

SITE INVESTIGATION RECORD

D.P

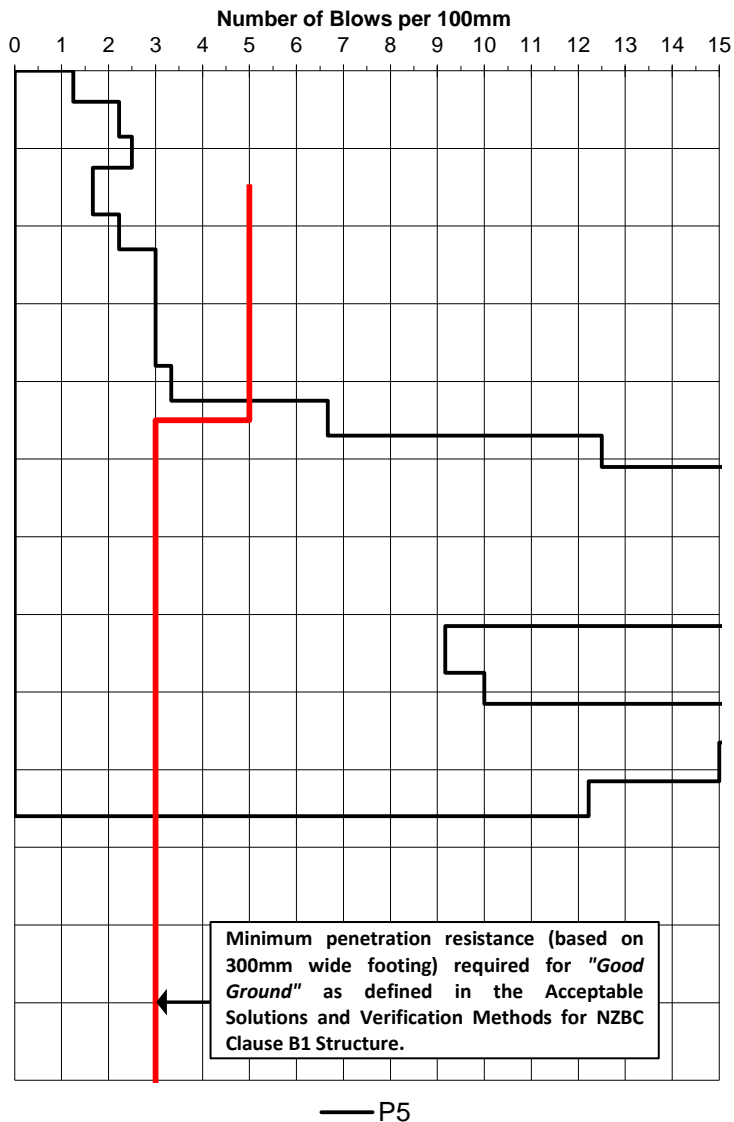
Lot

Client **Mr BL Clarke & Williams
McKenzie Trustees**

Site **141 South Belt (Lot 3 DP73557) &
104 Townsend Rd (Lot 1 DP 45826), Rangiora**

Technical Category
N/A Rural

SCALA PENETROMETER TESTS

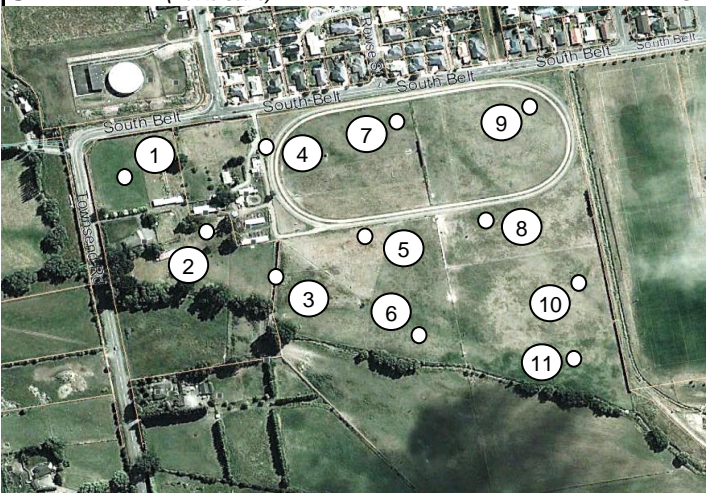


DEPTH

BORE LOGS

[m]	Hand Auger	Machine Auger	Test Pit
G.L.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
0.2	(Borehole @ 5)		
0.4	Dark brown silty TOPSOIL with rootlets <2mm Ø		
0.6	Grey clayey SILT, iron staining, with minor		
0.8	Grey clayey SILT, moist, iron staining		
1.0	Grey sandy clayey SILT, moist, iron staining		
1.2	STOP - Stones		
1.4			
1.6			
1.8			
2.0			
2.2			
2.4			
2.6			
2.8			
3.0			
3.2			
3.4			

SITE PLAN (Not to Scale)



COMMENTS

LOGGED BY: LW / PN

CHECKED BY: JTA

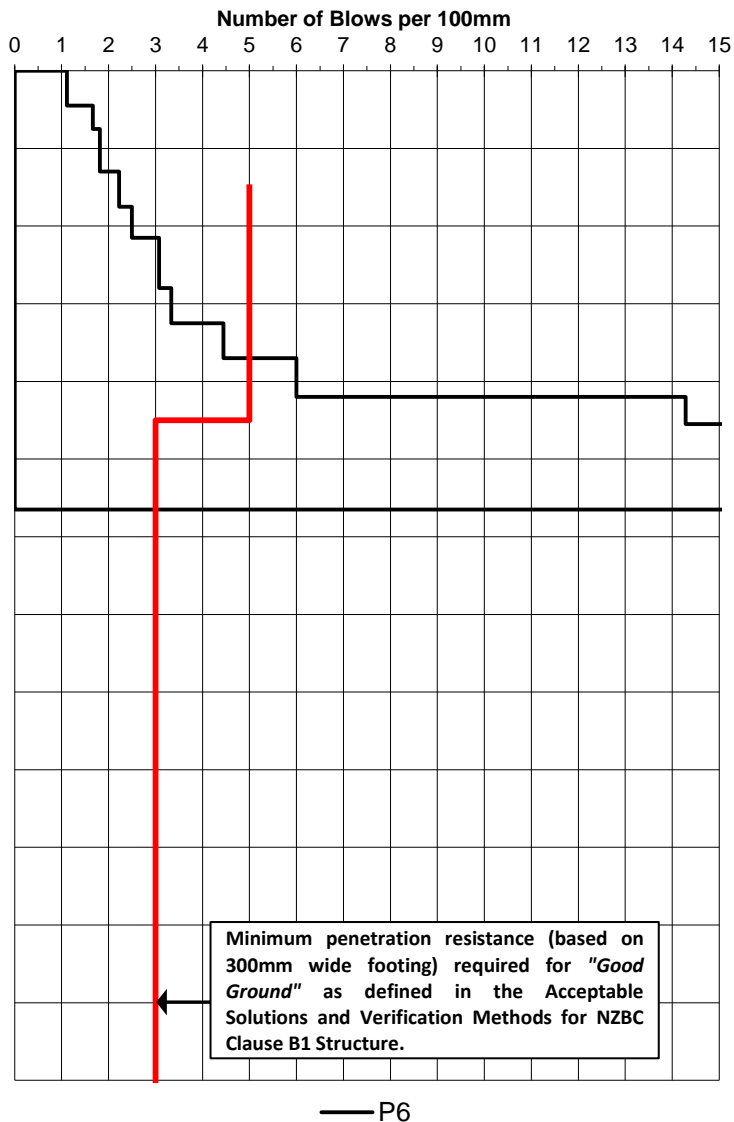
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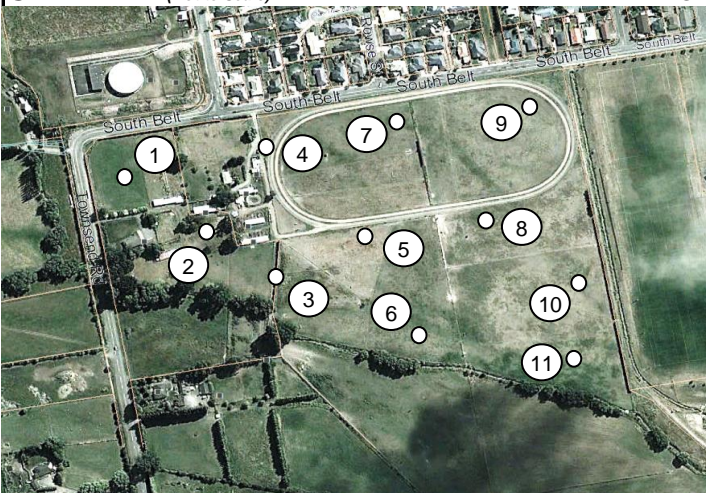


DEPTH

BORE LOGS

DEPTH [m]	Hand Auger	Machine Auger	Test Pit
G.L.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
0.2	(Borehole @ 6) Dark brown silty TOPSOIL, moist, with rootlets <2mm Ø		
0.4	Grey clayey SILT, moist, iron staining		
0.6			
0.8	Grey clayey sandy SILT, moist, iron staining		
1.0	STOP - Stones		
1.2			
1.4			
1.6			
1.8			
2.0			
2.2			
2.4			
2.6			
2.8			
3.0			
3.2			
3.4			

SITE PLAN (Not to Scale)



COMMENTS

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LW / PN

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JTA

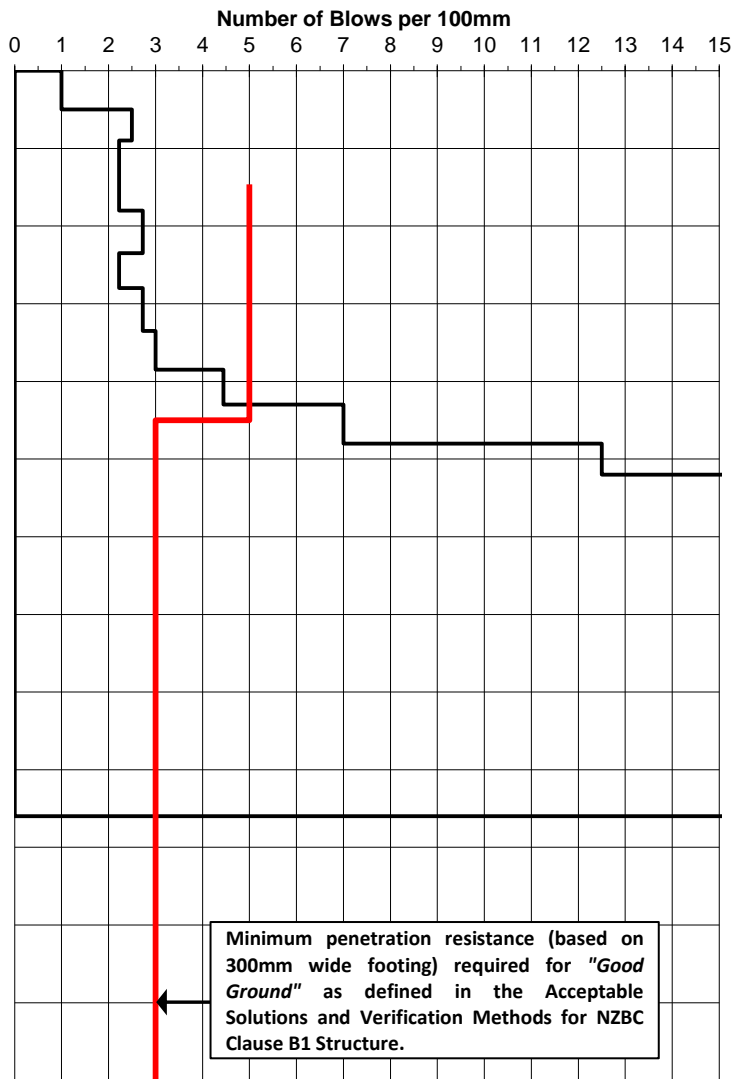
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SCALA PENETROMETER TESTS



— P7

DEPTH

[m]

BORE LOGS

Hand Auger



Machine Auger



Test Pit



G.L.

0.2

0.4

0.6

0.8

1.0

1.2

1.4

1.6

1.8

2.0

2.2

2.4

2.6

2.8

3.0

3.2

3.4

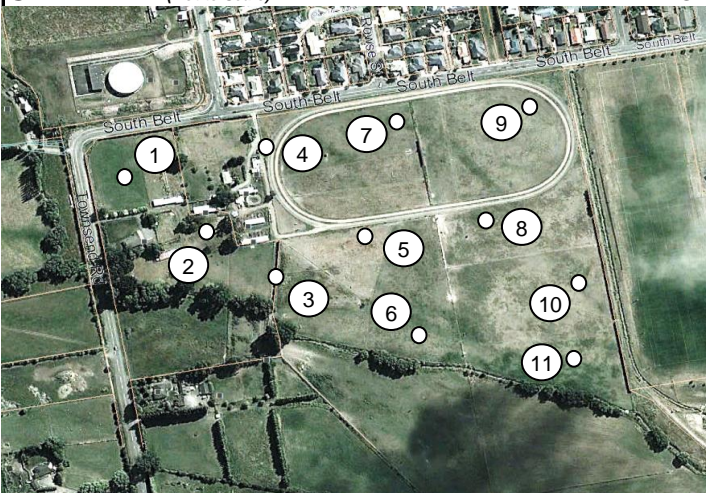
Dark brown silty TOPSOIL, moist, with rootlets <2mm Ø

Grey clayey SILT, moist, iron staining

Grey clayey sandy SILT, moist, iron staining
STOP - Stones

(Borehole @ 7)

SITE PLAN (Not to Scale)



COMMENTS

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LW / PN

CHECKED BY:

JTA

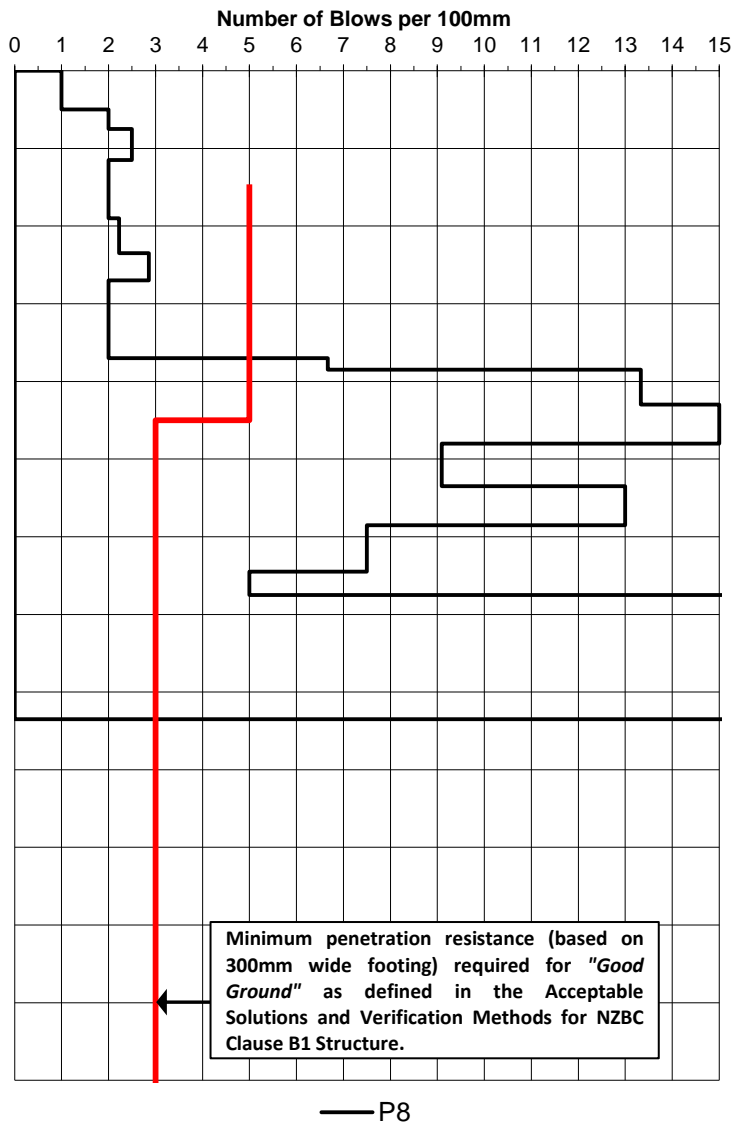
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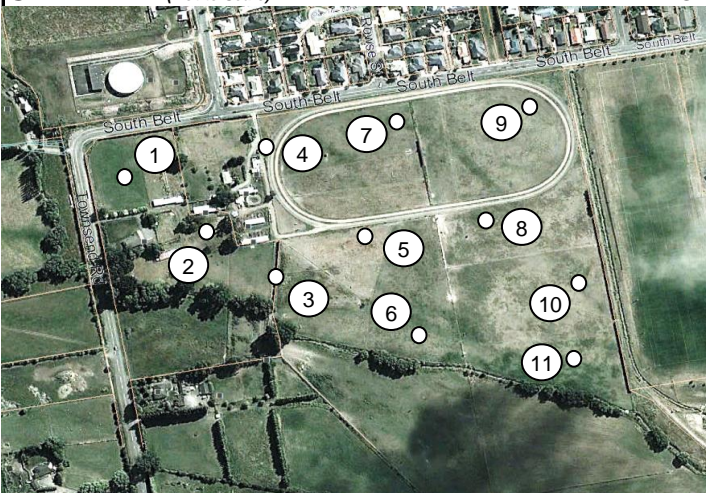


DEPTH

BORE LOGS

DEPTH [m]	Hand Auger	Machine Auger	Test Pit
G.L.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
0.2	(Borehole @ 8) Dark brown silty TOPSOIL, moist, with minor rootlets		
0.4	Grey clayey SILT, damp, iron staining		
0.6	Grey clayey sandy SILT, damp, iron staining		
0.8	STOP - Stones		
1.0			
1.2			
1.4			
1.6			
1.8			
2.0			
2.2			
2.4			
2.6			
2.8			
3.0			
3.2			
3.4			

SITE PLAN (Not to Scale)



COMMENTS

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CHECKED BY: JTA

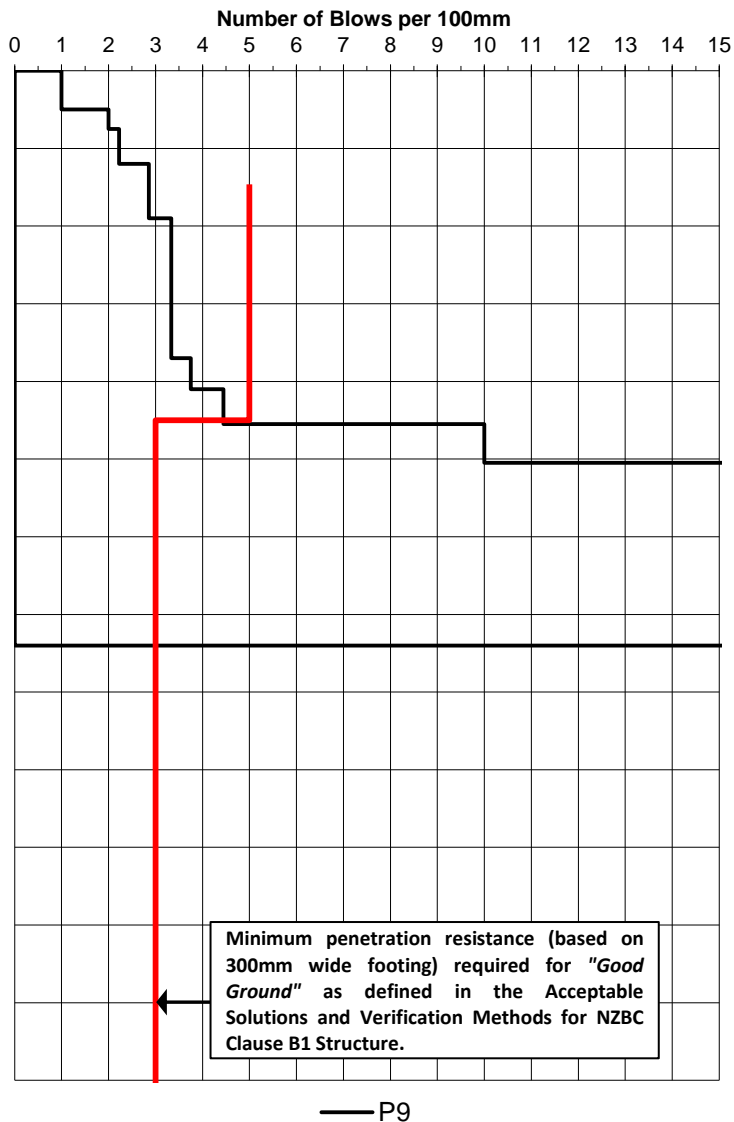
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SCALA PENETROMETER TESTS

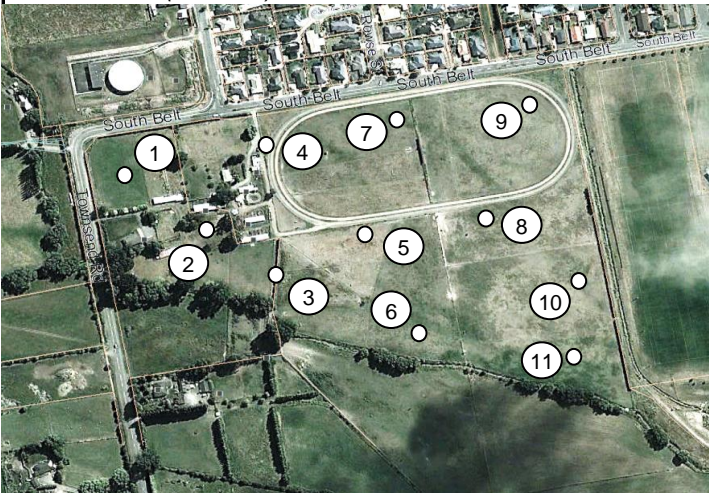


DEPTH

BORE LOGS

[m]	Hand Auger	Machine Auger	Test Pit
G.L.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
0.2	(Borehole @ 9) Dark brown silty TOPSOIL, moist, with minor rootlets		
0.4			
0.6	Grey clayey SILT, damp, iron staining, with minor rootlets		
0.8			
1.0	Grey clayey sandy SILT, damp, iron staining STOP - Stones		
1.2			
1.4			
1.6			
1.8			
2.0			
2.2			
2.4			
2.6			
2.8			
3.0			
3.2			
3.4			

SITE PLAN (Not to Scale)



COMMENTS

LOGGED BY:

LW / PN

CHECKED BY:

JTA

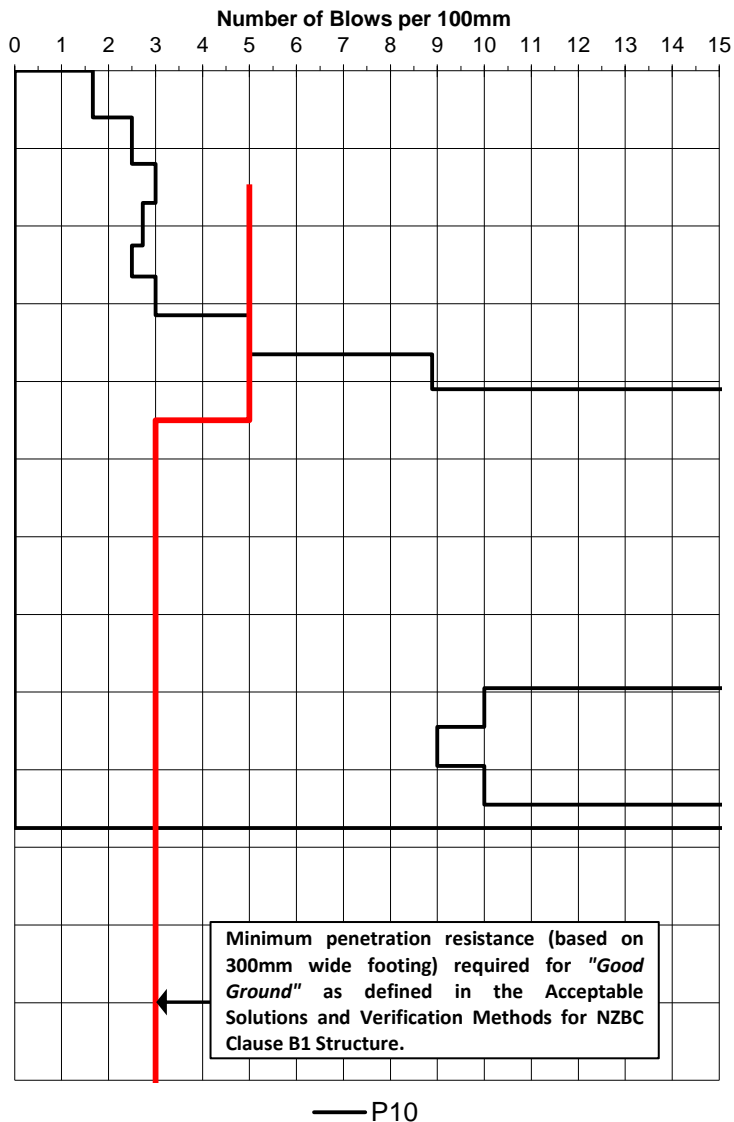
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Technical Category
N/A Rural

SCALA PENETROMETER TESTS



DEPTH

[m]

G.L.

0.2

0.4

0.6

0.8

1.0

1.2

1.4

1.6

1.8

2.0

2.2

2.4

2.6

2.8

3.0

3.2

3.4

BORE LOGS

Hand Auger



Machine Auger



Test Pit



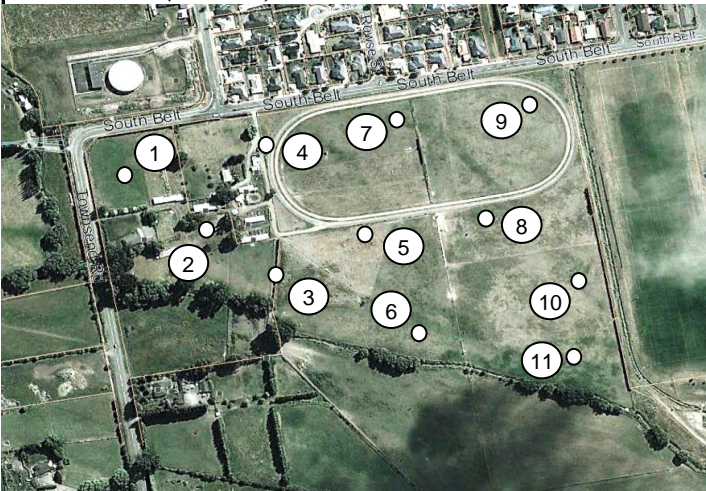
(Borehole @ 10)

Grey clayey SILT, damp, iron staining, with traces of rootlets

Grey clayey sandy SILT, moist, iron staining

STOP - Stones

SITE PLAN (Not to Scale)



COMMENTS

LOGGED BY:

LW / PN

CHECKED BY:

JTA

Appendix I: Contamination Assessment

GROUND CONTAMINATION ASSESSMENT

141 South Belt & 104 Townsend Road, Rangiora, Canterbury

M.A. Clarke & Williams McKenzie Trustees Ltd.

Eliot Sinclair
surveyors | engineers | planners

GROUND CONTAMINATION ASSESSMENT

141 South Belt & 104 Townsend Road, Rangiora

On behalf of M.A. Clarke and William McKenzie Trustees Ltd

Eliot Sinclair surveyors engineers planners			Eliot Sinclair & Partners Ltd 20 Troup Drive Tower Junction PO Box 9339 Christchurch 8149 New Zealand 03 379 4014
QUALITY CONTROL CERTIFICATE All relevant information is identified, has been reviewed and is approved for release.			
Prepared by:	 Jens Martin Zollhofer Senior Environmental Scientist, SQEP	PhD (Nat. Sciences) MSc (Biogeography) PGCertRS CEnvP	
And:	 Carly Fleming Graduate Environmental Scientist	BSc	
Reviewed by:	 Trudi Burney Senior Resource Management Planner	BSc, M.Appl.Sc Assoc. NZPI	
Directed and approved for release by:	 Mark Allan Director	BSurv, NZCLS, MNZIS	
Date:	15 October 2014		
Reference:	196916_13281154006_ENVTR_Ph1_jmz.docx		
Status:	Final		
Distribution:	1 copy 1 copy File copy	P.G. Harris Waimakariri River District Council Eliot Sinclair Ltd.	

Limitations

This report has been prepared for Mr M.A. Clarke and William McKenzie Trustees Ltd according to their instructions and for the particular objectives described in the report. The information contained in the report should not be used by anyone else or for any other purposes.

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The NES guidelines and contaminated land management reports make abundant use of acronyms. Some commonly used abbreviations are:

ACM	Asbestos Containing Material
AST	Above ground Storage Tank
BAP	Benzo-alpha-pyrene
bgl	Below ground level
CCC	Christchurch City Council
CoC	Chain of Custody (Transport and Laboratory Quality Assurance), or
CoC	Contaminants of Concern
CSM	Conceptual Site Model
DSI	Detailed Site Investigation (often referred to as Phase 2)
DQO	Data Quality Objectives
ECan	Environment Canterbury Regional Council
HMs	Heavy metals screen; GC scan for Arsenic, Cadmium, Chromium, Copper, Lead, Nickel, Zinc
HAIL	Hazardous Activities and Industries List (MfE, 2011)
LLUR	Listed Land Use Register (ECan database of land with known or suspected contamination)
LOSP	Light Organic Solvent-Based Preservative (timber treatment)
LWRP	Proposed Canterbury Land and Water Regional Plan (ECan 2012)
MfE	Ministry for the Environment
MMP	Monitoring and Management Plan (Phase 5)
NES _(soil)	National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health. Regulations 2011
NRRP	Natural Resources Regional Plan (Environment Canterbury 2011)
OCP	Organochlorine Pesticides
ONOP	Organophosphorus Pesticides
PAH	Polycyclic Aromatic Hydrocarbons
PEF	Potency Equivalent Factors, synonym with TEQ
PCP	Pentachlorophenol
PSI	Preliminary Site Investigation (often referred to as Phase 1)
QC/QA	Quality Control/Quality Assurance
RAP	Remedial Action Plan, often joint with a Health and Safety Plan (HSP) (Phase 3)
SCS _(health)	Soil Contaminant Standard for health for inorganic substances
SPLP	Synthetic Precipitation Leaching Procedure
SVOC	Semi Volatile Organic Compounds
SVR	Site Validation Report (Phase 4)
TCDD	2,3,7,8-Tetrachlorodibenzo- <i>p</i> -dioxin (persistent carcinogenic pollutant of 2,4,5-T; was widely used in forestry as defoliant herbicide in the 1950s-1960s.
TCLP	Toxicity Characteristic Leaching Procedure
TEQ	Toxic Equivalent
TLB	True Left Bank (of a river, as seen in the direction of flow)
TRB	True Right Bank
UST	Underground Storage Tank

1 Summary

A plan change from 'Residential 4B' to 'Residential 2' is proposed for land at 141 South Belt and 104 Townsend Road in Rangiora, North Canterbury. The Preliminary Site Investigation (PSI) identified caged chicken farming (HAIL A10) and a burn pad (HAIL G5). Consequently, a Detailed Site Investigation (DSI) has been carried out.

Six near-surface soil tests (0-50mm) from the area of the caged chicken sheds indicate slightly elevated concentrations of chromium and lead yet below NES_{Soil} contaminant standards. One sample from the burn pad has an arsenic concentration of 23mg/kg, slightly over the NES_{Soil} contaminant standards for residential land use. Consequently, the contaminated soil was removed and taken to Kate Valley.

The final validation sample from the remediated area confirmed that the concentration of arsenic (As) is now below NES_{Soil} contaminant standards and the land is suitable for residential zoning.

Table 1. Summary of Ground Contamination Assessment.

141 South Belt & 104 Townsend Road, Rangiora, Canterbury	
Local Authority	Waimakariri District Council
Resource consents	None
Legal Description, Area	Lot 1 DP 45826 (3.6737ha), Lot 3 DP 73557 (23.0040ha)
Owner/Occupier	M.A. Clarke, J.L. Clarke, L.M. Clarke, Williams McKenzie Trustees Ltd
Current land use	Pastoral/grazing
Proposed land use	Residential
LLUR ID	None
Identified HAIL activities	Two historical poultry sheds (1965 to 1974), burn pad indicating burning of treated timber
Contaminated areas	1 (burn pad) As: 23mg/kg
Remedial actions	Contaminated soil has been removed (approx. 10m ³)
Validation Sample	Concentrations are below soil contaminant standards

2 Introduction

Mr Clarke and Williams McKenzie Trustees Ltd have engaged Eliot Sinclair to undertake a ground contamination assessment of land at 141 South Belt and 104 Townsend Road in Rangiora, North Canterbury.

The assessment has been prepared in association with an application for a Plan Change, which would result in a change in land use from farmland to residential on the area between South Belt Road and the South Brook River.

The report has been prepared in accordance with the National Environmental Standard (NES_{Soil}¹), and MfE's Contaminated Land Management Guidelines 1-5. The NES_{Soil} regulations ensure that potential contamination from historical or recent HAIL² activities is identified and assessed at the time of development and, if necessary, remediated to make the land safe for human use.

The scope of this report comprises;

Preliminary Site Investigation (PSI)

- A description of the site and its surrounding environment to support a conceptual site model,
- Review of the Listed Land Use Register and resource consent database from Environment Canterbury,
- Review of available information from the property files from the Waimakariri District Council,
- Review of aerial photographs and satellite images,
- A site investigation and interview with the site owner.

Detailed Site Investigation (DSI)

- Conduct a targeted soil-sampling program to determine if residues from the poultry operation during the 1960s and 1970s are present, compare the laboratory results with background soil concentrations of trace metals and with the relevant acceptance criteria,
- Compile the findings in accordance with the NES and MfE's Contaminated Land Management Guidelines.

Conclusion and Recommendation

- Assess the likelihood of adverse effects of soil contaminants on human health and the environment, and recommend contaminant mitigation measures, if required.

Site Validation

- Soil-sampling to determine if soil is at background concentrations after remediation.

¹ Resource Management; National Environmental Standard (NES) for Assessing and Managing Contaminants in Soil to Protect Human Health; Regulations 2011/361.

² Hazardous Activities and Industries List, published by the Ministry for the Environment (MfE, 2011).

3 Site Description

The site is at the southwest fringes of Rangiora, North Canterbury. A site plan is appended in **Attachment A**. The associated street addresses are 141 South Belt and 104 Townsend Road.

Legal Description: The legal description, the area of the land area summarised in **Table 2**.

Table 2. Legal description of the site. Note that the site only refers to the land between South Belt and the South Brook. Refer to Figure 2 and Attachment A.

DP	Title	Area [ha]	Street Address
Part of Lot 1 DP 45826	CB24F/1150	3.6737	104 Townsend Road
Part of Lot 3 DP 73557	CB40A/812	23.0040	141 South Belt

Topography and Surface Runoff: The topography of the site is generally flat with a slight fall towards the southeast. The elevation of the site ranges from approximately 24 metres above sea level (m asl) at the southeastern boundary to approximately 27m asl at the northwestern boundary. This results in an average gradient of 1:155 from the southwest to the southeast.

The South Brook, which is a tributary to the Cam River, runs along the southern boundary. No further surface water is on, or adjacent to the site.

Land Use: The majority of the site is vegetated with grass used for grazing horses. Several dwellings, sheds, horse stables, and a horse racecourse exist at the western and northern part of the site.

Soils and Underlying Geology: Environment Canterbury's GIS identifies the soil on the site as *Waterton moderately deep silt loam and shallow silt loam*, which is an alluvial soil on the Windwhistle formation. This is a 'gley' soil; i.e. the subsoil is seasonally saturated. Landcare Research classifies the soil as 'imperfectly drained' (drainage class 3 out of 5³), which results in sodden ground conditions in winter. The underlying geology comprises alluvial deposits of sandy gravels, silt and loam.

'Level 1' trace metal concentrations (natural background) of the soil on the site are As: 8.7, Cd: 0.24, Cr: 16.8, Cu: 15.5, Hg: 0.06, Ni: 13.4, Pb: 17.8, Zn: 65.6 (all values in mg/kg soil).

Groundwater: Environment Canterbury's GIS indicates that the groundwater under the site is unconfined or semiconfined. Eliot Sinclair site investigations encountered saturated soils less than 1m bgl, caused by an approximately 1m thick pug layer beneath the topsoil, which prevents rain from infiltrating and results in seasonally saturated subsoils. Below the pug are free-draining gravels. Initial groundwater from

³ Landcare Research Soil Drainage Classes
Class 1: well drained, Class 2: moderately well drained, Class 3: imperfectly drained, Class 4: poorly drained, Class 5: very poorly drained.

Aquifer 0 is, according to Mr Clarke, approximately 3-4 metres below ground level. The general hydraulic gradient is towards the east parallel to the South Brook.

Zoning: The zoning of the site is Residential 4B. The surrounding zoning is Rural with residential and commercial zones further to the east of the site. A plan change from Residential 4B to Residential 2 is proposed.

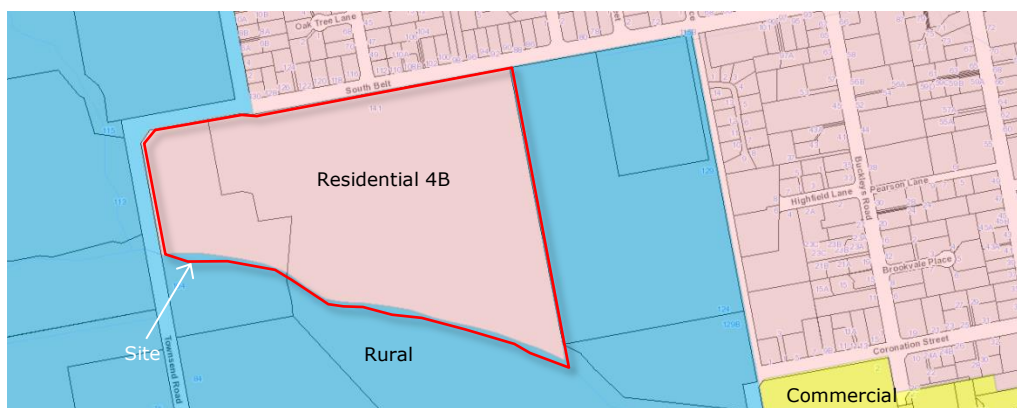


Figure 1. Current zoning of 141 South Belt and 104 Townsend Road. Source ECan GIS.

4 Site History

4.1 Environment Canterbury Listed Land Use Register (LLUR)

A search of Environment Canterbury's Listed Land Use Register (LLUR) has been undertaken. The LLUR is a database containing all known contaminated and potentially contaminated sites in Canterbury.

Environment Canterbury states that there are currently no known or anticipated HAIL activities associated on the site.

A neighbouring land parcel southeast of the site and on the true right bank of South Brook Stream is recorded on the LLUR as Site ID 3 at 1 Southbrook Road (**Figure 2**). The site comprises historical and current timber treatment or preservation and bulk storage of timber. The LLUR category is 'partially investigated'.

The LLUR record is within 50 metres of the legal boundary of 141 South Belt. The proposed plan change is approximately 300 metres at the nearest point, and the timber treatment area is downgradient of the site in the general direction of surface and groundwater flow.



Summary of sites:

Site ID	Site Name	Location	HAIL Activity(s)	Category
3	McAlpines Ltd	1 Southbrook Road, Rangiora	A18 - Wood treatment or preservation and bulk storage of treated timber	Partially Investigated

Please note that the above table represents a summary of sites intersecting the area of enquiry within a 50m buffer.

Figure 2. Screen clippings from the LLUR report with details about the timber treatment site east of the subject site. The red line denotes the area of the proposed plan change.

A copy of the LLUR statement is appended in **Attachment C**.

Conclusion: Neither the site nor immediately surrounding land of the subject site are recorded on the Listed Land Use Register. The recorded timber treatment site is approximately 300m downgradient at its nearest point; that is potential ground contamination from the timber treatment is highly unlikely to affect the subject site.

4.2 Environment Canterbury Resource Consents

Environment Canterbury's resource consent database indicates two terminated permits to take groundwater. No effluent discharge, above ground or below ground hazardous storage is, or has been consented. A screen clipping is appended in **Attachment D**.

Conclusion: Environment Canterbury's resource consent database does not hold specific information about consents that may have caused, or contributed to, persistent ground contamination.

4.3 Waimakariri District Council Records (Property File)

The property files for 141 South Belt and 104 Townsend Road, Rangiora were obtained from the Waimakariri District Council in January 2014.

The files comprises information on;

- Correspondence with Council regarding drainage issues and land development proposals,
- Consent applications documents and construction details for buildings,

Conclusion: The property files do not raise potential concerns about contamination of the site.

4.4 Site Inspections, Interview

The site was inspected on 14 October 2013 with the objective of identifying potential contaminants listed on MfE's Hazardous Activities and Industries List (HAIL⁴) such as;

- above ground storage tanks/underground storage tanks (AST/UST) for fuel, chemicals or liquid waste,
- storage, formulation and disposal of herbicides/pesticides,
- sheep dips or spray races including remnants thereof,
- hydrocarbon stains or bleached soils, disturbed, stressed or discoloured vegetation,
- soil mounds or excavations; change in natural contours of the land,

⁴ Ministry for the Environment 2011. Hazardous Activities and Industries List (HAIL).

- farm pits, deposits of refuse, burn pads,
- any other activity that might have led to intentional or accidental release of a hazardous substance in sufficient quantity that it could be a risk to human health or the environment.

Photographs taken during the site investigation are in **Attachment B**.

An interview with Mr Clarke was conducted during the site inspection on 14 October 2013.

The information from the site inspection and interview is summarised as follows:

- Mrs Clarke's father bought the land around 1946 from the previous farmer.
- The land is currently used to graze approximately 30 horses, 10 cattle and less than 10 sheep. No goods are produced on the farm.
- Previous land uses (approx. 40 years ago) comprised cattle, horses, pig and chicken farming.
- A historical farm pit was situated on a now neighbouring parcel southeast of the site (Lot 2 DP73557, **Figure 2**). This land has been sold to Waimakariri District Council, and subsequently, three stormwater detention and treatment have been constructed (**Attachment F**).
- Silt and gravel were stockpiled on the true left bank of the South Brook in 2011. The material is from deepening and straightening the watercourse.
- Horse manure and sawdust are stockpiled behind a horse stable. The material is regularly removed by Rangiora Landscaping and used for gardening.
- Mr Clarke stated that the farm was run on a low budget and grass grub was not treated in the 1960s and 1970.
- Today's spraying is undertaken by a registered sprayer who also works for Council. Spraying occurs mostly along the South Brook.
- No friable asbestos or cement fibreboards in deteriorated condition were noticed on farm buildings during the site inspection.
- A burn pad is situated between the existing residential dwelling at 104 Townsend Road and the South Brook. A photo of the pad is appended in **Attachment B**.
- An above ground storage tank (AST) is located amongst the horse stables. The tank was used to store diesel but has not been used for many years. The soil under the tank is densely vegetated with grass. No hydrocarbon stains were visible at the time of inspection (**Attachment B**).
- The two residential dwellings are serviced by septic wastewater systems.
- Two steel-trussed chicken cage buildings were located in the northwestern part of the site and operated between 1965 and 1974. The buildings were constructed with steel frames and roofs but no walls, and the floor was unsealed, apart from two concrete strips to access the caged chicken. A historical photo is appended in **Attachment B**.

- No bulk-storage of chemicals was identified on the land. Chemicals from the poultry operation were probably stored in the adjacent packing and cooling shed on concrete floor.
- No further land uses or activities were observed during the site visits that raised concerns to be a risk to human health or the environment.

Conclusion: Most of the site is used to graze and train horses. This poses an overall low risk of ground contamination. Two areas with HAIL activities were identified:

- A burn pad east of the residential house at 104 Townsend Road, and
- A poultry operation west of the house, operated for nine years between 1965-and 1974).

4.5 Historical Aerial Photographs and Satellite Images

A historical aerial photograph from 1941 and three satellite images from 2004, 2011 and 2013 were investigated. The results from investigating the historical photo and recent satellite images are summarised in **Table 3**.

Key features are identified on the aerial photo and satellite images in **Attachment H**.

Conclusion: No land use is identified that indicates persistent ground contamination.

Table 3. Summary of information from historical aerial photographs and recent satellite images.

Date	Description
14/10/1941	<ul style="list-style-type: none"> ▪ The entire site is farmed; shelterbelts and paddock size is similar to today's land use. ▪ Initial buildings comprise a farmhouse, pig pens, a barn, and several small sheds. ▪ The South Brook meanders significantly more than today; i.e. the watercourse has been straightened. ▪ A power pole, pump shed, above ground pipes and a trough are visible in the excavated area near the western boundary. The well is identified as CRC990745 on ECan's GIS. No structures or buildings are on the site. ▪ All neighbouring land is farmed.
26/09/1973	<ul style="list-style-type: none"> ▪ A horse track is now visible on the northeast part of the site with associated horse stalls nearby. ▪ Two chicken sheds have been constructed on the northwest part of the site.
01/01/2004	<ul style="list-style-type: none"> ▪ Several horse stables, a cow shed, a feed barn, two residential dwellings and a large horse racecourse are established in the northern half of the site. ▪ Two poultry sheds, each approximately 70m long and 5m wide and an

-
- associated packing/cooling shed are in the north-western part of the site. One of the two sheds has been removed. Refer to **Attachment B**.
- Three stormwater detention and treatment basins are constructed on the downgradient neighbouring site (where the historical farm pit was).
 - The South Brook is partially straightened.
 - Most of the land is used for grazing horses (plus few cattle and sheep).
 - The land adjacent to the north has been developed as residential subdivision. No further significant change in land use is identified.
- 28/02/2013
- Both poultry sheds are removed. The concrete strips of the southern shed are still in place.
 - A stockpile with excavation material from the South Brook is deposited on the true left bank of the watercourse.
 - A burn pad appears between the residential dwelling of 104 Townsend Road and the South Brook between March 2010 and January 2011.
 - Most of the land is used for grazing horses (plus few cattle and sheep).
-

5 Conclusion of Site History and Potential for Ground Contamination

The investigations for this ground contamination assessment identified a historical poultry operation and a farm burn pad as potential HAIL activities, which might have resulted in ground contamination.

The chicken farm was operated between 1965 and 1974; at a time when arsenic, heavy metals and persistent organochlorine pesticides like DDT were commonly used.

The burn pad has been in use since 2011. The owner noted that it was used to burn a garden shed (no ACM), which was destroyed by a falling tree in a storm. The garden shed is shown in photo in **Attachment B**.

A summary of possible HAIL activities, their potential for ground contamination and possible contaminants is listed in **Table 4**.

Table 4. Summary of potential ground contamination at 141 South Belt and 104 Townsend Road.

Activity	Location	Possible Contaminants	Likely Distribution
Historical Chicken Shed Operation (1965-74)	Northwest portion of the site	Arsenic, heavy metals, OCPs	Concentrations likely elevated in top soil ±evenly throughout the area of the former poultry sheds
Burn pad	South of the house	Arsenic, heavy metals, PAH	Locally elevated concentrations possible in top soil

6 Statutory Provisions

The historical land use of caged chicken farming comprises the possible storage and application of persistent agrichemicals such as DDT and other organochlorine pesticides. These activities are described in MfE's Hazardous Activity and Industries List (HAIL) and in Schedule WQL3, Chapter 4 of the Canterbury Natural Resources Regional Plan (NRRP).

Consequently, the investigations to assess soil concentrations, and remediations (if any) are subject to the following national and regional statutory provisions:

- National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health NES_{soil} (2011),
- Proposed Land and Water Regional Plan (LWRP), Rules 5.168, 5.169,
- Natural Resources Regional Plan (NRRP), Rule WQL46, WQL47.

6.1 National Environmental Standard (NES_{soil} 2011)

The NES_{soil} came into effect on 1 January 2012. Its main objective is to ensure that potential ground contamination is identified and assessed at the time of a change in land use to make sure the land is safe for its intended use.

In summary, the NES:

- Does not apply when a detailed site investigation demonstrates that any contaminants are at or below background concentrations.
- Permits activities such as sampling or disturbing soil, subdivision or change of land use, if the conditions of regulations 8.1 to 8.4 are met.
- Requires resource consent for a controlled activity where soil samples are elevated above background levels and below NES standards, a restricted discretionary or a discretionary where concentrations exceed the applicable soil standard.

Conclusion: The identified HAIL activities (chicken farm and burn pad) and proposed activities (subdivision and disturbance of more than 25m³ per 500m² of land) are covered under the regulations of the NES_{soil}. Consequently, a detailed site investigation (DSI) was required.

6.2 Environment Canterbury Regional Council

Rule 5.168 of the proposed Canterbury Land and Water Regional Plan (pLWRP) and Rule WQL46 require that the site investigation is undertaken in accordance with MfE's Contaminated Land Management Guidelines, and a copy of the report is provided to Environment Canterbury. In addition, the NRRP requires Environment Canterbury to be informed if soil samples are undertaken.

Environment Canterbury was informed within two days of the commencement of the investigation, the site investigation was undertaken in accordance with the Contaminated Land Management Guidelines and a copy of the site investigation is provided to Environment Canterbury in accordance with their requirements.

7 Soil Investigation

A targeted soil-investigation programme was carried out to investigate the current concentration levels of heavy metals and OCPs in the area of the former caged poultry operation, and in the area of the burn pad.

7.1 Soil Sampling Design and Rationale

The soil investigation design is based on the findings of the PSI, and comprised 16 soil samples from eight locations (two location at the burn pad and 6 at the former chicken shed), as shown in **Figure 3**. Two samples were collected at each location and 0-50mm bgl and 250-300mm bgl. The soil test results, relevant soil contaminant standards (SCSs) land use scenario (residential, 10% produce consumption), and background concentrations are discussed in Chapter 7 and are summarised in **Table 5**.

The data quality objectives (DQO) for this site are to assess whether the identified HAIL activities (poultry sheds and burn pad) left concentrations above acceptable standards and would pose a risk during the earthworks, including risks from runoff during construction on the environment, or later during residential land use.

The two poultry sheds covered an area of approximately 900m²; therefore, a 95% confidence level is achieved with six sampling points. The chicken sheds were constructed without walls or a sealed floor. Consequently, metals⁵ and/or organochlorine pesticides would be detectable in the topsoil within the footprint of the removed buildings. The two concrete footpaths under each of the roofs provided access to four rows of chicken cages, which itself were over uncovered topsoil. The concrete footpaths of the western shed remained in situ; the concrete from the eastern shed has been removed.

The selected analytes enable an assessment of potential contaminants of concern (CoC) associated with the former land use of the site.



Figure 3. Burn pad (left) and poultry sheds (removed in 2008/09, right). White symbols denote soil-sampling locations.

⁵ The strong affinity of aqueous heavy metals for topsoil usually results in the retention of metals in surface soils decades after the application.

7.1.1 Soil Sampling and Chain of Custody

The samples were collected with a pre-cleaned stainless steel spade and trowel, of which soil was wiped between samples, decontaminated with 1-molecular diluted nitric acid and rinsed with deionized water. The labelled glass jars (provided by Hill Laboratories Ltd) and plastic bags were stored in a chilled bin, covered with ice packs and delivered to Hill Laboratories Ltd in Christchurch on the day of collection. From there the samples were shipped via overnight courier and received by Hill Laboratories in Hamilton for analysis on the following day of delivery.

A copy of the Chain of Custody record is appended in **Attachment E**.

8 Analytical Results

Sixteen soil samples were collected on 15 November 2013 from eight locations. Two samples per location were collected from 0-50mm below ground level (bgl) and 250-300mm bgl, respectively. The surface samples from the burn pad were analysed for heavy metals (chrome, copper, cadmium, mercury, lead) and arsenic. The six surface samples from the chicken shed area were analysed for organochlorine pesticides, and two of the samples (S3a and S6a) were additionally analysed for chrome, copper, cadmium, mercury, lead and arsenic. All laboratory results are summarised below in **Table 5**; the original lab results are appended in **Attachment E**.

Table 5. Soil test results, NES residential soil contaminant standards and background soil concentrations. All values in mg/kg. Underlined values denote elevated levels above background concentrations, **red values denote exceedance of residential guideline values; NL denotes no limit for human health (environmental guidelines apply), <DL denotes below the laboratory detection limit.**

	NES SCS (residential 10% produce)	Natural Back- ground ⁶	S1 Burn Pad	S2 Burn Pad	S3a Chicken Shed	S4a Chicken Shed	S5a Chicken Shed	S6a Chicken Shed	S7a Chicken Shed	S8a Chicken Shed
Arsenic	20	8.7	23	8	<u>10</u>	-	-	<u>11</u>	-	-
Chromium ⁷	460	16.8	<u>26</u>	<u>18</u>	<u>19</u>	-	-	<u>21</u>	-	-
Copper	NL	15.5	<u>25</u>	12	14	-	-	12	-	-
Cadmium	3	0.24	0.1	0.12	-	-	-	-	-	-
Mercury	3	0.06	<0.1	<0.1	<0.1	-	-	<0.1	-	-
Lead	210	17.8	<u>35</u>	<u>33</u>	<u>64</u>	-	-	<u>30</u>	-	-
OCP:Σ DDT	70	0.43 ⁸	-	-	<DL	<DL	<DL	0.017	<DL	0.08
Sample depth [bgl]			0-50mm	0-50mm	0-50mm	0-50mm	0-50mm	0-50mm	0-50mm	0-50mm
Lab Reference 1203380			.1	.2	.3	.4	.5	.6	.7	.8
Date			14/11/13	14/11/13	14/11/13	14/11/13	14/11/13	14/11/13	14/11/13	14/11/13
Soil Fate			To be removed	To be removed	remains	remains	remains	remains	remains	remains

⁶ Trace elements Level 2 (Gley).

⁷ Assumes hexavalent chromium as conservative approach.

⁸ Buckland, Ellis & Salter 1998. OCP Concentrations in Christchurch. Ambient concentrations of selected organochlorine in soils. Organochlorine Programme, MfE 12/98.

8.1 Arsenic (As) and Heavy Metals (Cr, Cu, Cd, Hg, Pb)

8.1.1 Chromium (CrVI)

The four samples analysed for chromium contained concentrations between 18 and 26mg/kg, which is around or slightly above the background value of 19.3mg/kg. All values are significantly below the SCS for Chromium VI of 460mg/kg, and are below the US soil screening levels for ecological receptors (Eco SSL); i.e. chromium concentrations are not of concern to human health or the environment.

8.1.2 Copper (Cu)

Three out of four samples analysed for copper contained concentrations around or below the background value of 16.43mg/kg. One sample from the burn pad was slightly elevated at 25mg/kg.

The NES does not set a limit to copper concentrations in soil for the protection of human health (i.e. it is greater than 10,000mg/kg). The copper concentrations were significantly below the US EPA Ecological Soil Screening Levels (Eco SSL) for copper of 130mg/kg, and the ANZECC⁹ interim sediment quality guideline value for aquatic environments of 65mg Cu/kg sediment. Copper concentrations are not of concern to human health, or the environment.

8.1.3 Cadmium (Cd)

Cadmium concentrations in topsoil under the burn pad were 0.1mg/kg and 0.12mg/kg, respectively. This is significantly below the NES soil concentration standard of 3mg/kg (at pH 5).

8.1.4 Mercury (Hg)

All four samples analysed for mercury contained concentrations below the detection limit of 0.1mg/kg. This is around the natural background value for the gley soils in the area, significantly below the NES soil concentration standard of 3mg/kg, and below the US Eco SSL for ecological receptors.

Mercury concentrations are not of concern to human health or the environment.

8.1.5 Lead (Pb)

The four topsoil samples analysed for lead showed concentrations between 30mg/kg and 64mg/kg, which is clearly elevated above the background concentration of 19.3mg/kg. The source of the lead in the burn pad is likely to be the white paint from the garden shed that was burnt on the burn pad after being destroyed by tree in a NW storm.

The NES SCS for lead (residential land use, 10% produce) is 210mg/kg soil; i.e. the lead concentrations at the burn pad and the former chicken shed are significantly

⁹ Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC) 2000.

below the guideline value for the protection of human health. The lead concentration is also around or below the US guideline value for ecological receptors of 61mg/kg.

Consequently, lead concentrations are not considered to be of concern to human health or the environment.

8.1.6 Arsenic (As)

Arsenic was found to be around background concentrations between 8mg/kg and 11mg/kg in three out of four samples. One sample from the burn pad (S1) has an arsenic concentration of 23mg/kg, which is just above the NES soil concentration standard of for residential land use (10% produce consumption) of 20mg/kg¹⁰. The second sample from the burn pad (S2) had a concentration of 8mg/kg, which is considered background, which indicates that the extent of the arsenic contamination is small. The elevated copper and chrome concentrations in Sample 1 indicate that the likely source of the arsenic might be treated timber.

The slight exceedance of the arsenic value was discussed with the site owner and Conor Parker, Contaminated Site Officer at Environment Canterbury. It was concluded that the elevated arsenic concentration is limited to ash and topsoil of approximately 3-4 square metres.

8.2 Organochlorine Pesticides (OCP)

The lab results for DDT and its breakdown metabolites DDD and DDE were summed as Σ DDT. Organochlorine pesticides were below detection limit in four of the six samples from the chicken shed area. Samples S6a and S8a contained 0.017mg/kg and 0.08mg/kg, respectively.

The analysed concentrations are significantly below the NES_{soil} concentration standard of 70mg/kg, and below the background value of OCPs in Christchurch. This indicates that no DDT was used in the chicken sheds.

The US ecological screening level (Eco SSL) for mammalian carnivores (weasels in this case) is 0.021mg/kg, which is below the 0.08mg/kg found in soil sample S8a (US EPA¹¹). Due to their ecological niche and position in the food chain, mammalian carnivores are the most sensitive receptor to DDT residues. This is of little concern in NZ, given the pest status of all mustelids, and the lack of other mammals in their ecological niche. The Eco-SSL for mammalian herbivores (e.g. mice) is 24mg/kg, i.e. significantly above the highest measured concentration on the site.

Organochlorine pesticides and its breakdown products are not of concern to human health or the environment.

¹⁰ SCS residential land use without produce consumption: 24mg/kg; recreational land use: 80mg/kg.

¹¹ United States Environmental Protection Authority (US EPA) 2005. Ecological Screening Level Guidance (Eco SSL Documents). Online at <http://www.epa.gov/ecotox/ecoss/>

9 Remediation

The test results identified arsenic concentrations above residential standards in the topsoil of the burn pad. As a remediation measure, it was suggested to scrape the top 100mm of topsoil from the burn pad and remove from site. A soil validation sample, taken on 25 July 2014 showed arsenic, 21mg/kg, was still slightly above the NES_{Soil} contamination standards (20mg/kg) for residential land use after remediation. Therefore, it was recommended that more soil be removed to 200mm below ground level. The second validation test confirmed that arsenic concentrations are now at background levels in the area of the burn pad.

The area of the burn pad is approximately 3x3m. The removal of 300mm topsoil results in a volume of approximately 3m³. This is a permitted activity under regulation 8(3)d(ii) of the NES_(soil), which allows the removal of 5m³ per 500m² per year.

9.1 Site Validation Testing

Two site validation tests were carried out on two different dates. The first on 25 July 2014 found arsenic in one out of three samples to be 21mg/kg, slightly over the NES_{Soil} contaminant standard for residential land use (20mg/kg). In the other two samples, arsenic was at background concentrations. More soil was removed from the site and a second validation sample was taken on 2 September 2014. These samples recorded concentrations below NES_{Soil} standards for residential land use (10% produce). Results are summarised in **Table 6**.



Figure 4. Site validation sample locations on 25 July 2014 (left) and 2 September 2014 (right).

Table 6: Soil validation sample results, NES residential soil contaminant standards and background soil concentrations. All values in mg/kg. Underlined values denote elevated levels above background concentrations, red values denote exceedance of residential guideline values; NL denotes no limit for human health (environmental guidelines apply), <DL denotes below the laboratory detection limit.

	NES SCS (residential 10% produce)	Natural Back- ground ¹²	Validation 1: S1	Validation 1: S2	Validation 1: S3	Validation 2: S1
Arsenic	20	8.7	7	<u>12</u>	21	8
Chromium ¹³	460	16.8	-	-	-	<u>19</u>
Copper	NL	15.5	-	-	-	10
Cadmium	3	0.24	-	-	-	<dl
Nickel	400	13.4	-	-	-	<u>15</u>
Lead	210	17.8	-	-	-	<u>26</u>
Zinc	7400	65.6	-	-	-	<u>90</u>
Sample depth [bgl]			50-150mm	50-150mm	50-150mm	0-100mm
Lab Reference			1203380.1	1203380.2	1203380.3	1320464.1
Date			25/07/14	25/07/14	25/07/14	2/09/14

¹² Trace elements Level 2 (Gley).

¹³ Assumes hexavalent chromium as conservative approach.

10 Conclusions

The Preliminary Site Investigation identified two potential HAIL activities:

- Caged chicken farming, and
- A burn pad where treated timber and other materials might have been burnt in the past.

These activities are described in MfE's Hazardous Activity and Industries List (HAIL) and in Schedule WQL3, Chapter 4 of the Canterbury Natural Resources Regional Plan (NRRP). Consequently, soil investigations were undertaken to assess contaminant concentrations, and advice on remediation if required.

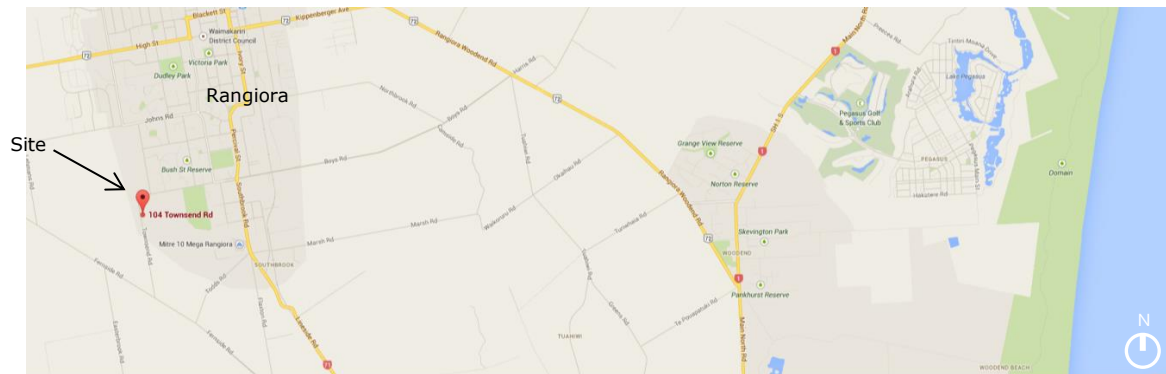
A targeted soil-sampling programme as part of the Detailed Site Investigation was undertaken to test the area of the caged chicken sheds. The samples were analysed for arsenic, heavy metals and OCP. The concentrations of heavy metals and OCPs were found to be elevated above background but below the adopted NES_{Soil} contaminant standards for residential land use.

In the area of the burn pad arsenic was recorded at a concentration of 23mg/kg, which is slightly above the NES soil concentration standard for residential land use (10% produce consumption) of 20mg/kg. The second sample from the burn pad (S2) had a concentration of 8mg/kg, which is considered background.

The top 200mm of soil was removed from the burn pad and taken to Kate Valley by a certified contractor. The soil validation testing confirms that the concentrations of arsenic and heavy metals are below the NES_{Soil} contaminant standards for residential land use.

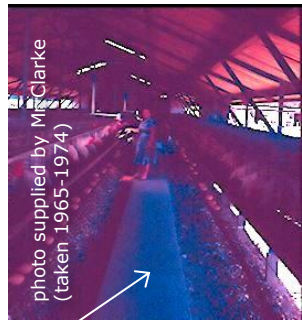
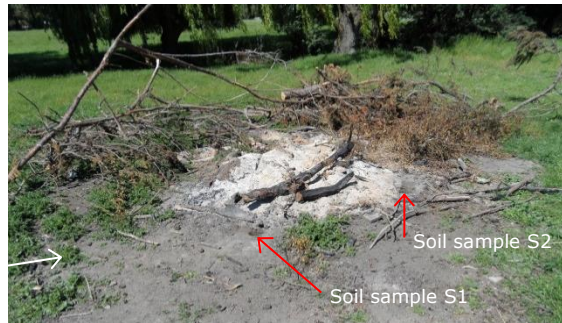
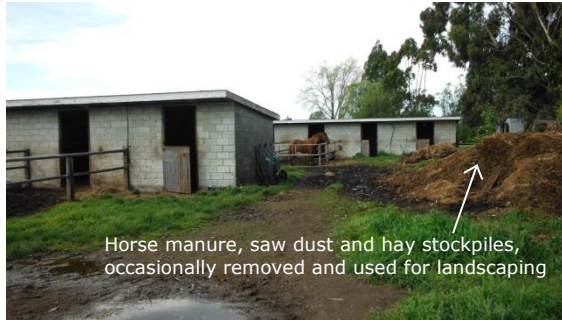
As the concentrations of all analytes are below the NES_{Soil} standards yet some are elevated above natural background concentrations, the application can proceed as a controlled activity under the NES.

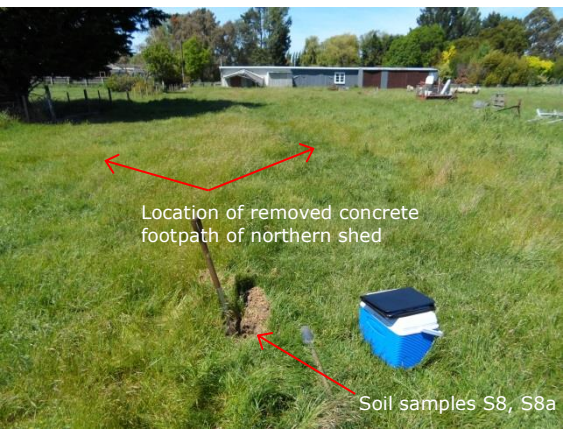
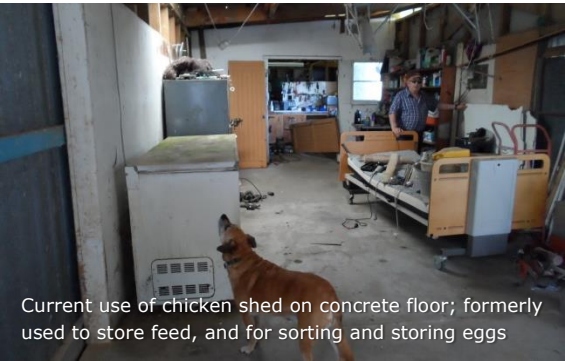
Attachment A: Site Plan



Attachment B: Site Photographs (taken on 1 and 14 October 2013)







Attachment C: Environment Canterbury Listed Land Use Register (LLUR)



Customer Services
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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 an 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