REPORT

Tonkin+Taylor

Kyle Park, Hornby

Desktop Ground Contamination and Geotechnical Study

Prepared for
Christchurch City Council
Prepared by
Tonkin & Taylor Ltd
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1 Introduction

Tonkin & Taylor Ltd (T+T) was commissioned by the Christchurch City Council (CCC) to carry out this initial ground contamination and geotechnical study relating to Kyle Park, which is located in the western Christchurch suburb of Hornby. The mainly desktop-based assessment for this report has been completed in accordance with the existing services agreement between T+T and CCC (Agreement No. 4600001076) and our proposal dated 31 July 2015.

The purpose of this report is to provide information and recommendations to assist CCC in the development of their Master Plan for Hornby. It is expected that further site-specific ground contamination and geotechnical investigation and assessment work will likely be required once particular development plan(s) are identified for the site.

The ground contamination part of our work for this report has been carried out in general accordance with the requirements for a Preliminary Site Investigation (PSI) referred to in the NES Soil regulations[1], and as outlined in the Contaminated Land Management Guidelines[2] published by the Ministry for the Environment (MfE).

1.1 Background

Based on discussions with CCC, T+T understands that both Kyle Park and Denton Park in Hornby (shown on Figure 1.1) are under consideration for the potential development of a new library and service centre along with associated infrastructure and recreational spaces.

T+T carried out desktop-based ground contamination and geotechnical studies on behalf of CCC for Denton Park in 2013[3,4], and this report for Kyle Park complements that work.

1.2 Proposed development

We understand that CCC wishes to develop Kyle Park and / or Denton Park as part of their Master Plan for Hornby and that the development is likely to include the following:

- A New Southwest Library and Service Centre (NSLSC). This building will likely have a footprint area of approximately 1,300 m^2 and may be up to 2 storeys high.
- Carparking and / or associated paved access facilities.
- Sport and recreation areas, which may include sports fields, playground areas and / or paved / astroturfed surfaces.

1.3 Scope of work

The following scope of work has been completed by T+T for the purposes of this mainly desktop-based ground contamination and geotechnical assessment report:

- Review of CCC property files.
- Review of historical aerial photographs.
- Review of historical certificates of title.

[1] Resource Management (National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health) Regulations 2011, which are referred to herein as NES Soil.
[2] Ministry for the Environment, updated 2011, Contaminated land management guidelines No. 1: *Reporting on Contaminated Sites in New Zealand*.
[3] New Southwest Library and Service Centre – Geotechnical Desktop Study (Dec 2013) – T+T Ref. 53404
[4] Ground Contamination Desk Study Investigation – New South West Library & Service Centre (Dec 2013) – T+T Ref. 53404

- Review of the Environment Canterbury (ECan) Listed Land Use Register (LLUR) Statement for the site.
- Review of geotechnical data for the site and surrounding area available from the Canterbury Geotechnical Database (CGD).
- Brief site walkover by a ground contamination specialist and a geotechnical engineer.
- Assessment of geotechnical issues associated with the site in relation to the proposed development.
- Assessment of geotechnical aspects associated with likely construction activities relating to the proposed development.
- Recommendations for further investigation / assessment work that may be considered for later stages of site development work.

Figure 1.1: Kyle Park (boundaries shown in red) and Denton Park (boundaries shown in yellow), Hornby (ECan Advanced GIS Web Viewer, 2015)

2 Site description

2.1 General

Kyle Park is located at 197 Waterloo Road, which is approximately 9 km west of the Christchurch Central Business District. The 8.7 hectare site is bounded by:

- Waterloo Road, residential housing and Hornby Primary School to the north.
- Residential housing to the west.
- Rail lines, Denton Park, and "The Hub" shopping centre to the south.
- Varied commercial / industrial properties along Smarts Road to the east.

The site comprises two property parcels with legal titles of Lot 1 DP 78681 and Lot 2 DP 34558.

2.2 Current site usage

Kyle Park currently hosts various uses comprising:

- A pocket of trees surrounding a grassed bank adjacent to the western boundary.
- A stormwater retention pond that is surrounded with vegetation.
- Grassed recreational areas with sporadic trees and a BMX track in the central portion.
- Meandering footpaths that converge at the south into a pedestrian railway underpass link to Denton Park.
- Sports fields and grassed recreational areas with sporadic trees in the eastern portion.

2.3 Topography

The topography of the area surrounding the site is essentially flat. The topography of the site itself has been heavily modified over several decades and comprises a mixture of flat areas (sports fields), undulating terrain (BMX track and area surrounding the stormwater retention pond) and terraces / embankments.

The central area of the site is relatively flat and lies at an elevation of approximately 30 m relative to the 1937 Lyttelton vertical datum (LVD). The stormwater retention pond lies at approximately 27 mLVD, while the eastern end of the site lies at approximately 28 mLVD. The stormwater retention pond is bounded to the west and south by a raised embankment walkway, and to the north and east by grassed embankments (Photograph 1, Appendix A). Generally, the site boundaries along Waterloo Road, Smarts Road and the rail lines comprise grassed embankments (Photograph 2, Appendix A).

2.4 Geological setting

The published geology[5] of the area indicates that the site is underlain by Holocene-age (less than 10,000 years old) alluvial gravel, sand and silt of historic Waimakariri River flood channels. This is collectively referred to as the Yaldhurst Member of the Springston Formation. Prior to human modification these soils would have been the dominant near-surface materials at the site. In this inland area of Christchurch, the Springston Formation deposits are directly underlain by well-graded gravels known as the Riccarton Gravels. These gravels may contain artesian groundwater pressures where capped by a low permeability clayey silt or peat layer.

[5] Brown, L.J., Weeber, J.H. 1992: Geology of the Christchurch Urban Area. Institute of Geological & Nuclear Sciences Geological Map 1. Scale 1:25 000.

3 Ground contamination desktop study

Site observations made by an environmental scientist from T+T at the time of the site walkover on 27 August 2015 are summarised below with key areas of interest shown on Figure A1 and Photographs 3 - 7 in Appendix A.

- Observations of the ground surface indicated the sporadic presence of humps and hollows across the site. At the time of the site walkover the cause of these humps and hollows was not apparent.
- The majority of the site was covered with grass. Mature trees are scattered across the area with high density stands in the eastern and western ends of the site. Sporadic patches of what appeared to be stressed vegetation were observed at various locations, with an example shown in Photograph 3 (Appendix A). At the time of the site walkover the cause of the stressed vegetation was not apparent.
- Waste materials (such as concrete fragments, bricks, and glass) were observed along the embankment at the southeastern site boundary.
- Waste materials (such as concrete fragments, bricks, plastic, and glass) were observed along the embankment at the southwestern site boundary (Photograph 5). A fragment of friable fibreboard was found on the ground surface at this location (refer Figure A1 and Photographs 5-6, Appendix A). The fibreboard was tested for asbestos presence/absence at IANZ accredited laboratory. The results indicated that the fibreboard contained amosite, chrysotile and crocidolite (white, brown and blue) asbestos (refer to Appendix B for laboratory test results).
- It is not clear from our brief walkover whether the demolition materials observed at the southeast and southwest embankments were placed on top of the embankment (i.e. fly-tipped) or were exposed due to ground surface disturbance.
- A small pile of refuse materials was observed to the south of the BMX track, which appeared to be recently placed (Photograph 7).

3.1 Site history

Historical information relating to the site has been collected from a variety of sources including the CCC property files, an ECan site contamination enquiry, historic aerial photographs, and current and historical certificates of title (CT). This historical review deals mainly with on-site activities, except for the aerial photograph review where comments are also provided on the readily observable surrounding areas. The information reviewed is summarised in the following sections.

3.1.1 Site ownership

Our review of the post-1870 CTs combined with information obtained from the other historic data sources described in this section, indicates the following progression of site ownership:

- A CT (24/74) for an approximately 8 ha section of the site was issued to John L. Wilson of Christchurch in 1877. The site was subsequently divided and two new CTs were issued:
  - A CT (32/232) was issued for the section at the western corner of the site to K. Burnett in 1878; and
  - A CT (33/76) for the remainder of the land (approximately 6.8 ha) was issued to J. L. Wilson in 1878. The land was subsequently transferred to various proprietors until being transferred to the Smart family in 1919. In 1930 and 1931 the land was transferred to Smart & Sons Ltd. The land was transferred in 1961 to Paparua County Council. Additional information between 1931 and 1961 was documented on the CT, however, it was illegible.

- A CT (23/200) was issued for an approximate 2 ha section at the north-western site boundary to Charles N. Bell in 1877. The land was transferred in 1883 to John L. Lawson and Ann Lawson.
- A CT (92/161) was issued for a section at the northeast corner of the site to a Charles N. Bell in 1883. The land was transferred to different proprietor until 1950 when it was transferred to the Smart family, and subsequently, in 1964 when it was transferred to Paparua County Council.
- A CT (2A/1119) for an approximately 0.11 ha section of the site, designated as RS 38277, was issued to Smart and Sons Ltd in 1960.
- A CT (8A/391) for Lot 2 DP 34558 was issued to Smart and Sons Ltd in 1968. The land was transferred to Paparua County Council in 1974 and a new CT (the current CT) was established (14A/1326).
- A CT (8A/572) for Lot 1 DP 25716 RS 38277 & part of RS 3554 was issued to Paparua County Council in 1968.
- A CT (45A/841) for Lot 1 DP 78681 was issued to CCC in 1998 (the current CT).
- The current CTs confirm that the site is owned by CCC.

No information relating to the actual uses of the land parcels was evident from the historic certificates of title/transfer of interests. However, the CTs indicate that Paparua District Council (subsequently CCC) acquired the site during the 1960s.

A copy of the two current certificates of title are provided in Appendix C.

3.1.2 Aerial photograph review

Historic aerial photographs were obtained from the Canterbury GIS Viewer for this review (these are reproduced as Figures D1 – 9 in Appendix D). Observations relating to the site and surrounds based on our review from each aerial photograph are provided in Table D-1 (refer Appendix D) with the main features summarised below:

- The site was used as a quarry from at least 1941 to the 1960s. The extent of quarrying operations appear to reach the current boundaries of the site, although the depth of excavation is unknown.
- From approximately 1965 to at least 1973, the site was filled and extensive landscaping had occurred.
- From approximately 1984 onwards, the site was used as a recreational park that contained a BMX track at the western end and playing fields at the eastern end of Kyle Park. In the late 1990s / early 2000s, a stormwater retention pond was established at the western end of Kyle Park and the BMX track was relocated further east.

3.1.3 CCC property file review

The CCC property files for the site were reviewed on 27 August 2015. Relevant historical information identified in the property files is summarised below with source information provided in Appendix E:

- In a 1990 CCC "Hazard and Special Site Characteristics" document, it is stated that the site was previously an uncontrolled general refuse landfill run by Paparua County Council until 1981. The exact depth and perimeter of the landfill is unknown.
- In a 1999 Christchurch City Council plan, a landfill gas ventilation unit was installed in the Christchurch BMX Club hut, located at the centre of the site.
- In 1999, a consent to construct a stormwater retention and treatment pond was granted. The construction plans included: cut and fill details around the pond construction area, the

relocation of the BMX track, and the construction of an embankment around the pond. In an assessment of environmental effects by Woodward-Clyde[6] that was attached to the consent, it is stated that:

  - The site was formally owned by the Smart Family and was used as a quarry;
  - Christchurch City Council purchased the site in 1960s and landfilling occurred until 1972, after which, the landfill was compacted and contoured. In 1985/1986, silt was placed on top of the central low area and topsoil was brought in for the playing fields.

- In 2003, a consent was issued to demolish an existing building and construct a public toilet facility that was located at the northern edge of the site. The conditions attached to the tender document stated that the foundations should be excavated to 1 m below ground level, but if fill material was encountered then excavations were to go deeper. The document also stated that all excavated materials were to be removed off-site.

3.1.4 Christchurch City Library heritage records

Christchurch City Library records[7] indicate that Smart's Pit was established at 197 Waterloo Road sometime around 1884. This was a gravel pit and stone-breaking plant which supplied stone and sand for the development of local road and rail infrastructure. Quarrying and associated operations continued at the pit until 1968 when the land was purchased by the Paparua County Council for use as a rubbish dump. In 1973 the dump was shut down. By 1981 the former pit / dump and adjoining land had been named Kyle Park and developed into sports fields used for rugby, cricket and hockey along with a BMX track in the western corner.

3.1.5 ECan contamination enquiry

An enquiry to the ECan Listed Land Use Register (LLUR) was placed by a T+T environmental scientist on 28 August 2015 and a copy of the letter is provided in Appendix F. The LLUR (ID 25086) identified that the site was on a former landfill that operated from pre-1973 to approximately 1984 (note, other historical information, as discussed in this report, document that the landfill was decommissioned in the 1970s). The site is classified as HAIL[8] activity G3 – "Landfill sites" and is categorised as "Not Investigated".

3.2 Potential for ground contamination

Our review of the available information indicates that HAIL activities were undertaken at the site. The activities, potential contaminants and an assessment of the likelihood, potential magnitude and possible extent of contamination are presented in Table 3.1 (below).

[6] Woodward-Clyde, 1999. Assessment of Environmental Effects; Stormwater Retention and Treatment Pond, Kyle Park.
[7] Christchurch City Library heritage records, July 2015.
http://christchurchcitylibraries.com/Heritage/PlaceNames/ChristchurchPlaceNames-A-M.pdf
[8] HAIL means the current edition of the Hazardous Activities and Industries List, Wellington, Ministry for the Environment.

Table 3.1 – HAIL activities

Land use/activity	Potential contaminants	Likelihood, magnitude and possible extent of contamination	HAIL reference
Landfilling	Dependent on original waste composition. Potential contaminants include hydrocarbons, heavy metals, organic acids, landfill gas, and ammonia.	The ECan LLUR suggests the site was previously used as an uncontrolled landfill. Details on the landfill, such as its composition and depth are currently unknown. The likelihood of ground contamination is high and would likely encompass most of the site. Contamination of the groundwater, via leachate, is also likely.	Yes Activity G3 – Landfill sites.
Use of pesticides on playing field areas.	Heavy metals, herbicides, organophosphates and possibly organochlorides.	There has been a playing field located towards the eastern site boundary since at least 1984. Pesticides may have been applied to the playing field during this time. Low likelihood of contamination, which (if present) would likely to be restricted to shallows soils in the playing field areas.	Yes Activity A10 – Persistent pesticides bulk storage or use including sport turfs, market gardens, orchards, glass houses or spray sheds.
Surface debris	Asbestos.	During a site walkover, a piece of asbestos fibreboard was observed on an embankment at the northwestern site boundary. It was noted that the same embankment also had visible surface debris typically associated with demolition material (i.e. concrete and brick) on it. As only a brief site walkover was undertaken, there is a potential for more asbestos containing materials to be present on-site.	Yes Activity I – land that has been subject to the intentional or accidental release of hazardous substance in sufficient quantity that it could be a risk to human health or the environment.

3.2.1 Preliminary conceptual site model

A conceptual model as defined by the MfE CLMG No. 5[9], sets out known and potential sources of contamination, potential exposure pathways, and potential receptors. For there to be an effect from the proposed activity there has to be a contamination source and a mechanism (pathway) for contamination to affect human health or the environment (receptor).

A preliminary conceptual site model has been developed for the proposed site development activity which takes into account the available information about the site, and our understanding of the potential effects on human health and the environment. The model is presented below.

[9] Ministry for the Environment, updated 2011, *Contaminated Land Management Guidelines No. 5 Site Investigation and Analysis of Soils*

Table 3.2 – Preliminary conceptual site model

Source	Pathway	Current Receptors	Future Receptors
Landfill material	Inhalation of dust, inhalation of landfill gases, dermal contact, and incidental ingestion.	Recreational park users, CCC park maintenance workers, surrounding residents, and commercial property employees and customers.	Construction and excavation workers during possible site development. Future Library and Service Centre users (if applicable).
	Mobilisation of contaminants via groundwater migration.	The Heathcote River aquatic ecosystem and recreational users.	Same as current receptors.
Contaminated soil from pesticide usage	Inhalation of dust, dermal contact, and incidental ingestion.	Recreational park users, CCC park maintenance workers, surrounding residents, and commercial property employees and customers.	Construction and excavation workers during possible site development. Future Library and Service Centre users (if applicable).
Asbestos	Inhalation of asbestos fibres.	Recreational park users, CCC park maintenance workers, surrounding residents, and commercial property employees and customers.	Construction and excavation workers during possible site development. Future Library and Service Centre users (if applicable).

3.3 Regulatory framework and implications

The rules and associated assessment criteria relating to the control of contaminated sites in the Canterbury region are specified in the following documents:

- NES Soil.
- The Christchurch City Plan (City Plan).
- ECan's Land and Water Regional Plan (LWRP), Natural Resources Regional Plan (NRRP) and proposed Canterbury Air Regional Plan (pCARP).

The NES Soil and City Plan contain provisions relating to land use and the protection of human health. The ECan regional plans contain provisions relating to the protection of the general environment including ecological receptors. A summary of potential resource consent requirements under each of these regulatory instruments is set out below.

3.3.1 NES Soil

The NES Soil came into effect on 1 January 2012. The NES Soil sets out nationally consistent planning controls appropriate to district and city councils for assessing contaminants in soil with regard to human health. The NES Soil prevails over the rules in the City Plan, except where the rules permit or restrict effects that are not related to effects on human health. The NES Soil does not apply to any functions of regional councils and does not affect rules in regional plans (Regulation 4(b)).

The NES Soil applies to specific activities on land where a HAIL activity is known to have occurred, or is more likely than not to have occurred. Activities covered under the NES Soil include soil disturbance, soil sampling, fuel systems removal, subdivision and land use change. Table 3.3 (below), which is based on the NES Soil Users Guide (April 2012), confirms that the NES Soil applies to the site.

Table 3.3 – PSI Checklist

NES Soil Requirement	Applicable to site?
Is an activity described on the HAIL currently being undertaken on the piece of land to which this application applies?	Yes
Has an activity described on the HAIL ever been undertaken on the piece of land to which this application applies?	Yes
Is it more likely than not that an activity described on HAIL is being or has been undertaken on the piece of land to which this application applies?	Yes
If 'Yes' to any of the above, then the NES Soil may apply. **The five activities to which the NES applies are:**	
Is the activity you propose to undertake removing or replacing a fuel storage system or parts of it?	No
Is the activity you propose to undertake sampling soil?	No
Is the activity you propose to undertake disturbing soil?	Likely
Is the activity you propose to undertake subdividing land?	No
Is the activity you propose to undertake changing the use of the land?	Likely
Conclusion: The NES Soil likely applies to Kyle Park, 197 Waterloo Road, depending on the nature of the proposed redevelopment works	

3.3.2 NES Soil activity status

Details regarding the proposed development at the site are not yet available. Therefore, we cannot assess the likely resource requirements at this time. Subject to the activities that will be carried out as part of any site development work then the NES Soil Permitted Activity (PA) conditions for soil disturbance and land use change will need to be considered to assess whether resource consent is required under the NES Soil.

3.3.3 Christchurch City Plan

As noted in Section 3.5.1 above, the NES Soil now prevails over the rules in the City Plan, except where the rules permit or restrict effects that are not dealt with in the NES Soil. The City Plan contains a rule within the earthworks provisions that relates to contaminants in soil. Part 9, Critical Standard Rule 5.8.1 is as follows:

> *In addition to compliance with the standards relating to the volume and depth of filling and excavation in Clauses 5.2 and 5.3 of these rules, any filling or excavation of land, is a non-complying activity where:*
>
> *a) The fill or excavated material contains putrescible, pollutant, inflammable or hazardous components; and/or*
>
> *b) Fill consists of material other than soil, gravel, sand, silt, or demolition material, and/or has a particle size in excess of 200 mm; and/or*
>
> *c) Fill material consists of vegetation which comprises more than 5% of any load by volume, and/or which is derived from a different site to the rest of the fill material except that this rule shall not apply to any filling or excavation on any land within the Special Purpose*

(Landfill) Zone, and rule 5.4.1 (b) shall not apply to the Rural Quarry Zone in respect to particle size.

This rule seeks to protect water quality as well as human health. Therefore, it applies in addition to the provisions of the NES Soil.

Any excavation on the site will require resource consent as a non-complying activity under this rule if the excavated material contains 'hazardous components', as advised by CCC staff.

3.3.4 Regional Plans

The following regional plans contain objectives, policies and rules that may be relevant to any earthworks, including disturbance of contaminated soil, undertaken on the site:

- The LWRP has been developed to manage the effects of activities on land or water within the Canterbury Region. The LWRP became partially operative on 1 September 2015, and the rules that relate to earthworks and contaminated land at this site are operative.
- The provisions in the NRRP that relate to land and water have been partially superseded by the LWRP. The provisions that relate to air quality remain operative.
- The pCARP seeks to implement a new air quality management framework for Canterbury. The plan was publicly notified in February 2015 and the rules have legal effect as of that date.

The resource consents required will depend on the details of the proposed works (e.g. volume and depth of soil disturbed) and the results of any soil testing. The proposed works may require resource consent from ECan under the rules in the LWRP for the discharge of stormwater from a contaminated site to land or to water, and any discharges of dust may require consent under the NRRP and/or pCARP. Resource consent may also be required for other activities that form part of the site development works e.g. earthworks, dewatering.

3.4 Conclusions

This desktop-based assessment has been undertaken to identify current and historic activities that have occurred at the site and the potential for these activities to have resulted in ground contamination, including implications for the proposed development.

The site was previously used as a quarry since at least 1941. In the 1960s, the site was procured by Paparua County Council and was used as an uncontrolled landfill until 1981. Following the decommissioning of the landfill the site was converted to a recreational park. The site presently contains a stormwater retention pond, a BMX track and playing fields. Debris typically associated with demolition material, such as concrete, bricks and plastic was observed on the ground surface at the southwest and southeast embankments. In addition, a piece of asbestos-containing fibreboard was found on the ground surface on the southwest embankment. It is not clear from our brief walkover whether the observed demolition materials were placed on top of the mulch (i.e. fly-tipped) or exposed due to disturbance of the ground surface. Given the nature of our site walkover it is possible that more asbestos-containing material is present on the site.

The following HAIL activities have been identified at the site:

- Previous landfilling activities.
- Persistent use of pesticides on the playing fields.
- Intentional or accidental release of hazardous substances (i.e. asbestos).

Based on the current information it is likely that any development on the site will require:

- Consideration of resource consent requirements relating to the NES Soil and rules in the Regional Plans.
- The disposal of soils to an appropriate landfill, if required.
- Controls to mitigate possible discharge of contaminants to air and water during earthworks.
- A site management plan to determine the health and safety controls required when conducting earthworks on-site.

3.5 Recommendations

Based on our mainly desktop-based ground contamination assessment it is recommended that a two-part detailed site investigation (DSI) be conducted into the extent of contamination from the identified HAIL activities. The first part of the DSI should be undertaken to assess if more asbestos containing materials (ACM) are present on the site, as soon as possible. The DSI would assist in the identification of management options for any asbestos remaining on site, in the context of the continued recreational use of the site.

Given that the site is currently used as a recreational park then there is a potential for the friable asbestos, if present in further quantities, to be disturbed and for site users to be exposed to the disturbed and surficial asbestos material. As a specific assessment of the site for the presence of asbestos has not been completed, the extent and potential risk associated with further additional asbestos material (if present) on the site cannot be assessed. However, as a precautionary approach, T+T recommends that the embankment areas where building/demolition materials were observed are fenced to prevent public access as a matter of urgency.

The second part of the DSI should be undertaken once more specific development plans are available, which would help identify the resource consents required for the proposed development. This would also help to identify potential cost implications of developing on this site, including, but not limited to the management of fill materials previously disposed of at the site.

4 Geotechnical desktop study

4.1 Site history considerations

Given that the historical gravel pit and landfill footprint occupies almost the entire site, it must be appreciated that there are little to no natural near-surface materials remaining. The depth below ground at which natural materials would be encountered is unknown, but this is expected to be variable across the site and may be in the order of 3 to 8 m. This fill thickness would only be able to be confirmed by intrusive ground investigations at the site itself.

4.2 Existing geotechnical information

4.2.1 Published geological information

Published geology[10] indicates that the site is underlain by Holocene-age (less than 10,000 years old) gravels, sands and silt. These represent the deposition of historic river flood channel sediments from distributaries of the Waimakariri River. These sediments are collectively known as the Yaldhurst Member of the Springston Formation and prior to human modification these soils would have been the dominant near-surface materials at the site. In this inland area of Christchurch, the Springston Formation deposits are directly underlain by well-graded gravels known as the Riccarton Gravels. These gravels may contain artesian groundwater pressures where capped by a low permeability clayey silt or peat layer.

4.2.2 Canterbury Geotechnical Database

A review of the Canterbury Geotechnical Database[11] (CGD) revealed several intrusive ground investigations in the vicinity of the site. Due to fill materials being the dominant near-surface materials at the site itself, only investigations which penetrated more than 3 metres below ground level were considered. Figure G1 (refer Appendix G) shows the locations of the 13 deep borehole investigations which were reviewed in our assessment. These investigations are located between 200 m and 1.3 km away from the site and may not accurately represent the conditions within the upper soil profile underlying the site. Copies of the borehole logs are provided in Appendix G. The naturally occurring stratigraphy observed from the available borehole information is in general agreement with the published geological information for the site area.

4.2.3 Stratigraphy

Based on our review of the published geological information and borehole data, we infer that the general stratigraphy of the site is as summarised in Table 4.1 below.

[10] Brown, L.J., Weeber, J.H. 1992: Geology of the Christchurch Urban Area. Institute of Geological & Nuclear Sciences Geological Map 1. Scale 1:25 000.
[11] https://canterburygeotechnicaldatabase.projectorbit.com

Table 4.1 – Inferred generalised subsurface profile

Layer	Geological Unit	Description	Approximate depth to top of layer (m)	Approximate layer thickness (m)
1	Topsoil and fill	Variable FILL. Unknown thickness and composition (likely comprises manmade, organic and locally won ground materials).	0	3 – 8*
2	Yaldhurst Member of the Springston Formation	Sandy fine to coarse GRAVEL, with minor silt. Medium dense to very dense. Occasional sand and / or silt layers (typically <1 m thickness). Loose / soft to dense / stiff.	3 – 8*	10 – 15
3	Riccarton Gravel	Fine to coarse GRAVEL with some sand. Dense to very dense.	15 – 20	>10

* Estimated provisional value based on greatest likely depth of gravel pit from interpretation of historical aerial photographs.

4.2.4 Ground and surface water

Groundwater is likely to be encountered at the site between 10 and 13 metres below ground level. Groundwater levels are likely to vary seasonally (by up to 2 metres), as well as in response to rainfall patterns and flood events in nearby watercourses. Surface water level in the stormwater retention pond at the western end of the site is approximately 7 to 10 metres higher than the level of the natural groundwater level. The closest significant watercourse is at least 3 km to the east of the site.

4.3 Geotechnical considerations

4.3.1 Building foundations

Constructing buildings on former landfills can be very challenging due to the potential for unplanned settlement to occur within the fill. We expect that the landfill material underlying various areas of the site will be highly variable, with random voids, soft spots and organic material that could decompose over time and lead to settlement and subsidence at the ground surface. This provides the potential for unplanned and unpredictable differential settlement and / or loss of bearing capacity that can cause damage to overlying structures that are built on shallow foundations.

Therefore, for any building that is considered as part of any site development, a detailed geotechnical investigation will be required to characterise the materials beneath the proposed structure(s). This would likely comprise machine-drilled boreholes and test pit investigations to observe the materials that are encountered and assess the strength and likely settlement characteristics of the soil profile. The depth and scope of the investigations will need to be sufficient to ensure that the extent of the landfill materials can be clearly established. Depending on the type of structure(s) and associated foundation loads considered for the development then various options can be assessed to address the geotechnical conditions, including:

1 Ground improvement measures, such as dynamic compaction, impact rolling, or construction of a compacted gravel capping layer (which may include geogrid reinforcement). For example, ground improvement using an impact roller followed by the construction of a 1 m thick gravel raft reinforced with 2 layers of geogrid has been used elsewhere to support relatively light-

weight single level buildings located on a former landfill with only minor to moderate amounts of poorer quality fill materials.

2 Pile foundations may be required if ground improvement measures are not practical. Pile design will require careful consideration of potential obstructions in the landfill material which may affect pile driving.

The extent of potential soil excavation associated with a particular foundation system will need to be considered since the cost of disposing of contaminated soil can be significant. In addition, the possible presence of landfill gas will need to be assessed and appropriately considered in the design of any foundation system.

4.3.2 Site subsoil class

The site subsoil category is assessed to be Class D (deep or soft soil sites) in terms of NZS1170.5[12]. A potential library structure would be designed to the serviceability and ultimate limit state (SLS and ULS) earthquake actions as set out in Table 4.2 (below).

Table 4.2 – Design earthquake actions

Design earthquake action*	Magnitude	Peak ground acceleration	Event return period (years)
SLS1	7.5	0.13 g	25
SLS2	6.0	0.19 g	25
ULS	7.5	0.44 g	1,000

* Assuming a 50 year design life and an Importance Level 3 building (i.e. more than 250 occupants)

4.3.3 Liquefaction

Disruption at the ground surface due to liquefaction is not expected to occur at the site. This is due to the expected significant depth to the groundwater table (at least 10 m) and the nature of gravel soils expected to be present at or below this depth. A review of the post-earthquake aerial photography and satellite imagery suggests that no ground disruption or surface expression of liquefaction was observed at, or in the general vicinity of, the site throughout the Canterbury earthquake sequence (CES) of 2010 and 2011[13].

4.3.4 Paved areas

We consider that the construction of pavements and / or carparking areas is likely to be feasible at the site. Consolidation and / or settlement of landfill material, either due to decomposition of organic material within the fill and/or under traffic loads may occur, which could damage overlying pavement. There are two general approaches to deal with this:

1 Accept the pavement damage and make allowance for potential future maintenance / repair costs.

2 Improve initial pavement performance by, for example, increasing pavement thickness, adding geogrid reinforcement to the subgrade, etc.

4.3.5 Sport and recreation areas

Given its current use and performance throughout the CES, we consider that geotechnical considerations do not preclude the future development of recreational areas and sports fields,

[12] Standards New Zealand: NZS1170.5: 2004. Structural Design Actions, Part 5: Earthquake Actions, New Zealand.
[13] Canterbury Geotechnical Database, https://canterburygeotechnicaldatabase.projectorbit.com

provided the potential for future localised subsidence due to decomposition of organic fill material is accepted.

4.4 Further work

If CCC wishes to consider developing the site for building and / or pavement construction then intrusive ground investigations will be required to understand the nature of the underlying man-made fill and natural soils. A geotechnical investigation, assessment and design scope for structures should include:

- Machine-drilled boreholes[14] advanced to approximately 20 m depth (sufficient to establish the thickness of the fill materials and penetrate a significant depth into natural soils). Standard Penetration Tests (SPTs) should be carried out at 1.5 m intervals.
- Test pit investigations to observe and characterise the landfill material.
- Assessment of ground improvement options based on the results of the ground investigations and the nature of the proposed structure(s).
- Ground improvement design, construction and monitoring.
- Detailed foundation design, construction and monitoring.

For new carparking / pavement areas then the scope should include:

- Test pit investigations to characterise the materials underlying the pavement areas. Depending on the materials encountered then Dynamic Cone Penetration (DCP) tests and associated hand auger boreholes may be appropriate to provide soil strength information. The depth of these investigations will depend on the nature of the materials encountered, but should be sufficient to clearly identify the depth of any underlying landfill material.
- Pavement design, construction and monitoring.

The final investigation scope of work should be developed and confirmed based on the specific development plans for the site.

[14] The site is considered to be unsuitable for Cone Penetration Tests (CPTs) due to the expected subsurface soil conditions.

5 Applicability

This report has been prepared for the benefit of Christchurch City Council with respect to the particular brief given to us and it may not be relied upon in other contexts or for any other purpose without our prior review and agreement.

The purpose of this report is to provide information and recommendations to assist CCC in the development of their Master Plan for Hornby. Further ground contamination and geotechnical work (investigations, analyses, assessments) will be required to complete detailed design work for the chosen development option(s).

Tonkin & Taylor Ltd

Prepared for Tonkin & Taylor Ltd by:

Anna Winkley

Geotechnical Engineer

Prepared for Tonkin & Taylor Ltd by:

Louise Murphy

Environmental Scientist

Reviewed for Tonkin & Taylor Ltd by:

Hayden Bowen

Geotechnical Engineer

Reviewed for Tonkin & Taylor Ltd by:

Paul Walker

Senior Contaminated Land Specialist

Authorised for Tonkin & Taylor Ltd by:

Gordon Ashby

Project Director / Senior Geotechnical Engineer

AMMW
p:\53404\53404.0020\workingmaterial\2015.08.17.ammw.rep.geo+groundcontam.desktop.v04 final.docx

Appendix A: Site layout and photographs

LEGEND

- Property Boundaries
- Raised Path
- Area where topography ≈ 2 m lower than the surrounding area
- Embankment were surface debris was visible
- Site Boundary

A3 SCALE 1: 2500

0 50 100 150 (m)

ORIGINAL IN COLOUR

NOTES:

1. Aerial photo sourced from Linz Data Service <https://data.linz.govt.nz/layer/Christchurch Post-Earthquake 0.1m Urban Aerial Photos (24 February 2011)> , licensed by LINZ for re-use under the Creative Commons Attribution 3.0 New Zealand licence (CC BY 3.0 NZ)
2. Property boundaries sourced from Terralink International (Copyright 2002-2005 Terralink International Limited and its licensors).

Tonkin+Taylor
33 Parkhouse Road, Wigram, Christchurch
www.tonkintaylor.co.nz

DRAWN	NSW	Sep. 15
DRAFTING CHECKED	TGM	9/15
APPROVED	TGM	9/15
CADFILE : \\53404.002-FA1.dwg		
SCALES (AT A3 SIZE) 1: 2500		
PROJECT No. 53404.002		

CHRISTCHURCH CITY COUNCIL

KYLE PARK
197 WATERLOO ROAD
Site Feature Plan

FIG. No. 53404.002-FA1 REV. 0

Photograph 1: A stormwater retention pond on the site. Date taken: 27/08/15; photo facing north.

Photograph 2: The different topography of the site to its surrounds. Date taken: 27/08/15; photo facing the northeast.

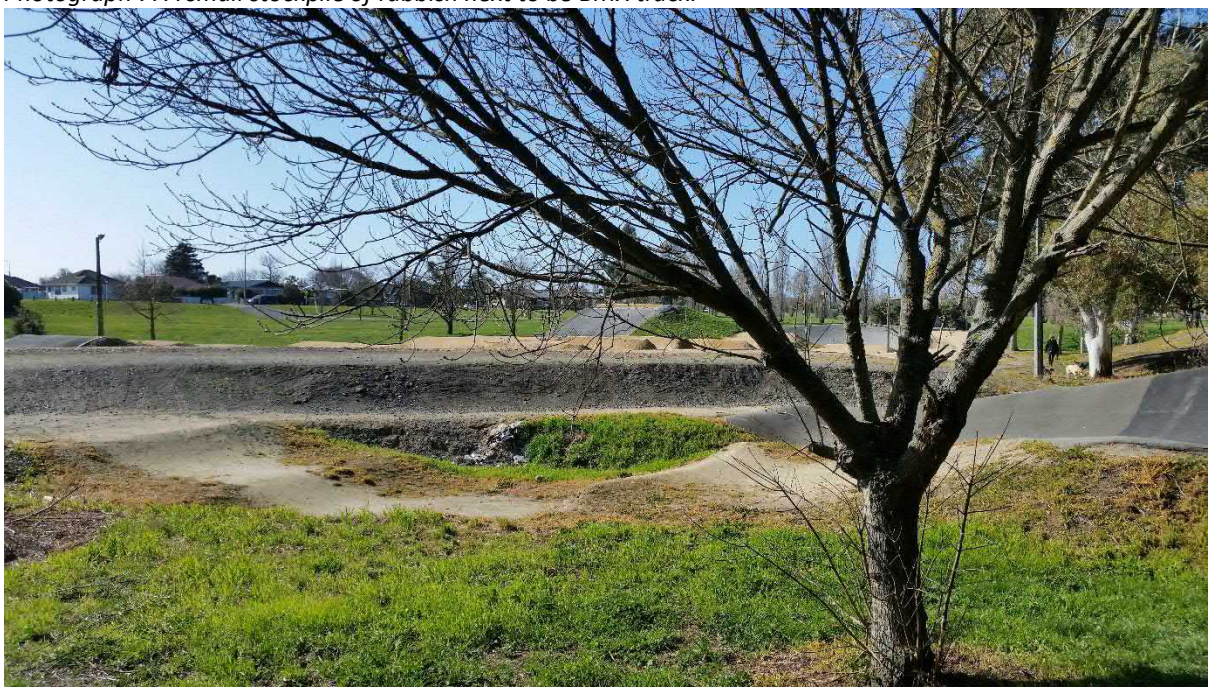
Photograph 3: An area of stressed vegetation is visible on the field. Date taken: 27/08/15; photo facing the east.

Photograph 4: A concrete fragment visible on the ground surface by the southwestern embankment. Date taken: 27/08/15; photo facing west.

Photograph 5: A photograph of the embankment where the asbestos fibreboard was found. Date taken: 27/08/15; photo facing south.

Photograph 6: An asbestos fragment amongst the bark mulch on the embankment. Date taken: 27/08/15.

Photograph 7: A small stockpile of rubbish next to be BMX track.



Appendix B: Asbestos results

DATE: 31st August 2015

JOB NUMBER: J106102 (1)

PRECISE
CONSULTING & LABORATORY

Tonkin and Taylor (Christchurch)

33 Parkhouse Road
Wigram
Christchurch
8042

Client Reference: 53404.002

Dear Mark Morley,

Re: Asbestos Identification Analysis – 197 Waterloo Road, Hornby 8042

One (1) samples received on 28th August 2015 by Luana Piuila-Afitu.

The results of fibre analysis were performed by Julian Staite of Precise Consulting and Laboratory Ltd on 31st August 2015.

The sample(s) were stated to be from 197 Waterloo Road, Hornby 8042.

Sample analysis was performed using polarised light microscopy with dispersion staining in accordance with the guidelines of *AS4964-2004 Method for the qualitative identification of asbestos in bulk samples.*

The results of the fibre analysis are presented in the appended table.

Should you require further information please contact Julian Staite.

Yours sincerely

Julian Staite
PRECISE LABORATORY IDENTIFIER

Precise Consulting & Laboratory Ltd Limited
Unit 4, 91 Byron Street, Sydenham, Christchurch 8023
P: (03) 943 5394 W: www.preciseconsulting.co.nz

Sample Analysis Results

PRECISE
CONSULTING & LABORATORY

Job No: J106102

31 August 2015

Note 1: The reporting limit for this analysis is 0.1g/kg (0.01%) by application of polarised light microscopy, dispersion staining and trace analysis techniques.
Note 2: If mineral fibres of unknown type are detected (UMF), by PLM and dispersion staining, these may or may not be asbestos fibres. To confirm the identity of this fibre, another independent analytical technique such as XRD analysis is advised.
Note 3: The samples in this report are "As Received" the laboratory does not take responsibility for the sampling procedure or accuracy of sample location description.
This document may not be reproduced except in full.

Identified by:

Julian Staite
Approved Identifier

Reviewed by:

Tim Trembath
Key Technical Person

Site Address: 197 Waterloo Road, Hornby 8042			
Sample ID	Client Sample Number	Sample Location/Description/Dimensions	Analysis Results
BS026014	GS1	Discrete Sample L1 - Cement Sheet 45 x 35 x 6 mm	Amosite + Chrysotile + Crocidolite (Brown,White & Blue Asbestos)

Precise Consulting & Laboratory Ltd Limited
Unit 4, 91 Byron Street, Sydenham, Christchurch 8023
P: (03) 943 5394 W: www.preciseconsulting.co.nz

Appendix C: Current Certificate of Title

COMPUTER FREEHOLD REGISTER
UNDER LAND TRANSFER ACT 1952

Search Copy

R.W. Muir
Registrar-General
of Land

Identifier	**CB45A/841**
Land Registration District	**Canterbury**
Date Issued	14 July 1998

Prior References
CB8A/572

Estate	Fee Simple
Area	7.0429 hectares more or less
Legal Description	Lot 1 Deposited Plan 78681

Proprietors
The Christchurch City Council

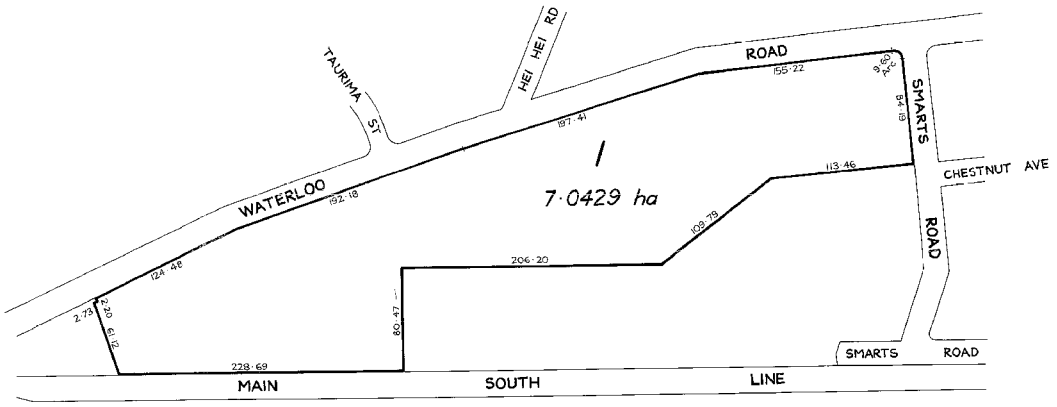
Estate	Fee Simple
Area	7.0429 hectares more or less
Legal Description	Lot 1 Deposited Plan 78681
Purpose	Recreation Reserve

Proprietors
The Christchurch City Council

Interests

Subject to Section 59 Land Act 1948 (affects the part formerly in RS 38277)

Appurtenant hereto is a right to convey water over part Lots 1 and 2 DP 34558 CsT CB14A/1325 and CB14A/1326 coloured blue and sepia on the diagram in and created by Proclamation 466399 - 17.9.1957 at 1.41 pm (affects the part formerly in RS 38277)



NEW CT ALLOCATED : 45A/841

PARCEL	FORMERLY	CT REF
Lot 1	Pt Lot 1 D.P. 25716	8A/572

Reference Plans D.P.'s 25716 & 78499

Total Deduced Area 7·0429 ha

Approved for CT diagram purposes only

Deputy Chief Surveyor

Deposited for CT diagram purposes only

14/1/1999

District Land Registrar

DISTRICT LAND REGISTRAR CANTERBURY N.Z.

LAND DISTRICT CANTERBURY
Survey Blk. & Dist. 1X Christchurch

PLAN OF LOT 1 FOR CT DIAGRAM PURPOSES

TERRITORIAL AUTHORITY Christchurch City
Surveyed by Terralink NZ Ltd
Scale Proportional Date 16 June 1998

Drawn by J.K.R.
Checked by BM

DP 78681

Approved CH 97/3

A.J.BEVIN, SURVEYOR GENERAL, LAND INFORMATION NEW ZEALAND

COMPUTER FREEHOLD REGISTER
UNDER LAND TRANSFER ACT 1952

Search Copy

R.W. Muir
Registrar-General
of Land

Identifier	**CB14A/1326**
Land Registration District	**Canterbury**
Date Issued	02 October 1974

Prior References
CB8A/391

Estate	Fee Simple
Area	1.6590 hectares more or less
Legal Description	Lot 2 Deposited Plan 34558
Purpose	Reserve

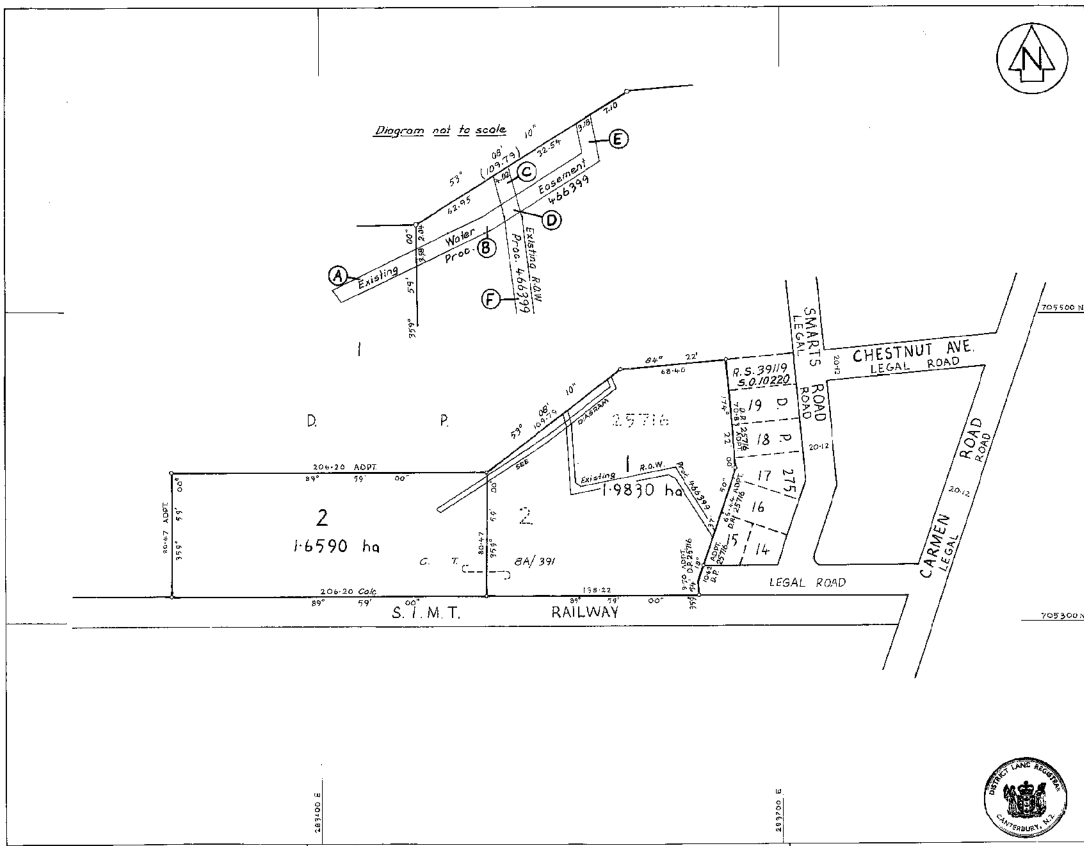
Proprietors
The Paparua County Council

Interests

Subject to the Reserves and Domains Act 1953

466399 Proclamation creating the following easements - 17.9.1957 at 1.41 pm

Type	Servient Tenement	Easement Area	Dominant Tenement
Convey water	Lot 2 Deposited Plan 34558 - herein	Part herein	Rural Section 38277 - CT CB8A/572



Approvals.

REGISTERED OWNER.

The Paparua County Council certifies that there is no operative district scheme under the Town & Country Planning Act 1953 which affects the subdivision shown hereon.

Dated 10:4:74

County Engineer

In pursuance of the Provisions of Section 34 of "The Counties Amendment Act 1961," the Paparua County Council hereby approves of the Plan of Subdivision shown hereon.

IN WITNESS WHEREOF the Common Seal of the Corporation of the County of Paparua was hereto affixed this 11th day of April 1974, in the presence of

CHAIRMAN

COUNTY CLERK

EXISTING EASEMENTS

Purpose	Shown	Serv. Ten.	Dom. Ten.	Doc.
R.O.W.	C,D & F	Lot 1	P^t C.T. 8A/572	Proc. 466399
Convey Water	A,B,D & E	Lots 1 & 2	P^t C.T. 8A/572	Proc. 466399

Lot 2 has no legal frontage

Total Area 3·6420 ha

Comprised in C.T. 8A/391

I, GRAHAM HARVEY FOWLER of CHRISTCHURCH Registered Surveyor and holder of an annual practising certificate hereby certify that this plan has been made from Surveys executed by me or under my direction; that both plan and Survey are correct and have been made in accordance with the regulations under the Surveyors Act 1966

Dated at CHRISTCHURCH this 4TH day of MARCH 1974 Signature

Field Book p. Traverse Book p.

Reference Plans

Examined K.P. Shone CB.427 Correct

Approved as to Survey

22.7.74. Chief Surveyor

Deposited this 26th day of July 1974

District Land Registrar

LAND DISTRICT CANTERBURY SURVEY BLK.& DIST. IX CHRISTCHURCH NZMS 177 SHEET No. S.84	464,465 LT 2/55 LOTS 1 & 2 BEING SUBD. OF LOT 2 D.P. 25716.	LOCAL AUTHORITY PAPARUA COUNTY Surveyed by T.E. MILES & ASSOCIATES Scale 1:1500 Date JAN 74

File 1445
Received 18.4.74
Instructions

DP34558

Printed by Littlejohns Instruments Ltd. Wellington, New Zealand.

I.F. Stirling, Surveyor General, Department of Lands and Survey, Wellington.

Appendix D: Historic aerial photographs

Relevant features of the site and surrounds are summarised in the Table below:

Table D.1 – Summary of aerial photograph review

Aerial photograph (date and source)	Key point identified	Surrounding land features
1941, Source: Canterbury Maps	A significant portion of the site has been excavated, which is likely associated with gravel extraction/quarry activities activity. No excavation appears to have occurred at two sections within the north and east site boundaries.	The majority of the surrounding area appears to be pastoral land with a low density of commercial and residential structures visible. To the east of the site, there appears to be an industrial site with an adjoining storage yard. To the immediate southeast of the site (which appears to have originally been a part of the of the greater Kyle Park area), the land has been excavated and there are four structures visible within this area.
1946, Source: Canterbury Maps	Most of the site has been cut for extraction/quarrying. Some bushes are visible around the centre of the site. At the north site boundary, a cylindrical tank is visible.	The surrounding land remains similar to the previous aerial. To the immediate southeast of the site, the previously identified structures.
1955, Source: Canterbury Maps	The site appears to have been completely cut for extraction. Vegetation now appears throughout the site. Pathways running through the site are now evident. Although the previously identified buildings remain on-site, mining activity on the site is not evident.	Residential development has occurred to the north and northwest of the site (beyond Waterloo Road). To the east of the site (beyond Smarts Road), the previously identified industrial area has been expanded and the storage yard appears to be holding rows of containers.
1965, Source: Canterbury Maps	The northeast of the site appears to have been filled in. More vegetation at the western corner of the site is visible. Pathways, possible vehicle access roads, are now visible at the eastern section of the site.	There has been major residential developments to the north and west of the site. To the south of the site, an oval sports field, a velodrome, in Denton Park is evident. Commercial/industrial development has continued to the south east of the site. Earthworks are evident to the south of the railway lines (east of the current Denton Park). To the immediate southeast of the site, the quarried area has been refilled.
1973, Source: Canterbury Maps	The majority of the site appears to have been filled in and covered. Most of the vegetation from the centre of the site to the west has been cleared. A grassed area (possibly a playing field) is visible at the northeast site boundary.	There has been major residential developments to the southwest of the site. To the south of the site, the residential buildings have been cleared and replaced with commercial buildings.
1984, Source: Canterbury Maps	The site has been covered with grass and what appears to be a BMX park is visible within the northwest section of the site. Two pathways running through the site are evident.	To the immediate southeast of the site, structures have been removed and replaced with a large warehouse. The area appears to have been divided and what appears to be the current boundaries of Kyle Park (the site) are visible. To the south of the site, a circular object (a water reservoir) is visible in Denton Park.
1994, Source: Canterbury Maps	At the eastern section of the site, trees and/or bushes have been planted. The border of the western section of the site has been planted with trees/bushes. The pathways previously identified have been removed and four new pathways running through the site	Similar to the previous aerial. To the immediate southeast of the site, the previously identified warehouse has been replaced and a larger warehouse, which extend closely to the site boundary, is now evident.

	are evident. Three paths run from the north to the south and one path runs from the south to the east.	
2004, Source: Canterbury Maps	The BMX track has been relocated towards the southern site boundary. To the east of the BMX track, a small metallic hut has been constructed. A stormwater retention pond has been constructed towards the northwestern section of the site. A pathway running south of the pond to the BMX track is evident. A high density of trees and/or bushes is evident at the southwestern site boundary.	Similar to the previous aerial. To the south of the site, more commercial structures are evident.
2011, Source: Canterbury Maps	The site remains similar to the last aerial. Bushes appear to have been planted around the stormwater pond. More trees are evident around the site.	Similar to the previous aerial. To the immediate southeast of the site, the left wing of the warehouse has been removed and construction activities are occurring in its place.

Figure D1: 1941 aerial of the site and surrounds. Red line represents the indicative site location. Source: Canterbury Maps.

Figure D2: 1946 aerial of the site and surrounds. Red line represents the indicative site location. Source: Canterbury Maps.

Figure D3: 1955 aerial of the site and surrounds. Red line represents the indicative site location. Source: Canterbury Maps.

Figure D4: 1965 aerial of the site and surrounds. Red line represents the indicative site location. Source: Canterbury Maps.

Figure D5: 1973 aerial of the site and surrounds. Red line represents the indicative site location. Source: Canterbury Maps.

Figure D6: 1984 aerial of the site and surrounds. Red line represents the indicative site location. Source: Canterbury Maps.

Figure D7: 1994 aerial of the site and surrounds. Red line represents the indicative site location. Source: Canterbury Maps.

Figure D8: 2004 aerial of the site and surrounds. Red line represents the indicative site location. Source: Canterbury Maps.

Figure D9: 2011 aerial of the site and surrounds. Red line represents the indicative site location. Source: Canterbury Maps.

Appendix E: Property files

Woodward-Clyde

PRODUCER STATEMENT - CONTROL OF HAZARDOUS SUBSTANCES ON SITE

ISSUED BY: Woodward-Clyde (NZ) Ltd

TO: Christchurch BMX Club Points Hut

(Site Owner)

IN RESPECT OF: Landfill Gas Control Measures for Christchurch BMX Club Points Hut on a Site of Lot DP 78681

(Description of Site)

AT: 197 Waterloo Road, Hornby, Christchurch/Smarts Pit

(Address)

Woodward-Clyde (NZ) Ltd has been engaged by The Christchurch City Council

(Consultant) (Owner/Developer/Contractor)

provide engineering advice on measures required to minimise the effects from landfill gas on the proposed Christchurch BMX Club Points Hut. The design covers only landfill gas control measures to the Christchurch BMX Club Points Hut and does not cover any subsequently constructed out buildings or ancillary structures in respect of the requirements of Clause F1 of the NZ Building Code.

As independent professional engineering and environmental consultants covered by a current policy of Professional Indemnity Insurance to a minimum value of $250,000, we believe on reasonable grounds that the site is suitable for the uses as defined by and in accordance with the following limitations or requirements:

a) Implementation of site use controls as detailed on drawings numbered AA26660087.00001-W-001and defined on attached Site Control Sheet number 1.
b) Implementation of future periodic monitoring as defined on attached Site Control Sheet 1.
c) The opinion expressed herein is based on, and limited to, our understanding of current generally accepted scientific methodologies and regulatory evaluation criteria for landfill gas assessment. Because scientific methodologies and regulatory evaluation criteria may change in the future, concentrations of and types of contaminants currently present, and considered to be acceptable at this time may, in the future, become subject to different regulatory standards which cause them to become unacceptable and require further remedial action for the site to be suitable for existing or proposed activities.
d) This statement is limited to the subject site as defined herein. It does not provide any opinion in relation to contamination of adjacent soil, to the discharge of contaminants offsite or to site conditions which may change substantially from those present now.
e) This statement is limited to the condition of the subject site at the date specified below.
f) Our insurance cover is limited to Professional Indemnity as specified above and does not cover, nor do we accept responsibility for, any commercial loss and/or consequential loss arising from contamination of the subject or adjoining sites or any associated expenses.

M M Evans

(Signed for and on behalf of Woodward-Clyde (NZ) Limited)

Registered Engineer, MIPENZ.

(Professional Qualifications)

Date :- 12th October 1999

ERB Reg No 8389

CHRISTCHURCH CITY COUNCIL
CONSENT DOCUMENT
16 NOV 1999
All building work shall comply with the New Zealand Building Code notwithstanding any inconsistencies which may occur in the drawings and specifications.

Woodward-Clyde (NZ) Ltd
Bank Direct Centre, 13-15 College Hill
PO Box 821, Auckland, New Zealand
Fax : 0-9-355 1333

COPY FOR YOUR INFORMATION

CHRISTCHURCH
THE GARDEN CITY
the city that shines

Resource Management Act 1991/Building Act 1991

Hazards or Special Site Characteristics

SOCKBURN SERVICE CENTRE

Location Waterloo Road. Number: (197) - 239

Legal Description: Lot 1 D.P. 78681 Ward: Wigram

Lot 2 DP 34558. Kyle Park.

Date Recorded 1:4:90 Severity 2 Accuracy A Recorded by George Marsh. Computer Entry 2:11:99.

DETAILS:

Uncontrolled fill - Stormwater Control - Trade Waste

LOCATION OF INFORMATION: SOCKBURN SERVICE CENTRE /197

File No. or Source of Information Drainage & Waste Management Unit

Further Details: file S 54/25

Site is located on a former Papanui County Council rubbish tip - filled with general rubbish - the tip was closed in 1981 - the exact depth and perimeter are not known.

STRUCTURAL ENGINEER'S soil response and bore hole tests are required for any structures on this site. Where necessary, provide design foundation drawings and supporting calculations or a "Producer Statement, Design".

WARNING No certificate of compaction or type of fill material used has been received.

The catchment area your project falls in **allows the option** of returning stormwater (roof areas) to the ground via an approved soakage chambers **or** to the stormwater channel.

A Registered Engineer's Design may be requested.

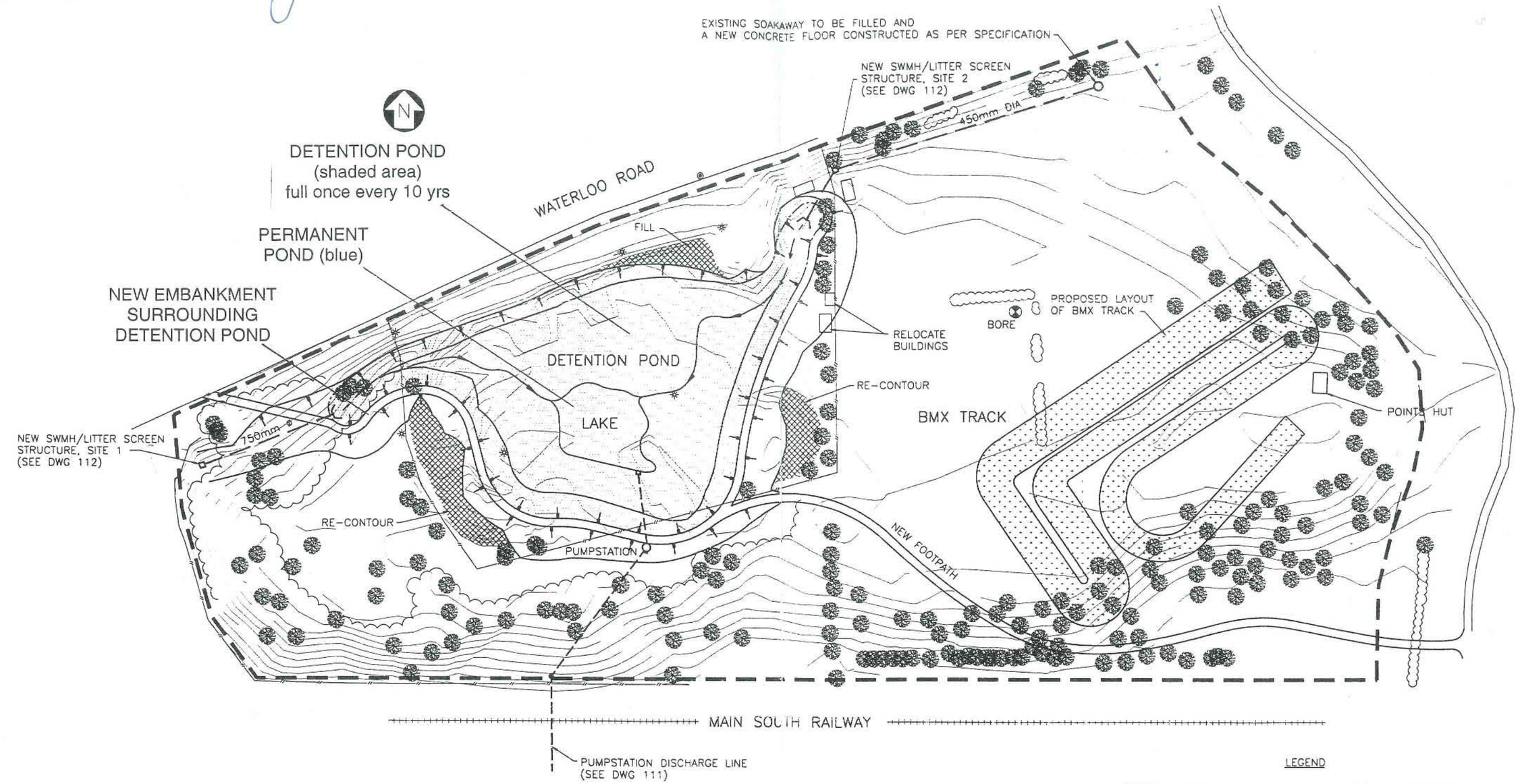
Exception where the site has been identified as contaminated.

Surface water from sealed or hard standing areas via oil interceptor or silt traps to an approved outlet will be required.

Due to the unknown depth or type of material used in the fill, a Registered Engineer's Design for the soakage chamber **must** be provided. The depth and capacity of the chamber will need to ensure that water saturation has no detrimental effect on the fill causing ground slumping.

KEY Severity [1] Low [2] Moderate [3] Extreme [4] Unknown

Accuracy [A] Confirmed [B] Unconfirmed [C] Personal Observation



DENTON PARK

NOTES

1. REMOVE EXISTING TREES WITHIN AND AROUND LIMITS OF BMX TRACK. TO BE CONFIRMED ON SITE BY THE ENGINEER.
2. BMX TRACK WILL BE PEGGED OUT ON SITE BY OTHERS.

LEGEND

- BMX TRACK
- MAXIMUM AREA OF WATER IN DETENTION POND
- RECONTOURED OR FILLED AREAS OUTSIDE OF DETENTION POND
- BORE HOLE
- LAMP POLE
- HEDGE
- TREE
- BUSH LINE
- Existing FENCE to be removed
- EXTENT OF WORKING AREA

0 10 20 30 40 50 60 70 80 90 100m

THIS PLAN DOES NOT SHOW PROPOSED NEW PLANTINGS

REV	DESCRIPTION OF REVISION	BY	CHK	DATE

CHRISTCHURCH CITY COUNCIL

Woodward-Clyde
Woodward-Clyde (NZ) Ltd.
LANDSBOROUGH HOUSE, 287 DURHAM STREET
CHRISTCHURCH NEW ZEALAND
Ph (03) 374 8500
Fax (03) 377 0655

CAD FILE NAME:	S:\JOBS\2666\AC27\0001\6400\CC27CH20
VIEW NAME	
XREF FILES	
SCALES	1:500 (A1) 1:1000 (A3)
DESIGNED	WTC, AMI
DRAWN	DRF
CHECKED	
PROJECT MANAGER	
DATE	9/4/99

KYLE PARK STORMWATER

EXTENT OF WORKS
KYLE PARK

STATUS	CONSULTATION
REVISION	△
DRAWING NUMBER	AC266627-001

Appendix F: ECan's LLUR Statement

Environment Canterbury Regional Council
Kaunihera Taiao ki Waitaha

Customer Services
P. 03 353 9007 or 0800 324 636

PO Box 345
Christchurch 8140

P. 03 365 3828
F. 03 365 3194
E. ecinfo@ecan.govt.nz

www.ecan.govt.nz

Dear Sir/Madam

Thank you for submitting your property enquiry in regards to our Listed Land Use Register (LLUR) which holds information about sites that have been used, or are currently used for activities which have the potential to have caused contamination.

The LLUR statement provided indicates the location of the land parcel(s) you enquired about and provides information regarding any LLUR sites within a radius specified in the statement of this land.

Please note that if a property is not currently entered on the LLUR, it does not mean that an activity with the potential to cause contamination has never occurred, or is not currently occurring there. The LLUR is not complete, and new sites are regularly being added as we receive information and conduct our own investigations into current and historic land uses.

The LLUR only contains information held by Environment Canterbury in relation to contaminated or potentially contaminated land; other information relevant to potential contamination may be held in other files (for example consent and enforcement files).

If your enquiry relates to a farm property, please note that many current and past activities undertaken on farms may not be listed on the LLUR. Activities such as the storage, formulation and disposal of pesticides, offal pits, foot rot troughs, animal dips and underground or above ground fuel tanks have the potential to cause contamination.

Please contact and Environment Canterbury Contaminated Sites Officer if you wish to discuss the contents of the LLUR statement, or if you require additional information.
For any other information regarding this land please contact Environment Canterbury Customer Services.

Yours sincerely

Contaminated Sites Team

Property Statement
from the Listed Land Use Register

Visit www.ecan.govt.nz/HAIL for more information about land uses.

Environment Canterbury Regional Council
Kaunihera Taiao ki Waitaha

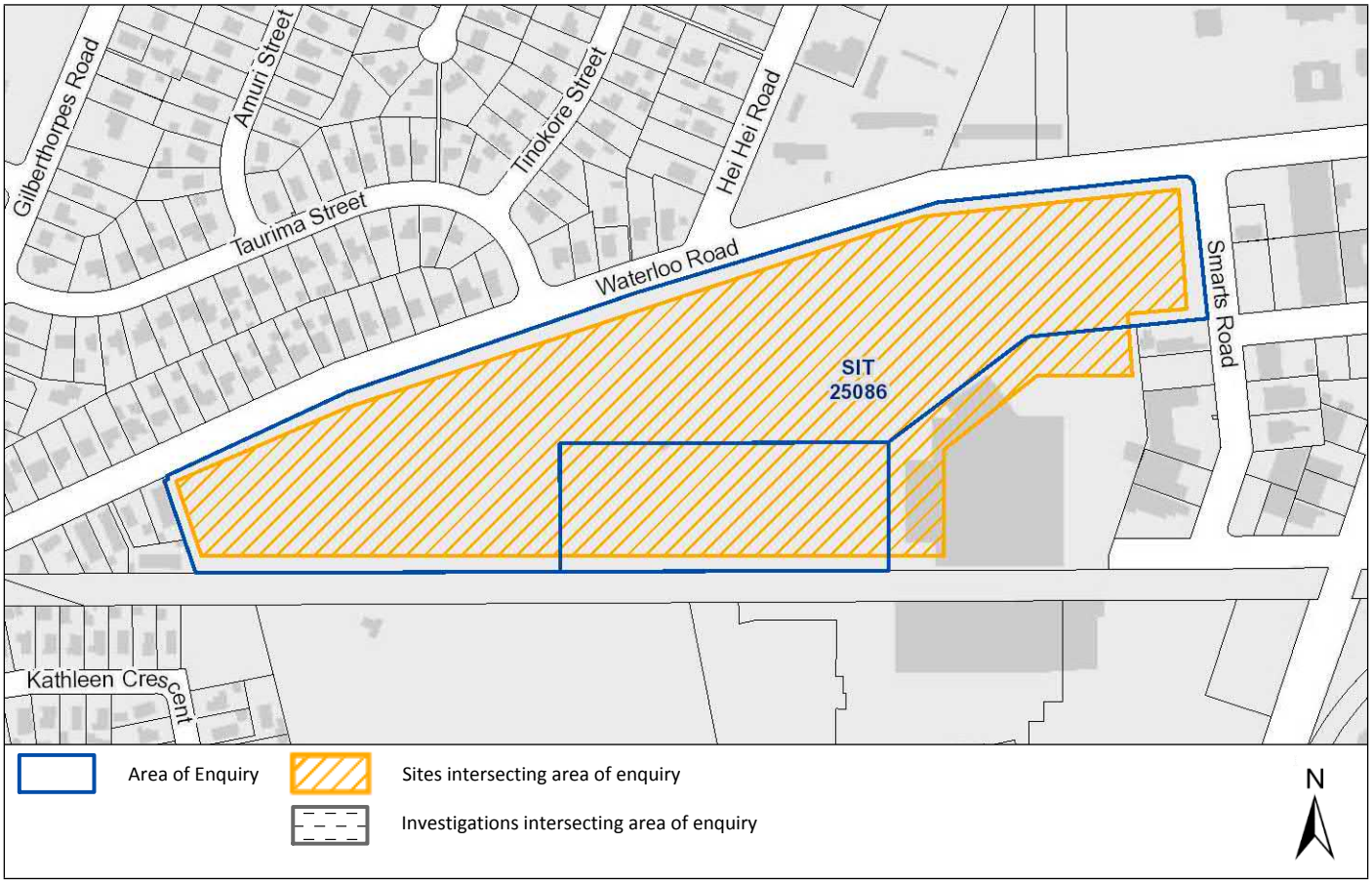
Customer Services
P. 03 353 9007 or 0800 324 636

PO Box 345
Christchurch 8140

P. 03 365 3828
F. 03 365 3194
E. ecinfo@ecan.govt.nz

www.ecan.govt.nz

Date:	28 August 2015	
Land Parcels:	Lot 1 DP 78681	Valuation No(s): 2343205000
	Lot 2 DP 34558	Valuation No(s): 2343205000



The information presented in this map is specific to the property you have selected. Information on nearby properties may not be shown on this map, even if the property is visible.

Summary of sites:

Site ID	Site Name	Location	HAIL Activity(s)	Category
25086	Christchurch City Council, Landfill	197 WATERLOO ROAD	G3 - Landfill sites;	Not Investigated

Please note that the above table represents a summary of sites and HAILs intersecting the area of enquiry only.

Information held about the sites on the Listed Land Use Register

Site 25086: Christchurch City Council, Landfill (Intersects enquiry area.)

Site Address:	197 WATERLOO ROAD
Legal Description(s):	Lot 1 DP 34558,Lot 1 DP 78681,Lot 2 DP 34558

Site Category:	Not Investigated
Definition:	Verified HAIL has not been investigated.

Land Uses (from HAIL):

Period From	Period To	HAIL land use
Pre 1973	Pre 1984	Landfill sites

Notes:

Investigations:

There are no investigations associated with this site.

Information held about other investigations on the Listed Land Use Register

For further information from Environment Canterbury, contact Customer Services and refer to enquiry number ENQ106829.

Disclaimer:

The enclosed information is derived from Environment Canterbury's Listed Land Use Register and is made available to you under the Local Government Official Information and Meetings Act 1987 and Environment Canterbury's Contaminated Land Information Management Strategy (ECan 2009).

The information contained in this report reflects the current records held by Environment Canterbury regarding the activities undertaken on the site, its possible contamination and based on that information, the categorisation of the site. Environment Canterbury has not verified the accuracy or completeness of this information. It is released only as a copy of Environment Canterbury's records and is not intended to provide a full, complete or totally accurate assessment of the site. It is provided on the basis that Environment Canterbury makes no warranty or representation regarding the reliability, accuracy or completeness of the information provided or the level of contamination (if any) at the relevant site or that the site is suitable or otherwise for any particular purpose. Environment Canterbury accepts no responsibility for any loss, cost, damage or expense any person may incur as a result of the use, reference to or reliance on the information contained in this report.

Any person receiving and using this information is bound by the provisions of the Privacy Act 1993.

Environment Canterbury Regional Council
Kaunihera Taiao ki Waitaha

Listed Land Use Register

What you need to know

Everything is connected

What is the Listed Land Use Register (LLUR)?

The LLUR is a database that Environment Canterbury uses to manage information about land that is, or has been, associated with the use, storage or disposal of hazardous substances.

Why do we need the LLUR?

Some activities and industries are hazardous and can potentially contaminate land or water. We need the LLUR to help us manage information about land which could pose a risk to your health and the environment because of its current or former land use.

Section 30 of the Resource Management Act (RMA, 1991) requires Environment Canterbury to investigate, identify and monitor contaminated land. To do this we follow national guidelines and use the LLUR to help us manage the information.

The information we collect also helps your local district or city council to fulfil its functions under the RMA. One of these is implementing the National Environmental Standard (NES) for Assessing and Managing Contaminants in Soil, which came into effect on 1 January 2012.

For information on the NES, contact your city or district council.

How does Environment Canterbury identify sites to be included on the LLUR?

We identify sites to be included on the LLUR based on a list of land uses produced by the Ministry for the Environment (MfE). This is called the Hazardous Activities and Industries List (HAIL)[1]. The HAIL has 53 different activities, and includes land uses such as fuel storage sites, orchards, timber treatment yards, landfills, sheep dips and any other activities where hazardous substances could cause land and water contamination.

We have two main ways of identifying HAIL sites:

- We are actively identifying sites in each district using historic records and aerial photographs. This project started in 2008 and is ongoing.
- We also receive information from other sources, such as environmental site investigation reports submitted to us as a requirement of the Regional Plan, and in resource consent applications.

[1] The Hazardous Activities and Industries List (HAIL) can be downloaded from MfE's website www.mfe.govt.nz, keyword search HAIL

How does Environment Canterbury classify sites on the LLUR?

Where we have identified a HAIL land use, we review all the available information, which may include investigation reports if we have them. We then assign the site a category on the LLUR. The category is intended to best describe what we know about the land use and potential contamination at the site and is signed off by a senior staff member.

Please refer to the Site Categories and Definitions factsheet for further information.

What does Environment Canterbury do with the information on the LLUR?

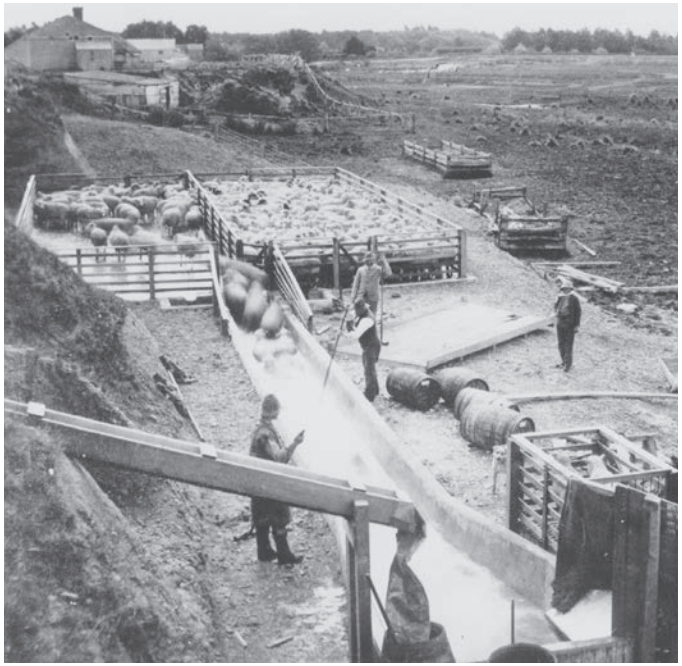
The LLUR is available online at www.llur.ecan.govt.nz. We mainly receive enquiries from potential property buyers and environmental consultants or engineers working on sites. An inquirer would typically receive a summary of any information we hold, including the category assigned to the site and a list of any investigation reports.

We may also use the information to prioritise sites for further investigation, remediation and management, to aid with planning, and to help assess resource consent applications. These are some of our other responsibilities under the RMA.

If you are conducting an environmental investigation or removing an underground storage tank at your property, you will need to comply with the rules in the Regional Plan and send us a copy of the report. This means we can keep our records accurate and up-to-date, and we can assign your property an appropriate category on the LLUR. To find out more, visit www.ecan.govt.nz/HAIL.

IMPORTANT!

The LLUR is an online database which we are continually updating. A property may not currently be registered on the LLUR, but this does not necessarily mean that it hasn't had a HAIL use in the past.



Sheep dipping (ABOVE) and gas works (TOP) are among the former land uses that have been identified as potentially hazardous. (Photo above by Wheeler & Son in 1987, courtesy of Canterbury Museum.)

My land is on the LLUR – what should I do now?

IMPORTANT! Just because your property has a land use that is deemed hazardous or is on the LLUR, it doesn't necessarily mean it's contaminated. The only way to know if land is contaminated is by carrying out a detailed site investigation, which involves collecting and testing soil samples.

You do not need to do anything if your land is on the LLUR and you have no plans to alter it in any way. It is important that you let a tenant or buyer know your land is on the Listed Land Use Register if you intend to rent or sell your property. If you are not sure what you need to tell the other party, you should seek legal advice.

You may choose to have your property further investigated for your own peace of mind, or because you want to do one of the activities covered by the National Environmental Standard for Assessing and Managing Contaminants in Soil. Your district or city council will provide further information.

If you wish to engage a suitably qualified experienced practitioner to undertake a detailed site investigation, there are criteria for choosing a practitioner on www.ecan.govt.nz/HAIL.

I think my site category is incorrect – how can I change it?

If you have an environmental investigation undertaken at your site, you must send us the report and we will review the LLUR category based on the information you provide. Similarly, if you have information that clearly shows your site has not been associated with HAIL activities (eg. a preliminary site investigation), or if other HAIL activities have occurred which we have not listed, we need to know about it so that our records are accurate.

If we have incorrectly identified that a HAIL activity has occurred at a site, it will be not be removed from the LLUR but categorised as Verified Non-HAIL. This helps us to ensure that the same site is not re-identified in the future.

Contact us

Property owners have the right to look at all the information Environment Canterbury holds about their properties.

It is free to check the information on the LLUR, online at www.llur.ecan.govt.nz.

If you don't have access to the internet, you can enquire about a specific site by phoning us on (03) 353 9007 or toll free on 0800 EC INFO (32 4636) during business hours.

Contact Environment Canterbury:

Email: ecinfo@ecan.govt.nz

Phone:
Calling from Christchurch: (03) 353 9007
Calling from any other area: 0800 EC INFO (32 4636)

Environment Canterbury Regional Council
Kaunihera Taiao ki Waitaha

Everything is connected

Promoting quality of life through balanced resource management.

www.ecan.govt.nz E13/101

Listed Land Use Register

Site categories and definitions

When Environment Canterbury identifies a Hazardous Activities and Industries List (HAIL) land use, we review the available information and assign the site a category on the Listed Land Use Register. The category is intended to best describe what we know about the land use.

If a site is categorised as **Unverified** it means it has been reported or identified as one that appears on the HAIL, but the land use has not been confirmed with the property owner.

If the land use has been confirmed but analytical information from the collection of samples is not available, and the presence or absence of contamination has therefore not been determined, the site is registered as:

Not investigated:

- A site whose past or present use has been reported and verified as one that appears on the HAIL.
- The site has not been investigated, which might typically include sampling and analysis of site soil, water and/or ambient air, and assessment of the associated analytical data.
- There is insufficient information to characterise any risks to human health or the environment from those activities undertaken on the site. Contamination may have occurred, but should not be assumed to have occurred.

If analytical information from the collection of samples is available, the site can be registered in one of six ways:

At or below background concentrations:

The site has been investigated or remediated. The investigation or post remediation validation results confirm there are no hazardous substances above local background concentrations other than those that occur naturally in the area. The investigation or validation sampling has been sufficiently detailed to characterise the site.

Below guideline values for:

The site has been investigated. Results show that there are hazardous substances present at the site but indicate that any adverse effects or risks to people and/or the environment are considered to be so low as to be acceptable. The site may have been remediated to reduce contamination to this level, and samples taken after remediation confirm this.

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Managed for:

The site has been investigated. Results show that there are hazardous substances present at the site in concentrations that have the potential to cause adverse effects or risks to people and/or the environment. However, those risks are considered managed because:

- the nature of the use of the site prevents human and/or ecological exposure to the risks; and/or
- the land has been altered in some way and/or restrictions have been placed on the way it is used which prevent human and/or ecological exposure to the risks.

Partially investigated:

The site has been partially investigated. Results:

- demonstrate there are hazardous substances present at the site; however, there is insufficient information to quantify any adverse effects or risks to people or the environment; or
- do not adequately verify the presence or absence of contamination associated with all HAIL activities that are and/or have been undertaken on the site.

Significant adverse environmental effects:

The site has been investigated. Results show that sediment, groundwater or surface water contains hazardous substances that:

- have significant adverse effects on the environment; or
- are reasonably likely to have significant adverse effects on the environment.

Contaminated:

The site has been investigated. Results show that the land has a hazardous substance in or on it that:

- has significant adverse effects on human health and/or the environment; and/or
- is reasonably likely to have significant adverse effects on human health and/or the environment.

If a site has been included incorrectly on the Listed Land Use Register as having a HAIL, it will not be removed but will be registered as:

Verified non-HAIL:

Information shows that this site has never been associated with any of the specific activities or industries on the HAIL.

Please contact Environment Canterbury for further information:

(03) 353 9007 or toll free
on 0800 EC INFO (32 4636)
email ecinfo@ecan.govt.nz

Environment Canterbury Regional Council
Kaunihera Taiao ki Waitaha

E13/102

Appendix G: Geotechnical investigations

Approx Scale

0 100 200 300 400 500 (m)

" Borehole (BH) Location

Aerial photo sourced from Google Earth (Copyright 2012). Imagery Date: April 2012
Borehole data and locations sourced from Canterbury Geotechnical Database (August 2015)

Tonkin+Taylor
www.tonkintaylor.co.nz

DRAWN	AMMW	8/15
DRAFTING CHECKED	GGA	9/15
APPROVED	GGA	9/15
FILE: 53404.002		
APPROX. SCALE (AT A3 SIZE) AS SHOWN		
PROJECT No. 53404.002		

CHRISTCHURCH CITY COUNCIL
GEOTECHNICAL DESKTOP STUDY
KYLE PARK, HORNBY
Nearby Deep Ground Investigation Locations

FIG. No. Figure G1

REV. 0

BH_13850

AECOM

LOG OF DRILLHOLE

HOLE IDENTIFICATION **BH1**

Client Hawkins Construction
Project 27 Foremans Road
Project number 60265497

Co-ordinates 2469761.2mE 5740417.3mN
Orientation -90° Elevation
Location 27 Foremans Road, Christchurch
Feature Car Park

GEOLOGICAL DESCRIPTION	Test Records (Shear Vane residual - peak 0 - 200 kPa; N Values 0 - 50)	Drilling Method / Casing remarks	Core Loss/Lift 0 - 100%	Depth	Graphic Log	MATERIAL DESCRIPTION (Subordinate MAJOR minor; colour; structure. Strength; moisture condition; grading; bedding; plasticity; sensitivity; major fraction description; subordinate fraction description; minor fraction description etc)	Instrumentation
ASPHALT FILL	ss 2,1,2,2,2,2 N=8	HQ3 SPT		1		Asphalt Fine to coarse GRAVEL; grey, well graded, subangular to subrounded SW greywacke.	N/A
FILL	ss 1,1,1,1,1,1 N=4	HQ3 SPT		2		Sandy fine to coarse GRAVEL; grey with red staining, brownish red and black, angular to subrounded, SW greywacke, brick fragments and iron slag. Sand; fine to coarse, brownish red.	
	ss 2,2,2,3,8,10 N=23	HQ3 SPT		3			
	ss 11,15,16,13,12,8 N=49	HQ3 SPT		4		3.45m: with minor iron and no brick fragments, less red staining.	
SPRINGSTON FORMATION - YALHURST MEMBER - Alluvial Depost	ss 9,10,34,16,0,0 Refusal, 50 blows for 130mm N=50	HQ3 SPT		5		Sandy fine to coarse GRAVEL with rare cobbles; grey with minor red staining, poorly graded, subangular to subrounded, SW greywacke.	
	ss 1,4,10,15,14,11 Refusal, 50 blows for 270mm N=50	HQ3 SPT		6 7		5.45m: sand becomes reddish brown	
	sc 6,14,14,20,16,0 Refusal, 50 blows for 225mm N=50	HQ3 SPT		8 9			
	sc 6,6,7,8,13,16 N=44	SPT					

GROUNDWATER OBSERVATIONS
Depth Piezometer Reading Date

Date logged
Logged KDL
Checked MPN

Casing Details
Depth Diameter

Remarks
1: Coordinates are in NZMG and are approximate.
2: Water table was not observed during drilling.

Hand held Shear Vane

vane shear strength per NZGS guideline

Driller McNeill Drilling
Started 21/05/212
Drill Rig UDR600
Finished 23/05/2012
Core Boxes 3

Date Printed: 4/07/2012

DRILLHOLE LOG SOIL 60265497_27FOREMANSRD_BH1&2.GPJ BASE.GDT 04/07/12

BH_13850

AECOM

LOG OF DRILLHOLE

HOLE IDENTIFICATION **BH1**

Client Hawkins Construction
Project 27 Foremans Road
Project number 60265497

Co-ordinates 2469761.2mE 5740417.3mN
Orientation -90° Elevation
Location 27 Foremans Road, Christchurch
Feature Car Park

GEOLOGICAL DESCRIPTION	Test Records: Shear Vane residual - peak (0 - 200 kPa)	Test Records: N Values (0 - 50)	Drilling Method / Casing remarks	Core Loss/Lift (0 - 100%)	Depth	Graphic Log	MATERIAL DESCRIPTION (Subordinate MAJOR minor; colour; structure. Strength; moisture condition; grading; bedding; plasticity; sensitivity; major fraction description; subordinate fraction description; minor fraction description etc)	Instrumentation
SPRINGSTON FORMATION - YALHURST MEMBER - Alluvial Depost		sc 6,8,8,12,14,15 N=49	HQ3		11			N/A
			SPT					
							BH1 terminated at 11.45m Target Depth	
					12			
					13			
					14			
					15			
					16			
					17			
					18			
					19			

GROUNDWATER OBSERVATIONS
Depth Piezometer Reading Date

Date logged
Logged KDL
Checked MPN

Casing Details
Depth Diameter

Remarks
1: Coordinates are in NZMG and are approximate.
2: Water table was not observed during drilling.

Hand held Shear Vane

vane shear strength per NZGS guideline

Driller Started
McNeill Drilling 21/05/212
Drill Rig Finished
UDR600 23/05/2012
Core Boxes 3

Date Printed: 4/07/2012

DRILLHOLE LOG SOIL 60265497_27FOREMANSRD_BH1&2.GPJ BASE.GDT 04/07/12

BH_13852

LOG OF DRILLHOLE

HOLE IDENTIFICATION **BH2**

Client Hawkins Construction
Project 27 Foremans Road
Project number 60265497

Co-ordinates 2469839.6mE 5740327.7mN
Orientation -90° Elevation
Location 27 Foremans Road, Christchurch
Feature Car Park

GEOLOGICAL DESCRIPTION	Test Records (Shear Vane residual - peak 0 - 200 kPa; N Values 0 - 50)	Drilling Method / Casing remarks	Core Loss/Lift 0 - 100%	Depth	Graphic Log	MATERIAL DESCRIPTION (Subordinate MAJOR minor; colour; structure. Strength; moisture condition; grading; bedding; plasticity; sensitivity; major fraction description; subordinate fraction description; minor fraction description etc)	Instrumentation
FILL: ASPHALT / FILL		HQ3		0		Asphalt Fine to coarse GRAVEL; grey, well graded, subangular to subrounded, SW greywacke with trace fine black and red iron slag. 0.28m: becomes clayey	N/A
BURIED SOIL: BURIED SOIL	ss 1,0,1,0,1,2 N=4	SPT		1		Organic SILT with minor sand and gravel; dark brown, dry,	
		HQ3					
SPRINGSTON FORMATION: SPRINGSTON FORMATION - YALDHURST MEMBER - Alluvial Deposit	ss 3,5,6,5,6,6 N=23	SPT		2		Sandy fine to coarse GRAVEL; grey, well graded, Subangular to subrounded SW greywacke. Sand; fine to coarse, light brown.	
		HQ3					
	ss 2,4,16,29,5,0 Refusal, 50 blows for 170mm N=50	SPT		3			
		HQ3					
	ss 2,16,13,15,19,3 Refusal, 50 blows for 245mm N=50	SPT		4			
		PERC					
	sc 3,7,10,9,10,14 N=40	SPT		5			
		PERC		6			
	sc 2,5,12,10,11,9 N=42	SPT					
		PERC		7			
	sc 9,6,12,12,10,9 N=43	SPT		8			
		PERC		9			
	sc 11,11,11,9,9,5 N=34	SPT					

GROUNDWATER OBSERVATIONS
Depth Piezometer Reading Date

Date logged
Logged KDL
Checked MPN

Casing Details
Depth Diameter

Remarks
1: Coordinates are in NZMG and are approximate.
2: Water table was not observed during drilling.

Hand held Shear Vane

vane shear strength per NZGS guideline

Driller McNeill Drilling
Started 23/05/2012
Drill Rig UDR600
Finished 25/05/2012
Core Boxes 3

Date Printed: 4/07/2012

DRILLHOLE LOG SOIL 60265497_27FOREMANSRD_BH1&2.GPJ BASE.GDT 04/07/12

BH_13852

AECOM

LOG OF DRILLHOLE

HOLE IDENTIFICATION **BH2**

Client Hawkins Construction
Project 27 Foremans Road
Project number 60265497

Co-ordinates 2469839.6mE 5740327.7mN
Orientation -90° Elevation
Location 27 Foremans Road, Christchurch
Feature Car Park

GEOLOGICAL DESCRIPTION	Test Records (Shear Vane residual - peak 0 - 200 kPa; N Values 0 - 50)	Drilling Method / Casing remarks	Core Loss/Lift 0 - 100%	Depth	Graphic Log	MATERIAL DESCRIPTION (Subordinate MAJOR minor; colour; structure. Strength; moisture condition; grading; bedding; plasticity; sensitivity; major fraction description; subordinate fraction description; minor fraction description etc)	Instrumentation
SPRINGSTON FORMATION - YALDHURST MEMBER - Alluvial Deposit SPRINGSTON FORMATION	sc 3,3,6,6,10,13 N=35	PERC		11		11m: becomes wet, light greyish brown	N/A
		SPT					
		PERC		12			
	sc 2,3,15,16,16,3 Refusal, 50 blows for 250mm N=50	SPT		13			
		PERC		14			
	sc 13,19,18,24,8,0 Refusal, 50 blows for 180mm N=50	SPT					
		PERC		15			
	sc 11,13,16,20,14,0 Refusal, 50 blows for 220mm N=50	SPT		16		BH2 terminated at 15.95m Target Depth	
				17			
				18			
				19			

GROUNDWATER OBSERVATIONS
Depth Piezometer Reading Date

Date logged
Logged KDL
Checked MPN

Casing Details
Depth Diameter

Remarks
1: Coordinates are in NZMG and are approximate.
2: Water table was not observed during drilling.

Hand held Shear Vane

vane shear strength per NZGS guideline

Driller McNeill Drilling
Started 23/05/2012
Drill Rig UDR600
Finished 25/05/2012
Core Boxes 3

Date Printed: 4/07/2012

DRILLHOLE LOG SOIL 60265497_27FOREMANSRD_BH1&2.GPJ BASE.GDT 04/07/12

BH_33829

BOREHOLE LOG

GHD Limited

PO Box 13468
Christchurch 8141

Site Identification: **BH2**

Sheet 1 of

Project:	Main South Rd	**Coordinates:** E 1560 211, N 5178 499	**Datum:**
Client:	Fulton Hogan	**Surface RL (m):**	**Total Depth:** 14.0m
Site:	Main South Rd	**Commenced:** 20-Feb-12	**Contractor:** Prodrill
Job No.:	5130730	**Completed:** 20-Feb-12	**Driller:** Kane

Equipment:	Sonic	**Inclination:** -90	**Logged:** DBS & DW
Shear Vane:	Geo 308	**Comments:**	**Processed:** DBS
Bore Diameter (mm):	80		**Checked:** JM

Depth (m)/ [Elev.]	Classification	Graphic Log	SOIL DESCRIPTION: (Soil Code), Soil Name [minor MAJOR], colour, structure [zoning, defects, cementing], plasticity or grain size, secondary components, structure. (Geological Formation) / ROCK DESCRIPTION: Weathering, colour, fabric, ROCK NAME (Formation Name)	Moisture Condition	Consistency/ Relative Density	Weathering	Estimated Rock Strength (EW VW W MS S VS ES)	RQD (%)	Defect Spacing (mm) (20 60 200 600 2000)	TESTS & SAMPLES / ROCK MASS DEFECTS: Depth, Type, Inclinations, Roughness, Texture, Aperture, Coating
0.8			Fill, sand.	D						
1.5	GP		Sandy fine to coarse GRAVEL; brown; dry; well graded; sub rounded to sub angular; sand, fine to coarse; well graded. (SPRINGSTON FORMATION).	D						
2.0	GP		Sandy fine to coarse GRAVEL with minor silt; brown; dry to moist; well graded; sub rounded to sub angular; sand, fine to coarse; well graded. (SPRINGSTON FORMATION).	M						
	GP		Sandy fine to coarse GRAVEL; brown; dry; well graded; sub rounded to sub angular; sand, fine to coarse; well graded. (SPRINGSTON FORMATION).	D						N 1 11,8, 6,7, 3,6, [22]
4.3	SM		Silty fine to coarse SAND; brown; wet; well graded (dense). (SPRINGSTON FORMATION).	W						N 2 For 35 mm 15,13, 14,*, *,*, [14]
5.0	GP		Sandy fine to coarse GRAVEL; brown; moist; well graded; sub rounded to rounded; sand, fine to coarse; cobble present at 8.03m. (SPRINGSTON FORMATION).	M						N 3 For 70 mm 13,14, 21,29, *,*, [50]
6.0	GP		Sandy fine to coarse GRAVEL with some cobbles; brown; moist; well graded; sub rounded to angular; sand, fine to coarse; cobbles sub rounded. (SPRINGSTON FORMATION).	M						N 4 For 55 mm 17,50, *,*, *,*, [50]
8.5	GP		Sandy fine to coarse GRAVEL; brown; dry to moist; well graded; sub rounded to angular; sand, fine to coarse. (SPRINGSTON FORMATION).	M						
10										

BOREHOLE LOG NZ ALT 51 30730 FULTON HOGAN.GPJ NZ GINT DATA TEMPLATE VER 1.3.GDT 28/2/12

BH_33829

BOREHOLE LOG

GHD Limited

PO Box 13468
Christchurch 8141

Site Identification: **BH2**

Sheet 2 of

Project:	Main South Rd	**Coordinates:** E 1560 211, N 5178 499	**Datum:**
Client:	Fulton Hogan	**Surface RL (m):**	**Total Depth:** 14.0m
Site:	Main South Rd	**Commenced:** 20-Feb-12	**Contractor:** Prodrill
Job No.:	5130730	**Completed:** 20-Feb-12	**Driller:** Kane

Equipment:	Sonic	**Inclination:** -90	**Logged:** DBS & DW
Shear Vane:	Geo 308	**Comments:**	**Processed:** DBS
Bore Diameter (mm):	80		**Checked:** JM

Depth (m)/ [Elev.]	Drilling Method	Core Run / Recovery (%)	Support / Casing (m)	Water	Geological Fm	Classification	Graphic Log	SOIL DESCRIPTION: (Soil Code), Soil Name [minor MAJOR], colour, structure [zoning, defects, cementing], plasticity or grain size, secondary components, structure. (Geological Formation) / ROCK DESCRIPTION: Weathering, colour, fabric, ROCK NAME (Formation Name)	Moisture Condition	Consistency/ Relative Density	Weathering	Estimated Rock Strength (EW VW W MS S VS ES)	RQD (%)	Defect Spacing (mm) (20 60 200 600 2000)	TESTS & SAMPLES / ROCK MASS DEFECTS: Depth, Type, Inclinations, Roughness, Texture, Aperture, Coating
10.0 0						GP		Sandy fine to coarse GRAVEL with minor silt; brown; moist; sub rounded to angular; sand, fine to coarse. (SPRINGSTON FORMATION).	M						N 5 For 75 mm 50,*, [50]
10.7 0						GP		Sandy fine to coarse GRAVEL with minor cobbles; grey; wet; sub rounded to angular; sand, fine to coarse. (SPRINGSTON FORMATION).	W						
12.0 0						GP		Sandy fine to coarse GRAVEL with minor clay and occasional cobbles; brown; wet; sub rounded to sub angular; sand, fine to coarse. (SPRINGSTON FORMATION).	W						N 6 For 55 mm 50,*, [50]
14.0 0								Termination Depth = 14m, refusal							N 7 Refusal 15,*, [N=]

BOREHOLE LOG NZ ALT 51 30730 FULTON HOGAN.GPJ NZ GINT DATA TEMPLATE VER 1.3.GDT 28/2/12

BH_31454

GEOSCIENCE consulting (NZ) LIMITED

Bore Hole No. *BH01*

Sheet *1 of 1*

Project No. *12096*

Engineering Log - Machine Bore Hole

Client: Mark Brown

Principal: -

Project: 744 Halswell Junction Road, Islington

Bore Hole Location: Refer to Site Location Plan

Date Started: *22/05/2012*

Date Completed: *22/05/2012*

Logged By: *CL*

Checked By: *NC*

Machine Type: Edson

Contractor: Pro-Drill

Diameter (mm): 63

Drilling Method: Rotary Cored

Excavation Information				Material Substance								
Material	Water	Notes, samples, tests etc	Depth (m)	Graphic Log	Classification Symbol	Material Soil - soil type, colour, structure, grading, bedding, plasticity, sensitivity; Secondary and minor components Rock - colour, fabric, rock type; discontinuities; additional information	Moisture Condition	Consistency / Density Index	TCR (%)	SPT N-value (Uncorrected)	
ALLUVIUM			1		GW	Silty sandy fine to coarse GRAVEL with trace cobbles; brown to greyish brown. Well graded; subrounded gravel; medium sand.	M	D	70		
			2						90		SPT 1.5m N=29 450mm pen.
			3		GW	Sandy fine to coarse GRAVEL; brownish grey. Well graded; subrounded gravel; medium sand.	S	VD	90		
			4						100		SPT 3.5m N=50 300mm pen.
			5						60		
			6		GW	Inferred sandy medium to coarse GRAVEL. Fines washed out.	S	VD	40		SPT 5m N=50 435mm pen.
			7								SPT 6.5m N=50 435mm pen.
			8						30		SPT 8m N=50 370mm pen.
			9						30		SPT 9m N=50 375mm pen.

EOH: 9.88 m

Termination: Target depth

Notes:

Borehole terminated at target depth.

Solid SPTs undertaken at 5, 6.5, 8 and 9 m depth.

BH_55322

Beca

BOREHOLE No: BH2

MACHINE BOREHOLE LOG

SHEET 1 of 2

PROJECT: Chch EQ 24 Amyes Rd
JOB NUMBER: 5323568
SITE LOCATION: 24 Amyes Road
CLIENT: Elcano Ltd

CIRCUIT: NZTM
COORDINATES: N 5,178,188 m
E 1,561,744 m
BOREHOLE LOCATION: Outside CAT offices on grass verge
R L:
DATUM:

DRILLING: FLUID LOSS	WATER LEVEL	CORE RECOVERY	METHOD	ROD	CASING	IN-SITU TESTS: SV	τ (kPa)	SPT 'N'	SAMPLES	DEPTH (m)	GRAPHIC LOG	USCS	MOISTURE	SOIL / ROCK DESCRIPTION	GEOLOGICAL UNIT	DEPTH (m)
		80 %	Sonic							0		OL	M	'Firm,' SILT, some organics, minor fine to medium sand, trace clay; dark brown, moist, low plasticity. Organics: grass and rootlets. [TOPSOIL]		
												OL	D	'Firm,' SILT, some fine to coarse sand, some fine to medium gravel, trace organics; brown; dry, non plastic. Gravel: angular to sub angular, SW greywacke. Organics: rootlets. 0.6m: trace fine to medium sand, trace clay.	Fill	
		80 %	SPT					1 2 1 1 0 2 N=4		1		ML	D	'Firm,' fine to medium sandy, SILT, trace clay; light brown; dry, low plasticity.		1
		100 %	Sonic							2		CH	M	Firm, clayey SILT, trace fine to medium sand; light brown mottled orange; moist, high plasticity.		2
		90 %	SPT					1 0 1 1 2 2 N=6		3		ML	M	Firm, fine to medium sandy, SILT, minor clay; light brown mottled orange; moist, low plasticity, slightly dilatant.		3
		100 %	Sonic							4		SW	M	Loose, fine to medium SAND, some silt, trace clay; brown mottled orange, moist, low plasticity.		4
		90 %	SPT					3 3 5 4 18 21 N=48		5		GP	M	Very dense, fine to coarse sandy, fine to coarse GRAVEL, trace silt; orangish brown, moist, non plastic. Gravel: subangular to subrounded (with rounded clasts), SW greywacke. Becomes greyish brown.	Springston Formation	5
		100 %	Sonic							6						6
		70 %	SPT					10 9 12 13 15 10 for 60mm N=50+		7				Some cobbles. Cobbles: subrounded to rounded, SW greywacke.		7
		100 %	Sonic							8						8
		70 %	SPT					10 19 20 18 12 for 55mm N=50+		9						9
		100 %	Sonic													
		60 %	SPT					9 11 10 10 10 9 N=39								

DATE STARTED: 26/2/14
DATE FINISHED: 26/2/14
LOGGED BY: PYF
SHEAR VANE No: N/A

DRILLED BY: Land test Ltd
EQUIPMENT: Geo 305
DRILL METHOD: Sonic
DRILL FLUID: Polyplus and water
DIAMETER/INCLINATION: 100 mm / 90°

COMMENTS:
Borehole terminated at target depth. Groundwater: 10mbgl at 2:10pm with all casing stll in ground.

FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS SEE KEY SHEET

Revision A

A4 Scale 1:50

MACHINE_BOREHOLE P:\5325323568\TGE 2\1. JOB COMISSIONING\3. WORK PACKAGE PHASE GEOTECHNICAL\12. INPUTS, REFERENCE, RESEARCH AND DATA\BOREHOLE LOGS\24 AMYES ROAD.GPJ BECA.GDT 3/4/14

BH_55322

Beca

BOREHOLE No: BH2

MACHINE BOREHOLE LOG

SHEET 2 of 2

PROJECT: Chch EQ 24 Amyes Rd — JOB NUMBER: 5323568

SITE LOCATION: 24 Amyes Road — CLIENT: Elcano Ltd

CIRCUIT: NZTM — BOREHOLE LOCATION: Outside CAT offices on grass verge

COORDINATES: N 5,178,188 m — R L:

E 1,561,744 m — DATUM:

DRILLING: FLUID LOSS	WATER LEVEL	CORE RECOVERY	METHOD	ROD	CASING	IN-SITU TESTS: SV	τ (kPa)	SPT 'N'	SAMPLES	DEPTH (m)	GRAPHIC LOG	USCS	MOISTURE	SOIL / ROCK DESCRIPTION	GEOLOGICAL UNIT	DEPTH (m)
	26/02/14	100 %	Sonic					6		11		GW	W	Medium dense, fine to coarse GRAVEL, some cobbles, minor fine to medum sand, trace silt; greyish brown; wet, non plastic. Gravel/cobbles: subangular to subrounded, SW greywacke.		11
		60 %	SPT					8								
								6								
								7								
								6								
								5								
								N=24								
		90 %	Sonic							12		GP	W	Very dense, fine to coarse sandy, fine to coarse GRAVEL, some silt, some cobbles; orange brown, wet, non plastic. Gravel/cobbles: subangular to subrounded, SW greywacke.	Springston Formation *(Contd.)*	12
		67 %	SPT					3								
								5								
								6								
								18								
								17								
								9 for 45mm								
								N=50+								
		100 %	Sonic							13						13
		60 %	SPT					5								
								12								
								7								
								9								
								13								
								21								
								N=50+		14						14
		100 %	Sonic													
		67 %	SPT					20								
								19						Medium dense.		
								9		15						15
								6								
								4								
								6						END OF LOG @ 15.45 m		
								N=25								
										16						16
										17						17
										18						18
										19						19

DATE STARTED: 26/2/14 — DRILLED BY: Land test Ltd

DATE FINISHED: 26/2/14 — EQUIPMENT: Geo 305

LOGGED BY: PYF — DRILL METHOD: Sonic

SHEAR VANE No: N/A — DRILL FLUID: Polyplus and water

DIAMETER/INCLINATION: 100 mm / 90°

COMMENTS:
Borehole terminated at target depth. Groundwater: 10mbgl at 2:10pm with all casing stll in ground.

FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS SEE KEY SHEET

Revision A

A4 Scale 1:50

MACHINE_BOREHOLE P:\5325323568\TGE 2\1. JOB COMISSIONING\3. WORK PACKAGE PHASE GEOTECHNICAL\12. INPUTS, REFERENCE, RESEARCH AND DATA\BOREHOLE LOGS\24 AMYES ROAD.GPJ BECA.GDT 3/4/14

BH_55321

Beca

BOREHOLE No: BH1

MACHINE BOREHOLE LOG

SHEET 1 of 2

PROJECT: Chch EQ 24 Amyes Rd — JOB NUMBER: 5323568

SITE LOCATION: 24 Amyes Road — CLIENT: Elcano Ltd

CIRCUIT: NZTM — BOREHOLE LOCATION: North of Engineering Building on pavement

COORDINATES: N 5,178,376 m — R L:

E 1,561,605 m — DATUM:

DRILLING: FLUID LOSS	WATER LEVEL	CORE RECOVERY	METHOD	ROD	CASING	IN-SITU TESTS: SV	τ (kPa)	SPT 'N'	SAMPLES	DEPTH (m)	GRAPHIC LOG	USCS	MOISTURE	SOIL / ROCK DESCRIPTION	GEOLOGICAL UNIT	DEPTH (m)
		100 %	Sonic							0		ML	D	Loosely packed, fine to medium sandy, SILT, some fine to medium gravel; brown; dry, non plastic. Gravel: subrounded to rounded, SW greywacke.	Fill	
										1		ML	M	'Firm,' fine to medium sandy SILT, minor clay; brown mottled orange, moist, low plasticity.		1
		78 %	SPT					2 2 1 2 3 2 N=8		2		SM	M	Loose, fine to medium SAND, some silt, trace clay; light brown; moist, low plasticity.		2
		67 %	Sonic							3		ML	M	Soft-firm, fine to medium sandy SILT, minor clay; brown mottled orange; moist, low plasticity.		3
														3.0m - 3.4m depth: No recovery (possibly washed away during casing advancement).		
		100 %	SPT					1 1 1 0 1 1 N=3		4		ML	M	Soft, fine to medium sandy SILT, minor clay; brown mottled orange; moist, low plasticity, sensitive.		4
		100 %	Sonic									SM	M	Loose, silty, fine to medium SAND, minor clay; orange brown; moist, low plasticity.		
		90 %	SPT					2 8 16 27 7 for 25mm N=50+		5		GW	M	Very dense, fine to coarse sandy fine to coarse GRAVEL, minor cobbles, minor silt; light brown; moist, non plastic. Gravel: sub angular to subrounded, SW greywacke.	Springston Formation	5
		100 %	Sonic											5.3 - 5.55m: orange brown mottled dark brown.		
		75 %	SPT					9 14 14 17 16 3 for 15mm N=50+		6						6
		100 %	Sonic							7						7
		80 %	SPT					16 20 24 22 4 for 15mm N=50+		8						8
		100 %	Sonic													
		80 %	SPT					8 11 11 10 10 10 N=41		9						9
		100 %	Sonic													

DATE STARTED: 25/2/14 — DRILLED BY: Land test Ltd

DATE FINISHED: 25/2/14 — EQUIPMENT: Geo 305

LOGGED BY: PYF — DRILL METHOD: Sonic

SHEAR VANE No: N/A — DRILL FLUID: PolyPlus and water

DIAMETER/INCLINATION: 100 mm / 90°

COMMENTS:
Borehole terminated at target depth. Groundwater: 10.3mbgl at 2:45pm with all casing still in ground.

FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS SEE KEY SHEET

Revision A

A4 Scale 1:50

MACHINE_BOREHOLE P:\5325323568\TGE 2\1. JOB COMISSIONING\3. WORK PACKAGE PHASE GEOTECHNICAL\12. INPUTS, REFERENCE, RESEARCH AND DATA\BOREHOLE LOGS\24 AMYES ROAD.GPJ BECA.GDT 3/4/14

BH_55321

Beca

BOREHOLE No: BH1

MACHINE BOREHOLE LOG

SHEET 2 of 2

PROJECT: Chch EQ 24 Amyes Rd — JOB NUMBER: 5323568

SITE LOCATION: 24 Amyes Road — CLIENT: Elcano Ltd

CIRCUIT: NZTM — BOREHOLE LOCATION: North of Engineering Building on pavement

COORDINATES: N 5,178,376 m — R L:

E 1,561,605 m — DATUM:

DRILLING: FLUID LOSS	WATER LEVEL	CORE RECOVERY	METHOD	ROD	CASING	IN-SITU TESTS: SV	IN-SITU TESTS: τ (kPa)	IN-SITU TESTS: SPT 'N'	SAMPLES	DEPTH (m)	GRAPHIC LOG	USCS	MOISTURE	SOIL / ROCK DESCRIPTION	GEOLOGICAL UNIT	DEPTH (m)
	25/02/14	100 %	Sonic					6 10 13 15 11 11 for 70mm N=50+		11		GW	M W	Very dense, fine to coarse sandy fine to coarse GRAVEL, minor cobbles, minor silt; light brown; moist, non plastic. Gravel: sub angular to subrounded, SW greywacke. Very dense, fine to coarse sandy fine to coarse GRAVEL, minor cobbles, minor silt; light brown; moist, non plastic. Gravel: sub angular to subrounded, SW greywacke. 10.3m: Becomes wet. 10.6m: Some cobbles. Cobbles: subrounded to rounded, SW greywacke.	**Springston Formation** *(Contd.)*	11
		67 %	SPT													
		100 %	Sonic					5 10 10 13 14 13 for 60mm N=50+		12						12
		55 %	SPT													
		100 %	Sonic					6 11 10 12 11 10 N=43		13						13
		67 %	SPT													
		100 %	Sonic					5 9 12 10 7 9 N=38		14						14
		67 %	SPT							15				END OF LOG @ 15.45 m		15
										16						16
										17						17
										18						18
										19						19

DATE STARTED: 25/2/14 — DRILLED BY: Land test Ltd

DATE FINISHED: 25/2/14 — EQUIPMENT: Geo 305

LOGGED BY: PYF — DRILL METHOD: Sonic

SHEAR VANE No: N/A — DRILL FLUID: PolyPlus and water

DIAMETER/INCLINATION: 100 mm / 90°

COMMENTS:
Borehole terminated at target depth. Groundwater: 10.3mbgl at 2:45pm with all casing still in ground.

FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS SEE KEY SHEET

Revision A

A4 Scale 1:50

MACHINE_BOREHOLE P:\5325323568\TGE 2\1. JOB COMISSIONING\3. WORK PACKAGE PHASE GEOTECHNICAL\12. INPUTS, REFERENCE, RESEARCH AND DATA\BOREHOLE LOGS\24 AMYES ROAD.GPJ BECA.GDT 3/4/14

BH_34591

GEOTECH

DRILLHOLE BORELOG

Hole ID:	**BH02**
Sheet:	1 of 1
Date:	9/12/2013

Project No.: 4572	**Equipment:** VTR 9750 - Track	**G.L R.L:** 0.00m	**Logged By:** YUY
Project: 18 Chalmers Street	**Drilling Co:** McMillan Drilling	**Max Depth:** 3.60m	**Checked By:** IMC
Client: -	**Operator:** C. Nee	**Inclination:** 90°	**Sampled By:** YUY
North (m): 5178825.5 **East (m):** 1561375.9	**Grid:** NZTM	**Location:** Please refer to the site plan.	

Geological Formation	STRATA DESCRIPTION	Graphic Log	Depth	Classification Symbol	Piezometer & Water Levels	TCR (%)	Drill Method	Samples	Tests	SPT (blows/mm)
	Asphalt.									
	Gravel (FILL).									
	SAND with minor Silt; greyish brown. Very fine to fine Sand. -1.72-1.82m, trace of Gravel. Fine to medium Gravel. Sub-rounded to rounded.		1.0	SP		20%			1.00m SPT (C)	4 2 3 5/262mm
	Silty SAND; greyish brown. Very fine to fine Sand .		2.0	SM		75%				
	Sandy GRAVEL with trace of Silt; brownish grey. Very fine to fine Sand, fine to coarse Gravel. Sub-rounded to rounded. -2.4m, fine to coarse Sand.		3.0	GW					2.40m SPT (C)	22 22 15 37/300mm
	SAND with minor Silt; dark brown. Very fine to fine Sand.			SP		75%				
	Sandy GRAVEL with trace of Silt; brownish grey. Fine to coarse Sand, fine to coarse Gravel. Sub-rounded to rounded.			GW					3.60m SPT (C)	35 24 17 41/300mm
EOH: 3.60m										

Remarks: No Static Water Level Recorded
Safety Auto Trip Hammer #396 used (energy ratio 76.4%)

BH_40710

Soil & Rock Consultants
GEOTECHNICAL & ENVIRONMENTAL ENGINEERS

CLIENT: Mortlock McElroy Ltd

PROJECT: 1 Brynley Street, Hornby

Machine Borehole No: MB01

Sheet 1 of 2

Drill Type:	Rotary Drilling	Project No:	C14315	Logged By:	MLB/MG
Drilled By:	Speight Drilling Ltd	Coordinates:	1561859 E, 5178723 N	Reviewed By:	PS
Date Started:	22/7/14	Ground Elevation:	28m LYTTHT1937	Surface Conditions:	Near level, grass
Date Finished:	22/7/14	Water Level:	Groundwater Masked by Drilling	Shear Vane Number:	N/A

STRATIGRAPHY	GRAPHIC LOG	Soil description in accordance with the NZ Geotechnical Society Inc 2005 "Guidelines for Field Description of Soil and Rock in Engineering Use"	WATER LEVEL (m)	DEPTH (m)	SAMPLE TYPE	SPT / c_u (kPa) (blows/300mm)	DRILLING METHOD	RECOVERY (%)	TCR SCR RQD	If	WATER CONTENT	Heave (mm)
Topsoil		Dark brown, SILT, trace fine sand, trace fine sub-rounded to rounded gravel, very loose, moist, non-plastic		0.0			Triple T.					
Fill		Grey, sandy fine to coarse sub-rounded to rounded GRAVEL, loose to medium dense, wet to saturated		0.5								
		mottled orange		1.0		3 5 4 N=9	SPT					
		Light brown, sandy SILT, trace fine to medium sub-rounded to sub-angular gravel, medium dense to dense, wet to saturated, non-plastic		1.5			Triple T.					
Springston Formation		Greyish brown, fine sandy fine to coarse sub-rounded to rounded GRAVEL, trace sub-rounded cobble, very dense, saturated		2.0		1 28 31 N=59	SPT					
		grey		2.5			Triple T.					
				3.0		52 34 26 N=60	SPT					
				3.5			Triple T.					
				4.0		31 53 7 N=60	SPT					
		Grey, fine to coarse, sub-rounded to rounded GRAVEL, some fine to coarse sand, trace sub-rounded cobble, dense to very dense, saturated		4.5			Triple T.					
				5.0		8 15 17 N=32	SPT					
				5.5			Triple T.					
				6.0								

MACHINE LOG C14315_MB1.GPJ S+R_2012-AGS - REVISED.GDT 31/7/14

BH_40710

Soil & Rock Consultants
GEOTECHNICAL & ENVIRONMENTAL ENGINEERS

CLIENT: Mortlock McElroy Ltd

PROJECT: 1 Brynley Street, Hornby

Machine Borehole No: MB01

Sheet 2 of 2

Drill Type:	Rotary Drilling	Project No:	C14315	Logged By:	MLB/MG
Drilled By:	Speight Drilling Ltd	Coordinates:	1561859 E, 5178723 N	Reviewed By:	PS
Date Started:	22/7/14	Ground Elevation:	28m LYTTHT1937	Surface Conditions:	Near level, grass
Date Finished:	22/7/14	Water Level:	Groundwater Masked by Drilling	Shear Vane Number:	N/A

STRATIGRAPHY	GRAPHIC LOG	Soil description in accordance with the NZ Geotechnical Society Inc 2005 "Guidelines for Field Description of Soil and Rock in Engineering Use"	WATER LEVEL (m)	DEPTH (m)	SAMPLE TYPE	SPT (blows/300mm) / c_u (kPa)	DRILLING METHOD	RECOVERY (%)	TCR SCR RQD	If	WATER CONTENT	Heave (mm)
Springston Formation		Grey, fine to coarse, sub-rounded to rounded GRAVEL, some fine to coarse sand, trace sub-rounded cobble, dense to very dense, saturated		6.0		38 59 1 N=60	SPT					
				6.5			Triple T.					
				7.0		20 30 30 N=60	SPT					
				7.5			Triple T.					
				8.0		24 30 30 N=60	SPT					
				8.5			Triple T.					
				9.0		13 21 20 N=41	SPT					
				9.5			Triple T.					
				10.0		23 23 31 N=54	SPT					
		END OF BORE. 10.45 METRES. [Target Depth]		10.5								
				11.0								
				11.5								
				12.0								

MACHINE LOG C14315_MB1.GPJ S+R_2012-AGS - REVISED.GDT 31/7/14

BH_29250

Bore Log

McMILLAN Drilling GROUP

Client: GHD NZ Ltd

Project: 282 Main South Road, Christchurch

Bore No.: BH001

Job No.: 12405

Site Location: 282 Main South Road, Christchurch
Grid Reference: 1562727.48mE, 5178812.75mN (NZTM)
Rig Operator: D. Berger
Rig Model & Mounting: Geoprobe 8140LS

Date Commenced: 29/07/2013
Date Completed: 29/07/2013
Consent: -
Datum: Ground

Description	Method	Drivability	Recovery	Depth	Graphic Log	SPT N-value (Uncorrected)	SPT Data (Uncorrected)	Samples	Installation & Resources
TOPSOIL Brown fine to medium Sandy fine to coarse GRAVEL; minor to some cobbles	Sonic core drilling	1 2 3 4 5	25 50 75	0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0 5.5 6.0 6.5 7.0 7.5 8.0 8.5 9.0 9.5 10.0		10 20 30 40 50	N = 60 (C) 1.00m 13, 16 / 15, 16, 14, 15 450mm N = 51 (C) 2.00m 17, 17 / 16, 14, 12, 9 450mm N = 60+ (C) 3.00m 10, 14 / 25, 23, 13 345mm Effective Refusal N = 35 (C) 4.00m 12, 11 / 8, 8, 9, 10 450mm N = 34 (C) 5.00m 4, 4 / 7, 5, 8, 14 450mm N = 60+ (C) 6.00m 7, 17 / 17, 23, 20 360mm Effective Refusal N = 60+ (C) 7.00m 14, 19 / 21, 20, 19 370mm Effective Refusal N = 60+ (C) 8.00m 30, 30 135mm Effective Refusal N = 60+ (C) 9.00m 25, 35 125mm Effective Refusal N = 60+ (C) 10.00m 30, 30 140mm Effective Refusal		Bentonite (4.5 bags) 3.2m Surrounding ground collapse 10.14m

EOH: 10.14m

Remarks

Geotechnical Investigation Borehole BH001 with SPT Testing

No Static Water Level Recorded
1000 Litres Water Added
Safety Auto Trip Hammer #368 used (energy ratio 99%)

Drivability

1 Easy Push - No Hammer \ Fast Penetration
2 Relatively Easy Push - Light Hammer \ Relatively Fast
3 Medium Push - Consistent Hammer \ Medium
4 Hard Push - Full Hammer \ Somewhat Slow
5 Very Hard Push - Full Hammer \ Very Slow

Additional Resources:

Plastic Liner	**m**	-
Flush Mounted Toby Box		
- Standard	**ea**	
- Environmental	**ea**	
Above Ground Protective Surround	**ea**	
Geotextile Sock	**m**	-
Hand Clear Location	**ea**	
Decontaminate Equipment	**ea**	

120 High Street, Southbridge 7602, Canterbury, New Zealand ph: (03) 324 2571 fax: (03) 324 2431 web: www.drilling.co.nz

Hole Depth: 10.14m

Generated by GEROC Core-GS

Created: 2/08/2013 7:26:24 a.m.

BH_29251

Bore Log

McMILLAN Drilling GROUP

Client: GHD NZ Ltd

Project: 282 Main South Road, Christchurch

Bore No.: BH002

Job No.: 12405

Site Location: 282 Main South Road, Christchurch
Grid Reference: 1562803.56mE, 5178809.26mN (NZTM)
Rig Operator: D. Berger
Rig Model & Mounting: Geoprobe 8140LS

Date Commenced: 30/07/2013
Date Completed: 30/07/2013
Consent: -
Datum: Ground

Description	Method	Drivability (1–5)	Recovery (25–75)	Depth	Graphic Log	SPT N-value (Uncorrected) (10–50)	SPT Data (Uncorrected)	Samples	Installation & Resources
TOPSOIL Brown fine to medium Sandy fine to coarse GRAVEL; minor to some cobbles	Sonic core drilling		100%	0.5			N = 14 (C) 1.00m 10, 6 / 5, 4, 2, 3 450mm		Bentonite (1 bags) 1.3m
			100%	1.0					
			100%	1.5			N = 60+ (C) 2.00m 11, 15 / 16, 15, 16, 13 420mm Effective Refusal		
			100%	2.0					
			100%	2.5			N = 60+ (C) 3.00m 10, 14 / 13, 16, 18, 13 420mm Effective Refusal		
			100%	3.0					
			100%	3.5			N = 47 (C) 4.00m 18, 16 / 13, 13, 10, 11 450mm		
			100%	4.0					
			100%	4.5			N = 60+ (C) 5.00m 16, 21 / 17, 17, 18, 8 405mm Effective Refusal		
			100%	5.0					
			100%	5.5			N = 48 (C) 6.00m 15, 13 / 12, 12, 13, 11 450mm		
			100%	6.0					
			100%	6.5			N = 60+ (C) 7.00m 22, 22 / 21, 21, 18 370mm Effective Refusal		
			100%	7.0					
			100%	7.5			N = 60+ (C) 8.00m 27, 29 / 29, 28, 3 310mm Effective Refusal		
			100%	8.0					
			100%	8.5			N = 60+ (C) 9.00m 16, 18 / 14, 21, 17, 3 385mm Effective Refusal		
			100%	9.0					
			100%	9.5			N = 60+ (C) 10.00m 13, 13 / 15, 14, 21, 10 410mm Effective Refusal		Surrounding ground collapse 10.41m
				10.0					

EOH: 10.41m

Remarks

Geotechnical Investigation Borehole BH002 with SPT Testing

No Static Water Level Recorded
1000 Litres Water Added
Safety Auto Trip Hammer #368 used (energy ratio 99%)

Drivability

1 Easy Push - No Hammer \ Fast Penetration
2 Relatively Easy Push - Light Hammer \ Relatively Fast
3 Medium Push - Consistent Hammer \ Medium
4 Hard Push - Full Hammer \ Somewhat Slow
5 Very Hard Push - Full Hammer \ Very Slow

Additional Resources:

Plastic Liner	**m**	-
Flush Mounted Toby Box		
- Standard	**ea**	
- Environmental	**ea**	
Above Ground Protective Surround	**ea**	
Geotextile Sock	**m**	-
Hand Clear Location	**ea**	
Decontaminate Equipment	**ea**	

120 High Street, Southbridge 7602, Canterbury, New Zealand ph: (03) 324 2571 fax: (03) 324 2431 web: www.drilling.co.nz

Hole Depth: 10.41m

Created: 2/08/2013 7:26:50 a.m.

BH_38385

Soil & Rock Consultants
GEOTECHNICAL & ENVIRONMENTAL ENGINEERS

CLIENT: Halswell Road Properties Limited

PROJECT: 47 Waterloo Road, Hornby, Christchurch

Machine Borehole No: BH1

Sheet 1 of 2

Drill Type:	Rotary Drilling	Project No:	C13364	Logged By:	JP/AM
Drilled By:	Speight Drilling Ltd	Coordinates:	1562948 E, 5179334 N	Reviewed By:	PS
Date Started:	24/4/14	Ground Elevation:	25m LYTTHT1937	Surface Conditions:	Near Level, asphalt
Date Finished:	24/4/14	Water Level:	Groundwater masked by drilling	Shear Vane Number:	N/A

STRATIGRAPHY	GRAPHIC LOG	Soil description in accordance with the NZ Geotechnical Society Inc 2005 "Guidelines for Field Description of Soil and Rock in Engineering Use"	WATER LEVEL (m)	DEPTH (m)	SAMPLE TYPE	SPT / c_u (kPa) (blows/300mm)	DRILLING METHOD	RECOVERY (%)	TCR SCR RQD	If	WATER CONTENT	Heave (mm)
		Asphalt		0.0								
Fill		Greyish brown, sandy fine to medium sub-rounded to rounded GRAVEL, medium dense to dense, dry to moist [FILL]		0.5			Hand Auger					
Springston Formation		Greyish brown, fine to coarse sub-rounded to rounded GRAVEL, some medium to coarse sand, very dense, saturated [SPRINGSTON FORMATION]		1.0		22 50 10 for 325mm N=60	SPT					
		trace cobbles		1.5			Triple T.					
				2.0		26 27 33 N=60	SPT					
		fine to medium sub-rounded to rounded gravel, trace to minor silt, no cobbles, medium dense		2.5			Triple T.					
				3.0		6 5 8 N=13	SPT					
		fine to coarse sub-rounded to rounded gravel		3.5			Triple T.					
		trace silt, very dense		4.0		24 32 28 for 400mm N=60	SPT					
				4.5			Triple T.					
		Greyish brown, medium to coarse SAND, minor to some fine sub-rounded to rounded gravel, loose, saturated		5.0		1 1 6 N=7	SPT					
				5.5			Triple T.					
				6.0								

MACHINE LOG C13364 BH1 30-4-14.GPJ S+R_2012-AGS - REVISED.GDT 2/5/14

PO Box 5486, Papanui, Christchurch 8542. Phone: (03) 352 4519
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BH_38385

Soil & Rock Consultants
GEOTECHNICAL & ENVIRONMENTAL ENGINEERS

CLIENT: Halswell Road Properties Limited

PROJECT: 47 Waterloo Road, Hornby, Christchurch

Machine Borehole No: BH1

Sheet 2 of 2

Drill Type:	Rotary Drilling	Project No:	C13364	Logged By:	JP/AM
Drilled By:	Speight Drilling Ltd	Coordinates:	1562948 E, 5179334 N	Reviewed By:	PS
Date Started:	24/4/14	Ground Elevation:	25m LYTTHT1937	Surface Conditions:	Near Level, asphalt
Date Finished:	24/4/14	Water Level:	Groundwater masked by drilling	Shear Vane Number:	N/A

STRATIGRAPHY	GRAPHIC LOG	Soil description in accordance with the NZ Geotechnical Society Inc 2005 "Guidelines for Field Description of Soil and Rock in Engineering Use"	WATER LEVEL (m)	DEPTH (m)	SAMPLE TYPE	SPT / c_u (kPa) (blows/300mm)	DRILLING METHOD	RECOVERY (%)	TCR SCR RQD	If	WATER CONTENT	Heave (mm)
Springston Formation		Greyish brown, medium to coarse SAND, minor to some fine sub-rounded to rounded gravel, loose, saturated		6.0		5 5 6 N=11	SPT					
				6.5			Triple T.					
		Light brown, SILT, minor to some fine sand, loose, saturated, non-plastic		7.0		2 3 5 N=8	SPT					
		bluish grey, mottled oranges, trace fine sand		7.5			Triple T.					
		light brown, mottled grey, minor fine sand		8.0		3 6 5 N=11	SPT					
		Light brown, fine to medium sandy SILT, medium dense, saturated, non-plastic, mottled bluish grey		8.5			Triple T.					
		medium to coarse sandy silt		9.0		20 43 17 for 375mm N=60	SPT					
Riccarton Gravel		Greyish brown, sandy fine to coarse sub-rounded to rounded GRAVEL, very dense, saturated [RICCARTON GRAVEL]		9.5			Triple T.					
				10.0		16 16 21 N=37	SPT					
		END OF BORE. 10.45 METRES. [Target Depth]		10.5								
				11.0								
				11.5								
				12.0								

MACHINE LOG C13364 BH1 30-4-14.GPJ S+R_2012-AGS - REVISED.GDT 2/5/14

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BH_31223

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BOREHOLE RECORD

HOLE NO. **BH 2**

PROJECT NO. **238331**

PROJECT **Champions' Mile**
Riccarton Racecourse

METHOD **SNC**	CO-ORDINATES (NZTM) **E 1562624 N 5180202**	SHEET **1** of **2**
MACHINE & NO. **AMS**		DATE from **17/09/2013** to **17/09/2013**
FLUSHING MEDIUM **Water**	ORIENTATION **VERTICAL**	GROUND-LEVEL **+26.10** m RL

Drilling Progress	Casing depth/size	Water level (m) shift start/ end	Water Recovery %	Total core Recovery %	Solid core Recovery %	R.Q.D.	Fracture Index	Tests	Samples Type	Ref	Depth	Reduced Level	Depth (m)	Legend	STRATA DESCRIPTION
											0.00		0.00		
				100				98 kPa	SNC		0.00	+25.80	0.30		SILT with some sand and occasional rootlets. *Soft*, moist, low plasticity; sand, fine.
								122 kPa							SILT with some sand; yellowish brown. Firm to stiff, moist, low plasticity; sand, fine.
				22				(1, 3, 2, 2, 2, 1) N = 7	SPT		1.50				
				100				98 kPa			1.95				
								122 kPa	SNC			+23.50	2.60		
				80				(13, 14, 16, 16, 18) N = 50/225 mm	SPT		3.00				Sandy fine to coarse GRAVEL with minor silt; yellowish brown. Very dense, moist; gravel, subangular to subrounded; sand, fine to coarse.
				63							3.38				3.00m Becomes with some sand; brownish grey.
									SNC		3.38				
				66				(9, 10, 18, 14, 18) N = 50/225 mm	SPT		4.50	+21.60	4.50		Fine to coarse GRAVEL with minor sand; grey. Very dense, moist; gravel, subangular to subrounded; sand, fine.
				100							4.87				
									SNC						
				100				(3, 3, 1, 3, 3, 1) N = 8	SPT		6.00				6.00m - 6.45m Becomes medium dense.
				100							6.45				
									SNC						
				100				(2, 3, 2, 4, 5, 5) N = 16	SPT		7.50				7.50m - 7.95m Becomes dense.
				66							7.95				7.80m Becomes with some sand and minor silt
									SNC						
				44				(7, 12, 12, 10, 11, 9) N = 42	SPT		9.00				9.00m - 9.45m Becomes very dense.
				100							9.45				
									SNC						

Report ID: AGS4 BOREHOLE RECORD || Project: CHAMPIONS MILE LOGS.GPJ || Library: AGS 4_0.GLB || Date: 23 October 2013

- Small Disturbed Sample
- Large Disturbed Sample
- SPT Liner Sample
- Thin Wall Undisturbed Sample
- U100 Undisturbed Sample
- Pocket Penetrometer Test
- Piston Sample
- Water Level
- Impression Packer Test
- Standard Penetration Test
- Permeability Test
- Piezometer / Standpipe Tip
- Packer Test
- In-situ Vane Shear Test

LOGGED **C. WILSON**

DATE **18/09/2013**

CHECKED **A. WELLS**

DATE **23/09/2013**

REMARKS

Co-ordinates from CERA Public Viewer, accurate to +/-5m.

Ground level from LiDAR data, using the Lyttelton vertical datum, accurate to +/-1m.

Groundwater not recorded.

Hammer energy ratio 85.4%

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BOREHOLE RECORD

HOLE NO. **BH 2**

PROJECT NO. **238331**

PROJECT **Champions' Mile**
Riccarton Racecourse

METHOD **SNC**	CO-ORDINATES (NZTM) **E 1562624 N 5180202**	SHEET **2** of **2**
MACHINE & NO. **AMS**		DATE from **17/09/2013** to **17/09/2013**
FLUSHING MEDIUM **Water**	ORIENTATION **VERTICAL**	GROUND-LEVEL **+26.10** m RL

Drilling Progress	Casing depth/size	Water level (m) shift start/ end	Water Recovery %	Total core Recovery %	Solid core Recovery %	R.Q.D.	Fracture Index	Tests	Samples Type	Ref	Depth	Reduced Level	Depth (m)	Legend	STRATA DESCRIPTION
				100									10.00		
				44				(8, 10, 14, 14, 10, 9) N = 47	SNC		10.50				
				85					SPT		10.95				
									SNC						
				44				(8, 7, 10, 12, 12, 13) N = 47	SPT		12.00				
				100							12.45				
									SNC						
				44				(2, 6, 5, 6, 8, 10) N = 29	SPT		13.50				
				100							13.95				14.00m Becomes brownish grey. Saturated
									SNC						
				44				(3, 5, 5, 8, 7, 11) N = 31	SPT		15.00				
											15.45	+10.65	15.45		End of Sonic core drilling at 15.45m, on 17/09/2013 *Termination Reason:* Target depth achieved.

- Small Disturbed Sample
- Large Disturbed Sample
- SPT Liner Sample
- Thin Wall Undisturbed Sample
- U100 Undisturbed Sample
- Pocket Penetrometer Test
- Piston Sample
- Water Level
- Impression Packer Test
- Standard Penetration Test
- Permeability Test
- Piezometer / Standpipe Tip
- Packer Test
- In-situ Vane Shear Test

LOGGED **C. WILSON**

DATE **18/09/2013**

CHECKED **A. WELLS**

DATE **23/09/2013**

REMARKS

Co-ordinates from CERA Public Viewer, accurate to +/-5m.

Ground level from LiDAR data, using the Lyttelton vertical datum, accurate to +/-1m.

Groundwater not recorded.

Hammer energy ratio 85.4%

Report ID: AGS4 BOREHOLE RECORD || Project: CHAMPIONS MILE LOGS.GPJ || Library: AGS 4_0.GLB || Date: 23 October 2013

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BH_33525

GEOSCIENCE
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MACHINE BOREHOLE - BH03

32 Roberts Road
Islington
Christchurch

Client	: 1Geotechnical	**Date**	: 20/08/13
Project	: Geotechnical Investigation	**Contractor**	: LandTest
Geoscience Ref.	: 10224.000.011	**Hammer Efficiency**	: 84 %
Drilling Method	: Sonic	**Hole Depth**	: 15.45 m
Core Diameter	: 68 mm	**Logged/Reviewed By**	: EG/LF

Depth (m)	Material	USCS Symbol	DESCRIPTION	Graphic Log	Water Level	Moisture Condition	Consistency / Density Index	TCR (%) 25 50 75	SPT N-Value 0 10 20 30 40 50	
0.0	TS	ML	SILT with some gravel, trace sand and rootlets; brown [TOPSOIL].				S-St			
0.5	ALLUVIUM	GW	Sandy fine to coarse GRAVEL with minor cobbles; brownish grey. Well graded, subrounded to subangular. Sand, fine to coarse, well graded, subrounded to subangular.			N/R	MD-D			SPT: 1.5 m 14,9,7,5,5,6 N =23 450 mm pen.
1.0										
1.5										
2.0										
2.5										
3.0										SPT: 3.0 m 13,17,17,20, 13 N = 50 335 mm pen.
3.5										
4.0										
4.5										SPT: 4.5 m 7,7,6,6,6,8 N = 26 450 mm pen.
5.0										
5.5										
6.0										SPT: 6.0 m 7,16,12,11,12, 14 N = 49 450 mm pen.
6.5										
7.0							L			
7.5										SPT: 7.5 m 2,3,2,1,2,2 N = 7 450 mm pen.
8.0			Sand becomes trace from 8.0 to 8.3 m depth.							
8.5										

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GEOSCIENCE
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MACHINE BOREHOLE - BH03

32 Roberts Road
Islington
Christchurch

Client	: 1Geotechnical	**Date**	: 20/08/13
Project	: Geotechnical Investigation	**Contractor**	: LandTest
Geoscience Ref.	: 10224.000.011	**Hammer Efficiency**	: 84 %
Drilling Method	: Sonic	**Hole Depth**	: 15.45 m
Core Diameter	: 68 mm	**Logged/Reviewed By**	: EG/LF

Depth (m)	Material	USCS Symbol	DESCRIPTION	Graphic Log	Water Level	Moisture Condition	Consistency / Density Index	TCR (%) 25 50 75	SPT N-Value 0 10 20 30 40 50	
8.5	ALLUVIUM	GW	Continued: Sandy fine to coarse GRAVEL with minor cobbles; brownish grey. Well graded, subrounded to subangular. Sand, fine to coarse, well graded, subrounded to subangular.							
9.0										SPT: 9.0 m 16,23,26,24 N = 50 300 mm pen.
9.5										
10.0						N/R				
10.5										SPT: 10.5 m 7,12,12,12,14,9 N = 47 450 mm pen.
11.0										
11.5			Becomes saturated at 11.8 m depth.		▼					
12.0							MD-D			SPT: 12.0 m 5,6,5,4,4,3 N = 16 450 mm pen.
12.5										
13.0										
13.5						S				SPT: 13.5 m 3,3,6,9,11,6 N = 32 450 mm pen.
14.0			Cobbles become trace between 14.2 m depth and 14.7 m depth.							
14.5										
15.0										SPT: 15.0 m 7,8,10,6,5,8 N = 29 450 mm pen.
15.5			EOH: 15.45 m							
16.0										
16.5										
17.0										

Termination: Target depth
Machine Borehole met target depth at 15.45 m depth.
Groundwater encountered at 11.8 m depth.
Core lost (due to stone in drill) berween 7.5 m depth and 7.6 m depth.
TS = TOPSOIL, N/R = Not Recorded

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