Appendix 8: Full Services Report

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Plan Change Servicing Assessment

February 2025

805-819 North Road Industrial Development

PLAN CHANGE SERVICING ASSESSMENT

Revision A – Issued for Consent

Quality Assurance Statement

Project number	7895
Project Name	805-819 North Road Industrial Development
Project Manager	Jeremy Rees
Revision	A – Issued for consent

	Name	Signature	Date
Prepared by	Meredith Ryan		18-Feb-2025
Reviewed by	Jeremy Rees		21-Feb-2025
Approval for issue	Jeremy Rees		21-Feb-2025

Contents

Plan Change Servicing Assessment 1

1. Introduction and Purpose of Report 4
2. Site Description and Proposed Development 4
3. Geotechnical, Earthworks and Site Shaping 5
   - 3.1 Investigations Completed 5
   - 3.2 Proposed Earthworks 6
4. Traffic, Roading, Footpaths and Lighting 7
   - 4.1 Existing Site Access 7
   - 4.2 Intersections and Site Access 8
   - 4.3 Roading Corridor Layout 8
5. Stormwater 9
   - 5.1 Existing Stormwater Context 9
   - 5.2 Servicing Methodology 11
   - 5.3 Stormwater Network Preliminary Design and assessment 11
6. Wastewater 12
   - 6.1 Existing Infrastructure 12
   - 6.2 Development Flows 13
   - 6.3 Servicing Methodology 13
7. Water Supply 14
   - 7.1 Existing Infrastructure 14
   - 7.2 Development demand 14
8. Power and Telecommunications 15
   - 8.1 Power 15
   - 8.2 Telecommunications 15
9. Conclusion 16

Appendix A
Geotechnical Investigation Report
Appendix B
Integrated Transport Assessment Report
Appendix C
Council Correspondence

1. Introduction and Purpose of Report

The following report outlines the civil engineering aspects of the proposed industrial development at 805 – 819 North Road, Invercargill.

The purpose of this report is to detail how the proposed development can be practically serviced for roading and utilities in support of the consent application for rezoning of the land.

2. Site Description and Proposed Development

The site is located on the eastern side of North Road, Lorneville, Invercargill. The existing land use is both industrial (wool storage) and stock grazing with an existing dwelling located at the south-west corner 819 North Road and 805 North Road. The overall site area of 805, 815 and 819 North Road is approximately 9.7 ha.

The undeveloped portion of site generally has grass pasture cover with a vegetated drainage channel running through the middle of 819 North Road. The site falls generally eastwards and falls away to a lower terrace behind the existing wool storage. The eastern boundary of the site is adjacent to an open rural drainage channel. This channel is part of a wider network which drains a larger catchment from the north to the Waikiwi Stream to the south.



Figure 1: Existing Site Aerial Photo

The proposed development is to extend the use of 805, 815 and 819 North Road, Invercargill into an industrial area with generally as per the proposed concept plan layout below. Note, that the lot layout provided is indicative only, and will be subject to future subdivision consents as appropriate.

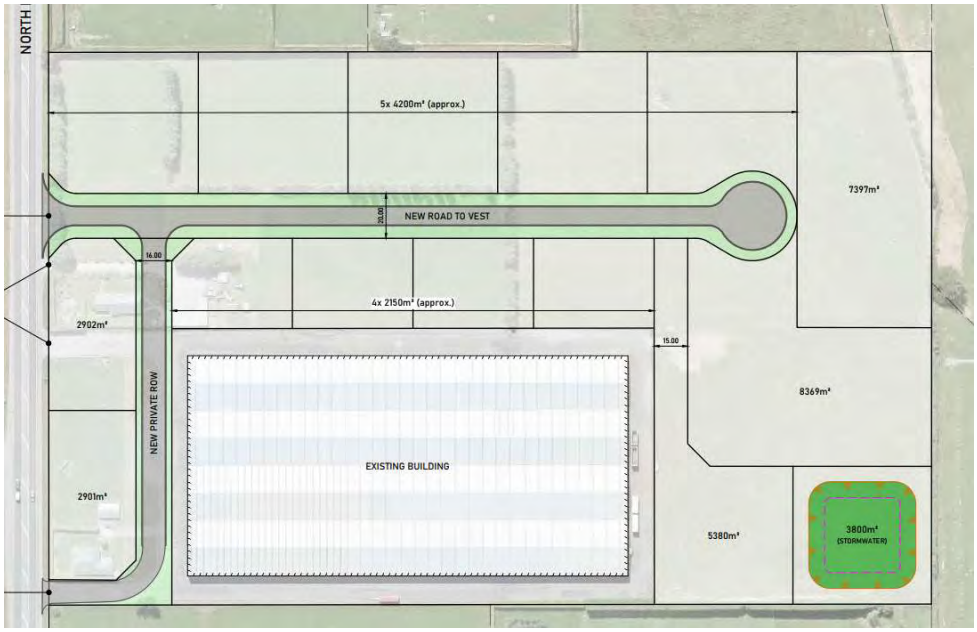


Figure 2: Preliminary development layout

3. Geotechnical, Earthworks and Site Shaping

3.1 INVESTIGATIONS COMPLETED

To support the application, a number of investigations have been undertaken, as noted below:

- Geotechnical investigations
- Land contamination investigations
- Property file
- Topographical survey
- LiDAR information
- Site visit
- Aerial Photography
- S-Maps
- District Plan hazard maps

3.1.1 GEOTECHNICAL INVESTIGATIONS

Geotechnical investigations have been completed by Geosolve for the site including test pits with associated scala penetrometer testing, heavy dynamic probe testing (DPH) and soakage testing. A brief summary is provided below, and the full report is provided in Appendix A.

Testing indicates the site is generally alluvial deposits overlaid by topsoil with isolated areas of uncontrolled fill and swamp deposits up to 1.2 m in depth which will require either removal from building footprints and replacement with engineered fill or piles extending through these layers.

Groundwater was observed at 0.8-3.0 m below ground level in the lower terrace and 1.8-2.8 m in the upper terrace and is not expected to be encountered during normal foundation excavations.

Soakage testing on site indicates ground infiltration rates will be slow at 0.07 – 22.5 mm/hr. It is unlikely soakage will be used for stormwater disposal for the development and stormwater soakage is not proposed for any vested infrastructure.

Additional key recommendations are:

- Shallow foundations will require specific engineering design in accordance with Figure 4 of the Geosolve report
- Piled foundations extending into the medium dense to dense alluvial gravel can be considered on site.
- Pavement CBR values can be assumed at 2% for pavement design and should be confirmed during construction.

3.1.2 GROUNDWATER SUPPLY

In addition, it is understood there is currently a bore feed on site with sufficient capacity to service the existing industrial building. It is not proposed to utilise this for any additional buildings.

3.1.3 LAND CONTAMINATION

A Detailed Site Investigation (DSI) report dated 12-Dec-24 has been completed by PDP and indicate that development at the site is not considered to pose an unacceptable risk to human health (in the context of commercial/industrial land use), not the environment. The DSI is included in the plan change application itself.

Additional recommendations highlighted in the report are:

- Soil material removed from site may need to be disposed of at an approved managed fill facility.
- Erosion and sediment control measures should include protocols for accidental discovery of contaminated materials.
- Soil disturbance should be limited as much as is practical around water tanks and waterways to prevent contaminant egress.

3.2 PROPOSED EARTHWORKS

3.2.1 SITE CLEARANCE AND DEMOLITION

General site clearance and demolition would be required to remove existing farm fencing, trees and vegetation located within the site extent. Removal of minor structures (garden sheds or standalone garages) is also likely to be required.

3.2.2 PROPOSED SITE SHAPING / EARTHWORKS

Earthworks will be required to enable construction of roading and servicing infrastructure as well as general smoothing of the site in preparation for industrial use (i.e. buildings, storage and parking).

The existing open channel running through 819 North Road is proposed to be filled with engineered fill to enable road construction as well as providing an approximately levelled surface for buildings or parking. The management of the upstream flows through this open channel is discussed in Section 5 below. It is not expected that additional major earthworks will be undertaken as part of the development.

Major filling in the other areas of the site is not expected to be required as part of the development, with each lease area likely being required to complete some site shaping earthworks and removal of topsoil to enable development to match their needs.

Earthworks in the lower portion of the site to the east may be required to facilitate stormwater basins for treatment and attenuation. These would likely be achieved through excavation to waste.

It is assumed surplus topsoil from site would be bunded in the lower-level lot area during construction and respread in construction areas. Excess topsoil is expected to be removed to waste off site.

3.2.3 EARTHWORKS VOLUMES

The expected earthworks volumes required are summarised below:

- Topsoil strip to stockpile and reinstate on completion = 9,000 m³
- Cut to waste (onsite) = 4,000 m³
- Import aggregates for road and services construction = 2,500 m³
- Engineered fill for reshaping of the existing drainage swale = 5,000 m³

3.2.4 EROSION AND SEDIMENT CONTROL

A site-specific erosion and sediment control plan will be produced during the construction phase of the development. It is proposed this is submitted to Council for approval prior to construction.

The plan will detail how the works will be undertaken to control and minimise the discharge of sediment into the receiving environment and control and minimise wind-blown dust and dirt.

For this site it is expected this will be achieved via the below measures with particular attention to the swale outlet to the west and the existing drainage ditch along the western boundary:

- Minimising the construction footprint and completing work in stages, stabilising exposed areas quickly
- Installing perimeter controls and diversions (silt fencing, earth bunds / cutoff drains) to divert clean water around the site and control dirty water within it
- Providing a stabilised entranceway for construction traffic
- Use of the following tools to control and minimise erosion and sediment discharge:
  - Silt fences / earth bunding
  - Silt socks / Geotextile / Witches' hats to protect Sump Inlets
  - Decanting Earth Bund (recommended maximum catchment 0.3 ha)

4. Traffic, Roading, Footpaths and Lighting

4.1 EXISTING SITE ACCESS

The existing site has multiple access points to North Road. These are described below:

815 North Road which houses the existing woolshed has an entry only access to the north, and exit only to the south. There is an internal loop road surrounding the woolshed building typically ranging in width from approximately 10.5 m to 11.5 m. Angle parking is included along the northern frontage of the woolshed. The existing access around the woolshed will remain as a private accessway. Any existing pavement that would be incorporated into vested roading will be renewed and tested to ensure it complies with ICC's engineering standards.

On the opposite side of North Road there is an industrial access to Prime Range Meats and Adventure Southland. This access point is located directly between the existing entry and exit points to 815 North Road (55 m separation to each)

805 North Road houses a single dwelling which has no access from North Road, and instead accessed from the internal loop road within 815 North Road.

819 North Road includes a single dwelling that has driveway access direct off North Road. This is approximately 35 m north of the entry access to 815 North Road.

4.2 INTERSECTIONS AND SITE ACCESS

An Integrated Transport Assessment (ITA) Report dated 31-Oct-24 has been completed by Stantec New Zealand for the proposed development and is attached in Appendix B. This report recommends:

- Closing the existing northern site access and relocating the site entrance north with a new access road to increase separation distances from other existing intersections on the western side of North Road.
- New road turning layouts with associated signage and physical passive traffic calming methods (kerbs or traffic islands).

4.3 ROADING CORRIDOR LAYOUT

The internal road network will be generally as per the proposed layout plan (Figure 3: Proposed Road Layout) to accommodate changes in access location as required. This includes:

- Construction of a new local road (to be vested) with new intersection on SH6 with right turn bay
- Extension of the existing private Right of Way providing access to the southern lots with left exit only at the existing southern vehicle access.

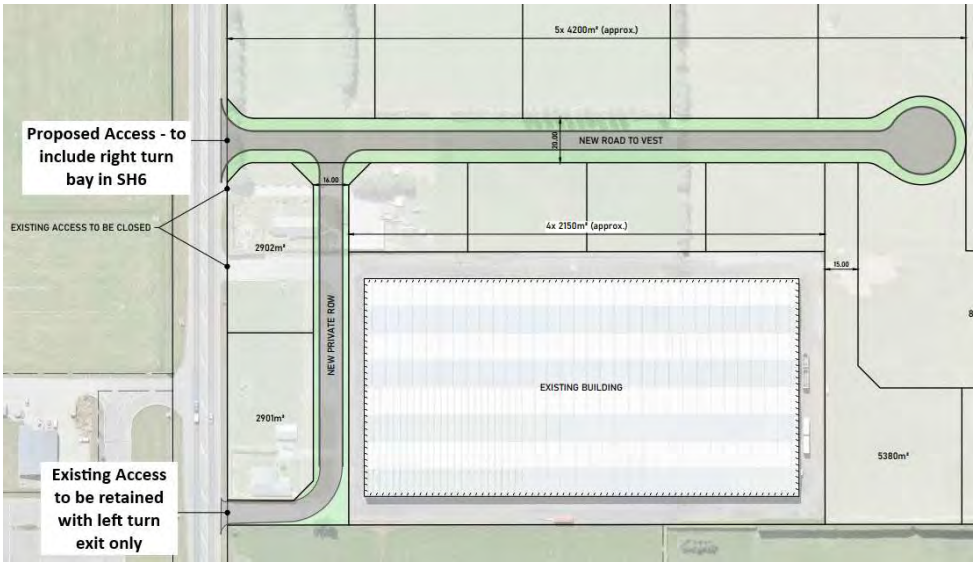


Figure 3: Proposed Road Layout

The new road to be vested is proposed to be 8.0 m in width allowing for 1 x 3 m lane widths with 2x 2.5 m parking lanes, as per Table 5.4 of ICC's Code of Practice (2023) for Commercial/Industrial – M4 - Minor. Footpaths on both sides will be provided in line with Table 5.4 as well.

The new Right of Way is proposed to have a 6.0 m carriageway.

It is proposed to light the roading corridor to the appropriate P category in line with NZ standards.

5. Stormwater

5.1 EXISTING STORMWATER CONTEXT

5.1.1 INVESTIGATIONS COMPLETED – SUMMARY

In order to understand the runoff characteristics of the existing site, multiple sources of information were consulted, and investigations completed including the below:

- LiDar sourced from LINZ Data Service
- Aerial Photography sourced from LINZ Data Service
- Topographical survey of key features
- Council GIS of pipe networks
- Site visit
- S-Maps
- Geotechnical testing including infiltration testing
- District Plan Hazard Maps

5.1.2 EXISTING CATCHMENTS

A high-level catchment definition of the area has been completed utilising the available LiDAR information. A site walkover was also undertaken to ground-truth the LiDAR catchments and flowpaths.

The site is generally falling towards an existing stormwater drainage channel on the eastern site boundary with an historic drainage channel conveying runoff from the western side of the State Highway running through the centre of the site and under the existing building on site (both indicated in blue in Figure 4 below). It appears that this historic flowpath has been disrupted by the construction of the current building and redirected by piped network (525 mm concrete main shown indicatively in green) to outlet to the drainage channel at the eastern boundary.

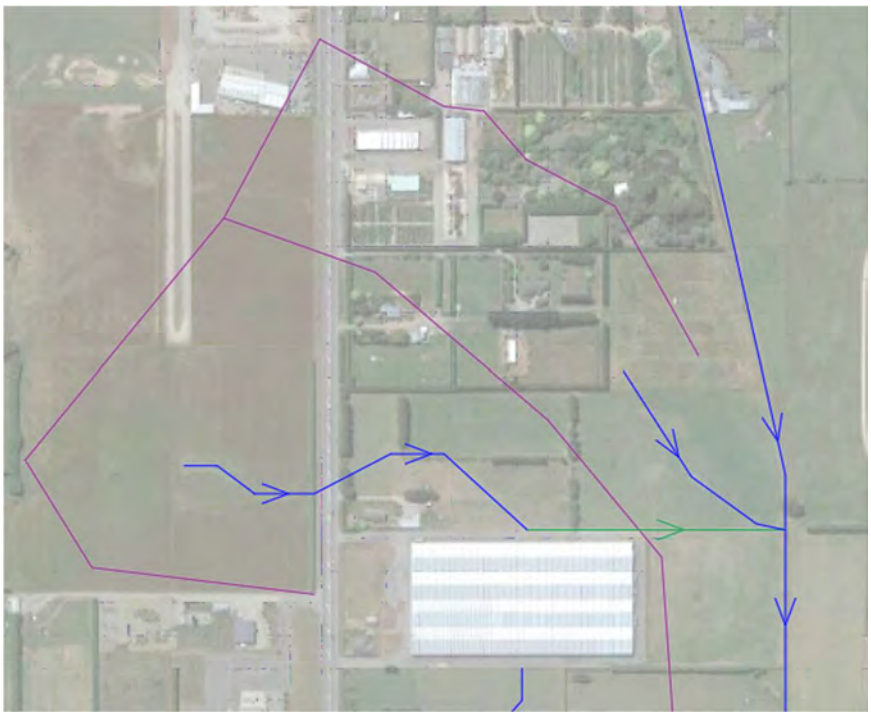


Figure 4: Site assessed catchments and flow paths

5.1.3 EXISTING INFRASTRUCTURE

There is an existing 525 mm RCRRJ pipe running west-east along the northern side of the existing main accessway draining into the adjacent drainage channel in the east of the site. This pipe has a varying capacity depending on the hydraulic grade achievable in the system. The grade of the main is not known but it is expected it will be between 0.5% to 3% which provides capacity between 330 l/s to 806 l/s.



The existing runoff from the development site, independent of the wider catchment, is 280 l/s and is expected to increase to 730 l/s with an assumption of a fully developed industrial area for a 20% AEP storm event.

Based on this, post development flows may exceed the capacity of the existing 525 mm pipe and should be confirmed during detailed design, however it is expected we can manage this through use of swales to direct flow in the proposed development area, or upsizing of relevant infrastructure as required.

The existing outfall of the site is to the drainage channel towards the south adjacent to the eastern site boundary. The drainage channel is currently servicing a large upper catchment. The development will not change or inhibit flows through this channel.

5.1.4 LEVEL OF SERVICE AND OTHER REQUIREMENTS

As per the ICC Subdivision, Land Use, and Development Cod of Practice 2023 Clause 6.3.6 the level of service for the stormwater system is:

- Primary Event – 20% AEP
- Secondary Event – 1% AEP

Additionally:

- Rainfall intensity shall allow for climate change. Rainfall intensity design charts developed from NIWA High Intensity Rainfall Design Systems (HIRDS) V4 RCP 6.0 data for 2081-2100 should be used for rainfall design

Environment Southland have confirmed (refer to Appendix C for correspondence) that attenuation is not required for the development however they have indicated an expectation for onsite stormwater treatment prior to discharge from site which is further detailed in Section 5.2.

5.2 SERVICING METHODOLOGY

The below stormwater servicing methodology, with reference to the layout plan in Figure 5 below is proposed for conveyance and treatment. Note that soakage to ground is not being relied on as a means of stormwater disposal due to low infiltration rates observed from site investigations:

- The existing building drainage connection to the existing 525 mm concrete pipe is intended to be left in situ. Capacity will be confirmed during detailed design and will be subject to engineering approval.
- The existing 525 mm concrete pipe provides drainage for the existing overland swale and catchment west of North Road. The existing culvert underneath North Road appears to be insufficient for the catchment and the proposed roading layout will require the channel to be piped. The existing culvert beneath North Road will not be modified by this development, but provision for an upgrade will be made by providing a manhole connection point at the boundary.
- Roof and road runoff will be collected from each new allotment via private lot laterals and roadside swales with sump inlets to trap hydrocarbons and coarse sediments with a siphon outlet.
- Site specific treatment (depending on end use) as required by any trade waste or building consents obtained during the building construction process and under ICC's stormwater bylaw. It is expected that site specific systems to provide removal of contaminants that arise as a result of industrial activities.
- Allotment roof and road, and new road stormwater runoff will then be conveyed through the site via a piped network discharging to the first flush pond for initial sediment removal prior to discharge to the existing 525 mm concrete pipe outfall before discharge drainage channel. During detailed design, the sizing of the outfall pipe will be confirmed.
- Finished floor levels for all new buildings will be set during detailed design to ensure freeboard from pond levels. The site was not noted as being within an identified floodplain by Environment Southland.
- The existing drainage channel to the east encroaches into the northeastern corner of the proposed development, it is not proposed to undertake any realignment works of this channel and leave the existing flow path and maintenance access undisturbed.
- Secondary flow will be directed towards the road corridor which falls generally to the east and the existing drainage channel.

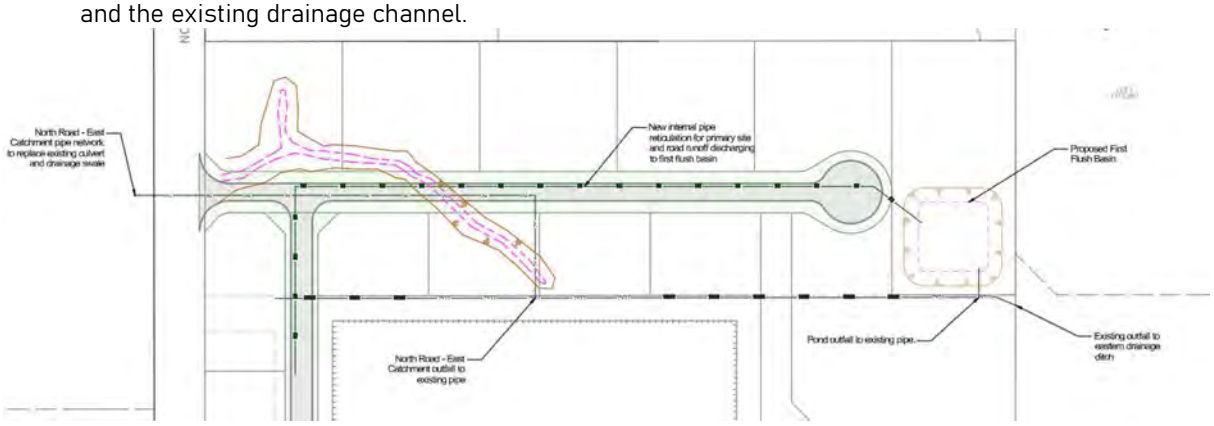


Figure 5: Preliminary stormwater layout

5.3 STORMWATER NETWORK PRELIMINARY DESIGN AND ASSESSMENT

In order to confirm the proposed servicing methodology a preliminary design has been completed as below.

5.3.1 DESIGN COEFFICIENTS AND INPUTS

Surface water runoff has been calculated using the Rational Method.

Design rainfall intensities have been derived for the site from HIRDS V4 RCP8.5 for 2081-2100 as below:

Design Rainfall Table

Source - NIWA HIRDS

Rainfall intensities (mm/hr) :: RCP8.5 for the period 2081-2100

ARI	AEP	10m	20m	30m	1h	2h	6h	12h	24h	48h	72h	96h	120h
5	0.2	54.4	36.8	29.2	19.6	12.9	6.47	4.14	2.62	1.66	1.27	1.05	0.905
100	0.01	139	89.5	69.1	44.2	27.8	13	7.93	4.79	2.9	2.16	1.75	1.48

Run-off coefficients have been derived from New Zealand Building Code E1 Surface Water as follows:

- Commercial/Industrial - 0.85
- Rural/Reserves – 0.35

Time of concentration was assessed for the various catchments based on NZ building code E1 formula and assumed pipe/channel flow durations as follows:

- Development Site Catchment – 13 minutes (pre), 34 minutes (post)
- Wider Catchment – 41 minutes

5.3.2 WATER QUALITY VOLUME AND FIRST FLUSH BASIN

The water quality volume for the site has been calculated below. This is used to size the first flush basin. Noting that the existing building and external western catchment are captured by an independent network and bypasses the first flush pond as treatment for these areas is ether not required or is part of the existing solution, the proposed arrangement of the stormwater system is as below:

- the development pipe network will discharge directly to the first flush basin.
- When the first flush basin is overwhelmed flow from the first flush basin will overtop the broad crested weir and enter the existing 525 mm concrete pipe, or directly into the receiving water channel via a discharge structure.
- An emergency overflow and overland flow path from the first flush basin is proposed that discharges to the existing drainage channel.
- A first flush basin of up to 1,000 m² will be provided to provide treatment for the development's road runoff, and to provide final treatment of the individual allotment runoff. This volume will provide first flush treatment for approximately 63,000 m³ of hardstand area, based on a first flush depth of 20 mm.

6. Wastewater

6.1 EXISTING INFRASTRUCTURE

There is currently no reticulated wastewater connections to the site. It is understood from Karl Boniface plumbing that the existing woolshed utilises two separate on-site septic tanks and dispersal fields for wastewater disposal. The below summary was provided by Karl:

There are two septic tanks on the property.

- *West septic tank*
  - *Serves amenities on west wall.*
  - *Discharges to adjacent soakhole.*

- *Property at 805 also discharges to soakhole.*
- *Last cleaned out around 2016 from memory.*
- *Soakhole has backed up previously and an explosive charge was used to free it up. Not aware of any current problems but most likely nearing end of life.*

- *North septic tank*
  - *Located under North sealed yard near East end of building.*
  - *Unknown when last cleaned out.*
  - *Appears to be working freely.*
  - *Unknown where it discharges to but possibly to adjacent stormwater line to creek as this practice was common back then but does not meet current requirements. A dye test may help confirm.*
  - *Fresh air inlet vent against building broken and blocked. Will repair when repairing terminal vent by offices.*
  - *First 50m of sewer drains to this inspected by camera and confirmed in good condition.*

The nearest council infrastructure is located within North Road approximately 690 m south of the existing site entrance. This drains to the Moore Road pump station. This station discharges to a rising main on North Road which ultimately connects to the ICC gravity network.

6.2 DEVELOPMENT FLOWS

Flow from industrial / commercial premises is difficult to predict and is very reliant on the type of industry which chooses to establish, and the number of staff and customers.

The likely future use of the area is for storage facilities with general facilities for staff rather than manufacturing type activities generating trade waste. On this basis a preliminary assessment of development flows has been completed below to provide a range. The assessment has been completed based on industry guidance from Watercare firstly for office based activities, and secondly for industrial based warehouse activities.

The office based flow calculation generally aligns with flow demand predictions for the industrial development on the north-western corner of the Lorneville Roundabout.

Office Based Calculation									
Item	Number	Flow/Demand Allowance (l/day)	Dry weather peaking factor	Wet weather peaking factor	Average Dry Weather Flow (litres/second)	Average Dry Weather Volume (m3/day)	Peak Dry Weather Flow (litres/second)	Maximum Flow (peak wet weather) (litres/second)	Notes
Staff	160	65	2	5	0.12	10.40	0.24	0.60	Based on 1 person per 15m2 (office buildings). Based on Thompson plan approx area for staff on each site would be 200m2 office space. Assume woolstore accounts for 400m2. Expect up to 12 office spaces total including woolstore. On this basis expect 160 staff

The industry based calculation below predicts higher flows, essentially predicting either higher staff numbers per floor area.

Industry Based Calculation									
Item	Floor Area m2	Flow/Demand Allowance (l/m2/d)	Dry weather peaking factor	Wet weather peaking factor	Average Dry Weather Flow (litres/second	Average Dry Weather Volume	Peak Dry Weather Flow (litres/second)	Maximum Flow (peak wet weather)	Notes
New Demand	6000	4.5	5	6.7	0.31	27.00	1.56	2.09	Assume light water usage, with floor area making up 20% of lot area. Expect approx 30,000m2 of lot area.
Existing Demand	1950	4.5	5	6.7	0.10	8.78	0.51	0.68	Assume light water usage, with 10% of woolshed floor area being active for WW flows. SO 19500 x .1 = 1950m2

Based on the above peak flows and daily volumes could range from 0.6 l/s to 2.77 l/s, and 10.4 m³/day to 35.78 m³/day.

6.3 SERVICING METHODOLOGY

It is proposed to service the development by constructing a low-pressure sewer network extending down North Road and connecting to the ICC network. It is intended that each new

building will be required to install an individual site pump as part of the building construction. Early consultation with ICC has been undertaken and it has been accepted, in principle, that connection to the North Road rising main from the Moore Road pumpstation is acceptable but discharge directly to the Moore Road pump station is not possible due to lack of additional capacity. Specific connection to the network has 2 options:

- Connection to the existing rising main in North Road with controls given to ICC for the low-pressure sewer pumps, or
- Extension of the new rising main to the existing gravity sewer in North Road.

Connection to the existing rising main is the recommended approach enabling greater flexibility in grades/levels as well as additional controls over discharge volumes and pump cycles. We expect this will be developed further during detailed design and engineering approval.

7. Water Supply

7.1 EXISTING INFRASTRUCTURE

There is currently no reticulated water supply connection to the site. It is understood from Karl Boniface plumbing that the existing woolshed is serviced by an on-site bore. The below summary was provided by Karl:

- *A bore water supply and pump is located on the northern property boundary not far from main offices.*
- *There is an underground storage tank within the building used as a reservoir for sprinkler supply which presumably overflows to stormwater main.*

The existing on site water bore is considered to be sufficient to cater for the existing woolshed and is not expected to have capacity for the full development.

Council have confirmed that connection to the new Branxholme transmission line is not permissible for the development. Therefore, each allotment will capture rainwater and provide onsite treatment for potable water, as outlined in the following sections.

7.2 DEVELOPMENT DEMAND

7.2.1 EXPECTED DEVELOPMENT DEMAND

Water supply demand is expected to closely match the calculated wastewater flows expected and be dependent on the industry that establishes on site. Some additional water use that does not contribute to wastewater may increase volumes e.g. irrigation, isolated washing activities that are collected.

7.2.2 FIRE FIGHTING REQUIREMENT

The minimum firefighting requirement for the site is FW2, with the potential for the requirement to increase dependant on the building design for industry establishing on site. Each building/allotment will be responsible for providing their own fire water storage and this will be managed during the building consent phase of each building.

SNZ PAS 4509:2008 Table 2 stipulates the below requirements:

Table 2 – Method for determining firefighting water supply

	Reticulated water supply			Non-reticulated water supply	
Fire water classification	Required water flow within a distance of 135 m	Additional water flow within a distance of 270 m	Maximum number of fire hydrants to provide flow	Minimum water storage within a distance of 90 m (see Note 8)	
				Time (firefighting) (min)	Volume (m^3)
FW1	450 L/min (7.5 L/s) (See Note 3)	–	1	15	7
FW2	750 L/min (12.5 L/s)	750 L/min (12.5 L/s)	2	30	45
FW3	1500 L/min (25 L/s)	1500 L/min (25 L/s)	3	60	180
FW4	3000 L/min (50 L/s)	3000 L/min (50 L/s)	4	90	540

8. Power and Telecommunications

8.1 POWER

Early consultation with PowerNet indicate that the site can be serviced however specific requirements are yet to be confirmed. It is expected that to service the site, a new transformer will be required with the existing overhead lines to be replaced with new 11kV underground cables.

8.2 TELECOMMUNICATIONS

Early design consultation with Chorus indicates the site can be serviced for the additional industrial development however specific layout and infrastructure requirements have not been confirmed.

Broadband maps show there is currently no Fibre to the gate, however the other industrial sites at Lorneville do have Fibre access. The network could likely be extended to the site if required. There is high-speed wireless access. Alternatively wireless high-speed internet could be achieved through Starlink. We can engage with telecommunications providers in the next phase of the project to better understand available options.

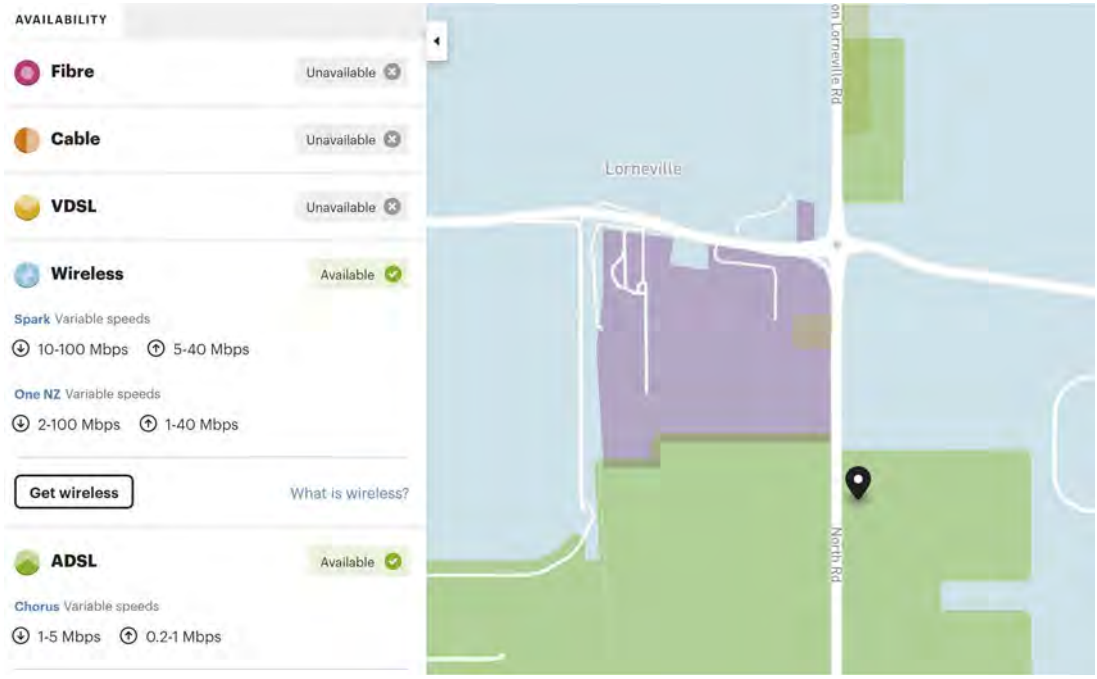


Figure 6: Broadband Map Excerpt

9. Conclusion

Based on the information available at the time of writing this report, it is considered that the site can be practically serviced from a civil infrastructure perspective utilising the servicing methodology presented.

Some new infrastructure will be vested with ICC as part of the development, namely the new road and associated stormwater infrastructure. The proposed sewer rising main is also proposed to be vested with ICC, but the individual sewer pump stations will be privately owned.

Appendix A

Geotechnical Investigation Report

Geotechnical Report

805, 815, 819 North Road

Invercargill

Report prepared for:

Tulloch Group Ltd

Report prepared by:

GeoSolve Limited

Distribution:

Tulloch Group Ltd

Bonisch Consultants Ltd

GeoSolve Limited (File)

September 2023

GeoSolve Ref: 230505

Revision	Issue Date	Purpose	Author	Reviewed
0	25.09.23	Client issue	SLB	TJP/FAW

GEOTECHNICAL WATER RESOURCES PAVEMENTS

Table of Contents

1 Introduction 1

1.1 General 1

1.2 Development 1

2 Site Description 2

2.1 General 2

2.2 Topography and Surface Drainage 2

3 Geotechnical Investigations 3

4 Subsurface Conditions 3

4.1 Geological Setting 3

4.1.1 Regional Geology 3

4.2 Stratigraphy 4

4.3 Groundwater 5

5 Liquefaction Analysis 6

5.1 Design Earthquakes 6

5.2 Liquefaction Analysis 6

5.3 Liquefaction Results 7

6 Engineering Considerations 10

6.1 General 10

6.2 Geotechnical Parameters 10

6.3 Site Preparation/Earthworks 11

6.4 Groundwater Issues 11

6.5 Excavations 12

6.6 Preliminary Foundation Options 12

6.6.1 General 12

6.6.2 Shallow Foundations 13

6.6.3 Piled Foundations 14

6.7 Pavement CBR Values 14

6.8 Site Subsoil Category 15

6.9 Further Geotechnical Involvement 15

7 Wastewater Disposal Infiltration Rates 16

7.1 General 16

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7.2 Permeability Analysis – Infiltration Rates and Soil Category 16
7.2.1 General 16
7.2.2 Wastewater Disposal Infiltration Rates 16
7.2.3 Preliminary Wastewater Disposal Soil Category 17
7.3 Conclusions and Recommendations 18
8 Neighbouring Structures/Hazards 18
9 Conclusions and Recommendations 19
10 Applicability 20

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1 Introduction

1.1 General

This report presents the results of a geotechnical investigation carried out by GeoSolve Ltd in order to determine subsoil conditions and provide geotechnical inputs for a proposed commercial subdivision located at 805, 815 and 819 North Road, Invercargill.



Figure 1 – Site overview photo looking North.

The investigations were carried out for Tulloch Group Ltd. in accordance with GeoSolve Ltd's proposal dated 20 July 2023, which outlines the scope of work and conditions of engagement.

1.2 Development

We understand the proposed development will comprise approximately 10 lease areas for development including associated roading and infrastructure. An engineering feasibility report has been provided by Bonisch Consultants Ltd. (Project number 7895, Rev A, dated May 2023) and outlines the extent and layout of the proposed development.

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2 Site Description

2.1 General

The subject site is located approximately 6.5 km north of Central Invercargill, as shown in Figure 2 below.



Figure 2 – Site location plan (red marking)

The site is bounded by North Road to the west, commercial and residential properties to the north and rural properties to the east and south.

An existing dwelling is located at the southwest corner of the property and a large shed covers the centre-south of the site. The property is currently fenced and covered in grass with some trees along field boundaries.

2.2 Topography and Surface Drainage

The majority of the site occupies a sub-horizontal upper terrace, and slopes down in the east to a lower terrace and drainage ditch. The drainage ditch is approximately 1 m deep and runs generally north-south along the eastern boundary. A second drainage ditch runs generally north to south between the western boundary and North Road.

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A paleochannel cuts across the property from the north-western boundary toward the centre of the site. Water was observed to be ponding in the paleochannel during investigations. A further channel has been excavated along the western and southern boundaries of the south-eastern field. This channel runs to a low point in the southeast corner of the site where evidence of ponded water is noted on the property and a swampy area and pond were observed in the field directly to the south of the property boundary.

3 Geotechnical Investigations

An engineering geological site assessment has been undertaken with confirmatory subsurface investigations. GeoSolve visited the subject property on 7, 8 and 9 August 2023, undertaking geotechnical investigations comprising:

- 13 deep test pits with associated Scala penetrometer tests (TP01- TP13) which were advanced to a maximum depth of 3.9 m.
- 9 shallow test pits with associated Scala penetrometer tests (TP14 – TP22) which were advanced to a maximum depth of 0.4 m.
- 6 heavy dynamic probe tests (DPH 1- 6) advanced to refusal at a maximum depth of 11.6 m, to assess liquefaction potential and the relative density of the subsoils.
- 2 soakage pits (SP1-2) which were advanced to a maximum depth of 2.8 m below ground level (bgl) to undertake soakage testing, assess the relative permeability and soakage potential of the subsoils.

Test pit and Scala Penetrometer locations and logs are contained in Appendix A and B respectively.

DPH locations and logs are contained in Appendix A and C respectively.

4 Subsurface Conditions

4.1 Geological Setting

4.1.1 Regional Geology

The site is underlain by topsoil, which in turn overlies alluvial deposits with Tertiary-age marine sediments at depth.

The alluvial deposits comprise Quaternary outwash gravels developed during former glaciation, which occurred inland. More recent silty and sandy floodplain or mudflat deposits overlie these gravels. The alluvial deposits merge with marine deposits in the vicinity of Invercargill.

No active faults were identified in the field, nor have any been reported in the vicinity of Invercargill. Strong earthquakes are common in Fiordland near the current tectonic plate boundary and consequently some ground shaking can be expected to occur in Invercargill during such events. The nearest trace of any mapped active fault is the Hillfoot Fault, approximately 60 km to the north of the site.

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Seismic risk exists in this region from potentially strong ground shaking, likely to be associated with a rupture of the Alpine Fault, located along the West Coast of the South Island. There is a high probability that an earthquake with an expected magnitude of over 8 will occur along the Alpine Fault within the next 50 years.

4.2 Stratigraphy

Subsurface soils encountered beneath the site generally comprise the following:

- 0.2-0.5 m of **topsoil**, overlying;
- 0.5-0.6 m of **uncontrolled fill** (only in TP01, TP02 and TP04), overlying
- 0.1 m of **buried topsoil** (only in TP02), overlying
- 0.6-2.6 m of **alluvial silt** (all test pits except TP01 & TP02), or 1.2 m of **swamp deposit** (only in TP04), overlying
- 0.5-2.6+ m of **alluvial sand** (TP02, TP03, TP05, TP06, TP07, TP08, TP09, TP10, TP11, TP12, TP13) or
- 1.1-2.9+ m of **alluvial gravel** (TP01, TP02, TP04).

Topsoil was observed at the surface of all test pits to depths of between 0.2 and 0.5 m. The topsoil typically comprises soft to stiff, organic SILT with trace to some sand and/or gravel.

Uncontrolled fill was observed underlying the topsoil in TP01, TP02 and TP04, to depths of between 0.8 and 1.1 m. The uncontrolled fill typically comprises firm to stiff, organic SILT with trace to some sand, gravel and rubbish, or SILT with some gravel and/or trace sand.

Buried topsoil was observed underlying the uncontrolled fill in TP02 at 0.8-0.9 m. The buried topsoil typically comprises stiff, organic SILT with minor sand.

Swamp deposit was observed underlying the uncontrolled fill in TP04 in the southeast corner of the site, to a depth of 2.3 m. The swamp deposit typically comprises very soft to soft, organic SILT with trace to some sand.

Alluvial silt was observed underlying the topsoil, uncontrolled fill or swamp deposit in all test pits, except TP01 and TP02. The alluvial silt typically comprises soft to very stiff, sandy SILT or SILT with trace to some sand**.** Alluvial silt was also interbedded with the alluvial sand in TP02, TP03, TP12 and TP13 in layers up to 1.8 m+ thick.

Alluvial sand was observed underlying or interbedded with the alluvial silt in all test pits except TP01 and TP04. The alluvial sand typically comprises loose to dense, SAND, silty SAND or SAND with trace silt.

Alluvial gravel was observed in TP01 and TP02 below the uncontrolled fill and buried topsoil and TP04 below the alluvial silt. The alluvial gravel typically comprises medium dense to dense, sandy GRAVEL with trace organics and/or silt. DPH testing infers this medium dense to dense material continues to at least the maximum testing depth of 11.6 m bgl.

Although uncontrolled fill was not observed in all test pits during investigations, the use of the site as farmland plus the presence of the existing dwelling, sheds and surrounding landscaping suggest potential for the presence of isolated uncontrolled fill at the site.

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4.3 Groundwater

The static groundwater table was measured in the test pits at 0.8 – 3.0 m below existing ground level (bgl) in the lower terrace, and at 1.8 – 2.8 m bgl in the upper terrace. Groundwater seepages were also observed between 0.9 m and 3.5 m depth.

Groundwater is likely to be subject to seasonal variations and vary in response to rainfall.

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5 Liquefaction Analysis

5.1 Design Earthquakes

The site is mapped in the Invercargill City Council Liquefaction Vulnerability map as "Undetermined" however, due to the variable water-table and alluvial soils a liquefaction assessment has been undertaken.

Two earthquake scenarios have been assessed in accordance with NZS 1170 – Structural Design Actions[1] for an Importance Level 2 structure with a 50-year design life. We have also considered a 1 in 100-year intermediate earthquake event to provide further insight to the liquefaction risk at the site.

Peak horizontal ground accelerations and effective magnitudes were calculated using the procedure from the MBIE NZGS Module 1[2]. Table 1 summarises the scenarios considered.

The MBIE NZGS Module 1 design earthquakes are an interim hazard recommendation until results of the national seismic hazard update are made available for use. Therefore, we have undertaken a sensitivity assessment for a range of earthquake events to provide further insight to the liquefaction risk.

Table 1 – Earthquake accelerations and effective magnitudes for liquefaction assessment

Scenario	Performance Requirements	Annual Probability of Exceedance (APE)	Peak Horizontal Ground Acceleration (PGA)	Effective Magnitude
Serviceability Limit State (SLS)	*Avoid damage that would prevent the structure being used as originally intended without repair.*	1/25	0.05 g	6.1
Intermediate earthquake event	*No specific requirements, unless further resilience is desired.*	1/100	0.11 g	6.1
Ultimate Limit State (ULS)	*Avoid collapse of the structural system.*	1/500	0.21 g	6.1

5.2 Liquefaction Analysis

The following analysis has been undertaken:

- A liquefaction assessment was undertaken using the heavy dynamic probe data based on the method of Boulanger and Idriss (2014).

[1] NZS 1170-5 (2004) Structural Design Actions, Part 5: Earthquake Actions – New Zealand.
[2] https://www.building.govt.nz/assets/Uploads/building-code-compliance/b-stability/b1-structure/geotechnical-guidelines/module-1-overview-of-earthquake-geotechnical-engineering-practice-guidelines-version-1.pdf.

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- The DPH data has been correlated to equivalent SPT N60 values for this assessment.
- All layers have been assumed to be able to liquefy from a plasticity perspective below the ground water level. Fines content has been estimated based on test pit logs and knowledge of the deeper ground conditions. We have assumed that there are no further liquefiable layers below the refusal of the DPH tests at 11.6 m depth.
- Ishihara and Yoshimine (1992) method has been used to calculate settlement.
- Groundwater levels have been adopted at between 1 and 4 m depth based on investigation observations and ground level variations.
- Lateral spreading has been assessed quantitatively based on topography, calculated liquefiable layers and comments in the MBIE (2017) and MBIE/NZGS Module 3[3].

5.3 Liquefaction Results

The liquefaction analysis indicates the following with reference to Table 2 and Figure 3 below:

- No liquefaction is calculated for the SLS and intermediate design earthquakes due to the relatively low levels of shaking.
- The alluvial sand and silt layers are calculated to liquefy at depths between 7-8 m in DPH 1, 5.5-6 m in DPH2, 4-5 m in DPH3, 3.5-4 m in DPH4, 4.5-5 m in DPH 5 and between 4-5.5 m in DPH6. Based on this we have calculated up to 40 mm of liquefaction induced settlement and limited expression of liquefaction or ground damage.
- Liquefaction at the site is triggered at a PGA of around 0.10g which has an annual probability of exceedance (AEP) of around 100 years. More layers liquefy in earthquake events above a ULS design event with up to 90 mm of liquefaction-induced reconsolidation settlements occurring and increased LSN in the 1 in 2,500 year return period (IL4 ULS event). This is shown in Figure 3.
- Although not applicable for this site given the proposed development, the west of the project area is equivalent to a MBIE TC2 site in Canterbury, albeit with a crust thickness typically more than 3.5 m and the remainder of the site is MBIE TC1 equivalent (see Figure 2, Appendix A).
- Further cone penetrometer (CPT) testing may rule out some of the liquefiable zones and reduce the liquefaction hazard.

[3] New Zealand Geotechnical Society (NZGS) and Ministry of Business, Innovation & Employment (MBIE) Earthquake Geotechnical Engineering Practice in New Zealand, Rev 1, Issue date November 2021, ISBN: 947497-51-4 (Online).

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Table 2 – Summary of factors considered to assess the consequences of the predicted liquefaction

Factor	Assessment		Implications
Crust thickness	The crust thickness is typically more than 3.5 m for the ULS design earthquake. Data from the Canterbury earthquake sequence plus other historic earthquakes[4] has been collated and observed surface damage compared with crust thickness. This data indicates that surface damage is likely for crusts of less than about 3.5 m thickness.		The crust across the site is sufficiently thick to limit surface damage in a ULS seismic event.
LSN	1/500 AEP (ULS)	LSN range = 0-11	Insignificant to mild, negligible deformation of the ground and small settlements.
	1/100 AEP (INT)	LSN range = 0-1	
	1/25 AEP (SLS)	LSN range = 0	
Free field settlement	1/500 AEP (ULS)	Settlement = 0-40 mm	Minor differential settlement likely, up to 40 mm estimated in the area tested.
	1/100 AEP (INT)	Settlement = 0-5 mm	
	1/25 AEP (SLS)	Settlement = 0 mm	
Lateral spread	Free faces of less than 2 m depth are present along the channel which runs approximately north to south along the eastern boundary.		The lateral spreading is limited as the free face is less than 2 m and liquefiable layers are not continuous.

A detailed discussion of the process of liquefaction and the various considerations summarised in Table 2 above can be found in Appendix C, which also contains the full liquefaction analysis results from the DPH's.

[4] *Bowen, H.J. and Jacka, M.E. (2013).* Liquefaction induced ground damage in the Canterbury Earthquake: Predictions versus reality. Proceedings of the 19th NZGS Geotechnical Symposium. Editor CY Chin. Queenstown, New Zealand.

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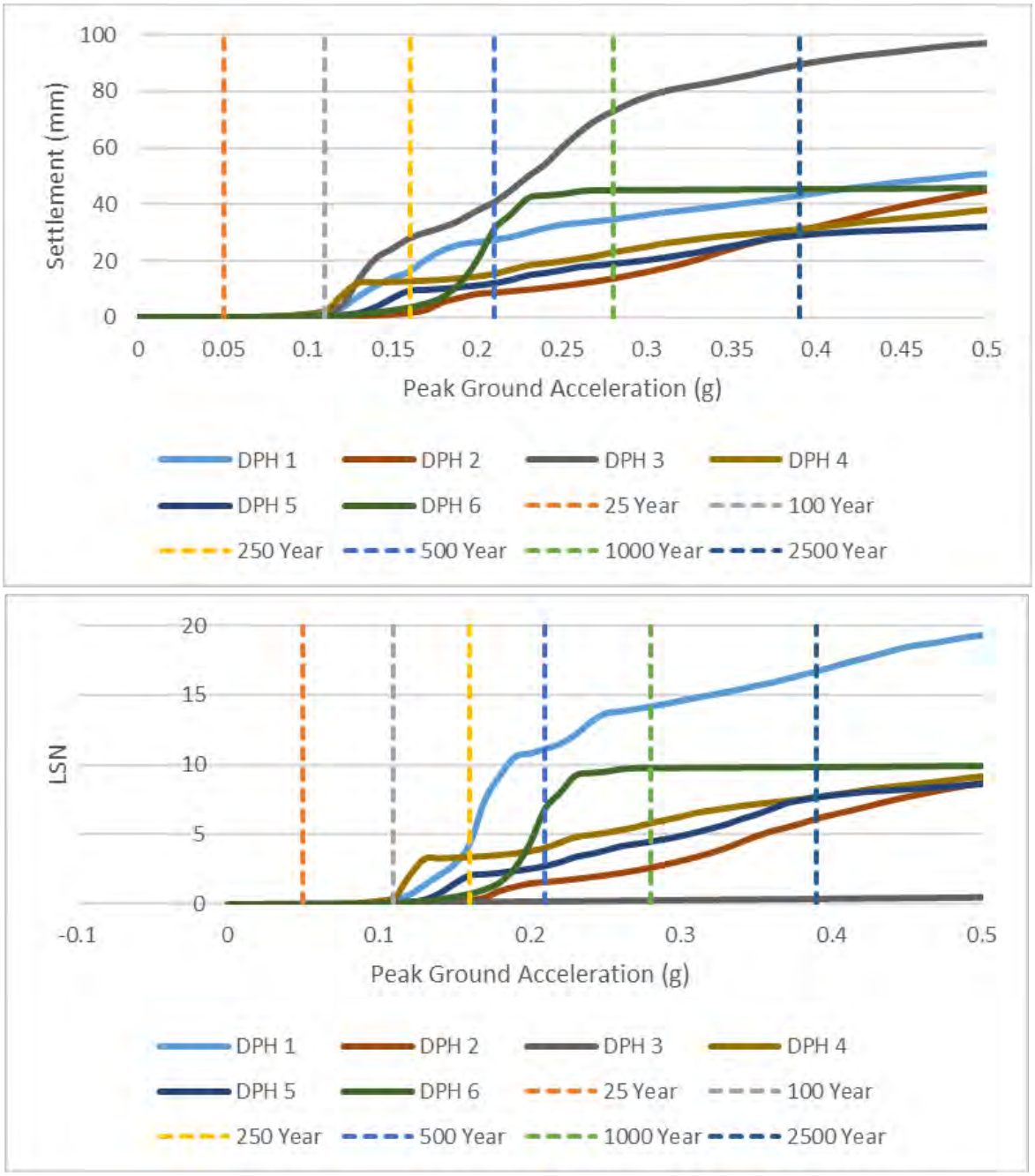


Figure 3: Calculated settlements and LSN for various Peak Ground Accelerations (PGA).

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6 Engineering Considerations

6.1 General

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.

6.2 Geotechnical Parameters

Table 3 provides a summary of the recommended geotechnical design parameters for the soil materials expected to be encountered during construction of the proposed development.

Table 3 – Recommended geotechnical design parameters

Unit	Thickness (m)	Bulk Density γ (kN/m^3)	Effective Cohesion c´ (kPa)	Effective Friction ϕ´ (deg)	Elastic Modulus E (kPa)	Poissons Ratio ν
Topsoil (soft to stiff, organic SILT with trace to some sand and/or gravel).	0.2-0.5	17	To be removed from beneath building footprint, or piles to extend through these layers.			
Uncontrolled fill (firm to stiff, organic SILT with trace to some sand, gravel and rubbish, or SILT with some gravel and/or trace sand).	0.5-0.6	17				
Buried topsoil (stiff, organic SILT with minor sand).	0.1	17				
Swamp deposit (very soft to soft, organic SILT with trace to some sand)	1.2	17				
Alluvial SILT (soft to very stiff, sandy SILT or SILT with trace to some sand).	0.6-2.6	18	0	29-30	3,000-7,000	0.3
Alluvial Sand (loose to dense, SAND, silty SAND or SAND with trace silt).	0.5-2.6+	18	0	30-32	7,000-10,000	0.3
Alluvial GRAVEL (medium dense to dense, sandy GRAVEL with trace organics and/or silt).	1.1-2.9+	19	0	34-36	20,000-50,000	0.3

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6.3 Site Preparation/Earthworks

During the earthworks operations all topsoil, organic matter, uncontrolled fill and other unsuitable materials (observed to 0.2-1.7 m depth in test pits but possibly deeper in isolated areas) should be removed from the construction areas in accordance with the recommendations of NZS 4431:2022. Alternatively, piles should extend through these layers.

Robust, shallow graded sediment control measures should be instigated during earthworks construction where rainwater and drainage run-off over exposed soils is anticipated.

The fine-grained alluvial silt soils are particularly susceptible to moisture and will weaken if subject to rainfall, frost or vehicle trafficking. Exposure to the elements should be limited for fine-grained soils and covering the soils with polythene sheeting, site concrete or granular engineered fill will reduce degradation due to wind, rain and surface run-off.

Water should not be allowed to pond or collect near or under a foundation slab, footings or earthworks subgrade under any circumstances. Positive grading of the subgrade should be undertaken to prevent water ingress or ponding.

Engineered fill that is utilised as bearing for foundations should be placed and compacted in accordance with the recommendations of NZS 4431:2022 and certification provided to that effect.

Granular fill is recommended to be imported from a local source or quarry for consistency and fine-grained site won soils can be reused as landscaping fill if needed.

We recommend topsoil stripping and subsequent earthworks be undertaken only when a suitable interval of fair weather is expected, or during the earthworks construction season.

Exposure to the elements should be limited for all soils. Excavations in soils should be left proud of the finished subgrade level by 300 mm if a delay prior to construction is expected. The final cut to grade should be performed immediately prior to foundation construction or engineered fill compaction.

6.4 Groundwater Issues

The static groundwater table was measured in the test pits at 0.8 – 3 m depth in the lower terrace, and at 1.8 – 2.8 m in the upper terrace. Groundwater seepages were also observed between 0.9 m and 3.5 m depth. The static groundwater table is expected to lie below typical excavation levels for building platforms. However, this should be reviewed when an earthworks plan and foundation levels are available. Groundwater seepage will need considered during service trench excavations.

It is important that GeoSolve be contacted should there be any seepage, spring flow or under-runners encountered during construction.

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6.5 Excavations

No earthworks plans have been provided to date for this development, however excavations may be required to remove topsoil and uncontrolled fill at the site, create service trenches and to create level building platforms.

Table 4 summarises the recommended batter slopes for temporary and permanent slopes up to 3.0 m high formed in dry ground.

Table 4 - Recommended maximum batters for cut slopes in site soils less than 3.0 m high in dry ground.

Material Type	Recommended Maximum Batter Angles for Temporary Cut Slopes Formed in Dry Soil (horizontal to vertical)	Recommended Maximum Batter Angles for Permanent Cut Slopes Formed in Soil – dry ground only (horizontal to vertical)
Topsoil & Uncontrolled Fill	2H: 1V	3H: 1V
Silt & Sand	1.5H: 1V	3H: 1V
Alluvial Gravel	1H: 1V	2.5H: 1V
Engineered Fill	NA	2.5H: 1V

If wet slopes are encountered, they should be inspected on a case-by-case basis by a geotechnical engineer/engineering geologist to confirm any specific recommendations e.g. drainage installation, cut off diversion drains or retaining.

All cuts should be periodically monitored during construction for signs of instability and excessive erosion, and, where necessary, corrective measures should be implemented to the satisfaction of a geotechnical engineer or engineering geologist.

6.6 Preliminary Foundation Options

6.6.1 General

We have undertaken a geotechnical investigation to assist with feasibility and consenting for the development. Further geotechnical investigation will be required to be undertaken following completion of the development plans to support building consent assessments. However, for completeness we have provided advice on potential foundation options, with the geotechnical information to date.

Based on the above either shallow or piled foundations can be used. We have provided further recommendations below.

During earthworks all uncontrolled fill, organic matter and other soft/unsuitable materials should be removed from the building platforms in accordance with the recommendations of NZS 4431:2022. Any engineered fill underlying a foundation should be placed and compacted in accordance with NZS 4431:2022 and certification provided to that effect.

The alluvial silt soils are susceptible to softening from rainfall, frost and vehicle trafficking. If softening occurs further undercutting will be required.

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Once the final development plan has been completed, it should be reviewed by a suitability experienced geotechnical engineer to confirm the design assumptions are met and whether further geotechnical investigation is warranted. It is also standard practice that the stripped building and earthworks platforms will need to be inspected and tested by a geotechnical practitioner.

6.6.2 Shallow Foundations

Near surface foundation bearing will be governed by the alluvial silt which will provide a reduced bearing capacity and will require specific engineering design, as shown on Figure4 below.

Figure 4 provides an assessment of allowable bearing capacity for shallow footings. It should be noted the foundation working stresses presented in Figure 4 are governed by bearing capacity in the case of narrow footings and settlement in the case of wide footings.

As an example, from Figure 4, it can be seen an allowable working stress of approximately 50 kPa is recommended for a 400 mm wide by 400 mm deep strip footing founded within alluvial silt. This corresponds to a factored (ULS) bearing capacity of approximately 75 kPa and an ultimate geotechnical bearing capacity of 150 kPa.

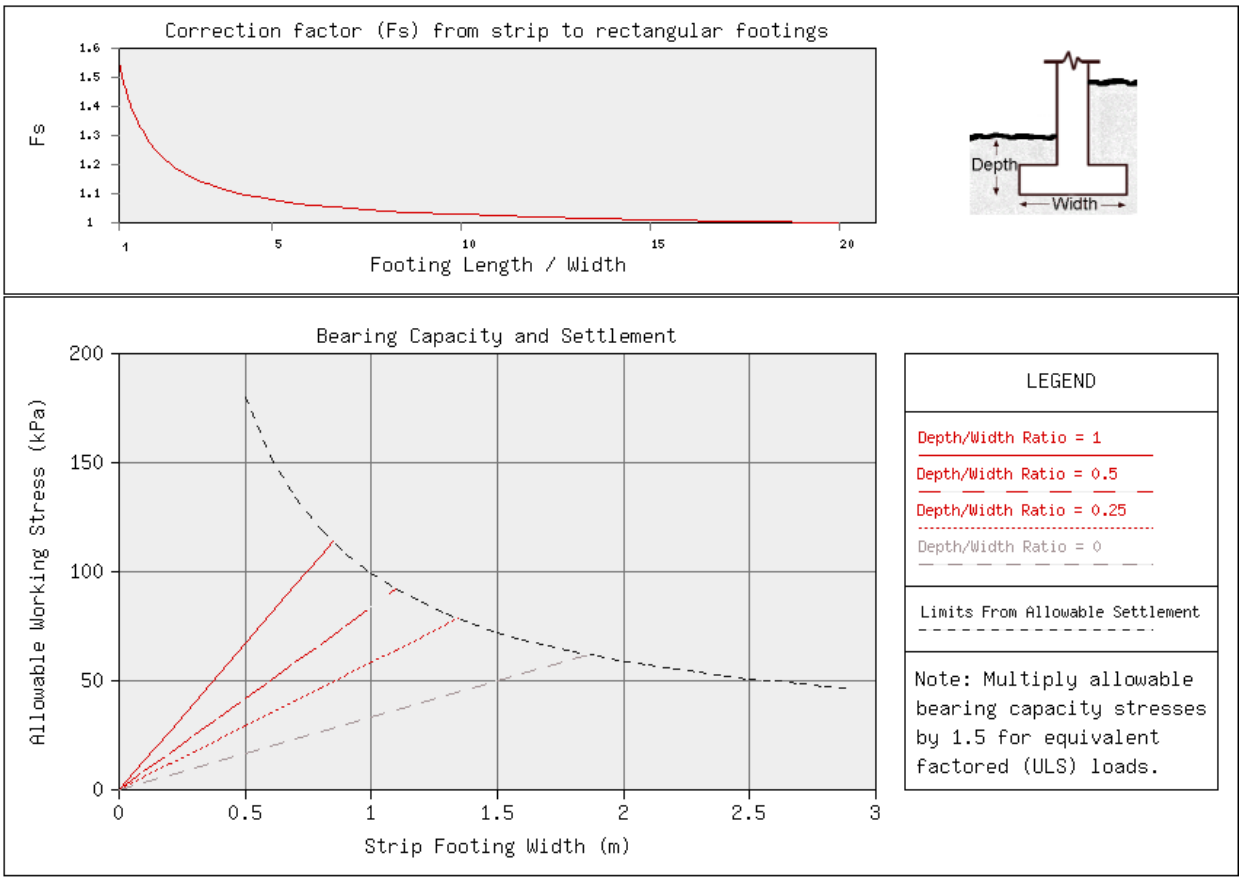


Figure 4– Recommended Bearing for Alluvial Silt

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It should be noted that the bearing capacities presented above assume that the loads are vertical with no horizontal loads or moments applied to the foundations. Reduction factors to account for eccentric and/or horizontal loads can be provided during detailed design once loads are finalised.

If the bearing capacity is not sufficient for design, or structural engineering input is not preferred, ground improvement can be conducted to improve the bearing capacity of the underlying soil materials. Undercut and replacement with engineered fill can be used to increase the bearing capacity. The depth of undercut required can be confirmed during detailed design once the footing dimensions and loads are known. It is recommended that the engineered fill extends sufficiently past the edges of the footings. This is to allow enough width to ensure that there is sufficient allowable load spread below the footing and for a minimum 400 kg plate compactor to work in the footing to compact the engineered fill.

Any softened soils will need to be undercut and replaced with engineered fill placed and compacted in accordance with NZS4431:2022.

Liquefaction is not calculated in a SLS or intermediate level event and is calculated at variable depth in the ULS event. Therefore, as long as foundations are kept narrow and shallow, it is possible to design based on the above to meet minimum building code design levels, subject to final foundation design review. Regardless, thought should be given to design so all foundations are tied together to gain further resilience, where practicable. If further resilience is desired than the above, the foundation could be designed to span fully unsupported 2 m around the edge of the building and 4 m internally. GeoSolve can provide further advice if required.

6.6.3 Piled Foundations

Driven timber or bored piled foundations could be founded within the medium dense to dense alluvial gravel. As the gravel and liquefiable layers vary in depth across the site, GeoSolve can provide further advice on proposed depths and capacities once further development information is known.

6.7 Pavement CBR Values

Preliminary testing for pavements has been undertaken at this stage. Subsurface shallow test pits and Scala penetrometers have been undertaken across the subdivision area providing sufficient information on the near surface soil profile for preliminary pavement CBR recommendations.

Following removal of the unsuitable soils, topsoil and uncontrolled fill, the pavement subgrade layer will predominantly comprise alluvial silt. A preliminary design CBR of 2% can be assumed for the silt subgrade. Note that with rain saturation, ponding and machinery trafficking the CBR could reduce to less than 2%. Further testing including falling weight deflectometer (FWD) testing could be completed if the proposed pavement design requires a value greater than 2%.

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All soft, wet or unsuitable materials, which are exposed during preparation of the pavement subgrade should be excavated and replaced with engineered fill. Note that subgrade soils with any organic content will not be suitable as a pavement subgrade and will require undercutting. Road construction undertaken during the winter months will also need to take into account the presence of fine-grained soils and be planned accordingly. Saturated soils damaged by weathering, frost or construction traffic will need to be undercut and replaced with granular fill.

Silt softened by the excavation process will require rolling to recompact the softened layer prior to placement of any granular pavement layers.

All engineered fill beneath pavements should be placed and compacted in accordance with Invercargill City Council requirements. Inspection of the pavement subgrade should be completed during construction by a suitably qualified geotechnical practitioner/civil engineer to confirm subsurface conditions are in accordance with this report.

A geotextile separation layer is recommended between the undercut surface of fine-grained soils and granular hard fill.

It is recommended that pavement design CBR's are reviewed following earthworks contour design. Specific road alignment testing can be undertaken at detailed design stage to prove higher CBR values at the design pavement levels.

6.8 Site Subsoil Category

For detailed design purposes it is recommended the magnitude of seismic acceleration be estimated in accordance with the recommendations provided in NZS 1170.5:2004.

Based on readily available information at the time of writing this report, GeoSolve recommends that Subsoil Category Class D is used for structural design.

6.9 Further Geotechnical Involvement

Development plans were not confirmed at the time of reporting; therefore, this report is focussed on allowing concept development. Further investigations and assessment may be required for detailed design of structures, these could include additional shallow investigations such as test pitting as well as deep testing such as cone penetrometer testing (CPTs) to confirm piling layers and liquefaction risk.

In addition, further geotechnical assessment of foundations, once loadings and systems are known, may be required.

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7 Wastewater Disposal Infiltration Rates

7.1 General

Soakage infiltration testing was undertaken at two locations, at depths of 2.2 and 2.8 m in the alluvial sand unit, adjacent to TP03 and TP05 respectively (refer to Appendix A and B for soakage/test pit locations and logs) to assess preliminary infiltration rates for wastewater disposal to ground scoping. Five test pits (TP1-5) were undertaken in the east of the site where wastewater disposal is proposed to review the ground model and groundwater levels and should be reviewed alongside the preliminary infiltration rates.

Prior to undertaking soakage testing, adjacent test pits were excavated to 3.5-3.8 m depth to log the subsoil conditions and determine a suitably consistent layer for soakage testing. Two smaller test pits/soak pits (1.4-1.8 m long and 0.4 m wide) were then excavated for the soakage test. The dimensions of the soakage pit were recorded to calculate the volume and area of soakage during testing.

Soakage testing was performed by introducing water until the designated testing level was reached. The inflow was then shut off and the time it took for the water level to drop was recorded. Where possible, testing was completed multiple times until 3 consistent readings had been achieved.

7.2 Permeability Analysis – Infiltration Rates and Soil Category

7.2.1 General

Surficial layers of topsoil, uncontrolled fill, alluvial silt and swamp deposits will provide very low infiltration rates. Infiltration testing has targeted the more permeable sand layers.

GeoSolve are to be consulted to review the final depth and location of the proposed wastewater disposal system to ensure the infiltration rates and recommendations of this report are applicable. Further testing will be required once the proposed wastewater disposal system and location are confirmed.

It is recommended the wastewater disposal areas are located downslope and are well offset from the proposed building platforms.

Provision should be included for long-term inspection and routine maintenance of any disposal system installed. Performance of the disposal systems may decline below an acceptable level over time if sufficient maintenance is not completed.

7.2.2 Wastewater Disposal Infiltration Rates

The results from field soakage infiltration testing are presented below in Table 5 and Appendix C.

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Table 5 - Calculated Infiltration Rates.

Test	Depth of test	Observed thickness of alluvial sand beneath base of test	Soil type at base of pit	Unfactored infiltration rate*	Factored infiltration rate**
SP01	2.2m	1.3 m +	Fine to medium SAND	**45 mm/hr**	**22.5 mm/hr**
SP02	2.8 m	0.7 m (then alluvial SILT)	Fine to medium SAND	**0.15 mm/hr**	**0.07 mm/hr**
*Does not include a reduction factor to account for loss of soakage performance over time. ** Includes a reduction factor of 0.5 to account for loss of soakage performance over time.					

Unfactored and factored infiltration rates are provided above within Table 5. To allow for any loss of soakage performance over, a reduction factor of at least 0.5 should be applied to the unfactored values for detailed design purposes.

As discussed above, the infiltration rate is expected to vary significantly based on the proposed depth and location of the disposal system, and it is recommended that this is considered at an early stage in the layout planning.

A geotechnical practitioner who is familiar with the findings of this report should inspect the base/infiltration depth of any proposed disposal system location to ensure the infiltration rates presented in Table 5 above are applicable.

7.2.3 Preliminary Wastewater Disposal Soil Category

Table 6 – Preliminary wastewater disposal soil category

Test	Depth of test	Soil type at testing level and test subsoil	AS/NZS 1547:2012 Soil Category (Table 5.1)
SP01	2.2m	Fine to medium SAND	3-4
SP02	2.8 m	Fine to medium SAND	5

A preliminary soil category for each test, in accordance with Table 5.1 of AS/NZS 1547:2012, is presented above in Table 6. The category is based on observed grain size, soil structure and permeability test results.

It is recommended that soil category in the proposed system location be reviewed by the wastewater system designer.

7.3 Conclusions and Recommendations

Due to the varying ground model and groundwater level further testing or review will be required once the location and method of the proposed wastewater disposal field is confirmed.

8 Neighbouring Structures/Hazards

Natural Hazards: A risk of seismic activity has been identified for the region as a whole and appropriate allowance should be made for seismic loading during detailed design of dwellings, but there are no site-specific constraints.

Liquefaction risk is outlined in Section 5.

No flooding or contamination assessment has been undertaken for this report.

Distances to adjoining structures: The site is located within a rural/commercial area with an existing residential dwelling adjacent to the south-western edge of the site and existing commercial building located on the property and to the north.

Noise and vibration: Pile driving foundation options and construction of engineered fill close to the nearby structures will need to consider vibration effects on these buildings.

The construction contractor should take standard measures to control construction noise, in accordance with Invercargill City Council requirements.

Aquifers: The regional groundwater table is expected to lie below the proposed building platform levels and no aquifer resource is expected to be adversely affected by the proposed development.

Dust: The soils have a relatively low potential to generate dust. However, the Contractor should take appropriate measures to control dust in accordance with Invercargill City Council requirements. Regular dampening with sprinklers during summer months is expected to be an effective measure to control airborne dust during construction.

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9 Conclusions and Recommendations

- The stratigraphy at the site comprises topsoil and uncontrolled fill overlying alluvial silt, sand and gravel.
- The static groundwater table was measured in the test pits at 0.8 – 3.0 m depth in the lower terrace, and at 1.8 – 2.8 m in the upper terrace. Groundwater seepages were also observed between 0.9 m and 3.5 m depth.
- Based on the liquefaction analysis in Section 5 of this report, the site is equivalent to both a MBIE TC1 and MBIE TC2 site in Canterbury.
- No liquefaction is calculated for the SLS and intermediate earthquake due to the relatively low levels of shaking.
- Geotechnical design parameters are presented in Table 3 of the report.
- All unsuitable materials identified in foundation excavations, particularly those softened by exposure to water, should be undercut and replaced with engineered fill during construction.
- Potential foundation options are discussed in Section 6.6.
- Pavement CBR values are included in Section 6.7.
- Fill that is utilised as bearing for foundations should be placed and compacted in accordance with NZS 4431:2022 and certification provided to that effect.
- Class D subsoil category is recommended to be used for structural design.
- Wastewater disposal infiltration rates and soil categories are presented in Section 7 of this report.
- It is recommended that the foundation excavations and earthworks subgrade be inspected and tested by a suitably qualified and experienced geotechnical specialist to confirm the conditions are in accordance with the assumptions and recommendations provided in this report.

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10 Applicability

This report has been prepared for the benefit of Tulloch Group Ltd. 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.

It is important that we be contacted if there is any variation in subsoil conditions from those described in this report.

Report prepared by:



.....

Sharyn Buunk

Engineering Geologist

Reviewed for GeoSolve Ltd by:



.....

Tim Plunket

Senior Geotechnical Engineer (CPEng)



.....

Fraser Wilson

Senior Engineering Geologist

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Appendix A: Site Investigation Plan



Notes:
1. These drawings have been prepared for the benefit of Tulloch Group Ltd 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.

SCALE 1: 1200

0 12 24 36 48 60 (m)

Key

- TP01 Deep Test pit and Scala Penetrometer
- TP22 Shallow Test pit and Scala Penetrometer
- SP01 Soak pit
- DPH01 Dynamic Probe Heavy Test (DPH)
- Property Boundary

GEOSOLVE
192 Spey Street, Invercargill
www.geosolve.co.nz

DRAWN	AJJ	Sep 23
DRAFTING CHECKED	SLB	Sep 23
APPROVED	FAW	Sep 23
CADFILE: Site Plan-new.dwg		
SCALES (AT A3 SIZE): 1 : 1200		
PROJECT No: 230505		

Tulloch Group Ltd

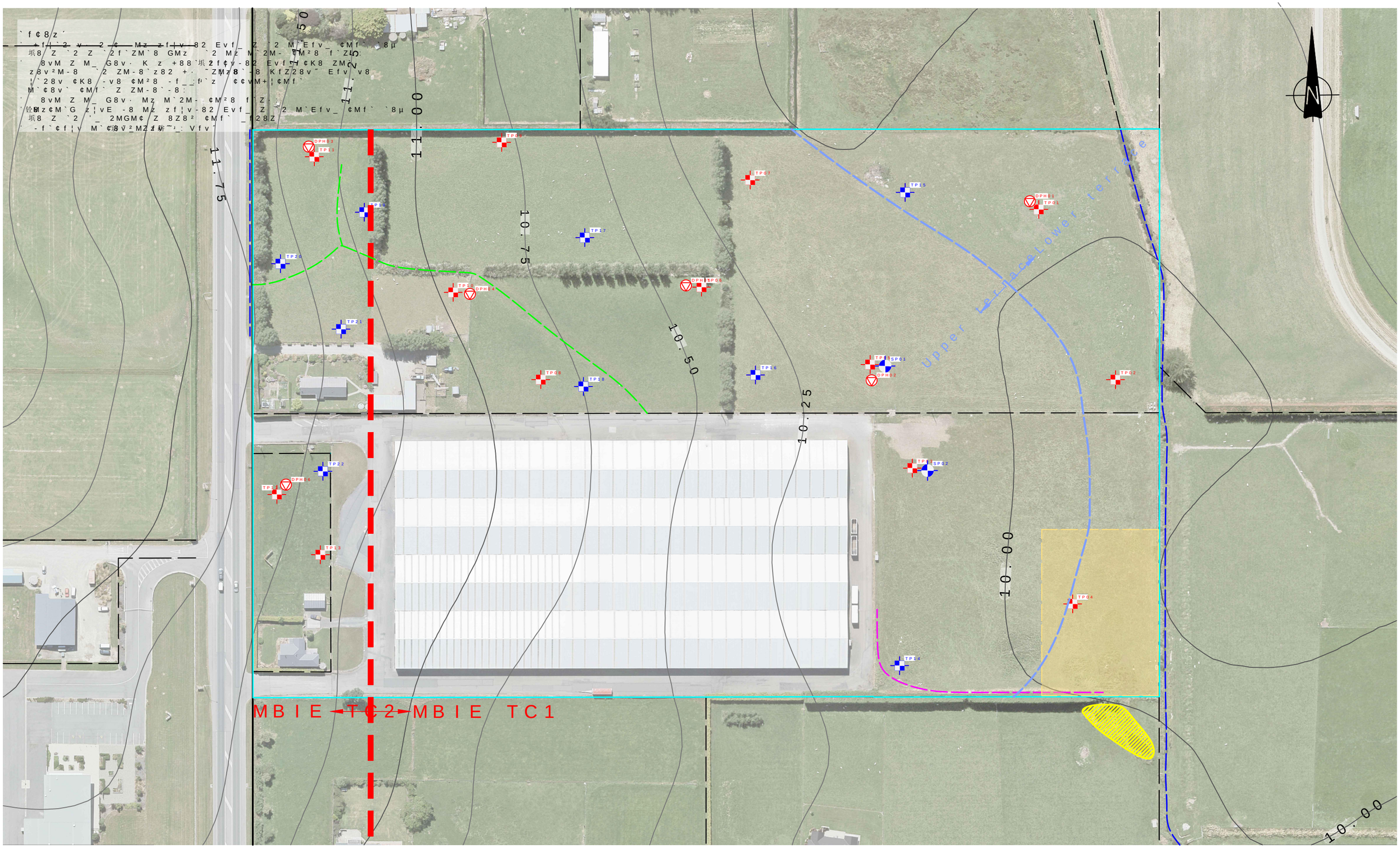
805, 815 & 819 North Road

Invercargill

Site Investigation Plan

FIG No: Appendix A - Figure 1

REV. 0



Notes:
1 These drawings have been prepared for the benefit of Tulloch Group Ltd 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.

SCALE 1: 1500
0 15 30 45 60 75 (m)

Key
Deep Test Pit
Shallow Test Pit
Soak Hole
Dynamic Cone Penetrometer
Hand Vane Test
Property Boundary
Swampy area and pond
Potential swamp deposit area
Approximate TC1/TC2 Boundary
Drainage Ditch
Paleochannel
Excavated channel
Approximate upper and lower terrace boundary

GEOSOLVE
192 Spey Street, Invercargill
www.geosolve.co.nz

DRAWN	AJJ	Sep	23
DRAFTING CHECKED	SKB	Sep	23
APPROVED	FAW	Sep	23
CADFILE: Site Plan-new.dwg			
SCALES (AT A3 SIZE): 1 : 1500			
PROJECT No: 230505			

Tulloch Group Ltd
805, 815 & 819 North Road
Invercargill
Site Investigation Plan

FIG No: Appendix A - Figure 2
REV. 0

Appendix B: Investigation Data

TEST PIT LOG

HOLE NO.: TP01

CLIENT: Tulloch Group Ltd. C/- Bonish Consultants

PROJECT: 805, 815, 819 North Road, Invercargill

JOB NO.: 230505

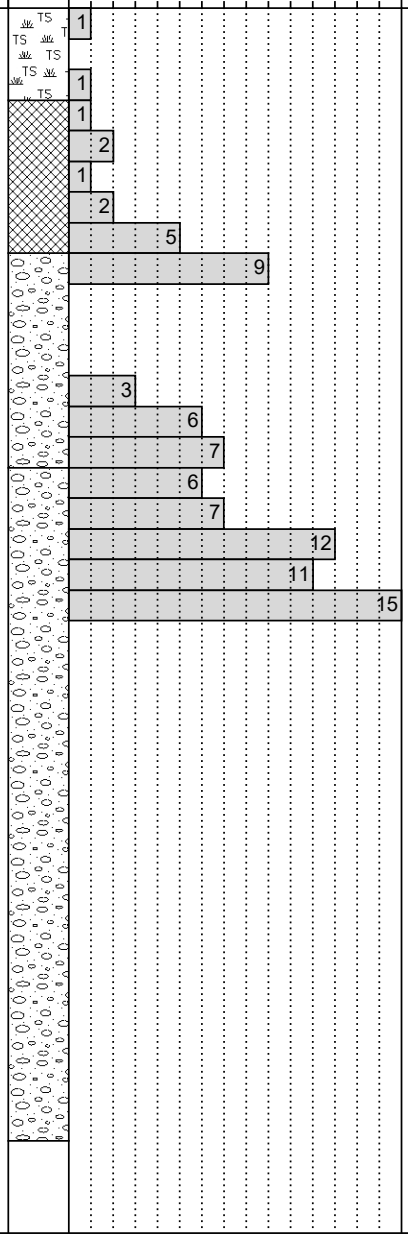
SITE LOCATION: 805, 815, 819 North Road, Invercargill
CONTRACTOR: SM Civil
START DATE: 07/08/2023

COORDINATES:
EQUIPMENT: 5T
END DATE: 07/08/2023

LOCATION METHOD: Map or aerial photograph
ACCURACY: ± 3 m
LOGGED BY: AJJ

ELEVATION: Existing ground level
OPERATOR: Johnny
CHECKED DATE: 18/08/2023

SOIL / ROCK TYPE	MATERIAL DESCRIPTION (See Classification & Symbology sheet for details)	SAMPLES	DEPTH / RL
TOPSOIL	Organic SILT with some gravel and a trace of sand, dark brown. Soft, moist, sand, fine to medium; gravel, fine to medium, subangular to subrounded; a trace of rootlets. 0.3 m		
UNCONTROLLED FILL	Organic SILT with some sand, gravel and rubbish, dark brown. Firm to stiff, moist to wet, sand, fine to medium; gravel, fine to medium, subangular to subrounded; rubbish, wood, steel, wires, brick, plastic. 0.8 m		0.5
ALLUVIAL GRAVEL	Sandy fine to medium GRAVEL with a trace of organics, grey. Medium dense to dense, saturated, gravel, subangular to subrounded; sand, fine to medium. 1.5 m		1.0
	Sandy fine to medium GRAVEL, orange brown. Medium dense to dense, saturated, gravel, subangular to subrounded; sand, fine to medium. 3.7 m		1.5, 2.0, 2.5, 3.0, 3.5
	End Of Hole: 3.70 m		



SHEAR STRENGTH (kPa)
Vane: 50 100 150 200 Values

WATER
07/08/2023

PHOTO(S)

REMARKS

Excavation terminated at maximum reach.

WATER

- Standing Water Level
- Out flow
- Seepage

Generated with CORE-GS by Geroc - Test Pit x Hand Auger - scala & vane bars - 11/09/2023 2:49:30 pm

TEST PIT LOG

HOLE NO.: TP02

CLIENT: Tulloch Group Ltd. C/- Bonish Consultants

PROJECT: 805, 815, 819 North Road, Invercargill

JOB NO.: 230505

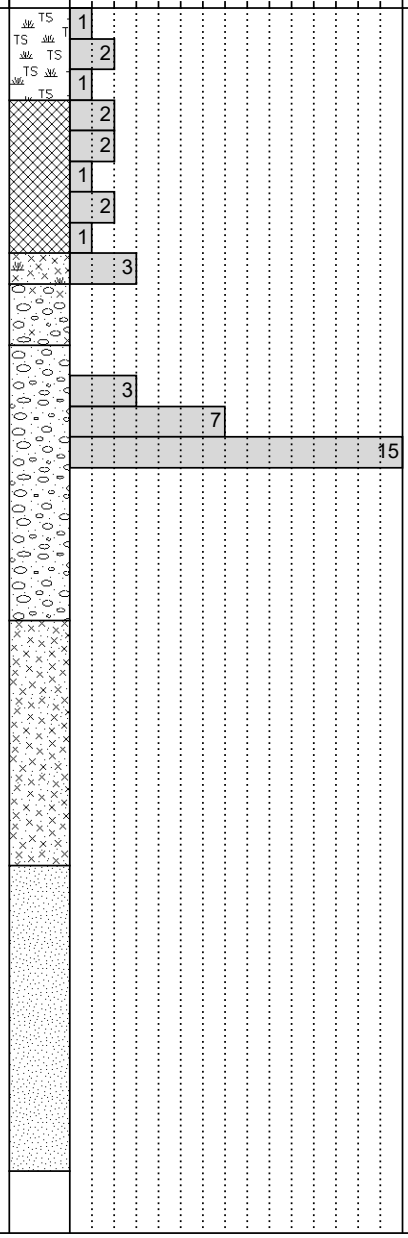
SITE LOCATION: 805, 815, 819 North Road, Invercargill
CONTRACTOR: SM Civil
START DATE: 07/08/2023

COORDINATES:
EQUIPMENT: 5T
END DATE: 07/08/2023

LOCATION METHOD: Map or aerial photograph
ACCURACY: ± 3 m
LOGGED BY: AJJ

ELEVATION: Existing ground level
OPERATOR: Johnny
CHECKED DATE: 18/08/2023

SOIL / ROCK TYPE	MATERIAL DESCRIPTION (See Classification & Symbology sheet for details)	SAMPLES	DEPTH / RL
TOPSOIL	Organic SILT with some gravel and a trace of sand, dark brown. Firm, moist, gravel, fine to medium, subangular to subrounded; a trace of rootlets. 0.3 m		
UNCONTROLLED FILL	SILT with a trace of sand, gravel and minor organics, orange brown mottled grey. Firm, moist, gravel, fine to medium, subangular to subrounded; sand, fine to medium; a trace of rootlets. 0.8 m		0.5
BURIED TOPSOIL	Organic SILT with minor sand, brown. Stiff, moist, sand, fine to medium; a trace of rootlets. 0.9 m		
ALLUVIAL GRAVEL	Sandy fine to medium GRAVEL with some silt, grey. Medium dense, moist, sand, fine to medium; gravel, subangular to subrounded. 1.1 m		1.0
	Sandy fine to medium GRAVEL, orange brown. Medium dense to dense, moist to wet, sand, fine to medium; gravel, subangular to subrounded. 2.0 m		1.5
ALLUVIAL SILT	Sandy SILT, orange brown. Very stiff, wet, sand, fine to medium. 2.8 m		2.0 2.5
ALLUVIAL SAND	Fine to medium SAND, orange brown. Medium dense, wet. 3.8 m		3.0 3.5
	End Of Hole: 3.80 m		



PHOTO(S)

REMARKS

Excavation terminated at maximum reach.

WATER

- Standing Water Level
- Out flow
- Seepage

Generated with CORE-GS by Geroc - Test Pit x Hand Auger - scala & vane bars - 11/09/2023 2:49:33 pm

TEST PIT LOG

HOLE NO.: TP03

CLIENT: Tulloch Group Ltd. C/- Bonish Consultants

PROJECT: 805, 815, 819 North Road, Invercargill

JOB NO.: 230505

SITE LOCATION: 805, 815, 819 North Road, Invercargill
CONTRACTOR: SM Civil
START DATE: 07/08/2023

COORDINATES:
EQUIPMENT: 5T
END DATE: 07/08/2023

LOCATION METHOD: Map or aerial photograph
ACCURACY: ± 3 m
LOGGED BY: AJJ

ELEVATION: Existing ground level
OPERATOR: Johnny
CHECKED DATE: 18/08/2023

SOIL / ROCK TYPE	MATERIAL DESCRIPTION (See Classification & Symbology sheet for details)	SAMPLES	DEPTH / RL	LEGEND	SCALA PENETROMETER (Blows / 100 mm)	SHEAR STRENGTH (kPa) Vane: Values	WATER
TOPSOIL	Organic SILT with minor gravel and a trace of sand, brown. Firm to stiff, moist, sand, fine to medium; gravel, fine to medium, subangular to subrounded; a trace of rootlets. 0.3 m			TS	2		
ALLUVIAL SILT	SILT with a trace of sand, orange brown. Stiff to very stiff, moist, sand, fine to medium. 1.3 m		0.5	TS	2, 5, 6, 5, 4, 4, 6, 6		
	SILT with some sand, orange brown. Firm to very stiff, moist, sand, fine to medium. 2.1 m		1.0 1.5 2.0		1, 2, 3, 2, 4, 5, 7, 10, 15		
	SILT with a trace of sand, orange brown. Stiff to very stiff, moist, sand, fine to medium. 2.6 m		2.5				
ALLUVIAL SAND	Fine to medium SAND, grey mottled orange brown. Medium dense, moist. 3.5 m		3.0				
ALLUVIAL SILT	SILT with a trace of sand, orange brown. Very stiff, moist, sand, fine to medium. 3.8 m		3.5				07/08/2023
	End Of Hole: 3.80 m						

PHOTO(S)

REMARKS

Excavation terminated at maximum reach.

WATER

- Standing Water Level
- Out flow
- Seepage

Generated with CORE-GS by Geroc - Test Pit x Hand Auger - scala & vane bars - 11/09/2023 2:49:35 pm

TEST PIT LOG

HOLE NO.: TP04

CLIENT: Tulloch Group Ltd. C/- Bonish Consultants

JOB NO.: 230505

PROJECT: 805, 815, 819 North Road, Invercargill

SITE LOCATION: 805, 815, 819 North Road, Invercargill | **CONTRACTOR:** SM Civil | **START DATE:** 07/08/2023

COORDINATES: | **EQUIPMENT:** 5T | **END DATE:** 07/08/2023

LOCATION METHOD: Map or aerial photograph | **ACCURACY:** ± 3 m | **LOGGED BY:** AJJ

ELEVATION: Existing ground level | **OPERATOR:** Johnny | **CHECKED DATE:** 18/08/2023

SOIL / ROCK TYPE	MATERIAL DESCRIPTION (See Classification & Symbology sheet for details)	SAMPLES	DEPTH / RL	LEGEND	SCALA PENETROMETER (Blows / 100 mm)	SHEAR STRENGTH (kPa) Vane: Values	WATER
TOPSOIL	Organic SILT with some sand, gravel and a trace of rubbish, brown. Soft to firm, moist, sand, fine to medium; gravel, fine to medium, subangular to subrounded; rubbish, brick; a trace of rootlets. 0.5 m		0.5	TS	1, 1, 1, 2, 1		
UNCONTROLLED FILL	SILT with some gravel and a trace of sand, orange brown. Stiff to very stiff, moist, sand, fine to medium; gravel, fine to medium, subangular to subrounded; a trace of rootlets. 0.7 m SILT with a trace of sand, orange brown mottled brown. Stiff, moist, sand, fine to medium. 1.1 m		1.0		4, 5, 4, 3		
SWAMP DEPOSIT	Organic SILT with a trace of sand, dark brown. Very soft to soft, moist, sand, fine to medium; some roots and a trace of rootlets. 1.7 m		1.5		1		07/08/2023
SWAMP DEPOSIT	Organic SILT with some sand, dark grey. Soft to stiff, moist, sand, fine to medium; some roots and a trace of rootlets. 2.3 m		2.0		1, 1, 1, 2, 3, 3		
ALLUVIAL GRAVEL	Sandy fine to medium GRAVEL with minor silt, bluish grey mottled orange brown. Medium dense to dense, wet to saturated, sand, fine to medium; gravel, subangular to subrounded. 3.0 m Sandy fine to coarse GRAVEL with minor silt, orange brown. Medium dense to dense, saturated, sand, fine to medium; gravel, subangular to subrounded. 3.8 m		2.5 3.0 3.5				07/08/2023
	End Of Hole: 3.80 m						

PHOTO(S)

REMARKS

Excavation terminated at maximum reach.

WATER

- Standing Water Level
- Out flow
- Seepage

Generated with CORE-GS by Geroc - Test Pit x Hand Auger - scala & vane bars - 11/09/2023 2:49:38 pm

TEST PIT LOG

HOLE NO.: TP05

CLIENT: Tulloch Group Ltd. C/- Bonish Consultants

PROJECT: 805, 815, 819 North Road, Invercargill

JOB NO.: 230505

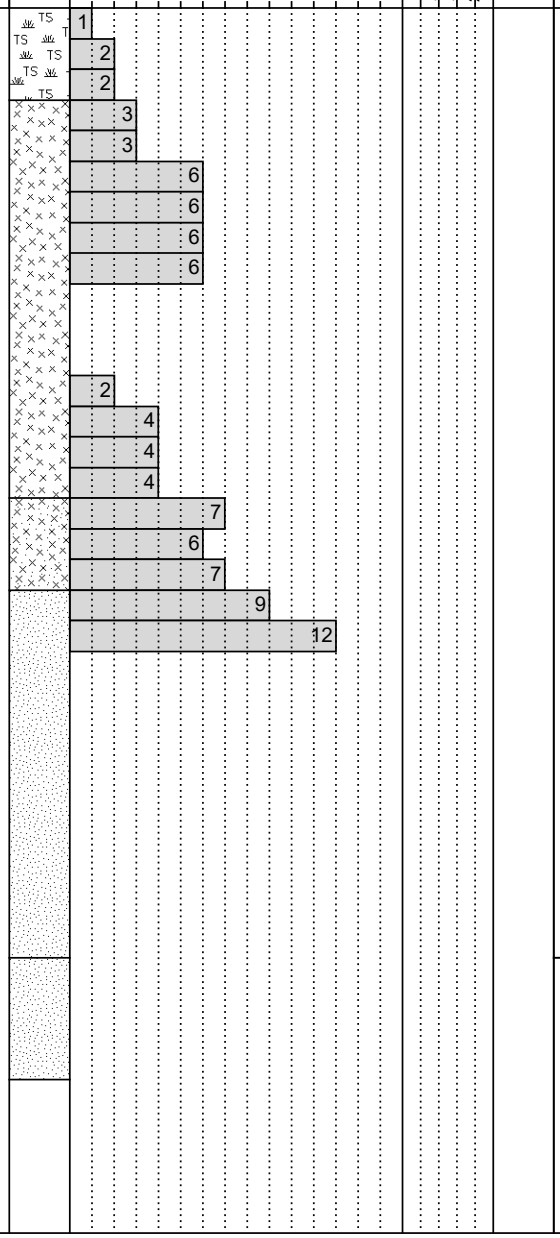
SITE LOCATION: 805, 815, 819 North Road, Invercargill
CONTRACTOR: SM Civil
START DATE: 07/08/2023

COORDINATES:
EQUIPMENT: 5T
END DATE: 07/08/2023

LOCATION METHOD: Map or aerial photograph
ACCURACY: ± 3 m
LOGGED BY: AJJ

ELEVATION: Existing ground level
OPERATOR: Johnny
CHECKED DATE: 18/08/2023

SOIL / ROCK TYPE	MATERIAL DESCRIPTION (See Classification & Symbology sheet for details)	SAMPLES	DEPTH / RL
TOPSOIL	Organic SILT with a trace of sand, dark brown. Soft to firm, moist, sand, fine to medium; a trace of rootlets. 0.3 m		
ALLUVIAL SILT	SILT with a trace of sand, orange brown. Stiff to very stiff, moist, sand, fine to medium; a trace of rootlets. 1.6 m		
	Sandy SILT, orange brown. Very stiff, moist, sand, fine to medium. 1.9 m		
ALLUVIAL SAND	Fine to medium SAND, grey. Medium dense to dense, moist. 3.1 m		
	Fine to coarse SAND, orange brown. Medium dense to dense, moist. 3.5 m		
	End Of Hole: 3.50 m		



SHEAR STRENGTH (kPa)
Vane: 50 100 150 200 Values

WATER
07/08/2023

PHOTO(S)

REMARKS

Excavation terminated at maximum reach.

WATER

- Standing Water Level
- Out flow
- Seepage

Generated with CORE-GS by Geroc - Test Pit x Hand Auger - scala & vane bars - 11/09/2023 2:49:40 pm

TEST PIT LOG

HOLE NO.: TP06

CLIENT: Tulloch Group Ltd. C/- Bonish Consultants

JOB NO.: 230505

PROJECT: 805, 815, 819 North Road, Invercargill

SITE LOCATION: 805, 815, 819 North Road, Invercargill | **CONTRACTOR:** SM Civil | **START DATE:** 07/08/2023

COORDINATES: | **EQUIPMENT:** 5T | **END DATE:** 07/08/2023

LOCATION METHOD: Map or aerial photograph | **ACCURACY:** ± 3 m | **LOGGED BY:** AJJ

ELEVATION: Existing ground level | **OPERATOR:** Johnny | **CHECKED DATE:** 18/08/2023

SOIL / ROCK TYPE	MATERIAL DESCRIPTION (See Classification & Symbology sheet for details)	SAMPLES	DEPTH / RL
TOPSOIL	Organic SILT with a trace of sand and gravel, dark brown. Soft to firm, moist, sand, fine to medium; gravel, fine to medium, subangular to subrounded; a trace of rootlets. 0.3 m		
ALLUVIAL SILT	SILT with a trace of sand, orange brown. Firm to very stiff, moist, sand, fine to medium; a trace of rootlets. 2.0 m		0.5, 1.0, 1.5, 2.0
	Sandy SILT, grey. Stiff to very stiff, moist, sand, fine to medium. 2.3 m		
ALLUVIAL SAND	Fine to medium SAND, grey. Medium dense, moist to wet. 3.6 m		2.5, 3.0, 3.5
	Fine to medium SAND, orange brown mottled grey. Medium dense to dense, wet. 3.7 m		
	End Of Hole: 3.70 m		

LEGEND

SCALA PENETROMETER (Blows / 100 mm)

Depth (m)	Blows / 100 mm
0.0 – 0.1	1
0.1 – 0.2	1
0.2 – 0.3	2
0.3 – 0.4	4
0.4 – 0.5	3
0.5 – 0.6	3
0.6 – 0.7	3
0.7 – 0.8	3
0.8 – 0.9	3
0.9 – 1.0	3
1.0 – 1.1	2
1.1 – 1.2	2
1.2 – 1.3	3
1.3 – 1.4	5
1.4 – 1.5	4
1.5 – 1.6	5
1.6 – 1.7	4
1.7 – 1.8	6

SHEAR STRENGTH (kPa) Vane: 50, 100, 150, 200 | Values

WATER

07/08/2023

PHOTO(S)

REMARKS

Excavation terminated at maximum reach.

WATER

- Standing Water Level
- Out flow
- Seepage

Generated with CORE-GS by Geroc - Test Pit x Hand Auger - scala & vane bars - 11/09/2023 2:49:42 pm

TEST PIT LOG

HOLE NO.: TP07

CLIENT: Tulloch Group Ltd. C/- Bonish Consultants

PROJECT: 805, 815, 819 North Road, Invercargill

JOB NO.: 230505

SITE LOCATION: 805, 815, 819 North Road, Invercargill
CONTRACTOR: SM Civil
START DATE: 07/08/2023

COORDINATES:
EQUIPMENT: 5T
END DATE: 07/08/2023

LOCATION METHOD: Map or aerial photograph
ACCURACY: ± 3 m
LOGGED BY: AJJ

ELEVATION: Existing ground level
OPERATOR: Johnny
CHECKED DATE: 18/08/2023

SOIL / ROCK TYPE	MATERIAL DESCRIPTION (See Classification & Symbology sheet for details)	SAMPLES	DEPTH / RL
TOPSOIL	Organic SILT with a trace of sand, dark brown. Firm, moist, sand, fine to medium; a trace of rootlets.		
			0.3 m
ALLUVIAL SILT	SILT with a trace of sand, orange brown. Firm to stiff, moist, sand, fine to medium; a trace of rootlets.		0.5
			1.0
			1.5
			1.9 m
	Sandy SILT, orange brown mottled grey. Very stiff, moist, sand, fine to medium.		2.0
			2.2 m
ALLUVIAL SAND	Fine to medium SAND, grey. Medium dense, moist to wet.		2.5
			3.0
			3.2 m
	Fine to medium SAND, orange brown mottled grey. Medium dense, wet.		3.5
			3.6 m
	End Of Hole: 3.60 m		

LEGEND

SCALA PENETROMETER (Blows / 100 mm)

Depth (m)	Blows / 100 mm
0.0 – 0.3	1, 2, 2
0.3 – 1.9	3, 3, 3, 3, 3, 4, 2, 4, 4, 4, 4, 4, 4
1.9 – 2.2	10, 15

SHEAR STRENGTH (kPa)
Vane: Values

WATER
07/08/2023

PHOTO(S)

REMARKS

Excavation terminated due to pit wall collapse.

WATER

- Standing Water Level
- Out flow
- Seepage

Generated with CORE-GS by Geroc - Test Pit x Hand Auger - scala & vane bars - 11/09/2023 2:49:45 pm

TEST PIT LOG

HOLE NO.: TP08

CLIENT: Tulloch Group Ltd. C/- Bonish Consultants

PROJECT: 805, 815, 819 North Road, Invercargill

JOB NO.: 230505

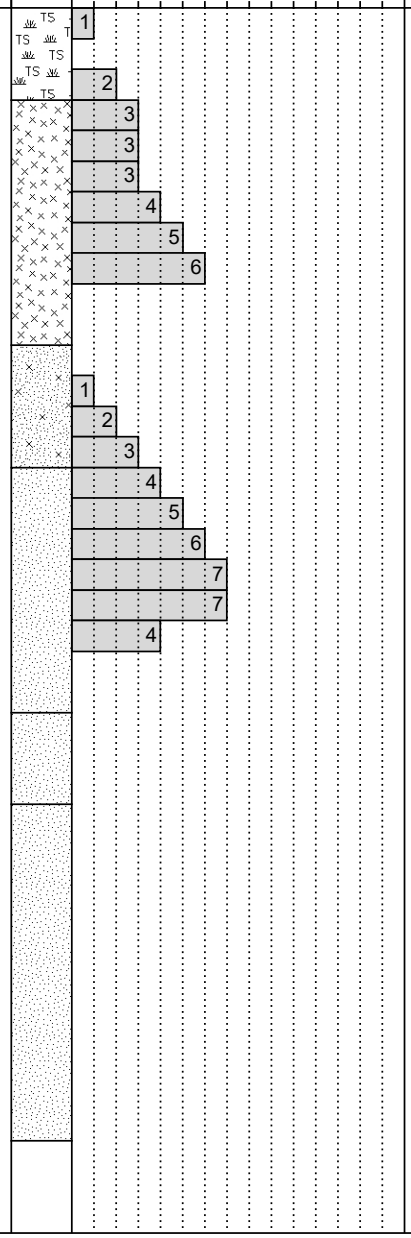
SITE LOCATION: 805, 815, 819 North Road, Invercargill
CONTRACTOR: SM Civil
START DATE: 08/08/2023

COORDINATES:
EQUIPMENT: 5T
END DATE: 08/08/2023

LOCATION METHOD: Map or aerial photograph
ACCURACY: ± 3 m
LOGGED BY: AJJ

ELEVATION: Existing ground level
OPERATOR: Johnny
CHECKED DATE: 18/08/2023

SOIL / ROCK TYPE	MATERIAL DESCRIPTION (See Classification & Symbology sheet for details)	SAMPLES	DEPTH / RL
TOPSOIL	Organic SILT with a trace of sand, dark brown. Very soft to firm, moist, sand, fine to medium; a trace of rootlets. 0.3 m		
ALLUVIAL SILT	SILT with a trace of sand, orange brown. Stiff to very stiff, moist, sand, fine to medium; a trace of rootlets. 1.1 m		0.5, 1.0
ALLUVIAL SAND	Silty fine SAND, grey. Loose to medium dense, moist. 1.5 m		1.5
	Fine to medium SAND, grey. Medium dense to dense, moist to wet. 2.3 m		2.0
	Fine to medium SAND, orange brown. Medium dense, wet. 2.6 m		2.5
	Fine to medium SAND, grey mottled orange brown. Medium dense to dense, wet. 3.7 m		3.0, 3.5
	End Of Hole: 3.70 m		



PHOTO(S)

REMARKS

Excavation terminated due to pit wall collapse.

WATER

- Standing Water Level
- Out flow
- Seepage

Generated with CORE-GS by Geroc - Test Pit x Hand Auger - scala & vane bars - 11/09/2023 2:49:47 pm

TEST PIT LOG

HOLE NO.: TP09

CLIENT: Tulloch Group Ltd. C/- Bonish Consultants

PROJECT: 805, 815, 819 North Road, Invercargill

JOB NO.: 230505

SITE LOCATION: 805, 815, 819 North Road, Invercargill

CONTRACTOR: SM Civil

START DATE: 08/08/2023

COORDINATES:

EQUIPMENT: 5T

END DATE: 08/08/2023

LOCATION METHOD: Map or aerial photograph

ACCURACY: ± 3 m

LOGGED BY: AJJ

ELEVATION: Existing ground level

OPERATOR: Johnny

CHECKED DATE: 18/08/2023

SOIL / ROCK TYPE	MATERIAL DESCRIPTION (See Classification & Symbology sheet for details)	SAMPLES	DEPTH / RL
TOPSOIL	Organic SILT with a trace of sand, dark brown. Firm to stiff, moist, sand, fine to medium; a trace of rootlets. 0.3 m		
ALLUVIAL SILT	Sandy SILT, orange brown mottled grey. Firm to very stiff, moist, sand, fine to medium. 2.6 m		
	SILT with a trace of sand, grey. Stiff to very stiff, moist to wet, sand, fine to medium. 2.9 m		
ALLUVIAL SAND	Silty fine to medium SAND, grey mottled orange brown. Medium dense, wet. 3.7 m		
	End Of Hole: 3.70 m		

LEGEND

SCALA PENETROMETER (Blows / 100 mm)

Depth (m)	Blows / 100 mm
0.0 – 0.5	1, 2, 3, 3, 3, 4, 3, 5, 5
0.5 – 1.0	2, 1, 2, 4, 3, 5, 5, 5, 7

SHEAR STRENGTH (kPa) Vane: Values

WATER

08/08/2023

PHOTO(S)

REMARKS

Excavation terminated due to groundwater ingress.

WATER

- Standing Water Level
- Out flow
- Seepage

Generated with CORE-GS by Geroc - Test Pit x Hand Auger - scala & vane bars - 11/09/2023 2:49:50 pm

TEST PIT LOG

HOLE NO.: TP10

CLIENT: Tulloch Group Ltd. C/- Bonish Consultants

JOB NO.: 230505

PROJECT: 805, 815, 819 North Road, Invercargill

SITE LOCATION: 805, 815, 819 North Road, Invercargill | **CONTRACTOR:** SM Civil | **START DATE:** 08/08/2023

COORDINATES: | **EQUIPMENT:** 5T | **END DATE:** 08/08/2023

LOCATION METHOD: Map or aerial photograph | **ACCURACY:** ± 3 m | **LOGGED BY:** AJJ

ELEVATION: Existing ground level | **OPERATOR:** Johnny | **CHECKED DATE:** 18/08/2023

SOIL / ROCK TYPE	MATERIAL DESCRIPTION (See Classification & Symbology sheet for details)	SAMPLES	DEPTH / RL	LEGEND	SCALA PENETROMETER (Blows / 100 mm)	SHEAR STRENGTH (kPa) Vane: Values	WATER
TOPSOIL	Organic SILT with a trace of sand, dark brown. Firm, moist, sand, fine to medium; a trace of rootlets. 0.3 m			TS	1, 1		
ALLUVIAL SILT	SILT with a trace of sand, orange brown. Firm to very stiff, moist, sand, fine to medium; a trace of rootlets. 0.9 m		0.5		2, 3, 3, 2, 2, 2, 5		08/08/2023
	SILT with a trace of sand, grey mottled orange brown. Firm to very stiff, mosit to wet, sand, fine to medium. 2.0 m		1.0		2, 3, 5, 9, 9, 10, 12		
ALLUVIAL SAND	Fine to medium SAND, orange brown mottled grey. Medium dense to dense, wet. 2.8 m		1.5		14, 15		08/08/2023
	Fine to medium SAND, grey. Medium dense to dense, wet. 3.4 m		2.0				
	Fine to medium SAND, orange brown mottled grey. Medium dense, wet. 3.7 m		2.5				
	End Of Hole: 3.70 m		3.0				
			3.5				

PHOTO(S)

REMARKS

Excavation terminated due to pit wall collapse.

WATER

- Standing Water Level
- Out flow
- Seepage

Generated with CORE-GS by Geroc - Test Pit x Hand Auger - scala & vane bars - 11/09/2023 2:49:52 pm

TEST PIT LOG

HOLE NO.: TP11

CLIENT: Tulloch Group Ltd. C/- Bonish Consultants

JOB NO.: 230505

PROJECT: 805, 815, 819 North Road, Invercargill

SITE LOCATION: 805, 815, 819 North Road, Invercargill

CONTRACTOR: SM Civil

START DATE: 08/08/2023

COORDINATES:

EQUIPMENT: 5T

END DATE: 08/08/2023

LOCATION METHOD: Map or aerial photograph

ACCURACY: ± 3 m

LOGGED BY: AJJ

ELEVATION: Existing ground level

OPERATOR: Johnny

CHECKED DATE: 18/08/2023

SOIL / ROCK TYPE	MATERIAL DESCRIPTION (See Classification & Symbology sheet for details)	SAMPLES	DEPTH / RL
TOPSOIL	Organic SILT with a trace of sand, dark brown. Firm to stiff, moist, sand, fine to medium; a trace of rootlets. 0.3 m		
ALLUVIAL SILT	SILT with a trace of sand, orange brown. Firm to stiff, moist, sand, fine to medium; a trace of rootlets. 1.5 m		
	Sandy SILT, grey mottled orange brown. Firm to stiff, wet, sand, fine to medium. 2.9 m		
ALLUVIAL SAND	Fine to medium SAND, grey. Medium dense, wet. 3.4 m		
	End Of Hole: 3.40 m		

LEGEND

SCALA PENETROMETER (Blows / 100 mm)

Depth	Blows
0.0 – 0.3	1, 1
0.3 – 0.5	3, 3
0.5 – 1.0	3, 3, 4, 5, 6
1.0 – 1.5	2, 2, 2
1.5 – 2.0	4, 2, 2, 3, 4

SHEAR STRENGTH (kPa) Vane: Values

WATER

08/08/2023

PHOTO(S)

REMARKS

Excavation terminated due to groundwater ingress.

WATER

- Standing Water Level
- Out flow
- Seepage

Generated with CORE-GS by Geroc - Test Pit x Hand Auger - scala & vane bars - 11/09/2023 2:49:55 pm

TEST PIT LOG

HOLE NO.: TP12

CLIENT: Tulloch Group Ltd. C/- Bonish Consultants

PROJECT: 805, 815, 819 North Road, Invercargill

JOB NO.: 230505

SITE LOCATION: 805, 815, 819 North Road, Invercargill
CONTRACTOR: SM Civil
START DATE: 08/08/2023

COORDINATES:
EQUIPMENT: 5T
END DATE: 08/08/2023

LOCATION METHOD: Map or aerial photograph
ACCURACY: ± 3 m
LOGGED BY: AJJ

ELEVATION: Existing ground level
OPERATOR: Johnny
CHECKED DATE: 18/08/2023

SOIL / ROCK TYPE	MATERIAL DESCRIPTION (See Classification & Symbology sheet for details)	SAMPLES	DEPTH / RL	LEGEND	SCALA PENETROMETER (Blows / 100 mm)	SHEAR STRENGTH (kPa) Vane: Values	WATER
TOPSOIL	Organic SILT with a trace of sand, dark brown. Soft to stiff, moist, sand, fine to medium; a trace of rootlets. 0.3 m			TS	1, 1, 3		
ALLUVIAL SILT	SILT with a trace of sand, orange brown. Firm to very stiff, moist, sand, fine to medium; a trace of rootlets. 1.6 m		0.5, 1.0, 1.5		2, 3, 4, 5, 5, 4, 2, 3, 3, 4		
ALLUVIAL SAND	Silty fine to medium SAND, orange brown mottled grey. Medium dense to dense, moist. 2.1 m		2.0		8, 8, 9, 8, 9		08/08/2023
ALLUVIAL SILT	SILT with trace to minor sand, grey mottled orange brown. Firm, moist to wet, sand, fine to medium. 3.4 m		2.5, 3.0				
ALLUVIAL SAND	Fine to medium SAND with a trace of silt, grey mottled orange brown. Medium dense, wet. 3.9 m		3.5				
	End Of Hole: 3.90 m						

PHOTO(S)

REMARKS

Excavation terminated at maximum reach.

WATER

- Standing Water Level
- Out flow
- Seepage

Generated with CORE-GS by Geroc - Test Pit x Hand Auger - scala & vane bars - 11/09/2023 2:49:57 pm

TEST PIT LOG

HOLE NO.: TP13

CLIENT: Tulloch Group Ltd. C/- Bonish Consultants

JOB NO.: 230505

PROJECT: 805, 815, 819 North Road, Invercargill

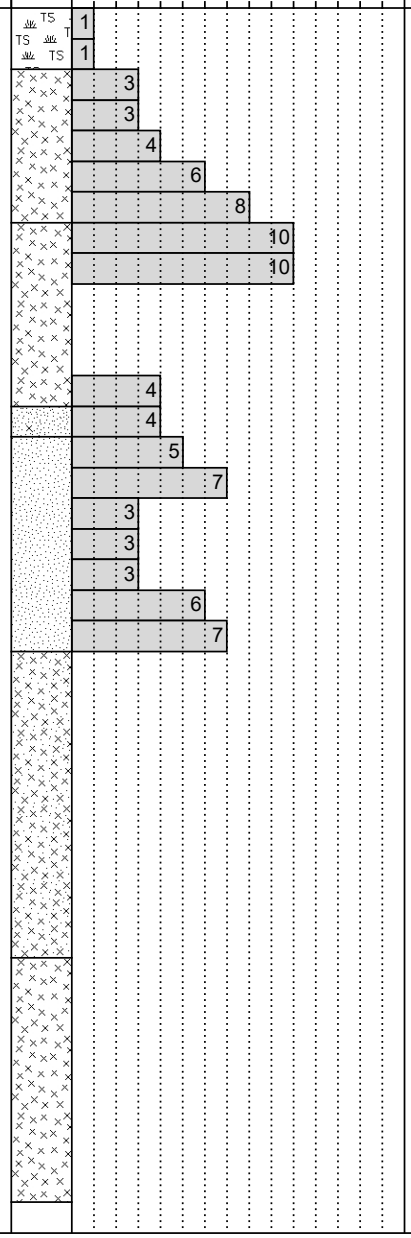
SITE LOCATION: 805, 815, 819 North Road, Invercargill | **CONTRACTOR:** SM Civil | **START DATE:** 08/08/2023

COORDINATES: | **EQUIPMENT:** 5T | **END DATE:** 08/08/2023

LOCATION METHOD: Map or aerial photograph | **ACCURACY:** ± 3 m | **LOGGED BY:** AJJ

ELEVATION: Existing ground level | **OPERATOR:** Johnny | **CHECKED DATE:** 18/08/2023

SOIL / ROCK TYPE	MATERIAL DESCRIPTION (See Classification & Symbology sheet for details)	SAMPLES	DEPTH / RL
TOPSOIL	Organic SILT with a trace of sand, dark brown. Soft, moist, sand, fine to medium; a trace of rootlets. 0.2 m		
ALLUVIAL SILT	SILT with a trace of sand, orange brown. Stiff to very stiff, moist, sand, fine to medium; a trace of rootlets. 0.7 m		
ALLUVIAL SILT	SILT with a trace of sand, orange brown mottled grey. Very stiff, moist, sand, fine to medium; a trace of rootlets. 1.3 m		
ALLUVIAL SAND	Silty fine to medium SAND, orange brown mottled grey. Medium dense, moist. 1.4 m Fine to medium SAND, grey mottled orange brown. Medium dense, wet. 2.1 m		
ALLUVIAL SILT	Sandy SILT, orange brown. Firm to stiff, wet, sand, fine to medium. 3.1 m SILT with a trace of sand, orange brown mottled grey. Firm to stiff, wet, sand, fine to medium. 3.9 m		
	End Of Hole: 3.90 m		



PHOTO(S)

REMARKS

Excavation terminated at maximum reach.

WATER

- Standing Water Level
- Out flow
- Seepage

Generated with CORE-GS by Geroc - Test Pit x Hand Auger - scala & vane bars - 11/09/2023 2:50:00 pm

TEST PIT LOG

HOLE NO.: TP14

CLIENT: Tulloch Group Ltd. C/- Bonish Consultants

PROJECT: 805, 815, 819 North Road, Invercargill

JOB NO.: 230505

SITE LOCATION: 805, 815, 819 North Road, Invercargill
CONTRACTOR: SM Civil
START DATE: 07/08/2023

COORDINATES:
EQUIPMENT: 5T
END DATE: 07/08/2023

LOCATION METHOD: Map or aerial photograph
ACCURACY: ± 3 m
LOGGED BY: AJJ

ELEVATION: Existing ground level
OPERATOR: Johnny
CHECKED DATE: 18/08/2023

SOIL / ROCK TYPE	MATERIAL DESCRIPTION (See Classification & Symbology sheet for details)	SAMPLES	DEPTH / RL	LEGEND
TOPSOIL	Organic SILT with some gravel and a trace of sand, brown. Firm, moist, sand, fine to medium; gravel, fine to medium, subangular to subrounded; a trace of rootlets.			TS
			0.3 m	
ALLUVIAL SILT	SILT with a trace of sand, orange brown. Stiff, moist, sand, fine to medium; a trace of rootlets.		0.4 m	
	End Of Hole: 0.30 m		0.5	
			1.0	

SCALA PENETROMETER (Blows / 100 mm)

1 2 3 4 5 6 7 8 9 10 11 12 13 14

5 5 5 5 3 2 2 3 4

SHEAR STRENGTH (kPa) Vane: 50 100 150 200 Values

WATER

Groundwater Not Encountered

PHOTO(S)

REMARKS

Shallow pit for CBR.

WATER

- Standing Water Level
- Out flow
- Seepage

Generated with CORE-GS by Geroc - Test Pit x Hand Auger - scala & vane bars - 11/09/2023 2:50:03 pm

TEST PIT LOG

HOLE NO.: TP15

CLIENT: Tulloch Group Ltd. C/- Bonish Consultants

JOB NO.: 230505

PROJECT: 805, 815, 819 North Road, Invercargill

SITE LOCATION: 805, 815, 819 North Road, Invercargill | **CONTRACTOR:** SM Civil | **START DATE:** 07/08/2023

COORDINATES: | **EQUIPMENT:** 5T | **END DATE:** 07/08/2023

LOCATION METHOD: Map or aerial photograph | **ACCURACY:** ± 3 m | **LOGGED BY:** AJJ

ELEVATION: Existing ground level | **OPERATOR:** Johnny | **CHECKED DATE:** 18/08/2023

SOIL / ROCK TYPE	MATERIAL DESCRIPTION (See Classification & Symbology sheet for details)	SAMPLES	DEPTH / RL	LEGEND	SCALA PENETROMETER (Blows / 100 mm)	SHEAR STRENGTH (kPa) Vane: Values	WATER
TOPSOIL	Organic SILT with a trace of sand, brown. Soft to firm, moist, sand, fine to medium; a trace of rootlets.			TS	2		Groundwater Not Encountered
	0.3 m						
ALLUVIAL SILT	SILT with a trace of sand, orange brown. Soft, moist, sand, fine to medium; a trace of rootlets.		0.5		1		
	0.4 m End Of Hole: 0.30 m				1		
					1		
					1		
			1.0		1		
					1		
					2		
					2		

Scala penetrometer: 1 2 3 4 5 6 7 8 9 10 11 12 13 14

Shear strength (kPa) Vane: 50 100 150 200

PHOTO(S)

REMARKS

Shallow pit for CBR.

WATER

- Standing Water Level
- Out flow
- Seepage

Generated with CORE-GS by Geroc - Test Pit x Hand Auger - scala & vane bars - 11/09/2023 2:50:06 pm

TEST PIT LOG

HOLE NO.: TP16

CLIENT: Tulloch Group Ltd. C/- Bonish Consultants

PROJECT: 805, 815, 819 North Road, Invercargill

JOB NO.: 230505

SITE LOCATION: 805, 815, 819 North Road, Invercargill
CONTRACTOR: SM Civil
START DATE: 08/08/2023

COORDINATES:
EQUIPMENT: 5T
END DATE: 08/08/2023

LOCATION METHOD: Map or aerial photograph
ACCURACY: ± 3 m
LOGGED BY: AJJ

ELEVATION: Existing ground level
OPERATOR: Johnny
CHECKED DATE: 18/08/2023

SOIL / ROCK TYPE	MATERIAL DESCRIPTION (See Classification & Symbology sheet for details)	SAMPLES	DEPTH / RL	LEGEND
TOPSOIL	Organic SILT with a trace of sand, brown. Firm, moist, sand, fine to medium; a trace of rootlets.			TS
ALLUVIAL SILT	SILT with a trace of sand, orange brown. Firm to stiff, moist, sand, fine to medium; a trace of rootlets. 0.3 m End Of Hole: 0.30 m 0.4 m		0.5 1.0	

SCALA PENETROMETER (Blows / 100 mm)

1	2	3	4	5	6	7	8	9	10	11	12	13	14
	2	3	3	5	5	6	5	6	6				

SHEAR STRENGTH (kPa) Vane: 50 100 150 200 Values

WATER

Groundwater Not Encountered

PHOTO(S)

REMARKS

Shallow pit for CBR.

WATER

- Standing Water Level
- Out flow
- Seepage

Generated with CORE-GS by Geroc - Test Pit x Hand Auger - scala & vane bars - 11/09/2023 2:50:08 pm

TEST PIT LOG

HOLE NO.: TP17

CLIENT: Tulloch Group Ltd. C/- Bonish Consultants

JOB NO.: 230505

PROJECT: 805, 815, 819 North Road, Invercargill

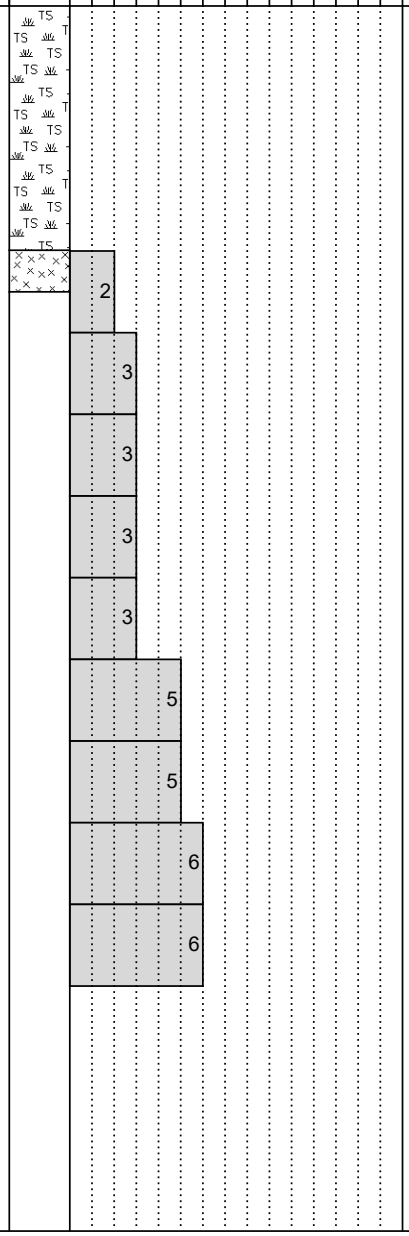
SITE LOCATION: 805, 815, 819 North Road, Invercargill | **CONTRACTOR:** SM Civil | **START DATE:** 08/08/2023

COORDINATES: | **EQUIPMENT:** 5T | **END DATE:** 08/08/2023

LOCATION METHOD: Map or aerial photograph | **ACCURACY:** ± 3 m | **LOGGED BY:** AJJ

ELEVATION: Existing ground level | **OPERATOR:** Johnny | **CHECKED DATE:** 18/08/2023

SOIL / ROCK TYPE	MATERIAL DESCRIPTION (See Classification & Symbology sheet for details)	SAMPLES	DEPTH / RL
TOPSOIL	Organic SILT with a trace of sand, dark brown. Firm to stiff, moist, sand, fine to medium; a trace of rootlets.		
			0.3 m
ALLUVIAL SILT	SILT with a trace of sand, orange brown. Firm to stiff, moist, sand, fine to medium; a trace of rootlets.		0.4 m
	End Of Hole: 0.30 m		



SHEAR STRENGTH (kPa)
Vane: 50 100 150 200 | Values

WATER
Groundwater Not Encountered

PHOTO(S)

REMARKS

Shallow pit for CBR.

WATER

- Standing Water Level
- Out flow
- Seepage

Generated with CORE-GS by Geroc - Test Pit x Hand Auger - scala & vane bars - 11/09/2023 2:50:10 pm

TEST PIT LOG

HOLE NO.: TP18

CLIENT: Tulloch Group Ltd. C/- Bonish Consultants

JOB NO.: 230505

PROJECT: 805, 815, 819 North Road, Invercargill

SITE LOCATION: 805, 815, 819 North Road, Invercargill | **CONTRACTOR:** SM Civil | **START DATE:** 08/08/2023

COORDINATES: | **EQUIPMENT:** 5T | **END DATE:** 08/08/2023

LOCATION METHOD: Map or aerial photograph | **ACCURACY:** ± 3 m | **LOGGED BY:** AJJ

ELEVATION: Existing ground level | **OPERATOR:** Johnny | **CHECKED DATE:** 18/08/2023

SOIL / ROCK TYPE	MATERIAL DESCRIPTION (See Classification & Symbology sheet for details)	SAMPLES	DEPTH / RL	LEGEND	SCALA PENETROMETER (Blows / 100 mm)	SHEAR STRENGTH (kPa) Vane: Values	WATER
TOPSOIL	Organic SILT with a trace of sand, dark brown. Firm to stiff, moist, sand, fine to medium; a trace of rootlets.						
ALLUVIAL SILT	SILT with a trace of sand, orange brown. Firm to stiff, moist, sand, fine to medium; a trace of rootlets. 0.3 m / 0.4 m		0.5		2, 2, 3, 4, 5, 5, 6, 6, 6		Groundwater Not Encountered
	End Of Hole: 0.30 m		1.0				

PHOTO(S)

REMARKS

Shallow pit for CBR.

WATER

- Standing Water Level
- Out flow
- Seepage

Generated with CORE-GS by Geroc - Test Pit x Hand Auger - scala & vane bars - 11/09/2023 2:50:13 pm

TEST PIT LOG

HOLE NO.: TP19

CLIENT: Tulloch Group Ltd. C/- Bonish Consultants

JOB NO.: 230505

PROJECT: 805, 815, 819 North Road, Invercargill

SITE LOCATION: 805, 815, 819 North Road, Invercargill | **CONTRACTOR:** SM Civil | **START DATE:** 08/08/2023

COORDINATES: | **EQUIPMENT:** 5T | **END DATE:** 08/08/2023

LOCATION METHOD: Map or aerial photograph | **ACCURACY:** ± 3 m | **LOGGED BY:** AJJ

ELEVATION: Existing ground level | **OPERATOR:** Johnny | **CHECKED DATE:** 18/08/2023

SOIL / ROCK TYPE	MATERIAL DESCRIPTION (See Classification & Symbology sheet for details)	SAMPLES	DEPTH / RL
TOPSOIL	Organic SILT with a trace of sand, dark brown. Soft to firm, moist, sand, fine to medium; a trace of rootlets.		
ALLUVIAL SILT	SILT with a trace of sand, orange brown. Firm to stiff, moist, sand, fine to medium; a trace of rootlets. 0.4 m / 0.5 m End Of Hole: 0.40 m		0.5 1.0

LEGEND

SCALA PENETROMETER (Blows / 100 mm)

1	2	3	4	5	6	7	8	9	10	11	12	13	14
	2	1	1	2	6	7	6	5	3				

SHEAR STRENGTH (kPa) Vane: 50 100 150 200 Values

WATER: Groundwater Not Encountered

PHOTO(S)

REMARKS

Shallow pit for CBR.

WATER

- Standing Water Level
- Out flow
- Seepage

Generated with CORE-GS by Geroc - Test Pit x Hand Auger - scala & vane bars - 11/09/2023 2:50:15 pm

TEST PIT LOG

HOLE NO.: TP20

CLIENT: Tulloch Group Ltd. C/- Bonish Consultants

JOB NO.: 230505

PROJECT: 805, 815, 819 North Road, Invercargill

SITE LOCATION: 805, 815, 819 North Road, Invercargill | **CONTRACTOR:** SM Civil | **START DATE:** 08/08/2023

COORDINATES: | **EQUIPMENT:** 5T | **END DATE:** 08/08/2023

LOCATION METHOD: Map or aerial photograph | **ACCURACY:** ± 3 m | **LOGGED BY:** AJJ

ELEVATION: Existing ground level | **OPERATOR:** Johnny | **CHECKED DATE:** 18/08/2023

SOIL / ROCK TYPE	MATERIAL DESCRIPTION (See Classification & Symbology sheet for details)	SAMPLES	DEPTH / RL	LEGEND	SCALA PENETROMETER (Blows / 100 mm)	SHEAR STRENGTH (kPa) Vane: Values	WATER
TOPSOIL	Organic SILT with a trace of sand, dark brown. Firm, moist, sand, fine to medium; a trace of rootlets.			TS			
ALLUVIAL SILT	SILT with a trace of sand, orange brown. Firm to stiff, moist, sand, fine to medium; a trace of rootlets. 0.3 m 0.4 m		0.5		2 2 2 2 2 2 4 4 5		Groundwater Not Encountered
	End Of Hole: 0.30 m		1.0				

PHOTO(S)

REMARKS

Shallow pit for CBR.

WATER

- Standing Water Level
- Out flow
- Seepage

Generated with CORE-GS by Geroc - Test Pit x Hand Auger - scala & vane bars - 11/09/2023 2:50:18 pm

TEST PIT LOG

HOLE NO.: TP21

CLIENT: Tulloch Group Ltd. C/- Bonish Consultants

JOB NO.: 230505

PROJECT: 805, 815, 819 North Road, Invercargill

SITE LOCATION: 805, 815, 819 North Road, Invercargill | **CONTRACTOR:** SM Civil | **START DATE:** 08/08/2023

COORDINATES: | **EQUIPMENT:** 5T | **END DATE:** 08/08/2023

LOCATION METHOD: Map or aerial photograph | **ACCURACY:** ± 3 m | **LOGGED BY:** AJJ

ELEVATION: Existing ground level | **OPERATOR:** Johnny | **CHECKED DATE:** 18/08/2023

SOIL / ROCK TYPE	MATERIAL DESCRIPTION (See Classification & Symbology sheet for details)	SAMPLES	DEPTH / RL	LEGEND	SCALA PENETROMETER (Blows / 100 mm)	SHEAR STRENGTH (kPa) Vane: Values	WATER
TOPSOIL	Organic SILT with a trace of sand, dark brown. Firm to stiff, moist, sand, fine to medium; a trace of rootlets.						
ALLUVIAL SILT	SILT with a trace of sand, orange brown. Firm to stiff, moist, sand, fine to medium; a trace of rootlets.		0.5		2, 2, 3, 4, 4, 6, 7, 8, 10		Groundwater Not Encountered
	End Of Hole: 0.40 m		1.0				

0.4 m
0.5 m

PHOTO(S)

REMARKS

Shallow pit for CBR.

WATER

- Standing Water Level
- Out flow
- Seepage

Generated with CORE-GS by Geroc - Test Pit x Hand Auger - scala & vane bars - 11/09/2023 2:50:20 pm

TEST PIT LOG

HOLE NO.: TP22

CLIENT: Tulloch Group Ltd. C/- Bonish Consultants

PROJECT: 805, 815, 819 North Road, Invercargill

JOB NO.: 230505

SITE LOCATION: 805, 815, 819 North Road, Invercargill
CONTRACTOR: SM Civil
START DATE: 08/08/2023

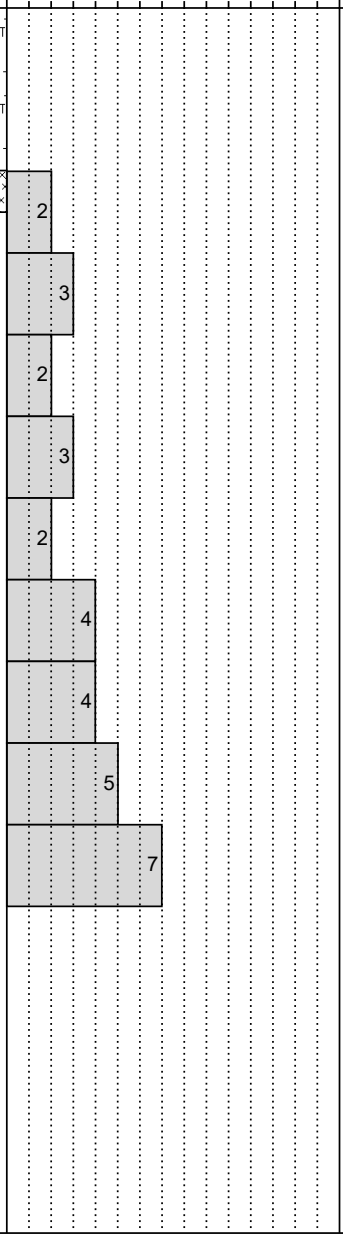
COORDINATES:
EQUIPMENT: 5T
END DATE: 08/08/2023

LOCATION METHOD: Map or aerial photograph
ACCURACY: ± 3 m
LOGGED BY: AJJ

ELEVATION: Existing ground level
OPERATOR: Johnny
CHECKED DATE: 18/08/2023

SOIL / ROCK TYPE	MATERIAL DESCRIPTION (See Classification & Symbology sheet for details)	SAMPLES	DEPTH / RL	LEGEND
TOPSOIL	Organic SILT with a trace of sand and gravel, dark brown. Stiff, moist, sand, fine to medium; gravel, fine to medium, subangular to subrounded; a trace of rootlets.			TS
			0.2 m	
ALLUVIAL SILT	SILT with a trace of sand, orange brown. Firm to stiff, moist, sand, fine to medium; a trace of rootlets.		0.3 m	
	End Of Hole: 0.20 m			

SCALA PENETROMETER (Blows / 100 mm)



SHEAR STRENGTH (kPa)
Vane: 50 100 150 200 Values

WATER
Groundwater Not Encountered

PHOTO(S)

REMARKS

Shallow pit for CBR.

WATER

- Standing Water Level
- Out flow
- Seepage

Generated with CORE-GS by Geroc - Test Pit x Hand Auger - scala & vane bars - 11/09/2023 2:50:23 pm

TEST PIT LOG

HOLE NO.: SP01

CLIENT: Tulloch Group Ltd. C/- Bonish Consultants

PROJECT: 805, 815, 819 North Road, Invercargill

JOB NO.: 230505

SITE LOCATION: 805, 815, 819 North Road, Invercargill
CONTRACTOR: SM Civil
START DATE: 08/08/2023

COORDINATES:
EQUIPMENT: 5T
END DATE: 08/08/2023

LOCATION METHOD: Map or aerial photograph
ACCURACY: ± 3 m
LOGGED BY: AJJ

ELEVATION: Existing ground level
OPERATOR: Johnny
CHECKED DATE: 18/08/2023

SOIL / ROCK TYPE	MATERIAL DESCRIPTION (See Classification & Symbology sheet for details)	SAMPLES	DEPTH / RL	LEGEND	SCALA PENETROMETER (Blows / 0 mm)	SHEAR STRENGTH (kPa) Vane: Values	WATER
TOPSOIL	Organic SILT with a trace of sand, dark brown. Soft to firm, moist, sand, fine to medium; a trace of rootlets. 0.3 m						
ALLUVIAL SILT	SILT with a trace of sand, orange brown. Stiff to very stiff, moist, sand, fine to medium; trace of rootlets. 1.6 m		0.5, 1.0, 1.5				Groundwater Not Encountered
	Sandy SILT, orange brown. Very stiff, moist, sand, fine to medium. 1.9 m						
ALLUVIAL SAND	Fine to medium SAND, grey. Medium dense, moist. 2.2 m		2.0				
	End Of Hole: 2.20 m		2.5				

Scala penetrometer scale: 1 2 3 4 5 6 7 8 9 10 11 12 13 14

Shear strength (kPa) Vane: 50 100 150 200

PHOTO(S)

REMARKS

Target depth achieved.

WATER

- Standing Water Level
- Out flow
- Seepage

Generated with CORE-GS by Geroc - Test Pit x Hand Auger - scala & vane bars - 11/09/2023 2:49:25 pm

TEST PIT LOG

HOLE NO.: SP02

CLIENT: Tulloch Group Ltd. C/- Bonish Consultants

PROJECT: 805, 815, 819 North Road, Invercargill

JOB NO.: 230505

SITE LOCATION: 805, 815, 819 North Road, Invercargill
CONTRACTOR: SM Civil
START DATE: 07/08/2023

COORDINATES:
EQUIPMENT: 5T
END DATE: 08/08/2023

LOCATION METHOD: Map or aerial photograph
ACCURACY: ± 3 m
LOGGED BY: AJJ

ELEVATION: Existing ground level
OPERATOR: Johnny
CHECKED DATE: 18/08/2023

SOIL / ROCK TYPE	MATERIAL DESCRIPTION (See Classification & Symbology sheet for details)	SAMPLES	DEPTH / RL	LEGEND	SCALA PENETROMETER (Blows / 0 mm)	SHEAR STRENGTH (kPa) Vane: Values	WATER
TOPSOIL	Organic SILT with minor gravel and a trace of sand, brown. Firm to stiff, moist, sand, fine to medium; gravel, fine to medium, subangular to subrounded; a trace of rootlets. 0.3 m		0.5 1.0 1.5 2.0 2.5	TS	1 2 3 4 5 6 7 8 9 10 11 12 13 14	50 100 150 200	Groundwater Not Encountered
ALLUVIAL SILT	SILT with a trace of sand, orange brown. Stiff to very stiff, moist, sand, fine to medium. 1.3 m						
	SILT with some sand, orange brown. Firm to very stiff, moist, sand, fine to medium. 2.1 m						
	SILT with a trace of sand, orange brown. Stiff to very stiff, moist, sand, fine to medium. 2.6 m						
ALLUVIAL SAND	Fine to medium SAND, grey mottled orange brown. Medium dense, moist. 2.8 m						
	End Of Hole: 2.80 m						

PHOTO(S)

REMARKS

Target depth achieved.

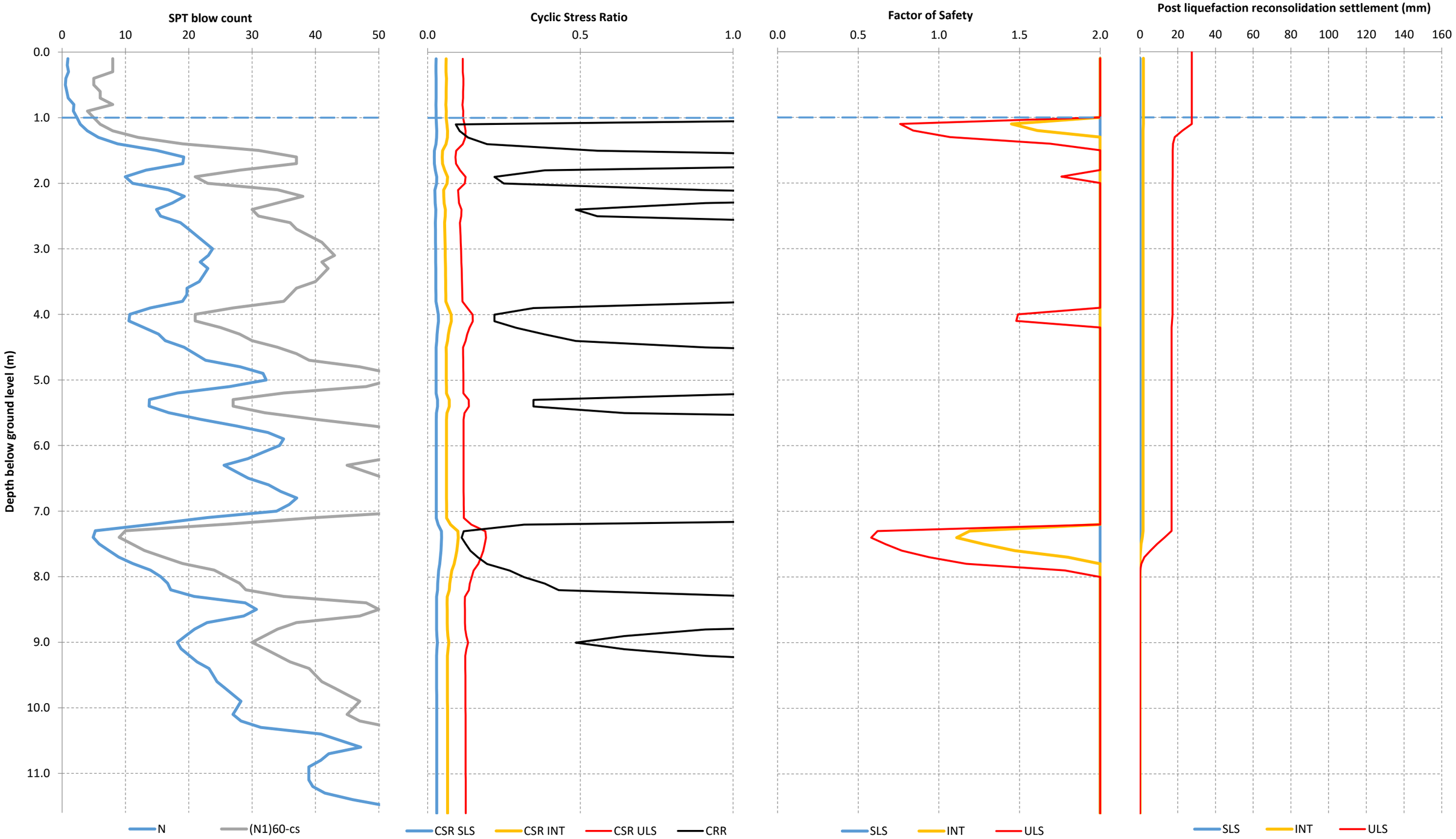
WATER

- Standing Water Level
- Out flow
- Seepage

Generated with CORE-GS by Geroc - Test Pit x Hand Auger - scala & vane bars - 11/09/2023 2:49:28 pm

Appendix C: Liquefaction Analysis

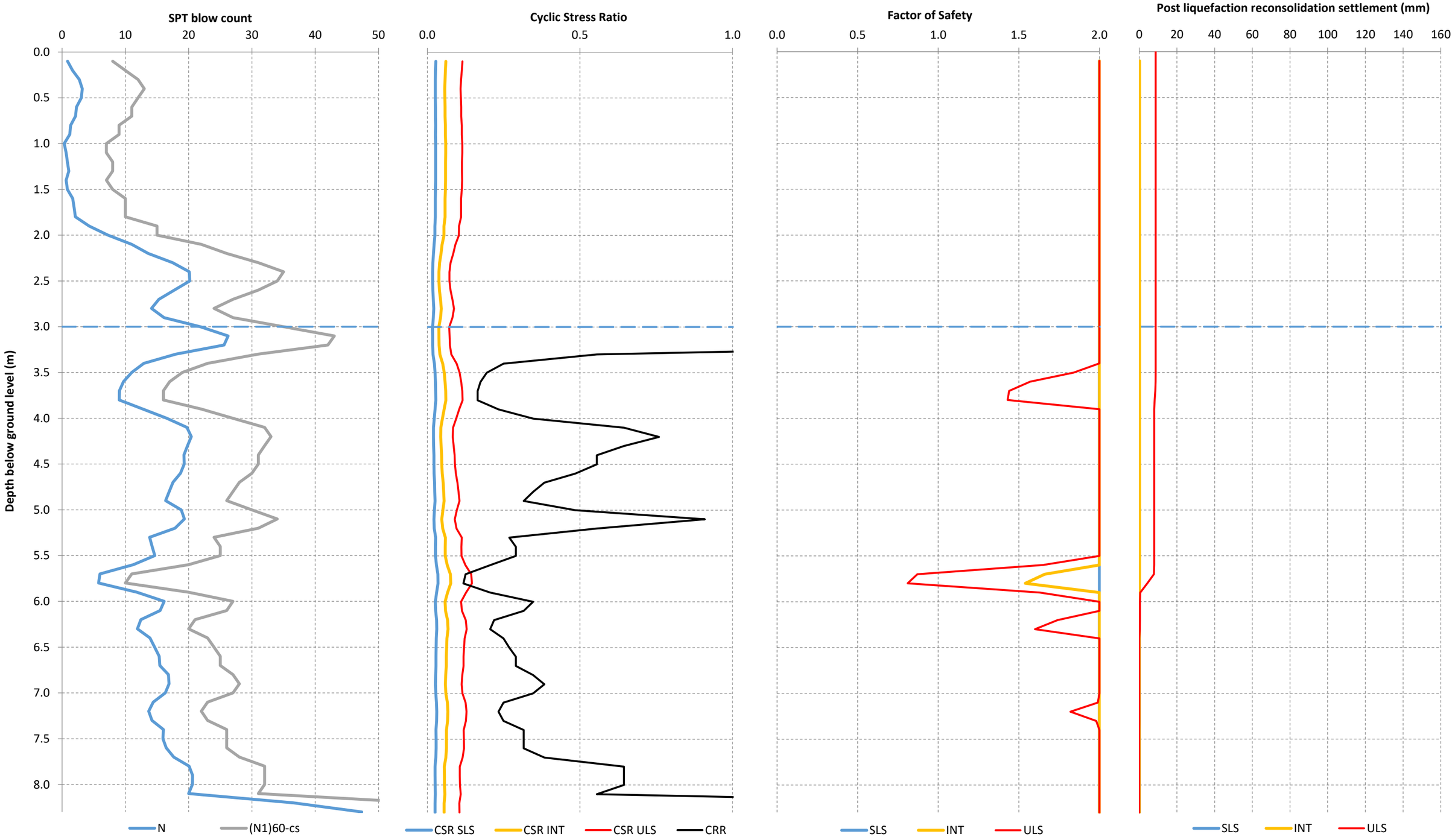
LSN (SLS)	LSN (INT)	LSN (ULS)	Settlement (SLS)	Settlement (INT)	Settlement (ULS)
0	0	11	0 mm	0 mm	25 mm



Note: Settlements as per Idriss and Boulanger (2014)

PROJECT	230505 - 805-815-819NorthRoad_Invercargill	CLIENT	Bonisch Consultants
DESCRIPTION	Liquefaction Assessment	TEST NUMBER	DPH 1
LOCATION	805,815 & 819 North Road, Invercargill	DATE	7/08/2023
		LOGGED BY	RC
		ANALYSED BY	RC
		CHECKED BY	FAW

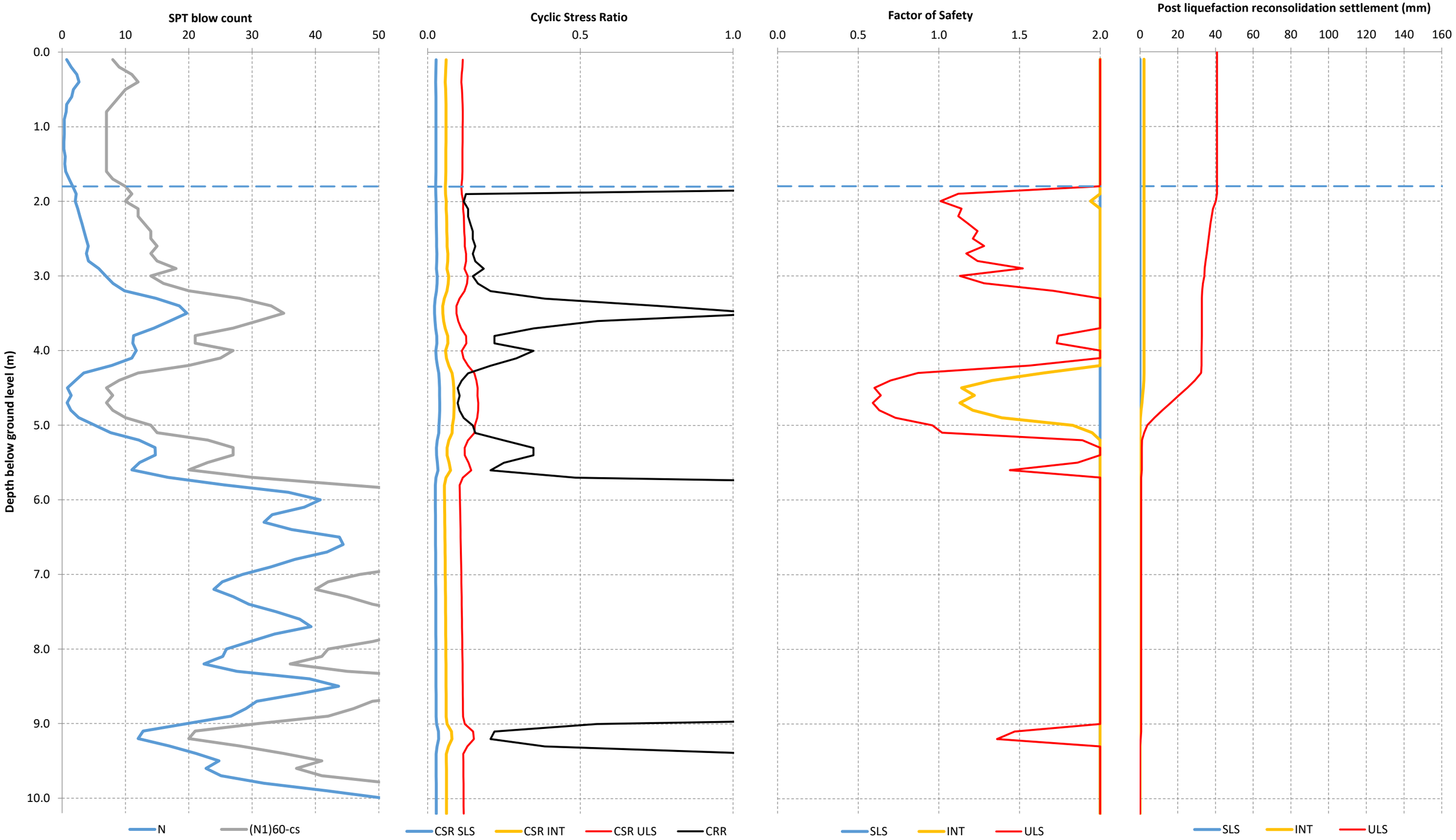
LSN (SLS)	LSN (INT)	LSN (ULS)	Settlement (SLS)	Settlement (INT)	Settlement (ULS)
0	0	2	0 mm	0 mm	10 mm



Note: Settlements as per Idriss and Boulanger (2014)

PROJECT	230505 - 805-815-819NorthRoad_Invercargill	CLIENT	Bonisch Consultants
DESCRIPTION	Liquefaction Assessment	TEST NUMBER	DPH 2
LOCATION	805,815 & 819 North Road, Invercargill	DATE	7/08/2023
		LOGGED BY	RC
		ANALYSED BY	RC
		CHECKED BY	FAW

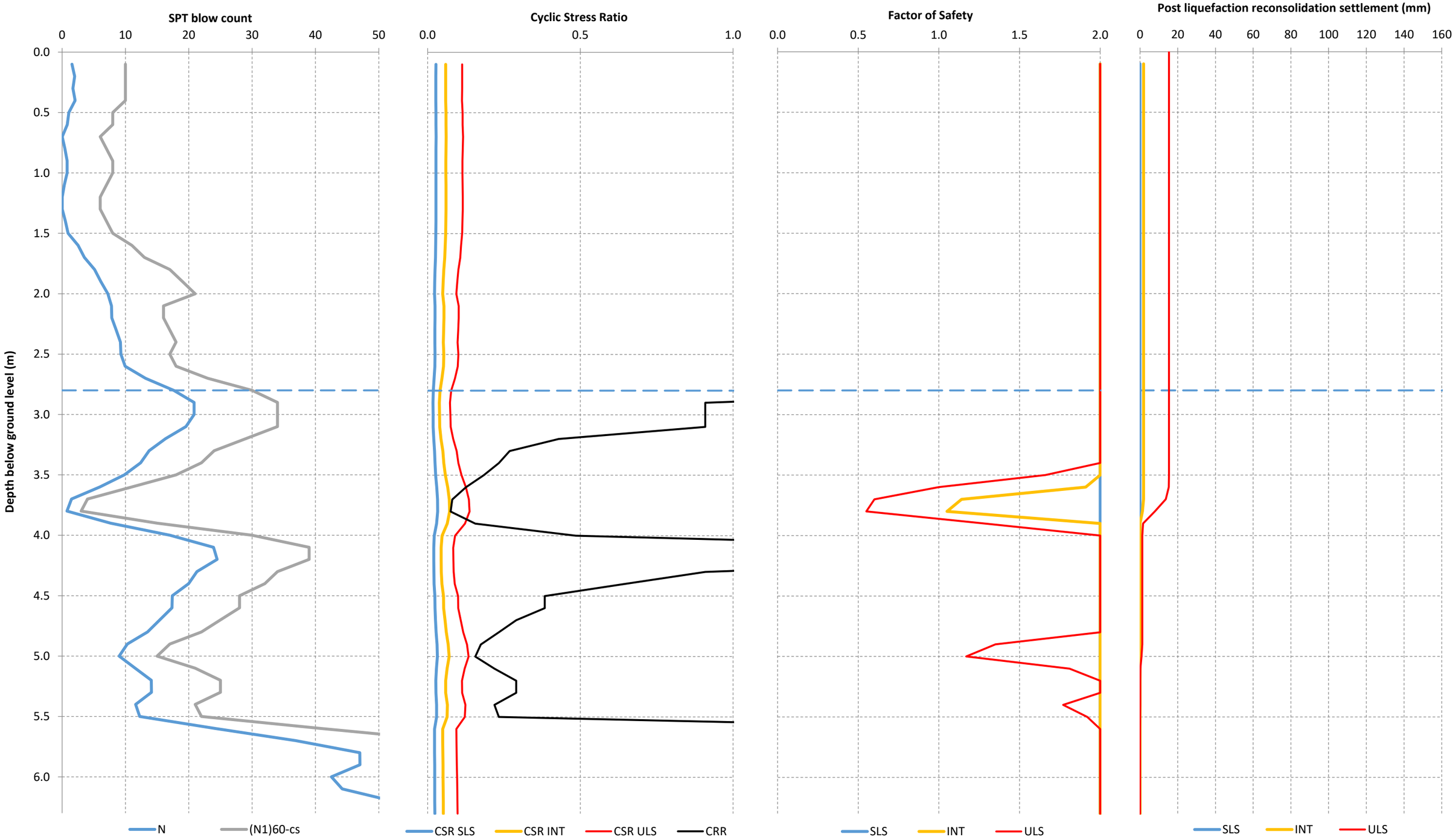
LSN (SLS)	LSN (INT)	LSN (ULS)	Settlement (SLS)	Settlement (INT)	Settlement (ULS)
0	0	10	0 mm	0 mm	40 mm



Note: Settlements as per Idriss and Boulanger (2014)

PROJECT	230505 - 805-815-819NorthRoad_Invercargill	CLIENT	Bonisch Consultants
DESCRIPTION	Liquefaction Assessment	TEST NUMBER	DPH 3
LOCATION	805,815 & 819 North Road, Invercargill	DATE	8/08/2023
		LOGGED BY	RC
		ANALYSED BY	RC
		CHECKED BY	FAW

LSN (SLS)	LSN (INT)	LSN (ULS)	Settlement (SLS)	Settlement (INT)	Settlement (ULS)
0	1	4	0 mm	0 mm	15 mm

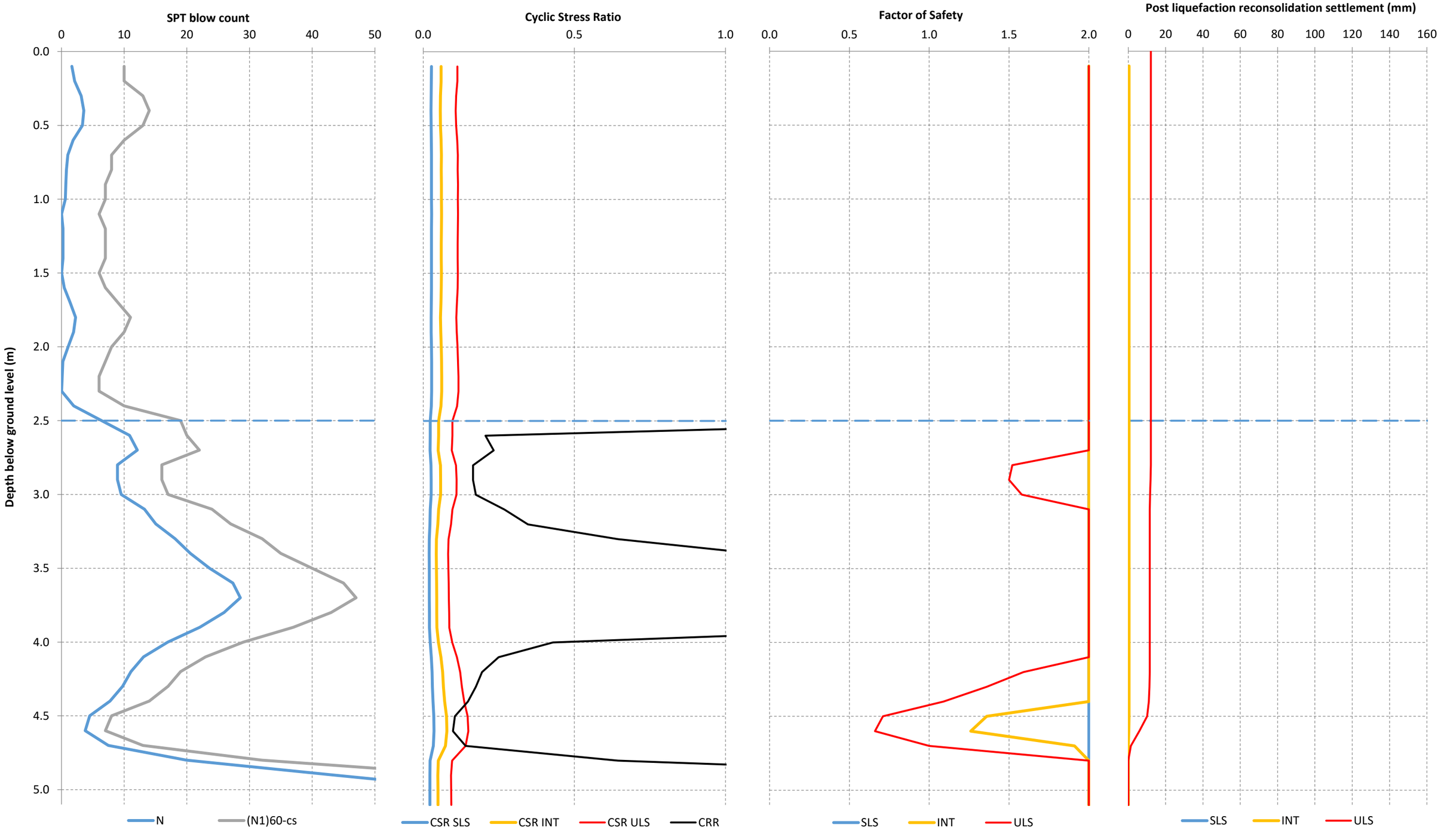


Note: Settlements as per Idriss and Boulanger (2014)

GEOSOLVE

PROJECT	230505 - 805-815-819NorthRoad_Invercargill
DESCRIPTION	Liquefaction Assessment
LOCATION	805,815 & 819 North Road, Invercargill
CLIENT	Bonisch Consultants
TEST NUMBER	DPH 4
DATE	8/08/2023
LOGGED BY	RC
ANALYSED BY	RC
CHECKED BY	FAW

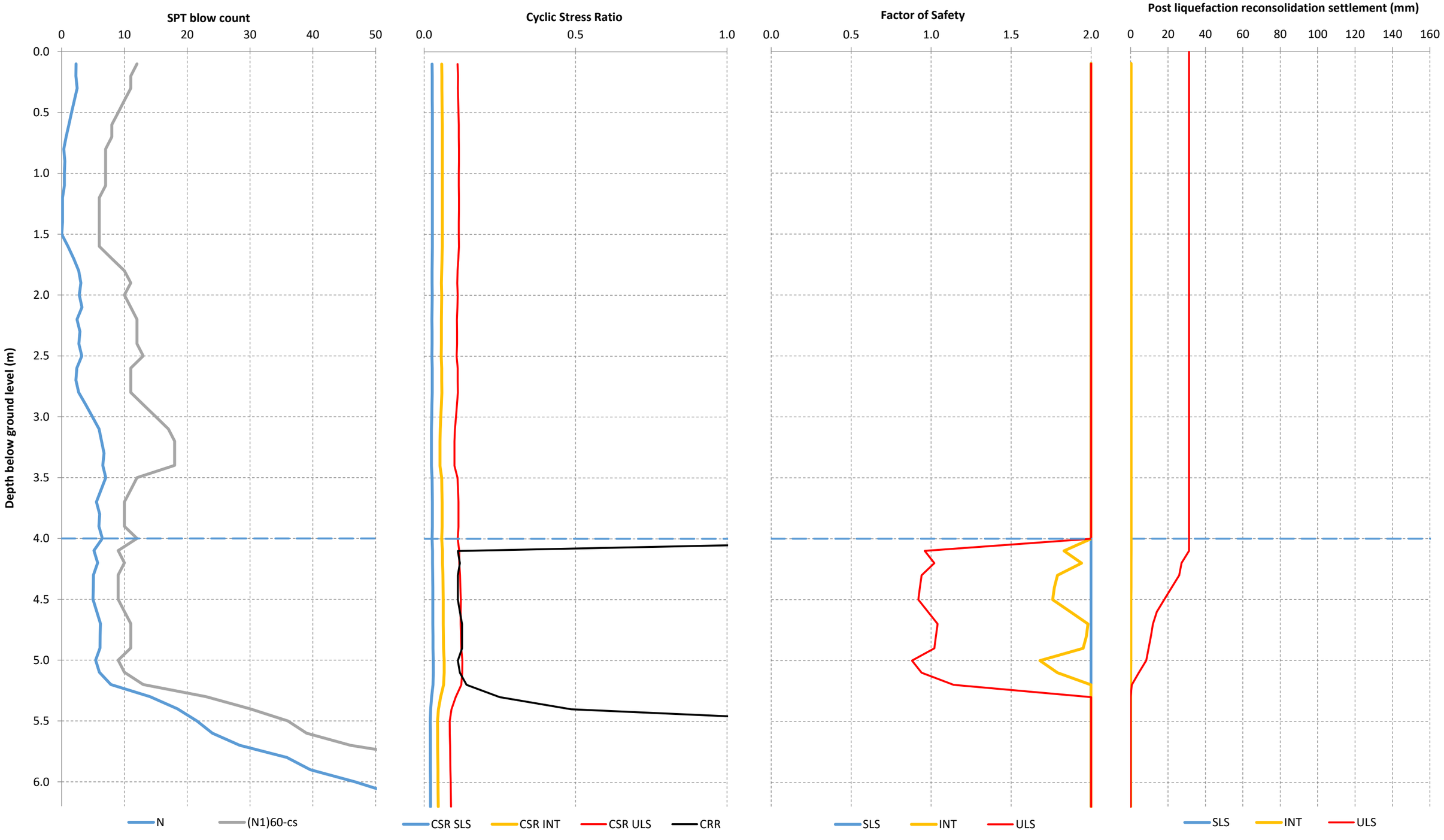
LSN (SLS)	LSN (INT)	LSN (ULS)	Settlement (SLS)	Settlement (INT)	Settlement (ULS)
0	0	3	0 mm	0 mm	10 mm



Note: Settlements as per Idriss and Boulanger (2014)

PROJECT	230505 - 805-815-819NorthRoad_Invercargill	CLIENT	Bonisch Consultants
DESCRIPTION	Liquefaction Assessment	TEST NUMBER	DPH 5
LOCATION	805,815 & 819 North Road, Invercargill	DATE	8/08/2023
		LOGGED BY	RC
		ANALYSED BY	RC
		CHECKED BY	FAW

LSN (SLS)	LSN (INT)	LSN (ULS)	Settlement (SLS)	Settlement (INT)	Settlement (ULS)
0	0	7	0 mm	0 mm	30 mm



Note: Settlements as per Idriss and Boulanger (2014)

PROJECT	230505 - 805-815-819NorthRoad_Invercargill	CLIENT	Bonisch Consultants
DESCRIPTION	Liquefaction Assessment	TEST NUMBER	DPH 6
LOCATION	805,815 & 819 North Road, Invercargill	DATE	8/08/2023
		LOGGED BY	RC
		ANALYSED BY	RC
		CHECKED BY	FAW

Appendix C - Liquefaction Analysis

General

Liquefaction occurs when susceptible, saturated soils attempt to move to a denser state under cyclic shearing. In this report, liquefaction is defined as when pore pressures rise to reach the overburden stress. When this occurs, the following effects can happen at flat sites:

- loss of strength;
- ejection of material under pressure to the ground surface; and
- post-liquefaction volumetric densification as the materials reconsolidate.

In addition, sloping sites or sites with a 'free face' may experience lateral spreading or movement.

Liquefaction Susceptibility

Soils susceptible to liquefaction have the following characteristics:

- Saturated. Below the ground water level;
- Have "sand like" behaviour[5]; and
- Are in loose or medium dense condition.

Soils which are susceptible to liquefaction require a certain level of earthquake shaking (trigger) to cause them to liquefy. Denser soils require more intense and/or longer duration of shaking (higher trigger) than less dense soil.

Analysis Method

Liquefaction analyses were undertaken on the test data using the Boulanger & Idriss (2014)[7] deterministic method.

Assessment of Consequences of Liquefaction

The following can be assessed to estimate the consequences of liquefaction at this site:

- Crust thickness
- Liquefaction severity index
- Free field settlements
- Lateral spread

Crust Thickness

The non-liquefiable upper layer of soils (crust) provides some protection against ground surface damage as a result of liquefaction. The thicker the crust, the less ground surface damage is expected with significant protection provided by thicknesses of more than 5 m.

Empirical correlations have been developed by Ishihara[6] to quantify the thickness of non-liquefiable crust required to prevent the formation of sand boils resulting from the

---

[5] "Geotechnical earthquake engineering practice: Module 1 Guideline for the identification, assessment and mitigation of liquefaction hazards", Rev 0, July 2010. New Zealand Geotechnical Society. This document states that soil with: Fc <30%, or; Fc >30% and PI < 7% (where Fc= percent passing a 0.075mm sieve and PI=plasticity index) is considered as "sand-like" and is susceptible to liquefaction.

[6] Ishihara, K. (1985). "Stability of natural deposits during earthquakes," Theme lecture, Proc. 11th Int. Conf. On Soil Mechanics and Foundation Engineering, San Francisco, 2, 321-376pp.

liquefaction of underlying soil layers. These correlations indicate that for a given thickness of liquefiable soil, as the peak ground acceleration increases a greater thickness of non-liquefiable soil is required to prevent liquefaction damage from manifesting on the surface.

Liquefaction Severity Number

Liquefaction severity number (LSN) is a single value which can be calculated from a liquefaction assessment considering the thickness density and depth of liquefiable layers and the intensity of earthquake shaking. Based on observations of ground surface damage in Christchurch an indicative correlation has been developed between ground surface damage from liquefaction and LSN as described below.

As the LSN increases, so does the risk of severe effects on the land and structure. In general, the following surface effects are considered likely at sites with various LSN values.

Table 1C - Liquefaction Severity Number[7]

	Effects from excess porewater pressure and liquefaction	**Characteristic LSN**	**Characteristics of liquefaction and its consequences**
L0	Insignificant	< 10	No significant excess pore water pressures (no liquefaction)
L1	Mild	5 – 15	Limited excess pore water pressures; negligible deformation of the ground and small settlements.
L2	Moderate	10 – 25	Liquefaction occurs in layers of limited thickness (small proportion of the deposit, say 10 percent or less) and lateral extent; ground deformation results in relatively small differential settlements.
L3	High	15 – 35	Liquefaction occurs in significant portion of the deposit (say 30 percent to 50 percent) resulting in transient lateral displacements, moderate-to-large differential movements, and settlement of the ground in the order of 100 mm to 200 mm.
L4	Severe	> 30	Complete liquefaction develops in most of the deposit resulting in large lateral displacements of the ground, excessive differential settlements and total settlement of over 200 mm.
L5	Very severe		Liquefaction resulting in lateral spreading (flow), large permanent lateral ground displacements and/or significant ground distortion (lateral strains/stretch, vertical offsets and angular distortion).

Free Field Settlements

This describes the settlement of ground not occupied by a building, occurring due to dissipation of excess pore water pressure generated during earthquake shaking. Where appropriate, we have estimated reconsolidation settlement of any potentially liquefiable layers using the methodology recommended by Idriss & Boulanger (2014)[7].

A component of building settlement may also occur due to yield of any liquefied founding soils. This component of settlement is very difficult to predict and depends on the interaction of the building and the soil it is founded on.

[7] New Zealand Geotechnical Society [NZGS] and Ministry of Business, Innovation and Employment [MBIE] (2021). Earthquake geotechnical engineering practice in New Zealand. Module 3: Identification, assessment and mitigation of liquefaction hazards. Rev 1.

Appendix B

Integrated Transport Assessment Report

805, 815 & 819 North Road, Lorneville

Private Plan Change Request
Integrated Transport Assessment Report

Prepared for:
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Tulloch Limited

Prepared by:
Chris Rossiter and Sayuni Jayasinghe

04 November 2024

Project/File:
310206118



Stantec New Zealand

Revision	Description	Author	Date	Quality Check	Date	Independent Review	Date
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B	For consultation	S Jayasinghe	12/08/24	C Rossiter	12/08/24	S Lloyd	12/08/24
1	Final	S Jayasinghe	31/10/24	C Rossiter	31/10/24	S Lloyd	31/10/24

The conclusions in the Report titled 805, 815 & 819 North Road are Stantec's professional opinion, as of the time of the Report, and concerning the scope described in the Report. The opinions in the document are based on conditions and information existing at the time the scope of work was conducted and do not take into account any subsequent changes. The Report relates solely to the specific project for which Stantec was retained and the stated purpose for which the Report was prepared. The Report is not to be used or relied on for any variation or extension of the project, or for any other project or purpose, and any unauthorized use or reliance is at the recipient's own risk.

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Table of Contents

Abbreviations ..... **iii**
1 Introduction **1**
2 Existing Transport Environment **2**
2.1 Site Context 2
2.2 Road Network 6
2.3 Active Mode Network 9

3 Existing Travel Patterns **10**
3.1 State Highway Traffic Volumes 10
3.2 Existing Activity 12
3.3 Road Safety 12

4 Proposed Plan Change **14**
4.1 NZTA Consultation 14
4.2 Concept Masterplan 15
4.3 Traffic Generation 15

5 Assessment of Transport Effects **17**
5.1 Site Access 17
5.2 Road Safety 17
5.3 Traffic Volumes 18

6 District Plan **19**
6.1 Transport Objectives 19
6.2 Transport Policies 19
6.2.1 TRA-P1 Infrastructure 19
6.2.2 TRA-P2 Noise 19
6.2.3 TRA-P3 Roading Hierarchy 20
6.2.4 TRA-P4 Standards 20
6.2.5 TRA-P5 Adverse Effects 20
6.2.6 TRA-P6 State Highways 20
6.2.7 TRA-P7 Cross Boundary Effects 20
6.2.8 TRA-T8 Public Health 20
6.2.9 TRA-T9 Integration 21
6.2.10 TRA-T10 Public Transport, Walking and Cycling 21
6.2.11 TRA-T11 Significant Transport Networks 21
6.3 Transport Rules 21

7 Conclusion **23**

List of Tables

Table 5-1: Intersection Performance - Morning Peak (8:00am) 17
Table 5-2: Intersection Performance – Afternoon / Evening Peak (4:00pm) 17

Table C 1: Existing Situation
Table C 2: North Road with new intersection

List of Figures

Figure 2-1: Site Location in Context of Surrounding Area (Invercargill City Council Maps) 2
Figure 2-2: Site Layout 5
Figure 2-3: Land zoning 5

Figure 2-4: State Highway Network 6
Figure 3-1: Annual Traffic Volumes South of Lorneville Roundabout 10
Figure 3-2: Weekday Traffic Volumes on SH6, 2022-2023 11
Figure 3-3: Hourly Traffic Volumes on SH6 South of Lorneville Roundabout 11
Figure 3-4: Weekday Directional Traffic Volumes on SH6 south of Lorneville Roundabout 12
Figure 4-1: Plan Change Site and Access 15

Figure A 1: Potential Road layout based on existing driveways
Figure A 2: Potential Road with restricted movement intersections
Figure A 3: New Road and intersection

Figure B 1: AGTM6 Warrant for Turning Treatments – 70km/h < design speed < 100 km/h

List of Photographs

Photograph 2-1: Entry Driveway 3
Photograph 2-2: Internal driveway (north) 3
Photograph 2-3: Internal Driveway (South) 4
Photograph 2-4: Exit Driveway 4
Photograph 2-5: SH6 North Road – View North from Site Entrance 7
Photograph 2-6: SH6 North Road – View South from Site Entrance 7
Photograph 2-7: Stop signs at exit 8
Photograph 2-8: Concealed stop sign at exit 8

List of Appendices

Appendix A Site Access Assessment
A.1 Primary Site Access Requirements
A.2 Access Options
A.2.1 Use Existing Driveways
A.2.2 Restricted Movement Intersections
A.2.3 New Intersection and Road

Appendix B Intersection Design
B.1 Design Warrant
B.2 Right Turn Treatment

Appendix C Safe System Assessment
C.1 Summary

Appendix D Intersection Concept Design

Abbreviations

Abbreviations	Full Name
ADT	Annual Average Daily Traffic Volume
ICC	Invercargill City Council
NZTA	New Zealand Transport Agency
vpd	Vehicle movements per day
vph	Vehicle movements per hour

1 Introduction

Tulloch Limited operates an industrial warehouse activity at 815 North Road, Lorneville north of Invercargill. Access to the site from North Road, which forms part of State Highway 6 (SH6), is currently provided by two one-way driveways. A Private Plan Change Request is proposed to rezone the site and two adjacent lots from Rural to Industrial 1. Primary access to the rezoned land will be via a new single, all-movement intersection to North Road.

Following preliminary consultation in relation to the site access, NZTA raised concerns with forming a new intersection at the location of the existing entrance because of the potential for conflict with right turn movements at the driveway to the commercial activities on the opposite side of the highway. This report provides an assessment of alternate access options and identifies a preferred configuration.

The report then provides an assessment of the potential transport effects that could arise from the rezoning. The focus of the report is the location and design of the vehicle access to the rezoned land.

The report has been structured to provide:

- A description of the existing transport environment;
- A description of the existing travel patterns in the area;
- A description of the proposal and activities enabled by the rezoning;
- An assessment of transport effects;
- An assessment of compliance with the relevant rules, policies and objectives of the District Plan.

2 Existing Transport Environment

2.1 Site Context

Figure 2-1 shows the location of the plan change site in the context of the surrounding area. The site is located on the eastern side of North Road which forms part of SH6. State Highway 98 (SH98) and State Highway 99 (SH99) meet SH6 at a roundabout about 600 metres north of the site.



Figure 2-1: Site Location in Context of Surrounding Area (Invercargill City Council Maps)

The existing access to the site is via two one-way driveways as shown in Photograph 2-1 and Photograph 2-4. The vehicle routes (Photograph 2-2 and Photograph 2-3) around the warehouse operate with one-way, clockwise movement controls as shown in Figure 2-2.

Figure 2-2 also shows a driveway on the opposite side of the highway approximately midway between the two site driveways. The driveway leads to a commercial activity.



Photograph 2-1: Entry Driveway



Photograph 2-2: Internal driveway (north)



Photograph 2-3: Internal Driveway (South)



Photograph 2-4: Exit Driveway

Figure 2-3 shows the land zoning surrounding the site. The site itself is located on rural zoned land. Land to the west of SH6 and south of SH99 is zoned as Business 5. New buildings are under construction on the rural zoned land in the north-east quadrant of the SH6 / SH98 / SH99 roundabout.



Figure 2-2: Site Layout

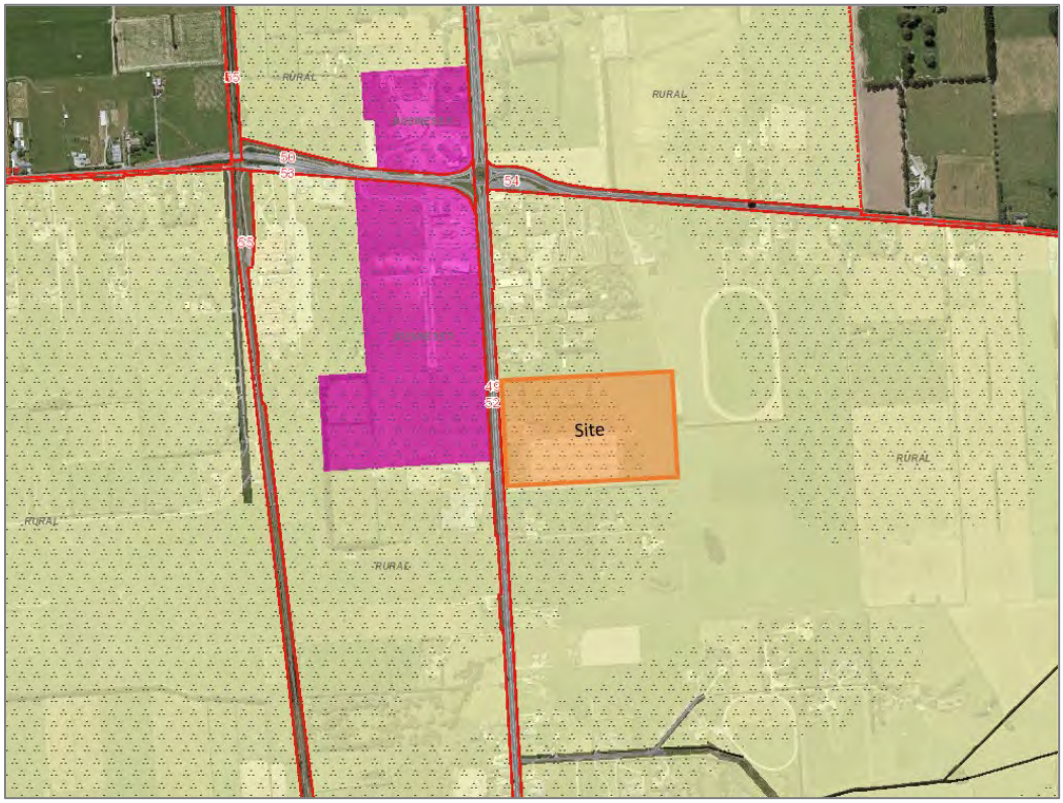


Figure 2-3: Land zoning

2.2 Road Network

Figure 2-4 shows the state highway network for the surrounding area. SH6 forms the primary strategic link for towns along the West Coast to Queenstown and Invercargill. SH98 and SH99 are regional links for Southland. SH6 meets State Highway 1 (SH1) which forms the primary link through towns and cities along the east coast in Invercargill. SH1 continues south from Invercargill to Bluff.

All state highways in the area are classified as High Productivity Motor Vehicle (HPMV) routes.

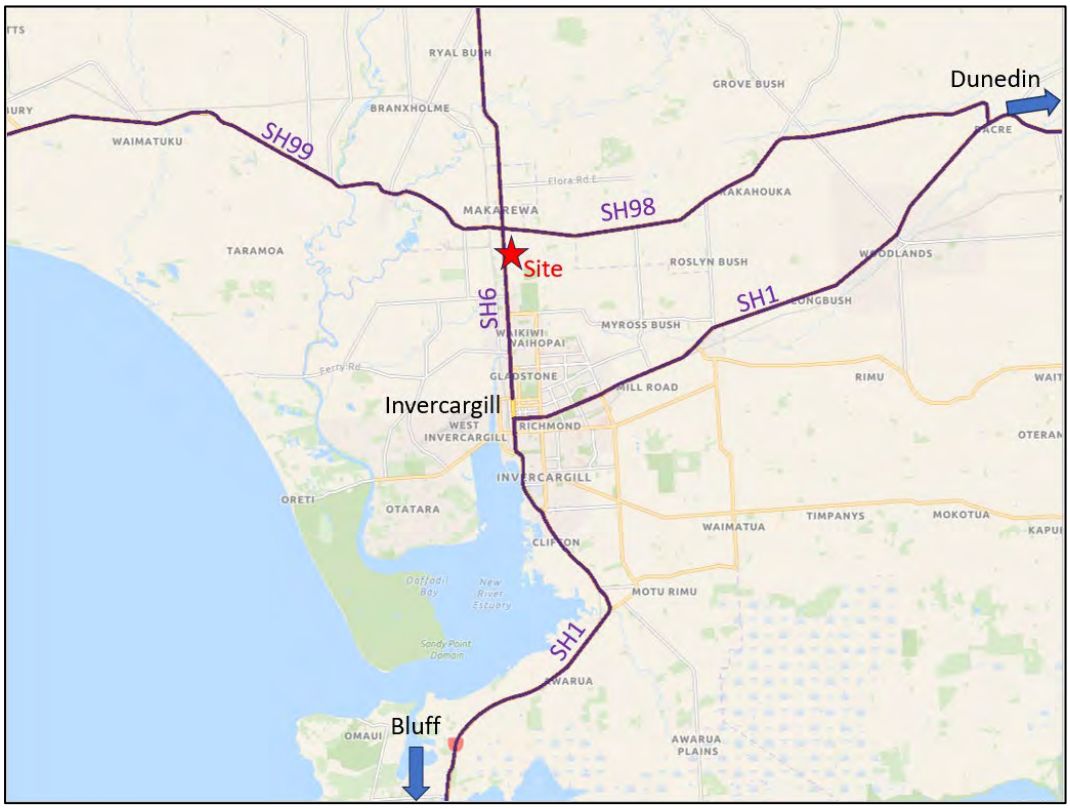
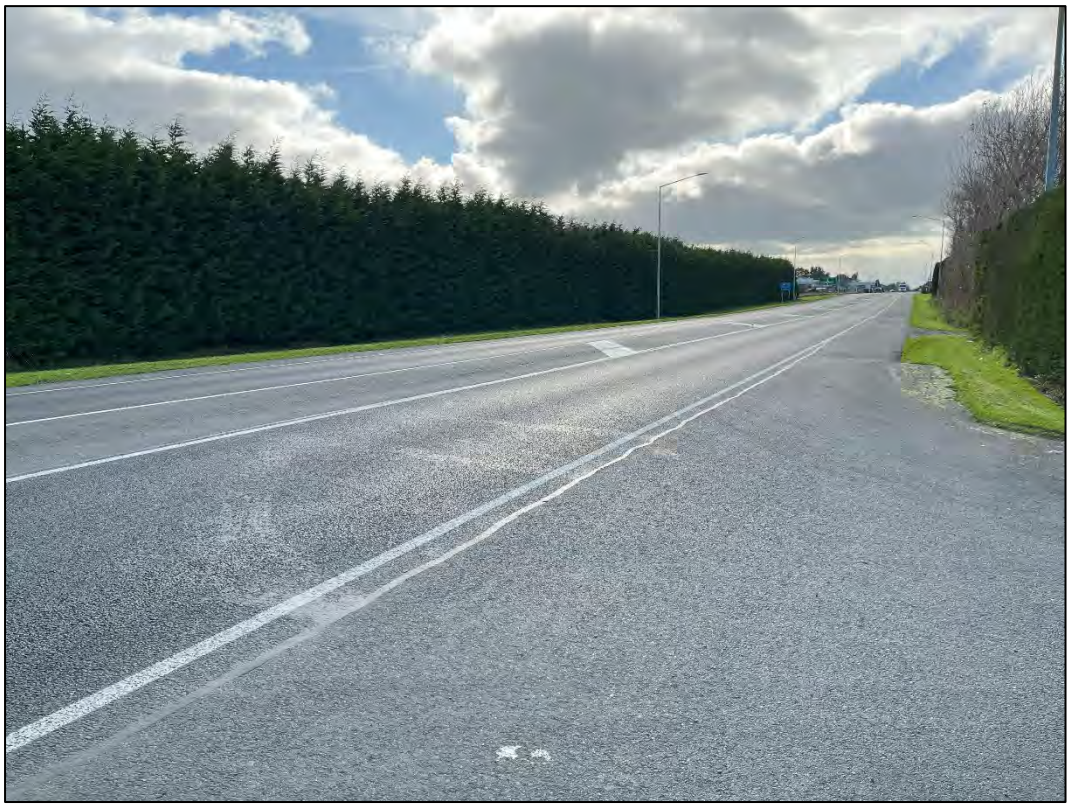


Figure 2-4: State Highway Network

SH6 North Road has been constructed as a two-lane, median divided carriageway with wide sealed shoulders south of the SH6 / SH98 / SH99 roundabout as shown in Photograph 2-5 and Photograph 2-6. There is one through lane in each direction with a flush median and wide shoulders. The central flush median is about three metres wide which provides sufficient width for large trucks to stop clear of through traffic before turning right into driveways. Right turn bays are marked within the median at the local road intersections with Beaconsfield Road and Moore Road. The speed limit on North Road is 80km/h.

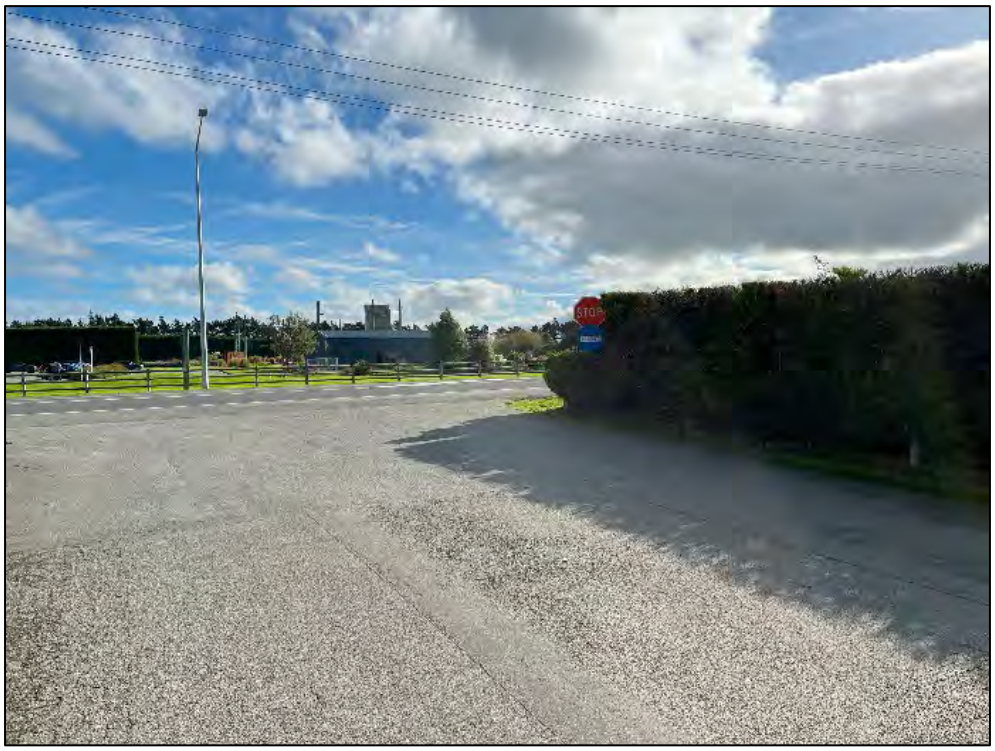
The exit driveway has stop signs installed but these are largely hidden by the hedgerows (Photograph 2-7 and Photograph 2-8). A Stop line has not been marked.



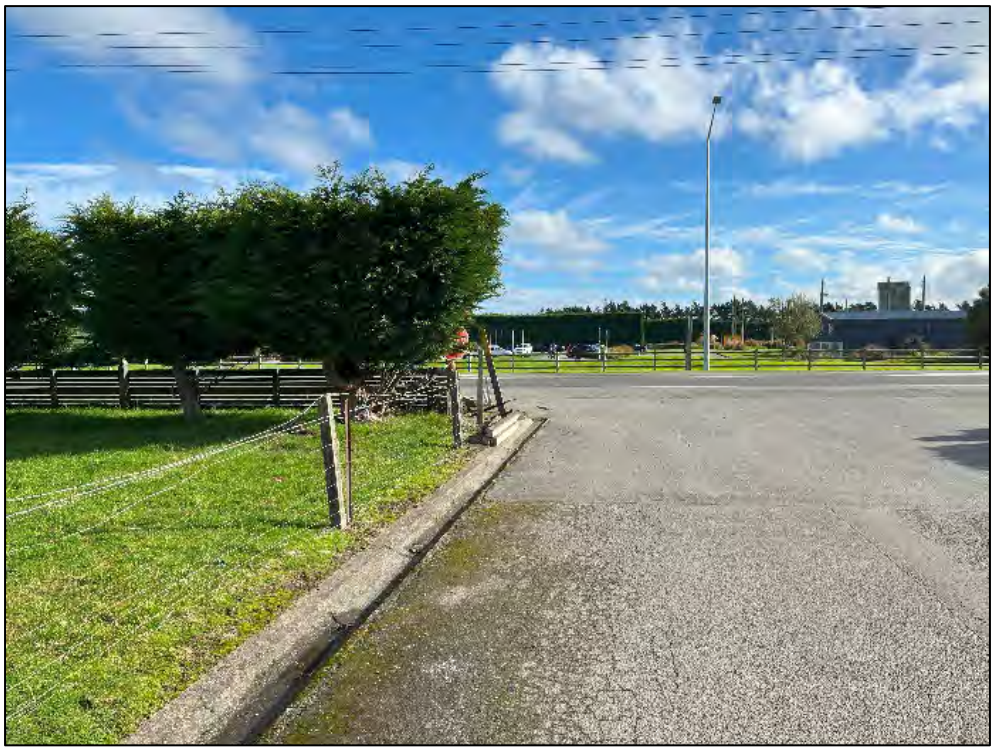
Photograph 2-5: SH6 North Road – View North from Site Entrance



Photograph 2-6: SH6 North Road – View South from Site Entrance



Photograph 2-7: Stop signs at exit



Photograph 2-8: Concealed stop sign at exit

2.3 Active Mode Network

There are no footpaths, cycle lanes or bus routes on North Road. The nearest cycle lanes and bus routes to the site are in Invercargill to the south of the site. However, the wide sealed shoulders do provide space for cyclists to travel along SH6 clear of the traffic lane.

3 Existing Travel Patterns

3.1 State Highway Traffic Volumes

Figure 3-1 shows the annual average daily traffic volumes recorded on SH6 between the site and the Lorneville roundabout. The daily volumes have been about 12,200 vehicles per day (vpd) since 2018. The 90th and 98th percentile traffic volumes which provide an indication of the volumes during the busiest weeks of the year were about 14,300 vpd and 15,200 vpd respectively. Although there has been some year to year variation in daily volumes, there is no evidence for any growth over the 2018-2023 period.

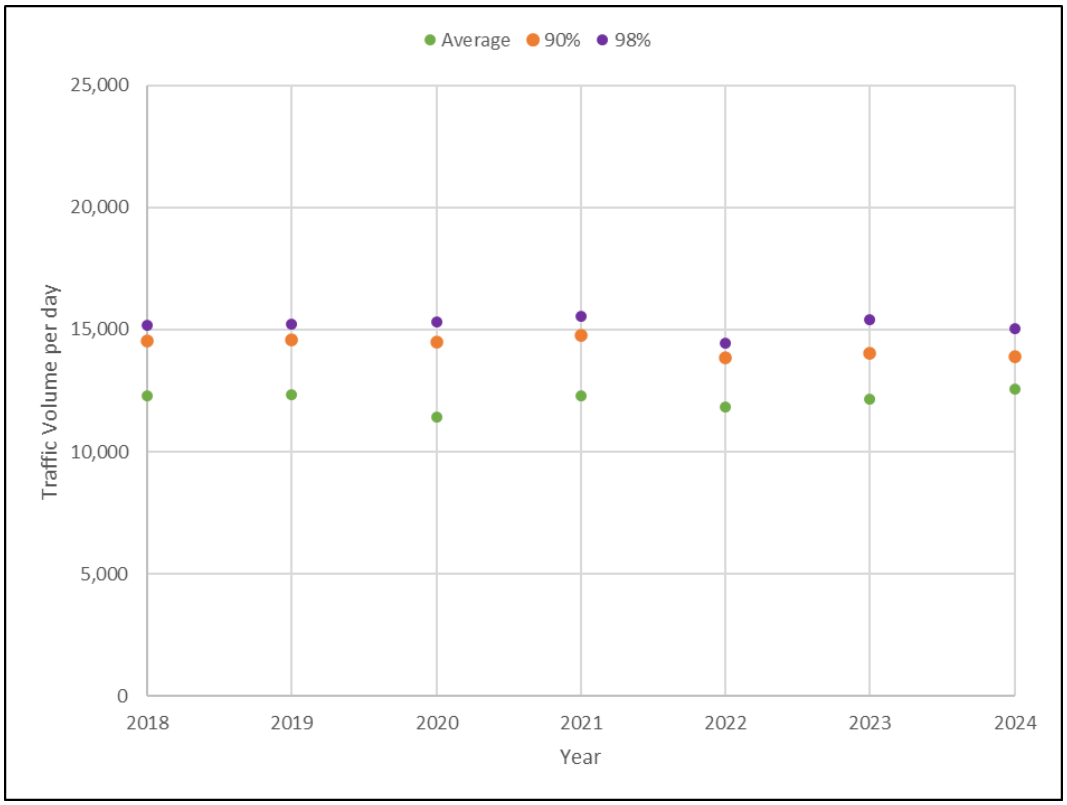


Figure 3-1: Annual Traffic Volumes South of Lorneville Roundabout

Figure 3-2 shows the weekday traffic volumes recorded on SH6 for the 2022-23 period. The lowest weekday volumes occur during the peak holiday period in early January with the highest volumes occurring the November-December period.

Figure 3-3 shows the hourly volumes recorded on SH6 in March 2024 which reflects typical volumes for much of the year. On weekday, there are clear peaks in the flows, one in the morning (7:30am-8:30am) and the other in the late afternoon (4.45pm-5:45pm). Figure 3-4 shows that the dominant flow direction is southbound towards Invercargill in the morning and northbound in the afternoon. This represents typical workplace travel patterns. At the weekend, there are single broad peaks during the middle of the day.

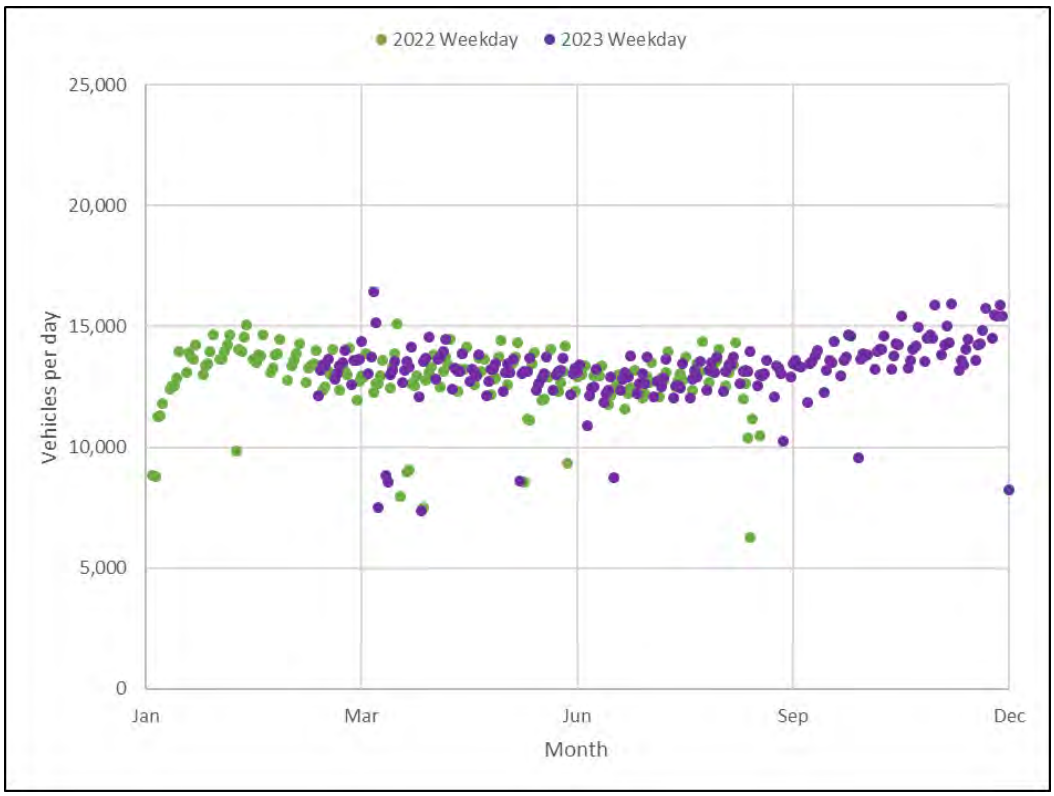


Figure 3-2: Weekday Traffic Volumes on SH6, 2022-2023

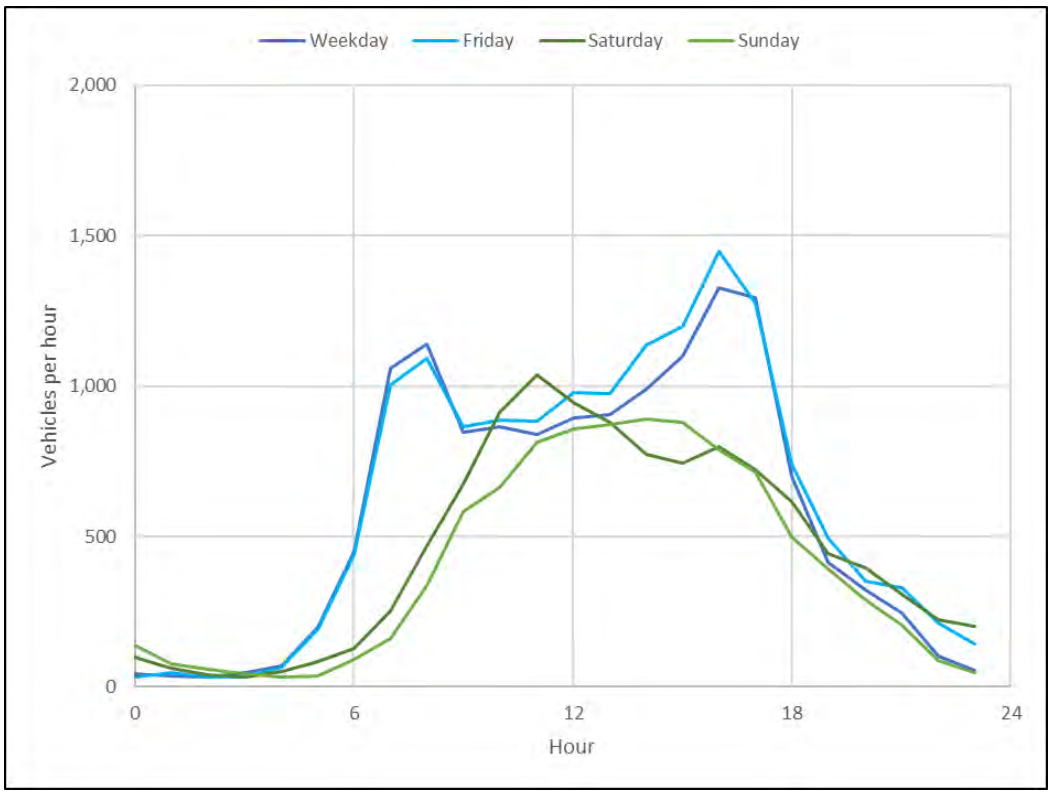


Figure 3-3: Hourly Traffic Volumes on SH6 South of Lorneville Roundabout

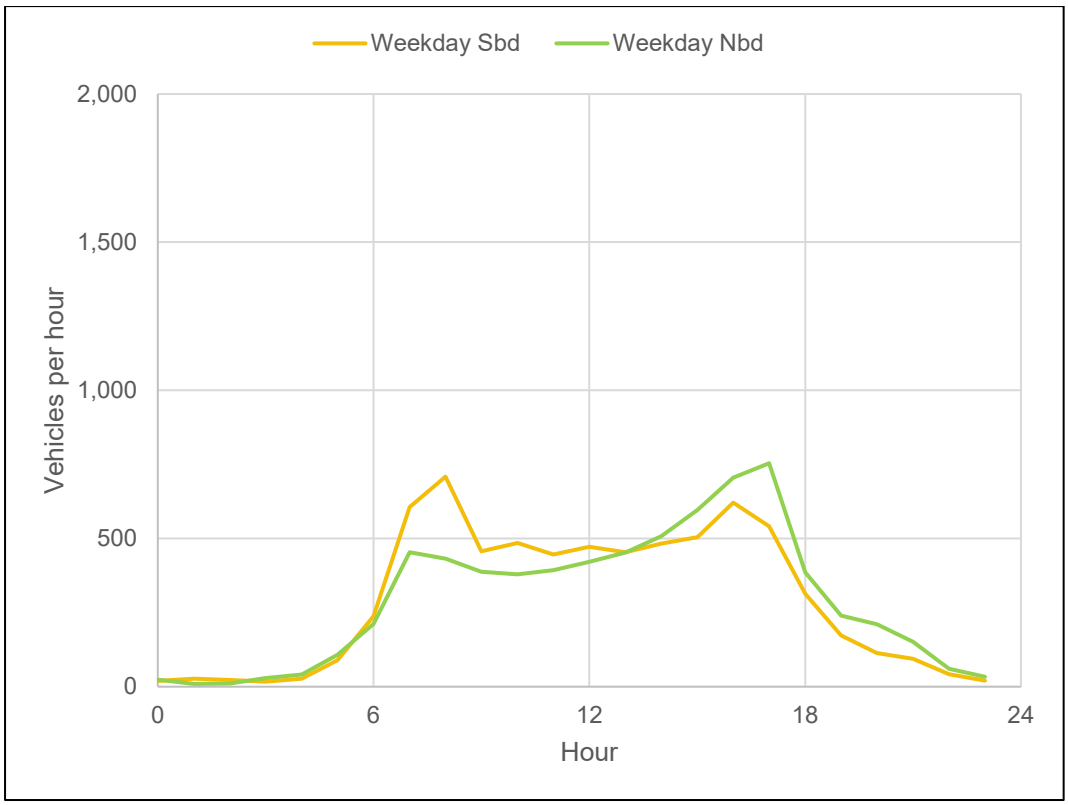


Figure 3-4: Weekday Directional Traffic Volumes on SH6 south of Lorneville Roundabout

3.2 Existing Activity

The warehouse employs six full-time staff and two casual staff during the peak season. Staff typically travel independently to the site by vehicle and have an average daily traffic generation of about 12 vpd.

Truck movements at the warehouse vary widely across the year. Wool is transported to the warehouse in a wide variety of trucks but is generally shipped using truck and trailer units. During the peak season, there can be 40-50 truck movements into the site bringing wool into the warehouse with these trucks generating a similar number of outbound movements. The exports from the site can involve 5-10 truck and trailer movements (in and out combined).

During the off-season, imports to the warehouse typically involve less than ten inbound truck movements per day.

Peak hourly movement volumes are typically below 10 vpd throughout the year.

3.3 Road Safety

Crash records of the surrounding road network from the full five-year period 2019-2023 have been reviewed using the NZTA Crash Analysis System. During the five-year period, there have been four crashes reported along North Road between the Lorneville roundabout 500 metres to the north of the site and Moore Road about 800 metres to the south. One of these resulted in a serious injury, one caused minor injury with no injuries being reported following the other two crashes.

The serious injury crash involved a driver travelling north on North Road at high speed, reportedly as high as 140 km/h, before losing control and leaving the road.

The minor injury crash involved a vehicle travelling north on North Road, just south of the Lorneville roundabout, running into the rear end of a stationary vehicle from traffic in the middle of the road. The crash was likely to be attributable to driver error because they were following too close to the vehicle in front.

One of the non-injury crashes involved a vehicle travelling north on North Road, to the south of Lorneville roundabout, falling asleep behind the wheel and hitting a fence to the left of the road. The second non-injury crash occurred when a driver attempted to u-turn but failed to check their blind spot as they pulled into the road from the shoulder, leading to a crash with a vehicle travelling south of North Road.

There were no crashes associated with turning movements the driveways to the site. The reported crashes do not raise any specific safety concerns with the road network.

From a Safe System perspective, the wide sealed shoulders reduce the potential for drivers to lose control if they inadvertently move out of the traffic lane. The wide flush median provides separation between opposing traffic lanes which will reduce the potential for head-on type crashes and also provides space for right-turning vehicles to stop in the carriageway clear of through traffic. The wide shoulders also provide space for any cyclists using the highway to travel outside the high speed traffic lane.

The primary safety concern is the short separation between the entry driveway to the site and the driveway on the opposite side of the road. Although only low volumes of movement were observed at both driveways, the short separation means that there will be a conflict between the paths of right turning vehicles if these occur at the same time.

4 Proposed Plan Change

4.1 NZTA Consultation

Consultation with NZTA began in 2020 with a request for preliminary comment on a site layout that was based on retaining the existing crossings but with the northern crossing and internal access lane being vested as a local road. NZTA raised a number of concerns with the proposed access arrangements including:

- *There is a potential that safety issues could occur with the proposed commercial operation and the existing operations on the western side of the highway (Adventure Southland Limited and Prime Range Fresh). The safety issues would mainly be associated with right turning vehicles into the existing access for these existing operations and if vehicles were to turn right into the northern access of the proposed activity.*
- *Any vehicle movements with the proposed activity will need to avoid conflicts from the existing access on the opposite side of the highway.*
- *Right turning vehicle movements could be mitigated if only right turns into the site were to occur at the southern entrance.*
- *No right turn turns in the northern entrance, only left in / left out and potentially right out could occur.*
- *Appropriate signage and road markings (painted right turn bay) would be required to ensure that the southern entrance is identified as the main entrance and that no right turns in could occur at the northern entrance.*
- *Ensure that internal accessways are positioned more than 45m from the intersection.*
- *Ensure that vehicles will not be required to park on the highway or cause obstruction to the highway.*
- *This section of the State Highway is a Limited Access Road under the Government Roading Powers Act 1989. The two entrances to the site have registered vehicle crossings that have conditions associated with them. These conditions do not reflect what is being proposed and would need to be updated once there is agreement on the access situation.*

Following this feedback, a range of alternate access arrangements were considered in relation to how the access to the site as a whole would operate. Appendix A provides a summary of the options that were considered. The revised access arrangements involve forming a new local road intersection about 60 metres north of the existing northern crossing and retaining the southern crossing for one-way exit movements only.

Appendix B includes details of the design criteria that have been adopted for the new intersection with Appendix C providing an assessment of the arrangements from a Safe System perspective. Appendix D includes drawings of the intersection concept design.

Further comment from NZTA was sought on the revised access arrangements. Although NZTA have indicated a preference for the southern crossing to be closed once the new local road intersection has been formed, retention of the crossing is desired by Tulloch to better manage truck movements to the south from the warehouse. Following further discussion, NZTA have indicated that they would accept retention of the southern crossing subject to the crossing being modified to restrict movements to left turn out only. It is anticipated that this would require regulatory signage requiring a left turn out only,

no entry signage from the highway and some reshaping of the crossing with kerbing and islands to physically prevent right turns.

4.2 Concept Masterplan

Tulloch Limited is seeking rezoning of its land at 805, 815 and 819 North Road from rural to industrial. The industrial zoning reflects the existing activity at its warehouse at 815 North Road. The site masterplan in Figure 4-1 shows the extent of the proposed rezoning and the proposed access arrangements.

The existing exit-only driveway from 815 North Road will be retained as a private driveway and continue to operate one-way. A new intersection is proposed on North Road to provide access to the currently undeveloped land. The new intersection will replace the existing entry driveway to 815 North Road and two-way driveway to 819 North Road.

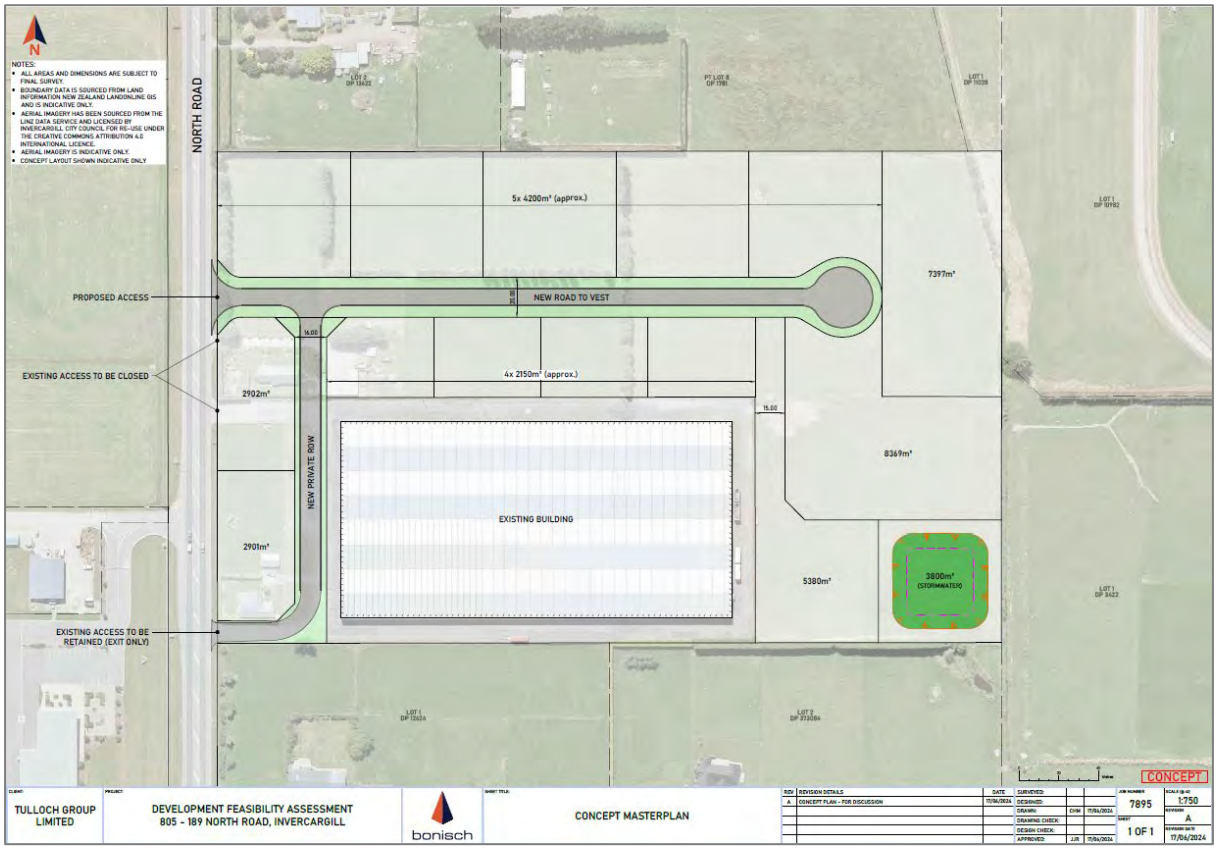


Figure 4-1: Plan Change Site and Access

4.3 Traffic Generation

The plan change site has a total area of about 9.7 ha with the existing wool store activity occupying about 3 ha, inclusive of the driveways. The rezoning would create about 5.6 ha of developable land after allowing for the existing wool store, new road reserve and other reserves.

The traffic generation of the site will be dependent upon the nature of activities that are established. Warehouse type activity such as the wool store generate lower volumes of movement than manufacturing or contractor type activities.

The 2018 New Zealand Trip and Parking Database includes traffic generation rates for industrial parks and suggest that the peak hour generation rate could be in the range 21-23 vph per hectare. Since this information is based on surveys collected in 2004-5, reference to other sources have also been considered.

The Institute of Transportation Engineers (ITE) Trip Generation web-based application reports traffic generation rates for light industrial activity of 0.41 vph per 1,000 sq ft of floor area which represents a rate of about 17 vph per hectare based on 40 percent site coverage.

The Trip Rate Information Computer System (TRICS) is a database of trip rates for developments used in the United Kingdom for transport planning purposes. This reports traffic generation rates for an Industrial Estate of 6.3 vph per hectare.

The wide range of rates is likely to be a reflection of the very wide range of activities that exist in industrial zones. For the purposes of this assessment, a peak hour traffic generation rate of 17 vph per hectare has been adopted. Based on that rate, new development at the site would generate about 95 vph at peak times. This means that peak hour volumes with full development of the site inclusive of the existing activity at the wool store will be 95-110 vph.

Light industrial activity typically has a short duration traffic generation peak early in the morning, 7:00-8:00am, as workers arrive but a broader peak in the afternoon that can extend from 2:00pm through to 6:00pm. This reflects the different working hours that often are adopted in the industry compared with office based activity. During the morning peak, 80-90 percent of vehicle movements are typically made into the site with this reversing during the afternoon.

The daily traffic generation of industrial activity can be 5-8 times the peak hour volume. On this basis, the site as a whole could generate 500-900 vpd on average.

5 Assessment of Transport Effects

5.1 Site Access

The SIDRA intersection analysis software has been used to assess the likely delays and operational performance of a new priority intersection. The analysis has been based on about 80% of movements being to or from the south during the peak periods. Table 5-1 shows the longest delays are for the lowest volume movement, that is the right turn out, could be about 20 seconds on average. The forecast delays during the afternoon / evening peak period are shown in Table 5-2. The average delay for the right turn out movement in the afternoon is about 25 seconds because of the higher two-way volumes on SH6 at that time. Average delays for all other turning movements are low, typically less than 10 seconds. Overall, this suggests that a priority intersection would provide an acceptable level of service.

Table 5-1: Intersection Performance - Morning Peak (8:00am)

Approach	Movement	Volume (vph)	Delay (s) / LOS
SH6 Invercargill	Through	430	n/a
	Right	60	11 (B)
New Road	Left	20	4 (A)
	Right	5	20 (C)
SH6 Lorneville	Left	10	7 (A)
	Through	710	n/a

Table 5-2: Intersection Performance – Afternoon / Evening Peak (4:00pm)

Approach	Movement	Volume (vph)	Delay (s) / LOS
SH6 Invercargill	Through	700	n/a
	Right	20	10 (A)
New Road	Left	70	4 (A)
	Right	10	25 (D)
SH6 Lorneville	Left	5	7 (A)
	Through	630	n/a

5.2 Road Safety

Although a priority intersection would operate with low levels of delay, the 80 km/h speed limit means that in the event of a crash, the consequences are likely to involve serious injuries or a fatality. The NZTA Moneterised Benefit and Cost Manual (MBCM) includes crash rate forecast models. The crash rate model for a high speed priority intersection has been used to assess likely crash rates at the proposed new intersection.

The forecast average crash rate is about 0.1 injury crashes per annum based on the new industrial zone generating 900 vpd on average. This crash rate is not considered sufficiently high to warrant construction of a roundabout.

5.3 Traffic Volumes

Full development of the plan change site could result in an average daily traffic generation of up to 900 vpd. It is expected that about 80% of all movements will be to or from the South. This means that the traffic volumes on SH6 south of the plan change site could increase by about 700 vpd. The higher traffic volumes at peak times will contribute to small increases in average delays at all driveways and intersections south of the site.

6 District Plan

6.1 Transport Objectives

Development of transport infrastructure and land use takes place in an integrated and planned manner which:

1. Integrates transport planning with land use.
2. Protects the function, safety, efficiency and effectiveness of the transport network.
3. Minimises potential for reverse sensitivity effects to arise from changing land uses.
4. Provides for positive, social, recreational, cultural and economic outcomes.
5. Minimises, where practical, the adverse public health and environmental effects.

The existing woolstore operation represents an industrial activity and has been established on rural land. The proposed rezoning will allow for expansion of industrial activities on the adjacent land. Since the site is located beside the state highway, it provides direct access to the strategic road network which will limit the potential for new industrial activity affecting residential activity within the wider area.

Access to the industrial zone will be via a new intersection that is formed in accordance with Austroads design standards. The design provides drivers with good visibility from limit lines which will enable drivers to clearly assess approaching traffic before turning. Since the zone will attract usage by large, articulated vehicles, the intersection has been designed to accommodate two-way movement of that size of vehicle. Overall, it is considered that the design will allow the intersection to operate safely and with the little effect on the operation of the highway.

6.2 Transport Policies

6.2.1 TRA-P1 Infrastructure

To provide for the safe and efficient operation, improvement and protection of transport infrastructure.

Access to the industrial zone is proposed via a new intersection rather than a vehicle crossing. This represents an appropriate approach to the access design because of the high volume of movements that is anticipated compared with the current situation. This will not affect the movement of existing traffic on the state highway and will allow turning movements to be undertaken safely.

6.2.2 TRA-P2 Noise

To manage the impact of noise associated with the airport, seaport, State Highway and railway networks.

Since the proposed industrial zone is located beside the state highway and will contribute to a small increase in traffic volumes, it could contribute to higher traffic noise on the highway. However, any increase is consistent with the purpose of the highway which is intended for carrying high volumes of traffic.

6.2.3 TRA-P3 Roading Hierarchy

To have regard to the Council's Roading Hierarchy when considering subdivision, use and development of land.

The subdivision site has frontage to the state highway only and access is proposed to the highway. This will ensure that any new industrial activities do not generate heavy commercial vehicle movements onto roads where these would not be anticipated. On that basis, the development of the subdivision and proposed road is considered to be consistent with the overall road hierarchy for the district.

6.2.4 TRA-P4 Standards

To set development standards for vehicle access, loading, parking and manoeuvring facilities.

There are no reasons why development within the site will not be able to meet the District Plan standards in relation to parking and loading.

6.2.5 TRA-P5 Adverse Effects

To manage subdivision, use and development adjacent to transport infrastructure in such a way as to avoid, remedy or mitigate potential effects, including reverse sensitivity effects on transportation infrastructure.

The proposed plan change involves rezoning of land from rural to industrial and does not involve any subdivision. Access to the new zone is proposed at a new intersection that will mitigate any potential effects on existing driveways on North Road. The provision of direct access to the state highway via the new local road will ensure that heavy vehicle movements at the site will not generate traffic effects on adjacent properties.

6.2.6 TRA-P6 State Highways

To have regard to any New Zealand Transport Agency standards regarding the location of new accesses on to, and egresses from, State Highways where the speed limit exceeds 50 kph.

The new intersection will be designed to mean NZTA requirements. Its location will provide appropriate separation from nearby driveways to allow a right turn bay to be marked.

6.2.7 TRA-P7 Cross Boundary Effects

To promote the management of the effects of activities which occur outside the District on the transportation networks of the District.

This policy is not applicable to this application because the proposed rezoning and activities enabled by the rezoning are within the District.

6.2.8 TRA-T8 Public Health

To manage transport activities and surrounding land use activities to protect public health and environmental values.

The plan change site is located adjacent to the state highway and will promote use of the highway for access. This will enable consolidation of industrial activities which will reduce the potential for generating effects on the surrounding land use activities.

6.2.9 TRA-T9 Integration

To integrate the planning of land use with existing transport infrastructure and provide for future transportation requirements.

The plan change site is located opposite the Business 5 zoned land and will provide an opportunity for industrial activity to be established close to that zone. The site location adjacent to the state highway will promote use of the highway for access.

6.2.10 TRA-T10 Public Transport, Walking and Cycling

To promote the use of public transport,and walking and cycling networks.

Since the site is located remote from existing public transport, walking and cycling networks, it is not practical to promote use of these travel modes.

6.2.11 TRA-T11 Significant Transport Networks

To recognise that the Invercargill Airport, seaport, railway, State Highways, and the arterial roads which link this infrastructure are regionally significant transportation networks and are essential to the ongoing viability and functioning of the District.

The plan change site is located adjacent to the state highway and will promote use of the highway for access. This will ensure that new activities can easily access the strategic road network and contribute to the viability and functioning of the District.

6.3 Transport Rules

The size of the plan change site means that there are no reasons why compliance with the rules relating to provision of parking and loading cannot be met (TRA-R1 to TRA-R10).

Under TRA-R11, construction of a new intersection on the State Highway represents a Discretionary Activity because the speed limit is greater than 50 km/h. The matters of discretion include:

The location of the vehicle accesses and egresses

1. The dimensions, formation and surfacing of the vehicle accesses and egresses

2. Any additional works that may be required on site or on the roadway itself to avoid, remedy or mitigate any potential traffic safety problems.

The proposed location of the new intersection provides sufficient separation from nearby driveways to allow a right turn bay to be marked within the flush central median and minimise the potential conflict with right turn movements at nearby driveways. The new road can be constructed to a standard that is suitable for the volumes of heavy vehicle movement anticipated within the proposed industrial zone.

Appendix D includes a concept design for the new intersection. The construction of the new intersection does not involve major alterations to the state highway. New kerbs will be constructed at the intersection and the existing line markings altered to include a right turn bay.

7 Conclusion

Tulloch Limited operates an industrial warehouse activity on rural zoned land at 815 North Road, Lorneville north of Invercargill. A Private Plan Change Request is proposed to rezone the site and two adjacent lots from Rural to Industrial. Following preliminary consultation with NZTA, site access to the rezoned land will be via a new single, all-movement intersection to North Road about 115 metres north of the driveway proving access to commercial activity on the western side of the highway. The separation of the new intersection from the western driveway will minimize the potential for conflict between right turns and is sufficient to allow a right turn bay to be marked at the new intersection.

Based on the size of the proposed industrial zone, it will have potential to generate 500 -900 vpd depending on the activities that are established. The priority intersection will provide sufficient capacity for this volume of movement. The right turn out movement will experience the greatest delays and are likely to be in the range 20-25 seconds at peak times if traffic generation is at the upper end of the forecast range.

The location of the proposed industrial zone adjacent to the highway ensures direct access to the strategic road network is possible which will reduce the potential for reverse sensitivity effects.

Overall, it has been concluded that the plan change proposal can be supported from a transport perspective subject to the following access arrangements being implemented.:

1. A new local road and intersection with SH6 being formed in accordance with an outline development plan that provides a minimum separation of 115 metres from the nearest driveways on the western side of SH6.
2. A right turn bay being marked on the state highway at the new intersection.
3. Regulatory signage being installed at the southern crossing permitting left turn out movements only.
4. Physical measures such as kerbs or raised islands to prevent right turn out movements.

Appendices

Appendix A Site Access Assessment

A.1 Primary Site Access Requirements

Create a new local road through the site that provides access to all potential future lots and meets the state highway at an all movement intersection.

The new road needs to accommodate two-way movement of large, articulated vehicles.

A.2 Access Options

A.2.1 Use Existing Driveways

Figure A 1 shows an indicative layout for new local roads based on the existing driveway locations. A full intersection would be formed at the northern driveway location with the existing exit only driveway being retained.



Figure A 1: Potential Road layout based on existing driveways

This option would require the road to be formed with at least two small radius curves to provide an access route to new industrial land. It creates a short section of road between the highway and the wool store for vehicle queuing.

This option would not address the concerns raised by NZTA in relation to the conflicting right turns at the new intersection and driveway on the western side of the highway.

A.2.2 Restricted Movement Intersections

Figure A 2 shows one way to eliminate the potential conflict with right turn movements on the highway. This involves creating two new intersections with movements at the northern driveway restricted to left-in / right-out and movements at the southern intersection restricted to right-in / left-out.

Although this option could resolve the NZTA concern, it creates a more complex internal movement network and will increase the volume of movements across the western side of the wool store building which is used for access by the Segard Masurel business. Truck movements associated with this activity require the whole of the yard space along the west side of the building for manoeuvring which would conflict with the movement of general traffic.



Figure A 2: Potential Road with restricted movement intersections

A.2.3 New Intersection and Road

Figure A 3 shows an access option based on a new road being formed through the northern part of the site and meeting the highway at a new all-movement intersection. Under this option, the existing northern crossing would be closed. Entry to the existing wool store would be via the new road with truck exiting via the existing southern driveway. Access to the Segard Masurel business could be via new right of way.

Since access arrangements based on this road configuration would provide good access to new industrial zoned land and have the least effect on the operation of the existing activities, this represents the preferred layout from a transport perspective.



Figure A 3: New Road and intersection

Appendix B Intersection Design

B.1 Design Warrant

Figure B 1 shows the Austroads design warrants for turning treatments at priority intersections for a design speed of 70-100 km/h. A channelised treatment for right turns from the highway is considered appropriate at the new intersection because peak hour turning volumes will exceed 5 vph and the major road volumes during the day are greater than 800 vph.

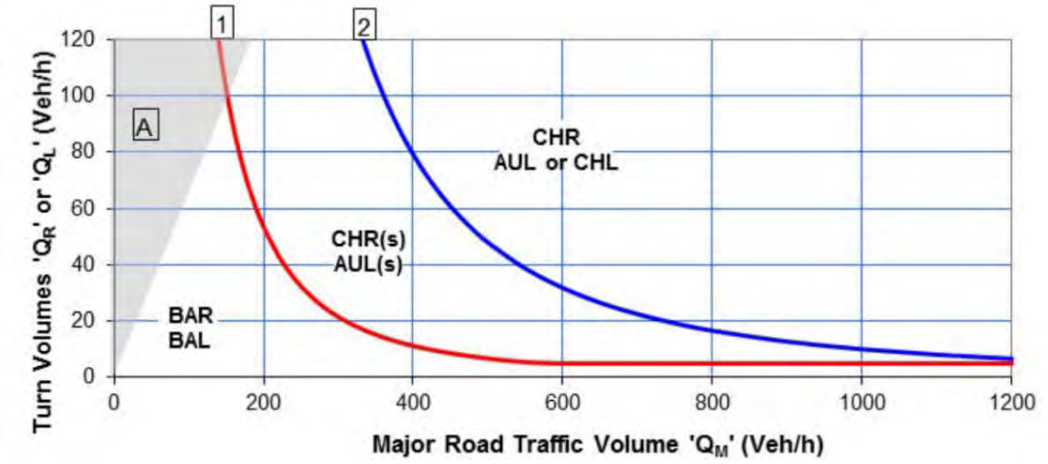


Figure B 1: AGTM6 Warrant for Turning Treatments – 70km/h < design speed < 100 km/h

B.2 Right Turn Treatment

Since the Austroads Guide to Road Design Part 4A does not include specific design guidelines for a rural, median divided road such as SH6 along the site frontage, the intersection design has been based on providing sufficient space to enable back-to-back right turn bays to be formed in relation to the driveway on the west side of SH6. The design parameters are set out in Table B 1.

Table B 1: Design Parameters - Right Turn Treatment

Design Parameter	Value
Design speed	80 km/h
Lane Width	3.5m (existing)
Flush median width	3.0 m (existing)
Storage length	25m
Taper length	20m
Deceleration length (including taper)	65m

Based on these design parameters, the new road should be located no closer than 110 metres north of the driveway on the western side of the highway.

Appendix C Safe System Assessment

C.1 Summary

The construction of a new, all movement intersection on SH6 is considered to be the most appropriate way to provide access to the rezoned land while maintaining access to the existing activities. Although the intersection will increase the number of conflict points at the site entrance, its relocation to the north will increase the separation from other driveways. From a Safe System perspective, the effects on safety are expected to be largely neutral.

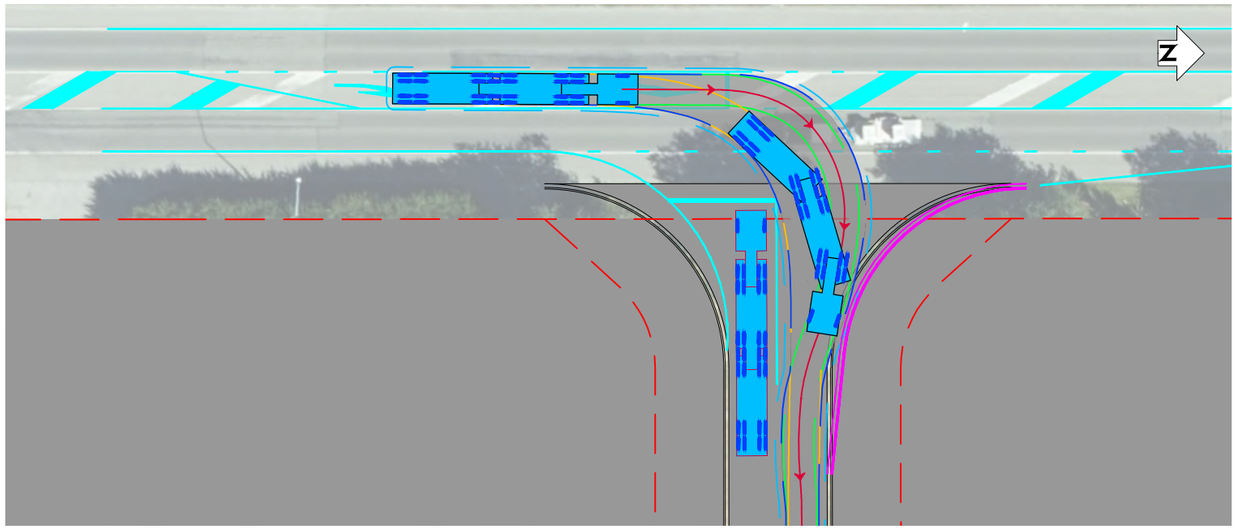
Table C 1: Existing Situation

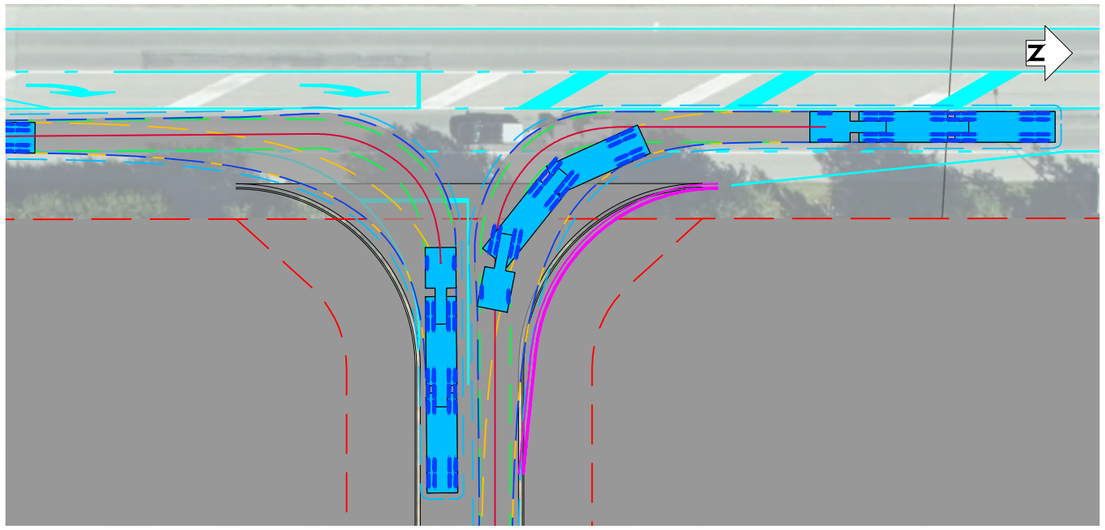
	Run-off road	Head-on	Intersection	Other	Pedestrian	Cyclist	Motorcyclists
Exposure Comments:	SH6 – 13,000 vpd	SH6 – 13,000 vpd	SH6 – 13,000 vpd Driveways – 100 vpd	Nearby driveways Driveways – 100 vpd	SH6 – < 10 per day	SH6 – < 10 per day	SH6 – < 150 per day
Exposure Score:	4/4	4/4	4/4	1/4	1/4	1/4	4/4
Likelihood Comments:	Factors that increase the likelihood include: • Grassed berms	Factors that increase the likelihood include: • No median barriers	Factors that increase the likelihood include: • Conflicting right turns	Factors that increase the likelihood include: • Short separation • Conflicting right turns	Factors that increase the likelihood include: • No footpaths	Factors that increase the likelihood include: • Truck volumes	Factors that increase the likelihood include: • Truck Volumes
	Factors that decrease the likelihood include: • Wide sealed shoulders • Straight road alignment • Lighting	Factors that decrease the likelihood include: • Wide flush median • Straight road alignment • lighting	Factors that decrease the likelihood include: • Wide flush median • Wide, one-way driveways • Stop controls • Good sightlines	Factors that decrease the likelihood include: • Straight road alignment • Good visibility between driveways • Wide sealed shoulders	Factors that decrease the likelihood include: • Wide sealed shoulders	Factors that decrease the likelihood include: • Wide sealed shoulders	Factors that decrease the likelihood include: • Wide sealed shoulders
Likelihood Score:	2/4	1/4	2/4	2/4	1/4	1/4	2/4
Severity Comments:	Factors that increase the severity include: • 80 km/h speed limit • Trees and power poles •	Factors that increase the severity include: • 80 km/h speed limit •	Factors that increase the severity include: • 80 km/h speed limit •	Factors that increase the severity include: • 80 km/h speed limit	Factors that increase the severity include: • 80 km/h speed limit • Truck volumes	Factors that increase the severity include: • 80 km/h speed limit • Truck volumes	Factors that increase the severity include: • 80 km/h speed limit • Truck volumes
	Factors that decrease the severity include: • •	Factors that decrease the severity include: • •	Factors that decrease the severity include: • •	Factors that decrease the severity include: • Decelerating vehicles •	Factors that decrease the severity include: •	Factors that decrease the severity include: •	Factors that decrease the severity include: •
Severity Score:	4/4	4/4	3/4	3/4	4/4	4/4	4/4
Product **(multiply scores above for crash type)**	**32/64**	**16/64**	**24/64**	**6/64**	**4/64**	**4/64**	**32/64**
			TOTAL				**118/448**

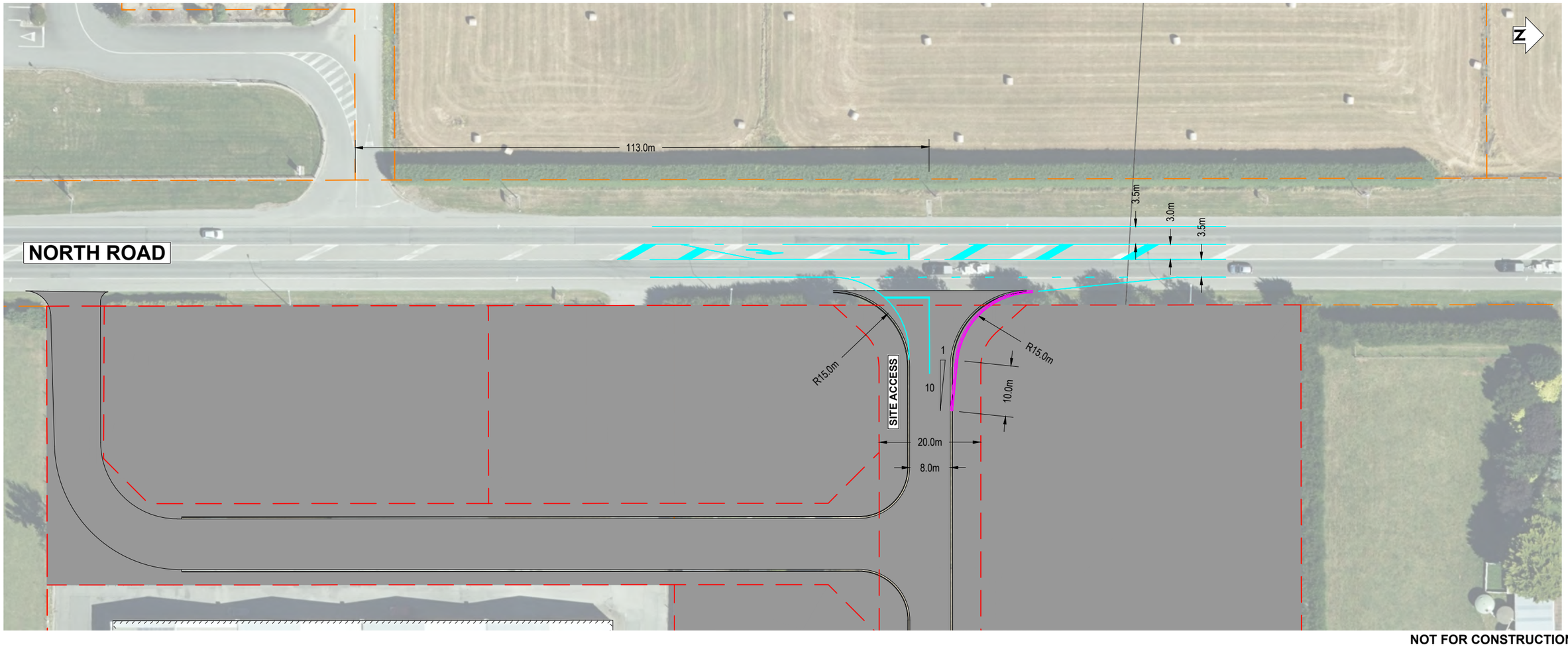
Table C 2: North Road with new intersection

	Run-off road	Head-on	Intersection	Other	Pedestrian	Cyclist	Motorcyclists
Exposure Comments:	SH6 – 13,000 vpd	SH6 – 13,000 vpd	SH6 – 13,000 vpd ~~Driveways – 100 vpd~~ New local road – 1,000 vpd	Nearby driveways Driveways – 100 vpd	SH6 – < 10 per day	SH6 – < 10 per day	SH6 – < 150 per day
Exposure Score:	4/4	4/4	4/4	1/4	1/4	1/4	4/4
Likelihood Comments:	Factors that increase the likelihood include: • Grassed berms •	Factors that increase the likelihood include: • No median barriers •	Factors that increase the likelihood include: • ~~Conflicting right turns~~ • More conflict points with intersection	Factors that increase the likelihood include: • ~~Short separation~~ • ~~Conflicting right turns~~	Factors that increase the likelihood include: • No footpaths •	Factors that increase the likelihood include: • Truck volumes •	Factors that increase the likelihood include: • Truck Volumes •
	Factors that decrease the likelihood include: • Wide sealed shoulders • Straight road alignment • Lighting	Factors that decrease the likelihood include: • Wide flush median • Straight road alignment • lighting	Factors that decrease the likelihood include: • Wide flush median • ~~Wide, one-way driveways~~ • Stop controls • Good sightlines • Right turn bay	Factors that decrease the likelihood include: • Straight road alignment • Good visibility between driveways • Wide sealed shoulders • Separation > 115m	Factors that decrease the likelihood include: • Wide sealed shoulders	Factors that decrease the likelihood include: • Wide sealed shoulders	Factors that decrease the likelihood include: • Wide sealed shoulders
Likelihood Score:	2/4	1/4	2/4	1/4	1/4	1/4	2/4
Severity Comments:	Factors that increase the severity include: • 80 km/h speed limit • Trees and power poles •	Factors that increase the severity include: • 80 km/h speed limit •	Factors that increase the severity include: • 80 km/h speed limit •	Factors that increase the severity include: • 80 km/h speed limit	Factors that increase the severity include: • 80 km/h speed limit • Truck volumes	Factors that increase the severity include: • 80 km/h speed limit • Truck volumes	Factors that increase the severity include: • 80 km/h speed limit • Truck volumes
	Factors that decrease the severity include:	Factors that decrease the severity include:	Factors that decrease the severity include:	Factors that decrease the severity include: • Decelerating vehicles	Factors that decrease the severity include:	Factors that decrease the severity include:	Factors that decrease the severity include:
Severity Score:	4/4	4/4	3/4	3/4	4/4	4/4	4/4
Product (multiply scores above for crash type)	**32/64**	**16/64**	**24/64**	**3/64**	**4/64**	**4/64**	**32/64**
			TOTAL				**115/448**

Appendix D Intersection Concept Design







DO NOT SCALE - IF IN DOUBT, ASK

200 mm 150 100 90 80 70 60 50 40 30 20 10 0

ORIGINAL SIZE A1

NOT FOR CONSTRUCTION

REV	REVISIONS	DRN	CHK	APP	DATE

SURVEYED		
DESIGNED		
DRAWN		
CAD REVIEW		
DESIGN CHECK		
DESIGN REVIEW		
APPROVED	NOT APPROVED	
PROF REGISTRATION:		

Stantec

Client:

805 NORTH ROAD
LORNEVILLE

PROPOSED SITE ACCESS
CONCEPT LAYOUT

Status Stamp: **WORKING PLOT**

Date Stamp: **26.06.2024**

Scales: 1:250@A1 1:500@A3

Drawing No.: 310206118_001_001

Rev.: A

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Appendix C

Council Correspondence

Meredith Ryan

From: Paul Pollard <paul.pollard@es.govt.nz>
Sent: Wednesday, 29 January 2025 10:49 am
To: Meredith Ryan
Subject: RE: [External] FW: 805 - 819 North Road, Industrial Development

CAUTION: This Email is from an EXTERNAL source. Please exercise caution. DO NOT open attachments or click on links from unknown senders or unexpected email.

Hi Meredith

I talked to Colin Young about it yesterday and he thought attenuation wouldn't be necessary but did recommend installing a sump to intercept any sediment before it exits into the Waikiwi Stream trib on the eastern boundary.

Regards, Paul

Paul Pollard
Team Leader Catchment Operations
Environment Southland *Te Taiao Tonga*

P 03 211 5115 |M 021 784 953
Cnr Price St & North Rd, Private Bag 90116, Invercargill 9840
paul.pollard@es.govt.nz|es.govt.nz|facebook.com/environmentsouthland
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From: Meredith Ryan <meredith@bonisch.nz>
Sent: Wednesday, 29 January 2025 10:45 am
To: Paul Pollard <paul.pollard@es.govt.nz>
Subject: RE: [External] FW: 805 - 819 North Road, Industrial Development

Hi Paul,

Just following up to see if you'd managed to look into this query at all?

Thanks,

Meredith Ryan
CIVIL ENGINEER

bonisch

03 218 2546 EXT 219
027 320 1554
0800 802 546
Level 4, 25 Esk Street , Invercargill

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From: Paul Pollard <paul.pollard@es.govt.nz>
Sent: Monday, 27 January 2025 2:17 pm
To: Meredith Ryan <meredith@bonisch.nz>
Subject: RE: [External] FW: 805 - 819 North Road, Industrial Development

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Hi Meridith

Colin usually works here on Tuesday afternoons as he's semi retired so I'll follow up tomorrow unless he sees the earlier message and responds directly

Regards Paul

Paul Pollard
Team Leader Catchment Operations
Environment Southland *Te Taiao Tonga*

P 03 211 5115 |M 021 784 953
Cnr Price St & North Rd, Private Bag 90116, Invercargill 9840
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From: Meredith Ryan <meredith@bonisch.nz>
Sent: Monday, 27 January 2025 2:12 pm
To: Paul Pollard <paul.pollard@es.govt.nz>
Cc: Colin Young <colinshenyoung@gmail.com>
Subject: RE: [External] FW: 805 - 819 North Road, Industrial Development

Hi Paul,

The current intention is to leave the existing drain in situ without realignment etc, so I don't expect there to be any interference with the maintenance access. We may however, be looking at an additional outfall in the southeast of the site to drain the proposed first flush pond.

That would be great if you could follow up with Colin and come back to me,

Thanks,

Meredith Ryan
CIVIL ENGINEER

bonisch

03 218 2546 EXT 219
027 320 1554
0800 802 546
Level 4, 25 Esk Street , Invercargill
Connect with us bonisch.nz

LAND DEVELOPMENT SURVEYING PLANNING CIVIL ENGINEERING

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From: Paul Pollard <paul.pollard@es.govt.nz>
Sent: Monday, 27 January 2025 2:01 pm
To: Meredith Ryan <meredith@bonisch.nz>
Cc: Colin Young <colinshenyoung@gmail.com>
Subject: RE: [External] FW: 805 - 819 North Road, Industrial Development

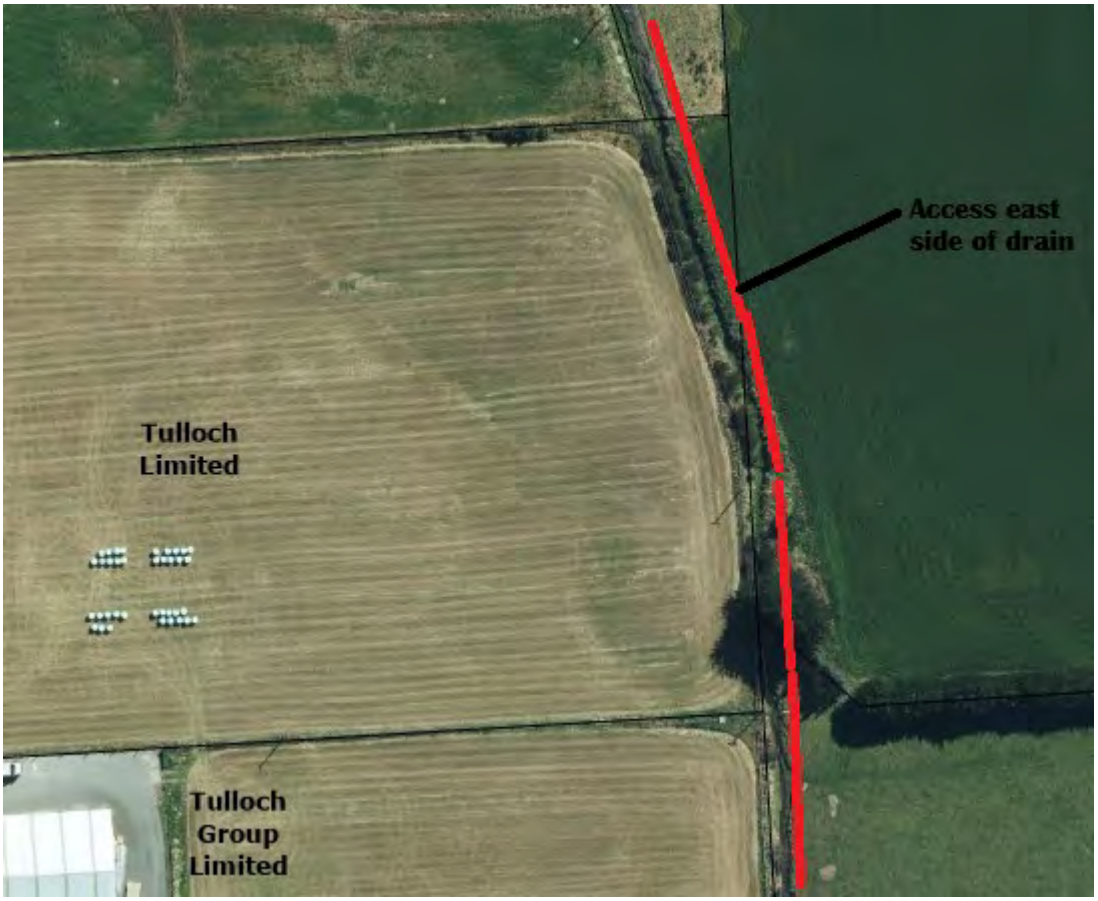
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Hi Meredith

I look after the Lorne Trib drain that runs along the east boundary of the site and we periodically clean the weed and silt out of it to ensure properties upstream have sufficient drainage outfall. Maintenance machinery travels up the eastern side of the drain and technically the upper eastern corner of the Tulloch property cuts across the drain. My question is whether the development work is likely to interfere with this access?

I'll talk to Colin Young about the stormwater when I catchup with him tomorrow.

Regards, Paul



Paul Pollard
Team Leader Catchment Operations
Environment Southland *Te Taiao Tonga*

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From: Meredith Ryan <meredith@bonisch.nz>
Sent: Monday, 27 January 2025 1:37 pm
To: Colin Young <Colin.Young@es.govt.nz>
Cc: Paul Pollard <paul.pollard@es.govt.nz>
Subject: [External] FW: 805 - 819 North Road, Industrial Development

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Hi Colin/Paul,

We are investigating a proposed industrial development at 805 - 819 North Road, Invercargill (proposed plan attached) and currently looking at stormwater discharge from site. The site currently discharges to the drainage channel adjacent the eastern boundary..

This job has been in the pipeline for a number of years and it seems that previously, ES have told us attenuation is not required for discharge to the eastern channel. Can you please confirm this is still the case?

I've been pointed in your direction for this so hopefully you can give us a steer in the right direction, let me know if you need any additional information etc,

Regards,

Meredith Ryan
CIVIL ENGINEER

bonisch

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