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GEOTECHNICAL INVESTIGATION REPORT

JOB TITLE	NEWMAN SUBDIVISION GEOTECH
ADDRESS	PT SECTION 1 SO 23541 MCDONNELL ROAD ARROWTOWN
JOB NUMBER	50595
	13 February 18

Client: Richard Newman

C/- Clark Fortune Macdonald and Associates

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50595 Newman Subdivision Geotech Report

1. INTRODUCTION

This report presents the results of a geotechnical investigation carried out by RDAgritech on behalf of Richard Newman for the proposed residential development located on McDonnell Road, Arrowtown as indicated on the site plan in Appendix A. The proposed development consists of a 13 Lot subdivision which will be utilised for residential dwellings on 3,714 m^2 to 5,312 m^2 sections.

The work was commissioned by Richard Newman in a signed SFA, dated 6 December 2017. Clark Fortune McDonald and Associates provided a site plan of the proposed development.

The initial scope of work for the geotechnical investigation report included providing recommendations on:

A Geotechnical Investigation of the proposed residential subdivision development in accordance with QLDC land development and subdivision standards comprising:

- Site walkover by an Engineering Geologist to determine onsite hazards;
- Desktop study of previously reported Hazards and the QLDC Webmaps;
- A minimum of thirty Scala penetrometer tests to establish bearing capacity beneath the building platforms and likely CBR strengths for pavement design;
- A minimum of twelve test pits to investigate soils beneath the building platforms and depths of any fill placed;
- Reporting on the geotechnical conditions for the subdivision development, with documentation suitable for inclusion in a Resource Consent application.

RDAgritech conducted the work in general accordance with our proposal, reference 50595, Newman Subdivision Geotech, dated 15 November 2017.

1.1. PROPOSAL

The proposed residential development consists of subdividing an existing property into a 13 Lot subdivision located south east of Arrowtown located off McDonnell Road.

Access to the site is directly off McDonnell Road and enters the site along the southern boundary via an existing driveway. Three arterial ROW's originating from the existing access way are indicated on the subdivision plan to provide access to all lots.

The survey plans contain more details on the proposal and these are attached in the appendices. Our investigation has been based on the set issued to us on 6 June 2017 and dated 3 June 2017.

The following report presents the results of field investigations and provides discussion and recommendations relevant to the above scope of work.

1.2. LIMITATIONS

Findings presented as a part of this report are for the sole use of Richard Newman in accordance with the specific scope and the purposes outlined above. While other parties may find this reporting useful the findings are not intended for use by other parties, and may not contain sufficient information for the purposes of other parties or other uses.

Our professional services are performed using a degree of care and skill normally exercised, under similar circumstances, by reputable consultants practicing in this field at this time. No other warranty, expressed or implied, is made as to the professional advice presented in this report.

1.3. RELATED DOCUMENTS

In this report, reference is made to the following documents:

- NZS 3604: 2011 Timber Framed Buildings,
- NZS 1170.5: 2012 Structural design actions Part 5 Earthquake actions – New Zealand
- NZS 4431:1989 and amendments. Code of Practice for Earthfill for Residential Development.
- QLDC COP for Land Development and Subdivision
- Canterbury Guidance – Technical Guidance Part A
- Geology of the Wakatipu area 1:250,000 QMap (Qm18), GNS Science: 2000

2. SITE INFORMATION

- The site is located on McDonnell Road, PT Section 1 SO 23541;
- The site covers an area of approximately 6.54 ha;
- The site has an existing dwelling positioned midway along the southern boundary of the site at the end of the existing site entrance;
- The site has a full cover of grass and mature tree lines along the south and north west boundaries;
- The sites to the north east consist of established residential dwellings. A Golf course is located across the west boundary and farm land surrounds the remainder of the site;
- The highest elevation across the site is located within the south west corner at 411.00 m and decreases in elevation toward the north east where the approximate elevation is 394.00 m.
- There is a well-defined depression passing through the northern portion of the site which acts as a surface drain.

3. GEOLOGY

The geology of the site is mapped by the NZGS Qm18 indicates two geological units across the site. The southwest portion of the site is indicated as Late Pleistocene glacier deposits comprising: Unweathered to slightly weathered, loose, poorly sorted, boulder gravel, sand, and silt, (till); often with contorted bedding.

The north east portion of the site is indicated to consist of basement metamorphic rocks comprising of: Very well segregated and laminated, abundant politic and subordinate psammitic, grey schist, minor greenschist and metachert, TZ4.

The Qmap is at a 1:250,000 scale so only details the larger units present. Site investigations indicated alluvial materials which are interpreted to be overlying the glacial and basement deposits.

No active faults were mapped in the field, however, the active Cardrona fault shown on the published Qm 18 approximately 9km from the site. There is a significant seismic risk to the Wakatipu region when the rupture of the alpine fault system occurs; recent probability predictions estimate a magnitude 7.5 or greater is highly likely within the next 45 years. Significant ground shaking is expected from this type of event.

The site is located in an area of past glacial activity with several advance and retreat events causing the underlying bedrock to be scoured by glacial ice sheets resulting in the deposition of glacial sediments such as till over the schist bedrock and lacustrine and deltaic alluvial fan deposits.

Lacustrine sediments were not encountered during our limited depth investigations onsite.

4. FIELDWORK

Fieldwork carried out on 14 December 2017 and comprised of:

- Onsite review of available desktop information;
- Nine (9) test pits conducted with an excavator;
- Field testing with twenty eight (28) Scala penetrometer tests;
- A site walkover by an Engineering Geologist.

All field work was carried out in the fulltime presence of an RDAgritech representative who located the test pit and Scala penetrometer sites and produced Geological Logs of the test pits, which are contained in Appendix B.

Approximate locations are shown on the Test Location Plan in Appendix A.

5. RESULTS OF INVESTIGATION

5.1. SURFACE CONDITIONS

The surface conditions at the time of site visit, were as follows:

- As the topographic plan indicates, the site topography is gently rolling;
- The central portion of the site, particularly where the existing dwelling is located, consists of minor ridges and knolls;
- A slope dipping north east is located within the south west corner of the site.

- An irrigation race is located along the south west corner of the site and was dry during our site visit. An intake pipe was located within the irrigation race which drained into a holding pond at the base of the slope. The pond was dry also.
- All proposed lots, except for the location of the existing dwelling, were vegetated with pasture. Along the highest portions of rolling topography, the grass was particularly sparse and brown compared to the vegetation within the gully areas where it was dense and green.
- The vegetation below the irrigation race was also noticeably greener than the vegetation above. The irrigation race is not a lined structure and was evidently seeping into the down slope soils.
- The northern portion of the site within Lot 11 consists of the lowest portion of an existing gully/depression. The lots influenced by the depression are 6 – 8 and 10 – 12.
- Groundwater was exposed within all lots located in the depression. A groundwater bore was located along the boundary of Lot 11 and 12.
- Mature trees were present along the north and south boundaries and within Lot 3 around the existing dwelling.
- A power substation is located north of the site, adjacent to Lot 11. A stormwater drain has been excavated along the boundary which disposes into the McDonnell Road stormwater culvert.
- Power lines extended across the site, parallel to the north west boundary. They exit the site to the north from Lot 5.

5.2. INTERPRETED SUBSURFACE CONDITIONS

The typical soil types encountered during the field investigations have been divided into six geotechnical units as summarised in Table 1. Geological Logs of the test pits are presented in Appendix B.

During the excavation of Test pits 1 - 4, the alluvial soils were collapsing into the excavation, unable to maintain the vertical excavated face of the pit wall. This is due to the free running gravel nature of the materials with insufficient fines present to bind the soils together.

TABLE 1 – SUMMARY OF GEOLOGICAL UNITS AND SOIL TYPES

UNIT	SOIL TYPE	DESCRIPTION
1	Topsoil	SILT; brown; organic; 50 mm rootlets throughout, organic
2	Loess Colluvium	SILT; light brown; massive; rootlets throughout; medium dense
3	Silt Alluvium	SILT; brown; massive; medium dense
4	Sand Alluvium	SAND; grey; fine grain sand; massive; dense to very dense
5	Alluvial Deposit	Silty cobbly GRAVEL; light brown; fine to coarse, sub angular to sub rounded gravel; sub angular to sub rounded cobbles; medium dense to very dense
6	Alluvial Deposit	Sandy Cobbly GRAVEL; grey/brown; medium to coarse grain sand; fine to coarse sub angular to sub rounded gravel; sub angular to sub rounded cobbles; medium dense to very dense

TABLE 2 – SUMMARY OF DISTRIBUTION OF GEOLOGICAL UNITS ENCOUNTERED AT TEST PIT LOCATIONS

TEST PIT LOCATION	DEPTH ENCOUNTERED BELOW EXISTING GROUND LEVEL (m)					
	UNIT 1	UNIT 2	UNIT 3	UNIT 4	UNIT 5	UNIT 6
TP1	0.0 - 0.2	0.2 - 0.6	-	-	0.6 – 1.1	1.1 - >2.3
TP2	0.0 - 0.2	0.2 – 0.4	-	-	0.4 – 0.6	0.6 – >2.5

TP3	0.0 - 0.2	0.2 – 0.4	-	-	0.5 – 1.0	1.0 - >1.6
TP4	0.0 – 0.2	0.2 – 0.3	-	-	0.3 – 0.5	0.5 - >1.9
TP5	0.0 - 0.2	0.2 – 0.4	-	-	0.4 – 0.9	0.9 - >2.9
TP6	0.0 - 0.2	-	0.4 – 1.6	1.6 - >2.1	0.2 – 0.4	-
TP7	0.0 – 0.2	-	-	-	0.2 – 0.8	0.8 – >2.0
TP8	0.0 – 0.2	0.2 – 0.8	-	0.8 – >1.9	-	-
TP9	0.0 – 0.2	0.2 – 0.7	-	1.1 - >3.3	0.7 – 1.1	-
- NOT ENCOUNTERED > UNIT EXTENDS BELOW DEPTH OF TEST PIT						

5.3. EXISTING FILL

Existing earthfill was not encountered within the test pits conducted and it is inferred that the investigation area which broadly consists of a paddock utilised for grazing, has not received any major earthworks. Located within Lot 4, the existing irrigation holding pond has excavated material located around the perimeter. The excavated material should not be utilised as structural earthfill during preparation of building platforms due to the likely organic content of this material.

It is likely that earthfill is present within Lot 3, within and adjacent to the existing dwelling, however investigations into Lot 3 were not required for this reporting as it is an existing dwelling to be encompassed into this new subdivision.

If earthfill is encountered during proposed site works and particularly within the proposed building platforms, it should be inspected by suitably qualified Geo-professional. Documents should be sourced that indicate earthfill has been placed and compacted in accordance with NZS4431:1989. If no documents are available, the Geo-professional will determine the nature and conditions of use for this (if any).

6. GROUNDWATER

The test pits conducted within the depression indicated inflow of groundwater when the fine grain sand material (Sand Alluvium) was exposed. The fine grain sand indicated it had greater permeability than the overlying silt material and topsoil capping. The silt material, labelled as Loess, was dry/moist indicating the underlying groundwater had not risen high enough to reach this layer into the soil.

Whilst conducting the test pit within Lot 7, following excavation through capping layer, groundwater rapidly flowed into the pit when the fine grain sand was exposed 1.6m below the existing ground level. The capping silt layer acts as a hydraulic aquitard, significantly restricting flow through to the surface.

Within the Lot 11 test pit, which is approximately 1.5 to 2.0 m below the level of the test pit conducted within Lot 7, following removal of the silt capping layer, the pit began filling with groundwater to within 800 mm of the existing ground surface.

The soils within areas with shallow groundwater consisted of a massive fine grain sand. The adjacent areas across the site elevated above the depressions consisted of dry to moist gravel which had no trace of groundwater seepage.

As indicated in the site plan attached, the proposed building platforms along the north west portion of the subdivision are partly founded across the existing depression.

The finished ground level across the proposed lots within the depression should be raised slightly above the natural contour to shed any resultant overland flow away from the platforms and advice to earthworks contractors to limit services trenches and other excavations to within the silt capping layer to prevent encountering the groundwater surface.

An existing pump shed is located along the north west boundary of Lot 12. It is likely that a bore within the pump shed is pumping groundwater up to the existing dwelling for irrigation and stock water. The depth of the bore is unknown.

It should be noted that fluctuations in the groundwater levels can occur as a result of seasonal variations, temperature, rainfall and other similar factors. Is it likely that lots located on higher elevated ground such as Lots 2, 4 and 9, have sufficient clearance from groundwater and would not result in surface flooding from high groundwater levels.

Seasonal variations would likely affect the lots located within the depression and low lying areas of the site with saturation of these soils likely to result in surface ponding during the wetter periods of the year. There is no evidence to suggest the sites are susceptible to flooding.

7. DISCUSSION AND RECOMMENDATIONS

7.1. SITE PREPARATION

Site preparation and earthworks suitable for structure and pavement support should consist of:

- Undercutting and removing any earthfill encountered on site. As indicated above, no earthfill was encountered on site however, if any is exposed during site development, advice from a Geo-professional should be sought to determine the quality of the material;
- Prior to the placement of any new structural fill, the proposed areas should be stripped to remove all vegetation, topsoil, buried topsoil and root affected or other potentially deleterious material including the existing fills. Stripping is generally expected to be required to depths of about 0.1 m to 0.2 m;
- New site fill beneath structures should be placed and compacted to a minimum density ratio of 95% Standard Compaction and within acceptable limits of Optimum Moisture Content; in accordance with NZS4431 and if over 0.6m deep be certified in accordance with the standard.
- All new structural fill should be supported by properly designed and constructed retaining walls or else battered at 1V:2H or flatter and protected against erosion were cuts or Fills are near slope edges.
- Earthworks and landscaping fills not requiring certification should be in accordance with the recommendations of NZS 4431:1989 '*Earth Fill for Residential development'*. With particular emphasis on benching into steep slopes and appropriate drainage being installed.

7.2. EXCAVATION CONDITIONS

Where excavation is required, it is anticipated that the upper soil materials could be excavated by conventional dozer blade or excavator (3.5 tonne) bucket at least to the depths indicated on the appended logs using a toothed bucket. The depths of topsoil material, fill and levels of refusal where encountered during field work are summarised in Table 2.

It is expected that Haast Schist bedrock is located within 5.0 m of the surface. Bedrock was not exposed during our investigation although bedrock was exposed surrounding the site and it is inferred that the shallowest bedrock across site, is located within the largest knolls throughout the central portion of the site.

7.3. SUITABILITY OF SITE SOILS AS FILL

The following comments are made regarding the suitability of the site materials for reuse in filled areas:

- Where site regrade is proposed, topsoil, buried topsoil and vegetation or other potentially deleterious material (Unit 1) should be removed to spoil or stockpiled for reuse as landscaping materials only. Stripping is generally expected to be required to depths of about 0.2 m;
- The underlying fine grain material, Unit 2, 3 and 4 should also be utilised as landscaping materials. Silt and fine grain sand are suitable earthfill materials, however the time of year and moisture condition would need to be carefully controlled during placement and compaction to avoid heaving.
- Unit 5 and 6, the alluvial material is suitable to be placed and compacted as engineered earthfill in accordance with NZS4431:1989. The material should be stockpiled separately to the materials indicated above.
- Exposed natural soils should be appropriately protected from erosion by suitable batter slope formation, diversion drainage to intercept overland flows and covering the exposed soils with suitable vegetation/landscaping; appropriate batter angles are detailed below in section 7.8;
- Earthworks on the site should be in accordance with the recommendations of NZS 4431:1989. From site stripping, stockpiling, fill placement, removal of surpluses off site, protection of the excavation surfaces and surface water control;
- Should fill be supporting of structures then certification in accordance with NZS 4431:1989 will also need to be undertaken.

7.4. NATURAL HAZARDS

Review of the Queenstown Lakes District Council webmap shows one natural hazard identified across the west portion of the site.

Liquefaction Category: LIC 1 has been identified on the QLDC website. The risk description is nil to low risk for the site which is considered to be less than minor. We would agree with the nil to low risk assessment as the soil and groundwater conditions for liquefaction are not present within this area.

A seismic ground shaking risk for the Wakatipu region on the whole has been identified and prudent design to mitigate the risk of seismic ground shaking should be applied to all proposed structures. Design to the relevant structural and building codes is expected to mitigate this issue.

Freeze and thaw effects are relevant for the region and it is recommended that all NZS3604 foundations are embedded at least 0.4m below finished ground levels with careful consideration given to final ground level clearances from exterior claddings.

With the current topography across the site, overland flow is expected during high rainfall events. However, it is recommended that any potential overland flow paths are either piped or regraded away from the building platforms and associated landscaping structures.

7.5. SUBSOIL SUBCLASS FOR SEISMIC DESIGN

Soils in this site are considered to fall in the site subsoil 'Class C – Shallow Soil sites' in accordance with NZS 1170.5.2012.

Bedrock was not encountered during our investigation however outcrops are present on surrounding properties and the knolls located across the site are considered to consist of Haast Schist Bedrock.

7.6. FOUNDATION DESIGN OPTIONS & PARAMETERS

At the time of preparation of this geotechnical investigation report, there were no development plans of specific site buildings for each lot. The foundations for each residential lot are expected to be shallow strip, raft or waffle slab style footings with associated retaining measures for sloping sites. Dependant on the required finished floor levels (FFL), fill may be placed in accordance with NZS4431:1989 to achieve the correct FFL.

For the locations where 300 kPa bearing capacity (geotech ultimate bearing capacity) soils were relatively shallow, shallow strip footings may be used as the foundation type. The subgrade within Lot 10, 11, 12, 13 would be able to utilise the shallow strip footings.

Technical Categories from Canterbury may also be utilised to define the required foundation types where 300 kPa geotech ultimate bearing capacity soils were not encountered directly below the topsoil.

Due to the varying depth of 300 kPa geotech ultimate bearing capacity across the site, replacement of upper materials required to increase bearing is an option. TC2 options available that are likely to be suitable for the site.

Reinforced concrete floor in the TC2 classification indicates options where TC2 soils are present:

Option 1:

- Undercut a minimum of 800 mm from the underside of the foundation and replace with engineered earthfill. The subgrade below the earthfill must have a minimum of 200 kPa geotech ultimate bearing capacity. A layer of geogrid is also required in the design.

Option 2:

- Increase the thickness of the foundation slab. The ground immediately below the slab must have a minimum geotechnical ultimate bearing capacity of 200 kPa. Where a two storey heavy-weight dwelling is proposed, the slab thickness needs to increase to 400 mm thick.

Option 3:

- Construct a generic beam grid and slab foundation. The soil underlying the slab must have a geotech ultimate bearing capacity of 200 kPa. The post-tensioned slabs are tensioned to overcome drying shrinkage and give some bridging capacity.

Option 4:

- Following a topsoil strip, if 200 kPa geotech ultimate bearing capacity soils are present, a waffle style slab is possible to be utilised. Waffle style slabs are readily utilised in the Wakatipu due to a variety of reasons including thermal efficiency as well as lower bearing capabilities.

Option 5:

- Deep piles which would target a dense layer of material, either driven or augered.

7.7. BEARING CAPACITY STRESSES AND SETTLEMENT

The Scala Penetrometer results across the site generally show that soils do not meet the requirements for 'good ground' in accordance with NZS3604:2011. This is due to the bearing capacities indicated in the Scala penetrometer testing to be less than 300 kPa at varying depths.

As indicated within Lot 8, SP19 and SP20 indicated varying depths to suitable bearing strata as SP19 indicates 1.25 m of variable material is located within the upper portion of the test whereas SP20 indicates 'good ground' is exposed 0.35 m below the surface.

Where 'good ground' was not exposed, bearing capacities ranging between 200 kPa and 250 kPa geotech ultimate bearing capacity were present.

At the time of construction all foundation excavation subgrades should be inspected by a suitably qualified Geoprofessional to ensure foundation conditions are as reported and the appropriate design assumptions for bearing capacity by the structural engineer are met.

Any foundations on fill shall have the fill placed and compacted in accordance with NZS4431:1989 with certification by a suitable qualified engineer if depths of 600mm are required.

Settlement is expected to be within limits set by NZS3604:2011 for the above allowable bearing capacity stresses.

All foundation excavation subgrades should be inspected by a suitably qualified geotechnical professional to ensure foundation conditions are as reported.

7.8. GEOTECHNICAL SOIL PARAMETERS

Geotechnical Soil parameters for retaining design are tabulated below:

TABLE 3 GEOTECHNICAL SOIL PARAMETERS

SOIL/ROCK TYPE	BULK DENSITY (KN/M^3)	EFFECTIVE COHESION (KPA)	EFFECTIVE FRICTION ANGLE ($^{\circ}$)
Topsoil/Fill	15.5	-	25
Engineered Fill	18	0	35
Loess Colluvium	17	0	31
Alluvial Deposit	18.5	0	27
Sand Alluvium	18	0	30
Silt Alluvium	18	0	27

A suitably qualified geotechnical Professional will be required to assess excavations into the alluvial gravel material where excavations exceed 1.5m deep due to the free running nature of the materials when unconfined as mentioned in Section 5.2.

All retaining structures should be designed by a suitably qualified Engineer and have full height of retaining drainage measures installed with a collection drain at the base, to suitable outfall to the stormwater system.

7.9. SUITABILITY FOR ONSITE STORMWATER DISPOSAL

Onsite disposal has been suggested as the stormwater disposal system. It is recommended that stormwater is disposed into the relatively free draining alluvial gravel within each lot. Further recommendations for stormwater disposal are discussed in the RDAgritech report titled "Newman Subdivision Geotech Stormwater" attached separately.

7.10. RETAINING

The existing plans do not indicate any locations where retaining will be required as part of initial subdivision development applications.

7.11. BATTER SLOPE ANGLES

At this stage no earthworks are proposed across the lots with the exception of roading access ways. Landscaping mounds are still subject to confirmation, however are not proposed at this stage. Should any of this change please advise us to amend this assessment and reporting.

However, if individual lot owners are performing earthworks then the following would apply.

Temporary and permanent batter angles are summarised in the table below up to a maximum cut height of 3.0 m in fully drained conditions. Batters greater than 3.0 m high will need specific inspection and assessment by a suitably qualified geotechnical professional during construction. Where more than one soil type is present in the batter slope the batter must still be to the slopes recommended for each type.

As indicated in the attached test pit logs, the alluvial gravel across the site was unable to be cut vertically whilst conducting test pits. Therefore, it is recommended that the batter angles indicated in Table 4 are followed whilst conducting excavations and preparing batters on site. This would be prudent for services installations such as power and telecom contractors to be aware of the groundwater and trench collapsing conditions.

Should water or seepage be encountered during excavation of the proposed batters then a Geoprofessional shall assess additional slope drainage requirements. The type, spacing and details would be confirmed at that stage.

Where steeper batters than those recommended are proposed then they will be subject to specific design by a geotechnical professional.

TABLE 4 BATTER ANGLE SUMMARY

MATERIAL TYPE	TEMPORARY CONSTRUCTION BATTERS (H):(V)	PERMANENT BATTERS (H):(V) (UNRETAINED)
Engineered Fill	1:1	2:1
Topsoil/Fill and Colluvium	1:1	2:1
Alluvial Gravel	1.5:1	2:1
Sand/Silt Alluvium	1:1	2:1

7.12. BUILDING PLATFORM ASSESSMENTS

The proposed building platforms have all been assessed for:

- Instability
- Inundation/Flooding
- Erosion
- Subsidence

We can confirm that natural instability, erosion and subsidence are not likely to affect the platforms.

Flooding is not likely to affect the platforms however during wet seasonal or weather events minor, saturation and surface ponding could be experienced in building platforms 7, 8, 10 and 11. For these we would recommend building platform levels are a nominal 0.5m above the existing ground levels within the depression areas and shaped to allow potential flows to follow the existing flow path.

7.13. ACESSWAY AND ROAD CBR STRENGTHS

Based on the site scala testing conducted an initial design CBR post topsoil stripping of 5 is expected for pavement design.

Further soaked CBR testing and laboratory testing should be conducted if further design recommendations are required for pavement design.

Insitu testing at subgrade exposure should be conducted to confirm the design CBR is achieved prior to pavement placement.

8. SITE MANAGEMENT

8.1. EROSION AND SEDIMENT CONTROL

Earthworks shall be undertaken in a controlled manner so that erosion of disturbed areas is kept to a practical minimum and eroded material is confined on site as far as possible. Haul roads shall be treated as disturbed areas. Without exception, any stormwater from disturbed areas shall be directed to temporary silt ponds with erosion and sediment controlled in accordance with the Resource consents and the Otago Regional Council and Queenstown Lakes District Council guidelines for sediment control from construction sites.

We would expect a construction management plan from the contractor to address any erosion and sediment control issues and mitigation required for construction.

8.2. DUST

Earthmoving should be carried out and haul roads and cut/fill areas maintained so that dust is not raised near or blown over the working area and adjacent properties. The site shall be kept watered as necessary to meet this requirement untill covered by dust-free materials, mulch, or established grass cover.

We would expect a construction management plan from the contractor to address any dust issues and mitigation required for construction.

8.3. NOISE

The development will have various noise producing activities when construction is underway. To minimise noise pollution to neighbouring sites, screening can be utilised to act as a barrier between the site and neighbouring properties. Location of stockpiles is also something to be considered when construction is underway as there is generally an increased amount of activity around the location of a stockpile.

Utilising appropriate construction times for noisy activities should also be conducted, we would expect a construction management plan from the contractor to address any noise issues and mitigation required for construction.

9. GEOTECHNCIAL CONSIDERATIONS FOR DEVELOPMENT

The following table sumarises the lots with SPECIFIC requirements for development. All lots are also subject to sections 7 to 9 above.

TABLE 5 SPECIFIC REQUIREMENTS FOR EACH LOT

LOT NUMBER	SPECIFIC RECOMMENDATIONS
12, 13	Only Sections 7 to 9 above apply. NZS3604:2011 design possible following exposure of good ground.
2, 4, 5, 6, 7, 8, 9, 10, 11 and 14	Specific Geotechnical Engineering and Design assessment of foundation in addition to sections 7 to 9 of this report Or Utilise the recommendations with Section 7.6 in relation to TC2 foundations
2, 4, 6, 9, 14	Up to 1.0 m of surface material to be undercut and replaced with NZS4431:1989 earthfill to allow for a NZS3604:2011 foundation

10. CONCLUSIONS

The proposed development and associated earthworks are considered geotechnically suitable for the site; and as long as the above considerations in Sections 7, 8, and 9 above are followed for design and construction, no adverse geotechnical effects are expected.

11. APPLICABILITY

This report is only to be used by the parties named above for the purpose that it was prepared and shall not be relied upon or used for any other purpose without the express written consent of the principal and RDAgritech Ltd.

The extent of testing associated with this assessment is limited to discrete locations and variations in ground conditions can occur between and away from such locations. If subsurface conditions encountered during construction differ from those given in this report further advice should be sought without delay.

12. PHOTOS

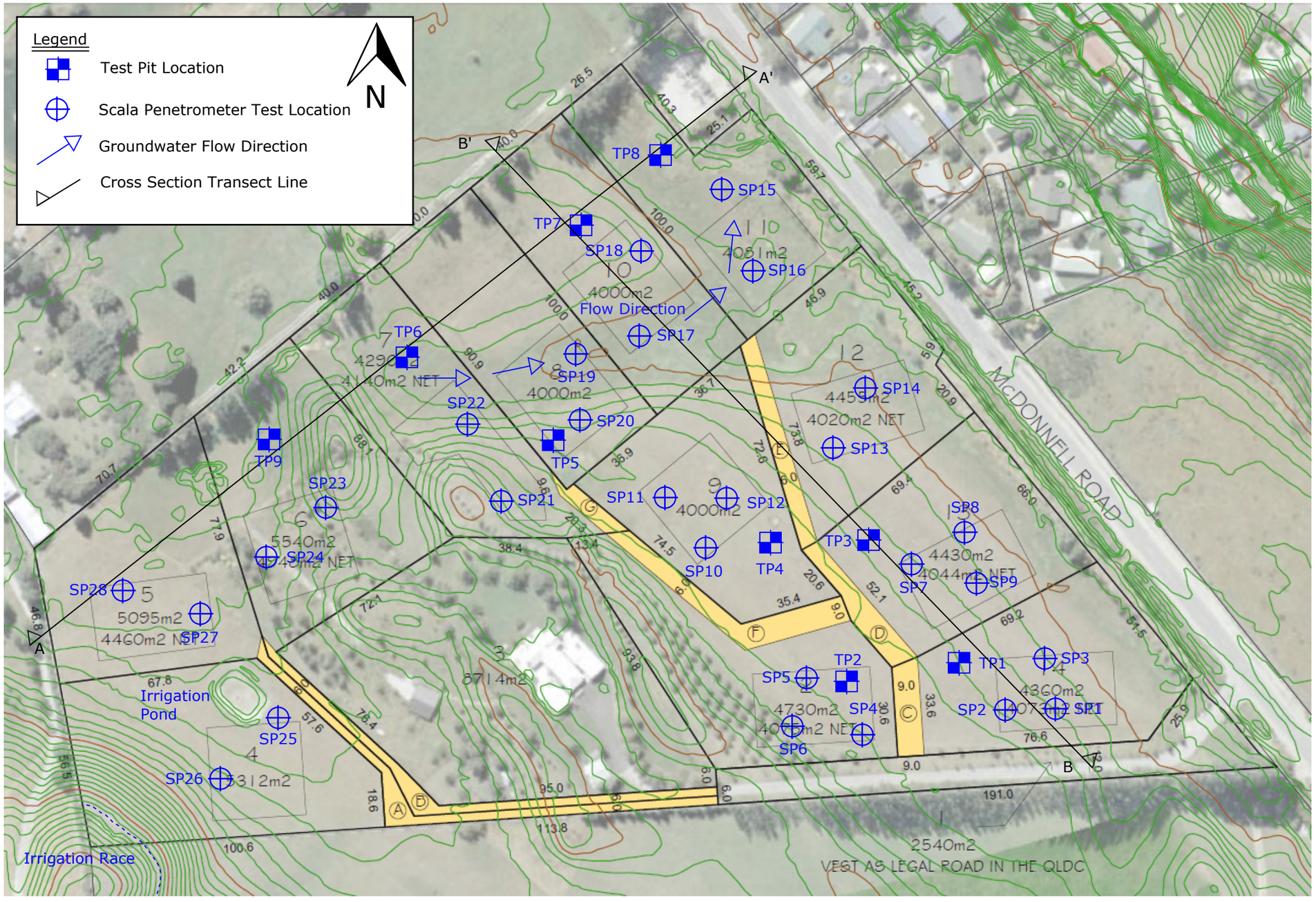
Photo 1: Looking south across Lot 2, indicates the gravel material excavated from Test Pit 2.

Photo 2: Looking south west across Lot 4 indicates green pasture where seepage from the existing water race is located.

Photo 3: Indicates groundwater 800 mm below surface of Test Pit 8

APPENDIX A. SITE PLANS

1. Testing Location Plan
2. Hazards Map



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			Scale: NTS
			Job No: 50595

Queenstown Lakes District Council

Webmaps your view of your information

Newman Subdivision Geotech - Hazard Plan

19 December 2017

0 20 40 60 80 Metres

N

Hazards

- 150 Year Flood Return Period
- 100 Year Flood Return Period
- 75 Year Flood Return Period
- 50 Year Flood Return Period
- Active Fault - Location approximate
- Inactive Fault - Location approximate
- Flooding due to Rainfall
- Flooding due to Damburst
- Landslide: Active Pre-existing Schist Debris Landslides
- Landslide: Pre-existing Schist Debris Landslides (Activity Unknown)
- Landslide: Dormant Pre-existing Schist Debris Landslides
- Landslide: Shallow Slips and Debris Flows in Colluvium
- Landslide: Debris Flow Hazards
- Landslide: Slope Failure Hazard in Superficial Deposits
- Landslide: Rockfall
- Landslide: Pre-existing or Potential Failure in Lake Sediments or Tertiary Sediments
- Landslide: Piping potential in the Artesian Zone of the Wanaka Aquifer
- Landslide: Potential Hazard - Debris Flood/Debris Flow
- Landslide Areas - non verified
- Contaminated Sites
- Potentially Contaminated Sites
- Managed Sites
- Landfill
- Erosion Areas
- Alluvial Fan - Incision Line
- Alluvial Fan - Channels
- Alluvial Fan - Source Area
- Alluvial Fan - Catchment Areas
- Alluvial Fan - Hazard Area
- Alluvial Fan - ORC: fan active bed
- Alluvial Fan - ORC: fan recently active
- Alluvial Fan - ORC: fan less recently active
- Alluvial Fan (Regional scale) Active, Composite
- Alluvial Fan (Regional scale) Active, Debris-dominated
- Alluvial Fan (Regional scale) Active, Floodwater-dominated
- Alluvial Fan (Regional scale) Inactive, Composite
- Alluvial Fan (Regional scale) Inactive, Debris-dominated
- Alluvial Fan (Regional scale) Inactive, Floodwater-dominated
- Avalanche Areas
- Liquefaction Risk: Nil to Low (T&T 2012)
- Liquefaction Risk: Probably Low (T&T 2012)
- Liquefaction Risk: Possibly Moderate (T&T 2012)
- Liquefaction Risk: Possibly High (T&T 2012)
- Liquefaction Risk: Possibly Susceptible (Opus 2002)
- Liquefaction Risk: Susceptible (Opus 2002)

APPENDIX B. TEST LOG SHEETS

1. Test Pit Logs (TP1-TP9)
2. Scala Penetrometer Logs (SP1-SP28)

TP-1

TEST PIT LOG

RDAgritech
ENGINEERED BY NATURE

JOB NUMBER: 50595	PROJECT:	Newman Subdivision Geotech	
	LOCATION:	McDonnell Road, Arrowtown	
CO-ORDINATES:	HOLE STARTED:	14-Dec-17	
Refer Investigation Site Plan	HOLE FINISHED:	14-Dec-17	
ELEVATION: m	OPERATOR:	Luke	
DATUM:	COMPANY:	C'n'R Earthwork	EQUIP.: 8T excavator

ENGINEERING DESCRIPTIONS							GEOLOGICAL
STRENGTH TESTING	GROUNDWATER	SAMPLES	DEPTH (m)	GRAPHIC LOG	SOIL / ROCK CLASSIFICATION, PARTICLE SIZE CHARACTERISTICS,PLASTICITY, COLOUR, WEATHERING, SECONDARY AND MINOR COMPONENTS	MOISTURE CONDITION	SOIL / ROCK TYPE, ORIGIN, DEFECTS, STRUCTURE, FORMATION
				ψψψψψ ψψψψψ	SILT; brown; organic; 50 mm rootlets throughout, organic	D	Topsoil
			0.4	xxxxxxxxx xxxxxxxxx xxxxxxxxx xxxxxxxxx	SILT; light brown; massive; rootlets throughout; medium dense to dense		Loess Colluvium
			0.8	xOooxOoo xOooxOoo xOooxOoo xOooxOoo xOooxOoo	Silty cobbly GRAVEL; light brown; fine to coarse, sub angular to sub rounded gravel; sub angular to sub rounded cobbles; very dense		Alluvial Deposit
			1.2	.Ooo.Ooo. .Ooo.Ooo. .Ooo.Ooo. .Ooo.Ooo. .Ooo.Ooo. .Ooo.Ooo. .Ooo.Ooo. .Ooo.Ooo. .Ooo.Ooo. .Ooo.Ooo.		Alluvial Deposit
			1.6 2.0 2.4		End of test pit, unable to excavate further due to sides of test pit collapsing		
			2.8 3.2 3.6 4.0				

OTHER COMMENTS:	Logged By:	MJD
	Checked Date:	13-Feb-18
PHOTO REF.:	Sheet:	1 of 1

TP-2

TEST PIT LOG

RDAgritech — ENGINEERED BY NATURE

JOB NUMBER: 50595	PROJECT: Newman Subdivision Geotech		
	LOCATION: McDonnell Road, Arrowtown		
CO-ORDINATES: Refer Investigation Site Plan	HOLE STARTED: 14-Dec-17		
	HOLE FINISHED: 14-Dec-17		
ELEVATION: m	OPERATOR: Luke		
DATUM:	COMPANY: C'n'R Earthwork	EQUIP.: 8T excavator	

ENGINEERING DESCRIPTIONS							GEOLOGICAL
STRENGTH TESTING	GROUNDWATER	SAMPLES	DEPTH (m)	GRAPHIC LOG	SOIL / ROCK CLASSIFICATION, PARTICLE SIZE CHARACTERISTICS,PLASTICITY, COLOUR, WEATHERING, SECONDARY AND MINOR COMPONENTS	MOISTURE CONDITION	SOIL / ROCK TYPE, ORIGIN, DEFECTS, STRUCTURE, FORMATION
				ψψψψψψ ψψψψψψ	SILT; brown; organic; 50 mm rootlets throughout, organic	D	Topsoil
			0.4	xxxxxxxxx xxxxxxxxx	SILT; light brown; massive; rootlets throughout; medium dense		Loess Colluvium
				xOooxOoo xOooxOoo	Silty cobbly GRAVEL; light brown; fine to coarse, sub angular to sub rounded gravel; sub angular to sub rounded cobbles; medium		Alluvial Deposit
			0.8, 1.2, 1.6, 2.0, 2.4	.Ooo.Ooo. (repeated)	Sandy Cobbly GRAVEL; grey/brown; medium to coarse grain sand; fine to coarse sub angular to sub rounded gravel; sub angular to sub rounded cobbles; medium dense to very dense		Alluvial Deposit
			2.8, 3.2, 3.6, 4.0		End of test pit, unable to excavate further due to test pit walls collapsing		

OTHER COMMENTS:	Logged By: MJD
	Checked Date: 13-Feb-18
PHOTO REF.:	Sheet: 1 of 1

TP-3

TEST PIT LOG

RDAgritech
ENGINEERED BY NATURE

JOB NUMBER:	50595	PROJECT:	Newman Subdivision Geotech
		LOCATION:	McDonnell Road, Arrowtown
CO-ORDINATES:		HOLE STARTED:	14-Dec-17
Refer Investigation Site Plan		HOLE FINISHED:	14-Dec-17
ELEVATION:	m	OPERATOR:	Luke
DATUM:		COMPANY:	C'n'R Earthwork
		EQUIP.:	8T excavator

ENGINEERING DESCRIPTIONS							GEOLOGICAL
STRENGTH TESTING	GROUNDWATER	SAMPLES	DEPTH (m)	GRAPHIC LOG	SOIL / ROCK CLASSIFICATION, PARTICLE SIZE CHARACTERISTICS,PLASTICITY, COLOUR, WEATHERING, SECONDARY AND MINOR COMPONENTS	MOISTURE CONDITION	SOIL / ROCK TYPE, ORIGIN, DEFECTS, STRUCTURE, FORMATION
				ψψψψψ ψψψψψ	SILT; brown; organic; 50 mm rootlets throughout, organic	D	Topsoil
			0.4	xxxxxxxxx xxxxxxxxx	SILT; light brown; massive; rootlets throughout; medium dense		Loess Colluvium
			0.8	xOooxOoo xOooxOoo xOooxOoo xOooxOoo xOooxOoo xOooxOoo	Silty cobbly GRAVEL; light brown; fine to coarse, sub angular to sub rounded gravel; sub angular to sub rounded cobbles; medium dense to dense		Alluvial Deposit
			1.2	.Ooo.Ooo. .Ooo.Ooo. .Ooo.Ooo. .Ooo.Ooo. .Ooo.Ooo. .Ooo.Ooo.	Sandy Cobbly GRAVEL; grey/brown; medium to coarse grain sand; fine to coarse sub angular to sub rounded gravel; sub angular to sub rounded cobbles; medium dense to very dense		Alluvial Deposit
			1.6				
			2.0		End of test pit, unable to excavate further due to test pit walls collapsing		
			2.4				
			2.8				
			3.2				
			3.6				
			4.0				

OTHER COMMENTS:	Logged By:	MJD
	Checked Date:	13-Feb-18
PHOTO REF.:	Sheet:	1 of 1

TP-4

TEST PIT LOG

RDAgritech
ENGINEERED BY NATURE

JOB NUMBER:	50595	PROJECT:	Newman Subdivision Geotech
		LOCATION:	McDonnell Road, Arrowtown
CO-ORDINATES:		HOLE STARTED:	14-Dec-17
Refer Investigation Site Plan		HOLE FINISHED:	14-Dec-17
ELEVATION:	m	OPERATOR:	Luke
DATUM:		COMPANY:	C'n'R Earthwork
		EQUIP.:	8T excavator

ENGINEERING DESCRIPTIONS							GEOLOGICAL
STRENGTH TESTING	GROUNDWATER	SAMPLES	DEPTH (m)	GRAPHIC LOG	SOIL / ROCK CLASSIFICATION, PARTICLE SIZE CHARACTERISTICS,PLASTICITY, COLOUR, WEATHERING, SECONDARY AND MINOR COMPONENTS	MOISTURE CONDITION	SOIL / ROCK TYPE, ORIGIN, DEFECTS, STRUCTURE, FORMATION
				ψψψψψ ψψψψψ	SILT; brown; organic; 50 mm rootlets throughout, organic	D	Topsoil
				xxxxxxxxx	SILT; light brown; massive; rootlets throughout; medium dense		Loess Colluvium
			0.4	xOooxOoo xOooxOoo	Silty cobbly GRAVEL; light brown; fine to coarse, sub angular to sub rounded gravel; sub angular to sub rounded cobbles; dense		Alluvial Deposit
			0.8 1.2 1.6 2.0	.Ooo.Ooo. .Ooo.Ooo. .Ooo.Ooo. .Ooo.Ooo. .Ooo.Ooo. .Ooo.Ooo. .Ooo.Ooo. .Ooo.Ooo. .Ooo.Ooo. .Ooo.Ooo. .Ooo.Ooo. .Ooo.Ooo.	Sandy Cobbly GRAVEL; grey/brown; medium to coarse grain sand; fine to coarse sub angular to sub rounded gravel; sub angular to sub rounded cobbles; medium dense to very dense		Alluvial Deposit
			2.4 2.8 3.2 3.6 4.0		End of test pit, unable to excavate further, test pit walls collapsing		

OTHER COMMENTS:	Logged By:	MJD
	Checked Date:	13-Feb-18
PHOTO REF.:	Sheet:	1 of 1

TP-5

TEST PIT LOG

RDAgritech
ENGINEERED BY NATURE

JOB NUMBER: 50595	PROJECT:	Newman Subdivision Geotech	
	LOCATION:	McDonnell Road, Arrowtown	
CO-ORDINATES:	HOLE STARTED:	14-Dec-17	
Refer Investigation Site Plan	HOLE FINISHED:	14-Dec-17	
ELEVATION: m	OPERATOR:	Luke	
DATUM:	COMPANY:	C'n'R Earthwork	EQUIP.: 8T excavator

ENGINEERING DESCRIPTIONS							GEOLOGICAL
STRENGTH TESTING	GROUNDWATER	SAMPLES	DEPTH (m)	GRAPHIC LOG	SOIL / ROCK CLASSIFICATION, PARTICLE SIZE CHARACTERISTICS,PLASTICITY, COLOUR, WEATHERING, SECONDARY AND MINOR COMPONENTS	MOISTURE CONDITION	SOIL / ROCK TYPE, ORIGIN, DEFECTS, STRUCTURE, FORMATION
				ψψψψψ ψψψψψ	SILT; brown; organic; 50 mm rootlets throughout, organic	D	Topsoil
			0.4	xxxxxxxxx xxxxxxxxx	SILT; light brown; massive; rootlets throughout; medium dense		Loess Colluvium
			0.8	xOooxOoo xOooxOoo xOooxOoo xOooxOoo xOooxOoo	Silty cobbly GRAVEL; light brown; fine to coarse, sub angular to sub rounded gravel; sub angular to sub rounded cobbles; dense		Alluvial Deposit
			1.2 1.6 2.0 2.4 2.8	.Ooo.Ooo. .Ooo.Ooo. .Ooo.Ooo. .Ooo.Ooo. .Ooo.Ooo. .Ooo.Ooo. .Ooo.Ooo. .Ooo.Ooo. .Ooo.Ooo. .Ooo.Ooo. .Ooo.Ooo. .Ooo.Ooo. .Ooo.Ooo. .Ooo.Ooo. .Ooo.Ooo.	Sandy Cobbly GRAVEL; grey/brown; medium to coarse grain sand; fine to coarse sub angular to sub rounded gravel; sub angular to sub rounded cobbles; dense to very dense		Alluvial Deposit
			3.2 3.6 4.0		End of test pit, unable to excavate further due to boulder in base of test pit		

OTHER COMMENTS:	Logged By:	MJD
	Checked Date:	13-Feb-18
PHOTO REF.:	Sheet:	1 of 1

TP-6

TEST PIT LOG

RDAgritech
ENGINEERED BY NATURE

JOB NUMBER: 50595	PROJECT:	Newman Subdivision Geotech	
	LOCATION:	McDonnell Road, Arrowtown	
CO-ORDINATES:	HOLE STARTED:	14-Dec-17	
Refer Investigation Site Plan	HOLE FINISHED:	14-Dec-17	
ELEVATION: m	OPERATOR:	Luke	
DATUM:	COMPANY:	C'n'R Earthwork	EQUIP.: 8T excavator

ENGINEERING DESCRIPTIONS							GEOLOGICAL
STRENGTH TESTING	GROUNDWATER	SAMPLES	DEPTH (m)	GRAPHIC LOG	SOIL / ROCK CLASSIFICATION, PARTICLE SIZE CHARACTERISTICS,PLASTICITY, COLOUR, WEATHERING, SECONDARY AND MINOR COMPONENTS	MOISTURE CONDITION	SOIL / ROCK TYPE, ORIGIN, DEFECTS, STRUCTURE, FORMATION
				ψψψψψ ψψψψψ	SILT; brown; organic; 50 mm rootlets throughout, organic	D	Topsoil
			0.4	xooxooxoo xooxooxoo	Silty GRAVEL; light brown; fine to coarse, sub angular to sub rounded gravel; medium dense	M	Alluvial Deposit
	▽		0.8 / 1.2 / 1.6	xxxxxxxxx	SILT; brown; massive; medium dense		Silt Alluvium
			2.0	.....	SAND; grey; fine grain sand; massive; very dense	W	Sand Alluvium
			2.4 / 2.8 / 3.2 / 3.6 / 4.0		End of test pit, unable to excavate further due to possibly encountering bedrock. Base of test pit not visible as groundwater inflow occurred 		

OTHER COMMENTS:	Logged By:	MJD
	Checked Date:	13-Feb-18
PHOTO REF.:	Sheet:	1 of 1

TP-7

TEST PIT LOG

RDAgritech
ENGINEERED BY NATURE

JOB NUMBER:	50595	PROJECT:	Newman Subdivision Geotech
		LOCATION:	McDonnell Road, Arrowtown
CO-ORDINATES:		HOLE STARTED:	14-Dec-17
Refer Investigation Site Plan		HOLE FINISHED:	14-Dec-17
ELEVATION:	m	OPERATOR:	Luke
DATUM:		COMPANY:	C'n'R Earthwork
		EQUIP.:	8T excavator

ENGINEERING DESCRIPTIONS							GEOLOGICAL
STRENGTH TESTING	GROUNDWATER	SAMPLES	DEPTH (m)	GRAPHIC LOG	SOIL / ROCK CLASSIFICATION, PARTICLE SIZE CHARACTERISTICS,PLASTICITY, COLOUR, WEATHERING, SECONDARY AND MINOR COMPONENTS	MOISTURE CONDITION	SOIL / ROCK TYPE, ORIGIN, DEFECTS, STRUCTURE, FORMATION
				ψψψψψ ψψψψψ	SILT; brown; organic; 50 mm rootlets throughout, organic	D	Topsoil
			0.4	xOooxOoo xOooxOoo xOooxOoo xOooxOoo xOooxOoo xOooxOoo	Silty cobbly GRAVEL; light brown; fine to coarse, sub angular to sub rounded gravel; sub angular to sub rounded cobbles; medium dense to dense		Alluvial Deposit
			0.8				
			1.2	.Ooo.Ooo. .Ooo.Ooo. .Ooo.Ooo. .Ooo.Ooo. .Ooo.Ooo. .Ooo.Ooo. .Ooo.Ooo. .Ooo.Ooo. .Ooo.Ooo. .Ooo.Ooo.	Sandy Cobbly GRAVEL; grey/brown; medium to coarse grain sand; fine to coarse sub angular to sub rounded gravel; sub angular to sub rounded cobbles; very dense		Alluvial Deposit
			1.6				
			2.0				
			2.4		End of test pit, unable to excavate further due to dense material 		
			2.8				
			3.2				
			3.6				
			4.0				

OTHER COMMENTS:	Logged By:	MJD
	Checked Date:	13-Feb-18
PHOTO REF.:	Sheet:	1 of 1

TP-8

TEST PIT LOG

RDAgritech
ENGINEERED BY NATURE

JOB NUMBER:	50595	PROJECT:	Newman Subdivision Geotech
		LOCATION:	McDonnell Road, Arrowtown
CO-ORDINATES:		HOLE STARTED:	14-Dec-17
Refer Investigation Site Plan		HOLE FINISHED:	14-Dec-17
ELEVATION:	m	OPERATOR:	Luke
DATUM:		COMPANY:	C'n'R Earthwork
		EQUIP.:	8T excavator

ENGINEERING DESCRIPTIONS							GEOLOGICAL
STRENGTH TESTING	GROUNDWATER	SAMPLES	DEPTH (m)	GRAPHIC LOG	SOIL / ROCK CLASSIFICATION, PARTICLE SIZE CHARACTERISTICS,PLASTICITY, COLOUR, WEATHERING, SECONDARY AND MINOR COMPONENTS	MOISTURE CONDITION	SOIL / ROCK TYPE, ORIGIN, DEFECTS, STRUCTURE, FORMATION
				ψψψψψ ψψψψψ	SILT; brown; organic; 50 mm rootlets throughout, organic	D	Topsoil
			0.4	xxxxxxxxx xxxxxxxxx xxxxxxxxx xxxxxxxxx xxxxxxxxx xxxxxxxxx	SILT; light brown; massive; rootlets throughout; dense to very dense		Loess Colluvium
	▽		0.8				
			1.2	....	SAND; grey; fine grain sand; massive	W	Sand Allivium
			1.6				
			2.0		End of test pit, test pit filled with groundwater to 800 mm below the surface whilst logging.		
			2.4				
			2.8				
			3.2				
			3.6				
			4.0				

OTHER COMMENTS:	Logged By:	MJD
	Checked Date:	13-Feb-18
PHOTO REF.:	Sheet:	1 of 1

TP-9

TEST PIT LOG

RDAgritech
ENGINEERED BY NATURE

JOB NUMBER: 50595	PROJECT:	Newman Subdivision Geotech	
	LOCATION:	McDonnell Road, Arrowtown	
CO-ORDINATES:	HOLE STARTED:	14-Dec-17	
Refer Investigation Site Plan	HOLE FINISHED:	14-Dec-17	
ELEVATION: m	OPERATOR:	Luke	
DATUM:	COMPANY:	C'n'R Earthwork	EQUIP.: 8T excavator

ENGINEERING DESCRIPTIONS							GEOLOGICAL
STRENGTH TESTING	GROUNDWATER	SAMPLES	DEPTH (m)	GRAPHIC LOG	SOIL / ROCK CLASSIFICATION, PARTICLE SIZE CHARACTERISTICS,PLASTICITY, COLOUR, WEATHERING, SECONDARY AND MINOR COMPONENTS	MOISTURE CONDITION	SOIL / ROCK TYPE, ORIGIN, DEFECTS, STRUCTURE, FORMATION
				ψψψψψ ψψψψψ	SILT; brown; organic; 50 mm rootlets throughout, organic	D	Topsoil
			0.4	xxxxxxxxx xxxxxxxxx xxxxxxxxx xxxxxxxxx xxxxxxxxx	SILT; light brown; massive; rootlets throughout		Loess Colluvium
			0.8	xOooxOoo xOooxOoo xOooxOoo xOooxOoo	Silty cobbly GRAVEL; light brown; fine to coarse, sub angular to sub rounded gravel; sub angular to sub rounded cobbles; medium		Alluvial Deposit
	▽		1.2 1.6 2.0 2.4 2.8 3.2	.....	SAND; grey; fine grain sand; massive; medium dense	W	Sand Alluvium
			3.6 4.0		End of test pit, target depth encountered 		

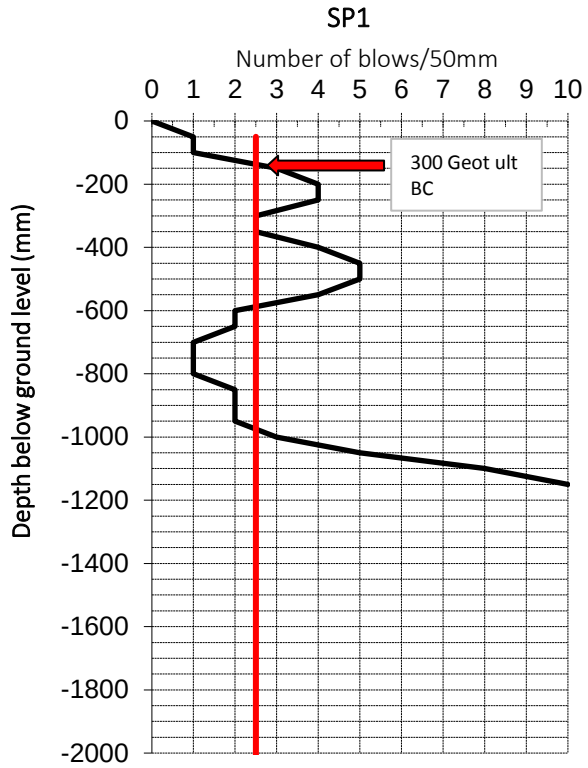
OTHER COMMENTS:	Logged By:	MJD
	Checked Date:	13-Feb-18
PHOTO REF.:	Sheet:	1 of 1

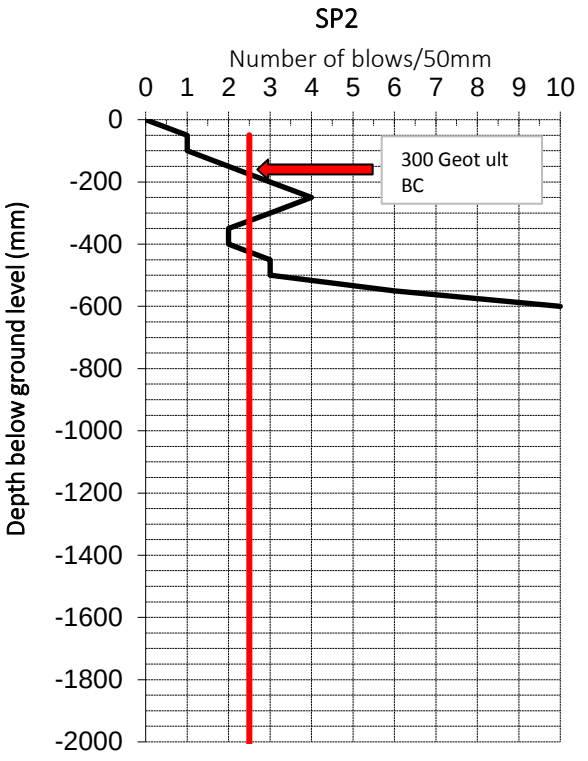
SCALA PENETROMETER RESULTS

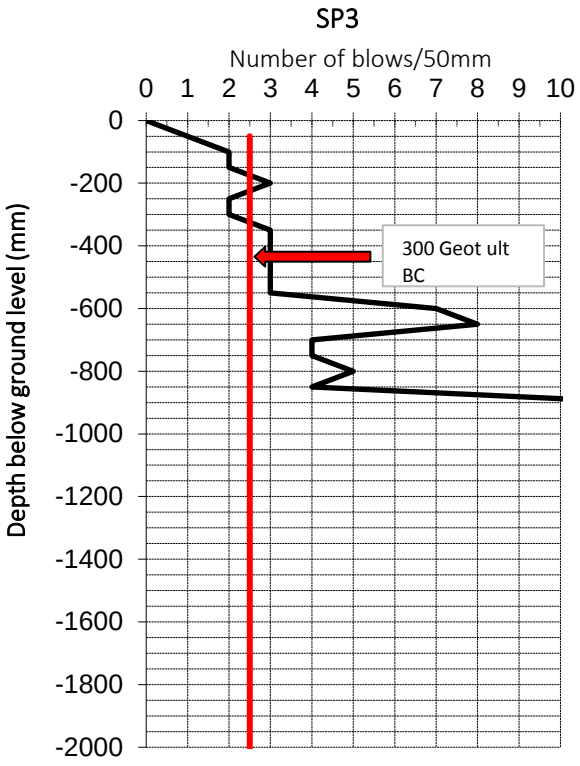
JOB NUMBER:	50595	PROJECT:	Newman Subdivision Geotech
		LOCATION:	McDonnell Road, Arrowtown
CO-ORDINATES:	mE	DATE:	19-Dec-17
See attached plan	mN	OPERATOR:	OMB

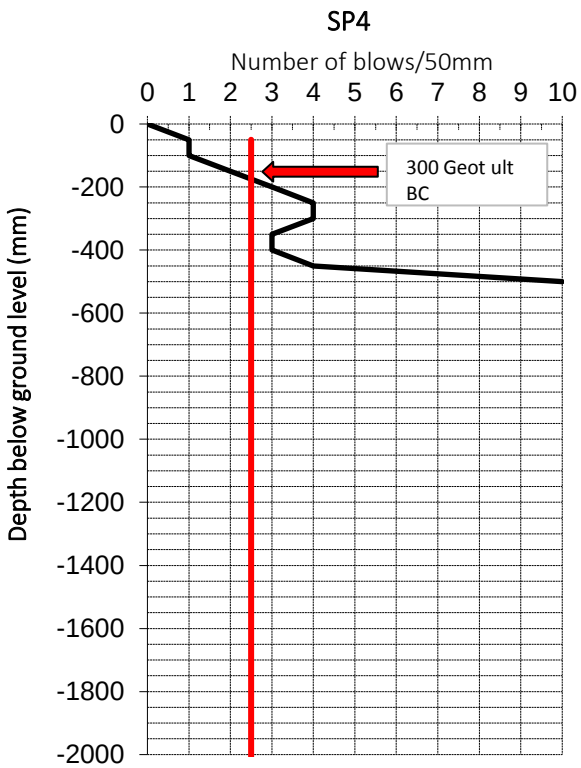
RDAgritech
ENGINEERED BY NATURE

Note: No Friction correction has been applied to the field results. 5 Blows per 100mm is considered compliance with NZS3604 3.3.7





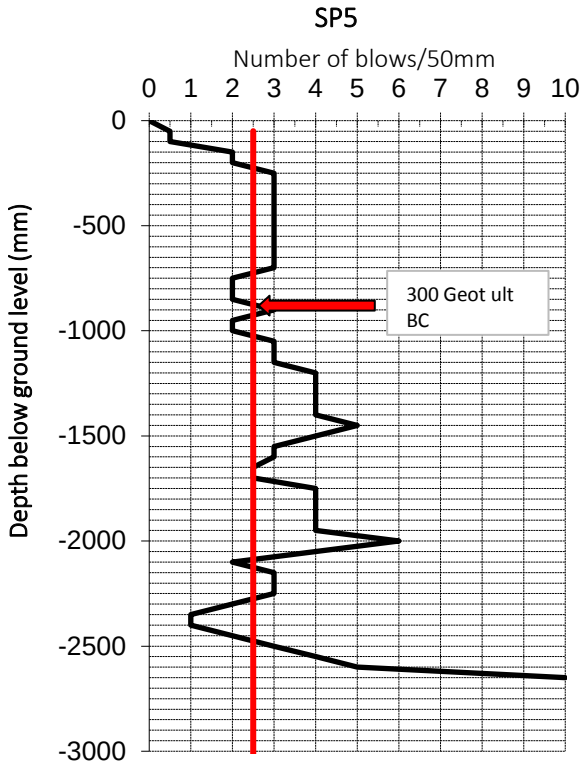


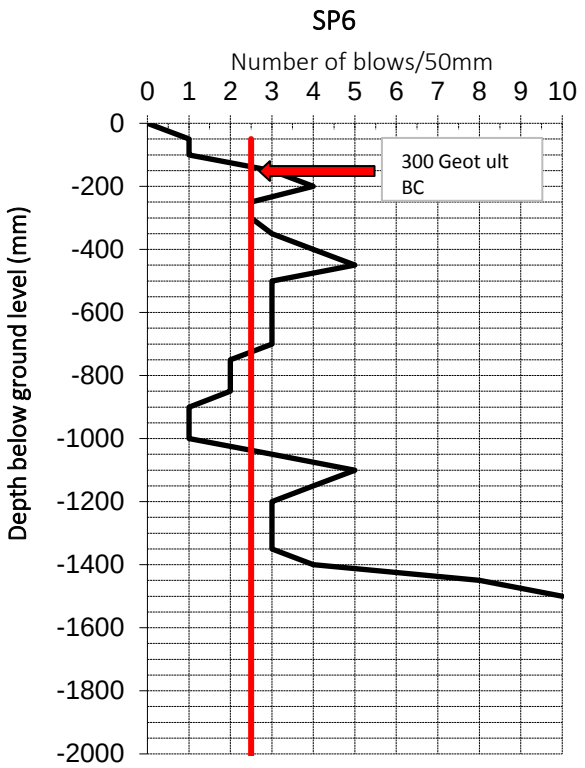


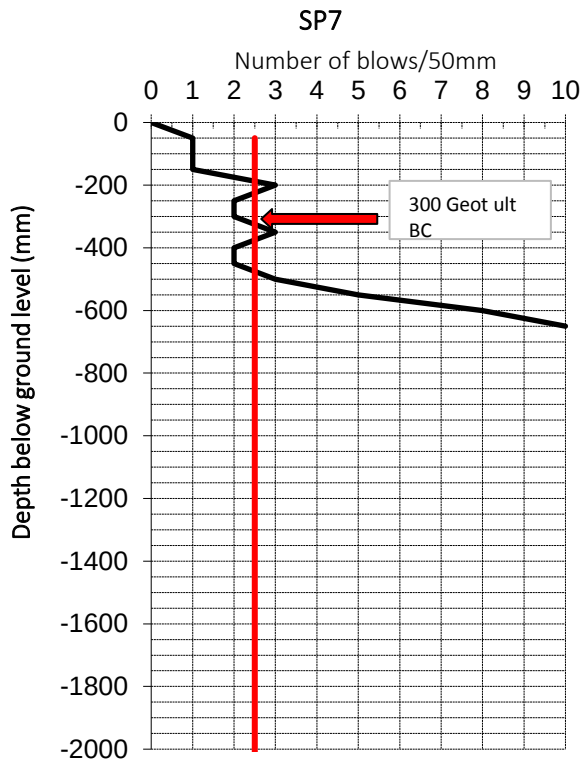
SCALA PENETROMETER RESULTS

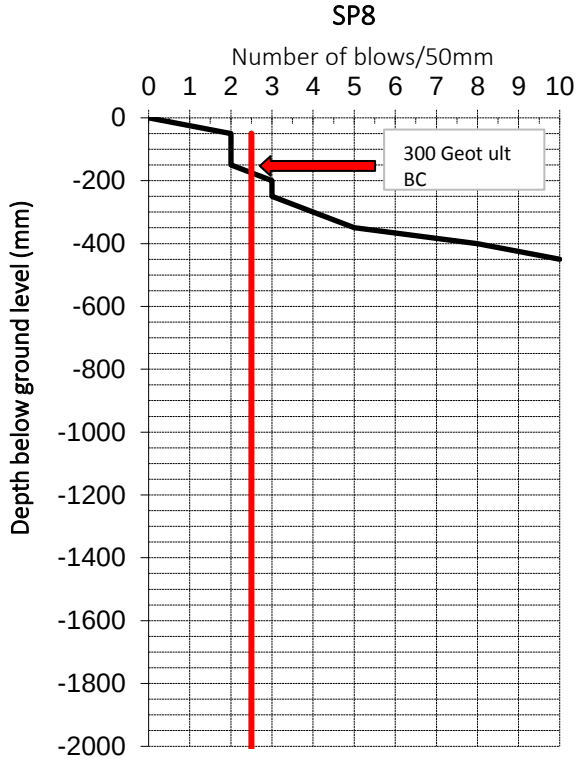
JOB NUMBER:	50595	PROJECT:	Newman Subdivision Geotech
		LOCATION:	McDonnell Road, Arrowtown
CO-ORDINATES:	mE	DATE:	19-Dec-17
See attached plan	mN	OPERATOR:	OMB

Note: No Friction correction has been applied to the field results. 5 Blows per 100mm is considered compliance with NZS3604 3.3.7









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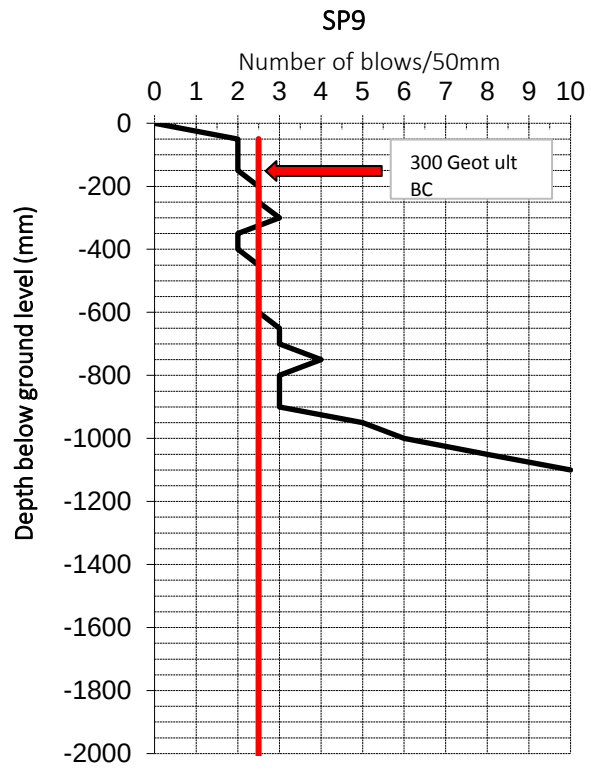
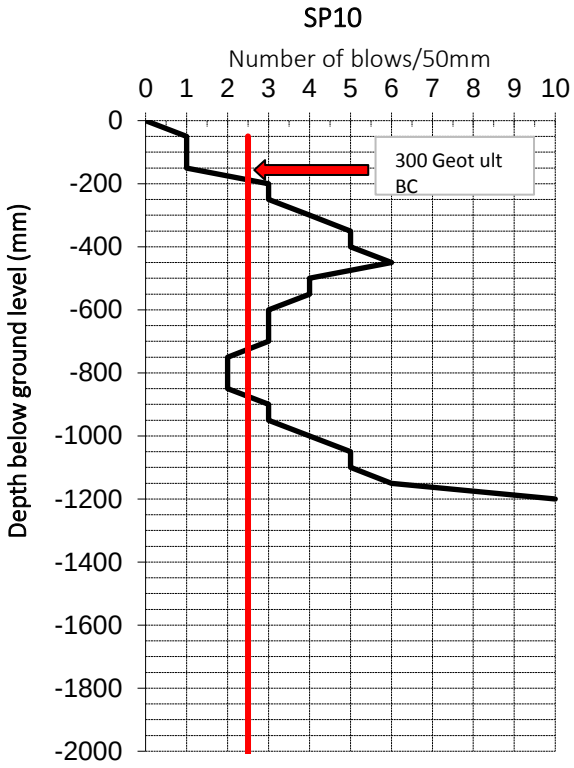
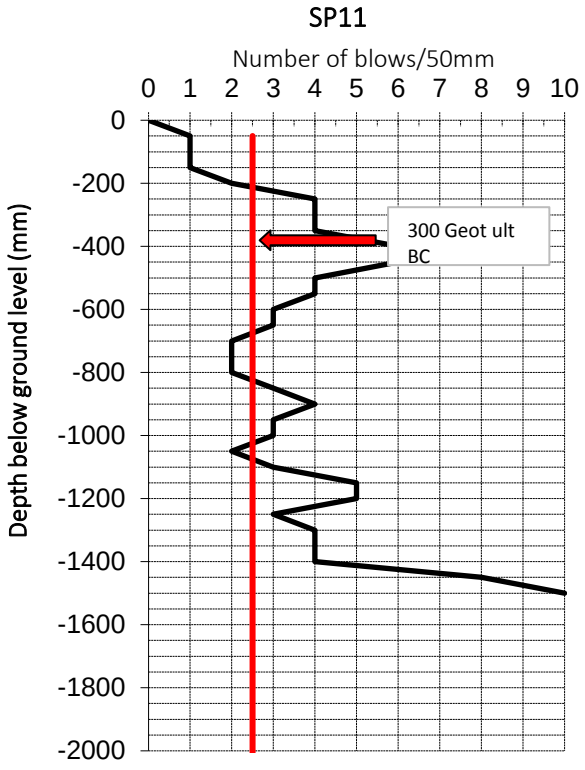
SCALA PENETROMETER RESULTS

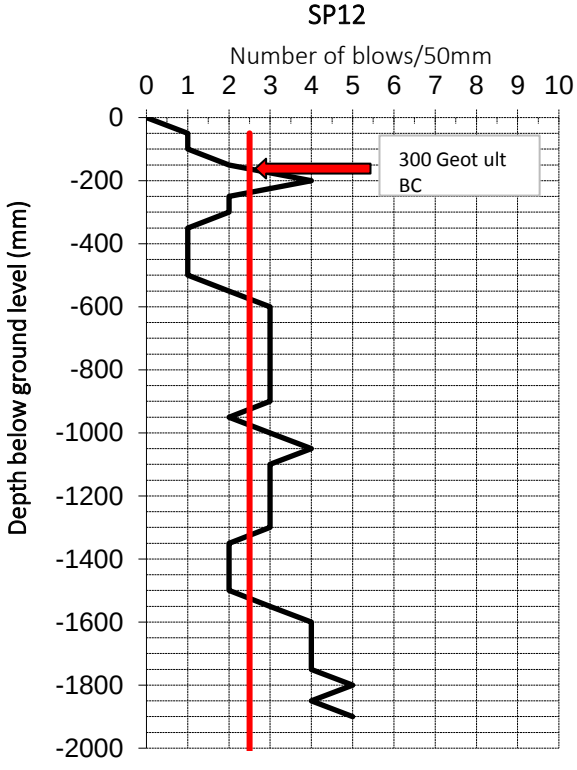
JOB NUMBER:	50595	PROJECT:	Newman Subdivision Geotech
		LOCATION:	McDonnell Road, Arrowtown
CO-ORDINATES:	mE	DATE:	19-Dec-17
See attached plan	mN	OPERATOR:	OMB

Note: No Friction correction has been applied to the field results. 5 Blows per 100mm is considered compliance with NZS3604 3.3.7









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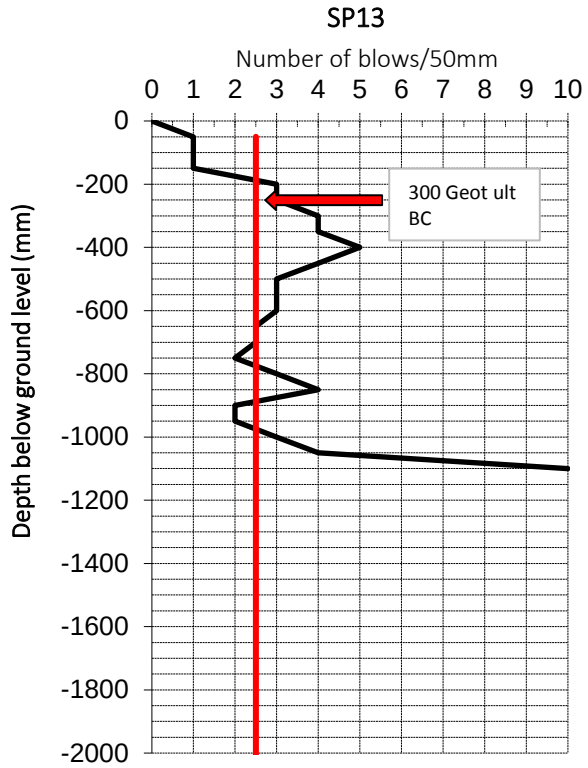
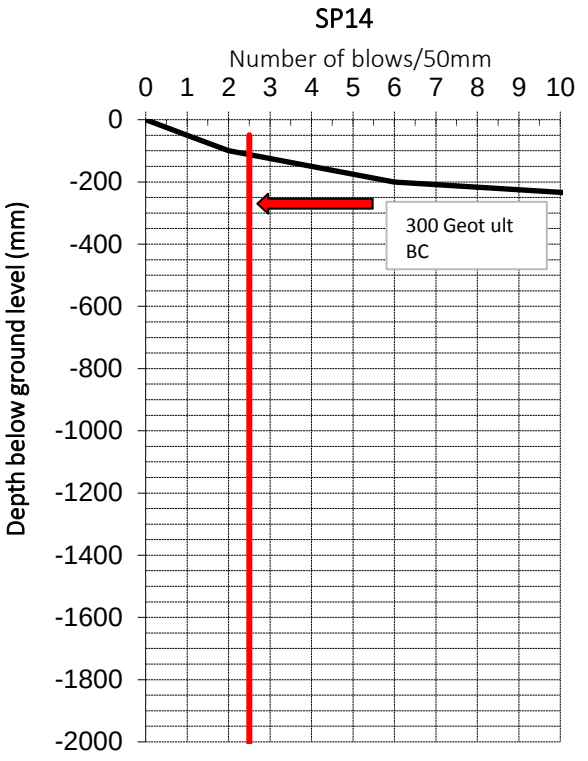
SCALA PENETROMETER RESULTS

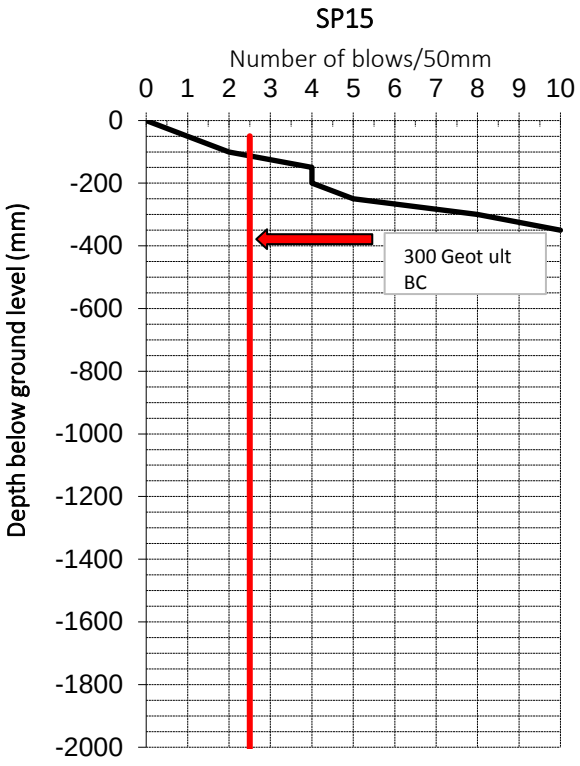
JOB NUMBER:	50595	PROJECT:	Newman Subdivision Geotech
		LOCATION:	McDonnell Road, Arrowtown
CO-ORDINATES:	mE	DATE:	19-Dec-17
See attached plan	mN	OPERATOR:	OMB

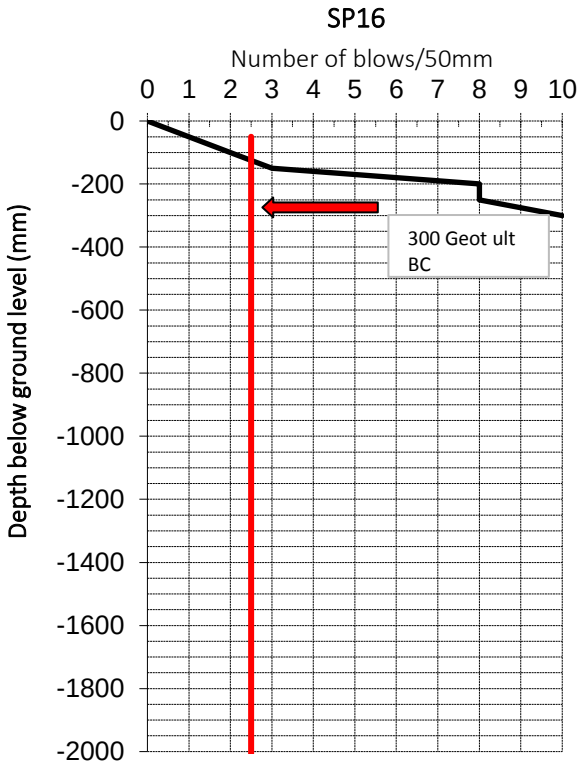
RDAgritech
ENGINEERED BY NATURE

Note: No Friction correction has been applied to the field results. 5 Blows per 100mm is considered compliance with NZS3604 3.3.7





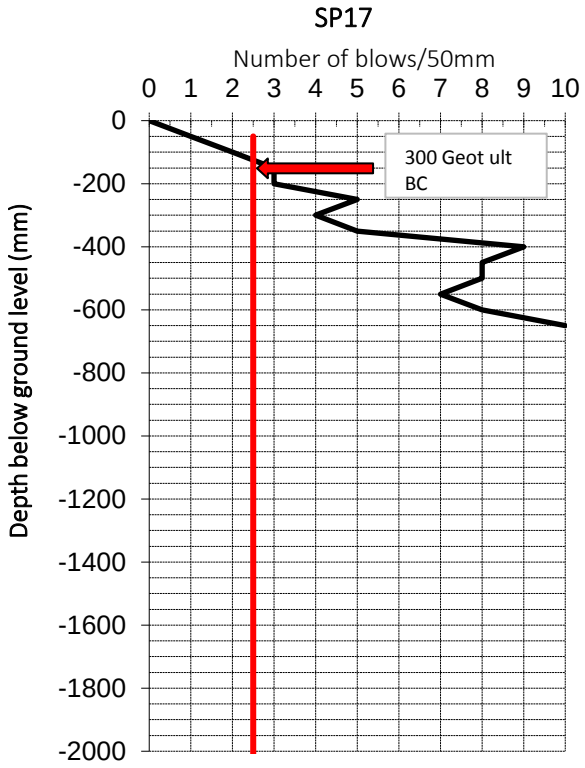


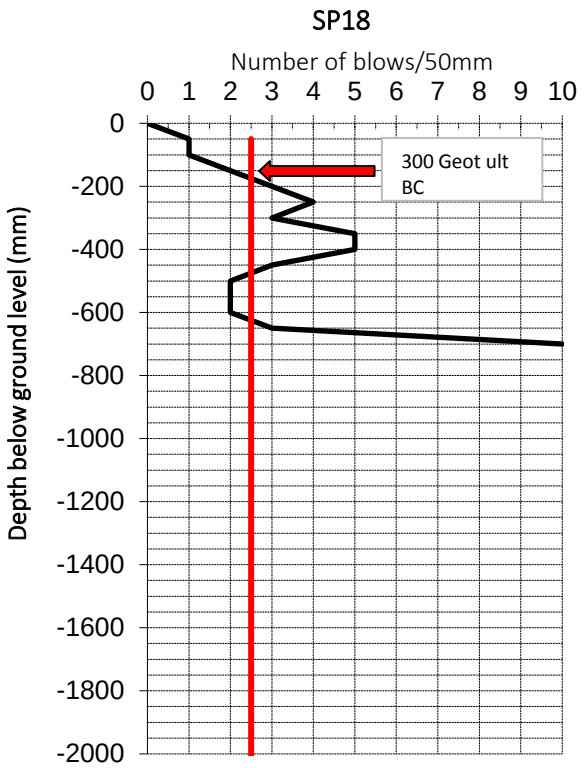


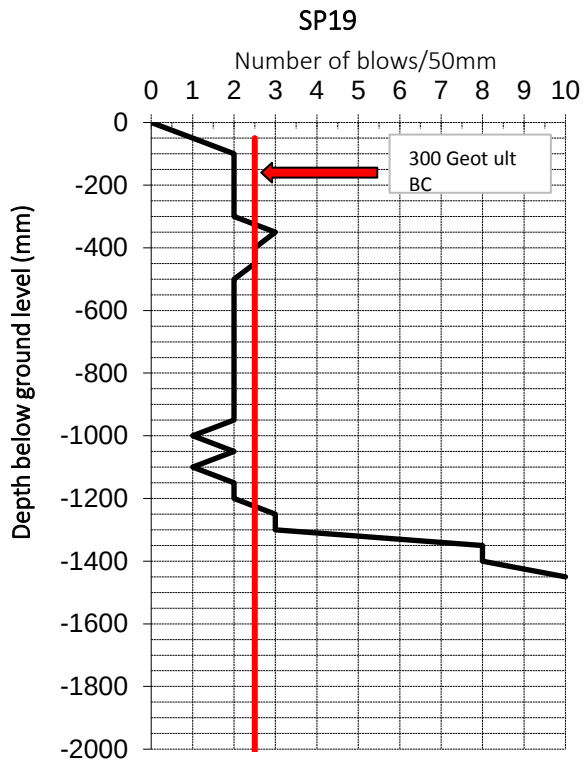
SCALA PENETROMETER RESULTS

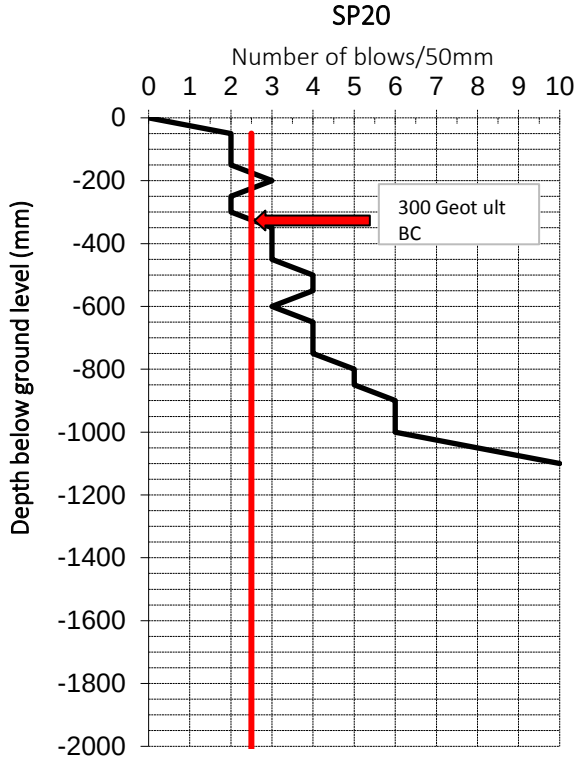
JOB NUMBER:	50595	PROJECT:	Newman Subdivision Geotech
		LOCATION:	McDonnell Road, Arrowtown
CO-ORDINATES:	mE	DATE:	19-Dec-17
See attached plan	mN	OPERATOR:	OMB

Note: No Friction correction has been applied to the field results. 5 Blows per 100mm is considered compliance with NZS3604 3.3.7









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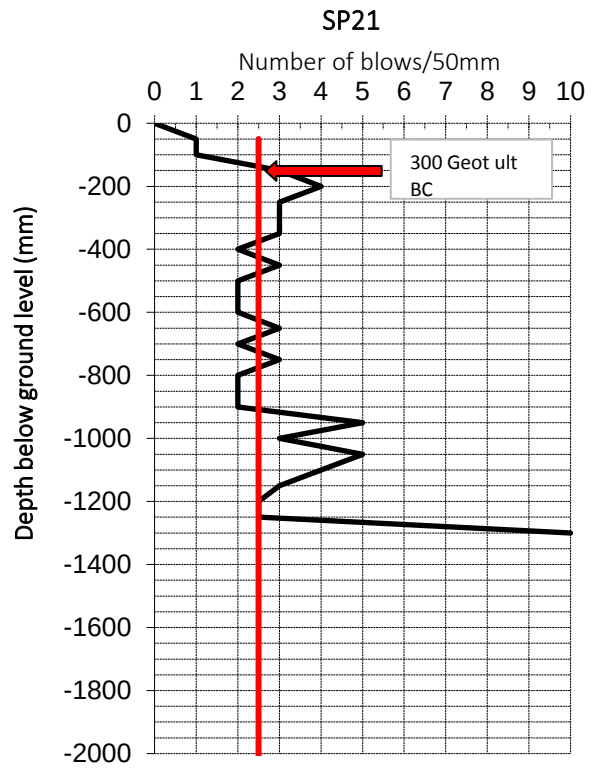
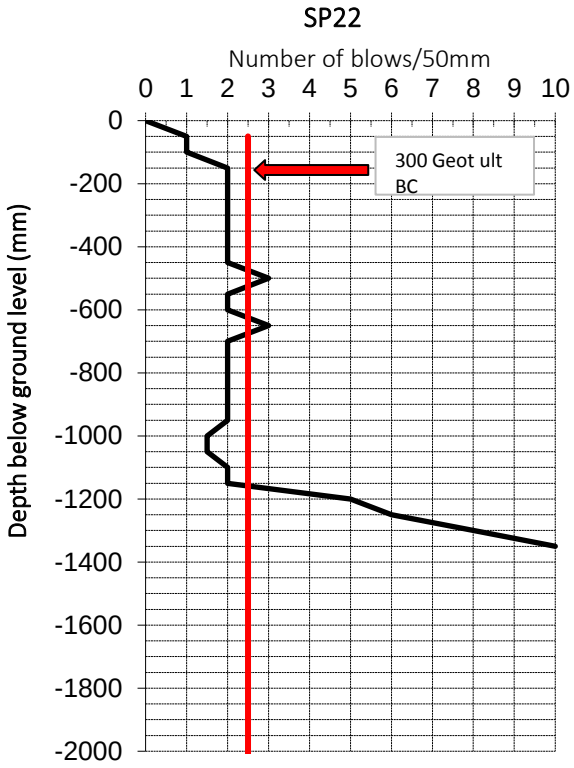
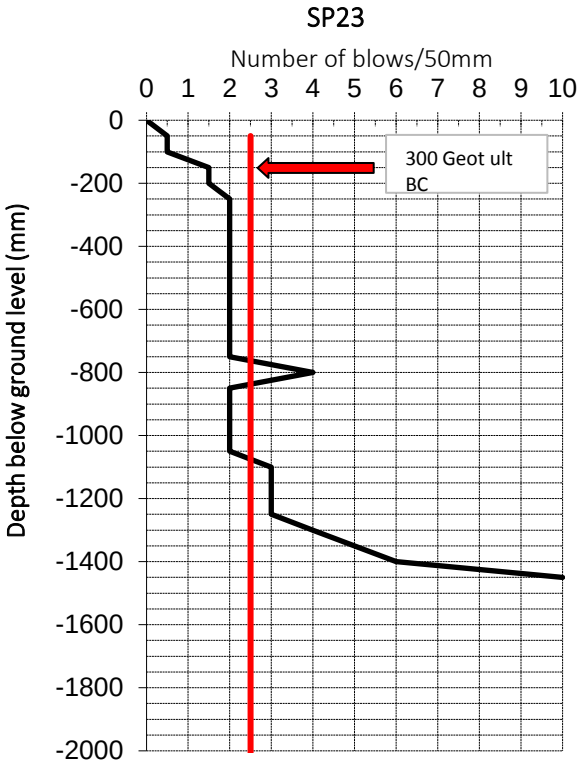
SCALA PENETROMETER RESULTS

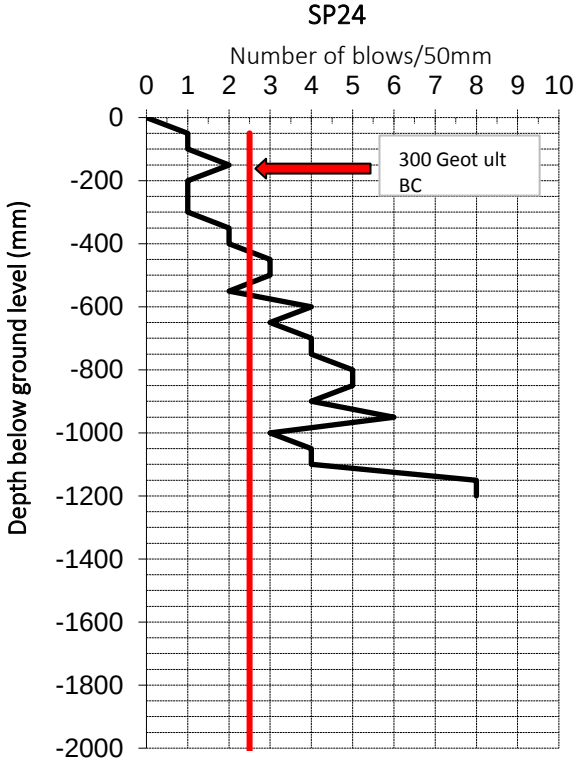
JOB NUMBER:	50595	PROJECT:	Newman Subdivision Geotech
		LOCATION:	McDonnell Road, Arrowtown
CO-ORDINATES:	mE	DATE:	19-Dec-17
See attached plan	mN	OPERATOR:	OMB

Note: No Friction correction has been applied to the field results. 5 Blows per 100mm is considered compliance with NZS3604 3.3.7









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SCALA PENETROMETER RESULTS

JOB NUMBER:	50595	PROJECT:	Newman Subdivision Geotech
		LOCATION:	McDonnell Road, Arrowtown
CO-ORDINATES:	mE	DATE:	19-Dec-17
See attached plan	mN	OPERATOR:	OMB

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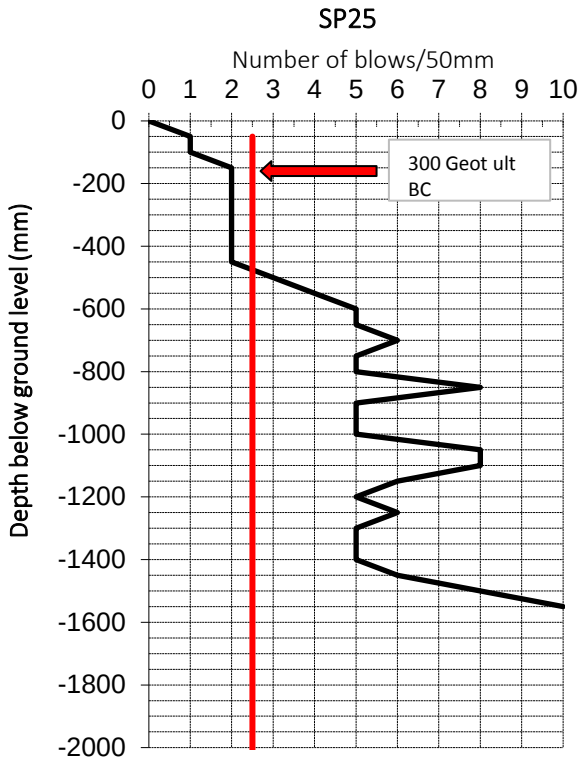
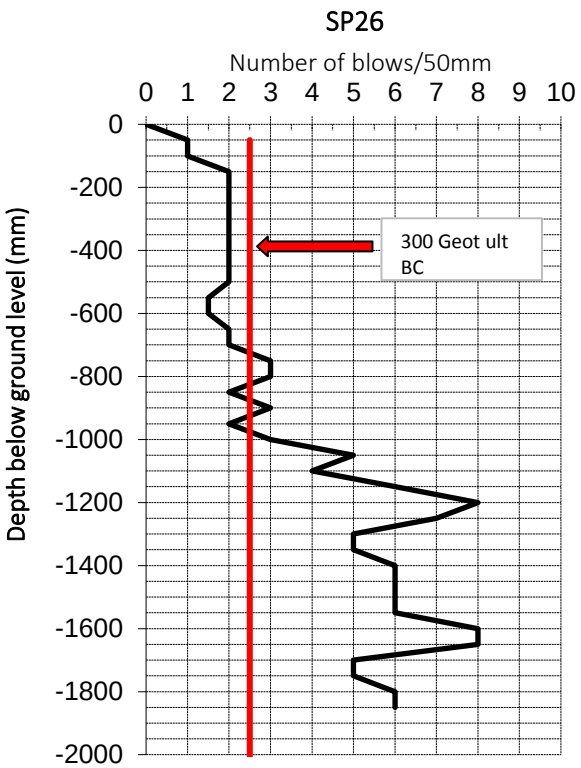
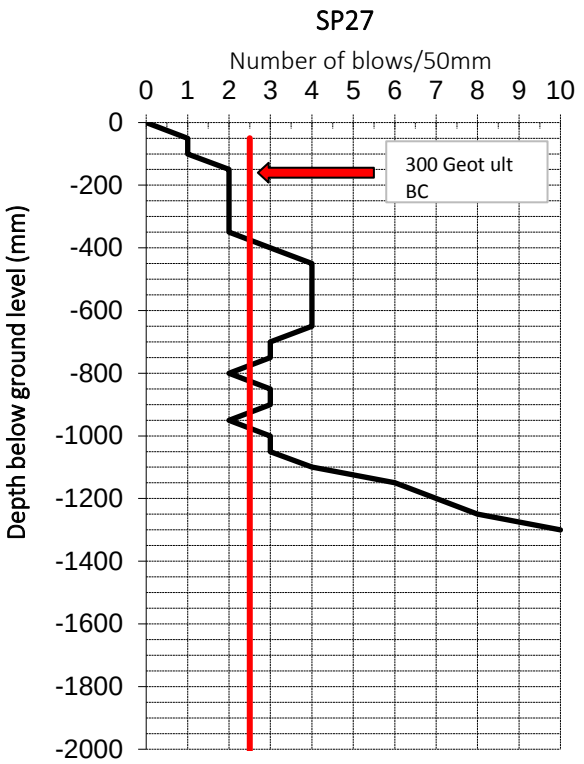
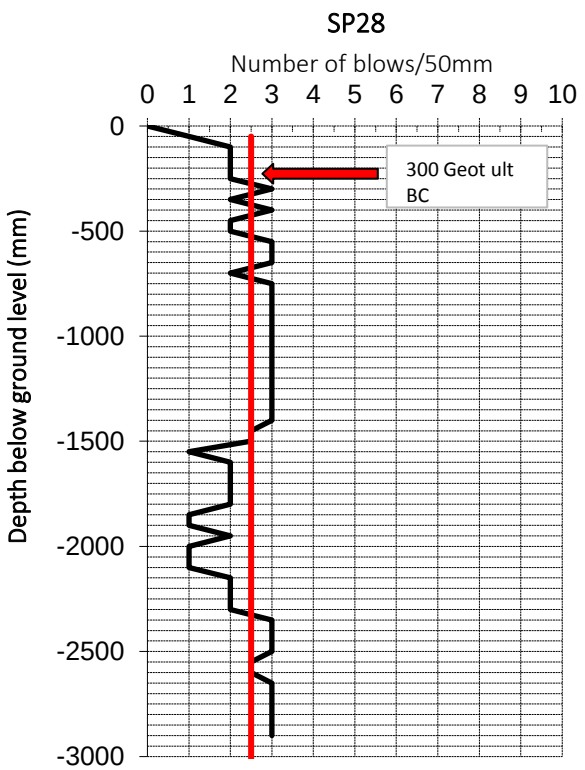
Note: No Friction correction has been applied to the field results. 5 Blows per 100mm is considered compliance with NZS3604 3.3.7









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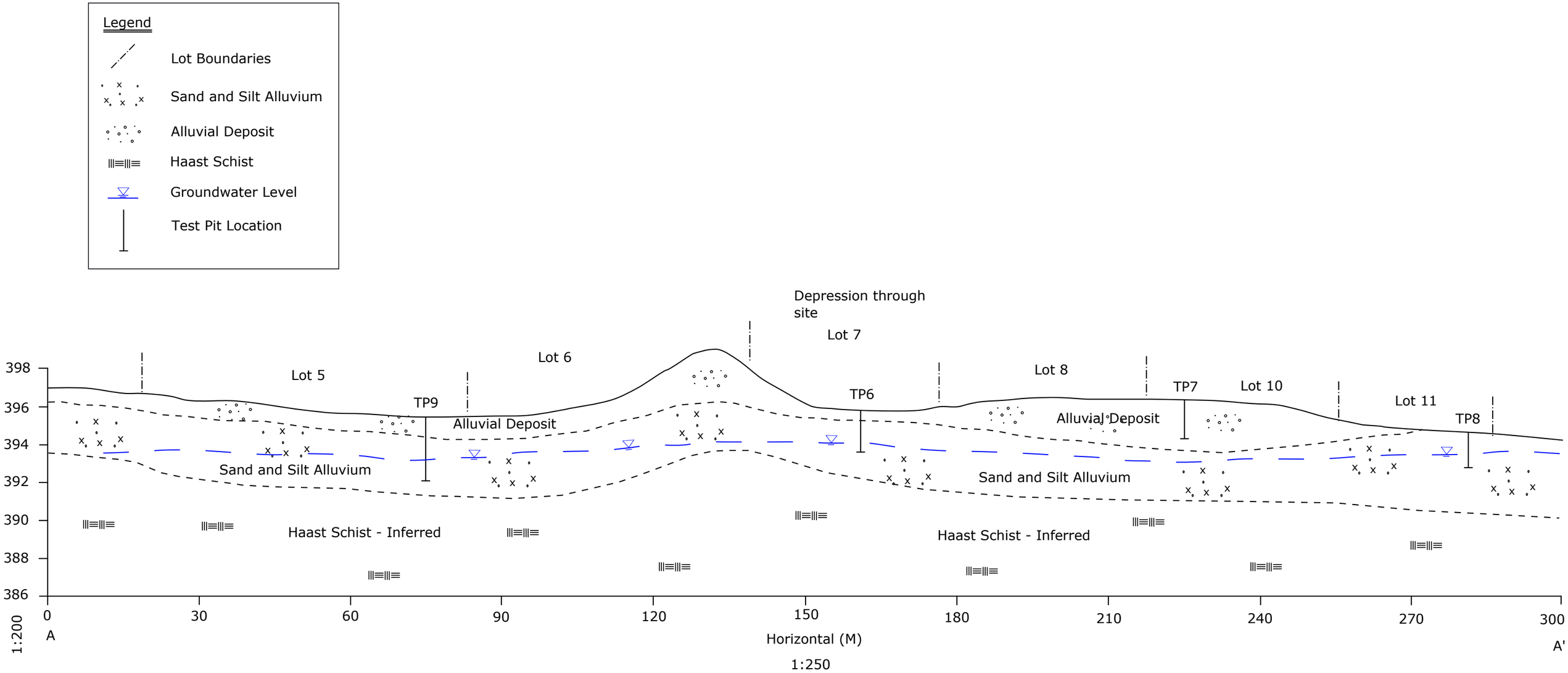
APPENDIX C. CROSS SECTIONS

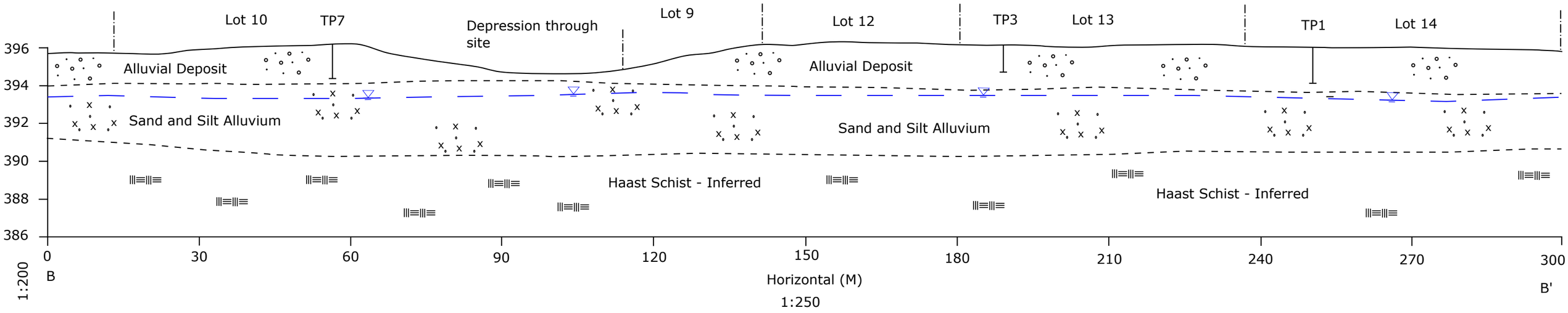
1. Geological Cross Sections AA’
2. Geological Cross Section BB’



RDAgritech ENGINEERED BY NATURE	Engineering firm: RDAGRITECH LTD PO BOX 1880 QUEENSTOWN	Client: Richard Newman C/- Clark Fortune McDonald and Associates	Sheet Title: Newman Subdivision Geotech Geological Cross Section A-A' RDAgritech OMB 15/01/18	Scale: As Shown @A3 Job No: 50595

Legend

- Lot Boundaries
- Sand and Silt Alluvium
- Alluvial Deposit
- Haast Schist
- Groundwater Level
- Test Pit Location



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Engineering firm:
RDAGRITECH LTD
PO BOX 1880
QUEENSTOWN

Client: Richard Newman
C/- Clark Fortune McDonald and Associates

Sheet Title: Newman Subdivision Geotech
Geological Cross Section B-B'
RDAgritech
OMB 15/01/18

Scale: As Shown

Job No: 50595