ENGEO

Expect Excellence

Geotechnical Investigation

520 Great South Road

Papakura

Auckland

Submitted to:

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1 Introduction

ENGEO Limited was requested by 520 GSR Limited to undertake a geotechnical investigation of the property at 520 Great South Road, Papakura, Auckland. Our work is intended to support an application to Auckland Council for Resource Consent and a Plan Change request to enable a proposed residential development and subdivision at the site. This work has been carried out in accordance with our signed agreement dated 12 February 2019.

This revised report (REV1) includes the new Masterplan prepared by Barker and Associates (B&A); dated 06/06/2019, reference #17104 (Appendix 1). This replaces the previous Masterplan prepared by Isthmus Group Limited. This later B&A Masterplan now also includes the property at 21 Gatland Road within the proposed plan change area.

It should be noted that our geotechnical investigations were undertaken solely within 520 Great South Road. The property at 21 Gatland Road is included in the new Masterplan and Plan Change area but was not investigated geotechnically as part of this report.

We have not been provided with any earthworks plans for this development. However, given the relatively level existing contours, we expect that only minor cuts and fills will be required to create the proposed development.

This report has been prepared to address the following:

- Geological setting and ground conditions for the site, including an assessment of natural features and geohazards that may affect a future development of the nature currently proposed.
- Geotechnical guidance for future earthworks based on the ground conditions likely to be encountered during site stripping and bulk cut operations.
- Broad geotechnical recommendations for future foundations for typical residential structures, based on the current subdivision concept.

2 Site Description

The subject site incorporates two adjoining properties: 520 Great South Road and 21 Gatland Road.

520 Great South Road is an irregularly shaped block of land having a total area of 30,193 m^2. It is legally described as Lot 2 DP 172553, and is currently primarily an unused, grassed paddock. A commercial building is located in the south-western portion of the property, with associated sheds, storage facilities in the general vicinity with an associated carpark along the south- western property boundary. The balance of the site is undeveloped and in grass, with a small drainage feature present along the north-eastern property boundary. The Investigation Location Plan included in Appendix 2 of this report illustrates the local setting.

The landform slopes broadly towards the north and northeast, with an average slope angle of 6º across the elevated portions of the site. The landform becomes slightly steeper (up to 8º) with proximity to the drainage feature in the north-eastern portion of site. The site is bounded to the west by Great South Road, to the northeast by a small drainage feature and the Papakura South Cemetery, to the southeast by the heavily vegetated Plantarama Garden Centre and all other sides by partially developed residential properties.

An existing 150 mm diameter earthenware wastewater pipe with three associated wastewater manholes generally trends northwest across the western area of the property. Approximate location of this is detailed in the investigation location plan (Appendix 2).

We have reviewed historical aerial photographs of the site dating from 1959 to 2019 available on the Auckland Council GeoMAPS viewer and Google Earth. These photographs generally display the site appearing as a grassed, undeveloped area used for agricultural purposes, with a slight variance in existing structures in the south-western corner of site. The site landform does not appear to vary significantly over this period.

The property at 21 Gatland Road, Legal Description Lot 16, DP 43579 is a roughly rectangular property located immediately north of 520 Great South Road. This 1.2070 hectare site is relatively level in contour but slopes gently from west to east within the northern portion of the site, and also slopes gently from north to south within the southern portion of the site.

This site currently contains a centrally located house and large shed with a shelterbelt of large trees located along the southern boundary and other large trees located adjacent to the house and shed within the central portion of the site.

3 Development Proposal

We have been provided with the B&A Masterplan which depicts a proposal to subdivide the site, creating 113 new residential lots with associated new roads and infrastructure. This plan is presented in Appendix 1.

We have also been provided with a copy of the Airey Consultants Limited ‘Preliminary Engineering Feasibility Assessment’ (ref. 12530-01, dated February 2018) which indicates that earthworks on site will comprise cut to fill operations proposed to ease the steeper contours and fill the lower lying areas to achieve an overall contour suitable for conventional residential building development. This is proposed through construction of battered slopes, without the need for retaining wall installation. This report is included in Appendix 1. It should be noted that this report was prepared for the previous Masterplan and does not comment on the property at 21 Gatland Road.

4 Regional Geology

The site is mapped by the Institute of Geological and Nuclear Sciences (GNS) as being located on alluvial deposits of the Puketoka Formation (Pup), which comprise pumiceous mud, sand and gravel with muddy peat and lignite, rhyolite pumice, including non-welded ignimbrite, tephra and alluvia.

5 Site Investigation

5.1 Investigation

Subsurface investigations for this report were undertaken solely within the 520 Great South Road site and included six hand auger boreholes to depths of up to 5.0 m below existing ground level. Subsurface investigations were undertaken in the locations shown in the Investigation Location Plan (Appendix 2).

Full borehole logs are presented as an attachment (Appendix 1) and are written in general accordance with the New Zealand Geotechnical Society field classification guidelines (NZGS, 2005). The material encountered in our subsurface investigations is broadly consistent with published mapping and a generalised summary of our findings is summarised below. The attached boring logs (Appendix 3) should be consulted for specific subsurface conditions at each location.

Topsoil was encountered at all borehole locations to depths between 0.3 m and 0.5 m.

Uncontrolled fill was encountered in boreholes HA01 and HA02 underlying the topsoil and extending to depths of 0.5 m and 1.0 m respectively. The fill was described as hard clayey silt with minor sand, trace gravel and organics, and was typically brown and grey. It was not underlain by topsoil at either location.

Beneath the encountered topsoil and uncontrolled fill, all boreholes encountered clayey silt and silty clay soils with variable content of sand and gravel typical of the Puketoka Formation. These materials were generally found to be firm to hard in consistency, relatively plastic and cohesive. Organic silt was encountered in HA02 from 3.3 m to 4.2 m.

Groundwater levels were measured in the hand auger boreholes immediately upon completion. No groundwater was noted in HA05 when dipped. Groundwater was recorded at depths between 1.8 m and 4.6 m below existing ground levels in the remaining boreholes.

5.2 Laboratory Testing

One soil sample was selected for Shrink-Swell Index testing in accordance with AS1289: Test 7.1.1-2003. This sample comprised native silty clay material taken from within hand auger HA05. Full results are presented in Appendix 4 and are summarised in Table 1.

Table 1: Shrink Swell Index Testing

Borehole ID	Sample Depth (m)	Moisture Content (%)	Shrink-Swell Index
HA-05	0.4 - 0.7	24.2	2.1

6 Geotechnical Recommendations

Based on our desktop review and site investigation, we consider the subject site at 520 Great South Road is generally suitable for the proposed development as indicated on the B&A Masterplan, provided works are carried out in accordance with the following site specific recommendations, Auckland Council's Code of Practice and other appropriate standards.

Ground conditions within the site at 21 Gatland Road were not investigated as part of this report. However, given the similar topography and proximity to the site at 520 Great South Road it is considered likely that geological conditions will be similar at both properties.

We make the following site specific geotechnical recommendations.

6.1 Building Foundations

A preliminary geotechnical ultimate bearing capacity of 300kPa is considered likely to be available for shallow foundations constructed on identified competent natural ground or engineered certified fill.

However, due to variations in measured shear strengths within the natural ground profile and the variable depths of cut and fill earthworks proposed across the site, a value of less than 300 kPa may be specified for shallow foundation design in some areas of deeper cut. This issue should be re-addressed in a Geotechnical Completion Report (GCR) once final cut and fill earthworks are completed.

The preliminary assessed AS 2870 expansive site class in this case is M (moderate) and the characteristic surface ground movement is up to 40 mm. However, final expansive class for each lot should also be re-addressed in a GCR once earthworks have been completed.

6.2 Roading and Services

As future road levels are likely to vary from existing ground levels, site specific CBR testing was not completed as part of this investigation. Based on the observed soil properties and elevated groundwater levels at the site, we recommend a preliminary CBR of 4% be assumed for road subgrades in cut areas. Within fill areas, provided that the subgrade fill is compacted in keeping with best practice, CBRs of 7% or greater may be appropriate.

Given the expected variation in CBR values at grade between cut and fill areas, we recommend that a program of penetration resistance testing is carried out when the roads are being formed to their final levels to confirm actual CBR values.

Construction of stormwater and sanitary sewage reticulation during the winter months could involve raised groundwater levels which may cause problems with the stability of trench sides, leading to a need for additional subsoil drainage and / or dewatering, especially in areas where deep lines are required.

Firm, organic silts were encountered within the reach of service trenches during the site investigation. As such, service lines with shallow gradients may be at risk of ponding where service trenches encounter this material at pipe invert levels.

Where encountered, undercutting of this soft, compressible material to a suitable depth and replacement with a suitable ‘bridging’ layer may be required. If organic soil is encountered during trench excavations, evaluation of need for and extent of undercut operations should be made on site by a suitably qualified geotechnical engineer.

6.3 Earthworks Operations

6.3.1 Site Preparation

Within areas of the subdivision affected by earthworks, all vegetation should be cleared. Outside the extent of the earthworks, vegetation cover should be disturbed as little as possible and reinstated wherever practical.

Topsoil should be stripped from all cut and fill areas with stripping operations being planned to extend well beyond cut and fill lines to avoid peripheral fill contamination. Stockpiles of topsoil and unsuitable materials should be sited well clear of the works on suitable areas of natural ground or removed from site.

6.3.2 Material Suitability

Earthworks operations involving borrow materials from the elevated portions of the site are likely to involve inorganic clays and silts that should be suitable for handling and compaction by conventional earthmoving plant. However, recorded soil moisture condition and elevated groundwater conditions at the site indicate that *in situ* materials are potentially significantly wet of optimum and may require conditioning prior to placement as fill.

Near-surface groundwater and wet soils can cause problems for earthmoving plant but usually the materials become suitable for inclusion in the earthworks after drying and / or mixing. It may be necessary for some drying to take place before compaction. Drying may be accomplished by taking thin cuts over broad areas, or by disking *in situ* before transportation, or by carrying out the earthworks at a relatively slow and controlled rate with minimal plant. Lime drying may also be considered where project timelines or space constraints do not accommodate conditioning of fill materials on site.

6.3.3 Benching of Slopes

All benching of slopes prior to the placement and compaction of filling should be undertaken in accordance with the normal requirements of NZS 4404 and the Auckland Council Code of Practice for Land Development and Subdivision. Benching should be the subject of engineering inspections prior to the placement of any drainage works or filling.

Shallow keyways may be required to found the toe of any fill embankments on competent ground. The requirement for keyways and associated geotechnical drainage will be assessed when the earthworks design and engineering methodology are finalised.

6.3.4 Existing Filling

Existing filling was encountered in two borehole locations. However, it is not unusual to encounter fill within farm environments which may include end-tipped soil and other materials at gully heads, offal pits, or localised fill areas associated with dwellings and farm buildings, and associated landscaping.

When encountered during site clearing works, pre-existing fill areas should be referred to the geotechnical engineer for observation and comment. If assessed to be free of significant deleterious inclusions, existing fill may be suitable with removal, conditioning, and mixing, for use in certified fills. Materials considered to be unsuitable for use will need to be cut to unsuitable stockpiles or removed from site.

6.3.5 Unsuitable Materials

All identifiable deposits of unsuitable materials including existing undocumented filling that are considered unfit for reworking should be undercut and disposed of off the site or on topsoil stockpiles if appropriate.

6.3.6 Stability of Cut and Fill Batters

Based on the existing contours across the site we anticipate that final contours will likely be formed no steeper than 1V:4H (14 degrees). Where slopes are formed steeper than this they may require drainage and/or other geotechnical considerations to ensure global stability and we should therefore be given an opportunity to review the final earthworks plans and provide comment on this.

6.4 Earthworks Specification and Compaction Control

A site specific earthworks specification including compaction control criteria should be prepared for the site by a sufficiently qualified geotechnical engineer, prior to engaging with a contractor to complete the subdivision earthworks. The specification should be prepared when the subdivision earthworks concept is finalised.

6.5 Liquefaction Potential

Soil liquefaction results from loss of strength during cyclic loading, such as imposed by earthquakes. Soils most susceptible to liquefaction are clean, loose, saturated, uniformly graded, fine-grained, cohesionless materials. Empirical evidence indicates that loose to medium dense gravel, silty sands, low-plasticity silts, and some low-plasticity clays are also potentially liquefiable.

Based on the regional setting and data collected from our investigation, we consider the potential for liquefaction at the site to be low. This is due to the highly plastic nature of the near surface subsoils (0 to 5 m depth) and the absence of saturated loose sand horizons. However, a site specific liquefaction assessment has not been undertaken at this stage and deeper soils may be more susceptible.

6.6 Assessment against RMA Section 106

Based on our desktop review and site investigation, we consider the subject site not to be subject to erosion, significant subsidence (including liquefaction), falling debris, slippage or inundation by soil or rock in accordance with the provision of Section 106 of the Resource Management Act 1991.

Further, we consider that future development of the land is not likely to accelerate, worsen or result in material damage to the land provided that proper engineering practices are followed during any development, including those recommended in this report.

7 Plan Review and Further Work

We have not yet received any current earthworks plans and so have made assumptions around the proposed works. We therefore must be given an opportunity to carry out a plan review of the final earthworks plans prior to submission for earthworks consent to ensure our assumptions are valid and that the recommendations of this report have been appropriately incorporated.

It should be noted that it was not possible to cover all proposed building lots during the site investigation work carried out for this report. Accordingly, it will be necessary, at the time of preparation of our Geotechnical Completion Report, to undertake specific site investigation work on any previously uninvestigated lots that have either been cut or not affected by the earthworks and carry out additional shrink swell testing to more accurately determine expansive site classes for the proposed lots.

Specific slope stability assessments and design will be required for finished slopes having angles greater than 1(V):4(H), and further geotechnical investigation and design may also be required for stream crossings and / or retaining structures that may be designed as the development concept progresses.

The site at 21 Gatland Road was not investigated as part of this report. Geotechnical investigation of that site is recommended prior to application for earthworks consent as the findings of that report may affect earthworks design.

8 Limitations

i. We have prepared this report in accordance with the brief as provided. This report has been prepared for the use of our client, 520 GSR Limited, their professional advisers and the relevant Territorial Authorities in relation to the specified project brief described in this report. No liability is accepted for the use of any part of the report for any other purpose or by any other person or entity.

ii. The recommendations in this report are based on the ground conditions indicated from published sources, site assessments and subsurface investigations described in this report based on accepted normal methods of site investigations. Only a limited amount of information has been collected to meet the specific financial and technical requirements of the client's brief and this report does not purport to completely describe all the site characteristics and properties. The nature and continuity of the ground between test locations has been inferred using experience and judgement and it should be appreciated that actual conditions could vary from the assumed model.

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

iv. This Limitation should be read in conjunction with the Engineering NZ/ACENZ Standard Terms of Engagement.

v. This report is not to be reproduced either wholly or in part without our prior written permission.

We trust that this information meets your current requirements. Please do not hesitate to contact the undersigned on (09) 972 2205 if you require any further information.

Report prepared by

Grant Caldwell

Engineering Geologist

Report reviewed by

Paul Fletcher, CMEngNZ (CPEng)

Associate Geotechnical Engineer

APPENDIX 1:

B&A Masterplan. Airey Consultants Preliminary Feasibility Assessment

B&A

Level 4 Old South British Building
3-13 Shortland Street, Auckland
www.barker.co.nz

INDICATIVE MASTERPLAN
520 Great South Road
B&A Ref # 17104

Scale: NTS
Drawn by: CW
Date: 06/06/2019

AIREY CONSULTANTS LTD.

PRELIMINARY ENGINEERING FEASIBILITY ASSESSMENT
FOR A 75 LOT DEVELOPMENT
AT 520 GREAT SOUTH ROAD
PAPAKURA
FOR NEWHAVEN

12530-01

February 2018

Document Control Record

GENERAL INFORMATION - Consultant

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Quality Assurance Statement	
NewHaven Property Ltd **Proposed apartment building development** 520 Great South Road, Papakura	**Prepared by:** Pieter Stellingwerf
	Reviewed by:
Project Manager: Michael Lee	**Approved for issue by:** Michael Lee

Revision Schedule					
Rev. No.	Date	Description	Prepared by	Reviewed by	Approved by

Executive Summary

This report addresses the civil engineering aspects and requirements for infrastructure for the proposed 75 Lot development at 520 Great South Road, Papakura.

The report concludes that the development can be serviced by the existing infrastructure available and the proposed infrastructure assessed within this report. The sites will be provided with stormwater, wastewater and water supply service, and will be connected to the local power and telecommunications reticulation.

Contents

1 INTRODUCTION

This feasibility assessment identifies the engineering issues related to the proposed development and highlights the civil works that will be necessary to ensure that the proposed Lots can be adequately serviced.

2 SITE DESCRIPTION

2.1 Location

The subject site is general tr8angular on shape and has an area of 30,198m^2. The site is bounded to the north by Residential Lots, a large lot and the Papakura South Cemetery, to the south east by a residential property and a garden centre and to the west by Great South Road.

2.2 Titles/Zoning

The legal description of the site is LOT 2 DP 172553. The site is zoned Future Urban Zone under the Auckland Council Unitary Plan (AUP).

2.3 Topography

The site topography generally slopes from south west to north east across the site. The ground slopes at gradients of between approximately 0% at the Great North Road side to 18% in the north east corner. The site is covered in pasture.

2.4 Geology

The GNS Science web map identifies the site is situated on Zealandia Megasequence Terrestrial and Shallow Marine Sedimentary Rocks (Neogene). These soils are typically comprised of Alluvial and colluvial gravel, sand and mud, commonly pumice-rich in central areas, with intercalated lignite or peat; locally includes non-welded ignimbrite and tephra, and, in the south and east, loess.

We note from Auckland Councils Stormwater Disposal via Soakage in the Auckland Region that there is potentially peat in the area. A separate geotechnical assessment of the site will need to be completed at resource consent stage to identify any potential design issues due to the soil structure.

Geotech for roading & ponds

3 PROPOSED DEVELOPMENT

The development proposes to construct a 75 Lot development on the site at 520 Great South Road, Papakura. The scheme plan layout for the development has been completed by Isthmus, with a network of proposed Roads and accessways to service each site of the development.

3.1 Flooding Considerations & Overland Flow Path (OLFP)

3.1.1 Flood plain and flood sensitive areas

There is a flood plan shown on the northern side of the site, which is formed as the result of the overland flow path across the site. There are no flood sensitive areas or flood prone areas identified within the site, or in the vicinity of the site.

The building platforms will be designed at levels that are significantly greater than 0.5m above the 100 year flood plain.

3.1.2 Coastal Inundation

The site is not subject to coastal inundation.

3.1.3 Overland flow paths

The mechanism of overland flow is due to the storm event exceeding the capacity of the stormwater system. Auckland Council's records identify an overland flow path to flow across the

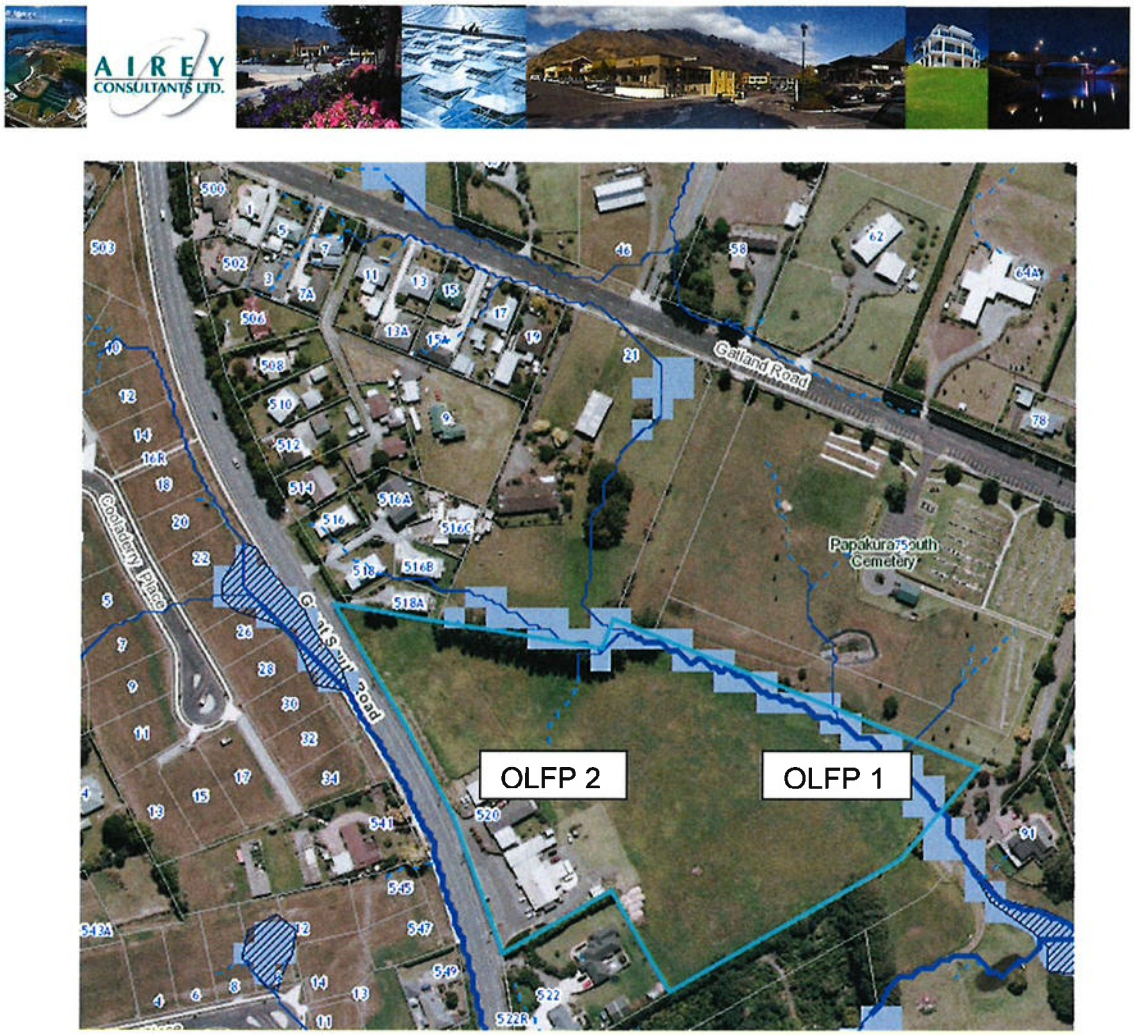
northern boundary of the site (OLFP 1), taking the flow from the residential development at the corner of Gatland Street & Great South Road, Great South Road & Gatland Street carriageway, a large lot to the north and the Papakura South Cemetery.

A second potential overland flow path (OLFP 2) is shown to originate in the site and flow to the main overland flow path on the northern boundary of the site.

The overland flow paths identified on Council records are modelled using LIDAR contours which have variable accuracy, and do not fully take into account existing structures such as buildings, fences, retaining walls, driveways etc. A site inspection was carried out by Airey Consultants to determine the presence and location of any overland flow paths located on the site. In this particular case, it was found that the overland flow path as shown on Council's records will generally flow as shown in the Council GeoMaps site with the exception of the Cemetery OLFP which is intercepted by a pond on the Cemetery site.

The proposed development will cater for the overland flow paths within the development:-
OLFP 1 – It is proposed to re-construct this overland flow path as an open grassed swale which is proposed to be re-aligned as close to the northern boundary as possible. The overland flow path will not alter the location of any overland flow entering or exiting the site.
OLFP 2 - The contributing catchment for this overland flow path is minor. Sheet flow will be directed to the proposed roading network which will act as the overland flow for this overland flow path, and will be clear of any building platforms.

The stormwater collection and mitigation will ensure there is no increase the risk of hazards to downstream properties.



3.2 Access Requirements

The proposed access to the site will be formed off Great South Road. The current speed limilt outside the applicant property is 70km/hr. The 70km/hr zone is effective for a distance of 1.2km, from the north of the applicant property at 468 Great South Road to the south at 600 Great South Road, where the road enters the Drury Township.

It is suggested that the Auckland Transport be approached to look at the feasibility to have this speed reduced to 50km/hr.

The most likely requirements from Auckland Transport for entry & exit to and from the site will be to widen the road carriageway by one lane and install a flush median. This is consistent with the other developments which access Great South Road, both in the existing 50 and 70km/hr zones.

The internal access layout has been assessed and designed by Isthmus to allow for access to each of the lots and further links to the future designated paper roads.

3.3 Earthworks

Proposed Earthworks

The sites are zoned Future Urban Zone under the Auckland Council Unitary Plan (AUP).

It is proposed that the earthworks will be undertaken as a cut to fill operation with the site. The site will be formed to accommodate the roading network and Lot layout. It is envisaged at this stage that a portion of the existing gully which conveys the overland flow path will be filled to form the overland flow path, the proposed detention pond and level the sites in the vicinity to provide better building platforms.

At this stage it is not anticipated that retaining walls will be required to form the design levels, due to the relatively shallow gradients on the bulk of the site.

The proposed earthworks generated will be of a relatively small scale but to construct the layout the area will be greater than 2,500m^2, with a volume estimated to exceed 2,500m^3. The earthworks are considered a Restricted Discretionary Activity.

3.4 Stormwater

3.4.1 Existing Stormwater

There is no public stormwater infrastructure serving the site. An open drain runs across the northern boundary of the site taking the stormwater flow from the upstream catchments which includes residential properties, large lot property, a cemetery and a portion of Great South Road carriageway.

3.4.2 Proposed Stormwater

It is proposed to re-construct and re-align the existing open drain as an open grassed swale across the northern boundary of the site to convey the stormwater flow from the upstream catchment. This swale will be located within the rear of the sites bounding the cemetery.

It is proposed that stormwater mitigation will be provided for in two formats:-

- On-site mitigation for each of the formed Lots
- Stormwater treatment and detention pond for the road and accessway network.

Stormwater reticulation will be constructed as part of the development. Each of the lots will have its own connection to the stormwater network, and due to the storage within the lot will discharge direct to the open swale. The road and accessway network will discharge separately to the stormwater treatment and detention pond.

The provision of storage within the lots and within the site will mitigate any adverse effects on the properties below the applicant site.

3.4.3 Stormwater Management - Flow

The site is not located with the Stormwater Management Area (SMA) Flow 1 or 2 overlay. The stormwater management has been assessed in accordance with the requirements Auckland Unitary Plan (AUP) section E8. Stormwater – Discharge and diversion.

The stormwater rules in Table E8.4.1 Activity table state:-
Diversion and discharge of stormwater runoff from impervious areas involving a stormwater network onto land or into water or to the coastal marine area pursuant to sections 14 and 15 of the Resource Management Act 1991 - (A11) Diversion and discharge of stormwater runoff from an existing or a new stormwater network is a Discretionary Activity.

A new stormwater network will be constructed as part of the development. The proposal is to provide stormwater mitigation on each of the individual sites of the development. These will be connected to a new stormwater network which will serve the development.

The stormwater from the roading and accessways will be collected separately and discharged to a stormwater pond which is proposed to be located at the northeast corner (low corner) of the site. This will provide detention and mitigation for all of the roading and accessways.

Stormwater Management - Quality

Stormwater quality treatment is not required for the individual lots of the development as the Lots do will not create any high contaminant yielding roofing, spouting, cladding material or architectural features. The parking and manoeuvring areas for the individual lots are not considered high contaminant generating road or parking areas.

Stormwater Quality treatment will be provided for the road and accessway network as water quality treatment portion of the proposed stormwater pond.

3.5 Wastewater

3.5.1 Existing Wastewater

There is an existing 150mm diameter public wastewater pipe located across the western (Great South Road side) of the site which serves the adjacent residential sites on the corner of Gatland Road and Great South Road.

The pipe flows south down Great South Road, receiving wastewater from the recent developments on the western side of Great South Road to a wastewater pump station in the township of Drury.

Preliminary catchment calculations show the pipe network has the capacity to accept the flows from the proposed development.

We have also contacted the asset owners Veolia Water to ascertain if they are aware of any restrictions or limitations within the downstream network which will affect the proposed development of the site, particularly as the network connects to a wastewater pump station. Veolia have verbally advised they are currently carrying out a capacity analysis of the wastewater pump station. There is a potential cost in that if the pump station does not have pump capacity or storage capacity the developer will be asked to upgrade this facility. I have asked Veolia Water to contact us as soon as they have a result.

3.5.2 Proposed Wastewater

It is proposed to re-align the existing reticulation within the site to align with the proposed roading and accessway layout. The public network will be extended to serve the remainder of the development which is able to gravity feed into the existing and proposed reticulation network.

We have looked at two options (attached) which are feasible and will provide gravity feed to varying portions of the development. One option is totally within the development but serves less lots by gravity whereas the second option uses the adjacent paper road to serve the development but serves a greater portion by gravity. The remainder of the Lots will be served by

a private low pressure wastewater system which will connect into the proposed public reticulation. A low pressure system consists of small bore polyethylene pipes welded into a fully sealed system, with a separate boundary kit provided at the connection point to serve each Lot. Each lot will have their own individual pump station chamber which will have emergency storage included along with appropriate alarm controls.

3.6 Water Supply

3.6.1 Existing Water Supply

An existing 150mmø water reticulation pipe is located in Great South Road along the length of the road frontage side of the site. There is another 150mmø water reticulation pipe located on the opposite side of Great South Road.

3.6.2 Proposed Water Supply

An extension to the existing water supply network will be required to serve the development. New 100mmØ PE water supply mains and 50mmø rider mains are able to be installed as part of the development serve each site within the development at 520 great South Road.

Auckland Council often generally require that the water supply to a development is to be constructed so it will be looped back to the existing water main or is able to be connected to future developments to form a looped network.

The layout of the water supply will follow the internal roading network. It is proposed that the water supply can be blanked of at the end of the proposed roads which can then be connected to future reticulation in the paper road network. Should Council insist on a looped system with the development, it is easy to construct a link to the Gatland Road 100mmø network.

We have contacted the asset owners Veolia Water to ascertain if they are aware of any restrictions or limitations within the public water supply network to supply water to the development. Veolia Water advise there are no restrictions to service this development.

3.6.3 Water Supply Fire Fighting

The buildings will be residential dwellings and as such the development is classified as FW2 within the New Zealand Fire Service Firefighting Water Supplies Code of Practice Table 1. The

firefighting requirements for FW2 developments consist of one fire hydrant within 135m of every dwelling and an additional hydrant within 270m of every dwelling.

There are existing hydrants located on the water mains outside the property in Great South Road. The water supply network will be extended into the site & hydrants will be installed to meet the firefighting rules.

3.7 Utilities

3.7.1 Power and Telecommunications

Power and Telecommunications service are able to be supplied to the development by connecting to the existing infrastructure located along Great South Road.

The power is by overhead supply on the property side of Great South Road and underground on the opposite side. I would be possible to underground the power reticulation along the frontage of the site following discussions with the power supplier.

Telecommunications is by underground supply along Great South Road.

4 SUMMARY

The proposal to construct a 75 Lot development at 520 Great South Road, Papakura is considered feasible from an engineering perspective through the provision of stormwater, wastewater, utilities, water supply and access in accordance with relevant Unitary Plan requirements, Engineering Standards and Construction Good Practice.

Mitigation of effects of construction and subsequent use are able to be practicably undertaken. Sediment controls can be erected to mitigate the potential adverse effects of sediment laden runoff from earthworks, which will be of a medium scale with rapid stabilisation anticipated for the development.

Construction of infrastructure for the development is feasible to serve the proposed development, with minimal adverse effects.

There will be an increase in stormwater flows from the site as a result of the proposed development and mitigation will be provided to meet the requirements of the Auckland Unitary Plan. It is proposed that stormwater mitigation will be provided for in two formats:-

- On-site mitigation for each of the formed Lots
- Stormwater treatment and detention pond for the road and accessway network.

There will be an increase wastewater flows from the site as a result of the proposed development. The existing wastewater network will be re-aligned to suit the development and gravity connection will be provided for the bulk of the individual lots. The lots which cannot be serviced by gravity reticulation are able to be serviced by wither individual Lot pumps or a private wastewater low pressure system.

Capacity checks show the existing wastewater pipes downstream of the applicant property are capable of taking the additional flows. Works will be constructed to minimise any adverse effect or disruption on any existing infrastructure. We have contacted Veolia Water to ascertain any restrictions apply to the downstream wastewater network and are awaiting a response.

Water and utility services may be provided to the development by underground means by way of connection to the existing reticulation on Great South Road.

Appendix A

Design Plans

- Plan 12530-01 SK01 – Scheme Plan Sketch Wastewater – Option 1
- Plan 12530-01 SK02 – Scheme Plan Sketch Wastewater – Option 2
- Plan 12530-01 SK03 – Scheme Plan Sketch – Stormwater Management

OPTION 1

LEGEND

PROPERTIES WILL BE SERVICED BY PUMP

PROPERTIES WILL BE GRAVITY FED

Legend

EXISTING MAJOR CONTOURS

EXISTING MINOR CONTOURS

PROPOSED PROPERTY BOUNDARIES

PROPOSED WW PIPE

No.	Revision Details (Current Revision Date : ###)	Date

Design	P.E.
Survey	AC GEOMAPS
Drawn	PE & EDG
Checked	VALUE
Date	31/01/2018
Scale	1:500 (A1) 1:1000 (A3)
CAD Filename	12530-01-SK01-PE

DRAFT

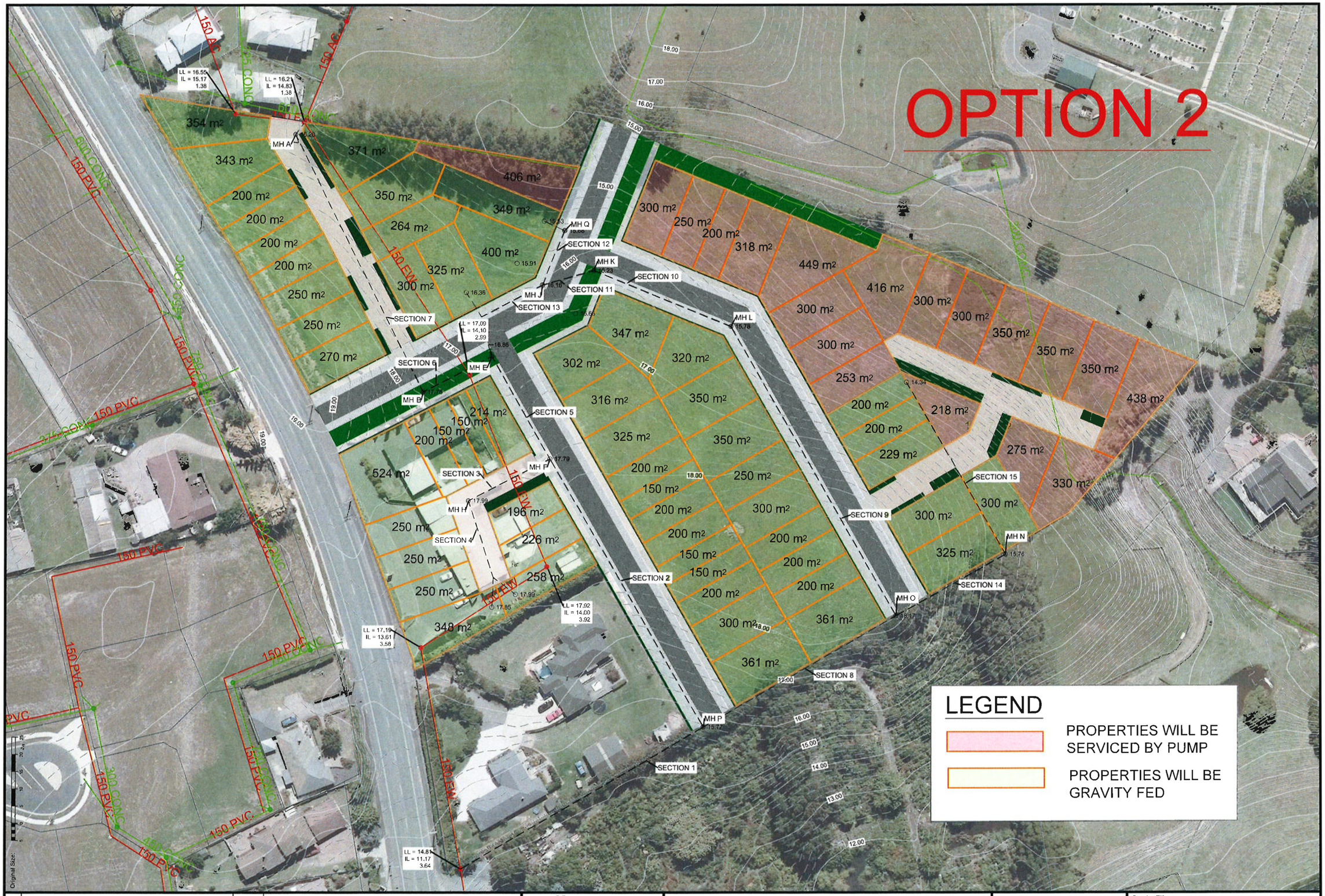
Job Title.
NEWHAVEN PROPERTY LTD
520 GREAT SOUTH ROAD
PAPAKURA
AUCKLAND 2113
LOT 2 DP 172553

AIREY CONSULTANTS LTD.
CONSULTING CIVIL & STRUCTURAL ENGINEERS
Takapuna, Pukekohe, Howick, Queenstown, Christchurch, Orewa

Drawing Title.
Scheme Plan Sketch Wastewater- Option 1

File No.	Rev.	Dwg. No.
12530-01	----	SK01

OPTION 2



No.	Revision Details (Current Revision Date : ####)	Date

Legend

- EXISTING MAJOR CONTOURS
- EXISTING MINOR CONTOURS
- PROPOSED PROPERTY BOUNDARIES
- PROPOSED WW PIPE

Design	P.E.
Survey	AC GEOMAPS
Drawn	PE & EDG
Checked	VALUE
Date	31/01/2018
Scale	1:500 (A1) 1:1000 (A3)
CAD Filename	12530-01-SK01-PE

DRAFT

Job Title.
NEWHAVEN PROPERTY LTD
520 GREAT SOUTH ROAD
PAPAKURA
AUCKLAND 2113
LOT 2 DP 172553

AIREY CONSULTANTS LTD.
CONSULTING CIVIL & STRUCTURAL ENGINEERS
Takapuna, Pukekohe, Howick, Queenstown, Christchurch, Otewa
ACENZ

Drawing Title.
Scheme Plan Sketch Wastewater - Option 2

File No.	Rev.	Dwg. No.
12530-01	----	SK02

Original Size:

No.	Revision Details (Current Revision Date : ####)	Date

Legend

EXISTING MAJOR CONTOURS
EXISTING MINOR CONTOURS
PROPOSED PROPERTY BOUNDARIES

Design	P.E.
Survey	AC GEOMAPS
Drawn	PE & EDG
Checked	VALUE
Date	02/02/2018
Scale	1:500 (A1) 1:1000 (A3)
CAD Filename	12530-01-SK01-PE

DRAFT

Job Title.
NEWHAVEN PROPERTY LTD
520 GREAT SOUTH ROAD
PAPAKURA
AUCKLAND 2113
LOT 2 DP 172553

AIREY CONSULTANTS LTD.
CONSULTING CIVIL & STRUCTURAL ENGINEERS
Takapuna, Pukekohe, Howick, Queenstown, Christchurch, Orewa

Drawing Title.
Scheme Plan Sketch - Stormwater Management

File No.	Rev.	Dwg. No.
12530-01	----	SK03

Appendix B

Stormwater Detention and Retention Calculations

- TP108 Stormwater Runoff Volume Calculations
- Pond Calculations

AIREY CONSULTANTS LTD.

ACENZ

ENGINEERING CALCULATIONS

Job: Hydraulic Neutrality Report

Location: 520 Great South Road, Papakura

Client:	NewHaven Properties
Job No:	12530/01
Date:	January 2018
Design Engineer:	PS
Checked By:	ML

Contact Phone: (09) 486 4542 **Fax:** (09) 489 5455

Email: pieters@aireys.co.nz

AIREY CONSULTANTS LTD.

CLIENT: NewHaven Properties **SHEET No.:** 1
PROJECT: 520 Great South Road, Papak **CALCS BY:** PS
JOB No.: 12530/01 **DATE:** January 2018

WORKSHEET 1: RUNOFF PARAMETERS & TIME OF CONCENTRATION

REFERENCE

ARC TP108

PRESENT CATCHMENT

Note: 3.0198ha Catchment,

1: Runoff Curve Number (CN) and Initial Abstraction (I_a)

Soil Classification	Cover Description	Connected Reticulation	Curve Number	Area (ha)	CN x Area
Waitematas, C	Paddocks	No	74	2.7078	200.38
	Existing Impermeable Areas	No	98	0.3120	30.58
			Total	3.0198	230.95

	Unconnected	Connected		
Total CN x Area	230.95	0.00		
Total Area	3.0198	0.0000	ha	
$CN_{(Weighted)}$	**76**	**0**		$= {}^{Total\ CN\ x\ Area}/_{Total\ Area}$
$I_{a\ (Weighted)}$	**4.5**	**0.0**	mm	$= {}^{5\ x\ Permeable\ Area}/_{Total\ Area}$

2: Time of Concentration

Channelisation Factor: C	**0.8**	**0.6**		*Table 4.2*
Catchment Length: L	**0.500**	**0.500**	km	*(Along drainage path)*
Catchment Slope: S_c	**0.010**	**0.010**	m/m	*(by equal area method)*
Runoff Factor: R_f	0.62	0.00		$= {}^{CN}/_{(200 - CN)}$
t_c	**0.37**	**-**	**hrs**	$= 0.14.C.L^{0.66}.R_f^{-0.55}.S_c^{-0.30}$
SCS Lag for HEC-HMS	**0.24**	**-**	**hrs**	$= {}^{2}/_{3}.t_c$
Area for HEC-HMS	**0.0302**	**-**	**km^2**	

WORKSHEET 2: GRAPHICAL PEAK FLOW RATE

REFERENCE

PRESENT CATCHMENT

ARC TP108

Note: 3.0198ha Catchment,

1: Data

		Unconnected	Connected		
Catchment Area:	**A =**	0.0302	0.0000	km^2	*From Worksheet 1*
Runoff Curve Number:	**CN =**	76	0		*From Worksheet 1*
Initial Abstraction:	I_a =	4.5	0.0	mm	*From Worksheet 1*
Time of Concentration:	t_c =	0.37	-	hrs	*From Worksheet 1*
Storage:	**S =**	78.1	0.0	mm	*= [(1000/CN)-10].25.4*

2: Peak Flow Rate and Volume

		Storm 1	Storm 2	Storm 3	Storm 4	Storm 5		
Av Recurrence Int.	**ARI =**	**2**	**10**	**EDV**	**WQV**		yr	
24hr Rainfall Depth	P_{24} =	**76**	**121**	**34.5**	**25.3333**		mm	*From TP108 Charts*
Climate Change Depth	P_{24} =	**82.8**	**137.0**	**34.5**	**27.6**		mm	*Auckland Council SW Code of Practice - Table 4.1*

Unconnected Catchment

Unconnected Index	**c* =**	**0.32**	**0.45**	**0.14**	**0.11**			*= $(P_{24}-2.I_a)/(P_{24}-2.I_a+2.S)$*
Specific Flow Rate	**q* =**	**0.069**	**0.090**	**0.033**	**0.026**			*From Fig. 5.1* ***tc = 0.37***
Peak Flow Rate	q_p =	0.174	0.373	0.035	0.022		m^3/s	*= q*.A.P_{24}*
Runoff Depth	Q_{24} =	39	83	8	5		mm	*= $(P_{24}-I_a)^2/[(P_{24}-I_a)+S)]$*
Runoff Volume	V_{24} =	1185	2517	252	160		m^3	*= 1000.Q_{24}.A*

Connected Catchment

Connected Index	**c* =**							*= $(P_{24}-2.I_a)/(P_{24}-2.I_a+2.S)$*
Specific Flow Rate	**q* =**							*From Fig. 5.1* ***tc = -***
Peak Flow Rate	q_p =						m^3/s	*= q*.A.P_{24}*
Runoff Depth	Q_{24} =						mm	*= $(P_{24}-I_a)^2/[(P_{24}-I_a)+S)]$*
Runoff Volume	V_{24} =						m^3	*= 1000.Q_{24}.A*

Total Catchment

Av Recurrence Int.	**ARI =**	**2**	**10**	**EDV**	**WQV**		yr
Peak Flow Rate	q_p =	**0.174**	**0.373**	**0.035**	**0.022**		m^3/s
Runoff Volume	V_{24} =	**1185**	**2517**	**252**	**160**		m^3

WORKSHEET 1: RUNOFF PARAMETERS & TIME OF CONCENTRATION

REFERENCE

ARC TP108

DEVELOPED CATCHMENT

Note: 3.0198ha Proposed Catchment, 20% Impermeable -

1: Runoff Curve Number (CN) and Initial Abstraction (I_a)

Soil Classification	Cover Description	Connected Reticulation	Curve Number	Area (ha)	CN x Area
Waitematas, C	Urban Grass	Yes	74	2.4878	184.10
	Proposed Impermeable Areas	Yes	98	0.6040	59.19
			Total	3.0918	243.29

	Unconnected	Connected		
Total CN x Area	0.00	243.29		
Total Area	0.0000	3.0918	ha	
$CN_{(Weighted)}$	**0**	**79**		$= {}^{Total\ CN\ x\ Area}/_{Total\ Area}$
$I_{a\ (Weighted)}$	**0.0**	**4.0**	mm	$= {}^{5\ x\ Permeable\ Area}/_{Total\ Area}$

2: Time of Concentration

Channelisation Factor: C	**0.6**	**0.6**		*Table 4.2*
Catchment Length: L	**0.500**	**0.500**	km	*(Along drainage path)*
Catchment Slope: S_c	**0.010**	**0.010**	m/m	*(by equal area method)*
Runoff Factor: R_f	0.00	0.65		$= {}^{CN}/_{(200 - CN)}$
t_c	-	**0.27**	**hrs**	$= 0.14.C.L^{0.66}.R_f^{-0.55}.S_c^{-0.30}$
SCS Lag for HEC-HMS	-	**0.18**	**hrs**	$= {}^{2}/_{3}\, t_c$
Area for HEC-HMS	-	**0.0309**	**km^2**	

WORKSHEET 2: GRAPHICAL PEAK FLOW RATE

REFERENCE

DEVELOPED CATCHMENT

ARC TP108

Note: 3.0198ha Proposed Catchment, 20% Impermeable - all

1: Data

		Unconnected	Connected		
Catchment Area:	**A =**	0.0000	0.0309	km^2	*From Worksheet 1*
Runoff Curve Number:	**CN =**	0	79		*From Worksheet 1*
Initial Abstraction:	**I_a =**	0.0	4.0	mm	*From Worksheet 1*
Time of Concentration:	**t_c =**	-	0.27	hrs	*From Worksheet 1*
Storage:	**S =**	0.0	68.8	mm	*= [(1000/CN)-10].25.4*

2: Peak Flow Rate and Volume

		Storm 1	Storm 2	Storm 3	Storm 4	Storm 5		
Av Recurrence Int.	**ARI =**	2	10	EDV	WQV		yr	
24hr Rainfall Depth	**P_{24} =**	82.8	137.0	34.5	27.6		mm	*From TP108 Charts*

Unconnected Catchment

Unconnected Index	**c* =**							*= $(P_{24}-2.I_a)/(P_{24}-2.I_a+2.S)$*
Specific Flow Rate	**q* =**							*From Fig. 5.1* **tc = -**
Peak Flow Rate	**q_p =**						m^3/s	*= $q^*.A.P_{24}$*
Runoff Depth	**Q_{24} =**						mm	*= $(P_{24}-I_a)^2/[(P_{24}-I_a)+S)]$*
Runoff Volume	**V_{24} =**						m^3	*= $1000.Q_{24}.A$*

Connected Catchment

Connected Index	**c* =**	**0.35**	**0.48**	**0.16**	**0.12**			*= $(P_{24}-2.I_a)/(P_{24}-2.I_a+2.S)$*
Specific Flow Rate	**q* =**	**0.084**	**0.106**	**0.043**	**0.034**			*From Fig. 5.1* **tc = 0.27**
Peak Flow Rate	**q_p =**	0.215	0.451	0.046	0.029		m^3/s	*= $q^*.A.P_{24}$*
Runoff Depth	**Q_{24} =**	42	88	9	6		mm	*= $(P_{24}-I_a)^2/[(P_{24}-I_a)+S)]$*
Runoff Volume	**V_{24} =**	1301	2709	289	186		m^3	*= $1000.Q_{24}.A$*

Total Catchment

Av Recurrence Int.	**ARI =**	**2**	**10**	**EDV**	**WQV**		yr
Peak Flow Rate	**q_p =**	**0.215**	**0.451**	**0.046**	**0.029**		m^3/s
Runoff Volume	**V_{24} =**	**1301**	**2709**	**289**	**186**		m^3

HYDRAULIC NEUTRALITY REPORT SUMMARY

REFERENCE

PRESENT - DEVELOPED SUMMARY

1: Data

		Catchment Area	
Present:	**A =**	3.0198	ha
Developed:	**A =**	3.0918	ha
Percentage Difference		102%	
Difference:	**A =**	0.0720	ha

		% Impermeable
Present:	**A =**	10%
Developed:	**A =**	20%

		Storm 1	Storm 2	Storm 3	Storm 4	Storm 5	
Av Recurrence Int.	ARI =	2	10	EDV	WQV		yr
24hr Rainfall Depth	P_{24} =	82.8	137.0	34.5	27.6		mm

2: Peak Flow Rate Summary

Av Recurrence Int.	**ARI =**	**2**	**10**	**EDV**	**WQV**		yr
Present Peak Flow	q_p =	0.174	0.373	0.035	0.022		m^3/s
Developed Peak Flow	q_p =	0.215	0.451	0.046	0.029		m^3/s
Percentage Difference		**124%**	**121%**	**131%**	**133%**		
Peak Flow Difference	**q =**	**0.041**	**0.077**	**0.011**	**0.007**		m^3/s

3: Runoff Volume Summary

Av Recurrence Int.	**ARI =**	**2**	**10**	**EDV**	**WQV**		yr
Present Volume	V_{24} =	1185	2517	252	160		m^3
Developed Volume	V_{24} =	1301	2709	289	186		m^3
Percentage Difference		**110%**	**108%**	**115%**	**117%**		
Volume Difference	**V =**	**116**	**192**	**38**	**27**		m^3

AIREY CONSULTANTS LTD.

CLIENT: NewHaven Properties Ltd | **SHEET No.: 1**
PROJECT: 520 Great South Road. Papakura | **CALCS. BY: PS**
JOB No.: 12503/01 | **DATE: Jan 2018**

WQV & DETENTION POND CALCULATIONS - RECTANGULAR

REFERENCE

Pond Characteristics

WQV	**27**	m^3	*From TP108 Calculation*
Volume Required	14	m^3	*WQV/2 for Ex Detention*
Side Slope 1:	**3.5**		
Dimension Ratio	**1**	Wide	
	8.65	Long	

Pond Design Volume

Depth	**0.1**	m	
Surface Width	**4.1**	m Wide	
Surface Length	35.9	m Long	
Surface Area	149	m^2	
Base Width	**3.4**	**m Wide**	**OK**
Base Length	**35.2**	**m Long**	**OK**
Base Area	121	m^2	
Design Volume	**14**	**m^3**	**OK**

Extended Detention

Volume Required	**38**	m^3	*From TP108 Calculation*
Depth above WQV Req'd	**0.21**	m	
Base Width	4.1	m	
Base Length	35.9	m	
Surface Width	5.6	m	
Surface Length	37.4	m	
Design Volume	**38**	**m^3**	**OK**

Orifice Diameter	**30**	mm	
Orifice Area	0.00072	m^2	
Average Flow Q_{avg}	0.000	m^3/s	
Max Flow Q_{max}	0.001	m^3/s	
Design Flow Qi	**0.001**	**m^3/s**	**OK**

WQV & DETENTION POND CALCULATIONS - RECTANGULAR

REFERENCE

2 Year Detention

Volume Required	**116**	m^3		*From TP108 Calculation*
Depth above WQV Req'd	**0.51**	m		
Base Width	4.1	m		
Base Length	35.9	m		
Surface Width	7.7	m		
Surface Length	39.5	m		
Design Volume	**116**	**m^3**	**OK**	

10 Year Detention

Volume Required	**192**	m^3		*From TP108 Calculation*
Depth above WQV Req'd	**0.73**	m		
Base Width	4.1	m		
Base Length	35.9	m		
Surface Width	9.2	m		
Surface Length	41.0	m		
Design Volume	**192**	**m^3**	**OK**	

Check Flows

2 Year Outlet Type	**Orifice**			
2 Year Max Discharge	**0.118**	m^3/s		*From TP108 Calculation*
Max. Flow from Ex Detn Orifice	0.001	m^3/s		
2 Year Orifice Diameter	**50**	mm		*Use 0 if no Orifice*
2 Year Orifice Invert	0.21	m		
Total 2 Year Discharge	**0.004**	**m^3/s**	**OK**	

10 Year Max Discharge	**0.249**	m^3/s		*From TP108 Calculation*
Max. Flow from Previous Outfalls	0.005	m^3/s		
Weir Depth	0.217	m		
10 Year Weir Width Required	**1.4**	**m**		

Pond Design Details

Pond Freeboard	**0.3**	m	
Total Depth	**1.1**	**m**	
Total Width	**11.3**	**m**	
Total Length	**43.1**	**m**	
Total Area	**489**	**m^2**	
Total Volume	**344**	**m^3**	

Appendix C

Wastewater Capacity Analysis

- Wastewater Flow and Capacity Calculations for the critical 150mmø pipe

Pre Development · 111 + 25 + 2 + 20 = 158 lots = 8.2 l/s.

Post Development 158 + 75 = 233 lots. = 12.1 l/s.

Pipe Capacity (GIS) · OK.

upstream MH IL = 5.70

downstream MH IL = 5.36

0.34m Distance = 36.1m ⇒ Pipe 0.94% · ⇒ Pipe Capacity 17.2 l/s

AIREY CONSULTANTS LTD.	Consulting Civil and Structural Engineers	Client: Newhaven Property Ltd		Sheet No: 1
		Job: 520 Great South Road Papakura		Job No: 12530/01
Pukekohe Waiuku Takapuna Howick Orewa		Calc's By: PS Checked: ML	Phone: (09) 4864542	Date: Jan-18

Watercare Code of Practice Wastewater Flow Calculations

PRE-DEVELOPMENT

Enter Values
Result Cells

1. Occupany Allowance

Number of dwellings	=	158
Watercare Design Occupancy (per dwelling)	=	3
Total occupancy for design purposes	=	474

2. Residential Wastewater Flows

Peak Wet Weather Flow (PWWF) (Litres/Person/Day)	=	1500
Residential Wastewater Design Flow (Litres/sec)	=	8.23

3. Commercial, Industrial or CBD Wastewater Design Flows

Design Flow (Litres/second/hectare)	=	0.4	Table 5.1 Watercare CoP
Commercial Floor Area (m^2)	=	0	
Commercial Wastewater Design Flow (Litres/sec)	=	0.00	
Total Wastewater Design Flow (Litres/sec)	=	8.23	

PIPE CAPACITY FORMULA

Colebrook-White $V=-2\sqrt{(2gDS)}\log(ks/3.7D+2.51\upsilon/(D\sqrt{(2gDS)}))$

υ= 1.141 $\times 10^{-6}$ kinematic viscosity of fluid (water at 15 degrees)

k_s= 0.6 mm (effective roughness)

D= diameter

S= hydraulic gradient

R= d/4 (circ. pipes)

Q= VA

Pipe Grade S(%)	Pipe Dia D (mm)	Pipe Vel'y (m/s)	PIPE CAP'Y (l/s)	DESIGN FLOW (l/s)
0.94	150	0.97	17.2	8.23

Notes:

1) Grade calculated from GIS.

AIREY CONSULTANTS LTD. Consulting Civil and Structural Engineers Pukekohe Waiuku Takapuna Howick Orewa	Client: Newhaven Property Ltd	Sheet No: 1
	Job: 520 Great South Road Papakura	Job No: 12530/01
	Calc's By: PS Phone: (09) 4864542 Checked:	Date: Jan-18

Watercare Code of Practice Wastewater Flow Calculations

POST-DEVELOPMENT

Enter Values
Result Cells

1. Occupany Allowance

Number of dwellings	=	233
Watercare Design Occupancy (per dwelling)	=	3
Total occupancy for design purposes	=	699

2. Residential Wastewater Flows

Peak Wet Weather Flow (PWWF) (Litres/Person/Day)	=	1500
Residential Wastewater Design Flow (Litres/sec)	=	12.14

3. Commercial, Industrial or CBD Wastewater Design Flows

Design Flow (Litres/second/hectare)	=	0.4	Table 5.1 Watercare CoP
Commercial Floor Area (m²)	=	0	
Commercial Wastewater Design Flow (Litres/sec)	=	0.00	
Total Wastewater Design Flow (Litres/sec)	=	12.14	

PIPE CAPACITY FORMULA

Colebrook-White $V=-2\sqrt{(2gDS)}\log(ks/3.7D+2.51\upsilon/(D\sqrt{(2gDS)}))$

υ= 1.141 $\times 10^{6}$ kinematic viscosity of fluid (water at 15 degrees)

k_s= 0.6 mm (effective roughness)

D= diameter

S= hydraulic gradient

R= d/4 (circ. pipes)

Q= VA

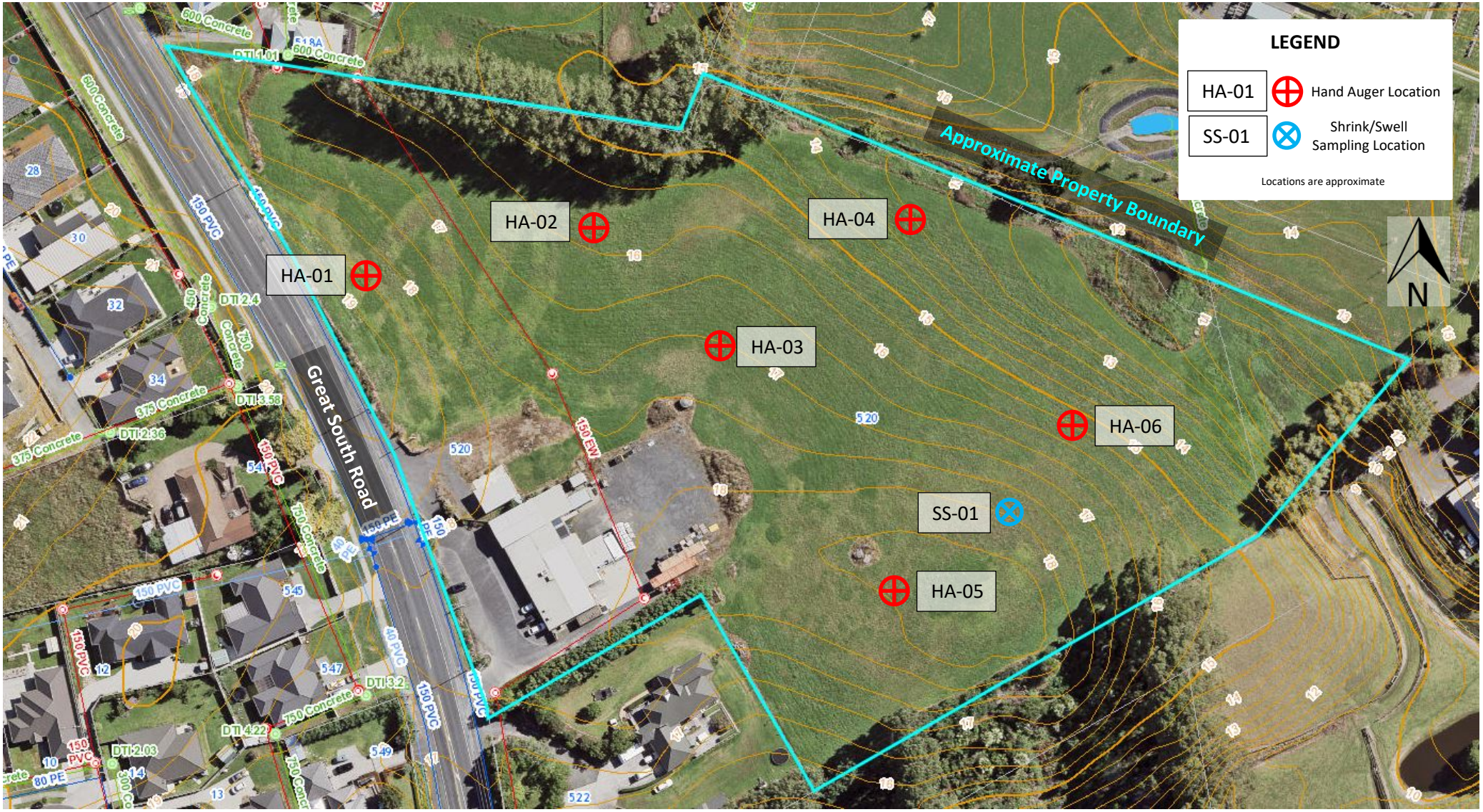
Pipe Grade S(%)	Pipe Dia D (mm)	Pipe Vel'y (m/s)	PIPE CAP'Y (l/s)	DESIGN FLOW (l/s)
0.94	150	0.97	17.2	12.14

Notes:

1) Grade calculated from GIS.

APPENDIX 2:

Investigation Location Plan



ENGEO
Expect Excellence

Title: Investigation Location Plan

Client: 520 GSR Limited

Project: 520 Great South Road, Papakura, Auckland

Designed: GC
Drawn: GC
Checked: DT
Date: 04/03/2019

Project No: 15932.000.000

Not to Scale

Figure No: 1

Size: A4

Revision: 0

APPENDIX 3:

Hand Auger Investigation Logs

LOG OF HAND AUGER HA01

ENGEO Expect Excellence

Geotechnical Investigation
520 Great South Road
Papakura, Auckland

Client : 520 Great South Road LTD
Client Ref. : 15932.000.000
Date : 21/03/2019
Hole Depth : 5 m
Hole Diameter : 50 mm
Shear Vane No : 2182
Logged By : GC
Reviewed By : NB
Latitude : -37.088867
Longitude : 174.944065

Depth (m)	Material	USCS Symbol	DESCRIPTION	Graphic Symbol	Water Level	Moisture Cond.	Consistency/ Density Index	Shear Vane Undrained Shear Strength (kPa) Peak/Remolded	Notes/Remarks
	TS	ML	Topsoil.				NA		
	FILL	ML	Clayey SILT with minor fine to coarse sand, trace gravel and organics; intermixed dark brown, light brown and black. Low plasticity [FILL].				H	200+	
0.5	PUKETOKA FORMATION	ML	Clayey SILT with minor fine to coarse sand; light brown with light grey and orange streaks. Low plasticity.			M	H	200+	
1.0								200+	
			Becomes moderately plastic from 1.3 m depth.					200+	
1.5							VSt	176/66	
								191/88	
2.0		CH	Silty CLAY with minor fine to coarse sand; light grey with grey, light brown and orange streaks. High plasticity.			W	VSt	122/72	
			At 2.2 m depth encountered silty CLAY; becomes light grey with orange brown streaks. High plasticity.					138/60	
2.5								135/78	
			Becomes moist, grey with blue grey and orange streaks from 2.8 m depth.			M		185/128	
3.0								176/100	
								188/125	
3.5			Encountered minor fine to coarse sand from 3.5 m depth.					154/66	
			Encountered trace sand from 3.8 m depth.					160/72	
4.0					▼				
4.5		ML	Fine to coarse sandy SILT with trace fine gravel; light grey with white mottles. Low plasticity.			W	VSt	103/34	
		CH	Silty CLAY; brown. High plasticity.			M	VSt	160/78	
5.0			End of Hole Depth: 5 m Termination Condition: Target depth						

Hand auger met target depth at 5 m.
NA = Not Assessed
Dip test showed standing water at 4.2 m.

GEOTECH HAND AUGER - NO SCALA HAS PRE REVIEW_LA.GPJ NZ DATA TEMPLATE 2.GDT 2/4/19

LOG OF HAND AUGER HA02

Geotechnical Investigation
520 Great South Road
Papakura, Auckland

Client : 520 Great South Road LTD
Client Ref. : 15932.000.000
Date : 21/03/2019
Hole Depth : 4.2 m
Hole Diameter : 50 mm
Shear Vane No : 2556
Logged By : LA
Reviewed By : GC
Latitude : -37.088804
Longitude : 174.944586

Depth (m)	Material	USCS Symbol	DESCRIPTION	Graphic Symbol	Water Level	Moisture Cond.	Consistency/ Density Index	Shear Vane Undrained Shear Strength (kPa) Peak/Remolded	Notes/Remarks
0.0	TOPSOIL	ML	Topsoil.			D	H	UTP	
0.5	FILL	ML	Clayey SILT; intermixed light grey brown, brown and dark brown. Low plasticity [FILL].				H	200+	
1.0	PUKETOKA FORMATION	CH	CLAY; light grey with orange streaks. High plasticity.			M	H	200+	
1.5		CH	Silty CLAY; grey with orange streaks. High plasticity. Becomes grey from 1.5 m depth.		▼		VSt	195/62 125/27	
2.0		ML	Clayey SILT; light brown. Low plasticity. Becomes saturated from 2.0 m depth.			W	VSt	103/15 133/63	
2.5		CH	CLAY; light grey with orange streaks. High plasticity. Becomes with white streaks from 2.5 m depth.				St	99/37 96/37	
3.0		CH	Silty CLAY; light yellow brown. High plasticity. Becomes intermixed dark brown, orange and white from 3.2 m depth.				St	89/34 56/22	
3.5		OL	Organic SILT; dark brown with black streaks. Low plasticity.			S	St	66/34 59/30	
4.0			End of Hole Depth: 4.2 m Termination Condition: Practical refusal						
4.5									
5.0									

Hand auger met practical refusal at 4.2 m depth due to poor recovery.

Dip test showed standing water at 1.7 m.

LOG OF HAND AUGER HA03

Geotechnical Investigation
520 Great South Road
Papakura, Auckland

Client : 520 Great South Road LTD
Client Ref. : 15932.000.000
Date : 21/03/2019
Hole Depth : 5 m
Hole Diameter : 50 mm
Shear Vane No : 2556
Logged By : LA
Reviewed By : GC
Latitude : -37.089075
Longitude : 174.945034

Depth (m)	Material	USCS Symbol	DESCRIPTION	Graphic Symbol	Water Level	Moisture Cond.	Consistency/ Density Index	Shear Vane Undrained Shear Strength (kPa) Peak/Remolded	Notes/Remarks
	TOPSOIL	ML	Topsoil.			D	VSt	184/37	
0.5	PUKETOKA FORMATION	ML	Clayey SILT; light orange brown. Low plasticity.				H	200+	
1.0								200+	
		CH	Silty CLAY; light orange brown. High plasticity. Becomes with grey and orange streaks from 1.5 m depth.				VSt - H	200+	
1.5								170/81	
		CH	CLAY; grey with orange and red streaks. High plasticity.				VSt	177/96	
2.0								158/77	
							H	200+	
2.5						M	VSt	145/74	
3.0		ML	Clayey SILT; light brown with grey and orange streaks. Low plasticity.				VSt	177/66	
								192/44	
3.5							St	96/44	
								66/30	
4.0					▼			74/37	
4.5								71/35	
								89/44	
5.0			End of Hole Depth: 5 m Termination Condition: Target depth						

Hand auger met target depth at 5 m.

Dip test showed standing water at 4.1 m.

LOG OF HAND AUGER HA04

ENGEO Expect Excellence

Geotechnical Investigation
520 Great South Road
Papakura, Auckland

Client : 520 Great South Road LTD
Client Ref. : 15932.000.000
Date : 21/03/2019
Hole Depth : 5 m
Hole Diameter : 50 mm
Shear Vane No : 2182
Logged By : GC
Reviewed By : NB
Latitude : -37.088905
Longitude : 174.94551

Depth (m)	Material	USCS Symbol	DESCRIPTION	Graphic Symbol	Water Level	Moisture Cond.	Consistency/ Density Index	Shear Vane Undrained Shear Strength (kPa) Peak/Remolded	Notes/Remarks
	TOPSOIL	ML	Topsoil.			D	H	200+	
0.5	PUKETOKA FORMATION	ML	Clayey SILT with minor fine to coarse sand; light brown with light grey, orange and grey streaks. Low plasticity.				H	200+	
1.0								200+	
		CH	Silty CLAY with trace sand; light grey with orange and light brown streaks. Low plasticity.			M	VSt	188/81	
1.5			Becomes light brown with orange streaks from 1.4 m depth.					113/66	
							St	100/34	
2.0								97/34	
		CH	Silty CLAY; light brown with orange streaks. High plasticity.			W	St	60/25	
2.5		ML	Clayey SILT; light brown. Low plasticity.		▼	S	F	47/28	
								47/28	
3.0							St	72/22	
3.5		ML	Sandy SILT with some fine to medium gravel; Light brown with orange brown mottles. Low plasticity.				VSt - H	200+	
								188/34	
4.0		ML	Clayey SILT with minor fine to medium sand; dark grey. Low plasticity.			M	H	200+	
4.5								200+	
		SM	Silty fine to coarse SAND; grey with dark grey mottles.				H	200+	
5.0			End of Hole Depth: 5 m Termination Condition: Target depth						

Hand auger met target depth at 5 m.

Dip test showed standing water at 2.8 m.

LOG OF HAND AUGER HA05

Geotechnical Investigation
520 Great South Road
Papakura, Auckland

Client : 520 Great South Road LTD
Client Ref. : 15932.000.000
Date : 21/03/2019
Hole Depth : 5 m
Hole Diameter : 50 mm
Shear Vane No : 2556
Logged By : LA
Reviewed By : GC
Latitude : -37.089533
Longitude : 174.945437

Depth (m)	Material	USCS Symbol	DESCRIPTION	Graphic Symbol	Water Level	Moisture Cond.	Consistency/ Density Index	Shear Vane Undrained Shear Strength (kPa) Peak/Remolded	Notes/Remarks
	TOPSOIL	ML	Topsoil.			D	H	UTP	
0.5	PUKETOKA FORMATION	ML	Clayey SILT; light orange brown. Low plasticity.				H	200+	
								200+	
1.0		CH	Silty CLAY ; light brown with grey streaks. High plasticity.				H	200+	
1.5			Becomes with grey and orange streaks from 1.4 m depth.			M		200+	
		CH	CLAY grey with orange streaks. High plasticity.				H	200+	
2.0			Becomes with orange and red streaks from 2.2 m depth.					200+	
2.5							VSt	155/74	
		ML	Clayey SILT; pale grey with red streaks. Low plasticity.				VSt	148/66	
3.0								133/59	
								69/30	
3.5			Becomes pink from 3.5 m depth.				St	89/50	
						W	VSt	118/81	
4.0		CH	CLAY; yellowish orange. High plasticity.				H	200+	
4.5								200+	
								200+	
5.0			End of Hole Depth: 5 m Termination Condition: Target depth						

Hand auger met target depth at 5 m.

Standing groundwater was not encountered

LOG OF HAND AUGER HA06

Geotechnical Investigation
520 Great South Road
Papakura, Auckland

Client : 520 Great South Road LTD
Client Ref. : 15932.000.000
Date : 21/03/2019
Hole Depth : 5 m
Hole Diameter : 50 mm
Shear Vane No : 2182
Logged By : GC
Reviewed By : NB
Latitude : -37.08921
Longitude : 174.946032

Depth (m)	Material	USCS Symbol	DESCRIPTION	Graphic Symbol	Water Level	Moisture Cond.	Consistency/ Density Index	Shear Vane Undrained Shear Strength (kPa) Peak/Remolded	Notes/Remarks
0	TS	ML	Topsoil.			D	NA		
	PUKETOKA FORMATION	ML	Fine to coarse sandy SILT; light brown with orange and light grey mottles. Low plasticity.				H	200+	
0.5		CH	Silty CLAY; grey with red streaks. Moderate plasticity.				H	UTP	
1.0								200+	
								200+	
1.5			Encountered high plasticity, becomes light grey with red and orange streaks from 1.4 m depth.			M	VSt	141/75	
								113/78	
2.0							St	97/47	
			Becomes wet, light grey with light orange brown streaks from 2.2 m depth.					91/34	
2.5						W		72/41	
3.0								91/31	
		ML	Clayey SILT; light brown with light grey streaks. Low plasticity.				St	75/31	
3.5							VSt	122/31	
								125/34	
4.0			Becomes brown with light brown and light grey streaks from 4 m depth.			S		122/41	
4.5		ML	Clayey SILT with some fine to coarse sand; dark grey, Low plasticity.		▼		VSt	169/60	
								128/50	
5.0			End of Hole Depth: 5 m Termination Condition: Target depth						

Hand auger met target depth at 5 m.
NA = Not Assessed
Dip test showed standing water at 4.6 m.

APPENDIX 4:

Laboratory Testing

Babbage Geotechnical Laboratory
Level 4
68 Beach Road
Auckland 1010
P O Box 2027
New Zealand
Telephone 64-9-367 4954
E-mail wec@babbage.co.nz

Please reply to: W.E. Campton

ENGEO LTD.
PO Box 33-1527
Takapuna
Auckland 0740

Attention: **GRANT CALDWELL**

Job Number: 61628#L
BGL Registration Number: 2543
Checked by: WEC

1st April 2019

SHRINK-SWELL INDEX TESTING

Dear Sir,

Re: 520 GREAT SOUTH ROAD, PAPAKURA

Report Number: 61628#L/520 GSR Shrink-swell Index

Borehole No: HA-05 **Sample No: TUBE** **Depth: 0.40 – 0.70m**

The following report presents the results of Shrink-swell Index testing at BGL of a 60mm diameter undisturbed push-tube soil sample delivered to this laboratory on the 22nd of March 2019. The test standards used were:

Water Content:	NZS4402:1986:Test 2.1
Sampling Tube *in situ* Density:	NZS4402:1986:Test 5.1.3
Shrink-swell Index:	AS1289:Test 7.1.1 - 2003

SHRINK-SWELL TEST RESULTS	
Sample Identification	**HA-05 / 0.40 – 0.70m**
SWELL TEST	
Initial Water Content	**25.7 %**
Initial Bulk Density	**1.88 t/m^3**
Initial Dry Density	**1.50 t/m^3**
Initial Air Voids	**5.5 %**
Total Swell	**0.2 mm**
SWELLING STRAIN	**1.0 %**

BGL
Babbage Geotechnical Laboratory

SHRINK-SWELL TEST RESULTS	
Sample Identification	**HA-05 / 0.40 – 0.70m**
SHRINKAGE TEST	
Water Content	**24.2 %**
Initial Bulk Density	**1.86 t/m^3**
Initial Dry Density	**1.50 t/m^3**
Initial Air Voids	**7.0 %**
Total Shrinkage	**3.0 mm**
SHRINKAGE STRAIN	**3.3 %**
SHRINK-SWELL INDEX	**2.1%**

Sample Description (*not part of BGL IANZ Accreditation*)

HA-05 / **TUBE** / **0.40 – 0.70m:** CLAY, silty, hard, slightly to moderately plastic, mottled brown & dark brown, dry.

As per the reporting requirements of AS1289: Test 7.1.1 – 2003: the shrink-swell index value has been reported to the nearest 0.1%. As per the reporting requirements of NZS4402: 1986: Test 2.1: water content is reported to two significant figures for values below 10%, and to three significant figures for values of 10% or greater. As per the reporting requirements of NZS4402: 1986: Test 5.1.3: sampling tube density, all density values have been reported to the nearest 0.02t/m^3 and air voids have been reported to two significant figures.

For calculating the air voids percentages a solid density of 2.65t/m^3 was assumed for these tests. Note that this assumed value is not part of the IANZ endorsement for this report.

Please note that the test results relate only to the sample as-received, and relate only to the sample under test. Thank you for the opportunity to carry out this testing. If you have any queries regarding the content of this report please contact the person authorising this report below at your convenience.

Yours faithfully,

Justin Franklin
Signatory (Assistant Laboratory Manager)
Babbage Geotechnical Laboratory

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