Geotechnical Investigation
Pak'nSave Westwood, Blenheim
Foodstuffs (SI) Ltd

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Contents

1. Introduction

Foodstuffs (NZ) Ltd is proposing to develop an area of vacant land on the west side of Blenheim into a Pak'nSave Supermarket (see Figure 1). The proposed development will consist of a new building with an approximate area of 3,000m^2 with a large carpark area.

The development will be within the larger Westwood Subdivision and as part of the subdivision development site earthworks will be carried out to meet the minimum building levels. We understand that at this stage the assumed finished floor level for the proposed building will be in the order of RL21.6m to 21.8m. Based on the existing ground levels, the building floor level will be close to existing ground level at the northern end of the site and be up to 0.3m above existing ground level at the southern end of the site.

Foodstuffs (SI) Ltd has commissioned Aurecon to provide engineering services for the new development, part of which is to carry out the geotechnical investigation and to provide advice on foundation options and geotechnical design parameters.

The agreed scope of works was:

- A detailed desk study of the available geological and geotechnical information for this site.
- A site walkover and reconnaissance of the direct surroundings to determine any site specific hazards from a geotechnical perspective.
- Organising and supervising test pit excavations to determine the subsoil geology (the number of test pits being dependent upon the consistency of the ground encountered.
- Undertake Scala Penetrometer testing to provide near surface soil strength information.
- Organise two geotechnical boreholes with standard penetration test (SPT) to provide information on the soils at depth.
- Determine the subsoil geotechnical parameters.
- Carry out liquefaction analysis of the underlying ground based on the test results.
- Recommendations of suitable foundation system
- Prepare a factual and interpretive geotechnical report detailing the above.

This work excludes the detailed design of any remediation or foundation options.

Our limitations are attached as Section 6 of this report. This report shall be read as a whole.

2. Executive Summary

Foodstuffs (NZ) Ltd is proposing to develop an area of vacant land on the west side of Blenheim into a Pak'nSave Supermarket (see Figure 1). The proposed development will consist of a new building with an approximate area of 3,000m^2 with a large carpark area.

Foodstuffs (SI) Ltd has commissioned Aurecon to provide engineering services for the new development, part of which is to carry out the geotechnical investigation and to provide advice on foundation options and geotechnical design parameters.

The site is located on the north side of Middle Renwick Road, at the western end of Blenheim Township (see Figure 1). The general area comprises of a low lying alluvial plains that are currently used for horticultural purposes.

The field investigations consisted of two geotechnical boreholes, eleven test pits, nine Scala probes, and a site inspection by an engineering geologist. The objectives of the investigation were to determine ground and groundwater conditions in order to assess the founding conditions across the site for the proposed development.

The test log indicate the stratigraphy is relatively consistent across the site and comprised of a layer of topsoil overlying alluvial silts and sands, which in turn overlies alluvial gravels, with minor sand layers.

Groundwater levels were encountered at depths of 1.9m to 3.2m below existing ground level. The boreholes appeared to encounter groundwater at higher levels of 1m to 1.3m below existing ground level. This may indicate that a sub artesian groundwater level is present within the gravels and hence a higher groundwater level was measured.

Based on the ground conditions encountered during our investigation the key geotechnical aspects for safely and economically developing the site are:

- Liquefaction potential;
- Foundation recommendations and design parameters;
- Site flexibility;
- Pavement design parameters.

The liquefaction analysis identified the following:

- The expected liquefaction induced ground settlements for the most part are likely to be within tolerable limits. Settlements were calculated as ranging up to 15mm. Global settlements of this magnitude are considered to be minor in terms of the severity of damage to a building.
- The potential for surface expression (i.e. sand boils) and subsequent induced ground damage was identified to low.
- Given the flat nature of the site and lack of free edges the risk of liquefaction induced lateral spreading at the site is considered to be minimal.

Due to the presence of low bearing capacity soil in the upper soils layers we consider the following foundation options are suitable for the site, given the low susceptibility of the soils to liquefaction:

- Over excavated foundations with a slab on grade.

- Driven piles with a slab on grade.
- Raft foundation.

Detailed recommendations for each of these foundation systems are provided within the report.

We have assessed the subsoil flexibility based on the geotechnical information obtained as part of the investigation and against Clause 3.1.3.2 of NZS 1170.5:2004. We consider that the site subsoil category in terms of NZS 1170.5:2004 Clause 3.1.3.2 is Class D.

For the purpose of designing the pavement on natural soils we recommend a CBR of 2% be adopted. The advised pavement CBR is relatively low. Considering the area of car park and pavement required there may be the opportunity to carry out remediation of the subgrade with a deep impact roller. Such remediation may result in a reduction in the depth of the pavement. If this remediation option is to be on considered, we recommend that a specialist contractor is consulted.

3. Site Description

The site is located on the north side of Middle Renwick Road, at the western end of Blenheim Township (see Figure 1). The general area comprises of a low lying alluvial plains that are currently used for horticultural purposes. The main site features are:

- The area of interest is approximately 150m by 100m, with the proposed building located in the northwest corner of the site.
- The area of the development is relatively flat with less than 1m height change across the site.
- The site is used for horticultural purposes and is currently vacant of any structures.
- No active drainage channels are present within the site however an old alluvial channel runs from the west to the east across the site. This can be seen on site as a slight low point within the topography. It is assumed that this channel acts as a secondary flow path in extreme rainfall events.
- The site is bounded to the north and west by a cherry orchard, to the south by Middle Renwick Road, and to the east by horticultural fields.
- Access to the site is through No.198 Middle Renwick Road, which is the adjacent property to the east. The access through the site is on a farm tracks.

4. Geotechnical Investigation

The field investigations consisted of two geotechnical boreholes, eleven test pits, nine Scala probes, and a site inspection by an engineering geologist. The objectives of the investigation were to determine ground and groundwater conditions in order to assess the founding conditions across the site for the proposed development.

The test pits were carried out on 18 May 2010 using a 10 tonne excavator supplied by March Construction from Blenheim. The test pits were excavated under supervision of an engineering geologist from Aurecon (NZ) Limited. The purpose of the pits was to provide soil samples for visual identification and insitu strength testing. Test pits reached a maximum depth of 4m. Scala probe tests were carried out at the time of the test pitting to determine the ground consistency across the site and provide an indication of the soil strength.

The geotechnical boreholes were carried out on 13 and 15 July 2011 using a drill rig supplied by CW Drilling from Motueka. The boreholes were drilled to a maximum depth of 12m, with SPT's (Standard Penetration Tests) at 1.5m centre. The purpose of the drilling was to confirm the soil profile at depth and provide insitu strength information of the soil.

The field investigation locations are shown on Figure 2 and 3 in Appendix A. Logs from the boreholes, test pits and Scala probes are presented in Appendices A, B and C, respectively. Soil logging was carried out using NZ Geotechnical Society's "Guidelines for the Description of Soil and Rock Material for Engineering Purposes: 2005". An explanatory sheet outlining the terms used on the logs is presented in Appendix B.

5. Geotechnical Assessment

5.1 Regional Geology and Seismicity

The geology of the area is shown on the Geology of the Wellington Area scale 1:250,000 map. The map indicates that the site is underlain by *"well sorted flood plain gravels (Q1a)"*. While approximately 100m to the east the ground conditions consist of *"swamp deposits consisting of poorly consolidated silt, mud, peat and sand (Q1a)".*

A number of active and inactive faults lie near the site, the nearest is the active Wairau Fault, which is located approximately 4km to the north. The Marlborough District Council report *"Identification of Active Fault Traces in Marlborough District"*, 2003 and New Zealand Active Faults Database on the Geological and Nuclear Sciences website indicates that the Wairau Fault has a reoccurrence interval of 600 to 1800 years with the last event approximately 1500 years ago. The Wairau Fault is identified on the GNS database as active.

5.2 General Subsurface Conditions

The test log indicate the stratigraphy is relatively consistent across the site and comprised of a layer of topsoil overlying alluvial silts and sands, which in turn overlies alluvial gravels, with minor sand layers. A summary of the site stratigraphy is present in Table 1.

Table 1: Summary of Site Stratigraphy

Unit	Description	Depth to Top of Unit	Unit Thickness	Relative Density or Consistency	Insitu Test Values
Topsoil	Topsoil: SILT, low plasticity.	0m	0.2m to 0.4m	Firm	
Alluvial Deposit - Unit 1	SILT, yellow brown, low plasticity.	0.2m to 0.4m	0.4m to 1.3m	Silt Firm to Very Stiff	SILT: SV = 40 to 180kPa
Alluvial Deposit – Unit 2	SILT, Sandy SILT, Silty SAND or SAND, yellow brown with orange brown mottling. Silt low plasticity. Sand fine to medium grained.	0.7m to 1.1m	0.7m to 1.8m	Silt: Firm to Hard Sand: Loose to Medium Dense	SILT: SV = 40 to 180kPa SILT: PP = 100 to 225kPa Silt: N = 2
Alluvial Deposit – Unit 3	Silty SAND or SAND, grey. Sand fine to medium grained. Note: Only identified in test pits located on the east side of the site.	0.9m to 2.6m	0.2m to 1.5m	Medium Dense to Dense	N = 16
Alluvial Deposit – Unit 4	Sandy GRAVEL with minor Gravelly SAND layers. Gravel fine to coarse grained, with possibly cobbles, and subrounded to angular. Sand fine to coarse grained	1.4m to 3.1m	6m+ (based on borehole log)	Medium Dense to Very Dense.	N = 29 to 60+

SV = Peak Shear Vane Measurement; PP = Pocket Penetrometer Measurement; N = SPT 'N' Value

Scala probe results indicate that consistently competent ground (i.e. ≥2 blows per 50mm penetration) was typically encountered from depths ranging from 0.8m to 1.6m below existing ground level. Effective refusal (i.e. ≥10 blows per 50mm penetration) were encountered at depths ranging from 1.5m to 2.8m below existing ground level. The Scala probe refusal is due to the very dense nature of the gravels at depth.

5.3 Groundwater Levels

A summary of the groundwater levels is presented in Table 2.

Table 2: Summary of Groundwater Levels

Test Location	Groundwater Level (Below Existing Ground Level)
BH1	1m
BH2	1.3m
TP1	2.6m
TP2	2.6m
TP3	2m
TP4	1.9m
TP5	N/A
TP6	2.1.m
TP7	2.2m
TP8	2.4m
TP9	2.3m
TP10	3.2m
TP11	2.7m

Groundwater levels were encountered in the majority of the test pits. Groundwater levels were typically encountered within the gravels, however Test Pits TP1 and TP2 encountered groundwater levels within the alluvial silts and sands, along more permeable layers. Boreholes BH1 and BH2 appeared to encounter groundwater at higher levels than the test pits. However, we do note that the Blenheim area experienced rainfall during the period the drilling was carried out and therefore the higher groundwater levels could reflect an elevated level within the gravels due to recharge of the underlying gravels. This would indicate that a sub artesian groundwater level is present within the gravels. A groundwater level was not encountered in Test Pit TP5 as it was not taken down to the depth of the underlying gravel layer.

6. Engineering Considerations

Foodstuffs (NZ) Ltd is proposing to develop an area of vacant land on the west side of Blenheim into a Pak'nSave Supermarket (see Figure 1). The proposed development will consist of a new building with an approximate area of 3,000m^2 with a large carpark area.

The development will be within the larger Westwood Subdivision and as part of the subdivision development site earthworks will be carried out to meet the minimum building levels. We understand that at this stage the assumed finished floor level for the proposed building will be in the order of RL21.6m to 21.8m. Based on the existing ground levels, the building floor level will be close to existing ground level at the northern end of the site and be up to 0.3m above existing ground level at the southern end of the site.

We understand that the development will consist of a typical supermarket type building. However, as the building design and finished floor levels have not been finalised we consider that the foundation recommendations provided in this report are preliminary and should be confirmed by the geotechnical engineer once the detailed building design is complete.

Based on the ground conditions encountered during our investigation the key geotechnical aspects for safely and economically developing the site are:

- Seismically induced liquefaction potential;
- Foundation recommendations and design parameters;
- Site flexibility;
- Pavement design parameters.

Each of these is discussed in the following sections.

6.1 Liquefaction Assessment

6.1.1 Introduction

Under cyclic loading during an earthquake cohesionless material (gravels, sands, silty-sands) tend to decrease in volume. This tendance to decrease in volume is much greater in loose than dense soils. When cohesionless soils are saturated and cyclic loading occurs under undrained conditions, the soil densification causes excess pore water pressure to increase. The increase in pore water pressure results in a loss of soil strength due to a decrease in effective stress and eventually liquefaction when the effective stress drops to zero. Liquefaction of loose sands can lead to large displacements of foundations, ground surface settlement, sand boils, and post earthquake stability failures.

For the site development the main factors to be considered are:

- Will liquefaction occur?
- What will be the effect of liquefaction if it occurs?
- What options are available to limit or prevent liquefaction?

Each of these is considered below.

6.1.2 Liquefaction Potential

The three primary factors that contribute to liquefaction potential are:

- Loose, uniformly graded soils.

- High groundwater table.
- Sufficiently high, earthquake induced ground acceleration and sustained shaking.

Each of these is considered below together with conclusions on the site liquefaction potential.

Soil Grading and Density

Liquefiable soils generally have a Coefficient of Uniformity of less than 5 and a low proportion of soil finer than 75 microns in size (typically less than 5% to 10% but up to 30%). Test logs indicate the ground conditions consist of alternating layers of silt, silty sand and sand of variable strength at shallow depths overlying gravels.

Based on the test logs and in situ test results the silts and sands at shallow depths may have a liquefaction potential, particularly if the groundwater level is high.

Groundwater

The depth to groundwater has been measured directly from the test pits and borehole logs. The groundwater levels were measured as being between 1m and 3.2m below ground level. Soils are therefore potentially liquefiable from between 1.3m and 1.8m depth onwards. Based on the depth to the water measured in the boreholes we have used a groundwater level of 1m for Borehole BH1 and 1.3m for Borehole BH2 for our analysis.

Earthquake Intensity

The level of ground shaking is one of the key factors in determining whether liquefaction will or will not occur. Commonly site specific seismicity assessments are carried out for a site to assess probable levels of ground accelerations. For this study, we have used two levels of ground shaking as follows:

1. Ultimate Limit State (ULS) earthquake based on the NZGS Guidelines.
2. Serviceability Limit State (SLS) earthquake based on the NZGS Guidelines.

Each of these cases is discussed in detail below:

Ultimate Limit State (ULS) Earthquake

For the site we have assessed the ULS earthquake return period based on the New Zealand Loadings Standard (NZS1170.0:2004). We have assessed the ULS earthquake return period as follows:

- From Table 3.2 of NZS1170.0:2004 - Importance Level 2;
- From Table 3.3 of NZS1170.0:2004 - Earthquake annual probability of exceedance 1/500 for a 50 year lifetime.

NZS1170 states that the standard is not to be used for liquefaction analyses therefore we have used the Geotechnical Earthquake Engineering Practice, Module 1 – Guideline for the Identification, Assessment and Mitigation of Liquefaction Hazards (NZGS 2010) to derive a peak ground acceleration of 0.37g. In accordance with NZGS we have assumed that the ground shaking will be generated by a Magnitude 7.5 earthquake. Buildings/structures designed for the ULS event are expected to retain their structural integrity and form during an earthquake. Some plastic deformation of structural elements within the structure is expected to occur but ideally the damage can be repaired and the structure can be returned to service after the event, although repair may be uneconomical.

Serviceability Limit State (SLS) Earthquake

For the site we have assessed the SLS earthquake return period based on NZS1170.0:2004 Loading Codes. NZS1170.0:2004 Table 3.3 indicates that for an Importance Level 2 building a SLS level ground shaking is based on a 1 in 25 year event. However, we consider this value to be too low to be

applicable when assessing liquefaction because of its discreet nature of liquefaction (i.e. the site either liquefies or does not and when a site has liquefied there is very little difference in expected deformations for a 'small' earthquake that causes liquefaction relative to a 'large' earthquake that causes liquefaction), and the disproportionate effect seismically induced liquefaction has on a building. We have therefore adopted a more severe (although not unrealistic) earthquake event that has a probabilistic return period of 150 years.

We have adopted the method outlined by the NZ Geotechnical Society for using the New Zealand Loadings Standard to obtain the design earthquake for the liquefaction assessment. A 1 in 150 year return period earthquake for Blenheim has a Peak Ground Acceleration (PGA) of 0.18g. In accordance with NZGS we have adopted a Magnitude 7.5 earthquake event.

Buildings are expected to perform well for the SLS event and be returned to service after only nominal repair.

Summarised below in Table 3 are the earthquakes analysed as part of the liquefaction analysis.

Table 3 - Summary of Earthquakes Analysed

Earthquake	Peak Ground Acceleration (PGA)	Magnitude
ULS Design Earthquake	0.37g	7.5
SLS Design Earthquake	0.18g	7.5

6.1.3 Liquefaction Effects

The ability of the subsoils to resist the effect of ground shaking associated with the two design earthquakes has been assessed using the borehole logs, laboratory results and the *Liquefy Pro 5* computer programme by Civiltech. The method of Stark & Olsen (1995) modified for fines content, was used to calculate the potential for liquefaction and the method of Ishihara and Yoshimine (1992) to estimate liquefaction induced settlements.

The settlements due to liquefaction as calculated in the liquefaction assessment are presented in Table 4 below:

Table 4 – Calculated settlements for the four design earthquake scenarios

Test Number	ULS EQ	SLS EQ
BH1	10mm	0mm
BH2	15mm	0mm
Average	10mm	0mm

Note: The settlements presented in Table 4 above are to the nearest 5mm and have a likely error of ± 50%

6.1.4 Surface Expression

Published information (after Ishihara, 1985) can be used to assess the potential for surface expression of liquefaction and hence the likelihood of ground induced damage. Our assessment is present in Table 5 below.

Table 5 – Potential for liquefaction induced surface expression at the site

Test Number	ULS EQ	SLS EQ
BH1	N	N
BH2	N	N

6.1.5 Lateral Spreading

Flow failures caused by seismically induced liquefaction can occur when the shear stress required for static equilibrium of a soil mass is greater than the shear strength of the soil in its liquefied state (Kramer, 1996).

As the site is relatively flat and there are no drainage channels or streams that would form a free edge, we consider the risk of liquefaction induced lateral spreading at the site to be minimal. As such no further analysis has been undertaken.

6.1.6 Discussion

The liquefaction analysis identified the following:

- The expected liquefaction induced ground settlements for the most part are likely to be within tolerable limits. Settlements were calculated as ranging up to 15mm. Global settlements of this magnitude are considered to be minor in terms of the severity of damage to a building.
- The potential for liquefaction induced ground damage has been assessed as being low.
- Given the flat nature of the site and lack of free edges the risk of liquefaction induced lateral spreading at the site is considered to be minimal.
- Based on the analysis results we consider that the risk of liquefaction affecting the site is low.

6.2 Foundation Assessment

6.2.1 Introduction

Investigation results indicate that once the topsoil is stripped, the site is typically underlain by firm to very stiff silts and loose to medium silty sand and sand, which in turns overlies medium dense to dense gravel.

Based on the test results we consider that the loose silty sand layers in the upper 1.5m of the soil profile will affect the building foundation. Scala probe and SPT test results indicate that this layer is of low strength and hence it would be of limited bearing capacity as well as be susceptible to significant amounts of settlement.

Due to the presence of low bearing capacity soil in the upper soils layers we consider the following foundation options are suitable for the site, given the low susceptibility of the soils to liquefaction:

- Over excavated foundations with a slab on grade.
- Driven piles with a slab on grade.
- Raft foundation.

Both of these are discussed in the following sections.

6.2.2 Over Excavated Foundations

Therefore considering the investigation results, and the proposed building platform requirements, we recommend that footing excavations for both pad and strip foundations should be over excavated to a depth of 1.5m below existing ground level and reinstated with compacted hardfill to the base of the proposed footing level. For the hardfill, the sub-excavation will have to have plan dimensions of B+D where B is the footing width and D is the depth of undercut.

For foundations on a compacted hardfill we recommend that a ultimate bearing capacity of 450kPa is used for isolated pad footings and an ultimate bearing capacity of 300kPa is used for strip footings. If

pad footings are to be larger than 2m in dimension the geotechnical engineer should confirm the available ultimate bearing capacity.

The following capacity reduction factors should be used with the ultimate rupture bearing capacities:

Earthquake capacity overstrength	0.8
Ultimate Limit State with factored loads (1.2G+1.5Q, G+Q+E)	0.5
Serviceability Limit State with unfactored loads (G+Q)	0.33

There will be some settlement beneath the footings under applied load and total settlement in the order of 10mm to 20mm may occur. Differential settlement could be in the range of 10mm to 15mm. The structural engineer should confirm that the angular distortions caused by such differential settlements remain within acceptable limits.

Although this foundation option that has been used in Blenheim area, there are construction issues with opening up large footing excavations, which include dealing with groundwater as well as the large quantity of hardfill that needs to be imported to backfill the foundation excavations.

6.2.3 Driven Pile Foundations

As the gravels are present at relatively shallow depths driven piles, placed to bear on the gravel layer, are considered a suitable foundation option. Test piling will need to be carried out to confirm pile capacity however for preliminary design purposes we recommend that a single pile bearing on the gravels can be proportioned for an ultimate bearing capacity of 6MPa. Reduction capacities provided in Section 6.2.2 should be used with the ultimate bearing capacity.

If driven piles are to be used, we recommend that the borehole logs and design loads are supplied to the contractor and they are asked to verify pile capacity with appropriate tools such as the Hiley formula. We recommend testing with Pile Driving Analyzer (PDA) on at least 5% of the piles. A factor of safety of three should be used on the limit state loads when using the Hiley formula. At least one week should be allowed between driving and PDA testing to allow for excess pore pressures generated during driving to dissipate. As the depth to the gravel layer varies across the site the contractor should allow for test piling to confirm the required pile lengths.

Vibrations caused by driven pile installation is not considered to be an issue as the site is adjacent to rural land and there are no residential buildings in the immediate vicinity. If it becomes apparent that pile driving is an issue then we recommend that the contractor allows for pre-drilling the upper 1.5m of the pile hole. In addition we recommend that the requirements regarding driven pile driving is confirmed with the Marlborough District Council, as pile driving in Blenheim may require council consent.

Settlement of piles founded on the gravels will occur but the magnitude of pile settlement is assessed as being small. Ground stiffness for the assessment of pile settlement, under serviceability limit state loading, is in the order of 15kN/mm to 25kN/mm, depending on the pile size, and can be used to determine the settlement effects and any differential effects. The extent of settlement will depend on the column dead load.

Additional Piling Recommendations

Pile foundation design will need to take into account the following:

- Uplift loads for the majority of the building are anticipated to be low. Driven piles are unlikely to be suitable, as these will refuse within the dense gravels and may not reach the required depth.

- If piles are at less than 4B (B = diameter of pile) centres or piles are connected by a rigid pile cap, then the individual pile capacity is likely to be affected by the adjacent piles. Piles in these

situations will need to be analysed as a pile group. If piles are to be spaced less than 4B, group analysis should be carried out once the pile configuration and loading is finalised.

- At this stage lateral capacity of the piles have not been assessed as these will depend on the location of the piles, structural loading and the underlying ground conditions at that location. However if required lateral capacities can be provided on request, once the structural loads are finalised.

6.2.4 Uplift Loads

Due to the building configuration it is possible the building could be subject to uplift loads due to wind or rocking of seismic bracing elements during an earthquake. Uplift loads could be taken by mass concrete footings, however if these are considered to be uneconomic then ground anchors or tension piles will need to be used to resist the uplift loads. Recommendations regarding anchor/pile options can be provided on request.

6.2.5 Slab on Grade Floor

The proposed building is likely to include a reinforced concrete floor slab, which will include relatively high racking loads. The site is underlain by a layer of topsoil overlying variable strength silts and sands. Therefore, we recommend the following ground preparation to allow construction of the concrete floor slab:

- All topsoil, unsuitable material and uncertified fill is stripped. Based on our ground investigations approximately 0.4m of topsoil will need to be removed, but locally greater depths of this material may be present.

- The trimmed subgrade should be proof rolled in the presence of a geotechnical engineer before any filling of the site commences to identify any soft spots and to decide their treatment and any undercutting.

- We recommend that where undercutting is required or softer subgrade exposed a geotextile should be placed, prior to hardfill placement, to minimise the migration of fines into the hardfill and reduce penetration of hardfill into the subgrade. The geotextile should be at least a Bidim A29 or similar approved.

- The gravel hardfill should consist of a minimum of 200mm of AP65 subbase beneath 100mm of AP40 basecourse. All hardfill shall be subangular with at least one broken face on all particles and screened to be free of debris. The hardfill is to be placed with a minimum loose layer thickness of 200mm and be compacted to 95% of maximum dry density (MDD) at +/- 2% of optimum moisture content (OMC) in accordance with NZS4402: 1986, Test 4.1.3. The basecourse should be placed and compacted to no less than 98% of MDD at +/- 2% of OMC in accordance with NZS4402: 1986, Test 4.1.3. Care should be taken not to overwork the subgrade or to cause weaving.

- Note the final depth of the gravel hardfill will depend on the final building level and depth of topsoil to be stripped out. If the depth of hardfill required is significant then an AP150 or river run with one broken face may be used. This should be confirmed with the geotechnical engineer once the building levels and hardfill depths are confirmed.

- All old service trenches or over excavations (undercuts) shall be excavated out and backfilled with AP65 compacted to the standards above.

- The soil excavated from the footing excavations will be predominantly silts. We recommend the excavated soil is not used for hardfilling as it is moisture sensitive and hence difficult to work and adversely affected by rainfall and stormwater. However, it may be used for bulk fill under landscape areas where fill stability, strength and settlement are of lesser importance.

The proposed hardfill shall be compacted to provide a uniform layer of consistent strength and stiffness. A slab on grade floor can be designed for a modulus of subgrade reaction of 50kPa/mm or a CBR of 8%.

6.2.6 Raft Slab Foundation

The raft foundation should be constructed on a hardfill base. We recommend the hardfill base should consist of a minimum of 200mm of AP65 overlain by 100mm of AP40. Note the final depth of the gravel hardfill will depend on the final building level and depth of topsoil to be stripped out. However, based on our investigation results there were some areas where soft material will be encountered. We recommend that the proof testing at the slab level be carried out by proof rolling. Where soft layers exist beneath the sub-excavation, the softer material will have to be excavated and replaced with compacted hardfill to the design foundation level.

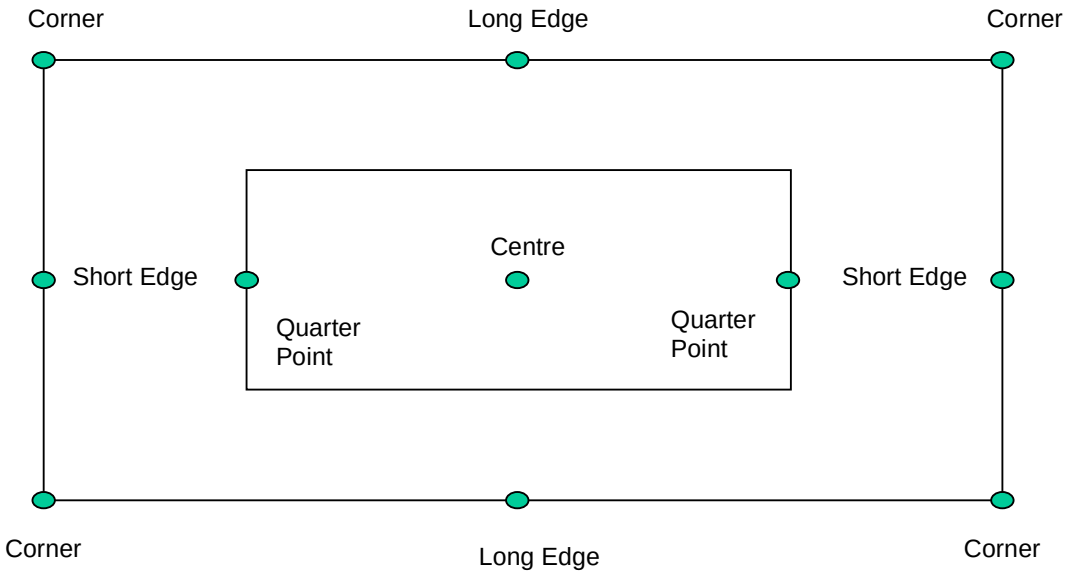
From the plans provided to us we have assessed equivalent elastic modulus of the soil for the entire floor area with approximate dimensions of 50m by 60m. The soil spring stiffness is as follows:

Table 6 – Raft Foundation Stiffness Values

Location on the raft	Spring Stiffness (kPa/mm)
	E_s = 26MPa
Centre	2.1
Quarter points	2.1
Long Edges	4.3
Short Edges	4.3
Corners	9.1

Spring stiffness values can be provided for different raft foundation dimensions on request.

The locations are defined in the following diagram. Linear interpolation should be used between the points.



The values given for spring stiffnesses are estimated mean values but it must be understood that the values could vary across the site. Therefore, we recommend that a sensitivity analysis be performed during raft design, by alternatively halving and doubling individual stiffness values. Furthermore, the

values given are based on correlations with using soil parameters defined from the logged soil profile and are considered to be conservative.

6.2.7 Foundation Construction Recommendations

To ensure that excavated footings are adequately founded we recommend that excavation should be undertaken by digger fitted with a smooth edge bucket. The bases should be tidily trimmed by hand, lightly compacted with a plate compactor and immediately covered with a concrete tidy slab or 100mm of compacted granular hardfill. A geotechnical engineer should be retained to verify that adequate founding has been achieved.

Footings should be proof tested to a depth of at least 2B below founding level where B = minimum footing dimension. This testing can be carried out by Scala probing but as the soil is predominantly cohesive we recommend that shear vanes are included in the proof testing.

If there are significant soft layers beneath a sub-excavation, the softer material will have to be excavated and backfilled with 10MPa concrete or compacted hardfill. For the hardfill, the sub-excavation will have to have plan dimensions of B+2D where B is the footing width and D is the depth of undercut. For 10MPa concrete the sub-excavation can have the same dimensions as the footing.

Depending on the soil encountered, the time of year, and fluctuations of the groundwater level, it is possible that excavations may encounter groundwater. The building contractor is to take appropriate measures to deal with any groundwater ingress to the foundation excavations and keep the excavations and backfill be kept free of groundwater intrusion until the footings are cast. We note that any excavation into the gravel may encounter a sub artesian groundwater level and appropriate measures will need to be in place to deal with the water ingress if encountered.

The footing excavations are likely to expose layers of silty soils, which could be adversely affected by rainfall and stormwater. Such soil will be difficult to work in wet conditions and we highly recommend that foundation excavations are carried out in dry weather conditions, with the reinforcing and concrete placed as soon as practicable. Foundation excavations should not be left open for more than three days. In addition, rainfall and stormwater should not be allowed to pond within the footing excavations.

6.2.8 Liquefaction Foundation Remedial Measures

While there is a limited potential for damage to the site from liquefaction, we recommend the following measures to mitigate possible seismically induced damage:

- Ensure that the floor slab has sufficient capacity to enhance its ability to redistribute loads, if necessary, during extreme seismic events. The structural engineer will need to design a suitably thick floor slab to accommodate the structural requirements as well as the expected loads;

- Tie all pads and foundations together both through the floor slab and ground beams joined to the perimeter edge beam beneath the external wall lines.

Some deformation and articulation of the floor may still occur during a major seismic event but this should be repairable.

6.3 Subsoil Flexibility

We have assessed the subsoil flexibility based on the following:

- Test logs indicate underlying ground conditions consist of firm to very stiff silts with loose to medium dense sands overlying dense gravels (i.e. depth of investigation).
- A review of the limited published geological information indicates the area is underlain by Pleistocene and Quaternary alluvial deposits that are considered to be of a significant depth.

- The table in Clause 3.1.3.2 of NZS 1170.5:2004.

We consider that the site subsoil category in terms of NZS 1170.5:2004 Clause 3.1.3.2 is Class D (Deep Soil Site).

6.4 Base Shear

The base shear of the building will be carried by a combination of friction on the sides of foundations and friction on the underside of the floor slab. The friction on the side of shallow footings will be small and we recommend that it be neglected. Our recommendations for friction on the floor slab are presented below.

Shear Friction Coefficient

Concrete to soil interface	0.5
Concrete to DPC to soil interface	0.25

The full friction capacity will develop within 20mm of movement. These values are ultimate rupture capacities and should be used in conjunction with the reduction factors provided in Section 6.2.2.

6.5 Pavement Design

Once the topsoil and any unsuitable ground is stripped, we recommend for the purpose of designing the pavement on natural soils a CBR of 2% be adopted. The advised pavement CBR is relatively low, which is likely to result in a relatively thick pavement. Considering the area of car park and pavement required for the supermarket there may be the opportunity to carry out remediation of the subgrade with a deep impact roller. Such remediation may result in a reduction in the depth of the pavement. If this remediation option is to be on considered, we recommend that a specialist contractor is consulted. As part of any pavement construction the subgrade should be inspected by an engineer and proof rolled to identify any localised soft areas that will need to be undercut.

7. Limitations

We have prepared this report in accordance with the brief as provided. The contents of the report are for the sole use of the Client and no responsibility or liability will be accepted to any third party. Data or opinions contained within the report may not be used in other contexts or for any other purposes without our prior review and agreement.

The recommendations in this report are based on data collected at specific locations and by using suitable investigation techniques. Only a finite amount of information has been collected to meet the specific financial and technical requirements of the Client's brief and this report does not purport to completely describe all the site characteristics and properties. The nature and continuity of the ground between test locations has been inferred using experience and judgement and it must be appreciated that actual conditions could vary from the assumed model.

Subsurface conditions relevant to construction works should be assessed by contractors who can make their own interpretation of the factual data provided. They should perform any additional tests as necessary for their own purposes.

Subsurface conditions, such as groundwater levels, can change over time. This should be borne in mind, particularly if the report is used after a protracted delay.

8. References

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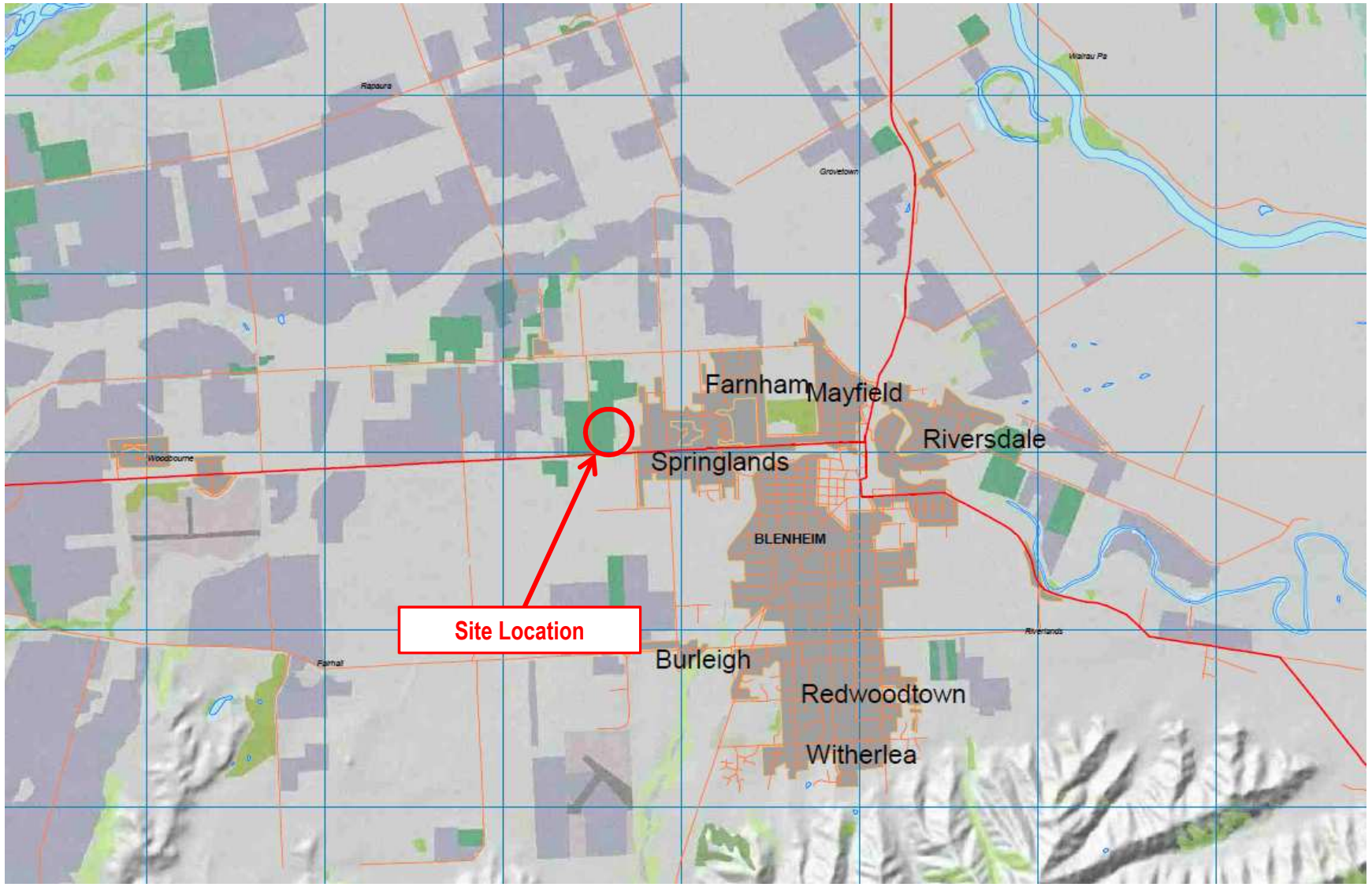
Appendix A
Figures

BC120191



Source: QuickMap (2011)

Note: Not to scale; boundaries and locations are approximate only

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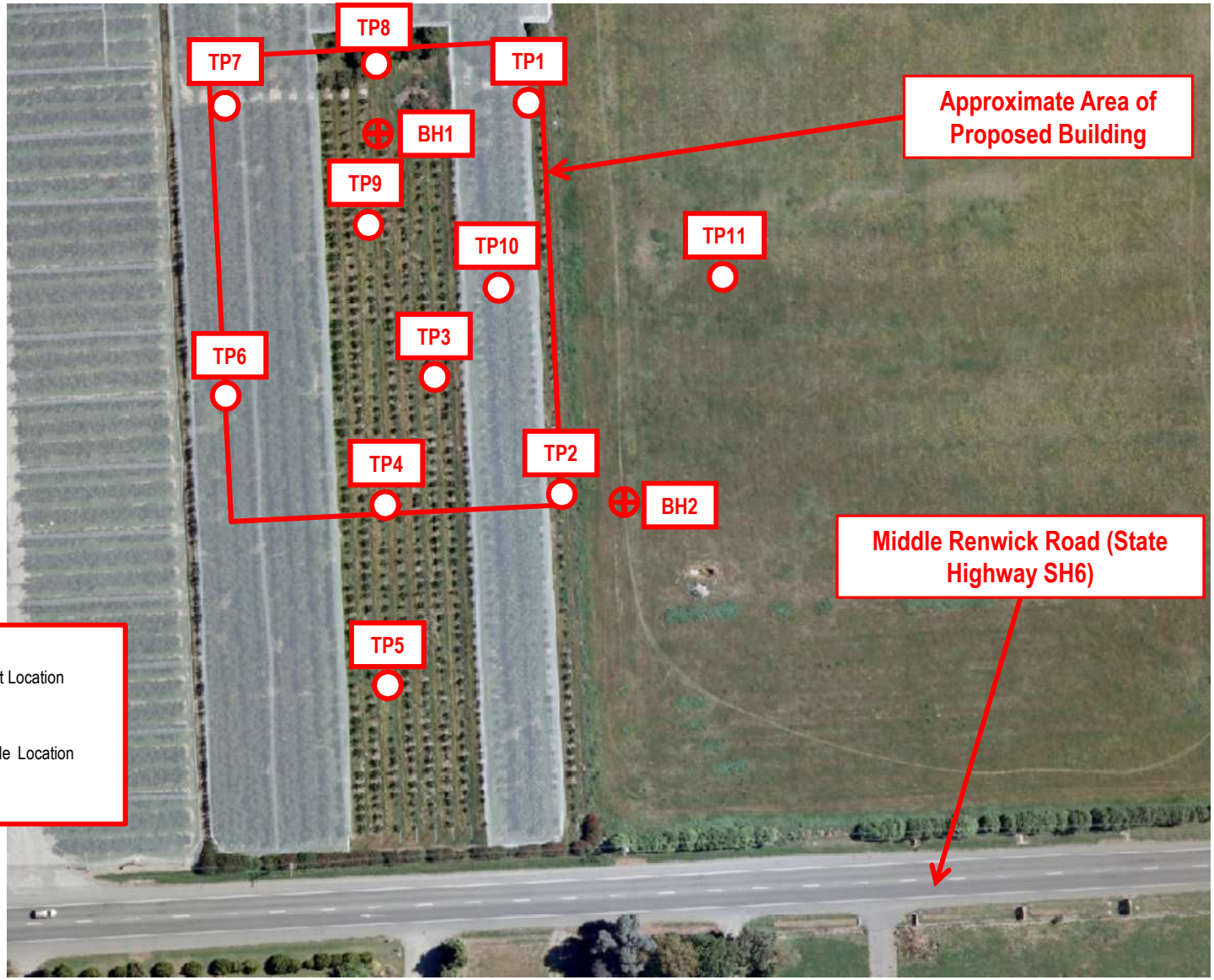
Client	Foodstuffs (SI) Ltd
Project	Pak'nSave Blenheim
By	JSM
Date	26 May 2011
Job Number	221198
Figure 1	Site Location
Paper Size	A4
Revision	0

BC120191



Source: MDC GIS (2011)

Note: Not to scale; boundaries and locations are approximate only

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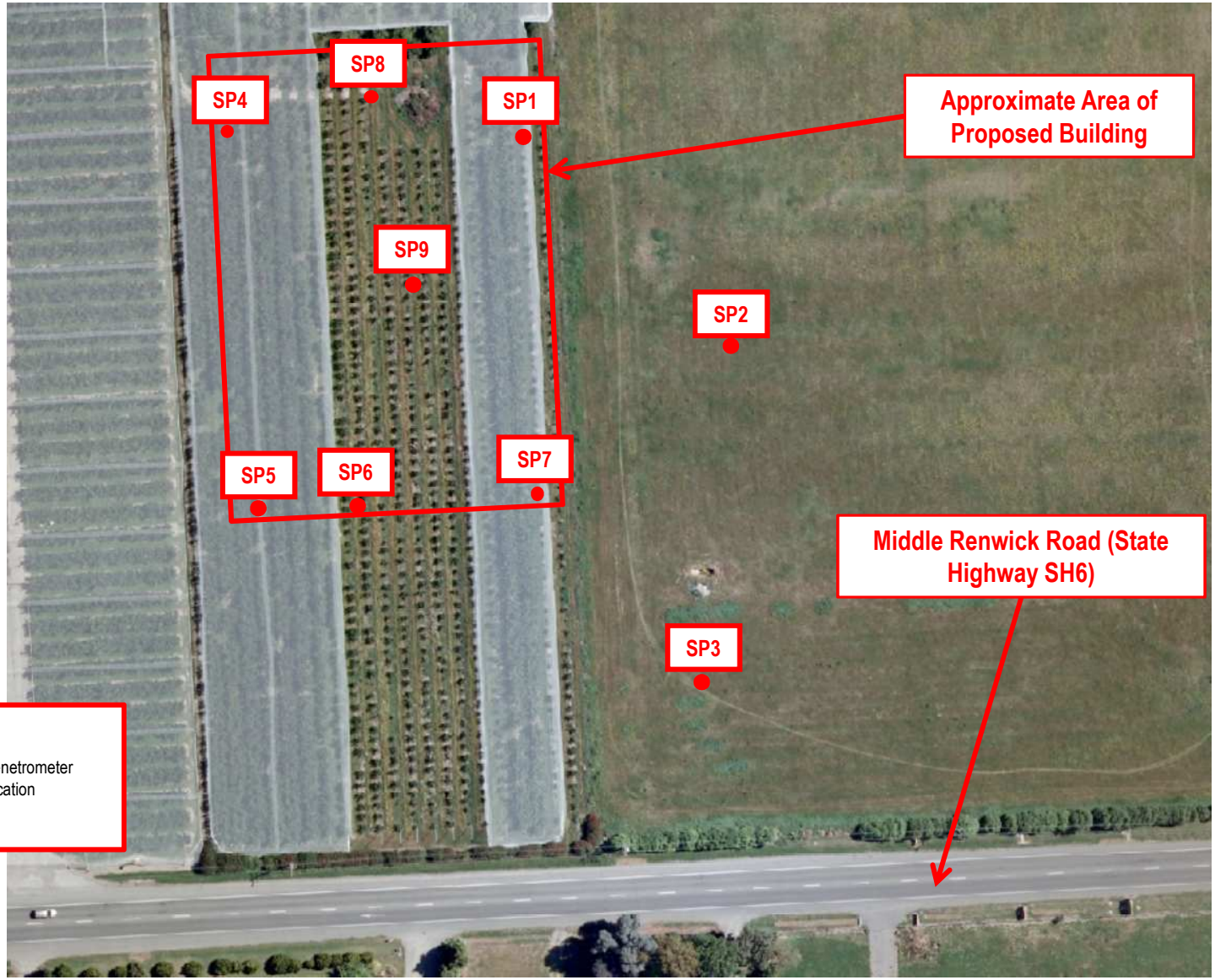
Client: Foodstuffs (SI) Ltd	Figure 2 Test Pit & Borehole Locations		Paper Size: A4
Project: Pak'nSave Blenheim			Revision: 0
By: JSM	Date: 26 May 2011	Job Number: 221198	

BC120191



Note: Not to scale; boundaries and locations are approximate only

Source: ECan (2011)

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Client: Foodstuffs (SI) Ltd	Figure 3		Paper Size: A4
Project: Pak'nSave Blenheim	Scala Penetrometer Locations		Revision: 0
By: JSM	Date: 26 May 2011	Job Number: 221198	

Appendix B
Borehole Logs

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Client: **Geotechnical Investigation**
Project Name: **Foodstuffs (South Island) Limited**
Location: **See Location Plan**
Project Reference: **221198**

SOIL LOG

BH1

Sheet **1** of **2**

BOREHOLE INFORMATION	CO-ORDINATES N/A		
Drilling Method: Track Mounted Drill Rig	Easting: N/A	Date Started: 13/07/2011	Logged by: RS
Diameter Core: 115mm	Northing: N/A	Date Completed: 14/07/2011	Input by: RS
Contractor:	Ground Level: N/A	Inclination:	Checked by: JSM
		Orientation:	Verified by: JK

Method/Casing	Core Recovery (%)	Water Loss (%)	Groundwater Level (m)	R.L. (m)	Depth (m)	Graphic Log	Material Description	USC Description	Consistency/Density	Moisture	Sample	In-Situ Testing	Laboratory Testing	Notes	Backfill	Geological Unit
WASH			▽		0		SILT with trace rootlets; dark brown. Firm. Moist. Low plasticity. TOPSOIL	ML	F				NO LABORATORY TESTING			
					0.30		SILT with minor clay and trace fine grained sand; dark grey with occasional black streaks. Stiff. Moist. Low plasticity. ALLUVIUM	ML	S to F			SPT at 1.7m N = 2 0, 1/0, 1, 0, 1 450mm (SS)				
					3.10		Sandy GRAVEL with some silt; brown and grey. Dense. Wet. Gravel is fine to coarse grained and subrounded to angular. Sand is fine to coarse grained.	GW	MD to D			SPT at 3.1m N = 29 5, 5/6, 6, 7, 10 450mm (SS)				
					4.60		Minor silt.	GW				SPT at 4.6m N = 53 10, 11/12, 12, 12, 17 450mm (SS)				
					6.10		Sandy GRAVEL with minor silt; brown and grey. Dense. Wet. Gravel is fine to coarse grained and subrounded to angular. Sand is fine to coarse grained.	GW	D to VD			SPT at 6.1m N = 49 9, 9/9, 10, 14, 16 450mm (SS)				
					9.10		Trace silt.	GW	VD			SPT at 7.6m N = 44 6, 7/9, 10, 11, 14 450mm (SS)				
												SPT at 9.1m N = 60 8, 10/15, 16, 17, 20 450mm (SS)				

Method
CC concrete core
OB open barrel
SSA solid stem auger
HSA hollow stem auger
WASH wash drill
PQ3 PQ Triple Tube
HQ3 HQ Triple Tube
NQ3 NQ Triple Tube
NMLC NMLC Triple Tube
DP Direct Push
DT Dual Tube (70mm)
Casing

USC Classification
CH Inorganic CLAYS high plasticity
CI Inorganic CLAYS medium plasticity
CL Inorganic CLAYS low plasticity
GC Clayey GRAVEL
GM Silty GRAVEL
GP Poorly Graded GRAVEL
GW Well Graded GRAVEL
MH Inorganic SILT high plasticity
ML Inorganic SILT low plasticity
OH ORGANIC CLAY medium to high plasticity
OL ORGANIC SILT low plasticity
PT PEAT and highly organic soils
SC Clayey SAND
SM Silty SAND
SP Poorly graded SAND
SW Well graded SAND

Consistency
VS very soft
S soft
F firm
S stiff
VS very stiff
H hard

Density
VL very loose
L loose
MD medium dense
D dense
VD very dense

Soil Samples
B bulk
U undisturbed
D disturbed

Water
▽ at end of excavation
▼ at time of excavation
▼ at time of closure

In Situ Testing
PP pen penetrometer
VS vane shear
SPT std. pen. test
SS split spoon
SC solid cone
HB hammer bouncing
SH sinks under own weight

Moisture
D dry
M moist
W wet
S saturated

Graphic Log
Topsoil
SILT
Sandy GRAVEL
Backfill

BC120191

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Client: **Geotechnical Investigation**
Project Name: **Foodstuffs (South Island) Limited**
Location: **See Location Plan**
Project Reference: **221198**

SOIL LOG

BH1

Sheet **2** of **2**

BOREHOLE INFORMATION	CO-ORDINATES N/A		
Drilling Method: Track Mounted Drill Rig	Easting: N/A	Date Started: 13/07/2011	Logged by: RS
Diameter Core: 115mm	Northing: N/A	Date Completed: 14/07/2011	Input by: RS
Contractor:	Ground Level: N/A	Inclination:	Checked by: JSM
		Orientation:	Verified by: JK

Method/Casing	Core Recovery (%)	Water Loss (%)	Groundwater Level (m)	R.L. (m)	Depth (m)	Graphic Log	Material Description	USC Description	Consistency/Density	Moisture	Sample	In-Situ Testing	Laboratory Testing	Notes	Backfill	Geological Unit
WASH					11		Trace silt. *(Layer Continued from previous page)*	GW	VD			SPT at 10.6m N = 50+ 8, 8/15, 27, 8 340mm (SS)	NO LABORATORY TESTING			
							10.60 Gravel is subangular to angular. Minor to some silt.	GW								
					12		12.10 Minor silt. 12.34	GW				SPT at 12.1m N = 50+ 12, 20/40, 10 240mm (SS)				
							Borehole Terminated at 12.34m (Target Depth)									
					13											
					14											
					15											
					16											
					17											
					18											
					19											

Method
CC concrete core
OB open barrel
SSA solid stem auger
HSA hollow stem auger
WASH wash drill
PQ3 PQ Triple Tube
HQ3 HQ Triple Tube
NQ3 NQ Triple Tube
NMLC NMLC Triple Tube
DP Direct Push
DT Dual Tube (70mm)
Casing

USC Classification
CH Inorganic CLAYS high plasticity
CI Inorganic CLAYS medium plasticity
CL Inorganic CLAYS low plasticity
GC Clayey GRAVEL
GM Silty GRAVEL
GP Poorly Graded GRAVEL
GW Well Graded GRAVEL
MH Inorganic SILT high plasticity
ML Inorganic SILT low plasticity
OH ORGANIC CLAY medium to high plasticity
OL ORGANIC SILT low plasticity
PT PEAT and highly organic soils
SC Clayey SAND
SM Silty SAND
SP Poorly graded SAND
SW Well graded SAND

Consistency
VS very soft
S soft
F firm
S stiff
VS very stiff
H hard

Density
VL very loose
L loose
MD medium dense
D dense
VD very dense

Soil Samples
B bulk
U undisturbed
D disturbed

Water
at end of excavation
at time of excavation
at time of closure

In Situ Testing
PP pen penetrometer
VS vane shear
SPT std. pen. test
SS split spoon
SC solid cone
HB hammer bouncing
SH sinks under own weight

Moisture
D dry
M moist
W wet
S saturated

Backfill

Graphic Log
Topsoil
SILT
Sandy GRAVEL

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Project Name: **Foodstuffs (South Island) Limited**
Location: **See Location Plan**
Project Reference: **221198**

SOIL LOG

BH2

Sheet **1** of **2**

BOREHOLE INFORMATION	CO-ORDINATES N/A		
Drilling Method: Track Mounted Drill Rig	Easting: N/A	Date Started: 14/07/2011	Logged by: RS
Diameter Core: 115m	Northing: N/A	Date Completed: 15/07/2011	Input by: RS
Contractor:	Ground Level: N/A	Inclination:	Checked by: JSM
		Orientation:	Verified by: JK

Method/Casing	Core Recovery (%)	Water Loss (%)	Groundwater Level (m)	R.L. (m)	Depth (m)	Graphic Log	Material Description	USC Description	Consistency/Density	Moisture	Sample	In-Situ Testing	Laboratory Testing	Notes	Backfill	Geological Unit
WASH			▽		0		SILT with trace rootlets; dark brown. Firm. Moist. Low plasticity. TOPSOIL	ML	F				NO LABORATORY TESTING			
					0.40		SILT with minor clay and trace fine grained sand; dark grey. Stiff. Moist. Low plasticity. ALLUVIUM	ML	St							
					1.80		Gravelly SAND with trace silt; brownish grey. Medium dense. Moist. Sand is fine to coarse grained. Gravel is fine to coarse grained and subrounded to subangular.	SW	MD to D			SPT at 1.7m N = 32 4, 4/4, 6, 6, 16 450mm (SS)				
					3.10		SAND with some gravel; brownish grey. Medium dense to dense. Wet. Sand is fine to coarse grained. Gravel is fine to coarse grained and subrounded to subangular.	SW				SPT at 3.1m N = 30 6, 7/6, 8, 8, 8 450mm (SS)				
					4.60		Sandy GRAVEL with trace silt; brown and grey. Medium dense to dense. Wet. Gravel is fine to coarse grained and subrounded to angular. Sand is fine to coarse grained.	GW				SPT at 4.6m N = 48 5, 8/9, 10, 12, 17 450mm (SS) SPT at 6.1m N = 50+ 6, 7/15, 16, 17, 2 380mm (SS) SPT at 7.6m N = 35 5, 6/7, 10, 9, 9 450mm (SS)				
					9.10		Gravelly SAND with trace silt; brownish grey. Dense. Moist. Sand is fine to coarse grained. Gravel is fine to coarse grained and subrounded to subangular.	SW				SPT at 9.1m N = 50 6, 7/10, 15, 13, 12 450mm (SS)				

Method
CC concrete core
OB open barrel
SSA solid stem auger
HSA hollow stem auger
WASH wash drill
PQ3 PQ Triple Tube
HQ3 HQ Triple Tube
NQ3 NQ Triple Tube
NMLC NMLC Triple Tube
DP Direct Push
DT Dual Tube (70mm)
Casing

USC Classification
CH Inorganic CLAYS high plasticity
CI Inorganic CLAYS medium plasticity
CL Inorganic CLAYS low plasticity
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GM Silty GRAVEL
GP Poorly Graded GRAVEL
GW Well Graded GRAVEL
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ML Inorganic SILT low plasticity
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PT PEAT and highly organic soils
SC Clayey SAND
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SP Poorly graded SAND
SW Well graded SAND

Consistency
VS very soft
S soft
F firm
S stiff
VS very stiff
H hard

Density
VL very loose
L loose
MD medium dense
D dense
VD very dense

Soil Samples
B bulk
U undisturbed
D disturbed

Water
▽ at end of excavation
▼ at time of excavation
▼ at time of closure

In Situ Testing
PP pen penetrometer
VS vane shear
SPT std. pen. test
SS split spoon
SC solid cone
HB hammer bouncing
SH sinks under own weight

Moisture
D dry
M moist
W wet
S saturated

Graphic Log
Topsoil
SILT
Gravelly SAND
SAND
Sandy GRAVEL
GRAVEL
Backfill

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Client: **Geotechnical Investigation**
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Project Reference: **221198**

SOIL LOG

BH2

Sheet **2** of **2**

BOREHOLE INFORMATION	CO-ORDINATES N/A		
Drilling Method: Track Mounted Drill Rig	Easting: N/A	Date Started: 14/07/2011	Logged by: RS
Diameter Core: 115m	Northing: N/A	Date Completed: 15/07/2011	Input by: RS
Contractor:	Ground Level: N/A	Inclination:	Checked by: JSM
		Orientation:	Verified by: JK

Method/Casing	Core Recovery (%)	Water Loss (%)	Groundwater Level (m)	R.L. (m)	Depth (m)	Graphic Log	Material Description	USC Description	Consistency/Density	Moisture	Sample	In-Situ Testing	Laboratory Testing	Notes	Backfill	Geological Unit
WASH					11		Gravelly SAND with trace silt; brownish grey. Dense. Moist. Sand is fine to coarse grained. Gravel is fine to coarse grained and subrounded to subangular. *(Layer Continued from previous page)*	SW								
							10.60 Sandy GRAVEL with trace silt; brown and grey. Very Dense. Wet. Gravel is fine to coarse grained and subrounded to angular. Sand is fine to coarse grained.	GW	MD to D			SPT at 10.6m N = 50+ 6, 7/14, 20, 16 340mm (SS)				
					12		12.10 GRAVEL with some sand and trace silt; grey and brown. Dense. Wet. Gravel is fine to coarse grained and subrounded to subangular. Sand is fine to coarse grained.	GW				SPT at 12.1m N = 42 1, 3/5, 6, 11, 20 450mm (SS)				
							12.55 Borehole Terminated at 12.55m (Target Depth)						NO LABORATORY TESTING			
					13											
					14											
					15											
					16											
					17											
					18											
					19											

Method
CC concrete core
OB open barrel
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GW Well Graded GRAVEL
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OH ORGANIC CLAY medium to high plasticity
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SP Poorly graded SAND
SW Well graded SAND

Consistency
VS very soft
S soft
F firm
S stiff
VS very stiff
H hard

Density
VL very loose
L loose
MD medium dense
D dense
VD very dense

Soil Samples
B bulk
U undisturbed
D disturbed

Water
at end of excavation
at time of excavation
at time of closure

In Situ Testing
PP pen penetrometer
VS vane shear
SPT std. pen. test
SS split spoon
SC solid cone
HB hammer bouncing
SH sinks under own weight

Moisture
D dry
M moist
W wet
S saturated

Graphic Log
Topsoil
SILT
Gravelly SAND
SAND
Sandy GRAVEL
GRAVEL
Backfill

NZ GEOTECHNICAL SOCIETY INC

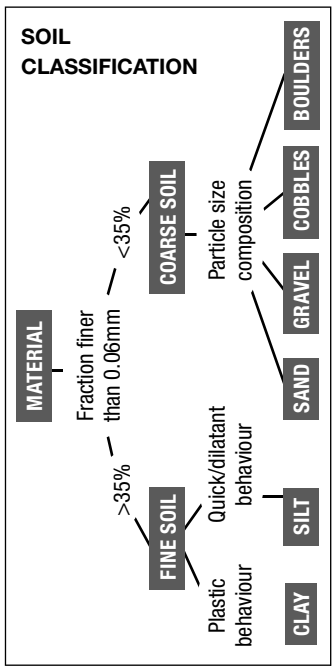
SOIL > field guide sheet

FIELD DESCRIPTION OF SOIL

SEQUENCE OF TERMS – fraction – colour – structure – strength – moisture – bedding – plasticity – sensitivity – additional

GRAIN SIZE CRITERIA

TYPE	COARSE								FINE		ORGANIC
	Boulders	Cobbles	Gravel			Sand			Silt	Clay	Organic Soil
			coarse	medium	fine	coarse	medium	fine			
Size Range (mm)	200	60	20	6	2	0.6	0.2	0.06	0.002		
Graphic Symbol											



PROPORTIONAL TERMS DEFINITION (COARSE SOILS)

Fraction	Term	% of Soil Mass	Example
Major	(….) [UPPER CASE]	≥ 50 [major constituent]	GRAVEL
Subordinate	(….) y [lower case]	20 – 50	Sandy
Minor	with some … with minor …	12 – 20 5 – 12	with some sand with minor sand
	with trace of (or slightly)…	< 5	with trace of sand (slightly sandy)

DENSITY INDEX (RELATIVE DENSITY) TERMS

Descriptive Term	Density Index (R_D)	SPT "N" value (blows / 300 mm)	Dynamic Cone (blows / 100 mm)
Very dense	> 85	> 50	> 17
Dense	65 – 85	30 – 50	7 – 17
Medium dense	35 – 65	10 – 30	3 – 7
Loose	15 – 35	4 – 10	1 – 3
Very loose	< 15	< 4	0 – 2

Note: • No correlation is implied between Standard Penetration Test (SPT) and Dynamic Cone Test values.
• SPT "N" values are uncorrected. • Dynamic Cone Penetrometer (Scala)

CONSISTENCY TERMS FOR COHESIVE SOILS

Descriptive Term	Undrained Shear Strength (kPa)	Diagnostic Features
Very soft	< 12	Easily exudes between fingers when squeezed
Soft	12 – 25	Easily indented by fingers
Firm	25 – 50	Indented by strong finger pressure and can be indented by thumb pressure
Stiff	50 – 100	Cannot be indented by thumb pressure
Very stiff	100 – 200	Can be indented by thumb nail
Hard	200 – 500	Difficult to indent by thumb nail

ORGANIC SOILS/ DESCRIPTORS

Term	Description
Topsoil	Surficial organic soil layer that may contain living matter. However topsoil may occur at greater depth, having been buried by geological processes or man-made fill, and should then be termed a buried topsoil.
Organic clay, silt or sand	Contains finely divided organic matter; may have distinctive smell; may stain; may oxidise rapidly. Describe as for inorganic soils.
Peat	Consists predominantly of plant remains. ***Firm***: Fibres already compressed together ***Spongy***: Very compressible and open stucture ***Plastic***: Can be moulded in hand and smears in fingers ***Fibrous***: Plant remains recognisable and retain some strength ***Amorphous***: No recognisable plant remains
Roolets	Fine, partly decomposed roots, normally found in the upper part of a soil profile or in a redeposited soil (e.g. colluvium or fill)
Carbonaceous	Discrete particles of hardened (carbonised) plant material.

MOISTURE CONDITION

Condition	Description	Granular Soils	Cohesive Soils
Dry	Looks and feels dry	Run freely through hands	Hard, powdery or friable
Moist	Feels cool, darkened in colour	Tend to cohere	Weakened by moisture, but no free water on hands when remoulding
Wet			Weakened by moisture, free water forms on hands when handling
Saturated	Feels cool, darkened in colour and free water is present on the sample		

PLASTICITY (CLAYS & SILTS)

Term	Description
High plasticity	Can be moulded or deformed over a wide range of moisture contents without cracking or showing any tendency to volume change
Low plasticity	When moulded can be crumbled in the fingers; may show quick or dilatant behaviour

GRADING (GRAVELS & SANDS)

Term	Description	
Well graded	Good representation of all particle sizes from largest to smallest	
Poorly graded	Limited representation of grain sizes - further divided into:	
	Uniformly graded	Most particles about the same size
	Gap graded	Absence of one or more intermediate sizes

compiled by KATE WILLIAMS design KARRYN MUSCHAMP

NZ GEOTECHNICAL SOCIETY INC

This field sheet has been taken from and should be used and read with reference to the document FIELD DESCRIPTION OF SOIL AND ROCK: Guideline For the Field Classification and Description of Soil and Rock for Engineering Purposes. NZ Geotechnical Society Inc, December 2005. **www.nzgeotechsoc.org.nz**

Appendix C
Test Pit Logs

BC120191

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Email: christchurch@ap.aurecongroup.com

Client: **Foodstuffs (SI) Ltd**
Project Name: **Pak'nSave Blenheim**
Location: **State Highway SH6 Blenheim**
Project Reference: **221198**

TP1

Sheet **1** of **1**

TEST PIT INFORMATION	CO-ORDINATES N/A		
Excavator Type: 12t Excavator	Easting: N/A	Date Started: 18/05/2011	Logged by: JSM
Test Pit Dimensions: 1.5m Wide 3m Long	Northing: N/A	Date Completed: 18/05/2011	Input by: JSM
Contractor: March Construction	Ground Level: N/A		Checked by: JK
			Verified by: JK

Depth (m)	Sample	Water Level (m)	Graphic Log	Shear Vane Tests	Pocket Penetrometer Tests	Soil Description	Elevation (m)
0.5				Shear vane at 0.3m: 27/2kPa Shear vane at 0.5m: 60/8kPa		SILT with trace rootlets; dark brown. Firm. Moist. Low plasticity. TOPSOIL 0.20 SILT with minor sand; dark yellow brown. Firm to stiff. Moist. Low plasticity. Sand fine to medium grained. ALLUVIUM 0.70 Sandy SILT; dark yellow brown with orange brown and grey mottling. Stiff. Moist. Low plasticity. Sand fine to medium grained. 0.90	
1.0				Shear vane at 0.8m: 75/8kPa Shear vane at 1.1m: 75/19kPa		Silty SAND: dark yellow brown with orange brown and grey mottling. Loose. Wet. Sand fine to medium grained. 1.00 Sandy SILT; dark yellow brown with orange brown and grey mottling. Stiff. Moist. Low plasticity. Sand fine to medium grained. 1.20 SAND; dark yellow brown with orange brown and grey mottling. Loose to medium dense. Wet. Sand fine to medium grained.	
1.5							
2.0							
2.5		▼				2.20 Silty SAND; dark gey with orange brown mottling. Medium dense. Moist to wet. Sand fine to medium grained. 2.80	
3.0						Sandy GRAVEL; dark grey with orange brown mottling. Dense. Saturated. Gravel fine to coarse grained, rounded. Sand fine to coarse grained. 3.00 End of Test Pit at 3m (Pit Collapse)	
3.5							
4.0							
4.5							

Remarks:

Logged by: JSM
Input by: JSM
Checked by: JK
Verified by: JK

Sheet **1** of **1**

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Client: **Foodstuffs (SI) Ltd**
Project Name: **Pak'nSave Blenheim**
Location: **State Highway SH6 Blenheim**
Project Reference: **221198**

TP10

Sheet **1** of **1**

TEST PIT INFORMATION	CO-ORDINATES N/A		
Excavator Type: 12t Excavator	Easting: N/A	Date Started: 18/05/2011	Logged by: JSM
Test Pit Dimensions: 1.5m Wide 3m Long	Northing: N/A	Date Completed: 18/05/2011	Input by: JSM
Contractor: March Construction	Ground Level: N/A		Checked by: JK
			Verified by: JK

Depth (m)	Water Level (m)	Shear Vane Tests	Pocket Penetrometer Tests	Soil Description	Elevation (m)
				SILT with trace rootlets; dark brown. Firm. Moist. Low plasticity. TOPSOIL	
				0.40 SILT with minor sand; dark yellow brown with orange brown and grey mottling. Very stiff. Moist. Low plasticity. Sand fine to medium grained. ALLUVIUM	
0.5		Shear vane at 0.5m: 105/22kPa			
		Shear vane at 0.7m: 135/45kPa		0.80 SAND with some silt; dark yellow brown with orange brown and grey mottling. Loose to medium dense. Moist. Sand fine grained.	
1.0				1.00 SILT with minor sand; dark yellow brown with orange brown and grey mottling. Hard. Moist. Low plasticity. Sand fine to medium grained.	
1.5		Shear vane at 1.1m: 180kPa			
				2.00 Sandy SILT; dark grey with orange brown mottling. Very stiff. Moist. Low plasticity. Sand fine grained.	
2.0			Pocket Penetrometer at 2.1m: 125kN/m² Pocket Penetrometer at 2.3m: 150kN/m²		
2.5				2.60 SAND: dark grey with orange brown mottling. Medium dense. Wet. Sand fine to medium grained.	
3.0	▼			3.10 Sandy GRAVEL with some cobbles; dark grey. Dense. Wet to saturated. Gravel fine to coarse grained, rounded. Sand fine to medium grained.	
				3.40 Gravelly SAND with trace tree branches; dark yellow brown. Medium dense to dense. Saturated. Sand fine to medium grained. Gravel fine to coarse grained, rounded.	
3.5				3.60 Sandy GRAVEL with some cobbles; dark grey. Dense. Wet to saturated. Gravel fine to coarse grained, rounded. Sand fine to medium grained.	
4.0				4.00 End of Test Pit at 4m (Pit Collapse)	
4.5					

Remarks:

Logged by: JSM
Input by: JSM
Checked by: JK
Verified by: JK

Sheet **1** of **1**

Marlborough District Council
Date Received: 7/3/2012

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Client: **Foodstuffs (SI) Ltd**
Project Name: **Pak'nSave Blenheim**
Location: **State Highway SH6 Blenheim**
Project Reference: **221198**

TP11

Sheet **1** of **1**

TEST PIT INFORMATION	**CO-ORDINATES N/A**		
Excavator Type: 12t Excavator	Easting: N/A	Date Started: 18/05/2011	Logged by: JSM
Test Pit Dimensions: 1.5m Wide 3m Long	Northing: N/A	Date Completed: 18/05/2011	Input by: JSM
Contractor: March Construction	Ground Level: N/A		Checked by: JK
			Verified by: JK

Depth (m)	Sample	Water Level (m)	Graphic Log	Shear Vane Tests	Pocket Penetrometer Tests	Soil Description	Elevation (m)
0.5				Shear vane at 0.6m: 95/16kPa Shear vane at 0.8m: 63/10kPa		SILT with trace rootlets; dark brown. Firm. Moist. Low plasticity. TOPSOIL 0.30 SILT with minor sand; dark yellow brown with orange brown and grey mottling. Stiff. Moist. Low plasticity. Sand fine to medium grained. ALLUVIUM 0.90 Silty SAND: dark yellow brown with orange brown and grey mottling. Loose to medium dense. Wet. Sand fine grained. 1.20	
1.0							
1.5				Shear vane at 1.3m: 96/18kPa	Pocket Penetrometer at 1.4m: 125kN/m² Pocket Penetrometer at 1.6m: 150kN/m²	SILT with minor sand; dark yellow brown with orange brown and grey mottling. Very stiff. Moist. Low plasticity. Sand fine to medium grained. 1.90 Silty SAND: dark grey with orange brown mottling. Medium dense. Wet. Sand fine to medium grained. 2.10 Sandy GRAVEL with some cobbles; dark grey. Dense. Wet to saturated. Gravel fine to coarse grained, rounded. Sand fine to coarse grained.	
2.0							
2.5		▼					
3.0							
3.5						3.50 End of Test Pit at 3.5m (Pit Collapse)	
4.0							
4.5							

Remarks:

Logged by: JSM
Input by: JSM
Checked by: JK
Verified by: JK

Sheet **1** of **1**

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Client: **Foodstuffs (SI) Ltd**
Project Name: **Pak'nSave Blenheim**
Location: **State Highway SH6 Blenheim**
Project Reference: **221198**

TP2

Sheet **1** of **1**

TEST PIT INFORMATION	CO-ORDINATES N/A		
Excavator Type: 12t Excavator	Easting: N/A	Date Started: 18/05/2011	Logged by: JSM
Test Pit Dimensions: 1.5m Wide 3m Long	Northing: N/A	Date Completed: 18/05/2011	Input by: JSM
Contractor: March Construction	Ground Level: N/A		Checked by: JK
			Verified by: JK

Depth (m)	Sample	Water Level (m)	Graphic Log	Shear Vane Tests	Pocket Penetrometer Tests	Soil Description	Elevation (m)
0.5				Shear vane at 0.6m: 128/30kPa Shear vane at 0.8m: 98/15kPa		SILT with trace rootlets; dark brown. Firm. Moist. Low plasticity. TOPSOIL 0.35 SILT with minor sand; dark yellow brown with orange brown and grey mottling. Stiff to very stiff. Moist. Low plasticity. Sand fine to medium grained. ALLUVIUM 0.90 SAND with some silt; dark grey with orange brown mottling. Loose to medium dense. Moist to wet. Sand fine to medium grained. 2.40 Silty SAND; dark grey with orange brown mottling. Dense. Moist to wet. Sand fine to medium grained. 2.80 End of Test Pit at 2.8m (Pit Collapse)	
1.0							
1.5							
2.0							
2.5		▼					
3.0							
3.5							
4.0							
4.5							

Remarks:

Logged by: JSM
Input by: JSM
Checked by: JK
Verified by: JK

Sheet **1** of **1**

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Client: **Foodstuffs (SI) Ltd**
Project Name: **Pak'nSave Blenheim**
Location: **State Highway SH6 Blenheim**
Project Reference: **221198**

TP3

Sheet **1** of **1**

TEST PIT INFORMATION	CO-ORDINATES N/A		
Excavator Type: 12t Excavator	Easting: N/A	Date Started: 18/05/2011	Logged by: JSM
Test Pit Dimensions: 1.5m Wide 3m Long	Northing: N/A	Date Completed: 18/05/2011	Input by: JSM
Contractor: March Construction	Ground Level: N/A		Checked by: JK
			Verified by: JK

Depth (m)	Sample	Water Level (m)	Graphic Log	Shear Vane Tests	Pocket Penetrometer Tests	Soil Description	Elevation (m)
0.0						SILT with trace rootlets; dark brown. Firm. Moist. Low plasticity. TOPSOIL	
0.30						SILT with minor sand; dark yellow brown. Firm to very stiff. Moist. Low plasticity. Sand fine to medium grained. ALLUVIUM	
0.5				Shear vane at 0.5m: 120/27kPa			
1.0				Shear vane at 0.8m: 90/27kPa			
1.5				Shear vane at 1.1m: 180kPa			
1.60						Sandy GRAVEL with minor cobbles; dark grey. Dense. WetSaturated. Gravel fine to coarse grained, rounded. Sand fine to coarse grained.	
2.0		▼					
2.5							
2.60						End of Test Pit at 2.6m (Pit Collapse)	
3.0							
3.5							
4.0							
4.5							

Remarks:

Logged by: JSM
Input by: JSM
Checked by: JK
Verified by: JK

Sheet **1** of **1**

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Client: **Foodstuffs (SI) Ltd**
Project Name: **Pak'nSave Blenheim**
Location: **State Highway SH6 Blenheim**
Project Reference: **221198**

TP4

Sheet **1** of **1**

TEST PIT INFORMATION	CO-ORDINATES N/A		
Excavator Type: 12t Excavator	Easting: N/A	Date Started: 18/05/2011	Logged by: JSM
Test Pit Dimensions: 1.5m Wide 3m Long	Northing: N/A	Date Completed: 18/05/2011	Input by: JSM
Contractor: March Construction	Ground Level: N/A		Checked by: JK
			Verified by: JK

Depth (m)	Sample	Water Level (m)	Graphic Log	Shear Vane Tests	Pocket Penetrometer Tests	Soil Description	Elevation (m)
0.5				Shear vane at 0.4m: 90/15kPa		SILT with trace rootlets; dark brown. Firm. Moist. Low plasticity. TOPSOIL (0.20) SILT with minor sand; dark yellow brown. Stiff. Moist. Low plasticity. Sand fine grained. ALLUVIUM (0.70) Silty SAND: dark yellow brown. Loose. Moist. Sand fine to medium grained. (1.40) Sandy GRAVEL with some cobbles; dark grey. Dense. Wet to saturated. Gravel fine to coarse grained, rounded. Sand fine to medium grained. (2.50) End of Test Pit at 2.5m (Pit Collapse)	
1.0							
1.5							
2.0		▼					
2.5							
3.0							
3.5							
4.0							
4.5							

Remarks:

Logged by: JSM
Input by: JSM
Checked by: JK
Verified by: JK

Sheet **1** of **1**

Marlborough District Council
Date Received: 7/3/2012

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Client: **Foodstuffs (SI) Ltd**
Project Name: **Pak'nSave Blenheim**
Location: **State Highway SH6 Blenheim**
Project Reference: **221198**

TP5

Sheet **1** of **1**

TEST PIT INFORMATION	**CO-ORDINATES N/A**		
Excavator Type: 12t Excavator	Easting: N/A	Date Started: 18/05/2011	Logged by: JSM
Test Pit Dimensions: 1.5m Wide 3m Long	Northing: N/A	Date Completed: 18/05/2011	Input by: JSM
Contractor: March Construction	Ground Level: N/A		Checked by: JK
			Verified by: JK

Depth (m)	Sample	Water Level (m)	Graphic Log	Shear Vane Tests	Pocket Penetrometer Tests	Soil Description	Elevation (m)
0.0						SILT with trace rootlets; dark brown. Firm. Moist. Low plasticity. TOPSOIL	
0.30						SILT; dark yellow brown with orange brown and grey mottling. Very stiff. Moist. Low plasticity. ALLUVIUM	
0.5				Shear vane at 0.5m: 102/3kPa			
0.80						SAND; dark yellow brown with orange brown and grey mottling. Loose to medium dense. Wet. Sand fine to medium grained.	
1.0							
1.10						SILT; dark yellow brown with orange brown and grey mottling. Firm. Moist. Low plasticity.	
				Shear vane at 1.2m: 42/3kPa			
1.40						End of Test Pit at 1.4m (Target Depth)	
1.5							
2.0							
2.5							
3.0							
3.5							
4.0							
4.5							

Remarks:

Logged by: JSM
Input by: JSM
Checked by: JK
Verified by: JK

Sheet **1** of **1**

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Client: **Foodstuffs (SI) Ltd**
Project Name: **Pak'nSave Blenheim**
Location: **State Highway SH6 Blenheim**
Project Reference: **221198**

TP6

Sheet **1** of **1**

TEST PIT INFORMATION	CO-ORDINATES N/A		
Excavator Type: 12t Excavator	Easting: N/A	Date Started: 18/05/2011	Logged by: JSM
Test Pit Dimensions: 1.5m Wide 3m Long	Northing: N/A	Date Completed: 18/05/2011	Input by: JSM
Contractor: March Construction	Ground Level: N/A		Checked by: JK
			Verified by: JK

Depth (m)	Sample	Water Level (m)	Graphic Log	Shear Vane Tests	Pocket Penetrometer Tests	Soil Description	Elevation (m)
0.5				Shear vane at 0.5m: 126/30kPa		SILT with trace roots and rootlets; dark brown. Firm. Moist. Low plasticity. TOPSOIL (0.30)	
1.0				Shear vane at 1m: 180kPa		SILT with minor sand; dark yellow brown with orange brown and grey mottling. Very stiff. Moist. Low plasticity. Sand fine grained. ALLUVIUM	
1.5				Shear vane at 1.2m: 180kPa		(1.60)	
2.0		▼				Sandy GRAVEL with some cobbles; dark grey. Dense. Wet to saturated. Gravel fine to coarse grained, rounded. Sand fine to medium grained. (2.30)	
2.5						End of Test Pit at 2.3m (Pit Collapse)	
3.0							
3.5							
4.0							
4.5							

Remarks:

Logged by: JSM
Input by: JSM
Checked by: JK
Verified by: JK

Sheet **1** of **1**

Marlborough District Council
Date Received: 7/3/2012

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Client: **Foodstuffs (SI) Ltd**
Project Name: **Pak'nSave Blenheim**
Location: **State Highway SH6 Blenheim**
Project Reference: **221198**

TP7

Sheet **1** of **1**

TEST PIT INFORMATION	CO-ORDINATES N/A		
Excavator Type: 12t Excavator	Easting: N/A	Date Started: 18/05/2011	Logged by: JSM
Test Pit Dimensions: 1.5m Wide 3m Long	Northing: N/A	Date Completed: 18/05/2011	Input by: JSM
Contractor: March Construction	Ground Level: N/A		Checked by: JK
			Verified by: JK

Depth (m)	Sample	Water Level (m)	Graphic Log	Shear Vane Tests	Pocket Penetrometer Tests	Soil Description	Elevation (m)
0.5				Shear vane at 0.5m: 90/18kPa Shear vane at 0.7m: 98/15kPa Shear vane at 0.9m: 180kPa Shear vane at 1m: 180kPa	Pocket Penetrometer at 0.9m: 225kN/m²	SILT with trace rootlets; dark brown. Firm. Moist. Low plasticity. TOPSOIL 0.25 SILT with minor silt; dark yellow brown with orange brown and grey mottling. Stiff. Moist. Low plasticity. ALLUVIUM Very stiff to hard from 0.6m. 1.10 SAND; dark yellow brown with orange brown and grey mottling. Loose to medium dense. Wet. Sand fine to medium grained. 1.80 Sandy GRAVEL with some cobbles; dark grey. Dense. Wet to saturated. Gravel fine to coarse grained, rounded. Sand fine to coarse grained. 2.70 End of Test Pit at 2.7m (Pit Collapse)	
1.0							
1.5							
2.0		▼					
2.5							
3.0							
3.5							
4.0							
4.5							

Remarks:

Logged by: JSM
Input by: JSM
Checked by: JK
Verified by: JK

Sheet **1** of **1**

Marlborough District Council
Date Received: 7/3/2012

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Client: **Foodstuffs (SI) Ltd**
Project Name: **Pak'nSave Blenheim**
Location: **State Highway SH6 Blenheim**
Project Reference: **221198**

TP8

Sheet **1** of **1**

TEST PIT INFORMATION	CO-ORDINATES N/A		
Excavator Type: 12t Excavator	Easting: N/A	Date Started: 18/05/2011	Logged by: JSM
Test Pit Dimensions: 1.5m Wide 3m Long	Northing: N/A	Date Completed: 18/05/2011	Input by: JSM
Contractor: March Construction	Ground Level: N/A		Checked by: JK
			Verified by: JK

Depth (m)	Sample	Water Level (m)	Graphic Log	Shear Vane Tests	Pocket Penetrometer Tests	Soil Description	Elevation (m)
						SILT with trace rootlets; dark brown. Firm. Moist. Low plasticity. TOPSOIL (0.20)	
0.5				Shear vane at 0.5m: 72/15kPa		SILT with minor sand; dark yellow brown. Stiff. Moist. Low plasticity. Sand fine to medium grained. ALLUVIUM (0.70)	
1.0						Silty SAND: dark yellow brown with orange brown mottling. Loose. Wet. Sand fine to medium grained. (1.20)	
1.5				Shear vane at 1.3m: 113/22kPa	Pocket Penetrometer at 1.7m: 100kN/m²	SILT with minor sand; dark yellow brown. Very stiff. Moist. Low plasticity. Sand fine to medium grained. (1.80)	
2.0						Gravelly SAND; dark grey. Medium dense. Wet. Sand fine to coarse grained. Gravel fine to coarse grained, rounded. (2.00)	
2.5		▼				Sandy GRAVEL with some cobbles; dark grey. Dense. Wet to saturated. Gravel fine to coarse grained, rounded. Sand fine to coarse grained. (3.00)	
3.0						End of Test Pit at 3m (Pit Collapse)	
3.5							
4.0							
4.5							

Remarks:

Logged by: JSM
Input by: JSM
Checked by: JK
Verified by: JK

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Client: **Foodstuffs (SI) Ltd**
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Location: **State Highway SH6 Blenheim**
Project Reference: **221198**

TP9

Sheet **1** of **1**

TEST PIT INFORMATION	CO-ORDINATES N/A		
Excavator Type: 12t Excavator	Easting: N/A	Date Started: 18/05/2011	Logged by: JSM
Test Pit Dimensions: 1.5m Wide 3m Long	Northing: N/A	Date Completed: 18/05/2011	Input by: JSM
Contractor: March Construction	Ground Level: N/A		Checked by: JK
			Verified by: JK

Depth (m)	Sample	Water Level (m)	Graphic Log	Shear Vane Tests	Pocket Penetrometer Tests	Soil Description	Elevation (m)
0.5				Shear vane at 0.4m: 37/3kPa Shear vane at 0.7m: 120/22kPa		SILT with trace rootlets; dark brown. Firm. Moist. Low plasticity. TOPSOIL (0.35) SILT with minor sand; dark yellow brown. Firm. Moist. Low plasticity. Sand fine grained. ALLUVIUM (0.80)	
1.0						SAND; dark yellow brown with orange brown mottling. Loose to medium dense. Moist. Sand fine grained. (1.00) SILT; dark yellow brown with orange brown mottling. Very stiff to hard. Moist. Low plasticity. (1.60)	
1.5				Shear vane at 1.1m: 200kPa	Pocket Penetrometer at 1.2m: 225kN/m²		
2.0						Silty SAND: dark yellow brown with orange brown and grey mottling. Loose to medium dense. Wet. Sand fine to medium grained. (1.90) Silty SAND: dark grey. Medium dense. Wet. Sand fine to medium grained. (2.20)	
2.5		▼				Sandy GRAVEL with some cobbles; dark grey. Dense. Wet to saturated. Gravel fine to coarse grained, rounded. Sand fine to medium grained. (2.80)	
3.0						End of Test Pit at 2.8m (Pit Collapse)	
3.5							
4.0							
4.5							

Remarks:

Logged by: JSM
Input by: JSM
Checked by: JK
Verified by: JK

Sheet **1** of **1**

Marlborough District Council
Date Received: 7/3/2012

Last Generated: 25/08/2011 9:52:22 a.m.

Database File: 221198 PNS BLENHEIM.GPJ, Library: COPY OF CHCH LIBRARY MARCH 2011.GLB, Data template: CHCH DATA TEMPLATE NOV 2010.GDT, Last Generated: 25/08/2011.

Appendix D
Scala Probe Logs

Site Description:

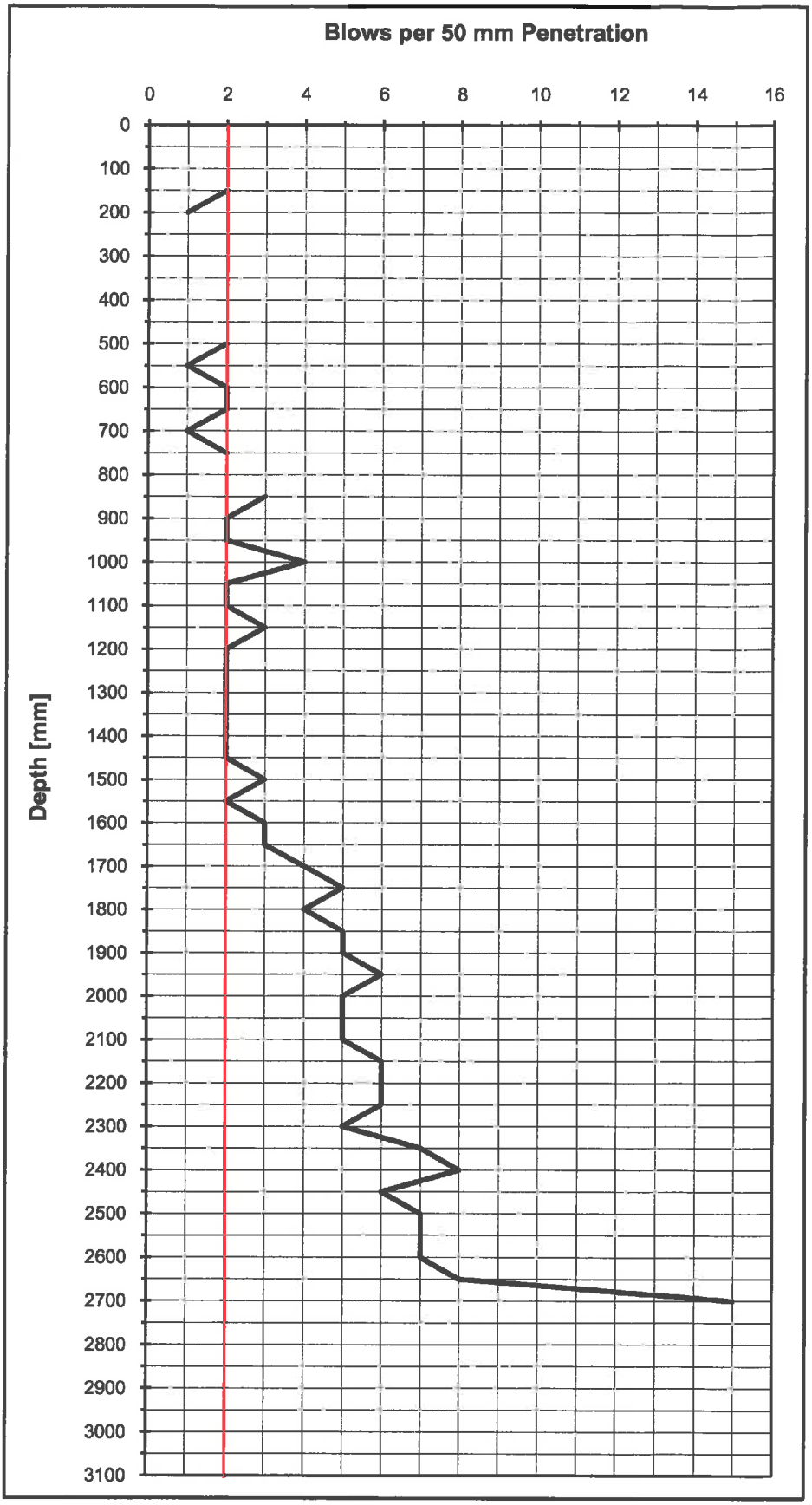
Refer attached site plan.

RL:

Notes:

.

Depth (mm)	Blows (no.)	Depth (mm)	Blows (no.)
50		2300	5
100		2350	7
150	2	2400	8
200	1	2450	6
250		2500	7
300	4	2550	7
350		2600	7
400	2	2650	8
450		2700	15
500	2	2750	
550	1	2800	
600	2	2850	
650	2	2900	
700	1	2950	
750	2	3000	
800		3050	
850	3	3100	
900	2	3150	
950	2	3200	
1000	4	3250	
1050	2	3300	
1100	2	3350	
1150	3	3400	
1200	2	3450	
1250	2	3500	
1300	2	3550	
1350	2	3600	
1400	2	3650	
1450	2	3700	
1500	3	3750	
1550	2	3800	
1600	3	3850	
1650	3	3900	
1700	4	3950	
1750	5	4000	
1800	4	4050	
1850	5	4100	
1900	5	4150	
1950	6	4200	
2000	5	4250	
2050	5	4300	
2100	5	4350	
2150	6	4400	
2200	6	4450	
2250	6	4500	



PROBE DESCRIPTION:
9 kg Hammer falling half a metre to a steel anvil, driving a 16 mm diameter rod fitted with a 20 mm diameter cone.

aurecon

Client: Foodstuffs		SCALA PROBE	
Location: Westwood Development - Blenheim		No: SP 1	A4
Tester: SAH / AC	Date: 24 May 2011	Job Number: 221198	Rev: 1

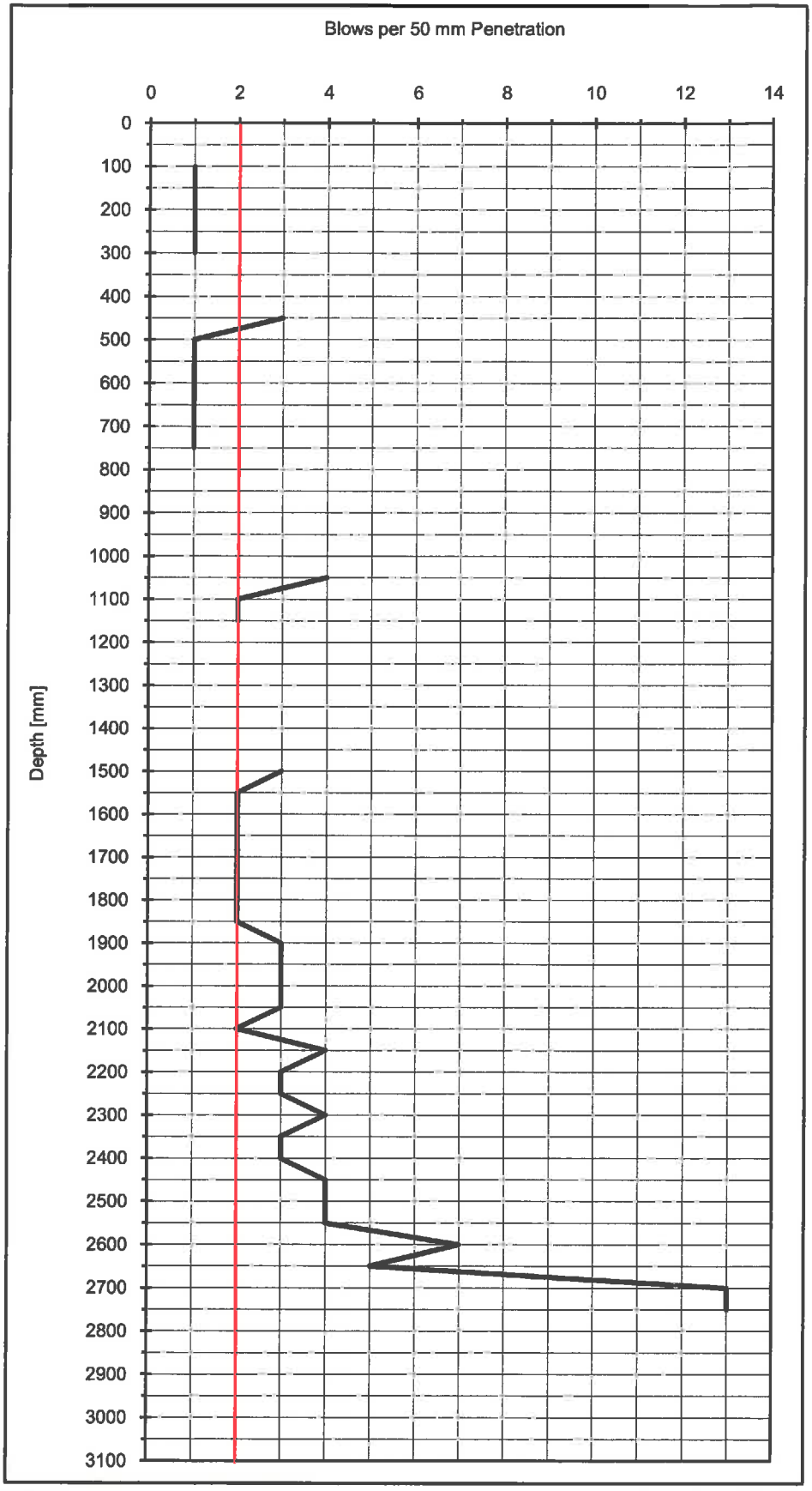
Site Description:

Refer attached site plan.

RL:

Notes:

Depth (mm)	Blows (no.)	Depth (mm)	Blows (no.)
50		2300	4
100	1	2350	3
150	1	2400	3
200	1	2450	4
250	1	2500	4
300	1	2550	4
350		2600	7
400		2650	5
450	3	2700	13
500	1	2750	13
550	1	2800	
600	1	2850	
650	1	2900	
700	1	2950	
750	1	3000	
800		3050	
850	2	3100	
900		3150	
950		3200	
1000		3250	
1050	4	3300	
1100	2	3350	
1150	2	3400	
1200		3450	
1250	4	3500	
1300		3550	
1350		3600	
1400	4	3650	
1450		3700	
1500	3	3750	
1550	2	3800	
1600	2	3850	
1650	2	3900	
1700	2	3950	
1750	2	4000	
1800	2	4050	
1850	2	4100	
1900	3	4150	
1950	3	4200	
2000	3	4250	
2050	3	4300	
2100	2	4350	
2150	4	4400	
2200	3	4450	
2250	3	4500	



PROBE DESCRIPTION:
9 kg Hammer falling half a metre to a steel anvil, driving a 16 mm diameter rod fitted with a 20 mm diameter cone.

aurecon

Client: Foodstuffs		SCALA PROBE	
Location: Westwood Development - Blenheim		No: SP 2	A4
Tester: SAH / AC	Date: 24 May 2011	Job Number: 221198	Rev: 1

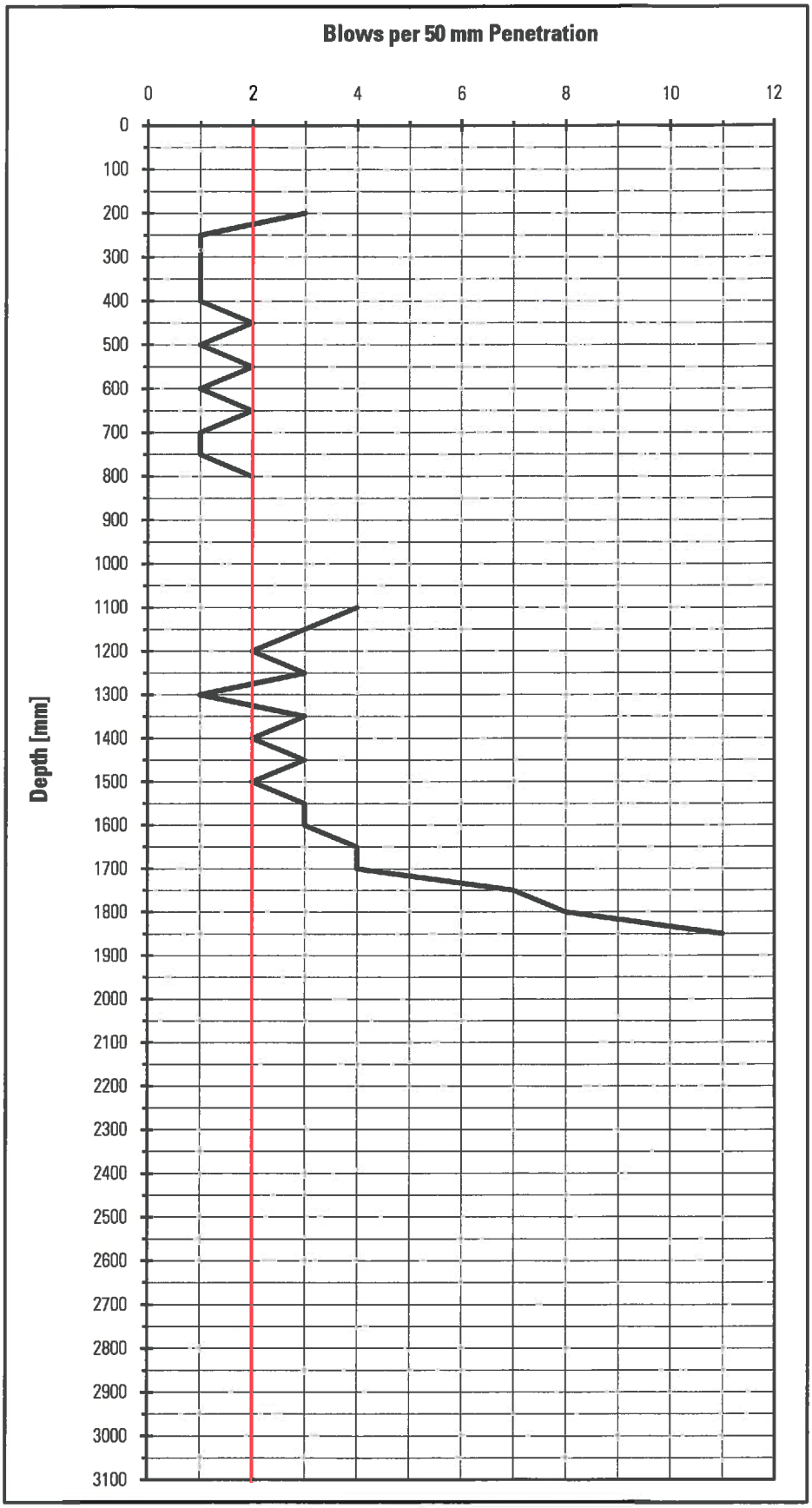
Site Description:

Refer attached site plan.

RL:

Notes:

Depth (mm)	Blows (no.)	Depth (mm)	Blows (no.)
50		2300	
100		2350	
150		2400	
200	3	2450	
250	1	2500	
300	1	2550	
350	1	2600	
400	1	2650	
450	2	2700	
500	1	2750	
550	2	2800	
600	1	2850	
650	2	2900	
700	1	2950	
750	1	3000	
800	2	3050	
850		3100	
900	3	3150	
950		3200	
1000	3	3250	
1050		3300	
1100	4	3350	
1150	3	3400	
1200	2	3450	
1250	3	3500	
1300	1	3550	
1350	3	3600	
1400	2	3650	
1450	3	3700	
1500	2	3750	
1550	3	3800	
1600	3	3850	
1650	4	3900	
1700	4	3950	
1750	7	4000	
1800	8	4050	
1850	11	4100	
1900		4150	
1950		4200	
2000		4250	
2050		4300	
2100		4350	
2150		4400	
2200		4450	
2250		4500	



PROBE DESCRIPTION:
9 kg Hammer falling half a metre to a steel anvil, driving a 16 mm diameter rod fitted with a 20 mm diameter cone.

aurecon

Client	SCALA PROBE	
Foodstuffs		
Location: Westwood Development - Blenheim	No: SP 3	A4
Tester: SAH / AC	Date: 24 May 2011	Job Number: 221198	Rev: 1

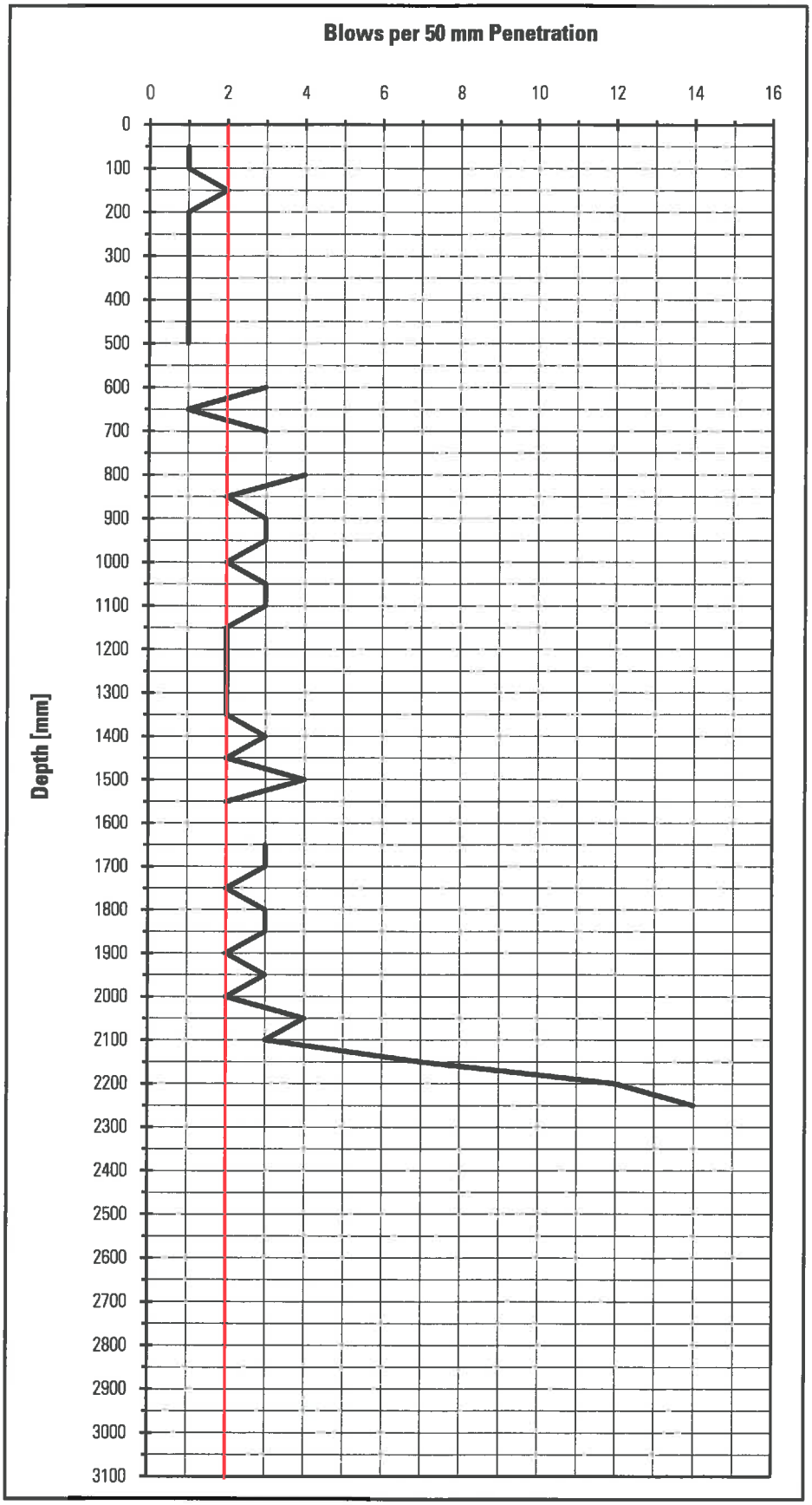
Site Description:

Refer attached site plan.

RL:

Notes:

Depth (mm)	Blows (no.)	Depth (mm)	Blows (no.)
50	1	2300	14
100	1	2350	
150	2	2400	
200	1	2450	
250	1	2500	
300	1	2550	
350	1	2600	
400	1	2650	
450	1	2700	
500	1	2750	
550		2800	
600	3	2850	
650	1	2900	
700	3	2950	
750		3000	
800	4	3050	
850	2	3100	
900	3	3150	
950	3	3200	
1000	2	3250	
1050	3	3300	
1100	3	3350	
1150	2	3400	
1200	2	3450	
1250	2	3500	
1300	2	3550	
1350	2	3600	
1400	3	3650	
1450	2	3700	
1500	4	3750	
1550	2	3800	
1600		3850	
1650	3	3900	
1700	3	3950	
1750	2	4000	
1800	3	4050	
1850	3	4100	
1900	2	4150	
1950	3	4200	
2000	2	4250	
2050	4	4300	
2100	3	4350	
2150	7	4400	
2200	12	4450	
2250	14	4500	



PROBE DESCRIPTION:
9 kg Hammer falling half a metre to a steel anvil, driving a 16 mm diameter rod fitted with a 20 mm diameter cone.

aurecon

Client: Foodstuffs		SCALA PROBE
Location: Westwood Development - Blenheim	No: SP 4	A4
Tester: SAH / AC	Date: 24 May 2011 / Job Number: 221198	Rev: 1

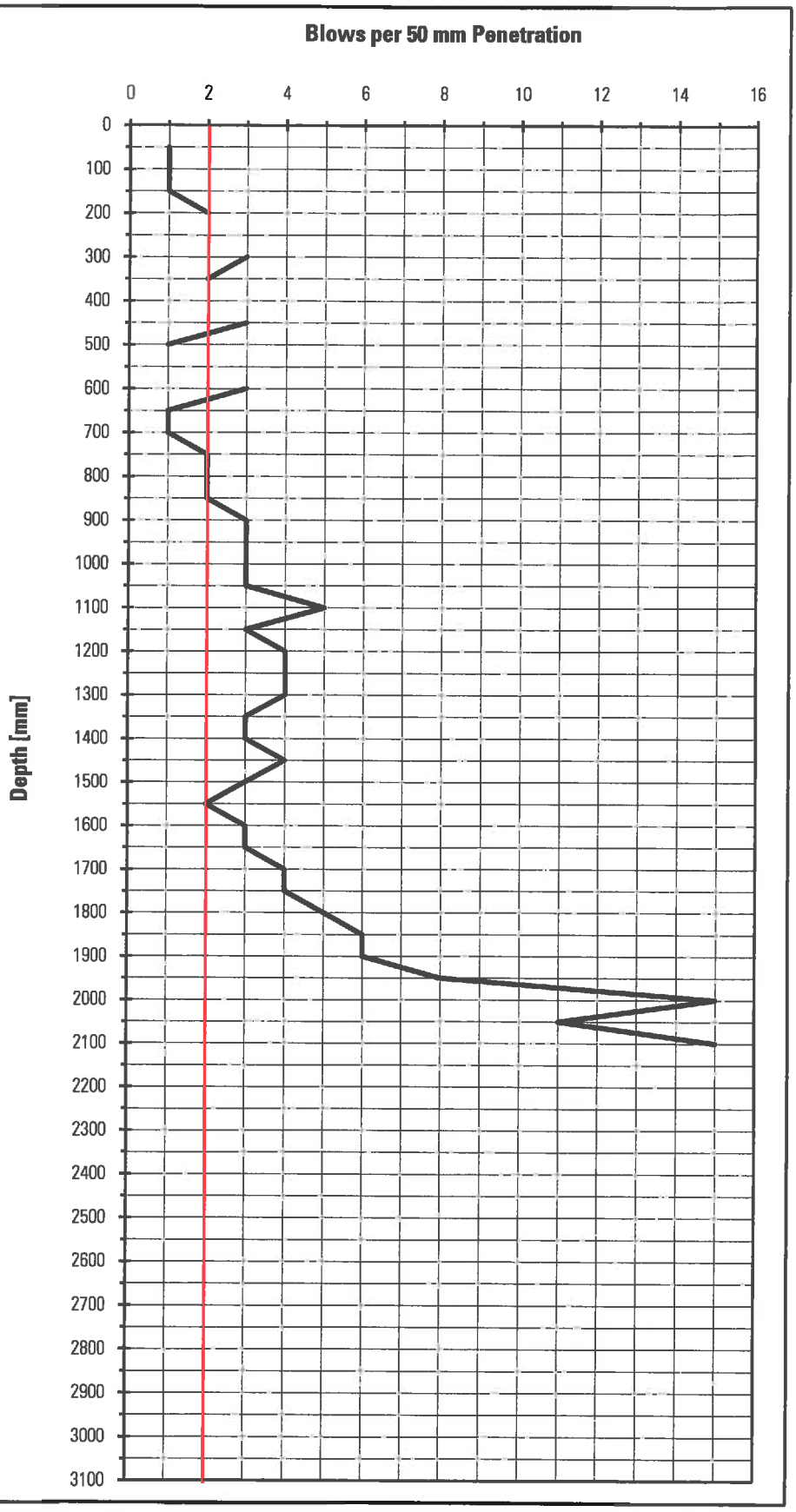
Site Description:

Refer attached site plan.

RL:

Notes:

Depth (mm)	Blows (no.)	Depth (mm)	Blows (no.)
50	1	2300	
100	1	2350	
150	1	2400	
200	2	2450	
250		2500	
300	3	2550	
350	2	2600	
400		2650	
450	3	2700	
500	1	2750	
550		2800	
600	3	2850	
650	1	2900	
700	1	2950	
750	2	3000	
800	2	3050	
850	2	3100	
900	3	3150	
950	3	3200	
1000	3	3250	
1050	3	3300	
1100	5	3350	
1150	3	3400	
1200	4	3450	
1250	4	3500	
1300	4	3550	
1350	3	3600	
1400	3	3650	
1450	4	3700	
1500	3	3750	
1550	2	3800	
1600	3	3850	
1650	3	3900	
1700	4	3950	
1750	4	4000	
1800	5	4050	
1850	6	4100	
1900	6	4150	
1950	8	4200	
2000	15	4250	
2050	11	4300	
2100	15	4350	
2150		4400	
2200		4450	
2250		4500	



PROBE DESCRIPTION:
9 kg Hammer falling half a metre to a steel anvil, driving a 16 mm diameter rod fitted with a 20 mm diameter cone.

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Client	SCALA PROBE	
Foodstuffs		
Location: Westwood Development - Blenheim	No: SP 5	A4
Tester: SAH / AC	Date: 24 May 2011	Job Number: 221198	Rev: 1

BC120191

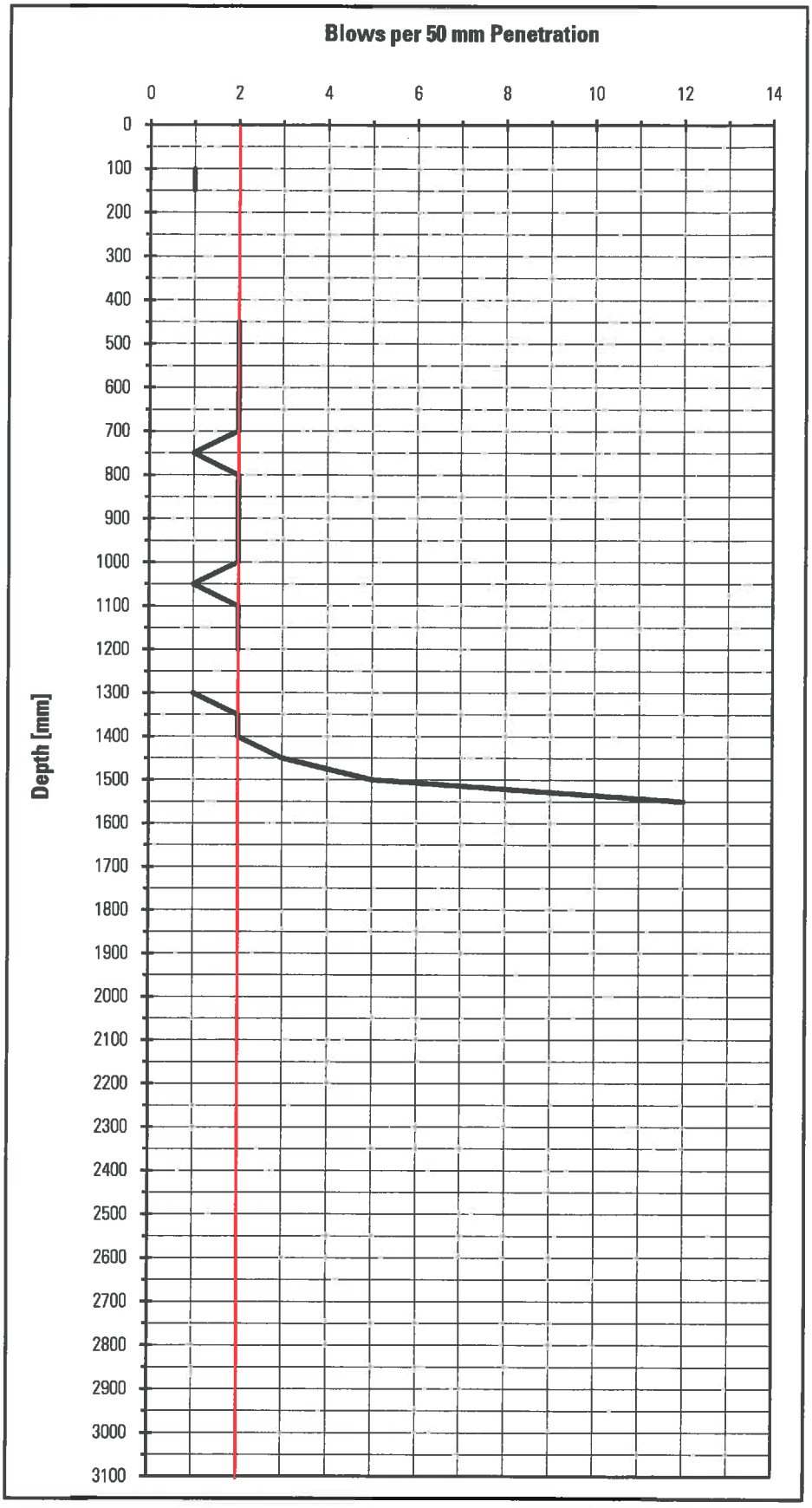
Site Description:

Refer attached site plan.

RL:

Notes:

Depth (mm)	Blows (no.)	Depth (mm)	Blows (no.)
50		2300	
100	1	2350	
150	1	2400	
200		2450	
250		2500	
300		2550	
350	4	2600	
400		2650	
450	2	2700	
500	2	2750	
550	2	2800	
600	2	2850	
650	2	2900	
700	2	2950	
750	1	3000	
800	2	3050	
850	2	3100	
900	2	3150	
950	2	3200	
1000	2	3250	
1050	1	3300	
1100	2	3350	
1150	2	3400	
1200	2	3450	
1250		3500	
1300	1	3550	
1350	2	3600	
1400	2	3650	
1450	3	3700	
1500	5	3750	
1550	12	3800	
1600		3850	
1650		3900	
1700		3950	
1750		4000	
1800		4050	
1850		4100	
1900		4150	
1950		4200	
2000		4250	
2050		4300	
2100		4350	
2150		4400	
2200		4450	
2250		4500	



PROBE DESCRIPTION:
9 kg Hammer falling half a metre to a steel anvil, driving a 16 mm diameter rod fitted with a 20 mm diameter cone.

aurecon

Client: Foodstuffs		SCALA PROBE	
Location: Westwood Development - Blenheim		No: SP 6	A4
Tester: SAH / AC	Date: 24 May 2011	Job Number: 221198	Rev: 1

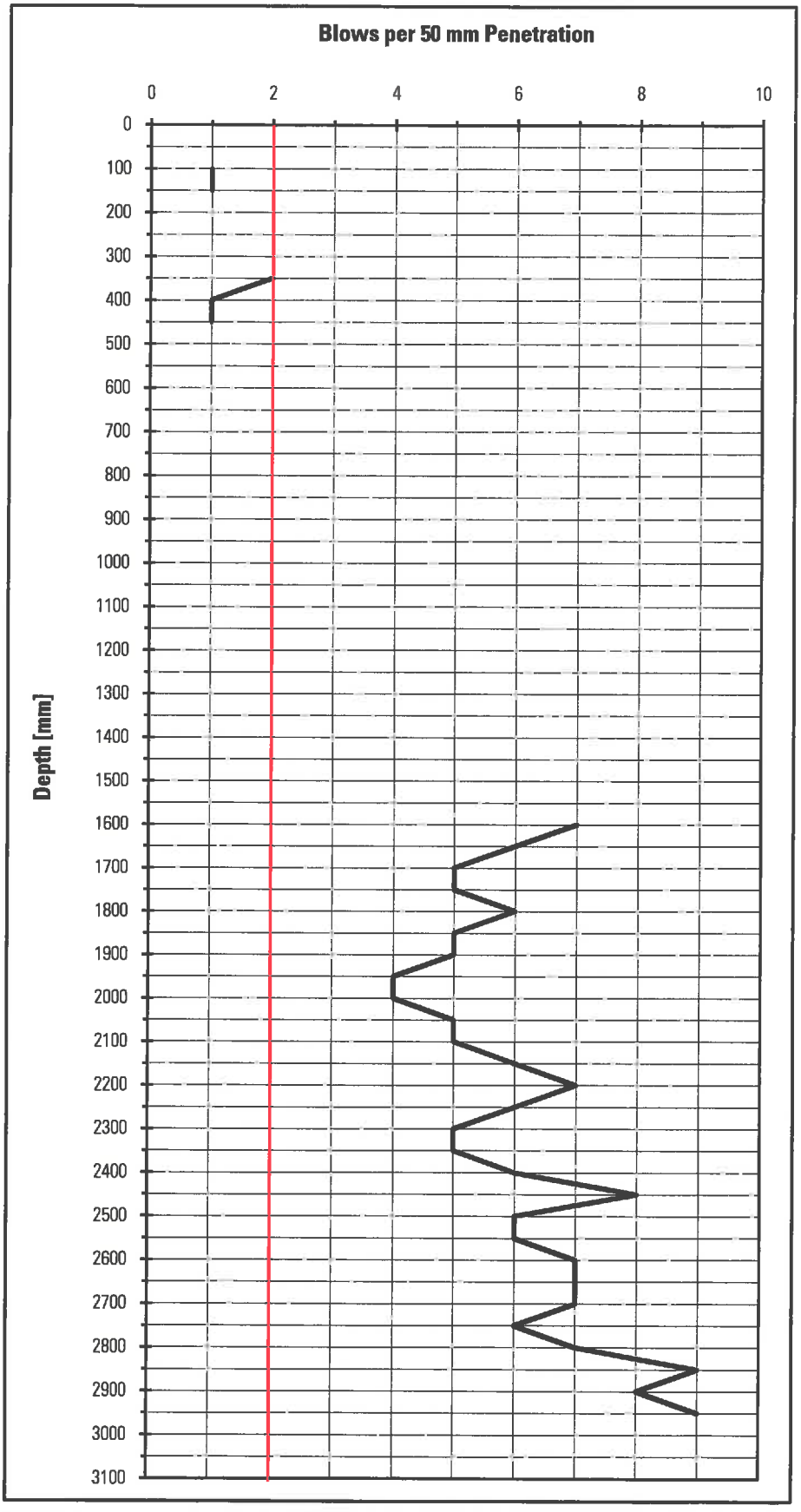
Site Description:

Refer attached site plan.

RL:

Notes:

Depth (mm)	Blows (no.)	Depth (mm)	Blows (no.)
50		2300	5
100	1	2350	5
150	1	2400	6
200		2450	8
250		2500	6
300		2550	6
350	2	2600	7
400	1	2650	7
450	1	2700	7
500		2750	6
550		2800	7
600	4	2850	9
650		2900	8
700	3	2950	9
750		3000	
800		3050	
850		3100	
900	5	3150	
950		3200	
1000		3250	
1050		3300	
1100	4	3350	
1150		3400	
1200	3	3450	
1250		3500	
1300	5	3550	
1350		3600	
1400	4	3650	
1450		3700	
1500	5	3750	
1550		3800	
1600	7	3850	
1650	6	3900	
1700	5	3950	
1750	5	4000	
1800	6	4050	
1850	5	4100	
1900	5	4150	
1950	4	4200	
2000	4	4250	
2050	5	4300	
2100	5	4350	
2150	6	4400	
2200	7	4450	
2250	6	4500	



PROBE DESCRIPTION:
9 kg Hammer falling half a metre to a steel anvil, driving a 16 mm diameter rod fitted with a 20 mm diameter cone.

aurecon

Client: Foodstuffs		SCALA PROBE
Location: Westwood Development - Blenheim	No: SP 7	A4
Tester: SAH / AC	Date: 24 May 2011 / Job Number: 221198	Rev: 1

Site Description:

Refer attached site plan.

RL:

Notes:

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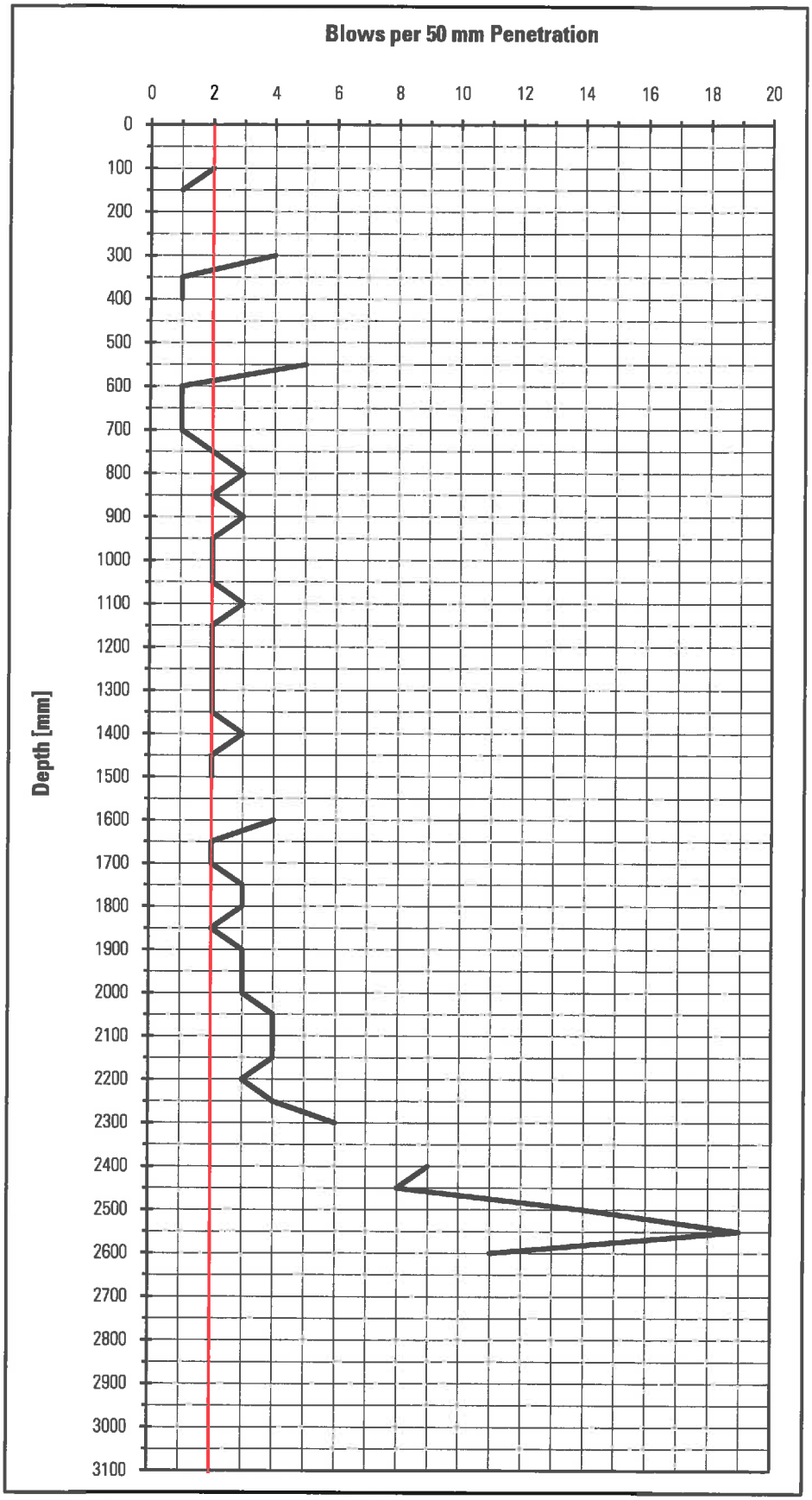
Depth (mm)	Blows (no.)	Depth (mm)	Blows (no.)
50		2300	6
100	2	2350	
150	1	2400	9
200		2450	8
250		2500	14
300	4	2550	19
350	1	2600	11
400	1	2650	
450		2700	
500		2750	
550	5	2800	
600	1	2850	
650	1	2900	
700	1	2950	
750	2	3000	
800	3	3050	
850	2	3100	
900	3	3150	
950	2	3200	
1000	2	3250	
1050	2	3300	
1100	3	3350	
1150	2	3400	
1200	2	3450	
1250	2	3500	
1300	2	3550	
1350	2	3600	
1400	3	3650	
1450	2	3700	
1500	2	3750	
1550		3800	
1600	4	3850	
1650	2	3900	
1700	2	3950	
1750	3	4000	
1800	3	4050	
1850	2	4100	
1900	3	4150	
1950	3	4200	
2000	3	4250	
2050	4	4300	
2100	4	4350	
2150	4	4400	
2200	3	4450	
2250	4	4500	



PROBE DESCRIPTION:
9 kg Hammer falling half a metre to a steel anvil, driving a 16 mm diameter rod fitted with a 20 mm diameter cone.

aurecon

Client: Foodstuffs		SCALA PROBE	
Location: Westwood Development - Blenheim		No: SP 8	A4
Tester: SAH / AO	Date: 24 May 2011	Job Number: 221198	Rev: 1

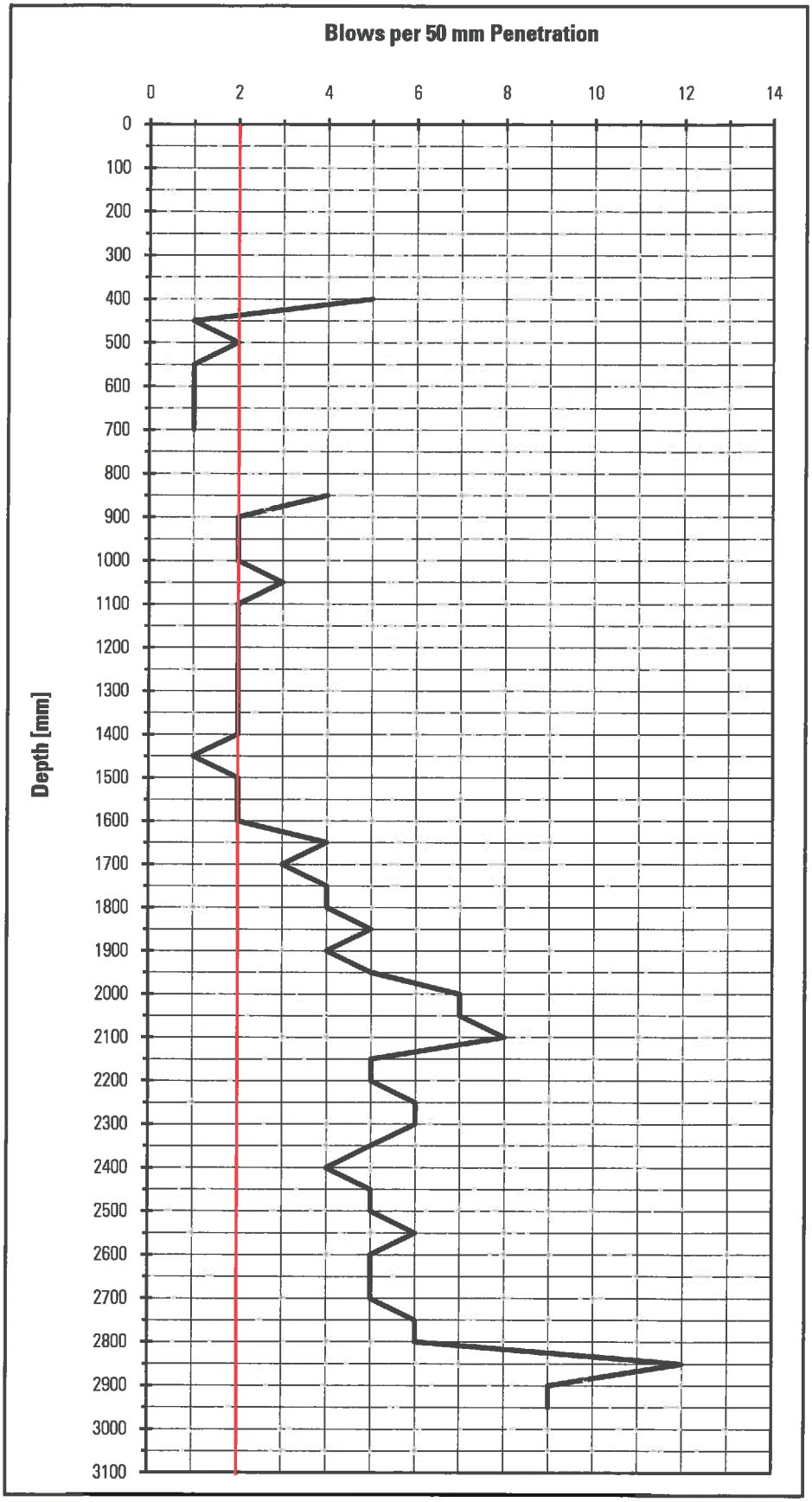
Site Description:

Refer attached site plan.

RL:

Notes:

Depth (mm)	Blows (no.)	Depth (mm)	Blows (no.)
50		2300	6
100	1	2350	5
150		2400	4
200	1	2450	5
250		2500	5
300		2550	6
350		2600	5
400	5	2650	5
450	1	2700	5
500	2	2750	6
550	1	2800	6
600	1	2850	12
650	1	2900	9
700	1	2950	9
750		3000	
800		3050	
850	4	3100	
900	2	3150	
950	2	3200	
1000	2	3250	
1050	3	3300	
1100	2	3350	
1150	2	3400	
1200	2	3450	
1250	2	3500	
1300	2	3550	
1350	2	3600	
1400	2	3650	
1450	1	3700	
1500	2	3750	
1550	2	3800	
1600	2	3850	
1650	4	3900	
1700	3	3950	
1750	4	4000	
1800	4	4050	
1850	5	4100	
1900	4	4150	
1950	5	4200	
2000	7	4250	
2050	7	4300	
2100	8	4350	
2150	5	4400	
2200	5	4450	
2250	6	4500	



PROBE DESCRIPTION:
9 kg Hammer falling half a metre to a steel anvil, driving a 16 mm diameter rod fitted with a 20 mm diameter cone.

aurecon

Client: Foodstuffs		SCALA PROBE	
Location: Westwood Development - Blenheim		No: SP 9	A4
Tester: SAH / AC	Date: 24 May 2011	Job Number: 221198	Rev: 1