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# HARTLEY ROAD PARTNERSHIP

## REQUEST FOR A CHANGE TO THE OPERATIVE CENTRAL OTAGO DISTRICT PLAN LAND PRODUCTIVITY REPORT

| | |
|---|---|
| PROJECT: | Springvale Road, Clyde, Request for a Change to the Operative Central Otago District Plan |
| PRINCIPAL: | Hartley Road Partnership |
| OUR REF: | A5202 |
| DATE: | May 2024 |

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REVISION / APPROVAL PANEL

| Rev: | Date: | Prepared By: | Reviewed By: | Comments: |
|---|---|---|---|---|
| 0 | 2 May 2024 | PLD | DW | Initial Draft |
| 1 | | | | Final |
| | | | | |
| | | | | |

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| | |
|---|---|
| Job No: | A5202 |
| Date | 24 April 2024 |
| Report Prepared For | Hartley Road Partnership |

## Table of Contents

## 1.0 Scope

Paterson Pitts Limited Partnership (PPLP) has been engaged by Hartley Road Partnership to provide a land productivity report to support a private plan change request that seeks to re-zone 6.6ha of land at Springvale Road and SH8 , Clyde from Rural Resource Area to Industrial Resource Area.

Part of the site is mapped as Land Use Capability ("LUC") Class 3 by Landcare Research NZ Ltd . Refer to the Landcare mapping at **Appendix "1"**. The request is therefore subject to the National Policy Statement for Highly Productive Land 2022 ("NPS-HPL") in accordance with sec 3.5 (7) of the NPS-HPL.

This report analyses the productive land capacity of the site and addresses the application of the NPS-HPL to the Request . The report needs to be read in conjunction with the Landscape , Geotechnical and Soil Contamination reports that support the Request

## 2.0 The Site

A topographic plan and soil type map of the site is attached at **Appendix "2"** . The site is described in some detail in the above reports . Approximately ¼ of the site consists of the lower southwest facing slopes of a 120m high terrace riser above the site with the slope angle varying from 15 degrees to 30 degrees . This slope is traversed by the remains of a defunct water race which is to be retained as a stormwater intercept channel.
The southerly aspect and steepness of this slope make it unsuitable for intensive productive use for viticulture or horticulture.

The remainder of the site is a sandy flat covered in depleted dryland pasture and bare ground , part of which is currently used a contractors storage yard . Part of the site was formerly used as a poultry farm for a time , but the site has otherwise never historically been used for productive rural use .

The area of the site suitable for intensive productive rural use is approximately 4.5ha
There is nothing in the soil contamination report that would prevent the 4.5 ha of flat from being used for productive rural use .

The site is a pocket of rural zoned land isolated from other land used for productive rural purposes by roads , the terrace riser, the Clyde urban area , the Clyde cemetery , land used for industrial purposes by Contact Energy , the Central Otago Rail Trail terminus and life- style blocks along Springvale Road .

## 3.0 Soils

The site's soils have been mapped by Landcare Research and the ORC's "Grow Otago" database . The "Grow Otago" mapping is however derived from the Landcare mapping . The soil types are strongly correlated with topography as shown in the plan at **Appendix "2"**

The Landcare and ORC soil mapping and supporting information is attached at **Appendix "3"**

The lower sandy flat soil is classified as Molyneux*f* (Sib 8) by Landcare Research being very a semi-arid , shallow sandy soil , well drained with a Plant Available Water (PAW) profile of 86mm . Grow Otago classifies the soil as Mx3aG being Molyneux stoney sand, flat to gently undulating with low PAW . This soil is utilised elsewhere in the region for horticulture and viticulture , but requires significant irrigation application to realise this potential

The gentler slopes at the foot of the terrace riser are classified as Molyneux*f* (Sib 5) by Landcare Research being a very shallow well drained sandy soil with a PAW of 106mm . Grow Otago classifies the soil as Rp3aR being Ripponvale stoney sand, rolling with low PAW . This soil is commonly used for viticulture and horticulture , but likewise requires significant irrigation . However , the southerly aspect of this soil on this sloping site make it generally unsuitable for viticulture

The steep (30 deg ) slopes of the upper terrace riser are classified as Molyneux*f* (Sib 10) by Landcare Research being a shallow sandy well drained soil with a PAW of 78mm . Grow Otago classifies the soil as Lt2sS being Letts shallow sand , steep with low PAW . These soils are formed on the distinctive steep terrace risers in the Upper Clutha and Lower Manuherikia Valleys which are far too steep to allow any highly productive use , being generally used for very low intensity dryland grazing .

## 4.0 Climate

From the Otago Regional Council's "grow Otago" data base at **Attachment "4"** :

- Growing Degree Days (GDD) for 10deg C base are 951-1000hours
- Median Annual Rainfall is 401-450mm
- Dry summer rainfall is 61-80mm
- Median Summer Rainfall is 101-120mm
- Median potential evapotranspiration (Nov-Dec) is 231- 235mm
- Median potential evapotranspiration (Jan-Feb) is 206-210mm

The high GDD of the site makes it very suitable for intensive productive use of the flatter parts of the site , most likely for viticulture and horticulture , including cherries and all types of pip and stone fruit.

However , given the very high summer moisture deficit of the site , significant Irrigation application is essential to realise this productive potential as is the norm for highly productive land throughout Central Otago . This is particularly so given the site's very high potential evapotranspiration rate over the summer growing season and low Plant Available Water (PAW) of the site, due to its light sandy/gravelly soils.

## 5.0 Irrigation/Frost Fighting Water Requirements and Water Supply Availability

The Otago Regional Council has prepared a report **Guidelines for Reasonable Irrigation Water Requirements in the Otago Region C15000 dated 24/07/2017**
( the "Aqualinc Report" ) . Relevant extracts from the Aqualinc Report are at **Appendix "5"**

The relevant irrigation water demand from the report is as follows

| Crop | Area (ha) | Maximum Daily Demand (mm) | Maximum Daily Demand (m3) | Seasonal Demand (mm) 90% | Seasonal Demand (m3)90% |
|---|---|---|---|---|---|
| Pasture | 4.5 | 4.8 | 216 | 773 | 37,785 |
| Viticulture | 4.5 | 2.42 | 109 | 217 | 9,765 |
| Stone & Pip fruit | 4.5 | 5.3 | 239 | 724 | 32,580 |

As a check on these Otago specific requirements , Irrigation NZ's generic New Zealand wide on-line calculator (prepared by Aqualinc) at **Appendix "5"** gives the following very similar results :

Pasture – 238m3/day & 33,786m3/year
Viticulture – 99m3/day & 7,160m3/year
Stone fruit – 225m3/day & 31,869m3/year

Significant amounts of water will also be required for frost fighting for viticulture and horticulture , given that the proximity of the site to the Clyde Township will prevent the use of frost fans . At an allowance of a 6mm/hour application rate over a 6 hour frost event over 4.5ha for up to 8 events per season will require 12,960m3 of water per season . As the application period is much less than the irrigation daily application period , storage is normally required . This will require a storage dam of approximately 8500m2 , further reducing the area available for crop growing .

In conclusion , large amounts of irrigation and frost fighting water will be required to realise any highly productive use of the site . However the site does not have access to an irrigation supply , either from a reticulated irrigation scheme or from a potential groundwater source . Please refer to the attached letter at **Appendix "6"** from the Manuherikia Irrigation Co-operative Society Ltd dated 18 January 2000 which stated that the site had no water entitlement from the Manuherikia Scheme . The Requestor advises that the situation has not changed since then . Given that the upcoming setting of a minimum flow for the Manuherikia River under a new Regional Land and Water Plan will almost certainly result in a reduction in the scheme's allowable take out of the river , it is highly unlikely that a block of water will be available from the scheme in the future . An attempt was made on 23 December 1999 to drill for water on the site by the then McNeil Drilling Company Ltd . The well was dry and the Requestor was advised that there was *"no groundwater potential from clay bound gravels "* . See bore log at **Appendix "6"**

## 6.0 Reverse Sensitivity Effects

Frost fans will not be able to comply with the noise requirements of standard 4.7.6 E ( c) of the Operative District Plan ("ODP") due to the proximity of the site to the Clyde Residential Area which includes Dunstan Hospital and a retirement village . A further constraint on the use of the site for horticulture and viticulture is that audible bird deterrent devices will also not be able to comply with noise standard 4.7.6E(b) of the ODP due to the aforementioned proximity. Other potential reverse sensitivity effects on the Clyde Residential Area include spray drift, night shooting for rabbit control and machinery noise, particularly at night .

In general horticulture and viticulture are incompatible with closely adjoining residential neighbourhoods . The use of frost fans and audible bird scaring devices in particular are a persistent and ongoing source of controversy and complaints to the Central Otago District Council from residents in the Cromwell , Clyde and Alexandra townships , Pisa Moorings , Bannockburn etc and their surrounding lifestyle blocks .

## 7.0 National Policy Statement on Highly Productive Land 2022 (NPS-HPL)

The Landcare LUC mapping in Attachment A shows the site to be subject to LUC Class 3 and LUC Class 6 classification . The mapping does not correlate well with the detailed topography of the site in that the steep unproductive terrace riser within the site is mapped as LUC class 3 while half of the potentially productive lower flat is classed as LUC 6 . However this is likely a consequence of the small (1:25,000) regional scale of the mapping.

### 7.1 Policies and Objectives

The Objectives and Policies of the NPS-HPL are :

**Objective 2.1** : *Highly productive land is recognised as a resource with finite characteristics and long-term values for land-based primary production.*

**Policy 2.2 (1) :** *Highly Productive land is recognised as a resource with finite characteristics and long – term values for land-based primary production.*

Comment : It is acknowledged that part of the site is potentially suitable for highly productive use . However the lack of a suitable irrigation supply and potential reverse sensitivity effects with the adjacent Clyde residential area effectively prevents this potential from ever being realised

**Policy 2.2 (4) :** *The use of highly productive land for land-based primary production is prioritised and supported .*

Comment : See above comments under policy 2.2 (1)

**Policy 2.2 (5) :** *The urban re-zoning of highly productive land is avoided , except as provided for in this National Policy Statement*

Comment : See discussion below under clauses 3.6 , 3.9 ,3.10 of the NPS-HPL for an explanation of how the Request complies with the exception provisions of the NPS-HPL

**Policy 2.2 (8) :** *Highly Productive Land is protected from inappropriate use and development*

Comment : Given that it is not possible to realise the productive potential of the site , re-zoning the site for industrial activity is not an inappropriate use of the site

**Policy 2.2 (9) :** *Reverse Sensitivity effects are managed so as not to constrain land-based primary production activities on highly productive land*

Comment : The site is an isolated pocket of rural zoned land which is at least a kilometre away from any other land used for land-based primary production on highly productive land . Zoning the site industrial will have no reverse sensitivity effects on highly productive land . In fact , the opposite is the case as the proximity of the Clyde residential area creates reverse sensitivity effects within Clyde consequent on the use of the site itself for highly productive use .

## 7.2 Clauses 3.6 (4) & (5)

These clauses provide that :

*(4) Territorial authorities that are not Tier 1 or 2 may allow urban rezoning of highly productive land only if :*

- *(a) The urban zoning is required to provide sufficient development capacity to meet expected demand for housing or business land in the district; and*
- *(b) There are no other reasonably practical and feasible options for providing the required development capacity ; and*
- *(c) The environmental , social, cultural and economic benefits of re-zoning outweigh the environmental , social and economic costs associated with the loss of highly productive land for primary based production , taking into account both tangible & intangible values*

*(5) Territorial authorities must take measures to ensure that the spatial extent of any urban zone covering highly productive land is the minimum necessary to provide the required development capacity while achieving a well-functioning urban environment*

Comment : As outlined in the Economic Assessment prepared by Savvy Consulting there is a requirement for sufficient development capacity to be provided at Clyde for industrial use and this site is the best practicable option and of sufficient size to provide that capacity . There is other land on the opposite side of Springvale Road that is currently used for industrial purposes under a scheduled activity in the ODP . However use of this land is restricted to the scheduled activity (Clyde Storage Shed) associated with the Clyde & Roxburgh Hydro Dams . The Economic Assessment also finds that the economic benefits of re-zoning outweigh the economic costs associated with the loss

of highly productive land . Given that it is not possible to realise the primary based productive capacity of the land in any case , there will be no actual loss of highly productive land and therefore no environmental , social and economic costs associated with the loss of highly productive land .

## 7.3 Clause 3.9 (3)

This clause provides that

*Territorial authorities must take measures to ensure that any use or development on highly productive land :*

*(a) Minimises or mitigates any actual loss or potential cumulative loss of the availability and productive capacity of highly productive land in their district; and*

*(b) Avoids if possible , or otherwise mitigates any actual or potential reverse sensitivity effects on land-based primary production activities from the use or development*

Comment: There is no actual loss of highly productive land , given the land's productive potential cannot be realised. The site is remote from other land used for highly productive rural purposes , therefore no reverse sensitivity effects arise from Industrial use of the site

## 7.4 Clause 3.10 Exemption for highly productive land subject to permanent or long-term constraints

This clause provides that :

*(1) Territorial authorities may only allow highly productive land to be subdivided, used , or developed for activities not otherwise enabled under clauses 3.7,3.8, or 3.9 if satisfied that :*

*(a) There are permanent or long-term constraints on the land that mean the use of the highly productive land for land-based primary production is not able to be economically viable for at least 30 years ; and*

Comment : The lack of a suitable irrigation supply and reverse sensitivity effects with the adjoining Clyde township are permanent and fatal constraints on the use of the site for highly productive land-based primary production .

*(b) The subdivision ,use, or development :*

*(i) Avoids any significant loss ( either individually or cumulatively ) of productive capacity of highly productive land in the district ; and*

*(ii) Avoids the fragmentation of large and geographically cohesive areas of highly productive land ; and*

*(iii) Avoids if possible , or otherwise mitigates , any potentially reverse sensitivity effects on surrounding land-based primary production from the subdivision use , or development ; and*

Comment : As the site cannot be used for highly productive purposes, there is no actual loss of highly productive land . The site is not part of a large and geographically cohesive area of highly

productive land . The site is remote from any other area of highly productive land subject to the NPS-HPL , therefore no reverse sensitivity issues arise

*(c) the environmental , social , cultural and economic benefits of the subdivision, use or development outweigh the long-term environmental , social , cultural and economic costs associated with the loss of highly productive land for land-based primary production , taking into account both tangible and intangible values*

Comment : refer to the comments under clause 3.6(4) ( c) in para 7.2 above

*(2) In order to satisfy a territorial authority as required by subclause 1 (a) , an applicant must demonstrate that the permanent or long term constraints on economic viability cannot be addressed through any reasonably practicable options that would retain the productive capacity of the highly productive land , by evaluating options such as (without limitation ) :*

*(a) alternate forms of land-based primary production:*
*(b) improved land management strategies:*
*(c) alternative production strategies:*
*(d) water efficiency or storage methods:*
*(e) reallocation or transfer of water and nutrient allocations:*
*(f) boundary adjustments(including amalgamations):*
*(g) lease arrangements*

Comment : The fundamental issue at stake is that any form of highly productive land-use in Central Otago , be it horticulture , viticulture , cropping , market gardening or pastoral use requires irrigation regardless of what land management strategy or alternative production strategy is used . The site does not have access to an irrigation water supply and there are no alternative water allocations available and it is highly unlikely they will ever be available , given the likely outcome of the upcoming new Regional Policy Statement and Land and Water Plan. A boundary adjustment with other adjoining land is not an option .

*(3) Any evaluation under subclause (2) of reasonably practical options :*

*(a) must not take into account the potential economic benefit of using the highly productive land for the purposes other than land-based primary production; and*
*(b) must consider the impact that the loss of the highly productive land would have on the landholding on which the highly productive land occurs ; and*
*(c) must consider the future productive potential of land-based primary production on the highly productive land, not limited by past or present uses*

Comment : This evaluation does not consider the economic benefit of the use of the land for industrial purposes . As the landholding cannot actually be used for land-based highly productive purposes, there is no adverse impact on the landholding ( "landholding" as defined in in the Resource Management (National Environmental Standard for Freshwater) Regulations 2020 ). This evaluation does not consider past or present uses of the site in assessing its productive land use capacity.

*(4) The size of the land holding in which the highly productive land use is not of itself a determinant of a permanent long-term constraint.*

Comment : This evaluation does not consider the size of the land holding as a constraint on its productive capacity . It is acknowledged that 4.5ha of highly productive land is a viable unit for horticulture , in particular cherries , or viticulture.

## 8.0 Conclusion

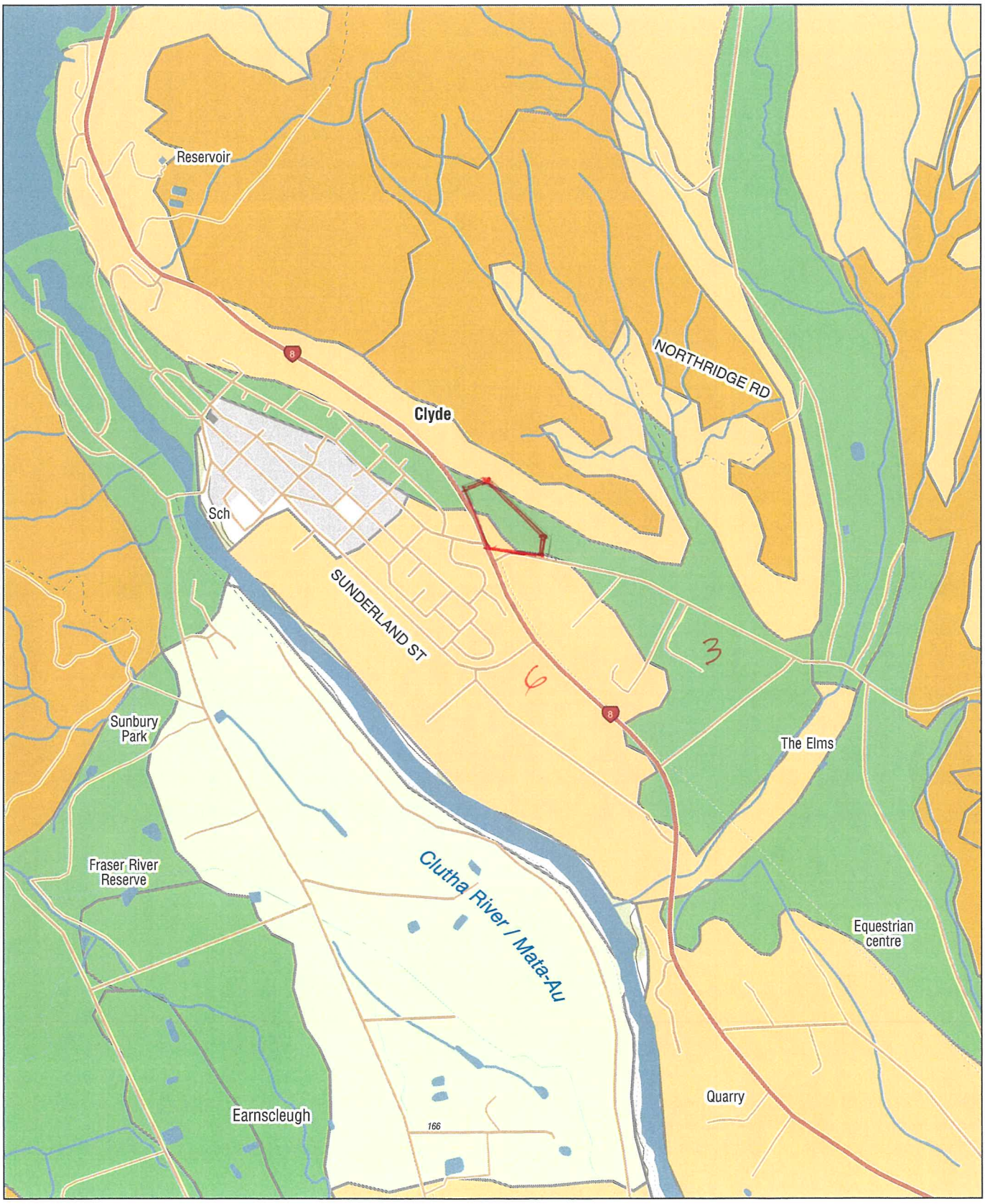
Although the topography of a large part of the site and the site's climate and soils make it suitable for highly productive use , the lack of an irrigation and frost fighting water supply means that this productive potential cannot be realised . Potential reverse sensitivity issues with the adjacent Clyde Township , including a hospital and retirement village, further inhibit realisation of the site's productive potential .

The Request complies with all of the exception criteria in the NPS-HPL that enables Council to rezone a site of highly productive land for non-rural use .

Peter Dymock
B.Sc, Dip Mgt, R.P. Surv, MNZIS, CSNZ
Paterson Pitts Limited Partnership

# APPENDIX 1

Landcare LUC Mapping




**OUR**ENVIRONMENT

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Scale: 1:25,000

0 200 400 600 800m

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# Legend

## Land Use Capability

- LUC Class 1
- LUC Class 2
- LUC Class 3
- LUC Class 4
- LUC Class 5
- LUC Class 6
- LUC Class 7
- LUC Class 8

OURENVIRONMENT

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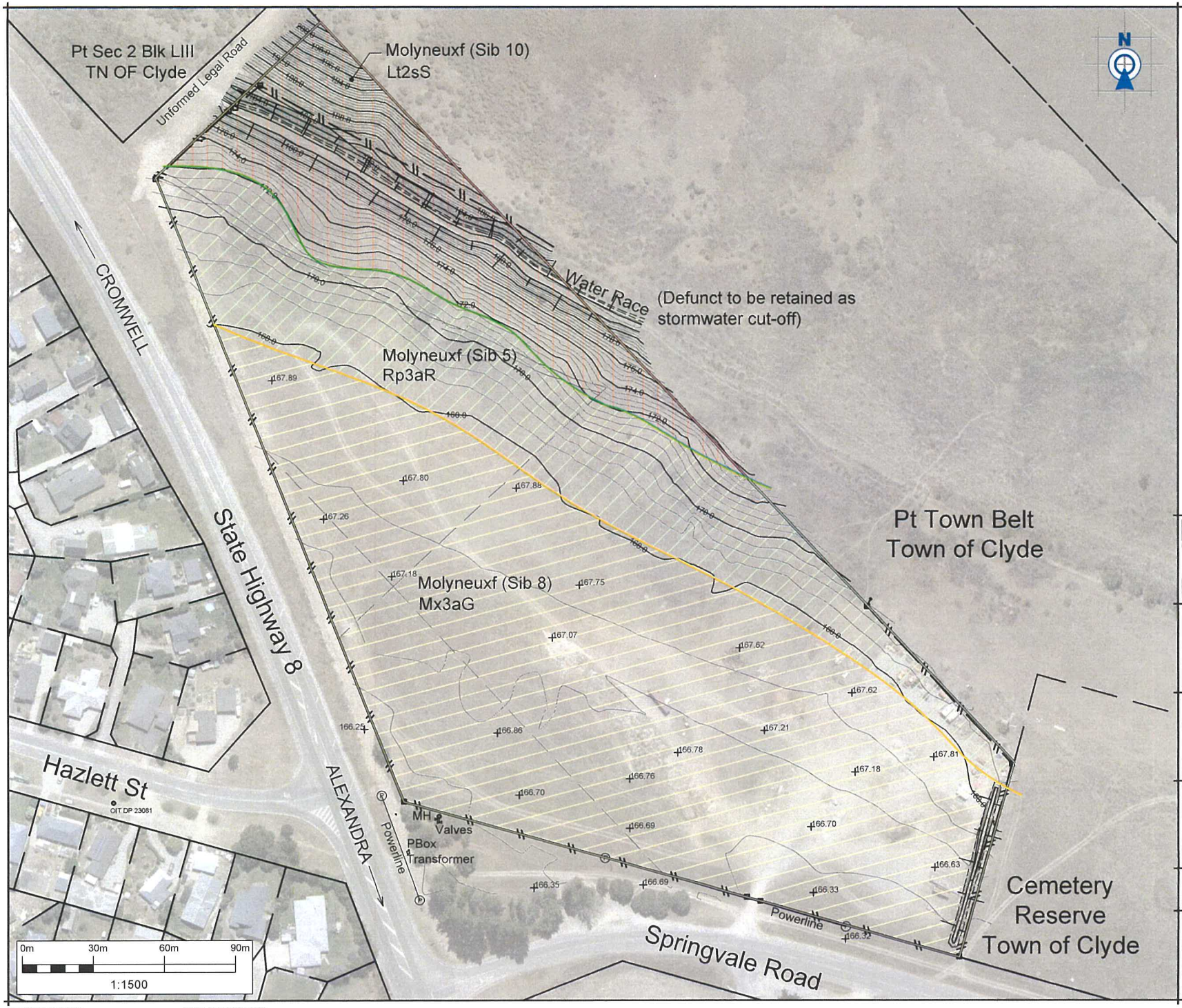
# APPENDIX 2

Topographic Plan & Soil Type Map




NOTES:

Coordinates are in terms of Lindis Peak 2000.

Elevation in Terms of:
NZVD 2016 Level Datum

Origin of Levels
IT DP 23081 (EWEG)
RL= 166.30m

Contour Intervals = 0.50m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Client & Location

Hartley Road Partnership

Purpose & Drawing Title

TOPO PLAN
& SOIL TYPE

FOR INFORMATION

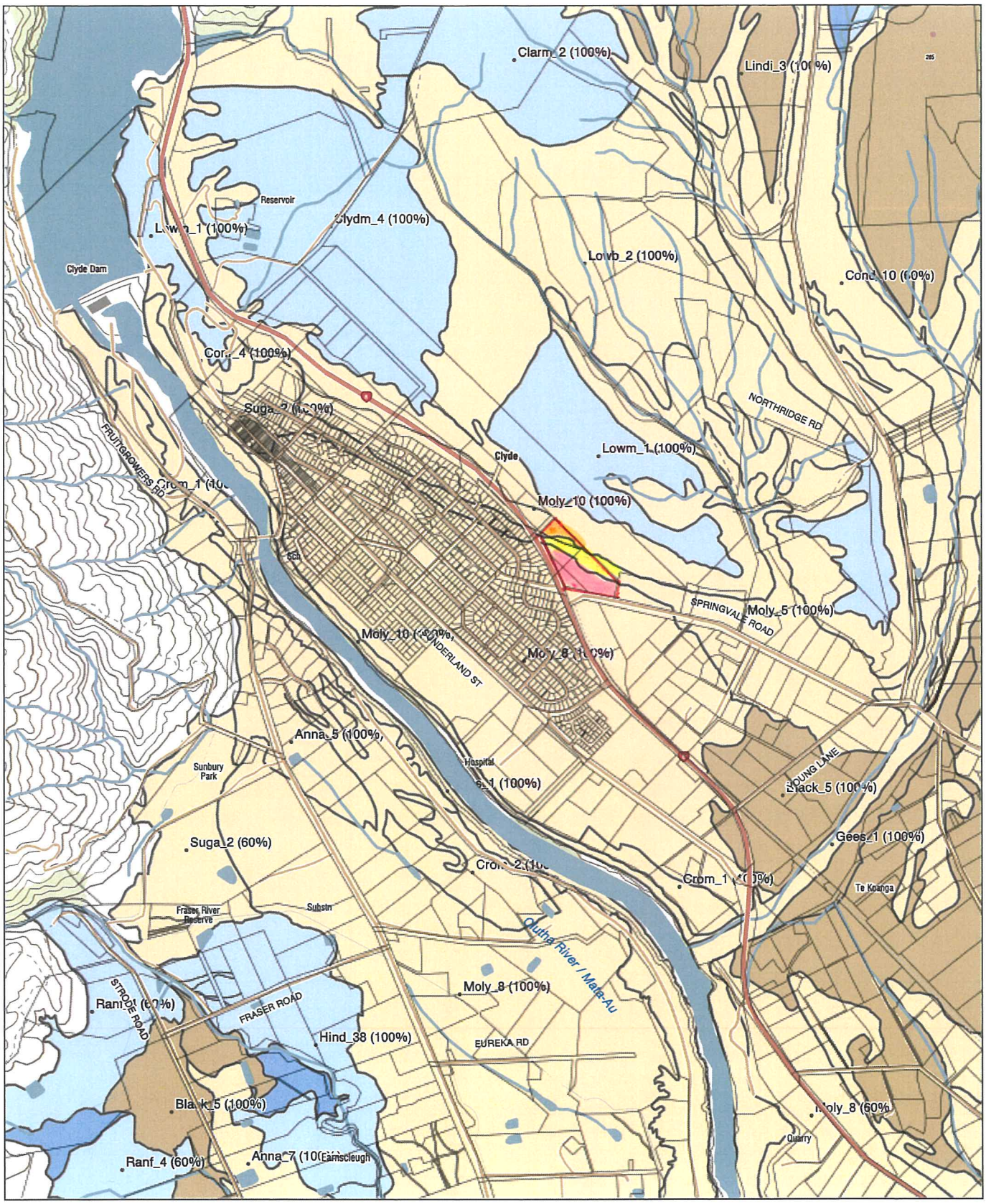
| | | | | |
|---|---|---|---|---|
| Surveyed by | BD | Original Size | Scale | |
| Designed by | | A3 | 1:1500 | |
| Drawn by | KWG | | | |
| Checked by | PD | | DO NOT SCALE | |
| Approved by | PD | | | |
| Job No | Drawing No | Sheet No | Revision No | Date |
| A5202 | TOPO | 2 | A | 24/04/2024 |

# APPENDIX 3

Landcare & ORC Soil Mapping

Molynaux f (Si68) Molynaux f (Si55)

Molynaux f (Si510)




S-MAPONLINE

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Scale: 1:25,000

0 200 400 600 800m

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# Legend

## Soil Drainage

- Very Poorly Drained
- Poorly Drained
- Imperfectly drained
- Moderately well drained
- Well drained

## Polygons & Labels

- S-map soil data

S-MAPONLINE

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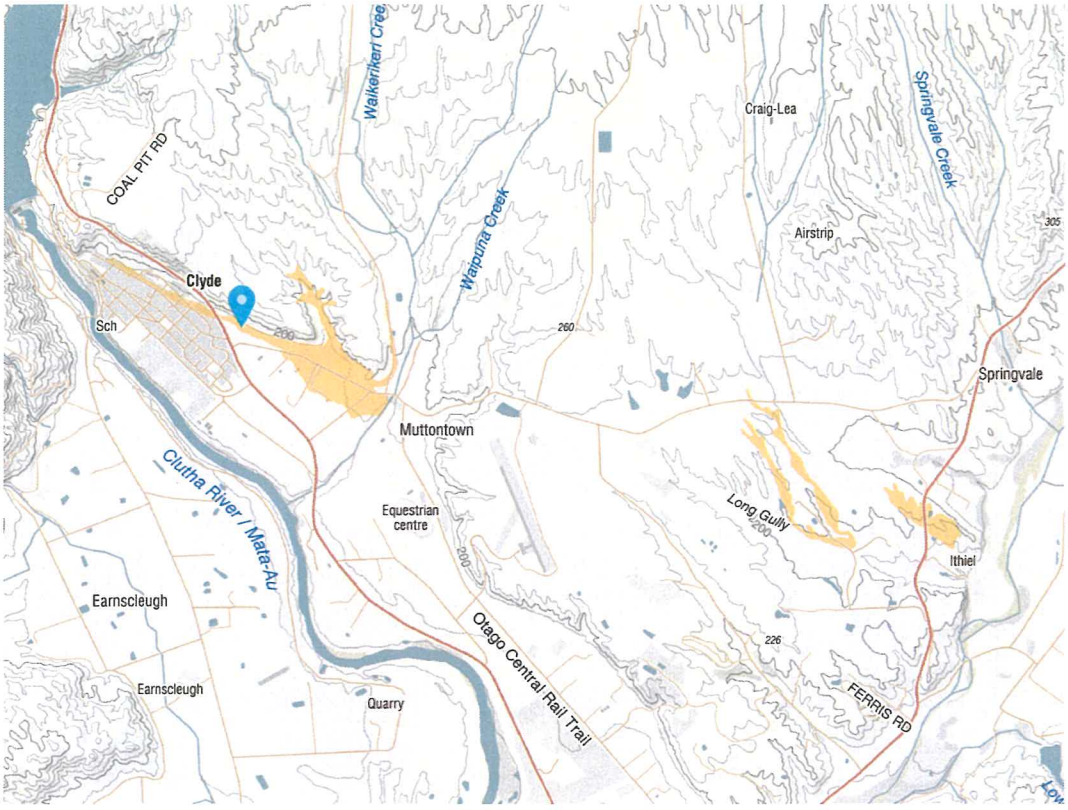
Molyneux (Sis5)

# Soil map unit factsheet

Report generated: 18/04/2024 from https://smap.landcareresearch.co.nz/maps-and-tools/app/?gislayer=Otago&soilmapuc=Rp3aR&factsheetType=undefined&siblingNumber=undefined&objectId=undefined&pinCoordinate=1312142.8149154412%2C4989172.7

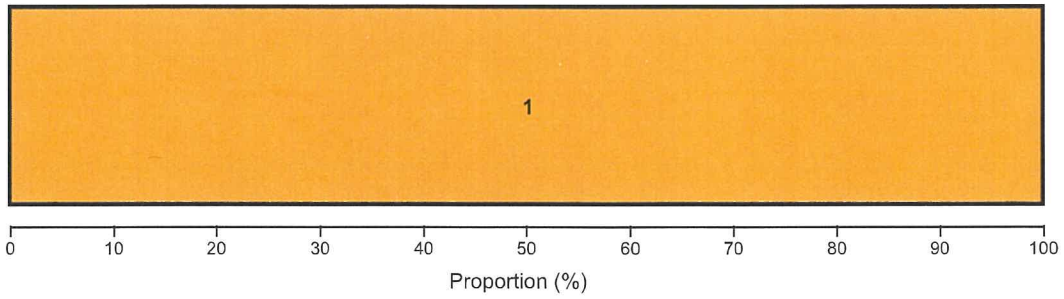
Areas with Otago\Rp3aR map unit code are shown on the map below. A soil map unit is a collection of areas that have the same soils (i.e. siblings) in the same proportion.




Map contains data sourced from LINZ. Crown Copyright Reserved

## Proportion of siblings in this map unit

Graph is coloured according to the NZSC soil order of each sibling within this map unit.




**Sibling**

1: Molyneux_5a.1 (100%)

**Soil Order**

Semiarid

## Soil properties of the siblings within the soil map unit

This table shows the details of the soil siblings within the map unit. The profile available water (Paw) is a measure of the capacity of the soil sibling to store water to a depth of 1 metre. Click the links below to find out more about each item:

Soil Order, Drainage Class, Depth Class

| No. | Smap name | Proportion (%) | Depth | Texture | Drainage class | PAW (mm) | Order |
|---|---|---|---|---|---|---|---|
| 1 | Molyneux_5a.1 | 100 | Very Shallow | sand | Well drained | 106.5 | Semiarid |

## Soil Survey

This soil mapunit was mapped within the following soil survey:

**Survey Title:** Grow Otago
**Survey Scale:** 50000
**Survey Date:** 2010 to 2014
**Origin:** legacy update major
**Map Unit Delineation Method:** Hand-drawn
**Map Unit Labelling Method:** Observations
**Sibling Base Property Classification Method:** Observations
**Description:** Low to moderate predictability, minimal soil observations, or a relatively coarse mapping for the scale of variation.

## Landform

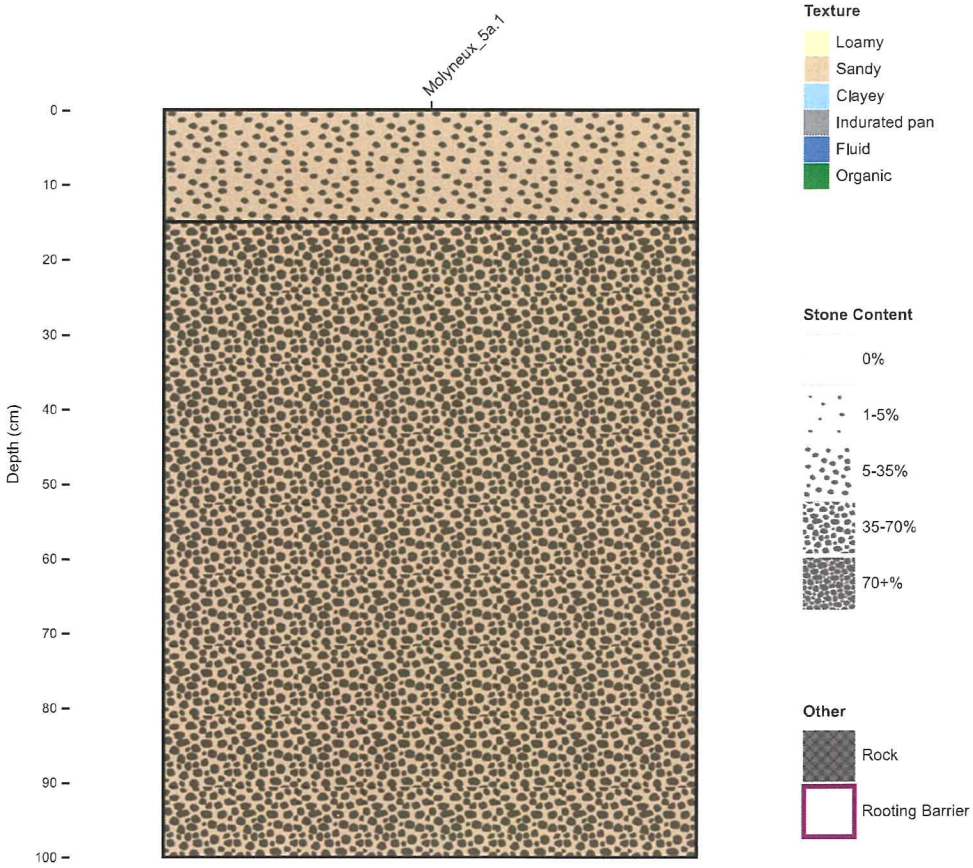
The landform tree hierarchy below shows where the selected soil mapunit fits within the wider landscape

**Land province** - Otago basins and ranges
Prominent steep-sided and flat to rolling broad-crested ranges with tors, separated by wide deformation controlled flat-floored sediment-filled basins and valleys with extensive glacial moraine, outwash terraces, and recent valley fill. Predominately schist (tz IIa – tz IV) with minor Torlesse sedimentary rocks of acid-intermediate quartzo- feldspathic composition. Tertiary aged sedimentary soft rock inliers incorporating minor alkali to basaltic volcanics underlie the floor floors, with remnants present on ridge crests as outliers and fringe the coastline in places. Extensive loess mantles lower elevation slopes.

- **Land region** - Valley floors
  Flat-floored sediment-filled basins and valleys with extensive glacial moraine, outwash terraces, and recent valley fill.
  - **Land subregion** - Terraces and Fans
    - **Land system** - Young fans
      - **Land unit** - Greywacke alluvium
        Young greywacke fans < 12,000 yrs old (Q1a), with a semi-arid climate <540mm/yr, and a subxerous to dry-subhygrous moisture regime. Typical soils include shallow and shallow and stony Immature Semiarid Soils.

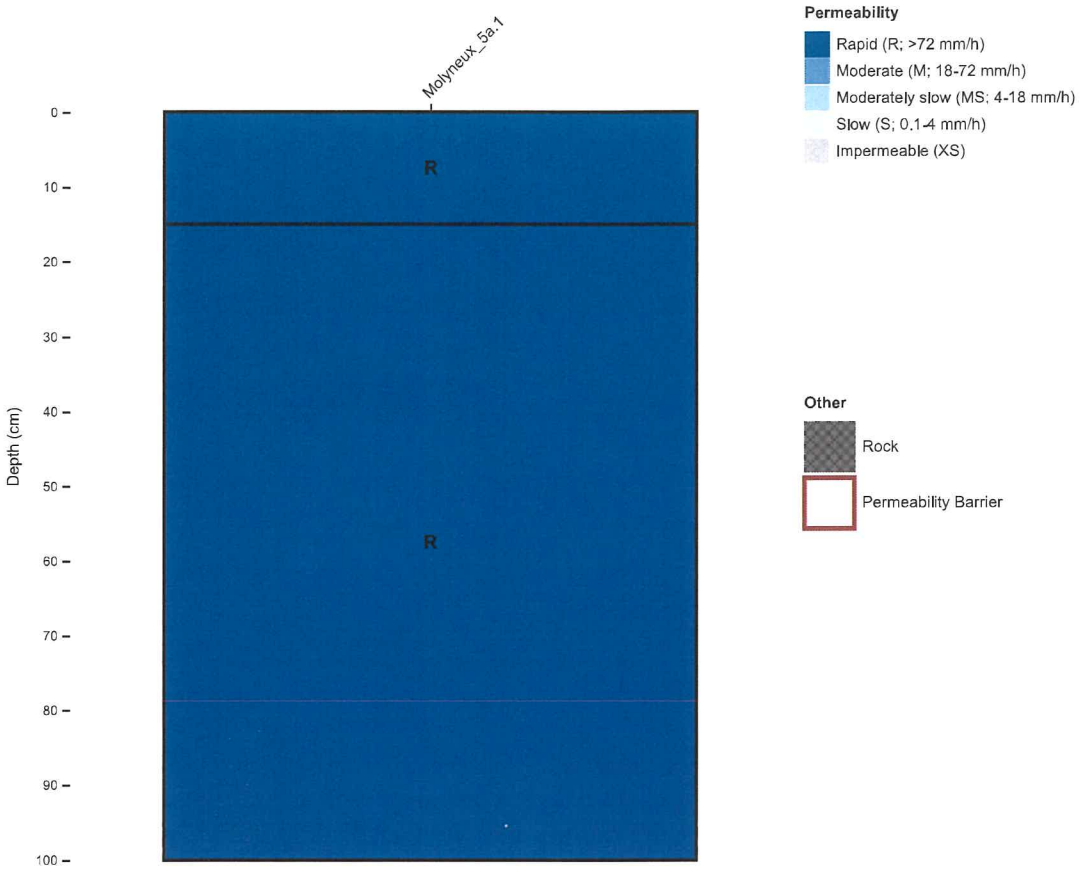
## Texture graph

This graph shows the texture profile of the siblings found in the map unit. Each horizon is coloured according to its texture.



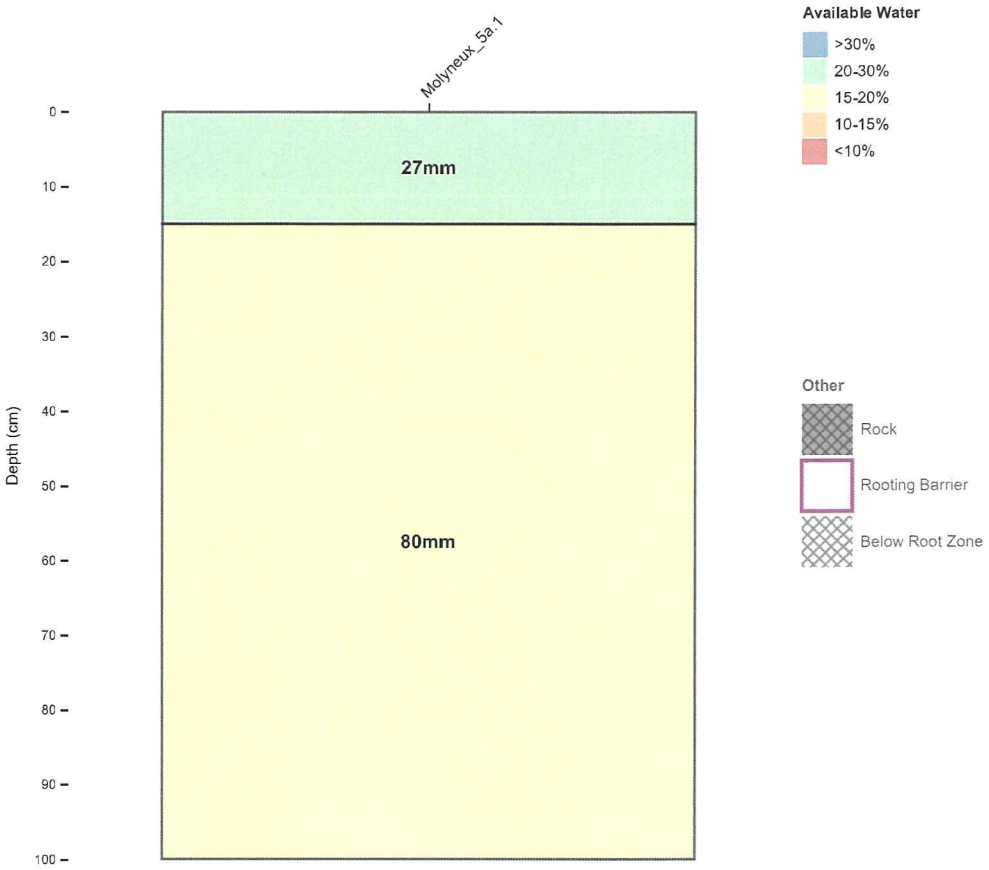
## Permeability graph

This graph shows the permeability profile of the siblings found in the map unit. Each horizon is coloured according to its permeability. Click here for more information on permeability.



## Available Water Graph

This graph shows the available water profile of the siblings found in the map unit. This is capacity of the soil to hold water that is available to plants. Each horizon is coloured according to its percent available water content. Click here for more information on available water.



**About this publication**

- This information sheet describes the typical average properties of the specified soil map unit.
- For further information on individual soils, contact Landcare Research New Zealand Ltd
- Advice should be sought from soil and land use experts before making decisions on individual farms and paddocks.
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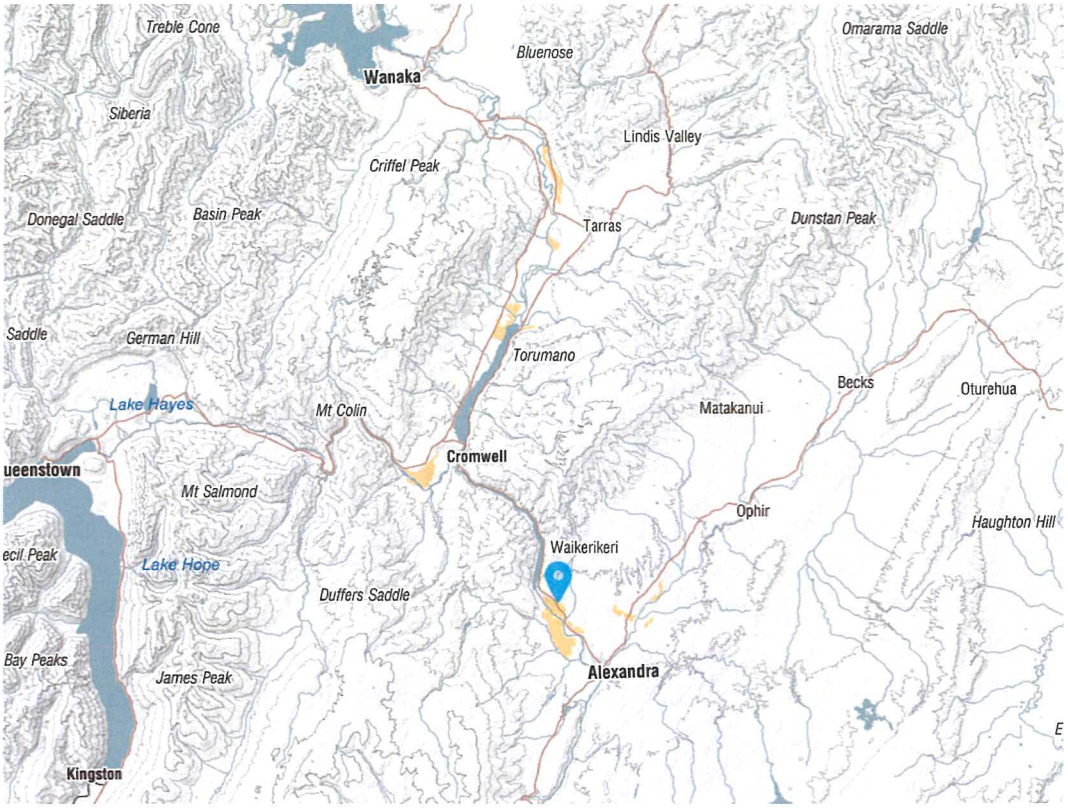
Mdg near f (Sib &)

# Soil map unit factsheet

Report generated: 18/04/2024 from https://smap.landcareresearch.co.nz/maps-and-tools/app/?gislayer=Otago&soilmapuc=Mx3aG&factsheetType=undefined&siblingNumber=undefined&objectId=undefined&pinCoordinate=1312104.7349838007%2C4989078.6

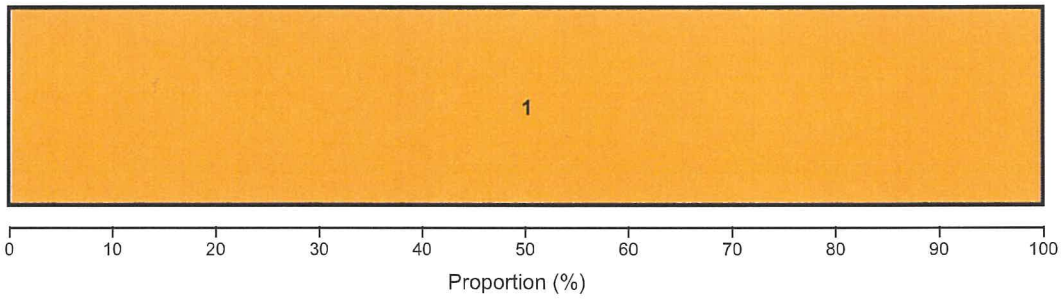
Areas with Otago\Mx3aG map unit code are shown on the map below. A soil map unit is a collection of areas that have the same soils (i.e. siblings) in the same proportion.






## Proportion of siblings in this map unit

Graph is coloured according to the NZSC soil order of each sibling within this map unit.




**Sibling**

1: Molyneux_8a.1 (100%)

**Soil Order**

Semiarid

## Soil properties of the siblings within the soil map unit

This table shows the details of the soil siblings within the map unit. The profile available water (Paw) is a measure of the capacity of the soil sibling to store water to a depth of 1 metre. Click the links below to find out more about each item:

Soil Order, Drainage Class, Depth Class

| No. | Smap name | Proportion (%) | Depth | Texture | Drainage class | PAW (mm) | Order |
|---|---|---|---|---|---|---|---|
| 1 | Molyneux_8a.1 | 100 | Very Shallow | sand | Well drained | 86.2 | Semiarid |

## Soil Survey

This soil mapunit was mapped within the following soil survey:

**Survey Title:** Grow Otago
**Survey Scale:** 50000
**Survey Date:** 2010 to 2014
**Origin:** legacy update major
**Map Unit Delineation Method:** Hand-drawn
**Map Unit Labelling Method:** Observations
**Sibling Base Property Classification Method:** Observations
**Description:** Low to moderate predictability, minimal soil observations, or a relatively coarse mapping for the scale of variation.

## Landform

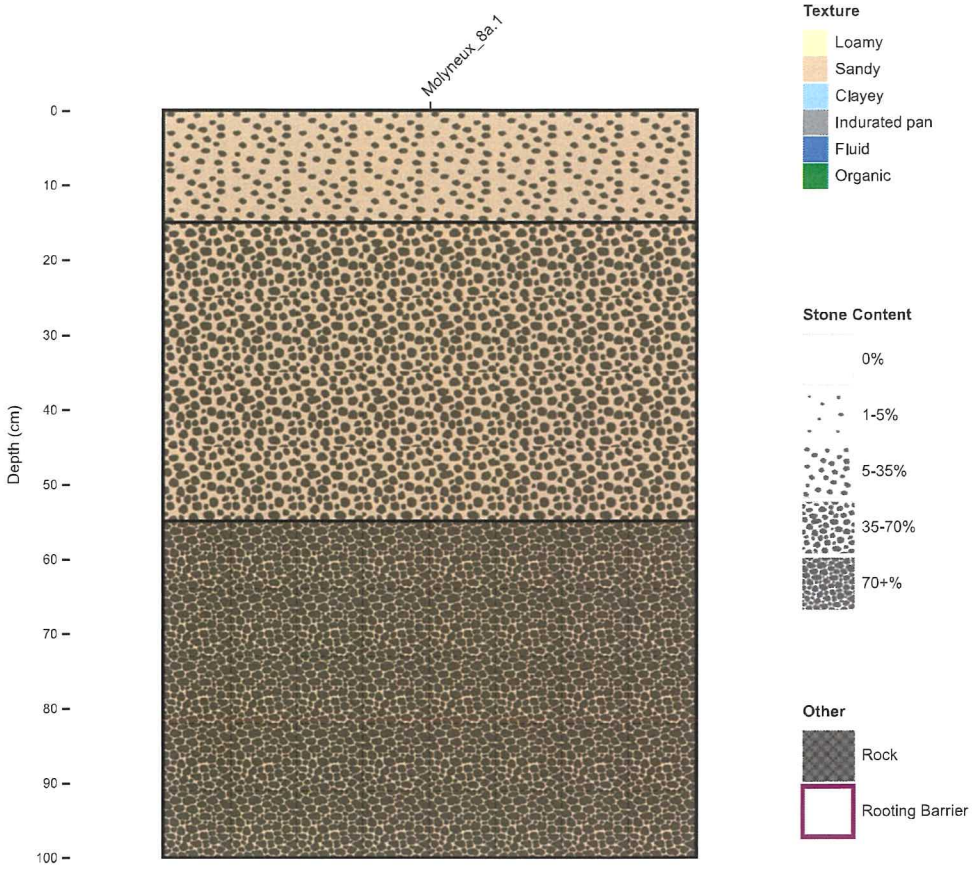
The landform tree hierarchy below shows where the selected soil mapunit fits within the wider landscape

**Land province** - Otago basins and ranges
Prominent steep-sided and flat to rolling broad-crested ranges with tors, separated by wide deformation controlled flat-floored sediment-filled basins and valleys with extensive glacial moraine, outwash terraces, and recent valley fill. Predominately schist (tz IIa – tz IV) with minor Torlesse sedimentary rocks of acid-intermediate quartzo- feldspathic composition. Tertiary aged sedimentary soft rock inliers incorporating minor alkali to basaltic volcanics underlie the floor floors, with remnants present on ridge crests as outliers and fringe the coastline in places. Extensive loess mantles lower elevation slopes.

- **Land region** - Valley floors
  Flat-floored sediment-filled basins and valleys with extensive glacial moraine, outwash terraces, and recent valley fill.
  - **Land subregion** - Terraces and Fans
    - **Land system** - Intermediate terraces
      - **Land unit** - Greywacke (including tuffaceous greywacke) alluvium
        Intermediate aged terraces of greywacke alluvium, >12,000 yrs old, (>Q2a), with a semi-arid (<540mm/yr) or moist (<760mm/yr) climate, and a dry-subhygrous or subhygrous soil moisture regime. Typical soils include moderately deep and shallow Immature Semiarid, Argillic and Laminar Argillic Semiarid Soils, Mottled Fragic, Argillic-mottled Fragic, and Typic Argillic Pallic Soils, and Pallic Orthic Brown Soils.

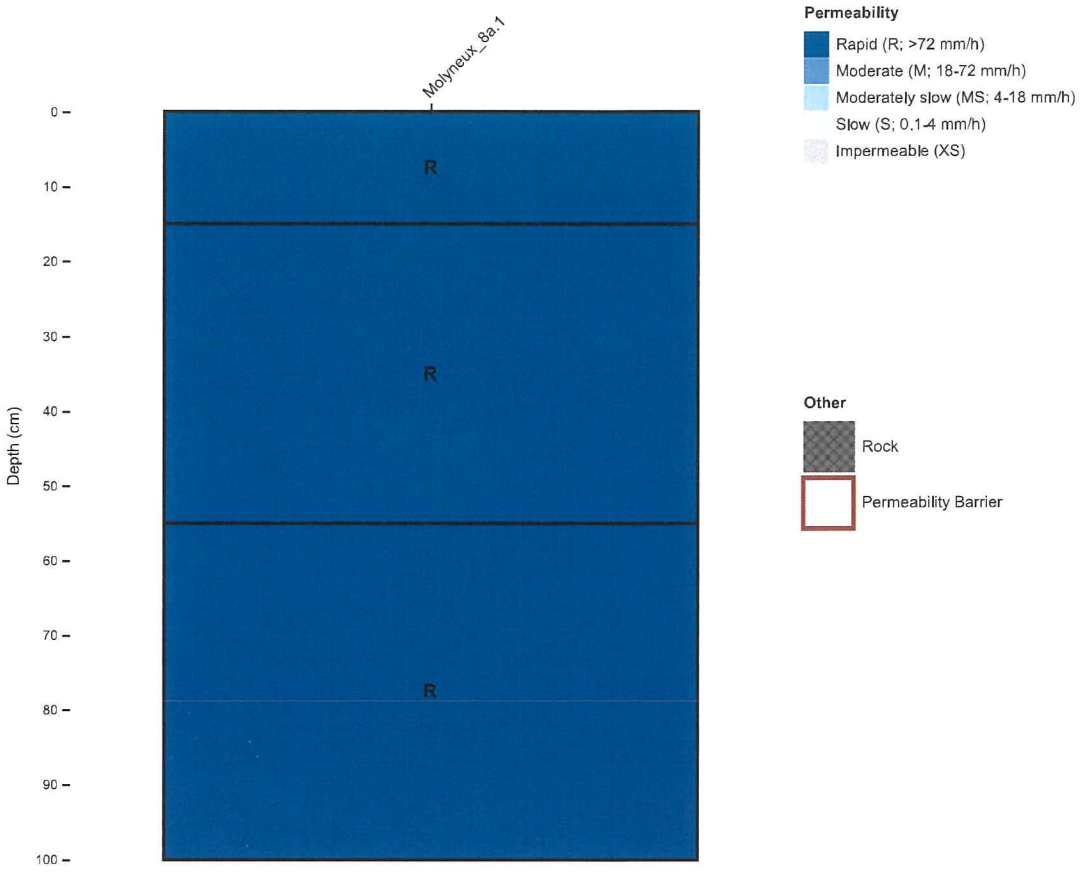
## Texture graph

This graph shows the texture profile of the siblings found in the map unit. Each horizon is coloured according to its texture.



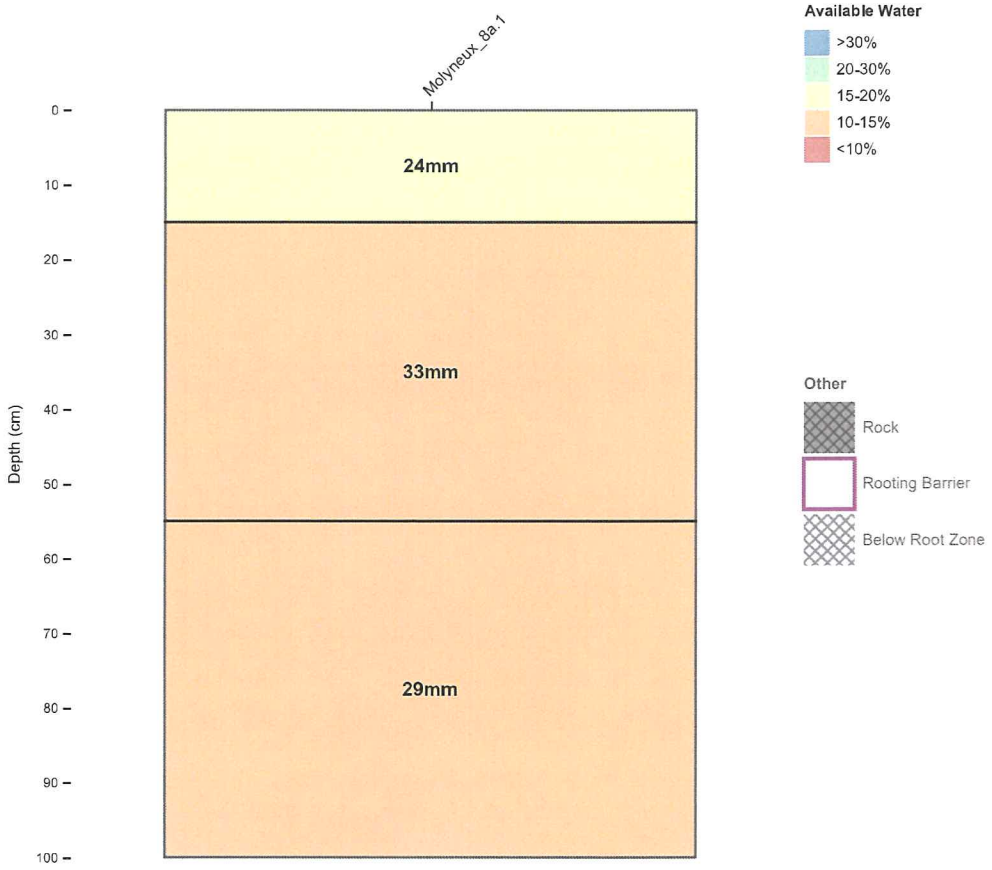
## Permeability graph

This graph shows the permeability profile of the siblings found in the map unit. Each horizon is coloured according to its permeability. Click here for more information on permeability.



## Available Water Graph

This graph shows the available water profile of the siblings found in the map unit. This is capacity of the soil to hold water that is available to plants. Each horizon is coloured according to its percent available water content. Click here for more information on available water.



**About this publication**

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- For further information on individual soils, contact Landcare Research New Zealand Ltd
- Advice should be sought from soil and land use experts before making decisions on individual farms and paddocks.
- The information has been derived from numerous sources. It may not be complete, correct or up to date.
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- Landcare Research shall not be liable on any legal basis (including without limitation negligence) and expressly excludes all liability for loss or damage howsoever and whenever caused to a user of this factsheet.

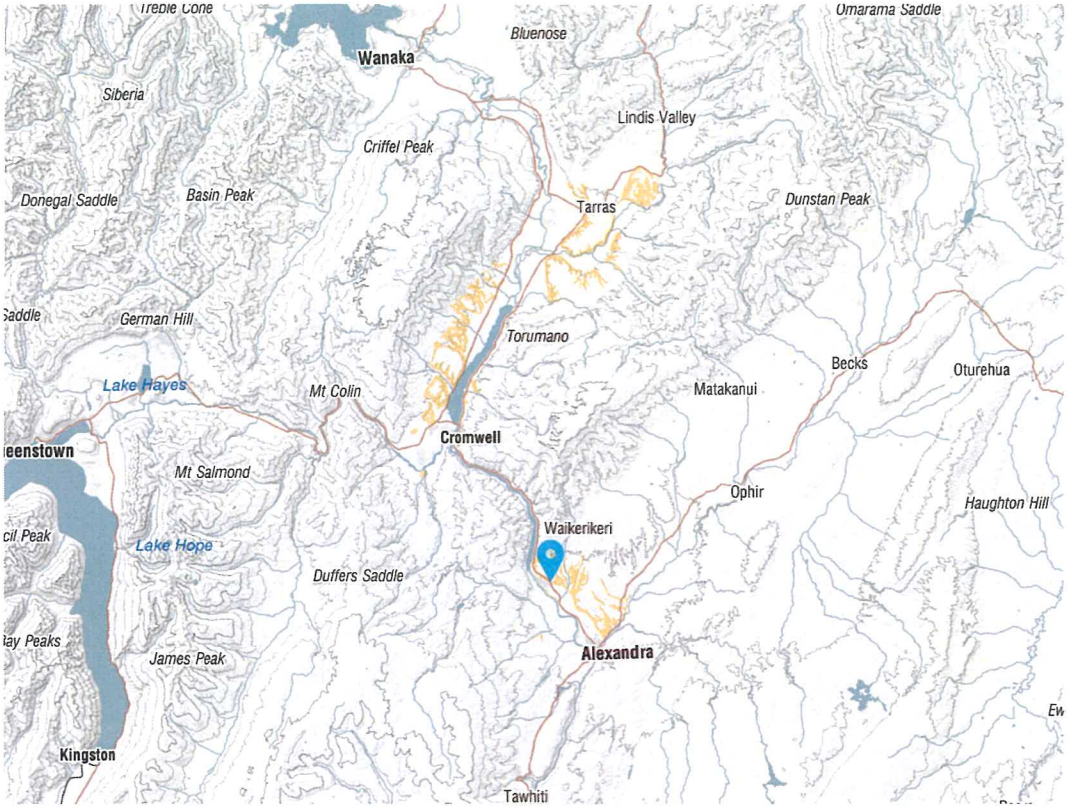
Manaaki Whenua
Landcare Research

Molyneux f (Si5i0)

# Soil map unit factsheet

Report generated: 18/04/2024 from https://smap.landcareresearch.co.nz/maps-and-tools/app/?gislayer=Otago&soilmapuc=Lt2sS&factsheetType=undefined&siblingNumber=undefined&objectId=undefined&pinCoordinate=1311992.7349838007%2C4989338.51

Areas with Otago\Lt2sS map unit code are shown on the map below. A soil map unit is a collection of areas that have the same soils (i.e. siblings) in the same proportion.




Map contains data sourced from LINZ. Crown Copyright Reserved

## Proportion of siblings in this map unit

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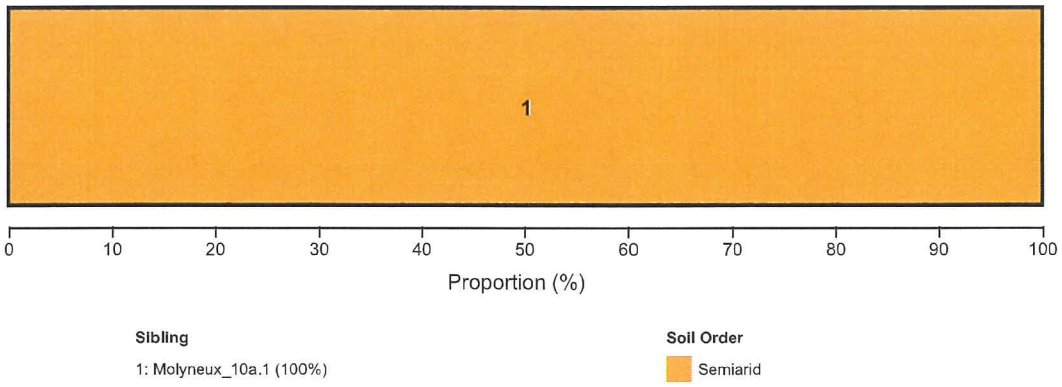


| Sibling | Soil Order |
|---|---|
| 1: Molyneux_10a.1 (100%) | Semiarid |

## Soil properties of the siblings within the soil map unit

This table shows the details of the soil siblings within the map unit. The profile available water (Paw) is a measure of the capacity of the soil sibling to store water to a depth of 1 metre. Click the links below to find out more about each item:

Soil Order, Drainage Class, Depth Class

| No. | Smap name | Proportion (%) | Depth | Texture | Drainage class | PAW (mm) | Order |
|---|---|---|---|---|---|---|---|
| 1 | Molyneux_10a.1 | 100 | Shallow | sand | Well drained | 78.6 | Semiarid |

## Soil Survey

This soil mapunit was mapped within the following soil survey:

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**Survey Scale:** 50000
**Survey Date:** 2010 to 2014
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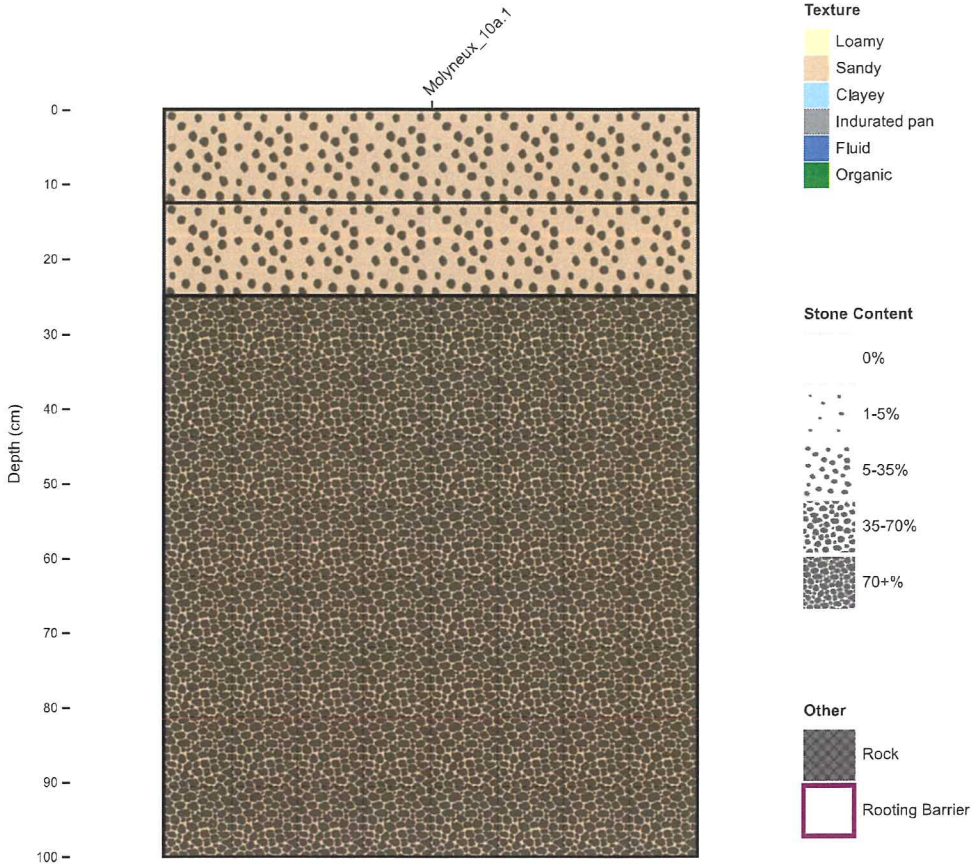

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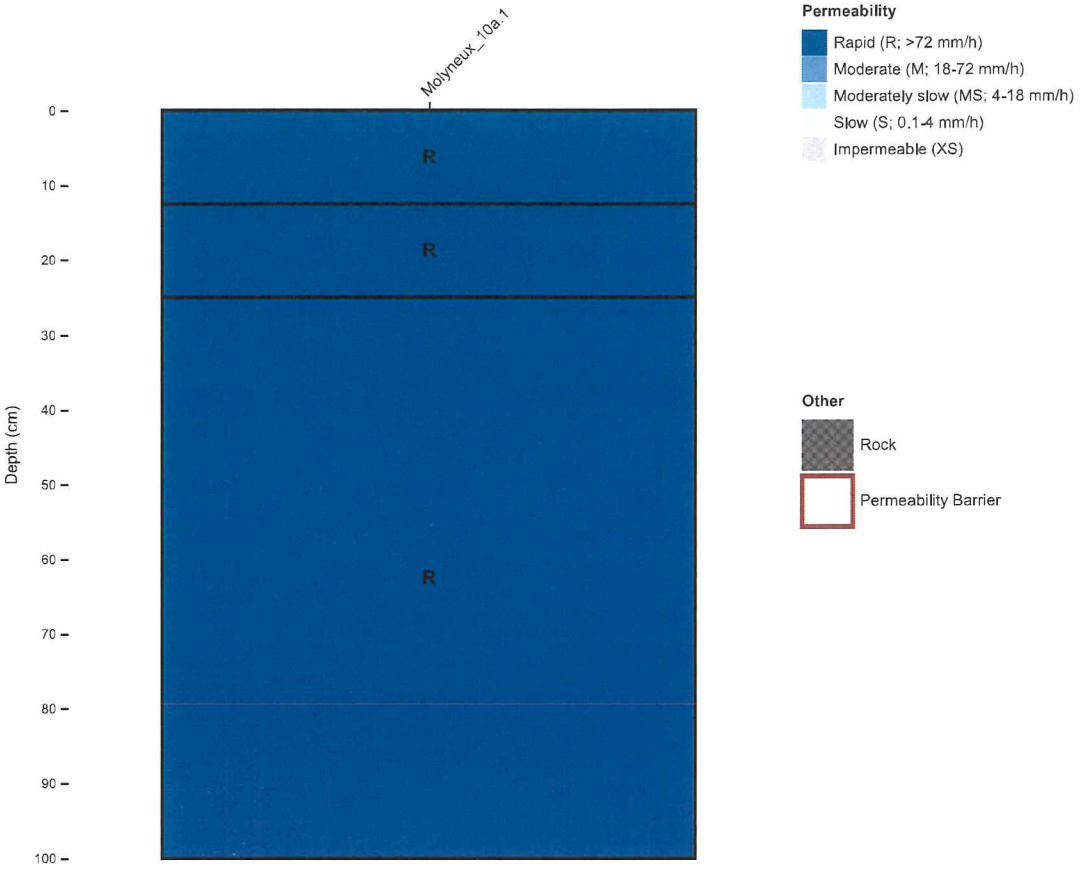

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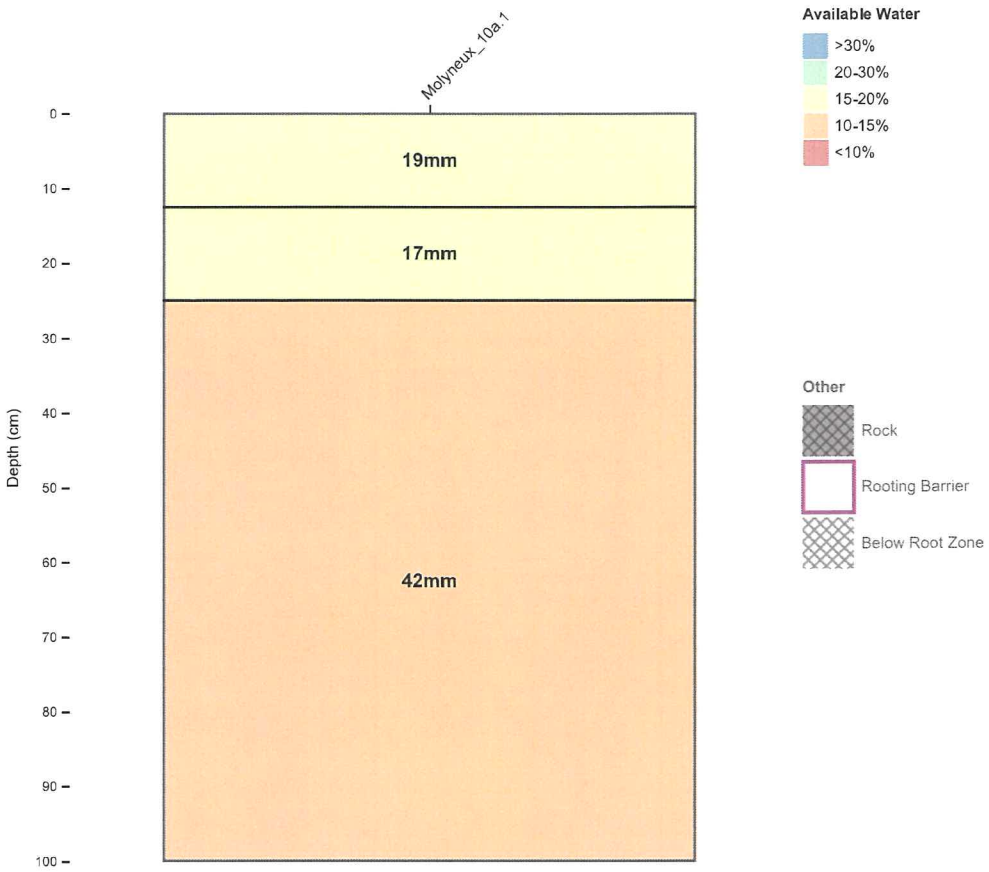

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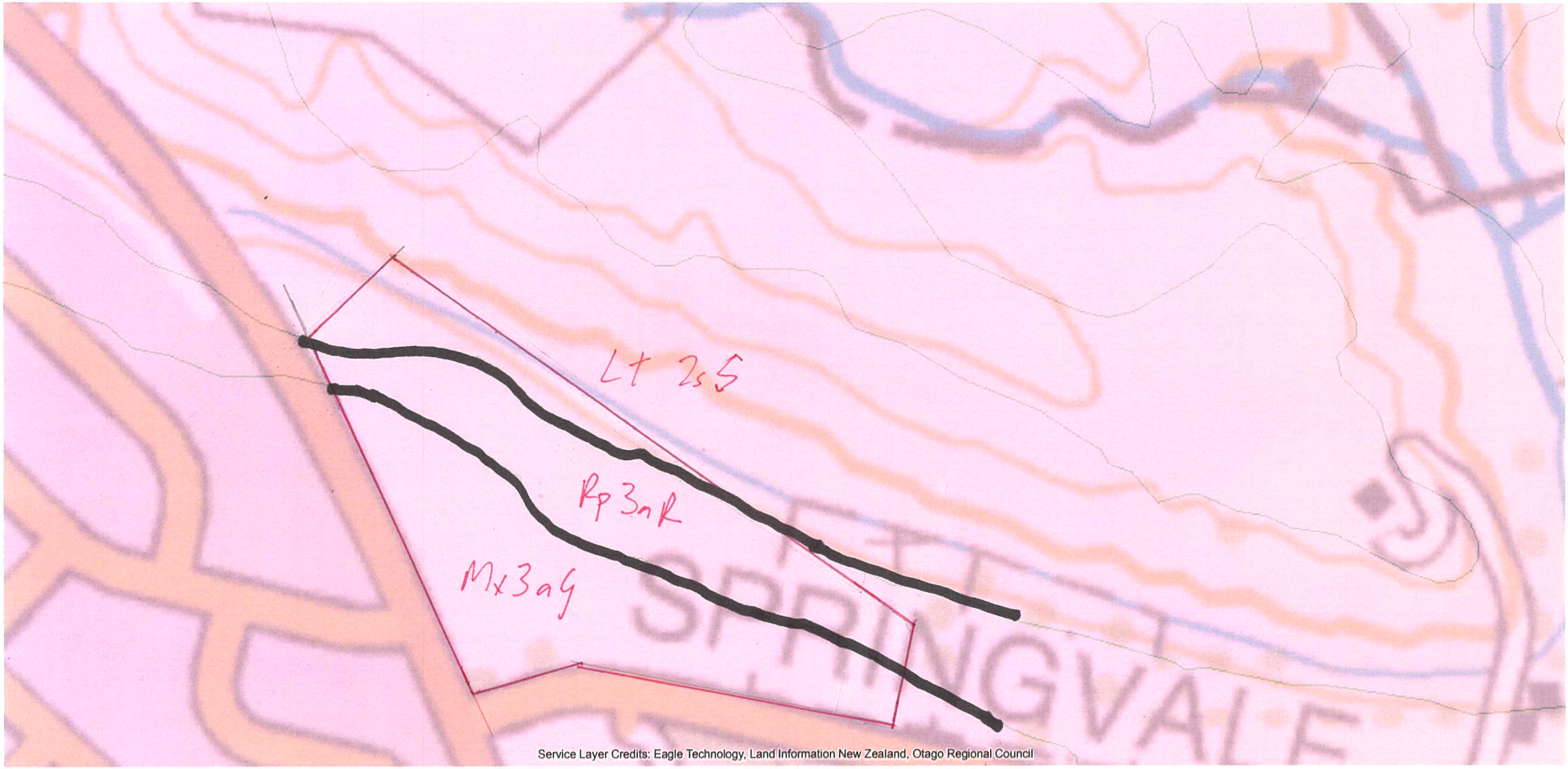
Manaaki Whenua
Landcare Research

# Otago Maps Soils




Semiarid soils

0 0.05 0.1 0.2
Kilometres

North

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## Soil Type Codes

This Help page shows how to interpret the **GrowOtago** Maps soil codes.

The colours on the soil map show the first two levels, Order and Group, of the New Zealand Soil Classification (NZSC) (Hewitt 1998 Landcare Research Science Series No. 1)

The next section shows how the lowland codes are constructed. The subsequent sections list the codes, both lowland and upland.

## Interpreting Lowland Soils Codes

### Example: Gd0sU^M

| | | |
|---|---|---|
| Series | Gd | Gladbrook |
| Depth | 0 | deep |
| Texture | s | sandy loam |
| Slope | U | undulating |
| Phase | ^M | mottled phase |

**Gd0sU^M** = Gladbrook deep sandy loam, undulating, mottled phase

**Depth**

| | | |
|---|---|---|
| 0 | >90cm | deep |
| 1 | 45-90cm | moderately deep |
| 2 | 20-45cm | shallow |
| 3 | 10-20cm | stony |
| 4 | <10cm | very stony |

**Texture**

| | |
|---|---|
| a | sand |
| b | loamy sand |
| b/a | loamy sand on sand |
| b/z | loamy sand on silt loam |
| c | clay loam |
| c/d | clay loam on silty clay |
| d | silty clay |
| d/a | silty clay on sand |
| d/b | silty clay on loamy sand |
| d/c | silty clay on clay loam |
| d/s | silty clay on sandy loam |
| d/z | silty clay on silt loam |
| e | clay |
| f | fine sandy loam |
| f/a | fine sandy loam on sand |
| f/c | fine sandy loam on clay loam |

| | |
|---|---|
| f/p | fine sandy loam on peaty loam |
| f/s | fine sandy loam on sandy loam |
| f/z | fine sandy loam on silt loam |
| o | peat |
| o/b | peat over loamy sand |
| o/d | peat over silty clay |
| o/f | peat over fine sandy loam |
| o/p | peat over peat loam |
| p | peaty loam |
| p/c | peaty loam over clay loam |
| p/d | peaty loam silty clay |
| p/s | peaty loam over sandy loam |
| p/z | peaty loam over silt loam |
| q | loamy peat |
| q/z | peaty loam over silt loam |
| r/a | slight peaty clay loam on sand |
| r/b | slight peaty clay loam on loamy sand |
| r/z | slight peaty clay loam on silt loam |
| s | sandy loam |
| s/a | sandy loam on sand |
| s/c | sandy loam on clay loam |
| s/z | sandy loam on silt loam |
| y | loamy silt |
| y/a | loamy silt on sand |
| y/b | loamy silt on loamy sand |
| y/d | loamy silt on silty clay |
| y/o | loamy silt on peat |
| z | silt loam |
| z/a | silt loam on sand |
| z/b | silt loam on loamy sand |
| z/c | silt loam on clay loam |
| z/d | silt loam on silty clay |
| z/e | silt loam on clay |
| z/f | silt loam on fine sandy loam |
| z/o | silt loam on peat |
| z/p | silt loam on peaty loam |
| z/s | silt loam on sandy loam |
| z/y | silt loam on loamy silt |

**Slope**

| | | |
|---|---|---|
| G | 0-3Â° | gently undulating |
| H | 16-25Â° | hilly |
| R | 8-15Â° | rolling |
| S | >25Â° | steep |
| U | 4-7Â° | undulating |

**Phase**

| | |
|---|---|
| B | bouldery phase |
| BM | "bouldery, mottled phase" |
| C | complex |
| D | disturbed variant |

| | |
|---|---|
| E | eroded variant |
| G | strongly gleyed variant |
| J | argillic variant |
| JM | argillic mottled variant |
| M | mottled phase |
| MX | "mottled, weakly saline phase" |
| MXX | "mottled, moderately saline phase" |
| P | peaty phase |
| T | thickened topsoil variant |
| U | undifferentiated |
| W | raw variant |
| X | weakly saline phase |
| Y | moderately saline phase |
| Z | strongly saline phase |

## Lowland Codes

| | |
|---|---|
| Ab | Abbotsford |
| Ac | Arcadia |
| Ad | Ardlussa |
| Ae | Andrews |
| Ai | Airedale |
| Aj | Ardlui |
| Ak | Akatore |
| An | Annan |
| Ao | Arrow |
| Ar | Arthurton |
| As | Ainsley |
| At | Athol |
| Au | Ardgour |
| Aw | Awamoko |
| Ax | Alexandra |
| Bb | Bannockburn |
| Bc | Blackmans |
| Bd | Bendigo |
| Be | Becks |
| Beach | Beach |
| Bi | Bickerstaff |
| Bk | Brassknocker |
| Bl | Blackstone |
| Bn | Benio |
| Bo | Bortons |
| Br | Brighton |
| Bs | Brookstead |
| Bt | Bungtown |
| Bw | Berwick |
| By | Broad Bay |
| Ca | Charlton |
| Cb | Camphill-Beck |
| Cc | Conical Hill |

| | |
|---|---|
| Cd | Cluden |
| Ce | Carrick |
| Cf | Chalmers |
| Cg | Cargill |
| Ch | Chatto |
| Ck | Crookston |
| Cl | Clare |
| Cm | Claremont |
| Cn | Clinton |
| Co | Conroy |
| Cp | Camphill |
| Cq | Chapman |
| Cr | Craigdale |
| Cs | Chasm |
| Ct | Chatton |
| Cu | Clutha |
| Cv | Clydevale |
| Cw | Cromwell |
| Cx | Conroy-Becks |
| Cy | Clyde |
| D | Disturbed |
| Db | Drybread |
| Dd | Dunedin |
| Di | Diamond |
| Dk | Dukes |
| Dl | Darnley |
| Dn | Dunstan |
| Dp | Dip |
| Dt | Dart |
| Ed | Eden |
| Ee | Eely |
| Ef | Enfield |
| El | Earnscleugh |

| | |
|---|---|
| Em | Tima |
| En | Earnslaw |
| Estuary | Estuary |
| Ev | Evansdale |
| Ew | Eweburn |
| Ey | Eyre |
| Fd | Fereday |
| Fk | Frankton |
| Fm | Fleming |
| Fr | Ferndale |
| Fs | Fraser |
| Ft | Felton |
| Gb | Gibbston |
| Gd | Gladbrook |
| Gf | Greenfield |
| Gh | Glenlea |
| Gi | Glenfield |
| Gl | Glasnevin |
| Gn | Glenure |
| Gr | German |
| Gt | Georgetown |
| Gv | Glenavy |
| Gw | Galloway |
| Gy | Glenorchy |
| Ha | Hakataramea |
| Hc | Harbour Cone |
| Hf | Hatfield |
| Hg | Hogburn |
| Hi | Highcliff |
| Hk | Hokonui |
| Ho | Hillock |
| Hs | Hawksburn |
| Hu | Hurunui |
| Hy | Henley |
| Id | Idaburn |
| Ja | Janefield |
| Jn | Jacobstown |
| Ka | Kauru |
| Kb | Kaimata |
| Kc | Kuri |
| Ke | Kiteroa |
| Kg | Kaitangata |
| Kh | Kaihiku |
| Ki | Koinga |
| Kk | Kakahu |
| Kl | Kilmarnock |
| Km | Komako |
| Ko | Koau |
| Kp | Kaherekoau |
| Kr | Kairaki |

| | |
|---|---|
| Ks | Cass |
| Ku | Kuriwao |
| Kw | Kaiwera |
| La | Landon |
| Lake | Lake |
| Lb | Linnburn |
| Lc | Lochar |
| Ld | Landslip |
| Le | Leith |
| Lh | Lindis |
| Li | Lintley |
| Ll | Lammerlaw |
| Ln | Longridge |
| Ls | Lismore |
| Lt | Letts |
| Lu | Luggate |
| Lw | Lowburn |
| Ma | Mataura |
| Mb | Maude |
| Md | Middlemarch |
| Me | Mandeville |
| Mf | Mayfield |
| Mg | Maungatua |
| Mi | Matukituki |
| Mk | Makarewa |
| Mm | Momona |
| Mn | Matakanui |
| Mp | Mihiwaka |
| Mq | Motukarara |
| Mr | Matarae |
| Ms | Mt Mistake |
| Mt | Matau |
| Mu | Manuherikia |
| Mw | Maungawera |
| Mx | Molyneux |
| My | Mt Misery |
| Nb | Naseby |
| Nd | Narrowdale |
| Np | Ngapara |
| Nt | Nithdale |
| Oa | Oamaru |
| Oc | Otakou |
| Od | Omeo |
| Oe | Oreti |
| Ok | Otokia |
| Om | Otama |
| On | Otanomomo |
| Op | Opuha |
| Or | Otaraia |
| Os | Okia |

| | |
|---|---|
| Ot | Otikerama |
| Ou | Oturehua |
| Ow | Mine workings |
| Pa | Papakaio |
| Pb | Portobello |
| Pd | Paradise |
| Pe | Pukeawa |
| Pf | Parata |
| Pg | Pigburn |
| Pi | Purakanui |
| Pj | Pinelheugh |
| Pk | Pukeuri |
| Pm | Pomahaka |
| Po | Patearoa |
| Pond | Pond |
| Pq | Pukerangi |
| Pr | Paerau |
| Ps | Porteous |
| Pt | Paretai |
| Pu | Pukerau |
| Pv | Puerua |
| Qi | Quion |
| Qn | Queenstown |
| QU | Quarry |
| RB | Riverbed |
| Rb | Roseberry |
| Re | Rees |
| Rf | Ranfurly |
| Rg | Rangitata |
| Ri | Riversdale |
| Rk | Rakaia |
| Rp | Ripponvale |
| Rw | Rapuwai |
| RX | Rock outcrop |
| Sa | Saddle |
| Sb | Sowburn |
| Sc | Scotland Poin |
| Sh | Shotover |
| Si | Stirling |
| Sl | Selwyn |
| Sn | Struan |
| Sp | Spottis |
| St | Steward |
| Sv | Springvale |
| Sw | Swinburn |
| Ta | Te-Aneraki |
| Tc | Taiko |
| Td | Tokoiti |

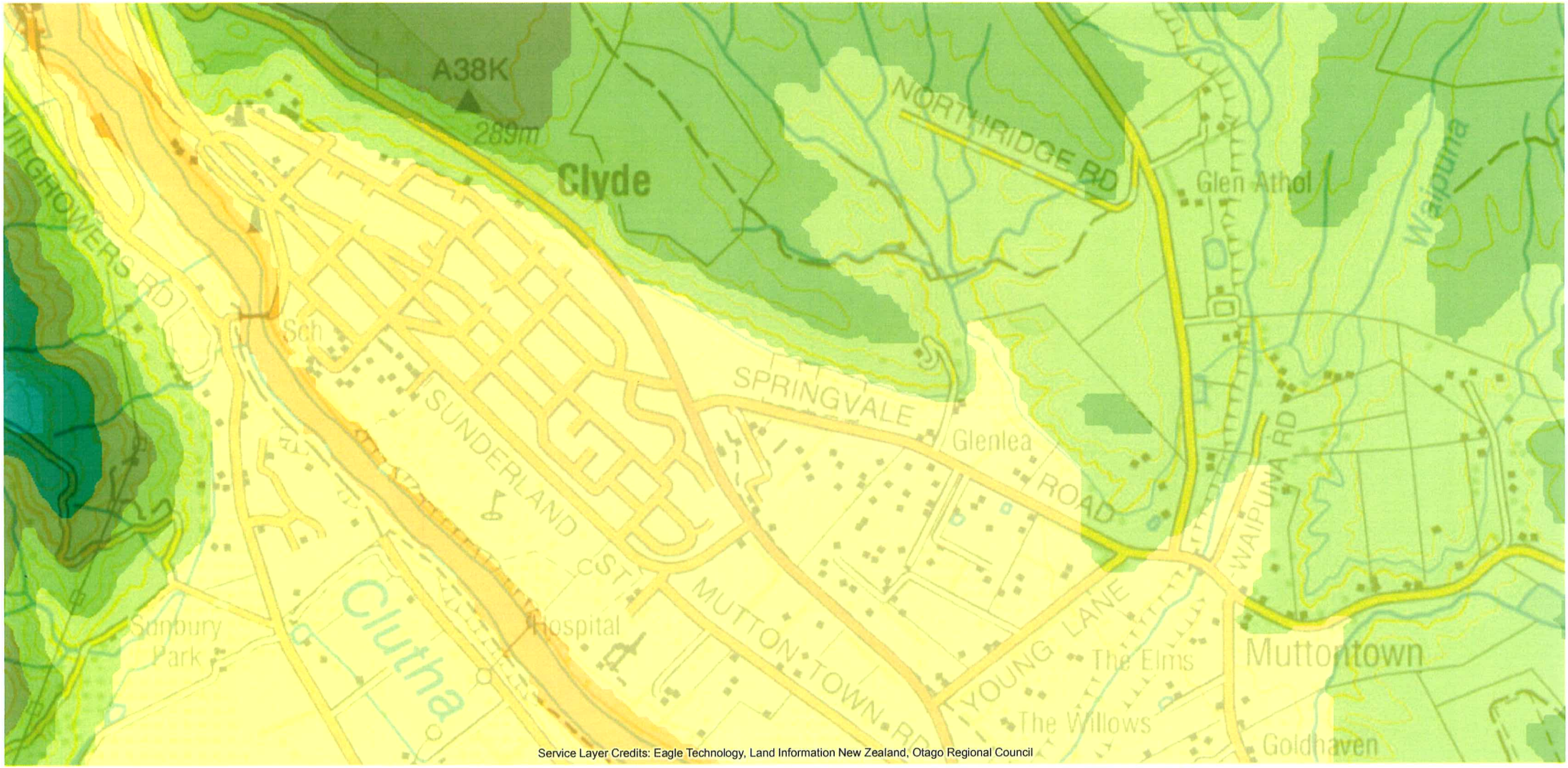
| | |
|---|---|
| Te | Templeton |
| Tf | Tuapeka |
| Tg | Tengawai |
| Th | Te Houka |
| Ti | Timaru |
| Tj | Tomahawk |
| Tk | Tokomairiro |
| Tl | Tailings |
| Tm | Temuka |
| Tn | Tirohanga |
| To | Tiroiti |
| Tp | Titipua |
| Tq | Taratu |
| Tr | Tokarahi |
| Ts | Tarras |
| Tt | Taitapu |
| Tu | Tuakitoto |
| Tv | Teviot |
| Tw | Tawhiti |
| Tx | Trotter |
| Ty | Taieri |
| Tz | Takitao |
| Urban | Urban |
| Ux | Uxbridge |
| Ve | Venlaw |
| Wa | Waimakariri |
| Wb | Wetherburn |
| Wc | Wanaka |
| We | Wendon |
| Wf | Wickliffe |
| Wg | Wingatui |
| Wh | Waikakahi |
| Wj | Wangaloa |
| Wk | Wakanui |
| Wn | Waenga |
| Wp | Wakatipu |
| Wq | Waikoikoi |
| Wr | Warepa |
| Wt | Wetherston |
| Wu | Waitahuna |
| Wx | Waikaka |
| Wy | Waikarara |
| Ya | Waitati |
| Yh | Wehenga |
| Yk | Waiareka |
| Yp | Waipori |
| Yt | Waitohi |

# APPENDIX 4

Grow Otago Extracts

# Otago Maps

GDD (10°C base)




701 - 750
751 - 800
801 - 850
851 - 900
901 - 950
951 - 1000
1001 - 1050

0 0.2 0.4 0.8
Kilometres

North

# Otago Maps

Median Annual Rainfall


351 - 400
401 - 450
451 - 500
501 - 550
551 - 600

0 0.42 0.85 1.7
Kilometres

North

# Otago Maps

Dry Summer Rainfall


41 - 60 61 - 80 81 - 100 101 - 120

0 0.75 1.5 3
Kilometres

North

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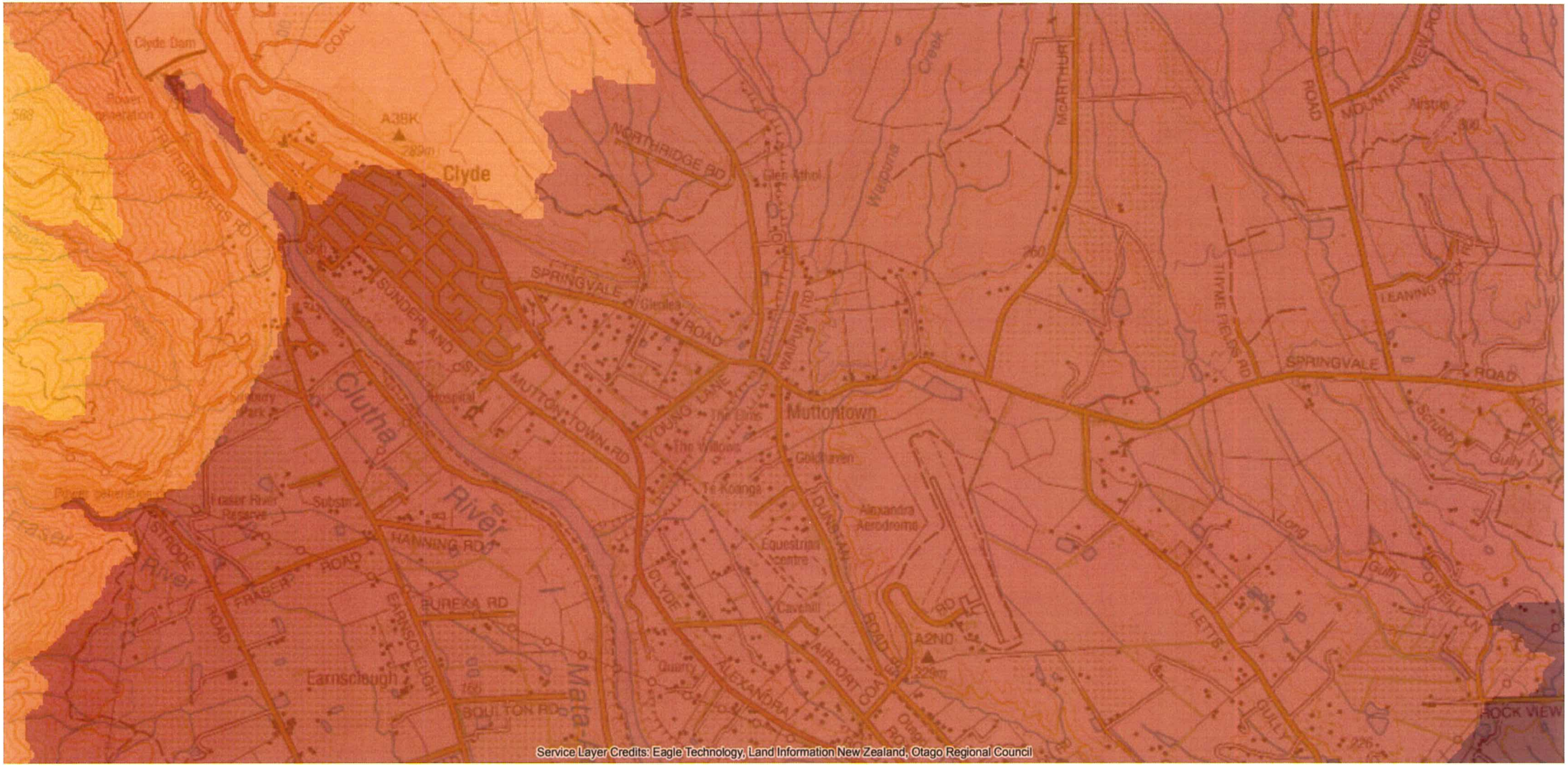
# Otago Maps

Median Summer Rainfall



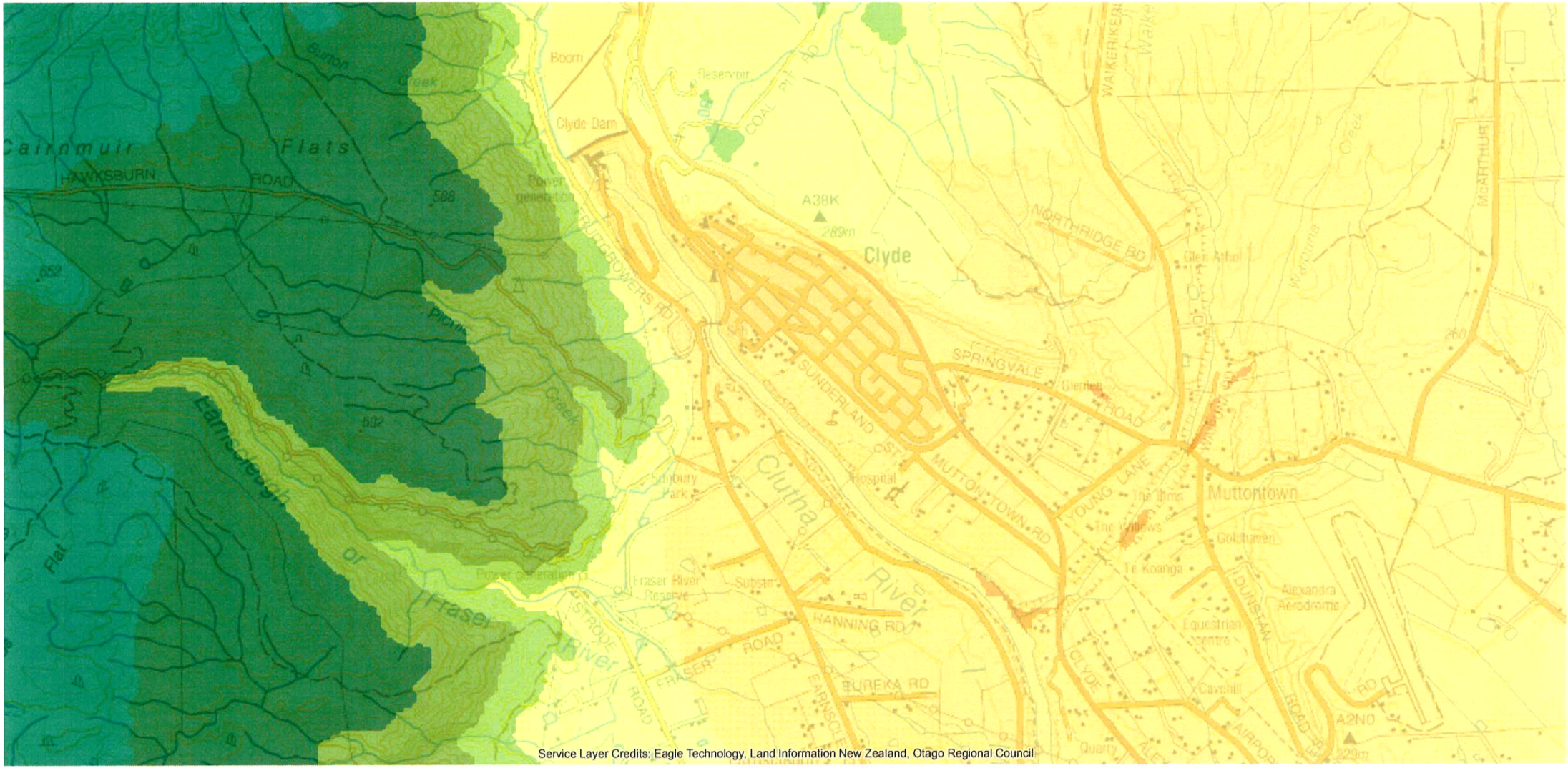

81 - 100 | 101 - 120 | 121 - 140 | 141 - 160

0 0.42 0.85 1.7
Kilometres

North

# Otago Maps

Median Potential Evapotranspiration (Nov - Dec)



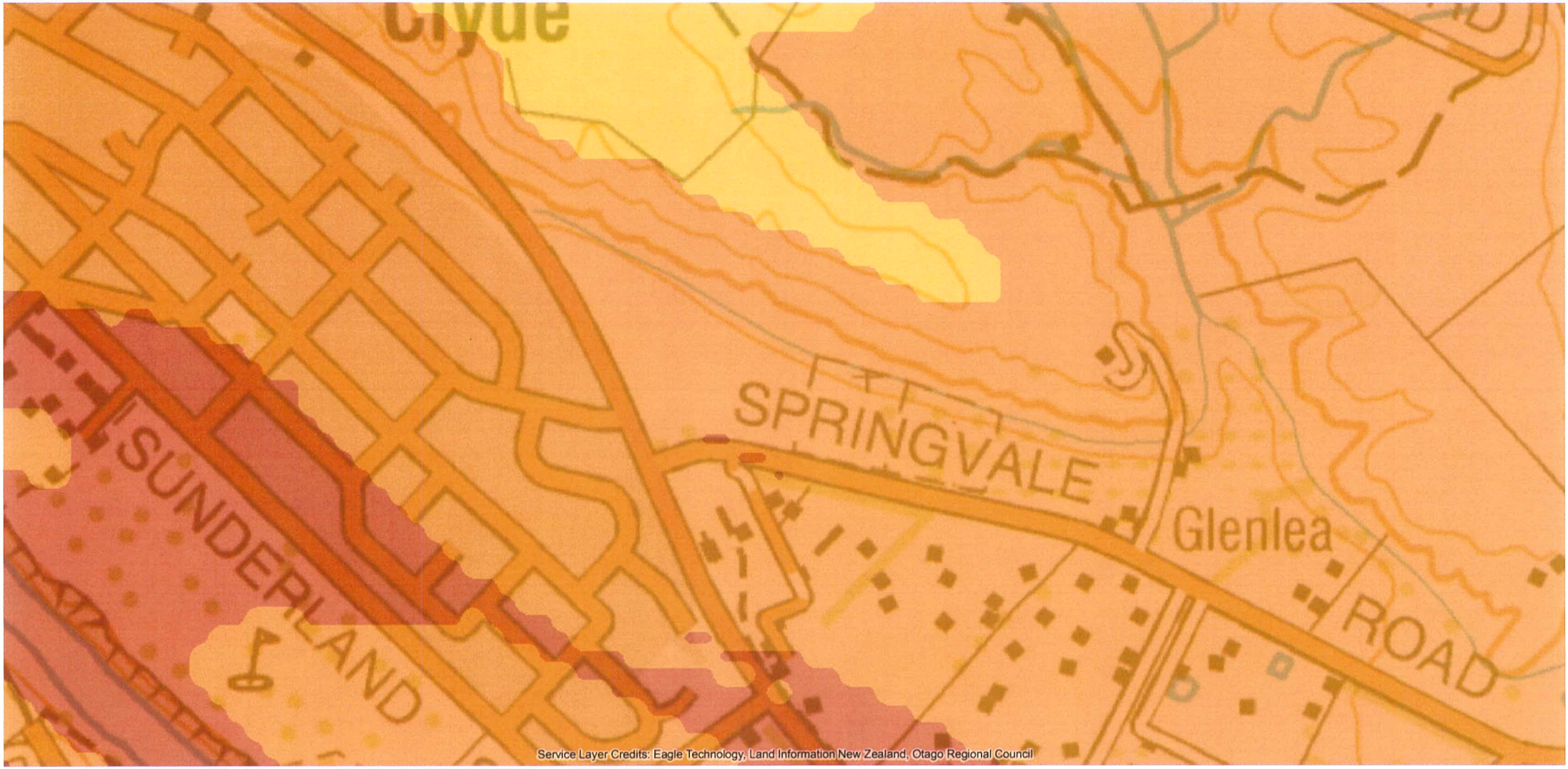

191 - 200 | 201 - 210 | 211 - 220 | 221 - 225 | 226 - 230 | 231 - 235 | 236 - 240

0 0.42 0.85 1.7
Kilometres

North

# Otago Maps

Median Potential Evapotranspiration (Jan – Feb)




201 - 205 206 - 210 211 - 215

0 0.1 0.2 0.4
Kilometres

North

# APPENDIX 5

Aqualinc Report extracts and Irrigation Calculator

AQUALINC

Irrigation REPORT

# GUIDELINES FOR REASONABLE IRRIGATION WATER REQUIREMENTS IN THE OTAGO REGION

**PREPARED FOR**
**Otago Regional Council**

C15000

2017/07/24

PREPARED BY
Ian McIndoe
Peter Brown
Channa Rajanayaka
Birendra K.C.

www.aqualinc.com

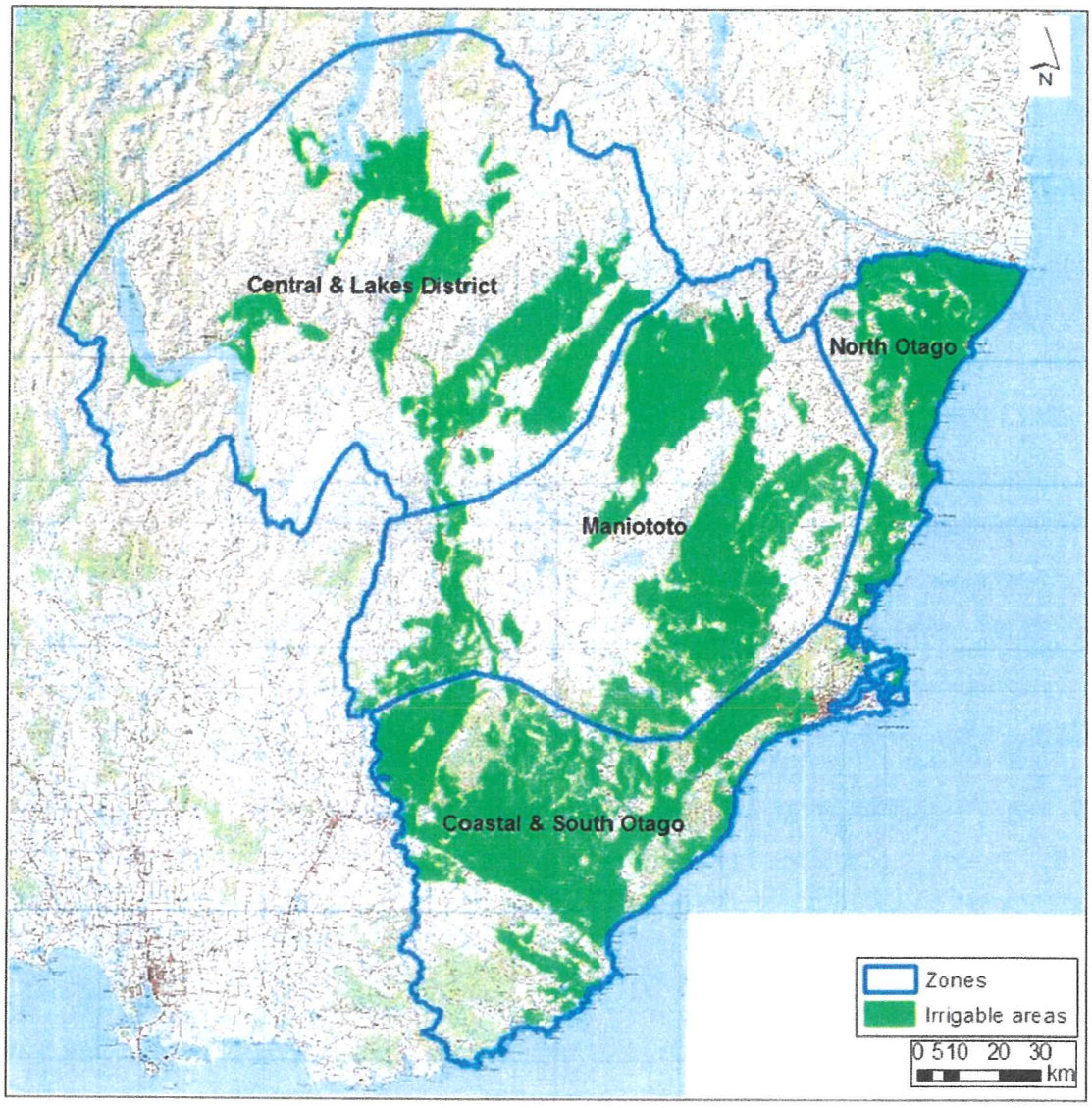



*Figure 3: Likely irrigable areas*

# 6 IRRIGATION DEMANDS

ORC and other users should use these values in combination with the map shown in Figure 5 (a digital copy of this map will be provided to ORC on request) to determine the relevant zone and MAR for specific locations to determine reasonable irrigation demands for that area. The relevant soil PAW for a farm can be obtained from S-map, the FSL database or a site specific soil investigation.

## 6.1 Pasture

A summary of reasonable irrigation water demands for pasture is given in Table 5.

As outlined in Section 5, reasonable irrigation demands have been estimated on the basis that the irrigation system capacities (i.e. peak daily demand) should not result in more than an approximately 0.5% average annual pasture production decrease. The annual (i.e. seasonal) demands are presented for average, 80$^{th}$ percentile (i.e. two-in-ten year drought), 90$^{th}$ percentile (one-in-ten year drought) and maximum situations. These values are calculated based on irrigation water requirements for the 1972-2014 irrigation seasons.

*Table 5 : Irrigation water demand for pasture*

| Zone | MAR (mm/yr) | 600 mm PAW (mm) | Peak daily demand (mm/d) | Maximum monthly demand (mm/month) | Annual demand (mm/yr) | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Average | 80%ile | 90%ile | Maximum |
| Central & Lakes District | 350 | 40 | 5.6 | 174 | 747 | 833 | 866 | 1,002 |
| | | 60 | 5.2 | 161 | 734 | 806 | 866 | 988 |
| | | 90 | 4.8 | 149 | 700 | 802 | 835 | 950 |
| | | 120 | 4.4 | 136 | 659 | 752 | 792 | 911 |
| | | 150 | 4.4 | 136 | 635 | 726 | 774 | 942 |
| | 450 | 40 | 5.5 | 171 | 685 | 787 | 820 | 919 |
| | | 60 | 5.1 | 158 | 668 | 770 | 791 | 913 |
| | | 90 | 4.8 | 149 | 628 | 748 | 773 | 883 |
| | | 120 | 4.2 | 130 | 578 | 714 | 714 | 840 |
| | | 150 | 3.9 | 121 | 547 | 659 | 710 | 796 |
| | 550 | 40 | 5.5 | 171 | 645 | 754 | 785 | 875 |
| | | 60 | 5.1 | 158 | 629 | 729 | 769 | 877 |
| | | 90 | 4.7 | 146 | 575 | 696 | 729 | 818 |
| | | 120 | 4.2 | 130 | 525 | 660 | 672 | 777 |
| | | 150 | 3.7 | 115 | 489 | 622 | 654 | 714 |
| | 650 | 40 | 5.4 | 167 | 579 | 673 | 724 | 821 |
| | | 60 | 4.7 | 146 | 552 | 635 | 689 | 785 |
| | | 90 | 4.7 | 146 | 508 | 619 | 649 | 771 |
| | | 120 | 4.2 | 130 | 462 | 580 | 630 | 714 |

| Zone | MAR (mm/yr) | 600 mm PAW (mm) | Peak daily demand (mm/d) | Maximum monthly demand (mm/month) | Annual demand (mm/yr) | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Average | 80%ile | 90%ile | Maximum |
| | | 90 | 2.9 | 90 | 385 | 466 | 493 | 551 |
| | | 120 | 2.8 | 90 | 348 | 447 | 485 | 510 |
| | | 150 | 2.7 | 84 | 324 | 410 | 460 | 494 |
| | | 40 | 3.9 | 121 | 398 | 492 | 511 | 558 |
| | | 60 | 3.0 | 93 | 373 | 459 | 499 | 543 |
| | 750 | 90 | 2.9 | 90 | 331 | 430 | 464 | 493 |
| | | 120 | 2.8 | 87 | 282 | 392 | 431 | 470 |
| | | 150 | 2.2 | 68 | 257 | 354 | 375 | 405 |

## 6.2 Viticulture

Table 6 lists the daily, monthly and seasonal irrigation water demands for grapes. These demands include a 10% system loss that occurs between water take (e.g. pump) and soil surface, which is considered to be reasonable for a well-managed irrigation system. This system loss may include evaporative losses from bare soil or uneven soil characteristics for example.

We recommend an allocation of 2.42 mm/d daily irrigation demand (i.e. 2.2 mm/d irrigation demand plus 10% loss) for grapes.

The mm/d daily demand figures should be applied to the total planted area of the vineyard, including the inter-row area, regardless of planting density.

Assuming that water is applied to the vines using drip irrigation at a planting density of 2500 vines per hectare, the 2.2 mm/d corresponds to 8.8 litres/vine/day.

The demand figures do not allow for irrigation of and uptake of water by the inter-row. If the inter-row is to be irrigated, or the inter-row is likely to be removing significant amounts of water that would have otherwise been available to the vines, additional water could be required.

Table 6 (last column) shows that the available soil moisture (ASM) meets or exceeds the irrigation criteria of exceeding 40% PAW for 90% of the time in the irrigation season (September to April).

*Table 6: Irrigation water demand for grapes*

| Zone | MAR (mm/yr) | 900 mm PAW (mm) | Daily demand (mm/d) | Maximum monthly demand (mm/month) | Annual demand (mm/yr) | | | | %ASM> 40%PAW |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | Average | 80%ile | 90%ile | Maximum | |
| | | 40 | 2.42 | 75 | 201 | 232 | 258 | 329 | 98 |
| | | 60 | 2.42 | 75 | 188 | 219 | 248 | 332 | 100 |
| Central & Lakes District | 350 | 90 | 2.42 | 75 | 171 | 201 | 234 | 322 | 100 |
| | | 120 | 2.42 | 77 | 159 | 193 | 222 | 310 | 100 |
| | | 150 | 2.42 | 77 | 147 | 179 | 212 | 300 | 100 |
| | | 200 | 2.42 | 77 | 136 | 173 | 203 | 290 | 100 |

| Zone | MAR (mm/yr) | 900 mm PAW (mm) | Daily demand (mm/d) | Maximum monthly demand (mm/month) | Annual demand (mm/yr) | | | | %ASM> 40%PAW |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | Average | 80%ile | 90%ile | Maximum | |
| | 450 | 40 | 2.42 | 75 | 173 | 217 | 239 | 293 | 99 |
| | | 60 | 2.42 | 75 | 157 | 205 | 229 | 281 | 99 |
| | | 90 | 2.42 | 75 | 136 | 182 | 217 | 259 | 100 |
| | | 120 | 2.42 | 77 | 122 | 163 | 203 | 247 | 100 |
| | | 150 | 2.42 | 77 | 110 | 144 | 193 | 237 | 100 |
| | | 200 | 2.42 | 77 | 98 | 131 | 183 | 227 | 100 |
| | 550 | 40 | 2.42 | 73 | 156 | 196 | 208 | 247 | 99 |
| | | 60 | 2.42 | 75 | 137 | 180 | 198 | 235 | 100 |
| | | 90 | 2.42 | 73 | 112 | 156 | 176 | 208 | 100 |
| | | 120 | 2.42 | 73 | 97 | 140 | 164 | 198 | 100 |
| | | 150 | 2.42 | 73 | 83 | 130 | 150 | 189 | 100 |
| | | 200 | 2.42 | 73 | 72 | 120 | 140 | 174 | 100 |
| | 650 | 40 | 2.42 | 73 | 125 | 162 | 174 | 215 | 99 |
| | | 60 | 2.42 | 73 | 106 | 146 | 162 | 203 | 100 |
| | | 90 | 2.42 | 73 | 81 | 121 | 144 | 184 | 100 |
| | | 120 | 2.42 | 73 | 67 | 102 | 135 | 165 | 100 |
| | | 150 | 2.42 | 73 | 55 | 89 | 125 | 145 | 100 |
| | | 200 | 2.42 | 73 | 44 | 76 | 110 | 136 | 100 |
| | 750 | 40 | 2.42 | 73 | 129 | 157 | 169 | 225 | 99 |
| | | 60 | 2.42 | 73 | 109 | 141 | 159 | 213 | 100 |
| | | 90 | 2.42 | 75 | 84 | 113 | 140 | 198 | 100 |
| | | 120 | 2.42 | 73 | 69 | 105 | 130 | 189 | 100 |
| | | 150 | 2.42 | 73 | 57 | 91 | 116 | 179 | 100 |
| | | 200 | 2.42 | 68 | 46 | 81 | 106 | 165 | 100 |
| | 850 | 40 | 2.42 | 70 | 98 | 126 | 133 | 157 | 100 |
| | | 60 | 2.42 | 70 | 79 | 111 | 123 | 143 | 100 |
| | | 90 | 2.42 | 70 | 56 | 91 | 108 | 116 | 100 |
| | | 120 | 2.42 | 63 | 44 | 73 | 91 | 106 | 100 |
| | | 150 | 2.42 | 58 | 34 | 61 | 77 | 97 | 100 |
| | | 200 | 2.42 | 48 | 25 | 46 | 67 | 87 | 100 |
| Coastal & South Otago | 650 | 40 | 2.42 | 61 | 56 | 75 | 84 | 109 | 100 |
| | | 60 | 2.42 | 53 | 43 | 64 | 77 | 99 | 100 |
| | | 90 | 2.42 | 44 | 28 | 48 | 60 | 85 | 100 |
| | | 120 | 2.42 | 39 | 19 | 39 | 44 | 77 | 100 |
| | | 150 | 2.42 | 34 | 12 | 24 | 34 | 63 | 100 |
| | | 200 | 2.42 | 34 | 7 | 14 | 24 | 53 | 100 |
| | 750 | 40 | 2.42 | 58 | 52 | 74 | 80 | 106 | 100 |
| | | 60 | 2.42 | 56 | 38 | 56 | 63 | 94 | 100 |
| | | 90 | 2.42 | 46 | 22 | 41 | 46 | 73 | 100 |

| Zone | MAR (mm/yr) | 900 mm PAW (mm) | Daily demand (mm/d) | Maximum monthly demand (mm/month) | Annual demand (mm/yr) | | | | %ASM> 40%PAW |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | Average | 80%ile | 90%ile | Maximum | |
| | | 120 | 2.42 | 53 | 21 | 39 | 57 | 97 | 100 |
| | | 150 | 2.42 | 44 | 14 | 24 | 47 | 87 | 100 |
| | | 200 | 2.42 | 39 | 9 | 15 | 33 | 73 | 100 |

Note: Daily demand includes 10% irrigation system losses. Monthly and annual demand also includes this system loss. Modelled minimum return interval is 1 day for PAW's up to 90 mm, and 2 days for PAW> 90 mm.

## 6.3 Cherries and apricots

A summary of reasonable irrigation water demands for apricots and cherries is given in Table 7. These have been estimated on the basis that the system capacities (i.e. peak daily demand) should maintain available soil moisture (ASM) above 50% PAW in 90% of the time based on October to April irrigation seasons.

These demands include a 5% system loss that occurs between the water take (e.g. pump) and soil surface, which is considered to be reasonable for a well-managed irrigation system. The annual (i.e. seasonal) demands are presented for average, 80$^{th}$ percentile (i.e. two-in-ten drought year), 90$^{th}$ percentile (one-in-ten drought year) and maximum. These values are calculated based on irrigation water requirements for the 1972-2014 irrigation seasons.

*Table 7: Irrigation water demand for apricots and cherries*

| Zone | MAR (mm/yr) | 1000 mm PAW (mm) | Daily demand (mm/d) | Maximum monthly demand (mm/month) | Annual demand (mm/yr) | | | | %SAM>50%PAW |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | Average | 80% ile | 90% ile | Maximum | |
| | 350 | 200 | 4.9 | 152 | 582 | 664 | 736 | 834 | 90 |
| | | 150 | 5.0 | 155 | 602 | 693 | 751 | 851 | 90 |
| | | 120 | 5.2 | 161 | 619 | 704 | 765 | 868 | 90 |
| Central & Lakes District | | 90 | 5.4 | 167 | 627 | 703 | 768 | 873 | 89 |
| | | 60 | 5.7 | 177 | 655 | 728 | 786 | 898 | 88 |
| | 450 | 200 | 4.7 | 146 | 511 | 622 | 680 | 785 | 90 |
| | | 150 | 4.9 | 152 | 536 | 633 | 707 | 803 | 90 |
| | | 120 | 5.0 | 155 | 553 | 646 | 707 | 819 | 90 |
| | | 90 | 5.3 | 164 | 567 | 668 | 724 | 824 | 89 |
| | | 60 | 5.6 | 174 | 605 | 682 | 750 | 847 | 87 |
| | 550 | 200 | 4.5 | 140 | 466 | 581 | 648 | 737 | 90 |
| | | 150 | 4.8 | 149 | 494 | 602 | 676 | 756 | 89 |
| | | 120 | 4.9 | 152 | 513 | 614 | 675 | 772 | 88 |
| | | 90 | 5.2 | 161 | 533 | 631 | 693 | 786 | 88 |
| | | 60 | 5.5 | 171 | 576 | 656 | 702 | 809 | 86 |
| | 650 | 200 | 4.4 | 136 | 414 | 538 | 582 | 707 | 90 |

# IRRIGATION REASONABLE USE DATABASE

5 STEPS - TO GET THE IRRIGATION REQUIREMENTS INFORMATION YOU NEED FOR IRRIGATION PLANNING, CONSENTING AND DESIGN

IRRIGATION NEW ZEALAND

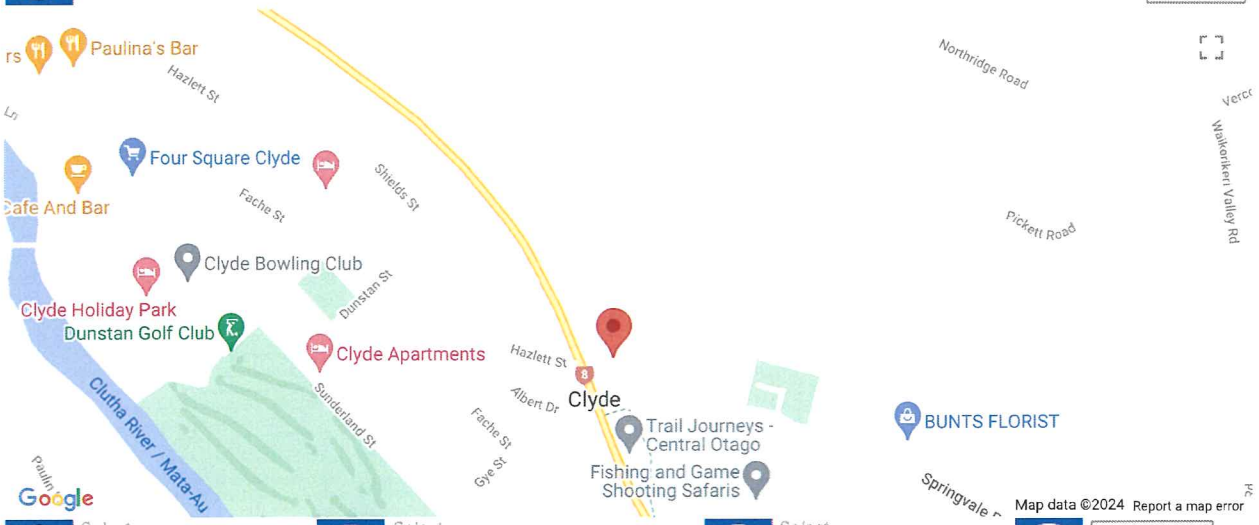
Ministry for Primary Industries
Manatū Ahu Matua
Sustainable Farming Fund

LGA

aqualinc

**1** Enter the address or coordinates (latitude, longitude) of your farm and click 'Locate' or click on the map

-45.193 , 169.335 **Locate**




**2** Select Crop: Pasture

**3** Select Plant Available Water: (b) User specified PAW's

**4** Select Irrigation Method: 80% Efficient Irrigator

**5** **Fetch Data**

| Farm Details | | Plant Available Water Details | | | Irrigation Requirements | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Description | | PAW(mm) | Indicative Likelihood | Area (hectares) | | Per Hectare | | Total Area | |
| Latitude | -45.193 | 90 | 0.3 | 4.5 | System Capacity | 0.61 | (l/s/ha) | 2.74 | (l/s) |
| Longitude | 169.335 | PAW | | 0 | System Capacity | 5.3 | (mm/day) | | |
| Council | Otago | PAW | | 0 | Daily Volume | 53 | ($m^3$/ha) | 238 | ($m^3$) |
| Climate Site ID | P067049 | PAW | | 0 | 7 Day Volume | | ($m^3$/ha) | | ($m^3$) |
| Distance to Climate Site (km) | 2.15 | PAW | | 0 | 28 Day Volume | | ($m^3$/ha) | | ($m^3$) |
| Rainfall (mm) | 432 | | Total area = | 4.5 | 90% ile Annual Volume | 7,508 | ($m^3$/ha) | 33,786 | ($m^3$) |

These estimates of irrigation requirements are based on the assumption that the crop you selected can be grown and irrigated at the site you have selected. Constraints such as topography and crop-specific climate requirements are not taken into account.

Irrigation requirements may be less than reported here if your soils are poorly drained or the water table is close to the soil surface.

**Detailed Results** **Save this Page** **User Guide**

# IRRIGATION REASONABLE USE DATABASE

5 STEPS - TO GET THE IRRIGATION REQUIREMENTS INFORMATION YOU NEED FOR IRRIGATION PLANNING, CONSENTING AND DESIGN

IRRIGATION NEW ZEALAND

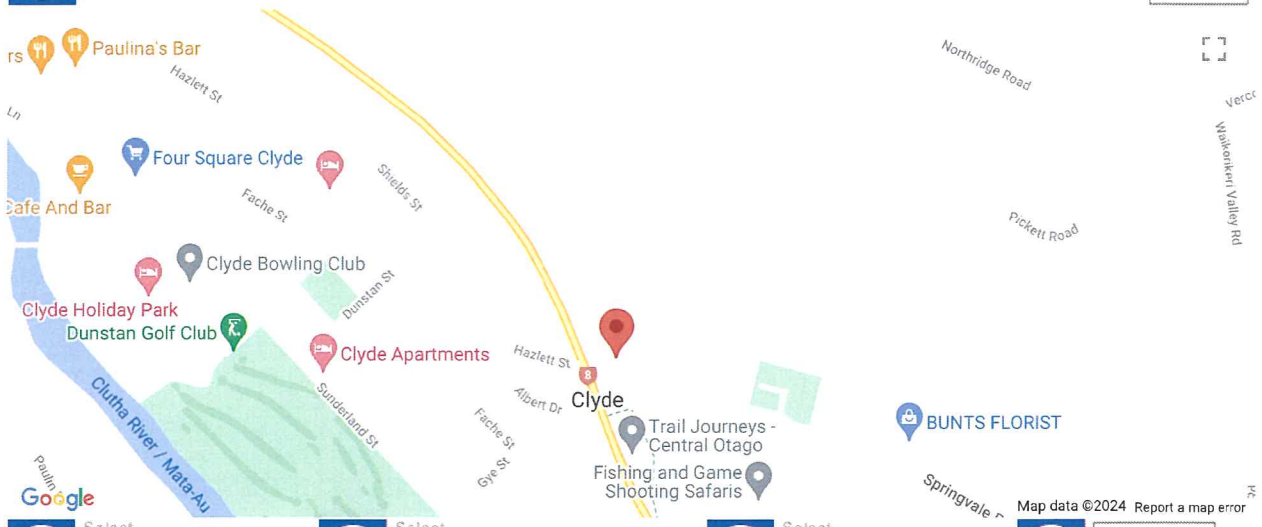
Ministry for Primary Industries
Manatū Ahu Matua
Sustainable Farming Fund

LGA

aqualinc

**1** Enter the address or coordinates (latitude, longitude) of your farm and click 'Locate' or click on the map

-45.193 , 169.335 Locate




**2** Select Crop: Grapes

**3** Select Plant Available Water: (b) User specified PAW's

**4** Select Irrigation Method: Micro/Drip

**5** Fetch Data

**Farm Details**

| | |
|---|---|
| Description | |
| Latitude | -45.193 |
| Longitude | 169.335 |
| Council | Otago |
| Climate Site ID | P067049 |
| Distance to Climate Site (km) | 2.15 |
| Rainfall (mm) | 432 |

**Plant Available Water Details**

| PAW(mm) | Indicative Likelihood | Area (hectares) |
|---|---|---|
| 90 | 0.3 | 4.5 |
| PAW | | 0 |
| PAW | | 0 |
| PAW | | 0 |
| PAW | | 0 |
| Total area = | | 4.5 |

**Irrigation Requirements**

| | Per Hectare | | Total Area | |
|---|---|---|---|---|
| System Capacity | 0.26 | (l/s/ha) | 1.17 | (l/s) |
| System Capacity | 2.2 | (mm/day) | | |
| Daily Volume | 22 | ($m^3$/ha) | 99 | ($m^3$) |
| 7 Day Volume | | ($m^3$/ha) | | ($m^3$) |
| 28 Day Volume | | ($m^3$/ha) | | ($m^3$) |
| 90% ile Annual Volume | 1,591 | ($m^3$/ha) | 7,160 | ($m^3$) |

These estimates of irrigation requirements are based on the assumption that the crop you selected can be grown and irrigated at the site you have selected. Constraints such as topography and crop-specific climate requirements are not taken into account.

Irrigation requirements may be less than reported here if your soils are poorly drained or the water table is close to the soil surface.

Detailed Results | Save this Page | User Guide

# IRRIGATION REASONABLE USE DATABASE

5 STEPS - TO GET THE IRRIGATION REQUIREMENTS INFORMATION YOU NEED FOR IRRIGATION PLANNING, CONSENTING AND DESIGN

IRRIGATION NEW ZEALAND

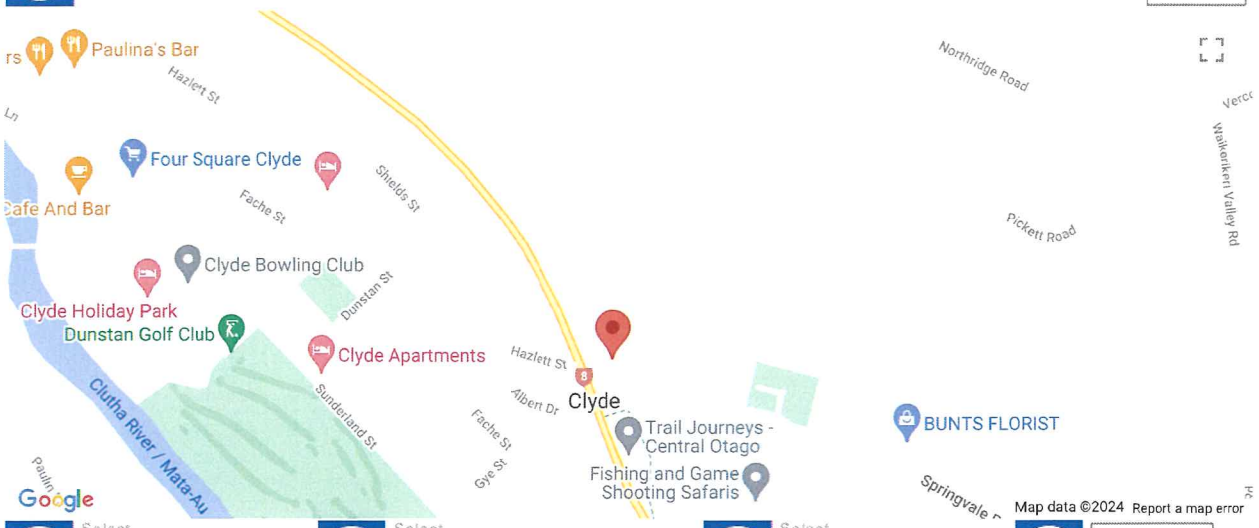
Ministry for Primary Industries
Manatū Ahu Matua
Sustainable Farming Fund

LGA

aqualinc

1 Enter the address or coordinates (latitude, longitude) of your farm and click 'Locate' or click on the map

-45.193 , 169.335 Locate




2 Select Crop: Stonefruit

3 Select Plant Available Water: (b) User specified PAW's

4 Select Irrigation Method: Micro/Drip

5 Fetch Data

**Farm Details**

| | |
|---|---|
| Description | |
| Latitude | -45.193 |
| Longitude | 169.335 |
| Council | Otago |
| Climate Site ID | P067049 |
| Distance to Climate Site (km) | 2.15 |
| Rainfall (mm) | 432 |

**Plant Available Water Details**

| PAW(mm) | Indicative Likelihood | Area (hectares) |
|---|---|---|
| 90 | 0.3 | 4.5 |
| PAW | | 0 |
| PAW | | 0 |
| PAW | | 0 |
| PAW | | 0 |
| | Total area = | 4.5 |

**Irrigation Requirements**

| | Per Hectare | | Total Area | |
|---|---|---|---|---|
| System Capacity | 0.58 | (l/s/ha) | 2.61 | (l/s) |
| System Capacity | 5 | (mm/day) | | |
| Daily Volume | 50 | ($m^3$/ha) | 225 | ($m^3$) |
| 7 Day Volume | | ($m^3$/ha) | | ($m^3$) |
| 28 Day Volume | | ($m^3$/ha) | | ($m^3$) |
| 90% ile Annual Volume | 7,082 | ($m^3$/ha) | 31,869 | ($m^3$) |

These estimates of irrigation requirements are based on the assumption that the crop you selected can be grown and irrigated at the site you have selected. Constraints such as topography and crop-specific climate requirements are not taken into account.

Irrigation requirements may be less than reported here if your soils are poorly drained or the water table is close to the soil surface.

Detailed Results | Save this Page | User Guide

# APPENDIX 6

Manuherikia Irrigation Scheme Letter and Bore Log

**Manuherikia Irrigation Co-operative Society Ltd**
PO Box 201
ALEXANDRA

Secretary/Treasurer: Allison Sutton
Phone/Fax: (03) 449 2562

---

18 January 2000

Leon van Boxtel
68 Newcastle Street
CLYDE

Dear Sir

**Re: Application for Irrigation water Supply ex AG Raceline**

We acknowledge receipt of your letter dated 11 January 2000 wherein you make application for irrigation water for the block of land contained in CT 17D/457 (formerly CT 16B/206).

The block currently has no water entitlement. As you are aware the Society's water resource is fully allocated but blocks of water do become available from time to time.

Your application will be put on file for consideration when the rosters are redrafted for the 2000/2001 season. This will be done in July/August 2000.

Yours faithfully

Allison Sutton
Secretary/Treasurer
(file: l18011)

McNEILL DRILLING

# MCNEILL DRILLING CO. LTD

## WATER BORE/WELL SUMMARY FORM

| | |
|---|---|
| CLIENTS NAME: LEON VAN BOXTEL. | BORE SIZE: 75mm. |
| FULL ADDRESS: CLYDE | START DATE: 23.12.99 |
| RAPID NO: | FINISH DATE: 23.12.99 |
| GRID REFERENCE: | |
| DRILLER: CHRIS DEKONING | MACHINE: EDSON |
| MEASURED FROM: GROUND LEVEL. | DRILL METHOD: |
| TOTAL DEPTH BORE: 36.0 METRES | NQ AIR CORE |
| TOP LEADER: — | |
| SWL: 26.5 METRES | |
| SCREEN: SLOT: — | LENGTH: — |
| TYPE: — | SIZE: — |
| PVC SLOTTED: TOP: — | BASE: — |
| SCREEN/LEADER/SUMP: — | SUMP SIZE: — |
| TOTAL CASING USED: — | |
| AIRLIFTED/PUMPED AT: — | |
| TEST PUMP PERIOD: — HOURS — MIN | |
| DRAWDOWN FROM SWL: — | |
| AIR/PUMP INTAKE: — | |
| BACTERIAL WATER TEST: — | |
| CHEMICAL WATER TEST: — | |

EXTRA NOTES: NO GROUNDWATER POTENTIAL FROM CLAY BOUND GRAVELS

BORE LOG:

| | |
|---|---|
| 00.000 — 10.60 | SANDY SILTY GRAVEL. |
| 10.60 - 12.80 | SAND |
| 12.80 - 18.10 | SANDY GRAVEL |
| 18.10 - 18.90 | COARSE SANDY GRAVEL. |
| 18.90 - 23.80 | SANDY SILTY GRAVEL |
| 23.80 - 24.60 | LOOSE SANDY GRAVEL |
| 24.60 - 26.10 | SAND |
| 26.10 - 36.00 | VERY SILTY CLAY BOUND GRAVEL |