	PURPOSE	SOURCE
Schedule B	Letter of Assurance Form: Assurance of Professional Design and Commitment for Field Review	*BCBC* or VBBL
Schedule C-B	Letter of Assurance Form: Assurance of Professional Field Review and Compliance	*BCBC* or VBBL
Schedule S-B	Intraprofessional Form: Assurance of Professional Design and Commitment for Field Review By Supporting Registered Professional	*Joint Professional Practice Guidelines: Professional Design and Field Review By Supporting Registered Professionals* [a]
Schedule S-C	Intraprofessional Form: Assurance of Professional Field Review and Compliance By Supporting Registered Professional	*Joint Professional Practice Guidelines : Professional Design and Field Review By Supporting Registered Professionals* [a]

NOTE:

[a] AIBC and Engineers and Geoscientists BC 2020

B2 LETTERS OF ASSURANCE FOR GEOTECHNICAL ENGINEERING PRACTICES

B2.1 APPLICATION OF LETTERS OF ASSURANCE TO GEOTECHNICAL COMPONENTS

For Part 3 buildings, a subsurface investigation by an RPR is mandated by the *BCBC*, Division B, Part 4, Sentence 4.2.2.1.(1). The Coordinating Registered Professional (CRP) must submit a Schedule B from the RPR for the geotechnical discipline at the time of building permit application to the Authority Having Jurisdiction. Due to the variable nature of subsurface conditions, geotechnical designs based upon the subsurface investigation may have to be altered to suit the site conditions found during Field Reviews. Furthermore, the GER is obligated to notify the Authority Having Jurisdiction if unsafe or substantially unforeseen conditions are encountered, to determine if updated submissions are required.

For Part 9 buildings, in accordance with the *BCBC*, Division C, Part 2, Sub-clause 2.2.7.1.(1)(c)(ii), a subsurface investigation by an RPR is only required when the geotechnical conditions at the building site fall outside the scope of Part 9 in Division B. This could include any of the following conditions:

- Allowable bearing pressure is less than 75 kPa
- Foundations are supported on compacted fill that exceeds 300 mm in thickness
- Foundations are supported on permafrost
- Foundations may be subject to slope instability
- Underpinning
- Deep foundations
- Foundation walls exceed the criteria of Subsection 9.15.4. in Part 9 of Division B
- Retaining walls, other than foundation walls, are subject to lateral earth pressure
- Retained height exceeds 1.5 metres

Due to the variable nature of geotechnical conditions, the conditions noted above for Part 9 buildings may not become apparent until after the excavation has commenced. In such a case, the Owner must retain a RPR for the geotechnical discipline to undertake subsurface investigation, provide geotechnical design, and submit a Schedule B to the Authority Having Jurisdiction upon completion of the design. However, retention of a GER prior to building permit application would enhance a Part 9 building permit application and preemptively address risks associated with variable geotechnical conditions, and the GER may cross off the items on Schedule B that do not apply to the project. The GER will conduct Field Reviews during construction and submit a Schedule C-B, Assurance of Professional Field Review and Compliance to the Owner for submission to the Authority Having Jurisdiction prior to occupancy.

Environmental aspects related to investigation, testing, handling, and disposal of contaminated soil and groundwater are not included and do not form part of the geotechnical items or responsibilities as set out in the Letters of Assurance.

B2.2 SCHEDULE B: GEOTECHNICAL – TEMPORARY

Temporary works are those which are designed for the purpose and duration of construction of the building only, with associated drawings specifying the intended design life of the temporary works. This period is normally less than two years and may be as short as several hours. Seismic design of the works is not normally required, but the design should consider weather. If temporary systems are to be in place longer than the period assumed in the design, the design should be reviewed by the GER and/or others, and supplementary assessment, design, and/or remedial construction work may be required.

The GER taking responsibility for the Geotechnical – Temporary section of Schedule B does not have to be the same GER taking responsibility for the Geotechnical – Permanent section of Schedule B. In fact, these two areas can be completed by Engineering Professionals

from separate companies; however, their efforts and design intents should be coordinated.

The GER has the following responsibilities when signing off on the design and Field Reviews of items 7.1 to 7.4 in the Geotechnical – Temporary section of Schedule B.

7.1 Excavation

Excavation refers to the removal of ground. The scope of this item is normally limited to the responsibility for stability of temporary cut slopes. The scope does not include any aspect of the contractor's responsibilities for construction methods, techniques, sequences, procedures, safety precautions, or the operation of equipment on, to, or from the site (but may include restrictions for staging of surcharge loads), nor does this scope include the responsibility for the layout of the location of the excavated cuts. However, as per Section 20 in the WorkSafeBC *Occupational Health and Safety Regulation*, the GER must consider potential construction loading in their stability assessments of slope cuts and must limit or restrict (i.e., recommend safe offsets for) such loading. See Appendix A: WorkSafeBC Occupational Health and Safety Requirements Related to Geotechnical Engineering and Section 3.3.1 Project Definition and Permitting Stage of these guidelines for more information.

7.2 Shoring

Shoring refers to soil reinforcing and retention and structural works for supporting excavation cuts, and the structures, elements, and features beyond those areas. This normally includes both geotechnical and structural aspects, including consideration of groundwater; estimation and consideration of proximate surcharge loading; and consideration of the condition of proximate features and their potential vulnerability to movement.

7.3 Underpinning

Underpinning refers to soil reinforcing and retention and structural works, including specification of construction sequence, for supporting existing building foundations adjacent to the excavation cuts. This normally includes both geotechnical and structural aspects, including consideration of groundwater and estimation and consideration of proximate structural surcharge loads.

7.4 Temporary construction dewatering

Temporary construction dewatering refers to the installation of well and/or pumping systems and/or temporary cut-off structures to maintain stability of the excavation and partially constructed buildings (i.e., due to buoyancy) by control of groundwater levels or flow. This normally is related to the pumping and drainage of groundwater, including consideration of measures to reduce temporary and long-term (i.e., if subject structure will not be removed) off-site impacts such as settlement or subsidence due to raising or lowering the water table.

This does not include:

- diversion and pumping as required to maintain the excavation free of surface run-off;
- precipitation;
- minor bank seepage (e.g., interflow);
- control or treatment of sediment discharge; or
- measures to prevent deposit of sediment or soil on or in adjacent properties, streets, or services.

B2.3 SCHEDULE B: GEOTECHNICAL – PERMANENT

Permanent works are those designed for the life of the building. This design life is normally assumed to be between 50 and 75 years but may differ based on project requirements. Temporary construction aspects necessary to build the permanent works are not included in this section.

The GER has the following responsibilities when signing off on the design and Field Reviews of items 8.1 to 8.7 in the Geotechnical – Permanent section of Schedule B.

8.1 Bearing capacity of the soil

Bearing capacity of the soil refers to the allowable bearing of the ground for the Subgrade Support of the Building using shallow foundations. Factors that may affect bearing capacity include, but are not limited to:

- subsurface soil or rock and groundwater conditions;
- long-term settlement;
- seismic ground response; and
- frost.

This does not include:

- structural design of the foundation member;
- layout of the locations of the foundation members; or
- supervision and operation of personnel and machinery used for installing the foundation members.

8.2 Geotechnical aspects of deep foundations

This refers to the geotechnical aspects of deep foundations (e.g., piles, caissons) for the Subgrade Support of the Building. Consideration of factors that may affect the building include:

- subsurface soil or rock and groundwater conditions;
- long-term settlement; and
- the pile response to seismic ground and building movement.

This does not include:

- structural design of the deep foundation member (e.g., pile, caisson);
- detailed layout of the locations of the deep foundation members; or
- supervision and operation of personnel and machinery used for installing the deep foundation members.

Consideration of corrosion should be addressed jointly by the Structural Engineer of Record (SER) and the GER.

Where rock bolts or anchors are used to secure unfavourable jointing in bedrock supporting a building, these would be considered deep foundations.

8.3 Compaction of engineered fill

Compaction of engineered fill refers to fills used for the Subgrade Support the Building foundations. It is recommended that compacted fills supporting building slabs be included.

Not included are fills supporting landscaping or exterior to building foundation walls.

8.4 Structural considerations of soil, including slope stability and seismic loading

This item includes assessment of the soil and groundwater conditions that affect the strength properties of the soil surrounding and supporting the building, and whether any of those conditions could affect the structural design of the building. Considerations must include the potential influence of the stability of adjacent slopes that interact with the building foundation, and whether any changes in soil properties caused by weather, temperature, ground movement, or seismic events could alter the interaction between the building and the surrounding and supporting soil.

Refer to *Professional Practice Guidelines – Legislated Landslide Assessments for Proposed Residential Development in BC* (Engineers and Geoscientists BC 2010a) for further guidance. For instances where the Authority Having Jurisdiction requires that the project produce a landslide assessment according to the standard of practice defined in those guidelines, the associated report should be accompanied by the Landslide Assessment Assurance Statement provided in Appendix D of those guidelines.

8.5 Backfill

Backfill refers to soil placed against building walls that affect the walls themselves and/or their performance. Considerations should include loading on the building wall, including the effects of compaction, moisture content, and density of fills placed adjacent to foundation walls, and support for adjacent properties. Fill is normally not included, as it does not impinge on the performance of the building or adjacent property (e.g., fill under on-site sidewalks and driveways, landscaping fill, or fill for the bedding of services). However, where on-site sidewalks and other hard-landscaped areas span backfill areas adjacent to the building that will be traversed by the public, measures should be considered to reduce the risk that hazards may develop on site due to settlement or other concerns (e.g., the potential for slips or trips).

8.6 Permanent dewatering

Permanent dewatering refers to the geotechnical aspects of the installation of well, drainage, and/or groundwater cut-off systems. This normally relates to the pumping, drainage, and/or groundwater cut-off structures that are required to limit hydrostatic pressures acting on the building. Considerations should include seismic load and performance, soil and structure interaction, measures to reduce off-site impacts such as settlement or subsidence due to raising or lowering the water table. This item also includes specification of design hydraulic conductivities, and seepage estimates. This should include setting or affirming an appropriate maximum design groundwater elevation, which incorporates a 'freeboard' or factor of safety, and potentially relates to a specific return period, if available.

This does not include:

- design of pumping;
- normal perimeter foundation and underslab drains or plumbing systems;
- interflow;
- precipitation; or
- design of the moisture or waterproofing membranes for the building walls or slabs.

Where a groundwater cut-off structure will be permanently relied upon to maintain lateral pressures acting on the building to design levels, the design and Field Reviews should also consider seismic loads, seismic performance, and soil and structure interaction.

8.7 Permanent underpinning

Permanent underpinning refers to the permanent soil reinforcing, soil retention, and structural works that support existing building foundations adjacent to the new building. This normally includes gravity loads but the GER should coordinate with the SER to confirm whether lateral loads should be resisted. Considerations should include both geotechnical and structural aspects, including lateral deformation, groundwater, freeze-thaw, of proximate seismic load estimates, structural surcharge loads, vulnerability of the adjacent building to movement, corrosion and/or soil aggressivity, and design life.

This item also includes relevant permanent shoring, referring to the permanent soil reinforcing, soil retention, and structural works for supporting excavation cuts, and the elements and features beyond or facilitating

steep-to-vertical grade changes that substantially affect the building design or its safety. Considerations should include both geotechnical and structural aspects, including lateral deformation, groundwater, freeze-thaw, proximate seismic load estimates, non-building surcharge loads, the condition of proximate features and their potential vulnerability to movement, corrosion and/or soil aggressivity, and design life, notwithstanding that such shoring does not apply to permanent support of adjacent buildings.

B2.4 SCHEDULE B: PLUMBING

The following professionals are responsible for signing off on the design and Field Reviews of item 4.2 in the Plumbing section of Schedule B.

- The GER is responsible for aspects of item 4.2 in coordination with and depending on the engagement of other discipline Registered Professionals of Record as noted below, if neither a Mechanical Engineer of Record (MER) nor a Civil Engineer of Record (CER) is engaged on the project (see below):
  - The GER should work with the CRP or Owner to determine if a project scope for site and foundation drainage is required and, if so, add it to the GER's scope of services. The GER must then determine if the GER is prepared and qualified to undertake this work or if a mechanical engineer, civil engineer, and/or a Specialty Geotechnical Engineer should be engaged.
  - Projects where the GER may be asked to take responsibility for this item include Part 9 buildings and home improvement projects.
  - When the GER takes on this work, it must be performed according to the *Guidelines for Mechanical Engineering Services for Building Projects* (Engineers and Geoscientists BC 1993), including the requirement to coordinate with a civil engineer (if engaged on the project).
- If an MER is engaged on the project, they are normally responsible for Item 4.2.
  - For sites where below-grade portions of the building do not extend close to the property lines, a civil engineer should be engaged to address surficial site drainage. The MER must coordinate with the project CER for surficial drainage and site services, to determine and confirm scope boundaries related to drainage and site services, which are typically a 1 metre offset from the building perimeter.
  - The MER must coordinate with the GER to ensure the MER's design is compatible with maximum design groundwater elevation, hydraulic conductivity, estimation of seepage, and/or dewatering approaches. With respect to geotechnical specialty items, coordination with the GER and provision by the GER of Schedule S-B, Assurance of Professional Design and Commitment for Field Review By Supporting Registered Professional is required.
- If a CER is engaged on the project, they are normally responsible for the "site service" aspects of item 4.2, as outlined above and according to the agreed project-specific scopes of work for the MER and the CER.
  - If the CER's design relies on geotechnical specialty items, such as determination of maximum design groundwater elevation, hydraulic conductivity, and estimation of seepage, coordination with the GER and provision of a Schedule S-B by the GER is required.

The following responsibilities must be fulfilled by the professionals responsible for signing off on the design and Field Reviews of item 4.2 in the Plumbing section of Schedule B, as described above.

4.2 Site and foundation drainage systems

Site and foundation drainage systems refers to the arrangement of site grading and buried (subsoil) pipes, trenches, and other engineered systems that intercept surface and subsurface (both groundwater and interflow) water flow and direct it away from a building and its below-grade envelope system. In the *BCBC* Letters of Assurance, this item is pertinent to buildings, and ensures the codified requirements to direct water flow away from buildings are met.

Although engineering input to the design of site-grading and other systems to manage surface and subsurface water that do not affect buildings may add value to a project, this is a separate issue and does not require declaration of professional responsibility for item 4.2.

Within a nominal 1 metre offset from the perimeter of the building, item 4.2 is normally undertaken by mechanical engineers and is related to the design and Field Reviews of on-site stormwater and groundwater management features. Typical design features may include foundation and perimeter drainage pipes, interior catch basins and sediment sumps, weep holes, pumps, alarm floats, back-up generators, triggering elevations, and connections to a site drainage system or municipal infrastructure. If appropriate to the site and project, this typical offset distance may be adapted in coordination between the project's mechanical, civil, and geotechnical professionals.

Outside of the nominal 1 metre offset from the perimeter of the building, item 4.2 as relates to site service aspects are normally undertaken by a civil engineer. According to the Guide to the Letters of Assurance in the BC Building Code (Province of BC 2010), this may include, but is not limited to:

- site grading;
- stormwater piping, including on-site stormwater system features such as sumps, catch basins, inspection chambers, pipes, detention tanks (including proprietary), swales, drains, dry wells (including rock pits, infiltration trenches, fields, galleries, or proprietary stormwater management facilities), pumps, alarm floats, back-up generators, and triggering elevations;
- drainage for site retaining walls;
- sanitary piping, including on-site sanitary systems such as septic fields;
- domestic water piping;
- fire suppression water piping; and
- fire hydrants on private property.

For sites where infiltration of rainwater will be managed as part of a development's drainage systems, the approach must be coordinated with site-specific geotechnical considerations. Site-specific geotechnical considerations should be based on knowledge of the governing groundwater regime (including possible seasonal and tidal effects) and the receiving geology (including hydraulic conductivities and stability of sloping sites), the stability of proximate structures including retaining walls, climate change impacts, and the maximum design groundwater elevation. Potential hydraulic connections from subsurface infiltration features to the building envelope should be considered in, and managed by, the design, such as through the use of seepage collars.

Not included in item 4.2 are:

- dewatering (temporary or permanent);
- design of 'tanking' or waterproofing;
- selection of or design of building envelope elements below the maximum design groundwater elevation; or
- proprietary stormwater management facilities.

Likewise, providing maximum design groundwater elevations, hydraulic conductivities, and/or seepage analyses to other members of the project design team who may be designing pumped or other systems (including groundwater cut-off) to maintain groundwater at design levels and pressures is covered in the scope of Geotechnical – Permanent, under item 8.6, Permanent Dewatering.

Evaluation of potential off-site impacts due to rainwater infiltration, drainage discharge, and temporary/permanent dewatering (including lowering or raising of proximate groundwater elevations), including impacts due to seasonal and climate change effects, is out of scope for this line item but is encompassed by item 8.6. Such an assessment for the project may be compelled by the Authority Having Jurisdiction, per their responsibilities as noted in Section 2.2.7 Authority Having Jurisdiction.

B2.5 INVOLVING A SPECIALTY GEOTECHNICAL ENGINEER

If the GER does not have the appropriate expertise in an area related to the geotechnical items in the Letters of Assurance, an appropriately qualified professional must be engaged to act as the Specialty Geotechnical Engineer.

The Specialty Geotechnical Engineer completes Schedule S-B, Assurance of Professional Design and Commitment for Field Review by a Supporting Registered Professional and Schedule S-C, Assurance of Professional Field Review and Compliance by a Supporting Registered Professional, taking responsibility for the provided special elements of subsurface work and supporting services, including associated Field Reviews. The Specialty Geotechnical Engineer submits Schedules S-B and S-C to the GER. Where applicable, the Specialty Geotechnical Engineer should ensure the design of the secondary or specialty element is coordinated with the design of the primary structural system. Note that where an Engineering Professional is working as an SRP for multiple disciplines, Schedule S-B and S-C should be submitted to each discipline RPR as necessary.

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