BASE GROUP CONSULTING
Structural & Civil Engineering

SUBDIVISION ASSESSMENT

60 HAWKEN ROAD

WHANGAREI

For: S. Williamson

Ref: 16036

Date: 18 April 2016

Filename: 16036_C01_180416

PO Box 1032, Whangarei 0140, New Zealand **P** +64 9 437 3432 **E** office@basegroup.co.nz **www.basegroup.co.nz**

TABLE OF CONTENTS

ATTACHMENTS

1. INTRODUCTION

S. Williamson proposes to construct a seven lot residential subdivision at 60 Hawken Road, Whangarei. The subdivision site is currently occupied by a residential dwelling and the proposal creates five new building sites within the property, accessed via new Right of Ways from Hawken Road. Scheme plans of the proposed development are included in Appendix 1.

This report details the assessment of engineering matters relevant to the residential development of proposed Lots 2-6 and is intended to support Resource Consent application to Whangarei District Council (WDC).

This report considers the following engineering aspects of the scheme:

- The existing stability of the site
- The effect of the proposed development on stability of the site
- Geotechnical suitability for foundations
- Access arrangements
- Natural hazards
- Stormwater management
- Wastewater management

2. SITE DESCRIPTION

The site is located at 60 Hawken Road, Whangarei adjacent to State Highway 14 and has a legal description of Lot 1 DP 86368 being 4.065ha in size. WDC planning maps indicate that the property is located within an Urban Transition Environment. The property is classified as Low and Moderate Risk for Instability Hazard and no flood susceptible areas are mapped at the property. The land is classified as medium unsuitability for effluent disposal.

The proposed development looks to create five new residential building sites (Lots 2-6) with the existing residential dwelling retained with the balance of land as Lot 1. Lot 7 will be created as a common access lot.

The subdivision site is positioned within steep to moderately graded terrain on the lower flanks of the scoria dome that characterises the immediate area. The land falls to the southeast towards State Highway 14 with slope relief reducing towards the highway. Steeper grades within the property are located on the elevated parts of the site. The site is generally surfaced in pasture with some mature trees along the road frontage with State Highway 14 and at the rear of the section and along the northern boundary. The subdivision site is surrounded by existing low density rural residential housing with a number of recent subdivision developments positioned along State Highway 14 towards the City. The property has access available via an existing vehicle crossing and driveway from the end of Hawken Road. A new Right of Way (ROW) access for the subdivision will be created from this entrance to facilitate vehicle access to the new building sites.

Figure 1 below taken from WDC GIS shows the site and surrounds including the existing vegetation and access arrangements.

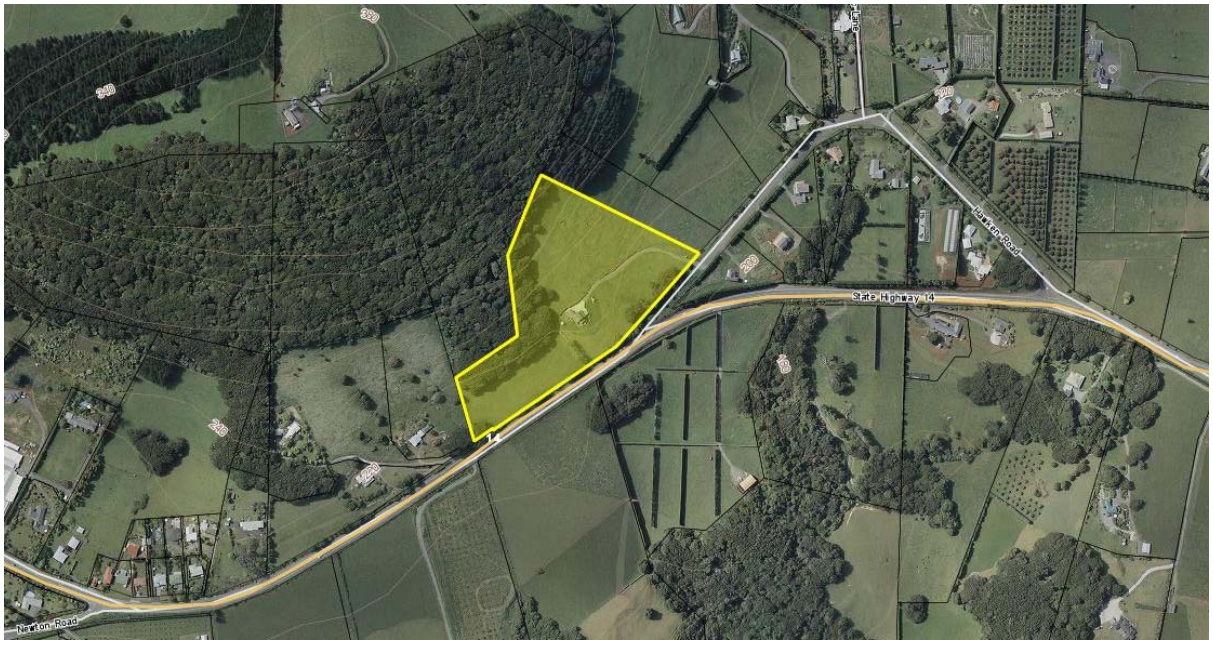


Figure 1: WDC GIS aerial image

The subdivision terrain varies approximately RL280m to RL210m above sea level and falls 70m from the steeper flanks of the scoria cone down to State Highway 14. The pasture land typically falls southeast and is located near the head of the Cemetery Road sub-catchment within Otaika Stream. Surface water runoff from the land is directed via sheet flow to the

roadside drainage table adjacent to the State Highway carriageway. Roadside table drains from the driveway convey runoff to the entrance to the site where it is directed from the end of Hawken Road through a small area of bush to the State Highway drainage system.

Northland Regional Council GIS maps indicate the site is being positioned within the Maunu aquifer which is classified as a semi unconfined Principal Aquifer in Taheke Basalt overlying sandstone/mudstone with a saturated thickness of 8-58m. Several water bores are mapped in the surrounding area but none are recorded within the subdivision site. No areas of the property are classified as flood susceptible based on alluvial soils mapping.

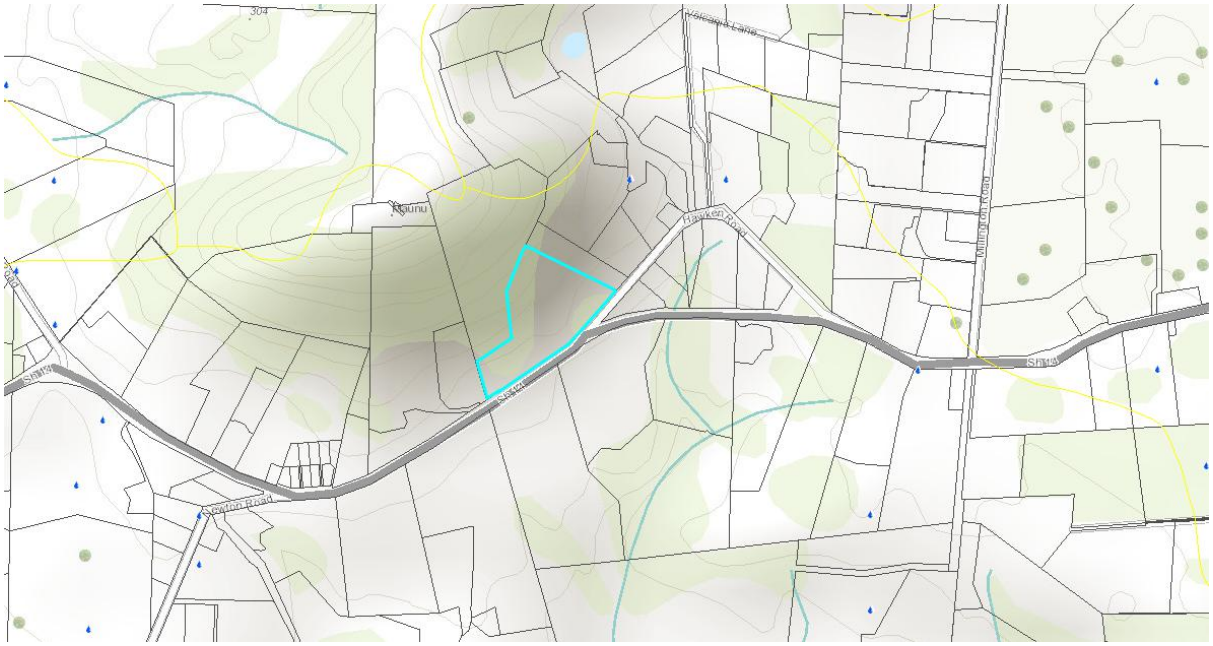


Figure 2: NRC GIS aerial image

The property is not within the mapped tsunami evacuation zone and is not within the Erosion Prone Land hazard mapped by NRC. Similarly, the property is not mapped to be within the Coastal Hazard zone for erosion, flooding or landslide.

3. GEOTECHNICAL

3.1 Ground Investigations

A site visit and walkover inspection of the subdivision property was carried out on 15th March 2016. On 30th March 2016 a series of shallow subsurface ground investigations were carried out consisting of five hand auger boreholes with in-situ shear vane tests and a series of 20 dynamic cone scala penetrometer tests.

The location of all tests within the property and results of the ground investigations are included within Appendix 2.

3.1.1 Boreholes

A series of five hand auger boreholes (HA) were carried out across the property to gain coverage of the nominated building platforms and to establish the surficial soil characteristics.

The excavations were progressed to 4.0m depth except for HA2 which achieved 3.4 depth before the soil was too hard to auger by hand. The boreholes identified a general trend across the site of red brown silty clay overlying orange brown silty clay being highly plastic stiff soils. Standing groundwater was not encountered during excavation but moisture content was seen to increase with depth and the soil was very wet at shallow depths of 1.5m-2.0m.

HA3 & HA4 undertaken near the centre of the site recorded gravelly silt from 3.3m and 2.0m depths respectively with gravels <5mm in size. HA4 was undertaken on the knoll within the ROW access (Lot 7) and gravels were recorded for the full depth of the excavation.

3.1.2 Shear strength

Undrained shear strengths were measured at 0.5m intervals during excavation of the hand auger boreholes to determine the in-situ shear strength properties of the surficial soils.

The results included in Appendix 2 indicate that the peak undrained shear strengths vary between test locations but are typically in excess of 100kPa. The surficial soils at the site are considered to be stiff to hard.

3.1.3 Scala penetrometer

A total of 20 dynamic cone scala penetrometer tests (SP) were undertaken within the subdivision site to determine the available bearing capacity for foundation design and for right of way pavement construction.

Three scala penetrometer tests were carried out at each of the five nominated building platforms. The tests identified a general increase in bearing resistance with depth. At normal foundation level of 0.45m to 0.6m b.e.g.l. an inferred allowable bearing capacity in excess of 100kPa is considered to be available.

The allowable bearing pressures established by the scala penetrometer testing are based on the methods described by Stockwell (New Zealand Engineering (32, 6) 15 June 1977) using a correlation of mm/blow and bearing pressure. This approach is intended to ensure against slow plastic movements of underlying soft strata and rapid local soil shear failure of the soil beneath the foundations. The inferred allowable bearing pressure includes a factor of safety

of three against soil shear failure. If these allowable pressures are used, settlement should generally be within the following limits:

(i) maximum settlement of any one of a group of footings = 25 mm
(ii) maximum differential settlement between footings = 20 mm

These deflections are regarded as the acceptable limits a modern building can withstand without distress.

The assessed available bearing capacity does not consider gradual settlement of the foundation caused by consolidation (expulsion of air and water from the soil matrix voids) of underlying compressible strata such as peat or soft clay. Based on the findings of the subsurface investigations peat or soft clay is unlikely to be present beneath the nominated building platforms and consolidation settlement is not expected to affect building foundations.

3.2 Mapped Geology

The geology of the area is defined on the Institute of Geological and Nuclear Sciences Geological Map 2: Geology of the Whangarei Area as basaltic lava flows and scoria cones of the Kerikeri Volcanic group.

The geomorphology of the general area is that of eroded basalt flows within the Puhipuhi-Whangarei Volcanic field which usually pre-date the present topography. The distribution of volcanoes near Whangarei is partly related to the local fault pattern and has formed the young and well preserved volcanic features of shield volcanoes built up from thin lava flow sequences, steep sided scoria cones and thick lava flows. Areas of basalt lava flows are expected to remain relatively stable unless underlain by soft rocks.

New Zealand Land Inventory map NZMS 290 Sheet Q 06/07 defines the pedology as Papakauri clay loam being well to moderately well drained soils of rolling and hilly land, weakly to moderately leached red loams.

3.3 Stability

The existing topography of the site is resultant from the regional geologic events, the natural weathering and erosion processes common to a high rainfall temperate climate zone, and the underlying geological formations. The produced soil profiles have a high proportion of clay and silt components and exhibit expansive, plastic and friable properties. The moderate to steeply sloping topography of the landform has a significant influence on the stability of the site.

The surficial soil profile is considered to be consistent with the geological description for the site. Land underlain by scoria cones and basalt lava flows of the Kerikeri Volcanics can be steep and are generally considered to be stable unless underlain by soft rocks. Water erosion and saturation of the weathered friable residual soils creating oversteepened faces has the potential to create shallow shear surfaces and slippage planes on the steeper slopes.

A visual inspection of the development site identified extensive areas of surface creep extending to shallow seated slippage plus shallow surface water channels which are largely confined to the steeper slopes above the residential building sites. The area of surface creep and land instability extends into proposed Lot 2 and largely corresponds to the area

recorded by WDC as a moderate instability hazard zone. The building sites within proposed Lots 3-6 are on moderately sloping ground and no evidence of instability was observed at these sites which are considered to be suitable for residential subdivision. A small knoll is present below the existing dwelling and adjacent to the State Highway and areas of surface creep exacerbated by the grazing of livestock are present on the steeper slopes within the proposed access Lot 7.

Figure 3: 1950 aerial image

Review of historical aerial photographs of the area indicate that the site was largely undeveloped in 1950 with some isolated residential dwellings and minor buildings indicated in Figure 3. The subdivision site was cleared of vegetation some time prior to 1950 with the underlying land form visible in the aerial image below. The extent of cleared land has remained largely unchanged although an area of pine trees is now present north of the site as indicated in Figure 1. The extensive area of surface creep and shallow seated slippage is visible in Figure 3 although no evidence of large scale land instability is observed. The site appears to have remained stable over the past 60 years however it is expected that the steeper slopes are subject to ongoing downslope creep movement.

A number of cut batters are present along the road frontage with State Highway 14 and a visual inspection of the batters did not identify any recent areas of instability. The residential platforms are considered to be sufficiently set back from the top of the cut batters, however the proposed ROW access (Lot 7) is positioned above the largest cut batter and will require due consideration for stability. The ROW pavement is to be sufficient setback allow for localised slumping and drop outs of the batter should this occur in the future.

3.4 Slope Stability

The risk of slope failure is quantified by means of a FS and is determined by the ratio of stabilising forces to destabilising forces. An acceptable slope will generally have a FS value of 1.5 for residential development under normal conditions and 1.2 under temporary adverse groundwater conditions. The factors of safety adopted by engineers in geotechnical design have been developed to accommodate uncertainties in geometric accuracy, soil properties, analysis method, and the validity of assumptions made.

The modelled FS does not assure safety from instability or slope movement but reduces the risk of failure. The risk of any slope failure is dependent on the ratio of forces causing and resisting movement. Factors causing movement include the slope gradient, weight of soil, ground water, surcharge, and the factors resisting movement include slope support, soil strength parameters. Groundwater plays a critical role in slope stability, and soil shear strength when wet may be reduced to less than half of the strength when dry.

It is expected that the building platforms within Lots 3-6 have a sufficient margin of stability to facilitate residential construction.

The steeper terrain within proposed Lot 2 and the roadside cut batter below the ROW access Lot 7 have been assessed for slope stability using effective stress parameters which have been derived from published correlations and previous experience with similar materials encountered within the region. Analysis of the slopes have been undertaken under normal conditions and also under transient adverse groundwater conditions.

3.4.1 Proposed Lot 2

The analysis indicates that under normal conditions the steeper slopes within the subdivision and proposed Lot 2 are susceptible to creep and shallow seated slippage. The critical failure surfaces from the model correspond to the steeper slopes above the nominated building platform within proposed Lot 2 which is positioned on the lower slopes of the site adjacent to the existing driveway and ROW access. The ground slope at the proposed Lot 2 building site is estimated at 10-15° with steeper grades of up to 35° on the slopes above the lot. The nominated building site within proposed Lot 2 is on gently to moderately sloping ground and is considered to be suitable for residential development.

A building restriction line is indicated on the site plan enclosed and future dwellings within Lot 2 should be positioned southeast of the line as indicated. Building upslope and northwest of this restriction line is likely to require a structural solution to enhance the stability of the site and mitigate the risks associated with shallow seated slope instability and surface creep which can be in the form a series of bored pile foundations taken to approximately 5-6m below existing ground level. Building northwest of this restriction line will also likely require a landslide debris barrier positioned upslope side of the nominated building platform. The debris barrier will offer protection for the building, infrastructure and people against the land instability hazard. Building upslope of the restriction line will require further appropriate engineering advice from a suitably qualified Chartered Professional Engineer.

Vegetation improves slope stability by binding of the soil, providing mechanical reinforcement to resist surface water erosion and by water uptake in transpiration processes. It is recommended that the existing vegetation within the property be retained and that the

stability sensitive slopes above Lot 2 be planted with suitable vegetation to improve slope stability.

3.4.2 Cut Batter

At the time of inspection the roadside cut batter below proposed Lot 7 and the ROW access had been excavated approximately 4-5m high adjacent to the State Highway table drain. The cut batter appeared stable with no obvious signs of instability and was estimated to have a face slope of approximately 60°. Inspection of the exposed cut batters in the surficial weathered material appear to be stable but have been subject to surface fretting and erosion where subject to surface water runoff.

Assessment of the cut batter stability at this location indicates that it is likely to have an insufficient margin of stability for residential development and a setback of 7m from the toe of the batter is recommended for the ROW pavement construction.

Surface water runoff from the ROW pavement should be collected and conveyed away from this area where the cut batter is the highest for disposal at more suitable locations in the east and west of the site. Concentrated surface water runoff should not discharge at this batter location as this will be detrimental to stability.

3.5 Earthworks

The proposed earthworks at the site are required to provide suitable Right of Way vehicle access and to provide clearly defined stormwater drainage flow paths. It is the general intention to minimise the extent of earthworks while creating suitable vehicle access to the proposed lots. Minor earthworks will be required at Building Consent stage to create suitable building platforms within the individual lots.

The volcanic derived loam soils that occupy the development site tend to be friable and erosion prone. Care must be taken to ensure that all exposed bare earth is adequately protected from erosion and scour during earthworks operations. Likewise to ensure the integrity of exposed cut and fill batters consideration should be given to surface stabilisation measures such as mulching, grassing, and erosion control blankets. In the long term exposed earth areas should be regrassed and revegetated.

Extensive cut batters are not required for the development, however a small knoll is present below the existing house within Lot 1 and the State Highway which will require cutting to form the ROW. It is expected that cut batters up to 2.0m high will be required at this location. The batters when constructed at moderate grades of 3H:1V and once revegetated are considered to remain stable, however given the areas of surface creep identified at this location and softer ground conditions, consideration should be given to construction of timber pole retaining walls to support cut batters in excess of 1m high. The surficial soils identified across the site are generally considered stable and are unlikely to present any difficulties during earthworks operations.

Appropriate soil testing and engineering supervision is to be carried out during the construction of all earthworks and relevant NRC RWSP and WDC EES requirements will be adhered to. All earthworks will be carried out in accordance with NZS4431:1989A1 Code Of Practice For Earth Fill For Residential Development. All filling works carried out are to be tested and certified by a Chartered Professional Engineer.

3.6 Expansive Soils

The surficial clay soils at the site are considered to be expansive and subject to shrink/swell effects with changes in moisture. At the time of house construction it is recommended that the subgrade within the building footprints be maintained close to its natural moisture content to avoid drying out and associated shrinkage, which may result in subgrade swelling after building construction. Subgrade swelling can have adverse effects including heaving and cracking of the floor slab plus associated cracking of the brittle cladding from differential movement. The risk of damage can be reduced during construction by placement of a 300mm minimum thick granular layer (or other barrier to water loss) within three days of excavation of the building subgrade.

The surficial soils observed during the field investigations are considered to be expansive and are interpreted as Class M to Class H1 in accordance with AS2870. It is recommended that specific engineering design of foundations for future dwellings at the site be carried out. Any strip or pad foundations at the site should be taken a minimum of 0.45m below cleared ground level.

3.7 Foundations

The scala penetrometer results within proposed Lot 4 as included in Appendix 2 do not meet the NZBC B1 threshold criteria for soils to be acceptable as good ground for building foundations, however the available bearing capacity is considered to be suitable for construction of residential dwellings.

It is expected that a dependable bearing capacity in excess of 135kPa will be available (an ultimate bearing capacity of 300kPa in conjunction with a strength reduction factor of 0.45) within the natural soils.

The surficial soils observed during the field investigations are considered to be expansive and are interpreted as Class M to Class H1 in accordance with AS2870 and it is recommended that any strip and pad footings be taken a minimum of 450mm below cleared ground level. Specific engineering design of foundations by a Chartered Professional Engineer will be required.

It is expected that waffle raft foundation slab or conventional slab on grade foundation systems will be suitable for use at the building sites. Alternatively, elevated timber subfloor construction with shallow bored timber pile footings will be suitable for use.

4. WASTEWATER MANAGEMENT

4.1 Existing System

There is currently no reticulated wastewater system available at the site and as such all wastewater generated by the proposed development will require on-site management.

4.2 Management System

Design of a specimen wastewater treatment and disposal system considered suitable for use at the site has been carried out accordance with AS/NZS 1547:2012. The system has been designed to accommodate a flow of 180 l/person/day, on-site roof water tank supply is used with standard fixtures. A three bedroom dwelling is used for design purposes with a maximum occupancy of five persons. This gives a design daily flow rate of 900 l/day for disposal system treatment.

The soil identified during field investigations is classified as moderately structured well drained clay loam being Soil Category 4 in accordance with AS/NZS 1547:2012.

Due to the site constraints and sensitive receiving environment, secondary treatment utilising a low pressure irrigation system is recommended for use at the site. This can be achieved using a Cleanstream TXR-1 textile system (or similar) which is capable of achieving secondary treatment.

Disposal of the treated wastewater within the site is to be by means of a covered surface pressure compensating dripper irrigation (PCDI) system. The secondary treated effluent from the treatment plant is to be discharged to land using a covered surface irrigation system utilising a low-pressure network of 16mm diameter pipe with spaced, self-compensating drippers providing a uniform distribution of the wastewater to the designated area.

For a surface irrigation system, the dripper lines are installed on the ground surface covered with a minimum of 150mm of soil topsoil and/or mulch to allow the treated effluent to be distributed into the topsoil layer. The secondary treated effluent shall be distributed from a system of pressure compensating drip emitters into the topsoil layer.

This type of disposal system will provide further treatment to the wastewater by retaining the effluent within the aerobic soils, and enabling significant biodegradation by the soils micro organisms. Sustainable management of on-site effluent disposal should be promoted by keeping treated wastewater within the shallow soil layers where it can easily be absorbed by plants via transpiration and into the atmosphere via evaporation.

The design irrigation rate used for determining the required land application area is 3.5mm/day requiring a land application area of 257m² plus an additional 30% reserve area of 77m². Where the land application area is positioned on sloping ground in excess of 6°, the design irrigation rate should be in accordance with AS/NZS 1547:2012. The enclosed plans provide a suitable location of the land application and treatment systems.

4.3 NRC RWSP Compliance

The site is not expected to contain environmental limitations, however design of the system is carried out in accordance with AS/NZS 1547:2012 to ensure compliance with Northland Regional Council Regional Water and Soil Plan (Part 15.1.4) as a permitted activity.

The table below sets out the requirements of the RWSP permitted activity rules for primary treated effluent and demonstrates how the proposed management system achieves compliance.

The lowest point of the disposal system is not less than 0.6 metres above the winter groundwater table.	Geotechnical investigations to 2.5m depth did not encounter groundwater within the proposed land application areas
Prior to being discharged to ground the effluent is treated to a standard such that: (i) the five day biochemical oxygen demand (BOD5) of any sample taken is less than or equal to 30 grams per cubic metre; and (ii) the total suspended solids (TSS) concentration of any sample taken is less than or equal to 45 grams per cubic metre	The proposed Cleanstream TXR-1 treatment plant (or similar) exceeds the requirements for secondary treated effluent.
No part of the disposal area and reserve area is located within 20 metres, measured horizontally, of any existing groundwater bore located on any other property	No groundwater bores for potable water use are identified at the site
No part of the disposal area and reserve area is located within 15 metres, measured horizontally, of any surface water	There is in excess of 15m separation surface water
The effluent is discharged into or onto land using a dripper system that has been designed to evenly distribute effluent and to avoid clogging by soil or root intrusion	Land application of the treated effluent is via covered surface pressure compensating irrigation for even distribution and to prevent clogging
The selection and sizing of the treatment and disposal system has been based on: (i) the volume of the discharge; (ii) the appropriate design loading rates for the identified soil type; and (iii) has taken into account any constraints identified by a detailed site investigation.	Design of the effluent treatment system has been carried out in accordance with the principles and procedures outlined in Australian/New Zealand Standard "*On-site Domestic Wastewater Management*" (AS/NZS 1547:2012) with consideration to site constraints
There is no surface runoff of any contaminants from the disposal area.	Design of the effluent treatment system has been carried out in accordance with AS/NZS 1547:2012 utilising appropriate long term acceptance irrigation rates for the site. The PCDI is to be constructed as a covered surface system limiting the potential for surface runoff of contaminants.
The discharge results in no more than minor contamination of ground and surface water beyond a 20 metre separation distance measured horizontally from any part of the disposal system, or beyond the boundary of the property on which the discharge is taking place, whichever is the lesser.	Design of the effluent treatment system has been carried out in accordance with AS/NZS 1547:2012 utilising advanced secondary treatment to reduce contaminant loading and increase soil treatment and vegetation uptake. Specific mitigation measures for the system are identified in this assessment
The volume of effluent discharged does not exceed 3 cubic metres per day, averaged over the month of greatest discharge	Design of the effluent treatment system based on three bedroom dwelling with standard water facilities generating 0.9m³ / day peak discharge in accordance with AS/NZS 1547:2012
The maximum volume of effluent discharge does not exceed 6 cubic metres over any 24 hour period	
A reserve area equivalent to 30% of the design	A 30% reserve area of 77m² is allowed for and is

disposal area has been allowed for and set aside	indicated on the enclosed plans
A programmed maintenance contract for the treatment and disposal system is entered into.	The Building Consent for the on-site wastewater system should include a maintenance agreement for the treatment and land application system

Table 1: NRC RWSP permitted activity rules for secondary treated effluent

4.4 Site Specific Mitigation Measures

Specific mitigation measures are recommended for use of a secondary treatment system at the site and the following should be adhered to for the on-site management of wastewater:

- The system should be constructed by a registered drain layer familiar with the specific requirements of this type of system.
- A service agreement between the property owner and the supplier of the treatment plants is entered into to ensure effective ongoing operation and performance. A maintenance strategy and contract for the system shall be put into place, which will include programmed inspections and maintenance of both secondary treatment systems and application areas.
- The treatment plant shall be capable of producing secondary treated effluent (Cleanstream TXR-1 or similar).
- To minimise the risk of slope instability/mass movement associated with the land application area the wastewater is to be applied over a large area at low rates. During installation and construction supervision by a suitably qualified geotechnical engineer should be carried out.
- The disposal field should also be fenced off from stock and vehicles to prevent damage to the system.
- The ingress of surface water into the land application area shall be controlled or prevented by means of a surface water interceptor drain constructed upslope to divert surface away from the land application area.
- The design irrigation rate should be decreased to accommodate sloping ground in accordance with AS/NZS 1547:2012. The design irrigation rate should be reduced by 20% for slopes in excess of 6° and 50% for slopes in excess of 12° to ensure that effluent migration down slope is taken up adequately within the top soil and plant root system.
- A reserve area of 30% is to be set aside for the future extension of the land application area in accordance with NRC RWSP for secondary treated effluent. The purpose of setting aside a reserve area for future extension of a land application system is to allow a factor of safety against unforeseen malfunction or failure, perhaps following increased household occupancy or inadvertent misuse of the system. This ensures it is possible to provide additional pre-treatment or to extend the land application system if appropriate.
- The land application areas shall be mounded to shed rainwater and are to be planted with suitable high water use vegetation to aid in evapotranspiration. Surface vegetation for PCDI shall be plants such as grasses and shrubs that tolerate wet

conditions and have a high evapotranspiration capacity. Such planting should be selected on the basis of local experience.

- A maximum distance of 1.0m between the irrigation lines in clay soils to provide an effective even distribution of effluent over the whole of the design area and on sloping ground all irrigation lines shall be installed along the contour. The irrigation area shall have an adequate depth of natural good quality topsoil (or imported topsoil if necessary) to store the applied effluent and to support the growth of vegetation to maximise evapotranspiration. A minimum topsoil depth of 150 mm is required.

4.5 Maintenance Requirements

NRC provides the following recommended maintenance for on-site wastewater systems utilising secondary treatment plants and PCDI.

4.5.1 Treatment Plant

All treatment plants require regular service and maintenance checks by a suitably qualified person to ensure the system continues to work properly. The manufacturer or supplier of the treatment plant will have a service and maintenance contract that must be entered into when the system is installed. Sludge will accumulate in the various parts of the treatment plant and should be pumped out regularly in accordance with the recommendations of the manufacturer or supplier. How often a treatment plant needs to be desludged depends mainly on the number of people using it and the size of the tank.

Household cleaners, strong detergents and toxic chemicals can kill the 'good' bacteria within treatment plant systems and only suitable detergents and cleaners should be used with an on-site treatment system. The use of bleach-based products such as whiteners, nappy soakers and stain removers should be avoided. Harmful compounds such as acids, pesticides, medicines, paint, thinners, engine oil or other materials should not be put into the treatment system and should be disposed of properly at a local transfer station or landfill. Likewise grease or cooking oil should not enter the treatment system.

4.5.2 Planted disposal areas

This service and maintenance contract should also cover the PCDI disposal system. A well-maintained and operating treatment plant will help reduce the build-up of slime within the irrigation lines and drippers, thereby reducing the risk of the drippers becoming clogged

If you have a planted irrigation line disposal area, then the plants should be well looked after to ensure that they do their job to maximum effect. Maintenance should include replanting and pruning of plants to promote healthy growth.

The disposal system should be protected by restricting access areas of land that have been specially planted as part of the disposal system. Vehicle and stock access should not be allowed and deep rooting trees should not be planted over the disposal system.

4.5.3 Surface water cut-off drains

If your disposal system is located on a slope, a surface water cut-off drain will usually be installed above the effluent disposal system to prevent stormwater runoff from the slope entering the disposal area. All surface water cut-off drains need to be maintained to make

sure they work properly. This may include removing excess grass or plant growth from the drains and making sure there are no other obstructions to prevent the free flow of water.

Prior to winter, it is a good idea to give all surface water cut-off drains a quick visual check and to carry out any required maintenance as soon as possible. If a surface water cut-off drain is not working properly, the excess stormwater entering the disposal area will cause failure of the disposal system and result in effluent flowing down the slope.

5. STORMWATER MANAGEMENT

5.1 Existing Drainage

Existing surface water runoff form the driveway is collected in roadside table drains for conveyance to the base of the slope where it discharges to ground surface. A culvert is present in the upper parts of the driveway which drains under the carriageway into proposed lot 3 with a concentrated discharge to ground surface. General surface water runoff is conveyed south following the natural topography via overland surface flow where it collects in the State Highway roadside drainage system.

5.2 Proposed Drainage

The existing drainage system will not be altered by the formation of the subdivision and surface water runoff from the developed site will be directed to the State Highway drainage system to replicate current flow paths as much as possible while achieving the water quantity and quality objectives of WDC EES.

Stormwater management for the site looks to maintain the existing drainage flow paths while providing suitable systems for collecting and treating surface runoff form the vehicle access routes. WDC EES stormwater objectives are achieved by providing swale drains and dry balancing ponds for attenuation of the ROW surface water runoff.

For development of the lots, individual on-site attenuation will be required at the time of Building Consent to ensure WDC EES requirements are met. The attenuated stormwater is to discharge in a controlled manner via a level spreader outlet to ensure an acceptable rate of dispersed discharge at the boundary.

All stormwater created from the newly formed impermeable surfaces should be collected and piped away from the building sites for disposal in a responsible manner to prevent erosion. Surface water runoff should not discharge above on-site wastewater disposal fields. The existing culvert that drains into Lot 3 should be removed or redirected to ensure concentrated flows do not discharge above the building platform and runoff should be conveyed to the base of the slope in a responsible manner for attenuation. Similarly the roadside table drain that is currently directed through Lot 2 should be redirected along the carriageway for conveyance of runoff to the proposed dry balancing at the base of the slope.

No evidence of erosion was identified at the site, however further concentration of stormwater flows and lack of vegetation post development may cause erosion of exposed areas if not protected.

5.3 Water Quantity Treatment

Proposed Lots 2-6 are less than 1ha and runoff from the developed site is to be less than 80% of the existing site including an allowance of 20% for climate change for a 100 year rainfall event. The most convenient means to achieve this is to collect roof runoff from the new buildings and direct to an above ground attenuation tank where it is released at a slower rate to the downstream stormwater drainage system. This method can also be used to compensate for other impervious surfaces which cannot be readily collected and attenuated (i.e. driveways, paved areas, paths). Allowing for a 300m² roof area it is likely that attenuation storage between 15-20m³ will be required. However WDC encourages the re-use of stormwater as a means of attenuation and recognises that roof water tanks can

provide a significant contribution to stormwater attenuation. Providing a roof water tank sized 25,000 litres, WDC allows a 25% reduction in the required attenuation volume.

Design of the stormwater management for the subdivision Right of Way access has been carried out in accordance with WDC EES. Of particular relevance is the requirement to reduce stormwater runoff from increased impervious areas for the critical design events (5yr & 100yr ARI) including 20% climate change to less than 80% of the predevelopment discharge. Analysis has been conducted with a hydrological model built using the modified SCS method, in accordance with ARC TP108 and NRCS TR-55 Type 1A rainfall distribution, as per WDC EES. Rainfall data is sourced from NIWA HIRDS v3.

Model parameters for the design are detailed below:

- Soil category = C
- Land cover = pasture/grassland
- SCS CN = 74 (pre-development – WDC EES Table 4.1)
- SCS CN = 98 (impervious areas – WDC EES Table 4.1)
- Time of Concentration = 10 min pre-development, 5 min post-development
- 5yr ARI 24hr Depth = 138mm
- 100yr ARI 24hr Depth = 255mm
- Climate change = 20% increase in rainfall depth

The new ROW constructed within Lot 7 falls to two different catchments. Allowing for a 4m wide sealed formation with 530m² falling northeast and 530m² falling southwest in conjunction with the existing sealed driveway which is to be upgraded gives the following catchment characteristics.

- Catchment 1: Existing impervious area = 450m² (driveway)
  Proposed impervious area = 60m² (driveway)
  Proposed impervious area = 530m² (Lot 7 ROW)
- Catchment 2: Proposed impervious area = 530m² (Lot 7 ROW)

5.3.1 Catchment 1

Catchment 1 includes part of the new ROW access and the existing driveway which drains to the northeast of the subdivision site at the existing vehicle crossing. The proposed development creates an additional 590m² of impervious area for sealed vehicle access in addition to the existing 450m² of driveway. It is proposed to direct the runoff from this catchment via roadside swale drains and erosion protected channels to a dry balancing pond adjacent to the subdivision entrance. The catchment has been modelled as two separate impervious areas with the total combined ROW producing the following peak discharge attributes and requirements:

	Pre Peak (l/s)	Post Peak (l/s)	Post Peak Attenuated (l/s)
5 yr ARI	6.7	11.5	5.2
100 yr ARI	14.8	21.2	11.9

Table 2: Pre and Post development peak discharge

The attenuation volume required to achieve the run-off requirements detailed above is included in the enclosed calculations and indicates 45m³ of live storage will be required. This

is achieved by providing 80m² x 0.6m deep dry balancing basin adjacent to the ROW access at the entrance to the site.

The restricted flow outlet from the balancing basin can be formed using a conventional concrete chamber with dual orifice outlet discharging to the downstream system. A low level Ø70mm orifice and a Ø70mm high level orifice set 300mm above the lower will be suitable for use. The flow control chamber outlet will drain via a Ø150 uPVC pipe for discharge to ground via a suitably sized flow dispersal trench or level spreader.

5.3.2 Catchment 2

Catchment 2 includes part of the new ROW access which drains to the southwest of the subdivision site towards proposed Lot 6. The proposed development creates an additional 590m² of impervious area for sealed vehicle access. It is proposed to direct the runoff from this catchment via roadside swale drains and erosion protected channels to a dry balancing pond adjacent to the subdivision entrance. The catchment has been modelled with the ROW producing the following peak discharge attributes and requirements:

	Pre Peak (l/s)	Post Peak (l/s)	Post Peak Attenuated (l/s)
5 yr ARI	1.6	3.9	5.2
100 yr ARI	4.2	7.1	11.9

Table 3: Pre and Post development peak discharge

The attenuation volume required to achieve the run-off requirements detailed above is included in the enclosed calculations and indicates 20m³ of live storage will be required. This is achieved by providing 60m² x 0.4m deep dry balancing basin at the end of the ROW access within proposed Lot 6.

The restricted flow outlet from the balancing basin can be formed using a conventional concrete chamber with dual orifice outlet discharging to the downstream system. A low level Ø40mm orifice and a Ø40mm high level orifice set 180mm above the lower will be suitable for use. The flow control chamber outlet will drain via a Ø150 uPVC pipe for discharge to ground via a suitably sized flow dispersal trench or level spreader.

5.4 Water Quality Treatment

Contaminants of concern from trafficked areas are Zinc and Copper, sediment and petroleum hydrocarbons (TPH). It is proposed that water quality objectives will be met with low impact drainage solutions comprising shallow road side vegetated swales. The overall concept of a vegetated swale is to slow stormwater flows, capture some contaminants, and allow for some reduction in the total volume of runoff. The passage of stormwater through vegetated swales utilises a number of physical, chemical, and biological factors to reduce stormwater contaminants. Primarily this will be achieved through the process of:

- Physical filtration by the dense vegetation which also improves retention of settled material
- Infiltration via gravel trench under drain (swale slopes less than 2%)
- Chemical processes including complexing, adsorption and conversion of soluble contaminants to insoluble forms.
- Uptake of nutrients and contaminants by swale vegetation

Surface runoff from the ROW access to the lots will be directed via sheet flow to the road side swale drains where it will accumulate for treatment via the above mentioned processes. The swale will also act as a conveyance system for directing the runoff to the dry balancing pond locations.

Calculations included in Appendix 2 indicate that the treatment capacity of a 1.5m wide swale drain exceeds the water quality requirements for the 4.0m wide vehicle access runoff. A traditional trapezoidal profile with 0.5m wide base and side slopes of 1:5 to facilitate easy maintenance is suitable for use. The longitudinal gradient of the swales varies along the length of pavement and slopes greater than 5% will require a series of check dams to reduce flow velocities plus adequate erosion control and energy dissipation.

Maintenance of the swale systems will be required to ensure that they function as intended with the primary objectives being a dense mat of vegetation and a swale free of obstructions such as leaf litter and significant deposits of sediment. Homeowners should also be discouraged from cutting the grass too short.

The swales are to be fully stabilised prior to accepting stormwater runoff to reduce channel erosion potential. It may be necessary to provide additional protective measures until such time as the vegetation is fully established.

Roof runoff does not require water quality treatment on the basis that exposed galvanised or copper roofing material is not used. Where possible roof runoff from individual house lots shall not discharged directly to the swale drains.

5.5 Overland Flow Paths

Where the capacity of the primary drainage systems are exceeded or there are blockages, overland flow paths (OLFP) will be provided to ensure the surface water is conveyed away from building sites. The building sites are well elevated above the ROW access locations and surface runoff is directed away and downslope from the nominated building platforms. The vehicle access is to be designed to ensure that such flow will not overflow onto adjacent properties and buildings are to be constructed to ensure adequate freeboard above the OLFP in accordance with WDC EES. Proposed overland flow paths are included on the plans in Appendix 1.

Globally, the existing overland flow paths discharging to the State Highway roadside drainage network will be maintained.

5.6 Flood Susceptible Areas

Neither Whangarei District Council nor Northland Regional Council hazard maps indicate flood susceptible areas located at the building site and given the site topography the building site is not expected to be flood susceptible. The building sites may however receive sheet flow runoff from the sloping ground upslope of the lots and should be given consideration when developing the house sites.

6. ACCESS ARRANGEMENTS

6.1 Design Standards

The design of the access is based on WDC EES with consideration to low impact design. Low impact design is a concept whereby land development minimises the effect of stormwater runoff and associated contaminants that pollute the downstream environment such as rivers, lakes and oceans. The adoption of low impact design principles such as minimising impervious surfaces and maintaining dispersed flow can contribute to a more sustainable approach for site design and development.

The subdivision site is accessed via an existing vehicle crossing and sealed driveway from the end of Hawken Road that presently services the existing residential dwelling. The existing vehicle crossing will be upgraded to comply with WDC EES requirements for access to six residential lots. The driveway is to be upgraded to facilitate residential access to proposed lot 1-3 and it is expected that a Category D privateway will be suitable for use.

A new ROW access is to be formed from the vehicle crossing via proposed Lot 7 to service Lots 3-6 and it is expected that a Category D privateway will be suitable for use. At the entrance to the subdivision, a short length of the ROW (Easement A) will service six lots and a Category G ROW is considered suitable for use.

The following formation standards are expected for use at the site:

Number of lots	WDC Category	Carriageway width	Seal width	Surfacing
2	C (alt)	4.5m	4.0m	Chip seal
3-5	D	4.5m	4.0m	Chip seal
6-8	G	6.0m	5.5m	Chip seal

Table 4: ROW access formation standard

The private way width shall be sufficient to ensure that the road berms are wide enough to contain any required cut/fill batters, swale drains and services within the access corridor. The access alignments are typically at gentle to moderate grades. The maximum permissible gradient specified in WDC EES for rural private access ways is 1 in 4.5 (22.2%) however it is recommended that maximum grades of 1 in 8 be provided and it is anticipated that this can be readily achieved at the site.

6.2 Structural Design

It is anticipated that the ROW pavement and vehicle crossings will be formed from a flexible unbound granular pavement with chip seal surfacing. Conventional sub-base materials comprising GAP65 and AP40 are considered suitable for use at the site in accordance with WDC EES.

The structural design of the pavement should be carried out to ensure the pavement has sufficient capacity to accommodate the anticipated traffic volumes. The empirical or mechanistic design method for flexible pavements to Austroads guidelines is considered appropriate for use at this development.

Detailed design of the road pavement should be carried out by a Chartered Professional Engineer with suitable geotechnical experience. Any filling to be carried out in the formation of the ROW access should be tested and certified by a Chartered Professional Engineer. Where required, the existing driveway formation can be incorporated into the ROW access, with checking out of the shoulder and localised widening carried out as required to achieve the required formation standard. The thickness of the existing hard fill formation should be confirmed during detailed design.

Based on a design CBR of 3% and assumed design traffic of 1 x 10^3 ESA the following typical pavement of 250mm thickness is considered acceptable for use at the site. This is comprised of:

- Compacted subgrade CBR > 3%
- 150mm thick GAP65 granular sub-base
- 100mm thick AP40 granular basecourse

6.3 Surface water drainage

Surface water drainage from the ROW access formation is to be managed using low impact sustainable drainage systems by directing surface runoff to shallow road side swales for treatment and conveyance.

This allows for surface water runoff generated from newly formed impermeable surfaces to be collected and conveyed to the existing discharge locations replication of existing drainage paths. Low impact design of the access routes shall include maintenance of over edge stormwater dispersed flow by forming vegetative strips and swale drains adjacent to the access road, eliminating the need for kerbing and associated piped drainage. The pavement should be provided with a flush edge beam in accordance with WDC EES.

Any swale and/or side drains to the carriageways provided for stormwater conveyance and treatment shall be designed to keep groundwater below the road pavement under normal events. It is unlikely that groundwater will be encountered during construction of the ROW access, however consideration should be given to the incorporation of subsoil drainage where required.

6.4 Sight Distances

Hawken Road is defined as a Local Road in the District Plan which recommends a minimum sight distance of 55m for low volume crossings in a 60km/h operating environment. A low speed operating environment is considered appropriate at this location due to the property entrance being positioned at the end of a dead end road.

Hawken Road carriageway follows a gently graded alignment and offers suitable sight distances in excess of 130m at the existing vehicle crossing and subdivision entrance location. It is considered that suitable sight distances will be available in accordance with WDC EES for the existing vehicle crossing.

7. SUMMARY

S. Williamson proposes to construct a seven lot residential subdivision at 60 Hawken Road, Whangarei. The subdivision site is currently occupied by a residential dwelling and the proposal creates five new building sites within the property, accessed via new Right of Ways from Hawken Road. This assessment has considered the residential development of proposed lots 2-6.

Geotechnical investigations across the building platforms reveal stiff volcanic derived red brown clay loam soils. A visual inspection of the development site identified extensive areas of surface creep extending to shallow seated slippage which are largely confined to the steeper slopes above the residential building sites. The area of surface creep and land instability extends into proposed Lot 2. Review of historical aerial images indicates that the site appears to have remained stable over the past 60 years with no evidence of large scale instability, however it is expected that the steeper slopes are subject to ongoing downslope creep movement. The nominated building platforms within proposed Lots 2-6 are expected to have an adequate Factor of Safety for slope stability to facilitate residential subdivision and development of the land.

A building restriction line has been included within Appendix 2 to limit residential house sites on the flatter parts of the lot. Dwelling construction north of this building restriction line is likely to require an in-ground (palisade) retaining wall to enhance the stability of the site formed via a series of bored pile foundations plus a landslide debris barrier constructed upslope of the dwelling. Building upslope of the restriction line will require further appropriate engineering advice from a suitably qualified Chartered Professional Engineer.

A dependable bearing capacity in excess of 135kPa is considered to be available for design of new house foundations. Waffle raft, shallow reinforced concrete strip/pad foundation systems or elevated timber subfloor construction will be suitable for use at the site. The surficial soils are considered to be expansive and are interpreted as Class M to Class H1 in accordance with AS2870 and it is recommended that any strip and pad footings be taken a minimum of 450mm below cleared ground level. Specific engineering design of foundations for future dwellings at the site should be carried out.

Provisions will be required for on-site wastewater management and preference given to systems that disperse effluent over a wide area rather than concentrating it in one location. It is recommended that a secondary treatment system (Cleanstream TXR-1 or similar) in conjunction with pressure compensating dripper irrigation be used at the site. Specific design of individual on-site systems will be required at the time of Building Consent.

The design of the stormwater management system for the proposed subdivision meets the requirements of WDC EES through provision of road side swale drains discharging to dry balancing basins with a restricted flow outlet. Water quantity treatment is achieved with a 45m³ dry balancing basin near the entrance to the site and a 20m³ dry balancing basin within proposed Lot 6. Roof runoff from new houses shall be directed to individual on-site attenuation tanks designed to accommodate the 100yr CC ARI event. Preliminary design of the required attenuation volumes in accordance with WDC EES requirements is included within this assessment. The proposed drainage system maintains the existing flow paths at the property. Water quality treatment is achieved through use of vegetated swales parallel

with the ROW access. The capacity of the proposed low impact system utilising a 1.5m wide grassed swale exceeds the treatment requirements of the proposed development.

Access to the subdivision will be formed via the existing vehicle crossing from the end of Hawken Road. Adequate sight distances are considered to be available at the existing crossing. The existing driveway and vehicle crossing will require upgrading to satisfy the requirements of WDC EES and a new ROW access within proposed Lot 7 will facilitate residential vehicle access to proposed Lots 4-6.

8. LIMITATIONS

This report has been prepared for the benefit of S. Williamson as our client with respect to residential subdivision at 60 Hawken Road, Whangarei and for Whangarei District Council approval. No liability is accepted by Base Group Consulting where other parties rely on the information or opinions contained in this report and any other person who relies upon any matter contained in this report does so entirely at their own risk. Any recommendations, opinions, or guidance provided by Base Group Consulting in this report are limited to technical engineering requirements and are not made under the Financial Advisers Act 2008.

Base Group Consulting have performed the services for this site assessment in accordance with the standard agreement for consulting services and current professional standards. No guarantees are either expressed or implied.

A S MacPherson
Chartered Professional Engineer
BE Civil (Hons), CPEng, MIPENZ, IntPE(NZ)

BASE GROUP CONSULTING
Structural & Civil Engineering

APPENDIX 1: SITE PLANS

PROPOSED DRY POND BALANCING BASIN TO TEMPORARILY STORE SURFACE WATER RUNOFF TO CONTROL THE PEAK RATE OF DISCHARGE FROM THE POST DEVELOPED SITE. THE ATTENUATION VOLUME REQUIRED TO STORE THE SURFACE WATER RUNOFF HAS BEEN SIZED TO ACHIEVE THE RESTRICTED RUN-OFF REQUIREMENTS TO LESS THAN 80% OF PRE-DEVELOPMENT FLOWS AS REQUIRED BY WDC EES. DRY POND SHOWN WITH BASE AREA OF 80m² x 0.6m DEEP ACHIEVING AN ATTENUATION STORAGE VOLUME IN EXCESS OF 45m³. RESTRICTED FLOW OUTLET TO DISCHARGE TO GROUND SURFACE USING LEVEL SPREADER OR DISPERSAL TRENCH.

BUILDING RESTRICTION LINE WITHIN LOT 2 FOR LAND INSTABILITY. CONSTRUCTION NORTH OF BUILDING RESTRICTION LINE REQUIRES FURTHER APPROPRIATE ENGINEERING ADVICE FROM A SUITABLY QUALIFIED CHARTERED PROFESSIONAL ENGINEER. LIKELY SOLUTION WILL REQUIRE BORED PILE FOUNDATIONS ON DOWNSLOPE SIDE TAKEN 5-6M DEEP TO MITIGATE THE EFFECTS OF SOIL CREEP AND SHALLOW SEATED SLIPPAGE AND LANDSLIDE DEBRIS WALL ON UPSLOPE SIDE OF DWELLING. NOMINATED BUILDING PLATFORM WITHIN PROPOSED LOT 2 SHOWN AS 10m x 10m IN ACCORDANCE WITH WDC DISTRICT PLAN CL71.3.4 AND POSITIONED ON GENTLY TO MODERATELY GRADED TERRAIN ADJACENT TO EXISTING DRIVEWAY. BUILDING CONSTRUCTION AT THE SITE IS MOST SUITED TO EITHER AN ELEVATED TIMBER PLATFORM ON SHALLOW BORED TIMBER PILE FOUNDATIONS OR EXCAVATION INTO THE SLOPING SITE WITH SUITABLE RETAINING AS NECESSARY.

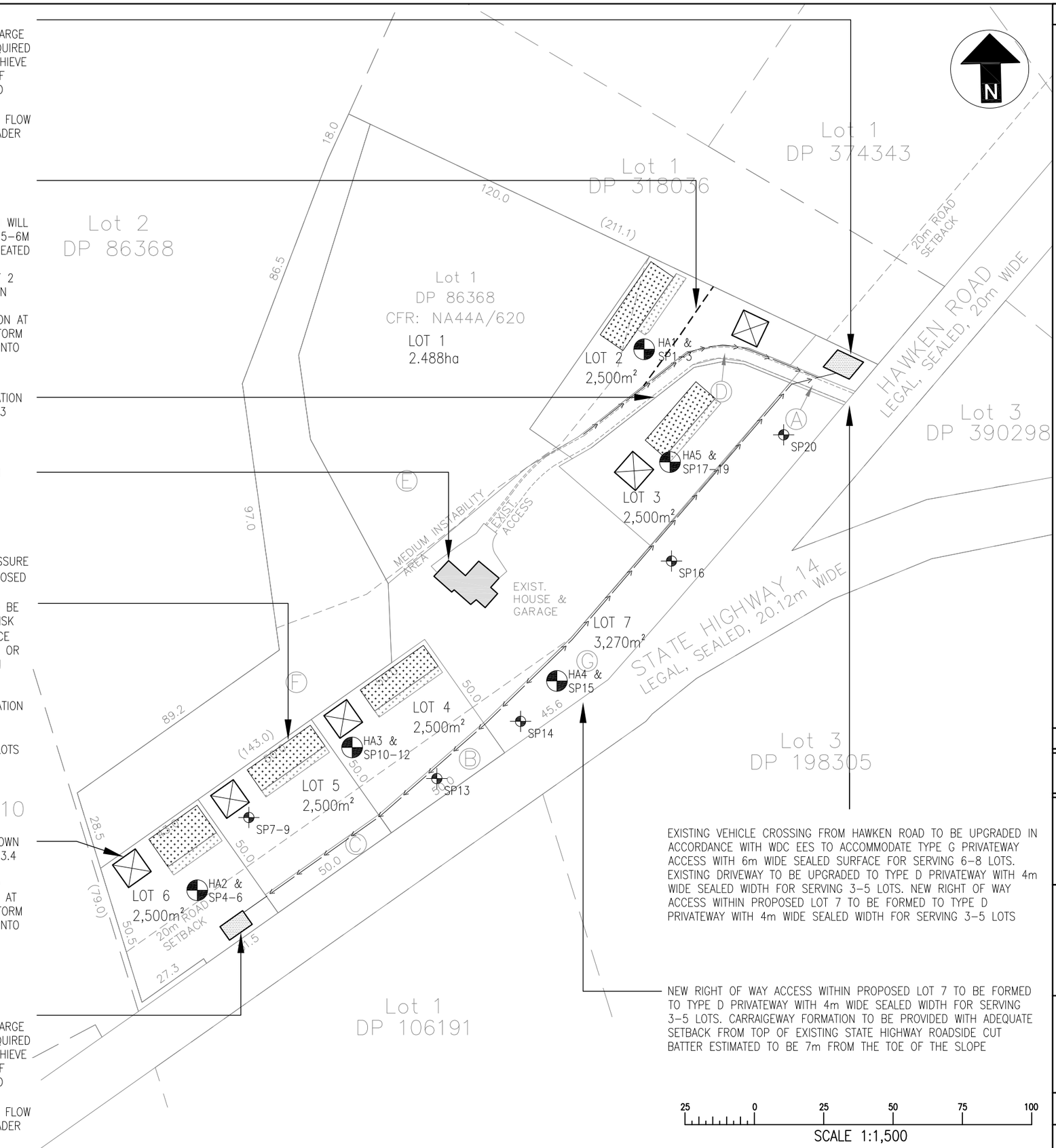
EXISTING DRIVEWAY CULVERT TO BE REDIRECTED TO DRY ATTENUATION POND AND TO ENSURE NO CONCENTRATED DISCHARGE INTO LOT 3

EXISTING RESIDENTIAL DWELLING AND ASSOCIATED DRIVEWAY FROM HAWKEN ROAD CONTAINED WITHIN BALANCE AREA LOT 1 DP 150910

PROPOSED LAND APPLICATION AREA FOR COVERED SURFACE PRESSURE COMPENSATING DRIPPER IRRIGATION SHOWN AS 257m² FOR PROPOSED LOTS 3-6 AND 320m² FOR PROPOSED LOT 2 FOR USE WITH SECONDARY TREATED WASTEWATER. TREATED WASTEWATER SHOULD BE APPLIED AT LOW RATES OVER A LARGE AREA TO MINIMISE THE RISK OF SLOPE INSTABILITY/MASS MOVEMENT. THE INGRESS OF SURFACE WATER INTO THE LAND APPLICATION AREA SHALL BE CONTROLLED OR PREVENTED BY MEANS OF A SURFACE WATER INTERCEPTOR DRAIN CONSTRUCTED UPSLOPE TO DIVERT SURFACE AWAY FROM THE DISPOSAL FIELD. ALL DISPOSAL FIELDS ARE TO BE PLANTED WITH SUITABLE HIGH WATER USE VEGETATION. PROPOSED LAND APPLICATION AREAS ARE SHOWN WITH 15m OFFSET FROM SURFACE WATER AS REQUIRED FOR COMPLIANCE WITH NRC RWSP FOR A PERMITTED ACTIVITY. 30% RESERVE AREA SHOWN AS 77m² FOR PROPOSED LOTS 3-6 AND 96m² FOR PROPOSED LOT 2.

NOMINATED BUILDING PLATFORM WITHIN PROPOSED LOTS 3-6 SHOWN AS 10m x 10m IN ACCORDANCE WITH WDC DISTRICT PLAN CL71.3.4 AND POSITIONED ON GENTLY TO MODERATELY GRADED TERRAIN ELEVATED ABOVE PROPOSED RIGHT OF WAY VEHICLE ACCESS AND ADJACENT STATE HIGHWAY CARRIAGEWAY. BUILDING CONSTRUCTION AT THE SITE IS MOST SUITED TO EITHER AN ELEVATED TIMBER PLATFORM ON SHALLOW BORED TIMBER PILE FOUNDATIONS OR EXCAVATION INTO THE SLOPING SITE WITH SUITABLE RETAINING AS NECESSARY.

PROPOSED DRY POND BALANCING BASIN TO TEMPORARILY STORE SURFACE WATER RUNOFF TO CONTROL THE PEAK RATE OF DISCHARGE FROM THE POST DEVELOPED SITE. THE ATTENUATION VOLUME REQUIRED TO STORE THE SURFACE WATER RUNOFF HAS BEEN SIZED TO ACHIEVE THE RESTRICTED RUN-OFF REQUIREMENTS TO LESS THAN 80% OF PRE-DEVELOPMENT FLOWS AS REQUIRED BY WDC EES. DRY POND SHOWN WITH BASE AREA OF 60m² x 0.4m DEEP ACHIEVING AN ATTENUATION STORAGE VOLUME IN EXCESS OF 20m³. RESTRICTED FLOW OUTLET TO DISCHARGE TO GROUND SURFACE USING LEVEL SPREADER OR DISPERSAL TRENCH.



EXISTING VEHICLE CROSSING FROM HAWKEN ROAD TO BE UPGRADED IN ACCORDANCE WITH WDC EES TO ACCOMMODATE TYPE G PRIVATEWAY ACCESS WITH 6m WIDE SEALED SURFACE FOR SERVING 6-8 LOTS. EXISTING DRIVEWAY TO BE UPGRADED TO TYPE D PRIVATEWAY WITH 4m WIDE SEALED WIDTH FOR SERVING 3-5 LOTS. NEW RIGHT OF WAY ACCESS WITHIN PROPOSED LOT 7 TO BE FORMED TO TYPE D PRIVATEWAY WITH 4m WIDE SEALED WIDTH FOR SERVING 3-5 LOTS

NEW RIGHT OF WAY ACCESS WITHIN PROPOSED LOT 7 TO BE FORMED TO TYPE D PRIVATEWAY WITH 4m WIDE SEALED WIDTH FOR SERVING 3-5 LOTS. CARRAIGEWAY FORMATION TO BE PROVIDED WITH ADEQUATE SETBACK FROM TOP OF EXISTING STATE HIGHWAY ROADSIDE CUT BATTER ESTIMATED TO BE 7m FROM THE TOE OF THE SLOPE

25 0 25 50 75 100

SCALE 1:1,500

Notes

1. THIS DRAWING IS NOT TO BE SCALED.
2. SUBDIVISION LAYOUT INCLUDING PROPERTY BOUNDARIES AND SITE FEATURES ARE INDICATIVE ONLY.
3. REFER TO REYBURN & BRYANT FOR DETAILS OF PROPOSED SUBDIVISION INCLUDING EASEMENT AND COVENANT DETAILS.
4. THE WASTEWATER IRRIGATION FIELDS ARE BASED ON A DIR OF 3.5mm/DAY FOR A 3 BEDROOM DWELLING ON RAINWATER SUPPLY. PCDI TO BE USED WITH SECONDARY TREATMENT SYSTEM COMPLYING WITH NRC REQUIREMENTS
5. THE 30% RESERVE AREA ALLOWS A FACTOR OF SAFETY AGAINST UNFORESEEN MALFUNCTION OR FAILURE, PERHAPS FOLLOWING INCREASED OCCUPANCY OR INADVERTENT MISUSE OF THE SYSTEM

PROPERTY BOUNDARY
PROPOSED BUILDING SITE
SCALA PENETROMETER TEST
HAND AUGER BOREHOLE
WASTEWATER LAND APPLICATION AREA
STORMWATER ATTENUATION POND / BALANCING BASIN
EXISTING BUILDINGS
ROW SWALE DRAIN
BUILDING LINE RESTRICTION

Rev	Description	Date	App

APPROVAL

S. WILLIAMSON
60 HAWKEN ROAD
MAUNU

BASE GROUP CONSULTING
Structural & Civil Engineering
PO Box 1032, Whangarei 0140, New Zealand
P 09 437 3432 E office@basegroup.co.nz www.basegroup.co.nz

SITE PLAN

Scale:	Date:	Drawn:	Checked:
1:1,500 @ A3	18 APR 2016	AM	

Drawing No.: 16036/C1 Rev:

BASE GROUP CONSULTING
Structural & Civil Engineering

APPENDIX 2: GEOTECHNICAL INVESTIGATIONS

166 Bank Street
Whangarei
P: 09 438 4417
E: info@geocivil.co.nz
M: 027 6565 226

TEST REPORT

Lab Job No: 8288-072

Your ref.: 16036

Date of Issue: 01/04/2016

Date of Re-Issue: -

Page: 1 of 27

Test Report.

No. W16-260

PROJECT:	60 Hawken Road, Maunu – Geotechnical Invesigations
CLIENT:	Base Group Consulting PO Box 1032, Whangarei 0140
ATTENTION:	Aaran MacPherson
INSTRUCTIONS:	Determination of the penetration resistance using a dynamic cone (scala) Penetrometer Hand Held Shear Vane Test Augerholes where required (not accredited)
TEST METHOD:	NZS 4402: 1988 Test 6.5.2 NZGS: August 2001 NZGS December 2005 (not accredited)
SAMPLING METHOD:	N/A
TEST RESULTS:	As Per Laboratory Sheets attached

N. Krissansen

Laboratory Technician

S. Kokich

Approved Signatory

IANZ ACCREDITED LABORATORY

Tests indicated as not accredited are outside the scope of the laboratory's accreditation

166 Bank Street
Whangarei
P: 09 438 4417
E: info@geocivil.co.nz

DYNAMIC CONE (SCALA) PENETROMETER

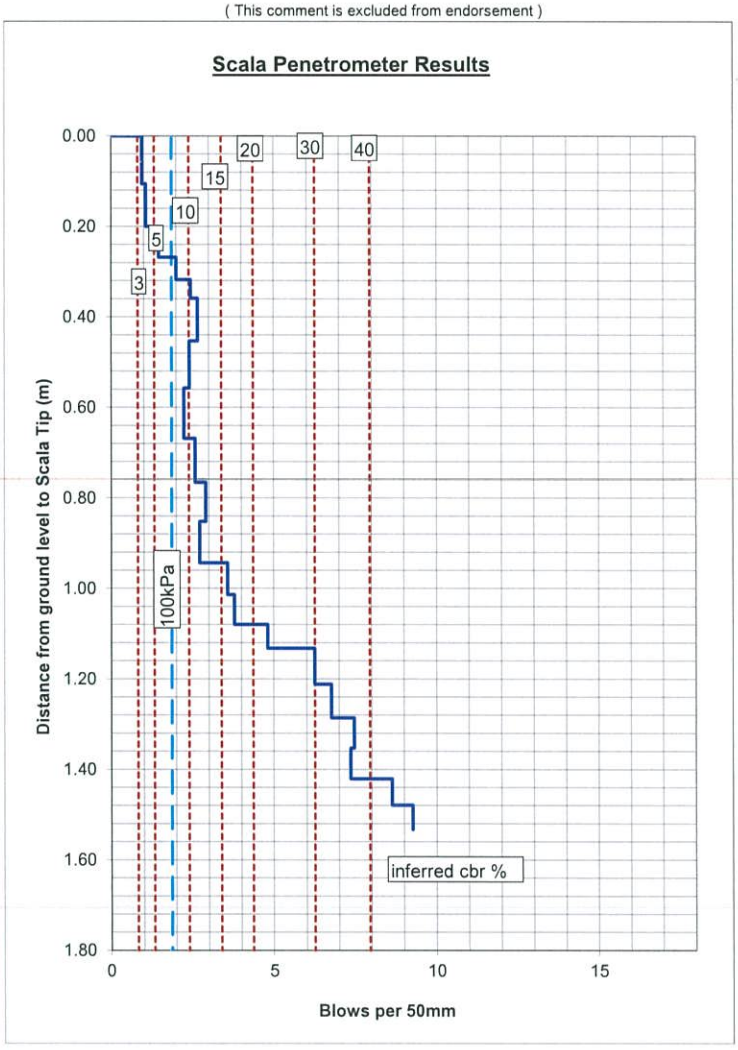
NZS 4402 :1988 Test 6.5.2

Lab Job No: 8288-072
Client: Base Group Consulting
Job: Geotechnical Investigations
Location: Lot 2, 60 Hawkens Road, Maunu
Start Depth (m): 0

Scala No: SP1
Ref : 16036
Report No: W16-260
Page: 2 of 27

The line are the suggested correlation of CBR values based on Figure 5.3, Correlation of Dynamic Cone Penetration and CBR AUSTROADS (2004) "Pavement Design - a guide to the design of road Pavements"
(This comment is excluded from endorsement)

No. Blows	Tip to ref (cm)	mm / blow	blows / 50mm	Blows / 300mm	Total Blows	depth (m)
0	105.4	0	0	0	0	0.00
2	94.8	53	1	6	2	0.11
2	85.4	47	1	6	4	0.20
2	78.6	34	1	9	6	0.27
2	73.6	25	2	12	8	0.32
2	69.5	21	2	15	10	0.36
5	60.1	19	3	16	15	0.45
5	49.7	21	2	14	20	0.56
5	38.5	22	2	13	25	0.67
5	28.8	19	3	15	30	0.77
5	20.2	17	3	17	35	0.85
5	11	18	3	16	40	0.94
0	111.2	0	0	0	40	0.94
5	104.2	14	4	21	45	1.01
5	97.6	13	4	23	50	1.08
5	92.4	10	5	29	55	1.13
10	84.4	8	6	38	65	1.21
10	77	7	7	41	75	1.29
10	70.3	7	7	45	85	1.35
10	63.5	7	7	44	95	1.42
10	57.7	6	9	52	105	1.48
10	52.3	5	9	56	115	1.53



Recorded By: S.K
Date: 30/03/2016
Checked by: N. Kokich
Date: 4-4-2016

Note: All readings taken below 1.5m from start depth are outside the scope of this test

S. Kokich
Approved Signatory

166 Bank Street
Whangarei
P: 09 438 4417
E: info@geocivil.co.nz

DYNAMIC CONE (SCALA) PENETROMETER

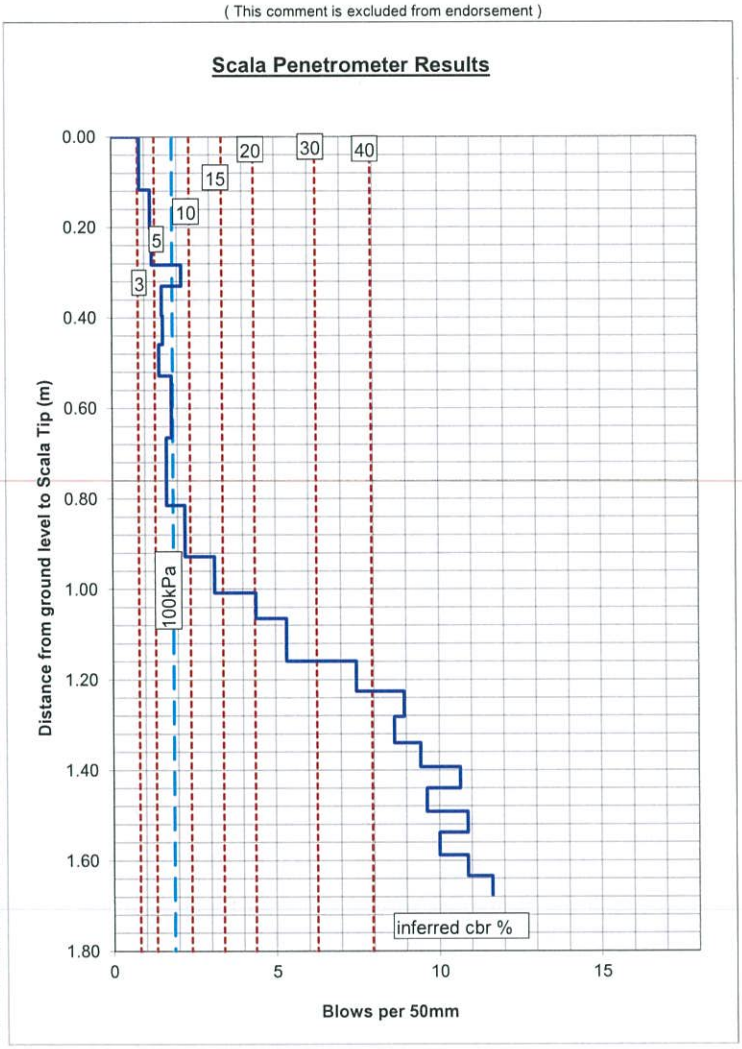
NZS 4402 :1988 Test 6.5.2

Lab Job No: 8288-072
Client: Base Group Consulting
Job: Geotechnical Investigations
Location: Lot 2, 60 Hawkens Road, Maunu
Start Depth (m): 0

Scala No: SP2
Ref : 16036
Report No: W16-260
Page: 3 of 27

The line are the suggested correlation of CBR values based on Figure 5.3, Correlation of Dynamic Cone Penetration and CBR AUSTROADS (2004) "Pavement Design - a guide to the design of road Pavements"
(This comment is excluded from endorsement)

No. Blows	Tip to ref (cm)	mm / blow	blows / 50mm	Blows / 300mm	Total Blows	depth (m)
0	99.3	0	0	0	0	0.00
2	87.6	59	1	5	2	0.12
2	79.1	43	1	7	4	0.20
2	71	41	1	7	6	0.28
2	66.3	24	2	13	8	0.33
2	59.8	33	2	9	10	0.40
2	53.4	32	2	9	12	0.46
2	46.5	35	1	9	14	0.53
5	32.8	27	2	11	19	0.67
5	17.8	30	2	10	24	0.82
5	6.5	23	2	13	29	0.93
0	107.8	0	0	0	29	0.93
5	99.8	16	3	19	34	1.01
5	94.1	11	4	26	39	1.07
10	84.7	9	5	32	49	1.16
10	78	7	7	45	59	1.23
10	72.4	6	9	54	69	1.28
10	66.6	6	9	52	79	1.34
10	61.3	5	9	57	89	1.39
10	56.6	5	11	64	99	1.44
10	51.4	5	10	58	109	1.49
10	46.8	5	11	65	119	1.54
10	41.8	5	10	60	129	1.59
10	37.2	5	11	65	139	1.63
10	32.9	4	12	70	149	1.68



Recorded By: S.K
Date: 30/03/2016
Checked by: N. Kinsman
Date: 4-4-2016

Note: All readings taken below 1.5m from start depth are outside the scope of this test

S. Kokich
Approved Signatory

166 Bank Street
Whangarei
P: 09 438 4417
E: info@geocivil.co.nz

DYNAMIC CONE (SCALA) PENETROMETER

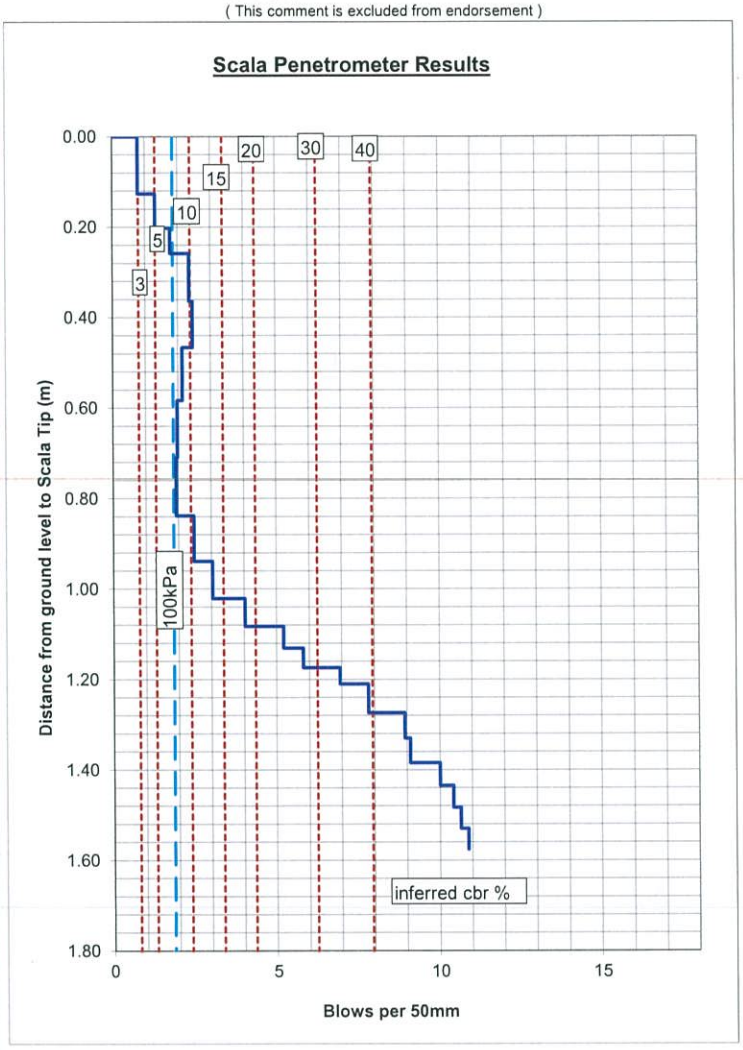
NZS 4402 :1988 Test 6.5.2

Lab Job No: 8288-072
Client: Base Group Consulting
Job: Geotechnical Investigations
Location: Lot 2, 60 Hawkens Road, Maunu
Start Depth (m): 0

Scala No: SP3
Ref : 16036
Report No: W16-260
Page: 4 of 27

The line are the suggested correlation of CBR values based on Figure 5.3, Correlation of Dynamic Cone Penetration and CBR AUSTROADS (2004) "Pavement Design - a guide to the design of road Pavements"
(This comment is excluded from endorsement)

No. Blows	Tip to ref (cm)	mm / blow	blows / 50mm	Blows / 300mm	Total Blows	depth (m)
0	103	0	0	0	0	0.00
2	90.4	63	1	5	2	0.13
2	82.8	38	1	8	4	0.20
2	77.2	28	2	11	6	0.26
5	66.6	21	2	14	11	0.36
5	56.4	20	2	15	16	0.47
5	44.7	23	2	13	21	0.58
5	32.1	25	2	12	26	0.71
5	19.2	26	2	12	31	0.84
5	9.1	20	2	15	36	0.94
0	109.8	0	0	0	36	0.94
5	101.6	16	3	18	41	1.02
5	95.4	12	4	24	46	1.08
5	90.6	10	5	31	51	1.13
5	86.3	9	6	35	56	1.17
5	82.7	7	7	42	61	1.21
10	76.3	6	8	47	71	1.27
10	70.7	6	9	54	81	1.33
10	65.2	6	9	55	91	1.39
10	60.2	5	10	60	101	1.44
10	55.4	5	10	62	111	1.48
10	50.7	5	11	64	121	1.53
10	46.1	5	11	65	131	1.58



Recorded By: S.K
Date: 30/03/2016
Checked by: N. Krissansen
Date: 4-4-2016

Note: All readings taken below 1.5m from start depth are outside the scope of this test

S. Kokich
Approved Signatory

166 Bank Street
Whangarei
P: 09 438 4417
E: info@geocivil.co.nz

DYNAMIC CONE (SCALA) PENETROMETER

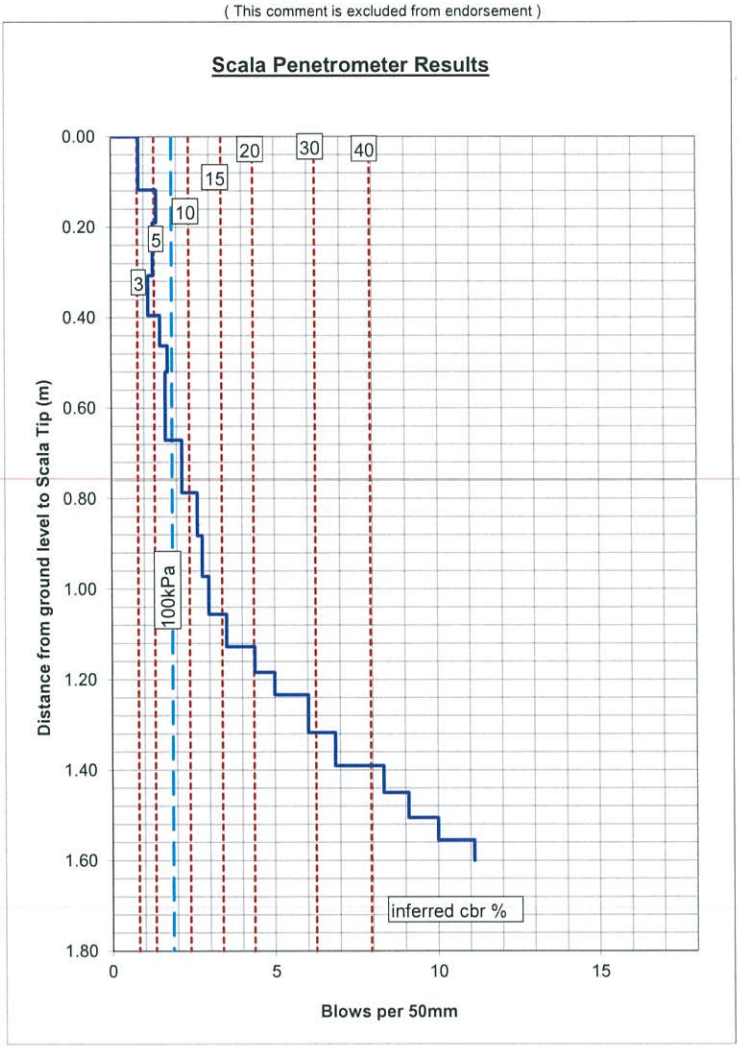
NZS 4402 :1988 Test 6.5.2

Lab Job No: 8288-072
Client: Base Group Consulting
Job: Geotechnical Investigations
Location: Lot 6, 60 Hawkens Road, Maunu
Start Depth (m): 0

Scala No: SP4
Ref : 16036
Report No: W16-260
Page: 5 of 27

The line are the suggested correlation of CBR values based on Figure 5.3, Correlation of Dynamic Cone Penetration and CBR AUSTROADS (2004) "Pavement Design - a guide to the design of road Pavements"
(This comment is excluded from endorsement)

No. Blows	Tip to ref (cm)	mm / blow	blows / 50mm	Blows / 300mm	Total Blows	depth (m)
0	102.9	0	0	0	0	0.00
2	91.1	59	1	5	2	0.12
2	83.9	36	1	8	4	0.19
3	72.2	39	1	8	7	0.31
2	63.4	44	1	7	9	0.40
2	56.7	34	1	9	11	0.46
2	50.9	29	2	10	13	0.52
5	35.8	30	2	10	18	0.67
5	24.2	23	2	13	23	0.79
5	14.7	19	3	16	28	0.88
5	5.7	18	3	17	33	0.97
0	105.9	0	0	0	33	0.97
5	97.5	17	3	18	38	1.06
5	90.4	14	4	21	43	1.13
5	84.7	11	4	26	48	1.18
5	79.7	10	5	30	53	1.23
10	71.4	8	6	36	63	1.32
10	64.1	7	7	41	73	1.39
10	58.1	6	8	50	83	1.45
10	52.6	6	9	55	93	1.51
10	47.6	5	10	60	103	1.56
10	43.1	5	11	67	113	1.60



Recorded By: S.K
Date: 30/03/2016
Checked by: N. Kissaan
Date: 4-4-2016

Note: All readings taken below 1.5m from start depth are outside the scope of this test

S. Kokich
Approved Signatory

166 Bank Street
Whangarei
P: 09 438 4417
E: info@geocivil.co.nz

DYNAMIC CONE (SCALA) PENETROMETER

NZS 4402 :1988 Test 6.5.2

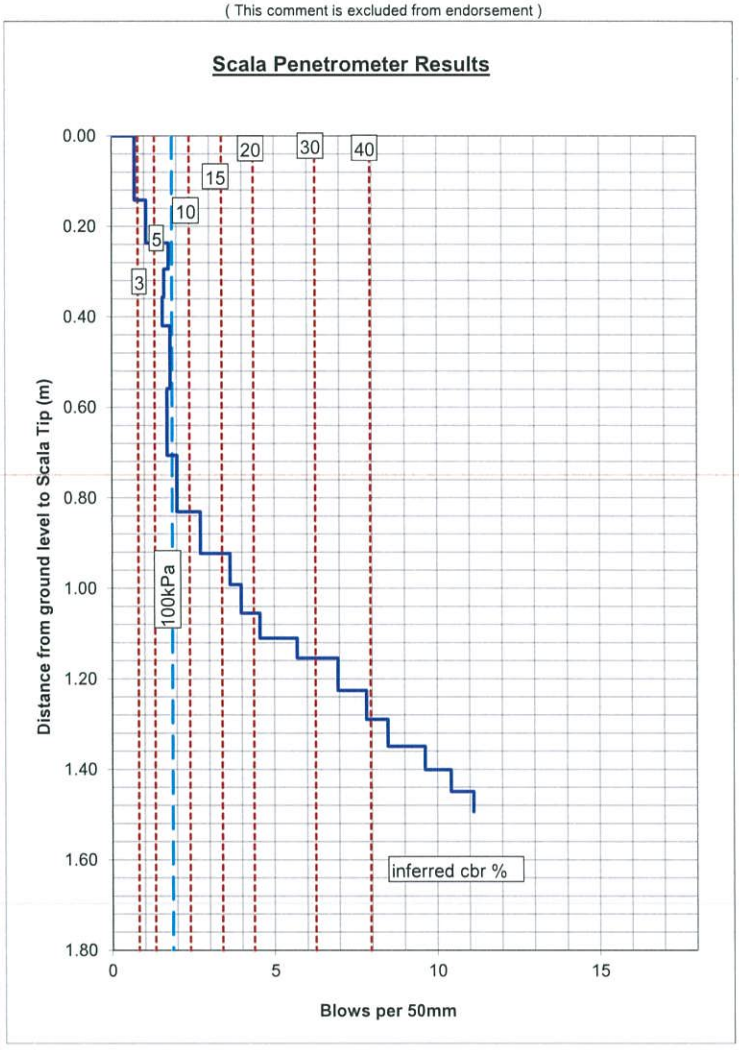
Lab Job No: 8288-072
Client: Base Group Consulting
Job: Geotechnical Investigations
Location: Lot 6, 60 Hawkens Road, Maunu
Start Depth (m): 0

Scala No: SP5
Ref : 16036
Report No: W16-260
Page: 6 of 27

The line are the suggested correlation of CBR values based on Figure 5.3, Correlation of Dynamic Cone Penetration and CBR AUSTROADS (2004) "Pavement Design - a guide to the design of road Pavements"
(This comment is excluded from endorsement)

No. Blows	Tip to ref (cm)	mm / blow	blows / 50mm	Blows / 300mm	Total Blows	depth (m)
0	104.4	0	0	0	0	0.00
2	90.2	71	1	4	2	0.14
2	80.7	48	1	6	4	0.24
2	75	29	2	11	6	0.29
2	68.8	31	2	10	8	0.36
2	62.4	32	2	9	10	0.42
5	48.5	28	2	11	15	0.56
5	33.8	29	2	10	20	0.71
5	21.3	25	2	12	25	0.83
5	12.1	18	3	16	30	0.92
5	5.2	14	4	22	35	0.99
0	105.6	0	0	0	35	0.99
5	99.3	13	4	24	40	1.06
5	93.8	11	5	27	45	1.11
5	89.4	9	6	34	50	1.15
10	82.2	7	7	42	60	1.23
10	75.8	6	8	47	70	1.29
10	69.9	6	8	51	80	1.35
10	64.7	5	10	58	90	1.40
10	59.9	5	10	62	100	1.45
10	55.4	5	11	67	110	1.49

Scala Penetrometer Results



Recorded By: S.K
Date: 30/03/2016
Checked by: N. Kokich
Date: 4-4-2016

Note: All readings taken below 1.5m from start depth are outside the scope of this test

166 Bank Street
Whangarei
P: 09 438 4417
E: info@geocivil.co.nz

DYNAMIC CONE (SCALA) PENETROMETER

NZS 4402 :1988 Test 6.5.2

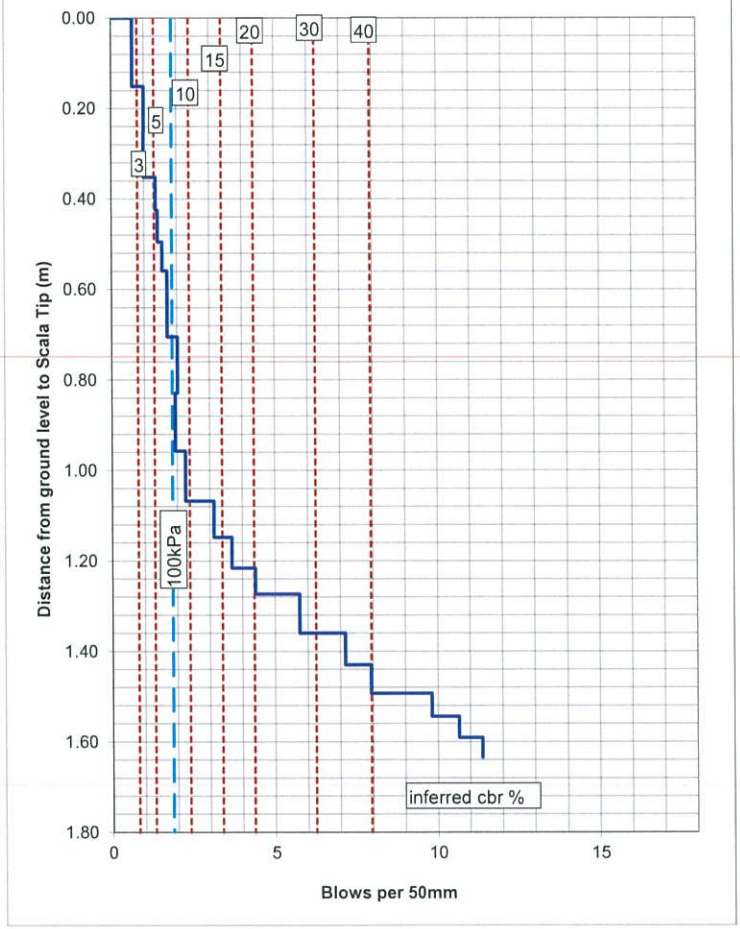
Lab Job No: 8288-072
Client: Base Group Consulting
Job: Geotechnical Investigations
Location: Lot 6, 60 Hawkens Road, Maunu
Start Depth (m): 0

Scala No: SP6
Ref : 16036
Report No: W16-260
Page: 7 of 27

The line are the suggested correlation of CBR values based on Figure 5.3, Correlation of Dynamic Cone Penetration and CBR AUSTROADS (2004) "Pavement Design - a guide to the design of road Pavements"
(This comment is excluded from endorsement)

No. Blows	Tip to ref (cm)	mm / blow	blows / 50mm	Blows / 300mm	Total Blows	depth (m)
0	100.1	0	0	0	0	0.00
2	85	76	1	4	2	0.15
2	75	50	1	6	4	0.25
2	64.9	51	1	6	6	0.35
2	57.6	37	1	8	8	0.43
2	50.6	35	1	9	10	0.50
2	44.2	32	2	9	12	0.56
5	29.6	29	2	10	17	0.71
5	17.2	25	2	12	22	0.83
5	4.4	26	2	12	27	0.96
0	105	0	0	0	27	0.96
5	93.9	22	2	14	32	1.07
5	85.9	16	3	19	37	1.15
5	79.1	14	4	22	42	1.22
5	73.4	11	4	26	47	1.27
10	64.7	9	6	34	57	1.36
10	57.7	7	7	43	67	1.43
10	51.4	6	8	48	77	1.49
10	46.3	5	10	59	87	1.54
10	41.6	5	11	64	97	1.59
10	37.2	4	11	68	107	1.64

Scala Penetrometer Results



Recorded By: S.K
Date: 30/03/2016
Checked by: N. Krissanse
Date: 4-4-2016

Note: All readings taken below 1.5m from start depth are outside the scope of this test

166 Bank Street
Whangarei
P: 09 438 4417
E: info@geocivil.co.nz

DYNAMIC CONE (SCALA) PENETROMETER

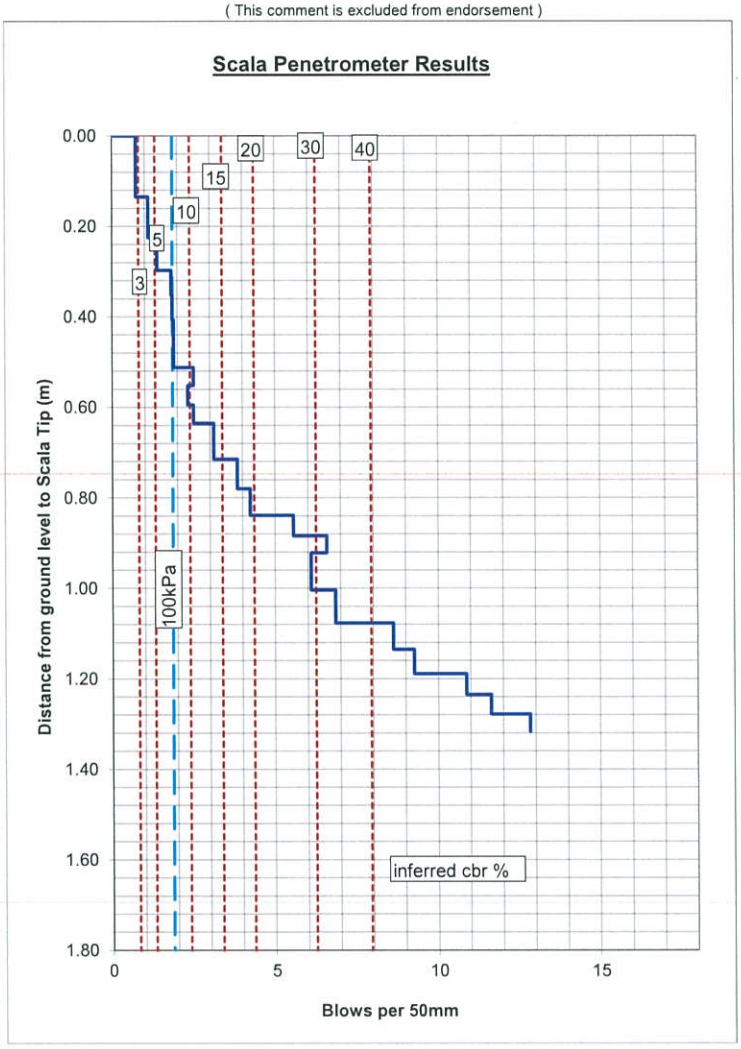
NZS 4402 :1988 Test 6.5.2

Lab Job No: 8288-072
Client: Base Group Consulting
Job: Geotechnical Investigations
Location: Lot 5, 60 Hawkens Road, Maunu
Start Depth (m): 0

Scala No: SP7
Ref : 16036
Report No: W16-260
Page: 8 of 27

The line are the suggested correlation of CBR values based on Figure 5.3, Correlation of Dynamic Cone Penetration and CBR AUSTROADS (2004) "Pavement Design - a guide to the design of road Pavements"
(This comment is excluded from endorsement)

No. Blows	Tip to ref (cm)	mm / blow	blows / 50mm	Blows / 300mm	Total Blows	depth (m)
0	102.3	0	0	0	0	0.00
2	88.8	68	1	4	2	0.14
2	79.8	45	1	7	4	0.23
2	72.6	36	1	8	6	0.30
2	67.1	28	2	11	8	0.35
2	61.7	27	2	11	10	0.41
2	56.4	27	2	11	12	0.46
2	51.1	27	2	11	14	0.51
2	47.1	20	3	15	16	0.55
2	42.8	22	2	14	18	0.60
2	38.8	20	3	15	20	0.64
5	30.8	16	3	19	25	0.72
5	24.3	13	4	23	30	0.78
5	18.4	12	4	25	35	0.84
5	13.9	9	6	33	40	0.88
5	10.1	8	7	39	45	0.92
0	110.9	0	0	0	45	0.92
10	102.7	8	6	37	55	1.00
10	95.4	7	7	41	65	1.08
10	89.6	6	9	52	75	1.14
10	84.2	5	9	56	85	1.19
10	79.6	5	11	65	95	1.24
10	75.3	4	12	70	105	1.28
10	71.4	4	13	77	115	1.32



Recorded By: S.K
Date: 30/03/2016
Checked by: N. Kissoon
Date: 4-4-2016

Note: All readings taken below 1.5m from start depth are outside the scope of this test

166 Bank Street
Whangarei
P: 09 438 4417
E: info@geocivil.co.nz

DYNAMIC CONE (SCALA) PENETROMETER

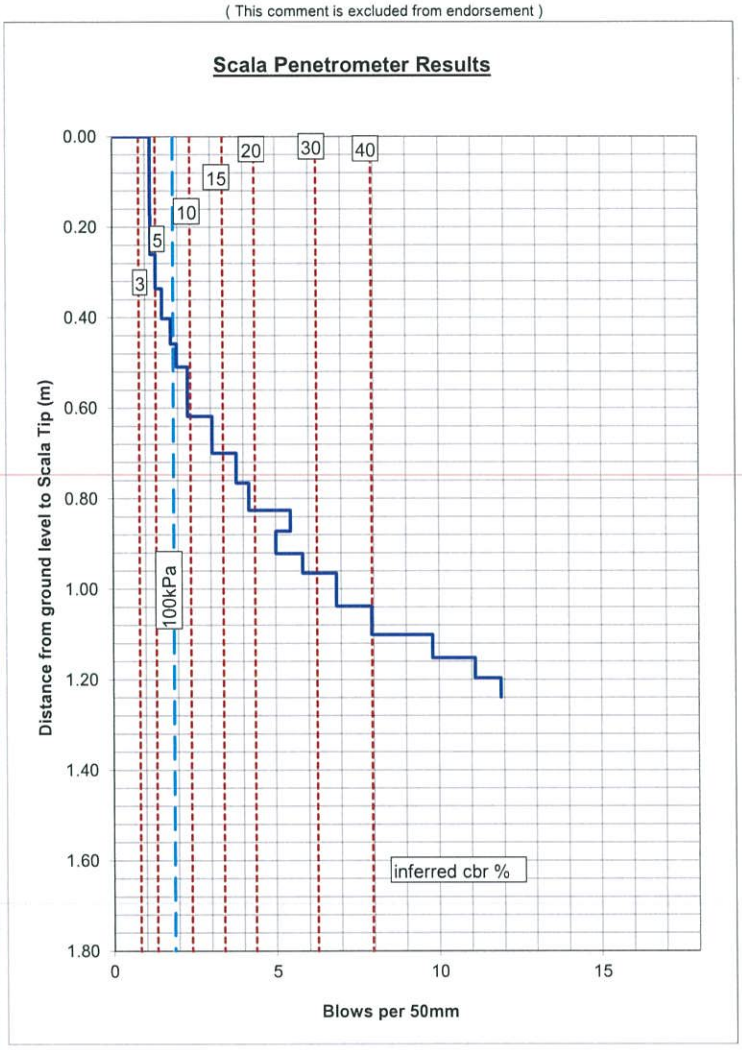
NZS 4402 :1988 Test 6.5.2

Lab Job No: 8288-072
Client: Base Group Consulting
Job: Geotechnical Investigations
Location: Lot 5, 60 Hawkens Road, Maunu
Start Depth (m): 0

Scala No: SP8
Ref : 16036
Report No: W16-260
Page: 9 of 27

The line are the suggested correlation of CBR values based on Figure 5.3, Correlation of Dynamic Cone Penetration and CBR AUSTROADS (2004) "Pavement Design - a guide to the design of road Pavements"
(This comment is excluded from endorsement)

No. Blows	Tip to ref (cm)	mm / blow	blows / 50mm	Blows / 300mm	Total Blows	depth (m)
0	102.6	0	0	0	0	0.00
4	85.2	44	1	7	4	0.17
2	76.6	43	1	7	6	0.26
2	69	38	1	8	8	0.34
2	62.4	33	2	9	10	0.40
2	56.8	28	2	11	12	0.46
2	51.7	26	2	12	14	0.51
5	40.8	22	2	14	19	0.62
5	32.6	16	3	18	24	0.70
5	26	13	4	23	29	0.77
5	20	12	4	25	34	0.83
5	15.4	9	5	33	39	0.87
5	10.4	10	5	30	44	0.92
5	6.1	9	6	35	49	0.97
0	106.4	0	0	0	49	0.97
10	99.1	7	7	41	59	1.04
10	92.8	6	8	48	69	1.10
10	87.7	5	10	59	79	1.15
10	83.2	5	11	67	89	1.20
10	79	4	12	71	99	1.24



Recorded By: S.K
Date: 30/03/2016
Checked by: N. Kissaan
Date: 4-4-2016

Note: All readings taken below 1.5m from start depth are outside the scope of this test

S. Kokich
Approved Signatory

166 Bank Street
Whangarei
P: 09 438 4417
E: info@geocivil.co.nz

DYNAMIC CONE (SCALA) PENETROMETER

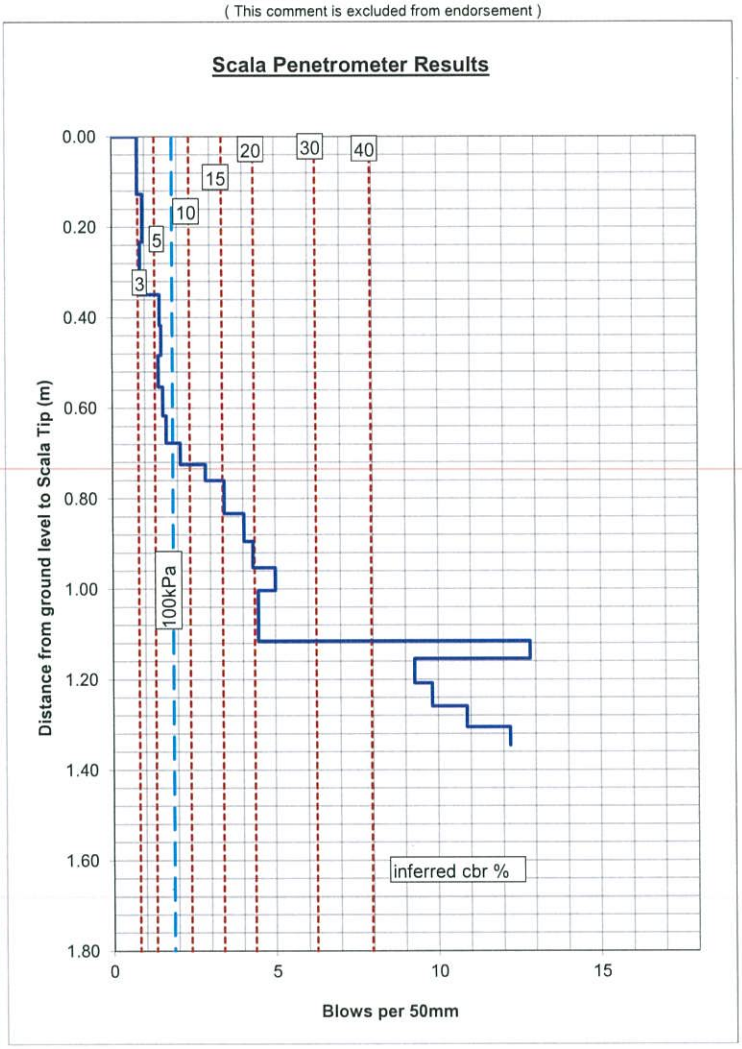
NZS 4402 :1988 Test 6.5.2

Lab Job No: 8288-072
Client: Base Group Consulting
Job: Geotechnical Investigations
Location: Lot 5, 60 Hawkens Road, Maunu
Start Depth (m): 0

Scala No: SP9
Ref : 16036
Report No: W16-260
Page: 10 of 27

The line are the suggested correlation of CBR values based on Figure 5.3, Correlation of Dynamic Cone Penetration and CBR AUSTROADS (2004) "Pavement Design - a guide to the design of road Pavements"
(This comment is excluded from endorsement)

No. Blows	Tip to ref (cm)	mm / blow	blows / 50mm	Blows / 300mm	Total Blows	depth (m)
0	104.7	0	0	0	0	0.00
2	92	64	1	5	2	0.13
2	81.4	53	1	6	4	0.23
2	69.8	58	1	5	6	0.35
2	63	34	1	9	8	0.42
2	56.4	33	2	9	10	0.48
2	49.4	35	1	9	12	0.55
2	43	32	2	9	14	0.62
2	37	30	2	10	16	0.68
2	32.2	24	2	13	18	0.73
2	28.7	18	3	17	20	0.76
5	21.4	15	3	21	25	0.83
5	15.2	12	4	24	30	0.90
5	9.4	12	4	26	35	0.95
0	109.4	0	0	0	35	0.95
5	104.4	10	5	30	40	1.00
10	93.2	11	4	27	50	1.12
10	89.3	4	13	77	60	1.15
10	83.9	5	9	56	70	1.21
10	78.8	5	10	59	80	1.26
10	74.2	5	11	65	90	1.31
10	70.1	4	12	73	100	1.35



Recorded By: S.K
Date: 30/03/2016
Checked by: N. Kissaun
Date: 4-4-2016

Note: All readings taken below 1.5m from start depth are outside the scope of this test

S. Kokich
Approved Signatory

166 Bank Street
Whangarei
P: 09 438 4417
E: info@geocivil.co.nz

DYNAMIC CONE (SCALA) PENETROMETER

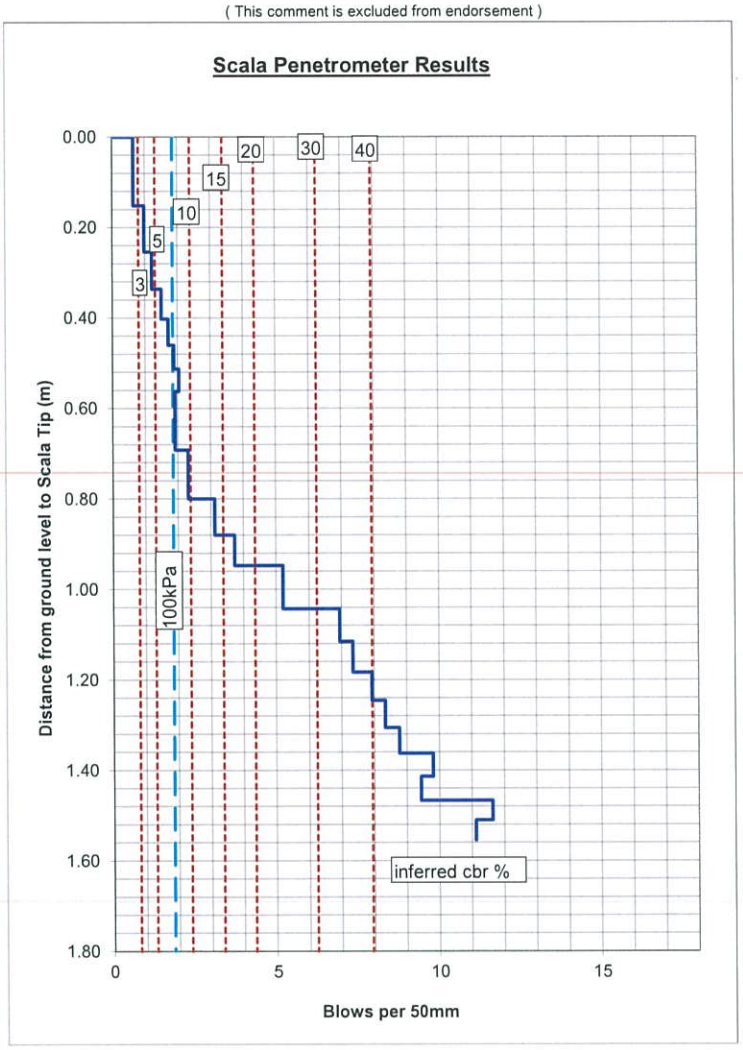
NZS 4402 :1988 Test 6.5.2

Lab Job No: 8288-072
Client: Base Group Consulting
Job: Geotechnical Investigations
Location: Lot 4, 60 Hawkens Road, Maunu
Start Depth (m): 0

Scala No: SP10
Ref : 16036
Report No: W16-260
Page: 11 of 27

The line are the suggested correlation of CBR values based on Figure 5.3, Correlation of Dynamic Cone Penetration and CBR AUSTROADS (2004) "Pavement Design - a guide to the design of road Pavements"
(This comment is excluded from endorsement)

No. Blows	Tip to ref (cm)	mm / blow	blows / 50mm	Blows / 300mm	Total Blows	depth (m)
0	104.4	0	0	0	0	0.00
2	89.2	76	1	4	2	0.15
2	79	51	1	6	4	0.25
2	70.8	41	1	7	6	0.34
2	64.2	33	2	9	8	0.40
2	58.4	29	2	10	10	0.46
2	53.1	27	2	11	12	0.51
2	48.2	25	2	12	14	0.56
5	35.2	26	2	12	19	0.69
5	24.4	22	2	14	24	0.80
5	16.4	16	3	19	29	0.88
5	9.7	13	4	22	34	0.95
0	109.4	0	0	0	34	0.95
10	99.8	10	5	31	44	1.04
10	92.6	7	7	42	54	1.12
10	85.8	7	7	44	64	1.18
10	79.5	6	8	48	74	1.25
10	73.5	6	8	50	84	1.31
10	67.8	6	9	53	94	1.36
10	62.7	5	10	59	104	1.41
10	57.4	5	9	57	114	1.47
10	53.1	4	12	70	124	1.51
10	48.6	5	11	67	134	1.56



Recorded By: S.K
Date: 30/03/2016
Checked by: N. Krissause
Date: 4-4-2016

Note: All readings taken below 1.5m from start depth are outside the scope of this test

166 Bank Street
Whangarei
P: 09 438 4417
E: info@geocivil.co.nz

DYNAMIC CONE (SCALA) PENETROMETER

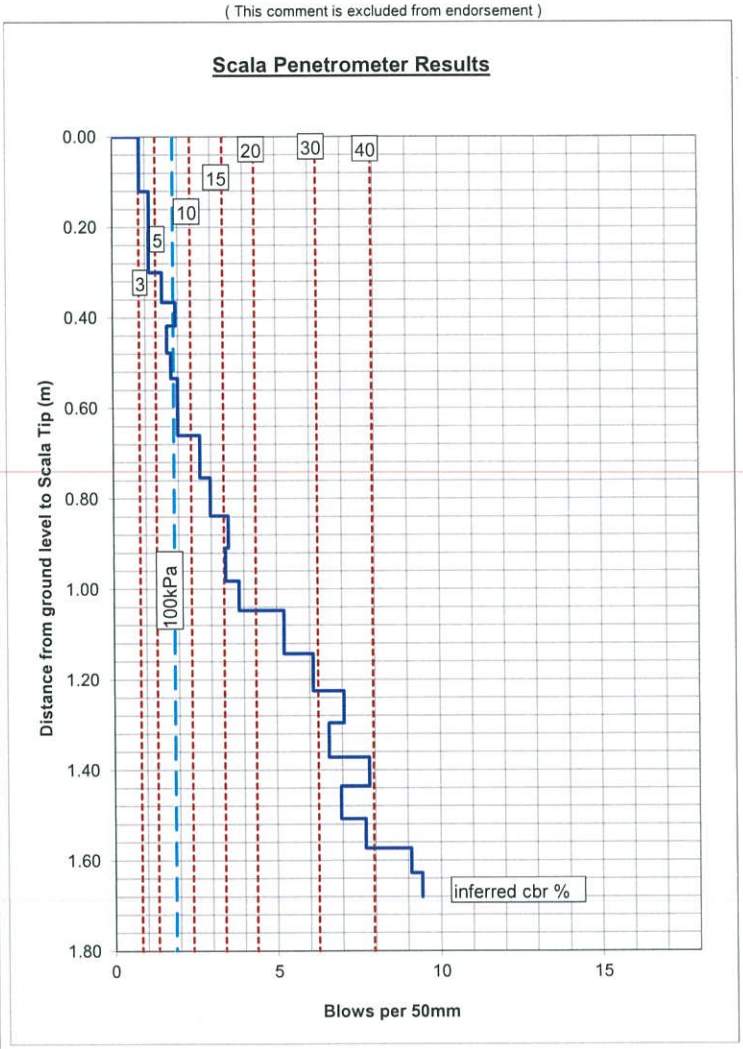
NZS 4402 :1988 Test 6.5.2

Lab Job No: 8288-072
Client: Base Group Consulting
Job: Geotechnical Investigations
Location: Lot 4, 60 Hawkens Road, Maunu
Start Depth (m): 0

Scala No: SP11
Ref : 16036
Report No: W16-260
Page: 12 of 27

The line are the suggested correlation of CBR values based on Figure 5.3, Correlation of Dynamic Cone Penetration and CBR AUSTROADS (2004) "Pavement Design - a guide to the design of road Pavements"
(This comment is excluded from endorsement)

No. Blows	Tip to ref (cm)	mm / blow	blows / 50mm	Blows / 300mm	Total Blows	depth (m)
0	104.4	0	0	0	0	0.00
2	92.3	61	1	5	2	0.12
2	83.4	45	1	7	4	0.21
2	74.4	45	1	7	6	0.30
2	67.8	33	2	9	8	0.37
2	62.6	26	2	12	10	0.42
2	56.6	30	2	10	12	0.48
2	51	28	2	11	14	0.53
5	38.4	25	2	12	19	0.66
5	29	19	3	16	24	0.75
5	20.6	17	3	18	29	0.84
5	13.5	14	4	21	34	0.91
5	6.2	15	3	21	39	0.98
0	106.7	0	0	0	39	0.98
5	100.2	13	4	23	44	1.05
10	90.6	10	5	31	54	1.14
10	82.4	8	6	37	64	1.23
10	75.3	7	7	42	74	1.30
10	67.7	8	7	39	84	1.37
10	61.3	6	8	47	94	1.44
10	54.1	7	7	42	104	1.51
10	47.6	7	8	46	114	1.57
10	42.1	6	9	55	124	1.63
10	36.8	5	9	57	134	1.68



Recorded By: S.K
Date: 30/03/2016
Checked by: N. Kissaun
Date: 4-4-2016

Note: All readings taken below 1.5m from start depth are outside the scope of this test

166 Bank Street
Whangarei
P: 09 438 4417
E: info@geocivil.co.nz

DYNAMIC CONE (SCALA) PENETROMETER

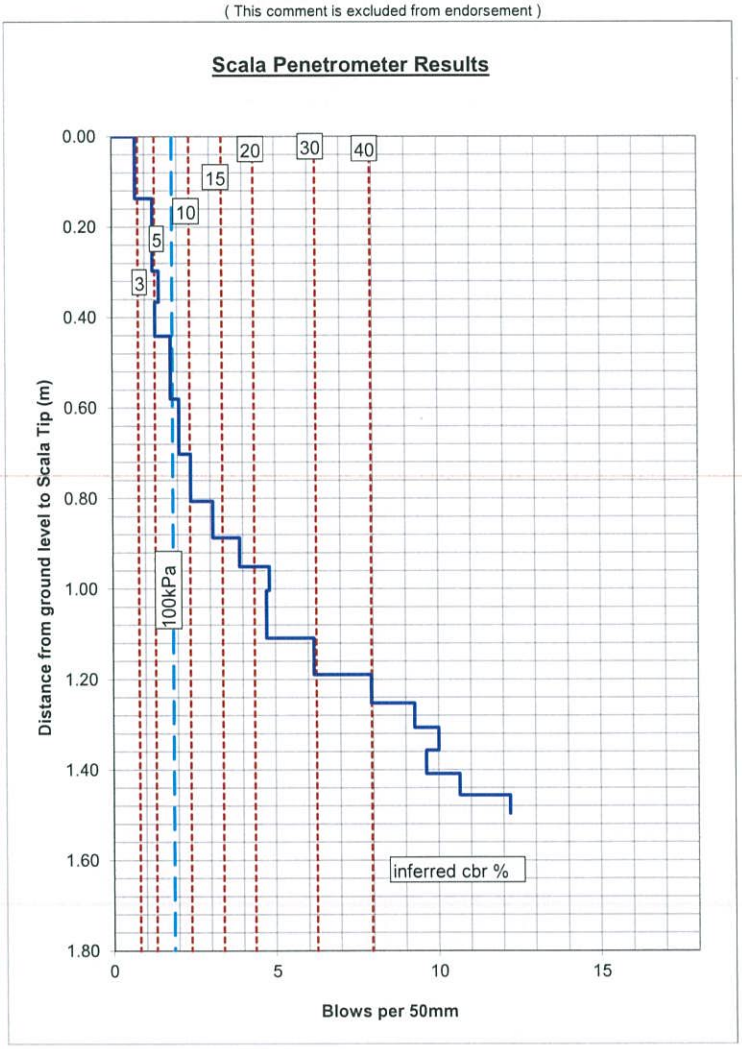
NZS 4402 :1988 Test 6.5.2

Lab Job No: 8288-072
Client: Base Group Consulting
Job: Geotechnical Investigations
Location: Lot 4, 60 Hawkens Road, Maunu
Start Depth (m): 0

Scala No: SP12
Ref : 16036
Report No: W16-260
Page: 13 of 27

The line are the suggested correlation of CBR values based on Figure 5.3, Correlation of Dynamic Cone Penetration and CBR AUSTROADS (2004) "Pavement Design - a guide to the design of road Pavements"
(This comment is excluded from endorsement)

No. Blows	Tip to ref (cm)	mm / blow	blows / 50mm	Blows / 300mm	Total Blows	depth (m)
0	106.4	0	0	0	0	0.00
2	92.7	69	1	4	2	0.14
2	84.7	40	1	8	4	0.22
2	76.7	40	1	8	6	0.30
2	69.8	35	1	9	8	0.37
2	62.3	38	1	8	10	0.44
5	48.4	28	2	11	15	0.58
5	36.2	24	2	12	20	0.70
5	25.8	21	2	14	25	0.81
5	17.7	16	3	19	30	0.89
5	11.3	13	4	23	35	0.95
5	6.1	10	5	29	40	1.00
0	106	0	0	0	40	1.00
10	95.4	11	5	28	50	1.11
10	87.3	8	6	37	60	1.19
10	81	6	8	48	70	1.25
10	75.6	5	9	56	80	1.31
10	70.6	5	10	60	90	1.36
10	65.4	5	10	58	100	1.41
10	60.7	5	11	64	110	1.46
10	56.6	4	12	73	120	1.50



Recorded By: S.K
Date: 30/03/2016
Checked by: N. Kissaise
Date: 4-4-2016

Note: All readings taken below 1.5m from start depth are outside the scope of this test

166 Bank Street
Whangarei
P: 09 438 4417
E: info@geocivil.co.nz

DYNAMIC CONE (SCALA) PENETROMETER

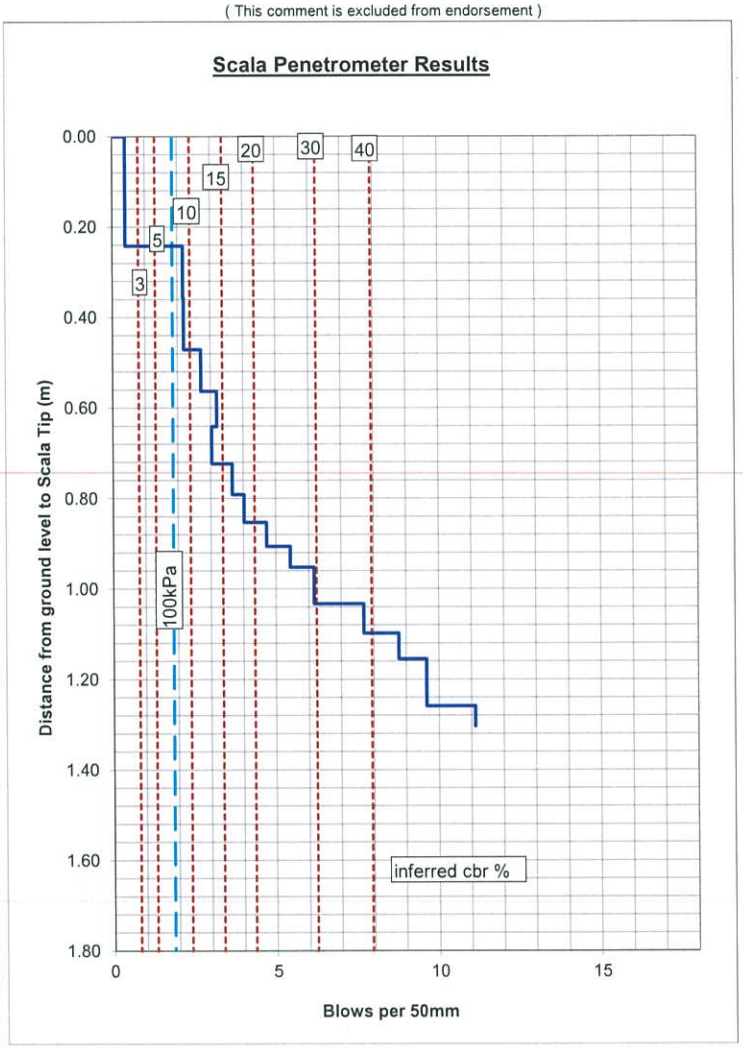
NZS 4402 :1988 Test 6.5.2

Lab Job No: 8288-072
Client: Base Group Consulting
Job: Geotechnical Investigations
Location: Lot 4, 60 Hawkens Road, Maunu
Start Depth (m): 0

Scala No: SP13
Ref : 16036
Report No: W16-260
Page: 14 of 27

The line are the suggested correlation of CBR values based on Figure 5.3, Correlation of Dynamic Cone Penetration and CBR AUSTROADS (2004) "Pavement Design - a guide to the design of road Pavements"
(This comment is excluded from endorsement)

No. Blows	Tip to ref (cm)	mm / blow	blows / 50mm	Blows / 300mm	Total Blows	depth (m)
0	103.9	0	0	0	0	0.00
2	79.7	121	0	2	2	0.24
5	68.2	23	2	13	7	0.36
5	56.8	23	2	13	12	0.47
5	47.6	18	3	16	17	0.56
5	39.8	16	3	19	22	0.64
5	31.6	16	3	18	27	0.72
5	24.8	14	4	22	32	0.79
5	18.6	12	4	24	37	0.85
5	13.3	11	5	28	42	0.91
5	8.7	9	5	33	47	0.95
0	108.7	0	0	0	47	0.95
10	100.6	8	6	37	57	1.03
10	94.1	7	8	46	67	1.10
10	88.4	6	9	53	77	1.16
10	83.2	5	10	58	87	1.21
10	78	5	10	58	97	1.26
10	73.5	5	11	67	107	1.30



Recorded By: S.K
Date: 30/03/2016
Checked by: N. Kissause
Date: 4-4-2016

Note: All readings taken below 1.5m from start depth are outside the scope of this test

S. Kokich
Approved Signatory

166 Bank Street
Whangarei
P: 09 438 4417
E: info@geocivil.co.nz

DYNAMIC CONE (SCALA) PENETROMETER

NZS 4402 :1988 Test 6.5.2

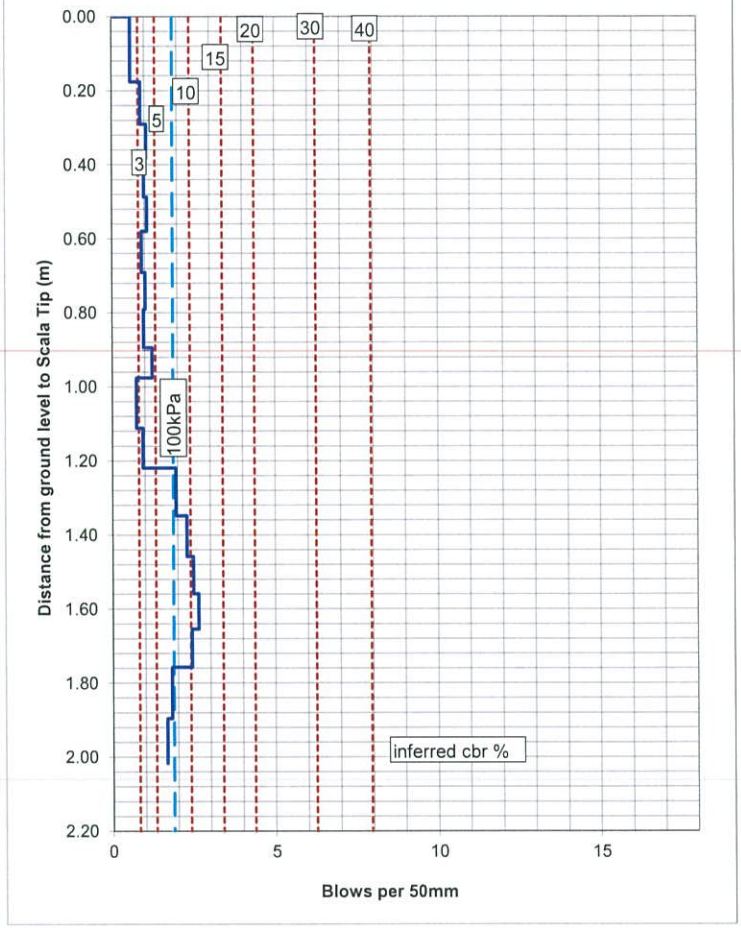
Lab Job No: 8288-072
Client: Base Group Consulting
Job: Geotechnical Investigations
Location: Lot 7, 60 Hawkens Road, Maunu
Start Depth (m): 0

Scala No: SP14
Ref : 16036
Report No: W16-260
Page: 15 of 27

The line are the suggested correlation of CBR values based on Figure 5.3, Correlation of Dynamic Cone Penetration and CBR AUSTROADS (2004) "Pavement Design - a guide to the design of road Pavements"
(This comment is excluded from endorsement)

No. Blows	Tip to ref (cm)	mm / blow	blows / 50mm	Blows / 300mm	Total Blows	depth (m)
0	105.8	0	0	0	0	0.00
2	88.2	88	1	3	2	0.18
2	76.8	57	1	5	4	0.29
2	67.3	48	1	6	6	0.39
2	57.1	51	1	6	8	0.49
2	47.8	47	1	6	10	0.58
2	36.7	56	1	5	12	0.69
2	26.8	50	1	6	14	0.79
2	16.4	52	1	6	16	0.89
2	8.2	41	1	7	18	0.98
0	108	0	0	0	18	0.98
2	94.4	68	1	4	20	1.11
2	83.7	54	1	6	22	1.22
5	70.8	26	2	12	27	1.35
5	59.8	22	2	14	32	1.46
5	49.7	20	2	15	37	1.56
5	40.2	19	3	16	42	1.65
5	29.9	21	2	15	47	1.76
5	16	28	2	11	52	1.90
4	3.9	30	2	10	56	2.02

Scala Penetrometer Results



Recorded By: S.K
Date: 30/03/2016
Checked by: N. Keissaise
Date: 4-4-2016

Note: All readings taken below 1.5m from start depth are outside the scope of this test

166 Bank Street
Whangarei
P: 09 438 4417
E: info@geocivil.co.nz

DYNAMIC CONE (SCALA) PENETROMETER

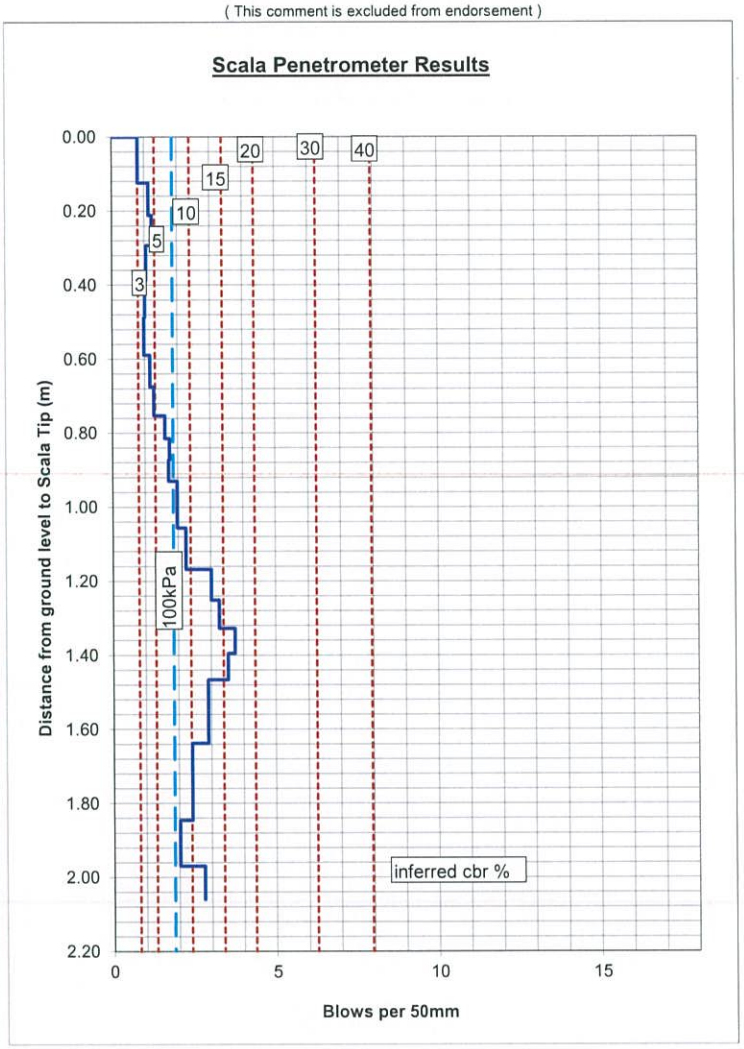
NZS 4402 :1988 Test 6.5.2

Lab Job No: 8288-072
Client: Base Group Consulting
Job: Geotechnical Investigations
Location: Lot 7, 60 Hawkens Road, Maunu
Start Depth (m): 0

Scala No: SP15
Ref : 16036
Report No: W16-260
Page: 16 of 27

The line are the suggested correlation of CBR values based on Figure 5.3, Correlation of Dynamic Cone Penetration and CBR AUSTROADS (2004) "Pavement Design - a guide to the design of road Pavements"
(This comment is excluded from endorsement)

No. Blows	Tip to ref (cm)	mm / blow	blows / 50mm	Blows / 300mm	Total Blows	depth (m)
0	106	0	0	0	0	0.00
2	93.6	62	1	5	2	0.12
2	84.8	44	1	7	4	0.21
2	76.7	41	1	7	6	0.29
2	67.2	48	1	6	8	0.39
2	57.3	50	1	6	10	0.49
2	47.1	51	1	6	12	0.59
2	38.5	43	1	7	14	0.68
2	30.7	39	1	8	16	0.75
2	24.5	31	2	10	18	0.82
2	18.8	29	2	11	20	0.87
2	13	29	2	10	22	0.93
0	113.2	0	0	0	22	0.93
5	100.6	25	2	12	27	1.06
5	89.4	22	2	13	32	1.17
5	81.1	17	3	18	37	1.25
5	73.4	15	3	19	42	1.33
5	66.7	13	4	22	47	1.40
5	59.6	14	4	21	52	1.47
10	42.4	17	3	17	62	1.64
10	21.6	21	2	14	72	1.85
5	9.2	25	2	12	77	1.97
5	0.2	18	3	17	82	2.06



Recorded By: S.K
Date: 30/03/2016
Checked by: N. Krissansa
Date: 4-4-2016

Note: All readings taken below 1.5m from start depth are outside the scope of this test

S. Kokich
Approved Signatory

166 Bank Street
Whangarei
P: 09 438 4417
E: info@geocivil.co.nz

DYNAMIC CONE (SCALA) PENETROMETER

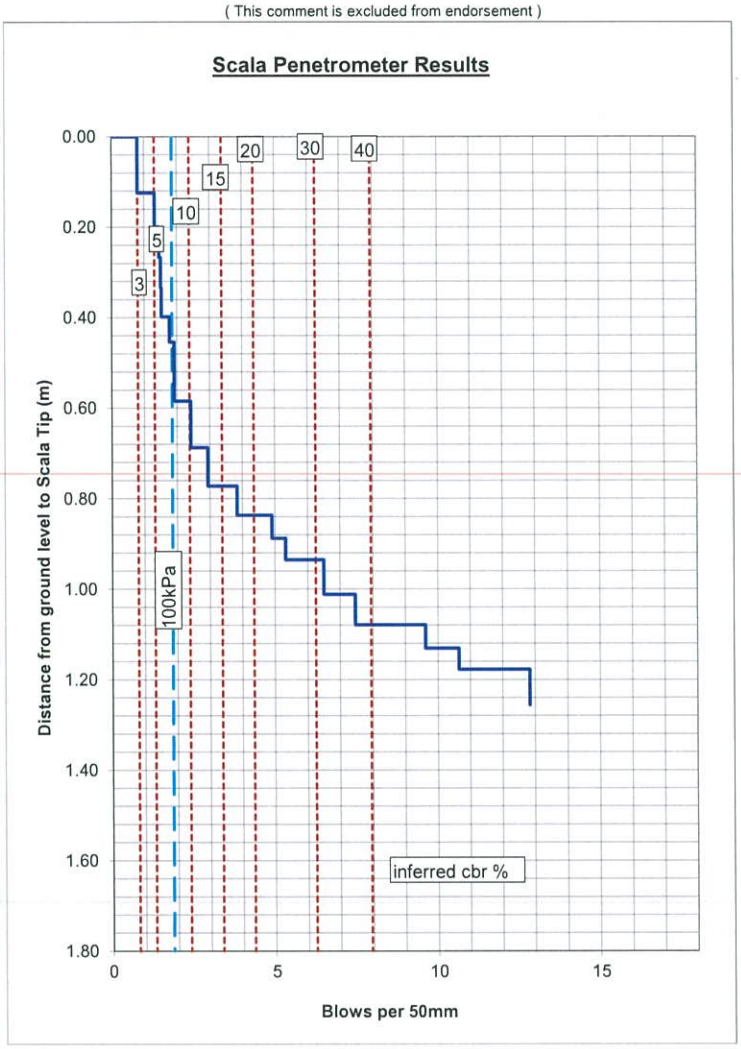
NZS 4402 :1988 Test 6.5.2

Lab Job No: 8288-072
Client: Base Group Consulting
Job: Geotechnical Investigations
Location: Lot 7, 60 Hawkens Road, Maunu
Start Depth (m): 0

Scala No: SP16
Ref : 16036
Report No: W16-260
Page: 17 of 27

The line are the suggested correlation of CBR values based on Figure 5.3, Correlation of Dynamic Cone Penetration and CBR AUSTROADS (2004) "Pavement Design - a guide to the design of road Pavements"
(This comment is excluded from endorsement)

No. Blows	Tip to ref (cm)	mm / blow	blows / 50mm	Blows / 300mm	Total Blows	depth (m)
0	102.8	0	0	0	0	0.00
2	90.4	62	1	5	2	0.12
2	82.9	38	1	8	4	0.20
2	76.1	34	1	9	6	0.27
2	69.5	33	2	9	8	0.33
2	63	33	2	9	10	0.40
2	57.4	28	2	11	12	0.45
5	44.4	26	2	12	17	0.58
5	34.1	21	2	15	22	0.69
5	25.6	17	3	18	27	0.77
5	19.1	13	4	23	32	0.84
5	14	10	5	29	37	0.89
5	9.3	9	5	32	42	0.94
0	109.4	0	0	0	42	0.94
10	101.7	8	6	39	52	1.01
10	95	7	7	45	62	1.08
10	89.8	5	10	58	72	1.13
10	85.1	5	11	64	82	1.18
10	81.2	4	13	77	92	1.22
10	77.3	4	13	77	102	1.26



Recorded By: S.K
Date: 30/03/2016
Checked by: N. Kissling
Date: 4-4-2016

Note: All readings taken below 1.5m from start depth are outside the scope of this test

166 Bank Street
Whangarei
P: 09 438 4417
E: info@geocivil.co.nz

DYNAMIC CONE (SCALA) PENETROMETER

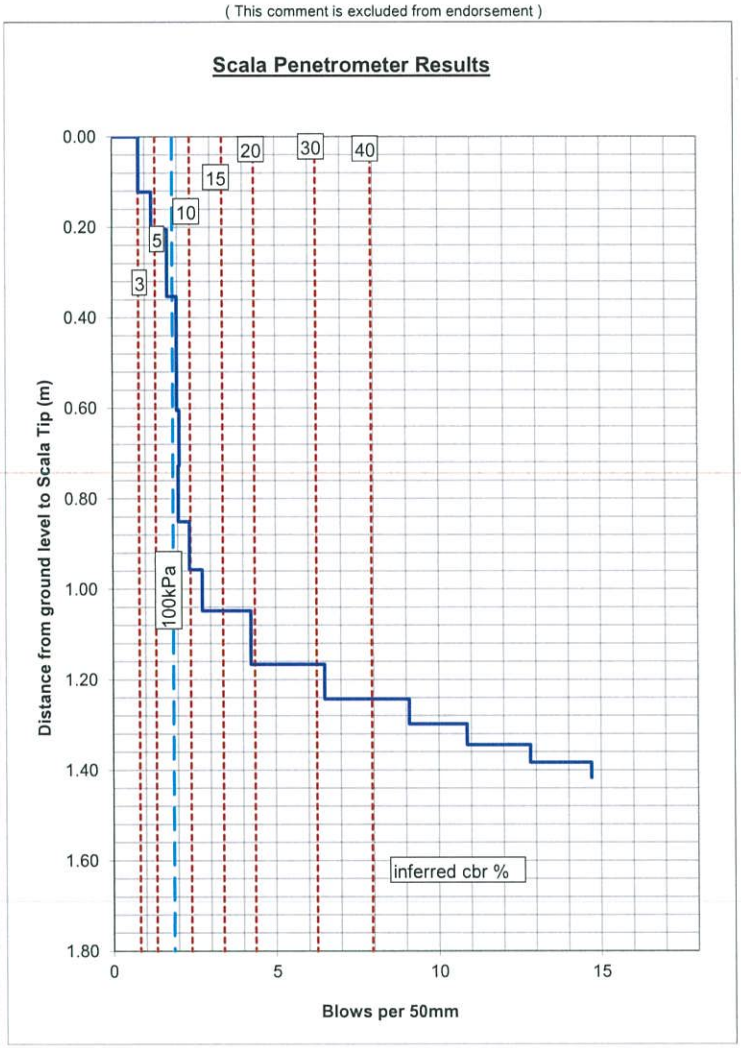
NZS 4402 :1988 Test 6.5.2

Lab Job No: 8288-072
Client: Base Group Consulting
Job: Geotechnical Investigations
Location: Lot 3, 60 Hawkens Road, Maunu
Start Depth (m): 0

Scala No: SP17
Ref : 16036
Report No: W16-260
Page: 18 of 27

The line are the suggested correlation of CBR values based on Figure 5.3, Correlation of Dynamic Cone Penetration and CBR AUSTROADS (2004) "Pavement Design - a guide to the design of road Pavements"
(This comment is excluded from endorsement)

No. Blows	Tip to ref (cm)	mm / blow	blows / 50mm	Blows / 300mm	Total Blows	depth (m)
0	105.4	0	0	0	0	0.00
2	93.2	61	1	5	2	0.12
2	84.9	42	1	7	4	0.21
5	70.1	30	2	10	9	0.35
5	57.5	25	2	12	14	0.48
5	44.9	25	2	12	19	0.61
5	32.7	24	2	12	24	0.73
5	20.3	25	2	12	29	0.85
5	9.7	21	2	14	34	0.96
0	109.6	0	0	0	34	0.96
5	100.5	18	3	16	39	1.05
10	88.7	12	4	25	49	1.17
10	81	8	6	39	59	1.24
10	75.5	6	9	55	69	1.30
10	70.9	5	11	65	79	1.34
10	67	4	13	77	89	1.38
10	63.6	3	15	88	99	1.42



Recorded By: M.P
Date: 31/03/2016
Checked by: N. Kissase
Date: 4-4-2016

Note: All readings taken below 1.5m from start depth are outside the scope of this test

166 Bank Street
Whangarei
P: 09 438 4417
E: info@geocivil.co.nz

DYNAMIC CONE (SCALA) PENETROMETER

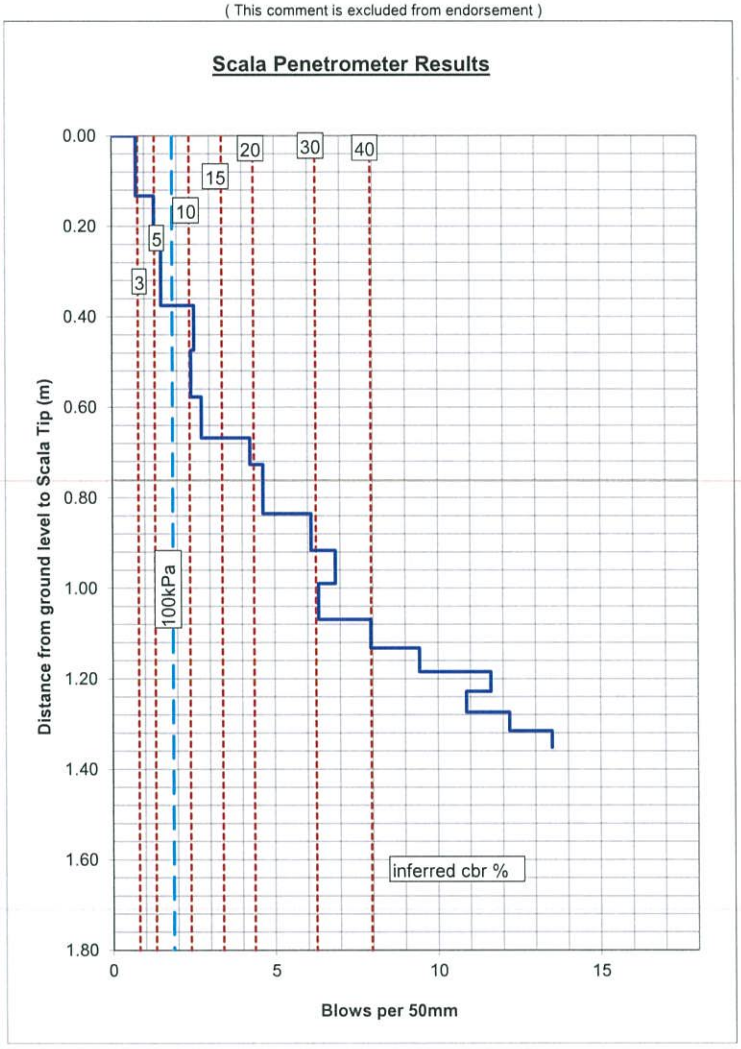
NZS 4402 :1988 Test 6.5.2

Lab Job No: 8288-072
Client: Base Group Consulting
Job: Geotechnical Investigations
Location: Lot 3, 60 Hawkens Road, Maunu
Start Depth (m): 0

Scala No: SP18
Ref : 16036
Report No: W16-260
Page: 19 of 27

The line are the suggested correlation of CBR values based on Figure 5.3, Correlation of Dynamic Cone Penetration and CBR AUSTROADS (2004) "Pavement Design - a guide to the design of road Pavements"
(This comment is excluded from endorsement)

No. Blows	Tip to ref (cm)	mm / blow	blows / 50mm	Blows / 300mm	Total Blows	depth (m)
0	106.7	0	0	0	0	0.00
2	93.4	67	1	5	2	0.13
2	85.7	39	1	8	4	0.21
5	69.2	33	2	9	9	0.38
5	59.3	20	3	15	14	0.47
5	49	21	2	15	19	0.58
5	39.9	18	3	16	24	0.67
5	34	12	4	25	29	0.73
10	23.2	11	5	28	39	0.84
10	15	8	6	37	49	0.92
10	7.7	7	7	41	59	0.99
0	107.5	0	0	0	59	0.99
10	99.6	8	6	38	69	1.07
10	93.3	6	8	48	79	1.13
10	88	5	9	57	89	1.19
10	83.7	4	12	70	99	1.23
10	79.1	5	11	65	109	1.27
10	75	4	12	73	119	1.32
10	71.3	4	14	81	129	1.35



Recorded By: M.P
Date: 31/03/2016
Checked by: N. Kokich
Date: 4-4-2016

Note: All readings taken below 1.5m from start depth are outside the scope of this test

S. Kokich
Approved Signatory

166 Bank Street
Whangarei
P: 09 438 4417
E: info@geocivil.co.nz

DYNAMIC CONE (SCALA) PENETROMETER

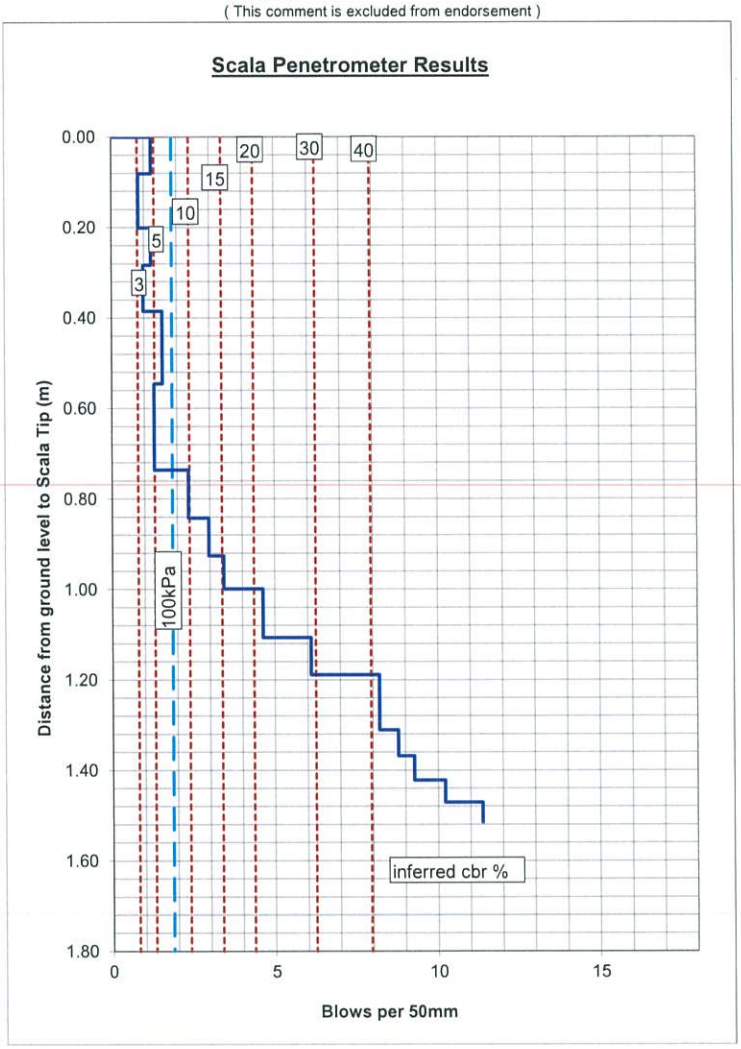
NZS 4402 :1988 Test 6.5.2

Lab Job No: 8288-072
Client: Base Group Consulting
Job: Geotechnical Investigations
Location: Lot 3, 60 Hawkens Road, Maunu
Start Depth (m): 0

Scala No: SP19
Ref : 16036
Report No: W16-260
Page: 20 of 27

The line are the suggested correlation of CBR values based on Figure 5.3, Correlation of Dynamic Cone Penetration and CBR AUSTROADS (2004) "Pavement Design - a guide to the design of road Pavements"
(This comment is excluded from endorsement)

No. Blows	Tip to ref (cm)	mm / blow	blows / 50mm	Blows / 300mm	Total Blows	depth (m)
0	106.6	0	0	0	0	0.00
2	98.5	41	1	7	2	0.08
2	86.5	60	1	5	4	0.20
2	78.3	41	1	7	6	0.28
2	68.1	51	1	6	8	0.39
5	52.1	32	2	9	13	0.55
5	33	38	1	8	18	0.74
5	22.4	21	2	14	23	0.84
5	14	17	3	18	28	0.93
5	6.7	15	3	21	33	1.00
0	106.8	0	0	0	33	1.00
10	96	11	5	28	43	1.11
10	87.8	8	6	37	53	1.19
10	81.7	6	8	49	63	1.25
10	75.6	6	8	49	73	1.31
10	69.9	6	9	53	83	1.37
10	64.5	5	9	56	93	1.42
10	59.6	5	10	61	103	1.47
10	55.2	4	11	68	113	1.52



Recorded By: M.P
Date: 31/03/2016
Checked by: N. Kokich
Date: 4-4-2016

Note: All readings taken below 1.5m from start depth are outside the scope of this test

S. Kokich
Approved Signatory

166 Bank Street
Whangarei
P: 09 438 4417
E: info@geocivil.co.nz

DYNAMIC CONE (SCALA) PENETROMETER

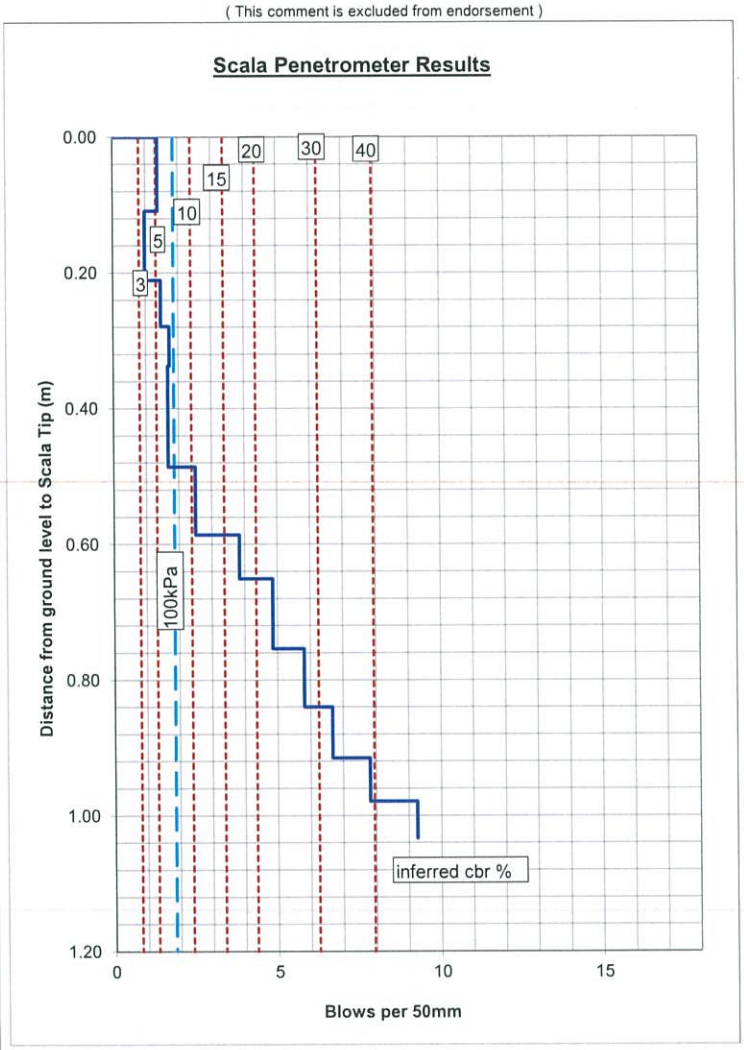
NZS 4402 :1988 Test 6.5.2

Lab Job No: 8288-072
Client: Base Group Consulting
Job: Geotechnical Investigations
Location: Lot 7, 60 Hawkens Road, Maunu
Start Depth (m): 0

Scala No: SP20
Ref : 16036
Report No: W16-260
Page: 21 of 27

The line are the suggested correlation of CBR values based on Figure 5.3, Correlation of Dynamic Cone Penetration and CBR AUSTROADS (2004) "Pavement Design - a guide to the design of road Pavements"
(This comment is excluded from endorsement)

No. Blows	Tip to ref (cm)	mm / blow	blows / 50mm	Blows / 300mm	Total Blows	depth (m)
0	106.3	0	0	0	0	0.00
3	95.4	36	1	8	3	0.11
2	85.2	51	1	6	5	0.21
2	78.4	34	1	9	7	0.28
2	72.6	29	2	10	9	0.34
5	57.7	30	2	10	14	0.49
5	47.7	20	3	15	19	0.59
5	41.2	13	4	23	24	0.65
10	30.9	10	5	29	34	0.75
10	22.3	9	6	35	44	0.84
10	14.8	8	7	40	54	0.92
10	8.4	6	8	47	64	0.98
10	3	5	9	56	74	1.03



Recorded By: M.P
Date: 31/03/2016
Checked by: N. Kissaser
Date: 4-4-2016

Note: All readings taken below 1.5m from start depth are outside the scope of this test

GEO CIVIL

AUGERHOLE LOG

166 Bank Street,
Whangarei,
M:027 6565226
E: info@geocivil.co.nz

Job No.:	**8288-072**	**Borehole No.:**	**BH1**	**Sheet:**	1 of 1
Report No.:	W16-260				
Client:	Base Group Consulting	**Coordinates:**		**Date:**	30/04/16
Client Ref. No.:	16036				
Project:	Geotechnical Investigation	**Location:**	60 Hawken Road, Maunu	**Ground Level:**	0

Geological Interpretation (In accordance with NZGS 2005)	UCS	Depth (m)	Water	Vane Shear Strength (kPa) (Tested in accordance with NZGS Aug 2001)	Values	Samples
Silty TOPSOIL, traces of organics (rootlets), dark brown, moist.	OH	0.0	Groundwater Not Encountered	50 100 150 200		
Silty CLAY, reddish brown, friable, high plasticity, moist.	CH	0.5			189 62	
		1.0			159 59	
		1.5			122 65	
Silty CLAY, light brown, friable, high plasticity, very moist.	CH	2.0			131 54	
Silty CLAY, traces of fine sand, light orangish brown, high plasticity, wet.	CH	2.5			104 27	
Silty CLAY, traces of fine sand, light orangish brown, high plasticity, saturated.	CH	3.0			141 20	
Silty CLAY, traces of fine sand, light brown with some orangish patches, moist, friable, high plasticity.	CH	3.5			114 32	
End of Borehole - Target depth.		4.0			68 23	

Remarks

Water
- Standing Water Level
- Out flow
- In flow

Investigation Type
- [x] Hand Auger
- [ ] Test Pit

Contractor:	Rig/Plant Used:	Page No.:	Logged By:	Checked By:	Hole Depth:
Geocivil	Hand Auger	22 of 27	M.P		4.00 m

GEO CIVIL

AUGERHOLE LOG

166 Bank Street,
Whangarei,
M:027 6565226
E: info@geocivil.co.nz

Job No.:	**8288-072**	**Borehole No.:**	**BH2**	**Sheet:**	1 of 1
Report No.:	W16-260	**Coordinates:**		**Date:**	30/04/16
Client:	Base Group Consulting				
Client Ref. No.:	16036				
Project:	Geotechnical Investigation	**Location:**	60 Hawken Road, Maunu	**Ground Level:**	0

Geological Interpretation (In accordance with NZGS 2005)	UCS	Depth (m)	Vane Shear Strength (kPa) (Tested in accordance with NZGS Aug 2001)	Values	Samples
Silty TOPSOIL, traces of organics (rootlets), dark brown, moist.	OH				
Silty CLAY, brown with some dark brown patches, high plasticity, friable, moist.	CH	0.5		118 26	
		1.0		159 54	
		1.5		142 70	
Silty CLAY, orangish brown, high plasticity, friable, moist.	CH	2.0		176 84	
Silty CLAY, brownish orange, high plasticity, friable, very moist.	CH	2.5		151 76	
		3.0		188 38	
Silty CLAY, brownish orange, high plasticity, friable, wet.	CH			UTP -	
End of Borehole - Too hard to auger.		3.5			
		4.0			

Groundwater Not Encountered

Vane Shear Strength (kPa): 50 100 150 200

Remarks

Water
- Standing Water Level
- Out flow
- In flow

Investigation Type
- [x] Hand Auger
- [ ] Test Pit

Contractor:	Rig/Plant Used:	Page No.:	Logged By:	Checked By:	Hole Depth:
Geocivil	Hand Auger	23 of 27	M.P		3.40 m

GEO CIVIL

166 Bank Street,
Whangarei,
M:027 6565226
E: info@geocivil.co.nz

AUGERHOLE LOG

Job No.:	**8288-072**	**Borehole No.:**	**BH3**	**Sheet:**	1 of 1
Report No.:	W16-260	**Coordinates:**		**Date:**	30/04/16
Client:	Base Group Consulting				
Client Ref. No.:	16036				
Project:	Geotechnical Investigation	**Location:**	60 Hawken Road, Maunu	**Ground Level:**	0

Geological Interpretation (In accordance with NZGS 2005)	UCS	Depth (m)	Vane Shear Strength (kPa) (Tested in accordance with NZGS Aug 2001)	Values	Samples
Silty TOPSOIL, traces of organics (rootlets), reddish brown, moist.	OH				
Silty CLAY, reddish brown, high plasticity, friable, moist.	CH	0.5		132 36	
		1.0		166 27	
Silty CLAY, orangish brown, high plasticity, friable, moist.	CH	1.5		149 35	
		2.0		139 18	
Silty CLAY, minor gravels <3mm, high plasticity, wet.	CH	2.5		111 5	
		3.0		189+ -	
Gravelly SILT, gravels <3mm, very wet, high plasticity.	MH	3.5		189+ -	
End of Borehole - Target depth.		4.0		189+ -	

Groundwater Not Encountered

Vane Shear Strength (kPa) scale: 50, 100, 150, 200

Remarks

Shearvanes from 2.5m to 4.0m may be inaccurate due to gravels.

Water

- Standing Water Level
- Out flow
- In flow

Investigation Type

- [x] Hand Auger
- [ ] Test Pit

Contractor:	Rig/Plant Used:	Page No.:	Logged By:	Checked By:	Hole Depth:
Geocivil	Hand Auger	24 of 27	M.P		4.00 m

GEO CIVIL

AUGERHOLE LOG

166 Bank Street,
Whangarei,
M:027 6565226
E: info@geocivil.co.nz

Job No.: 8288-072
Report No.: W16-260
Client: Base Group Consulting
Client Ref. No.: 16036
Project: Geotechnical Investigation

Borehole No.: BH4
Coordinates:
Location: 60 Hawken Road, Maunu

Sheet: 1 of 1
Date: 30/04/16
Ground Level: 0

Geological Interpretation (In accordance with NZGS 2005)	UCS	Depth (m)	Vane Shear Strength (kPa) Tested in accordance with NZGS Aug 2001	Values
Silty TOPSOIL, traces of organics (rootlets), reddish brown, moist.	OH			
Silty CLAY, minor gravels <3mm, reddish brown, high plasticity, moist.	CH	0.5		169 19
		1.0		189+ -
Silty CLAY, minor gravels <3mm, reddish brown, high plasticity, wet.	CH	1.5		116 19
Gravelly SILT, gravels <5mm, very wet, moderate to high plasticity, friable.	MH			
Gravelly SILT, gravels <5mm, saturated, moderate to high plasticity, friable.	MH	2.0		132 20
		2.5		119 32
		3.0		122 27
		3.5		111 22
		4.0		107 19
End of Borehole - Target depth.				

Water: Groundwater Not Encountered

Samples

Remarks
All shearvanes may be inaccurate due to gravels.

Water
- Standing Water Level
- Out flow
- In flow

Investigation Type
- [x] Hand Auger
- [ ] Test Pit

Contractor:	Rig/Plant Used:	Page No.:	Logged By:	Checked By:	Hole Depth:
Geocivil	Hand Auger	25 of 27	M.P		4.00 m

GEO CIVIL

AUGERHOLE LOG

166 Bank Street,
Whangarei,
M:027 6565226
E: info@geocivil.co.nz

Job No.:	**8288-072**	**Borehole No.:**	**BH5**	**Sheet:**	1 of 1
Report No.:	W16-260				
Client:	Base Group Consulting	**Coordinates:**		**Date:**	30/04/16
Client Ref. No.:	16036				
Project:	Geotechnical Investigation	**Location:**	60 Hawken Road, Maunu	**Ground Level:**	0

Geological Interpretation (In accordance with NZGS 2005)	UCS	Depth (m)	Vane Shear Strength (kPa) (Tested in accordance with NZGS Aug 2001)	Values	Samples
Silty TOPSOIL, traces of organics (rootlets), reddish brown, moist.	OH				
Silty CLAY, reddish brown, high plasticity, friable, moist.	CH	0.5		149 45	
		1.0		153 78	
		1.5		155 100	
		2.0		141 76	
Silty CLAY, brown, high plasticity, friable, very moist.	CH	2.5		155 61	
		3.0		149 38	
Silty CLAY, brown with some orange, high plasticity, slightly friable, very moist.	CH	3.5		165 20	
End of Borehole - Target depth.		4.0		122 18	

Vane Shear Strength (kPa): 50, 100, 150, 200

Groundwater Not Encountered

Remarks

Water
- Standing Water Level
- Out flow
- In flow

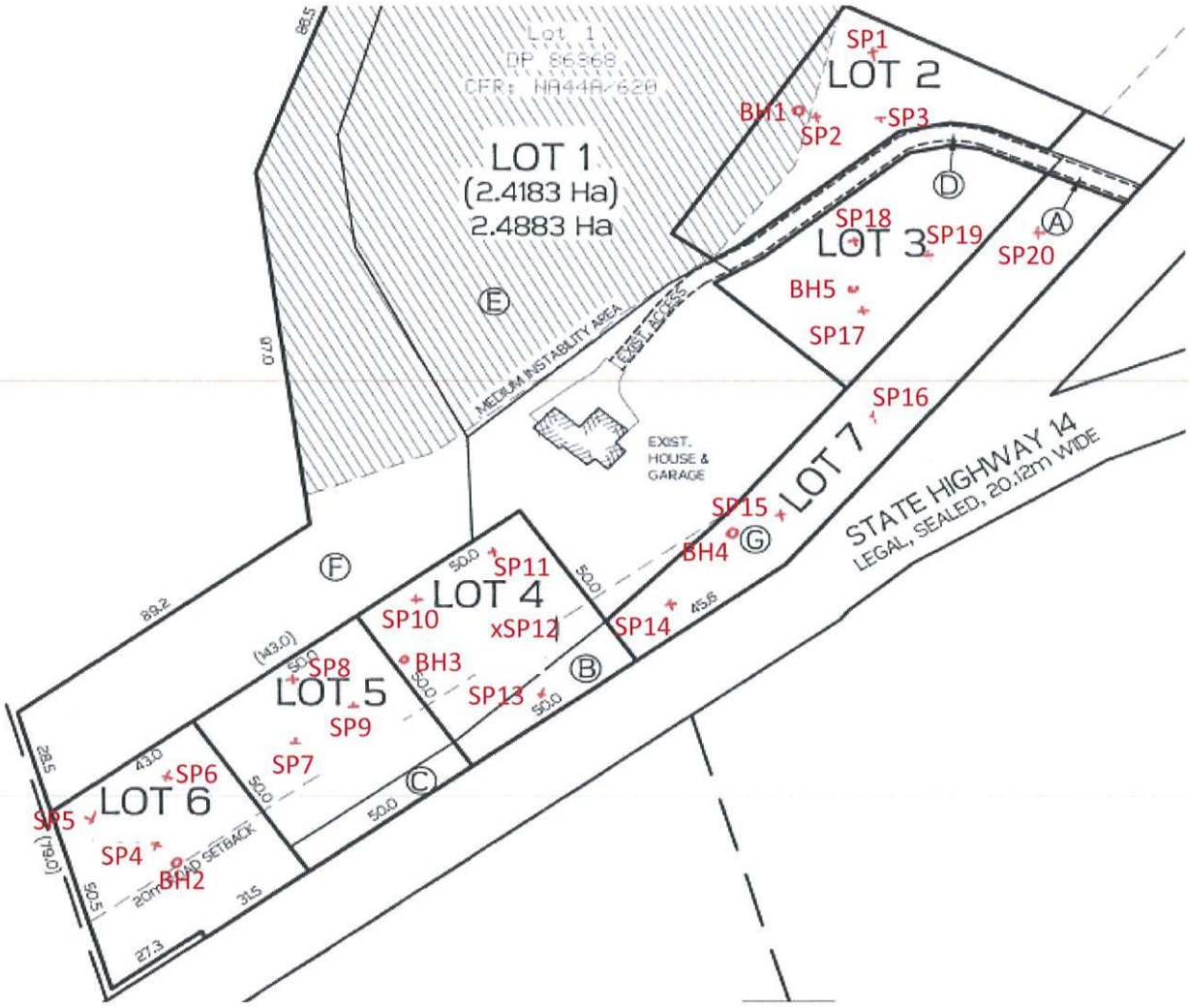
Investigation Type
- [x] Hand Auger
- [ ] Test Pit

Contractor:	Rig/Plant Used:	Page No.:	Logged By:	Checked By:	Hole Depth:
Geocivil	Hand Auger	26 of 27	M.P		4.00 m

166 Bank Street
Whangarei
P: 09 438 4417
E: info@geocivil.co.nz

SITE PLAN

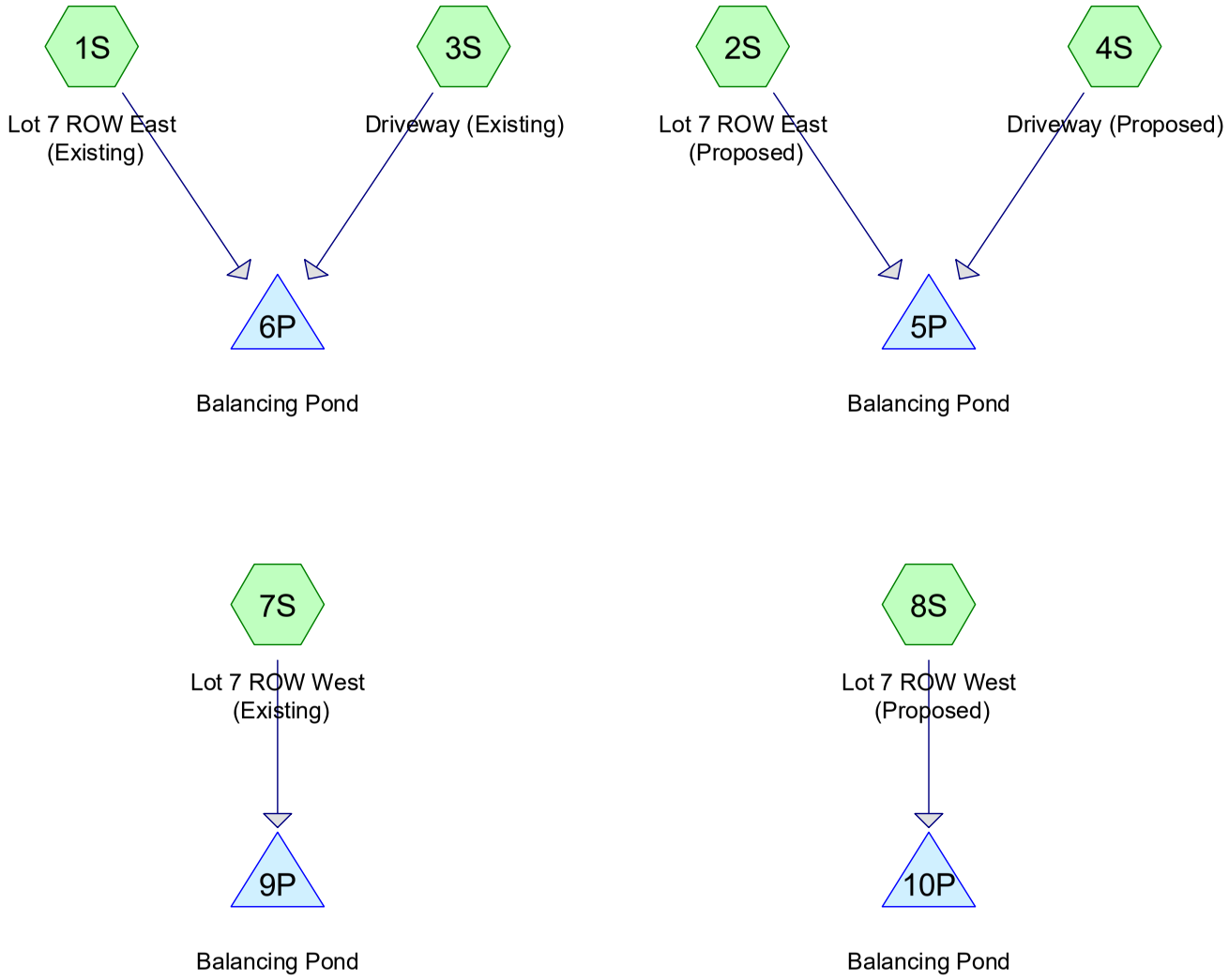
Lab Job No:	8288-072	**Tested by:**	M.P/S.K
Client:	Base Group Consulting	**Date:**	30/03/2016
Project:	Geotechnical Investigations	**Page:**	27 of 27
Location:	Lot 7, 60 Hawkens Road, Maunu		
Report No:	W16-260		
REF:	16036		



Site Plan
1/04/2016
8288-072, BGC16036, 60 Hawken Road, Maunu, 30-3-16

BASE GROUP CONSULTING
Structural & Civil Engineering

APPENDIX 3: STORMWATER CALCULATIONS



Subcat Reach Pond Link

Routing Diagram for 16036_ROW attenuation_180416

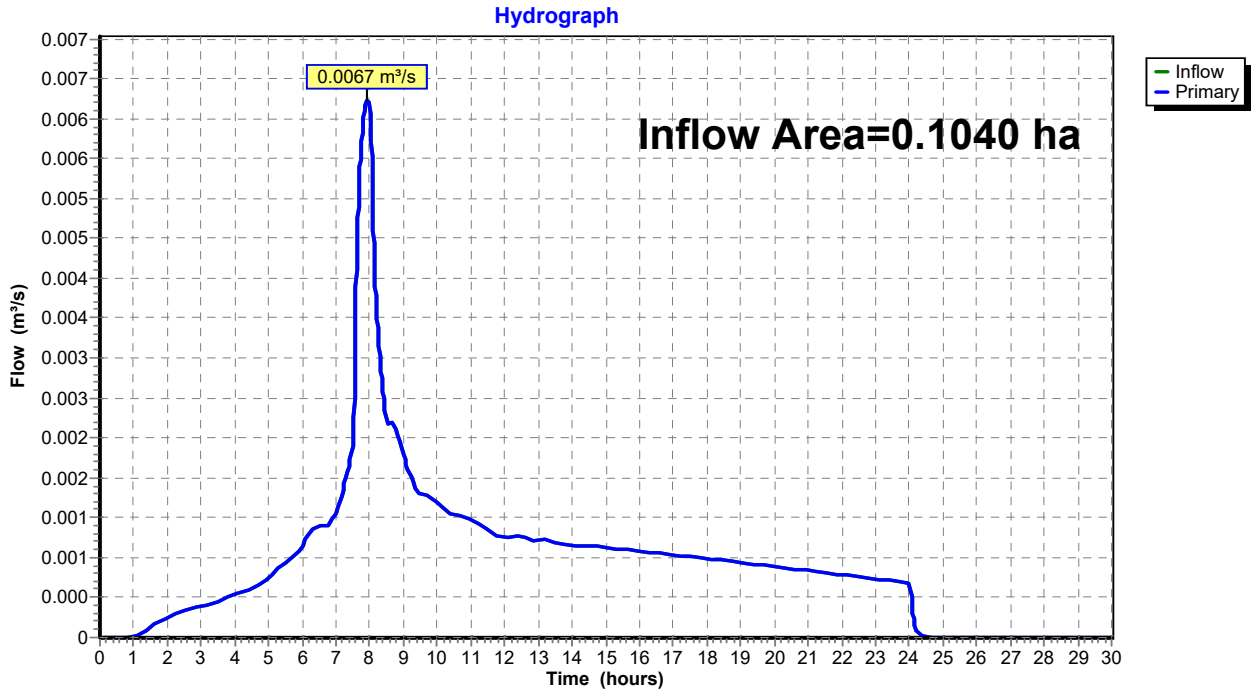
Prepared by Base Group Consulting, Printed 19/04/2016

Summary for Pond 6P: Balancing Pond

Inflow Area = 0.1040 ha, 43.27% Impervious, Inflow Depth = 96 mm for 5yr event
Inflow = 0.0067 m³/s @ 7.93 hrs, Volume= 0.099 Ml
Primary = 0.0067 m³/s @ 7.93 hrs, Volume= 0.099 Ml, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs

Pond 6P: Balancing Pond

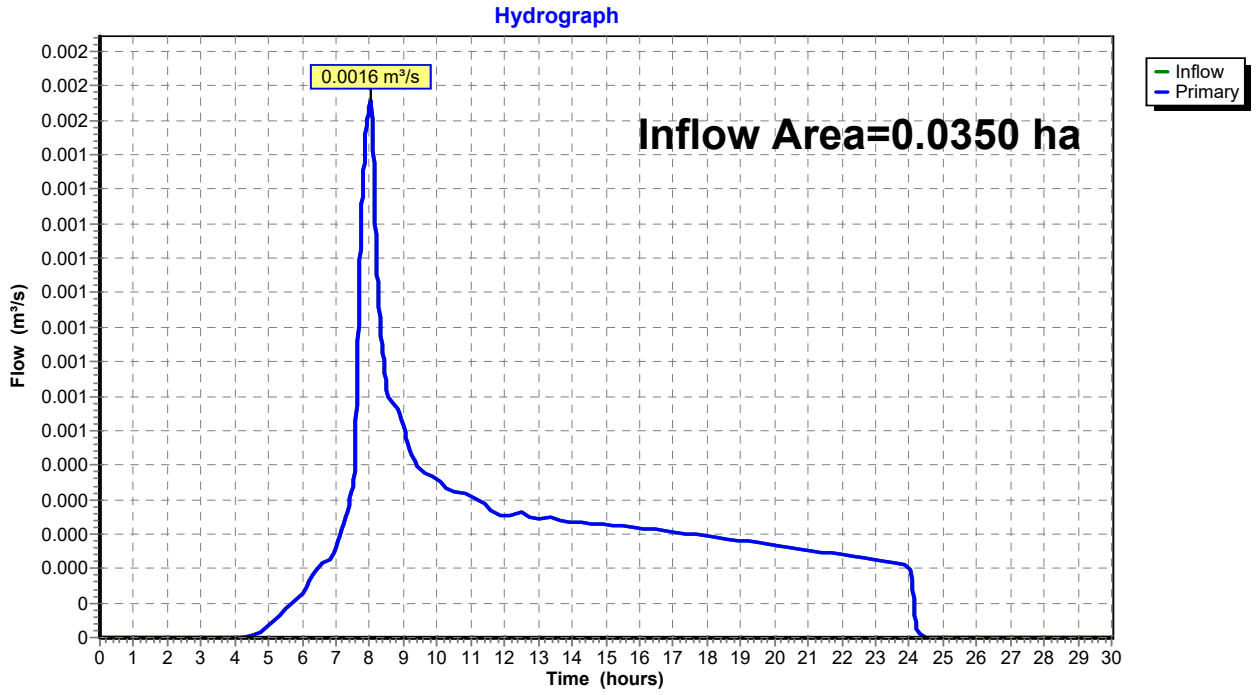


Summary for Pond 9P: Balancing Pond

Inflow Area = 0.0350 ha, 0.00% Impervious, Inflow Depth = 69 mm for 5yr event
Inflow = 0.0016 m³/s @ 8.03 hrs, Volume= 0.024 Ml
Primary = 0.0016 m³/s @ 8.03 hrs, Volume= 0.024 Ml, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs

Pond 9P: Balancing Pond

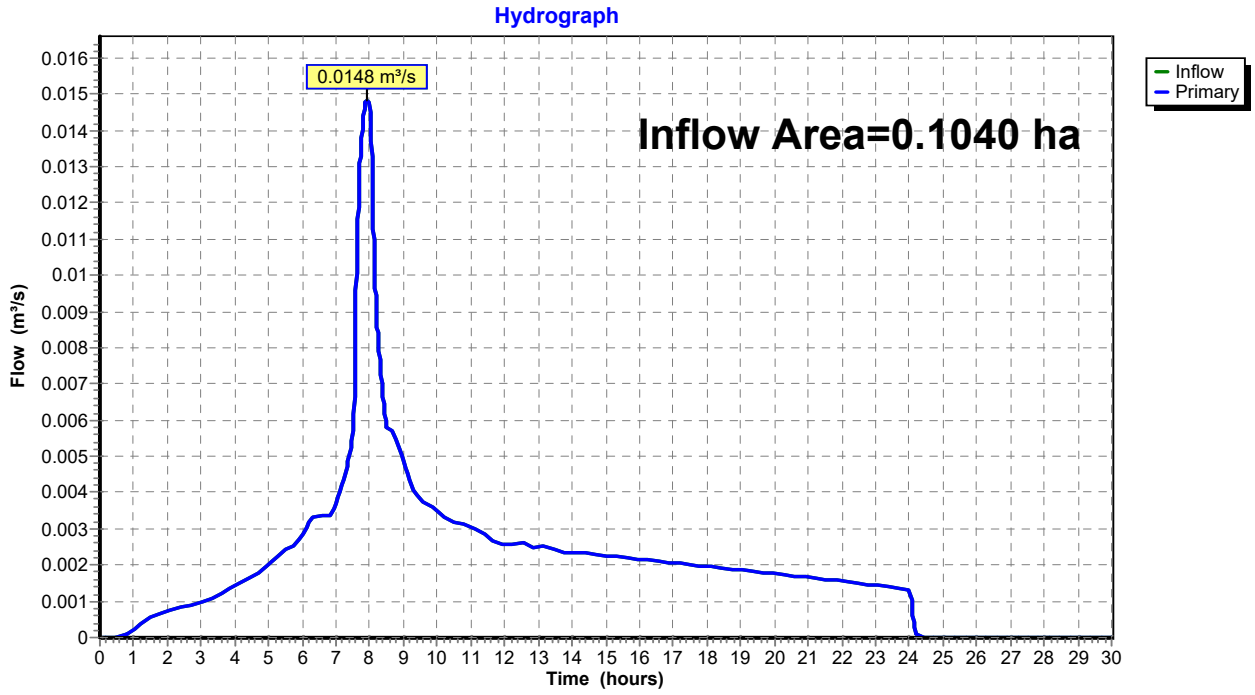


Summary for Pond 6P: Balancing Pond

Inflow Area = 0.1040 ha, 43.27% Impervious, Inflow Depth = 205 mm for 100yr event
Inflow = 0.0148 m³/s @ 7.92 hrs, Volume= 0.214 Ml
Primary = 0.0148 m³/s @ 7.92 hrs, Volume= 0.214 Ml, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs

Pond 6P: Balancing Pond

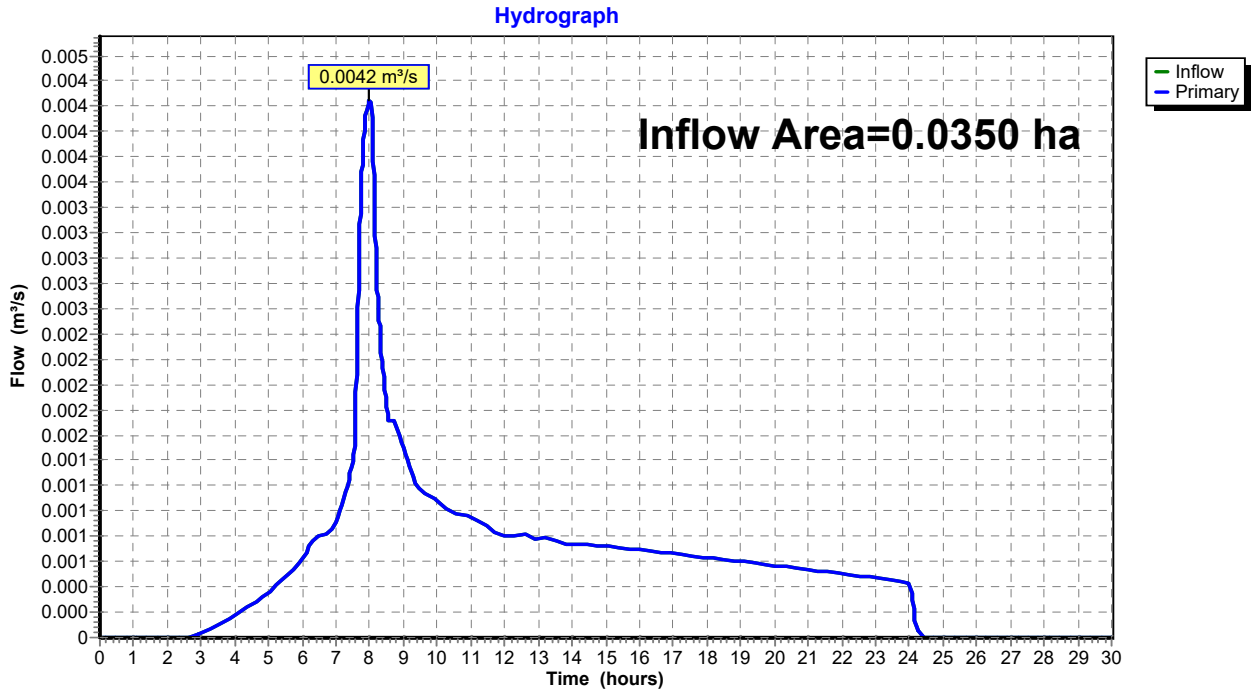


Summary for Pond 9P: Balancing Pond

Inflow Area = 0.0350 ha, 0.00% Impervious, Inflow Depth = 172 mm for 100yr event
Inflow = 0.0042 m³/s @ 7.99 hrs, Volume= 0.060 Ml
Primary = 0.0042 m³/s @ 7.99 hrs, Volume= 0.060 Ml, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs

Pond 9P: Balancing Pond



Summary for Pond 5P: Balancing Pond

Inflow Area = 0.1040 ha,100.00% Impervious, Inflow Depth = 160 mm for 5yr CC event
Inflow = 0.0115 m³/s @ 7.85 hrs, Volume= 0.166 Ml
Outflow = 0.0052 m³/s @ 8.31 hrs, Volume= 0.166 Ml, Atten= 55%, Lag= 27.7 min
Primary = 0.0052 m³/s @ 8.31 hrs, Volume= 0.166 Ml

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Peak Elev= 0.291 m @ 8.31 hrs Surf.Area= 80.0 m² Storage= 23.3 m³

Plug-Flow detention time= 57.5 min calculated for 0.166 Ml (100% of inflow)
Center-of-Mass det. time= 56.0 min (705.2 - 649.2)

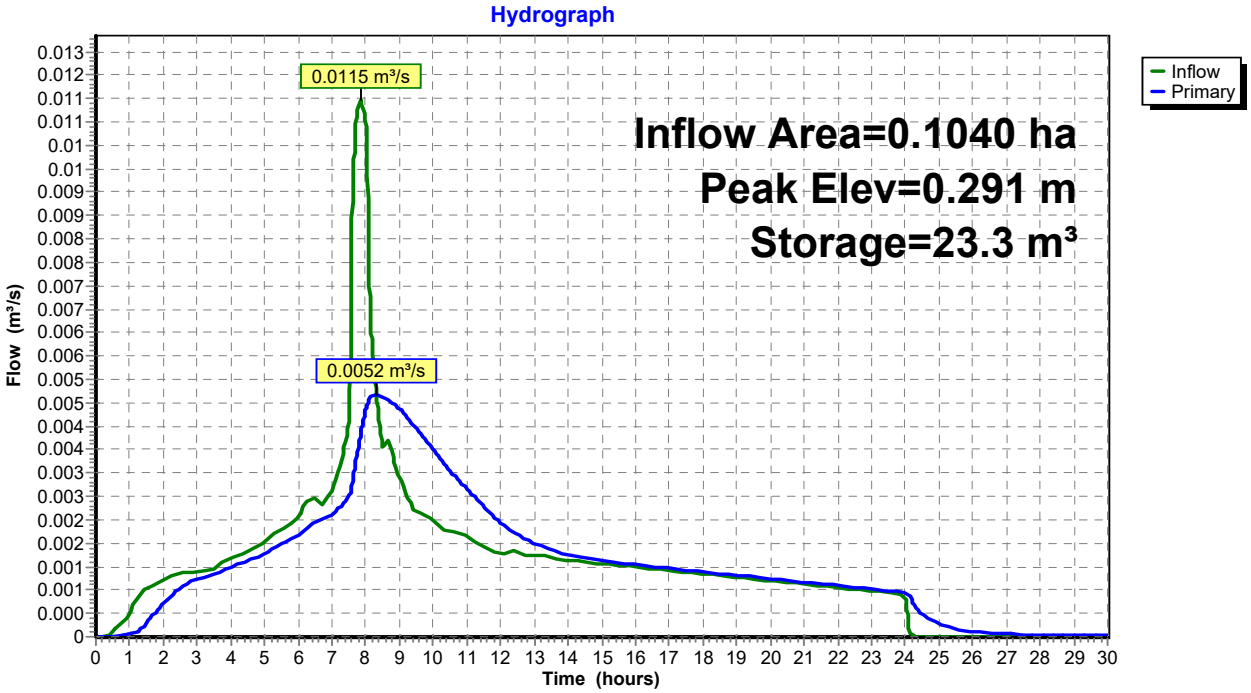
Volume	Invert	Avail.Storage	Storage Description
#1	0.000 m	80.0 m³	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (meters)	Surf.Area (sq-meters)	Inc.Store (cubic-meters)	Cum.Store (cubic-meters)
0.000	80.0	0.0	0.0
1.000	80.0	80.0	80.0

Device	Routing	Invert	Outlet Devices
#1	Primary	0.000 m	**150 mm Round Culvert** L= 5.00 m Ke= 0.600 Inlet / Outlet Invert= 0.000 m / -0.200 m S= 0.0400 m/m Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 0.018 m²
#2	Device 1	0.000 m	**70 mm Vert. Orifice/Grate** C= 0.600
#3	Device 1	0.300 m	**70 mm Vert. Orifice/Grate** C= 0.600

Primary OutFlow Max=0.0052 m³/s @ 8.31 hrs HW=0.291 m (Free Discharge)
└**1=Culvert** (Passes 0.0052 m³/s of 0.0205 m³/s potential flow)
  ├**2=Orifice/Grate** (Orifice Controls 0.0052 m³/s @ 1.35 m/s)
  └**3=Orifice/Grate** (Controls 0.0000 m³/s)

Pond 5P: Balancing Pond



Summary for Pond 10P: Balancing Pond

Inflow Area = 0.0350 ha,100.00% Impervious, Inflow Depth = 160 mm for 5yr CC event
Inflow = 0.0039 m³/s @ 7.85 hrs, Volume= 0.056 Ml
Outflow = 0.0013 m³/s @ 8.75 hrs, Volume= 0.056 Ml, Atten= 65%, Lag= 54.0 min
Primary = 0.0013 m³/s @ 8.75 hrs, Volume= 0.056 Ml

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Peak Elev= 0.181 m @ 8.75 hrs Surf.Area= 60.0 m² Storage= 10.9 m³

Plug-Flow detention time= 103.1 min calculated for 0.056 Ml (99% of inflow)
Center-of-Mass det. time= 99.0 min (748.2 - 649.2)

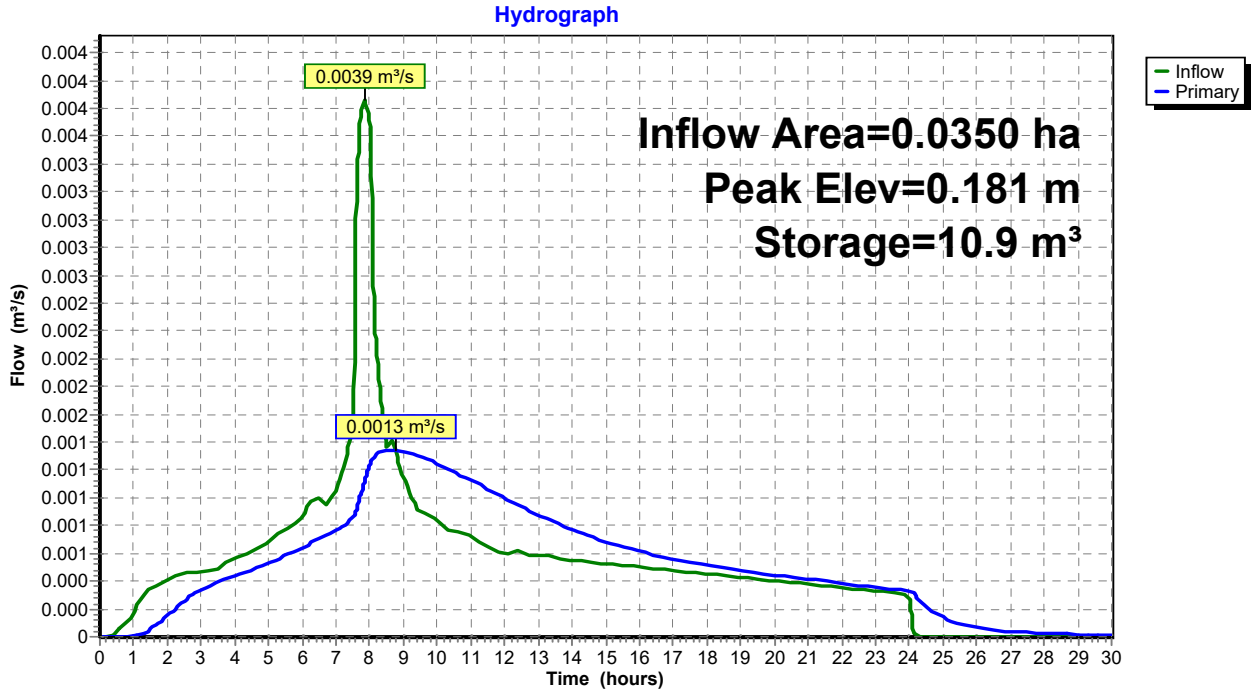
Volume	Invert	Avail.Storage	Storage Description
#1	0.000 m	30.0 m³	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (meters)	Surf.Area (sq-meters)	Inc.Store (cubic-meters)	Cum.Store (cubic-meters)
0.000	60.0	0.0	0.0
0.500	60.0	30.0	30.0

Device	Routing	Invert	Outlet Devices
#1	Primary	0.000 m	**150 mm Round Culvert** L= 5.00 m Ke= 0.600 Inlet / Outlet Invert= 0.000 m / -0.200 m S= 0.0400 m/m Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 0.018 m²
#2	Device 1	0.000 m	**40 mm Vert. Orifice/Grate** C= 0.600
#3	Device 1	0.182 m	**40 mm Vert. Orifice/Grate** C= 0.600

Primary OutFlow Max=0.0013 m³/s @ 8.75 hrs HW=0.181 m (Free Discharge)
└**1=Culvert** (Passes 0.0013 m³/s of 0.0144 m³/s potential flow)
  ├**2=Orifice/Grate** (Orifice Controls 0.0013 m³/s @ 1.07 m/s)
  └**3=Orifice/Grate** (Controls 0.0000 m³/s)

Pond 10P: Balancing Pond



Summary for Pond 5P: Balancing Pond

Inflow Area = 0.1040 ha,100.00% Impervious, Inflow Depth = 300 mm for 100yr CC event
Inflow = 0.0212 m³/s @ 7.85 hrs, Volume= 0.312 Ml
Outflow = 0.0119 m³/s @ 8.17 hrs, Volume= 0.312 Ml, Atten= 44%, Lag= 19.3 min
Primary = 0.0119 m³/s @ 8.17 hrs, Volume= 0.312 Ml

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Peak Elev= 0.542 m @ 8.17 hrs Surf.Area= 80.0 m² Storage= 43.4 m³

Plug-Flow detention time= 59.5 min calculated for 0.311 Ml (100% of inflow)
Center-of-Mass det. time= 58.6 min (700.0 - 641.4)

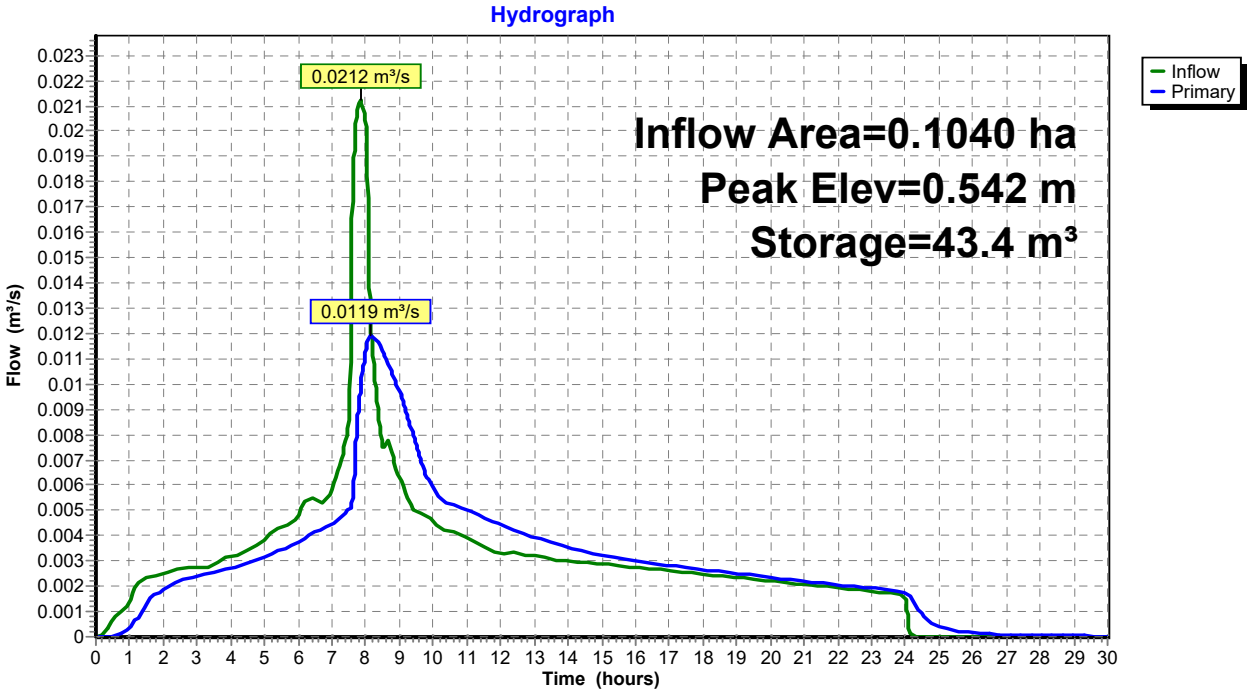
Volume	Invert	Avail.Storage	Storage Description
#1	0.000 m	80.0 m³	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (meters)	Surf.Area (sq-meters)	Inc.Store (cubic-meters)	Cum.Store (cubic-meters)
0.000	80.0	0.0	0.0
1.000	80.0	80.0	80.0

Device	Routing	Invert	Outlet Devices
#1	Primary	0.000 m	**150 mm Round Culvert** L= 5.00 m Ke= 0.600 Inlet / Outlet Invert= 0.000 m / -0.200 m S= 0.0400 m/m Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 0.018 m²
#2	Device 1	0.000 m	**70 mm Vert. Orifice/Grate** C= 0.600
#3	Device 1	0.300 m	**70 mm Vert. Orifice/Grate** C= 0.600

Primary OutFlow Max=0.0119 m³/s @ 8.17 hrs HW=0.542 m (Free Discharge)
└**1=Culvert** (Passes 0.0119 m³/s of 0.0301 m³/s potential flow)
  ├**2=Orifice/Grate** (Orifice Controls 0.0073 m³/s @ 1.89 m/s)
  └**3=Orifice/Grate** (Orifice Controls 0.0047 m³/s @ 1.21 m/s)

Pond 5P: Balancing Pond



Summary for Pond 10P: Balancing Pond

Inflow Area = 0.0350 ha,100.00% Impervious, Inflow Depth = 300 mm for 100yr CC event
Inflow = 0.0071 m³/s @ 7.85 hrs, Volume= 0.105 Ml
Outflow = 0.0031 m³/s @ 8.33 hrs, Volume= 0.105 Ml, Atten= 56%, Lag= 29.0 min
Primary = 0.0031 m³/s @ 8.33 hrs, Volume= 0.105 Ml

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Peak Elev= 0.340 m @ 8.33 hrs Surf.Area= 60.0 m² Storage= 20.4 m³

Plug-Flow detention time= 110.9 min calculated for 0.105 Ml (100% of inflow)
Center-of-Mass det. time= 108.2 min (749.6 - 641.4)

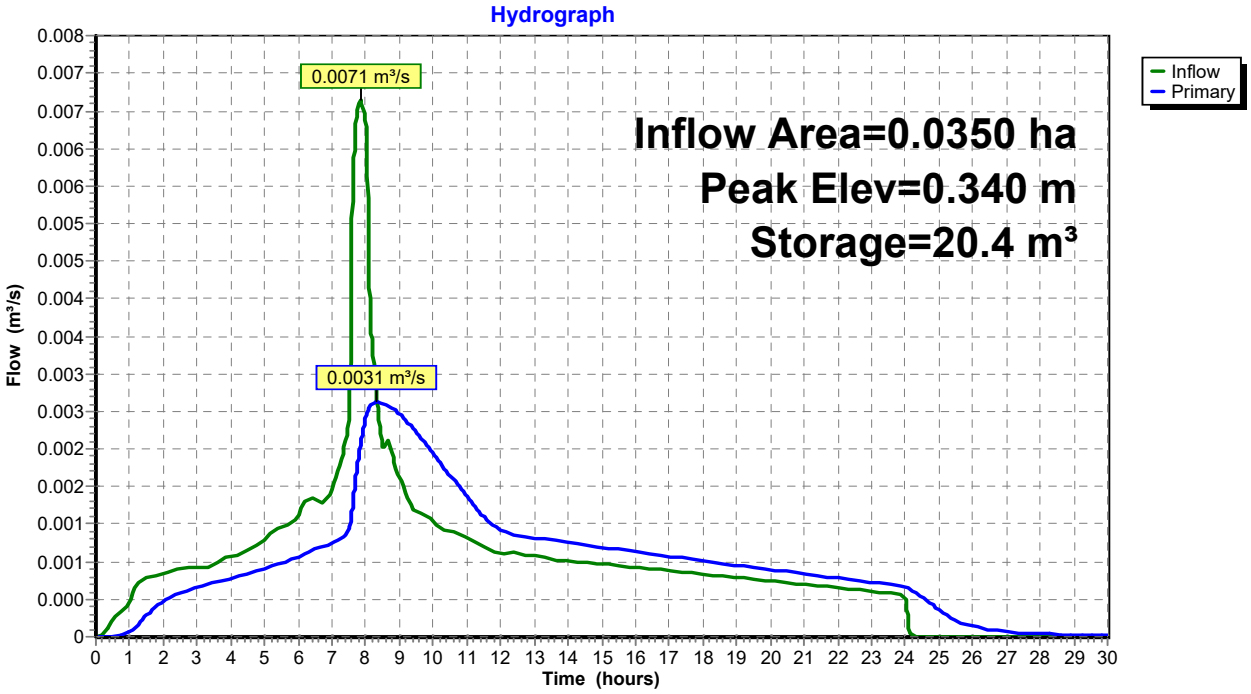
Volume	Invert	Avail.Storage	Storage Description
#1	0.000 m	30.0 m³	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (meters)	Surf.Area (sq-meters)	Inc.Store (cubic-meters)	Cum.Store (cubic-meters)
0.000	60.0	0.0	0.0
0.500	60.0	30.0	30.0

Device	Routing	Invert	Outlet Devices
#1	Primary	0.000 m	**150 mm Round Culvert** L= 5.00 m Ke= 0.600 Inlet / Outlet Invert= 0.000 m / -0.200 m S= 0.0400 m/m Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 0.018 m²
#2	Device 1	0.000 m	**40 mm Vert. Orifice/Grate** C= 0.600
#3	Device 1	0.182 m	**40 mm Vert. Orifice/Grate** C= 0.600

Primary OutFlow Max=0.0031 m³/s @ 8.33 hrs HW=0.340 m (Free Discharge)
└**1=Culvert** (Passes 0.0031 m³/s of 0.0227 m³/s potential flow)
  ├**2=Orifice/Grate** (Orifice Controls 0.0019 m³/s @ 1.50 m/s)
  └**3=Orifice/Grate** (Orifice Controls 0.0012 m³/s @ 0.99 m/s)

Pond 10P: Balancing Pond



BASE GROUP CONSULTING
Structural & Civil Engineering

APPENDIX 4: WASTEWATER MANAGEMENT

WHANGAREI DISTRICT COUNCIL
Forum North · Private Bag 9023 · Whangarei 0148 · New Zealand
Telephone (09) 430 4200 · 0800 WDC INFO · 0800 932 463 · Facsimile (09) 438 7632
Website http//www.wdc.govt.nz · E-mail mailroom@wdc.govt.nz

Form EES-SEW1

On-Site Wastewater Disposal Investigation/Site Evaluation Checklist for Resource Consent Application

This form is to be read in conjunction with AS/NZS 1547:2000 (or any amendments as applicable), and, in particular with Part 4: Means of Compliance

Part A - Contact Details

1 applicant

Name: Robert Thomson

Property Address: 60 Hawken Road, Maunu, Whangarei

Lot/DP Number: Lot 1 DP 86368

2 Consultant/Site Evaluator

Site Evaluator Name: Aaran MacPherson

Company Name: Base Group Consulting

Postal Address: PO Box 1032, Whangarei 0140

Business Phone: 4373432 Fax:

Mobile: 0272942774 Email: aaran@basegroup.co.nz

IQP Registered[25] *(See note 1 below)*

☑ Yes ☐ No If no, details of suitably registered IQP who will countersign the report are to be supplied below

Name of IQP who is Countersigning Report:

Company Name:

Postal Address:

Business Phone: Fax:

Mobile: Email:

[25] It is a requirement that the Evaluator be IQP registered to carry out on-site effluent investigations/designs. If not, then evaluation/design will need to be counter-signed by a suitably registered IQP

Part B - Site and Soil Evaluation

1 Desk Study

Requirements (✓ appropriate box)

Please complete **all** options. *(If more than one option applies to land under consideration, please clarify with supporting information)*

WDC Requirement		Applies to Lot(s)	Comments
1 Hazard maps/GIS hazard layer - stability			
☑ Low instability risk		Lots 2-6	
☑ Medium instability risk		Lot 2	Partially mapped as medium instability risk
☐ High instability risk			
2 GIS hazard layer – effluent on slope stability			
☐ Low disposal potential			
☑ Moderate disposal potential		Lots 2-6	Subdivision area not mapped
☐ High disposal potential			
3 GIS hazard layer – effluent suitability			
☑ Medium unsuitability		Lots 2-6	
☐ High unsuitability			
4 GIS hazard layer – flood susceptibility			
☐ Is flood susceptible			
☐ Is partially flood susceptible			
☑ Is not flood susceptible		Lots 2-6	
5 GIS land resources layer - streams			
Are there streams on or adjacent to land under investigation?	☐ Yes		
	☑ No	Lots 2-6	
6 GIS land resources layer – aquifers at risk			
Is land situated over or adjacent to aquifer?	☑ Yes	Lots 2-6	Maunu aquifer
	☐ No		
7 Annual rainfall (HIRDS)	1,500mm		

Important Note

It is to be noted that **all** information obtained off WDC GIS/Hazard Maps is to be taken as a guide **only**.

All information obtained from the above sites is to be confirmed by a specific site investigation as localised conditions could vary substantially. However, should the above data checks indicate the potential for a hazard/non-complying activity etc, this **must** be further investigated to confirm/deny the indicated situation.

2 On-Site Evaluation

a Determination of Soil Category *(refer table 4.1.1 AS/NZS 1547:2000)* (✓ appropriate box)

Soil Category	Structure	Applies to lot(s)	Comments
1 Gravels & Sands	☐ Structureless (massive)		
2 Sandy loams	☐ Weakly Structured		
	☐ Massive		
3 Loams	☐ High/Moderate structured		
	☐ Weakly structured or Massive		
4 Clay loams	☑ High/moderate structured	Lots 2-6	Papakauri clay loam
	☐ Weakly structured		
	☐ Massive		
5 Light clays	☐ Strongly structured		
	☐ Moderately structured		
	☐ Weakly structured or massive		
6 Medium to heavy clays	☐ Strongly structured		
	☐ Moderately structured		
	☐ Weakly structured or massive		

Notes

Refer 4.1 A4 – Soil Assessment AS/NZS 1547:2000 for assessment criteria.

Details of the method used to determine soil type etc are to be clearly stated, along with positions of boreholes/test pits etc clearly marked on a site plan. Bore logs are to be provided. Photos should be included.

The site plan should also clearly show the intended area for effluent disposal, along with any site features such as drains, water bores, overland flows etc, along with separation distance achieved.

On-Site Evaluation Continued

b Site Characteristics for Proposed Disposal Area: *(if there is a marked difference between sites, please fill in a separate form for each site and clearly note which site the assessment applies to)* (✓ appropriate box)

Details	**Applies to Site/s**
1 Flooding potential to proposed field and reserve field *(refer note 1 below)*	
☑ Fields will not flood, or	Lots 2-6
Fields will flood in:	
☐ 20% AEP event	
☐ 5% AEP event	
☐ 1% AEP event	
2 Surface water separation to proposed field and reserve field *(refer note 2 below)*	
☑ Main/reserve disposal field comply with NRC rules	Lots 2-6
☐ Main/reserve disposal field do **not** comply with NRC rules	
3 Winter ground water separation to proposed field and reserve field *(refer note 3 below)*	
☑ Main and reserve disposal field comply with NRC rules	Lots 2-6
☐ Main and reserve disposal field do NOT comply with NRC rules	

4 Slope of ground of proposed field and reserve field *(refer note 4 below)*

Description Ground slope typically 5°-10° Lot 3-6 and 10° -15° Lot 2

5 Shape of ground of proposed field and reserve field *(refer note 5 below)*

☐ Waxing divergent	☐ Linear divergent	☐ Waning divergent
☐ Waxing planar	☑ Linear planar	☐ Waning planar
☐ Waxing convergent	☐ Linear convergent	☐ Waning convergent

Comments

6 Intended water supply source	**Applies to Site/s**
☐ Public supply	
☑ Rainwater	On-site rainwater harvesting to Lots 2-6
☐ Bore	

7 Proposed method of disposal and recommended Daily Loading rate (DLR) *(refer note 6 below)*

Description Pressure compensating dripper irrigation with secondary treatment and enhanced nitrogen removal. Design Irrigation rate taken as 3.5mm/day to be reduced to accommodate sloping ground where required

Peak Loading factored in? *(refer note 6 below)* ☑ **Yes** ☐ **No** **Comments** Designed to AS/NZS1547 using peak daily flows from (assumed) 3 bedroom dwelling

8 Site Exposure *(refer note 7 below)*	**Description**	**Applies to Site/s**
Site/s aspect	Southeast	Lots 2-6

Pre-dominant wind direction	East	Lots 2-6
Presence of shelter belts	No	Lots 2-6
Presence of topographical features or structures	Base of local scoria cone	Lots 2-6

9 Proximity of water bores. (include adjacent properties). *(refer note 9 below)*

No water bores recorded at site

10 Visible evidence of slips/instability *(refer note 8 below)*

Surface creep and shallow slippage on steeper slopes within Lot 2

11 Total suitable area available for type of effluent disposal proposed *(including reserve area)*

In excess of 500m² for proposed Lots 2-6

12 Setback areas proposed (if any) *(refer note 10 below)*

Land application areas set back as much as practical from steeper slopes and watercourse (vehicle access swale drains)

Notes

1 If the WDC hazard maps/GIS indicate a flooding susceptibility on the site being evaluated, an on-site evaluation is to be carried out to determine the effects from 20%, 5% and 1% AEP storm events. This evaluation is to include all calculations to substantiate conclusions drawn. If necessary, include a detailed contour plan and photos.

2 NRC Water & Soil plan defines surface water as 'All water, flowing or not, above the ground. It includes water in continually or intermittently flowing rivers, artificial watercourses, lakes and wetlands, and water impounded by structures such as dams or weirs but does not include water while in pipes, tanks, cisterns, nor water within the Coastal Marine Area'. By this definition, separation (complying with NRC rules) is to be maintained by both the proposed disposal and reserve areas from any overland flowpaths and/or swale drains etc or R/C will be required from NRC. Surface water is to be clearly marked on each site plan, showing the extent of a 1% AEP storm event, and detailing separation distances to main/reserve disposal areas.

3 Positions of test borehole/s to be shown, and bore logs to be provided. Separation (complying with NRC rules) is to be maintained by both the proposed disposal and reserve areas from winter ground water level or R/C will be required from NRC. If the investigation is done outside of the winter period, allowance is to be made in determining the likely winter level.

4 Slopes of ground are to be compared with those recommended maximums for type of system proposed (refer Appendix 4.2B AS/NZS 1547:2000). Designs exceeding those maximums will require specific design to justify the proposal, and may also need Resource Consent from NRC.

5 Shape of ground is important as it will determine whether there is potential for concentrated overland flows from the upper slopes and also if effluent might be concentrated at base of slope if leeching occurs. Refer Figure 4.1B2 AS/NZS 1547:2000.

6 The proposed system (for residential developments) should be sized to accommodate an average 3 bedroom house with 5 people. Sites in holiday areas need to take peak loading into effect in determining daily volumes. The design must state what DLR was used to determine area necessary (including reserve area). If ground conditions are marginal for type of disposal proposed, then a soil permeability test utilising the constant head method is to be carried out across the proposed disposal area. Refer Appendix 4.1F AS/NZS 1547:2000.

7 The site aspect is important as a north-facing site that is not sheltered from wind and sun by shelterbelts or other topographical features or structures will perform far better than a south-facing site on the lee of a hill that is shaded from wind and sun etc

8 If any effluent disposal area (including any reserve area) proposed has or is adjacent to areas that show signs of instability, then a full report from a CPEng (Geotech) will be required to justify the viability of the area for effluent disposal.

9 If there are any water bores on the subject property or adjacent properties then a site plan will be required showing bore positions in relation to any proposed effluent field(s).

10 If setback areas are proposed to mitigate effects, the extent and position/s need to be shown on a site plan.

BASE GROUP CONSULTING
Structural & Civil Engineering

On-site Wastewater Management in accordance with AS/NZS1547:2012 - Individual Lot Assessment

Project Reference	16036	Assessed by	ASM
Client	Williamson	Date Assessed	14/04/2016
Site Location	60 Hawken Road, Whangarei		

Site and soil evaluation

Desktop	Legal descrition	Lot 1 DP 86368	Indicative permeability	Well/moderately well drained
	Lot size	4.065ha	Flood Susceptible	No
	Soil map	Papakauri clay loam	Annual rainfall	1500mm
			Other	
Site investigations	Ground slope	<5.7	Land instabilities	Slips
	Ground shape	Linear	Boulders/Rock outcrops	No
	Ground shape	Planar	Vegetation	Pasture
	Aspect	S-E	Watercourse	No
	Exposure	Exposed	Concentrated runoff	Yes
	Shelterbelts	No	Soil surface	Firm
	Topo features	Sloping terrain	Season	Autumn
	Wind direction	E	Buildings	Existing house
			Services	None
Soil Assessment	Colour	Red brown	Permanent water table	Not encountered
	Texture	Clay loams	Surface condition	Stiff, moist
	Coarse Fragments	None	Existing/Past land use	Pasture
	Structure	Weakly structured	Other	

Land Application systems

Design parameters	Water source	Roof runoff	No. of bedrooms	3
	Daily use / person	180 litres / person / day	Design occupancy	5
	Soil category	4	Design daily flow	0.9 m^3 <3m^3 OK
Design system	Level of treatment	Secondary	Area required	257 m^2
	DLR/DIR	3.5 mm/day	Width	25.7
	System type	Irrigation	Length	10
	Design LTAR	3.5 mm/day	No. required	1.0
Clearance	Boundaries	>1.5m	Clearance to surface water	>15m horizontally
	Groundwater	>0.6m	Clearance to bores	>20m horizontally
	Buildings	>6m	Cut off drains required	No
	Reserve area	>30% 77 m^2	Surface water interceptor	No

Determination of Soil Category		
Gravels and sands	Very little to no coherence; cannot be moulded; single grains stick to fingers	Rapidly drained
Sandy Loams	Forms a cast but will not roll into a coherent ball; individual sand grains can be seen and felt; gives a ribbon 15-25 mm long	Well drained
Loams	As for sandy loams but cast feels spongy, with no obvious sandiness or, silkiness; may feel greasy if much organic matter is present; forms a thick ribbon about 25 mm long	Moderately well drained
Clay Loams	Can be rolled into a ball with a rather spongy feel; slightly plastic; smooth to manipulate; will form a ribbon 40-50 mm long	Imperfectly drained
Light Clays	Smooth plastic ball that can be rolled into a rod; slight resistance to shearing between thumb and forefinger; forms a ribbon 50-75 mm long	Poorly drained
Medium to Heavy Clays	Smooth plastic ball that handles like stiff plasticine; can be moulded into rods without fracture; firm resistance to ribboning; forms a ribbon 75 mm or more in length	Very poorly drained

Determination of Soil Structure	
Massive	Coherent, with any partings both vertically and horizontally spaced at greater than 100 mm. Pieces do not break along planes of weakness but break according to stress loads
Weak	Peds indistinct and barely observable on pit face. When disturbed approx. 30 % consist of peds smaller than 100 mm
Moderate	Peds well formed and evident when disturbed but not distinct in undisturbed soil. When disturbed 30 % - 60 % consists of peds smaller than 100 mm
Strong	Peds quite distinct in undisturbed soil. When disturbed > 60 % consists of peds smaller than 100 mm