

**GEOTECHNICAL****WATER
RESOURCES****PAVEMENTS**

GeoSolve Reference: 260068

27 February 2026

Jacqueline Asplin
14 Buffalo Beach
Whitianga 3510

Geotechnical Assessment 19b Esplanade, Warrington

Dear Jacqueline,

In accordance with our Agreement (ref: 260068, dated: 27 January 2026), GeoSolve Limited (GeoSolve) has undertaken geotechnical investigations at the site in accordance with NZS 3604:2011. This letter report contains a summary of the investigations, as well as preliminary advice on site-specific geotechnical considerations and construction recommendations.



Photograph 1: Proposed building site at 19b Esplanade, Warrington

Site Description and Proposed Development

The site is located at 19b Esplanade, Warrington, and has an area of approximately 900 m². The building site is currently undeveloped and occupies a south-facing slope with a relatively gentle gradient. Prior to subdivision, the wider site was most recently used for grazing. A large, partially embedded concrete fragment was noted in the centre of the site, however our investigations did not find evidence of any other waste on the property. The property is bounded by developed residential land to the north and south, and undeveloped residential land to the east and west.

We are in receipt of concept plans by A1 Homes (ref: KH169, dated: 15 May 2024, rev: 1) and marked-up aerial images which illustrate that the proposed development comprises a single-story dwelling located near the centre of the property with a footprint of approximately 170 m². We understand that a waffle slab-type concrete foundation is proposed.

Subsurface Investigations

GeoSolve has undertaken investigations at the site comprising four hand augers and Scala penetrometer tests around the proposed building platform. A site plan illustrating the investigation locations is attached, as are the investigation logs.

Depths noted below are considered as depths below the existing ground level at the time of the investigations.

The subsoil profile at the site comprises topsoil overlying ancient landslide debris.

Surficial **topsoil** was observed in all locations, extending to depths of 0.2 to 0.35 m. This comprises a dark brown organic SILT, observed to be in soft and moist condition.

A relatively minor thickness of **uncontrolled fill** was observed to be underlying the topsoil in most locations, extending to depths ranging from 0.6 to 0.75 m. The fill typically comprises firm to stiff SILT of low plasticity with occasional organic patches and is likely to be locally-derived, i.e. during prior land cultivation.

Ancient landslide debris was observed to underlie the fill (or topsoil) to depths of at least 0.8 – 1.1 m. This comprises an orange/grey mottled silt with variable clay and sand, generally in firm to stiff condition, becoming stiff to very stiff with depth.

Bedrock was not encountered during the investigations but is expected to lie at moderate depth below the site, probably comprising rock types of the **Dunedin Volcanic Group** that likely persist to substantial depth.

The hand augers were terminated at depths of 0.8 to 1.10 m due to increasingly stiff soils. The Scala penetrometer tests were terminated at depths of 1.1 to 1.4 m due to effective refusal.

No groundwater contacts or seepages were encountered during the investigations, and the soils encountered were predominantly moist in condition.

Desktop Hazard Review

We have undertaken a desktop hazard review based on historic data held on the GeoSolve database, as well as readily available Otago Regional Council (ORC) and GNS Science Ltd hazard mapping:

- The nearest known potentially active mapped fault to the site is the Silver Stream-Merton Fault, the closest mapped trace of which lies approximately 6 km to the west of the site.

- Strong ground shaking throughout the South Island is likely to be associated with a rupture of the Alpine Fault, located along the West Coast of the South Island. Recent research¹ suggests there is a 75% probability of an Alpine Fault earthquake occurring within the next 50 years and an 82% probability that the next earthquake on the Alpine Fault will be of magnitude 8 or greater.
- Average return periods for shaking intensity are: MM 7 = 100 years, MM 8 = 450 years and MM 9 = >2,500 years. The most recent major earthquake to affect Dunedin occurred in 1974 and produced damage consistent with MM 7 intensity.
- A 2014 assessment² maps the site as within Domain A (i.e. sites predominantly underlain by rock or firm sediments) with respect to liquefaction hazard. Based on this mapping and the types of soils encountered, we consider the site liquefaction risk to be negligible.
- A 2017 landslide hazard review³ maps that the site is located on possible ancient landslide terrain. It is mapped as having “prehistoric” activity, “possible” certainty, and “low” sensitivity to destabilising influences. Based on this mapping, as well as the general site gradient, lack of groundwater and the soil types observed during the investigations, we consider the site slope stability risk to be relatively low.
- The area in which the subject property is located has been mapped as an area containing expansive soils, specifically the Warrington Silt Loam.⁴ We note that during the investigations, as well as during historic investigations undertaken nearby, the soils encountered did not appear to exhibit any characteristics associated with expansivity. Therefore, we consider the risk regarding the presence of potentially expansive soils at the site to be relatively low.
- Comment on flooding hazard is outside the scope of this report.

Geotechnical Considerations

The recommendations and opinions contained in this report are based upon ground investigation data obtained at discrete locations and historical information held on the GeoSolve database. The nature and continuity of subsoil conditions away from the investigation locations is inferred and cannot be guaranteed.

‘Good Ground’ Assessment

We have undertaken an assessment of ‘good ground’ in accordance with the requirements of NZS 3604:2011 (i.e. ≥ 5 Scala penetrometer blows and excluding any unsuitable soils). All unsuitable soils (e.g. topsoil and uncontrolled fill) will need to be removed for the site to fully meet the requirements of ‘good ground’. An assessment of 200 kPa geotechnical

¹ Howarth, J.D., et al. (2021). *Spatiotemporal clustering of great earthquakes on a transform fault controlled by geometry*. Nature Geoscience; doi: 10.1038/s41561-021-00721-4

² Barrell, D.J.A., Glassey, P.J., Cox, S.C., Smith Lyttle, B. (2014). *Assessment of liquefaction hazards in the Dunedin City district*. GNS Science Consultancy Report 2014/068. 68p.

³ Barrell D.J.A., Smith Lyttle B., Glassey P.J. (2017). *Revised landslide database for the coastal sector of the Dunedin City district*. Lower Hutt (NZ): GNS Science. 29 p. (GNS Science consultancy report; 2017/41).

⁴ Campbell, I.B. (1977). *Soils of Waikouaiti County, Otago, New Zealand*. Soil Bureau bulletin 37. Wellington: New Zealand Dept. of Scientific and Industrial Research.

ultimate bearing capacity (in accordance with MBIE technical guidance⁵) has also been undertaken. Depths to soils which meet these requirements are tabled below, as well as the observed thickness of unsuitable soils.

Table 1: Depths to 'good ground' and 200 kPa geotechnical ultimate bearing capacity and observed thickness of unsuitable soils.

Test location	Depth to 'good ground' in accordance with NZS 3604:2011	Depth to 200 kPa geotechnical ultimate bearing capacity	Observed thickness of unsuitable soils (topsoil and/or uncontrolled fill)
AH1	0.7	0.7	0.7
AH2	0.8	0.75	0.75
AH3	0.8	0.3	0.2
AH4	0.6	0.6	0.6

As tabled above, 'good ground' is generally expected to be available beyond 0.6 to 0.8 m below ground level. 200 kPa geotechnical ultimate bearing capacity is expected to be available beyond 0.3 to 0.75 m below ground level.

Inspection of foundation subgrades will be required during construction to confirm that footing excavations have been extended to suitable soils. This is discussed further below.

Foundation Recommendations

Foundation footings designed for 'good ground' should be extended to the respective depths tabled above and should bear on stiff or better natural soils.

Foundation footings designed for 200 kPa geotechnical ultimate bearing capacity should be extended to the respective depths tabled above and should bear on firm or better natural soils.

Based on the concept plans, we understand that a waffle slab-type (RibRaft) foundation is proposed.

Waffle slab footings designed for 200 kPa are likely to be appropriate for the site. Excavations will need to be extended to the depths outlined in the third column of Table 1 above and bear on firm or better natural soils to achieve this.

Alternatively, standard NZS 3604:2011 foundations designed for 'good ground' could be considered if preferred; however, we note that excavations would need to be extended further (to the depths outlined in the second column of Table 1 above) and bear on stiff or better natural soils.

⁵ Ministry of Business, Innovation and Employment (2012). *Repairing and rebuilding houses affected by the Canterbury earthquakes*. ISBN: 978-0-478-39908-0

All unsuitable soils will need to be removed from within the building platform for the site to fully meet the requirements of 'good ground' or 200 kPa geotechnical ultimate bearing capacity as per MBIE guidance.

If undercutting below design level is required to remove unsuitable soils, design levels can be restored using compacted granular engineered fill (typically required to be placed, compacted and certified in accordance with NZS 4431:2022 for waffle slabs). Note that all fill placed under footings (including internal ribs) requires certification regardless of thickness. GeoSolve can provide a fill specification on request if required.

We recommend that finalised architectural and structural plans are provided to GeoSolve for review prior to submission for building consent.

Construction Recommendations

We recommend the following information is provided to the contractor well in advance of earthworks commencing to minimise potential construction costs and/or delays:

- Site earthworks should be undertaken during a prolonged forecast of fair weather. Subgrade soils exposed to water may become softened and require removal.
- All unsuitable soils (e.g. topsoil, uncontrolled fill, soft material, construction debris, et cetera) should be removed from within the building platform.
- Any unsuitable material encountered beyond what is outlined in this report should be noted by the contractor and reported to a geotechnical specialist.
- Where filling is proposed beneath the building platform, subgrade excavations should extend horizontally beyond the extents of the building platform by a width equivalent to the proposed fill thickness at a given point to allow for load spread.
- Inspection of all foundation subgrades by a geotechnical specialist prior to fill placement or concrete pour will be required to enable geotechnical subgrade signoff (typically required by Council).
- Additional subgrade inspections may be required if all unsuitable material has not been fully removed from within the building platform in accordance with the recommendations of this report. We recommend that the contractor contacts a geotechnical specialist prior to inspection if there are any concerns regarding this.
- GeoSolve can undertake construction inspections upon request. We typically require a minimum of 48 hours' lead-in time for all inspections and may not be able to attend site at short notice.
- Once the geotechnical specialist has confirmed that the subgrade is suitable, the bases of the excavations should be covered in a 100 mm layer of compacted hardfill (or a 50 mm layer of 20 MPa site concrete) to protect the subgrade from softening.
- All fill that is utilised as bearing for foundations will typically require formal certification in accordance with NZS 4431:2022. This includes fill placed beneath raft foundations. We recommend that the structural plans, as well as the proposed fill thickness and material are reviewed by a geotechnical specialist prior to construction commencing to confirm whether formal certification will be required.

- If the contractor is unfamiliar with the fill certification process, advice from a geotechnical specialist should be sought.
- GeoSolve are able to undertake fill certification upon request. This should be arranged well in advance of fill placement as confirmation will be required that the contractor's proposed filling methodology and compaction equipment is appropriate. If GeoSolve is to certify the fill, fill placement may not proceed until this confirmation has been given.

GeoSolve should be contacted at the earliest stage possible if there are any questions or queries regarding the above.

Applicability

This report has been prepared for the sole use of our client, Jacqueline Asplin, with respect to the particular brief and on the terms and conditions agreed with our client. It may not be used or relied on (in whole or part) by anyone else, or for any other purpose or in any other contexts, without our prior review and written agreement.

Investigations have been undertaken at discrete locations in accordance with the brief provided. It must be appreciated that the nature and continuity of subsoil conditions away from the investigation locations are inferred and cannot be guaranteed.

During construction, foundation excavations should be examined by an inspector or engineer competent to confirm that subsurface conditions encountered throughout are compatible with the findings of this report. It is important that we be contacted if there is any variation in subsoil conditions from those described in this report.

Yours faithfully,



Jenna Fahey
Intern Geotechnical Engineer
GeoSolve Limited



Ethan Crosswell
Geotechnical Engineer
GeoSolve Limited

Reviewed and approved for GeoSolve Limited by: Rob Stuff, Senior Engineering Geologist (CMEngNZ)

Attachments: Site Plan [1p]
 Investigation Logs AH1 – AH4 [4p]



Legend:

 Hand auger and Scala penetrometer test location

Notes:

1. These drawings have been prepared for the benefit of Jacqueline Asplin 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.

2. Aerial imagery and approximate boundaries sourced from LINZ Data Service (imagery captured by Woolpert, 2023-2024).

3. Proposed dwelling location shown is approximate only and not to be relied upon.

SCALE 1:200

0 2 4 6 8 10 (m)



Level 1, 70 Macandrew Road, South Dunedin
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DRAWN	ETC	Feb.26
CHECKED	JF	Feb.26
APPROVED	RS	Feb.26
CAD File 260068.dwg		
Scale (at A3) 1:200		
Project No. 260068		Figure No. Figure 1
		Revision 0

Jacqueline Asplin

19b Esplanade, Warrington

Geotechnical Assessment

Site Investigation Plan

HAND AUGER LOG

HOLE NO.:

AH1

CLIENT: Jacqueline Asplin

PROJECT: ESPLANADE 19b

JOB NO.:

260068

SITE LOCATION: See Site Plan

CONTRACTOR: GeoSolve

START DATE: 05/02/2026

COORDINATES: 1412948 mE, 4935161 mN (NZTM2000)

EQUIPMENT: Hand auger & Scala penetrometer

END DATE: 05/02/2026

LOCATION METHOD: Handheld GPS

ACCURACY: $\pm 3\text{m}$

LOGGED BY: JF

ELEVATION: Existing ground level

OPERATOR: JF

CHECKED DATE: 10/02/2026

[illegible]

PHOTO(S)



REMARKS

Unable to penetrate beyond 1.1 m - increasingly stiff soils.

WATER

-  Standing Water Level
 Out flow
 In flow

