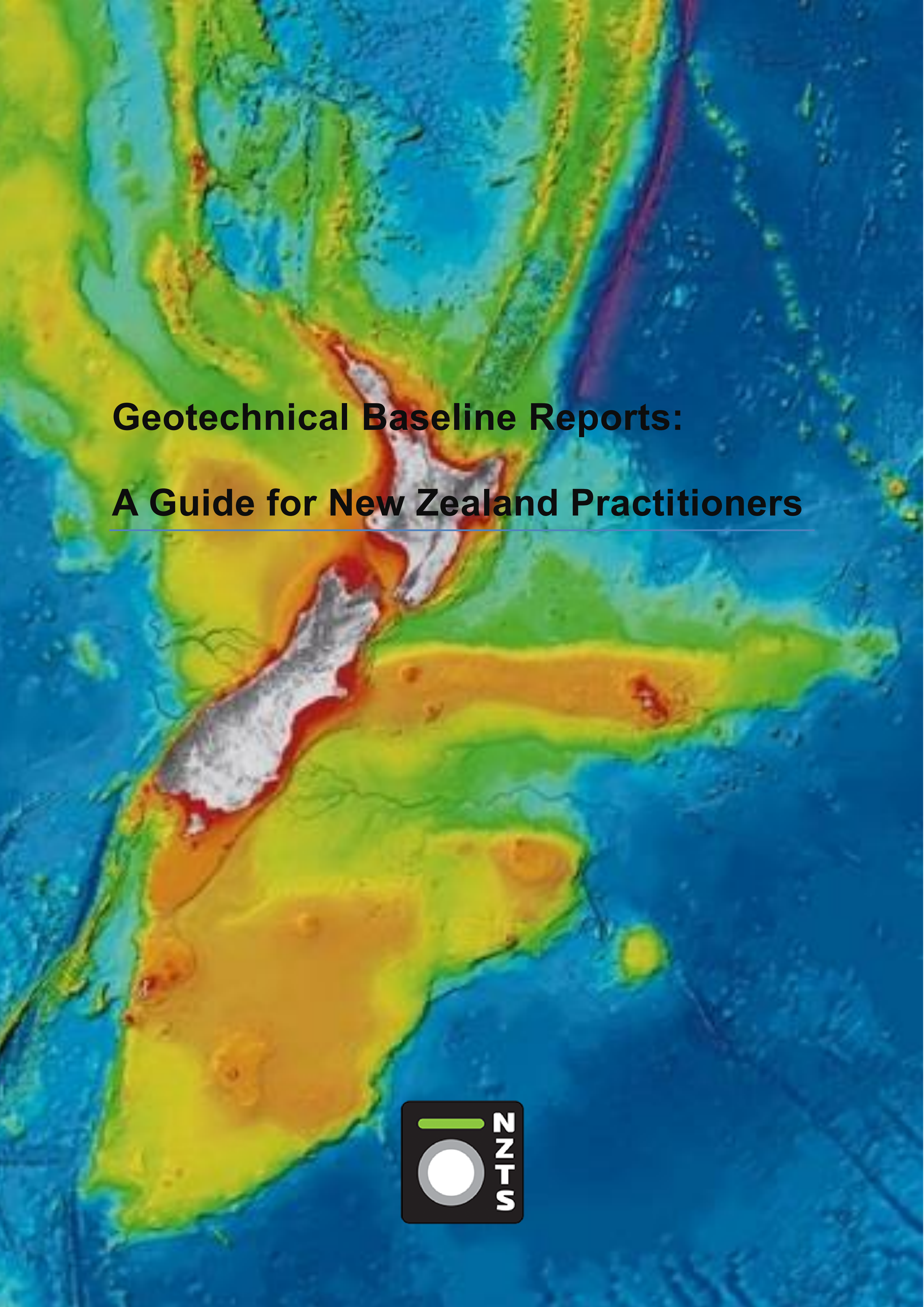

Geotechnical Baseline Reports:

A Guide for New Zealand Practitioners

NZTS

Contents

1. Introduction

Geotechnical Baseline Reports (GBR) have been used for over two decades in New Zealand. Due to concerns regarding their preparation and use the NZTS committee agreed to establish a working group[1] to

- integrate and consolidate the views of Society members based on their recent experiences and
- provide a good practice guide.
- review international guidelines, practices and trends.

The main objective of this NZTS Guide is to provide broad advice to practitioners in New Zealand and thereby improve risk management practices for procuring tunnels and underground projects and subsequently assist in their administration.

This NZTS Guide is intended to be a companion to the ASCE ‘Geotechnical Baseline Reports for Construction’ guidelines and the International Tunnelling Insurance Guide (ITIG) COP for Risk Management of Tunnel Works (both currently under revision). However, any perceived inconsistency should be referred to the NZTS.

Acknowledgement

This Guide has benefitted from reviews by Randy Essex[2], Arnold Dix[3] and Eugenio Zoppis[4], and their assistance is gratefully acknowledged.

[1] The working group included the following NZTS members:

Victor Romero	– McMillen Jacobs
Jim Benson	– WSP Opus
Andrew Campbell	– Mott MacDonald
Ed Ayre	– McConnell Dowell
Francesco Saibene	– Ghella
Rory Bishop	– Alta
Bill Newns	– NovoConsult (Chair)

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[3] Arnold.Dix.com
[4] Imperial College London

2. Background

The understanding between the parties to a contract of the risks at the time of forming the contract is essential in order that:

- risks (not just geotechnical risks) are clearly allocated; and
- financial provisions are made accordingly, and
- the parties understand the basis for changed conditions (from 'reference conditions' created by the GBR baselines) should they arise and thereby minimise the potential for dispute. (Refer Section 7)

Geotechnical baselines or geotechnical reference conditions should be the principal means to establish that changed conditions have arisen during tunnel construction, that are material to the progression of the works and thereby to establish there is entitlement to variations in time and/or cost.

> *'…the conditions of excavation and foundation cannot be entirely foreseen until the ground is opened up'*
>
> *EJ Rimmer 1939*

> *'…for a contract to be performed in an effective manner, the inherent risks must be allocated to the contracting parties on some logical basis, which should be made known to them. Thus, it has been said that the main purpose of a contract is to identify the principles of allocating the risks facing the contracting parties.*
>
> *Bunni N.G 2001*

> *'however unexpected the ground conditions prove to be, it is better to have a defined base for the tenders so that it is known where the incidence of the resulting cost will lie'*
>
> CIRIA 79

> *… 'reference conditions[5]' provides just that element of engineering judgement to baffle the lawyers and provide the best cost-effective value for the community.'*
>
> *Sir Alan Muir-Wood 1984*

[5] 'Reference conditions' were first described in CIRIA 79 in 1978 and adopted by ITIG in 2012. The term 'geotechnical baselines was proposed in the ASCE 2007 guidelines.

3. Issues Arising from NZTS Working Group Discussions

Role and Significance of Client Organisations (**Refer Section 3**)

Understanding project risks and a client organisation's tolerance for risk is a critical recommendation of ISO31000 in relation to improved organisational governance. Therefore, clients need to understand the significance and consequences of risk allocation when geotechnical baselines are drafted and agreed (and ensure they are consistent with other aspects of the Contract).

Exculpatory risk transfer, especially in low-bid environments often results in losses and disputes, i.e., does not achieve fair or optimum risk management. This principle is explicitly acknowledged in the ITIG guide and in the recent NZ construction sector accord[6].

Clients should acknowledge the influence upon project risk arising from the design alignment and operational features/structures and requirements as reflected in tender drawings and specifications. The ability for tenderers to eliminate risks are therefore constrained by that project context.[7] (see also **Section 6**). It follows that clients accept ground risks that have not otherwise been allocated by the GBR baselines to the contractor. (See for example FIDIC) [8]

Whatever the form of contract, baselines should be consistent with it and be within it (not just provided for information).

Accordingly, it is recommended that the form of contract is selected following rigorous risk appraisal by the client organisation so that the contractual risk provisions are consistent.

Site Investigations and Geotechnical Characterisation (Refer Section 4)

Concerns regarding the adequacy of scope and budget for site investigations

Baseline Drafting (Refer Section 5)

The effects of hydrogeological conditions are often under-estimated (especially for shafts) despite the prominence in the RMA upon hydrogeological effects assessments.

Often there is confusion between design parameters and baselines, so the role of baselines in contracts should be clarified.

GBR Drafting Process (Refer Section 6)

A GBR process should enable a more informed decision regarding selection of a contracting partner and an interactive GBR process should facilitate proper due diligence of the geotechnical risks by bidders and thereby enable more consistent bids. Therefore, GBR's are likely to add value to a procurement process and contribute to successful projects.

Changes in design or construction method may have a significant impact upon project risk and this may not be reflected in the GBR. For this reason, GBR's should be one of the last documents to be finalised before concluding contract negotiations.

GBR's require ongoing review and oversight during construction to ensure that material changes are not overlooked.

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[6] https://www.constructionaccord.nz/assets/Construction-Accord/files/0930eac2bb/construction-sector-accord.pdf

[7] The contractor in turn is allocated the risk of performance in accordance with the contract (see for example Thorn vs London Corporation (1876)) and risks associated with their chosen methods, subject to the GBR baselines.

[8] 'All subsurface conditions not addressed in the GBR shall be considered 'Unforseeable' FIDIC Emerald Book Notes

4. Client Enterprise Risks

The planning of underground construction requires a greater degree of risk assessment than other types of construction because of the level of uncertainty that cannot be avoided and the potential scale of the consequences that can arise, given the access limitations, the confined spaces of the work environment and the use of specialist plant and equipment. Therefore, such activities are likely to fall outside of 'business as usual' oversight for client organisations that do not regularly undertake underground construction or maintenance.

The NZTS recommends that Client organisations should establish a risk management framework for proposed or existing underground assets ('assets') in accordance with local and national regulations and requirements through design, construction and operational lifecycles.

The NZTS recommends adopting the risk management principles of ISO 31000. If the principles of ISO 31000 are adopted, the client organisation risk management objectives should be to:

1) Understand the risks facing the organisation in pursuit of its objectives
2) Ensure that underground project risks are adequately considered
3) Ensure that such risks are appropriate in the context of the organisation's objectives
4) Ensure that information about such risks and their allocation is properly communicated
5) Ensure that systems to manage risks will be effective

Client organisations should also implement and maintain oversight of health and safety processes for activities undertaken by them or on their behalf by formal review throughout design phases for the assets and throughout construction, operations and maintenance or whenever design changes are made.

To summarise, at the initial stages of project planning, it is important to establish the role of the client organisation in the context of the project risk profile with respect to:

- which risks or contingencies the client organisation is willing to retain, fully allocate or share with the contractor.
- contract administration and risk management for the underground project
- as a PCBU how the client will discharge its duty to manage health and safety risks so far as is reasonably practicable[9]

Having established the risk profile and the optimum risk allocation the Client organisation needs to ensure the mechanisms of risk allocation are consistent and compatible. For example, the GBR should be consistent with any payment mechanisms and provisions, scheduling quantities and technical specifications.

A key aspect of risk management is role definition and role competence. It is considered essential that each person involved in the project is competent to carry out their role and that each organisation involved in the project must ensure that their employees or agents are competent to carry out the work required of them. Competency may be assessed by

[9] '**Reasonably practicable**' See section 232 of the Health and Safety at Work Act 2015 (2015 No 70)

consideration of relevant experience and skill, development training and academic qualifications and/or certifications.

Given the critical role of the Client[10] during the development stage, the client should have or procure technical and contract management competence appropriate to the nature and scale of the project and only select competent designers and constructors.

For the purposes of this guidance, a competent person is a person who has the relevant knowledge, experience, and skill to carry out a task required by the project. During construction a competent person is also a person who can recognize risk sources (hazards) associated with a task and the ability and authority to mitigate those risks.

The NZTS notes the recent guidance from the NZ government on procurement

'…to achieve public value:

- *Identify and communicate the risks clearly, along with the parties they will be allocated to (e.g. agency, consultant and contractor) and on which basis (e.g. retained, shared or transferred).*
- *Review the risks to be allocated and ask yourself if they are being allocated to those best-placed to manage them.*
- *Understand the market in which you are operating, as this will have an impact on what is reasonable given market conditions.*
- *Make sure you have a clear understanding of the potential consequences of risk transfer, and their impact upon achieving the required project outcomes.*
- *Make sure that the proposed risk allocatlon will not become an excessive cost to the agency when considering the benefit that wlll accrue.*
- *Make sure you have undertaken any mitigating actions that are in your control before allocation, to reduce risk pricing by tenderers.*
- *Request clear tender information on risk pricing so that the cost implications of proposed risk allocation can be re-assessed and confirmed before award of contract.*
- *Engage with bidders in discussing the proposed risk allocation to determine if there are more effective ways of managing the risks. '*

[10] **Client and/or Client Organisation (Principal)**

The final owner of the project to be constructed and/or the procurer of goods or services including design services whether a public entity or a private agency or developer, and responsible for:

- The information issued to design or construction tenderers as "works information".
- The adequacy and suitability of designs prepared by or on behalf of the Client, construction supervision and monitoring of the project. Therefore, the Client must assess the competency of Designers.
- The adequacy and suitability of construction methodologies and organisation proposed by contractors during the tendering phase
- The supervision of all parties (designers, contractors and other technical services) during the construction and the commissioning of the project
- The creation and maintenance of a health, safety and wellbeing culture for all stakeholders
- The creation and maintenance of a risk management culture for all stakeholders

5. The Importance of Geotechnical Site Investigation

Determining the ground conditions likely to be encountered, the magnitude of uncertainty inevitably associated with such determinations and the significance of that uncertainty should be primary objectives throughout the planning, bidding and construction of any underground project. It follows that geotechnical investigation, testing and interpretation should be prioritised when developing budgets for planning, design and for on-site validation during construction. Using the language of ISO31000, the risk management activity (i.e., the site investigation and characterisation) should be ‘proportionate to the level of risk.’

> *‘.ground more than any other single factor determines the nature, form and cost of a tunnel’ CIRIA 79*

For guidance on good practice for underground investigation, refer to the NZGS New Zealand Ground Investigation specification.

Geotechnical investigations for a tunnelling project are typically undertaken in multiple phases to inform the developing design and as the organisation requires a better definition of project risks.

The amount of site investigation data generated for an underground project (and therefore what informs a GDR/GBR) should be based upon the understanding of the risks associated with a construction methodology and ground support design and the complexity and variability of geotechnical conditions

Investigations should be sufficient to characterise heterogeneity along the alignment and at key structures that connect to the tunnel (s) such as shafts and cross passages, if present.

The limitations of the site investigation extent and methods should be understood and explained. Some geotechnical risk sources (for deep alpine tunnelling or sub-sea crossings) may result in considerable residual uncertainty.

It is important that site investigations inform the likely ground response to excavation. To assist the understanding of ground behaviour and the ground/structure interaction there needs to be an appreciation of the geotechnical materials, the properties of the introduced structure and the methods (to assess for example disturbance) and timing of installation (to assess the impacts of ground movement). This will inform the types of investigation and the amount of laboratory or in-situ testing required.

Characterising hydrogeological properties is also extremely important as groundwater conditions are often perceived as the most important of all tunnelling (and shaft sinking) risks to quantify. Its significance is emphasized in the Resource Management Act (RMA) consenting process, so most tunnel projects apportion significant budgets to hydrogeological testing and often adopt pumping tests.[11]

Given the number of variables in any underground project (and project context) it is difficult to make specific budget recommendations for site investigation given the constraints of method and combinations of in-situ and laboratory tests required. However, in 1984 the U.S. National Academy of Sciences concluded inter alia

> *‘Expenditures for geotechnical site exploration should be increased to an average of 3.0 percent of estimated project cost, for better overall results and*
>
> *The level of exploratory borings should be increased to an average of 1.5 linear ft of borehole per route ft of tunnel alignment, for better overall results.*

[11] See also Proposition 19 of ITA Contractual Sharing of Risk in Underground Construction (1995)

Recent major tunnelling projects typically have site investigations budgets (including interpretation and laboratory testing) in the order of 1-2% of the overall CAPEX budget.

Smaller projects are likely to require a higher percentage of overall CAPEX to be allocated.

In locations with previous tunnels and with the relevant experience and lessons learned summarised in the GBR, the number of project specific data points (boreholes, geophysics, and in-situ tests) level of investigation could be less, and in areas of high uncertainty, or complexity, a more intensive investigation is recommended.

6. Drafting Baselines

GBR baselines should be supported by a Geotechnical Data Report (GDR), a report that summarises the available (and relevant) site investigation borehole data, and laboratory and in-situ testing, piezometers and pump testing, if these have been undertaken. The reasons for deviations from the GDR dataset, if present in the baselines, should be explained in the GBR.

It is noted that baselines are (or should be) contractually binding, whether or not they are supported by the GDR dataset. (Refer T&TI, 2004) In case of any inconsistency between the GDR and the GBR 'the GBR must be given precedence over the GDR'[12]

The limits of what was 'foreseen' are set (or agreed to) by the client organisation, who should understand the express and implied obligations, i.e., that the baseline statements can and will be relied on.

A baseline (and any other contract provision) is ambiguous if there are two *reasonable* interpretations consistent with the baseline language. Removing such ambiguity is obviously desirable and is an important reason to undertake discussions and interact (i.e., interactive tendering) to agree the GBR prior to forming the Contract. (see section 7).

It is considered good practice is to present a credible range of parameter values (as few as possible to capture material risks) and then state the Baseline(s) as precisely as possible as this reduces ambiguity.

Baselines of intrinsic physical properties such as material intact strength are relatively straightforward to establish. However, 'behavioural' baselines, how the ground responds to a construction method or treatment require more expertise and greater attention to define in baseline statements.

As construction methods are fundamental considerations when assessing geotechnical response (behaviour) it is recommended that the baselines are considered with detailed knowledge of the specific construction methods in mind. It is important to confirm the suitability of each construction method to address the geotechnical conditions and the conditions under which each method is no longer suitable and thus the conditions under which the baseline is exceeded. This may require discrete baselines for different zones or 'reaches' of a project differentiated by geotechnical conditions and different baselines for different tunnelling methods in the same 'reaches' if there are options.

It is also recommended to consider what happens if a baseline is exceeded in advance, and preferably as part of the tender process. If the consequences of the baseline exceedance are unclear, then the risk is inadequately defined and may become the subject of dispute. Therefore, the consequences of baseline exceedance should be a) understood by both parties and b) documented as far as possible.

The following quote was taken from a paper summarising claims under the FIDIC contracts after many years of use, and the principle is applicable when drafting GBR baselines

> *The more specifically and clearly such contingencies are recognized, their consequences (in money and time) addressed and the risks of them assigned to one of the parties, by the contract, the more easily and swiftly they can be dealt with by procedures within the contract, and injustices avoided*

[12] ASCE 2007 P.10

CR Seppala (2005)

It is most important that baselines are measurable during construction, and the methodology to quantify the baseline parameter or observation should be clearly stated in the originally agreed baseline. This is to avoid a dispute about how to establish if a baseline has been exceeded. It also reinforces the need for good record keeping of the conditions encountered during construction, preferably agreed by the parties as soon as is practicable at the time of construction.

> *'The specifications should be clear as to how conditions will be quantified in the field, for the purposes of confirming that a differing site condition does or does not exist'*

ASCE 2007

The degree of risk sharing is entirely up to the Client. However, full ground risk transfer to the Contractor by adopting extremely conservative baselines is undesirable in order to minimise bid contingencies, because ground risks should be accounted for by bidding contractors whether or not they eventuate.

> *'..if all bidders can base their estimates on a well-defined set of site conditions with assurance that equitable reimbursement will be made when changed conditions are encountered, the owner will receive the lowest reasonable bids with a minimum of contingencies for unknowns.'*

USNCTT 1974

It is important to note that (as per the ASCE 'Gold Book') that geotechnical baselines are not warranties that the baseline conditions will be encountered. Such a warranty would put a far greater degree of risk upon the GBR draftee (typically a consulting engineer responsible for the full tunnel design scope not just geotechnical aspects) who in turn would be incentivised to become more conservative to avoid being 'wrong'.

7. Interactive Tender Meetings

Discussing the biggest source of underground construction risk, i.e., the ground, should facilitate due diligence and risk management by all parties, so that ground risks may be properly accounted for in tender bids, thereby minimising the potential for misunderstandings and commercial losses arising from miscalculations.

A primary objective of an interactive tender process[13] is therefore to provide clarity on risk allocation to minimise the potential for future disputes, by discussing and agreeing the contents of the geotechnical baseline report and as necessary, related contract provisions.

Foregoing an interactive process is not recommended by the NZTS as skipping this important communication may (1) miss an opportunity to realise a worthy risk mitigation adjustment, and (2) lead to negative relationships and commercial outcomes on a project.

It is recommended that contractors are invited to submit interim proposals that are presented for discussion during an interactive tendering process initiated by the Client.

The purpose of the interim proposals and/or responses is to document how geotechnical risks are to be managed by the design and the construction methodologies proposed and how this is best expressed in the geotechnical baselines that are to be agreed.

A recommended interactive GBR development process is summarised as:

- Issue A – Issued by Client – Sets out process and initial baselines. This may include both intrinsic baselines and behavioural baselines associated with the construction methods of the Clients 'reference' or even fully prescribed and detailed design. This provides a common basis for bidders.
- Issue B – Submitted by Contractor – This response provides any alternative or modified baseline language, and/or any additional baselines to suit their preferred construction methods and plant.
- Issue C – Negotiation and agreement between Client and Contractor to establish the baselines as part of the Contract

With an interactive meeting occurring at each step of GBR development.

The NZTS considers that it is reasonable and desirable to acknowledge an implied duty to seek clarification on the part of contractors where there is perceived ambiguity in the GBR or other provisions of the Contract during the Tender phase. It follows, that it is incumbent upon the Client to provide it.

It is also desirable to define forward priced variations (for foreseeable scenario's outside of the baseline limits) and then agree the monitoring/response mechanisms that trigger the scope change, again with a focus on minimising misunderstandings and commercial losses rather than complicating the response to the changed conditions with a commercial negotiation or a protracted dispute.

Alternative Tenders[14]

Alternative tender designs are very important sources of risk i.e., they have positive and negative potential and whilst they should not be entirely discouraged, it is recommended that compliant tenders should always be required. Typically, they have not had the same level of resource applied to them as the reference design (or detailed design) of the Client. They are most unlikely to have had the time for decision making that may have been available during

[13] A term introduced in 1996 for the Manopouri Second Tailrace Tunnel. (R.Essex personal communication)

[14] See also Proposition 17 of ITA Contractual Sharing of Risk in Underground Construction (1995) that recommends conforming tenders are also submitted.

the project planning and development stage and are more likely to be influenced by optimism bias. They may provide considerable ultimate value but alternative ***alignments*** that are unsupported by geotechnical investigations, are a huge potential source of risk and may also suggest inadequate route option evaluation pre-tender and so should be avoided.

8. NZTS Recommendations and Principles

1. The client organisation should establish the scope, context and criteria for risk management and maintain oversight of this throughout project delivery

This should be done in relation to the characteristics and competence of the client organisation and thus its organisational risk 'appetite', the risks presented by the project, and an assessment of what is best overall 'value' in view of the market conditions. Accordingly, it is recommended that the form of contract and how it will be administered should be selected following rigorous risk appraisal by the client organisation.

2. The GBR baselines must be part of the Contract and must be able to be relied on

The GBR must be a contractual document (i.e., not just provided for information) and the contract must also include a differing site condition (DSC) clause – 'unforeseen physical conditions'. The NZTS recommends that for New Zealand contracts using NZS 3910 'Conditions of Contract for Building and Civil Engineering Construction'; the Geotechnical Baseline Report is included within the Schedule to General Conditions of Contract - Schedule 2 – 'Special Conditions of Contract – Other Conditions of Contract'.

Geotechnical baselines or geotechnical reference conditions should be a means to establish that changed conditions have arisen that are material to the progression of the works and thereby there is entitlement to variations in time and/or cost. These limits (of what was '*foreseen*') are set (or agreed to) by the client organisation who should understand the express and implied obligations, i.e., that the baseline statements may be relied on for that purpose.

The NZTS recommends drafting baselines that are based on information made fully available and in accordance with the ASCE Guidelines, the GBR should incorporate lessons learned from previous relevant projects.

The form of contract strongly influences risk allocation and therefore baselines should be compatible with the other provisions of the contract, e.g., bills of quantities and specifications.

3. The GBR baselines define 'forseeability' under the Contract

As the GBR defines what ground condition risks are foreseeable, it follows that conditions not described by a GBR are 'unforeseen physical conditions' and therefore may be subject to claims for variation under the Contract.

4. Ground risks are retained by the client unless they are allocated by the GBR baselines.

As it has selected the site and alignment, the client organisation is best placed to carry out a comprehensive site investigation of the ground conditions to be encountered. Therefore, the Client should bear the risk of differing site conditions and is liable for ground condition risks unless they have been allocated and relied on by a contractor in the GBR. It is recommended that this principle is expressly stated in the Contract.

5. Baselines should be measurable or quantifiable and these methods of measurement or observation should also be defined under the baselines.

It is important that baselines are measurable during construction, and the methodology to quantify the baseline parameter or observation should be clearly stated in the originally agreed baseline. This is recommended to avoid a dispute about how to establish if a baseline has been exceeded. It also reinforces the need for good record keeping of the conditions encountered during construction.

6. Geotechnical baselines are not a basis for design.

The GBR should describe the anticipated subsurface conditions and the likely ground behaviour for a given design and construction methodology for the purposes of establishing the commercial risks allocated using baseline statements.

GBR baselines should define limits of geotechnical properties and behaviour. Geotechnical behaviour or response baselines are influenced by works methods, particularly the timing of installation and the strength and stiffness characteristics of the support. The GBR should be subject to change management control processes requiring the re-assessment of baselines should construction methods change

7. Be clear, especially when drafting baselines.

The GBR baselines should not be ambiguous. Baselines that deviate from the GDR dataset, should be explained and the reasoning behind the difference.

8. Define, understand and agree the consequences of baseline exceedance

It is necessary to differentiate between a minor exceedance that has an insignificant impact and one that is significant and *material* to the performance of the works. The NZTS recommends drafting baselines that reflect limits of performance for the methods that are confirmed in the tender response documents.

A greater emphasis on price certainty is sometimes used to justify more conservative baselines and is a reasonable response[15] especially if there are other risk sharing features within the contract or within the contract procurement process e.g. ECI or the NZTA competitive alliance model, used on the Waterview Connection and since adopted by CRL.

Whilst full risk transfer has been a common feature of contracts, relief for 'changed conditions' for underground construction have been around for almost 100 years and is now contrary to the objectives of the modern tunnelling industry and is viewed as particularly undesirable by the NZTS in view of the size of the market in New Zealand.

> 'ITA's objective is to develop a global culture for fair risk apportionment in underground works' [16]

9. Invest in Interactive Tender Meetings and Develop 'Forward Priced' Variations

Variation benchmarking has been adopted on several New Zealand projects. It is recommended to define 'forward priced' variations during the tender stage (for foreseeable scenario's outside of the baseline limits) and then agree the monitoring/response mechanisms that trigger the variation.

10. Adopt the original ASCE baseline concepts:

> '…the risks associated with conditions consistent with or less than the baselines are allocated to the contractor and those significantly (materially) more adverse are accepted by the owner (client). (words in parentheses added) ASCE 2007

[15] (see for example https://learninglegacy.crossrail.co.uk/documents/crossrails-experience-of-geotechnical-baseline-reports/)

[16] Rock Beats Paper - A. Dix Tunnelling Journal September 2019

9. References

- Better Contracting for Underground Construction (1974) US National Committee on Tunnelling Technology National Academy of Sciences
- Tunnelling – improved contract practices – CIRIA Report 79 (1978)
- Geotechnical Baseline Reports for Underground Construction –Guidelines and Practices – ASCE (2007)
- FIDIC – Conditions of Contract for Underground Works
- ISO 31000 – Risk Management (2019)
- ITIG-COP – Code of Practice for Risk Management of Tunnel Works (2012) prepared by International Tunnelling Insurance Group
- ITA Recommendations on Contractual Sharing of Risks (1988)
- NZTS- Pipejacking Guide (2017)
- NZGS – New Zealand Ground Investigation Specification (2018)
- NZS 3910 – Conditions of contract for building and civil engineering construction
- Tunnels and Tunnelling Journal July 2004 Geotechnical Baseline Reports Revisited
- The Legal Impact of Geotechnical Baseline Reports Parnass J.D., Staheli, K. (2010) NASTT
- ITA Guidelines for tunnelling risk management (2004)
- ITA Contractual Sharing of Risk in Underground Construction (1995)
- The Ground Risk Under the Contracts and The Geotechnical Baseline Reports Zoppis, E. 14th International Underground Construction Prague (2019)
- Contractor's Claims Under the FIDIC Contracts for Major Works Seppala CR Construction Law Journal, London, 2005
- E.J. Rimmer, The Conditions of Engineering Contacts, Journal of The Institution of Civil Engineers (London, England) No. 4 1938-39, February 1939
- FIDIC's New Suite of Contracts - Clauses 17 to 19 Risk, Responsibility, Liability, Indemnity, Insurance and Force Majeure Bunni, NG. International Construction Law Review "ICLR", Vol. 18, Part 3, July 2001
- Geotechnical Site Investigations for Underground Projects" (1984), U.S. National Academy of Sciences. (Free to download) https://www.nap.edu/download/919
- https://learninglegacy.crossrail.co.uk/documents/crossrails-experience-of-geotechnical-baseline-reports/
- https://www.procurement.govt.nz/assets/procurement-property/documents/guide-risk-and-value-management-construction-procurement.pdf

Appendix 1

International Perspectives

North America

GBRs are used on nearly every tunnel project in the USA and Canada, regardless of project delivery, i.e., used on PPP, design/build and construct-only projects (known as design-bid-build in North America). It is standard practice. The ASCE “Gold Book” is generally adhered to. Contractors in the USA will almost universally not bid a project without a GBR. And many contractors will assess GBRs during tender and factor the conservativeness of baselines into “go/no go” decisions on bidding, depending on the market pressures at the time of bid.

Australia

GBRs are currently rarely used in Australia. The GBRs that have been used have been limited to parameter baselines only and hesitate on material quantity and ground behaviour baselines. Design/build is the most prevalent procurement method, and historically most clients in Australia contractually shed all geotechnical risks to the contractors. Complicating this are geotechnical investigations conducted by the client during tender periods, but results are not available in time for pricing the project. Contractors have traditionally accepted this risk transfer, as it is a lower risk in Sydney (with more predictable conditions) but is a higher risk in Melbourne, Brisbane and other places where geology is more complex. To date there has not been a lot of litigation over differing site conditions but increasing exposure may change this.

UK

CIRIA 79 recommendations on ‘Ground Reference Conditions’ adopted by ITIG has generally led to the implementation of GBRs in the UK. Some GBR implementation has followed North American practice, some has not. For Crossrail, GBRs were created for 34 different tunnel, shaft, station, and portal contracts[17] – all using the NEC3 form of contract – by far the most extensive and most successful application of GBRs in a single programme.

FIDIC

The FIDIC Conditions first published in 1957, were based on the English Institution of Civil Engineers (‘ICE’) Conditions and have been modified several times. Their use is widespread internationally. In 2019 and based on the ‘yellow’ book that has been used for the previous 17 years, FIDIC (in conjunction with the ITA) published the emerald book for the design and construction of underground works.

It includes the following which establishes the primacy of the role of the reference design and the employer’s enterprise risk ‘appetite’, with consequent limitations to alternative tender methods and contractor innovation as geotechnical baselines cannot be amended.

> *The design concept selected by the Employer and the interpretations stated in the GBR collectively represent the Employer’s preferred risk allocation for the subsurface physical conditions. This shall apply to the Employer’s reference design and any alternative design and method of construction submitted in the Contractor’s proposal by a tenderer’*

The GBR is stated to be the ‘only’ contractual document that describes the anticipated subsurface conditions to be encountered in the execution of the works (albeit other aspects such as bills of quantities etc may provide other ‘indications’). Physical conditions falling

[17] https://learninglegacy.crossrail.co.uk/documents/crossrails-experience-of-geotechnical-baseline-reports/

outside of the GBR are considered to be “Unforeseeable” and therefore at the employer’s risk. General Conditions Clause 4.10.3 provides the following;

> *“If an alternative construction method for the Excavation or Lining Works is agreed between the Parties, and if the GBR is silent on one or more parameters that are relevant to such alternative method, reference shall be made to the GDR to integrate or amend the GBR accordingly.’*

The NZTS is of the view that this provision may introduce considerable ambiguity and recommends the GBR (and baselines) is amended as part of negotiating and agreeing the alternative methodology during interactive discussions that occur in the staged process of agreeing the GBR. (Refer Section 6 and 7 above)

The emerald book allows for the Time for Completion to be extended if the conditions are more onerous than described in the GBR, but it can also be reduced if ground conditions are better. This is innovative and requires definition and observation of the time related, quantity and fixed rate terms. It is noted that whilst ‘rate elements’ appear in CIRIA 79 their use was optional.

Given some of the current mis-understandings regarding the use and purpose of GBR’s in New Zealand (that have precipitated this guide) and interim of more experience of the FIDIC emerald book the use of ‘balanced baselines’ that ‘cut both ways’ (see for example Doyle 2006) is not recommended. The NZTS recommends a focus from the Client organisation upon the project risks, its organisational risk ‘appetite’ and its preferred contract form and administration and an adoption of the original ASCE baseline concepts:

> ‘…the risks associated with conditions consistent with or less than the baselines are allocated to the contractor and those significantly (materially) more adverse are accepted by the owner (client). (words in parentheses added)
>
> ASCE 2007

International Tunnelling Insurance Guide (ITIG)
Since the first publication in 2012 the International Tunnelling Insurance Guide has had a positive impact upon risk management in tunnelling. Based on a recent survey by ITIG more than 90% of survey respondents believe risk management has a positive impact on industry.

The ITIG guide is typically used as a benchmark by insurers and risk engineers to assess the effectiveness of risk management practices for projects in construction.

The ITIG code defines reference conditions as follows:

> ‘Definitive statements about the nature, form, composition and structure of the ground (both artificial and natural) and groundwater together with geotechnical properties of the ground which serve as a basis for construction Contract tendering purposes and for the subsequent application of the contract with respect to the conditions actually encountered during Tunnel Works. The Ground Reference Conditions represent a contractual definition of 'what is assumed will be encountered'. However, the provision of such Conditions in the Contract is not a warranty that the Conditions will be encountered.’