

# **Section 3**

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**Tauranga City Council**

## **Part A: Geotechnical Matters**

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# Part A: GEOTECHNICAL MATTERS

## 3. Scope

A guide to the various aspects that need to be addressed as a means of complying with Section 3 of this Code is provided in the New Zealand Standard entitled “‘Land Development and Subdivision Engineering’ NZS 4404”. This standard sets out the areas in which the rational processes of engineering appraisal and design (site investigation) are necessary, and which requires the involvement of a geotechnical (soils) engineer.

*The NZS 4404 is a most relevant document and should be consulted when any doubt or guideline fails to provide a solution to land development practices.*

In summary, engineering appraisal and design are required:

- Prior to detailed planning, which may involve some form of subsurface investigation;
- During the review of and advice on design concepts;
- During construction to ensure the adequacy of the bulk filling and the execution of the earthworks design;

*Performance criteria stated in relevant sections of the New Zealand Building Code are the minimum performance standards by which land will be deemed suitable for building development and therefore display compliance a condition of resource consent.*

## 3. A Performance Criteria

**3.A.1** Every lot shall contain a safe building platform suitable for the erection thereon of building types appropriate to the zoning of the land.

*It is a general objective of Council to ensure that all land that is subdivided or developed is done so with a level of expertise and evaluation appropriate to the site and yields lots that are fully able to be developed without any further geotechnical input.*

Works may be required to be undertaken to ensure this criteria is met. The “Soils Engineer” shall ensure that appropriate solutions to geotechnical issues on a site are provided to meet the above criteria.

*Where this is unable to be achieved then as a minimum each lot will contain a designated practical building platform that can be built on without requiring further engineering input or contains recommendations on how best to develop or build on the designated house site. This reflects the public's expectations that when purchasing a lot that they should reasonably expect to have at least one place to build that requires little further input.*

The building platform shall be deemed safe when the performance criteria in either the resource consent, the performance criteria of the New Zealand Building Code or this Code have been met.

**3. A.2** Any land, the subject of a resource consent application for land subdivision, multiple unit development (residential, commercial or industrial) or as otherwise required by the District Plan to address suitability of the land for development, shall be accompanied by a Development Evaluation Report and shall include a statement in a format similar to Drawing G1.

*Further it is intended that the evaluation and reporting process be undertaken by a person who has displayed an appropriate level of proficiency and competency in this field and whose evaluations display that an acceptable level of investigation and reporting is being applied.*

After review of the Development Evaluation report Council may require that additional geotechnical investigation and evaluation be undertaken to prove the suitability of the site for its intended purpose.

*It is envisaged that for smaller developments( ie infill sub.) where no apparent soils problems appear to exist will only require an Development Evaluation Report in a format similar to G1 after due consideration has been given to the site.*

**3. A.3** Where the Development Evaluation Report identifies specific geotechnical requirements associated with the proposed development then consent may be granted subject to conditions which may involve specific works to be undertaken to avoid remedy or mitigate the issues identified, or in the case of minor

*It is recognised and accepted that no two engineers will approach any one problem in exactly the same way, nor will they reach entirely the same conclusion, nor present their data and interpretations in exactly the same way.*

*Often the comparative lack of specialised knowledge or experience acts to hinder the rationalisation of these issues, usually at considerable cost to all parties*

works which can be practically undertaken at the time of building a consent notice will be registered on the certificate of title of that allotment and also registered in Council's land management systems.

*involved, including the practitioner and the Council.*

*This Means of Compliance document provides a quality management means of overcoming these issues of communication and understanding within the framework of a generalised set of expectations*

**3.A.4** Where required by the conditions of the Resource Consent a Geotechnical Completion Report, including a statement of professional opinion in a format similar to Drawing G2, shall be submitted in respect of every lot/building site whether it has been affected by earthworks, contract civil works or not.

**3. A.5** All Development Evaluation Reports & Geotechnical Completion Reports shall be prepared by a person who is appropriately trained and experienced and whose training, experience and expertise in geotechnical engineering meets the criteria outlined in section 3.B of this Code.

### **3.B. Minimum requirements**

All geotechnical investigation and completion reports shall be prepared under the direction of a Chartered Professional Engineer on the IPENZ Geotechnical Practice College Register and who has Professional Indemnity Insurance as set out under 1.5.1. Reports may also be prepared under the direction of qualified Engineering Geologist who has recognised work experience with Council as described below

All reports must be prepared by suitably qualified professional and undergo a quality control process that includes internal peer review of the work by the supervising professional or another of equivalent standing, if need be, .

The Consent Holders Representative may act as the Geotechnical Engineer ("Soils Engineer") if possessing the above criteria and those required by this section of the Code.

A category 1 or 2 type engineer shall act as the Soils Engineer

Council maintains a Register of Geotechnical Engineers and Engineering Geologists, each of whom have attained either a Category 1 or 2 status based on recognised qualifications, work experience and knowledge and professional history of completed engineering projects in the complex soils of the Bay of Plenty region and who have been interviewed by a panel convened by the City.

Those complying with the above criteria need only provide verification public liability and professional indemnity cover is current and sufficient for inclusion in the Register. An engineering geologist with suitable geotechnical experience may also apply to be included on the Register, and to be allowed to submit geotechnical reports.

Those Chartered Professional Engineers and qualified Geotechnical Engineers not on the register would qualify as a Category 3 type Engineer.

### 3.B.1. Policies and Responsibilities of “Soils Engineer”

Council maintains a three tier geotechnical structure and register as follows:

**Category 1** A Chartered Professional Engineer or Engineering Geologist who is acknowledged by the Accreditation Panel as possessing the appropriate qualifications, skills and relevant experience in the Tauranga Region to provide advice on all geotechnical issues found in Tauranga City.

**Category 2** A Chartered Professional Engineer or Engineering Geologist who is acknowledged by the Accreditation Panel as possessing appropriate qualifications, skills and relevant experience in the Tauranga Region to provide advice on a limited number of less complex geotechnical issues found in Tauranga City.

**Category 3** A Chartered Professional Engineer or an Engineering Geologist with an appropriate level of supervised work experience in a related field.

Typically those professionally qualified and practising engineers not listed on Tauranga City Council’s Register

**3.B.2** Admittance to the geotechnical register by a suitably qualified Chartered Professional Engineer or Engineering Geologist to either Category 1 or Category 2 status is by way of an interview undertaken by an independent panel of specialists (Accreditation Panel) convened by Council, at the applicants expense.

*The three tier system is designed so that each site is dealt with by an appropriately qualified and experienced person.*

*It also recognises the need for flexibility to allow the less experienced practitioner the opportunity to gain experience by being able to undertake geotechnical work on more complex issues under the guidance of a Category 1 Professional*

*This ensures then that the practitioner and the Public are not placed at risk. It also recognises that all respected Professional bodies require that their members have the ability and opportunity to develop and advance themselves while working within their levels of competency*

*Site investigations for land development projects require the exercising of considerable skill, experience, and judgement, depending on the nature and complexity of the project*

*With most projects, the site investigation aspects of a project extend throughout the project and may require considerable flexibility during the development phase, particularly if complex and varying conditions not anticipated from the formal phases of investigation are encountered.*

*The processes that have been outlined provide the means of achieving the objectives of sound foundation investigation for subdivisional and land development purposes, viz:-*

- (i) identifying any constraints on land use;*
- (ii) mitigating any risks;*
- (iii) reducing the potential liability of all parties involved in the processes,*  
*ie. The consent holder*  
*the engineer*  
*the local authority*

*In general Council convenes the Accreditation Panel on an annual basis or as numbers of professionals applying for admittance to the register make the convening of the Panel financially viable.*

**3.B.3** As a minimum the following are the various areas where the above categories of engineers are to be utilised.

*The areas defined for each geotechnical category have been defined by the report commissioned by TCC (TL485) entitled "Relic Slip Verification Study – Tauranga District council Environs" compiled by Laurie Richards, David Bell and Royden Thomson dated 31 March 2001.*

**Category 1 Geotechnical Areas**

- where structures are proposed to be located within the 2H:1V upslope zone or the 4H:1V downslope zone. (Both sets of zones are defined on Council's GIS system)
- where structures are proposed to be located within the 2H:1V and 3H:1V upslope zones but where combined with various other factors i.e. relic geomorphic features
- where sites include possible/probable slope movement feature with
  - (a) clearly or poorly defined headscarp
  - (b) indications of recent or current activity
  - (c) hummocky debris
- where difficult settlement problems may exist in either:
  - (a) low lying areas
  - (b) areas subject to old uncertified filling and/or horticultural fills.
  - (c) estuarine silts and compressible soils
- seismic ground hazard including soil liquefaction and mitigation of effects
- lateral spread issues
- seepage issues from slope at any height
- low strength soils
- where a soakage method for stormwater disposal is proposed within the areas defined as "Specific Design" and within 150m of a relic geomorphic feature or from the outer extent of the displayed 2H:1V zone

*The report redefined the extent of relic geomorphic features, failure mechanisms for Tauranga and verified in a limited manner the 2:1 and 4:1 zones utilised to manage risk associated with steep land and geomorphic features.*

**Category 2**

- where site exhibits no evidence of relic geomorphic features within or in close proximity to the proposed development; and
- where proposed structures are to be located outside of the 2H:1V upslope and 4H:1V downslope zones
- areas not covered by Categories 1 or 3.
- where a soakage method for stormwater disposal is proposed within the areas defined as "Specific Design" but is outside of the distance of 150m from a relic geomorphic feature or from the outer extent of the displayed 2H:1V zone
- Specific design of foundations where limited extents of compressible soils or uncertified/horticultural filling exist. ("limited" is defined as being in the order of 2 – 4m in depth where the extent of poor bearing capacity soil is easily determined)

*These processes define the state of the practice for subdivisional and land development investigation, which being based largely on a common sense pragmatic approach to hazard identification and risk mitigation, in conjunction with a good measure of practical down to earth experience, will ensure:-*

- a) A low risk outcome for all parties involved;

**Category 3**

- minor soils work
- proving bearing capacity for foundations not included in Category 1 or 2 areas.
- soakage reports where the surrounding ground stability does not need to be proven.

**3.B.4.** Where an area of work is not covered by the categories above then the Group Manager: City Services or his delegate remains the sole arbiter when assigning a category to a specific site.

**3.B.5. (i)** A Category 2 practitioner may undertake work within a Category 1 area where the following criteria is observed:

- The practitioner engages a Category 1 practitioner or an appropriately qualified and experienced Person acceptable to Council, prior to commencing any site investigation to undertake a review of the proposed methodology for undertaking investigation for the site and agree the best approach. The site investigation is undertaken in accordance with the agreement and the Category 2 practitioner communicates regularly with the Category 1 practitioner to ensure professional coaching about key findings and assumptions occurs
- The final geotechnical report submitted to Council shall be peer reviewed by the person in 3.B.5.(i) and such peer review is attached to final report confirming the findings of the geotechnical report as being appropriate.
- The peer review cost is met by the applicant.

Where a review is sought by an appropriately qualified and experienced person who is not on the register for Category 1 practitioners' then the Category 2 practitioner shall apply in writing to Council for acceptance of the person as a reviewer. Note: This will occur in rare instances.

**(ii)** A Category 3 practitioner may undertake work within a Category 2 area where the criteria required in 3.B.5(i) of this Code is observed.

The reviewing practitioner is to be a Category 1 practitioner.

*(b) A product which is readily understood by most local authority officers, and which, through a logical process, should address their concerns;*

*(c) As a consequence of (b), a relatively easy progression through the approvals processes, which has a net benefit to a client in terms of minimal delays;*

*(d) For a well engineered subdivision or land development project, a product which is readily marketed, as a consequence of identified and mitigated risks.*

*-ie. Minimum uncertainties.*

*The object and development of these processes has the underlying objective of communicating a technical appreciation of a site in a manner which addresses all the relevant issues, and in a manner which can be readily understood by all parties involved, including the lot purchaser/home owner.*

*The process may be subject to variation, depending on specific site circumstances. However, if followed rationally, the outcome should always be the same – a quality managed engineering product based on hazard identification and risk mitigation, and which can vary from a one page letter through to a sizeable report, depending on the specific site circumstances.*

*It should be noted that any aspects of a report submitted to Council in compliance with the Geotechnical Assessment requirements of Council's Code of Practice for Development are the copyright of the writer.*

- 3.B.6.** Geotechnical reports compiled for Category 1 sites/areas must ensure that the subject site is assessed both for geomorphic features, processes and associated behaviours as well as for the engineering component associated with the report.

Compilation of a report may require the input of both an engineering geologist and geotechnical engineer to ensure the geological model developed and the assessment of the issues associated with that model are well defined, understood and assessed.

Council reserves the right to have any geotechnical reports peer reviewed if it deems this necessary.

Where this process is initiated Council will notify the applicant and outline why this course of action has been undertaken.

Peer reviews, whether Council or practitioner initiated, will be undertaken in accordance with section 3.D of this Code.

The cost of the peer review will be met by the applicant.

- 3.B.7.** The Consent Holder shall appoint a Category 1 or 2 Chartered Professional Engineer to undertake the duties of the Soils Engineer.
- 3.B.8.** The Consent Holder's Representative may act as the Soils Engineer if that person is accredited with the Council as a Category 1 or 2 Chartered Professional Engineer.
- 3.B.9.** Where any land development involves undertaking bulk earthworks, the assessment of slope stability, the detailed evaluation of the suitability of natural ground for the foundations of buildings, streets, services or other works, then a Soils Engineer shall be appointed by the Consent Holder's Representative to carry out the following functions:
- (a) Ensure an appropriate site investigation and evaluation is undertaken to determine the geological model for the site, what effect the geology has on the proposed development and how to avoid, remedy or mitigate the issues found.

*For the Tauranga environment it is critical to ensure that the expertise of an engineering geologist is utilised as often as possible. Some of the risks associated with the complex landform lie in fully understanding the nature of the geology prior to undertaking any assessment of that geology.*

*Council is seeing more frequently that geotechnical engineers are not assessing the correct geological model when compiling reports in the City. Therefore it is critical that the correct geological model is defined by a person who is very skilled in this area.*

*Council urges that practitioners consider the more frequent use of engineering geologist in assessing more complex sites to ensure the best geological model is developed.*

*Council will seek the input of an engineering geologist via the peer review mechanism where in our opinion the site warrants the use of an engineering geologist to ensure that the geomorphic setting of the site is correctly understood.*

- (b) Before construction commences review the drawings and specifications outlining the earthworks proposed and their design or other works required by (a) above, and submit, at the time of development plan approval, a written statement or report to the Council confirming that the proposed earthworks and/or works will be appropriate to manage the issues found in (a) above and to provide safe completed landforms and building platforms.
- (c) Before work commences and during construction to determine the extent of further specialist soils engineering services required (including investigation and geological work).
- (d) Before and during construction determine and review the methods and frequency of construction control tests to be carried out, determine the reliability of the testing, and to evaluate the significance of test results and field inspection reports in assessing the quality of the finished work.
- (e) During construction provide regular inspection as deemed appropriate by the Soils Engineer.
- (f) On completion to submit to Council a geotechnical completion report and associated as-built plans.

*While a daily visit might be regarded as reasonable on earthwork construction on minor projects, inspection on a nearly full time basis is often necessary).*

### **3.C. Investigation, Stability Criteria and Reporting**

**3.C.1** The investigation and evaluation of a site, earthwork design and reporting on the constructed and completed geotechnical matters shall conform to this Code and the general investigation guideline outlined in Appendix G of this Code and Part 2 of NZS 4404.

**3.C.2** Completed building platforms shall comply with sB1 of the NZ Building Code.

To achieve the performance criteria outlined by sB1 the stability criteria required by s2.5 of NZS 4404 and associated references shall be utilised.

As a minimum finished slopes should possess a factor safety against slope failure of 1.5 (static condition) unless a risk assessment based on probabilistic analysis or other methods is undertaken. In the case of differential settlement no more than 25mm settlement over 6m is a normally accepted tolerance. Settlement outside this range should be specifically identified within the geotechnical completion report.

### **3.D. Peer Review**

#### **3.D.1.**

A peer review report compiled by a Category 1 practitioner or an appropriately qualified and experienced person acceptable to Council, shall include the legal description of the site and clear reference to the report being reviewed.

#### **3.D.2.**

Where a report is to be peer reviewed, the practitioner shall nominate a Category 1 practitioner or an appropriately qualified and experienced person acceptable to Council, as reviewer. The acceptance of the nominated reviewer by Council shall be obtained in writing before the peer review commences.

#### **3.D.3.**

The peer review shall ensure the investigations, geological and engineering modelling and analyses, including seismic and stormwater components, meet the requirements and intent of this Code.

**3.D.4.**

The peer reviewer may recommend or request additional investigations and/or analyses to clarify or confirm any concerns, and these shall be addressed by the practitioner in writing to both Council and the reviewer.

**3.D.5.**

The peer reviewer shall provide a written report to Council confirming the advice provided in the report being reviewed meets the requirements and intent of this Code along with any other matters pertinent to the safe development of the site.

The report shall include a conclusion on the recommendations of the report reviewed, and confirm the suitability of the land for development, subject to the recommendations of the reviewed report and peer review.

The reviewer shall also confirm to Council that in the reviewer's opinion Council is able to rely on the opinion provided in the report.

**3.D.6.**

The cost of peer review reports shall be at the expense of the Applicant.

**3.E Earthwork Requirements**

The following topics may be developed as part of this Code of Practice for Development.

- Completed landform gradients (reduction of overland flow velocity and concentration of overland flow)
- Permanent management of overland flow across landforms (contour drains, cut off drains, formalised overland flowpaths not forming accessways etc)
- The place of man-made structures in the construction of safe landforms and building platforms
- Debris protection devices

**3.E.1.** Earthworks undertaken as part of a development shall be undertaken in a manner that ensures that every lot contains a safe building platform suitable for the erection thereon of building types appropriate to the zoning of the land.

The design, construction, supervision and testing of earthworks shall be undertaken in accordance with this Code and NZS 4402, NZS 4404 and NZS 4431.

*It is recommended that a full quality assurance system be developed to ensure that the end product, i.e. The completed building platform, is suitable for its end purpose.*

*In addition to following guidelines, set out in national publications (such as NZS4431 New Zealand Standard Code of Practice for Earth Fills for Residential Subdivisions), it is recommended that progressive testing be carried out to avoid rework and to avoid unsuspected poor quality fill.*

*The fill needs to have sufficient checks (quality assurance procedure) at progressive stages of the works, ie:-*

- on completion of clearing and removal of unsuitable soils;

**3.E.2.** The Soils Engineer shall ensure that an adequate level of inspection and testing is undertaken, to enable him to evaluate properly the quality of the finished work, make any corrective measures required and their associated re-work and re-testing and compliance testing to enable him to furnish a report as to the compliance of the work with all specifications and reports.

• on completion of compaction of each fill layer until completion of the whole fill;

• all with clearly dated and surveyed test points

**3.E.3.** Where necessary, sufficient fencing or barriers should be provided around trees or other features to be protected. All site activities including clearing, storage, cutting and filling must be kept away from the root zone of trees (best defined as the extent of the canopy).

*Corrective measures need to be specified and carried out where the target quality not met.*

*The final fill control certificate provides a record of work done and tests carried out (quality control record).*

*Visual inspections should be made:-*

*(a) After stripping and prior to filling..*

*(b) During installation of drains.*

*1 Sufficiently often to check that:-*

*(i) Fill is not placed over soft of organic ground, unless provided for by design.*

*(ii) Seepages and potential seepage areas are provided with drains.*

*(iii) Unsuitable materials are not used as fill..*

*(iv) Compaction operations are systematic and uniform.*

*(v) Conditions encountered are in keeping with those anticipated from the initial site investigation.*

*The actual level of monitoring should be based on the ACENZ guidelines for engagement of consultants depending on the level of complexity and importance of the works in question.*

**3.E.4.** Where earthworks are to undertaken on a development the Soils Engineer shall prepare the necessary earthworks designs and specifications to control all facets of the earthworks construction. It is the responsibility of the Consent Holder's Representative to undertake all compaction tests for bulk earthworks as per the Soil Engineer's requirements, otherwise to the standards specified in the "NZS4431:1989 - *Code of Practice for Earth Fill for Residential Development*". The following items shall be included in the application for engineering plan approval:

- the design parameters to be set for the fill materials.
- the suitability of the materials present to be placed as fill material.
- the method of placement of fill materials and the compaction to be utilised to construct the fill.
- the method to be used to measure acceptance of the earthfill material during construction

**3.E.5.** The method of placement of fill and its method of compaction shall be specified by the Soils Engineer as required by 3.E.4 above.

Fill material should be placed in a systematic and uniform manner to the compaction standards and methods specified by the Soils Engineer. Departures from the compaction standards and methods may only occur where specified by the Soils Engineer.

### 3.E.6. Provision of Permanent Services

Where settlement is expected to occur, all service pipes installed within or under filling shall be designed and constructed to ensure adequate capacity, strength and water-tightness to withstand the loads expected to occur due to settlement and to prevent leakage into the fill.

All drains, including sub soil, required permanently to protect the stability of fillings or to prevent flooding and erosion should be clearly identified as such on the 'As Built' drawings along with long term management recommendations.

*Design detailing of such drainage systems should minimise the need for maintenance.*

### 3.E.7. Temporary Drainage and Erosion Control.

During the construction period, measures shall be taken to prevent excessive water-logging of surface materials yet to be excavated or compacted or both, and to prevent fill material from being eroded and redeposited at lower levels.

All dust, sediment, erosion control and temporary stormwater discharge shall be undertaken in accordance with Environment Bay of Plenty's "Erosion and Sediment Control for Land Disturbing Activities."

### 3.E.8 Regional Consents

Where required under the appropriate Regional Council Plan the Consent Holder shall obtain an earthworks consent from Environment Bay of Plenty and shall comply with all conditions specified in that consent. A copy of the Regional Council's Consent shall be submitted as part of the Subdivision Application.

### 3.E.9. Standards

The minimum standard of compaction to be met for any fill material is as follows but in general shall be specified by the Soils Engineer.

Where the following criteria are not applicable for the materials being used, then the criteria to be adopted shall be those outlined in NZS 4431.

**(a) Cohesive Soils**

The maximum dry density of the fill material shall be established using the standard compaction test presented in NZS 4402

For compaction tests a site specific optimum moisture content/dry density curve is required.

Then either

- (i) Fill material should then be compacted to a minimum dry density which is/or greater than 95% of the value of maximum dry density obtained in the laboratory tested sample.

Or

- (ii) The compacted fill material shall obtain minimum undrained shear strength of 150kPa and a maximum voids ratio of 10%. The shear strength of the fill material shall be determined using a shear vane test as prescribed in NZS 4402. The use of scala penetrometer results to measure shear strength in cohesive soils will not be accepted.

*Allowing variations to this may be appropriate. For example a shear strength of 120 kPa with 6% air voids may provide an equivalent performing fill.*

**(b) Cohesionless Soils**

The maximum and minimum densities shall be obtained from laboratory testing as prescribed in NZS 4402.

Then either

- (i) The dry density of the fill material is then expressed as a relative density in terms of the laboratory tests.

*As well as these minimum requirements steps should be taken to ensure that cohesive fill is not too wet or over-compacted to an extent that wearing of the fill occurs.*

This can be done using a Scala penetrometer calibrated adjacent to a test bed as follows:

*Monitoring using Clegg Hammer or similar can also provide similar results if calibrated in a similar way.*

- Prior to commencement of earthworks establish the dry density of the cohesionless soil.
- After completion of a portion of the earthworks prepare a test bed and re-measure the dry density and establish the percentage compaction.

- The Scala penetrometer can then be calibrated adjacent to the test bed and using the test results.

Note:

- This test should not be used as a substitute for the maximum density and % compaction tests unless they are correctly calibrated.
- This method is for use on cohesionless soils only.

Or

- (ii) The dry density of the compacted fill material shall not be less than 95% of the maximum dry density of the fill material obtained from testing prescribed in NZS 4402.

### 3.E.10. Density Acceptance Criteria

The minimum acceptance criteria of test results will be as follows:

- for less than 10 tests  
All tests shall meet or exceed the specified minimum standard
- for more than 10 tests  
The average of 10 consecutive tests exceeds the specified minimum standard.

And

- Only 1 test/10 test results shall not be less than 90% of the minimum standard.

### 3.E.11 Fill Testing

Fill material will be tested in accordance with the soils engineers design and as a minimum, as follows:

- (1) For fills <10,000m<sup>3</sup>:
- 1 set of tests per every 750mm lift of fill; and  
1 set of tests every 800m<sup>3</sup> of fill.

Or

- (2) For fills <50,000m<sup>3</sup>:
- 1 set of tests per every 1.5m lift of fill.  
1 set of tests every 4,000m<sup>3</sup> of fill.

All tests for fill material are prescribed in NZS 4402.

Testing shall be more frequent than specified under the following:

*Quantitative testing should be related to the control criteria determined by the soils engineer and should have a higher frequency (say about 500 to 1000m<sup>3</sup> intervals) at the initial stages of earthworks to sort the operations out, with a lesser frequency as the fill progresses, the compaction criteria are being achieved, and visual appraisal indicates the overall operations are satisfactory.*

- On the final layer of fill of not less than 1.0m depth where the minimum frequency of in-situ density tests should be three sets of tests per every 3000m<sup>3</sup>.
- When relatively small quantities of fill are concentrated in localised areas and placed discontinuously for a long period of time.

### 3.F Road Subgrade Design

- 3.F.1.** The general principles of earthworks investigation, construction and control as outlined in this means of compliance also apply to road subgrades.

*The geotechnical report should address any specific design criteria perceived necessary for subgrade preparation (eg. Stabilisation, recompaction, geotextile, drainage, etc.)*

For the purposes of this document the road subgrade shall be classified as the layer of material contained within the zone between the subgrade surface and 1000mm below the subgrade surface.

- 3.F.2.** Two principal methods of pavement design currently in use are:-

either

- CBR method;
- or
- Deflection method.

- 3.F.3.** The CBR method is most commonly used and is based on laboratory or in situ tests and is independent upon approval of the subgrade for uniformity and standard of construction. Uniformity may be assessed by:-proof rolling or in situ tests such as the CBR test.

- 3.F.4.** The deflection method is based on end of service empirical performance criteria and requires the in situ testing of the subgrade by Benkelman beam prior to placing the metal courses.

*For subgrades located in fill materials, a higher strength fill shall be achieved within the layer of fill contained between 1000mm below the subgrade formation level and the subgrade formation level.*

*In general, cut ground may require more treatment for acceptance to road subgrade standards than a controlled earth fill. Undercutting and recompaction is often a prudent course to follow on cut ground.*

*For example local soils can be highly sensitive and require careful treatment to ensure they are not disturbed during construction.*

### 3.G Geotechnical Completion Report

**3.G.1.** A geotechnical completion report shall be provided to Council and is required to cover, but not necessarily be restricted to, the following:

(a) **Purpose**

To report on all geotechnical aspects of the development after completion of the works with a view to recording:

- the construction information
- Additional investigations
- Statements of suitability of the land for building development for all lots

The emphasis of the report shall be on stating what occurred during construction, supported by detailed field notes, test results, and construction reports to provide an accurate detailed 'As Built' record of the development.

(b) **Scope**

The report shall include:-

- the earthworks design;
- the design parameters set for the fill material to achieve the intended result;
- the parameters set for acceptance of the fill material;
- Test results and extent of engineering supervision;
- variations to the original earthworks design and specification;
- compaction plant employed;
- extent of certified and un-certified fill;
- 'As Built' drawings;
- the lot and deposited plan numbers covered by the contents of the report;
- statement of Professional Opinion in a format similar to Drawing G2;
- a lot summary sheet similar to Drawing G2a for inclusion on PIM reports;
- any other comment or recommendations pertinent to individual lots or building platforms within the development.

**3.G.2.** The report should cover, and re-evaluate where necessary, the requirements of the Development Evaluation Report, the requirements of NZS4431, and the requirements set out in the conditions of subdivision consent.

**3.G.3.** The description should include sufficient test results, site inspection data, and other information to enable an independent assessment to be made as to the suitability of the development.

*Not all soils will require the application of this means of compliance to the same degree. For example, a site with no obvious risks or identifiable hazards, and which has not been subject to earthworks or other engineering works such as the installation of services, may simply require a short letter from a competent person reaffirming the suitability of the site for its intended purpose. This assessment should be reported in letter form to ensure continuity of record of the Quality Assurance audit trail*

*For larger developments it is required that the completion report be a report that is capable of standing alone and be an accurate as-built record of all the work and testing that was required to construct the development along with a Professional Opinion as to the suitability of the site to fulfil its intended purpose. Where appropriate the development evaluation report should be appended to the completion report to provide a completed package.*

### 3.G.4 'As Built' Drawings

'As Built' drawings shall include;

- site plan showing borehole and test positions
- site plans showing the lot boundaries as submitted to LINZ:
  - i. the finished landform contour plan shown in 1m contours and to Moturiki Datum;
  - ii. the extent and depth of all certified and uncertified fills shown in a suitable contour interval.
  - iii. the positions of any Building Restriction Lines and/or Designated Building Platforms
  - iv. Extent, positions and depth of all permanent subsoil, contour, cut off drains etc
  - v. any other relevant engineering features

**3.G.5** A summary sheet of individual lots in a format shown in Drawing G2a shall be supplied within the Geotechnical Completion Report and appended to the Statement of Professional Opinion. This summary sheet will detail subsurface data and foundation recommendations and comments for the individual building platforms established on each lot (this information will be used by Council to form part of each PIM report for individual building projects).

A summary of all recommendations/restrictions and/or conditions should be made within the summary sheet and geotechnical completion report

**3.G.6.** A statement in a format similar to Drawing G2 shall be submitted.

**3.G.7.** Reports:

All reports submitted shall include 1 paper copy and 1 electronic copy in “**pdf**” format at the time of either building or resource consent or at the time of application for s224.

Plans:

Any as-built or completed contour plans as required shall be submitted in accordance with the plan standards and delivery requirements of Section 2.1 and Council's Digital Data Transfer Standard, and in “**pdf**” format.

## Part B: NATURAL LAND HAZARDS

### 3.H. Performance Criteria

**3.H.1.** Every lot shall contain a safe building platform suitable for the erection thereon of building types appropriate to the zoning of the land that is not subject to damage from a natural land feature.

Works maybe required to be undertaken to ensure this criteria is met.

A suitably qualified and experienced person shall ensure that appropriate solutions to any natural land feature are provided in the development evaluation report to ensure the above criteria is met.

The building platform shall be deemed safe when the performance criteria in either the resource consent or the New Zealand Building Code is met.

*Section 106 of the Resource Management Act 1991, the Operative District Plan, and Sections 71 and 72 of the Building Act 2004 provide for controls on the development of hazard prone land. These acts and plans must be complied with when building or developing land subject to a natural land hazard.*

*This section of the Code draws the consent holder's attention to some specific matters which are to be addresses to ensure the requirements of these Acts and the District Plan are met.*

### 3.I. MINIMUM REQUIREMENTS

**3.I.1.** All resource consent applications for land subdivisions, multiple residential, industrial or commercial units or any other type of development that is the subject of a natural land feature which may cause damage to any proposed structures or buildings shall be accompanied by a development evaluation report compiled by a suitably qualified and experienced person that display:

- the extent of the natural land hazard that exists on the site;
- the effect of the natural land hazard;
- how to avoid, remedy or mitigate the effects of the natural land feature so that any buildings or building platforms located on the subject site shall not be the subject of damage due to the land feature.

**3.I.2.** Natural land features that need to be addressed within the Development Evaluation Report are:

- Land below Council's minimum building platform level.
- Land that is shown as requiring "specific design for stormwater disposal"
- Coastal flooding (storm wave run up).
- Coastal erosion
- Harbour inundation not assessed as part of minimum building platform criteria above
- Flood prone land
- Stormwater Sensitive
- Overland flows
- Other

**3.I.3.** The investigation and reporting of a natural land feature for a site shall be undertaken by a practitioner who is appropriately qualified and experienced to compile the development evaluation report and provide appropriate advice and solutions for the effects of the natural land feature.

**3.I.4** A site for which specific works are required to mitigate the effect of a natural land feature may be approved subject to conditions requiring that work to be undertaken and also restrictions which may be registered on the certificate of title for the land by way of a consent notice or covenant and recorded in Council's land management systems.

*In addition to geotechnical hazards which are covered in Section 2 of this Code other hazards exist, such as the following:*

- (a) *flooding of streams, off site effects relating to overland flow or stormwater discharge, waterways, overland flowpaths and depressions. Council's catchment management plans contain some broad-brush information on these.*
- (b) *Coastal erosion: Council's District Plan and the report by coastal erosion specialist, Dr Jeremy Gibb for the Tauranga City Council titled "Coastal Hazard Risk Assessment between Mauao and Papamoa" (reference C.R.96/1) contain some broad-brush information and policies and rules relating to this hazard.*
- (c) *Coastal inundation (minimum building platform levels): See Ch 6 and 17 of the District Plan*

*The level of training and experience required is dependent upon the complexity of the issue to be addressed. Frequently matters of coastal erosion should only be addressed by a recognised specialist in this field. Many other matters can be addressed by a person who is appropriately qualified and experienced and who registered as a Chartered Professional Engineer.*

### 3.J. Means of Compliance

**3.J.1.** The minimum requirements can be met by ensuring an appropriately qualified and experienced practitioner provide advice on the mitigation, remediation or avoidance of any natural land feature present on a site. The advice will demonstrate how the effect of the natural land feature will be managed by the undertaking of works, or the placement of such restriction upon development of the land to overcome the natural land feature.

Any specified works shall be undertaken where required prior to the release of the 224 certificate or commencement of the activity or issue of code compliance for the structure.

### 3.K. Natural Land Feature Completion Report

**3.K.1.** A completion report shall be provided to Council and is required to cover, as a minimum, the following:

The report shall certify that the works required by the development evaluation report and/or the resource consent required to manage the effects of the natural land feature have been completed

- In accordance with that advice provided in the development evaluation report and the resource consent
- A statement of opinion that the land is now suitable for building development with respect to the natural land feature
- Have effectively managed the issues relating to the natural land feature
- Any recommendations or restrictions relating to the site
- Any ongoing maintenance matters required undertaken to ensure the mitigation measures remain effective
- any other comment or recommendations pertinent to individual lots or building platforms within the development or their ongoing development

#### Reports:

All reports submitted shall include 1 paper copy and 1 electronic copy in **pdf** format at the time of either building or resource consent or at the time of application for s224.

#### Plans:

Any as-built or completed contour plans as required shall be submitted in accordance with the plan standards and delivery requirements of Section 2.1 and the Council's Digital Data Transfer Standard or in **pdf** format.

*Council's preferred management method for natural land features is to ensure works are undertaken by the consent holder/developer to avoid, remedy or mitigate the effect of the natural land feature rather than the use of restrictions registered on the certificate of title that require subsequent developers of the sections to manage the effects of hazard.*

*It is acknowledged however, that sometimes the better solution can be found by allowing subsequent developers of the section to mitigate the effects of the natural hazard.*

*In these cases however, the requirements for such mitigation measures should be clearly communicated to purchasers of allotments. Consent notices or covenants registered on the Certificate of Title are an effective means of doing this. Consent holders are referred to Section 106 of the Resource Management Act which will need to be complied with in all cases. Council's preference is usually that works be done by the consent holder rather than subsequent purchases of allotments created.*

*To ensure the requirement of the District Plan, the Resource Management Act 1991 and the Building Act 2004 have been met a completion is needed to display the solutions required by the development evaluation report have been undertaken and which certifies that the effects of the natural land features have now been appropriately managed.*

*The completion report should be a report that is capable of standing alone and be an accurate as-built record of all work and testing that was required to construct the development along with a Professional Opinion as to the suitability of the site to fulfil its intended purpose. The development evaluation report should be appended to the completion report to provide a completed package*

