NEW ZEALAND GEOTECHNICAL SOCIETY INC

A Collaborating Technical Society of Engineering New Zealand

Building Policy
Building, Resources and Markets
Ministry of Business, Innovation and Employment
PO Box 1473
Wellington 6140
By email to building@mbie.govt.nz

25 June 2021

Feedback on the MBIE proposed occupational regulatory regime for Engineers

Introduction

Thank you for the opportunity to provide feedback on the Ministry of Business, Innovation and Employment's (MBIE) A proposed occupational regulatory regime for engineers.

The New Zealand Geotechnical Society (NZGS) is the affiliated organisation in New Zealand of the International Societies representing practitioners in soil mechanics, rock mechanics and engineering geology. NZGS is also affiliated to the Engineering New Zealand as one of its collaborating technical societies. We represent our 1,300 members practicing in the geotechnical and engineering geology fields in New Zealand.

We also work collaboratively with other disciplines in associated areas such as Earthquake, Structural and Fire Engineering, and have worked with these groups and Engineering New Zealand during the preparation of this submission.

This submission has been prepared by an NZGS Working Group made up of members of the NZGS Management Committee. Because of the short period of time allowed for this consultation, we have not had the opportunity to consult with our members. These responses have been approved by our management committee.

In our feedback we have answered only the questions on which we hold a strong opinion.

Our feedback

General feedback

The New Zealand Geotechnical Society recognises the need for regulation and agrees that the current regime requires revision. The current regime does not adequately manage the risks posed by poor quality engineering work. Overall, we support MBIE's proposal. This change is essential. We have been consulted with on this topic on several occasions previously. We urge MBIE to accelerate this process and to implement change soon.

We support the development of a two-tier system with a basic level of registration to ensure all practicing engineers are operating within a professional ethics framework, and higher levels of licencing where competence is assessed and demonstrated. We believe that to practise as a professional, engineers must be registered. Registration then becomes synonymous with professional commitment. We support Registration being about professionalism. We agree that registration should not involve an assessment of competence because it is purely a mechanism to bring engineers into a system that monitors ethics and professionalism. We would support a need to have passed a course on ethics and professionalism before registration.

We disagree with the proposal that licencing should only apply to a very limited list of 'high-risk' practices. We propose that wherever there is a need for technical competency assessments, these assessments should be carried out within a licensing system. Licensing then becomes about competency and restricting certain work to those whose competency has been assessed. The level of competence that needs to be demonstrated should be specific to the discipline and align with the requirements of the industry, clients and regulators.

We strongly support the intent to licence geotechnical engineers.

We strongly recommend that professional engineering geologists are licenced to the same standard as licenced geotechnical engineers. This already exists as the PEngGeol certification, which should be transitioned into the new system as Licenced Engineering Geologist with the technical competence set at an equivalent level to Licenced Geotechnical Engineers. NZGS has been working with Engineering New Zealand to develop a Body of Knowledge and Skills (BoKS) for both geotechnical engineering and engineering geology. Our BoKS are written to achieve a suitably high bar at a comparable level for geotechnical engineers and engineering geologists.

These BoKS set out in detail the expectations that we have for professionals operating in these two areas. We believe that they are set at the level required for licencing (i.e. somewhat more rigorous than the existing CPEng assessments) and would make a robust base for a future licencing system.

NZGS strongly believes that the primary legislation should require (via regulation) the development of a BOKS for each licensed discipline. The BOKS should be developed collaboratively by stakeholders such as the professional bodies (e.g. NZGS), the regulator, local authorities, government agencies and must include industry and subject matter experts.

We note that significant risks exist in practice areas that have not been identified as 'high risk', such as land development and residential projects, and strongly recommend that these other areas of engineering practice are also licenced. Many general practitioner engineers work in land development across multiple disciplines, including some geotechnical aspects, and we believe that regulation of this practice is essential.

Finally, we note that it is our strong opinion that a key measure of success for the future regime is that it must be credible and broad enough that it can address and negate alternate processes currently implemented by various territorial authorities (e.g. the Auckland Council Producer Statement Register).

Question specific feedback

THE CASE FOR INTERVENTION

MBIE Q1 Do you agree there is a case for occupational regulation of professional engineers? Why do you think so?

We agree that occupational regulation of professional engineers is essential to protect the public health, safety, and welfare against the potential for incompetent engineering services performed by individuals who lack the necessary education, training, experience, and other qualifications to perform engineering services. In many countries (e.g. US, Canada, UK etc.) the practice of engineering is regulated.

Many consumers will only use the services of an engineer once in a lifetime, and few will be able to easily differentiate good engineering from poor engineering. As a result, the usual market processes are ineffective at punishing poor performers and benefiting good performers. Instead, most consumers can base their decisions only on price, resulting in a technical 'race to the bottom'. Occupational regulation can be an effective mechanism to mandate a minimum level of acceptable performance in these circumstances.

Occupational regulation is also required to protect society more broadly. Many civil engineering failures that are not immediately life-threatening cause significant financial consequences for individuals, but in isolation do not justify the case for legislation. However, these lower-level failures are so widespread that in aggregate they create high costs for society as a whole.

MBIE Q2 Have we identified the issues with the status quo correctly? Are there any issues that we have not included?

In general we agree that the main issues have been identified.

In addition, we note that the definition of practice areas is poorly managed in land development, and further effort is required to define a practice area and suitable levels of competence for engineers operating in land development.

MBIE Q4 What is your perception of the overall performance of engineers? Does your perception depend on the engineering discipline? Do you have examples of poor engineering you can share?

While we are confident that most of our members perform well, we know of cases where performance has been unacceptable. We regularly hear anecdotal evidence of poor engineering practice, including some engineers practicing beyond their competence/qualification (for example, non-geotechnical engineers undertaking geotechnical design).

PROPOSAL 1: ESTABLISH A NEW REGISTRATION REQUIREMENT FOR PERSONS WHO PRACTISE PROFESSIONAL ENGINEERING

MBIE Q5 Does our working definition of professional engineer and professional engineering services adequately reflect the profession? Can you suggest any changes?

We agree with the bulk of the definition but recommend that it should be made more clear that engineering services includes the application of science to solving engineering problems.

The definition should also include 'investigating' within the list of acts. This brings the critical element of data collection (whether it be for forensic investigation of building failures, geotechnical ground investigations, or other similar activities) into the scope of the engineering services definition. These activities are critical to the successful engineering outcome and must be incorporated to mitigate the high risk that errors in this activity pose.

MBIE Q6 Do you agree that the regime should cover all professional engineers? Are there any disciplines that should be exempted and why?

We agree that the regime should cover all professional engineers.

MBIE Q7 Do you agree with establishing a new protected title? Do you have a preference for what it is?

We agree with establishing a new protected title. It should be a change from the existing Chartered Professional Engineer to avoid confusion between the two systems during transition. It should also cover Engineering Geologists.

We suggest protecting the term "Professional Geotechnical Engineer / Professional Engineering Geologist" at registration level and "Licenced Geotechnical Engineer / Licenced Engineering Geologist" at Licence level.

Alternatively, we could also support allowing for the practice field to be appended e.g. "Licenced Engineer (Geotechnical)" if this allows for better consistency across other disciplines.

We also recommend that the protection for "Chartered Professional Engineer" is maintained even if the term is no longer used, in order to prevent unlicensed engineers from misusing it.

MBIE Q8 Is a qualification enough for registration? Should we also include experience and an assessment of competence?

In addition to qualification (appropriate education and training), evidence of operating as a professional engineer (i.e. having a professional role working under the guidance of a registered engineer) and assessment of professionalism should be prerequisite to registration.

We do not believe that an assessment of competence at this level is useful. Engineering is a broad set of disciplines. Any standard assessment undertaken for registration that can apply to all engineers will not be suitable as a demonstration of competence in a specific field, and will therefore have very limited value. Evidence of a Washington Accord (or equivalent) qualification is more useful.

The aim of registration should be to get all engineers to operate within a regulatory system (and therefore under a code of ethics and subject to disciplinary processes). The inclusion of experience or a competency assessment would be detrimental. It would mean that there would always be some people operating outside the system because they have not yet met the experience or competence criteria. Registration should be focused on professionalism and ethics, and competence should be assessed at 'licenced' level.

While competence should not be assessed, each engineer should provide a detailed practice area description (which should be available to the public on the register), and an assessment should be made to confirm that their practice area description aligns with their training and practice.

MBIE Q9 Would limiting registration to those with an engineering qualification (such as a Washington Accord level degree or equivalent) exclude some engineers in the profession? How can we recognise those engineers?

Yes, this limitation would exclude many people who come into engineering with lower initial qualifications but who have gained the equivalent level of knowledge through on-the-job training. There should be multiple paths to obtaining professional status. The New Zealand engineering market is a melting pot of cultures and nationalities, and it is not appropriate to exclude large numbers of capable engineers from obtaining professional status. An assessment process must be included that allows individuals who have taken other pathways to demonstrate that they have reached the equivalent of Washington Accord level knowledge.

We recommend the inclusion of Engineering Technicians, Engineering Technologists and Engineering Geologists into the regulatory regime. Some existing Professional Engineering Geologists have Washington Accord degrees, but not all do.

Engineers with degrees in compatible science / technology subjects should be able to have their knowledge assessed to identify those with Washington Accord equivalence. For those without such a degree, an assessment considering their work experience and professional development should also exist.

MBIE Q11 Do you agree that all engineers should be subject to a code of conduct and continuing professional development obligations? Please share your reasons if you disagree.

Agree.

MBIE Q12 Do you agree with the proposal for a practising certificate? Do you have any other suggestions for how we can link registration to continuing professional development?

We disagree. A practicing certificate adds no value when there is an online and fully searchable register that is kept updated. This adds cost for no additional benefit. If an engineer does not make the annual declaration, they should be removed from the register as they have not complied with the code of ethics. This will be more up-to-date and useful than a practicing certificate.

It is essential that the online register is comprehensive, current and includes detailed information about what each specific engineer is licenced to do. It should include a description of practice area for all registered engineers so that members of the public and BCAs can identify when registered engineers are operating outside their field.

MBIE Q14 Should issuing a practising certificate be contingent on an engineer completing their continuing professional development commitments?

Yes. Some dispensation may be appropriate for engineers taking short career breaks (for example, maternity/paternity leave/sabbatical).

MBIE Q17 Should we include engineering associates, engineering technologists, engineering technicians and/or engineering geologists in the new regime?

Yes. Engineering is a system and failure by members of any of these groups could result in serious consequences that may not be picked up by other engineers without their specialist skills.

MBIE Q18 If we expand the scope, should we make registration mandatory for those practising in these additional areas?

Yes.

MBIE Q19 Is a recognised statutory credential of value for engineering associates, technologists, technicians, and engineering geologists? Why?

Yes. The lack of statutory credentials for these disciplines means that it is harder for competent individuals to demonstrate their worth to clients and regulators.

PROPOSAL 2: RESTRICT WHO CAN CARRY OUT OR SUPERVISE HIGH RISK ENGINEERING WORK

MBIE Q20 Do you support the Minister being able to decide what practice fields should be licensed? Or would you prefer greater certainty by setting out licensed practice fields in the primary legislation?

We agree the Minister should be able to decide what practice fields should be licensed. Prescribing practice fields in primary legislation would prevent the Regulator from responding to emerging fields of engineering, evolving societal expectations, or changes within the profession.

MBIE Q21 Do you agree with the proposed list of criteria that the Minister would use to prioritise the development of licence classes? Are there other criteria that should be considered?

We broadly agree with the criteria proposed. In addition, we recommend the Regulator be empowered to establish license classes where there is a need for a register of competency assessed engineers (for example, to demonstrate suitability to sign Producer Statements, design reports, engineering drawings etc.).

MBIE Q22 What sort of eligibility requirements for licensing would provide a suitable level of assurance on an engineer's expertise? Should they differ depending on the practice field?

The Regulator should prescribe eligibility requirements for licensing with input from the relevant technical society and engineering associations (for example the New Zealand Geotechnical Society), and also with the organisations that rely on licencing as a mark of competence – in particular

Building Consent Authorities. With this approach we would expect eligibility requirements for licenses to differ between disciplines and tiers of licensing.

MBIE Q23 Should licensed engineers undergo regular checks of their continued competency?

Yes

MBIE Q25 What tools would be most useful to check competency in your practice field?

A Body of Knowledge and Skills (BoKS) similar to those developed for Geotechnical Engineers and Engineering Geologists by the New Zealand Geotechnical Society should be developed for all licence areas and used in the competency assessment process. These should be the baseline against which competency is assessed.

A system should be set up to allow members of the public, BCA/Territorial Authorities and others to submit feedback and work samples to the Regulator for use in the competency assessment. This would allow the regulator to assess competence based on 'real-world' work samples provided by third parties, rather than via 'self-regulation' based on ideal samples cherry-picked by the engineer. Geotechnical Engineering is undertaken by a relatively small group of individuals, and there is significant reticence about reporting colleagues in the industry through a formal complaints process because there is a high likelihood that the complainant will need to work with the appellant for the rest of their careers. An anonymous tool for sending work samples (perhaps with a commentary about possible deficiencies) would be a valuable way to provide source material that could be used in the competency assessment process.

IMPLEMENTATION

MBIE Q32 Should the regulator have the flexibility to recognise and automatically deem some existing practitioners as registered and/or licensed?

The Regulator should have the flexibility to recognise and automatically deem some existing practitioners as registered, but not as licenced unless their existing assessment was against the same Body of Knowledge and Skills that will be used for the new licence class. A good example of this would be Professional Engineering Geologists (PEngGeol). All current PEngGeol individuals were assessed using the BoKS developed by the NZGS and Engineering New Zealand for this purpose. It is expected that this BoKS will be used for the future Licenced level equivalent for engineering geologists as it is already set at an appropriately high level. Assuming this occurs, existing PEngGeol individuals could be transferred to a new licence class for Engineering Geologists without further assessment.

MBIE Q34 Should we retain the Chartered Professional Engineer credential in the longer term? If we do, what role should it play?

We believe that it would only be appropriate to retain CPEng if the level for future registration were to be set at the current CPEng level. Otherwise, CPEng should be repealed to minimise confusion. Since we expect that these changes will result in a raising of the bar above the current CPEng level, we cannot support retaining Chartered Professional Engineer. However, consideration should be given to retaining protection for the term “Chartered Professional Engineer” to prevent it being misused.

Yours Sincerely

Ross Roberts
NZGS Chair
Email: chair@nzgs.org
Phone: +64 21 301 062

Appended:

- Body of Knowledge and Skills for Engineering Geology
- Body of Knowledge and Skills for Geotechnical Engineering

March 2019

Chartered Professional Engineer (Geotechnical) – Body of Knowledge and Skills

1. Introduction

This document defines the core knowledge and skills that a Chartered Professional Engineer (Geotechnical) (CPEng(Geotechnical)) is expected to have in order to competently investigate, design and monitor the construction of geotechnical works in New Zealand. This Body of Knowledge and Skills (BOKS) is intended to complement and inform the Chartered Professional Engineer assessment process.

The purpose of the BOKS is to:

- Define the prerequisite skills and knowledge that are required of a CPEng(Geotechnical)
- Provide a framework for Continuing Professional Development (CPD) and postgraduate training.

The BOKS is not intended to be a competence assessment framework. However, it is expected that the BOKS will inform the competence assessment process used by the Registration Authority to assess a CPEng(Geotechnical).

The title 'CPEng(Geotechnical)' is not proposed by NZGS or the Registration Authority. It is simply used as a convenient descriptor in this document.

2. Background

The Chartered Professional Engineers Registration Authority expects all Chartered Professional Engineers to:

- Either have a Washington Accord-accredited qualification (a four-year Bachelor of Engineering, Honours degree) or be able to demonstrate equivalent knowledge
- Demonstrate that they can work from first principles
- Demonstrate that they can solve complex engineering problems that require the application of engineering knowledge.
- The Registration Authority gives these expectations in a competence standard(1), which requires every Chartered Professional Engineer to demonstrate competence in their Practice Area. The Practice Area in which an engineer is assessed is aligned with one or two broad fields of engineering practice, which are published on the Register to assist the public when looking to engage an engineer. One of those Practice Fields is 'Geotechnical'.

[1] https://www.registrationauthority.org.nz/registration/competence-standard

While an engineer's Practice Area might be quite narrowly defined, engineers wishing to align their practice with the specialist field of geotechnical engineering, and be recognised as a CPEng(Geotechnical), are expected to demonstrate a breadth of geotechnical knowledge and skills (refer Section 3) which they are able to apply in a range of situations (refer Section 4).

The CPEng competence standard comprises twelve elements grouped into four competence areas:

1. Engineering knowledge
2. Professional acumen
3. Managing engineering work
4. Developing technical solutions.

Areas 1 and 4 can be considered the knowledge and skills that distinguish a CPEng(Geotechnical) from those of other Chartered Professional Engineers.

Complex engineering activities means engineering activities or projects that have some or all of the following characteristics:

(a) involve the use of diverse resources (resources includes people, money, equipment, materials, and technologies)

(b) require resolution of significant problems arising from interactions between wide-ranging or conflicting technical, engineering, and other issues

(c) have significant consequences in a range of contexts

(d) involve the use of new materials, techniques, or processes or the use of existing materials, techniques, or processes in innovative ways.

Complex engineering problems means engineering problems that have some or all of the following characteristics:

(a) involve wide-ranging or conflicting technical, engineering, and other issues

(b) have no obvious solution and require originality in analysis

(c) involve infrequently encountered issues

(d) are outside problems encompassed by standards and codes of practice for professional engineering

(e) involve diverse groups of stakeholders with widely varying needs

(f) have significant consequences in a range of contexts

(g) cannot be resolved without in-depth engineering knowledge.

Applicants for CPEng need to demonstrate competence for independent practice against the competence standard for their area of expertise. To remain registered, candidates undergo an ongoing reassessment at periodic intervals to prove continued competence. CPEng is the highest of the assessments that includes engineering professional (which includes engineering geologists), engineering technologist and engineering technician. An application typically includes five stages: preparation, validation, evaluation, recommendation and decision. Evidence is submitted and includes engineering qualification, work records, learning records (CPD), referees, Practice Field(s), a description of the Practice Area and a self-review demonstrating competence against the Assessment Criteria. The evaluation includes an interactive assessment including a Lead Assessor and a Practice Area Assessor. They make a recommendation to the Competency Assessment Board who make a decision regarding the application.

3. Knowledge and Skills

In looking to establish a finite set of knowledge and skills for a CPEng(Geotechnical), NZGS has defined the knowledge and skills required in order to deliver engineering outcomes for the different phases of a typical engineering project. Some knowledge and skills are specific to civil structures or building structures but most are required by all CPEng(Geotechnical).

The knowledge and skills of a Chartered Professional Engineer (Geotechnical) are applied to the typical phases for investigation, design and construction of a project, namely:

a) Options and alternatives identification and evaluation
b) Concept design
c) Site or project route selection
d) Assessment of the geotechnical issues that need to be addressed in a project
e) Preliminary design
f) Development of programmes of geotechnical investigation focussed on addressing these issues
g) Performance of geotechnical field and laboratory studies
h) Preparation and engineering evaluation of geotechnical reports
i) Analysis of geotechnical data and the performance of engineering computations
j) Detailed design
k) Preparation of design and construction documents
l) Safety in design
m) Earthquake geotechnical engineering
n) Performance and engineering evaluation of construction, post-construction and site monitoring
o) Monitor construction
p) Awareness and use of key technical documentation, guidance and standards
q) Understanding of key building and health and safety regulations.

It is recognised that there is overlap with the engineering geology profession and the PEngGeol registration administered by Engineering NZ and with the structural engineering BOKS (for example aspects of foundations and retaining walls).

<table>
<tr><th colspan="2">KNOWLEDGE AND SKILLS</th></tr>
<tr><th>Project phase</th><th>A Chartered Professional Engineer (Geotechnical) should be able to:</th></tr>
<tr><td>a) Options and alternatives identification and evaluation
b) Concept design</td><td>i. Understand design processes, coordination and information required at each stage
ii. Understand resource consent procedures and the level of information required for a resource consent
iii. Understand peer review and building consent procedures and the level of information required for a building consent
iv. Understand the general principles and terminology associated with geotechnical engineering as they relate to land development, building structures or civil structures
v. Understand and describe the need for the project
vi. Identify constraints and potential significant geotechnical issues
vii. Identify range of potential solutions
viii. Evaluate potential options and alternatives considering their relative feasibility, benefits and limitations
ix. Collaborate with other project stakeholders to integrate geotechnical elements into the design of the whole construction, and
x. Communicate design issues and options with clients and other stakeholders.</td></tr>
<tr><td>c) Site and route selection
d) Assessment of geotechnical issues
e) Preliminary design</td><td>i. Perform literature searches and site history analyses (including geology/geomorphology maps, hazard maps, aerial photographs, council files etc.) related to surface and subsurface conditions
ii. Undertake a walk over survey, demonstrate a good understanding of geology and geomorphology, and how these provide evidence of the geotechnical issues that need to be considered in the design process.
iii. Develop a preliminary ground model and possible hazards and documentation of the results, and
iv. Screen sites based on this evidence.</td></tr>
<tr><td>f) Development of programmes of geotechnical investigations</td><td>i. Communicate with other design consultants to determine the geotechnical input and the scope of the information needs
ii. Formulate or evaluate the engineering aspects of ground investigation and laboratory testing programmes with appropriate consideration of the benefits and limitations of each investigation and laboratory test method. The investigations should include a variety of techniques, for example boreholes, test pits, in-situ testing such as shear vane, CPTs, SPTs and shear wave testing, sample collection and a range of laboratory tests such as classification tests (Atterberg, PSD), strength tests (UCS, triaxial, CBR) and compaction/stiffness (MDD, oedometer)
iii. Specify the scope and engagement of site investigation</td></tr>
</table>

KNOWLEDGE AND SKILLS	
Project phase	**A Chartered Professional Engineer (Geotechnical) should be able to:**
	contractors, in consideration of the client's budget iv. Evaluate ground investigation and laboratory testing proposals, and v. Direct and/or modify ground investigation programmes, as required, upon evaluation of the conditions encountered with respect to the preliminary ground model.
g) Performance of geotechnical field and laboratory studies	i. Classify and evaluate subsurface conditions so as to further develop the ground model ii. Understand the purposes for and direct (and/or perform) routine field and laboratory tests for many of the following: a. soil and rock description in accordance with the NZGS guideline b. soil classification c. soil and rock strength d. bearing capacity e. expansion properties f. consolidation characteristics g. compaction characteristics and/or material acceptability for use in fill h. special properties such as soil collapse potential, erosion potential and acid sulphate conditions i. pavement sub-base qualities iii. Installation and monitoring of field instrumentation (e.g. groundwater, slope movements, settlement).
h) Preparation and engineering evaluation of geotechnical reports	i. Prepare appropriate plans, borelogs, in-situ and laboratory test results ii. Document laboratory and field testing results and observations iii. Prepare written factual and interpretive reports which present ground model and findings and present and interpret these reports to the clients iv. Interpret and review factual and interpretative geotechnical reports prepared by others v. Quantify and document geotechnical uncertainties on a systematic basis and incorporate of these into the design and risk assessment process, and vi. Demonstrate judgement as to the key risks and mitigation strategies and an awareness of current risk guidance and standards.

KNOWLEDGE AND SKILLS	
Project phase	**A Chartered Professional Engineer (Geotechnical) should be able to:**
i) Analysis of geotechnical data and performance of engineering computations j) Detailed design k) Preparation of design and construction documents l) Safety in design	i. Understand the engineering properties of soil and rock ii. Understand the manufacture, principal engineering properties, durability, cost, availability and potential applications of construction materials iii. Understand quality control processes, certification and traceability of supply iv. Provide the geotechnical aspects for Safety in Design reports for the full project lifecycle including construction, operation, maintenance, modification and demolition. Design, assess and calculate: v. Soil and rock strength vi. Bearing capacity, pile capacity (shallow and deep foundations) and allowable bearing pressures vii. Settlement and/or ground movement under static and seismic loads and over the design life, including expansion and consolidation properties viii. Slope stability and displacement under static and seismic actions ix. Geotechnical aspects of retaining systems under static and seismic loads x. Soil collapse and/or erosion potential xi. Control of groundwater xii. Earthworks including site preparation, cut/fill, compaction characteristics and material acceptability for use as fill xiii. Pavement subgrade qualities and pavement design xiv. Understand and have competency in the use, and have competency in reviewing outputs prepared by others, of most commonly used geotechnical analytical software (e.g. for retaining wall, foundation, pile and slope stability analysis and liquefaction assessment) xv. Understand the limitations and assumptions behind this software xvi. Prepare geotechnical design documentation, design features reports and relevant construction specifications xvii. Design and document construction sequence, and xviii. Prepare specifications and construction monitoring requirements.
m) Earthquake geotechnical engineering	Assess or calculate: i. Ground response to seismic action ii. Liquefaction susceptibility and vulnerability including assessment of secondary effect of settlement and lateral spread potential iii. Soil dynamic properties iv. Site subsoil class characterisation in terms of NZS1170.5 v. Seismic design parameters for geotechnical design

KNOWLEDGE AND SKILLS	
Project phase	**A Chartered Professional Engineer (Geotechnical) should be able to:**
	vi. Engagement with structural engineers, for example soil-structure interaction, and vii. Understand the broad principles behind probabilistic seismic hazard analysis.
n) Performance or engineering evaluation of construction, post-construction and site monitoring	Confirm encountered ground and groundwater conditions and structure response consistent with design assumptions, but not limited to: i. Perform or supervise geotechnical testing and monitor site construction such as foundations, earthworks, retaining walls and excavation ii. Analyse, design and evaluate instrumentation programmes to evaluate or monitor various phenomena in the field, such as settlement, deformations, slope creep, porewater pressures, groundwater variations and the development of trigger criteria and response actions iii. Evaluate geotechnical performance during construction, and iv. Evaluate engineering aspects of ground related distress associated with for example slope, foundation, and/or retaining wall distress or failure.
o) Monitor construction	i. Be familiar with health and safety requirements and processes ii. Understand Building Code compliance processes and documentation including different construction monitoring levels iii. Understand construction contracts in accordance with relevant standards iv. Oversee construction sequencing, managing the risk of instability throughout the construction sequence v. Review/update soil/rock exposures against the ground model and design assumptions vi. Design and review temporary support system proposals vii. Be familiar with geotechnical construction plant and machinery and their strengths and limitations viii. Monitor the construction to confirm it complies with the drawings and specifications and expected quality standards ix. Know when to commission tests on the engineering properties of soil, rock and engineered materials, and evaluate test reports x. Design and issue any variations to the design as required to mitigate nonconforming work xi. Keep records of all observations, contract variations and site instructions as they pertain to geotechnical matters xii. Understand and implement quality control processes, certification and traceability of supply xiii. Understand the management issues associated with contaminants

KNOWLEDGE AND SKILLS	
Project phase	**A Chartered Professional Engineer (Geotechnical) should be able to:**
	in soils, and xiv. Understand the management issues with sediment run-off, and xv. Prepare maintenance schedules for the life of the structure.
p) Awareness and use of key technical documentation, guidance and standards	Demonstrate general knowledge of the Building Act, Building Code, its core cited design actions and materials standards and other important guidelines and standards such as: i. AS/NZS1170 Structural Design Actions ii. NZS3604 Timber Framed Buildings iii. NZS4402 Methods of testing soils for civil engineering purposes iv. NZS4431 Code of Practice for Earth Fill for Residential Development v. AS2159 – 2009 Pile Design and Construction vi. AS4678 – 2002 Earth Retaining Structures vii. NZGS/MBIE Earthquake Geotechnical Engineering guidance modules viii. NZGS Field Description of Soil and Rock guideline ix. Awareness of international key standards for rock sample testing and in-situ testing etc x. MBIE guidance documents and practice advisories xi. NZTA Highways Structures Design Guide and Bridge Manual xii. Engineering NZ Practice notes and guidelines xiii. NZS 3910 Conditions of contract for building and civil engineering construction xiv. NZSEE/SESOC/NZGS/MBIE/EQC, The Seismic Assessment of Existing Buildings xv. Construction Industry Council – Design Documentation Guidelines xvi. Design Features Report templates xvii. AGS “Guideline for Landslide Susceptibility, Hazard and Risk Zoning for Land Use Planning xviii. ISO 31001 Risk management – Risk assessment techniques, and xix. Ministry of Education Structural and Geotechnical Guidelines for School Design and Education Infrastructure Design Guidance and other documents.
q) Understanding of building and health and safety regulations	Demonstrate a good understanding of: i. Building Act, Regulations and Building Code ii. Demonstrate a good understanding of the Health and Safety at Work Act (2015), and iii. The Chartered Professional Engineers of New Zealand Act (2002)

4. Examples of complex geotechnical engineering problems and activities

The CPEng competence standard requires an engineer to demonstrate an ability to analyse and develop solutions to complex engineering problems. The engineer uses his/her knowledge and skills to do these tasks. NZGS has identified a number of complex geotechnical engineering problems and activities for a CPEng(Geotechnical).

Engineers seeking specialist recognition as a CPEng(Geotechnical) are expected to demonstrate that they are capable of carrying out all of the following complex geotechnical engineering problems and activities.

A. Geotechnical engineering assessment for infrastructure route selection

B. Assessment and concept design of land for development or subdivision where the land has a range of ground conditions or is subject to natural hazards, and engineering works are required to enable development of the land

C. The assessment of the stability of natural, fill and cut slopes in soil and rock, in the order of 10m in height under static and seismic loadings with a medium to high risk to life (and/or property) if they fail

D. The geotechnical design of foundations and soil structure interaction analysis for IL 2 buildings (as defined by AS/NZS 1170.0) in the order of 3 storeys (about 10m) high, or bridges of comparable importance, founded on a range of ground conditions and a range of foundation types

E. Retaining structures in the order of 5m in height

F. Excavations in the order of 6m in depth (for example two levels of basement)

G. Assessment of situations with high risk to life or property where special precautions or expertise are or may be required, for example:

- During a response to an emergency events such as an earthquake or landslide
- Significant potential of undermining or overwhelming of a nearby building or utility,
- Obvious signs of distress of slope (natural, cut or fill) or retaining wall
- Obvious signs of contaminated soils
- Obvious signs of geothermal issues.

The difficulty of the ground conditions shall also be considered when assessing complexity. For example, a simple structure on very difficult ground conditions such as thick peat may be considered a complex geotechnical engineering problem.

5. Comments on demonstrating competency

The complex engineering problems and activities in Section 4 represent the range of projects to which knowledge and skills would be applied by Geotechnical Engineers working within small, large or specialised organisations. Applicants would be expected to have at least five years of practical experience following graduation to cover the range of complex problems and activities, and to have been supervised by and have their work reviewed by a more experienced CPEng(Geotechnical).

Applicants should also be able to demonstrate that they understand the boundaries of their knowledge and skills, and will seek assistance when asked to work outside their competency or level of expertise. For example, a retaining wall design task may have a Structural Engineer design the structural elements while a Geotechnical Engineer will define appropriate earth loadings and bearing capacities, and assess overall stability.

It is acknowledged that applicants will have a range of both experience and competency for each complex problem and activity. They are likely to have worked as part of a team, in which case they will need to demonstrate they have taken responsibility for most of the problem and activity and/or when the problems and activities are spread over more than one project.

Demonstration of competency is likely to be through a combination of:

- presenting a portfolio of design calculations, drawings and reports
- outlining the steps and judgment calls in the design process, and calculations for specific elements, and
- presenting case studies of project issues encountered and resolved, for example site inspections etc.

It is recognised that there are specialist fields or activities in geotechnical engineering that are not covered by the above BOKS. These include:

i. Tunnel engineering
ii. Mine design and mine slope engineering
iii. Offshore structure foundation design
iv. Water retaining structures and dams.

These specialist activities will require much of the same knowledge and skills as listed in the table in Section 3 and may require working from first principles which are applicable across the broader aspects of geotechnical engineering. It may therefore be possible to meet the geotechnical CPEng(Geotechnical) BOKS requirements above even though the range of activities is quite different to that listed in Section 4.

December 2019

Professional Engineering Geologist – Body of Knowledge and Skills

1. Introduction

This document defines the core knowledge and skills that a Professional Engineering Geologist (PEngGeol) is expected to have in order to competently investigate, analyse and communicate complex engineering geological issues which may arise as the result of the interaction between geology and the construction of engineering works, as well as to assess geological hazards and develop measures for mitigating them, in New Zealand. This Body of Knowledge and Skills (BOKS) is intended to complement and inform the Professional Engineering Geologist assessment process.

The purpose of this BOKS is to:

- Define the prerequisite skills and knowledge that are required of a PEngGeol;
- Provide a framework for Continuing Professional Development (CPD) and postgraduate training.

This BOKS has two key parts:

- The knowledge and skills are listed in the table in section 3. The list is comprehensive, but not exhaustive.
- The types of complex engineering geological problems and activities that a PEngGeol should be able to carry out are listed in section 4.

A PEngGeol is not expected to have all of the listed knowledge and skills. Rather they will have a broad range of them and in particular those relevant to their practice area. The knowledge and skills will be to a level sufficient to competently carry out the listed engineering geological problems and activities.

Care should be taken when comparing this BOKS to the BOKS for a Chartered Professional Engineer (Geotechnical). This BOKS relates to PEngGeol competence standard, whereas the CPEng (Geotechnical) BOKS relates to the specialist field of geotechnical engineering in the context of the CPEng competence standard, which applies to all areas and disciplines in engineering.

2. Background

Engineering New Zealand expects all Professional Engineering Geologists to:

- Have a geology degree at honours level or a postgraduate qualification in engineering geology, or be able to demonstrate equivalent knowledge
- Demonstrate they can assess the nature of the ground in activities requiring specialist and in-depth engineering geological knowledge
- Demonstrate they can work closely with other engineering professionals to solve (identify, investigate, assess and communicate) complex engineering geological problems.
- Demonstrate they can work closely with other engineering professionals to convey engineering geological context.

Engineering New Zealand gives sets out these expectations in a competence standard[1], which requires every Professional Engineering Geologist to demonstrate competence in their Practice Area. Competence for PEngGeol focuses on engineering geology practice and analysing complex engineering geological problems to inform land use policy, assessment and specific engineering solutions. The applicant needs to demonstrate that they have the ability, commitment, knowledge and skills to act effectively in each of these situations.

Engineering geologists wishing to register as PEngGeol are expected to demonstrate a breadth of knowledge and skills (refer Section 3) that they are able to apply in a range of situations and localities (refer Section 4). The PEngGeol competence standard comprises twelve elements grouped into four competence areas:

1. Engineering geological knowledge
2. Professional acumen
3. Managing engineering geological work
4. Analysing technical problems

Areas 1 and 4 can be considered the knowledge and skills required by a PEngGeol that distinguish them from those of other Chartered Professional Engineers, although it is acknowledged there is some overlap with CPEng (Geotechnical). Guidance on how Engineering New Zealand defines complexity is given below:

Complex engineering geological activities means activities or projects that have some or all of the following characteristics:

a. Diverse resources, e.g. people, money, equipment, materials and technologies;
b. Recognising, understanding and resolving significant problems when wide-ranging or conflicting engineering, engineering geology and/or other related issues defined by ground conditions interact;
c. New techniques or processes, or the innovative use of existing techniques or processes.

Complex engineering geological problems means problems that have some or all of the following characteristics:

a. Wide-ranging or conflicting technical or engineering issues;
b. Not easily recognised, understood or resolved without in-depth engineering geological knowledge;
c. Issues infrequently encountered, in an unfamiliar geological setting or requiring an original method of assessment;
d. Outside practice covered by guidelines, standards and codes of practice for professional engineering geology;
e. Involvement of diverse groups of stakeholders with a wide range of needs;
f. Significant consequences in a range of contexts.

Applicants for PEngGeol need to demonstrate their competence for independent practice against the competence standard for their area of expertise. An application typically includes five stages: preparation, validation, evaluation, recommendation and decision. The evidence that is submitted with the application includes their engineering geology qualification, work records, learning records (CPD), referees, Practice Field(s), a description of the Practice Area and a self-review demonstrating competence against the Assessment Criteria. The evaluation includes an

[1] https://www.engineeringnz.org/resources/rules-and-regulations/ refer to Election or Transfer to Membership Classes Regulations

interactive assessment including a Lead Assessor and a Practice Area Assessor. They make a recommendation to the Competency Assessment Board which makes a decision regarding the application. There may be a requirement for future reassessment at a pre-defined interval.

3. Knowledge and Skills

In looking to establish a set of knowledge and skills for a PEngGeol, NZGS has defined the knowledge and skills required in order to deliver engineering geology outcomes for the different phases of a project. For a typical engineering/engineering geological project this may be:

a. Scoping of Engineering Geological input to issues / problem / project;
b. Review of existing data;
c. Site or route selection;
d. Establishment of an initial geological and engineering ground model and assessment of the engineering geological issues that need to be addressed in a project;
e. Development of engineering geological investigation programmes focussed on addressing these issues;
f. Performance of engineering geological mapping, geotechnical field investigations and laboratory studies;
g. Interpretation of geological, geomorphological and hydrogeological conditions and hazards;
h. Refinement of initial ground model and clear communication of the significance of geological conditions and hazards to other engineering disciplines and related professionals involved in the project;
i. Development of recommendations related to design, mitigation and construction;
j. Preparation of engineering geological reports;
k. Documentation of the geological, geomorphological and hydrogeological conditions and hazards encountered during construction, and interpretation of the implications of those conditions for design or construction progression;
l. Supervision, inspection and sign-off of the geological, geomorphological and hydrogeological aspects of construction, post-construction and site monitoring;
m. Awareness and use of key technical documentation, guidance and standards;
n. Understanding of key building, environmental, resource management and health and safety regulations.

It is recognised that there is some capability overlap with other engineering professionals, in particular with geotechnical engineers. Many projects require the input of an experienced geotechnical engineer due to the type and complexity of the problem and the design issue being addressed.

The following table lists the core capabilities expected of a PEngGeol.

KNOWLEDGE AND SKILLS	
Project phase	**A PEngGeol should be able to :**
a) Scope engineering geological input b) Data review c) Site and route selection d) Establishment of initial ground model and assessment of	i. Understand the need for the project; ii. Perform literature searches and site history analyses (including geology/geomorphology maps, hazard maps, aerial photographs, satellite imagery, site usage, council files, New Zealand Geotechnical Database, etc.) related to regional and site surface and subsurface geological and hydrogeological conditions;

KNOWLEDGE AND SKILLS	
Project phase	**A PEngGeol should be able to :**
engineering geological issues	iii. Review preliminary project concept design plans to evaluate potential impacts from geological conditions; iv. Undertake or direct a walk over survey, conduct and clearly document field mapping; v. Demonstrate a good understanding of how geology and geomorphology provide evidence of the site conditions and help identify geological and geotechnical issues that need to be considered in the design process; vi. Identify constraints, gaps in understanding and potentially significant geotechnical issues and their associated risks; vii. Evaluate potential design options; viii. Develop and document a conceptual ground model showing existing subsurface conditions and hazards that have the potential to impact the proposed development; ix. Screen sites based on this evidence. x. Collaborate with other project stakeholders to integrate engineering geological elements into assessing the feasibility of the whole construction xi. Communicate potential engineering geological risks and options that may impact the design with clients and other stakeholders
e) Development of site investigation programmes	i. Communicate with other engineering professionals to determine the required engineering geological input and the scope of the information needs ii. Contribute to planning the scope and locations for ground investigation, field testing, instrumentation, sample collection and laboratory testing programmes with appropriate consideration of the benefits and limitations of each investigation, field test, sampling and laboratory test method and the site constraints, including buried/overhead services and existing structures/building. iii. Specify the scope and engagement of site investigation contractors, in consideration of the potential risks, the nature of the project and the client's budget iv. Consider regulatory and consent requirements for site investigation, monitoring and reporting; v. Direct and/or modify ground investigation programmes, as required, upon evaluation of the conditions encountered during investigation with respect to the conceptual ground model and changing design requirements.
f) Performance of geological mapping, geotechnical field and laboratory studies	i. Stereoscopic analysis and interpretation of remote sensing data (e.g. LIDAR, UAV, aerial photographs, satellite /imagery – including stereopairs); ii. Map geomorphology, lithology, geological structures (including defects, faults/shears and slope instability features), geohazards and hydrogeological features;

KNOWLEDGE AND SKILLS	
Project phase	**A PEngGeol should be able to :**
	iii. Log geological, hydrogeological and engineering properties of rock, soil and water in investigation borings, wells and excavations in accordance with New Zealand practice in a manner that considers the desired end use of the data; iv. Direct and/or employ field penetrometer techniques (SPT, CPT, DCPT) to investigate subsurface conditions and obtain geological and engineering properties of soil; v. Direct and/or perform rock, soil and groundwater sampling for laboratory testing; vi. Direct and/or employ field geophysical techniques to investigate subsurface conditions and obtain geological and engineering properties of rock and soil; vii. Direct and/or perform routine field and laboratory tests for many of the following: a. soil and rock mass classification b. soil and rock strength and stiffness c. clay mineralogy d. hydraulic conductivity e. expansion properties f. consolidation characteristics g. compaction characteristics h. material acceptability for use as aggregate, fill or armour i. special properties such as the potential for soil collapse or expansion, dispersion, slaking, erosion potential and liquefaction potential j. special conditions such as acid sulphate soils and acid rock drainage k. pavement sub-grade/aggregate qualities l. excavatability m. durability viii. Direct or perform the installation and monitoring of field instrumentation (e.g. groundwater, slope movements, settlement).
g) Interpretation of geological conditions and hazards h) Refinement and communication of ground model	i. Determine geomorphology, geological structure, hazards (such as landslide, earthquake/fault activity and active volcanism) and hydrogeology of the site from literature reviews, mapping, geophysics and/or subsurface investigations; ii. Prepare engineering geological maps, cross-sections and/or 3-D ground models to depict surface and subsurface conditions (rock, soil and groundwater) based on observations and interpretations from mapping, geophysics and subsurface investigations; iii. Determine geotechnical risk associated with geological hazards (in particular slope instability and earthquakes)

KNOWLEDGE AND SKILLS	
Project phase	**A PEngGeol should be able to :**
	iv. Interpret the results of laboratory testing to determine relevant physical, mechanical and chemical properties of rock, soil and water; v. Calculate geotechnical behaviour and associated risk, in response to natural and man-made processes (e.g. settlement, erosion, subsidence, liquefaction, slope failure, eruption blanket) specific to the geological conditions of the region; vi. Assess the impact of ground response on the existing environment, including adjacent properties; vii. Characterise site subsoil class in terms of seismic response; viii. Determine groundwater gradient and flow direction; ix. Identify materials that may be detrimental to projects and/or human health (e.g. asbestos, methane, contaminants); x. Estimate earthwork shrinkage and bulking factors. xi. Demonstrate an understanding of the consequences of hazards for other engineering disciplines. xii. Effectively and clearly communicate the significance of any hazards found to other engineering disciplines and/or the client on the project
i) Recommendations for design, mitigation and construction	Assess, develop or contribute to design, mitigation and construction solutions, ensuring the engineering geological factors are addressed over a range of designs such as:- i. Conceptual retaining wall design; ii. Remedial design for slope instability hazards; iii. Conceptual earthworks design; iv. Conceptual debris barrier/rockfall protection system design; v. Conceptual seawall design; vi. Infrastructure corridor assessments (e.g. pipeline, road, rail, etc.) vii. Subsurface drainage system design; viii. Design plans and mitigation of hazard associated with geothermal activity ix. Response plans for encountering contaminated soil and groundwater during construction; x. Ground response to seismic activity; xi. Setback distances of proposed structures from known active faults and cliff/slope crests and toes; xii. Mitigation plans for potentially soft, compressible and/or liquefiable soils; xiii. Selection or contribution to selection of trigger criteria and response actions for monitoring; xiv. Plans for sediment and erosion control; xv. Plans for pre-, during and post-construction monitoring (e.g. ground movement, groundwater, slope instability, settlement monitoring);

KNOWLEDGE AND SKILLS	
Project phase	**A PEngGeol should be able to :**
	xvi. Different engineering geological aspects of design solutions with recommendations for a preferred option; xvii. Design of construction sequencing and inspection schedule; xviii. Design documentation, design features reports, including for “safety in design” and relevant construction specifications;
j) Preparation of engineering geological reports	Be able to demonstrate experience in most of the following: i. Prepare appropriate maps, plans, drillhole logs, in-situ and laboratory test results; ii. Prepare 3D ground models appropriate to the engineering task; iii. Document laboratory and field testing results, instrumentation and observations; iv. Prepare written factual, baseline and interpretive reports which present ground model and findings v. Present to and interpret these reports for the clients; vi. Interpret and verify the engineering geological aspects of factual and interpretative geotechnical reports prepared by others; vii. Quantify and document geotechnical and geological uncertainties on a systematic basis and incorporate these into the design and risk assessment process; viii. Demonstrate judgement as to the key risks and mitigation strategies and an awareness of current risk guidance and standards.
k) Documentation of encountered conditions and implications l) Supervision and inspection of construction, post construction and site monitoring	Be able to demonstrate experience of most of the following: i. Monitor field instrumentation and assess against trigger criteria; ii. Perform or supervise geotechnical testing and observe site construction such as for foundations, earthworks, retaining walls and trench excavation; iii. Document geological and groundwater conditions encountered during construction and refine the ground model; iv. Assess, record and communicate unforeseen geological and groundwater conditions during construction; v. Evaluate geotechnical performance during construction, based on observations and field instrumentation; vi. Evaluate ground related distress associated with, for example, slope, foundation and/or retaining wall distress or failure; vii. Be familiar with geotechnical construction plant and machinery and its strengths and limitations; viii. Guide engineering geological aspects of the construction to confirm it complies with the drawings and specifications and expected quality standards, and alert designers if it does not;

KNOWLEDGE AND SKILLS	
Project phase	**A PEngGeol should be able to :**
	ix. Draft any variations to engineering geological aspects of the design as required to mitigate non-conforming work; x. Keep records of all observations, contract variations and site instructions as they pertain to geological matters; xi. Identify and/or respond identification of presence of contaminants in soils; xii. Respond to sediment run-off and erosion; xiii. Prepare post-construction reports in accordance with regulatory and contractual requirements.
m) Awareness and use of key technical documentation, guidance and standards	Demonstrate detailed knowledge of NZGS Field Description of Soil and Rock Description guideline. Demonstrate a broad familiarity with the Building Act, the New Zealand Building Code, its core cited design actions and materials standards and other important guidelines and standards such as (but not limited to): i. AS/NZS 1170 Structural Design Actions, in particular hazard criteria in 1170.5; ii. NZS 3604 Timber Framed Buildings (i.e. ‘good ground’); iii. NZS 4402 Methods of testing soils for civil engineering purposes; iv. Awareness of international key standards and guidelines for rock sample testing and in-situ testing etc; v. NZS 4431 Code of Practice for Earth Fill for Residential Development; vi. NZGS/MBIE Earthquake Geotechnical Engineering guidance modules; vii. NZGS guidelines such as NZ Ground Investigation Specification; viii. MBIE guidance documents and practice advisories; ix. NZTA Bridge Manual; x. NZTA Risk Management Process Manual; xi. Relevant IPENZ Practice notes and guidelines; xii. Design Features Report templates; xiii. AGS “Guideline for Landslide Susceptibility, Hazard and Risk Zoning for Land Use Planning”; xiv. AS1726 Geotechnical Site Investigations; xv. ISO 31001 Risk management — Risk assessment techniques; xvi. TNZ M/04:2006 Specification for basecourse aggregate; xvii. Technical guidance published by the relevant Territorial Authority.
n) Understanding of building, environmental, resource and health and safety regulations	Demonstrate a good working knowledge and understanding of the: i. Building Act, Regulations and Building Code; ii. Health and Safety at Work Act (2015);

KNOWLEDGE AND SKILLS	
Project phase	**A PEngGeol should be able to :**
	iii.Historic Places Act 1993; iv.Resource Management Act 1991; v.Wildlife Act; vi.Local authority plans and guidance documents.

4. Examples of complex engineering geological problems and activities

The PEngGeol competence standard requires an engineering geologist to demonstrate an ability to scope, investigate, analyse and communicate complex engineering geological problems. The engineering geologist uses his or her knowledge and skills to complete these tasks. The NZGS has identified a number of examples of complex engineering geological problems and activities to assist a PEngGeol applicant.

A candidate applying for PEngGeol is expected to demonstrate that they are capable of carrying out all of the following complex engineering geological problems and activities. The candidate does not need to have actually carried out the following problems and activities. Rather the candidate can demonstrate that they are capable of carrying out the problems and activities by drawing on relevant evidence from other problems and activities.

A. Mapping and characterisation of difficult soils and/or rocks for either infrastructure route selection, land development, dams, tunnels or mines;
B. Mapping and characterisation of complex soil and rock masses for stability assessment of natural, fill and cut slopes, under static and seismic loadings, and to inform the design of potential mitigation measures;
C. Mapping and characterisation of a range of ground conditions to inform the design of either IL 2 buildings (as defined by AS/NZS 1170.0; as an example of typology), or bridges, dams and tunnels of comparable importance, on or in a range of foundation types;
D. Assessment of situations with high risk to life or property where special precautions or expertise are or may be required to identify and assess impacts from geological hazards, for example during a response to an emergency event such as an earthquake
E. Characterisation and selection of soil and rock construction material for earthworks requiring a range of characteristics and properties.

5. Comments on demonstrating competency

The complex engineering geological problems and activities listed in Section 4 represent a range of projects to which knowledge and skills would be applied by Professional Engineering Geologists working within small, large or specialised organisations.

Applicants are expected to have at least five years' of practical experience following graduation, with exposure to a range of complex problems and activities, and to have been supervised by and have their work reviewed by a more experienced PEngGeol or CPEng (Geotechnical).

Applicants should also be able to demonstrate that they understand the boundaries of their own knowledge and skills and will actively seek assistance when asked to work outside their competence or level of expertise.

It is acknowledged that applicants will have gained a range of both experience and competency for each complex problem and activity to which they have been exposed. They are likely to have worked as part of a team, in which case they will need to demonstrate they have taken responsibility for a major part of the problem and activity and/or that their experience of complex problems and activities has been spread over more than one project.

Demonstration of competency is likely to be through a combination of:

- presenting a portfolio of geological models, assessments, reports and drawings;
- outlining the steps and judgement calls in the investigation, analysis, communication and reporting of specific elements;
- presenting case studies of project issues encountered, investigated and resolved;
- demonstrating their contributions, which may include use of referee support as to their roles and outcomes.

It is recognised that there are specialist fields or activities in engineering geology that are not specifically covered by the above BOKS (e.g. geothermal resource development). Engineering geological activities in these fields and activities require much of the same knowledge and skills as listed in the table in Section 3 and may also require working from first principles using their broader understanding of engineering geology and specialist knowledge of geological controls and impacts in their field of activity. It may therefore be possible to meet the PEngGeol BOKS requirements above even though the range of activities differs to a degree from that listed in Section 4.