Entry-to-Practice Competencies for Geoscience in Canada?

An idea under consideration by the
Canadian Geoscience Standards Board
for the Canadian Council of Professional Geoscientists

Report on a Concept Study Completed by

Oliver Bonham, PGeo and David Cane, PhD

October 2007

Table of Contents

Current Requirements for Geoscience Licensure

In order to qualify for licensure as professional geoscientists, Canadian geoscience regulators expect applicants to have completed educational and practice experience requirements.

The educational requirement is based upon a four-year Bachelor of Science degree, at the honours level (or equivalent). The content of acceptable degree programs is specified through educational units that must be completed in certain defined subject areas. The expected learning outcomes from each unit are not laid out in detail, but brief descriptors are provided to indicate course content. It is assumed that successful completion of the courses provides graduates with the enabling competencies that are necessary for geoscience practice.

The practice experience requirement is based up on a minimum duration of 48 months, with appropriate quality, currency, supervision and progression. While specific expectations for the nature of the practice experience are established, the anticipated learning outcomes are not specified. It is assumed that successful completion of the practice experience provides applicants with the professional competencies that are necessary for independent practice.

The Canadian Geoscience Standards Board (CGSB) has put very significant effort into revising the recommendations for the regulators that define educational and practice experience requirements[1]; nevertheless the revised specifications emphasize the expected learning process rather than the required learning outcomes. There are a number of problems that are inherent with regulatory decisions based upon this approach:

- It is difficult to evaluate the equivalency of education and work experience presented by candidates that deviate from the "norms" described in the requirements; this is particularly true when dealing with internationally -trained applicants.

- Differing interpretations of "equivalency" are common among the regulators.

- The evaluation of the proficiency of candidates for licensure is left to program faculty and practice supervisors, without proficiency expectations being clearly defined.

- Because there is no direct relationship between completing a specified learning process and obtaining learning outcomes that relate to public protection (which is

[1] *Recommended Minimum Requirements of Geoscience Knowledge and Work Experience for Professional Practice*, February 2001

the regulatory mandate), decisions that rely upon process rather than outcome are not readily defensible based upon the principles of natural justice.

Evolving Regulatory Practice

Competency-based approaches to statutory regulation are becoming increasingly important in the developed world, with leadership from Australia, Canada and the United Kingdom.

In Canada, the federal-provincial *Agreement on Internal Trade*[2] (AIT) effectively mandates provincial regulators to establish requirements that are competency-based.

The *Labour Mobility Chapter* of AIT (which is designed to ensure fair practice in the movement of regulated professionals between provinces) states[3]

> *Any measure adopted or maintained by a regulatory body or government relating to occupational licensing…should relate principally to competence.* (Page 6)

and goes on

> *The Chapter recognizes that competencies can be acquired through different combinations of training and experience.*
>
> *This means that…differences in training methods or in the amount or level of education / training required in different jurisdictions should not be a factor when regulatory bodies compare their standards. The length of a program of study is not always an indicator of what is taught and learned in the program.* (Page 25)
>
> *[Differences in the length of a period of work experience] should not be a basis for qualifying a worker from another jurisdiction, unless the difference can be shown to be directly related to the acquisition of competencies called for in the standard.* (Page 26)

AIT and its resulting initiatives make it clear that the federal government and provincial governments expect regulators to define their licensing standards in terms of the learning outcomes (occupational competencies or job skills) that are required of applicants, and not the learning process that candidates have to complete.

The reason for this emphasis on competencies is relatively straightforward, and has to do with the principles of natural justice. Regulators are delegated by government the

[2] *Agreement on Internal Trade*, signed by the Government of Canada and the Provincial and Territorial governments in 1994

[3] *Guidelines for Meeting the Obligations of the Labour Mobility Chapter*, published by the Forum of Labour Market Ministers, Labour Mobility Coordinating Group (revised edition February 2003)

authority to regulate their profession in order to protect the public. In doing so they have a right to assess the competence of individuals to practice, and to deny a license to those they deem to lack competence. By establishing requirements that are in the form of occupational competencies (actual job skills) that relate directly to public protection, the regulator can ensure that its expectations are transparent, defensible and most likely to withstand legal challenge.

To base a licensing requirement purely on a specific learning process (or its deemed equivalent) invites challenge on the grounds that (a) there are many different ways to acquire competence and (b) there is no direct link between a learning process and competencies acquired during or subsequent to it.

Since AIT was introduced, many Canadian regulators have established requirements that are competency-based.[4,5] Others are under continuing pressure to do so. The *Forum of Labour Market Ministers* recently reaffirmed its commitment to ensure that all existing regulated occupations are in full compliance with AIT provisions by April 1 2009.[6]

Once a regulator has established competency-based requirements for licensure, it is in a position to determine how candidates should be assessed relative to their possession of those competencies. Common approaches include:

- Recognizing academic credentials and / or work experience (as long as these can be directly demonstrated to provide holders with the required competencies)

- Creating a licensing examination (which is based on the competencies required and which may involve written, oral and / or practical assessment processes)

Established in this manner, and relying on a competency-based primary requirement, credentials, work experience and examinations can be regarded as secondary requirements for licensure, which is acceptable under AIT.

It should be noted that currently in geoscience the guideline *Recommended Minimum Requirements of Geoscience Knowledge and Work Experience for Professional Practice*, in conjunction with any additional specific knowledge or experience

[4] *Report on Implementation of the Labour Mobility Chapter of the Agreement on Internal Trade*, forum of Labour Market Ministers, July 2001

[5] See for example:

Certification Standards for the Profession of Forestry in Canada, Canadian Federation of Professional Foresters Associations, November 2006

Entry-to-Practice Competencies for Ontario Registered Nurses, College of Nurses of Ontario, January 2005

Profile of Occupational Therapy Practice in Canada, Canadian Association of Occupational Therapists, second edition, 2002

[6] News Release from Annual Meeting of the Federal-Provincial-Territorial Committee of Ministers on Internal Trade; St. John's, Newfoundland and Labrador - June 7, 2007

requirements set by individual regulators, and the widely-used Professional Practice and Ethics Examination, serve as primary, not secondary, licensure requirements.

The CGSB Concept Study

In January 2007 the Canadian Council of Professional Geoscientists (CCPG) submitted a proposal to Human Resources and Social Development Canada (HRSDC) that, if supported, would result in a project to enable the development of a more comprehensive Mutual Recognition Agreement (MRA) to replace the current Inter-Association Mobility Agreement.[7] The new MRA was planned to further enhance labour mobility for geoscientists and to meet the guidelines of AIT.

HRSDC provided support, and CCPG contracted one of the authors[8] of this report to assist. Following a presentation to CGSB on March 31 2007, CGSB initiated the concept study that is reported here, to examine the process necessary to, and the implications of, developing entry-to-practice competencies for professional geoscientists.

Independent of the concept study, but concurrent with it, CGSB completed its revision of *Recommended Minimum Requirements of Geoscience Knowledge and Work Experience for Professional Practice*. It should be noted that the revised requirements remain process-based rather than outcomes-based, and do not define the competencies required for safe and effective professional practice.

The concept study involved the following activities

- A literature search to identify existing competency-based standards in geoscience, as well as relevant non-geoscience materials[9]
- Development of a structural framework for the geoscience competencies
- Drafting of competency statements based on content suggested by source documents identified during the literature search
- Drafting of competency statements based upon the knowledge of a small working group of experienced geoscience professionals[10]
- Liaison / consultation meetings with CGSB, the Board of Directors of CCPG, the National Professional Practice Examination Advisory Committee and the National Geoscience Admission Officers Group

The concept study has culminated in this Report and a Concept Document: *Entry-to-Practice Competency Profile for Professional Geoscientists* (attached as an Appendix).

[7] "PGeo=PGeo" A Project to Advance National Labour Mobility for Professional Geoscientists; CCPG, January 24 2007
[8] Dr David Cane, Catalysis Consulting
[9] Key source documents are listed in the Appendix
[10] Oliver Bonham, PGeo; Jules Lajoie, PhD, PEng; Cat Brown, PEng, PGeo

Concept Document: *Entry-to-Practice Competency Profile for Professional Geoscientists*

The Concept Document is intended to serve as an example of the structure and content of a competency profile that might be developed by CGSB, for CCPG to recommend for adoption by the provincial regulatory bodies as an entry-to-practice requirement for geoscientists. The Concept Document is incomplete – within the concept study the time and financial resources necessary to develop a complete competency profile have not been available.

The Concept Document is an occupational competency profile based upon CCPG's definition of *professional geoscience*, and as such it provides a listing of job tasks which, delivered proficiently, may be deemed to constitute safe and effective professional practice.

The occupational competencies in the profile could be further sub-divided into enabling sub-competencies and practice sub-competencies that would respectively identify the learning outcomes of geoscience educational programs or supervised practice components, and reflect the layout of CGSB's current recommended regulatory requirements.

In reviewing the Concept Document, readers should note the following:

- The competency profile is intended to define a minimum entry-to-practice requirement; it does not seek to describe advanced or expert practice

- An occupational competency profile is best considered as an array of abilities, which competent practitioners should bring to the workplace in order to ensure safe and effective practice

- From within the array, competent practitioners select and apply competencies as and when required, using their professional judgment and according to the situation at hand (some of the competencies listed in the profile may not be applicable in certain practice settings, and may not be developed further as a professional's career progresses and becomes more specialized, but nevertheless they constitute important entry-to-practice abilities)

- The competencies form an integrated set of abilities (each one "informing and qualifying" the others); as a result a competency appears only once in the profile

- The framework within which the competencies are organized, and the order of listing the competencies, is for convenience only; it should not be construed as dictating a protocol or a process for their application

- Competencies are written as complete sentences using a verb that is externally oriented (eg “apply knowledge of” is preferable to “understand”); this is to aid the assessment of proficiency

A competency statement describes a job task. It does not in and of itself define a level of proficiency with which the task must be performed to constitute safe and effective practice. Proficiency is a developmental concept: the level of proficiency of a practitioner may be expected to increase over time, depending upon education and experience. Since the mandate of the regulator is to ensure that the individuals it licenses are sufficiently proficient to provide safe and effective practice (ie “competent”), it is incumbent upon the regulator to define in measurable terms an acceptable level of entry-to-practice proficiency. A proposed definition is included in the introductory section of the Concept Document.

It must be emphasized that the Concept Document is incomplete. Within the time and resources available, attention has focused on the generic *Competencies Applicable to all Professional Geoscientists* and the *Additional Competencies Applicable to Geology* ; relatively little attention has focused on the *Additional Competencies Applicable to Environmental Geoscience* and the *Additional Competencies Applicable to Geophysics*.

Completing the Development of a Competency Profile for Geoscience

Although incomplete, the Concept Document may be built upon to develop a complete competency profile for geoscience. The following process is recommended.

1. Establish a Working Committee of 6 – 8 experienced, practicing geoscientists including expertise in geology, environmental geoscience and geophysics

2. Secure non-geoscience consulting expertise in the development of competency-based regulatory standards to lead the Committee

3. Mandate the Working Committee to develop a complete draft Competency Profile through a series of face-to-face sessions supplemented as necessary by teleconference and e-mail communication

4. Undertake a validation survey (see below) to determine the consistency of the draft Competency Profile with the experience of practicing geoscientists across the country

5. Engage in a consultation process with the regulators to determine their current expectations and proposals for entry-to-practice competencies

6. Based upon the results of the survey and the input of the regulators, adjust the draft Competency Profile and recommend it to CCPG, through CGSB, as a final document for approval and adoption

A validation survey is a key step in the development of an occupational competency profile. It ensures that the competencies in the profile accurately reflect professional practice. Additionally, undertaking a broad consultation of the profession through a survey builds understanding of the purpose of the competency profile and the regulatory process, and provides an opportunity for increased buy-in from the profession at large.

A validation survey can be made available to every registered professional geoscientist in Canada through a simple and user-friendly on-line process. Relative to each competency in the draft profile, respondents would be asked:

- Rate the frequency with which you utilize this competency in your practice
- Rate the level of importance that you consider this competency to have relative to the provision of safe and effective practice

Demographic information would be collected to assist in the analysis of results, and respondents would be invited to suggest additional competencies (not currently in the draft profile) that they consider may be valuable entry-to-practice requirements.

Analysis of the results of the survey would provide statistically valid data[11] upon which final decisions of the content of the competency profile may be based.

Advantages to the Regulators of a Competency Profile for Geoscience

An earlier section of this Report discussed Evolving Regulatory Practice, and explained how a primary regulatory requirement that is based upon occupational competencies for public protection provides regulators with a standard that is transparent and defensible.

If adopted as the primary regulatory requirement, occupational competencies (which are inherently outcome-based) will enable CGSB, CCPG and the regulators to reduce their current reliance on guidelines that control the educational process, and allow geoscience educators increased flexibility to structure their programs in ways that meet their institutional goals and the unique needs of their students. Such flexibility will not in any way reduce the accountability of programs for their graduates' learning outcomes; in fact the regulators' expected learning outcomes will be clearer under this model.

Occupational competencies will also enable the regulators to better articulate outcome-based expectations for the supervised experience requirement.

[11] The use of incentives for completing the survey can increase response rates and improve the statistical reliability of results.

Currently there are no defined competency requirements for geoscience, no declared levels of entry-to-practice proficiency for those competencies, and no commonly agreed-to independent methods of measuring proficiency. Regulators essentially delegate the assessment of the suitability of candidates for licensure to established educational program providers and to practice supervisors. Furthermore, this delegation takes place without competency and proficiency expectations having been first defined by the regulators. As a result, there will inevitably be inconsistencies in assessment standards both within and across jurisdictions. If the regulators adopt occupational competencies as the primary requirement, and if they define entry-to-practice proficiency relative to these competencies, the regulators will be in a position to control the assessment of proficiency. Delegation is still possible, but it would take place within clear expectations, and with the potential for periodic review by the regulators.

The challenge of assessing applications for licensure from individuals who have not been through a "standard" Canadian geoscience education and practice experience process (including "internationally-trained" geoscientists) was mentioned earlier in the Report. Current attempts to assess these individuals rely upon comparing their particular education and supervised practice experience with Canadian norms. Since it is well-established that effective learning can take place by a variety of different processes over very different timeframes, this approach is fraught with difficulty and lacks defensibility. Identifying the occupational competencies required for licensure will position regulators to determine how the proficiency of non-standard candidates is to be assessed in a direct manner that relates to their current job skills.

Regulators are mandated by their governments to monitor the continuing competency to practice of licensees. No reasonable person would expect an experienced practitioner to rely upon entry-to-practice competencies throughout their career. With experience, and with practice specialization, practitioners become more focused in their skill sets, and also more proficient. It is not realistic to expect an experienced practitioner to continue to demonstrate entry-to-practice competencies in order to justify continuing licensure. It is for this reason that regulators often establish "continuing education" requirements as a measure of ongoing competence to practice. Such requirements involve the same shortcomings regarding defensibility as entry-to-practice requirements that focus on the educational process. The identification of entry-to-practice competencies for geoscientists will enable regulators to determine which of those competencies should be required on an ongoing basis, and so move toward establishing outcome-based requirements for continuing competency.

The inappropriateness of using entry-to-practice requirements as a means of assessing the eligibility for licensure of experienced geoscientists applies also to those Canadian applicants entering licensure late in their career (as is the case for many geoscientists because regulation of the profession is for the most part a relatively recently introduced requirement), to internationally-trained applicants, and to labour-mobility applicants from other Canadian jurisdictions. It is not reasonable to base an assessment for licensure

of these applicants on the education and practice components that they went through to qualify for entry-to-practice, perhaps many years in the past. Such components would be a poor measure of the current competence of these individuals. The identification of entry-to-practice competencies for geoscientists will enable regulators to base licensure decisions for experienced, internationally-trained and experienced labour-mobility applicants on their current occupational competencies.

Finally, defining occupational competency requirements, both for entry-to-practice and for continuing licensure, will assist regulators in their role to adjudicate public complaints (particularly those alleging professional "incompetence") and initiate discipline where appropriate. The better the requirements for competence are defined, the easier it will be to judge situations where deficient practice has occurred.

Recommendations

The authors of this Report recommend as follows:

- That CCPG, through CGSB, initiate a project to develop a complete Competency Profile for Professional Geoscience through a process similar to that outlined in this Report

- That the resulting Competency Profile be recommended to the geoscience regulators for adoption as the primary entry-to-practice requirement

- That following adoption of the Competency Profile, CGSB adjust the requirements for education and supervised practice experience, and the content of the Professional Practice and Ethics Examination, such that both are consistent with the Competency Profile and serve as effective secondary entry-to-practice requirements

--- end of report ---

Appendix: Concept Document

[See next page]

Canadian Geoscience Standards Board

Concept Document:

Entry-to-Practice Competency Profile for Professional Geoscientists

October 2007

Appendix to *Entry-to-Practice Competencies for Geoscience in Canada?* Report on a Concept Study Completed by Oliver Bonham and David Cane

The practice of Professional Geoscience is defined as the performing of any activity that requires application of the principles of the geological sciences, and that concerns the safeguarding of public welfare, life, health, property, or economic interests, including, but not limited to:

> investigations, interpretations, evaluations, consultations or management aimed at discovery or development of metallic or non-metallic minerals, rocks, nuclear or fossil fuels, precious stones and water resources;
>
> investigations, interpretations, evaluations, consultations or management relating to geoscientific properties, conditions or processes that may affect the well-being of the general public, including those pertaining to preservation of the natural environment.

The Competency Profile, when complete, will identify the occupational competencies of the Professional Geoscientist at entry-to-practice.

An *occupational competency* is defined as a job task that involves application of knowledge, skills and attributes that have been aquired through formal or informal learning. Proficient application of occupational competencies provides a level of assurance to the public of safe and effective professional practice.

The *Competency Profile* may be regarded as an array of abilities that the Professional Geoscientist carries within himself or herself, and is able to draw upon as necessary. These abilities are integrated, in the sense that each occupational competency informs and qualifies every other occupational competency.

This Concept Document is incomplete; it focuses on competencies applicable to the Geology and Environmental Geoscience streams, and provides only a brief outline of the competencies applicable to Geophysics.

Development of the Concept Document drew upon the following publications, to the extent that they relate to occupational competencies applicable to Professional Geoscience:

1	American Institute of Professional Geologists	*Education for Professional Practice* , February 2007
2	Association of Mineral Exploration of British Columbia	*Standards of Disclosure for Mineral Projects* , Workshop Slides, January 2007
3	Association of Professional Engineers and Geoscientists of British Columbia	*EIT / GIT Guidelines* , revision version, May 2007
4	Association of Professional Engineers, Geologists and Geophysicists of Alberta	*PPE Examination* , Scope and Syllabus
5	Association of Professional Geoscientists of Ontario	*Guideline to Registration* , 2002
6	Engineers Australia	*Australian Engineering Competency Standards*

7	Canadian Federation of Professional Foresters Associations	*Certification Standards for the Profession of Forestry in Canada* , November 2006
8	College of Nurses of Ontario	*Entry-to-Practice Competencies for Ontario Registered Nurses* , January 2005
9	National Association of State Boards of Geology	*Tasks of a Professional Geologist* , December 2004
10	Ordre des géologues du Québec	*Minimum Academic Training Required to Obtain a Geologist's Permit* , March 20, 2007
11	United Kingdom Quality Assurance Agency for Higher Education	*Subject Benchmark Statements: Earth Sciences, Environmental Sciences and Environmental Studies* **,** 2007
12	United Kingdom Science Council	*Chartered Scientist: The Standards for Professional Scientists* , 2004

Occupational competencies describe job tasks; they do not inherently refer to a *level of proficiency* in each task. Proficiency is a developmental concept - in general a practitioner's level of proficiency will increase with training and experience.
For regulatory purposes it is necessary to identify a level of proficiency that is required for entry to professional practice. This is referred to as *entry-to-practice proficiency* and is defined below. Regulators require a mechanism to establish an applicant's level of proficiency prior to granting a professional practice license.

Entry-to-practice proficiency is defined by the following statement:

> When presented with routine situations, the entry-to-practice Professional Geoscientist applies each relevant occupational competency in a manner consistent with generally accepted standards in the profession, without supervision or direction, and within a reasonable timeframe. The Geoscientist selects and applies competencies in an informed manner, based on the situation at hand. The Geoscientist anticipates what outcomes to expect in a given situation, and responds appropriately.
> The entry-to-practice Professional Geoscientist recognizes unusual, difficult to resolve and complex situations, and takes appropriate steps to address them based upon his / her level of skill and experience; this may include seeking advice or consultation, reviewing research literature, and referring the client to other qualified professionals.

Entry-to-practice proficiency may be contrasted with *advanced proficiency* , which is defined by the following statement:

> The Professional Geoscientist working at an advanced level has extensive experience and exhibits a nuanced understanding of presenting situations. Decision-making flows more efficiently because the Geoscientist readily perceives which aspects of the situation are the important ones, and how they should be addressed. The Geoscientist working at an advanced level deals effectively with most unusual, difficult to resolve and complex situations.

Entry-to-practice and advanced proficiencies may be contrasted with *expert proficiency* , at which level Professional Geoscientists may be recognized as leaders in their fields, who regularly contribute to the advancement of the profession.

The Competency Profile is structured using the following framework:

Section 1: Competencies Applicable to all Professional Geoscientists

- 1.1 Practice professionally.
- 1.2 Practice ethically.
- 1.3 Stay current with developments in the profession.
- 1.4 Communicate effectively.
- 1.5 Manage activities and lead people.
- 1.6 Apply scientific knowledge and methodology.
- 1.7 Use computers and electronic information systems.
- 1.8 Solve complex problems.

Section 2: Additional Competencies Applicable to Geology

- 2.1 Conduct field investigations.
- 2.2 Utilize laboratory analysis.
- 2.3 Incorporate knowledge of mineralogy and petrology.
- 2.4 Incorporate knowledge of sedimentology, stratigraphy and paleontology.
- 2.5 Incorporate knowledge of Quaternary geology, geomorphology and surficial processes.
- 2.6 Incorporate knowledge of structure and tectonics.
- 2.7 Prepare geological report.

Section 3: Additional Competencies Applicable to Environmental Geoscience

- 3.1 Conduct field investigations.
- 3.2 Utilize laboratory analysis.
- 3.3 Incorporate knowledge of bedrock geology.
- 3.4 Incorporate knowledge of surficial geology.
- 3.5 Incorporate knowledge of hydrogeology.
- 3.6 Incorporate knowledge of environmental investigations.
- 3.7 Incorporate knowledge of active earth processes.
- 3.8 Incorporate knowledge of engineering geology.
- 3.9 Prepare environmental geoscience report.

Section 4: Additional Competencies Applicable to Geophysics

4.1 Conduct field-based geophysical data acquisition surveys.
4.2 Analyze and interpret field geophysical survey data.
4.3 Incorporate knowledge of minerology and petrology.
4.4 Incorporate knowledge of sedimentation and stratigraphy.
4.5 Incorporate knowledge of structural geology.
4.6 Incorporate knowledge of rock properties.
4.7 Incorporate knowledge of geophysical properties of the planet earth.
4.8 Incorporate knowledge of seismology.
4.9 Incorporate knowledge of exploration geophysics.
4.10 Incorporate knowledge of potential fields, gravity and magnetics.
4.11 Incorporate knowledge of electrical and electromagnetic methods.
4.12 Incorporate knowledge of radiometrics.
4.13 Process data.
4.15 Prepare geophysical report.

Occupational Competencies	
1.1 Practice professionally.	
a	Identify and comply with relevant legislation, regulations and statutory reporting requirements.
b	Practice within the bounds of personal expertise and limitations.
c	Seek advice or assistance where necessary.
d	Act with confidence and flexibility in dealing with new and changing situations.
e	Create and sustain effective relationships with co-workers.
f	Work effectively in a team environment.
g	Work effectively with non-geoscience professionals.
h	Work effectively as a member of an interdisciplinary geoscience team.
i	Recognize the effect of personal values and assumptions of interactions with others.
j	Facilitate the learning of others.
k	Recognize the organization of geoscience as a profession.
l	Represent the profession in a positive manner.
m	Self-evaluate performance, and set goals for improvement.
1.2 Practice ethically.	
a	Identify and comply with relevant Codes of Ethics.
b	Recognize obligations and responsibilities to clients, to employers and to society.
c	Respect client and employer confidentiality.
d	Identify and address health and safety concerns in the workplace.

e	Act with appropriate concern for the natural environment and community.
f	Practice in a manner that is non-prejudicial, and that respects diverse cultural, ethnic and religious beliefs.
g	Manage risks, and maintain safeguards, including insurance where required.
1.3 Stay current with developments in the profession.	
a	Maintain relevant memberships in professional and technical associations.
b	Maintain knowledge of emerging professional issues.
c	Maintain knowledge of emerging technical / scientific issues.
d	Read geoscientific literature, evaluate information critically, and assess relevance to practice.
e	Participate in continuing professional development.
f	Manage self-learning.
1.4 Communicate effectively.	
a	Speak clearly and concisely.
b	Write clearly and concisely.
c	Prepare letters and reports.
d	Develop and deliver effective presentations.
e	Use terminology appropriate to the purpose and targeted audience.
f	Employ appropriate non-verbal communication.
g	Distinguish social interaction from professional communication.

1.5 Manage activities and lead people.	
a	Plan and organize projects effectively.
b	Prioritize activities and use time management and scheduling skills.
c	Supervise personnel effectively.
d	Organize logistical support for field activities.
e	Use map reading and orienteering skills to navigate and to establish position in the field.
f	Accept accountability for decisions and actions.
g	Utilize effective conflict resolution strategies.
h	Employ appropriate budgeting, accounting, record keeping and business practices.
1.6 Apply scientific knowledge and methodology.	
a	Apply basic knowledge in the pure and applied sciences that underpins the practice of professional geoscience.
b	Apply statistical principles and methods, consistent with the practice of professional geoscience.
c	Apply mathematical principles and methods, consistent with the practice of professional geoscience.
d	Apply knowledge of scientific method.
e	Apply knowledge of research methodologies.
f	Search scientific literature.
g	Use sources of geoscientific information.
h	Apply principles, and maintain documentation of quality assurance and quality control (QA / QC).
i	Undertake, and maintain evidence of, reasonable investigation and due diligence.
j	Manage scientific information.

k	Maintain documentation to support findings, decisions and opinions.
l	Use internal and external peer review processes for validation.
m	Archive data and other information.
1.7 Use computers and electronic information systems.	
a	Operate common electronic communication devices.
b	Operate standard notebook, laptop and desktop computers, and common peripheral devices.
c	Use a keyboard (or alternate interface) efficiently.
d	Install, utilize and update common software.
e	Access information from, and save information to, databases, networks and other storage systems.
1.8 Solve complex problems.	
a	Assist employer or client clarify needs and identify relevance of geoscientific information.
b	Apply established analytical and problem solving techniques to a wide variety of geoscientific situations.
c	Critically assess and incorporate appropriate external information; devise studies to obtain relevant new data.
d	Interpret and integrate information logically.
e	Develop reasonable assumptions and arguments.
f	Recognize uncertainty, ambiguity and limits to knowledge.
g	Apply geoscience principles and use good judgment to identify solutions or explanations.

Occupational Competencies	
2.1 Conduct field investigations.	
a	Conduct background literature study.
b	Utilize data from geophysical surveys, and other geoscientific studies.
c	Design and plan field program that addresses the objectives of the investigation and incorporates any site-specific considerations.
d	Undertake field investigation, including making observations, gathering data, and taking and maintaining geoscientific field notes, records, sketches and photographs.
e	Undertake sampling programs.
f	Prepare maps, geologic logs, sections and other diagrams.
g	Interpret field and related data.
2.2 Utilize laboratory analysis.	
a	Select appropriate analytical techniques.
b	Ensure sample integrity.
c	Determine validity and applicability of results.
d	Interpret and integrate findings.

2.3 Incorporate knowledge of mineralogy and petrology.	
a	Plan and conduct mineralogic and petrologic studies.
b	Idenfity rocks, their mineral compositions and characteristics.
c	Identify and interpret rock and mineral sequences, associations, and genesis.
d	Evaluate chemical and mineralogical data, and construct interpretive models.
e	Determine type, degree, and effects of rock and mineral alteration.
2.4 Incorporate knowledge of sedimentology, stratigraphy and paleontology.	
a	Plan and conduct sedimentologic / stratigraphic studies.
b	Identify and interpret sedimentary structures, depositional facies and depositional environments, and sediment provenance.
c	Identify fossils and fossil assemblages for age and paleoecologic interpretations.
d	Interpret sediment and rock geometries, sequences and ages.
e	Select appropriate stratigraphic nomenclature, and establish correlations.
2.5 Incorporate knowledge of Quaternary geology, geomorphology and surficial processes.	
a	Plan and conduct geomorphological studies.
b	Identify and classify landforms and surficial deposits.
c	Determine geometries, provenance, and absolute and relative age relationships of surficial deposits.
d	Evaluate geomorphic processes, identify past, and predict future, changes.
2.6 Incorporate knowledge of structure and tectonics.	
a	Plan and conduct structural / tectonic studies.
b	Identify and determine structural features, orientations and interrelationships.

c	Develop deformational history through structural analyses.
d	Interpret tectonic history.
2.7 Prepare geological report.	
a	Identify purpose and scope of investigation.
b	Reference prior studies and other relevant information.
c	Document geoscientific methodologies and analytical techniques employed.
d	Present results.
e	Incorporate maps, logs, sections, photographs and other relevant diagrams.
f	Provide interpretations, estimations, conclusions, opinions and recommendations as appropriate.

Occupational Competencies	
3.1 Conduct field investigations.	
a	Conduct background literature study.
b	Utilize data from other geoscientific and engineering studies.
c	Design and plan field program that addresses the objectives of the investigation and incorporates any site-specific considerations.
d	Undertake field investigation, including taking and maintaining geoscientific field notes, records, sketches and photographs.
e	Undertake sampling programs.
f	Prepare maps, logs, tables, sections and other diagrams.
g	Interpret field and related data.
3.2 Utilize laboratory analysis.	
a	Select appropriate analytical techniques.
b	Ensure sample integrity.
c	Determine validity and applicability of results.
d	Interpret and integrate findings.
3.3 Incorporate knowledge of bedrock geology.	
a	Identify rocks, their mineral compositions and characteristics.
b	Identify sedimentary and volcanic structures, and depositional facies.
c	Identify igneous and metamorphic environments, and characteristics.
d	Interpret depositional environments and sediment provenance.
e	Evaluate the consequences of bedrock geology on the investigation.

3.4 Incorporate knowledge of surficial geology.	
a	Identify and classify landforms and surficial deposits.
b	Determine geometries, provenance, and relative age relationships of surficial deposits.
c	Evaluate past and present geomorphic processes, and assess future events.
d	Evaluate the consequences of surficial geology on the investigation.
3.5 Incorporate knowledge of hydrogeology.	
a	Plan and conduct hydrogeological investigations.
b	Define and characterize saturated and vadose zone flow systems.
c	Undertake groundwater sampling, monitoring and observation programs.
d	Characterize and determine hydraulic properties.
e	Interpret age dating, isotopic, and tracer studies.
f	Characterize water quality and evaluate chemical fate and transport.
g	Evaluate sites for water extraction, and supply sustainability.
3.6 Incorporate knowledge of environmental investigations.	
a	Plan and conduct environmental investigations.
b	Interpret historical land use and environmental conditions from imagery, maps, or other records.
c	Determine site characteristics and possible contaminants.
d	Develop and undertake field program to determine subsurface conditions.
e	Characterize subsurface soil, rock and groundwater conditions.
f	Evaluate chemical and mineralogical data, and construct interpretive models.
g	Develop plan for management and remediation.

3.7 Incorporate knowledge of active earth processes.	
a	Identify palaeoseismic, volcanic and land instability and other geologic hazards history from imagery, maps, or other records.
b	Interpret data to assess potential risk.
3.8 Incorporate knowledge of engineering geology.	
a	Plan and conduct geological investigations to assist in engineering design.
b	Interpret historical land use, landforms, or environmental conditions from imagery, maps, or other records.
c	Classify soil and rock properties and sequences.
d	Determine general soil and rock strength characteristics.
e	Determine hydrologic and hydrogeologic conditions.
f	Identify slope stability and active earth processes.
g	Interpret data relevant to engineering design.
3.9 Prepare environmental geoscience report.	
a	Articulate purpose and scope of investigation.
b	Reference prior studies and other relevant information.
c	Document geoscientific methodologies and analytical techniques employed.
d	Present results.
e	Incorporate maps, logs, sections, photographs and other relevant diagrams.
f	Provide interpretations, conclusions, opinions and recommendations as appropriate.

Occupational Competencies	
4.1 Conduct field-based geophysical data acquisition surveys.	
a	Conduct background literature study.
b	Utilize data from other geoscientific studies.
c	Design and plan data acquisition program.
d	Undertake data acquisition, including taking and maintaining geoscientific field notes and records.
e	Ensure data quality.
f	Undertake data processing to produce interpretable information.
g	Prepare data presentation with accompanying metadata.
4.2 Analyze and interpret field geophysical survey data.	
a	Apply knowledge of geoscientific context.
b	Develop anticipated feature reponses.
c	Identify and interpret features in data.
4.3 Incorporate knowledge of minerology and petrology.	
	competencies to be developed
	competencies to be developed
	competencies to be developed
	competencies to be developed
4.4 Incorporate knowledge of sedimentation and stratigraphy.	
	competencies to be developed
	competencies to be developed

	competencies to be developed
	competencies to be developed
4.5 Incorporate knowledge of structural geology.	
	competencies to be developed
	competencies to be developed
	competencies to be developed
	competencies to be developed
4.6 Incorporate knowledge of rock properties.	
	competencies to be developed
	competencies to be developed
	competencies to be developed
	competencies to be developed
4.7 Incorporate knowledge of geophysical properties of the planet earth.	
	competencies to be developed
	competencies to be developed
	competencies to be developed
	competencies to be developed
4.8 Incorporate knowledge of seismology.	
	competencies to be developed
	competencies to be developed
	competencies to be developed

	competencies to be developed
4.9 Incorporate knowledge of exploration geophysics.	
	competencies to be developed
	competencies to be developed
	competencies to be developed
	competencies to be developed
4.10 Incorporate knowledge of potential fields, gravity and magnetics.	
	competencies to be developed
	competencies to be developed
	competencies to be developed
	competencies to be developed
4.11 Incorporate knowledge of electrical and electromagnetic methods.	
	competencies to be developed
	competencies to be developed
	competencies to be developed
	competencies to be developed
4.12 Incorporate knowledge of radiometrics.	
	competencies to be developed
	competencies to be developed
	competencies to be developed
	competencies to be developed

4.13 Process data.	
a	Receive and verify raw data.
b	Ensure data quality.
c	Apply corrections.
d	Plot unfiltered data.
e	Examine unfiltered data; select and apply appropriate filtering techniques.
4.14 Interpret data.	
a	Identify spatial relationships and patterns.
b	Identify and separate anomalous features.
c	Determine and apply appropriate interpretation methodology.
d	Display interpretation appropriately.
4.15 Prepare geophysical report.	
a	Identify purpose and scope of investigation.
b	Reference prior studies and other relevant information.
c	Document instrumentation and data acquisition procedures.
d	Document data processing techniques.
e	Present results.
f	Incorporate maps, logs, sections, photographs and other relevant diagrams.
g	Provide interpretations, conclusions, opinions and recommendations as appropriate.