APPENDIX J

Stormwater Assessment

Connell Wagner Limited
Level 4, Torrens House
195 Hereford Street
Christchurch 8140 New Zealand

Telephone: +64 3 366 0821
Facsimile: +64 3 379 6955
Email: cwchc@conwag.com
www.conwag.com

Prebbleton District Plan Change Application

Servicing Report

M and N Coffey and William Blake Ltd

1 October 2008
Reference P29731-003
Revision 4

Connell Wagner

Document Control

Connell Wagner

Document ID: P:\29731\003-CIVIL\DOCS\REPORT REV4\DISTRICT PLAN CHANGE APPLICATION - REV4.DOC

Rev No	Date	Revision Details	Typist	Author	Verifier	Approver
1	19/12/2007	Draft	TU	TU	MCD	MDF
2	21/1/2008	Final	TU	TU	MCD	MDF
3	10/4/2008	Final Including SDC Amendments	TU	TU	MCD	MDF
4	01/10/2008	Final including response to Council's S.92 request for further information	MS	MS		

Contents

1. Introduction

1.1 General

M and N Coffey and William Blake Ltd have engaged Connell Wagner to undertake a servicing feasibility study to support their application for a change to the Selwyn District Plan. The proposal will see the re-zoning of Part Lot 4 DP24908 (9.1940 ha), Lot 105 DP331951 (8.4515 ha) and Lot 4 DP8147 (1.2131ha), combined area of 18.8586 ha of rural land west of Prebbleton township for residential development purposes. Refer to the locality plan in ***Appendix A***.

This report investigates the following servicing issues:

- Wastewater Disposal
- Stormwater Management
- Water Supply

Information has been drawn from the Selwyn District Council (SDC), site investigations and experience gained from recent developments on neighbouring land.

1.2 Background

Preliminary site investigation work was undertaken by Connell Wagner during August 2007. The investigation included a site walkover, a topographic survey and subsurface geotechnical investigation.

General Layout
The site is irregular shaped and becomes narrower in the north. It is orientated in a northeast-southwest direction.

The site is bounded to the northeast by Blakes Road, to the east and south east by residential areas and to north and southwest by trees and pasture.

Access to site is via Cairnbrae Drive in the south east or via Blakes Road in the northeast.

Existing Use
The site is covered with grass and is currently used for grazing. A dry watercourse, previously used to convey irrigation water is located between the two properties. A small area of fill is located at the termination of Cairnbrae Drive.

Refer to ***Appendix E*** for site photographs.

Topography

The site is relatively flat with a slight fall towards the south east. The general grade of the site is approximately 0.5% (1:200).

Geotechnical Investigation

A geotechnical investigation was carried out on the site in early September 2007. The investigation included a walk over and test pitting in key locations to provide information on the underlying soil conditions. The geotechnical report has been included as ***Appendix B***. A summary of the results is as follows:

The following geological model has been inferred for the centre of the site:

- 300mm Topsoil overlying,
- 1700mm to 2000mm of Sandy SILT overlying,
- Sandy GRAVEL to depth

The following geological model has been inferred for the northern part of the site:

- 200mm Topsoil overlying,
- 2000mm Sandy SILT overlying,
- Silty SAND to depth

Groundwater

Well logs from the Environment Canterbury (ECan) database indicate that the depth to groundwater in the Prebbleton area is approximately 5m – 6m. This depth is expected to vary seasonally and annually.

The proposed rezoning area does not fall within the Christchurch Groundwater Recharge Zone.

Distance to Existing Wells

The nearest community supply well (M36/7504 - CRC050497) is approximately 530m across the peizometric contour gradient as described by the ECan database. Another community water supply well (M36/0870 - CRC010900) is approximately 915m south east (down peizometric gradient) of the site.

Both of the community supply bores are greater than 30m in depth, therefore the site does not currently fall within a theoretical Community Drinking Water Supply Protection Zone when plotted in accordance with the Proposed Natural Resources Regional Plan (PNRRP).

The proposed development currently has separation distances greater than 50m in the expected direction of groundwater flow from any known legally established existing wells. A separation distance of 50m between existing private wells and discharges to ground is generally used by ECan to trigger additional resource consent requirements.

2. Sewerage Reticulation

2.1 Outline Development Plan Servicing

Prebbleton has 906 permitted sewer connections which discharge to the CCC sewerage reticulation. These connections have all been allocated therefore this scheme is therefore effectively closed to further connections.

The SDC is in the process of developing and adopting a Wastewater Strategy for Prebbleton and other surrounding smaller townships within its District.

2.2 Design Flows

The proposed plan change includes re-zoning the area to cater for approximately 210 residential properties.

The Christchurch City Council Infrastructure Design Standard (Draft 2007) sets the following minimum design criteria for the design of sewerage reticulation.

Table 1 - Sewage Design Flows

Residential Sewer flows	220 l/s
Assuming population per lot	2.7 Persons/Lot
Total Lots	210 Lots
Peak to average ratio	2.5
Dilution from infiltration and inflow ratio	2.0

Average Sewer Flow *=210 Lots x 2.7 Persons/Lot x 220 l/s/Person*
=124,740 l/day
=1.44 l/s

Maximum Sewer Flow *=1.44 l/s x 2.5 x 2.0*
=7.22 l/s

The development area has three possible connection points, being William Street, Cairnbrae Drive and the Warratah Park subdivision, to the existing SDC reticulated sewer system. SDC have indicated that a new sewerage pump station to convey sewage to the Rolleston sewage treatment plant is likely to be located near Trents Road.

2.3 Physical Constraints

A preliminary reticulation plan has been prepared based on the proposed road layout for the area. A topographic survey of the site was undertaken and preliminary road levels estimated with consideration to sewage disposal.

The design criteria used in developing the sewer plan were:

- 1 in 250 grade for 225 dia mains
- 1 in 160 grade for 150mm dia mains
- 1 in 100 minimum grade for 100mm dia laterals

The preliminary sewerage layout is detailed in the Preliminary Service Plan included in ***Appendix C***.

Assuming the topography of the site remains relatively unchanged following development, the subdivision can be serviced under gravity provided a trunk pipe is laid along the eastern boundary of

the development area. For the purposes of determining the gravity sewer layout, it has been assumed that the development can connect to William Street, Cairnbrae Drive and Warratah Park.

Following detailed design and confirmation of sewage pipe easements, some sections to the east of the site may be required to pump sewage from a holding tank to enter the gravity sewage reticulation.

2.4 Staging of construction

It should be noted that if development is only undertaken on the William Blake Limited land or if this land is developed before the Coffey land, the proposed wastewater reticulation network will need to enable connection to the existing SDC reticulation network on Cairnbrae Drive or in the Warratah Park subdivision. This may require the construction of a wastewater pumping station, or for easements through the Coffey land for the extension of gravity sewer reticulation.

2.5 Additional Infrastructure Requirements

Given the relatively small scale of the proposed development and the way in which it must be serviced by three different connections, it is not expected that upgrades to existing infrastructure will be required.

2.6 Conclusions

SDC have indicated that sewage from additional developments within Prebbleton will be directed to the Rolleston sewage treatment plant. This will be via a new sewage pumping station to be located on Trents Road.

From preliminary calculations, the development can be serviced under gravity although following finalised design some sections on the eastern boundary may be required to pump sewage in order to enter the Prebbleton sewage reticulation.

Consideration needs to be given to the staging of construction to enable the developments to be serviced with gravity sewage reticulation. This could require cooperation between the two developers.

3. Stormwater

3.1 Existing Stormwater Management

Prebbleton township has a very limited stormwater reticulation network. As part of the Cairnbrae Drive subdivision a 450mm RCRRJ pipe was installed with an expected capacity of approximately 120l/s. The pipeline discharges into a 675mm pipe located under Springs Road prior to discharging to an open channel which discharges to Dawsons Creek on the eastern boundary of Prebbleton Township.

A resource consent for the discharge of stormwater from the Prebbleton pipe network could not be located following a search of the ECan database. A resource consent for the discharge of stormwater into this network is therefore expected to be required.

Recent subdivisions to the north and south of the proposed rezoning site have utilised soakage to ground for stormwater management where suitable soils exist.

3.2 Options for Stormwater Disposal

3.2.1 General

Options for the disposal of stormwater from the proposed re-zoning area include:

- Pre treatment of stormwater and discharge to ground. Discharge of private roof water directly to ground without pre-treatment. (Preferred Option)
- Discharge of stormwater from roading and miscellaneous surfaces to 450mm stormwater main following stormwater treatment and flow attenuation. Discharge of private roof water to ground without pre-treatment.
- Mixture of both discharge to ground and discharge to surface water.

The Geotechnical Investigation Report (included as ***Appendix B***) indicates that sandy gravels are present at a depth of approximately 2m on the eastern portion of the site. These soil conditions would allow for the effective discharge of stormwater to ground given that sandy gravels are expected to be capable of an infiltration rate of 500mm/hr.

A resource consent from ECan will be required in order to discharge water containing contaminants to either surface water or ground. Stormwater from the development will need to be treated to remove contaminants, to enable the effects on the environment to be less than minor. Provision of flow attenuation will be required to reduce erosion, protect the receiving environment and maintain the flood carrying capacity of the streams.

It is expected that there will be some pre-treatment (e.g. swales or proprietary treatment devices) prior to additional treatment such as the use of a stormwater pond or infiltration basin as required prior to discharging to surface or groundwater.

Stormwater from roof areas is expected to be discharged to ground via individual on-site soakage areas. During large duration events stormwater from roof areas will be directed to the road.

3.2.2 Discharge of Stormwater to Ground

Discharge of stormwater to ground has been utilised in recent subdivisions to the north and south of the development area. The site has good drainage characteristics on the eastern portion of the site which would make discharge to ground feasible. One option is to construct an infiltration basin that is lined with an infiltration media, such as 150mm of topsoil in the base of the pond to provide treatment of the stormwater as it infiltrated through to the underlying sands and gravels.

In general, the first flush stormwater (stormwater from the first 15-25mm of any storm) is more polluted than stormwater runoff from later in a storm event. As a result, the first flush stormwater is generally

treated using treatment systems which provide higher levels of contaminant removal than the treatment systems required for subsequent stormwater runoff. As a result, stormwater runoff from large rainfall events, which exceed the first 15-25mm runoff threshold, can be discharged to directly to ground using rapid infiltration trenches or soak pits.

A possible location for a stormwater treatment and infiltration basin has been shown on the Preliminary Servicing Plan attached in ***Appendix C***. This would allow the developer to use the extension of Cairnbrae Drive as a secondary flowpath for stormwater. An area of land on the eastern boundary of the site was considered as a possible alternative location for the stormwater attenuation basin. This was dismissed as there is no road frontage from the development area into Norris Street and hence a secondary flow path for stormwater could not be provided from this area.

Flows in excess of the capacity of the primary system can be directed to the road as a secondary flow path.

3.2.3 Discharge of Stormwater to SDC Stormwater Reticulation

An alternative option for the disposal of stormwater to ground is the discharge of stormwater to the Prebbleton reticulated pipe network, which ultimately discharges into a surface watercourse. In order to discharge to this pipe network stormwater treatment and attenuation would be required to reduce the effect of the discharge on the receiving environment to acceptable levels.

The stormwater attenuation process will require the installation of a large buffering vessel such as a pond. The pond would be designed to reduce the outflow rates to a level acceptable to both SDC and ECan. The major constraint governing the rate at which this may occur is the capacity of the downstream Prebbleton stormwater pipework and ensuring the effects on the open drain are less than minor.

The pond can provide significant levels of treatment, as ponds slow stormwater flow and facilitate sedimentation which removes sediment and metals from the stormwater flow.

Flows in excess of the capacity of the system can be directed to the road as a secondary flow path.

3.2.4 Conclusion

The existing connection to the Cairnbrae subdivision is expected to be under capacity to cope with the stormwater runoff from the whole development area. As a result a large stormwater attenuation and treatment basin will be required should the developer seek to dispose of stormwater to this network.

Given the underlying ground characteristics and the topography of the site, disposal to ground can be achieved feasibly. The treatment provided using the infiltration basin removes significant levels of contaminants, therefore reducing the effects on the environment.

It is therefore recommended that the development incorporates disposal of stormwater to ground as the main means of disposal of stormwater from the development.

3.3 Estimated Stormwater Infiltration Basin Characteristics

As stated above, it is anticipated that stormwater from private roof areas will be discharged to ground via individual on-site soakage areas. As discussed in Section 3.2.1, the Geotechnical Investigation Report (included as ***Appendix B***) indicates that sandy gravels are present at a depth of approximately 2m on the eastern portion of the site. The soak pits will need to be founded in gravel soils to ensure that adequate infiltration of stormwater can occur.

Individual property on-site stormwater soak pits have been sized as per guidelines in the "New Zealand Building Code Handbook"; (Building Industry Authority, 2004). The soak pit depths should be at least 2m, but will need to penetrate approximately 0.5m into the underlying gravel layers to ensure high

infiltration rates can be achieved. It is therefore recommended that individual house soak pits be approximately 2.5m deep. Preliminary soak pit dimensions (Width x Length x Height) for a rock soak pit and a chamber soak pit are 2 x 2 x 2.5m and 1.4 x 1.4 x 2.5m respectively.

Stormwater disposal from individual roads has been reviewed to include two infiltration ponds (one in the Coffey land and one in the William Blake Ltd land).

The infiltration basins were sized using preliminary calculations to ensure that the basins have capacity to contain and infiltrate the first flush run-off from the site. The basins will be lined to ensure that the infiltration rates are controlled to between 20-50mm/hr. This will ensure that stormwater is appropriately treated prior to entering groundwater without causing long residence times which can result in boggy or unsightly areas occurring.

Treatment volumes have been estimated using the assumptions in Table 2 below.

Table 2 - Catchment Assumptions

Coffey Land, infiltration basin	
Estimated area of impervious surfaces draining to infiltration basin	1.31 Ha
Estimated area of pervious surfaces draining to infiltration basin	4.61 Ha
Runoff coefficient for impervious surfaces	0.90
Runoff coefficient for pervious surfaces	0.30
Depth of First Flush	25mm
William Blake Ltd Land, infiltration basin	
Estimated area of impervious surfaces draining to infiltration basin	1.6 Ha
Estimated area of pervious surfaces draining to infiltration basin	5.69 Ha
Runoff coefficient for impervious surfaces	0.90
Runoff coefficient for pervious surfaces	0.30
Depth of First Flush	25mm

Estimated first flush volume (Coffey Land) = Rainfall Depth x Catchment Area x Runoff Coefficient
= 0.025 x (4.61 x 0.30 +1.31 x 0.90) x 10,000
= 641 m^3

Estimated first flush volume (William Blake Ltd Land) = Rainfall Depth x Catchment Area x Runoff Coefficient
= 0.025 x (5.69 x 0.30 +1.6 x 0.90) x 10,000
= 787 m^3

It has been assumed that the basins will have a live storage depth of between 0.5-1m in depth. This is mainly limited by safety considerations and deeper basins can be utilised provided adequate fencing or other measures have been incorporated. For the purposes of this report an additional 50% of land area has been included to provide for the landscaping, batters and miscellaneous unusable area. The estimated area to be set apart for a stormwater infiltration basins have therefore been calculated at between 960 – 1,920m^2 and 1,185 – 2,370m^2 for the Coffey land and William Blake Ltd land respectively.

Following the collection of the first flush volume in the infiltration basin, rapid infiltration trenches or soakage holes can be used to dispose of stormwater at a much higher rate. This is generally accepted by Environment Canterbury, provided the first flush is treated prior to discharge.

Section E1 (Surface Water) of the New Zealand Building Code states:
Except as otherwise required under the Resource Management Act 1991 for the protection of other property, surface water, resulting from an event having a 10% probability of occurring annually and

which is collected or concentrated by buildings or sitework, shall be disposed of in a way that avoids the likelihood of damage or nuisance to other property.

Preliminary calculations have been carried out to determine the rough order sizes of the proposed infiltration basins and base area of the rapid infiltration trenches required to dispose of stormwater on-site for up to a 10 year return period critical duration event. Calculations have been carried out assuming an infiltration rate of 20mm/hr through the base of the infiltration basin, which is considered conservative. The rapid infiltration trenches have been sized assuming an infiltration rate of 500mm/hr.

Table 3 - Preliminary Design of Stormwater Infiltration System

Coffey land infiltration basin		
Depth of Infiltration Basin	1.0 m	0.5 m
Base area of Infiltration Basin	641 m^2	1282 m^2
Base area of Rapid Infiltration Trenches	109 m^2	83 m^2
William Blake Ltd land infiltration basin		
Depth of Infiltration Basin	1.0 m	0.5 m
Base area of Infiltration Basin	787 m^2	1,574 m^2
Base area of Rapid Infiltration Trenches	133 m^2	102 m^2

As shown in the table above, the increase in base area of infiltration basin will decrease the base area for the infiltration trenches, given that more stormwater can be disposed to ground through the infiltration basin. Further work would be required to determine the most cost effective sizing for the stormwater system at the concept design phase of the project.

The infiltration basin would need to be located so that should the capacity of the infiltration basin and rapid infiltration trenches be exceeded, stormwater can be directed down secondary flow paths.

Topographic survey of street centrelines to the immediate east of the site has been undertaken as an addition to the site survey. The survey information shows that the topography of the township generally falls towards the southeast past Springs Road. It is therefore expected that the SDC and ECan will accept the Prebbleton roading network as a secondary flow path.

The stormwater infiltration basin finalised design is dependent on the finalised lot layout and detailed modelling which is outside of the scope of this report. The above preliminary calculations have demonstrated that the disposal to ground can be readily achieved.

A concept plan showing the possible stormwater layout using the above assumptions has been included in ***Appendix C***.

The infiltration basin in the Coffey Land has been positioned on the eastern boundary, to the western side of Cairnbrae Drive. The secondary flow path for this infiltration basin is southeast down Cairnbrae Drive.

The infiltration basin in the William Blake Ltd land has been positioned along the eastern border of the proposed road. This location has been chosen so the proposed road can be used as a secondary flowpath for stormwater flows exceeding the infiltration basin capacity, and this area is outside the proposed zone of high density housing located on the other side of the road. If the infiltration basin was positioned further southeast of the location shown in Appendix C, the secondary flowpath would pass through existing properties into Norris Street. It is not practical to create an easement through these existing properties for the secondary flow path, so if the basin was positioned in this location it would be necessary to pump flow exceeding the basin capacity up to the proposed road which would act as the secondary flowpath for stormwater.

3.4 Estimated Contaminant Loadings

Contaminant loadings for the roading stormwater runoff have been estimated using the Auckland Regional Council's TP10 document.

Following treatment using grassed swales with a nine minute retention time, the stormwater is expected to have the following contaminant loadings:

Contaminant	Expected Loading Following Swale Treatment
Sediment	16.3g/m3
Zinc	0.124g/m3
Copper	0.033g/m3
Total Petroleum Hydrocarbons	0.624g/m3

3.5 Conclusions

The area proposed for re-zoning is well suited to ground soakage as the primary method of stormwater removal and this method has been successfully implemented to the north and south of the development area.

As with all ground soakage systems, the efficiency can decrease over time. However, by adopting a conservative approach to the design of the systems, ensuring that there are adequate options for future upgrading and making allowance for secondary flows, ground soakage systems can provide a cost-effective long-term solution to stormwater disposal.

Adequate measures would need to be implemented to ensure the effects of the discharge on the underlying groundwater or receiving surface water are reduced to an acceptable level using suitable treatment and attenuation devices as required. The discharge will require a resource consent from ECan to discharge to ground or surface water given that it must be considered as a Discretionary Activity.

4. Water Supply

4.1 Outline Development Plan Servicing

Existing 150mm diameter water mains are located on Blakes Road and Cairnbrae Drive. An existing 100mm diameter water main is located in William Street.

Deficiencies in the existing Prebbleton water supply network mean that the network must be upgraded in order to provide the additional capacity required to service the proposed development. SDC have requested that a $10m^2$ utility lot be located at the Blakes Road end of the development for water supply purposes. This has been included in the Preliminary Servicing Plan in ***Appendix C***.

It is expected that this additional bore could be brought on-line relatively quickly following the SDC obtaining the required development contributions.

4.2 Required Demand

The proposed plan change includes re-zoning the area to cater for approximately 210 residential properties.

The Christchurch City Council Infrastructure Design Standard (CCC IDS) (Draft 2007) sets the following minimum design criteria for the design of sewerage reticulation.

Table 4 - Water Design Requirements

Total Additional Lots	210 Lots
Peak Living Zone Design Flow Rates	0.175 litres/second/connection

The peak expected domestic demand is therefore:
Peak Demand *=210 Lots x 0.175 l/s/connection*
=36.75 l/s

The water supply reticulation should comply with the New Zealand Fire Service Fire Fighting Water Supplies Code of Practice (SNZ PAS 4509:2003) for fire fighting flows, residual fire pressure and the spacing of hydrants. Residential housing without sprinkler systems is classified as W3 under the code of practice. Water demand for fire fighting is 25l/s as can be seen in Table 3.

Table 5 - New Zealand Fire Service Water Requirements

Water supply classification	Water flow required within a radial distance of 135m (l/s)	Additional water flow required within a radial distance of 270m (l/s)	Water Storage		Maximum number of fire hydrants to provide flow
			Time (min)	Volume (m3)	
W3	12.5	12.5	30	45	2

The total peak demand can be estimated using the following formula:
Peak $Demand_{Total}$ *= $Demand_{Fire\ Flow}$ + 0.5 x Peak $Demand_{Domestic}$*
=25l/s + 0.5 x 36.75l/s
=43.4l/s.

In order to comply with the Fire Service Code of Practice the principal mains within the development must have a minimum size of 100mm diameter.

4.3 Conclusions

The adjacent existing water reticulation system allows the proposed development to be serviced easily for good connection points for the proposed residential development area.

The SDC have identified that additional capacity will be required in order to service the development.

The SDC have identified a possible suitable location for an additional bore, being at the intersection of Shands and Blakes Roads. It is expected that this bore could be brought on-line relatively quickly to cope with any additional potable water demand caused by the development.

5. Summary

This report assesses the feasibility of providing services for the 210 lot residential development of 18.8586 ha of rural land west of Prebbleton township

The majority of the development can be serviced by gravity sewerage reticulation provided by the extension of the existing SDC sewer reticulation. Some sites on the east of the development may require private pumping systems into the gravity reticulation depending on final detailed design.

The site is well suited to ground soakage as a method for disposal of stormwater. Suitable long term solutions can be provided to dispose of stormwater on-site without placing the downstream limited stormwater network under increased pressure.

Capacity deficiencies within the existing Prebbleton water supply network have been identified by the SDC although a suitable location for an additional bore at the intersection of Shands and Blakes Road has been identified. This proposed bore is expected to meet the needs of the development.

Appendix A

Development Site

A4

PRELIMINARY

Rev.	Date	Revision Details	By
A	5.10.07	ISSUE	RD

Connell Wagner

Connell Wagner Limited
Level 4 Tomers House 195 Hereford St
(P.O. Box 1061) Christchurch New Zealand
Telephone +64 3 366 0821
Facsimile +64 3 379 6955
Email cwchch@conwag.com

Drawing Title:

LOCALITY PLAN
SELWYN DISTRICT COUNCIL
REZONING APPLICATION
PREBBLETON

	Signed	Date
Surveyed		
Designed	TU	10.07
Drawn	RD	10.07
Verified	MD	10.07
Approved	MF	10.07

CW Project No. 29731
Scale 15000@A4
Drawing No. C 01
Rev. A

P:\29731\CAD\civil\29731-C 01

Appendix B

Geotechnical Report

Connell Wagner

Connell Wagner Limited
Level 4, Torrens House
195 Hereford Street
(PO Box 1061)
Christchurch
New Zealand 8140

Telephone: +64 3 366 0821
Facsimile: +64 3 379 6955
Email: cwchc@conwag.com
www.conwag.com

4 October 2007

Maurice Coffey
25 Cairnbrae Drive
PREBBLETON

Dear Maurice,

GEOTECHNICAL SITE APPRAISAL
LOT 105 DP331951 AND PT LOT 104 DP 24908, CAIRNBRAE DRIVE, PREBBLETON

Introduction
Maurice Coffey is proposing to rezone a 17.7 ha block of land at the end of Cairnbrae Drive in Prebbleton. The site has the legal description of Lot 105 DP 331951 and Pt Lot 104 DP 24908.

As a part of the proposed residential development Maurice Coffey has engaged Connell Wagner to undertake a geotechnical site appraisal in order to provide geotechnical advice on developing the stormwater treatment system.

This report presents the results of geotechnical investigations and provides engineering consideration for the proposed stormwater treatment system.

Site Description
The site is located at the end of Cairnbrae Drive in Prebbleton. The legal title is Lot 105 DP 331951 and Pt Lot 104 DP 24908.

The site is irregular shaped and becomes narrower in the north. It is orientated in a northeast-southwest direction.

The site is bounded to the northeast by Blakes Road, to the east and south east by a residential area and to north and southwest by tree lines and vegetated pasture land.

Access to site is via Cairnbrae Drive in the south east or via Blakes Road in the northeast.

The site is flat, with a residential dwelling located in the south. The area surrounding the dwelling is used as a private garden and is bounded by trees, gorse and fences. The remainder of the site is vegetated in pastoral grass. A gorse hedge runs through the centre of the site, from the west to the southeast, effectively dividing the site into two similar size areas. Gorse and large trees grow along the boundaries.

The 1:100,000 scale, "Geology of the Banks Peninsula" map, published in 1993 by the Institute of Geological & Nuclear Sciences, indicates that the site is underlain by "dominantly alluvial sand and silt."

The review of the GNS Active Faults Database shows the site is approximately 27km south of the closest active fault.

Geotechnical Investigation

Physical site works included test pitting at different locations of the site. Test locations are shown in Figure 1. All soil samples and testing were logged by a geotechnical engineer in accordance with NZ Geotechnical Society "Guidelines for the Classification and Field Descriptions of Soils and Rocks in Engineering" and the Connell Wagner "Site Investigation Manual".

Seven test pits were dug out with a 12t excavator, see Figure 1. Excavations indicated a layer of topsoil underlain by different types of sand and silt to a depth of about 2.5m, followed by sandy gravel with cobbles to the maximum test pit depth of 5m. In the northern part of the site (TP3) we were unable to find the gravel layer at the maximum test pit depth of 5.2m. The test results are attached in Appendix A.

Samples taken at a depth of 4.5m in TP4 were sent to the laboratory for testing in order to determine the permeability of the gravel layer. The laboratory test results of the Particle Size Distribution are attached as Appendix B.

The classification was made by sieving the oven dried material. The results indicate the following distribution and soil type:

- 5% Silt
- 14% Sand
- 81% Gravel

Based on the laboratory results we were able to classify the tested soil sample as sandy-GRAVEL.

Groundwater was not encountered in any test pit. The maximum test pit depth was 5.2m.

Engineering Consideration

Based upon the above test results and review of published geological information we infer the following geological model for the area below the centre of the site:

- 300mm Topsoil overlying,
- 1700mm to 2000mm of Sandy SILT overlying,
- Sandy GRAVEL to depth

For the northern part of the site we infer the following geological model:

- 200mm Topsoil overlying,
- 2000mm Sandy SILT overlying,
- Silty SAND to depth

The determined permeability value presented by Lambre and Whitman in 'Soil Mechanics', 5th ed. is:

$k \approx 500mm/h$

Due to the sandy-gravel underlying the southern part of the site we suggest that the soakage pits are located towards the southern end of the site. In this area the stormwater is likely to drain into the highly permeable sandy-gravel soil.

Limitations

The contents of the report are for the sole use of the Maurice Coffey and no responsibility or liability will be accepted to any third party. Data or opinions contained within the report may not be used in other contexts or for any other purposes without our prior review and agreement.

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

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

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

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

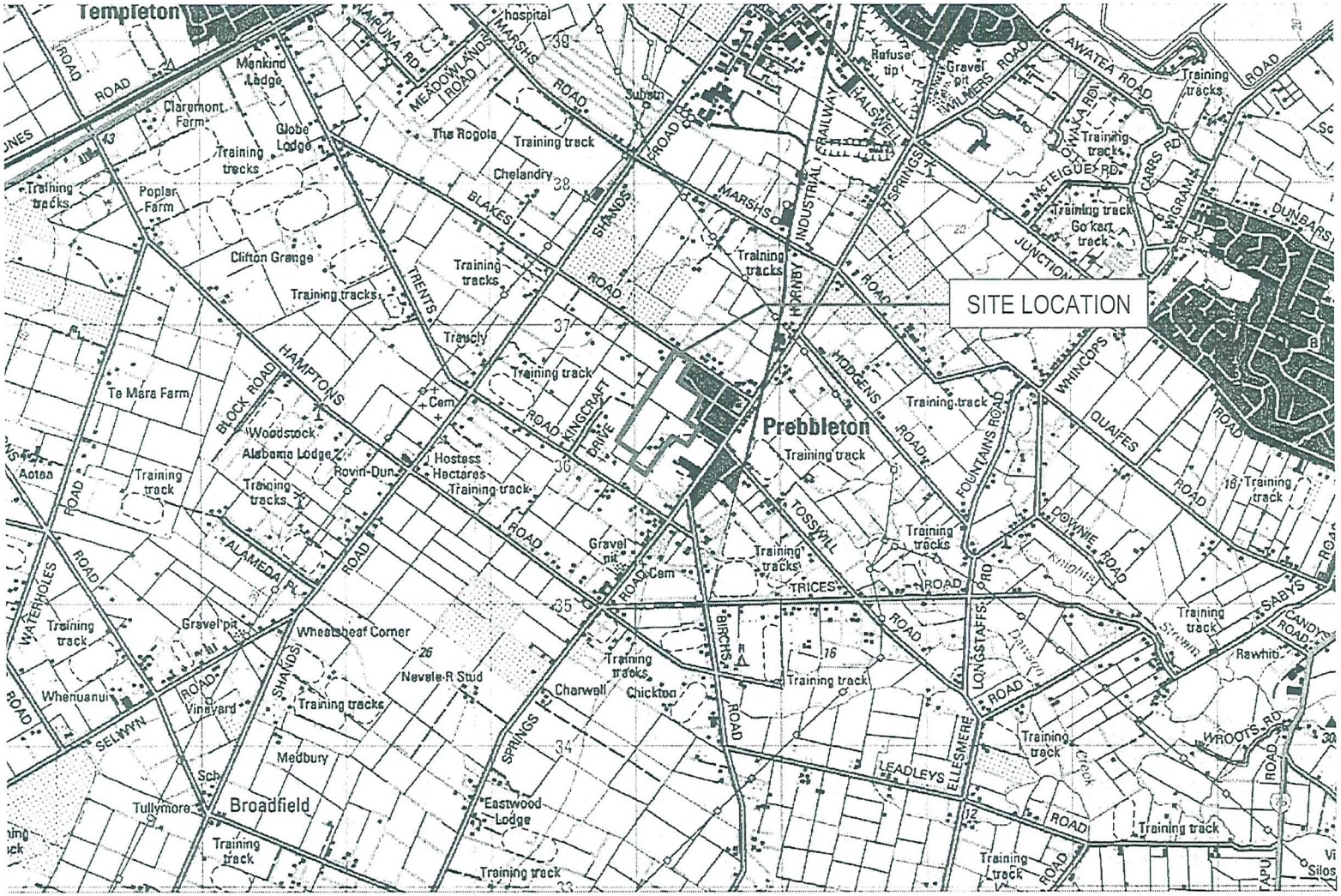
Obtaining any required consents from the local territorial authorities is the clients responsibility.

Should you have any queries regarding this letter or the project please do not hesitate to contact the writers.

Yours sincerely

Dr Jan Kupec
Geotechnical Consultant

Enc: Figures
Photos
Appendix A - Test Pits Logs
Appendix B - Labrotory Report



Note: Not to scale and locations are approximate only

Connell Wagner

Connell Wagner Limited
195 Hereford Street
PO Box 1061
Christchurch - New Zealand

Telephone: +64 3 366 0821
Facsimile: +64 3 379 6955
Email: cwchc@conwag.com

Client: Maurice Coffey	Figure 1 Site location		Paper Size: A4
Project: M Coffey-Cairnbrae Dr, Prebbleton			Revision:
By: FI	Date: 4 October 2007	Job Number: P29731-003G	

Note: Not to scale and locations are approximate only

Connell Wagner

Connell Wagner Limited
195 Hereford Street
PO Box 1061
Christchurch - New Zealand

Telephone: +64 3 366 0821
Facsimile: +64 3 379 6955
Email: cwchc@conwag.com

Client: Maurice Coffey	Figure 2 Site location detail		Paper Size: A4
Project: M Coffey-Cairnbrae Dr, Prebbleton			Revision
By: FI	Date: 4 October 2007	Job Number: P29731-003G	

Note: Not to scale and locations are approximate only

Connell Wagner	Client: Maurice Coffey	Figure 3 Geotechnical Testing Location	Paper Size: A4
	Project: M Coffey-Cairnbrae Dr, Prebbleton		Revision:
	By: FI	Date: 4 October 2007	Job Number: P29731-003G

Connell Wagner Limited
195 Hereford Street
PO Box 1061
Christchurch - New Zealand

Telephone: +64 3 366 0821
Facsimile: +64 3 379 6955
Email: cwchc@conwag.com

Connell Wagner Limited
195 Hereford Street
PO Box 1061
Christchurch - New Zealand
Telephone: +64 3 366 0821
Facsimile: +64 3 379 6955
Email: cwchc@conwag.com

Site Visit Date: 5-09-2007

Job Name: M Coffey-Cairnbrae Dr, Prebbleton

Job No: P29731-003

FILE LOCATION: P:\29731\003-civil\docs\Photo Prebbleton Geotech 2007-10-04.ppt

PHOTO: 1
NARRATIVE: Test pit 1

PHOTO: 2
NARRATIVE: Test pit 4. Note: Top layer sandy silt, bottom layer sandy gravel

Connell Wagner Limited
195 Hereford Street
PO Box 1061
Christchurch - New Zealand
Telephone: +64 3 366 0821
Facsimile: +64 3 379 6955
Email: cwchc@conwag.com

Site Visit Date: 5-09-2007

Job Name: M Coffey-Cairnbrae Dr, Prebbleton

Job No: P29731-003

FILE LOCATION: P:\29731\003-civil\docs\Photo Prebbleton Geotech 2007-10-04.ppt

PHOTO: 3
NARRATIVE: Bottom of test pit 3. Note: No gravel at maximum depth of 5.2m

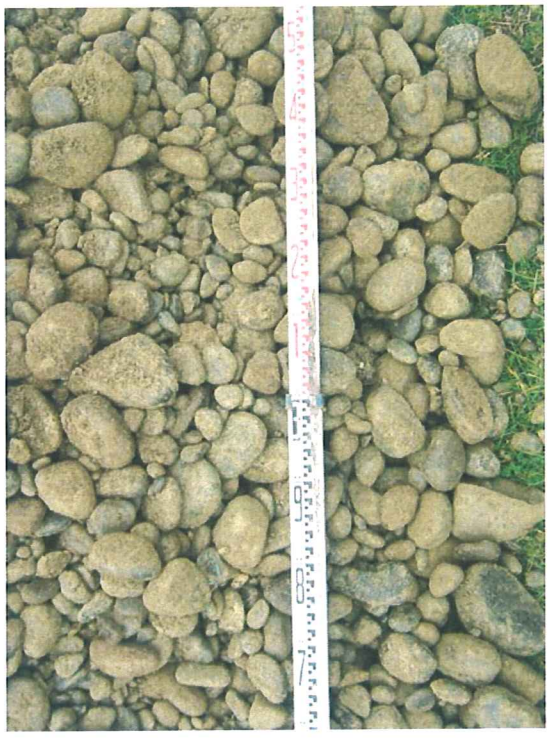


PHOTO: 4
NARRATIVE: Typical subsoil layer at depth consisting of coarse gravel and cobbles (TP6)

Connell Wagner

Connell Wagner Limited
199 Hereford St, (PO Box 1061)
Christchurch, New Zealand

Telephone: +64 3 366 0821
Facsimile: +64 3 379 6955

Open Excavation Log

Test Pit No.: **TP1**

Client: Maurice Coffey	Location: Prebbleton		Date: 5-Sep-2007
Project: Cairnbrae Drive, Prebbleton	Logged By: MH	Weather Conditions: rain, cold	Job Number: 29731-003

Water	Depth (m)	Soil Symbol	FACE 1/2 SOIL DESCRIPTION: Colour, structure, weathering, subordinate/ main / minor COMPONENTS.
			TOPSOIL, dark brown, with roots
	0.5		Sandy SILT, light brown, stiff to firm
	1		
	1.5		
	2		
			Sandy GRAVEL, rounded, medium dense to dense
	2.5		
	3		Sandy SILT with gravel, light brown, firm to stiff

Water	Depth (m)	Soil Symbol	FACE 2/2 SOIL DESCRIPTION: Colour, structure, weathering, subordinate/ main / minor COMPONENTS.
	3.5		
			Sandy GRAVEL, coarse, rounded, medium dense to dense, light brown, grey, with minor silt
	4		
	4.5		
	5		
			End of Test Pit 5.0m
	5.5		

Undrained Shear Strength (kPa) ●
Measured Using a Hand Held Shear Vane[1]
25 50 75 100 125 150

Scala Penetrometer Test[2] ×
(Blows/ 150mm)
2 4 6 8 10 12

Test Description

1 - Hand held shear vane test in accordance with BS1377:1990

2 - Scala Penetrometer Test in accordance with NZS4402:1986 for the first three meters

Connell Wagner

Connell Wagner Limited
199 Hereford St, PO Box 1061
Christchurch New Zealand

Telephone: +64 3 366 0821
Facsimile: +64 3 379 8955

Open Excavation Log

Test Pit No: **TP2**

Client: Maurice Coffey	Location: Prebbleton		Date: 5-Sep-2007
Project: Permeabillity tests	Logged By: MH	Weather Conditions: rain, cold	Job Number: 29731-003

Water	Depth (m)	Soil Symbol	FACE 1/2 — SOIL DESCRIPTION: Colour, structure, weathering, subordinate/ main / minor COMPONENTS.
	0		TOPSOIL, dark brown, with roots
	0.5		Sandy SILT, light brown, stiff to very stiff
	1		
	1.5		
	2		
	2.5		Sandy GRAVEL, with frequent cobbles. light brown, grey
	3		

Water	Depth (m)	Soil Symbol	FACE 2/2 — SOIL DESCRIPTION: Colour, structure, weathering, subordinate/ main / minor COMPONENTS.
	3.5		
	4		
	4.5		
	5		End of Test Pit 5.0m
	5.5		

Undrained Shear Strength (kPa) ●
Measured Using a Hand Held Shear Vane[1]
25 50 75 100 125 150

Scala Penetrometer Test[2] ×
(Blows/ 150mm)
2 4 6 8 10 12

Test Description

1 - Hand held shear vane test in accordance with BS1377:1990

2 - Scala Penetrometer Test in accordance with NZS4402:1986 for the first three meters

Connell Wagner Limited
199 Hereford St, (PO Box 1061)
Christchurch, New Zealand
Telephone: +64 3 366 0821
Facsimile: +64 3 379 8955

Open Excavation Log

Test Pit No.: **TP3**

Client: Maurice Coffey	Location: Prebbleton		Date: 5-Sep-2007
Project: Permeabillity tests	Logged By: MH	Weather Conditions: rain, cold	Job Number: 29731-003

Water	Depth (m)	Soil Symbol	FACE 1/2 — SOIL DESCRIPTION: Colour, structure, weathering, subordinate/ main / minor COMPONENTS.
	0		TOPSOIL, dark brown, with roots
	0.5		Sandy SILT, light brown, light grey, with minor clay
	1		
	1.5		
	2		
	2.5		Silty SAND, light brown, interbedded with layers of sandy silt
	3		

Water	Depth (m)	Soil Symbol	FACE 2/2 — SOIL DESCRIPTION: Colour, structure, weathering, subordinate/ main / minor COMPONENTS.
	3.5		
	4		
	4.5		
	5		Soil sample taken at 5.0m
	5.5		End of Test Pit 5.2m

Undrained Shear Strength (kPa) ●
Measured Using a Hand Held Shear Vane[1]
25 50 75 100 125 150

Scala Penetrometer Test[2] ×
(Blows/ 150mm)
2 4 6 8 10 12

Test Description

1 - Hand held shear vane test in accordance with BS1377:1990

2 - Scala Penetrometer Test in accordance with NZS4402:1986 for the first three meters

Connell Wagner

Connell Wagner Limited
199 Hereford St. (PO Box 1061)
Christchurch, New Zealand
Telephone: +64 3 366 0821
Facsimile: +64 3 379 6855

Open Excavation Log

Test Pit No: **TP4**

Client: Maurice Coffey	Location: Prebbleton		Date: 5-Sep-2007
Project: Cairnbrae Drive, Prebbleton	Logged By: MH	Weather Conditions: rain, cold	Job Number: 29731-003

Water	Depth (m)	Soil Symbol	FACE 1/2 SOIL DESCRIPTION: Colour, structure, weathering, subordinate/ main / minor COMPONENTS.
			TOPSOIL, dark brown, with roots
	0.5		Sandy SILT, light brown, light grey, orange mottling
	1		
	1.5		
	2		
	2.5		Sandy GRAVEL, coarse, rounded, with cobbles, light brown, grey
	3		

Water	Depth (m)	Soil Symbol	FACE 2/2 SOIL DESCRIPTION: Colour, structure, weathering, subordinate/ main / minor COMPONENTS.
	3.5		
	4		
	4.5		Soil sample taken at 4.5m
	5		End of Test Pit 4.9m
	5.5		

Undrained Shear Strength (kPa) ●
Measured Using a Hand Held Shear Vane[1]
25 50 75 100 125 150

Scala Penetrometer Test[2] ×
(Blows/ 150mm)
2 4 6 8 10 12

Test Description

1 - Hand held shear vane test in accordance with BS1377:1990

2 - Scala Penetrometer Test in accordance with NZS4402:1986 for the first three meters

Connell Wagner

Connell Wagner Limited
199 Hereford St. (PO Box 1061)
Christchurch, New Zealand
Telephone: +64 3 366 0821
Facsimile: +64 3 379 8855

Open Excavation Log

Test Pit No.: **TP5**

Client: Maurice Coffey	Location: Prebbleton		Date: 5-Sep-2007
Project: Permeabillity tests	Logged By: MH	Weather Conditions: rain, cold	Job Number: 29731-003

Water	Depth (m)	Soil Symbol	FACE 1/2 SOIL DESCRIPTION: Colour, structure, weathering, subordinate/ main / minor COMPONENTS.
	0		TOPSOIL, dark brown, with roots
	0.5		Sandy SILT, light brown, light grey, with orange mottling
	1		
	1.5		
	2		
	2.5		Sandy GRAVEL, with frequent cobbles, dense
	3		

Water	Depth (m)	Soil Symbol	FACE 2/2 SOIL DESCRIPTION: Colour, structure, weathering, subordinate/ main / minor COMPONENTS.
	3.5		
	4		
	4.5		
	5		End of Test Pit 4.7m
	5.5		

Undrained Shear Strength (kPa) ●
Measured Using a Hand Held Shear Vane[1]
25 50 75 100 125 150

Scala Penetrometer Test[2] ×
(Blows/ 150mm)
2 4 6 8 10 12

Test Description

1 - Hand held shear vane test in accordance with BS1377:1990

2 - Scala Penetrometer Test in accordance with NZS4402:1986 for the first three meters

Connell Wagner

Connell Wagner Limited
199 Hereford St, (PO Box 1061)
Christchurch New Zealand
Telephone: +64 3 366 0821
Facsimile: +64 3 379 8955

Open Excavation Log

Test Pit No.: **TP6**

Client: Maurice Coffey	Location: Prebbleton		Date: 5-Sep-2007
Project: Permeabillity tests	Logged By: MH	Weather Conditions: rain, cold	Job Number: 29731-003

Undrained Shear Strength (kPa) ●
Measured Using a Hand Held Shear Vane[1]
25 50 75 100 125 150

Scala Penetrometer Test[2] ×
(Blows/ 150mm)
2 4 6 8 10 12

Water	Depth (m)	Soil Symbol	FACE 1/2 SOIL DESCRIPTION: Colour, structure, weathering, subordinate/ main / minor COMPONENTS.
	0		TOPSOIL, dark brown, with roots
	0.5		Sandy SILT, light brown, light grey, with orange mottling
	1		
	1.5		
	2		
	2.5		GRAVEL with sand and cobbles, medium dense
	3		

Water	Depth (m)	Soil Symbol	FACE 2/2 SOIL DESCRIPTION: Colour, structure, weathering, subordinate/ main / minor COMPONENTS.
	3.5		
	4		
	4.5		End of Test Pit 4.5m
	5		
	5.5		

Test Description

1 - Hand held shear vane test in accordance with BS1377:1990

2 - Scala Penetrometer Test in accordance with NZS4402:1986 for the first three meters

Connell Wagner

Connell Wagner Limited
199 Hereford St, (PO Box 1061)
Christchurch, New Zealand

Telephone: +64 3 366 0821
Facsimile: +64 3 379 6955

Open Excavation Log

Test Pit No: **TP7**

Client: Maurice Coffey

Location: Prebbleton

Date: 5-Sep-2007

Project: Permeabillity tests

Logged By: MH

Weather Conditions: rain, cold

Job Number: 29731-003

Water	Depth (m)	Soil Symbol	FACE 1/2 — SOIL DESCRIPTION: Colour, structure, weathering, subordinate/ main / minor COMPONENTS.
	0		TOPSOIL, dark brown, with roots
	0.5		Sandy SILT, light brown, light grey, with orange mottling
	1		
	1.5		
	2		Sandy GRAVEL, with cobbles, high density
	2.5		
	3		

Water	Depth (m)	Soil Symbol	FACE 2/2 — SOIL DESCRIPTION: Colour, structure, weathering, subordinate/ main / minor COMPONENTS.
	3.5		
	4		
	4.5		
	5		End of Test Pit 4.7m
	5.5		

Undrained Shear Strength (kPa) ●
Measured Using a Hand Held Shear Vane[1]
25 50 75 100 125 150

Scala Penetrometer Test[2] ×
(Blows/ 150mm)
2 4 6 8 10 12

Test Description

1 - Hand held shear vane test in accordance with BS1377:1990

2 - Scala Penetrometer Test in accordance with NZS4402:1986 for the first three meters

Canterbury Laboratory
Fulton Hogan Ltd
325 Pound Rd, PO Box 16-064
Hornby, Christchurch
Phone (03) 349 9142
Facsimile (03) 349 9143
Toll Free 0800 LABORATORY
Email: martin.clay@fh.co.nz

Material Test Report

Report No: MAT:CAN07S-0737
Issue No: 1

Client: Connell Wagner Y
PO Box 1061
Christchurch 8140
NZ

Project: QA Testing - Aggregates

Approved Signatory: Max Burford (Supervisor)

IANZ Accreditation No: 200
Date of Issue: 18/09/2007

Sample Details

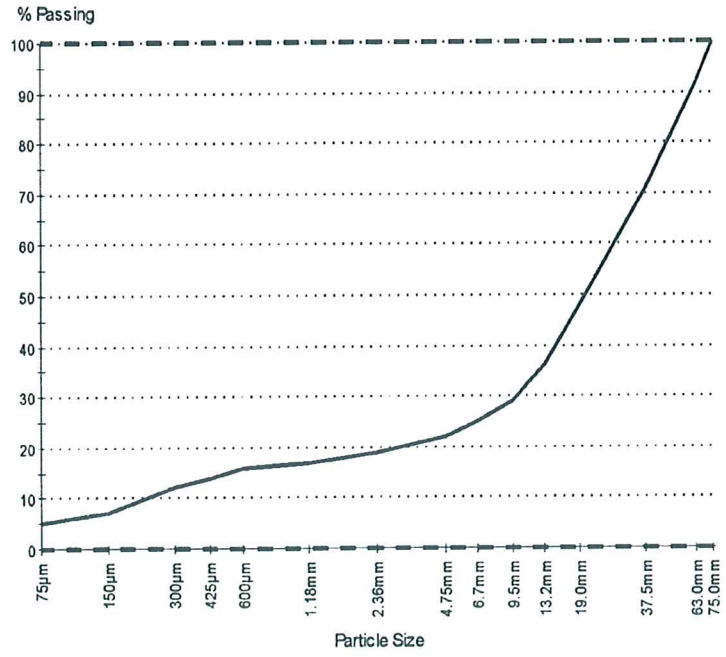
Sample ID: CAN07S-0737
Client Sample: Maurice Coffey
Date Sampled: N/A
Source: Test Pit 4
Material: Insitu Gravel
Specification: No Specification
Sampling Method: Not Advised - Not IANZ Accredited

Other Test Results

Description	Method	Result	Limits

Particle Size Distribution

Method: NZS 4407:1991 Test 3.8.2
Drying by: Oven
Date Tested: 17/09/2007



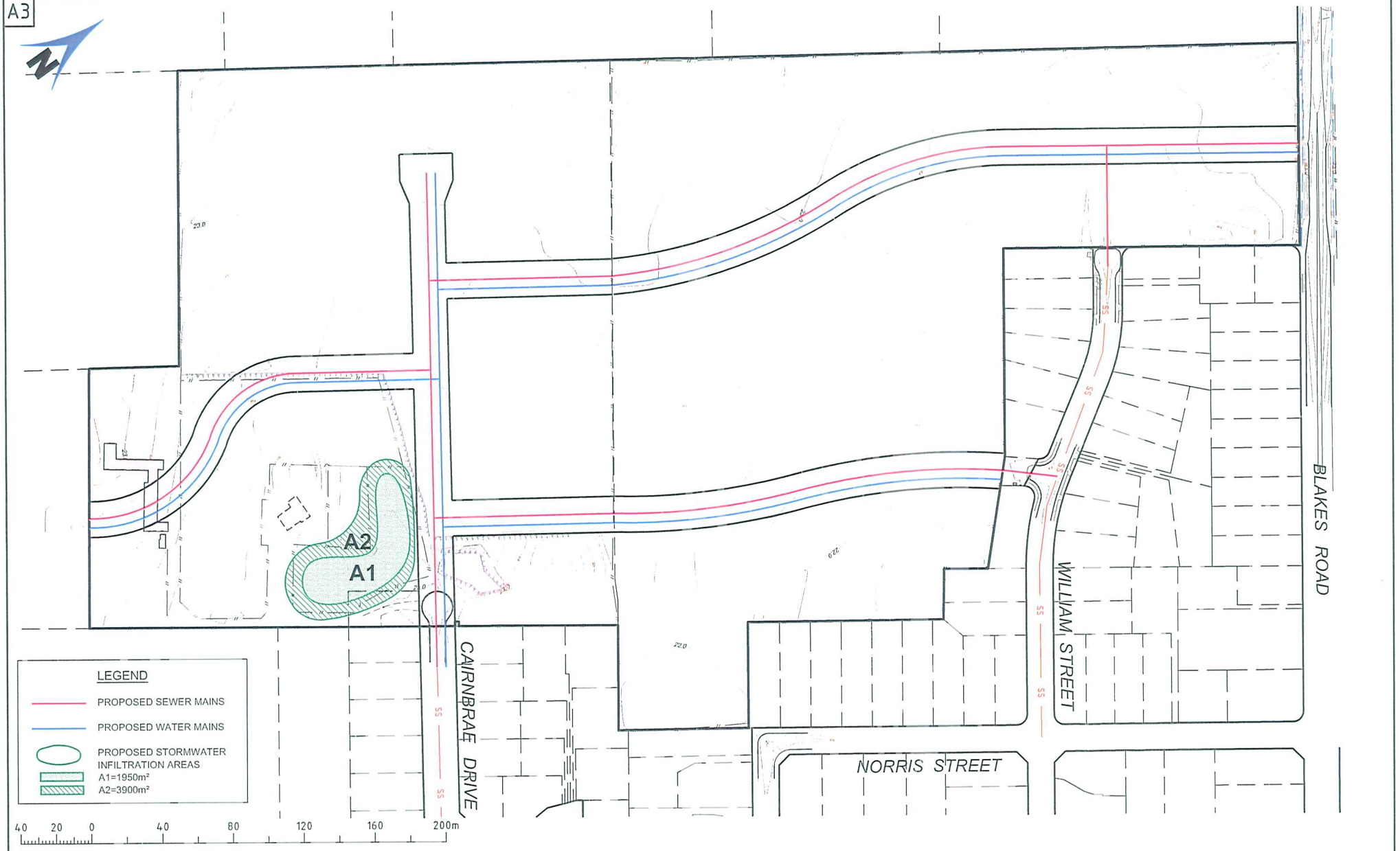
Sieve Size	% Passing	Limits
75.0mm	100	0 – 100
63.0mm	92	0 – 100
37.5mm	71	0 – 100
19.0mm	48	0 – 100
13.2mm	36	0 – 100
9.5mm	29	0 – 100
6.7mm	25	0 – 100
4.75mm	22	0 – 100
2.36mm	19	0 – 100
1.18mm	17	0 – 100
600µm	16	0 – 100
425µm	14	0 – 100
300µm	12	0 – 100
150µm	7	0 – 100
75µm	5	0 – 100

Comments
N/A

Appendix C

Preliminary Servicing Plan

A3



Rev.	Date	Revision Details	By	Ver.	App
A	02/08	Rezoning Report	TU	MD	MF

Connell Wagner

Connell Wagner Limited
Level 4, Torrens House 195 Hereford St
(P.O. Box 1061) Christchurch New Zealand

Telephone: +64 3 366 0821
Facsimile: +64 3 379 6955
Email: cwchc@conwag.com

M & N COFFEY & WILLIAM BLAKE LTD

Project: PREBBLETON REZONING

Drawing Title: PRELIMINARY SERVICING PLAN

	Signed	Date
Surveyed		
Designed	TU	11.07
Drawn	RD	11.07
Verified	MD	11.07
Approved	MF	11.07

CW Project No: 29731

Scale: 1:2000@A3

Drawing No: C 02 Rev: A

P:\29731\CAD\civil\29731-C-02

Appendix D

Correspondence with Selwyn District Council

Selwyn DISTRICT COUNCIL

HIGH STREET, LEESTON
PRIVATE BAG 1, LEESTON
PH: (03) 324-8080 FAX: (03) 324-3531

REF No.....

18 October 2007

Mr Tim Ure
Connell Wagner
P O Box 1061
CHRISTCHURCH

Dear Tim

Please find below a response to your general questions.

1. a) Christchurch City Council Standards, NZS 4404 and local interpretations are made in providing services. This includes connection drawings that Council staff utilise. Connell Wagner will be aware of this approach via other developments they have been involved in e.g. Rolleston, Lincoln.

   b) An additional bore would be required at the location which is yet to be determined. This may well be in an area to the south of Shands and Blakes Road.

2. The Prebbleton scheme is effectively closed and I am currently developing a strategy and scheme design to cater for growth identified under the Greater Christchurch Urban Development Strategy Process.

3. With respect to the remaining question:

   a) I do not believe that the most effective disposal point will be via Cairnbrae subdivision. In fact no pumpstation exists there. It may well be that a pumpstation is located near Trents Road.

   b) Your first step is to confirm capacity of surrounding available stormwater discharge points. Once completed and provided to me I will be able to assess possible options including yours for stormwater disposal.

   c) As above please complete a capacity assessment.

Yours faithfully

H Blake-Manson
ASSET MANAGER UTILITIES

Connell Wagner Limited
Level 4, Torrens House
195 Hereford Street
(PO Box 1061)

Christchurch New Zealand 8140

Telephone: +64 3 366 0821
Facsimile: +64 3 379 6955
Email: cwchc@conwag.com
www.conwag.com

2 October 2007

Hugh Blake-Manson
Asset Manager Utilities
Selwyn District Council
Private Bag 1
LEESTON

Dear Hugh

Proposed Prebbleton Rezoning

As per our telephone conversation earlier last month, a client has approached Connell Wagner, looking to rezone Lot 105 DP 331951 and Part Lot 4 DP 24908 (refer to attached plan) to develop approximately 200 additional residential lots within Prebbleton township.

Our telephone conversation last month discussed servicing issues related to both sewage and water. It would be appreciated if we could obtain a letter from the Selwyn District Council discussing the infrastructure required in order to service such a subdivision.

Connell Wagner telephone records include the following points as discussed in Sections 1 and 2:

1. Water

The design of any new water reticulation within the Prebbleton township is to be in accordance with the CCC infrastructure design standards.

An additional bore would be required in order to service the subdivision.

Selwyn District Council (SDC) have access to a bore located on Blakes Road which could be brought on line relatively quickly provided the SDC obtained development contributions in order to do so.

2. Sewer

The design of any new sewerage reticulation within the Prebbleton township is to be in accordance with the CCC infrastructure design standards.

Prebbleton has 906 sewer connections which discharge to the CCC sewerage reticulation. All of these connections have been allocated. The Prebbleton scheme is therefore effectively closed to further connections.

SDC is currently developing a Wastewater Strategy for Prebbleton and other surrounding towns which will be available for public review by the end of October 2007.

3. Additional Clarification Required

In addition to the above discussion, it would be appreciated if SDC could provide some indication for the following questions:

- Whether upgrades to the gravity sections of sewerage pipeline from Cairnebrae Drive to the SDC pump station would be required to allow for an additional maximum sewage flow of 7l/s from the subdivision?
- Whether SDC would accept treated stormwater into the capped stormwater main located at the termination of Carinbrae Drive? It is understood that resource consent would be required for a discharge to the surface water body at the outlet to this drain.
- Does SDC have any opinion as to the maximum flow rate stormwater can be discharged to this stormwater pipe given that it discharges into an existing main located under Springs Road?

If you have any questions, please don't hesitate to contact the undersigned.

Yours sincerely

Tim Ure
Civil Engineer

Enc: Draft Development Layout Plan

Appendix E

Photographs of Site

Photo 1 – Photograph looking north-west from south-east corner of Part Lot 4 DP24908

Photo 2 – Photograph looking north-west from south-east corner of Lot 105 DP331951

Photo 3 – Photograph looking south-east from termination end of Cairnbrae Drive