coffey geotechnics
SPECIALISTS MANAGING THE EARTH

GEOTECHNICAL COMPLETION REPORT ON STAGES 1 AND 2 OF THE MAHURANGI RIDGE SUBDIVISION AT 152 MAHURANGI EAST ROAD, SNELLS BEACH

Cabra Developments Limited

GENZOREW10880
29 October 2008

Coffey Geotechnics (NZ) Limited
First Floor, 65-69 Forge Road Silverdale 0932 New Zealand

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SPECIALISTS MANAGING THE EARTH

29 October 2008

Cabra Developments Limited
PO Box 197
Orewa

Attention: Lloyd Barker

RE: Geotechnical Completion Report for Stages 1 and 2 of the Mahurangi Ridge Subdivision for Cabra Developments Limited at Mahurangi East Road, Snells Beach

This report presents all supporting geotechnical data and our Suitability Statement in relation to land development works undertaken at the above site.

It has been prepared in accordance with instructions received from Ian Hutchinson Consultants Limited acting on behalf of Cabra Developments Limited and forms part of the documentation required by Rodney District Council to achieve certification under Section 224(c) of the Resource Management Act.

If you have any queries or you require any further clarification on any aspects of this report, please do not hesitate to contact the undersigned.

For and on behalf of Coffey Geotechnics (NZ) Limited

CS Thompson

Engineering Geologist

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	Rodney District Council	2 Copies
	Ian Hutchinson Consultants	1 Copy
	Coffey Geotechnics Archives	1 Copy

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1 INTRODUCTION AND DESCRIPTION OF SUBDIVISION

This Geotechnical Completion Report has been prepared for Cabra Developments Limited as part of the documentation required to be submitted to the Rodney District Council following residential subdivisional development.

It contains our Suitability Statement, relevant test data and the Ian Hutchinson Consultants Limited as-built plan set relating to Stages 1 and 2 of the Mahurangi Ridge Residential Subdivision as follows:

TABLE 1: IAN HUTCHINSON CONSULTANTS LIMITED AS-BUILT PLANS

Title	Reference No.	Date
Asbuilt Contour Plan	A3-9320 AB stg2/03	October 2008
Asbuilt Cut/Fill Depth Contours Plan	A3-9320 AB stg2/04	October 2008
Asbuilt Undercut Depth Contour Plan	A3-9320 AB stg2/05	October 2008
Asbuilt Shearkey Undercut Depth Contour Plan	A3-9320 AB stg2/06	October 2008
Asbuilt Batter Setback Plans	A3-9320 AB stg2/07-09	October 2008
Asbuilt Underfill and Counterfort Drainage Plan	A3-9320 AB stg2/13	October 2008
Asbuilt Stormwater Plans	A3-9320 AB stg2/14-17	October 2008
Asbuilt Sanitary Sewer Plans	A3-9320 AB stg2/18-21	October 2008
Asbuilt Consent Notice Area Plans	A3-9320 AB stg2/22-24	October 2008
Asbuilt Stormwater Wetland Plan	A3-9320 AB stg2/26	October 2008

This report covers the construction period from September 2007 to October 2008. It is intended to be used for certification purposes for 43 new lots on existing lots 1 and 2 DP211172 as follows:

- 36 residential lots numbered 1 to 26, 29 to 33 and 43 to 47,
- 4 new roads named Riverleigh Drive, Parkdale Close, portions of Hewson Drive and Clifton Lane all numbered as lot 82
- 2 jointly owned access lots numbered 87 and 88
- 2 recreation reserves numbered as lots 89 and 90
- 1 drainage reserve numbered as lot 91 and containing a stormwater pond
- 1 lot containing an existing dwelling numbered as lot 100

Stages 1 and 2 of the subdivision are accessed from both Mahurangi East Road and Muncaster Road. As can be seen on the Asbuilt Cut/Fill Depth Contours Plan and Asbuilt Undercut Depth Contour Plan, a total of 26 of the residential lots have been partly or totally affected by filling, to a maximum depth of approximately 6 metres.

total of 26 of the residential lots have been partly or totally affected by filling, to a maximum depth of approximately 6 metres.

2 RELATED REPORTS

A Geotechnical Investigation Report (GIR) on the subject land was prepared by Foundation Engineering Consultants Limited (FECL), reference 10880, dated 27 July 2004. An additional report was prepared by FECL, reference 10880, dated 24 January 2007, outlining earthworks construction recommendations for the shear key and stormwater pond. The conclusions and recommendations of those reports have been reviewed during the preparation of this document.

3 EARTHWORKS OPERATIONS

3.1 Plant

The main items of plant used by the Principal Contractor, Gideon Contractors Limited, the earthworks sub-contractor Hopper Construction Limited and lime stabilisation contractor Hiway Stabilizers Limited were:

6x 13t to 30t Hydraulic Excavators
2x Cat 815 4x4 Compactors
3x Cat Elevating Scrapers
1x Cat CS563E Compactor
3x Moxy MT31 6 Wheel Dump Trucks
1x Cat D6 Bulldozer
1x D155 Komatsu Bulldozer and Scoop
1x CS360 Lime Hoe
1x Lime Spreader
1x Cat Tractor and Discs

3.2 Construction Programme

Earthworks operations for this subdivision commenced in late September 2007 with the formation of silt control measures around all site boundaries. Earthworks were undertaken on all stages of the development concurrently.

Construction of the shear key in the southwestern portion of the site commenced in late September 2007 and progressed from north to south in staged excavations. The first stages of the excavation were to the southwest of Lot 23 and exposed variable strength materials which necessitated deepening of the shear key below the invert level of the adjacent stream. Lime and cement stabilised backfill was utilised for all stages of the shear key and a leading edge pressure relief drain was constructed to relieve any groundwater pressure in this area. A rear face chimney drain was installed along the length of the shear key that connects into the central manhole within the excavation. The majority of the shear key was completed in February 2008.

Muck-out of the lower central gully commenced mid October 2007 and progressed to the east and into the tributary gullies. In the base of these gullies deep underfill drains were installed during late October and early November 2007 that were typically excavated 0.5 metres into Northland Allochthon Bedrock. These drains initially comprised a 160mm Highway grade draincoil covered by 20/40 drainage

aggregate and fully wrapped in a non-woven geotextile filtercloth. Due to construction difficulties associated with trench collapse, the decision was made to switch to an approved TNZ F/2 specification drainage aggregate.

A temporary silt pond located in lots 8 and 100 was excavated in mid to late October 2007. Bulk filling commenced early November 2007 in the vicinity of lots 64, 65 and 71 to 78 (future stages) with material sourced from lots 1 to 9. An additional temporary silt pond was constructed within lot 89 during November 2007 following backfilling of the shear key in this area. Filling commenced in the central gully mid December 2007 and continued through to March 2008. During earthworks undercuts were carried out on all batters where transitional Northland Allochthon soils were likely to daylight or were near finished ground levels.

Service line installation was undertaken from January 2008 to September 2008 with compaction checks carried out to confirm suitability in critical areas.

Preparation for the widening of Mahurangi East Road began mid February 2008 with the works in this area completed by late May 2008.

The formation of the permanent stormwater pond commenced in February 2008 and continued through to April 2008, when the temporary silt pond within lot 89 was mucked out and backfilled. The permanent pond also had a clay-rich, low permeability liner installed during this time with a minimum thickness of 600mm. During March 2008 the road subgrades were lime and cement stabilised and formed to design levels.

The temporary silt pond in lots 8 and 100 was mucked-out and backfilled early April 2008.

Upon completion of earthworks in lot 89, unsuitable materials and topsoil were placed and compacted across the majority of this lot to a maximum depth of approximately 2 metres. Progressive re-spreading of topsoil was carried out upon completion of works in each area.

4 QUALITY ASSURANCE AND CONTROLS

4.1 Inspections

During earthworks construction, observations were undertaken on a near daily basis to assess compliance with NZS 4431:1989 and specific recommendations and specifications included in the subdivision geotechnical reports. Specific construction observations were required on these stages of the development for:

- gully areas prior to the placement of fill materials to ascertain that all mullock and soft inorganic subsoils had been removed to our satisfaction,
- shear key excavations and other undercuts to confirm ground conditions and design specifications,
- subsoil drain excavations to confirm depths, ground conditions, draincoil placement, backfilling and connections to outlets,
- silt traps/ ponds prior to backfilling to ensure that all silt had been removed and that the sides of the excavation were benched where necessary,

4.2 Quality Control Criteria

4.2.1 General

Two representative soil samples were recovered from the main borrow area prior to the commencement of earthworks. When tested in the IANZ (International Accreditation New Zealand) endorsed laboratory these samples produced standard compaction control data as appended.

The results of these tests were used to develop the fill testing specification. The compaction control criteria of minimum allowable shear strength and maximum allowable air voids were mainly used for quality assurance purposes.

Specification details were as follows:

TABLE 2: COMPACTION CONTROL CRITERIA

	Minimum Shear Strength and Maximum Air Voids Method	
(a)	Air Voids Percentage	
	(As defined in NZS 4402)	
	General Fill	
	Average value less than	10%
	Maximum single value	12%
	Pond Liner Fill	
	Maximum single value	6%
(b)	Undrained Shear Strength	
	(Measured by Pilcon shear vane - calibrated using NZGS 2001 method)	
	General fill	
	Average value not less than	140 kPa
	Minimum single value	110 kPa
	Pond Liner Fill	
	Maximum single value	100 kPa
	Minimum single value	70 kPa

4.2.2 Pond Liner Permeability

The clayey soils utilised for the pond liner construction were sourced from within the main cut area. A reduced minimum and limited maximum shear strength along with a reduced maximum air voids percentage were also used as described above, to maintain the fill in optimum condition for use as a pond liner.

4.3 Quality Assurance Testing

Regular insitu density, strength and water content tests were carried out on all areas of the filling at or in excess of the frequency recommended by NZS 4431 for compaction control.

Control tests carried out on the filling showed that on some occasions the required compaction standards were not being achieved. Results of the test failures were relayed to the site foreman and/or his staff, and to the best of our knowledge the affected areas of fill were re-worked as necessary. In each case, further testing was carried out until compliance with the standards was achieved.

5 PROJECT EVALUATION

5.1 Bearing Capacity and Settlement of Building Foundations

Following the completion of earthworks operations, we returned to the site and drilled a series of hand auger boreholes at appropriate natural ground locations in order to determine representative finished ground conditions and hence evaluate likely foundation options for future building development. Our resulting bearing capacity recommendations are presented in the Suitability Statement Summary (Table 3).

At current subgrade levels all areas of filling and the majority of the lots underlain by undisturbed natural ground have a geotechnical ultimate bearing capacity of 300 kPa within the influence of conventional shallow residential building foundation loads. However, due to the presence of firm natural subsoils on some lots, reduced geotechnical ultimate bearing capacities of 210 kPa and 240 kPa have been recommended.

At these bearing pressures differential settlements due to building loads should be within code limits.

Restrictions on cut and fill depths are presented in the Suitability Statement (Section 6).

It should be noted that NZS 3604 only allows a maximum backfill depth of 600mm over the building platform unless an Engineering design solution is proposed, on account of the risk of induced consolidation of the subsoils caused by the weight of the backfill.

5.2 Expansive Soils

Two sets of expansive soil tests were carried out on samples selected from the site within the zone of likely influence of shallow building foundations.

These shrink-swell tests were carried out in accordance with AS 1289, "Methods of Testing Soils for Engineering Purposes" test method 7.1.1 and were primarily intended to assess the Expansive Classes of the site materials as defined in AS 2870, "Residential Slabs and Footings – Construction". Test results are IANZ (International Accreditation New Zealand) endorsed and full details are appended.

On the basis of our results and visual-tactile assessment of the on-site subsoils, the AS 2870 Site Class for this subdivision is assessed to be M (moderate). Specific design alternatives for this Site Class are presented in the Suitability Statement.

5.3 Lot Gradients

Stability conditions at this site have been enhanced by cut to fill operations, construction of a shear key with associated land drainage along the lower site boundary, plus the installation of underfill drainage as described in section 3.2.

The appended Asbuilt Batter Setback Plans show specific design zones due to land gradients, including areas steeper than 1 in 4 or being immediately adjacent to land having such gradients. The extent of

extent of these areas has been determined by finished site contours and our final walkover inspection, but there may be localised areas having such gradients that have not been shown on the plans.

Details of resulting building and earthworks restrictions within the vicinity of these areas are presented in the Suitability Statement (Section 6).

The stability of critical areas, including the steep batters, have been assessed for potential planar and circular failure under worst case scenario groundwater conditions. The soil parameters selected were based on experience and testing within these materials using assumed realistic conditions and satisfactory factors of safety normally acceptable to Council were produced. We are therefore satisfied that these areas are not subject to the hazards described in section 71(3) of the Building Act.

5.4 Fill Induced Settlement

As a result of our pre-fill inspections, the installation of underfill drainage, quality control testing and the elapsed time since the placement of the majority of the filling, we are of the opinion that induced differential settlements beneath or within the certified filling due to its imposed weight should be insignificant with respect to conventional NZS 3604 residential building development.

5.5 Vegetation Cover

Wherever practical on the batters beyond building platform areas any existing vegetation cover should be maintained and even supplemented with new plantings. The contribution of appropriate vegetation cover to erosion control should not be underestimated.

5.6 Stormwater Controls

It is important on all lots that due care is paid to the design and construction of appropriate stormwater disposal systems. These systems should serve to collect all runoff from roofs, decks and paved areas, together with discharges from retaining wall drains and other subsoil drains and should connect directly into the public stormwater drainage network.

Uncontrolled stormwater discharges onto the ground surface or into soakage pits can cause erosion, scour and/or instability on sloping land and should not be permitted under any circumstances where stability could be compromised.

5.7 Service Trenches

As is normal on all subdivisions, building developments involving foundations within a 45 degree zone of influence from pipe inverts will require Engineering input. The appended Asbuilt Consent Notice Area Plans should be referred to for consent notice areas relating to these services.

5.8 Underfill Drains

The appended Asbuilt Underfill and Counterfort Drainage Plan shows the positions of both deep and shallow underfill drains.

Deep underfill drains were placed in mucked out gully inverts prior to filling to tap groundwater seepages and also in cut benches formed prior to filling, particularly when land gradients were greater than 1 in 4, as required by NZS 4431.

A shallow underfill drain was placed in the batter undercut within lots 24 to 26 and connects into the stormwater manhole within lot 22.

These drains were intended to intercept localised groundwater seepages and springs during earthworks and to help provide general control over groundwater levels. They were installed as a precautionary measure and they need no specific maintenance.

Due to the depth of the deep underfill drains below finished ground levels we consider that the consequences of damage to the drains from any future site excavation or piling operations (albeit extremely unlikely) would be insignificant. Accordingly, no future building restrictions will be required on their account. However, details of resulting building restrictions for the shallow underfill drain within lots 24 to 26 are presented in the Suitability Statement.

In addition, to the best of our knowledge, a 110mm perforated draincoil was installed in the bedding of all stormwater lines with gradients in excess of 1 in 6 as recommended in the subdivision Geotechnical Investigation Report.

5.9 Road Subgrades

All road subgrades were lime and cement stabilised to achieve appropriate standards and to allow a reduction in sub-base metal depths.

This consultancy was not involved in strength testing of the road and accessway subgrades for pavement design.

5.10 Stormwater Detention Pond

A stormwater detention pond has been constructed within Lot 91 in the southwestern corner of the site. Due to the location of the shear key and associated land drainage directly below the pond, it was necessary to provide a low permeability liner comprising 600mm thick clay-rich compacted filling. A specific compaction specification was developed following confirmation of the material suitability.

Pond design incorporated stability analyses and required seepage collars on inlet and outlet pipes. In addition, careful compaction and backfilling around all pipes and in the pipe trenches was required to reduce the possibility of future piping erosion.

Specific pond details including aspects pertaining to the operation and maintenance of the pond are contained in the Ian Hutchinson Consultants Limited Stormwater Wetland Operation and Maintenance Manual, ref. number LB9320, dated October 2008 and a copy of their Asbuilt Stormwater Wetland Plan is appended.

5.11 Topsoil

Topsoil depths in likely building platform areas were checked by the drilling of a borehole in the approximate centre of each lot. Our findings, which are indicative only and subject to variation at other locations, show that likely topsoil depths are between 50 mm and 400 mm.

Site specific findings are presented in the Suitability Statement Summary (Table 3).

5.12 Contractor's Work

We have relied on the Contractor's work practices and assume that the works have been carried out in accordance with:

(i) The approved Contract drawings and design details,

(ii) The approved Contract specifications,

(iii) Authorised Variations to (i) and (ii) during the execution of the works,

(iv) The conditions of Resource, Earthworks and Building Consents where applicable,

(v) The relevant FECL and Coffey Geotechnics reports, recommendations and site instructions,

and that all as-built information and other details provided to the Client, Ian Hutchinson Consultants and Coffey Geotechnics are accurate and correct in all respects.

6 STATEMENT OF PROFESSIONAL OPINION AS TO THE SUITABILITY OF LAND FOR BUILDING DEVELOPMENT

I, R.W. Melville-Smith, of Coffey Geotechnics (NZ) Limited, Auckland, hereby confirm that:

1. I am a Chartered Professional Engineer experienced in the field of geotechnical engineering as defined in section 1.2.3 of NZS 4404 and was retained by the Owner/Developer as the Geotechnical Engineer on stages 1 and 2 of the Mahurangi Ridge subdivision, Mahurangi East Road, Snells Beach.

2. The extent of preliminary investigations carried out to date are described in the Foundation Engineering Consultants Limited (FECL) Geotechnical Investigation Report reference 10880, dated 22 July 2004, and the report also prepared by FECL, reference 10880, dated 24 January 2007, outlining earthworks construction recommendations. The conclusions and recommendations of these documents have been re-evaluated in the preparation of this report. The results of all tests carried out are appended.

3. In my professional opinion, not to be construed as a guarantee, I consider that:

   (a) The earth fills shown on the appended Asbuilt Cut/Fill Depth Contours Plan have been placed in compliance with NZS 4431, Rodney District Council's Standards for Engineering Design and Construction, the provisions of the RDC District Plan, and related documents.

   (b) The completed earthworks give due regard to land slope and foundation stability considerations within the residential lots, but as shown on the appended Asbuilt Batter Setback Plans, Specific Design Zones shown shaded on lots 1 to 22, 24 to 26, 32, 33, 46 and 47 have gradients steeper than 1V in 4H or are adjacent to land having such gradients.

   No earthworks which increase the slope angle or surcharge loading of these zones involving cuts or fills (including subfloor hardfill) in excess of 600mm height should take place in these areas or elsewhere if similar gradients exist unless endorsed by a Chartered Professional Engineer experienced in geomechanics, as such operations may, in certain circumstances, have detrimental effects on overall site stability. Any

cuts into existing batters should be supported by engineer designed retaining walls with designs incorporating site specific slope stability analyses.

For building construction in accordance with the provisions of NZS 3604 within the shaded Specific Design Zones where a batter slope steeper than 1V in 4H is located below the proposed building, the leading (downslope) edge foundations will need to be piled to a typical minimum depth of approximately 2 metres. The Suitability Statement Summary (Table 3) should be referred to for lot specific piling depth recommendations. It is anticipated that a geotechnical ultimate bearing capacity of 300 kPa will be available for the specific design of piles in end bearing.

(c) The function of the underfill drains should not be impaired by any building development or landscaping works. In particular, any bored or driven piles must be positioned to avoid damaging these underfill drains.

All underfill drains have been installed in accordance with good engineering practice and should require no specific maintenance.

No building development should take place within the 45 degree zone of influence of the shallow underfill drain on lots 24 to 26 unless endorsed by a Chartered Professional Engineer experienced in geomechanics to ensure that lateral stability issues are addressed and that building loads are transferred below the drain invert and beyond the extent of the trench backfill.

(d) A geotechnical ultimate bearing capacity of 300 kPa may be assumed for shallow foundation design on lots 1 to 4, 6, 8 to 21, 23 to 26, 29 to 31, 33 and 43 to 47 inclusive.

Due to the presence of firm natural subsoils within the likely zone of influence of future shallow foundations on lots 5, 7 and 22, the geotechnical ultimate bearing pressure here should be limited to 240 kPa.

Due to the presence of soft natural subsoils within the likely zone of influence of future shallow foundations on lot 32, the geotechnical ultimate bearing pressure here should be limited to 210 kPa

On all other lots, any proposed building platform excavations in excess of 1 metre should be similarly checked.

(e) As recommended in the FECL Geotechnical Investigation Report, the backfilling and compaction of the stormwater and sanitary sewer trenches where the final gradient is greater than 1 in 6, has to the best of our knowledge been carried out to the highest attainable standards.

Nevertheless, no building development should take place within the 45 degree zone of influence of drain inverts unless endorsed by specific site investigations, foundation designs and by construction inspections undertaken by a Chartered Professional Engineer experienced in geomechanics to ensure that lateral stability and differential settlement issues are addressed and that building loads are transferred beyond the influence of the pipe and beyond the extent of the trench backfill.

(f) The assessed AS 2870 expansive site Class for all lots is M (moderate).

(g) Apart from Balance Lot 100 and subject to the geotechnical limitations, restrictions, recommendations and expansive soil assessments associated with 3(b), 3(c), 3(d), 3(e) and 3(f) above:

(i) The filled and undisturbed original ground within residential lot boundaries is generally suitable for residential buildings constructed in accordance with NZS 3604 and related documents.

(ii) On all lots foundation design may be carried out in accordance with AS 2870 (Class M) or in accordance with NZS 3604 provided that in this latter case the minimum foundation depth below cleared ground level following topsoil removal and benching of building platform areas is 600mm.

4. Balance Lot 100 contains an existing dwelling and this lot has not been subject to any earthworks operations or geotechnical assessments. Accordingly, no earthworks or building development should take place anywhere on this lot unless endorsed by site specific investigation and design by a Chartered Professional Engineer experienced in geomechanics.

5. Road subgrades have been formed having due regard for slope stability and settlement.

6. Geotechnical aspects of slope stability and pond permeability within utility reserve lot 91 have been appropriately addressed and in these respects the pond is suitable for its intended use, although restrictions apply to land having gradients steeper than 1 in 4 as for the residential lots described above.

7. Reserve Lot 89 contains up to approximately 2 metres of unsuitables and topsoil.

The professional opinion contained within this report is furnished to the Rodney District Council and Cabra Developments Limited for their purposes alone on the express condition that it will not be relied upon by any other person. Prospective purchasers should still satisfy themselves as to any specific conditions pertaining to their particular land interest.

It does not remove the necessity for the normal inspection of site conditions and the design of foundations as would be made under all normal circumstances.

The Suitability Statement Summary (Table 3) summarises the status of each residential lot covered by this Suitability Statement.

For and on behalf of Coffey Geotechnics (NZ) Limited

Report prepared by:

Chris Thompson

Engineering Geologist

Report reviewed by:

Richard Knowles
pp **Rod Melville-Smith**

Principal Geotechnical Engineer FIPENZ CPEng

TABLE 3: SUITABILITY STATEMENT SUMMARY (refer to Project Evaluation and Suitability Statement for details)

Lot No.	Comments	Topsoil Depth (mm)	Ultimate Bearing (kPa)	AS2870 :1996 Class
1	Specific site investigation, foundation design and construction inspections required in areas shown hatched on batter setback plans due to 1 in 4 gradient restrictions and on consent notice plans due to proximity to service lines. Typical depth of leading edge piling if required approximately 1 metre. Elsewhere, AS 2870 foundation design or NZS 3604 with minimum footing depth 600mm.	200	300	M
2	Specific site investigation, foundation design and construction inspections required in areas shown hatched on batter setback plans due to 1 in 4 gradient restrictions and on consent notice plans due to proximity to service lines. Elsewhere, AS 2870 foundation design or NZS 3604 with minimum footing depth 600mm.	200	300	M
3	Specific site investigation, foundation design and construction inspections required in areas shown hatched on batter setback plans due to 1 in 4 gradient restrictions and on consent notice plans due to proximity to service lines. Typical depth of leading edge piling if required approximately 1 metre. Elsewhere, AS 2870 foundation design or NZS 3604 with minimum footing depth 600mm.	200	300	M
4	Specific site investigation, foundation design and construction inspections required in areas shown hatched on batter setback plans due to 1 in 4 gradient restrictions and on consent notice plans due to proximity to service lines. Typical depth of leading edge piling if required approximately 1 metre. Elsewhere, AS 2870 foundation design or NZS 3604 with minimum footing depth 600mm.	100	300	M
5	Specific site investigation, foundation design and construction inspections required in areas shown hatched on batter setback plans due to 1 in 4 gradient restrictions. Typical depth of leading edge piling if required approximately 1.5 metres. Elsewhere, AS 2870 foundation design or NZS 3604 with minimum footing depth 600mm.	200	240	M
6	Specific site investigation, foundation design and construction inspections required in areas shown hatched on batter setback plans due to 1 in 4 gradient restrictions. Typical depth of leading edge piling if required approximately 1.5 metres. Elsewhere, AS 2870 foundation design or NZS 3604 with minimum footing depth 600mm.	100	300	M

Lot No.	Comments	Topsoil Depth (mm)	Ultimate Bearing (kPa)	AS2870 :1996 Class
7	Specific site investigation, foundation design and construction inspections required in areas shown hatched on batter setback plans due to 1 in 4 gradient restrictions and on consent notice plans due to proximity to service lines. Typical depth of leading edge piling if required approximately 1 metre. Elsewhere, AS 2870 foundation design or NZS 3604 with minimum footing depth 600mm.	200	240	M
8	Specific site investigation, foundation design and construction inspections required in areas shown hatched on batter setback plans due to 1 in 4 gradient restrictions and on consent notice plans due to proximity to service lines. Typical depth of leading edge piling if required approximately 1 metre. Elsewhere, AS 2870 foundation design or NZS 3604 with minimum footing depth 600mm.	200	300	M
9	Specific site investigation, foundation design and construction inspections required in areas shown hatched on batter setback plans due to 1 in 4 gradient restrictions. Typical depth of leading edge piling if required approximately 1 metre. Elsewhere, AS 2870 foundation design or NZS 3604 with minimum footing depth 600mm.	200	300	M
10	Specific site investigation, foundation design and construction inspections required in areas shown hatched on batter setback plans due to 1 in 4 gradient restrictions. Typical depth of leading edge piling if required approximately 1.5 metres. Elsewhere, AS 2870 foundation design or NZS 3604 with minimum footing depth 600mm.	100	300	M
11	Specific site investigation, foundation design and construction inspections required in areas shown hatched on batter setback plans due to 1 in 4 gradient restrictions. Typical depth of leading edge piling if required approximately 1.5 metres. Elsewhere, AS 2870 foundation design or NZS 3604 with minimum footing depth 600mm.	200	300	M
12	Specific site investigation, foundation design and construction inspections required in areas shown hatched on batter setback plans due to 1 in 4 gradient restrictions and on consent notice plans due to proximity to service lines. Typical depth of leading edge piling if required approximately 1 metre. Elsewhere, AS 2870 foundation design or NZS 3604 with minimum footing depth 600mm.	200	300	M
13	Specific site investigation, foundation design and construction inspections required in areas shown hatched on batter setback plans due to 1 in 4 gradient restrictions and on consent notice plans due to proximity to service lines. Typical depth of leading edge piling if required approximately 1.5 metres. Elsewhere, AS 2870 foundation design or NZS 3604 with minimum footing depth 600mm.	200	300	M

Lot No.	Comments	Topsoil Depth (mm)	Ultimate Bearing (kPa)	AS2870 :1996 Class
14	Specific site investigation, foundation design and construction inspections required in areas shown hatched on batter setback plans due to 1 in 4 gradient restrictions and on consent notice plans due to proximity to service lines. Typical depth of leading edge piling if required approximately 2 metres. Elsewhere, AS 2870 foundation design or NZS 3604 with minimum footing depth 600mm.	250	300	M
15	Specific site investigation, foundation design and construction inspections required in areas shown hatched on batter setback plans due to 1 in 4 gradient restrictions and on consent notice plans due to proximity to service lines. Typical depth of leading edge piling if required approximately 2.5 metres. Elsewhere, AS 2870 foundation design or NZS 3604 with minimum footing depth 600mm.	100	300	M
16	Specific site investigation, foundation design and construction inspections required in areas shown hatched on batter setback plans due to 1 in 4 gradient restrictions and on consent notice plans due to proximity to service lines. Typical depth of leading edge piling if required approximately 2 metres. Elsewhere, AS 2870 foundation design or NZS 3604 with minimum footing depth 600mm.	100	300	M
17	Specific site investigation, foundation design and construction inspections required in areas shown hatched on batter setback plans due to 1 in 4 gradient restrictions and on consent notice plans due to proximity to service lines. Typical depth of leading edge piling if required approximately 1.5 metres. Elsewhere, AS 2870 foundation design or NZS 3604 with minimum footing depth 600mm.	100	300	M
18	Specific site investigation, foundation design and construction inspections required in areas shown hatched on batter setback plans due to 1 in 4 gradient restrictions. Typical depth of leading edge piling if required approximately 1.5 metres. Elsewhere, AS 2870 foundation design or NZS 3604 with minimum footing depth 600mm.	100	300	M
19	Specific site investigation, foundation design and construction inspections required in areas shown hatched on batter setback plans due to 1 in 4 gradient restrictions and on consent notice plans due to proximity to service lines. Elsewhere, AS 2870 foundation design or NZS 3604 with minimum footing depth 600mm.	200	300	M
20	Specific site investigation, foundation design and construction inspections required in areas shown hatched on batter setback plans due to 1 in 4 gradient restrictions. Typical depth of leading edge piling if required approximately 1 metre. Elsewhere, AS 2870 foundation design or NZS 3604 with minimum footing depth 600mm.	200	300	M

Lot No.	Comments	Topsoil Depth (mm)	Ultimate Bearing (kPa)	AS2870 :1996 Class
21	Specific site investigation, foundation design and construction inspections required in areas shown hatched on batter setback plans due to 1 in 4 gradient restrictions and on consent notice plans due to proximity to service lines. Typical depth of leading edge piling if required approximately 1 metre. Elsewhere, AS 2870 foundation design or NZS 3604 with minimum footing depth 600mm.	100	300	M
22	Specific site investigation, foundation design and construction inspections required in areas shown hatched on batter setback plans due to 1 in 4 gradient restrictions and on consent notice plans due to proximity to service lines. Elsewhere, AS 2870 foundation design or NZS 3604 with minimum footing depth 600mm.	200	240	M
23	Specific site investigation, foundation design and construction inspections required in areas shown hatched on consent notice plans due to proximity to service lines. Elsewhere, AS 2870 foundation design or NZS 3604 with minimum footing depth 600mm.	300	300	M
24	Specific site investigation, foundation design and construction inspections required in areas shown hatched on batter setback plans due to 1 in 4 gradient restrictions and on consent notice plans due to proximity to service lines and underfill drainage. Elsewhere, AS 2870 foundation design or NZS 3604 with minimum footing depth 600mm.	300	300	M
25	Specific site investigation, foundation design and construction inspections required in areas shown hatched on batter setback plans due to 1 in 4 gradient restrictions and proximity to underfill drainage. Elsewhere, AS 2870 foundation design or NZS 3604 with minimum footing depth 600mm.	200	300	M
26	Specific site investigation, foundation design and construction inspections required in areas shown hatched on batter setback plans due to 1 in 4 gradient restrictions and proximity to underfill drainage. Elsewhere, AS 2870 foundation design or NZS 3604 with minimum footing depth 600mm.	300	300	M
29	Specific site investigation, foundation design and construction inspections required in areas shown hatched on consent notice plans due to proximity to service lines. Elsewhere, AS 2870 foundation design or NZS 3604 with minimum footing depth 600mm.	200	300	M
30	Specific site investigation, foundation design and construction inspections required in areas shown hatched on consent notice plans due to proximity to service lines. Elsewhere, AS 2870 foundation design or NZS 3604 with minimum footing depth 600mm.	300	300	M

Lot No.	Comments	Topsoil Depth (mm)	Ultimate Bearing (kPa)	AS2870 :1996 Class
31	Specific site investigation, foundation design and construction inspections required in areas shown hatched on consent notice plans due to proximity to service lines. Elsewhere, AS 2870 foundation design or NZS 3604 with minimum footing depth 600mm.	300	300	M
32	Specific site investigation, foundation design and construction inspections required in areas shown hatched on consent notice plans due to proximity to service lines. Elsewhere, AS 2870 foundation design or NZS 3604 with minimum footing depth 600mm.	300	210	M
33	Specific site investigation, foundation design and construction inspections required in areas shown hatched on batter setback plans due to 1 in 4 gradient restrictions and on consent notice plans due to proximity to service lines. Elsewhere, AS 2870 foundation design or NZS 3604 with minimum footing depth 600mm.	200	300	M
43	Specific site investigation, foundation design and construction inspections required in areas shown hatched on consent notice plans due to proximity to service lines. Elsewhere, AS 2870 foundation design or NZS 3604 with minimum footing depth 600mm.	200	300	M
44	Specific site investigation, foundation design and construction inspections required in areas shown hatched on consent notice plans due to proximity to service lines. Elsewhere, AS 2870 foundation design or NZS 3604 with minimum footing depth 600mm.	300	300	M
45	Specific site investigation, foundation design and construction inspections required in areas shown hatched on consent notice plans due to proximity to service lines. Elsewhere, AS 2870 foundation design or NZS 3604 with minimum footing depth 600mm.	200	300	M
46	Specific site investigation, foundation design and construction inspections required in areas shown hatched on batter setback plans due to 1 in 4 gradient restrictions and on consent notice plans due to proximity to service lines. Elsewhere, AS 2870 foundation design or NZS 3604 with minimum footing depth 600mm.	100	300	M
47	Specific site investigation, foundation design and construction inspections required in areas shown hatched on batter setback plans due to 1 in 4 gradient restrictions and on consent notice plans due to proximity to service lines. Typical depth of leading edge piling if required approximately 2 metres. Elsewhere, AS 2870 foundation design or NZS 3604 with minimum footing depth 600mm.	100	300	M
100	Existing house present on site. Specific site investigation, foundation design and construction inspections required for development anywhere on this site.	N/A	N/A	M