ATTACHMENT [C]: Contamination and Geotechnical Memorandum

Minister of Education: Notice of Requirement | Rolleston Secondary School

Tonkin+Taylor

Memo

To:	**Deb Taylor, MoE**	**Job No:**	**1017289**
From:	**Paul Walker/Kirsti Murahidy, T+T**	**Date:**	**8 February 2022**
cc:	**Daniel Thorne, TPG**		
Subject:	**Proposed new Rolleston school site** **Preliminary assessment of ground contamination and geotechnical development considerations**		

As per your request of 23 November 2021, this memo has been prepared to collate various advice that T+T has provided to MoE in regarding ground contamination and geotechnical considerations for the development of a school on the corner of Springston-Rolleston Road, in Rolleston, Canterbury (the 'site'). This memo is intended to be used by the MoE to support its preparation of a Notice of Requirement (NoR) for the site.

1 Preliminary ground contamination assessment

T+T's preliminary assessment of potential ground contamination conditions is based on:

1 The review of a series of site investigation reports prepared by Engeo Ltd (Engeo) on behalf of Hughes Developments Ltd (refer Appendix A for references).

2 Additional soil investigation completed by T+T at the site in December 2021 (refer Appendix B).

Several areas of potential or actual contamination were identified by Engeo within the site as follows:

- A small area of burnt waste to the rear of the former haybarn at 700 Selwyn Road (potential for metals polycyclic aromatic hydrocarbons (PAHs)).
- The former residence at 417 Springston-Rolleston Road (potential for asbestos containing material (ACM) in pre-2000s building).
- The former residence at 700 Selwyn Road (potential for asbestos containing material (ACM) in pre-2000s building).

These areas were either appropriately removed (i.e., ACM within residences) or remediated and appropriately validated (i.e., burn area).

Historically the site has been used for broad-scale agricultural (mainly pasture) activity. Such activity would not normally be considered to be a HAIL[1] activity or associated with significant contamination issues. However, given the size of the site and potential earthworks volumes, the presence of low level, but above background levels of contamination (for example associated with historic fertiliser or pesticide application) could constrain soil disposal options and increase site development costs

[1] HAIL – Hazardous Activities and Industries List.

T+T was therefore engaged to complete additional sampling across the site to investigate for the presence and associated development/regulatory implications of contaminants associated with the broad-scale agricultural use of the site.

T+T completed soil sampling from across the site in December 2021. Based on the results, T+T assessed that:

- The NESCS[2] will not apply to the site development works.
- The site area does not meet the definition of 'Contaminated Land' per the LWRP and this should therefore not trigger the requirement for resource consent for construction-phase stormwater discharge.
- Soil could (from a contaminated land perspective) be reused on the site.
- If offsite disposal of excess soil from the site is required, it is likely to be suitable for disposal as cleanfill, though this would need to be confirmed with the cleanfill operator in advance.
- As with any rural property, it is possible that historical farm waste pits are present on the site. These are typically localised, and may not be identifiable even when investigation is undertaken at industry guideline levels. If present and discovered during construction, we anticipate that these would be readily managed, though may require disposal of contents to a licensed landfill.

Based on the above assessments completed by Engeo and T+T, T+T has not identified ground contamination issues that would make the site unsuitable for development as a school.

2 Preliminary geotechnical assessment

T+Ts preliminary assessment of geotechnical conditions at the site is based on a review of:

- A series of site investigation reports prepared by Engeo Ltd on behalf of Hughes Developments Ltd (refer Appendix A for references).
- Geotechnical investigation data available on the New Zealand Geotechnical Database (NZGD).
- Historical aerial images for the site.
- Guidance provided by the Ministry of Business Innovation and Employment (MBIE).

From a geotechnical perspective, the ground conditions at the site are relatively favourable and suitably designed shallow foundations could be used for proposed one to two storey structures. The site shows evidence of paleo (historic) drainage channels, which have been infilled/modified during historic earthworks/farming activities.

Engeo undertook geotechnical investigations across the site that identified that the site is underlain by topsoil and organic silt (between approximately 0.1 and 1.0 m thick), beneath which gravel deposits were encountered.

The site falls within a 'rural and unmapped zone', however following the methods in the MBIE Guidance, the calculated liquefaction-related settlements indicate that the site would meet the Technical Category (TC) 1 criteria. Therefore, land damage induced by liquefaction is likely to be 'none to minor'.

Topsoil and organic silt materials are not suitable founding layers for shallow foundations and if encountered we would recommend that these materials are stripped prior to constructing foundations. We recommend that some further investigations (hand auger boreholes and Scala penetrometer tests) are undertaken during the Preliminary Design Phase once the locations of the

[2] Resource Management (National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health) Regulations 2011.

proposed buildings are known. These would confirm thickness of topsoil and the depth to gravel at specific building locations and confirm concept level recommendations. They would also form the basis of the documentation submitted for building consent.

Based on the information reviewed by T+T, we have not identified any geotechnical issues that would make the site unsuitable for development as a school.

3 Applicability

This memo has been prepared for the exclusive use of our client, Ministry of Education, with respect to the specific brief given to us and it may not be relied upon in other contexts or for any other purpose, or by any person other than our client, without our prior written agreement.

Tonkin & Taylor Ltd

Environmental and Engineering Consultants

Memo prepared by:	Authorised for Tonkin & Taylor Ltd by:
	
.....	.....
Paul Walker	Peter Cochrane
Technical Director, Contaminated Land	Project Director

8-Feb-22
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Appendix A: Engeo report references

Preliminary and Detailed Environmental Site Investigation. 694 Selwyn Road, Springston, Canterbury. Engeo Ltd, December 2016.

Preliminary Environmental Site Investigation. 417 Springston-Rolleston Road, Springston, Canterbury. Engeo Ltd. December 2016.

Preliminary Environmental Site Investigation. 700 Selwyn Road, Springston, Canterbury. Engeo Ltd, April 2018.

Detailed Environmental Site Investigation. Farringdon Southeast, Rolleston. Engeo Ltd, February 2021.

Soil Validation Report. Southeast Farringdon, Selwyn Road, Rolleston. Engeo Ltd, March 2021.

Asbestos Demolition Survey. 417 Springston-Rolleston Road, Rolleston. Engeo Ltd. September 2020.

Asbestos refurbishment survey. 700 Selwyn Road, Rolleston. Engeo Ltd, October 2020.

Geotechnical Investigation. Farringdon Subdivision. 697 Selwyn Road & 417 Springston-Rolleston Road, Rolleston. Engeo Ltd. 12 December 2016.

Geotechnical Investigation. 700 Selwyn Road, Springston, Canterbury. Engeo Ltd. 08 May 2018.

Geotechnical Investigation. 708 & 710 Selwyn Road, Rolleston. Engeo Ltd. 03 October 2019.

Geotechnical Investigation. 728 Selwyn Road, Springston, Christchurch. Engeo Ltd. 23 May 2017.

Appendix B: Additional ground contamination assessment report – T+T December 2021

Tonkin+Taylor

Job No: 1017289
16 December 2021

Ministry of Education
Education Infrastructure Service
48 Hereford Street
Christchurch 8013

Attention: Deb Taylor, Senior Delivery Manager, Acquisitions and Designations

Dear Deb

Ground Contamination Assessment
Rolleston School Site on the corner of Springston Rolleston Road and Selwyn Road

1 Introduction

Tonkin & Taylor Ltd (T+T) is pleased to present the findings of a ground contamination assessment carried out for the Ministry of Education (MoE) at the proposed school site on the corner of Springston Rolleston Road and Selwyn Road, Rolleston, Canterbury.

This report has been prepared in accordance with our work scope dated 21 September 2021. The personnel undertaking, managing, reviewing, and certifying this investigation are suitably qualified and experienced practitioners (SQEP) as required by the NESCS[1] and defined in the NESCS Users Guide[2].

2 Background and objectives

The MoE is planning to use a 10.1 hectare (ha) site on the corner of Springston Rolleston Road and Selwyn Road, Rolleston, for the construction of a new Rolleston school. The site is legally described as Lot 1000 DP 557037 and forms part of a wider subdivision by Hughes Developments Ltd (Hughes). Ground contamination assessments by Engeo Ltd[3,4,5,6,7,8,9] on behalf of Hughes investigated the wider subdivision, including the MoE site (shown in Figure 2.1 and referred to herein as 'The Site').

[1] Resource Management (National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health) Regulations 2011.
[2] Ministry for the Environment (MfE) NES Soil User's Guide, April 2012.
[3] Preliminary and Detailed Environmental Site Investigation. 694 Selwyn Road, Springston, Canterbury. Engeo Ltd, December 2016.
[4] Preliminary Environmental Site Investigation. 417 Springston-Rolleston Road, Springston, Canterbury. Engeo Ltd. December 2016.
[5] Preliminary Environmental Site Investigation. 700 Selwyn Road, Springston, Canterbury. Engeo Ltd, April 2018.
[6] Detailed Environmental Site Investigation. Farringdon Southeast, Rolleston. Engeo Ltd, February 2021.
[7] Soil Validation Report. Southeast Farringdon, Selwyn Road, Rolleston. Engeo Ltd, March 2021.
[8] Asbestos Demolition Survey. 417 Springston-Rolleston Road, Rolleston. Engeo Ltd. September 2020.
[9] Asbestos refurbishment survey. 700 Selwyn Road, Rolleston. Engeo Ltd, October 2020.

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Several areas of potential or actual contamination were identified by Engeo within The Site (see Figure 2.1), as follows:

- A small area of burnt waste to the rear of the former haybarn at 700 Selwyn Road (potential for metals polycyclic aromatic hydrocarbons (PAHs)).
- The former residence at 417 Springston-Rolleston Road (potential for asbestos containing material (ACM) in pre-2000s building).
- The former residence at 700 Selwyn Road (potential for asbestos containing material (ACM) in pre-2000s building).

These areas were either appropriately removed (i.e., ACM within residences) or remediated and appropriately validated (i.e., burn area).

Historically The site has been used for broad-scale agricultural (mainly pasture) activity. Such activity would not normally be considered to be a HAIL[10] activity or associated with significant contamination issues. However, given the size of The Site and potential earthworks volumes, the presence of low level, but above background levels of contamination (for example associated with historic fertiliser or pesticide application) could constrain soil disposal options and increase site development costs

T+T was therefore engaged to complete additional sampling across The Site to investigate for the presence and associated development/regulatory implications of contaminants associated with the broad-scale agricultural use of The Site.

[10] HAIL – Hazardous Activities and Industries List.

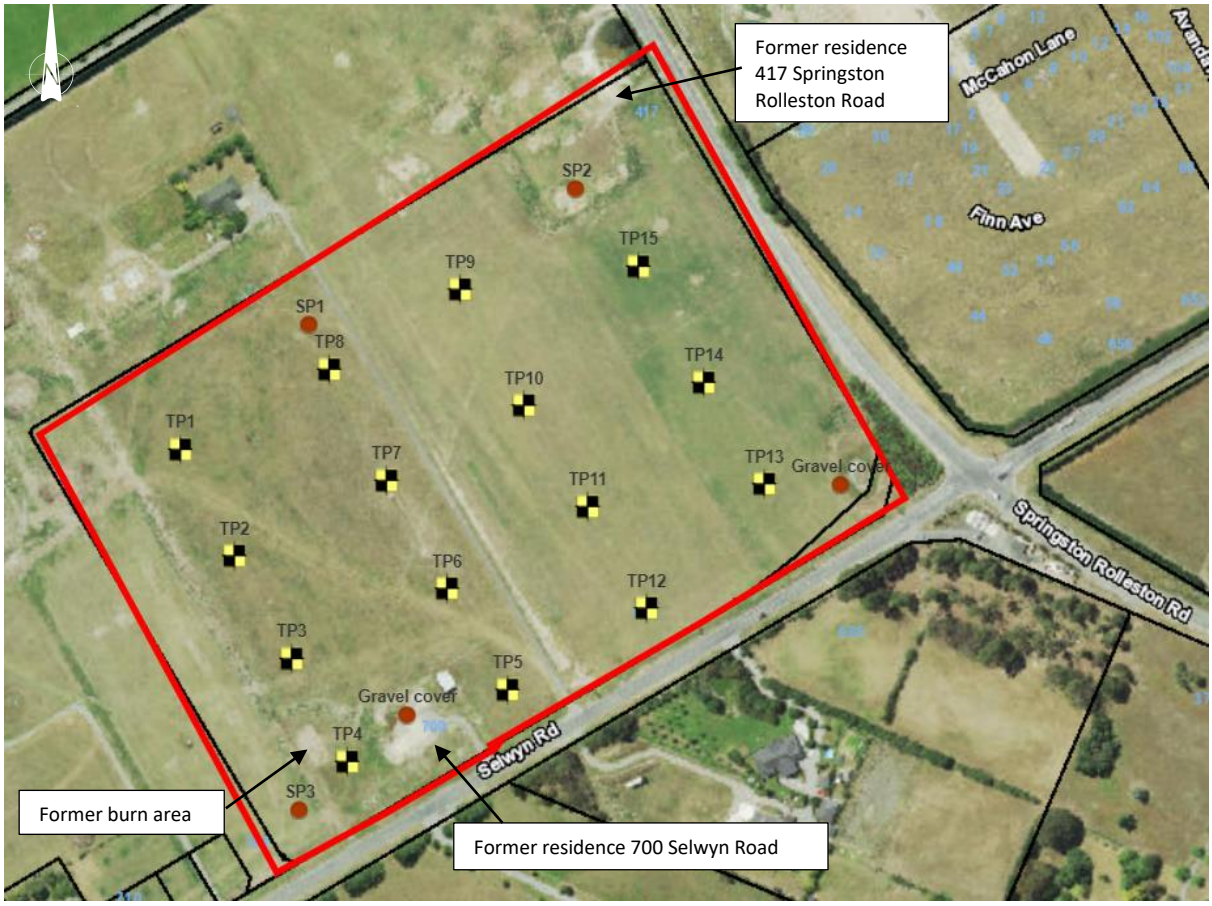


Figure 2.1: The Site (within the red boundary). Three stockpiles (orange feature points) were found onsite; SP1, SP2, and SP3, as well as patches of gravel cover. The yellow/black squares indicate the approximate soil sampling locations from within the site, labelled as test pit 1 through to test pit 15 (TP1 – TP15). NZ Aerial Imagery Sourced from ECAN, SDC, LINZ powered by esri.

3 Scope

The investigation completed by T+T comprised the following scope of work:

- A site walkover to confirm the current activities on site. This confirmed that all structures have been removed from The Site and stockpiles of soil associated with the Hughes subdivision are located on the northern boundary and in the south-western corner of The Site.
- Hand excavation of 15 test pits (TP1-TP15) in a grid pattern across The Site to a depth of 0.2 m below ground level (m bgl). Soil sampling locations are shown in Figure 2.1.
- The collection of surficial (0 – 0.1 m depth) and subsurface (0.2 m depth) soil samples, on the assumption that fertilisers and/or pesticides (if used) would have been applied to the ground surface, and any residues would be confined to near surface soils.
- Laboratory analysis of 15 surface (topsoil) samples for organochlorine pesticides (OCPs) and metals (one from each test pit).
- Comparison of soil analytical results against relevant published background and adopted ambient concentrations, land use standards and soil disposal criteria to assess the options for managing the earthworks-related construction activities for the excavated materials.

- The preparation of this report summarising the ground contamination-related advice previously provided by T+T to the MoE, along with the results of the T+T soil sampling and discussion of the contamination-related implications (if any) for site development.

3.1 Soil sampling procedures

Soil sampling was undertaken according to the following procedures:

- Samples were collected in general accordance with the MfE's CLMG No. 5[11], with samples collected with freshly gloved hands, directly from the recovered material, and placed directly into laboratory supplied glass jars.
- Materials encountered were logged in general accordance with the NZ Geotechnical Society's "*Guidelines for the classification and field description of soils and rock for engineering purposes*".
- Non-dedicated sampling equipment was decontaminated between sample locations using Decon-90 (a phosphate-free detergent) and freshwater rinses.
- Samples were couriered chilled, under chain of custody documentation, to IANZ-accredited Analytica Laboratories Ltd for analysis.

4 Results

4.1 Field observations

The soil profile encountered at each of the fifteen investigation locations can be summarised as follows:

- All sampling locations were covered with grass.
- Surface (0.0 m depth) and subsurface (0.2 m depth) samples comprised of medium to fine coarse sand of a light brown, dry nature. Additionally:
  - In the surface layer of TP4, TP5, TP7, and TP9 – TP14, trace levels of coarse gravel were encountered.
  - In the surface layer of TP6, TP12, and TP14 trace levels of cobbles were encountered and in TP11 and TP13 trace levels of cobbles and boulders were encountered.
  - In subsurface layer of TP3, TP4, TP7 – TP10, and TP12, trace levels of medium to fine gravel was encountered.
  - In subsurface layer of TP3, TP4, TP10, TP12, and TP15 trace levels of cobbles were encountered and in TP13 and TP14 trace levels of cobbles and boulders were encountered.
  - In TP6 – TP9 soils were transitioning to a silt at a depth of 0.2 m.
- No visual or olfactory indicators of contamination were noted.

Three stockpiles were found onsite (see Figure 2.1) and can be summarised as followed:

- SP1 on the Northern boundary was small and comprised of tree branches/wood. Approximate volume of SP1 was 2.0 m^3.
- SP2 on the Northern boundary was comprised mainly of coarse sand and gravel with trace levels of cobbles and boulders. Approximate volume of SP2 was 200 m^3.
- SP3 on the Southern-Western boundary was small and comprised mainly of coarse sand and gravel. Approximate volume of SP3 was 20 m^3.

[11] MfE- Contaminated Land Management Guidelines No. 5, Site Investigation and Analysis of Soils (revised 2011).

No samples were collected from the stockpiles as we understand that they will be removed by Hughes before the MoE commences site development.

There were two large patches of gravel cover identified within the MoE boundary. One was located on the former residence 700 Selwyn Road and the other close to the Selwyn Road and Springston Rolleston Road junction.

5 Analytical results

Table 1 in Appendix A summarises the soil analysis results. Laboratory analysis certificates are also included in Appendix A

5.1 Assessment criteria

Analytical results have been assessed against the following human health and environmental assessment criteria:

Worker exposure criteria:

- Commercial/industrial land use NESCS soil contaminant standards (NESCS SCS) and guideline values incorporated by reference (as a conservative proxy for outdoor construction worker protection) to provide an indication of the need for contamination-specific health and safety controls.

Future land use criteria (to assess soil reuse implications):

- Residential (10% produce consumption) NESCS SCS and guideline values incorporated by reference have been adopted to assess the ability to reuse soils on The Site. Although the application of residential standards is conservative for a high school setting, they have been applied in this instance to be consistent with assessments on other MoE sites.

Offsite disposal criteria:

- Published background[12] and adopted ambient concentrations for The Site and Christchurch area, to provide an initial assessment of the potential for soils to be disposed of as cleanfill.
- Local landfill/disposal destination acceptance criteria (i.e., Leggett Road cleanfill and controlled fill and Wheatsheaf managed fill facilities) to assess potential offsite disposal options for soils to be disturbed within The Site area.

5.2 Assessment results

In summary, the analytical results for all samples analysed (i.e., topsoil materials only) show that:

- All detected concentrations complied with residential land use criteria used to assess the suitability of soils to be reused on the future school site.
- With one exception, metals were not detected above published background concentrations or default cleanfill acceptance criteria, with the exception being a single detection of cadmium at 0.20 mg/kg, above the background/cleanfill concentration of 0.19 mg/kg. The average concentration and calculated 95%UCL[13] of cadmium (0.08 mg/kg and 0.0985 mg/kg respectively) across all 15 samples (in effect representative of soils excavated to stockpile) were below the published background concentration and Leggett Road cleanfill criteria.

[12] ECan GIS, Trace Elements Level 2.

[13] The 95% UCL is calculated using USEPA statistical software ProUCL 5.1.00 for environmental applications for data sets with and without non detect observations. The suggested 95% modified-t UCL (most conservative) was applied.

- All detected concentrations were below commercial/industrial and recreational land use criteria.
- OCPs were detected above the laboratory limit of reporting in two samples, though neither exceed the adopted ambient concentrations.

6 Discussion and implications

Whilst cadmium was detected above the published background concentration in one individual sample, we do not consider this indicative of the historical use of persistent pesticides. This is because:

- All other samples contained metals concentrations that were below background concentrations.
- OCPs were not detected above adopted ambient levels.

On this basis we consider that:

- The NESCS will not apply to The Site development works.
- The Site area does not meet the definition of 'Contaminated Land' per the LWRP and this should therefore not trigger the requirement for resource consent for construction-phase stormwater discharge.

The detected concentrations indicate that soil could (from a contaminated land perspective) be reused on the site. If offsite disposal of excess soil from The Site area is required, it is likely to be suitable for disposal as cleanfill, though this would need to be confirmed with the cleanfill operator in advance.

As with any rural property, it is possible that historical farm waste pits are present on the site. These are typically localised, and unlikely to be identified by either a site walkover or further investigation. If present and discovered during construction, we anticipate that these would be readily managed, though may require disposal of contents to a licensed landfill.

7 Applicability

This report has been prepared for the exclusive use of our client the Ministry of Education, with respect to the particular brief given to us and it may not be relied upon in other contexts or for any other purpose, or by any person other than our client, without our prior written agreement.

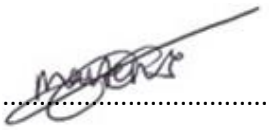
All recommendations and opinions which are contained in this report are based on data from discrete soil samples. The nature and continuity of subsoil away from the investigation points are inferred but it must be appreciated that actual conditions could vary from the assumed model.

We understand and agree that this report may be used by Christchurch City Council and/or Environment Canterbury in undertaking their regulatory functions in connection with the site.

Tonkin & Taylor Ltd

Environmental and Engineering Consultants

Report prepared by:



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Hilde Martens
Contaminated Land Consultant

Authorised for Tonkin & Taylor Ltd by:

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Peter Cochrane
Project Director

Report technically reviewed by:

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Paul Walker
Technical Director – Contaminated Land

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Appendix A: Laboratory results

1. **Table 1 - Soil analytical results summary: MoE Rolleston, corner of Springston Rolleston Road and Selwyn Road.**
2. **Analytica Laboratories certificate of analysis 21-47094.**

Table 1 - Soil analytical results summary: MoE Rolleston, corner of Springston Rolleston Road and Selwyn road

																		Assessment criteria				
Sample ID	**Units**	**TP1**	**TP2**	**TP3**	**TP4**	**TP5**	**TP6**	**TP7**	**TP8**	**TP9**	**TP10**	**TP11**	**TP12**	**TP13**	**TP14**	**TP15**	**Average**	**95% UCL**	**Background [2]**	**Commercial/industrial [4]**	**Residential (10% produce) [4a]**	**Leggett Road [6]**	**Wheatsheaf [7]**
Depth	m bgl	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0							
Metals and metalloids																							
Arsenic	mg/kg	3.2	3.4	3.2	4.5	4.1	3.7	4.2	4.4	3.4	4	3.9	3.3	3.4	3.2	3.6	3.7	-	12.58	70	20	12.58	17
Cadmium	mg/kg	0.079	0.12	0.088	**0.20**	0.062	0.068	0.085	0.075	0.061	0.062	0.064	0.047	0.074	0.067	0.055	0.08	0.0985	0.19	1,300	3	0.19	0.8
Chromium	mg/kg	12	12.8	11	15.2	14.5	14.0	14.5	14.5	13.1	14.7	14.8	13.2	13.0	12.6	12.6	13.5	-	22.7	6300 (VI)	460 (VI)	22.7	290
Copper	mg/kg	4.2	4.4	4.4	9.07	5.4	4.5	4.9	5.4	4.2	4.9	4.5	4.0	9.41	4.5	5.2	5.3	-	20.3	>10,000	>10,000	20.3	>10,000
Lead	mg/kg	11.6	13.3	12.5	20.0	14.4	14.3	15.2	15.6	13.2	15.7	15.2	13.4	15.2	14.4	15.1	14.6	-	40.96	3,300	210	40.96	160
Mercury	mg/kg	<0.025	<0.025	<0.025	0.026	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	-	0.11	4,200	310	0.11	200
Nickel	mg/kg	8.53	9.41	8.36	10.7	10.1	9.99	10.6	10.6	8.67	10.4	10.3	8.75	7.83	7.94	8.34	9.4	-	20.7	6,000 [5]	4000 [5a]	20.7	400 [5b]
Zinc	mg/kg	46.4	52.0	48.2	79.2	63.5	53.3	55.6	62.0	50.9	61.2	55.8	51.8	60.2	53.4	54.2	56.5	-	93.94	400,000 [5]	7400 [5a]	93.94	7,400 [5b]
Organochlorine Pesticides (OCPs)*																							
Total DDT [1]	mg/kg	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	0.070	0.11	0.070	-	-	0.431 [3]	1,000	70	0.431	45
All other OCPs	mg/kg	<LoR															-	-	NGV	-	-	-	-

Notes

*Full suite tested but selected compounds shown, refer Hill Laboratories Ltd certificate for full results.

<LoR - below the laboratory limit of reporting.

'-' Denotes not analysed or not applicable.

NGV indicates No Guideline Value.

Bold indicates that published background concentrations are exceeded.

GREEN cells indicates that cleanfill screening criteria is exceeded (Legget Road)

1 - Total DDT is the sum of the six DDT isomer concentrations.

2 - Environment Canterbury GIS, Trace Elements Level 2. Background concentrations at the site, from "Background concentrations of selected trace elements in Canterbury soils" prepared for Environment Canterbury by Tonkin & Taylor Ltd, July 2006.

3 - ECan has adopted composite sampling results from Christchurch reported in the MfE Ambient Concentrations of Selected Organochlorines in Soils (December 1998) to set an ambient soil concentration of 0.431 mg/kg for total DDT within Christchurch.

4 - Ministry for the Environment (MfE) 2011, NESCS Users' guide, Soil Contaminant Standards (SCS) - Commercial/industrial land use values adopted as a conservative proxy for worker protection and (4a) Residential (10% produce) values adopted as a conservative proxy for human health and current and future land-use criteria

5 - ASC NEPM Toolbox - Update February 2014 - www.nepc.gov.au/nepms/assessment-site-contamination/toolbox- Commercial/industrial land use values adopted as a conservative proxy for worker protection and (5a) Residential (10% produce) values adopted as a conservative proxy for human health and current and future land-use criteria and (5b) values based on low-density residential guidelines

6 - Backfill Management Plan- 81 Leggett Road, Templeton (September 2019). Prepared for Protranz Earthmoving Ltd by Tonkin & Taylor Ltd.

7 - Wheatsheaf resource consent CRC145183, Condition 24, values based on NES Soil SCS for Rural residential/lifestyle block 25% produce.

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Certificate of Analysis

Tonkin and Taylor
60 Cashel Street, West End
Christchurch 8013

Attention: Paul Walker
Phone: 022 174 5255
Email: pwalker@tonkintaylor.co.nz

Sampling Site: Rolleston School MoE

Lab Reference: 21-47094
Submitted by: HIMA (Hilda.m)
Date Received: 10/11/2021
Testing Initiated: 11/11/2021
Date Completed: 15/11/2021
Order Number:
Reference: 1017289

Report Comments

Samples were collected by yourselves (or your agent) and analysed as received at Analytica Laboratories. Samples were in acceptable condition unless otherwise noted on this report.
Specific testing dates are available on request.

Heavy Metals in Soil

			Client Sample ID	TP1 0.0	TP2 0.0	TP3 0.0	TP4 0.0	TP5 0.0
			Date Sampled	10/11/2021	10/11/2021	10/11/2021	10/11/2021	10/11/2021
Analyte	Unit	*Reporting Limit*		21-47094-1	21-47094-3	21-47094-5	21-47094-7	21-47094-9
Arsenic	mg/kg dry wt	*0.125*		3.2	3.4	3.2	4.5	4.1
Cadmium	mg/kg dry wt	*0.005*		0.079	0.12	0.088	0.20	0.062
Chromium	mg/kg dry wt	*0.125*		12	12.8	11	15.2	14.5
Copper	mg/kg dry wt	*0.075*		4.2	4.4	4.4	9.07	5.4
Lead	mg/kg dry wt	*0.25*		11.6	13.3	12.5	20.0	14.4
Mercury	mg/kg dry wt	*0.025*		<0.025	<0.025	<0.025	0.026	<0.025
Nickel	mg/kg dry wt	*0.05*		8.53	9.41	8.36	10.7	10.1
Zinc	mg/kg dry wt	*0.05*		46.4	52.0	48.2	79.2	63.5

Heavy Metals in Soil

			Client Sample ID	TP6 0.0	TP7 0.0	TP8 0.0	TP9 0.0	TP10 0.0
			Date Sampled	10/11/2021	10/11/2021	10/11/2021	10/11/2021	10/11/2021
Analyte	Unit	*Reporting Limit*		21-47094-11	21-47094-13	21-47094-15	21-47094-17	21-47094-19
Arsenic	mg/kg dry wt	*0.125*		3.7	4.2	4.4	3.4	4.0
Cadmium	mg/kg dry wt	*0.005*		0.068	0.085	0.075	0.061	0.062
Chromium	mg/kg dry wt	*0.125*		14.0	14.5	14.5	13.1	14.7
Copper	mg/kg dry wt	*0.075*		4.5	4.9	5.4	4.2	4.9
Lead	mg/kg dry wt	*0.25*		14.3	15.2	15.6	13.2	15.7
Mercury	mg/kg dry wt	*0.025*		<0.025	<0.025	<0.025	<0.025	<0.025
Nickel	mg/kg dry wt	*0.05*		9.99	10.6	10.6	8.67	10.4
Zinc	mg/kg dry wt	*0.05*		53.3	55.6	62.0	50.9	61.2

Heavy Metals in Soil

		Client Sample ID	TP11 0.0	TP12 0.0	TP13 0.0	TP14 0.0	TP15 0.0
		Date Sampled	10/11/2021	10/11/2021	10/11/2021	10/11/2021	10/11/2021
Analyte	Unit	*Reporting Limit*	21-47094-21	21-47094-23	21-47094-25	21-47094-27	21-47094-29
Arsenic	mg/kg dry wt	*0.125*	3.9	3.3	3.4	3.2	3.6
Cadmium	mg/kg dry wt	*0.005*	0.064	0.047	0.074	0.067	0.055
Chromium	mg/kg dry wt	*0.125*	14.8	13.2	13.0	12.6	12.6
Copper	mg/kg dry wt	*0.075*	4.5	4.0	9.41	4.5	5.2
Lead	mg/kg dry wt	*0.25*	15.2	13.4	15.2	14.4	15.1
Mercury	mg/kg dry wt	*0.025*	<0.025	<0.025	<0.025	<0.025	<0.025
Nickel	mg/kg dry wt	*0.05*	10.3	8.75	7.83	7.94	8.34
Zinc	mg/kg dry wt	*0.05*	55.8	51.8	60.2	53.4	54.2

Organochlorine Pesticides - Soil

		Client Sample ID	TP1 0.0	TP2 0.0	TP3 0.0	TP4 0.0	TP5 0.0
		Date Sampled	10/11/2021	10/11/2021	10/11/2021	10/11/2021	10/11/2021
Analyte	Unit	*Reporting Limit*	21-47094-1	21-47094-3	21-47094-5	21-47094-7	21-47094-9
2,4'-DDD	mg/kg dry wt	*0.005*	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
2,4'-DDE	mg/kg dry wt	*0.005*	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
2,4'-DDT	mg/kg dry wt	*0.005*	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
4,4'-DDD	mg/kg dry wt	*0.003*	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030
4,4'-DDE	mg/kg dry wt	*0.005*	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
4,4'-DDT	mg/kg dry wt	*0.005*	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Total DDT	mg/kg dry wt	*0.02*	<0.020	<0.020	<0.020	<0.020	<0.020
alpha-BHC	mg/kg dry wt	*0.005*	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Aldrin	mg/kg dry wt	*0.005*	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
beta-BHC	mg/kg dry wt	*0.005*	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
cis-Chlordane	mg/kg dry wt	*0.005*	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
cis-Nonachlor	mg/kg dry wt	*0.01*	<0.010	<0.010	<0.010	<0.010	<0.010
delta-BHC	mg/kg dry wt	*0.005*	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Dieldrin	mg/kg dry wt	*0.05*	<0.050	<0.050	<0.050	<0.050	<0.050
Endosulfan I	mg/kg dry wt	*0.005*	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Endosulfan II	mg/kg dry wt	*0.01*	<0.010	<0.010	<0.010	<0.010	<0.010
Endosulfan sulfate	mg/kg dry wt	*0.005*	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Endrin	mg/kg dry wt	*0.05*	<0.050	<0.050	<0.050	<0.050	<0.050
Endrin aldehyde	mg/kg dry wt	*0.01*	<0.010	<0.010	<0.010	<0.010	<0.010
Endrin ketone	mg/kg dry wt	*0.005*	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
gamma-BHC	mg/kg dry wt	*0.005*	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Heptachlor	mg/kg dry wt	*0.005*	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Heptachlor epoxide	mg/kg dry wt	*0.005*	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Hexachlorobenzene	mg/kg dry wt	*0.005*	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Methoxychlor	mg/kg dry wt	*0.01*	<0.010	<0.010	<0.010	<0.010	<0.010
trans-nonachlor	mg/kg dry wt	*0.01*	<0.010	<0.010	<0.010	<0.010	<0.010
trans-Chlordane	mg/kg dry wt	*0.01*	<0.010	<0.010	<0.010	<0.010	<0.010
Chlordane (sum)	mg/kg dry wt	*0.02*	<0.020	<0.020	<0.020	<0.020	<0.020
TCMX (Surrogate)	%	*1*	110	97	110	100	86

Organochlorine Pesticides - Soil

	Client Sample ID		TP6 0.0	TP7 0.0	TP8 0.0	TP9 0.0	TP10 0.0
	Date Sampled		10/11/2021	10/11/2021	10/11/2021	10/11/2021	10/11/2021
Analyte	Unit	*Reporting Limit*	21-47094-11	21-47094-13	21-47094-15	21-47094-17	21-47094-19
2,4'-DDD	mg/kg dry wt	*0.005*	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
2,4'-DDE	mg/kg dry wt	*0.005*	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
2,4'-DDT	mg/kg dry wt	*0.005*	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
4,4'-DDD	mg/kg dry wt	*0.003*	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030
4,4'-DDE	mg/kg dry wt	*0.005*	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
4,4'-DDT	mg/kg dry wt	*0.005*	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Total DDT	mg/kg dry wt	*0.02*	<0.020	<0.020	<0.020	<0.020	<0.020
alpha-BHC	mg/kg dry wt	*0.005*	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Aldrin	mg/kg dry wt	*0.005*	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
beta-BHC	mg/kg dry wt	*0.005*	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
cis-Chlordane	mg/kg dry wt	*0.005*	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
cis-Nonachlor	mg/kg dry wt	*0.01*	<0.010	<0.010	<0.010	<0.010	<0.010
delta-BHC	mg/kg dry wt	*0.005*	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Dieldrin	mg/kg dry wt	*0.05*	<0.050	<0.050	<0.050	<0.050	<0.050
Endosulfan I	mg/kg dry wt	*0.005*	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Endosulfan II	mg/kg dry wt	*0.01*	<0.010	<0.010	<0.010	<0.010	<0.010
Endosulfan sulfate	mg/kg dry wt	*0.005*	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Endrin	mg/kg dry wt	*0.05*	<0.050	<0.050	<0.050	<0.050	<0.050
Endrin aldehyde	mg/kg dry wt	*0.01*	<0.010	<0.010	<0.010	<0.010	<0.010
Endrin ketone	mg/kg dry wt	*0.005*	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
gamma-BHC	mg/kg dry wt	*0.005*	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Heptachlor	mg/kg dry wt	*0.005*	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Heptachlor epoxide	mg/kg dry wt	*0.005*	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Hexachlorobenzene	mg/kg dry wt	*0.005*	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Methoxychlor	mg/kg dry wt	*0.01*	<0.010	<0.010	<0.010	<0.010	<0.010
trans-nonachlor	mg/kg dry wt	*0.01*	<0.010	<0.010	<0.010	<0.010	<0.010
trans-Chlordane	mg/kg dry wt	*0.01*	<0.010	<0.010	<0.010	<0.010	<0.010
Chlordane (sum)	mg/kg dry wt	*0.02*	<0.020	<0.020	<0.020	<0.020	<0.020
TCMX (Surrogate)	%	*1*	110	100	89	98	110

Organochlorine Pesticides - Soil

	Client Sample ID		TP11 0.0	TP12 0.0	TP13 0.0	TP14 0.0	TP15 0.0
	Date Sampled		10/11/2021	10/11/2021	10/11/2021	10/11/2021	10/11/2021
Analyte	Unit	*Reporting Limit*	21-47094-21	21-47094-23	21-47094-25	21-47094-27	21-47094-29
2,4'-DDD	mg/kg dry wt	*0.005*	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
2,4'-DDE	mg/kg dry wt	*0.005*	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
2,4'-DDT	mg/kg dry wt	*0.005*	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
4,4'-DDD	mg/kg dry wt	*0.003*	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030
4,4'-DDE	mg/kg dry wt	*0.005*	<0.0050	<0.0050	0.065	0.11	0.069
4,4'-DDT	mg/kg dry wt	*0.005*	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Total DDT	mg/kg dry wt	*0.02*	<0.020	<0.020	0.070	0.11	0.070
alpha-BHC	mg/kg dry wt	*0.005*	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Aldrin	mg/kg dry wt	*0.005*	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
beta-BHC	mg/kg dry wt	*0.005*	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
cis-Chlordane	mg/kg dry wt	*0.005*	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
cis-Nonachlor	mg/kg dry wt	*0.01*	<0.010	<0.010	<0.010	<0.010	<0.010
delta-BHC	mg/kg dry wt	*0.005*	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Dieldrin	mg/kg dry wt	*0.05*	<0.050	<0.050	<0.050	<0.050	<0.050
Endosulfan I	mg/kg dry wt	*0.005*	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Endosulfan II	mg/kg dry wt	*0.01*	<0.010	<0.010	<0.010	<0.010	<0.010

Organochlorine Pesticides - Soil

			Client Sample ID	TP11 0.0	TP12 0.0	TP13 0.0	TP14 0.0	TP15 0.0
			Date Sampled	10/11/2021	10/11/2021	10/11/2021	10/11/2021	10/11/2021
Endosulfan sulfate	mg/kg dry wt	*0.005*		<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Endrin	mg/kg dry wt	*0.05*		<0.050	<0.050	<0.050	<0.050	<0.050
Endrin aldehyde	mg/kg dry wt	*0.01*		<0.010	<0.010	<0.010	<0.010	<0.010
Endrin ketone	mg/kg dry wt	*0.005*		<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
gamma-BHC	mg/kg dry wt	*0.005*		<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Heptachlor	mg/kg dry wt	*0.005*		<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Heptachlor epoxide	mg/kg dry wt	*0.005*		<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Hexachlorobenzene	mg/kg dry wt	*0.005*		<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Methoxychlor	mg/kg dry wt	*0.01*		<0.010	<0.010	<0.010	<0.010	<0.010
trans-nonachlor	mg/kg dry wt	*0.01*		<0.010	<0.010	<0.010	<0.010	<0.010
trans-Chlordane	mg/kg dry wt	*0.01*		<0.010	<0.010	<0.010	<0.010	<0.010
Chlordane (sum)	mg/kg dry wt	*0.02*		<0.020	<0.020	<0.020	<0.020	<0.020
TCMX (Surrogate)	%	*1*		96	110	110	110	100

Method Summary

Elements in Soil Samples dried and passed through a 2 mm sieve followed by acid digestion and analysis by ICP-MS. In accordance with in-house procedure based on US EPA method 200.8.

OCP in Soil Samples are extracted with hexane, pre-concetrated then analysed by GC-MSMS. (Chlordane (sum) is calculated from the main actives in technical Chlordane: Chlordane, Nonachlor and Heptachlor). (In accordance with in-house procedure).

Total DDT Sum of DDT, DDD and DDE (4,4' and 2,4 isomers)

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Technologist

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Technician