



CIVIL AND TRANSPORTATION INFRASTRUCTURE

ASSESSMENT OF GROUNDWATER AT RISK OF CONTAINING PATHOGENS [GARP]

VERSION 1.0
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**ENGINEERS &
GEOSCIENTISTS**
BRITISH COLUMBIA

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PREFACE

These *Professional Practice Guidelines – Assessment of Groundwater at Risk of Containing Pathogens* were developed with the support of the British Columbia (BC) Ministry of Health. These guidelines will assist Engineering and Geoscience Professionals in carrying out an assessment of groundwater in a consistent manner while incorporating best practices.

To provide additional guidance on the intent of the groundwater legislation, the Health Protection Branch of the Ministry of Health of the Government of British Columbia released two guidance documents:

- Guidance Document for Determining Ground Water at Risk of Containing Pathogens (GARP), Version 3 (referred to in these guidelines as the GARP Document) (BC MOH 2017)
- Drinking Water Treatment Objectives (Microbiological) for Ground Water Supplies in British Columbia, Version 1 (referred to in these guidelines as the DWTO Document) (BC MOH 2015)

The Ministry's guidance documents are intended for a broader audience that includes public health officials, Water Suppliers, and Qualified Professionals. It is also relevant to the work done by the groundwater specialists with the Ministry of Forests, Lands, Natural Resource Operations and Rural Development. These professional practice guidelines were developed in response to issues raised in the Ministry's guidance documents, and to address those issues as they pertain to the practice of professional engineering and professional geoscience.

It is important to note that these guidelines are not intended to replace any provisions of the Ministry's guidance documents and commentary but are intended to provide additional guidance in applying them.

These guidelines outline the appropriate standard of practice to be followed at the time that 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.

PROFESSIONAL PRACTICE GUIDELINES
ASSESSMENT OF GROUNDWATER AT RISK OF CONTAINING PATHOGENS

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ABBREVIATIONS

| ABBREVIATION | TERM |
|--------------|---|
| ASTTBC | Applied Science Technologists and Technicians of British Columbia |
| BC | British Columbia |
| DWO | Drinking Water Officer |
| DWTO | Drinking Water Treatment Objectives |
| GARP | Groundwater at Risk of Containing Pathogens |

DEFINED TERMS

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

| TERM | DEFINITION |
|---|---|
| Act | <i>Engineers and Geoscientists Act</i> [RSBC 1996], Chapter 116. |
| Approving Authority | The regulatory body that is ultimately responsible for determining whether a groundwater source is at risk of containing pathogens. |
| Association | The Association of Professional Engineers and Geoscientists of the Province of British Columbia, also operating as Engineers and Geoscientists BC. |
| Bylaws | The Bylaws of the Association made under the <i>Act</i> . |
| Client | Typically, a Water Supplier that could be a local government, First Nation government, or private owner. |
| Drinking Water Officer (DWO) | A person appointed under Section 3 of the <i>Drinking Water Protection Act</i> or his or her delegate. |
| DWTO Document | The British Columbia Ministry of Health document entitled Drinking Water Treatment Objectives (Microbiological) for Ground Water Supplies in British Columbia, Version 1. |
| Engineering/Geoscience Professional(s) | Professional engineers, professional geoscientists, and licensees, who are registered or licensed by the Association and entitled under the <i>Act</i> to engage in the practice of professional engineering or professional geoscience in British Columbia. |
| Engineers and Geoscientists BC | The business name for the Association. |
| GARP Document | The British Columbia Ministry of Health document entitled Guidance Document for Determining Ground Water at Risk of Containing Pathogens (GARP), Version 3. |
| Groundwater at Risk of Containing Pathogens (GARP) | Any groundwater source that is likely to be contaminated from any sources of human disease-causing microorganisms (pathogens) including various types of bacteria, viruses, and protozoa (e.g., <i>Giardia</i> and <i>Cryptosporidium</i>). Contamination may be continuous or intermittent. |
| Professional of Record | The Engineering/Geoscience Professional or licensee with overall or direct professional responsibility for the engineering or geoscience work required by an Approving Authority, Drinking Water Officer, and/or Water Supplier, and for any related engineering or geoscience document that is produced. |

| TERM | DEFINITION |
|--|---|
| Qualified Professional | An individual who is registered with the Engineers and Geoscientists of British Columbia with competency in the field of hydrogeology and experience in evaluating sources of groundwater supply. |
| Water Source Investigation | <p>An investigation that is conducted to assess potential risks to a water source and, ultimately, to support a GARP determination.</p> <p>Up to three levels of Water Source Investigations may be required to assess potential risks:</p> <ul style="list-style-type: none"> • Level 1: Review of existing records and field inspection • Level 2: Preliminary hydrogeological investigation • Level 3: Detailed hydrogeological investigation |
| Water Source Investigation Report | Written findings of a Water Source Investigation, issued by a Qualified Professional. |
| Water Supplier | A person who is the owner of a water supply system under the <i>Drinking Water Protection Act</i> . |

VERSION HISTORY

| VERSION NUMBER | PUBLISHED DATE | DESCRIPTION OF CHANGES |
|----------------|----------------|------------------------|
| 1.0 | July 16, 2019 | 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 qualifications 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 – Assessment of Groundwater at Risk of Containing Pathogens* provide guidance on professional practice for Engineering/Geoscience Professionals who conduct Water Source Investigations in response to the requirements under Section 6 of the *Drinking Water Protection Act* and Section 5(2) of the *Drinking Water Protection Regulation*.

The presence of pathogens in water that is used for human consumption poses a drinking water health hazard that endangers public health. Contamination may be continuous or intermittent, such as that introduced by seasonal flooding.

In BC, groundwater that, in the opinion of a Drinking Water Officer (DWO), is at risk of containing pathogens (GARP) must be disinfected according to the requirements of the Drinking Water Treatment Objectives (Microbiological) for Ground Water Supplies in British Columbia (referred to in these guidelines as the DWTO Document), issued by the

Health Protection Branch of the BC Ministry of Health (BC MOH 2015).

The *Drinking Water Protection Act* and the *Drinking Water Protection Regulation* give DWOs the flexibility and discretion to address public health risks by including treatment requirements in operating permits. The *Drinking Water Protection Act* outlines general requirements for Water Suppliers, and the *Drinking Water Protection Regulation* sets out more specific requirements. [Appendix A: Regulatory Requirements](#) of these guidelines summarizes the regulatory requirements related to drinking water.

Briefly, Section 6 of the *Drinking Water Protection Act* states in part that a Water Supplier must provide drinking water from the water supply system that:

- is potable water, and
- meets any additional requirements established by the regulations or by its operating permit.

In addition, Section 5(2) of the *Drinking Water Protection Regulation* states in part that:

- drinking water from a water supply system must be disinfected by a Water Supplier if the water originates from
 - surface water, or
 - groundwater that, in the opinion of a Drinking Water Officer, is at risk of containing pathogens.

The DWO is responsible for making a GARP determination that provides the basis for establishing measures a Water Supplier must take to ensure a water supply system is safe to use as drinking water and to protect public health. A Water Supplier should, having chosen to use a particular water source, provide information to the DWO that assists in that determination. Where a DWO or Water Supplier

considers that additional information is required, the Water Supplier may retain a Qualified Professional to undertake one or more Water Source Investigations and to provide a professional opinion regarding hazards to the water source.

The procedure outlined in the Guidance Document for Determining Groundwater at Risk of Containing Pathogens (GARP) (referred to in these guidelines as the GARP Document), issued by the Health Protection Branch of the BC Ministry of Health, recommends coordination and collaboration between the DWO, the Water Supplier, and the Qualified Professional in the process for assessing hazards that assists and leads up to the DWO making a determination (BC MOH 2017). Communication between these parties is necessary and should begin at an early stage in the GARP determination process.

1.1 PURPOSE OF THESE GUIDELINES

This document provides guidance on professional practice for Engineering/Geoscience Professionals who conduct Water Source Investigations in response to the requirements under Section 6 of the *Drinking Water Protection Act* and Section 5(2) of the *Drinking Water Protection Regulation*, as described in the GARP Document and the DWTO Document issued by the Health Protection Branch of the BC Ministry of Health (BC MOH 2017 and 2015).

In conjunction with the GARP Document and the DWTO Document, following are the specific objectives of these guidelines:

1. Describe the standard of practice that Engineering/Geoscience Professionals should follow when providing professional services related to these professional activities.
2. Specify the tasks and/or services that Engineering/Geoscience Professionals should complete to meet the appropriate standard of practice and fulfill their professional obligations under the *Act*. These obligations include the Engineering/Geoscience 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 Professional of Record, the Qualified Professional, owners, Approving Authority, 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 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. The final draft of these guidelines underwent a final consultation process with various committees and divisions of the Association. These guidelines 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/Geoscience Professionals provide to their Clients and the public.

An Engineering/Geoscience Professional must exercise professional judgement 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 or regulations subsequent to the publication of these guidelines. Where an

Engineering/Geoscience Professional intends to substantially depart from applying these guidelines, he or she should consider obtaining a second opinion on the merits of the departure, and he or she should also make full disclosure of the departure to the other participants/stakeholders, including the Client and the DWO.

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/Geoscience Professionals who are responsible for carrying out professional activities, so they can comply with the standard of practice provided in these guidelines. These guidelines may be used to assist in the level of service and terms of reference of an agreement between an Engineering/Geoscience Professional and a Client.

These guidelines are intended to assist Engineering/Geoscience 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 THE GUIDELINES

These guidelines apply to Water Source Investigations that are prepared in support of GARP determinations in accordance with the GARP Document, and in response to the requirements under

the *Drinking Water Protection Act* and the *Drinking Water Protection Regulation*. These guidelines apply to reporting under Section 8 of the GARP Document.

In these guidelines, the written findings of a Water Source Investigation are referred to as a Water Source Investigation Report.

The approaches outlined in the GARP Document and the DWTQ Document provide some flexibility in designing and implementing Water Source Investigations, and for interpreting the results from the investigations. Investigations and interpretations that are developed for one particular water source will not necessarily be applicable to other water sources. Therefore, these guidelines do not provide a prescriptive approach to Water Source Investigations; rather, they discuss the standard of practice that a Qualified Professional should meet when conducting Water Source Investigations, and which fulfills the Qualified Professional's obligations under the self-governing legislation regulating their practice. These obligations include the Qualified Professional's primary duty to protect the safety, health and welfare of the public and the environment.

1.5 APPLICABILITY OF THE GUIDELINES

These guidelines are influenced by current provincial legislation and its application by local government, provincial case law, advances in knowledge, and evolution of general professional practices in BC; therefore, from time to time, they may require updating.

These guidelines provide guidance on professional practice for Engineering/Geoscience Professionals who carry out groundwater assessments. These guidelines are not intended to provide systematic instructions for how to carry out these activities; rather, these guidelines outline considerations to be aware of when carrying out these activities.

An Engineering/Geoscience 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 judgements and decisions depend upon weighing facts and circumstances to determine whether other reasonable and prudent Engineering/Geoscience Professionals, in similar situations, would have conducted themselves similarly.

Conversely, following these Professional Practice Guidelines does not guarantee that the conclusions and recommendations contained within the Water Source Investigation Report will be accepted by the DWO.

Note that provincial legislation may not apply on land under federal jurisdiction. The Approving Authority on lands under federal jurisdiction often use provincial legislation and guidance as indicators of best practices, but the applicability of these guidelines should be reviewed with the Approving Authority at the project scoping stage.

1.6 ACKNOWLEDGEMENTS

These guidelines were prepared on behalf of Engineers and Geoscientists BC by professional engineers and geoscientists in the sector. This document was also reviewed by a group of technical experts and stakeholders, as well as by various committees and divisions of the Association.

The authors and reviewers are listed in [Appendix C: List of Contributors](#).

Engineers and Geoscientists BC and the authors thank the reviewers for their constructive suggestions.

Authorship and review of these guidelines does not necessarily indicate the individuals and/or their employers endorse everything in these guidelines.

2.0 PROJECT ORGANIZATION AND RESPONSIBILITIES

Sections [2.2.1 Client](#) and [2.2.3 Approving Authority](#) describe some of the typical responsibilities of a Client, Approving Authority, and Qualified Professional. [Section 2.2.2 Professional of Record](#) describes some of the typical responsibilities of a Qualified Professional when conducting Water Source Investigations, and when asked by an Approving Authority or Client to review a Water Source Investigation Report prepared by another Qualified Professional.

2.1 PROJECT ORGANIZATION

The DWO is responsible for making a GARP determination that provides the basis for establishing measures a Water Supplier must take to ensure a water supply system is safe to use as drinking water and to protect public health. A Water Supplier should, having chosen to use a particular water source, provide information to the DWO that assists the DWO in making a determination. Where a DWO or Water Supplier considers that additional information is required, the Water Supplier may retain a Qualified Professional to undertake one or more Water Source Investigations and provide a professional opinion regarding hazards to the water source.

The procedure outlined in the GARP Document recommends coordination and collaboration between the DWO, the Water Supplier, and the Qualified Professional in the process for assessing hazards that assists and leads up to the DWO making a determination (BC MOH 2017). Communication between these parties is necessary and should begin at an early stage in the GARP determination process.

The Client should be informed that the findings of the Qualified Professional could result in the groundwater source being considered GARP and/or the Approving Authority requiring risk mitigation measures, potentially including treatment as recommended in the DWTO Document. In this regard, it is useful if the Approving Authority is engaged early in the planning process for the Water Source Investigation(s). The Qualified Professional should be aware that his or her report will ultimately be submitted to, and likely be reviewed by, the Approving Authority.

2.2 RESPONSIBILITIES

The following sections outline the responsibilities of various potential project team members. Defining these responsibilities helps ensure that the Water Source Investigations will meet the appropriate standard of practice and the requirements of the applicable regulations.

2.2.1 CLIENT

The Client is typically a Water Supplier that could be a local government, First Nation government, or private owner.

As discussed in [Section 1 Introduction](#), the Client may retain a Qualified Professional to undertake one or more Source Water Investigations to identify and assess hazards to the water source.

When deciding how to manage potential risks to their groundwater source, the Client should inform themselves about the costs of conducting Water

Source Investigations and consider these against the costs of treating the water supply according to the DWO's specifications.

When a Water Source Investigation is being conducted, the Client should be knowledgeable about and provide the Qualified Professional with the following:

- During the Water Source Investigation the Client should:
 - show the Qualified Professional the location of the water supply well;
 - provide any data or information that the Client has on file that is pertinent to the Water Source Investigation;
 - allow the Qualified Professional unrestricted access to the property; and
 - obtain access, if required, to areas beyond the property.
- After the Water Source Investigation the Client should:
 - review the Water Source Investigation Report, and understand the limitations and qualifications that apply;
 - discuss the report with the Qualified Professional and seek clarification, where necessary;
 - notify the Qualified Professional if land use at the site or surrounding properties change or vary from those described in the report; and
 - include the Qualified Professional in discussions with the DWO regarding the Water Source Investigation.

2.2.2 PROFESSIONAL OF RECORD

2.2.2.1 Conducting Water Source Investigations

The Professional of Record is typically the Qualified Professional who is responsible for conducting Water Source Investigations, or who is taking responsibility for Water Source Investigations, that are unbiased and evidence-based. The Qualified Professional is also responsible for providing a professional opinion regarding the risk that a water source is considered GARP, to assist the DWO in making a GARP determination.

The DWO is not responsible for the professional practice of the Qualified Professional; professional practice remains the responsibility of the Professional of Record. (See [Section 4 Quality Management in Professional Practice](#).)

Prior to initiating the Water Source Investigation, the Qualified Professional and Client should complete an agreement confirming the scope, schedule, and compensation for the investigation. As discussed in the GARP Document, it is recommended that the scope and schedule for the Water Source Investigation be developed in collaboration with the DWO, who will ultimately make the GARP determination (BC MOH 2017). The Qualified Professional's cost estimate should indicate what services are included, and what circumstances may cause a change to the scope of work and associated costs.

It is the responsibility of the Qualified Professional to obtain the necessary information to conduct Water Source Investigations. As outlined in the GARP Document, the Qualified Professional may obtain information from a variety of sources to build lines of evidence that assess potential risks to a groundwater source. The Qualified Professional is responsible for assessing the quality of the information obtained for Water Source Investigations, assessing potential uncertainty, and identifying potential implications for the interpretation.

If aspects of the Water Source Investigation are delegated to subordinates, they should only be carried out under the direct supervision of the Qualified Professional. The Qualified Professional assumes full responsibility for all work delegated. (See [Section 4.1.3 Direct Supervision](#).)

The Qualified Professional must seal the final Water Source Investigation Report with signature and date (see [Section 4.1.2 Use of Seal](#)). The report will confirm that the appropriate requirements were met (both regulatory and technical) for the assessment that was carried out.

After the Water Source Investigation has been conducted, the Qualified Professional should:

- answer the questions that the Client and/or the DWO may have regarding the Water Source Investigation and/or the professional opinion provided;
- address any omissions or deficiencies that the Client and/or DWO identify in the report submission that should justifiably have been in the original scope of work; and
- perform follow-up work if requested by the Client and/or the DWO, and if retained by the Client to do so.

A Qualified Professional should clearly indicate to the Client the possible consequences if recommendations from the Water Source Investigation are not followed. To fulfill the Qualified Professional's obligations under the Association's Code of Ethics, if a Client or the DWO fails to or refuses to accept the conclusions and recommendations of the Water Source Investigation Report, the Qualified Professional should:

- advise the Client and/or the DWO in writing of the potential consequences of the Client's actions or inactions; and
- consider whether the situation warrants notifying the Association, the Water Supplier (if different from the Client), and/or appropriate authorities.

The above actions should be taken particularly if workplace safety, public health, or the environment is potentially jeopardized.

2.2.2.2 [Reviewing Water Source Investigation Reports](#)

A Qualified Professional may be engaged by a Client and/or a DWO to conduct an independent external peer review of a Water Source Investigation Report that was prepared by another Qualified Professional. This type of review is not the same as an internal or external peer review conducted at the request of the Qualified Professional prior to submitting the report to his or her Client and/or the DWO.

For the reviewing Qualified Professional to conduct an appropriate review, he or she must receive a copy of the Water Source Investigation. Furthermore, the requesting DWO or Client should:

- recognize that the Association's Code of Ethics requires that members follow respectful protocols when reviewing the work of other members, according to the Code of Ethics Principle 7;
- provide the reviewing Qualified Professional with additional necessary background information and the reason for the review;
- review the report or review letter provided by the reviewing Qualified Professional; and
- if necessary, discuss the report or review letter with the reviewing Qualified Professional and seek clarification.

The reviewing Qualified Professional should consider whether there may be a conflict of interest and act accordingly; conduct himself or herself with fairness, courtesy, and good faith towards colleagues; and provide honest and fair comment.

The reviewing Qualified Professional should:

- confirm with the Client who is approving the work, the terms, conditions, and scope of work related to the review and the ownership of the

information contained in the Water Source Investigation;

- inform the Qualified Professional who prepared the Water Source Investigation Report of the review and reasons for the review, and document in writing that the Qualified Professional was so informed;
- ask the Qualified Professional who prepared the report if the reviewing Qualified Professional should know about unreported circumstances that may have limited or qualified the Water Source Investigation and/or the report; and
- contact the Qualified Professional who prepared the report if the results of the review identify safety or environmental concerns, in order to allow the Qualified Professional the opportunity to comment before further action is taken.

The review should be appropriately documented in a report or review letter. The reviewing Qualified Professional should submit a signed, sealed, and dated review letter or report that includes limitations and qualifications regarding the review, and results and/or recommendations arising from the review.

The reviewing Qualified Professional should clarify questions the DWO or Client may have about the review letter or report.

Note that occasionally, a Qualified Professional is retained to provide a second opinion. This role goes beyond that of reviewing the work of the original Qualified Professional. The second Qualified Professional should carry out sufficient pre-field work, field work, assessment, and comparisons, as required, to accept full responsibility for his or her opinion regarding the Water Source Investigation.

2.2.3 APPROVING AUTHORITY

The requirement for Water Source Investigations comes from the DWO who, as a representative of the Approving Authority, is ultimately responsible for the determination of whether a groundwater source is GARP.

Before the Water Source Investigation is initiated, the DWO should:

- inform the Client and the Qualified Professional why a Water Source Investigation is required;
- identify concerns and/or uncertainties regarding hazards to the groundwater source; and
- provide additional information that he or she feels is necessary to conduct a Water Source Investigation.

After the Water Source Investigation, the DWO should:

- review the Water Source Investigation Report; and
- discuss the report with the Qualified Professional and seek clarification, if necessary.

Although the DWO does not approve the Qualified Professional's report, the DWO will make their GARP determination based on the screening criteria and taking the technical, economic, and practical considerations into account while developing treatment/risk mitigation measures. Therefore, because the Water Source Investigation Report will form the basis of the DWO's technical understanding of a GARP determination, it is critical that all Water Source Investigation Reports completed by Qualified Professionals contain all relevant supporting documentation and that they are written in a manner that allows the DWO to make a GARP determination based on a clear technical understanding.

3.0 GUIDELINES FOR PROFESSIONAL PRACTICE

3.1 GARP DETERMINATION PROCESS

The GARP determination process typically includes the following stages, also summarized in the figure in [Appendix B: GARP Determination Flowchart](#):

- Stage 1: Hazard Screening and Assessment
 - The groundwater source is screened for hazards that are considered to be present, which are assessed individually to determine whether the hazard makes the source potentially GARP. Stage 1 is supported by up to three levels of Water Source Investigation.
- Stage 2: GARP Determination
 - The DWO reviews the hazards identified in Stage 1 cumulatively, to make an overall determination if the groundwater source is “at risk” of containing pathogens (GARP), “GARP-viruses only” (i.e., only Hazard B4 – Viruses are present), or “at low risk” of containing pathogens (Non-GARP).
- Stage 3: Risk Mitigation
 - For groundwater sources that are determined to be GARP, measures are put in place to mitigate risks, either by further investigating specific hazards, by taking corrective measures, or through treatment acceptable to the DWO.
- Stage 4: Long-term Monitoring
 - All groundwater sources require ongoing monitoring to continually assess source water quality and hazards.

3.2 WATER SOURCE INVESTIGATIONS AND REPORTS

One or more Water Source Investigations are required to support the DWO in making a GARP determination. Up to three levels of Water Source Investigations may be required to reduce uncertainty related to specific issues identified during the Water Source Investigation process:

- Level 1: Review of existing records and field inspection
- Level 2: Preliminary hydrogeological investigation
- Level 3: Detailed hydrogeological investigation

The monitoring stage, Stage 4, may also be used at the discretion of the DWO to reduce uncertainty prior to resorting to mitigation measures, potentially including those outlined in the DWTO Document.

When a DWO or Water Supplier considers that additional information is necessary to understand a water source and expert advice is required, a Qualified Professional would be called in to conduct the more detailed investigations (Levels 2 and 3).

Water Source Investigations are not carried out under the traditional consultant-client-approving authority model. That means that the Qualified Professional does not:

- work in isolation from the Client and DWO;
- make decisions independent from the Client; or

- independently provide a report or plans and specifications that must be followed by a contractor; rather, recommendations should be provided to the Client and DWO for consideration.

The Qualified Professional should take the lead, in consultation with the DWO, in developing the scope of investigation(s) that can provide technical information needed to make the GARP determination. The DWO will take the opinion of the Qualified Professional into consideration when assessing the hazards and completing a GARP determination. Therefore, it is recommended that the Water Supplier, DWO, and Qualified Professional should collaborate to develop the scope for Water Source Investigations that reflect a shared understanding of the water source and address the information needs of the DWO.

The GARP Document does not provide a prescriptive approach to Water Source Investigations; rather, the GARP determination process presented in the GARP Document provides flexibility to develop and implement Water Source Investigations that are appropriate to the site-specific conditions. The GARP Document acknowledges that multiple lines of evidence may be required to reduce uncertainty to a level that is acceptable to the DWO. Qualified Professionals are expected to use their judgement in selecting appropriate methodologies, levels of effort, and scopes of assessment for Water Source Investigations.

Depending on the site-specific conditions and the hazards identified, an appropriate level of effort is required to conduct Water Source Investigations. The Qualified Professional should conduct such work as is appropriate for the complexity of the water source. This could include input from a variety of sources, including individuals who are not members of the Association but are registered with other regulatory bodies and have competency and/or experience with groundwater sources, such as well drillers registered with the Province of BC or technologists registered with Applied Science Technologists & Technicians of BC (ASTTBC).

The Qualified Professional should assess the input from these various information sources and use professional judgement to provide an opinion in the form of a report regarding the potential that a water source is GARP. The Qualified Professional would consider options listed in Section 8 of the GARP Document and would justify options used in the investigations.

The Water Source Investigation Report is an important document used to inform significant decisions for GARP determinations. For this reason, it is required that in addition to experienced individuals conducting the assessment, the Water Source Investigation Report is signed off by a Qualified Professional before submission to the Water Supplier and the DWO.

Qualified Professionals are expected to be competent in field investigation and assessment techniques and to keep abreast of advancements in scientific knowledge applicable to their work. If the Qualified Professional delegates aspects of the work, such as field investigation, to subordinates, the Qualified Professional must satisfy himself or herself of the subordinate's qualifications and skill level, and the Qualified Professional must provide sufficient instruction so that the work is carried out competently (see [Section 4.1.3 Direct Supervision](#)).

While Water Source Investigations conducted under these guidelines may identify floodplain areas, Water Source Investigations are not flood hazard assessments. There are specific statutory requirements and professional guidelines for flood hazard assessments; these do not fall under the GARP Document. Furthermore, a Water Source Investigation does not address other possible natural hazards. In the course of a Water Source Investigation, if a Qualified Professional identifies possible landslide, flood, or other hazards that might affect the subject property or the property of others, the Qualified Professional has a professional responsibility to draw these hazards to the attention of the Client and, if necessary, the authority having jurisdiction over land use.

4.0 QUALITY MANAGEMENT IN PROFESSIONAL PRACTICE

4.1 QUALITY MANAGEMENT REQUIREMENTS

Engineering/Geoscience 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/Geoscience 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/geoscience activities
- Retention of complete project documentation
- Regular, documented checks using a written quality control process
- Documented field reviews of engineering/geoscience designs/recommendations during implementation or construction

4.1.1 PROFESSIONAL PRACTICE GUIDELINES

In accordance with the *Act*, s.4(1) and Bylaw 11(e)(4)(h), Engineering/Geoscience Professionals are required to comply with the intent of any applicable professional practice guidelines related to the engineering or geoscience 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 conducting groundwater assessments and Water Source Investigations. Engineering/Geoscience 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/Geoscience Professionals are required to seal all professional engineering or professional geoscience 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/Geoscience 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/Geoscience Professionals are required to directly supervise any engineering or geoscience work they delegate. When working under the direct supervision of an Engineering/Geoscience Professional, unlicensed persons or non-members may assist in performing engineering and geoscience work, but they may not assume responsibility for it. Engineering/Geoscience Professionals who are limited licensees may only directly supervise work within the scope of their license.

With regard to direct supervision, the Engineering/Geoscience 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/Geoscience Professionals with overall responsibility should exercise judgement 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 2018a).

4.1.4 RETENTION OF PROJECT DOCUMENTATION

In accordance with Bylaw 14(b)(1), Engineering/Geoscience 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 or geoscience documentation is no longer in use.

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

Many Engineering/Geoscience Professionals are employed by organizations, which ultimately own the project documentation. Engineering/Geoscience Professionals are considered compliant with this quality management requirement when a complete set of project documentation is retained by the organizations that employ them at the time the Water Source Investigation was undertaken, 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 2018b).

4.1.5 DOCUMENTED CHECKS OF ENGINEERING AND GEOSCIENCE WORK

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

Regardless of sector, Engineering/Geoscience 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/Geoscience 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/Geoscience 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/Geoscience Professional’s training and experience.

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

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 or geoscience work. They are carried out by an Engineering/Geoscience Professional or a subordinate acting under the Engineering/Geoscience Professional’s direct supervision (see [Section 4.1.3 Direct Supervision](#)).

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

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

5.0 PROFESSIONAL REGISTRATION & EDUCATION, TRAINING, AND EXPERIENCE

5.1 PROFESSIONAL REGISTRATION

It is the responsibility of Engineering/Geoscience Professionals to determine whether they are qualified by training and/or experience to undertake and accept responsibility for carrying out assessments of groundwater (Code of Ethics Principle 2).

5.2 EDUCATION, TRAINING, AND EXPERIENCE

Assessment of GARP, as described in these guidelines, requires minimum levels of education, training, and experience in many overlapping areas of engineering and geoscience. The Engineering/Geoscience Professional 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 his or her qualifications and must possess the appropriate education, training, and experience to provide the services.

The level of education, training, and experience required of the Engineering/Geoscience Professional should be adequate for the complexity of the project.

Typical qualifications for the lead Engineering/Geoscience Professional or a team of professionals for groundwater assessments may include education and experience in the following areas:

- Hydrogeology
- Water chemistry
- Drinking water microbiology
- Water treatment engineering
- Public health issues related to drinking water
- Legislation related to surface water, groundwater, drinking water, and water treatment
- Human health risk assessment and risk management

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/Geoscience 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

Regulations referred to in these guidelines appear in [Section 6.1 Regulations](#). Documents cited in these guidelines appear in [Section 6.2 References](#).

6.1 REGULATIONS

Drinking Water Protection Act [SBC 2001], Chapter 9.

Drinking Water Protection Act, Drinking Water Protection Regulation, B.C. Reg. 200/2003.

Engineers and Geoscientists Act [RSBC 1996], Chapter 116.

Public Health Act [SBC 2008], Chapter 28.

Public Health Act, Health Hazards Regulation, B.C. Reg. 216/2011.

Water Sustainability Act [SBC 2014], Chapter 15.

Water Sustainability Act, Groundwater Protection Regulation, B.C. Reg. 39/2016.

6.2 REFERENCES

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7.0 APPENDICES

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APPENDIX A: REGULATORY REQUIREMENTS

This appendix summarizes the regulatory requirements for groundwater protection and drinking water protection; the actual current legislation should be referred to for details. These guidelines were current at the time of publication and the statutes or policy statements discussed in this section may have changed since they were first referenced.

A1 DRINKING WATER PROTECTION ACT

The *Drinking Water Protection Act* [SBC 2001], Chapter 9, states the following:

Part 2 – Drinking Water Supply

Water supply systems must provide potable water

- 6 Subject to the regulations, a Water Supplier must provide, to the users served by its water supply system, drinking water from the water supply system that
 - (a) Is potable water, and
 - (b) Meets any additional requirements established by the regulations or by its operating permit.

A2 DRINKING WATER PROTECTION REGULATION

The *Drinking Water Protection Regulation*, B.C. Reg. 200/2003, under the *Drinking Water Protection Act*, states the following:

Treatment

- 5 (2) For the purposes of section 6 (b) of the Act, drinking water from a water supply system must be disinfected by a Water Supplier if the water originates from
 - (a) surface water, or
 - (b) groundwater that, in the opinion of a Drinking Water Officer, is at risk of containing pathogens.

A3 GROUNDWATER PROTECTION REGULATION

The *Groundwater Protection Regulation*, B.C. Reg. 39/2016, under the *Water Sustainability Act*, states the following:

Part 2 – Well Drillers and Well Pump Installers

Division 1 – Registration and Qualification

Registers of well drillers and well pump installers

- 7 The comptroller must
 - (a) establish and maintain
 - (i) a register of well drillers who are authorized to operate in British Columbia, and
 - (ii) a register of well pump installers who are authorized to operate in British Columbia,
 - (b) include in the registers the following information in respect of each well driller and well pump installer:
 - (i) full name;
 - (ii) business contact information, including business name, if any, address, telephone number and, if available, email address and fax number;
 - (iii) the registration number issued by the comptroller and the date of registration;
 - (iv) a reference to any certificates of qualification held by the well driller or qualified well pump installer;
 - (v) in the case of a well driller, the class of well driller assigned by the comptroller in accordance with section 9 [registration and classification of well driller],
 - (c) make available to the public during normal business hours, or by posting on a publicly available website, a list of well drillers and well pump installers, which list may include any of the information set out in paragraph (b), and
 - (d) remove from the register any person who
 - (i) fails to meet a requirement for registration,
 - (ii) fails to maintain a requirement for registration, including any requirement for maintaining a certificate issued by another province or territory of Canada, or
 - (iii) is no longer actively working in Canada as a well driller or well pump installer.

Application for registration as well pump installer

- 10 (1) A person may apply to the comptroller for registration as a well pump installer by completing and submitting an application in the form and with the content specified by the comptroller.
- (2) A prospective registrant described in subsection (1) must provide with an application proof satisfactory to the comptroller that the prospective registrant
 - (a) is an individual who is at least 19 years of age, and

- (b) holds, for the purposes of the definition of "well pump installer" in section 48 (1) [definitions] of the Act, one of the following prescribed qualifications:
 - (i) a Certificate of Qualification as a Well Pump Installer issued by the Province of British Columbia;
 - (ii) a certificate issued by another province or territory of Canada that is equivalent to a certificate referred to in subparagraph (i);
 - (iii) a certificate as a Ground Water Pump Technician issued by the Canadian Ground Water Association before April 26, 2013.

Registration of well pump installer

- 11 (1) If the comptroller approves a person's application under section 10 (1) to be registered as a well pump installer, the comptroller must
 - (a) add the person to the register of well pump installers, and
 - (b) issue an identification card to the person that identifies that person as a well pump installer.
- (2) Promptly after this regulation comes into force, the comptroller must
 - (a) ensure that every person is added to the register of well pump installers who, immediately before the date this regulation comes into force, was registered in the register of qualified well pump installers under the former regulation, and
 - (b) issue an identification card to every person added to the register of well pump installers under paragraph (a) that identifies that person as a well pump installer.

Notice to comptroller

- 12 (1) A registered well driller or registered well pump installer must advise the comptroller in writing within 60 days after
 - (a) any changes to the information included in the register in relation to the well driller or well pump installer, as the case may be, or
 - (b) the person ceasing to work in Canada as a well driller or well pump installer, as the case may be.
- (2) The comptroller is not required to issue an identification card under section 9 or 11, as applicable, to a registered well driller or registered well pump installer if the registered well driller or registered well pump installer has not complied with subsection (1).

A4 HEALTH HAZARDS REGULATION

The *Health Hazards Regulation*, B.C. Reg. 216/2011, under the *Public Health Act*, states the following:

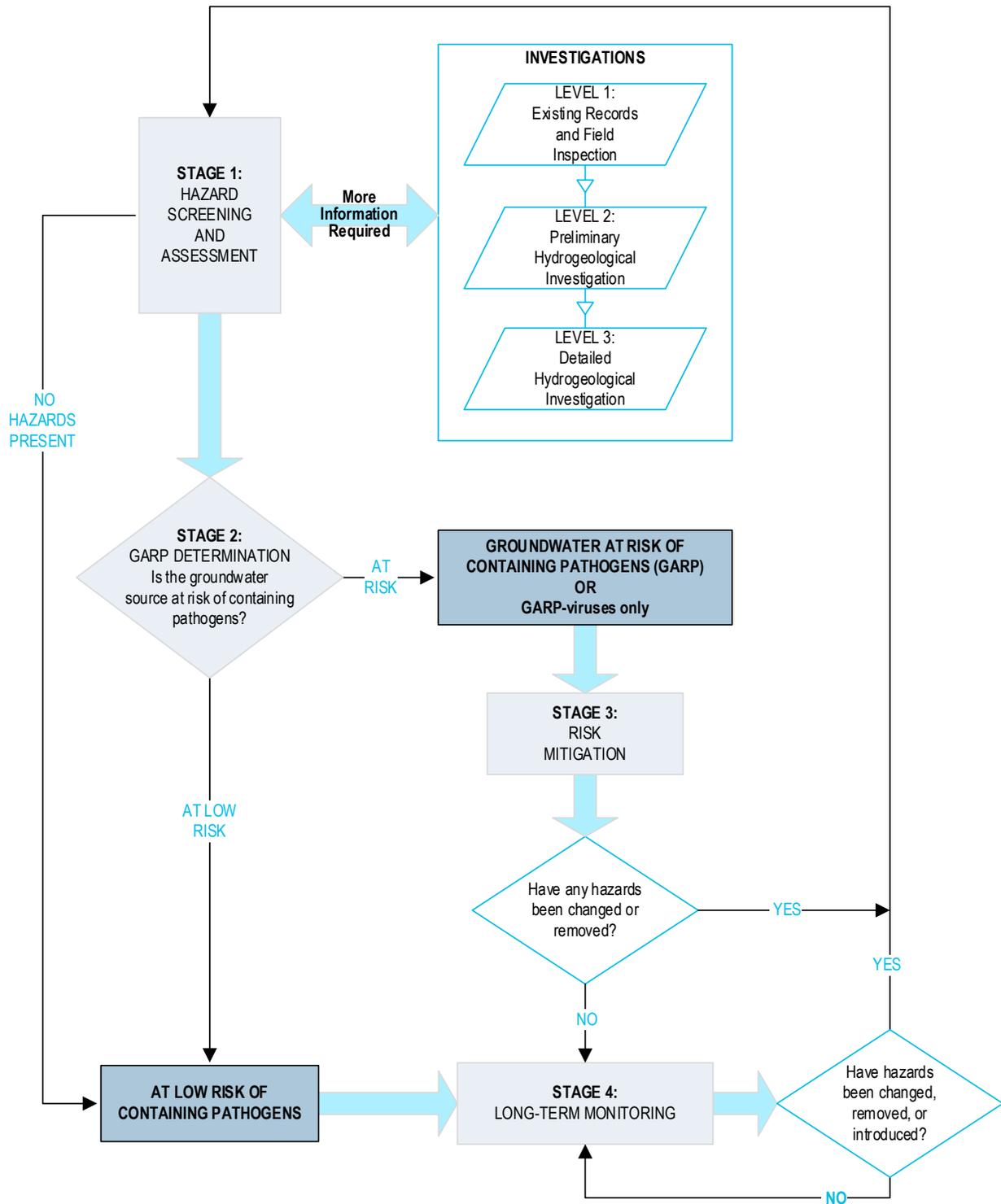
Division 3 – General

Distance of wells from possible source of contamination

- 8 (1) A person who installs a well, or who controls a well installed on or after July 20, 1917, must ensure that the well is located at least
 - (a) 30 m from any probable source of contamination,
 - (b) 6 m from any private dwelling, and
 - (c) unless contamination of the well would be impossible because of the physical conformation, 120 m from any cemetery or dumping ground.
- (2) A person who controls a well installed before July 20, 1917, must
 - (a) remove any source of contamination within the distances set out in subsection (1), or
 - (b) subject to subsection (3), decommission the well in accordance with Ground Water Protection Regulation.
- (3) Subsection (2) (b) does not apply to a well located within 6 m of a private dwelling unless it can be shown that the well should be abandoned for a reason other than proximity to a private dwelling.
- (4) A well that does not meet the requirements of this section is prescribed as health hazard.

APPENDIX B: GARP DETERMINATION FLOWCHART

GARP DETERMINATION FLOWCHART



Note: Figure adapted from Guidance Document for Determining Groundwater At Risk of Containing Pathogens (GARP), Version 3 (BC MOH 2017).

APPENDIX C: LIST OF CONTRIBUTORS

Authors and reviewers are listed in alphabetical order by last name.

AUTHORS

Mark Bolton, P.Geo., Associate – Senior Hydrogeologist, Golder Associates Ltd.

Harshan Radhakrishnan, P.Eng., Practice Advisor, Engineers and Geoscientists BC

Nick Sargent, P.Geo., Former Principal Senior Hydrogeologist (Retired), Golder Associates Ltd.

REVIEWERS

Rory Beise, Water and Land Use Consultant, Vancouver Island Health Authority

Christine Bieber, P.Geo., Hydrogeologist, BC Ministry of the Environment

Wayne Radomske, P.Eng., Public Health Engineer, Interior Health Authority

Alistair Stewart, P.Eng., Drinking Water/Wastewater Engineer, Ministry of Health

David Tamblyn, P.Eng., Public Health Engineer, First Nations Health Authority

Michael Wu, P.Eng., Public Health Engineer, Vancouver Coastal Health Authority

Michael Zemanek, P.Eng., Director, Healthy Community Environments, BC Ministry of Health

