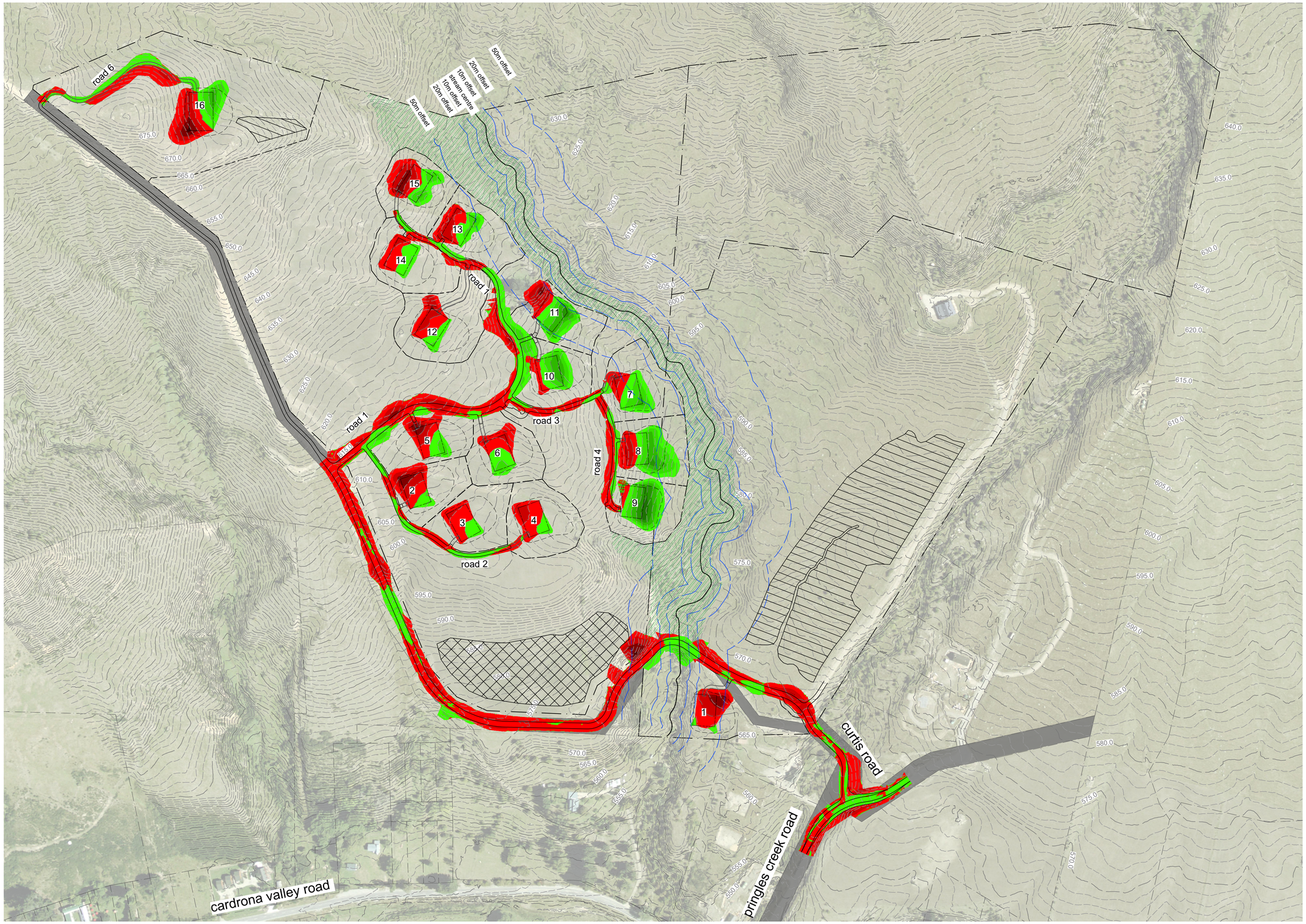

notes:

1. earthwork volumes shown are to final platform and road levels
2. cut and fill batter slopes at 3H:1V
3. no bulking factors are included in cut fill volumes
4. contours at 1m intervals

legend:

- Contours major (existing)
- Contours minor (existing)
- Lot boundary (existing)
- Adjacent lot boundary (existing)
- Proposed subdivision lot boundaries
- Building platforms (proposed)
- Curtilage Areas
- Disturbed areas (proposed)
- Pongs Creek Clutha Flathead Preservation Corridor
- Existing right of way
- Potential fill area

Surface Analysis: Elevation Ranges			
Number	Color	Minimum Elevation (m)	Maximum Elevation (m)
1		-4.000	-3.000
2		-3.000	-2.000
3		-2.000	-1.000
4		-1.000	0.000
5		0.000	1.000
6		1.000	2.000
7		2.000	3.000
8		3.000	4.000
9		4.000	5.000

Cut/Fill Summary

Name	Cut Factor	Fill Factor	2d Area	Cut	Fill	Net
Combined Volume	1.000	1.000	55091.229sq.m	22517.841 Cu. M.	17060.146 Cu. M.	5457.695 Cu. M.<Cut>
Totals			55091.229sq.m	22517.841 Cu. M.	17060.146 Cu. M.	5457.695 Cu. M.<Cut>

This drawing set contains colour.
All reproduction to be in colour.

All dimensions to be verified on site before making any shop drawings or commencing any work

Rev	Date	Appd	Reason
7	2022-07-19	GWF	Consent

Consultants

Baxter Design Group Ltd Landscape Architect	Environmental Associates Ltd Water Suply
Geosolve Ltd Geotech	Bartlett Consulting Traffic
Origin Consultants Ltd Archaeological	E3 Scientific Contamination and Ecology

Maestro
Project Delivery
maestroprojects.co.nz

Holmes
Holmes Consulting
39 Market Place
Auckland 1010
New Zealand
HolmesConsulting.co.nz
T: +64 9 965 4789

McDOUGALL'S BLOCK PROJECT
ROBERTS FAMILY TRUST
QUEENSTOWN

Sheet Title
enabling earthworks
cut fill and volumes plan

Drawn JAV | Scale 1:2000 (at A1)
Filename 138332.00 P - C20 Enabling works.dwg
Job No 138332.00 | Sheet No C21-01 | Rev 7

Appendix 2

Aurora Energy Provisioning Letter

Version 7
19 July 2022
138332.00

AURORA ENERGY LIMITED
PO Box 5140, Dunedin 9058
PH 0800 22 00 05
WEB www.auroraenergy.co.nz

2 September 2019

Thomas Shenton
Holmes Consulting LP
P O Box 90745
Auckland

Sent via email only: Thomas.shenton@holmesconsulting.co.nz

Dear Thomas,

ELECTRICITY SUPPLY AVAILABILITY FOR PROPOSED 17 LOT SUBDIVISION.
10 CURTIS ROAD, WANAKA. LOT 1 DP 433836, LOT 1 DP 425268, LOT 6 DP 344432.

Thank you for your inquiry outlining the above proposed development.

Subject to technical, legal and commercial requirements, Aurora Energy can make a Point of Supply[1] (PoS) available for this development.

Disclaimer

This letter confirms that a PoS **can** be made available. This letter **does not** imply that a PoS is available now, or that Aurora Energy will make a PoS available at its cost.

Next Steps

To arrange an electricity connection to the Aurora Energy network, a connection application will be required. General and technical requirements for electricity connections are contained in Aurora Energy's Network Connection Standard. Connection application forms and the Network Connection Standard are available from www.auroraenergy.co.nz.

Yours sincerely

Richard Starkey
COMMERCIAL MANAGER

[1] Point of Supply is defined in section 2(3) of the Electricity Act 1993.

Appendix 3

Chorus Network Services Provisioning Letter

Holmes

Version 7
19 July 2022
138332.00

Thomas Shenton

From: Chorus Property Developments <develop@chorus.co.nz>
Sent: Thursday, 5 September 2019 2:57 PM
To: Thomas Shenton
Subject: Chorus Development, WNK53864, 10 Curtis Road, Cardrona

Follow Up Flag: Flag for follow up
Flag Status: Completed

Categories: Filed by Newforma

Hello Thomas,

Thank you for providing an indication of your development plans in this area. I can confirm that we have infrastructure in the general land area that you are proposing to develop. Chorus will be able to extend our network to provide connection availability. However, please note that this undertaking would of course be subject to Chorus understanding the final total property connections that we would be providing, roll-out of property releases/dates and what investment may or may not be required from yourselves and Chorus to deliver the infrastructure to and throughout the site in as seamless and practical way as possible.

The cost involved would be a minimum of our current standard fee of $1600 per lot excluding GST. This cost can only be finalised at the time that you are ready to proceed.

Chorus is happy to work with you on this project as the network infrastructure provider of choice. What this ultimately means is that the end customers (business and home owners) will have their choice of any retail service providers to take their end use services from once we work with you to provide the physical infrastructure.

Please reapply with a detailed site plan when you are ready to proceed.

We're here to help – so please let us know if you need any further information.

Kind regards,

Aimee Smith
Property Development Coordinator

T 0800 782 386 opt1
M
E develop@chorus.co.nz
PO Box 9405
Hamilton
www.chorus.co.nz

CHORUS

Please consider the environment before printing this email

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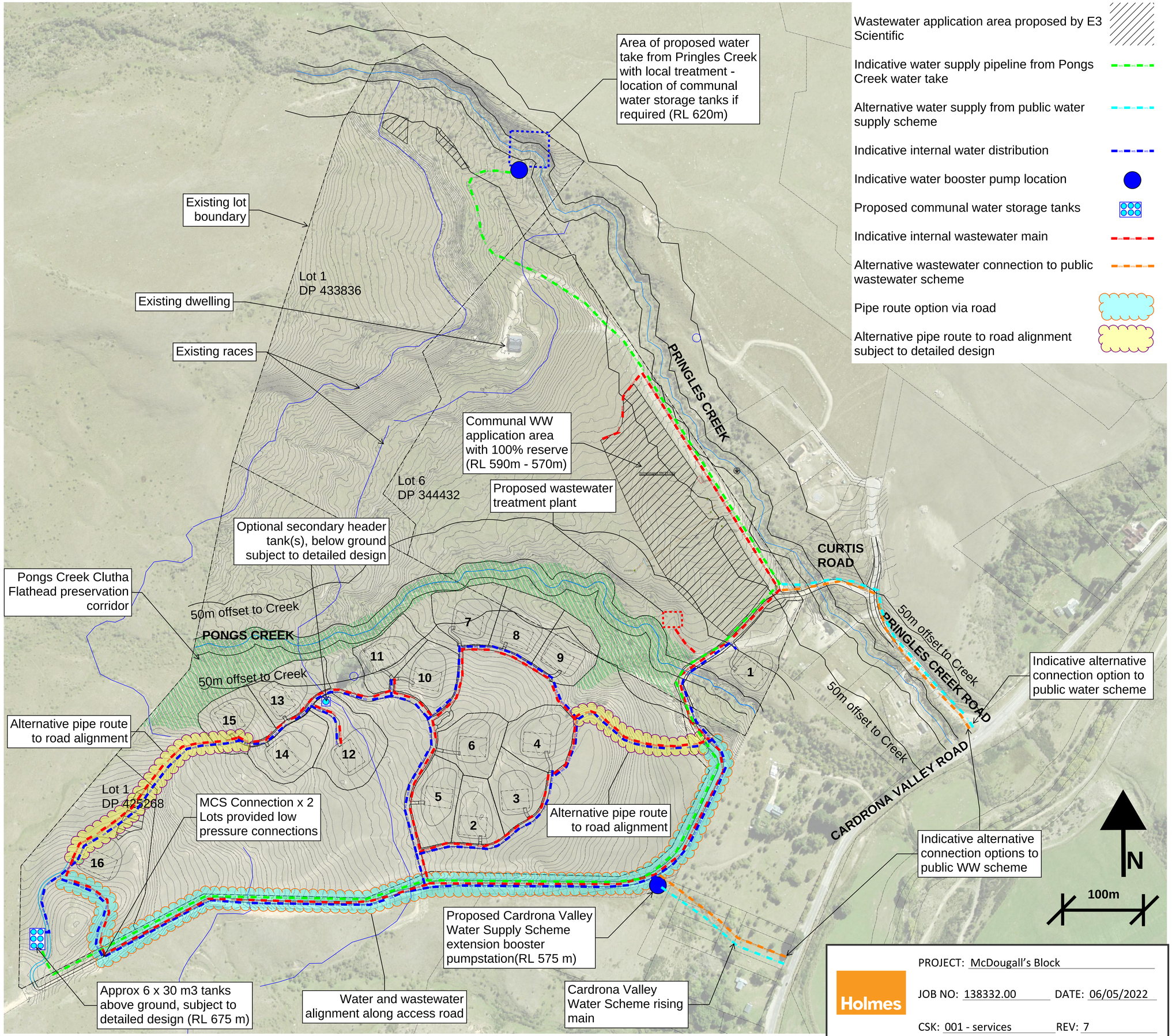
Appendix 4

Holmes Sketches

Version 7
19 July 2022
138332.00



Holmes

PROJECT: McDougall's Block

JOB NO: 138332.00 DATE: 06/05/2022

CSK: 001 - services REV: 7

Wastewater application area proposed by E3 Scientific

Existing / Proposed road to be upgraded to Figure E3 (sealed)

Proposed road to Figure E2 (sealed)

Proposed road to Figure E1 (sealed)

Existing driveway to Figure E1 (unsealed)

Proposed driveway to Figure E1 (unsealed)

Existing lot boundary

Lot 1
DP 433836

Existing races

Lot 6
DP 344432

PRINGLES CREEK ROAD

Widening of Curtis Road - Pringles Creek Road intersection in accordance with Proposed QLDC District Plan, Section 29.14.9, Diagram 9 – Access Design

CURTIS ROAD

Pongs Creek Clutha Flathead preservation corridor

50m offset to Creek

PONGS CREEK

50m offset to Creek

50m offset to Creek

PRINGLES CREEK ROAD

50m offset to Creek

CARDRONA VALLEY ROAD

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16

Lot 1
DP 425268

Downstream culvert extension required to accommodate increased road width

Provisional stormwater management area (dry pond)

N

100m

Holmes

PROJECT: McDougall's Block

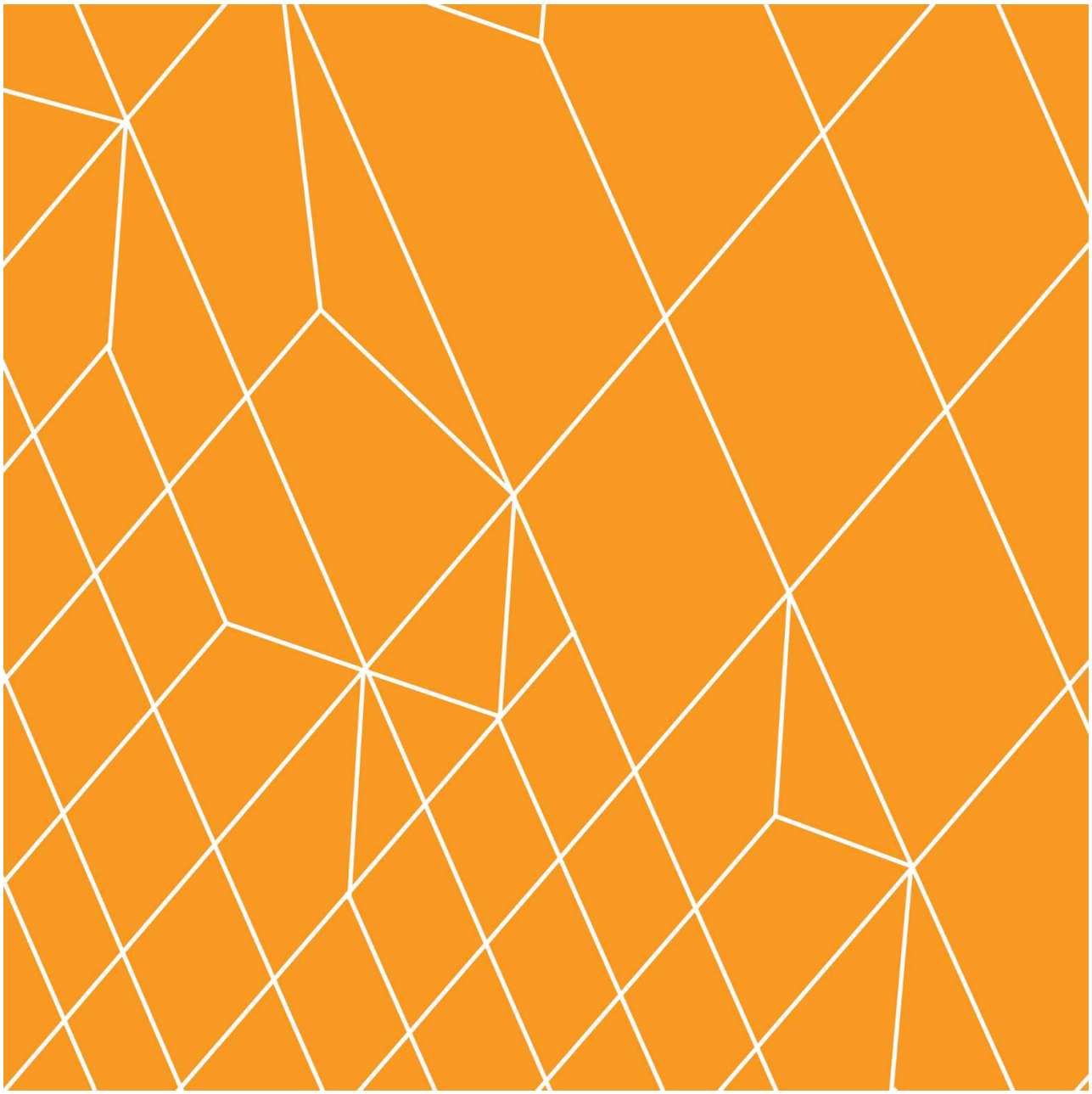
JOB NO: 138332.00 DATE: 06/05/2022

CSK: 002 - roading REV: 7

Appendix 5

Erosion and Sediment Control Plan

Version 7
19 July 2022
138332.00



Erosion and Sediment Control Plan
McDougall's Block

10 Curtis Road
Cardrona
New Zealand

Report

Holmes Consulting

Version 4
3 September 2021
138332.00

Report

McDougall's Block

Prepared For:
Roberts Family Trust

Date: 3 September 2021
Project No: 138332.00
Revision No: 4

Prepared By:

Gerhard Fourie
PROJECT ENGINEER
Holmes Consulting LP

Reviewed By:

Ben Henry
SENIOR PROJECT ENGINEER
Holmes Consulting LP

TABLE OF CONTENTS

1 INTRODUCTION

Holmes Consulting Limited Partnership has been engaged by Roberts Family Trust to prepare an infrastructure report suitable for a resource consent for the proposed 16 lot Development at 10 Curtis Road.

1.1 Objective

This report and plan have been issued to provide a preliminary erosion and sediment control framework to support a resource consent application. At the request of Otago Regional Council (ORC), extra consideration has been given to identify the erosion sediment control in relation to the potential construction methodology prior to the tender being awarded to a contractor. The design described in this report provides guidance to minimise dust, sediment, and erosion by a combination of prevention and control measures. It should be read and implemented in conjunction with Auckland Council's GD05 (Auckland Council, 2016) as design reference.

This erosion and sediment control plan (ESCP) should be considered a live document, updated to suit site specific conditions encountered at the time of construction. It is prepared to demonstrate how erosion and sediment control could be appropriately managed during construction. The appointed contractor is required to take ownership of this plan and develop it to meet their specific construction methodology based on actual site staging.

This report should be read in conjunction with the ESCP drawing C23-01.

1.2 Site and Project Description

The existing site is dominated by grassed surfaces and generally slopes from the west to the east at a gradient of 5˚-20˚, with some existing swales, hills, gullies and creeks within the site boundary. There are two water races crossing through the site and overland flow routes through the property drain to either Pongs or Pringles Creek. Pongs Creek and its associated Riparian zone is classified as a protection zone and is adjacent to Lots 1, 7-11, 13, and 15.

The project manager has supplied a staging plan:

- Stage 1 = lot 1, lot 16, lot 13, lot 14, lot 15.
- Stage 2 = lot 7, lot 8, lot 9, lot 10, lot 11, lot 12.
- Stage 3 = lot 2, lot 3, lot 4, lot 5, lot 6.

Surface water runoff from disturbed/un-vegetated surfaces has the potential to create excess sediment to leave the site and enter adjacent watercourses. Under Otago Regional Council (ORC) Regional Plan Clause 12.C.1, the discharge of water or any contaminant to water, or onto or into land in circumstances which may result in a contaminant entering water, is a permitted activity.

This plan focuses on minimising dust sediment, and erosion from the above sources by a combination of prevention and control measures described in the sections below. It shall be read and implemented in conjunction with Queenstown Lakes District Council's (QLDC's) 'QLDC Guidelines for Environmental Management Plans' (Queenstown Lakes District Council, 2019).

1.3 Geotechnical Summary

Site investigations into soil conditions have been undertaken in the vicinity of the proposed building platforms with the findings summarised in the Geotechnical Report (Geosolve Ltd, 2020). These investigations indicate that soils in the area are typified by topsoil, overlying softened fan alluvium overlying fan alluvium.

The observed stratigraphy is summarised below:

- 0.15-0.4 m of topsoil, overlying;
- 0.2-0.55 m of softened fan alluvium, overlying;
- 0.6-2.9 m+ of fan alluvium.

1.4 Erosion and Sediment Control Guidance Document

The erosion and sediment controls used on this site must meet the requirements of Auckland Council's Guidance Document 05 (GD05) 'Erosion and Sediment Control for land Disturbing Activities in the Auckland Region' (Auckland Council, 2016). This is also referred to as a best practice for ESCP's in the QLDC's 'Guidelines for Environmental Management Plans, June 2019' (Queenstown Lakes District Council, 2019).

2 PROJECT DESCRIPTION

2.1 Description of Work

There is potential for dust and sediment to exceed the existing conditions during construction. There is also potential for sediment to discharge into the existing watercourses if no controls are put in place. Dust and sediment could be generated from the following sources:

- Clearing of vegetation and topsoil
- Cut/fill of soil across the building platforms
- Cut/fill for access roads
- Excavation for utilities
- Unstabilised earth surfaces exposed to wind and rain, including stockpiles
- Truck movements

2.2 Proposed Methodology

For the purposes of this preliminary ESCP, a construction methodology has been assumed to demonstrate how erosion and sediment can be managed on site. Once a Contractor has been engaged, a final detailed ESCP will be provided to suit the Contractor's programme and methodology. The Contractor's ESCP shall include staging and sequencing and will be provided following ORC and QLDC Resource Consent uplift as part of Engineering Acceptance and satisfying pre-construction Consent Conditions. The Contractor's programme and sequence will depend on a number of factors, such as:

1. The Contractor's chosen methodology,
2. the time taken to obtain approvals, and
3. the remaining sealing season together with the restrictions on earthworks in the Consent Conditions.

The provisional staging is shown in the figure below.

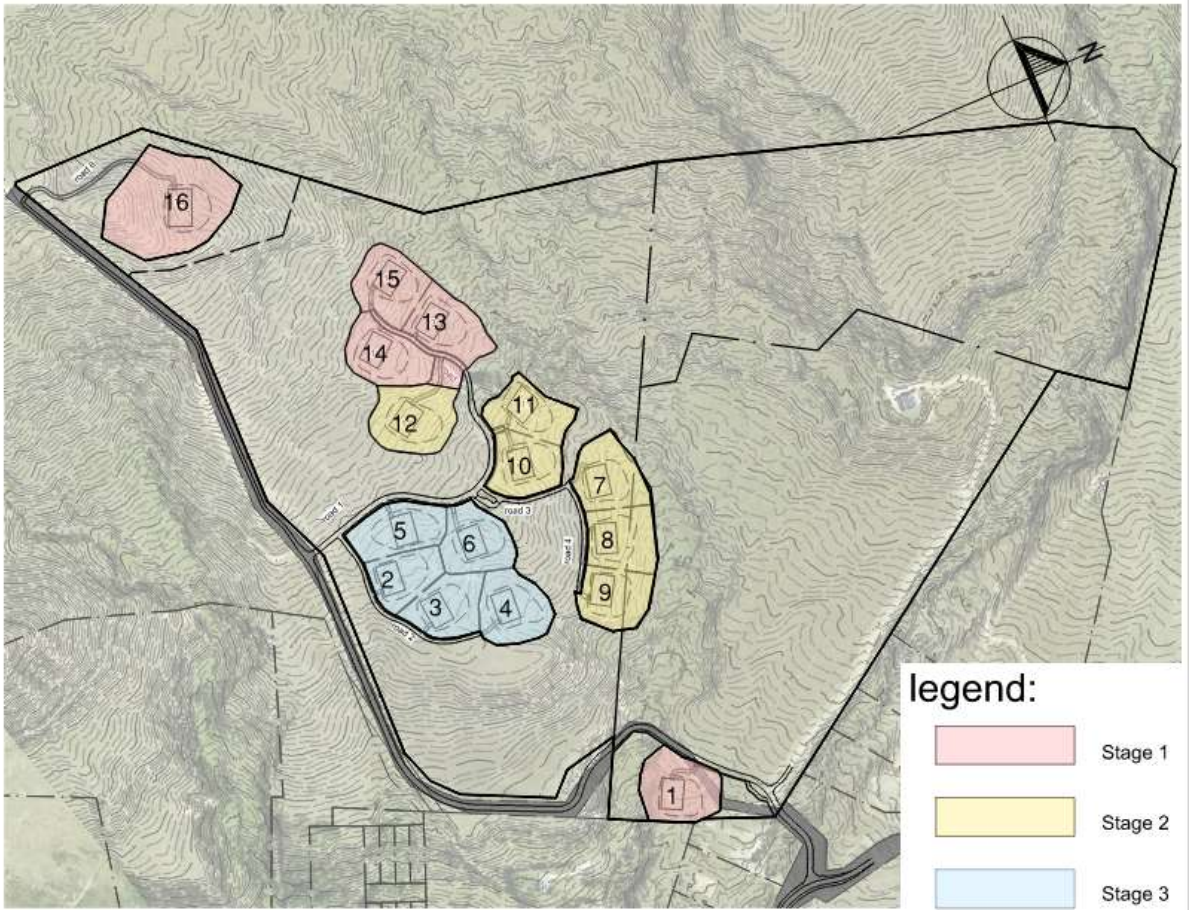


Figure 1: Provisional development staging plan

2.2.1 Stage 1

Stage 1 will include developing lots 1 and 13-16 as shown in Figure 1. Construction is likely to commence with earthworks for the access roads to lots 13-15 and 16 from the existing stabilised Curtis Road, including utilities along the new roads.

Once access can be gained to the new lots, individual cut/fill operations for each building platform can commence. The upgrading of Curtis Road to Type E1 standard, as per QLDC's Land Development and Subdivision Code of Practice (LDSC), includes road swales, check dams and soakage if required. Installation of utilities can happen in parallel with road construction, noting that Curtis Road is used for access to other properties. This will restrict the ability to have large open areas and require a sequence that allows the road to be trafficable in part during construction.

It is expected earthworks will be mostly localised to individual lots and road sections by cut to fill balancing to minimise the haulage of material. The construction duration is expected to be in the order of 4-5 months.

2.2.2 Stage 2

Stage 2 will include developing lots 9-12 as shown in Figure 1. Construction is likely to commence with earthworks for the access road to lots 7-9, including road swales, check dams and soakage if required and utilities along the new road.

Once access can be gained to the new lot's individual cut/fill, operations for the individual lots can commence. The upgrading of Curtis Road to Type E3 standard (QLDC LDSC) will also be required at this stage, which will include widening of the existing road from the junction with Pringles Creek Road to the main residential cluster. This can happen in parallel with the lot earthworks noting that Curtis Road is used for access to other properties. This will restrict the ability to have large open areas and require a sequence that allows the road to be trafficable in part during construction.

It is expected earthworks will be mostly localised to individual lots and road sections by cut to fill balancing to minimise the haulage of material. The construction duration is expected to be in the order of 3-5 months.

2.2.3 Stage 3

Stage 3 will include developing the final cluster of lots, 2-6, as shown in Figure 1. Construction is likely to commence with earthworks for the access road to lots 2-4, including road swales, check dams and soakage if required and utilities along the new road.

Once access can be gained to the new lot's individual cut/fill operations for the individual lots can commence. It is expected earthworks will be mostly localised to individual lots and road sections by cut to fill balancing to minimise the haulage of material. The construction duration is expected to be in the order of 3-5 months.

2.2.4 Disposal Fields

The disposal fields will consist of subsurface drains, laid along contour lines. It is assumed that the disposal field will be increased in size to suit the number of lots and follow the same staging. The following best practice guidelines from AC GD05 G3.2.2 should be considered for the installation of the drains:

- Plan the works to minimise the extent and duration of site disturbance.
- When trenching is completed independent of other activities on site, plan for progressive stabilisation and/or restoration of disturbed areas.
- Trenches should not be open for any longer than three days; complete the stabilisation of all disturbance in high-risk areas within two days of backfilling, and within five days in all other areas.
- Do not open trenches when there is a risk of high rainfall. (Note: An open trench becomes a diversion drain; consider where it will discharge.)
- Divert above-site water away from work areas with temporary diversion drains as shown on the ESCP drawing.
- Do not allow the trench excavation to concentrate or convey runoff.
- Topsoil and spoil should be stockpiled separately on the up-slope side of the trench.
- Do not put stockpiles of topsoil, spoil or bedding material in overland flow paths.
- Minimise soil loss by protecting all stockpiles with covers such as geotextile fabric.
- Remove excess spoil and/or bedding material from the site as soon as work is completed, or immediately incorporate into other works on site.

The proposed stage ESC plan is shown in Figure 2 below.

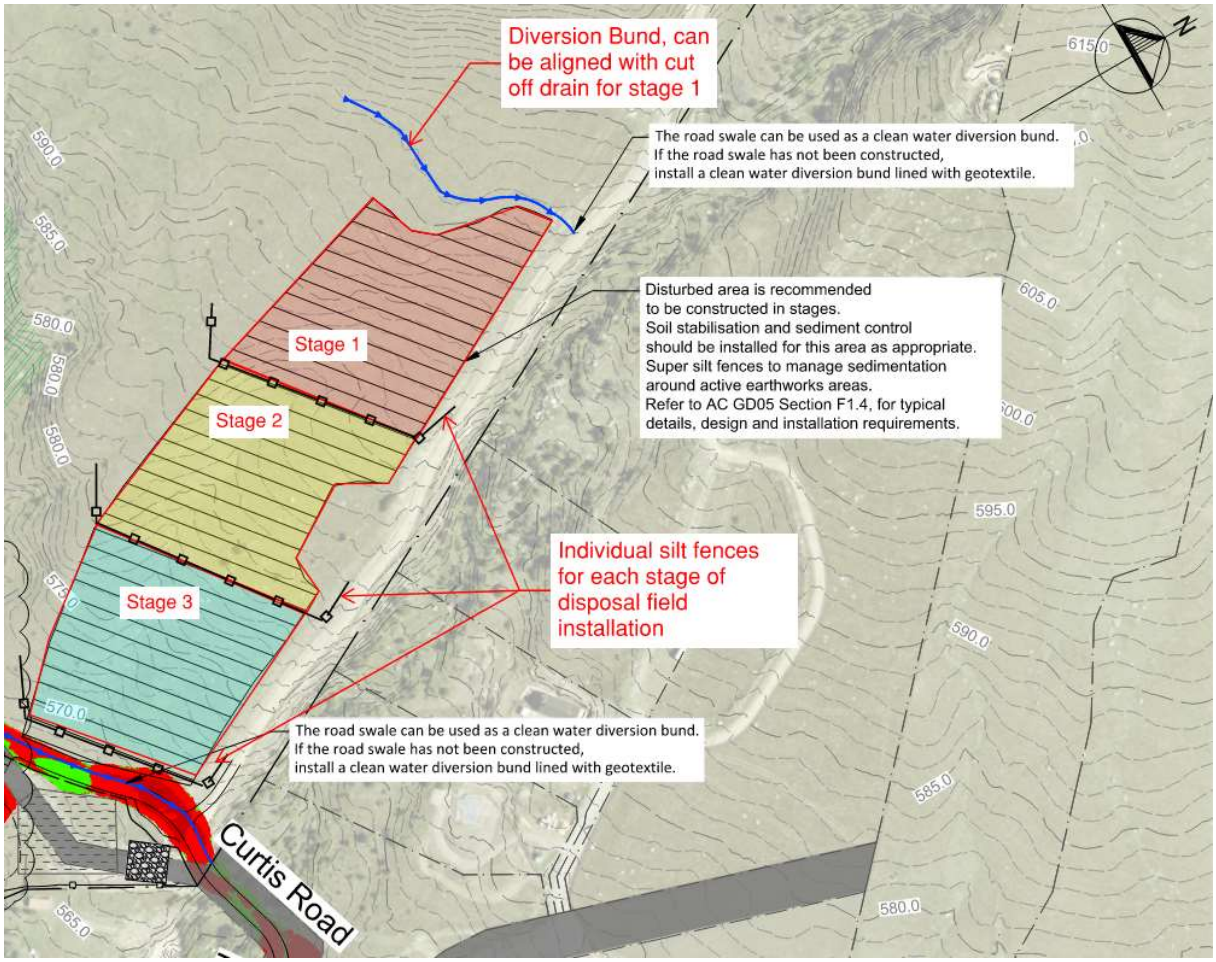


Figure 2: Disposal field stage ESC Plan

2.3 Earthworks

The proposed development will require earthworks to be completed to prepare the site for construction to include access roads and building platforms.

The development is embracing a low impact design philosophy to maintain its inherent rural and rustic character. The associated earthworks shall be sympathetic to the natural environment limiting visual impacts where possible.

Cut and fill volumes have been estimated comparing a conceptual bulk earthworks cut model with the existing site surface, see Table 1. All cut and fill volumes have been taken from the existing surface to proposed finished ground / surface levels, with no allowance being made for pavement or building platform build up at this stage. The batter slopes are based on the 1:3 grade advised by the geotechnical engineer. At the next design stage, the extent of the permanent works associated with this upgrade can be reviewed with options to reduce the extent by including retaining walls or steeper slopes, and potentially utilising ground reinforcement techniques.

The earthworks shown on drawing C23-01 show the potential disturbance areas associated with the possible wastewater application and fill areas.

The concept phase estimate of topsoil strip has been done by taking the total earthworks area (55,000m^2) less the existing road area (6,000m^2) = 49,000m^2 and multiplying this by a 200mm deep cut = 9,800m^3.

Table 1 Estimation of earthworks volumes from drawing C20-01, see Appendix 01

Earthwork	Volume
Cut	20,880 m^3
Fill	17,600 m^3
Total	+3,280 m^3

All earthworks will be undertaken under the supervision of a Geotechnical Engineer and in accordance with Geotechnical recommendations to ensure that the stability of the site and adjacent sites is maintained, and adequate compaction of fill is achieved during construction. All batter slopes will be constructed in accordance with the recommendations set out in Geosolve's Geotechnical Report, presented in Table 2 – the permanent cut slope values have been used as part of the conceptual earthworks modelling.

Table 2 Recommended maximum batter angles for cut slopes up to 3m high in site soils, taken from Table 2 of Geosolve Geotechnical Report

Material Type	Recommended Maximum Batter Angles for Temporary Cut Slopes Formed in Soil (horizontal to vertical)		Recommended Maximum Batter Angles for Permanent Cut Slopes Formed in Soil (horizontal to vertical)
	Dry Ground	Wet Ground	
Topsoil and Softened Fan Alluvium	2H : 1V	3H : 1V	3H : 1V
Fan Alluvium	1.5H : 1V	3H : 1V	2.5H : 1V

2.4 Treatment Requirements

The Contractor shall confirm treatment requirements with Otago Regional Council when submitting their final erosion and sediment control plan prior to earthworks commencing. As a minimum, 100 mm water clarity should be targeted for water treatment prior to discharging from site.

3 DUST CONTROL

3.1 Prevention Measures

- To minimise dust formation, the extent of exposed earth at one time shall be minimised where feasible.
- All exposed ground shall be sealed/re-vegetated as soon as practical.

3.2 Control Measures

Dust control is most critical during dry conditions. The potential for dust cloud formation will be monitored visually on a daily basis by the consent holder/construction supervisor, during periods of operation.

The following control measures are proposed:

- Water will be used to suppress dust if necessary.
- Construction should be completed in stages where possible, to minimise the area of exposed ground at one time.
- Sowing of grass or planting to reinstate batters and fill areas will be implemented as soon as possible, which will also help to mitigate dust from affected ground.
- Refer to AC GDO5 Section G9.2 for best practice for this activity.

4 EROSION AND SEDIMENTATION CONTROL

The existing site is dominated by grassed surfaces and generally slopes from the west to east at a gradient of 5°-20°. There are two races crossing through the site and overland flow routes through the property drain to either Pongs or Pringles Creek.

Left unchecked, stormwater runoff could erode exposed ground surfaces and deposit silt beyond the site onto private property or into the two water races. Measures to prevent this are described in the following sections.

4.1 Prevention Measures

The following preventative measures should be taken:

- Existing grass/vegetation will be retained where practical until construction works are ready to commence.
- Construction should take place in stages where possible to minimise the amount of exposed (i.e. un-vegetated/unsealed) ground at a time.
- It is recommended control measures be installed specifically for each lot rather than having an overall site control system for each stage of construction.
- Designated landscaped areas shall be vegetated as soon as practical.

4.2 Control Measures

The following measures could be used to help control sediment leaving the site in stormwater runoff.

4.2.1 General Control Measures

- To aid the effectiveness of the sedimentation control measures, work is recommended to not be undertaken during periods of heavy rain, and for the contractor to shore up and monitor the measures in place during any storm event.

- There have not been any springs encountered on-site. Perched ground water may need to be drained before work starts. The discharge of the perched ground water should not cause erosion or flooding to the adjacent land.
- Subsoil drains may need to be installed so that once ground water is struck, water has a place to drain to. The Contractor will need to develop their own strategy for managing ground water across this site.
- A freshwater assessment will be undertaken before the construction of the culvert by an ecologist. During their time on-site the ecologist should advise on the control measures that shall be put into place during the extension of the culverts.

4.2.2 Super Silt Fences

Super silt fencing will prevent sediment from leaving the individual lots and sections of road where earthworks are taking place in surface runoff. These are a standard boundary control measure, to be used downstream of any construction zone to control water leaving the area while preventing sediment loss.

The indicative layout of super silt fences is shown on the ESC drawing, and should be adjusted based on the detailed design and site conditions to adhere to the design criteria as shown in Table 3. Refer to AC GD05 Section F1.4, for typical details, design and installation requirements.

Table 3: Super silt fence design criteria - AC GD05 Section F1.4. Table 14

Slope steepness %	Slope length (m) (maximum)	Spacing of returns (m)	Super silt fence length (m) (maximum)
0 – 10%	Unlimited	60	Unlimited
10 – 20%	60	50	450
20 – 33%	30	40	300
33 – 50%	30	30	150
> 50%	15	20	75

Silt fences are not to be used as a means of reducing flow velocity or in areas where they will intercept concentrated flow.

4.2.3 Clean Water Diversion Channels and Bunds

Stabilised channels and bunds will be used to prevent clean surface water entering the construction areas. The stabilised channels will convey clean water away from the active earthworks areas. This will limit the volume of water that enters stormwater areas that needs treatment. Only rain that falls within the active earthworks area will need to be collected and treated prior to being discharged from site.

Refer to AC GD05 Section E2.1, for typical details, design, and installation requirements. The indicative layout of clean water diversion bunds is shown on the ESCP drawing C23-01. Alternative layouts can be considered where shorter individual clean water diversion bunds are used for individual lots, and should be adjusted based on the detailed design, contractor's construction methodology and site conditions, to adhere to the design criteria.

The largest catchment for the diversion is less than 5 ha (refer to Appendix A for calculations and sketches). Therefore, a standard clean water diversion arrangement is proposed as shown in the figure below.

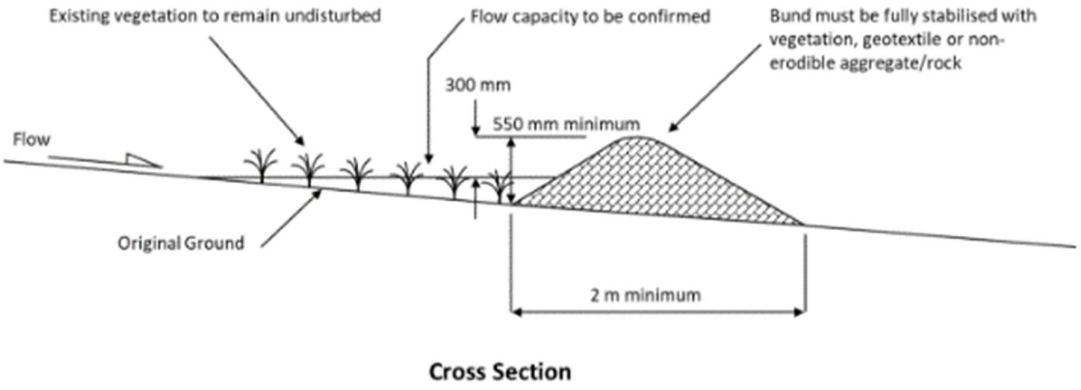


Figure 3: Cross-section of clean water diversion bund (AC GDO5 Figure 17)

The capacity of the diversion bund for various grades have been checked and is included in the calculations in Appendix A.

An alternative arrangement for a diversion channel is shown in Figure 4, below, and should be used where roadside swales have not yet been completed.

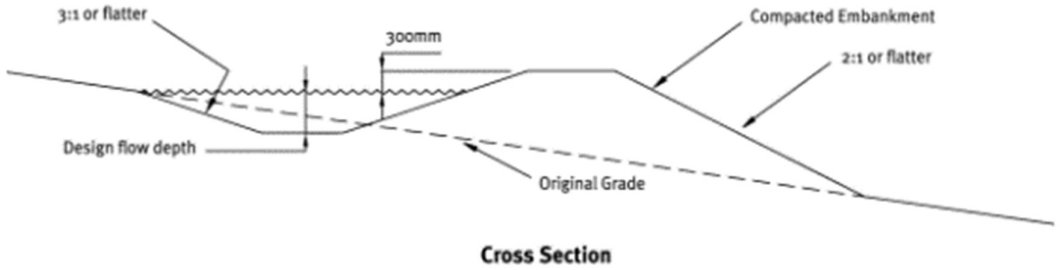


Figure 4: Alternative arrangement for diversion channels (AC GDO5 Figure 19)

It is important that the channels follow contour lines to keep the grades of the channels shallow. The contractor will need to incorporate stabilisation where velocities are greater than 1.0 m/s, as this will cause erosion in the channel bed.

The contractor will also need to provide an adequate and stabilised outlet for each diversion. In most cases the diversions will discharge to road swales or to stable watercourses. In all cases, the outlet must convey runoff to a point where outflow will not cause damage (erosion, flooding).

4.2.4 Stabilised Construction Entrance

A stabilised construction entrance is to consist of washed aggregate, average 50-150 mm diameter, placed 150 mm thick (minimum), 4.0 m wide (minimum) and 10 m long (minimum). The aggregate is to be placed on a woven geotextile mat, laid over the area where the stabilised entrance will be positioned. Ensure it is correctly pinned and overlapped. Ensure the stabilised entrance drains back into the construction site – a speed hump can be used for this purpose.

A stabilised construction entrance will reduce the amount of sediment leaving site. It also clearly identifies the authorised access points for construction vehicles. Combined with a formal wheel wash facility or shaker ramp, this will prevent sediment being tracked onto the adjacent roadways. Where a wheel wash is required, the surface of the stabilised entrance should be graded to the adjacent stabilised channel drain.

The Contractor shall check the vehicle entrance each day, to ensure no sediment is being tracked onto roads. Any sediment shall be cleaned up immediately. The washed aggregate is to be replaced when the amount of sediment build up is making the entrance ineffective.

Refer to AC GD05 Section E2.6, Figure 36 for typical details.

4.2.5 Geotextiles, Erosion Control Blankets, Revegetation and Mulching

Exposed areas should be stabilised as soon as practicable on completion of works, ensuring that any materials used for ground stabilisation are fully biodegradable to avoid plastic fragments remaining in the environment.

If any area of soil is to be left exposed for any long period of time; mulching, revegetation or geotextiles should be used, in consideration of the general site conditions. This will prevent dust during dry weather or erosion of the soil during periods of wet weather. When carrying out earthworks over a large area, use of geotextile to progressively stabilise the surface is recommended. Geotextiles or mulching will provide a quick-to-apply protective surface over exposed earth, allowing the Contractor to minimise the exposed area of earth. Once earthworks are complete, a more permanent stabilising surface can be constructed (e.g. compacted hardfill, coconut matting & grass seed).

Stockpiles shall be minimised by planning earthworks and cut to fill operations. If unavoidable they should be covered with plastic covers to prevent stormwater runoff from eroding the material and creating sedimentation.

Refer to AC GD05 Section E3.0 for soil and surface stabilisation practices.

4.3 Inspection Frequency

Table 4 sets out the minimum inspection requirements for the various sediment control devices on-site. The Contractor shall confirm any inspection schedules with Council prior to commencing construction.

Table 4: Minimum inspection requirements for devices on-site

Sediment and Erosion Control Device	Frequency of Inspection
Silt fences	Daily (minimum) + after every rainfall event
Stabilised construction entrance	Daily + after every rainfall event
Earth bunding	Weekly + after every rainfall event
Clean water diversion channels	Weekly + after every rainfall event
Stabilised areas (geotextiles etc.)	Daily + before/after every rainfall event

4.4 Contingency Measures

Weather forecasts will be regularly monitored by the Contractor for the duration of the works. Standard practise is to install a rain gauge on-site. Where practical, emergency measures will be installed at critical locations prior to the occurrence of heavy rainfall and storm events. For example; critical batters on site should be covered with pinned geotextile material and additional riprap placed at discharge points and in

diversion channels. This is to reduce the risk of sediment discharge from the site in the event of an extreme storm event. This is particularly crucial on this site, with the ecological sensitivity of the creeks.

4.5 Emergency Response

The Contractor shall prepare a site-specific Emergency Response Plan as part of their Construction Management Plan. However, any Emergency Response should aim to comply with the following procedures in the event of any failure of erosion and sediment device on-site:

1. The Contractor should visit the site to survey the extent of damage.

2. Contact Otago Regional Council and the Principal to report the failure of the device and what emergency measures are to be taken.

3. As soon as conditions allow safe work to progress, put temporary works in place to minimise further damage to the device or structure and the surrounding environment. Temporary control measures may include:

    a. Forming bunds and diversion drains to control runoff;

    b. Protect exposed surfaces by using geotextile or hay mulching;

    c. Temporary backfill of any voids created by erosion during device failure;

4. Cleaning out downstream channels.

5. As soon as conditions allow, carry out remedial work downstream of the failed device to repair any damage to infrastructure and property. Clean up deposited silt and debris. Reinstate surfaces and structures to their original condition.

6. Review to identify the cause of the device failure. Potential factors may include rainfall event intensity/duration, catchment size, catchment characteristics, the suitability of the device, construction issues (installation practices etc), lack of maintenance and monitoring.

7. Confirm any amendments to the design of the failed device prior to commencing project site works.

8. Re-construct the device or structure in accordance with approved plans and maintain for the remainder of the project work.

5 CONTRACTOR INPUT

5.1 Contractor's Construction Management Plan

Once a Contractor is appointed, and prior to start of the construction works, a Construction Management Plan (CMP) will be prepared which sets out the details of the proposed construction methodology and measures to be taken to minimise the potential erosion caused by construction.

5.2 Final Erosion & Sediment Control Plan

The Contractor will assume responsibility for overseeing erosion and sediment control maintenance and monitoring for the duration of the works.

A final version of the ESCP shall be produced by the Contractor and will form part of the CMP and be submitted to Otago Regional Council for approval. The Contractor's emergency shut-down procedure in the event of forecast heavy rainfall or spill shall be part of this documentation. Any conditions provided as part of the Resource Consent will be incorporated into the final ESCP.

6 REFERENCES

Auckland Council. (2016). *Erosion and Sediment Control Guide for Land Disturbing Activities in the Auckland Region.* Guidelin Document 2016/005.

Geosolve Ltd. (2020). *Geotechnical Report for Resource Consent, Mcdougall's Block.*

Queenstown Lakes District Council. (2019). *QLDC Guidelines for Environmental Management Plans.* Queenstown: QLDC.

Appendix A

Diversion Bund and Swale Flow Calcs

Project Name:	Roberts Development, Curtis Road, Cardrona
Project Number:	138332
Author:	GWF
Checked by:	
Date:	25/08/2021
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Rainfall Intensity for Development

HIRDS V4 Intensity-Duration-Frequency Results

Sitename: curtis road

Coordinate system: WGS84

Longitude: 169.0056

Latitude: -44.8744

Temperature change results for site:

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**
1.58	**0.633**	20.9	15.6	13.3	10.2	7.67	4.7	3.31	2.26	1.45	1.09	0.875	0.735
2	**0.5**	23.7	17.6	15	11.4	8.6	5.23	3.68	2.48	1.59	1.19	0.959	0.802
5	**0.2**	33.9	24.9	21	15.8	11.8	7.07	4.92	3.27	2.07	1.55	1.24	1.03
10	**0.1**	42.4	31	26	19.4	14.4	8.5	5.87	3.87	2.44	1.81	1.44	1.2
20	**0.05**	52.1	37.7	31.5	23.4	17.2	10.1	6.88	4.5	2.82	2.08	1.65	1.37
30	**0.033**	58.3	42.1	35.1	25.9	19	11	7.5	4.88	3.05	2.24	1.78	1.47
40	**0.025**	63	45.3	37.7	27.8	20.3	11.7	7.97	5.17	3.21	2.36	1.87	1.55
50	**0.02**	66.9	48	39.9	29.3	21.3	12.3	8.33	5.39	3.34	2.46	1.94	1.6
60	**0.017**	70.2	50.2	41.7	30.6	22.2	12.8	8.64	5.59	3.45	2.54	2	1.65
80	**0.012**	75.6	54	44.7	32.7	23.7	13.6	9.13	5.88	3.63	2.66	2.1	1.73
100	**0.01**	79.9	56.9	47.1	34.4	24.8	14.2	9.53	6.13	3.77	2.75	2.17	1.79
250	**0.004**	99.5	70.2	57.8	41.7	29.9	16.8	11.2	7.12	4.33	3.15	2.48	2.03

Notes:

1. Based on QLDC LDSC 2020 Section C4.3.5.1

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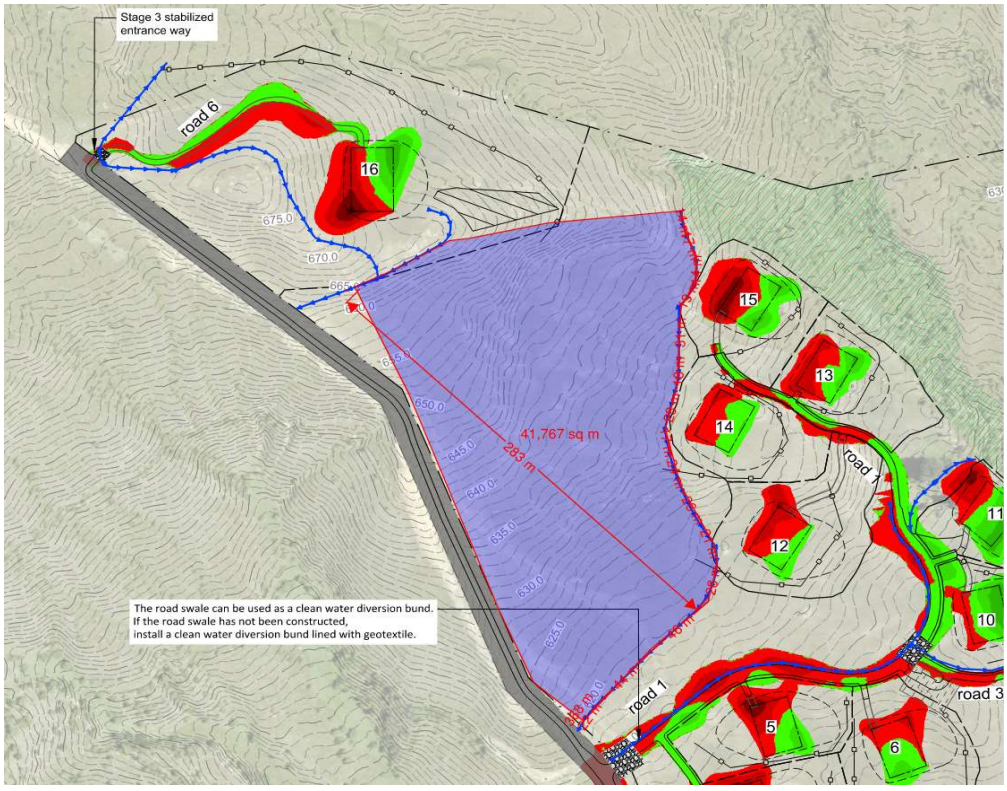
Time of Concentration (T_c) for largest diversion bund catchment			
L_o	283	m	Length of overland flow path
H	45	m	Elevation difference
S	16%		Average overland slope
n	0.045		Mannings n-value
t_c	42	mins	for overland flow
L_c	367	m	Length of Diversion Bund
t_c	5	mins	for channel flow at 1.2m/s flow velocity
Total t_c	47	mins	
Note: Calculations based on NZBC E1 - 2.3.2 (b)			

Calculations based on AEP of 5% as per AC GDO5 Rainfall intensities (mm/hr) :: RCP8.5 for the period 2081-2100							
Storm		**Total Area**	**Tc**	**C**	**I**	**Q**	**Comments**
ARI	AEP	m^2	mins	(avg)	mm/hr	m^3/s	
20	0.5	42000	20	0.350	37.7	0.154	
20	0.5	42000	30	0.350	31.5	0.129	
20	0.5	42000	47	0.350	26.9	0.110	Interpolated
20	0.5	42000	60	0.350	23.4	0.096	



Project Name:	Roberts Development, Curtis Road, Cardrona
Project Number:	138332
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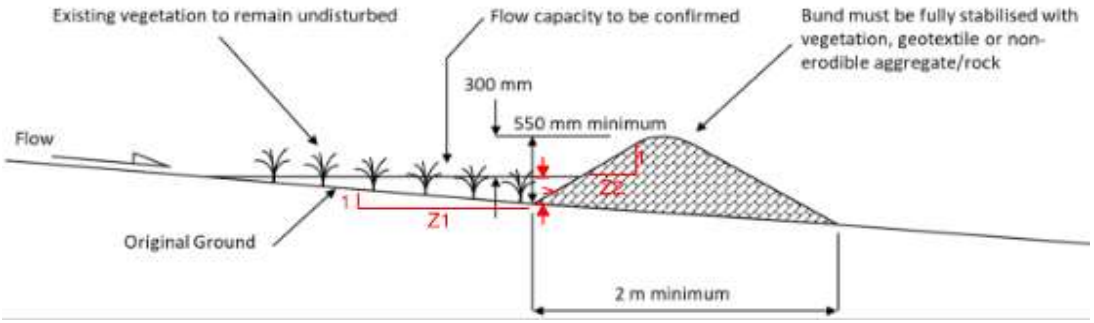
MANNINGS EQUATION SOLUTION FOR UNIFORM FLOW IN A TRAPEZOIDAL CHANNEL - DIVERSION BUNDS

CALCULATE FLOW DEPTH (Y) FOR A GIVEN FLOW AND CHANNEL CONFIGURATION

Q_d = Design storm flow
Z = Side Slope
W = Channel floor width
A = Area of flow
P = Wetted Perimeter
R = Hydraulic Radius = A/P
S = Channel Slope
n = Mannings n-value
V_{mann} = Calculated velocity
Q_{mann} = Calculated flow
Accuracy test (%) = 2.50%



How to use this table:

1 Enter the channel characteristics - n, S, W, Z1, Z2, and flow (Q)
2 Guess (estimate) y and then adjust y to satisfy the "Check"column.
Adjust the "Accuracy test" if required to suit the situation and allow a healthy freeboard.
Suggestion: Test for the variation in "y" for a range of Mannings n values.

Calc. No	Mannings n	Q_{20} (m^3/s)	S	W (m)	Z1	Z2	A (m2)	P (m)	R (m)	Estimate y (m)	V_{Mann} (m/s)	Q_{Mann} (m^3/s)	Check
1	0.025	0.110	0.25%	0	6.3	3.0	0.24	2.14	0.11	0.225	0.46	0.108	OK
2	0.025	0.110	0.5%	0	6.3	3.0	0.19	1.91	0.10	0.200	0.60	0.111	OK
3	0.025	0.110	1%	0	6.3	3.0	0.14	1.67	0.09	0.175	0.77	0.110	OK
4	0.025	0.110	2%	0	6.3	3.0	0.11	1.46	0.07	0.153	1.00	0.109	OK
5	0.025	0.110	4%	0	6.3	3.0	0.08	1.29	0.07	0.135	1.30	0.110	OK

Notes:

1. Typical section based on AC GDO5 Figure 17, cross section for clean water diversion bunds
2. Assume maximum allowable water depth to be 0.25m
3. Calculated water depth below maximum depth for range of channel grades
4. Based on velocity, channels should be lined for slopes from 2% and steeper

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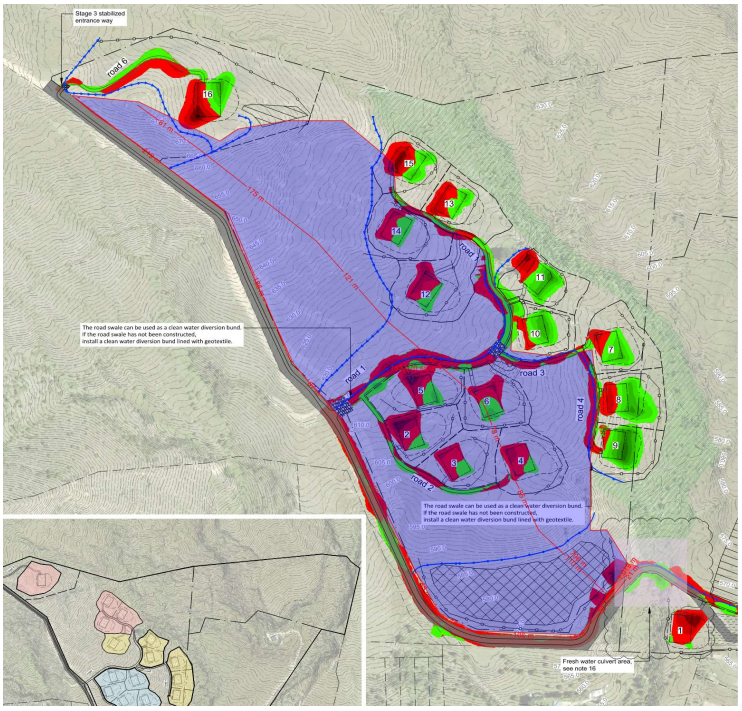
Time of Concentration (T_c) for largest possible swale catchment			
L_o	796	m	Length of overland flow path
H	105	m	Elevation difference
S	13%		Average overland slope
n	0.045		Mannings n-value
t_c	61	mins	for overland flow
L_c	1020	m	Length of Diversion Bund
t_c	14	mins	for channel flow at 1.2m/s flow velocity
Total t_c	75	mins	
Note: Calculations based on NZBC E1 - 2.3.2 (b)			

Calculations based on AEP of 5% as per AC GDO5 Rainfall intensities (mm/hr) :: RCP8.5 for the period 2081-2100							
Storm		**Total Area**	**Tc**	**C**	**I**	**Q**	**Comments**
ARI	AEP	m^2	mins	(avg)	mm/hr	m^3/s	
20	0.5	153000	20	0.350	37.7	0.561	
20	0.5	153000	30	0.350	31.5	0.469	
20	0.5	153000	60	0.350	23.4	0.348	
20	0.5	153000	75	0.350	21.8	0.325	Interpolated
20	0.5	153000	120	0.350	17.2	0.256	



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Project Number:	138332
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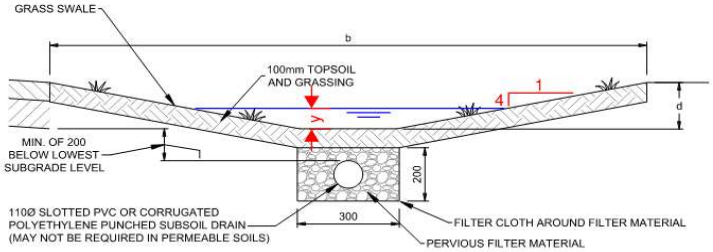
MANNINGS EQUATION SOLUTION FOR UNIFORM FLOW IN A TRAPEZOIDAL CHANNEL - SWALES

CALCULATE FLOW DEPTH (Y) FOR A GIVEN FLOW AND CHANNEL CONFIGURATION

Q_d = Design storm flow
Z = Side Slope
W = Channel floor width
A = Area of flow
P = Wetted Perimeter
R = Hydraulic Radius = A/P
S = Channel Slope
n = Mannings n-value
V_{mann} = Calculated velocity
Q_{mann} = Calculated flow
Accuracy test (%) = 2.50%



SWALE CROSS SECTION

How to use this table:

1 Enter the channel characteristics - n, S, W, Z1, Z2, and flow (Q)
2 Guess (estimate) y and then adjust y to satisfy the "Check"column.
Adjust the "Accuracy test" if required to suit the situation and allow a healthy freeboard.
Suggestion: Test for the variation in "y" for a range of Mannings n values.

Calc. No	Mannings n	Q_{20} (m^3/s)	S	W (m)	Z1	Z2	A (m2)	P (m)	R (m)	Estimate y (m)	V_{Mann} (m/s)	Q_{Mann} (m^3/s)	Check
1	0.03	0.325	0.25%	0.3	4.0	4.0	0.60	3.19	0.19	0.350	0.54	0.324	OK
2	0.03	0.325	0.5%	0.3	4.0	4.0	0.46	2.82	0.16	0.305	0.71	0.328	OK
3	0.03	0.325	1%	0.3	4.0	4.0	0.36	2.49	0.15	0.265	0.92	0.332	OK
4	0.03	0.325	2%	0.3	4.0	4.0	0.27	2.16	0.13	0.225	1.18	0.319	OK
5	0.03	0.325	4%	0.3	4.0	4.0	0.21	1.91	0.11	0.195	1.53	0.323	OK

Notes:

1. Typical swale section based on QLDC LDSC standard drawing B5-5
2. Propose swale depth (d) of 0.5m to allow for sufficient freeboard
3. Detailed design of roads will determine swale grade and final swale design
4. Check dams will be required for grades steeper than 5%, and will be determined during detailed design